DRAFT SUMMARY MINUTES

Ad Hoc Groundfish Information Policy Committee

Pacific Fishery Management Council
Embassy Suites Portland Airport Hotel
Cedars I and II Rooms
7900 NE 82nd Avenue
Portland, OR 97220
503-460-3000
January 25-26, 2005

TUESDAY, JANUARY 25, 2005

Members Present:
Mr. Don Hansen, Dana Wharf Sportfishing, Pacific Fishery Management Council Chairman
Dr. Elizabeth Clarke, National Marine Fisheries Service Northwest Fisheries Science Center
Ms. Marija Vojkovich, California Department of Fish and Game
Dr. Patty Burke, Oregon Department of Fish and Wildlife
Mr. Phil Anderson, Washington Department of Fish and Wildlife
Dr. Steve Freese, National Marine Fisheries Service Northwest Region
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration General Counsel

Others Present:
Dr. Don McIsaac, Pacific Fishery Management Council
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative
Mr. Rod Moore, West Coast Seafood Processors Association
Dr. Jim Hastie, National Marine Fisheries Service Northwest Fisheries Science Center
Mr. Steve Bodnar, Coos Bay Trawlers Association, Bandon Submarine Cable Committee
Mr. Pete Leipzig, Fishermen's Marketing Association
Ms. Michele Culver, Washington Department of Fish and Wildlife
Mr. Brian Culver, Washington Department of Fish and Wildlife
Mr. Dan Wolford, Coastside Fishing Club
Mr. Brad Pettinger, Oregon Trawl Commission
Ms. Gway Kirchner, Oregon Department of Fish and Wildlife
Dr. Ed Waters, Pacific Fishery Management Council
Mr. John DeVore, Pacific Fishery Management Council

A. Call to Order and Administrative Matters

1. Roll Call, Introductions, Announcements, etc.

Chairman, Don Hansen, called the meeting to order at 8:45 a.m.

2. Review of Committee's Charge

Dr. McIsaac reviewed the three-day Groundfish Information Policy Committee (GIPC) and Allocation Committee agendas. The priorities for the GIPC at this meeting are agenda items B, C, and D. If these discussions run long, the GIPC could take up agenda item E at a later date.

3. Approve Agenda.

Dr. McIsaac reviewed the draft agenda. A motion to approve the agenda was made, seconded, and passed by members of the GIPC.

B. Mid-Term OY Adjustments Policy

1. Current Status of Fishery Management Plans (FMP) Provisions

The FMP currently allows the ability to reduce optimum yields (OYs) during a biennial management period. The Council, however, intended to allow both upward and downward OY adjustments if new stock assessments indicate this is scientifically sound. Ms. Cooney said the Council record was ambiguous as to what was intended. An FMP amendment is necessary to allow consideration of upward OY adjustments midway through a management cycle. While a formal FMP amendment process may not be needed, some process is required. Dr. Freese said the Council announced their intent in September. The next step is to draft a letter with the correct amendatory language (from Amendment 17) and bring back before the Council for their approval. Council-approved amendatory language would then be transmitted to NMFS to solicit final Secretarial approval. Dr. McIsaac asked if the triggers and other mechanisms for adjusting OYs need to be in the FMP? Does this need to be specified in the FMP amendment process? Ms. Cooney said if more changes are desired than have been developed so far, a more formal FMP amendment process would be required. To raise OYs for 2006, a formal emergency type rule via a NEPA process with notice and comment would be required. Theoretically, the public notice and comment can be waived in an emergency, but an OY change affects rebuilding plans and other legal mandates.

2. NEPA and Rulemaking Considerations
    a. Schedule
    b. Emergency Exception for 2005-2006?
3. Review the History of Past Assessments and Management Responses
4. Policy Considerations
    a. Trigger Thresholds (Percentage of Change, Species' Applications)
    b. Management Reaction

Dr. McIsaac asked Dr. Clarke when new assessments would be available for Scientific and Statistical Committee (SSC) and Council consideration. Dr. Clarke reviewed the Stock Assessment Review (STAR) Panel schedule. She explained the schedule was designed to be in synchrony with the March, June, and September Council meetings. There are two contingency STAR Panels set up for late September and early October, if any of the assessments encounter problems. These assessments would then be theoretically available for the November meeting. One potential problem is getting the assessments reviewed during the week of May 16-20 into the June briefing book. She also reported a change in one of the assessments. The vermilion rockfish assessment has been upgraded from a data report to a full assessment because old catch data has recently surfaced. This does not pose a problem in the review process since the vermilion rockfish assessment has already been scheduled for a STAR Panel. She also mentioned that other species' assessments may have data problems and might be downgraded to data reports if they are not recommended by a STAR Panel.

Dr. McIsaac explained the issue here is how to deal with a major change in the status of any of these stocks. These assessments are designed to affect management in 2007 and 2008, but the Council may need to react sooner (i.e., change OYs and management measures for the 2006 fishery) if there is a dramatic change. Mr. Anderson briefly reviewed the recent history of bocaccio assessments as an example of why we need a policy to adjust OYs mid-term. Ms. Cooney said the Council should initiate action on changing OYs and management measures as soon as the science is validated and approved through the process. Mr. Anderson suggested the SSC and other advisors could review assessments in June and September and wait until November for Council consideration and approval. The November meeting is when the Council is scheduled to adopt a range of acceptable biological catches (ABCs)/OYs. He reiterated that a mid-term OY adjustment should be a very rare event. Ms. Cooney said that if the Council wants to consider an OY change, the process should start as early as possible. This is required to allow proper notice and comment for rulemaking. Dr. Burke asked how that could be done if the assessment has not been formally approved by the Council? Is it final science prior to Council adoption? Ms. Cooney said the science may be considered final after STAR Panel and SSC reviews indicate the assessment is the best available for management decision-making. Dr. Clarke said the laws we have in place seem not to be able to accommodate a multi-year management process. Dr. McIsaac said recommending how and when information enters into the Council process is the GIPC's charge. Mr. Anderson thought it would be important to demonstrate via a risk assessment that status quo management for one additional year (i.e., the second year in a biennial management cycle) will not jeopardize stock rebuilding. Mr. DeVore mentioned the SSC is developing an analytical tool to evaluate progress towards achieving rebuilding targets. The Terms of Reference for Groundfish Rebuilding Analyses should include some sort of risk assessment. This will be in place before the June Council meeting. Dr. Hastie remarked that a rebuilding analysis cannot be conducted until after the stock assessment is finalized. This will delay any process to change an OY mid-term in the cycle. Mr. Anderson envisioned the use of Dr. Andre Punt's rebuilding population simulation program to evaluate whether a rebuilding plan is compromised by leaving a status quo OY in place for the last year in a management cycle.

The GIPC addressed the timing of policy development. Can a policy be put in place by November 2005? Ms. Cooney said the process for formalizing a policy depends on the nature and magnitude of an OY adjustment. A full NEPA process is needed if an FMP amendment is contemplated to formalize a policy that allows both upward and downward OY adjustments. Otherwise, there are two different types of emergency rules: those that address non-compliance with the FMP, and those addressing non-compliance with the specified rulemaking. Mr. DeVore asked if a threshold or trigger mechanism needs to be described in the FMP? Ms. Cooney said that would help the NEPA process, but would not change the rulemaking requirements. Dr. McIsaac asked how the process would be affected if a trigger was tripped before the FMP was amended? Ms. Cooney said regardless of an FMP amendment, there would still need to be a NEPA process and notice and comment rulemaking to change the OY. Dr. Freese said a normal emergency rule requires an EA and notice and comment rulemaking. This takes a minimum of two months. If the change affects an approved rebuilding plan, then there are additional complications. Ms. Vojkovich said stock assessments are designed to project future recruitment and biomass. Therefore, projections shouldn't be applied to the current management period. She couldn't see how a new stock assessment would affect a current OY based on an existing stock assessment. Ms. Cooney stated an OY change may be required if new information indicates a rebuilding plan is in jeopardy. Dr. Freese remarked the pertinent question to ask is, what is the damage that would be caused by waiting a year to adjust an OY? He said this will depend on the species and whether or not there is an existing rebuilding plan. Ms. Cooney said, in an extreme situation, it will be difficult to sit on an OY for another year without a management change.

Ms. Vojkovich explained the 2004 California Recreational Fishery Survey (CRFS) estimates will be available by the March briefing book deadline (February 16). How do we consider adjustments indicated by that data? Mr. DeVore explained the 2005-2006 Specifications and Management Measures Environmental Impact Statement contemplated the delivery of these new data in 2005. Inseason adjustments of seasons, bag limits, retention rules, or size limits are considered routine and can be done in one Council meeting. However, a mid-term OY adjustment is not a routine change and may be difficult to implement quickly. Dr. Burke observed a complicated trigger mechanism requires a complicated response. She emphasized we do not have the resources to constantly do this.

Mr. DeVore explained the process for considering new information as the "best available science". The best available science with respect to stock assessments is determined by a STAR Panel and ultimately the SSC. For the Council to enact a mid-term OY adjustment policy, they need to establish the thresholds or triggers for making such an adjustment. Mr. Anderson noted the Council will be hard pressed not to respond if a new stock assessment suggests current management would jeopardize a rebuilding plan. The GIPC then discussed the frequency of future assessments for overfished species. Dr. Clarke said the plan is to assess all the overfished species every two years in time for deciding management measures for each upcoming biennial management cycle. Assessments for non-overfished species will occur less frequently. It may be difficult to cull the number of assessments to a reasonable level, which was the experience this last year when they tried to limit the number of assessments to 23. Assessment authors may also conduct independent assessments from time to time. Mr. DeVore said any considered policy needs to contemplate what to do if a new assessment indicates there is a new overfished species. Dr. Freese recommended the GIPC determine a list of questions they would like to see answered before considering an OY adjustment. Ms. Cooney agreed,, but added there needs to be at least a two-meeting process if analysis indicates an OY change is necessary. Mr. Moore asked Ms. Cooney if pessimistic scientific results are available in June, is there legal constraints to not changing the OY mid-term? Could the Council respond by adopting more conservative management measures? Ms. Cooney said she wanted to confer with others to explore the legal ramifications of such an action. She said she would consult with some folks in Washington D.C. over the lunch break. Dr. Burke asked if it was realistic to expect all the new stock assessments would be approved by September? Mr. DeVore said this might occur, but some of the critical rebuilding analyses (i.e., rebuilding analyses for canary and yelloweye rockfish) will not be available before November.

Mr. Anderson shared his strawman concept: if a fully reviewed stock assessment of a species that is currently classified as overfished recommends a reduction of the OY in the next biennial cycle, the Council will consider more conservative management measures and/or a more conservative OY if the assessment indicates the absence of a reduction in the second year of a biennial cycle causes the rebuilding probability to decrease or if it extends the rebuilding time frame. There was some thought that this policy, without more defined thresholds, would create a hair trigger mechanism. Regardless, the rebuilding analysis would provide the analytical basis for this mechanism. Dr. Burke said another criterion should be the resources that can be applied to pursue all these potential problems given the current Council workload. Mr. DeVore asked if rulemaking can include the contingency management measures that would be responsive to an OY change? Ms. Cooney said probably not.

Mr. DeVore reviewed the history of West Coast groundfish stock assessments and the management responses to these assessments. This historical perspective might be useful in considering a mid-term OY adjustment policy and the species-specific triggers or thresholds that might prompt an OY adjustment. The recent history of bocaccio and canary stock assessments provide vivid examples of highly variable assessments that dramatically affect management. Other examples of highly variable assessments include yellowtail rockfish and sablefish.

After the lunch break, Ms. Cooney said her feedback from NOAA General Counsel was that changing management measures in lieu of reducing the OY would not be legally sufficient. Emergency rulemaking would be required. Dr. McIsaac asked if raising an OY could be considered as a response to an economic emergency? Ms. Cooney said raising OYs mid-term would be a much more difficult process and probably could not be done with an emergency rulemaking. Dr. McIsaac recommended considering a few hypothetical situations to test some policy options. Dr. Hastie said these situations tend to be complex and highly variable. It will be difficult to find a policy that fits a “standard” situation. Dr. Freese asked what types of changes in a stock assessment indicate a biological problem? Dr. Clarke said the most important elements of a stock assessment have to do with assumptions laid over the data, which affect how we think the species is doing compared to what is observed. The largest changes in an assessment tend to occur due to changes in model assumptions or parameters such as initial, unfished biomass (B_0), catchability (q), mean generation time, etc. She ventured that maybe we need to construct rules regarding which assessments should be updates vs. which should be full assessments. Mr. Anderson asked if we are legally constrained to react quickly to a new stock assessment designed to affect the following biennial management cycle? Ms. Cooney reiterated there is risk if not changing the OY affects the ability to achieve an adopted rebuilding plan. Dr. Burke concluded we then need to have a policy since it’s clear that we have to act. Mr. Anderson recommended the GIPC define legal limits on when we need to act, and then move in a little from that. These sideboards could then be used as hard policies to trigger when an OY adjustment would occur. Ms. Vojkovich asked what about a case of a species that is newly discovered to be overfished? Ms. Cooney remarked we would have a year to develop a rebuilding plan in that case, so there is no need to act immediately. Mr. DeVore said the SSC will be working on an analytical tool for evaluating rebuilding plan progress. This tool and a developed protocol should answer Mr. Anderson’s concern.

After considerable discussion, the GIPC recommended mid-term OY adjustments be considered only for overfished species and only in a downward direction if it is needed to achieve the adopted rebuilding plan. They also recommended the triggers be developed on a case by case basis according to the SSC rebuilding plan review protocols.

C. Inseason Management Adjustments Policy

1. Consider The GMT Recommendation for Conservative Actions During the First Six Months of the Season

The GMT recommendation was in reaction to the problem of early attainment of darkblotched rockfish encountered in the trawl fishery last year. A remedial policy recommendation forwarded by the GMT last November was to not liberalize commercial management measures in the first six months of the fishing season unless an error or data problem warrants such consideration. The GIPC supported this recommendation to not liberalize management measures until the June Council meeting at the earliest.

2. Expected CRFS Data Delivery and Management Implications

Ms. Vojkovich said 2004 CRFS estimates will be available for the March briefing book deadline. They will characterize the confidence in different sampling modes. They do not expect to have the information to calibrate 2004 CRFS estimates with past Marine Recreational Fisheries Statistics Survey (MRFSS) estimates until June at the earliest and more likely September. The RecFIN Statistical Committee will explore this calibration step. Their next meeting is in March, which obviates the expected June or September delivery of results. There has been a delay in reconciling the apparently aberrant 2003 recreational catch estimates. They would like to look at some of the random digit dialing data used to derive the MRFSS effort estimates and report their initial analyses in March. They do not expect to use CRFS to recommend inseason adjustments in March.

Dr. McIsaac asked about the significance of the calibration step. The projection model cannot be updated with new CRFS data until it is calibrated with the historical MRFSS data. Dr. Hastie expressed concern about assessments for southern stocks relying on a RecCPUE index. It was explained this index is not affected since it is sampled catch relative to sampled effort. However, models for stocks with significant recreational removals could be somewhat compromised.

Ms. Vojkovich thought 2006 management decision-making (inseason adjustments) will be fully informed by CRFS data. The calibration methodology should be developed by then.

Ms. Culver explained there is a commitment by GMT members to provide monthly catch estimates to track harvest relative to harvest guidelines. Ms. Vojkovich said those CRFS estimates will be available monthly. The distribution of catch by time can be determined from the old MRFSS-based model, but the inseason estimates will be from CRFS.

3. Consideration of Moderating the Magnitude of Adjustments (i.e., ±10% Adjustment)

The GIPC did not feel this was a good policy, especially given the recommendation under C.1.

D. Update on Observer Data Reports Available in 2005

Dr. Clarke provided an update on anticipated observer data reports this year. In February a limited entry trawl report incorporating data through August 2004 will be available. These data will be used to update the bycatch model in April. There will also be a limited entry fixed gear report available in February for use at the March Council meeting. Additionally, there will be observer data available for the California halibut fishery. This was requested by the GMT to evaluate the exempt trawl Rockfish Conservation Area (RCA) bounds in California. An open access near shore report will be available in May and incorporated in a new bycatch model by the June Council meeting. An updated limited entry trawl observer data report with data through April 2005 will be available in August with a model update at the November Council meeting. After that, all limited entry and open access (all open access) data reports will be delivered in August of each year for November decision-making. Ms. Culver asked if data reports and bycatch models could be reviewed by the GMT prior to Council meetings could be accommodated. The new open access model will be a simple one not requiring SSC review. Ms. Vojkovich asked about data standards for releasing observer data reports? Dr. Clarke said there are no explicit standards, but the decision to publish a report is based on Northwest Fisheries Science Center (NWFSC) review of the data. These data need to be representative of the fleet. This is the de facto standard. NWFSC is currently meeting their goal of fleet-wide observer rates. Data inputs for the trawl bycatch model will be stratified by selective vs. no selective trawl gears shoreward of the RCA. The limited entry fixed gear sablefish observer data report will always be reported through October, the end of the primary season. These data have to be stratified this way due to the tier limit structure of the fishery. Mr. Leipzig asked if there is an open access/limited entry stratification in the California halibut data report? Dr. Hastie said he has only looked at the limited entry portion of that fishery so far. Dr. Clarke said she recommends this stratification. The California halibut data report in March will be limited entry only. The open access portion will be reported in May.

WEDNESDAY, JANUARY 26, 2005

Members Present:
Mr. Don Hansen, Dana Wharf Sportfishing, Pacific Fishery Management Council Chairman
Dr. Elizabeth Clarke, National Marine Fisheries Service Northwest Fisheries Science Center
Ms. Marija Vojkovich, California Department of Fish and Game
Ms. Cyreis Schmitt, Oregon Department of Fish and Wildlife (Dr. Patty Burke's designee)
Mr. Phil Anderson, Washington Department of Fish and Wildlife
Dr. Steve Freese, National Marine Fisheries Service Northwest Region
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration General Counsel

Others Present:
Dr. Don McIsaac, Pacific Fishery Management Council
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative
Mr. Rod Moore, West Coast Seafood Processors Association
Dr. Jim Hastie, National Marine Fisheries Service Northwest Fisheries Science Center
Mr. Steve Bodnar, Coos Bay Trawlers Association, Bandon Submarine Cable Committee
Mr. Pete Leipzig, Fishermen's Marketing Association
Mr. Steve Joner, Makah Tribe
Ms. Michele Culver, Washington Department of Fish and Wildlife

Mr. Brian Culver, Washington Department of Fish and Wildlife
Mr. Dan Wolford, Coastside Fishing Club
Mr. Brad Pettinger, Oregon Trawl Commission
Ms. Gway Kirchner, Oregon Department of Fish and Wildlife
Mr. Mike Burner, Pacific Fishery Management Council
Dr. Kit Dahl, Pacific Fishery Management Council
Dr. Ed Waters, Pacific Fishery Management Council
Mr. John DeVore, Pacific Fishery Management Council

E. Develop a Policy for Data and Models Used in Biennial Management Decision-Making

1. Procedures for Considering New Data and Models
    a. Data and Models Originating Outside the Council Process
    b. SSC and GMT Review Protocols
2. Establish a Deadline for Considering New Data and Models

Mr. DeVore stated the GIPC's charge under this agenda item was to recommend a policy that allowed outside data and models to be rigorously reviewed in the process while creating a deadline for these reviews and timely adoption of new best available science. He said any new models that are adopted after the first meeting when deciding biennial specifications and management measures (i.e., the November 2005 meeting is the first one in the process to decide 2007-2008 management measures) severely encumbers the process. Dr. Clarke briefly explained the latest any NMFS data and models would come into the process would be at the November Council meeting. These data and models would be assessments that are reviewed in the late September and early October wrap-up STAR panels. This was considered responsive to the Council's timeline for decision-making. Dr. McIsaac asked Dr. Clarke if all the NMFS assessment scientists are aware of the Council's timeline. Dr. Clarke said yes, but she has learned that there are new assessments not contemplated by the Council that are being developed, or at least considered. The problem is these unsolicited assessments could be introduced into the Council process as public comment. Dr. Clarke also has made contact with the greater scientific community (i.e., academia) to invite them into the process, educate them on the process and the data used in contemplated assessments to prevent new information coming in that might compromise an assessment or the process. This alternative invites the greater community to instead contribute to the established assessment process. As an example, Mr. Hansen brought up the Franke and Butler acoustic surveys which are being done experimentally. Dr. Clarke explained they are working on this to overcome technical problems with this new technique. She assured the Committee this experimental survey will undergo a thorough peer review before it will be an official survey used in an assessment. She did not expect this survey would be used in this year's cowcod assessment.

Mr. Anderson recommended we discuss a policy broad enough to encompass all the different models used in Council decision-making or consider different policies for different models. He mentioned the established review protocols for assessment (i.e., STAR Panels and the SSC). Would there ever be a separate process for reviewing "outside" assessments? What would be the timeline for considering these assessments? Should the recommendation for assessment scientists accepting outside data be in November a year prior to the Council meeting when the range of biennial ABCs/OYs is decided. Dr. Clarke said it could be difficult to force scientists to accept outside data. She said that data could be considered by June prior to the year that assessments are done. Therefore, June 2004 would be the deadline for considering assessments used for decision-making for the 2007-2008 period. It is noted the Council made their final decision on the proposed list of assessments in April 2004. However, there is still a problem with some NMFS scientists continuing to do assessments not formally recommended by the SSC and adopted by the Council. Ms. Vojkovich said state scientists could aid NMFS scientists in filling assessment data gaps. Mr. Anderson said if an outside assessment for a species already on the adopted list is proposed, it makes sense to have those individuals attend the scheduled data workshops and STAR Panels where that species' assessment is addressed. However, how do we deal with outside assessments not on the adopted species list? It needs the same rigorous review, but we don't have the resources to add new STAR Panels. Dr. Clarke said we could make such assessments a top priority for the next round. Mr. Anderson said it should not necessarily be a top priority, but included on the list of proposed assessments for the next round. The GIPC was in agreement with that recommendation.

Mr. Wolford explained the Coastside Fishing Club's recreational catch estimation model. It was really set up as a challenge to the old MRFSS estimation model. However, catch monitoring and estimation can be instrumental in an assessment that tracks species' removals. Dr. Clarke said the final decision on data inputs in an assessment is made by the assessment author. New data is solicited at a data workshop where it is discussed by assessment scientists, but ultimately decided to be used or not by the assessment author. However, such data sources could be dismissed by a STAR Panel or the SSC. Data sources contemplated in an assessment are now being advertised on the NWFSC and Council web sites. Dr. Clarke recommended the STAR Terms of Reference should require assessment authors to list the data sources considered with the reasons for accepting or rejecting these data sources.

Mr. Anderson then recommended the GIPC discuss protocols for non-assessment models considered in the process. Dr. Clarke said any new model reviews needs to fit into the SSC's schedule. For instance, the SSC held a workshop on the RecCPUE index considered for assessments. There were also workshops set up in the past to consider new models. Additionally, outside the Council process we have NMFS reviewing PacFIN data and other such review mechanisms that influence decision-making. Ms. Schmitt asked what constitutes a new model? What new indices in an assessment make an assessment model "new"? Such things are discussed and decided at data workshops set up by the SSC and the NWFSC.

Dr. McIsaac explained how items get on the SSC's agenda. The Council decides the agenda priorities on Friday of each meeting. Therefore, the SSC agenda is set at previous Council meetings. The public does not walk into the SSC and demand to get on the agenda. He recommended the GIPC explore Mr. Wolford's case as being a fruitful way to explore review protocols. Mr. Anderson suggested the first stop for new model reviews should be at the data workshops. If the new model has merit, the SSC could recommend a separate workshop to review a potentially useful new model. Dr. McIsaac explained how the new Coastside recreational catch estimation model was first brought to the GMT in November 2003 to react to a Council agenda item on California recreational fishery adjustments. The GMT recommended an SSC review, but the SSC agenda was too crowded to consider this review then. The Coastside model was subsequently brought to the RecFIN Data Committee. Mr. Anderson's proposed solution to start with a data workshop appeared to be a good protocol for such initial reviews. Ms. Vojkovich said the state could also be a review gatekeeper for contemplated models. For instance, the Coastside model will be reviewed by CDFG staff this year. Dr. Freese asked if there was a standard format for data considered in an assessment? Dr. Clarke said this is done and decided at the data workshops. Dr. Freese suggested the SSC should develop a standard format. Mr. Anderson was not in favor of establishing an expedited review process. It should be rigorous and deliberate. Dr. Freese explained he was not recommending an expedited review, but a standard protocol for early filtering of considered data.

Mr. DeVore suggested the GIPC discuss and recommend an ultimate deadline for the Council considering new data and models. He suggested the November meeting when biennial specifications decision-making is initiated should be considered as an ultimate deadline. Ms. Vojkovich was concerned that new projection models (i.e., recreational projections using CRFS data) may not be worked out by this November. Ms. Culver explained that data collection methodology for recreational catch monitoring is reviewed by the RecFIN Data Committee and then the SSC. After these data are recommended, the GMT considers models that use these data. These are sequential, yet separate, processes. Deadlines should be considered for both processes. Mr. Wolford asked if the best pathway is to go through the state reviews and then to the GMT? Ms. Culver said the GMT protocol is to only use data recommended by the official review bodies. Ms. Schmitt agreed with the recommendations, but cautioned that the ODFW may not have the resources or expertise to scientifically review new data and models. Mr. DeVore recommended the GIPC consider a deadline for new models. The November kick-off meeting for biennial specification decision-making is recommended so analyses can be done in time for the Council to decide a range of management measures the following April. The GIPC was in agreement that the November kick-off meeting should be the deadline for considering new models. Data feeds informing these models could be considered after the November meeting. Mr. Anderson recommended this flexibility and suggested new data should be brought to the GMT's attention by their February meeting.

Ms. Vojkovich asked about the process and schedule for deciding the STAR Terms of Reference? She has a laundry list of recommendations. It was explained the STAR Terms of Reference has been finalized for the current suite of assessments. This process is done in the science off year (even years under the current management regime). Dr. Clarke recommended the final STAR Terms of Reference be decided by the April meeting during the science off year and, therefore available prior to the data workshop(s). Therefore, the next STAR Terms of Reference should be decided in April 2006. The GIPC agreed with this recommendation.

Ms. Culver suggested draft models need to go before the GMT and/or SSC prior to November so that a final decision can be made in November. Should the SSC review recreational projection models? Currently, recreational catch estimation models are reviewed by the RecFIN Data Committee and recreational catch projection models are reviewed by the GMT. Dr. McIsaac recommended the GMT has the expertise to do this. Only if there is GMT disagreement on a catch projection model should it be reviewed by the SSC. Dr. Clarke said there should then be a placeholder for this review on the September SSC agenda. Mr. Anderson did not like this idea. He suggested GMT disagreement should be brought to the Council and a policy call could then be made. If the GMT suggested an SSC review, this recommendation should be brought to the Council. The Council could then task the SSC. Ms. Culver advocated new projection models should be brought to the GMT in June. Then the SSC could review new models in September if needed. The GIPC agreed with this recommendation.

(360) 697-5393 Dr. Freese asked if there should be a protocol for data brought into the process from industry or outside advocates. Such data includes economic data and EFH data. Dr. Clarke said there is a peer-review protocol for such data. She cautioned the Council should not interfere with this process.

The meeting was adjourned at 11 a.m.

ADJOURN

Summary of GIPC Recommendations

Mid-Term OY Adjustments Policy

- Mid-term OY adjustments should only be considered for overfished species and only in a downward direction if it is needed to achieve the adopted rebuilding plan.
- Triggers for adjusting OYs should be developed on a case by case basis according to the SSC rebuilding plan review protocols, which will be adopted during the March and April Council meetings.

Inseason Management Adjustments Policy

- Management measures should not be liberalized until the June Council meeting at the earliest unless data or model errors warrant earlier consideration.

Policy for Data and Models Used in Biennial Management Decision-Making

- Models originating from outside the NMFS and Council process should have the same rigorous review as agency models. The SSC will be the final arbitrating review body for considered new models.
- New models should not be accepted after the initial November meeting when biennial management decision-making is initiated. However, data feeds informing an adopted model can occur after then.
- The stock assessments and STAR Terms of Reference for reviewing these stock assessments designed for management decision-making should be decided by the April meeting of the next science "off year". That is, stock assessments for the 2009-2010 biennial management cycle should be decided by the April 2006 Council meeting.

PFMC
02/22/05

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON INSEASON MANAGEMENT RESPONSE POLICY

The Groundfish Advisory Subpanel (GAP) reviewed the recommendations of the Groundfish Management Team (GMT) and the Ad Hoc Groundfish Information Policy Committee on establishing an inseason management response policy.

In general, the GAP agrees that attempting to establish inseason changes in March, which are designed to either attain or stay within optimum yield levels, is far too uncertain a process. While mistakes or major modeling errors need to be corrected, adjusting such things as cumulative limits or seasons, based on soft data from the first month or two of the year, should be avoided at the March meeting.

However, the GAP is not comfortable waiting until the June meeting in all cases. An adjustment recommended in June would not go into effect until after the beginning of July, even with NMFS staff working overtime. Commercial and recreational fishermen could lose one or two months of good early summer weather. If adjustments were recommended in April, the Council would have the advantage of two months of hard data and over a month of soft data. They would know if the winter fisheries were more - or less - active and productive than normal. With the new monitoring program adopted by the GMT, we would not have the risk of major effort increases going undetected.

The GAP believes that considering April as the first potential meeting for inseason adjustments is warranted and urges the Council to modify the proposed policy accordingly.

PFMC
03/08/05

Agenda Item F.1
Situation Summary
March 2005

INSEASON MANAGEMENT RESPONSE POLICY

In recent years, inseason groundfish management has become a dominant feature of many Council meetings. The complexities of the management regime, including new mandates and strictures imposed with rebuilding plans and new monitoring systems, has translated into somewhat unpredictable outcomes when management adjustments are made. The Groundfish Management Team (GMT), Groundfish Advisory Subpanel (GAP), and the Council have consequently devoted such a large amount of time to consideration of inseason management adjustments, that there has been concern about the impact to some of the other important tasks on their agendas. Additionally, some of these adjustments, especially early in the fishing season, have resulted in early attainment of a species' optimum yield (OY) or fishery harvest guideline, which has caused hardship as fisheries closed prior to the normal end of the season. Therefore, the Council has scheduled consideration of an inseason management response policy to more efficiently and effectively manage Council meetings and the groundfish fishery.

Last November, the GMT recommended that management measures not be liberalized as part of any inseason action prior to the June Council meeting (unless data or model errors warrant such consideration). It was thought that early attainment problems may be lessened if inseason actions were more conservative during the first six months of the fishing season. The Groundfish Information Policy Committee (GIPC) met on January 25-26 to discuss and recommend, among other things, an inseason management response policy to help govern future Council actions (Agenda Item F.1.b, Attachment 1). The GIPC agreed with the GMT that this would be a sound policy for the Council to consider. Another inseason management response policy alternative the GIPC considered was limiting the magnitude of inseason adjustments. For instance, inseason adjustments, such as trip limits, could be limited to ± 10% of status quo under this alternative. The GIPC rejected this alternative because it seemed to be unnecessarily complicated and was obviated by their recommendation to not liberalize management measures during the first six months of the fishing season.

The Council task under this agenda item is to consider the recommendations of the GIPC and other Council advisors and adopt inseason management response alternatives or a draft policy for public review. Final action on an inseason management response policy will be scheduled for the April Council meeting.

Council Action:

1. Adopt Inseason Management Response Alternatives/Draft Policy for Public Review.

Reference Materials:

1. Agenda Item F.1.b, Attachment 1: Draft Summary Minutes of the January 25-26, 2005 Groundfish Information Policy Committee Meeting.

Agenda Order:

a. Agenda Item Overview John DeVore
b. Ad Hoc Groundfish Information Policy Committee (GIPC) Report Don Hansen
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action**: Adopt Inseason Management Response Alternatives/Draft Policy for Public Review

PFMC
02/22/05

NATIONAL MARINE FISHERIES SERVICE REPORT ON GROUNDFISH MANAGEMENT

National Marine Fisheries Service (NMFS) Northwest Region will briefly report on recent regulatory developments relevant to groundfish fisheries and issues of interest to the Council. NMFS Northwest Fisheries Science Center will also briefly report on groundfish-related science and research activities.

Council Task:

Discussion.

Reference Materials:

1. Agenda Item F.2.a, Attachment 1: January 11, 2005 letter from the Oregon Fishermen's Cable Committee to Bob Lohn, Administrator, National Marine Fisheries Service, Northwest Region regarding a proposal for a cooperative study between fishermen and the National Marine Fisheries Service to develop improved species distribution maps for the EFH EIS process.
2. Agenda Item F.2.b, Attachment 1: A Summary Report from The West Coast Groundfish Data Workshop held July 26-30, 2004 in Seattle, Washington.

Agenda Order:

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

PFMC
02/22/05

OREGON FISHERMEN'S CABLE COMMITTEE

Established as Oregon Fishermen's Undersea Cable Committee July 9, 1998

2021 Marine Drive, Suite 102
Astoria, Oregon 97103
Phone (503) 325-2285
Fax (503) 325-7012
www.ofcc.com

January 11, 2005

Bob Lohn, Regional Administrator
National Marine Fisheries Service, Northwest Region
7600 Sand Point Way NE, Building 1
Seattle, WA 98115

RECEIVED
JAN 12 2005
PFMC

Dear Mr. Lohn:

I am one of two fishing industry representatives on the Habitat Technical Review Committee (HTR Committee) working on the Essential Fish Habitat (EFH) EIS for Groundfish. As part of the process, a model has been created to identify EFH for groundfish. The model uses habitat information and a Habitat Utilization Database along with other inputs to map the Habitat Suitability Probability (HSP) for each life stage of each of 82 species of groundfish. The HTR Committee met in Portland in December to review the range of options for the PFMC to consider in designating EFH, and to review the model and the HSP maps. While the model is quite sophisticated and capable of producing extremely useful results, it quickly became apparent that there were some significant errors in the maps that were produced by the model. In fact, nearly every map that was reviewed had to be changed. Some of the corrections were needed due to incorrect data feeding the model, others because the model lacked the inputs that local experts at the meeting provided. The HTR Committee reviewed less than 50 of the 160 maps created. As the Committee's 12/8/04 statement says, "...the HSP approach and the data consolidated for the EIS is an important advance that, with updates and maintenance, will continue to improve the Council's and NMFS' ability to effectively manage EFH."

My concern is that the maps won't hold up under public scrutiny. The fishing industry will likely have little faith in the EFH process and any EFH regulatory changes if the maps are inaccurate in showing where fish live. As originally created, the maps have glaring discrepancies, some showing species of fish in areas that they do not live, others showing lower probability of fish in areas that the fish are heavily fished.

(cont'd.)

At the meeting, the HTR committee made an initial review of some of the maps. What is needed is a series of "ground-truthing" workshops along the west coast where local fishermen and scientists can review the Habitat Utilization Database and the output HSP maps and make the necessary corrections. I believe I speak for the committee in saying that a collaborative process involving commercial fishermen and fisheries and habitat scientists would be quite beneficial in making the needed corrections to the maps and the Habitat Utilization Database that feeds into the model. While the information would make the model and the HSP map more accurate, the information shared would be valuable in its own right to the fishermen and scientists involved.

The Port Liaison Project (PLP) is interested in funding fishermen's time and expenses for such collaborative workshops. As a port coordinator for the PLP, I think this a perfect example of the type of cooperative research projects the PLP was intended to support. What is needed is funding for the other costs—GIS technicians, meeting rooms and other logistical support, etc.

I request that funding for collaborative meetings be made available so the model can be corrected and the PFMC can have more accurate maps to base EFH decisions on. With a modest investment from NMFS and the PLP, I believe we can make these maps reliable and useful to the Council for EFH and fisheries management.

Best regards,

Scott McMullen

Scott McMullen, Oregon Fishing Industry Representative
Habitat Technical Review Committee

cc: Steve Freese, Acting Assistant Regional Administrator, NMFS NWR
Steve Copps, Senior Policy Analyst, NMFS NWR
✓Don McIsaac, Executive Director, PFMC
Randy Fisher, Executive Director, PSMFC
Ginny Goblirsch, Project Co-Director, Port Liaison Project
Flaxen Conway, Project Co-Director, Port Liaison Project

Agenda Item F.2.a
Supplemental NMFS Report
March 2005

2004 PACIFIC WHITING FISHERY
FOR NON-TRIBAL MOTHERSHIPS AND CATCHER/PROCESSORS
(Based on Observer Data)

TABLE 1. SUMMARY - CUMULATIVE NON-TRIBAL CATCH OF ALL SPECIES

Groundfish	Retention (mt)	Discard (mt)	Total (mt)
Pacific whiting	96,760.85	516.13	97,276.98
Rockfish	58.50	26.44	84.94
Flatfish	2.10	1.10	3.20
All other groundfish	35.39	344.41	379.80
TOTAL	96,856.84	888.08	97,744.92
Prohibited Species		Number of fish	
Halibut		72	
Salmon		861	

TABLE 2. NON-TRIBAL ROCKFISH CATCH AND RATIO BY AREA (in metric tons)

ROCKFISH	VANCOUVER - 670			COLUMBIA - 710			EUREKA - 720			TOTAL WOC		
	Ret	Dis	Tot	Ret	Dis	Tot	Ret	Dis	Tot	Ret	Dis	Tot
Bocaccio	0.00	0.03	0.03	0.04	0.09	0.12	0.00	0.00	0.00	0.04	0.12	0.16
Other rockfish	4.03	4.37	8.40	12.74	6.66	19.40	5.19	0.22	5.41	21.95	11.25	33.21
POP	0.01	0.02	0.03	0.12	0.16	0.28	0.71	0.04	0.75	0.84	0.22	1.05
Thornyhead	0.00	0.00	0.00	4.29	1.34	5.64	0.00	0.00	0.00	4.29	1.34	5.64
Canary	0.05	0.06	0.11	4.29	0.17	4.45	0.03	0.00	0.03	4.37	0.23	4.60
Yellowtail	2.33	2.31	4.64	10.78	3.03	13.80	0.05	0.00	0.05	13.16	5.33	18.49
Widow	0.01	0.08	0.10	12.27	6.81	19.08	0.63	0.00	0.63	12.91	6.89	19.80
Chilipepper	0.00	0.00	0.00	0.18	1.04	1.22	0.76	0.00	0.76	0.94	1.04	1.97
Shortbelly	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.01	0.01	0.02
TOTAL ROCKFISH	6.44	6.87	13.31	44.71	19.30	64.01	7.35	0.27	7.62	58.50	26.44	84.94
TOTAL WHITING	20,530	211	20,741	69,513	305	69,817	6,718	0	6,718	96,761	516	97,277
R[illegible]ckfish [illegible]ting [illegible]mt)	0.0006			0.0009			0.0011			0.0009		

Slight discrepancies occur due to rounding.

March 3, 2005

TABLE 3. NON-TRIBAL SALMON CATCH AND RATIO BY AREA

	VANCOUVER - 670	COLUMBIA - 710	EUREKA - 720*	TOTAL
Chinook (no.)	32	478	295	805
Other salmon (no.)	6	50	0	56
TOTAL salmon (no.)	38	528	295	861
Whiting (mt)	20,741	69,817	6,718	97,277
No. chinook/mt whiting	0.0015	0.0068	0.0439	0.0083

* Monterey area north of 39° rate was 0.03 salmon per mt whiting.

TABLE 4. CATCH BY NON-TRIBAL MOTHERSHIPS AND CATCHER/PROCESSORS

SPECIES	MOTHERSHIP					CATCHER/PROCESSOR					TOTAL WOC
	RETAIN (mt)	(%)	DISCARD (mt)	(%)	TOTAL (mt)	RETAIN (mt)	(%)	DISCARD (mt)	(%)	TOTAL (mt)	
Whiting	23,957	99	145	1	24,102	72,804	99	371	1	73,175	97,277
Rockfish	25.54	79	6.97	21	32.51	32.96	63	19.47	37	52.43	84.94
Flatfish	0.20	77	0.06	23	0.26	1.90	65	1.04	35	2.94	3.20
All other groundfish	12.30	59	8.41	41	20.71	23.09	6	336.00	94	359.10	379.80
TOTAL	23,995	79	160	22	24,155	72,862	58	728	42	73,589	97,745
SALMON				%	No.				%	No.	
Chinook				93	417				94	388	805
Other				7	28				6	28	56
Total					445					416	861
No.chinook/mt whiting					0.0173					0.0053	0.0083

Slight discrepancies occur due to rounding.

Table 5. CATCH OF ROCKFISH BY NON-TRIBAL MOTHERSHIPS AND CATCHER/PROCESSORS (metric tons)

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	TOTAL
Bocaccio	0.09	0.07	0.16
Other rockfish	3.71	29.50	33.21
POP	0.10	0.95	1.05
Thornyheads	0.01	5.62	5.64
Canary rockfish	4.11	0.48	4.60
Yellowtail rockfish	12.16	6.33	18.49
Widow rockfish	11.43	8.37	19.80
Chilipepper rockfish	0.88	1.10	1.97
Shortbelly rockfish	0.02	0.00	0.02
TOTAL ROCKFISH	32.51	52.43	84.94
Mt whiting	24.102.02	73,174.96	97,276.9[illegible]
Mt rockfish/mt whiting	0.0013	0.0007	0.0009

Slight discrepancies occur due to rounding.

March 3, 2005

Table 6. 1997-2004 PACIFIC WHITING NON-TRIBAL AT-SEA PROCESSING VESSELS (NMFS Observer Data)

	COMMON NAME	WEIGHT (mt)							
		1997	1998	1999	2000	2001	2002	2003	2004
	Pacific whiting	121,172	120,452	115,259	114,655	94,451	62,935	67,236	97,277
O	Pacific cod	0.01	0.00	0.04	0.19	0.00	0.00	0.25	0.02
U	Lingcod	0.14	0.11	0.06	0.41	0.66	0.27	0.49	1.18
N	Jack mackerel	13.18	229.14	Moved to coastal pelagics FMP in 1999					
D	Sablefish	0.81	27.83	2.10	47.13	21.50	21.02	16.95	28.71
F	Arrowtooth	0.16	1.04	3.21	8.61	3.76	2.17	2.86	1.12
L	Dover sole	0.00	0.01	0.00	0.27	1.53	0.65	0.85	0.14
A	English sole	0.00	0.00	0.02	0.22	0.10	0.11	0.02	0.02
T	Petrale sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	Rex sole	0.04	0.36	0.02	5.54	18.32	11.51	6.71	1.89
I	Rock sole	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	Starry flounder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	All other flatfish spp	0.05	0.01	0.01	1.32	7.05	0.15	0.18	0.02
R	Bocaccio	0.21	1.21	0.32	2.65	0.29	0.19	0.06	0.16
O	Canary rockfish	1.81	2.72	1.22	1.42	1.61	2.41	0.26	4.60
C	Chilipepper	0.01	0.01	0.54	4.83	3.57	4.90	1.26	1.97
K	Pacific oc. perch	3.28	21.28	14.15	9.61	19.74	3.62	5.16	1.05
F	Shortbelly	0.76	0.02	0.00	0.86	27.33	0.60	0.51	0.02
	Thornyhead	0.46	2.51	0.02	19.07	15.21	11.91	15.65	5.64
S	Widow rockfish	207.21	292.76	148.95	220.62	168.91	135.60	12.25	19.80
H	Yellowtail	290.15	376.98	684.13	555.56	124.99	14.28	2.32	18.49
	Other rockfish spp	81.56	62.36	33.15	120.34	78.22	23.67	29.05	33.21
	Other groundfish 1/	217.27	218.07	254.05	92.46	89.18	38.82	14.33	349.89
	TOTAL GROUNDFISH	121,989	121,689	116,401	115,746	95,033	63,207	67,345	97,745
NON	Pacific mackerel 2/	54.15	458.78	1.47	15.52	47.29	0.04	0.00	0.00
	Jack mackerel 2/			53.84	52.98	107.43	6.85	12.38	58.07
	Pacific sardine	0.31	1.94	0.18	0.06	0.23	0.01	0.00	0.00

PROHIBITED SPECIES	1997	1998	1999	2000	2001	2002	2003	2004
Chinook Salmon	1,398	1,477	4,391	6,260	2,568	1,679	2,648	805
Other Salmon 4/	924	27	802	115	770	173	224	56
TOTAL SALMON	2,322	1,504	5,193	6,375	3,338	1,852	2,872	861
Percent Chinook Salmon	60.2	98.2	84.6	98.2	76.9	90.7	92.2	93.5
No. Chinook/MT whiting	0.0115	0.0123	0.0381	0.0546	0.0272	0.0267	0.0394	0.0083
Pacific Halibut	9	7	47	211	74	59	199	72

1/ Defined as sharks, skates, kelp greenling, cabezon, ratfish, morids, and grenadiers.
2/ Non-groundfish species that are incidental to the whiting fishery, but which are not prohibited.
[illegible] discrepancies occur due to rounding.

March 3, 2005

2004 PACIFIC WHITING FISHERY SUMMARY, ALL SECTORS

SPECIES	TRIBAL						NON-TRIBAL MOTHER-SHIPS		CATCHER/ PROCESSORS		SHORE-BASED PROCESSORS			TOTAL WOC	
	MOTHERSHIP		SHORE BASED		ALL TRIBAL						EFP only		non-EFP		
	mt	Rate	mt	Rate	mt	Rate	mt	Rate	mt	Rate	mt	Rate	mt	mt	Rate
Whiting Allocation					32,500		51,720		73,270		90,510			250,000	
WHITING	23,313		5,335		28,648		24,102		73,175		89,251		1,644	216,819	
Yellowtail Rockfish	28.60	0.0012	3.50	0.0007	32.10	0.0011	12.16	0.0005	6.33	0.0001	114.63	0.0013		165.22	0.0008
Widow Rockfish	1.49	0.0001	0.14	0.0000	1.63	0.0001	11.43	0.0005	8.37	0.0001	28.59	0.0003		50.02	0.0002
Canary Rockfish	0.61	0.0000	0.00	0.0000	0.61	0.0000	4.11	0.0002	0.48	0.0000	0.83	0.0000		6.03	0.0000
Darkblotched Rockfish	0.00	0.0000	0.00	0.0000	0.00	0.0000	3.02	0.0001	4.36	0.0001	0.74	0.0000		8.12	0.0000
POP	0.02	0.0000	0.17	0.0000	0.19	0.0000	0.10	0.0000	0.95	0.0000	0.75	0.0000		1.99	0.0000
Lingcod	0.18	0.0000	0.00	0.0000	0.18	0.0000	0.81	0.0000	0.37	0.0000	3.70	0.0000		5.06	0.0000
All other groundfish	276.15		9.18		285.33		18.37		389.14		167.74			860.58	
TOTAL GROUNDFISH	23,620		5,348		28,968		24,152		73,585		89,568 a/		1,644	217,917	
Percent over/under Whiting Allocation					-12%		-53%		0%		1%			-13%	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate		Number	Rate
Chinook	3,690	0.1583	50	0.0094	3,740	0.1306	417	0.0173	388	0.0053	4,257	0.0477		8,802	0.0406
Non-Chinook (including salmon unident.)	227		53		280		28		28						

Data sources: All data is total catch (retained plus discarded catch). The at-sea Catcher/processor and mothership data is from the NorPac data base. Shore-based data is from Oregon Department of Fish and Wildlife 2004 shore-based sampling summary, and the tribal shore-based catch was provided by the Makah fisheries office

a/ Does not include Pacific cod, flatfish, skates or sharks other than spiny dogfish

A Summary Report from The West Coast Groundfish Data Workshop held July 26-30, 2004 in Seattle, Washington

Northwest Fisheries Science Center
February 16, 2005

Introduction

The following report summarizes the discussion and outcomes from the West Coast Groundfish Data Workshop, held July 26-30, 2004 at the NOAA Western Regional Center in Seattle, Washington. This workshop was the second of three "Off-Year" Science Improvement Workshops convened during 2004 for the purpose of preparing for the West Coast groundfish stock assessments to be conducted in 2005. The objectives of this workshop were to identify and discuss data and data sources to be used in conducting the 2005 assessments, to discuss and review methods for converting raw data into model inputs, and to explore the potential use of additional data sources in future stock assessments. Workshop participants included data experts from Washington, Oregon, California and NOAA Fisheries, West Coast groundfish stock assessment authors, members of the Scientific and Statistical Committee of the Pacific Fishery Management Council, and the public. Stacey Miller, Elizabeth Clarke, and James Hastie from the Fishery Resource Analysis and Monitoring Division (FRAMD) of the Northwest Fisheries Science Center (NWFSC) organized the workshop.

The first session of the workshop provided an opportunity for data stewards to present overviews of the principal data sources used in West Coast groundfish stock assessments. During the second session, data analysts and stock assessment authors presented methods that have been or could be used to analyze and pre-process input data from each of the principal data sources. The presentations were followed by technical discussions among workshop participants. Presentations and discussions on the use of secondary data sources and exploratory data sources that may be available during the next assessment cycle took place during the third session of the workshop. The recommendations, discussion points, and action items contained in this report were outlined during the wrap up session moderated by Elizabeth Clarke (NWFSC).

Workshop participants attempted to agree on default assumptions regarding how the various types of data are to be analyzed. Assessment authors are expected to produce and consider the default approaches in the assessments. Authors are free to add additional analyses, but must justify their approach and should notify other authors using the same data types of what they plan to do.

Session I. Introduction of Principal Data Sources

Data stewards presented overviews of available data, sampling methodology, data collection and storage, and the process for requesting data for each of the data sources. Presentations were followed by a brief question and answer period. Points of contact for each of the data sources are included in Appendix III.

Beth Horness (NWFSC) presented an overview of the Northwest Fisheries Science Center bottom-trawl groundfish survey, including the history and general features of the survey, sampling design, data collection, an overview of the database and available data, and future plans for the survey and database. Beth Horness is the point of contact for the NWFSC survey data (1998-present) and the 2004 NWFSC triennial shelf survey data. Mark Wilkins from the Alaska Fishery Science Center (AFSC) is the point of contact for the 1977-2001 AFSC triennial shelf survey data

William Daspit of the Pacific States Marine Fisheries Commission (PSMFC) gave a presentation on the Pacific Fisheries Information Network (PacFIN), which is the central repository for commercial catch, effort, and biological data along the West Coast. He provided an overview of the goals and purpose of the program, the general framework of the PacFIN database, along with a more detailed explanation of the sources contributing data to PacFIN and the data submission and review processes. William Daspit, Brad Stenberg, and Jason Sawicki are the points of contact at PSMFC for PacFIN data. The PacFIN coordinators for each of the states are listed on the PacFIN website www.psmfc.org/pacfin/contacts.html.

Jonathan Cusick and Kristen Moynihan provided an overview of the West Coast Groundfish Observer Program (WCGOP). Jonathan presented a summary of the program by highlighting the program goal of providing managers with accurate estimates of discards, the sampling methodology, vessel selection process, and collection of data. Kristen Moynihan followed with a presentation on the general framework of the database, data flow, and types of data stored in the database. A copy of the NWFSC 2004 WCGOP Data Report and Summary Analysis was provided on the workshop background materials CD. Jonathan Cusick is the point of contact for WCGOP data and data summary reports.

Wade Van Buskirk (PSMFC) presented information on the Recreational Fisheries Information Network (RecFIN), which has been designed to integrate state and federal marine recreational fishery sampling efforts into a single, central database. In addition to discussing the RecFIN database framework and the process for retrieving data from the RecFIN website, he also provided an overview of the Marine Recreational Fisheries Statistics Survey (MRFSS). The MRFSS data are used as base data in the RecFIN database. Background materials pertaining to RecFIN were provided on CD Rom and included The MRFSS User's Manual, a memorandum to the RecFIN Technical committee, and a letter summarizing RecFIN. Wade Van Buskirk is the point of contact for RecFIN related questions.

Overviews on recreational fishery sampling efforts conducted by Washington, Oregon, and California were also presented during this session. Farron Wallace presented information on Washington's Ocean Sampling Program (OSP). Three background documents describing the OSP basic program functions, historical accounting of changes in data collection fields, and algorithms to generate catch estimates were provided as part of the data workshop background materials. David Sampson from Oregon State University (OSU) provided an overview of Oregon's Ocean Recreational Boat Survey (ORBS) including the general history of the program, features and examples of the ORBS data for groundfish, and issues with using groundfish CPUE data from ORBS. Additional details on the ORBS program can be found on the data workshop background materials CD in a document titled "Oregon's Ocean Recreational Boat Survey" by David Sampson.

Tom Barnes from the California Department of Fish and Game (CDFG) presented a summary of California's Commercial Passenger Fishing Vessel (CPFV) Data including a an overview of the CPFV program history, logbook data, the Northern/Central California's CPFV onboard data collection program conducted during 1987–1998, and the Southern California's CPFV onboard data collection program conducted by CDFG during 1975-1978, 1986-1989, and 1999. Additional details on the CPFV logbook data can be found in the background document titled "Historical logbook databases from California's Commercial Passenger Fishing Vessel (Partyboat) Fishery, 1936-1997" by Hill et al. (1999). Deb Wilson-Vandenberg provided a summary of California recreational [fishing] regulatory history from 2000-03 for the background materials CD. The points of contact for CPFV data are as follows: Jana Robertson from CDFG for trip-specific CPFV logbook data from 1980-present; Kevin Hill (SWFSC) for historical logbook data; Deb Wilson-Vandenberg (CDFG) for the Northern/Central CA onboard data collection program data; and Steve Ralston (SWFSC) for the Southern CA onboard data collection program data.

Session II. Discussion of Principal Data Sources

NOAA Fisheries' Bottom Trawl Surveys.

Owen Hamel (NWFSC) presented methods for calculating traditional area-swept biomass estimates and building age and length compositions using bottom trawl survey data. The methodology is described in a document titled "The calculation of summary statistics for the Pacific West Coast upper continental slope trawl survey of groundfish resource off Washington, Oregon, and California" included on the background materials CD. Tom Helser (NWFSC) presented an analysis of a multi-vessel fishery resource survey using a generalized linear mixed model.

Recommendations and Action Items:

General

1) The 2004 survey data should be included in upcoming assessments. It is anticipated that the NWFSC 2004 triennial shelf survey data will be available by

January 15, 2005 and the NWFSC 2004 slope survey data by February 15, 2005. (Please note that the dates for availability of 2004 survey data have been extended in order to ensure accuracy and reliability of data).

2) Biological samples from the survey (i.e. aging structures) should be transmitted to the appropriate aging lab as soon as possible upon the completion of the surveys.
3) Exploratory work on whether trawlable and untrawlable areas should be differentiated when expanding density estimates from trawl data will be conducted by the NWFSC and reported to the modeling workshop in October 2004.
4) Additional discussion should occur at the modeling workshop in October 2004 on collapsing bin structure for ages and/or lengths instead of utilizing age-length keys.
5) Criteria to decide whether an assessment is an "update" or a "full assessment" when new data are used in the assessment should be included in the new Terms of Reference for Stock Assessments.

Shelf Surveys

1) Mark Wilkins from the Alaska Fishery Science Center (AFSC) is the point of contact for the AFSC triennial survey (1977-2001). Beth Horness at the Northwest Fisheries Science Center is the point of contact for the 2004 triennial shelf survey data.
2) The traditional area-swept biomass estimator will be the default for the triennial shelf survey conducted by the AFSC (1977-2001) and the NWFSC (2004) for the 2005 West Coast groundfish stock assessments. The NWFSC will coordinate with the AFSC to ensure the same methods will be used across all years to calculate biomass estimates and incorporate biological samples, ages, and lengths.
3) Due to coverage inconsistency for the triennial survey, 1977 data should not be used unless analysts can make a specific case on a species by species basis.
4) In keeping with the general need for simplicity, vessel effect in the triennial survey is noted as a potential topic for future analysis, but will not be addressed during this assessment cycle.
5) Mr. Mark Wilkins (AFSC) will re-code the performance field of the hauls identified as "waterhauls" by Zimmermann et al. 2001. The "waterhauls" in the triennial survey will be excluded in all analyses by default.

Slope Surveys

1) Workshop participants recommend treating the two slope surveys conducted by the AFSC using the R/V Miller Freeman and the NWFSC using chartered West Coast commercial fishing vessels, separately and applying separate generalized linear models (GLM's) to each survey.
2) Assessments should not include age- and length-composition data from the slope survey for years for which the survey was non-synoptic and biomass estimates are consequently based on a "super-year" approach, unless the survey covered a substantial portion of the stock's range.
3) Tom Helser (NWFSC) will produce GLM estimates for dover sole, thornyheads, and sablefish (DTS) and slope rockfish species and will also explore and report on

error models, specifically the error distribution assumed when analyzing the data for positive tows for each of the slope species.

Commercial Data Sources

The session on commercial data sources consisted of presentations on retrieving commercial landings and biological data from the Pacific Fishery Information Network (PacFIN) given by Ian Stewart (NWFSC) and the California Commercial database (CalCOM) given by Alec MacCall (SWFSC). Ian Stewart provided a current inventory of PacFIN biological sample data for West Coast groundfish species being assessed in 2005. Alec MacCall provided CalCOM documention as part of the workshop background materials. Randy Fishery (PSMFC) moderated the session.

Recommendations and Action Items:

General

1) All assessments should use data through 2004, to the extent that the data are available.

PacFIN Landings

1) Analysts should include only landings from U.S. offshore waters. Foreign catch (i.e. catch occurring outside of U.S. waters) and landings from Puget Sound should not be included.
2) Commercial landings summaries, or programming to easily extract them from PacFIN, will be available from Ian Stewart (NWFSC), and will maintain detail regarding the gear group and INPFC area of the catch.

PacFIN Biological Data System (BDS)

1) Assessment documents should list both the number of fish and the number of samples from which the biological data are drawn.
2) Routines for extracting biological data from PacFIN should include the size of the landing from which each sample is drawn, if that information is available.
3) Emphasis will be on submission and extraction of length data, rather than age data from the landings data for 2004. However, an effort will be made to age and submit to BDS a representative set of ages from the 2004 commercial fishery for assessments that include age-composition data, and have STAR panels scheduled for the summer rather than spring of 2005.
4) States should submit biological data such as length and age data to PacFIN promptly. Specifically, states need to submit age data to PacFIN after age reading is completed and data are delivered back to the states. A high priority should also be placed on submitting complete 2004 length data to PacFIN as early as possible in 2005. As of the end of July, only one state had submitted biological data for 2003.
5) PacFIN will develop a web-based summary of BDS data elements. (This summary was completed subsequent to the data workshop).

6) Assessment authors should provide feedback to Ian Stewart on biological data that were previously used in stock assessments that do not appear in current BDS summary tables.
7) Assessment authors need to compile and submit BDS errors and fixes to PacFIN data coordinators or other designee via email. Please Cc PacFIN so that they can track the completion.

CALCOM

1) PacFIN is working with the California Department of Fish and Game (CDFG) to accommodate data feeds of the "extreme" species composition expansions within the next few months. With the traditional species composition proportions currently provided to PacFIN, poundage landed in market categories is only distributed to individual species when composition sampling has occurred in the same gear/time/area stratum as a landing. The "extreme" expansions distribute all poundage landed in market categories to specific species.

Observer Data

Presentations and discussion during the observer data session focused on methodologies to estimate species discard tonnage for use in calculating total removals. Jim Hastie presented challenges to estimating discard, an overview of data sets and methods used to calculate historical discards, as well as a "simple" model to estimate current discard using data collected by the West Coast Groundfish Observer Program (WCGOP). Han-Lin Lai (NWFSC) presented advanced model techniques to estimate current discards using WCGOP data. Jim Hastie (NWFSC) moderated the session.

Recommendations and Action Items:

1) The "simple" bycatch model is endorsed for estimating discard using WCGOP observer data since it has been reviewed by the Scientific and Statistical Committee (SSC) of the Pacific Fishery Management Council (PFMC), is used for in-season management by the PFMC, and employs fairly simple methods.
2) The proposed "simple method" for estimating discard should be used until a formal review of the methods for estimating recent and historic discard can be conducted.
3) While employing the "simple method" to estimate discard, year-specific WCGOP data will be used to estimate discard in 2002 and 2003. There will be no pooling across calendar years for 2002-03 periods. The WCGOP data will be pooled from all years to estimate discard in 2000 and 2001. Authors assessing species with strong 1999-year classes will need to evaluate whether discard ratios based on data from 2002 and early-2003 are apt to overstate discard occurring during 2000-01.
4) Scientists from the NWFSC will evaluate stratification alternatives and develop annual estimates of discard by INPFC area for 2000-03 for species being assessed in 2005.
5) Scientists from the NWFSC will assemble and distribute to authors a compilation of historical discard assumptions used in the most recent assessments. This

compilation will be provided during the modeling workshop being held at the end of October, 2004 in Seattle, Washington.

6) The NWFSC will explore the potential for making historical observer data, Pikitch et al. (1988) and Oregon Department of Fish and Wildlife's Enhanced Data Collection Program (EDCP) data available to assessment authors for exploratory analysis.
7) Scientists from the NWFSC will explore the availability of length frequency data and average weights from observer data.
8) Discussion on how best to handle discard in stock assessment models will be continued at the Modeling Workshop at the end of October

Historical and Foreign Commercial Catch Data

Analyses to estimate historical and foreign components of commercial data were discussed in a session held on the afternoon of Wednesday, July 28. Steve Ralston (SWFSC) presented a summary of references that could be used to reconstruct pre-1981 data needed because PacFIN houses commercial data only for years from 1981 forward. He also described an approach used to estimate historical catches for the black rockfish assessment conducted by Ralston and Dick (2003). Ian Stewart (NWFSC) presented an overview of the Historical Annotated Landings database (HAL), which currently resides with PacFIN. Jean Rogers (NWFSC) reviewed her research of allocating the total catch by foreign countries from 1965 through 1976 off Washington, Oregon, and California among individual *Sebastes* and *Sebastolobus* species.

Recommendations and Action Items:

Reconstructing Pre-1980 Data

1) Authors should document the original data (including the sources), the reconstructed data, and the methods applied to determine the reconstructed data, in assessments that reconstruct historical catch data.
2) Authors should conduct sensitivity analyses to investigate the effects of including historic catch data in stock assessments.

Foreign Catch Species Composition

1) The default assumption for species composition of historical foreign catches of *Sebastes* and *Sebastolobus* spp. (1965-1987 off Washington, Oregon, and California) is to use the results of Rogers (2003).

HAL Database

1) Use the HAL database with caution. There has been little quality control and mistakes, such as typing errors and duplicates, were found during a preliminary check.

Data repository for Historical and Foreign Catch Data

1) The NWFSC will investigate developing an electronic repository to store historical commercial catch data reports such as the US-Canada Technical-Scientific Committee (TSC) Reports and/or the PFMC data series, grey literature, and any additional documents as needed.

Recreational Data

Tom Jagielo (WDFW, SSC) presented the outcomes from the Recreational CPUE Statistics Workshop held in Santa Cruz, California June 28-29, 2004 during the Recreational data session. The 2-day workshop was held to 1) provide recommendations to data stewards to identify the needs of data analysts and stock assessment scientists who seek to incorporate recreational data into groundfish stock assessments and derive indices of relative abundance from recreational CPUE statistics, 2) review analytical methods including calculation of effective fishing effort, General Linear Model (GLM) analysis, discard analysis, and bag limit analysis, 3) review existing datasets to identify potential problems and data gaps with respect to calculation of CPUE statistics for use in stock assessments, and 4) provide recommendations, as may be appropriate, to develop revisions to the SSC Terms of reference for stock assessments with respect to incorporating recreational data into groundfish stock assessments. A final report on the workshop findings and recommendations will be available from the SSC of the PFMC.

Recruitment Survey Data

Steve Ralston (SWFSC) presented a brief description of the California pelagic juvenile rockfish midwater trawl survey. Guy Fleischer followed with a presentation describing the Pacific Whiting Conservation Cooperative-National Marine Fisheries Service (PWCC-NMFS) hake/rockfish pre-recruit survey. Elizabeth Clarke (NWFSC) moderated the session.

Recommendations and Discussion Points:

1) Information for the southern juvenile rockfish survey will be available from the SWFSC Santa Cruz laboratory. Northern juvenile survey data will be available from the NWFSC. Please note that both surveys have expanded spatial coverage in recent years although integrated coast wide juvenile survey data are not yet ready for use. There is hope that data from these surveys can be combined by 2006.
2) Workshop participants noted that southern survey findings are generally consistent with age compositions from stock assessments.

CalCOFI Ichthyoplankton and Zooplankton Surveys

Christian Reiss (SWFSC) presented an overview of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) ichthyoplankton surveys. Ric Broduer (NWFSC) presented the CalCOFI North ichthyoplankton and zooplankton survey data.

Recommendations and Discussion Points:

1) Extensive data are scheduled to be available online from CalCOFI in one year. Richard Charter (SWFSC) is the point of contact until the data are available online.
2) Data do not yet include Monterey Bay Aquarium Research Institute (MBARI) surveys. Workshop participants recommend the MBARI survey data be included by 2006.
3) Most rockfish from the ichthyoplankton surveys are not yet identified to species. Genetic work to identify rockfish species will improve in the future.

4) Ichthyoplankton information from the NWFSC will be integrated into the CalCOFI database but most rockfish are not identified.
5) Authors should give considerable thought about the relevant time periods, geographic area, and/or gear types used as part of the generation of input files for the assessment of any species in which CalCOFI data may be used.

Session III. Secondary and Exploratory Data

The following presentations were given during the first half of the secondary and exploratory data session: Use of the Pacific whiting observer bycatch index and California power plant impingement data by Alec MacCall (SWFSC); California trawl logbook CPUE by Steve Ralston (SWFSC) based on Ralston, S. 1999. Environmental data sources and potential uses by Michael Schirripa (NWFSC); and the use of genetics in stock assessments by Ewann Berntson (NWFSC) and Paul Moran (NWFSC). Steve Ralston also presented a study conducted by Mary Yoklavich (SWFSC) and Milton Love (UCSB) on evaluating ecological recovery in Southern California's cowcod conservation area. Andre Punt (UW, SSC) moderated the session.

Waldo Wakefield (NWFSC) facilitated the second half of the session on exploratory data, which, consisted of presentations on submersible and in situ observational survey data and habitat mapping efforts. The first presentation, an analysis relating high-resolution submersible and ROV observational data to regional trawl survey data was given by Waldo Wakefield. Tom Jagielo (WDFW) followed with a presentation on the density of demersal groundfish in untrawlable habitat on the continental shelf of Washington. Waldo Wakefield also gave a talk on submersible studies on yelloweye rockfish being conducted in Southeastern Alaska by Victoria O'Connell of Alaska Department of Fish and Game (ADFG) and an overview of current habitat mapping efforts. Chris Romsos (OSU) provided details of the Benthic Habitat Database for Oregon and Washington. Background materials included two manuscripts by Lauth et al. currently in press. Waldo Wakefield also distributed a bibliography of papers, reports and data sets containing direct count information for the U.S. West Coat and for West Coast species in British Columbia and Alaska which is included in Appendix IV.

Farron Wallace (WDFW) provided a brief presentation on the availability of length data in the Coastal Washington Arrowtooth EFP Fishery and rockfish bycatch data in the International Pacific Halibut Commission (IPHC) survey data. Tom Barnes (CDFG) followed with a presentation on California Spearfishing Tournament data and archived California data sets which are available online at
http://gis.ca.gov/catalog/BrowseCatalog.epl?id=188&show_datasets=1.

Recommendations and Action Items:

1) Authors need to review the additional data sources discussed during the secondary and exploratory data sessions and their utility when developing a final list of data sources for each assessment.
2) Exploring the development of environmentally explicit stock assessments is encouraged.

3) Priorities for new genetics studies and stock identification work need to be identified as soon as possible and at the very least, as an outcome of the upcoming stock assessments.
4) Concern was expressed regarding the disparity among STAR panels of including or excluding data. The question of whether there should be more consistency in the inclusion or exclusion of data is addressed to the SSC and specifically, the Stock Assessment Terms of Reference.
5) Discussion on whether it is possible to include a minimum estimate of abundance or biomass derived from in situ observations in stock assessment models was deferred to the modeling workshop.

References

Hill, K., and N. Schneider.1999. Historical logbook databases from California's commercial passenger fishing vessel (partyboat) fishery, 1936-1997. SIO Reference Series No. 99-19.

Lauth, R., J. Ianelli, and W. Wakefield (in press). Estimating the size selectivity and catching efficiency of a survey bottom trawl for thornyheads, Sebastolobus spp., using a towed video camera sled. Fisheries Research.

Lauth, R., W. Wakefield, and K. Smith. (in press). Estimating the density of thornyheads, Sebastolobus spp., using a towed video camera sled. Fisheries Research.

Pikitch, E.K., D.L. Erickson, and J.R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. NWAFC Processed Report 88-27.

Ralston, S. 1999. Trends in standardized catch rate of some rockfishes *(Sebastes* spp.) from the California trawl logbook database, NMFS - SWFSC Admin. Rep. SC-99-01.

Ralston, S and E. Dick. 2003. The Status of Black Rockfish *(Sebastes melanops*) Off Oregon and Northern California in 2003. In Pacific Fishery Management Council. 2003. *Volume I Appendix: Status of the Pacific Coast Groundfish Fishery Through 2003: Stock Assessment and Fishery Evaluation.* Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland,Oregon 97220-1384.

Rogers, J. B. 2003. Species allocation of *Sebastes* and *Sebastolobus* sp. caught by foreign countries from 1965 through 1976 off Washington, Oregon, and California, USA. NOAA Tech Memo NMFS-NWFSC-57.

Zimmerman, M. M.E. Wilkins, K.L. Weinberg, R.R. Lauth, and F.R. Shaw. Retrospective analysis of suspiciously small catches in the National Marine Fisheries Service West Coast Triennial Bottom Trawl Survey. AFSC Processed Report 2001-03. National Marine Fisheries Service.

APPENDIX I. WEST COAST GROUNDFISH WORKSHOP AGENDA

West Coast Groundfish Data Workshop
July 26-July 30, 2004
Seattle, Washington

Monday, July 26, 2004
12:30 p.m. Welcome, Elizabeth Clarke, NWFSC

Session I. Introduction of Principal Data Sources
Moderator: Stacey Miller, NWFSC

12:45 p.m.	NWFSC Trawl Survey Data – Beth Horness, NWFSC
1:45 p.m.	Commercial Data: Catch/Effort/Biological Samples–William Daspit, PSMFC
2:45 p.m.	*Break*
3:00 p.m.	West Coast Groundfish Observer Data –Jonathan Cusick and Kristen Moynihan, NWFSC
4:00 p.m.	Marine Recreational Fisheries Statistics Survey (MRFSS) – Wade Van Buskirk, PSMFC
4:25 p.m.	California's Commercial Passenger Fishing Vessel Data (CPFV) – Tom Barnes, CDFG
4:45 p.m.	Oregon's Ocean Recreation Boat Survey (ORBS) – David Sampson, OSU
5:05 p.m.	Washington's Ocean Sampling Program (OSP) – Farron Wallace, WDFW

Tuesday, July 27, 2004

Session II. Detailed Discussions of Principal Data Sources

NMFS Trawl Survey Data
Moderator: Guy Fleischer, NWFSC

8:30 a.m.	Generating Biomass Indices - Owen Hamel, NWFSC
9:00 a.m.	A GLMM Analysis of a Multi-Vessel Fishery Resource Survey - Tom Helser, NWFSC
9:30 a.m.	Building Age and Length Comps – Owen Hamel, NWFSC
10:00 a.m.	Discussion
10:30 a.m.	*Break*
10:45 a.m.	Discussion of trawl survey data continued
12:30 p.m.	*Lunch*

Commercial Data Sources
Moderator: Randy Fisher, PSMFC

1:30 p.m.	PacFIN Landings and Biological Samples – Ian Stewart & Jim Hastie, NWFSC
2:15 p.m.	CalCOM – Alec MacCall, SWFSC
3:00 p.m.	Discussion
3:15 p.m.	*Break*
3:30 p.m.	Discussion of commercial data continued

Wednesday, July 28, 2004

Session II. Detailed Discussions of Principal Data Sources Continued

Observer Data

Moderator: Jim Hastie, NWFSC

8:30 a.m.	Evolution of Discard Estimation on the West Coast: Where do we go from here? - Jim Hastie, NWFSC
9:00 a.m.	Methods for Calculating Total Discards – Han-Lin Lai, NWFSC
10:00 a.m.	Discussion
10:30 a.m.	*Break*
10:45 a.m.	Discussion of observer data continued
12:30 p.m.	*Lunch*

Historical and Foreign Commercial Catch Data

Moderator: Rick Methot, NOAA Fisheries

1:30 p.m.	Reconstructing Pre-1980 Data- Steve Ralston, SWFSC
1:50 p.m.	HAL Database – Ian Stewart and Jim Hastie, NWFSC
2:10 p.m.	Foreign Catch Comps – Jean Rogers, NWFSC
2:30 p.m.	Discussion
3:15 p.m.	*Break*

Recreational Data

Moderator: Tom Jagielo, WDFW

3:30 p.m.	Draft Report from Recreational CPUE Statistics Workshop – Tom Jagielo, WDFW
4:00 p.m.	Discussion

Thursday, July 29, 2004

Session II. Detailed Discussions of Principal Data Sources (Continued)

Recruitment Survey Data

Moderator: Elizabeth Clarke, NWFSC

8:30 a.m.	California Juvenile Rockfish Survey- Steve Ralston, SWFSC
9:15 a.m.	PWCC-NMFS Hake/Rockfish Pre-recruit Survey – Guy Fleischer, NWFSC
10:00 a.m.	Discussion
10:30 a.m.	*Break*

CalCOFI Icthyoplankton Data

10:45 a.m.	Overview of CalCOFI Icthyoplankton Data – Christian Reiss, SWFSC
11:15 a.m.	CalCOFI North: Icthyoplankton and Zooplankton Data – Ric Brodeur, NWFSC
11:45 a.m.	Discussion
12:30 p.m.	*Lunch*

Session III. Secondary and Exploratory Data

Moderator: Andre Punt, UW

1:30 p.m.	Pacific Whiting Observer Bycatch Index – Alec MacCall, SWFSC
1:45 p.m.	California Powerplant Impingement Data – Alec MacCall, SWFSC
2:00 p.m.	California Trawl Logbook CPUE – Steve Ralston, SWFSC
2:30 p.m.	Environmental Data – Michael Schirripa, NWFSC
3:15 p.m.	*Break*
3:30 p.m.	Genetics and Stock Structure – Paul Moran and Ewann Berntson, NWFSC

Friday, July 30, 2004

Session III. Secondary and Exploratory Data Continued

Moderator: Stacey Miller and Waldo Wakefield, NWFSC

8:30 a.m.	Submersible In Situ Observational Data – Waldo Wakefield NWFSC, Tom Jagielo WDFW, and Steve Ralston SWFSC.
9:15 a.m.	Discussion
9:45 a.m.	Habitat Surveys – Waldo Wakefield, NWFSC and Chris Romsos, OSU
10:30 a.m.	*Break*
10:45 a.m.	IPHC Survey Data – Farron Wallace, WDFW
11:00 a.m.	California Spearfishing Tournament – Tom Barnes, CDFG
11:15 a.m.	Other Data Sources Not Previously Discussed
12:30 p.m.	*Lunch*

Session IV. Wrap Up, Discussion, and Recommendations

Moderator:	Elizabeth Clarke
1:30 p.m.	Review list of data sources to be used by all authors
	Discuss timeline for compiling a list of preferred methodologies for analyzing primary data sources
	Discuss opportunities and problems of using any of the data sources identified during the workshop

APPENDIX II. WORKSHOP PARTICIPANTS

Tom Barnes, CDF&G
Matt Barnhart, NWFSC
Jim Benante, PSMFC
Ewann Bertson, NWFSC
Ric Brodeur, NWFSC
Ed Casillas, NWFSC
Elizabeth Clarke, NWFSC
Dave Colpo, PSMFC
Jason Cope, UW, NWFSC
Steve Copps, NWR
Jennifer Cramer, NWFSC
Jonathan Cusik, NWFSC
William Daspit, PSFMC
Shannon Davis, The Research Group
Yvonne deReynier, NWR
Martin Dorn, SSC, AFSC
Eric Eisenhardt, WDFW
Gavin Fay, UW
Randy Fisher, PSFMC
Guy Fleischer, NWFSC
Mark Freeman, ODFW
Melissa Haltuch, UW, NWFSC
Owen Hamel, NWFSC
Jim Hastie, NWFSC
Tom Helser, NWFSC
Jon Hess, NWFSC
Beth Horness, NWFSC
Tom Jagielo, WDF&W
Steve Joner, Makah Tribe
Aimee Keller, NWFSC
Gerry Kobylinski, PSMFC, CDFG
Steve Kupillas, PSMFC, ODFW
Han-Lin Lai, NWFSC
Todd Lee, NWFSC
Carl Lian, NWFSC
Alec MacCall, SWFSC
Janell Majewski, NWFSC
Rick Methot, NWFSC
Stacey Miller, NWFSC
Paul Moran, NWFSC
Kristen Moynihan, NWFSC
Pat Patterson, NWFSC
Kevin Piner, SWFSC
Andre Punt, UW and SSC
Steve Ralston, SWFSC and SSC
Christian Reiss, SWFSC
Jean Rogers, NWFSC
Chris Romsos, OSU
David Sampson, OSU and SSC
Jason Sawicki, PSMFC
Michael Schirripa, NWFSC
Brad Stenberg, PSMFC
Ian Stewart, NWFSC
Ian Taylor, UW
Theresa Tsou, WDFW
Wade Van Buskirk, PSMFC
Waldo Wakefield, NWFSC
Farron Wallace, WDFW
John Wallace, NWFSC
Vidar Wespestad, PWCC
Mark Wilkins, AFSC
Curt Whitmire, NWFSC

APPENDIX III. POINTS OF CONTACT FOR DATA SOURCES

Data Source	Contacts	Email Address
NWFSC Survey Data (1998-Present)	Beth Horness	Beth.Horness@noaa.gov
Triennial Shelf Survey Data (2004)	Beth Horness	Beth.Horness@noaa.gov
Triennial Shelf Survey Data (1977-2004)	Mark Wilkins	Mark.Wilkins@noaa.gov
PacFIN data	William Daspit	William_Daspit@psmfc.org
PacFIN data	Brad Stenberg	Brad.Stenberg@psmfc.org
PacFIN data	Jason Sawicki	Jason_Sawicki@psmfc.org
West Coast Groundfish Observer Program data	Jonathan Cusick	Jonathan.Cusick@noaa.gov
RecFIN data	Wade Van Buskirk	Wade@psmfc.org
CDFG CPFV trip-specific logbook (1980-Present)	Jana Robertson	CDFG, 4665 Lampson Avenue, Suite C Los Alamitos, CA 90720 Fax: 562-342-7137
CDFG CPFV historical logbook data	Kevin Hill	Kevin.Hill@noaa.gov
Northern/Central CA Onboard Data Collection Program	Deb Wilson-Vandenberg	dwilsonv@dfg.ca.gov
Southern CA Onboard Data Collection Program	Steve Ralston	Steve.Ralston@noaa.gov

APPENDIX IV. BIBLIOGRAPHY FOR DIRECT COUNT INFORMATION FOR THE U.S. WEST COAST.

This bibliography contains a list of papers, reports and data sets containing direct count information for the U.S. West Coat and for West Coast species in British Columbia and Alaska. It was assembled by Waldo Wakefield, NOAA Fisheries, Northwest Fisheries Science Center FRAM Division, November 2004.

Papers and Reports:

Adams, P.B., J.L. Butler, C.H. Baxter, T.E. Laidig, K.A. Dahlin, and W.W. Wakefield (1995) Population estimates of Pacific Coast groundfishes from video transects and swept-area trawls. Fish. Bull. 93(3):446-455.

Allee, R.J., M. Dethier, D. Brown, L. Deegan, R.G. Ford, T.F. Hourigan, J. Maragos, C. Schoch, K. Sealey, R. Twilley, M.P. Weinstein, and M. Yoklavich. (2000). Marine and estuarine ecosystem and habitat classification. NOAA Technical Memorandum NMFS-F/SPO-43. 43 p.

Amend, M., M.M. Yoklavich, Y. Rzhanov, C.B Grimes, and W.W. Wakefield. In Review. Mosaics of benthic habitats using laser line scan technology: it's in the details. *In* B. Todd and H.G. Greene, editors. Marine benthic habitat mapping. Geological Association of Canada, St. Johns, Newfoundland, Canada.

Anderson, T. J., M. M. Yoklavich, and S. L. Eittreim. (In press). Linking fine-scale groundfish distributions with large-scale seafloor maps: issues and challenges of combining biological and geological data. In P. W. Barnes and J. P. Thomas.(eds). Benthic habitats and the effects of fishing.American Fisheries Society, Symposium 41, Bethesda, Maryland.

Brock, R. J., J.A. Bohnsack, M.J. Fogarty, S.A. Murawski, M.M. Yoklavich, and M.S. Love. (2003). Marine fisheries of the USA: moving from single-species management to a more holistic ecosystem-based approach. pp 521-531, IN: Beumer, J.P., A. Grant, and D.C. Smith (eds), Aquatic Protected Areas: What Works Best and How Do We Know?, University of Queensland Printery, St. Lucia, Queensland, Australia. 689pp.

Butler, J. L., W. W. Wakefield, P. B. Adams, B. H. Robison, and C. H. Baxter. 1991. Application of line transect methods to surveying demersal communities with ROVs and manned submersibles. Proceedings of the IEEE Oceans '91 Conference.

Cailliet, G.M., A.H. Andrews, W.W. Wakefield, G. Moreno, and K.L. Rhodes. 1999. A comparison of the fish fauna from beam trawl samples, camera sled photographs and submersible observations in benthic deep-sea habitats off central California. Oceanologica Acta, 22:579-592.

Drazen, J.C., S.K. Goffredi, B. Schlining, and D.S. Stakes. 2003. Aggregations of egg-brooding deep-sea fish and cephalopods on the Gorda Escarpment: a reproductive hot spot. Biological Bulletin 205:1-7.

Else,P., Halderson, L., Krieger, K., 2002. Shortspine thornyhead (*Sebastolobus alascanus)* abundance and habitat associations in the Gulf of Alaska. Fishery Bulletin100: 193-199.

Grantham, B.A.; Chan, F.; Nielsen K.J., Fox, D.S.; Barth, J.A.; Huyer, A.; Lubchenco, J; Menge, B. 2004. Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. Nature 429: 749-754.

Greene, H.G. M.M. Yoklavich, R.M. Starr. V.M. O'Connell, W.W. Wakefield, D.E. Sullivan, J.E. McCrea, and G.M. Cailliet. 1999. A classification scheme for deep seafloor habitats. Oceanologica Acta 22(6):663-678.

Greene, H.G., M.M. Yoklavich, V.M. O'Connell, R.M. Starr, W.W. Wakefield, C.K. Brylinski, J.J. Bizzarro, and G.M Cailliet. 2000. Mapping and classification of deep seafloor habitats. International Council for the Exploration of the Sea (ICES) CM2000/T:08

Greene, H.G., V.M. O'Connell, W.W. Wakefield, Brylinsky. The offshore Edgecumbe Lava Field, Southeast Alaska: Geologic and habitat characterization of a commercial fishing ground. *In* B. Todd and H.G. Greene, editors. Marine benthic habitat mapping. Geological Association of Canada, St. Johns, Newfoundland, Canada.

Gunderson, D.R., 1993. Surveys of fisheries resources. John Wiley and Sons, Inc., New York, NY.

Hixon, M. A., B. N. Tissot, and W. G. Pearcy. 1991. Fish Assemblages of rocky bBanks of the Pacific Northwest (Heceta, Coquille, and Daisy Banks). Final Report, OCS Study 91-0052, U. S. Minerals Management Service, Camarillo, California.

Hixon, M. A. and B. N. Tissot 1992. Fish assemblages of rocky banks of the Pacific Northwest. Final Report Supplement, OCS Study 91-0025, U. S. Minerals Management Service, Camarillo, California.

Jagielo, T. A. Hoffmann, J. Tagart, M. Zimmerman. 2003. Demersal groundfish densities in trawlable and untrawlable habitats off Washington: Implications for the estimation of habitat bias in trawl surveys. Fishery Bulletin 101:545-565.

Krieger, K.J. 1993. Distribution and abundance of rockfish determined from a submersible and bottom trawling. Fishery Bulletin 91: 87-96.

Krieger, K.J. and D.H. Ito. Distribution and abundance of rockfish determined from a submersible and by bottom trawling. Fishery Bulletin 97:87-96.

Laidig, T.E., J.R. Chess, E.S.Hobson, and D.F. Howard. In preparation. Long term trends in annual abundance of juvenile rockfish (*Sebastes* spp.) off northern California and possible mechanisms for the variation.

Lauerman, L.M.L, R.S. Kaufmann, K.L. Smith, Jr. 1996. Distribution and abundance of epibenthic megafauna at a long time-series station in the abyssal Northeast Pacific. Deep-Sea Research (Part I) 43(7): 1075-1103.

Lauth, R.R., W.W. Wakefield, K. Smith. 2004. Estimating the density of thornyheads, *Sebastolobus* spp., using a towed video camera sled. Fisheries Research. Fisheries Research 70:39-48.

Lauth, R.R., J. Ianelli, W.W. Wakefield. 2004. Estimating the size selectivity and catching efficiency of a survey bottom trawl for thornyheads, *Sebastolobus* spp., using a towed video camera sled. Fisheries Research 70:27-37.

Love,M. and M.Yoklavich. (In Review). Fishes on Deep Rock Habitats. In: Allen, Horn, and Pondella (eds.) Ecology of Marine Fishes of California. UC Press.

Love, M.S., M. Yoklavich and L. Thorsteinson. (2002). The Rockfishes of the Northeast Pacific. University of California Press. 405 pages.

Mathews, K.R. and L.J. Richards. Rockfish (Scorpaenidae) assemblages of trawlable and untrawlable habitats off Vancouver Island, British Columbia. North American Journal of Fsiheries Management 11:312-318.

Murie, D.J., D.C. Parkyn, B.G. Clapp, and G.G. Kruase. 1994. Observations on the distribution and activities of rockfish, *Sebastes* spp., Sannich Inlet, British Columbia, from the Pisces IV submersible. Fisheries Bulletin 92:313-323.

Nasby-Lucas, N.M., B.W. Embley, M.A. Hixon, S.G. Merle, B.N. Tissot, and D.W. Wright. 2002. Integration of submersible transect data and high-resolution multibeam sonar imagery for a habitat-based groundfish assessment of Heceta Bank, Oregon. Fishery Bulletin 100:739-751.

O'Connell, V.M, and C.W.Carlile. 1993. Habitat-specific density of adult yelloweye rockfish *Sebastes ruberrimus* in the Eastern Gulf of Mexico. Fishery Bulletin 91:304-309.

O'Connell, V.M. and W.W. Wakefield. 1994. Applications of Side-Scan Sonar and Laser-Line Systems in Fisheries Research. Alaska Department of Fish and Game, Special Publication no. 9.

Wakefield, W.W., V. M.. O'Connell, H.G. Greene, DW. Carlile, and J.E. McRea. 1998. The role of sidescan sonar in seafloor classification with a direct application to commercial fisheries management. International Council for the Exploration of the Sea (ICES) CM1998/O:36.

O'Connell, V.M., D.W. Carlile, and W.W. Wakefield. 1998. Using line transects and habitat-based assessment techniques to estimate the density of yelloweye rockfish (Scorpaenidae: *Sebastes*) in the eastern Gulf of Alaska. International Council for the Exploration of the Sea (ICES) CM1998/O:56.

O'Connell, V.M., C. Brylinsky, and D. Carlile. 2002. Demersal shelf rockfish stock assessment for 2003. Regional Information Report No. 1J02-44, Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau, Alaska.

O'Connell, V.M., C. Brylinsky, and D. Carlile. 2003. Demersal shelf rockfish stock assessment and fishery evaluation report 2004. Regional Information Report No. 1J03-39, Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau, Alaska.

O'Connell, V., C. Brylinsky, and H.G. Greene. In Review. The use of geophysical survey data in fisheries management: a case history from Southeast Alaska. *In* B. Todd and H.G. Greene, editors. Marine benthic habitat mapping. Geological Association of Canada, St. Johns, Newfoundland, Canada.

Pearcy, W.G., D.L. Stein, M.A. Hixon, E.K. Pikitch, W.H. Barss, and R.M. Starr. 1989. Submersible observations of deep-reef fishes of Heceta Bank, Oregon. Fishery Bulletin 87:955-965.

Richards, L.J. 1986. Depth and habitat distributions of three species of rockfish (*Sebastes*) in British Columbia: observations from the submersible PISCES IV. Environmental Biololgy of Fishes 17:13-21.

Romsos, C., C. Goldfinger, R. Robison, R. Milstein, and W. Wakefield. In review. Development of a Regional Seafloor Surficial Geologic (Habitat) Map for the Continental Margins of Oregon and Washington, USA. *In* B. Todd and H.G. Greene, editors. Marine benthic habitat mapping. Geological Association of Canada, St. Johns, Newfoundland, Canada.

Smith, C.R. and S.C. Hamilton. 1983. Epibenthic megafauna of a bathyal basin off southern California: patterns of abundance, biomass, and dispersion. Deep-Sea Research 30:907-928.

Starr, R.M., D.S. Fox, M.A. Hixon, B.N. Tissot, G.E. Johnson, and W.H. Barss. 1996. Comparison of submersible-survey and hydroacoustic-survey estimates of fish density on a rocky bank. Fishery Bulletin 94:113-123.

Stein, D. L., B. N. Tissot, M. A. Hixon, and W. Barss. 1992. Fish-habitat associations on a deep reef at the edge of the Oregon continental shelf. Fishery Bulletin 90:540-551.

Tissot, B.N., M.M. Yoklavich, M.S. Love, K.York, and M. Amend. (In Prep.) Structure-forming invertebrates as components of benthic habitat on deep banks off Southern California.

Wakefield, W.W. 1990. Patterns in the distribution of demersal fishes on the upper-continental slope off central California with studies on the role of ontogenetic vertical migration in particle flux. Ph.D. Thesis, Scripps Institution of Oceanography.

Wakefield, W.W. and K.L. Smith, Jr. 1990. Ontogenetic vertical migration in *Sebastolobus altivelis* as a mechanism for transport of particulate organic matter at continental slope depths. Limnol. Oceanog. 35: 1314-1328.

Wakefield, W.W., V. M.. O'Connell, H.G. Greene, D.W. Carlile, and J.E. McRea. 1998. The role of sidescan sonar in seafloor classification with a direct application to commercial fisheries management. International Council for the Exploration of the Sea (ICES) CM1998/O:36.

Wakefield, W.W., C.E. Whitmire, J.E.R. Clemons, B.N. Tissot. 2004. Fish habitat studies: Combining high-resolution geological and biological data. In P. W. Barnes and J. P. Thomas, editors. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

Yoklavich, M.M., H.G. Greene, G.M.Cailliet, D.E. Sullivan, R.N. Lea, and M.S. Love. 2000. Habitat associations of deep-water rockfishes in a submarine canyon: an example of a natural refuge. Fishery Bulletin 98:625-641.

Yoklavich, M.M., C.B. Grimes, and W.W. Wakefield. 2003. Using laser line scan imaging technology to assess deepwater habitats in the Monterey Bay National Marine Sanctuary. Marine Technology Society Journal 37:18-25.

Yoklavich, M.M., G.M. Cailliet, R.N. Lea, H.G. Greene, R. Starr, J.deMarignac, and J. Field. (2002). Deepwater habitat and fish resources associated with the Big Creek Ecological Reserve. CalCOFI Reports 43:120-140.

Yoklavich, M.M. (1997). Applications of side-scan sonar and in situ submersible survey techniques to marine fisheries habitat research. p.140-141. In: Boehlert, G.W. and J.D. Schumacher, eds. Changing oceans and fisheries: environmental data for fisheries research and management. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-239.146 pp.

ODFW, Marine Resources Program ROV and SCUBA Nearshore Reef/Fish Research (* identifies studies with fish density data)

* Amend, M., D.S. Fox, C. Romsos. 2001. 2001 Nearshore rocky reef assessment ROV Survey. Newport, OR: Oregon Department of Fish and Wildlife. 33 pp.

Fox, D.S., M. Amend, A. Merems, B. Miller, J. Golden. 1998. 1998 Nearshore rocky reef assessment. Newport, OR: Oregon Department of Fish and Wildlife. 54pp.

Fox, D.S. M. Amend, A. Merems. 1999. 1999 Nearshore rocky reef assessment. Newport, OR: Oregon Department of Fish and Wildlife. 40 pp.

* Fox, D.S., M. Amend, A. Merems, M. Appy. 2000. 2000 Nearshore rocky reef assessment. Newport, OR: Oregon Department of Fish and Wildlife. 32 pp.

* Fox, D., A. Merems, M. Amend, H. Weeks, C. Romsos and M. Appy. 2004. Comparative characterization of two nearshore rocky reef areas: a high-use recreational fishing reef vs. an unfished reef. Newport OR: Oregon Department of Fish and Wildlife, Marine Habitat Project, Marine Resources Program. 66 pp.

* Fox, D.S., A. Merems, J. Golden, M.Amend. 1996. 1996 Kelp/reef habitat assessment. Newport, OR: Oregon Department of Fish and Wildlife. 61pp.

Grantham, B.A.; F. Chan, K.J. Nielsen, D.S. Fox, J.A. Barth, A. Huyer, J. Lubchenco, B. Menge. 2004. Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. Nature 429: 749-754.

* Merems, A. 2003. 2002 Nearshore rocky reef assessment, ROV Survey. Newport, OR: Oregon Department of Fish and Wildlife. 24 pp.

Merems, A. and C. Romsos. 2004. Nearshore Rocky Reef Habitat Survey Using Multibeam Sonar. Newport, OR: Oregon Department of Fish and Wildlife, Marine Habitat Project, Marine Resources Program. 15 pp.

* Miller, B.M; D.S. Fox, A. Merems, M. Amend. 1997. 1997 Kelp/reef habitat assessment. Newport, OR: Oregon Department of Fish and Wildlife. 40pp.

Other Reports / Databases

ROV surveys off Calfornia: California Department of Fish and Game, Fort Bragg and Eureka Offices (Constantine Karpov and Michael Prall)

Karpov, et al. 2001b. Quantitative Inventory of Habitat and Species of Management Concern at Punta Gorda Ecological Reserve. In: Sea Grant Marine Ecological Reserves Research Program, Research Results 1996-2001. MERRPS Project Number PG-1, January, 2001, 204 p.

Datasets:
1998-1999 ROV survey at Punta Gorda Ecological Reserve, California.

2000 ROV survey of invertebrates (Red abalone and red urchin) at the Farallon Islands, California.

2001 ROV survey of nearshore fish at three sites near Fort Bragg, California. (Laguna Point, Soldier Point and Point Cabrillo).

2002 Assessment of temporal differences in nearshore reef fish abundance at Carmel Point and Stillwater Cove (ROV and SCUBA) – Carmel Bay, California.

2003 and 2004 ROV survey of habitat and nearshore fish inside and outside marine protected areas at Channel Islands.

2004 ROV survey of nearshore fish at two sites off Laguna Point – Fort Bragg, California.

Karpov and colleagues currently have two manuscripts in progress. One addresses sampling precision estimation for length and width of ROV strip transects and the other will present estimates of sampling effort needed (length of ROV transect using our methods) to survey key nearshore fish species for density.

Northwest Fisheries Science Center: Additional data sets and information

Unpublished data sets of density, size, habitat associations, species composition of all benthic fishes quantified by direct observations from ROVs and occupied submersibles off Oregon and southern Washington – this data is being developed into an assessment of demersal rockfish abundance on Heceta Bank:

Heceta Bank, Oregon (1988 – 1990, 2000, 2001, 2002 Wakefield, Hixon, Tissot, Yoklavich)

Astoria Canyon, Oregon/Washington (2001 Wakefield, Tissot, Brodeur, Yoklavich)

Southwest Fisheries Science Center, Santa Cruz Laboratory: Additional data sets and information

- Substantial data set on SCUBA surveys off northern and central CA conducted for the past 21 years (and continuing) by Tom Laidig (Habitat Ecology Team, Santa Cruz Lab, SWFSC). These are direct counts of blue, black, yellowtail, canary, and other species of young-of-the-year rockfishes during summer months of settlement in kelp beds.

- Unpublished data sets of density, size, habitat associations, species composition of all benthic fishes quantified by direct observations from an occupied submersible off CA:

  --within the Cowcod Conservation Areas off southern CA (2002; Yoklavich and Love)

  --off Point Sur, central CA coast (1994; Yoklavich)

  --within submarine canyon heads off central CA coast (1992, 1993, 2003, 2004; Yoklavich)

  --on shelf rock outcrops off central coast (1993, 2004; Yoklavich)

Other Groups / Projects with direct count information
SCUBA surveys off California: California Department of Fish and Game

Direct count surveys in Puget Sound area: Washington Department of Fish and Wildlife, Mill Creek Office (Wayne Palsson and Robert Pacunski)

Direct count surveys off the northern coast of Washington: Washington Department of Fish and Wildlife, Mill Creek Office (Tom Jagielo)

PISCO - Partnership for Interdisciplinary Studies of Coastal Oceans:
Oregon State University
Stanford University
University of California, Santa Barbara
University of California, Santa Cruz

Occupied submersible and ROV transect data for Olympic Coast National Marine Sanctuary: OCNMS, Port Angeles office (Ed Bowlby and Mary Sue Brancato)

Agenda Item F.3.a
Attachment 1
March 2005

SSC Terms of Reference for Groundfish Rebuilding Analyses

Final Draft

April 2001

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 overfished ($B_{25\%} = 0.25 \times B_0$). To prevent stocks from deteriorating to that point, the policy also specifies a precautionary threshold equivalent to 40% of B_0. At stock sizes less than $B_{40\%}$ the policy requires that OY, when expressed as a fraction of the allowable biological catch (ABC), be progressively reduced. 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, In review). In the absence of a credible estimate of B_{MSY}, which can be very difficult to estimate (MacCall and Ralston, In review), $B_{40\%}$ is a suitable proxy to use as a rebuilding target.

There are a number of ways that one could proceed in modeling stock rebuilding, but they fundamentally reduce to two basic kinds of approaches. These are: (1) an empirical evaluation of spawner-recruit estimates and (2) fitting spawner-recruit estimates to a theoretical model of stock productivity (e.g., the Beverton-Holt or Ricker curves). To date, however, rebuilding plans have largely been based on analyses of the former type (e.g., bocaccio, lingcod, POP#1, canary rockfish). Similarly, the cowcod rebuilding analysis involved an empirical evaluation of annual estimates of surplus production. Thus far, the only rebuilding analysis that has been based on the fit of spawner-recruit data to a theoretical model is the analysis presented in the last stock assessment of Pacific ocean perch (POP#2; Ianelli *et al*. 2000).

Presented here are 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). These basic calculations are required of all rebuilding analyses in order to provide a standard set of base case computations, which can then be used to compare and standardize rebuilding analyses among stocks. However, the SSC also encourages rebuilding analysts to explore alternative calculations and projections that may more accurately capture uncertainties in stock rebuilding, 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 projections to use.

---

[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 in 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.

Estimation of B_0

For the purpose of estimating B_0 empirically, analysts have selected a sequence of years, wherein recruitment is believed to be reasonably representative of the natality from an unfished stock. These recruitments, in association with growth, maturity, fecundity, and natural mortality estimates, can then be used to calculate equilibrium unfished spawning output. In selecting the appropriate temporal sequence of recruitments to use, investigators have generally utilized years in which stock size was relatively large, in recognition of the paradigm that groundfish recruitment is positively related to spawning stock size (Myers and Barrowman 1996). Moreover, due to the temporal history of exploitation in the west coast groundfish fishery (see Williams, In review), this has typically led to a consideration of the early years from an assessment model time series[2]. Thus, for example, in the case of bocaccio the time period within which recruitments were selected was 1970-79 and for canary rockfish it was 1967-77.

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 was probably affected adversely (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. Given that these two explanatory factors are highly confounded, i.e., generally high biomass/favorable conditions prior to 1980 and low biomass/unfavorable conditions thereafter, using all recruitments to estimate B_0 will usually result in a lower reference point than the situation where an abbreviated series taken from early in the time series is utilized.

At this time there is no incontrovertible information with which to distinguish between these two alternatives. If oceanic conditions along the west coast have shifted to a productive cold regime following the La Niña event of 1999, we may soon have observations of recruitment produced during a favorable environmental period from groundfish stocks at low spawning biomass. If the environmental and density-dependent effects are additive, it would then be possible to determine the relative importance of each of the two factors (e.g., Jacobson and MacCall 1995). In the interim, however, it would be prudent to favor calculations of B_0 that are based on an abbreviated time series of recruitments taken from a period when the stock was at a relatively high biomass and to favor the density-dependent hypothesis. Both theoretical and observational considerations support the belief that groundfish recruitment will decline as stock size dwindles (e.g., Myers and Barrowman 1996; Brodziak *et al*. 2001). Still, it would be informative to contrast the density-dependent/stock size based reference point with an estimate of

---

[2] 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.

B_0 based on the entire time series of recruitments (i.e., the environmental hypothesis). This was, in fact, discussed as a possible alternative in the Panel Report produced by the West Coast Groundfish Harvest Rate Policy Workshop sponsored by the SSC in March, 2000. With both numbers available it would be possible to evaluate the implication of each hypothesis on the calculation of stock reference points. As a refinement, for each of these two methods the actual distribution of B_0 can be approximated by re-sampling recruitments, from which the probability of observing any particular stock biomass can be examined under each hypothesis. This approach was taken in the original bocaccio rebuilding analysis, 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.

It is also possible to estimate B_0 by fitting spawner-recruit models to the full time series of spawner-recruit data (see Ianelli *et al*. 2000; Ianelli, In review). However, this approach is subject to the criticism that stock productivity is constrained to behave in a pre-specified manner according to the particular model chosen and there are different models to choose from, including the Beverton-Holt and Ricker. These two models can produce strongly contrasting management reference points (e.g., B_{msy} and SPR_{msy}) but are seldom distinguishable statistically. Moreover, there are statistical reasons to be suspect of resulting parameter estimates, including time series bias (Walters 1985), the "errors in variables" problem (Walters and Ludwig 1981), and non-homogeneous variance and small sample bias (MacCall and Ralston, In review). Consequently, analyses that derive stock management reference points by estimating a spawner-recruitment relationship shoulder a greater burden of proof. Thus, any such an analysis should attempt a balanced comparison of alternative spawner-recruit models, with explicit consideration of the estimation problems highlighted above. Moreover, in situations where a spawner-recruit meta-analysis is available (e.g., Dorn, In review), those results should be evaluated and considered. Ideally, reference points obtained by fitting a spawner-recruitment model (e.g., B_0, B_{MSY}, and F_{MSY}) should also be compared with values obtained by empirical analysis of the data, similar to that suggested above. Such a comparison would help delineate the overall degree of uncertainty in these quantities.

Population Projections During Rebuilding

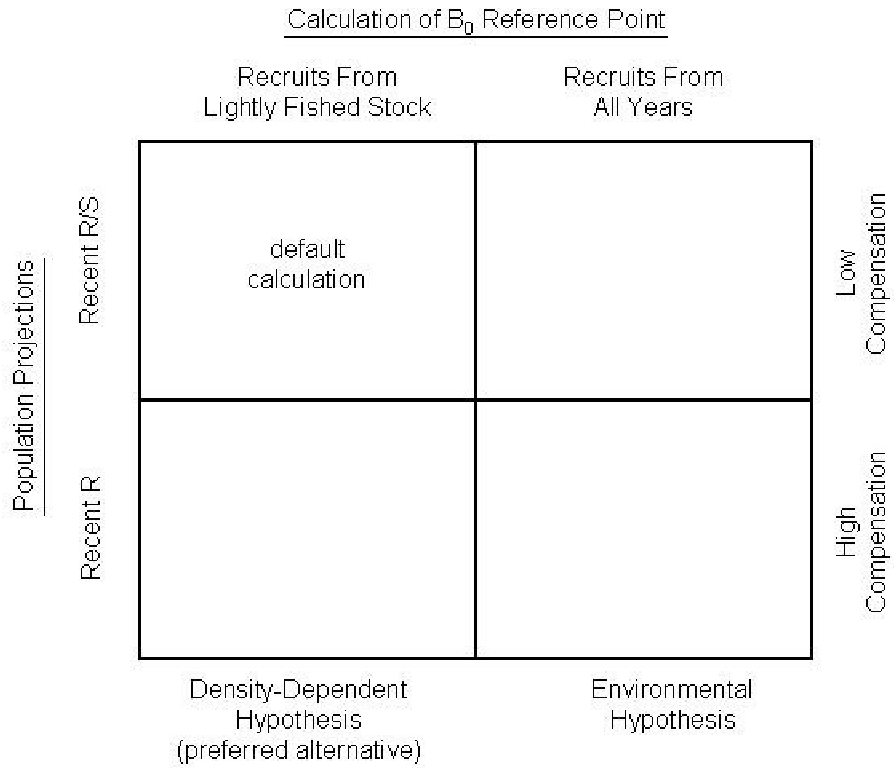
Given the population initial conditions from the last stock assessment (terminal year estimates of numbers at age and their variances) and the rebuilding target ($B_{40\%}$), one can project the population forward once renewal has been specified. For most rebuilding calculations that have been conducted thus far, two different approaches have been taken, both of which utilize contemporary recruitment estimates at the tail end of the time series (i.e., the most recent figures). For bocaccio, canary rockfish, and POP#1, recent recruitment was standardized to the size of the adult population (recruits per spawner = R/S_i), which was then randomly resampled to determine annual reproductive success. Annual R/S_i is then multiplied by S_i to obtain year-specific stochastic estimates of R_i. The population is then projected forward in time, with no fishing mortality, until S_i hits the rebuilding target. The process is repeated many times, until a distribution of the times to rebuild in the absence of fishing is obtained. Note that use of R/S_i as the basis for projecting the population forward ties recruitment values in a directly proportional manner to stock size; if stock size doubles, resulting recruitment will 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 = 0.20)[3].

Another way of projecting the population forward is to use recent recruitments, rather than recruits per spawner, as was done in the lingcod analysis. This approach, however, errs 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 (spawner-recruit steepness = 1.00). Thus, these two ways of projecting the population forward, by using re-sampled R_i or re-sampled R/S_i, includes a range of alternatives that is likely to encompass the real world.

Because stocks that have declined into an overfished condition are more likely to be unproductive (i.e., low spawner-recruit steepness), in the absence of any other information, rebuilding projections based on re-sampling recruits-per-spawner are generally to be favored over projections based on absolute recruitment. Note that the implied 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 contemporary recruits-per spawner. As progress toward rebuilding is evaluated in the future, the set of R/S_i will be revised based on a new set of recent recruitments obtained from the latest stock assessment. If the stock actually demonstrates a compensatory response during the course of rebuilding the R/S_i series will tend to a lower mean value. Although projections based on R/S_i represent a standard default way of proceeding, projections that use absolute recruitments (R_i) would be quite useful in establishing the overall uncertainty in the rebuilding analysis by providing an alternative model specification scenario. Moreover, a credible argument that a stock is relatively productive, as evidenced perhaps by observed high recruitment at low spawning biomass, may serve as a basis for favoring projections that utilize recent absolute recruitments (see figure).

---

[3]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 $B_{20\%}$.



Once the median time to rebuild in the absence of fishing is determined (τ_0), whether using the R/S_i or the R_i, the total allowable rebuilding time frame is fixed (τ_{max}). Namely, if τ_0 is less than 10 years then τ_{max} = 10 years. On the other hand, if $\tau_0 \geq$ 10 years then $\tau_{max} = \tau_0$ + one mean generation time. Mean generation time has been calculated as the mean age of the net maternity function.

Harvest During Rebuilding

Of course it will be the Council's prerogative to establish yields during the rebuilding period, as long as the stock recovers to the target ($B_{40\%} \approx B_{msy}$) within the specified time period (τ_{max}). Nonetheless, the simplest rebuilding harvest policy to simulate and implement is a constant harvest rate or fixed F policy. All rebuilding analyses should, therefore, calculate the maximum fixed fishing mortality rate during the rebuilding time period that will achieve the target biomass, with a 0.50 probability of success ($F_{0.50}$). In addition, calculations representing a profile of different fixed F values that are incrementally less than $F_{0.50}$ (e.g., $F_{0.60}$, $F_{0.70}$, and $F_{0.80}$) are needed for the Council to implement a precautionary reduction in the $F_{0.50}$ value to increase the probability of rebuilding success. Note that selecting a probability greater than 0.50 for successful rebuilding within τ_{max} is equivalent to electing to rebuild sooner than τ_{max} with probability equal to 0.50. In addition, based on its interpretation of Amendment 12 to the groundfish FMP, the National Marine Fisheries Service requires the expected time course of yield during recovery as a formal part of all rebuilding calculations.

Many other harvest policies could be implemented by the Council, based on whatever circumstances may mitigate against a constant harvest rate approach. For example, the canary rockfish rebuilding plan calls for a constant fixed yield over the entire period of rebuilding. Thus, as the stock rebuilds, the exploitation rate must decline, which makes bycatch avoidance a serious concern. For this reason the SSC recommends that the Council generally favor constant harvest rate policies over constant catch policies for all groundfish rebuilding plans. This would alleviate the problem of accelerating bycatch producing accelerated discard, an undesirable attribute of constant catch policies. Similarly, the Council may wish to implement some other form of variable rate harvest policy, e.g., a 40:10 adjustment similar to the default policy currently in use. Consequently, researchers conducting rebuilding analyses should be prepared to respond to requests by the Council for stock-specific projections on an individual case-by-case basis.

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 specific data elements that are needed to adequately document the analysis. Namely, information is needed on: (1) the time course of population spawning output and recruitment, (2) biological data on life history characteristics, and (3) initial values for projecting the stock into the future under exploitation. Therefore, two tables should include:

Table 1. Stock Population Trajectory

1. Year
2. Summary/Exploitable Biomass
3. Spawning Output
4. Recruits
5. Catch
6. Landings
7. Total Exploitation Rate

For each year in this table, entries 2 through 7 should include the expected value, a measure of uncertainty, and the appropriate units. The latter may require development of a standard electronic format for the simulation results that characterize the uncertainty, e.g., the results of each Monte Carlo replication from the stochastic population projection.

Table 2. Age-specific Population Characteristics.

1. Age
2. Natural mortality rate (♀ and ♂)
3. Individual weight (♀ and ♂)
4. Maturity (♀ only)
5. Fecundity (♀ only)
6. Terminal year (or other) composite selectivity (♀ and ♂)
7. Population numbers in terminal year (♀ and ♂)

In a similar manner, for each age in the table, entries 2 through 7 should ideally include measures of uncertainty. Uncertainty in table entry 7 (population numbers in terminal year), in particular, should be available from most age-structured assessment models.

In addition, all linkages with the most recent stock assessment document should be clearly delineated. This is important because assessments often present multiple scenarios that usually have important implications with respect to stock rebuilding. In such instances, a decision table analysis would be a useful way to express the implications of uncertainty in model specification. In addition, one scenario may be preferred by the assessment authors, while another may preferred by the STAR Panel. Clear specification of the exact assessment scenario(s) used as the basis for rebuilding analysis is essential. Further, all post-assessment analyses needed to produce the inputs for rebuilding analyses must be fully documented, e.g., the choice of selectivity estimates used for projections that are based on some composite of historical selectivities from the assessment.

Literature Cited

Ainley, D. G., R. H. Parrish, W. H. Lenarz, and W. J. Sydeman. 1993. Oceanic factors influencing distribution of young rockfish (*Sebastes*) in central California: a predator's perspective. CalCOFI Rept. 34:133-139.

Brodziak, J. K. T., W. J. Overholtz, and P. J. Rago. 2001. Does spawning stock affect recruitment of New England groundfish? Can. J. Fish. Aquat. Sci. 58:306-318.

Clark, W. G. 1991. Groundfish exploitation rates based on life history parameters. Can. J. Fish. Aquat. Sci. 48:734-750.

Clark, W. G. In review. $F_{35\%}$ revisited ten year later. North American Journal of Fisheries Management.

Dorn, M. In review. Advice on west coast harvest rates from Bayesian meta-analysis of stock-recruit relationships. North American Journal of Fisheries Management.

Francis, R. C., S. R. Hare, A. B. Hollowed, and W. S. Wooster. 1998. Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific. Fish. Oceanogr. 7(1):1-21.

Hare, S. R., N. J. Mantua, and R. C. Francis. 1999. Inverse production regimes: Alaska and west coast salmon. Fisheries 24(1):6-14.

Ianelli, J. N., M. Wilkins, and S. Harley. 2000. Status and future prospects for the Pacific Ocean perch resource in waters off Washington and Oregon as assessed in 2000. In: Appendix to the Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Acceptable Biological Catches for 2001 – Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, Oregon, 97201.

Ianelli, J. N. In review. Simulation analyses testing the robustness of harvest rate determinations from west-coast Pacific ocean perch stock assessment data. North American Journal of Fisheries Management.

Jacobson, L. D., and A. D. MacCall. 1995. Stock-recruitment models for Pacific sardine (*Sardinops sagax*). Can. J. Fish. Aquat. Sci. 52:566-577.

MacCall, A. D. 1996. Patterns of low-frequency variability in fish populations of the California Current. CalCOFI Rept. 37:100-110.

MacCall, A. D., and S. Ralston. In review. Erratic performance of logarithmic transformation in estimation of stock-recruitment relationships. North American Journal of Fisheries Management.

Marshall, C. T., O. S. Kjesbu, N. A Yaragina, P. Solemdal, and Ø. Ulltang. 1998. Is spawner biomass a sensitive measure of the reproductive and recruitment potential of northeast arctic cod? Can. J. Fish. Aquat. Sci. 55:1766-1783.

Myers, R. A., and N. J. Barrowman. 1996. Is fish recruitment related to spawner abundance? Fish. Bull., U. S. 94:707-724.

Roemmich, D., and J. McGowan. 1995. Climatic warming and the decline of zooplankton in the California Current. Science 267:1324-1326.

Rothschild, B. J., and M. J. Fogarty. 1989. Spawning stock biomass as a source of error in stock-recruitment relationships. J. Cons. Int. Explor. Mer. 45:131-135.

Trenberth, K. E., and J. W. Hurrell. 1994. Decadal atmosphere-ocean variations in the Pacific. Clim. Dyn. 9:303-319.

Walters, C. J. 1985. Bias in the estimation of functional relationships from time series data. Can. J. Fish. Aquat. Sci. 42:147-149.

Walters, C. J. and D. Ludwig. 1981. Effects of measurement errors on the assessment of stock-recruitment relationships. Can. J. Fish. Aquat. Sci. 38:704-710.

Williams, E. H. In review. The effects of unaccounted discards and mis-specified natural mortality on estimates of spawner-per-recruit based harvest policies. North American Journal of Fisheries Management.

4.5.3.3 Process for Development and Approval of Rebuilding Plans

Upon receiving notification that a stock is overfished, the Council will identify one or more individuals to draft the rebuilding plan. A draft of the plan will be reviewed and preliminary action taken (tentative adoption or identification of preferred alternatives), followed by final adoption at a subsequent meeting. The tentative plan or alternatives will be made available to the public and considered by the Council at a minimum of two meetings, unless stock conditions suggest more immediate action is warranted. Upon completing its final recommendations, the Council will submit the proposed rebuilding plan or revision to an existing plan to NMFS for concurrence. A rebuilding plan will be developed following the standard procedures for considering and implementing an FMP amendment under the Magnuson-Stevens Act and other applicable law.

The following elements in each rebuilding plan will be incorporated into the FMP in Section 4.5.4:

1. A brief description of the status of the stock and fisheries affected by stock rebuilding measures at the time the rebuilding plan was prepared.

2. The methods used to calculate stock rebuilding parameters, if substantially different from those described in Section 4.5.2.

3. An estimate at the time the rebuilding plan was prepared of:
   - unfished biomass ($B_{unfished}$) and target biomass (B_{MSY});
   - the year the stock would be rebuilt in the absence of fishing (T_{MIN});
   - the year the stock would be rebuilt if the maximum time period permissible under National Standard Guidelines were applied (T_{MAX}) and the estimated probability that the stock would be rebuilt by this date based on the application of stock rebuilding measures; and
   - the year in which the stock would be rebuilt based on the application of stock rebuilding measures (T_{TARGET}).

4. A description of the harvest control rule (e.g., constant catch or harvest rate) and the specification of this parameter. The types of management measures that will be used to constrain harvests to the level implied by the control rule will also be described (see also Section 4.5.3.4). These two elements, the harvest control rule and a description of management measures, represents the rebuilding strategy intended to rebuild the stock by the target year.

It is likely that over time the parameters listed above will change. It must be emphasized that the values enumerated in the FMP represent estimates at the time the rebuilding plan is prepared. Therefore, the FMP need not be amended if new estimates of these values are calculated. The values for these parameters found in the FMP are for reference, so that managers and the public may track changes in the strategy used to rebuild an overfished stock. However, any new estimates of the parameters listed above will be published in the SAFE documents as they become available.

4.5.3.4 Updating Key Rebuilding Parameters

In addition to an initial specification in the FMP, the target year (T_{TARGET}) and the harvest control rule (type and numerical value) will also be specified in regulations. If new information indicates a need to change the value of either of these two parameters, such a change will be accomplished through full (notice and comment) rulemaking as described in Section 6.2 of this FMP. The target year is the year by which the stock would be rebuilt to its target biomass. Therefore, if a subsequent analysis identifies an earlier target year for the current fishing mortality rate (based on the harvest control rule), there is no obligation to change in regulations either the target year (to the computed earlier year) or the harvest control rule (to delay rebuilding to the original target year). Since the target year is a key rebuilding parameter, it should only be changed after careful deliberation. For example, the Council might recommend that the target year be changed if, based on new information, they determine that the existing target year is later than the recomputed maximum rebuilding time (T_{MAX}) or if a recomputed harvest control rule would result in such a low optimum yield as to cause substantial socioeconomic impacts. These examples are not definitive: the Council may elect to change the target year because of other circumstances. However, any change to the target year or harvest control rule must be supported by commensurate analysis.

4.5.3.5 Implementation of Actions Required Under the Rebuilding Plan

Once a rebuilding plan is adopted, certain measures required in the rebuilding plan may need to be implemented through authorities and processes already described in the FMP. Management actions to achieve OY harvest, and objectives related to rebuilding requirements of the Magnuson-Stevens Act and goals and objectives of the FMP (each of which may require a slightly different process) include: automatic actions, notices, abbreviated rulemaking actions, and full rulemaking actions. (These actions are detailed in Section 4.6, Chapter 5, and Section 6.2.) Allocation proposals require consideration as specified in the allocation framework (see Section 6.2.3.1). Any proposed regulations to implement the rebuilding plan will be developed in accordance with the framework procedures of this FMP.

Any rebuilding management measures that are not already authorized under the framework of the existing FMP, or specified in the FMP consequent of rebuilding plan adoption, will be implemented by further FMP amendments. These plan amendments may establish the needed measures or expand the framework to allow the implementation of the needed measures under framework procedures.

The Council may designate a state or states to take the lead in working with its citizens to develop management proposals to achieve stock rebuilding.

4.5.3.6 Periodic Review of Rebuilding Plans

Rebuilding plans will be reviewed periodically, but at least every two years, although the Council may propose revisions to an adopted rebuilding plan at any time. These reviews will take into account the goals and objectives listed in Section 4.5.3.1, recognizing that progress towards the first goal, to achieve the population size and structure that will support MSY within the specified time period, will only be evaluated on receipt of new information from the most recent stock assessment. In evaluating progress towards achieving target biomass, the Council will use the standard identified in the rebuilding plan. When drafting a rebuilding plan one of the following standards, or a standard similar in kind to the following, may be chosen:

- If the probability of achieving the target biomass within the maximum permissible time period (T_{MAX}) falls below 50% (the required minimum value), then progress will be considered inadequate.

- If the probability of achieving the target biomass within the maximum permissible time period (T_{MAX}) falls below the value identified in the rebuilding plan, then progress will be considered inadequate.

- The Council, in consultation with the SSC and GMT, will determine on a case-by-case basis whether there has been a significant change in a parameter such that the chosen management target must be revised.

If, based on this review, the Council decides that the harvest control rule or target year must be changed, the procedures outlined in Section 4.5.3.3 will be followed. Regardless of the Council's schedule for reviewing overfished species rebuilding plans, the Secretary of Commerce, through NMFS, is required to review the progress of overfished species rebuilding plans toward rebuilding goals every two years, per Magnuson-Stevens Act at 16 U.S.C. §304(e)(7).

Abstract—Management of West Coast groundfish resources by the Pacific Fishery Management Council involves Federal government and academic scientists conducting stock assessments, generally using the stock synthesis framework, applying the 40-10 rule to determine harvest guidelines for resources that are not overfished and conducting rebuilding analyses to determine harvest guidelines for resources that have been designated as overfished. However, this management system has not been evaluated in terms of its ability to satisfy the National Standard 1 goals of the Sustainable Fisheries Act. A Monte Carlo simulation framework is therefore outlined that can be used to make such evaluations. Based on simulations tailored to a situation similar to that of managing the widow rockfish (*Sebastes entomelas*) resource, it is shown that catches during recovery and thereafter are likely to be highly variable (up to ±30% from one year to the next). Such variability is far greater than has been presented to the decision makers to date. Reductions in interannual variability in catches through additional data collection are, however, unlikely. Rather, improved performance will probably arise from better methods for predicting future recruitment. Rebuilding analyses include quantities such as the year to which the desired probability of recovery applies. The estimates of such quantities are, however, very poorly determined.

Manuscript approved for publication
24 April 2003 by Scientific Editor.

Manuscript received 26 June 2003
at NMFS Scientific Publications Office.

Fish. Bull. 101:860–873 (2003).

Evaluating the efficacy of managing West Coast groundfish resources through simulations

André E. Punt

School of Aquatic and Fishery Sciences
University of Washington
1122 NE Boat Street
Seattle, Washington 98195-5020
E-mail address: aepunt@u.washington.edu

National Standard 1 of the Sustainable Fisheries Act (SFA) of 1996 states that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States industry." The need to satisfy this National Standard has led *inter alia* to the requirement for the eight Regional Fishery Management Councils to develop control rules that are used to assess whether overfishing is occurring[1] or a stock is in an overfished state (e.g. Restrepo and Powers, 1999). In addition, the SFA specifies that a rebuilding plan has to be developed for any fish stocks that are designated as overfished. This plan needs to include the time period by which the stock will be rebuilt to B_{MSY} (the average biomass associated with maximum sustainable yield, MSY), and the strategy by which the stock is to be rebuilt.

The Pacific Fishery Management Council (PFMC) has adopted the "40-10" rule to manage groundfish stocks that are not designated as being overfished. This rule determines the harvest guideline for each groundfish stock by computing the catch corresponding to an F_{MSY} proxy ($F_{40\%}$[2] for flatfish, $F_{50\%}$ for rockfish in the *Sebastes* complex, and $F_{45\%}$ for other species) and reducing it if the spawning output is estimated to be less than 40% of the estimated B_0. This reduction in catch is linear with spawning output, being 0 at $0.4B_0$ and 100% at $0.1B_0$. For stocks that are designated as being in an overfished state (defined for West Coast groundfish as being that the spawning output is less than $0.25B_0$) a rebuilding plan is developed.[3] The main features of the technical aspects of a rebuilding plan (referred to as a rebuilding analysis) identified by the Scientific and Statistical Committee of the PFMC are outlined in Appendix 1. In brief, the rebuilding analysis used by the PFMC involves projecting the best estimates of the current age-structure of the overfished population forward under a range of alternative fishing mortality rates and selecting the fishing mortality rate that has a Council-selected probability that the population recovers to the proxy for B_{MSY} of $0.4B_0$ within a time frame consistent with the specifications of the SFA.

Detailed stock assessments are available for only a small subset of the 81 species included in the PFMC Groundfish Management Plan. Of these species, nine (bocaccio [*Sebastes paucispinis*], canary rockfish [*Sebastes pinniger*], cowcod [*Sebastes levis*], darkblotched rockfish [*Sebastes crameri*], lingcod [*Ophiodon elongates*], Pacific ocean perch [*Sebastes alutus*], Pacific whiting [*Merluccius productus*], widow rockfish [*Sebastes entomelas*], and yelloweye rockfish [*Sebastes ruberrimus*]) have been designated overfished and rebuilding plans have been or are being developed for them. The direct consequences

---

[1] In the present study, and consistent with usage by the Pacific Fishery Management Council, "overfishing" means that the level of fishing mortality exceeds that associated with MSY and "being in an overfished state" means that the current spawning output is less than 25% of the pre-exploitation equilibrium spawning output, B_0 (spawning output is the product of egg production-at-age and numbers-at-age).

[2] $F_{x\%}$ is the fishing mortality rate at which the spawning output-per-recruit is reduced to x% of its unfished level.

[3] One implication of this is that the 40-10 rule is not actually used if the stock is assessed to be below $0.25B_0$.

for industry of the implementation of a rebuilding plan can be substantial (e.g. a reduction in the catch of canary rockfish from 883 metric tons (t) in 1999 to only 90 t in 2001), although there are also indirect consequences in the form of reductions in the harvest of nonoverfished species to prevent overharvesting of overfished species through technical interactions.

The performance of the method commonly used for assessments of West Coast species has been evaluated to some extent (e.g. Sampson and Yin, 1998; Ianelli, 2002). However, the performance of this assessment method in combination with the rules used to determine harvest guidelines has not been evaluated.

Management procedures[4] are combinations of stock assessment methods and catch control laws that have been evaluated by means of Monte Carlo simulation to assess the extent to which they are able to satisfy the management objectives for a fishery. Evaluation of management procedures by means of Monte Carlo simulation has been argued to be essential because "if a management procedure is unable to perform adequately in the ideal world represented on a computer, what basis is there to assume that it will perform adequately in the real world?" (Sainsbury[5]). One caveat to this argument is that it is only possible to evaluate a management procedure if it is fully specified and if it will be followed for several years in reality.

Management procedures have been adopted by the International Whaling Commission for managing commercial and aboriginal whaling (e.g. IWC, 1992, 2001) and by southern African nations for managing a variety of pelagic and demersal resources (Butterworth and Bergh, 1993; Cochrane et al., 1998; Geromont et al., 1999). Management procedures are under consideration in Australia (Punt et al., 2001) and New Zealand (Starr et al., 1997). If it can be assumed that the same rules will be applied to modify rebuilding plans each time new information on abundance and year-class strength becomes available, it is possible to consider the combination of the assessment method, the default 40-10 rule, and rebuilding plans as a "management procedure" and evaluate it by means of Monte Carlo simulation. This study therefore involves determining from past practice the "management procedure" being applied by the PFMC. However, this "management procedure" has not been formally adopted in any way and the approach to managing West Coast groundfish could change in time.

This paper first outlines a simulation framework (a management procedure evaluation, MPE, framework) within which the expected performance of the approach used by the PFMC to determine harvest guidelines can be evaluated. It then evaluates variants of this approach for scenarios similar to that of managing the fishery for widow rockfish.

[4] Also referred to as "harvest strategies" (Punt et al., 2001), "management decision rules" (Starr et al., 1997), "fisheries control systems" (Hilborn, 1979), and "operational management procedures" (Barnes, 1999).

[5] Sainsbury, K. G. 2001. Personal commun. CSIRO Marine Research, Castray Esplanade, Hobart, TAS 7000, Australia.

Materials and methods

The steps in evaluating management procedures are as follows:

1. Identification of the management objectives and representation of these by using a set of quantitative performance statistics.
2. Identification of a range of alternative management procedures.
3. Development and parameterization of a set of alternative structural models (called operating models) of the system.
4. Simulation of the future use of each management procedure to manage the system (as represented by each operating model). For each year of the projection period, the simulations involve the following steps:
   a. Generation of the data available for assessment purposes.
   b. Application of a method of stock assessment to the generated data to determine key assessment-related quantities (e.g. current age-structure, spawning output in relation to target and limit levels, historical trends in recruitment) and any inputs to the catch control law.
   c. Application of the catch control law element of the management procedure to determine a harvest guideline.
   d. Determination of the biological implications of this harvest guideline by setting the catch for the "true" population represented in the operating model based on it. The step can potentially include "implementation uncertainty" (Rosenberg and Brault, 1993).

The harvest guideline is not updated every year in the simulations described in this article, but rather every third year (co-incident with the results from each new survey) and thus reflects the intended frequency with which assessments for West Coast groundfish species are conducted. Each simulation trial (i.e. each combination of an operating model variant and candidate management procedure) involves 100 simulations of an 80-year management period. The four steps listed above are discussed in detail below.

Note that for the application considered in this paper then, there are three "models": 1) the operating model that represents "reality" for the simulations, 2) an assessment model (a stock synthesis-like approach), and 3) a model to calculate the harvest guidelines. The data available to the last two models are generated from the first model.

The operating model

The operating model has been taken to be virtually identical to that on which the population assessments and rebuilding analysis calculations are based (Appendix 1), with two exceptions: 1) the approach used to generate recruitment and 2) the allowance for variability over time in commercial selectivity. Commercial selectivity is given

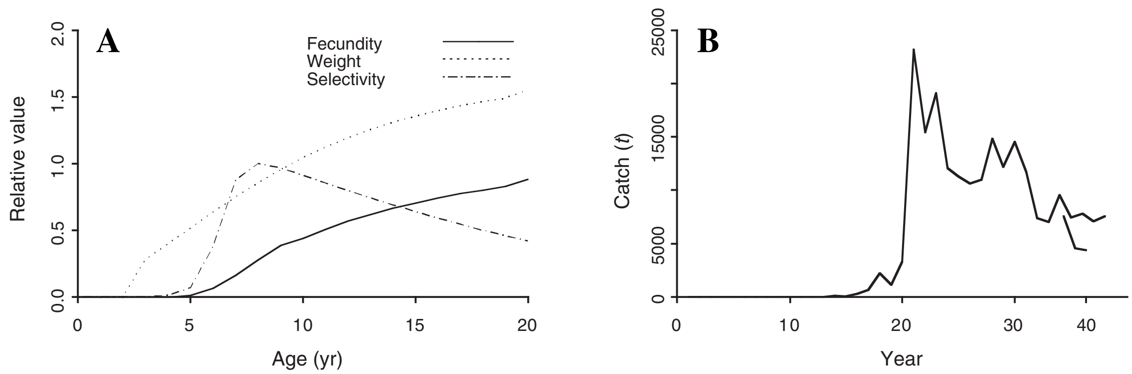


Figure 1

Biological parameters (**A**) and catch history (**B**) for widow rockfish (*Sebastes entomelas*).

by the following double-logistic equation:

$$S_{y,a} = S'_{y,a} / \max_{a'} S'_{y,a'}$$
$$S'_{y,a} = \frac{1}{1+e^{-\delta_1(a-a^1_{50}+\gamma_y)}} \frac{1}{1+e^{-\delta(a^2_{50}-a)}}, \qquad (1)$$

where $S_{y,a}$ = the selectivity on fish of age a during year y;

$a^1_{50}, a^2_{50}, \delta_1, \delta_2$ = the parameters of the double-logistic equation;

γ_y = the deviation from the average selectivity pattern in year y:

$$\gamma_y = \rho_s\,\gamma_{y-1} + \varepsilon^S_y \qquad \varepsilon^S_y \sim N(0;\sigma^2_S),$$

ρ_S = the interannual correlation in the deviation from average selectivity; and

σ_S = a measure of the standard deviation of the interannual deviations from average selectivity.

Recruitment is assumed to be governed by a Beverton-Holt stock-recruitment relationship:

$$R_y = \frac{R_0 4h(\tilde{B}_y / B_0)}{4h+(5h-1)(\tilde{B}_y / B_0 - 1)} e^{\varepsilon^R_y - \sigma^2_R/2} \qquad \varepsilon^R_y \sim N(0;\sigma^2_R), \quad (2)$$

where R_0 = the "virgin recruitment" (the number of zero-year-olds at the pre-exploitation equilibrium level);

$\tilde{B}_y$ = the spawning output at the start of year y;

h = the "steepness" of the stock-recruitment relationship (the fraction of virgin recruitment expected at $0.2B_0$); and

σ_R = the standard deviation of the logarithms of the random fluctuations in recruitment about its expected value.

The biological parameters of the operating model are set to those for widow rockfish (Fig. 1A), and the catches for the 40 years prior to the year in which the management procedure is first applied (referred to as "projection year 1") are set to the actual catches for widow rockfish (Fig. 1B). The baseline values for the parameters h, σ_R, ρ_S, and σ_S (Table 1) are educated guesses. The baseline choice for steepness, h, is lower than the posterior mean for this quantity (0.65) obtained by Dorn (2002) because, increasingly, West Coast rockfish are being found to be less productive than initially anticipated (e.g. Ianelli, 2002). The value assumed for the extent of variation in recruitment, σ_R, although based on the collection of estimates of this parameter by Beddington and Cooke (1983), is nevertheless also largely an educated guess. Sensitivity to the values for both h and σ_R is explored.

Table 1

The baseline parameters of the operating model and the values used in the tests of sensitivity. N/A = not available.

Parameter	Baseline value	Sensitivity values
ρ_S	0.707	N/A
σ_S	0.4	N/A
h	0.4	0.25; 0.7
σ_R	0.6	0.4; 1
M	0.15/yr	N/A
Spawning output in year 41	$0.2B_0$	$0.1B_0$; $0.4B_0$

The biomass at the start of year 1 is assumed equal to B_0, which is defined as the mean of the distribution for the unfished biomass which would arise given variability in recruitment about its expected value. However, this specification has little impact on the results. For example, the alternative that is defined to be the median of the distribution for the unfished biomass would only change B_0 by about 5%.

The value for B_0 for each simulation is selected so that the spawning output at start of year 41 (projection year 1) equals a prespecified fraction of B_0 (baseline fraction

Table 2
The parameters on which the generation of future data is based. n^e is the sample size for the multinomial distribution.

Data source	First year collected	Frequency	Precision
Catch rates	14	Every year	$\sigma^c = 0.4$
Fishery age-composition	21	Every year	n^e=200
Survey indices	13	Every third year	σ^s=0.5
Survey age-composition	13	Every third year	n^e=200

0.2—i.e. just below the level that defines an overfished stock). Sensitivity to alternative values for the ratio of the spawning output at the start of year 41 to B_0 is explored (Table 1).

Generating future data

The data available for assessment purposes are survey indices of relative abundance, age-composition data from surveys, catch-rate–based indices of relative abundance, and age-composition data from the commercial catches. Table 2 lists the baseline specifications regarding the frequency at which the various data sources are collected and the parameters that determine the sampling variability associated with each data source.

The survey and catch-rate indices are generated by using the equations

$$B_y^{s,obs} = B_y^s e^{\varepsilon_y^s-(\sigma^s)^2/2}, \qquad \varepsilon_y^S \sim N\left(0;(\sigma^s)^2\right); \qquad (3a)$$

$$I_y = B_y^e e^{\varepsilon_y^c-(\sigma^c)^2/2}, \qquad \varepsilon_y^c \sim N\left(0;(\sigma^c)^2\right); \qquad (3b)$$

where $B_y^{s,obs}$ = the survey index for year y;
B_y^s = the survey selected-biomass during year y:

$$B_y^s = \sum_{a=0}^{a_{\max}} w_a S_a^s N_{y,a} e^{-Z_{y,a}/2}; \qquad (4a)$$

w_a = the mass of an animal of age a;
S_a^s = the selectivity of the survey gear on animals of age a (assumed to be governed by a logistic function and to be independent of time);
$N_{y,a}$ = the number of animals of age a at the start of year y;
$Z_{y,a}$ = the total mortality on animals of age a during year y;
σ_s = the standard deviation of the random fluctuations in survey catchability;
$a_{\max}$ = the oldest age considered in the operating model;
I_y = the catch-rate index for year y;
B_y^e = is the exploitable biomass during year y;

$$B_y^e = \sum_{a=0}^{a_{\max}} w_a \frac{S_{y,a}F_y}{Z_{y,a}} N_{y,a}(1-e^{-Z_{y,a}}); \qquad (4b)$$

F_y = the fully selected fishing mortality during year y; and
σ^c = the standard deviation of the random fluctuations in fishery catchability.

Note that Equations 3a and 3b assume that the survey and fishery catchability coefficients are unity. This assumption can be made without loss of generality because the stock assessment method is not provided with this information and instead estimates these catchability coefficients. Note also that the key difference between the survey index and the catch-rate index is that selectivity for the latter changes over time (see Eq. 1), whereas selectivity for the former is time-invariant.

The age-composition data are generated by selecting a sample multinomially from the age-composition of the survey catch and of the fishery catch (see Eqs. 5a and 5b for the relative survey and fishery catches-at-age):

$$S_a^s n_{y,a} e^{-Z_{y,a}/2}; \qquad (5a)$$

$$\frac{S_{y,a}}{Z_{y,a}} n_{y,a}(1-e^{-Z_{y,a}}). \qquad (5b)$$

The PFMC management procedure

The "PFMC management procedure" (see Fig. 2 for an overview) involves first conducting a stock assessment by fitting an age-structured population dynamics model to the available data by maximizing a likelihood function. This approach mimics the common use of the stock synthesis framework (Methot, 2000) when conducting assessments of West Coast groundfish resources. The likelihood function is determined by assuming that the age-composition data are multinomially distributed (in the simulations with effective sample sizes given by the actual effective sample sizes) and by assuming that the survey and catch-rate series are log-normally distributed about the appropriate model quantities. The estimable parameters of the model are the annual recruitments, the annual fishing mortalities, the catchability coefficients, and the parameters that determine selectivity (the survey and fishery selectivity are [correctly] assumed to be governed by logistic and double-logistic equations). The values for the remaining parameters (weight-at-age, fecundity-at-age, and natural mortality) are assumed to be known without error. The key outputs from the assessment are time-series of recruitments and spawning out-

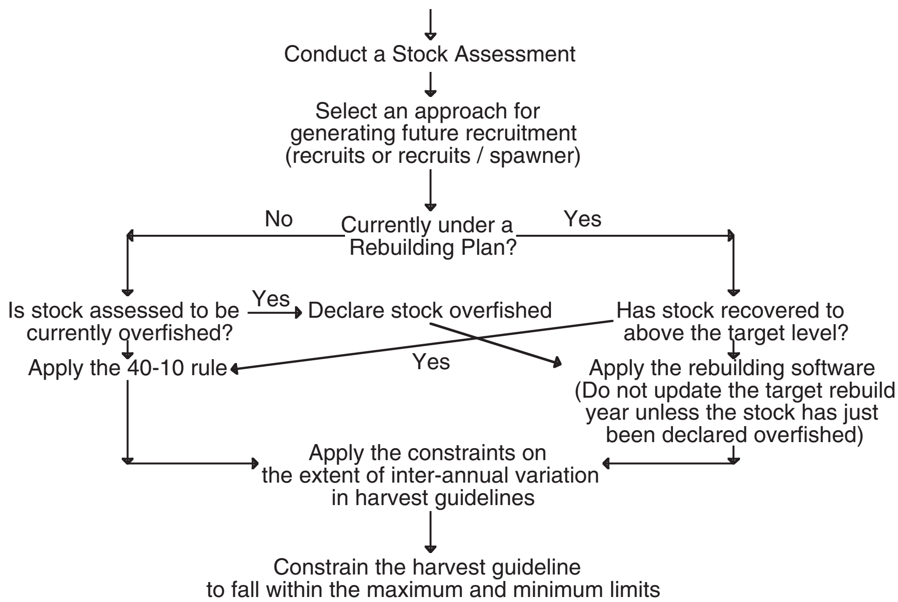


Figure 2

Flowchart of the Pacific Fishery Management Council management procedure.

puts, and the age structure at the start of the last year of the assessment.

An estimate of the pre-exploitation equilibrium spawning output (i.e. $\hat{B}_0$) is obtained by multiplying the average recruitment for the first ten years of the assessment period by the spawning output-per-recruit in the absence of fishing. This approach to estimating $\hat{B}_0$ has been used for several rebuilding analyses for West Coast groundfish species. If the estimate of the current spawning output exceeds $0.4\hat{B}_0$ or if it exceeds 0.25 $\hat{B}_0$ and the resource is not currently under rebuilding (i.e. has not yet been declared to be in an overfished state), a raw harvest guideline is computed using the 40-10 rule. On the other hand, if the estimate of the current spawning output is less than 0.25 $\hat{B}_0$ or the stock is currently under a rebuilding plan and the spawning output has not yet recovered to 0.4 $\hat{B}_0$, the raw harvest guideline is based on the application of the rebuilding analysis (see Appendix 1 for further details).

It is necessary to know the maximum possible rebuilding period, T_{max}, when using a rebuilding analysis to calculate a harvest guideline. If the stock is declared overfished in the present year, T_{max} is computed as described in Appendix 1. On the other hand, if the stock is currently under a rebuilding plan, T_{max} is taken to be the value computed when the stock was first declared overfished. Therefore, the implementations of the rebuilding plans considered in this paper are based on the assumption that the T_{max} and the probability of recovery by T_{max} are set when the first rebuilding analysis is conducted and not changed thereafter. The probability of recovery by T_{max} is taken to be 0.6 in this paper because this is the probability on which management of widow rockfish is currently based. This probability ranges between 0.55 and 0.92 among the seven overfished groundfish resources for which it has been selected by the PFMC.

Calculation of a harvest guideline using the 40-10 rule and application of the rebuilding analysis requires the ability to generate future recruitment. For the purposes of the present study (and consistent with current practice), future recruitment is either generated from the estimates of recruitment from the assessment or by multiplying the spawning output by a generated value for the recruits-per-spawning output ratio. The pool of recruitment to recruits-per-spawning output is taken to be those for the last 23 years of the assessment period less those for the last three years. The last three years are excluded because of their known poor precision. The approach used to generate recruitment therefore leads to the set of recruitments used to conduct projections changing with time. Allowing the set of recruitments to change with time is needed to avoid an inconsistency between the recruitments used for projections and the recruitments on which the estimate of B_0 is based.

Allowance is made for the raw harvest guideline to be constrained so as not to change by more than a prespecified percentage from that for the previous year and not to fall outside of specified limits, although this option is not part of the baseline simulations.

One aspect of the actual management process that is ignored in the simulation of the PFMC management procedure is the time-lag between the collection of data and their use in assessments (for example, catch-at-age information from surveys conducted in one year would usually not be available for use in the assessments conducted in the following year) and that between assessments

Table 3

The performance statistics used in the present study. For consistency with the definition of recovery used by the Pacific Fishery Management Council, "recovery by year x" is defined as the spawning output being larger than $0.4B_0$ at or before year x. Some of the statistics are based on the "actual" (i.e. operating model) spawning output and others are based on the "assessed" (i.e. assessment model) spawning output.

Abbreviation	Description
F_{rec}	The fraction of the simulations in which the stock is assessed to be overfished at the start of the first projection year that actually recover by the maximum possible recovery year determined from the rebuilding analysis conducted in projection year 1.
Y_{rec}	The median year in which the actual spawning output first reaches $0.4B_0$.
P_{decl}	The proportion of simulations in which the spawning output is assessed to be below $0.25B_0$ (i.e. overfished) at the start of projection year 1.
5%D/50%D	The lower 5th and median of the distribution of the actual spawning output in projection years 20 and 60 expressed in relation to the actual pre-exploitation spawning output, B_0.
AAV	Average annual absolute change in catch evaluated after 20 and 60 years, i.e. $AAV = \sum_y \lvert C_y - C_{y-1} \rvert / \sum_y C_y$, where C_y is the catch during year y.
$\overline{C}$	Average annual catch over projection years 1–20 and 1–60.
P_{rec}	The fraction of simulations in which actual spawning output reached $0.4B_0$ sometime between projections years 1 and 20 and between projection years 1 and 60 (but may have dropped below $0.4B_0$ again).

being conducted and their being used for management purposes.

The performance statistics

A variety of performance statistics are considered (Table 3). These consider both the performance of the management procedure in terms of the behavior of the rules used for management (statistics F_{rec}, Y_{rec}, and P_{decl}) and of satisfying the goals established by the SFA in relation to the status of the population and the fishery (statistics 5%D, 50%D, $\overline{C}$, AAV, and P_{rec}). The choice of years 20 and 60 in the definitions of the latter five statistics is meant to capture "short"-term and medium-term considerations. For instance, recovery should have occurred by year 60 in most cases and the population should be well above $0.25B_0$ after 20 years. The catch and catch variability statistics for the first 20 years provide an indication of the likely impacts of recovery on the industry.

The need to examine aspects of the behavior of the management rules can be understood from Figure 3, which shows results for four simulations for the combination of a PFMC management procedure and an operating model variant. The solid lines are the "true" time-trajectories of spawning output (expressed in relation to the pre-exploitation level) and the dotted lines reflect the estimates of this ratio each time an assessment is conducted (every third year for the analyses shown in Fig. 3). The up arrows indicate when the assessment first indicates that the population is overfished (based on the model estimates of spawning output)—note that a population may be identified to be overfished more than once during a given simulation. The down arrows indicate the years in which recovery is predicted by the rebuilding analysis software (with the estimates from the assessment) to occur with 60% probability. The solid bar parallel to the x-axis indicates the years in which management is based on the rebuilding plan (rather than the 40-10 rule). The bar will stretch from the up arrow to the down arrow unless the population is assessed to have recovered to $0.4B_0$ (when management reverts to being based on the 40-10 rule).

There are several possible impacts of the difference between the perceived and true state of the system. For example, the population can erroneously be assessed not to be overfished in the first projection year (e.g. simulation 1 in Fig. 3). The statistic P_{decl} is designed to capture the frequency of this possibility. Even if the population is assessed to be overfished, there is no guarantee that it will recover with the expected probability and in the "correct" year. For example, for simulation 1, the stock assessment indicates that recovery occurs in year 71 (the solid bar consequently stops in year 71) even though the true population size is less than 30% of B_0 at that time. The statistic F_{rec} attempts to capture whether the rebuilding analysis performs as expected given that the population is assessed to be overfished at the start of the first projection year.

There are other aspects to evaluating the behavior of the management rules in relation to the perceived and true state of the system (e.g. the difference between the true and estimated biomasses and recruitments). Although it is straightforward to evaluate these aspects (e.g. Patterson and Kirkwood, 1995; Punt et al., 2002), they are not considered in detail in this paper to reduce the volume of results presented.

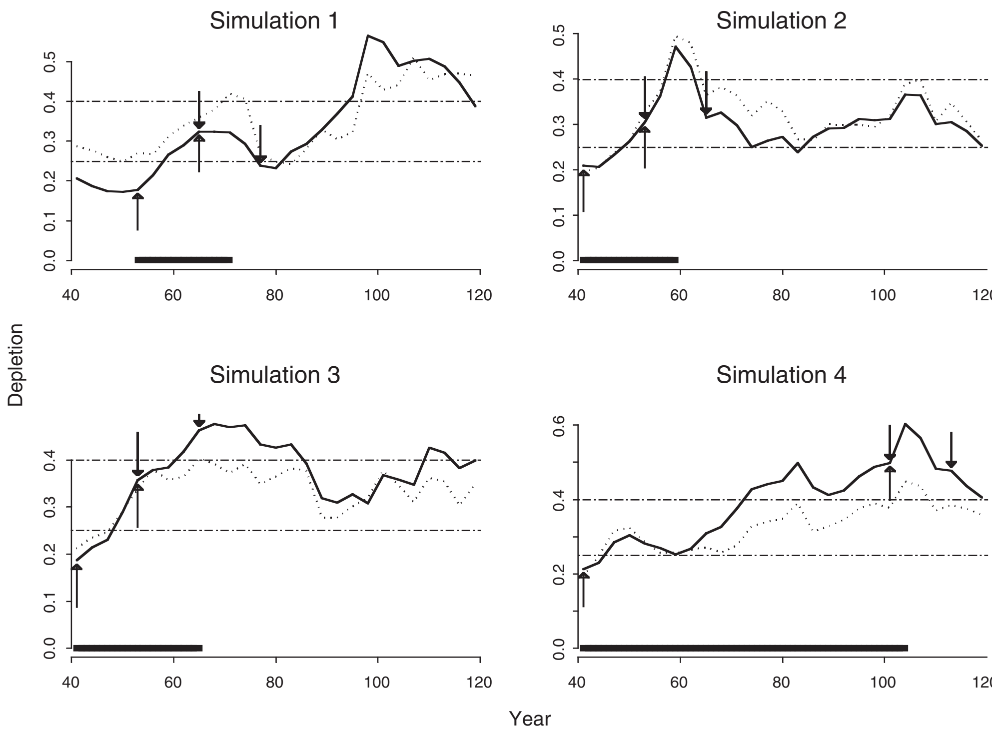


Figure 3

Time-trajectories of the "true" and the assessment model-estimated ratio of the spawning output to B_0 (depletion) for four simulations. The up arrows indicate the years in which the stock was declared to be in need of rebuilding and the down arrows show the values of T_{max}. The horizontal bars indicate the years during which the stock is under a rebuilding plan. Year 41 is the first "projection year," i.e. the first year in which the management procedure is used to determine the catches (the catches for the years prior to year 41 are set equal to the historical catches—see Fig. 1A)

Results and discussion

Detailed results for a single operating model variant and management procedure

Figures 4 and 5 and Table 4 summarize aspects of a simulation trial in which the operating model has its baseline parameterization (Tables 1 and 2) and in which the management procedure used to set harvest guidelines is the PFMC management procedure with no constraints on interannual variation in harvest guidelines other than an upper limit of 10,000 t. The lack of any constraints on changes in harvest guidelines has been imposed because the PFMC has not adopted any such constraints. The harvest guideline is updated every third year.

Figure 4 shows the time-trajectories of catch, spawning output in relation to the pre-exploitation equilibrium level ("true" and estimated), and the perceived fishing mortality on which the harvest guideline is based for three of the 100 simulations that constitute a simulation trial. The horizontal bars on the x–axis again reflect the year during which the stock is managed by using the results from the rebuilding analysis rather than the 40-10 rule. The most notable feature of Figure 4 is the high variability in annual catches. This variability arises for several reasons: 1) the additional information on population biomass obtained each time a survey occurs changes the perceived status of the resource and hence how far the spawning output is from the target level of $0.4B_0$; 2) an extension of the assessment period changes the set of recruitments on which generation of future recruitment is based; and 3) a change from being under a rebuilding plan to being managed by means of the 40-10 rule can lead to marked changes in catch. The latter is evident by the change in fishing mortality and catch when the spawning output is estimated to reach $0.4B_0$ (i.e. the end of the horizontal bar). A marked impact due to the addition of data for a single 3-year period may appear surprising. However, effects of this nature have already been observed for West Coast species (see, for example, the 2002 update to the sablefish [*Anoplopoma fimbria*] stock assessment [Schirripa and Methot[6]]).

[6] Schirripa, M. J., and R. Methot. 2002. Status of the sablefish resource off the continental U.S. Pacific Coast in 2001. *In* Stock assessment and fishery evaluation: appendix to the status of the Pacific Coast groundfish fishery through 2001 and acceptable biological catches for 2002, x + 122 p. Pacific Fishery Management Council, 7700 NE Ambassador Place, Portland, OR 97220.

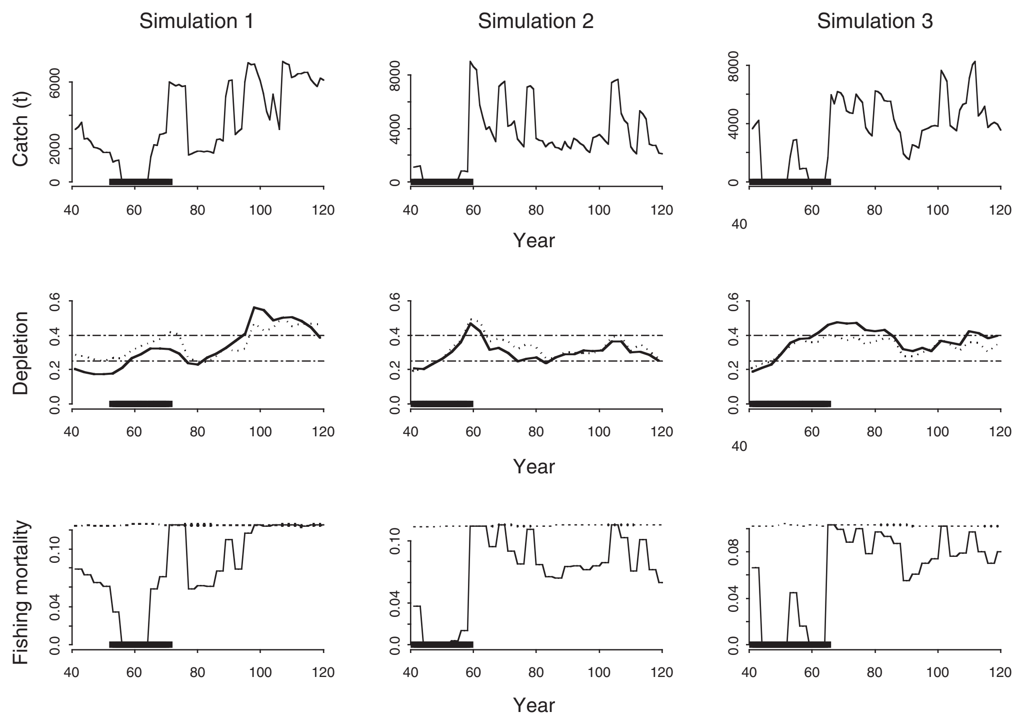


Figure 4

Time-trajectories of catch (**upper panels**), spawning output in relation to the pre-exploitation level (solid line is "true"; dotted line is estimated) (**center panels**), and perceived fishing mortality (used to set the harvest guideline [solid line]; dotted line=F_{MSY} proxy) (**lower panels**) for three individual simulations. The results in this figure pertain to the baseline operating model and baseline Pacific Fishery Management Council management procedure.

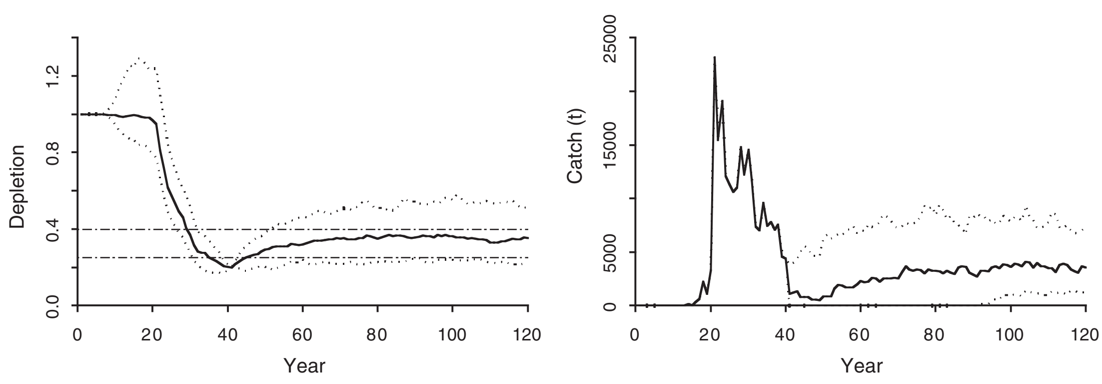


Figure 5

Piecewise medians (solid lines) and 90% intervals (dotted lines) for spawning output in relation to the pre-exploitation equilibrium level (left panel) and catch (right panel). The results in this figure pertain to the baseline operating model and baseline Pacific Fishery Management Council management procedure.

The extent of variability in catch in Figure 4 differs markedly from the way advice on expected catches during the rebuilding period is presented to the decision makers (e.g. Fig. 6). One way to improve the presentation of information on expected catches would be to include some individual catch trajectories from those on which the rebuilding analysis is based. However, even these would severely underestimate the actual extent of uncertainty

Table 4

Performance statistics (see Table 3 for definitions) for six alternative management procedure variants. All of the calculations in this table relate to the baseline operating model. PFMC = Pacific Fishery Management Council. N/A = not applicable.

				Results after 20 years					Results after 60 years				
Management procedure	F_{rec}	Y_{rec}	P_{decl}	5%D	50%D	AAV	$\bar{C}$	P_{rec}	5%D	50%D	AAV	$\bar{C}$	P_{rec}
Baseline	0.22	72	0.82	0.22	0.33	0.33	1759	0.32	0.23	0.36	0.25	2847	0.80
With constraints	0.27	61	0.82	0.24	0.40	0.38	591	0.54	0.24	0.41	0.17	2440	0.89
No 10 years and estimated F_{MSY}	0.42	68	0.82	0.24	0.34	0.30	1652	0.27	0.25	0.41	0.24	2649	0.84
Preferred	0.59	62	0.82	0.25	0.39	0.31	950	0.49	0.28	0.54	0.21	1961	0.96
PFMC (baseline)	N/A	95	N/A	0.19	0.29	0.23	2273	0.07	0.24	0.33	0.20	2851	0.55
PFMC (preferred)	N/A	64	N/A	0.23	0.36	0.30	1239	0.45	0.30	0.48	0.20	2265	0.93

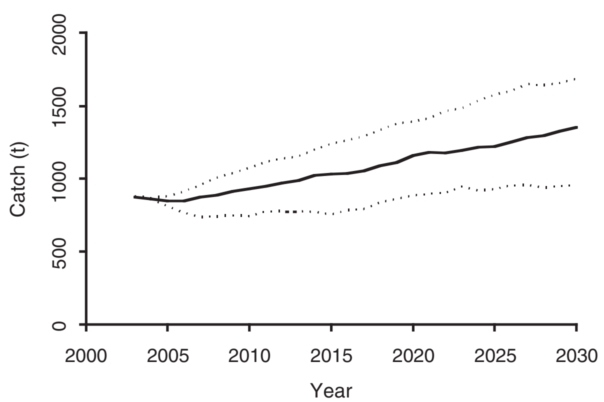


Figure 6

Time-trajectories of catch (median and 95% intervals) for the annual catch for widow rockfish based on a rebuilding analysis conducted in 2002.

because they are conditioned on knowing the age-structure of the population at the start of the projection period and are based on fixed levels of fishing mortality during the rebuilding period.

The impact of estimation uncertainty is also evident in Figure 4. The following are three examples of this: 1) management based on the rebuilding plan only starts in year 53 in simulation 1 because, prior to this year, the stock assessment indicates (erroneously) that the stock is above rather than below $0.25B_0$; 2) the resource is predicted to have recovered to $0.4B_0$ in year 71 in simulation 1 (and hence management is based on the 40-10 rule thereafter)—however, the spawning output is really only slightly larger than $0.3B_0$ at this time; and 3) in simulation 3 the assessment model indicates that the spawning output has recovered to above $0.4B_0$ in year 65 when, in fact, it recovered to $0.4B_0$ three years earlier.

The results of all 100 simulations are summarized by the time-trajectories in Figure 5. The trajectories of catch in Figure 5 are notably less variable that the individual trajectories in Figure 4 because, for instance, the 5th, median, and 95th intervals for the catch in year 80 are obtained by sorting all 100 year-80 catches and taking the appropriate percentiles. Unlike the individual trajectories, the median trajectories of catch and spawning output show quite smooth changes over time. This result highlights the importance of the AAV statistic that captures interannual variation in catches within individual simulations.

Overall, there is a high probability (0.82) that the assessment model identifies that the spawning output is less than $0.25B_0$ at the start of the projection period (Table 4). However, the probability that recovery occurs at or before the T_{max} year predicted from the rebuilding analysis conducted in projection year 1 is rather low (0.22) and 50% of simulations exceed $0.4B_0$ only in year 72 (i.e. after 30 years). The probability of being below the overfished level of $0.25B_0$ still exceeds 5% after 60 years of management with this management procedure although there is an 80% probability that the spawning output recovers to $0.4B_0$ sometime during the first 60 years of management with the management procedure.

It should be noted that the impact of recruitment variability and assessment errors following recovery to $0.4B_0$ can be consequential. For example, the probability of having reached $0.4B_0$ after 60 years of management by using the management procedure exceeds 0.8 but the median value of the ratio of the spawning output in year 60 to B_0 is nevertheless still less than 0.4 (Table 4, Fig. 5). One reason for the spawning output not stabilizing at $0.4\,B_0$ is a discrepancy between the fishing mortality rate that stabilizes the population at B_0 (deterministically) and $F_{50\%}$. For the baseline steepness of 0.4, the fishing mortality required to stabilize the spawning output at $0.4\,B_0$ actually corresponds to a lower fishing mortality than $F_{50\%}$ (closer to $F_{63\%}$).

Sensitivity to alternative management procedures

Table 4 includes results for a range of variants of the baseline management procedure designed to improve its performance. The following are areas where improved performance is desirable: 1) the extent of interannual variability in catches; 2) the similarity between the year in which the rebuilding analysis indicates recovery will occur and the year at or before which it actually occurs; and 3) the probability of being below the overfished level after 20 and 60 years.

The first variant of the baseline management procedure ("with constraints" in Table 4) involves imposing maximum and minimum catch limits of 30 and 8000 t and constraining changes in harvest guideline not to exceed 25% from one year to the next, except in the first year when reductions of up to 99% are allowed. This variant leads to much lower interannual variation in catches when a 60-year period is considered (17% compared with 25%) but the AAV is actually higher for the first 20 years. This variant also leads to higher probabilities of recovery. However, there is still a large discrepancy between the actual year of recovery to $0.4B_0$ and the year that underlies the management procedure (the value of F_{rec} in Table 4 is only 0.27 for the "with constraints" variant).

The second variant considered ("no 10 year and estimated F_{MSY}" see Table 4) drops the requirement that T_{max} be defined as 10 years if the resource can be recovered in 10 years and instead always sets T_{max} to T_{min} plus one mean generation. It also allows the F_{MSY} proxy used when applying the 40-10 rule to differ from the default value of $F_{50\%}$ by setting it to F_{rep} (Jakobsen, 1993) if F_{rep} is lower than F_{MSY}. Estimating (rather than fixing) F_{MSY} is consistent with the recommendation of Brodziak (2002). The major performance difference between this variant and the baseline management procedure is the increased value of F_{rec}.

The "preferred" variant in Table 4 combines the features of the "with constraints" and "no 10 years and estimated F_{MSY}" variants. Compared with the baseline management procedure, it leads to a markedly increased value for F_{rec} (remarkably close, in fact, to the desired value of 0.6), slightly lower catch variability, a less than 5% chance of being overfished after 20 years, and higher probabilities of being recovered to $0.4B_0$ after 20 and 60 years of management. The major disadvantage of this variant is the lower catches and that it leaves the spawning output well above 40% of B_0 after 60 years (see row "preferred" in Table 4).

Prior to the adoption of Amendment 11 of its Groundfish Management Plan, the PFMC set harvest guidelines using only the 40-10 rule.[7] Table 4 therefore also lists results for management procedures based on the 40-10 rule. When the 40-10 rule is applied without any constraints ("PFMC (baseline)" in Table 4), the probability of recovery and the values for the "50%*D*" statistic are lower (particularly the former) than for the "preferred" variant. In contrast, application of the 40-10 rule with constraints ("PFMC (preferred)" in Table 4) leads, arguably, to no more than a slight difference in catch (the 40-10 rule achieves higher catches) and probability of recovery (the "preferred" variant achieves a higher probability of recovery). The remaining analyses of this paper focus on the "preferred" variant. Future consideration of management procedures for West Coast groundfish resources should consider a management procedure that is based simply on the 40-10 rule and has no associated rebuilding analysis component, at least for comparative purposes. At present, however, such a management procedure would be inconsistent with the SFA because it would not specify the time to recover to the proxy for B_{MSY} (even if the results of this paper suggest that there is considerable uncertainty associated with the estimation of this particular quantity).

Sensitivity to alternative operating model specifications

The values assumed for h and σ_R in the baseline operating model are somewhat arbitrary. Table 5 therefore examines the sensitivity of the results for the "preferred" management procedure to varying the values assumed for these parameters, as well as that of the size of spawning output at the start of the first projection year to B_0.

The results are, as expected, sensitive to all three of the factors considered. Increasing σ_R from 0.4 through 0.6 to 1 leads to lower and more variable catches, a slightly higher probability of recovery in the first 20 years and a markedly higher value of 50%*D* after 60 years (0.74 for σ_R=1 compared to 0.46 for σ_R=0.4). The ability to detect an overfished stock declines slightly as the extent of variation in recruitment increases. The management procedure behaves as expected as steepness is increased from 0.25 through 0.4 to 0.7; the probability of recovery is markedly higher for high values of steepness even though the management procedure does identify cases with low steepness, and accordingly sets very low harvest guidelines in such cases. However, it is perhaps noteworthy that the probability of correctly identifying that the resource is overfished is lowest for the least productive scenario. The catches for the scenario in which the spawning output is 10% of B_0 at the start of the first projection year are much lower than for the baseline scenario, particularly over the first 20 years. However, these lower catches are necessary to achieve recovery (the median value of the statistic 50%*D* after 60 years is 0.52 and there is a 0.93 probability of the spawning output having recovered to $0.4B_0$ after 60 years for this scenario).

The behavior of the management procedure can be evaluated in terms of whether it eventually allows the stock to recover to $0.4B_0$ and whether it keeps the stock away from the overfished level of $0.25B_0$. The "preferred" management procedure can be argued to satisfy this criterion, except possibly for the scenario with the lowest steepness but, even in this case, the probability of recovery is 0.6 after 60 years.

The value for the F_{rec} statistic varies markedly depending on steepness and the ratio of the spawning output at the start of the first projection year to B_0. Although the "preferred" management procedure performs well for the baseline scenario in terms of recovering the resource by the predicted value for T_{max}, this good performance is clearly a fortunate anomaly. However, it does help to highlight that predictions of the year-to-recovery from rebuilding analyses should be interpreted with considerable caution.

Sensitivity to data quality

The data-related specifications for the baseline trial (Table 2) could be considered to be data-rich. It is therefore

---

[7] Albeit with different target fishing mortality levels.

Table 5

Performance statistics (see Table 3 for definitions) for 10 variants of the baseline operating model. All of the calculations in this table relate to the preferred management procedure. N/A = not applicable.

				Results after 20 years					Results after 60 years				
Operating model scenario	F_{rec}	Y_{rec}	P_{decl}	5%D	50%D	AAV	$\bar{C}$	P_{rec}	5%D	50%D	AAV	$\bar{C}$	P_{rec}
Baseline	0.59	62	0.82	0.25	0.39	0.31	950	0.49	0.28	0.54	0.21	1961	0.96
Structural changes													
$\sigma_R=0.4$	0.59	63	0.86	0.24	0.38	0.26	1242	0.44	0.25	0.46	0.18	2379	0.87
$\sigma_R=1$	0.59	61	0.72	0.23	0.41	0.43	417	0.54	0.32	0.74	0.32	592	0.96
h=0.25	0.15	94	0.76	0.20	0.28	0.76	86	0.02	0.23	0.38	0.50	126	0.60
h=0.7	0.84	53	0.87	0.31	0.46	0.16	3427	0.93	0.40	0.61	0.14	3951	1.00
Initial spawning out = 0.1 B_0	0.42	72	1.00	0.19	0.29	0.43	417	0.05	0.27	0.52	0.23	1375	0.93
Initial spawning out = 0.4 B_0	N/A	N/A	N/A	0.31	0.50	0.21	2881	0.92	0.30	0.66	0.19	2849	0.97
Data-related changes													
Deterministic data	0.68	61	0.84	0.29	0.38	0.30	957	0.51	0.31	0.55	0.20	2050	0.98
n^e=50	0.68	60	0.82	0.26	0.39	0.32	785	0.56	0.29	0.55	0.22	1938	0.97
σ^c=1	0.56	62	0.79	0.20	0.39	0.31	987	0.48	0.31	0.57	0.22	1962	0.97
5-yr update frequency	0.55	62	0.80	0.21	0.38	0.27	1160	0.49	0.27	0.53	0.19	1980	0.95

important to assess the sensitivity of the results to the quality of the data. The row "deterministic data" in Table 5 provides results for a trial in which the survey biomass index, the catch-rate index, and the age-composition data are known without error. The results from this trial provide an upper bound on the impact of improved data quality on the assessment results.[8] Somewhat surprisingly, the results for this trial are not notably better than for the baseline trial—the most notable difference between the baseline trial and the "deterministic data" trial being the higher values for the "5%*D*" statistics for the latter trial. The lack of major improvement in performance arises because, even with perfect information on spawning output and recruitment, it is still not possible to estimate B_0 exactly by multiplying average recruitment for the first 10 years of the assessment period by spawning output-per-recruit in the absence of fishing (hence the value of 0.84 for P_{decl}). Furthermore, the rebuilding analyses are still based on generating future recruitment by using spawning output and recruitment data for only 20 years, which is clearly a major source of variability in the predictions from the rebuilding analysis.

Decreasing the catch-at-age sample size from 200 to 50 has relatively little impact on the values for the performance statistics (the AAV statistic is marginally higher and the average catch, particularly for the 20-year projection horizon, is lower). Decreasing the precision of the catch-rate data has a rather larger impact. This is most evident in the value for the "5%D" statistic which is 0.2 rather than 0.25, as is the case for the baseline trial. The "5-yr update frequency" scenario in Table 5 examines the implications conducting assessments every fifth rather than every third year. The results are not markedly sensitive to the interassessment period although the lower values for the "5%D" statistics are perhaps noteworthy.

General remarks

The framework developed in this paper provides an objective basis for contrasting different management procedures and evaluating their sensitivity to uncertainty. Given such a framework, it becomes possible to compare variants of one class of management procedure (e.g. Table 4) and to compare variants among different classes of management procedure.

The management procedure options presented in this paper are but a small subset of those possible. In particular, it should be possible to improve performance by modifying the approach used to generate future recruitment when conducting rebuilding analyses to make use of some form of stock-recruitment relationship. One reason for expected improved performance is that it may then be feasible to estimate the fishing mortality rate corresponding to $0.4B_0$ rather than having to set it to the default value of $F_{50\%}$ or basing it on F_{rep}. Other possible management procedure options include 1) not increasing the rebuilding fishing mortality rate selected when the rebuilding analysis was first conducted if a stock is recovering faster than initially anticipated; 2) not decreasing the rebuilding fishing mortality rate as long of the probability of recovery by T_{max} is at least 0.5; and 3) smoothing the discontinuity that arises when a stock changes status from being under a rebuilding plan to being managed with the 40-10 rule when the

[8] The assessment still ignores interannual changes in selectivity; therefore the assessment results will not be exactly the same as the true values.

stock has recovered to $0.4B_0$. In terms of the last option, one of the issues considered an early rebuilding analysis for widow rockfish involved fishing mortality increasing to its target level as the stock approaches $0.4B_0$ (MacCall[9]).

The values for the F_{rec} statistic highlight that the predictions of the time to recovery (even in a probabilistic sense) from rebuilding analyses are highly uncertain. The uncertainty of this estimate of the time to recovery is due to the uncertainty about current stock size and that associated with making long-term predictions based on a short time-series of spawning output and recruitment data.

Although the performance of the management procedures is less than ideal, the results are almost certainly optimistic because the operating model is extremely simple and considers no major structural uncertainties (except for variability in selectivity over time). In contrast, Punt et al. (2002) found that including spatial structure in an operating model and assessing the stock by using a spatially aggregated assessment approach led to assessments that were markedly in error. However, the simulations conducted by Punt et al. (2002) were developed for a far more data-poor situation than that for West Coast groundfish, although there is also clearly spatial structure in the West Coast groundfish fishery. Another source of uncertainty not considered in this paper but that may be of critical importance to the management of West Coast groundfish species is the impact of environmental regime shifts, which have been argued to impact long-term trends in recruitment (e.g. Francis et al., 1998).

An important aspect of this study is the ability to focus on the relationship between the overall performance of a management procedure and the performance of its constituent parts. For example, the results for the "deterministic data" scenario in Table 4 show that given the approach used to conduct the future projections, even perfect information from surveys and very large age-composition samples are unlikely to lead to marked improvements over the current situation if that situation is adequately modeled by the baseline operating model. Identification of the key sources of uncertainty could be used to focus future management-related research activities.

The computational requirements of the calculations outlined above are substantial. In particular, the need to apply a fairly complicated method of stock assessment once every three years means that rapid evaluation of management procedures is (currently) computationally not feasible. It is possible, in principle, to simplify the management procedure considerably by assuming that the results from a stock assessment can be mimicked by generating a biomass estimate based on the "true" biomass but with some random error (e.g. Hilborn et al., 2002). However, although such an approach may be satisfactory for some management procedures (e.g. those that set the harvest guideline equal to some fraction of the current biomass), this is not the case for PFMC-type management procedures that depend on the (assessed) age-structure of the population.

[9] MacCall, A. D. 2002. Personal commun. NMFS Santa Cruz Laboratory, 110 Shaffer Rd, Santa Cruz, CA 95060.

It needs to be recognized that any simulation study is by design case-specific. However, the conclusions of this study may be relevant to a fairly broad set of West Coast rockfish species owing to their similar biology and exploitation history—the two factors most likely to impact the relative performance of different management procedures.

Acknowledgments

Discussions with Alec MacCall, John DeVore, and Richard Methot are gratefully acknowledged as are the comments on an earlier version of this paper by Pamela Mace and two anonymous reviewers. This work was funded through NMFS grant NA07FE0473.

Literature cited

Barnes, W. R.
1999. Viewpoint: an industry view of the application of operational management procedures to setting total allowable catches for the South African pelagic fishery. ICES. J. Mar. Sci. 56:1067–1069.

Beddington, J. R., and J. G. Cooke.
1983. The potential yield of fish stocks. FAO Fish. Tech. Pap. 242:1–47.

Brodiak, J.
2002. In search of optimal harvest rates of west coast groundfish. N. Am. Fish. Manage. 22:258–271

Butterworth, D. S., and M. O. Bergh.
1993. The development of a management procedure for the South African anchovy resource. *In* Risk evaluation and biological reference points for fisheries management (S. J. Smith, J. J. Hunt, and D. Rivard, eds.), p. 83–89. Can. Spec. Publ. J. Fish. Aquat. Sci. 120.

Cochrane, K. L., D. S. Butterworth, J. A. A. De Oliveira, and B. A. Roel.
1998. Management procedures in a fishery based on highly variable stocks and with conflicting objectives: experiences in the South African pelagic fishery. Rev. Fish. Biol. Fish. 8:177–214.

Dorn, M. W.
2002. Advice on west coast rockfish harvest rates from Bayesian meta-analysis of stock-recruit relationships. N. Am. Fish. Manage. 22:280–300.

Francis, R. I. C. C.
1992. Use of risk analysis to assess fishery management strategies: a case study using orange roughy (*Hoplostethus atlanticus*) on the Chatham Rise, New Zealand. Can. J. Fish. Aquat. Sci. 49:922–930.

Francis, R. S., A. Hare, A. Hollowed, and W. Wooster.
1998. Effects of interdecadal variability on the oceanic ecosystems of the NE Pacific. Fish. Oceanogr. 7:1–21.

Geromont, H. F., J. A. A. De Oliveira, S. J. Johnston, and C. L. Cunningham.
1999. Development and application of management procedures for fisheries in southern Africa. ICES J. Mar. Sci. 56:953–966.

Hilborn, R.
1979. Comparison of fisheries control systems that utilize catch and effort data. J. Fish. Res. Board Can. 36: 1477–1489.

Hilborn, R., A. Parma, and M. Maunder.
2002. Exploitation rate reference points for west coast rockfish: are they robust and are there better alternatives? N. Am. Fish. Manage. 22:365–375.
Ianelli, J. N.
2002. Simulation analyses testing the robustness of productivity determinations from West-Coast Pacific ocean perch stock assessment data. N. Am. Fish. Manage. 22: 301–310.
IWC (International Whaling Commission).
1992. Report of the Fourth Comprehensive Assessment Workshop on Management Procedures. Rep. Int. Whal. Comm. 42:305–321.
2001. Report of the standing working group on the development of an Aboriginal subsistence whaling management procedure. J. Cetacean Res. Manag. 4(suppl.):148–177.
Jakobsen, T.
1993. The behaviour of F_{low}, F_{med} and F_{high} in response to variation in parameters used for their estimation. *In* Risk evaluation and biological reference points for fisheries management (S. J. Smith, J. J. Hunt, and D. Rivard, eds.), p. 119–125. Can. Spec. Publ. J. Fish. Aquat. Sci. 120.
Methot, R. D.
2000. Technical description of the stock synthesis assessment program, 56 p. NOAA Tech. Memo., NMFS-NWFSC-43.
Patterson, K. R., and G. P. Kirkwood.
1995. Comparative performance of ADAPT and Laurec-Shepherd methods for estimating fish population parameters and in stock management. ICES J. Mar. Sci. 52: 183–196.
Punt, A. E., A. D. M. Smith, and G. Cui.
2001. Review of progress in the introduction of management strategy evaluation (MSE) approaches in Australia's South East Fishery. Mar. Freshw. Res. 52:719–726.
2002. Evaluation of management tools for Australia's South East Fishery. 2. How well do commonly-used stock assessment methods perform? Mar. Freshw. Res. 53:631–644.
Restrepo, V. R., and J. E. Powers.
1999. Precautionary control rules in US fisheries management: specification and performance. ICES. J. Mar. Sci. 56:846–852.
Rosenberg, A. A., and S. Brault.
1993. Choosing a management strategy for stock rebuilding when control is uncertain. *In* Risk evaluation and biological reference points for fisheries management (S. J. Smith, J. J. Hunt, and D. Rivard, eds.), 243–249. Can. Spec. Publ. J. Fish. Aquat. Sci. 120.
Sampson, D. B., and Y. Yin.
1998. A Monte Carlo evaluation of the stock synthesis assessment program. *In* Fishery stock assessment models (F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, and C. I. Zhang, eds.), p. 315–338. Alaska Sea Grant, Fairbanks, AK.
Starr, P. J., P. A. Breen, R. H. Hilborn, and T. H. Kendrick.
1997. Evaluation of a management decision rule for a New Zealand rock lobster substock. Mar. Freshw. Res. 48: 1093–1101.

Appendix 1 : An overview of the technical aspects of the PFMC's rebuilding analysis

The key steps of the PFMC's rebuilding analysis are 1) to select the maximum allowable rebuilding time (T_{max}), 2) to develop specifications for projecting the population size at the start of the current year-to-year T_{max}, and 3) to calculate the target fishing mortality rate so that the probability of the spawning output rebuilding to $0.4B_0$ at or before T_{max} equals a prespecified value, p_{rec} (taken to be 0.6 for purposes of the present study).

Projecting the population forward and defining B_0

The population projections are based on the equation

$$N_{y,a} = \begin{cases} R_y & \text{if } a = a_{min} \\ N_{y-1,a-1} e^{-(M+S_{a-1}F)} & \text{if } a_{min} < a < a_{max} \\ N_{y-1,a_{max}-1} e^{-(M+S_{a_{max}-1}F)} + N_{y-1,a_{max}} e^{-(M+S_{a_{max}}F)} & \text{if } a = a_{max}, \end{cases} \quad (A.1)$$

where $N_{y,a}$ = the number of animals of age a at the start of year y;
M = the instantaneous rate of natural mortality (assumed to be independent of age);
S_a = the selectivity for animals of age a;
F = the fully selected (i.e. $S_a \longrightarrow 1$) fishing mortality;
R_y = the recruitment (both sexes) during year y;
a_{min} = the lowest age class considered in the model; and
a_{max} = the oldest age class considered in the model (treated as a plus-group).

The age structure of the population at the start of the first year of the projection period is taken to be that from the most recent assessment. A variety of approaches are available to generate future recruitment (PFMC[10]). However, for consistency with the approach used in the bulk of the rebuilding analyses conducted to date, future recruitment is either based on randomly sampling recruitments (with replacement) from a prespecified historical period or based on randomly sampling the ratio of the recruitment to the spawning output that spawned that recruitment (with replacement) and then multiplying by current spawning output. The choice between basing the projections on sampling recruitments or sampling recruits-per-spawning output is determined by regressing each of these on time and selecting whichever has the lesser slope. The reason for doing this is that the lack of a trend in recruits-per-spawning output is indicative of a stock-recruitment relationship with low "steepness" (Francis, 1992), whereas the lack of a trend in recruitment is indicative of a stock-recruitment relationship with high "steepness."

The pre-exploitation equilibrium spawning output used to determine the rebuilding target is computed by multiplying the unfished spawning output-per-recruit by the average recruitment over a prespecified number of historical years. Note that the range of years on which to base the estimate of B_0 will usually differ from that on which generation of future recruitment is based.

[10] PFMC (Pacific Fishery Management Council). 2001. SSC terms of reference for groundfish rebuilding analysis, 9 p. Pacific Fishery Management Council, 7700 NE Ambassador Place, Portland, OR 97220.

It should also be noted that no account is taken of uncertainty regarding the current age structure, natural mortality, selectivity, etc., although the projections do account for uncertainty about future recruitment

Selecting the maximum allowable rebuilding period

The maximum allowable rebuilding time, T_{max}, is defined as the maximum of 10 years and the sum of the mean generation time and the minimum possible rebuilding time. This specification implements the requirement of the SFA to "take into account the status and biology of any overfished stocks of fish, [and] the needs of fishing communities." The minimum possible rebuilding period for a given future projection is computed by projecting the population forward with zero fishing mortality and by identifying the year in which the spawning output first reaches $0.4B_0$. T_{min} is the median of the distribution for this year constructed by conducting projections for many different (random) realizations of future recruitment.

Calculating the target fishing mortality rate

The target fishing mortality rate and hence the harvest guideline are determined by projecting the population forwards many times (100 times for the purposes of this paper), each time with a different sequence of future recruitment and for a variety of alternative *F*s and then identifying the level of F that corresponds to the spawning output having reached $0.4B_0$ by T_{max} with the prespecified probability p_{rec}.

Establishing Quantitative Criteria for Assessing Adequacy of Progress Towards Rebuilding Overfished West Coast Groundfish Stocks.

Summary of a meeting held at the SWFSC, Santa Cruz Laboratory, November 16-17, 2004 (participants: Steve Ralston, Alec MacCall, Andre Punt, Xi He, Marc Mangel, Anand Patil, Steve Munch, Rick Methot)

A number of west coast groundfish stocks have been declared overfished and rebuilding plans have been implemented to restore these populations to levels that can support productive, sustainable fisheries. These include: bocaccio (*Sebastes paucispinis*), cowcod (*S. levis*), canary rockfish (*S. pinniger*), darkblotched rockfish (*S. crameri*), Pacific ocean perch (*S. alutus*), widow rockfish (*S. entomelas*), yelloweye rockfish (*S. ruberrimus*) and lingcod (*Ophiodon elongatus*). In 2004 the Pacific Fishery Management Council (PFMC) adopted rebuilding plans for these species in the form of Amendments 16-2 and 16-3 to the groundfish FMP, which were approved by NMFS. All these stocks are currently being managed under very restrictive harvest guidelines that have severely constrained the entire west coast groundfish fishery. Moreover, each of these 8 species will be re-assessed in 2005 and, as a consequence, there will be an opportunity to determine whether or not stocks have responded to recovery efforts.

In developing the rebuilding plans, rebuilding analyses were conducted that were designed to meet the requirements of the NOAA Fisheries National Standard 1 Guidelines for implementing the 1996 Sustainable Fisheries Act. Specifically, these analyses determined the relationship between a rebuilding fishing mortality rate (**F**) and the probability (**P**) that a stock would recover to a population size capable of supporting maximum sustainable yield ($\mathbf{B_{msy}}$) within the maximum time allowable ($\mathbf{T_{max}}$). Under the NS1 Guidelines, $\mathbf{T_{max}}$ has been defined to be equal to $\mathbf{T_{min}}$ plus one mean generation time, where $\mathbf{T_{min}}$ is equal to the minimum amount of time a stock needs to rebuild (i.e., if fishing mortality were reduced to zero)[1]. Moreover, based upon Amendment 11 to the groundfish FMP, the Council adopted a value of $\mathbf{B_{40\%}}$ as a proxy for $\mathbf{B_{msy}}$, which is 40% of the population size that would be expected to occur if there were no fishing.

For ease of comparison among stocks and to standardize the basis of rebuilding calculations, it is useful to express any specific fishing mortality rate in terms of its effect on Spawning Potential Ratio (**SPR** = spawning/recruit relative to the unfished condition). Given fishery selectivity patterns and basic life history parameters, there is a direct inverse relationship between **F** and **SPR** (Figure 1). When there is no fishing, each new female recruit is expected to achieve 100% of its spawning potential. As fishing intensity increases, expected lifetime reproduction declines due to this added source of mortality. Conversion of **F** into the equivalent **SPR** has the benefit of standardizing for differences in growth, maturity, fecundity, natural mortality, and fishery selectivity patterns and, as a consequence, we recommend it be used routinely.

---

[1]An exception occurs for stocks that are able to rebuild within 10 years (e.g., lingcod), wherein the Guidelines require rebuilding within that period, although most groundfish stocks are incapable of doing so.

For each of the eight overfished groundfish stocks the Council adopted a **P** value as a policy decision, which established a target harvest rate and implied spawning potential ratio during rebuilding. Note that in all cases the probability of rebuilding within T_{max} exceeded 0.5, ranging between 0.6 and 0.9. As shown in Figure 2, there is a direct tradeoff between the probability of recovery on or before $\mathbf{T_{max}}$ and rebuilding harvests, i.e., given a policy choice on **P**, the harvest rate is determined, which can then be used to calculate the allowable catch each year as the stock rebuilds.[2]

Given that the initial policy decision made by the PFMC was to select a value of **P**, we suggest that when an updated stock assessments becomes available, the most logical standard to invoke, when evaluating whether a stock is rebuilding at an adequate pace, is to re-calculate **P** as it depends on **SPR** = f(**F**), using all the new information available, and to compare the existing and updated probabilities at the prevailing target **SPR**[3]. More explicitly, if a rebuilding analysis exists that has been used to set a rebuilding policy, we denote $\mathbf{P_0}$ to be the nominal probability of stock rebuilding that was adopted by the Council (e.g., 0.60 for widow rockfish) and we denote $\mathbf{SPR_t}$ to be the existing spawning potential ratio being used to rebuild the fishery. Then, if an update occurs at time ***t+1*** we re-estimate the general relationship between **SPR** and probability of rebuilding (i.e., $\mathbf{SPR_{t+1}}$ and $\mathbf{P_{t+1}}$) and determine $\mathbf{P_{t+1}}$ given $\mathbf{SPR_t}$ ($\mathbf{P_{t+1} \mid SPR_t}$). Depending on the relationship between ($\mathbf{P_{t+1} \mid SPR_t}$) and $\mathbf{P_0}$, we envision four possible scenarios. These are:

Case A (see Figure 3): ($\mathbf{P_{t+1} \mid SPR_t}$) > $\mathbf{P_0}$ – the new information indicates that the likelihood of rebuilding the stock by $\mathbf{T_{max}}$ at the current target spawning potential ratio ($\mathbf{SPR_t}$) is greater than the initial policy choice. In this instance, maintain the current target ratio to rebuild the stock as quickly as possible and/or to build a cushion against adverse conditions that may arise in the future.

Case B (see Figure 4): 0.5 < ($\mathbf{P_{t+1} \mid SPR_t}$) ≤ $\mathbf{P_0}$ – the new, updated information indicates that the likelihood of rebuilding at the current spawning potential ratio is less than the initial policy choice but is still more likely than not (i.e., greater than a 50:50 proposition). In this instance,

---

[2]Although the relationship between P{rebuilding by T_{max}} and SPR = f(F) is represented graphically in a simple deterministic way, in fact there is much uncertainty that is not depicted. That uncertainty is attributable to multiple sources, including: (1) measurement error, (2) process error, and (3) model specification error. The first of these can be overcome by simply increasing the number of simulated trajectories (N) used to calculate the median time to rebuild under any particular fishing rate, given the current state of knowledge. The second, which for example includes uncertainty in stock recruitment variability (σ_r) can be expected to change over time as our knowledge and understanding of stock dynamics improves. The third may also change, but may depend on falsification of assumed population dynamics. In any event, representing the P{recovery by T_{max}} = f(SPR) as a simple line on a graph is simplification that overstates our understanding of what we know.

[3]Note that when first applied the conversion SPR =f(F) for Bayesian rebuilding analyses should be based on the posterior mode.

because stock rebuilding involves the realization of a sequence of chance events, the current spawning potential ratio could be maintained.

Case C (see Figure 5): $0.0 \leq (\mathbf{P_{t+1}} \mid \mathbf{SPR_t}) \leq 0.5$ – the update suggests that rebuilding is seriously lagging and the biomass target is unlikely to be reached before $\mathbf{T_{max}}$ if the current spawning potential ratio is maintained. When this occurs the spawning potential ratio should be increased (F reduced, $\mathbf{SPR_{t+1}} > \mathbf{SPR_t}$) to insure that $0.5 < \mathbf{P_{t+1}}$.

Case D (see Figure 6): $\mathbf{P_{t+1}} < 0.5$ for all **SPR** – the update indicates that it is unlikely the stock will rebuild to the target stock size by $\mathbf{T_{max}}$, even if fishing is completely eliminated. When this situation arises the entire rebuilding plan may need to be redone and $\mathbf{T_{max}}$ re-estimated.

The group discussed some of the possible reasons why a stock may not rebuild as quickly as initially forecast. Obviously, chance recruitment events during rebuilding may have a very significant influence on the speed of recovery, and that is why rebuilding projections are based on stochastic simulations involving many hundreds or thousands of "realizations." However, another problem that has the potential to retard stock recovery occurs when harvests exceed the calculated allowable catch (i.e., overages). Hence, in order to evaluate how important this issue is, the group suggested that the relationship of $\mathbf{SPR_{t+1}}$ and $\mathbf{P_{t+1}}$ be calculated in two different ways (Figure 7). In the first case, these quantities would be determined using all of the available information, including the actual catches that occurred during the period between **t** and **t+1**. In the second case, the allowable catches that were estimated at time **t** would be substituted for the actual catches that occurred. Thus, any difference in the relationship between $\mathbf{SPR_{t+1}}$ and $\mathbf{P_{t+1}}$ would be attributable to insufficient constraints on fishing, which may then trigger a more aggressive reduction in harvest rate than if there were no appreciable difference in **P** values.

Another factor that should be considered, and may provide some flexibility to the Council, is the effect of a change in the estimate of exploitable biomass from assessments conducted at times **t** and **t+1**. Even if the target **SPR** rate has been achieved and actual catches have been equal to projected catches, the total allowable catch (TAC) may change markedly if there is a change in the estimate of exploitable biomass.

Recommendation:

- We recommend that a series of simulations be conducted to evaluate the stability and performance of the management system relative to the choice of $\mathbf{P_0}$, i.e., the initial rebuilding policy established by the Council. Obviously, conservative management (selection of a high $\mathbf{P_0}$) will require less adjustment to the target **SPR** rate (Cases C and D) and would be expected to rebuild stocks more quickly, but will require a greater reduction in catch in the short-term. The simulations should: (1) explore the relationship between $\mathbf{P_0}$ and the frequency of occurrence of the 4 cases described above and (2) estimate the optimal increase in SPR (i.e., reduction in fishing) when appropriate (i.e., optional in Case B, required in Cases C and D).

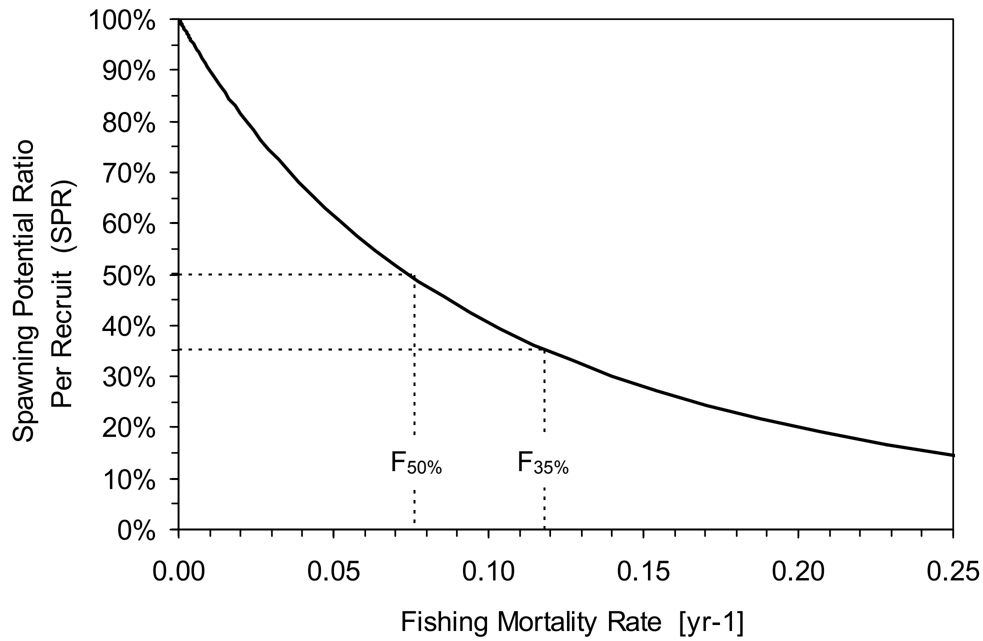


Figure 1. Relationship between spawning potential ratio (SPR) and instantaneous fishing mortality for a hypothetical rockfish.

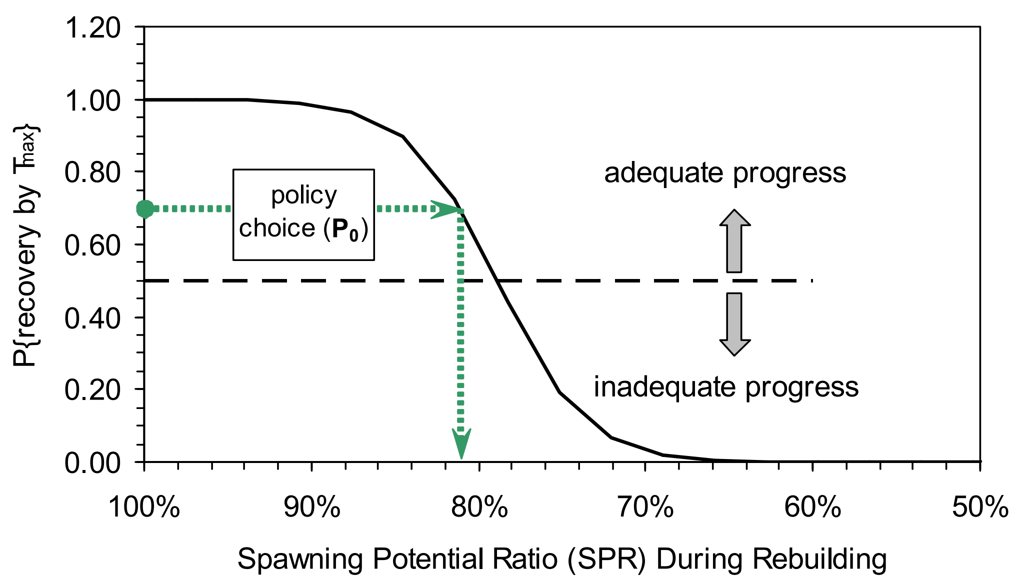


Figure 2. How management policy defines harvest rate during the rebuilding period. The more certain rebuilding, the lower the harvest rate. Minimally, there must be at least a 50% probability of rebuilding within T_{max}.

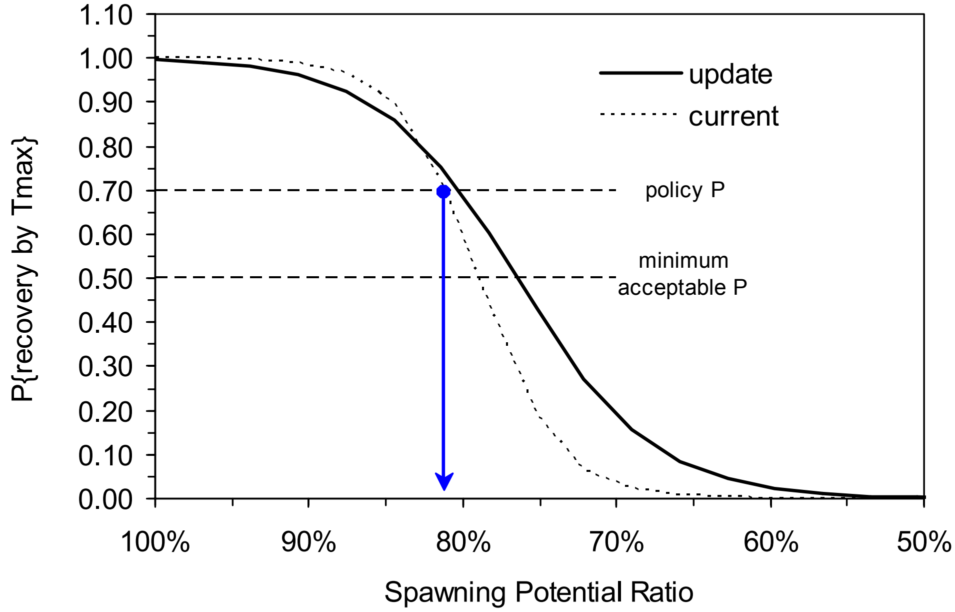


Figure 3. Case A: $(\mathbf{P_{t+1}} \mid \mathbf{SPR_t}) > \mathbf{P_0}$ – Status improves and rebuilding is more certain if catches are based on the current harvest rate.

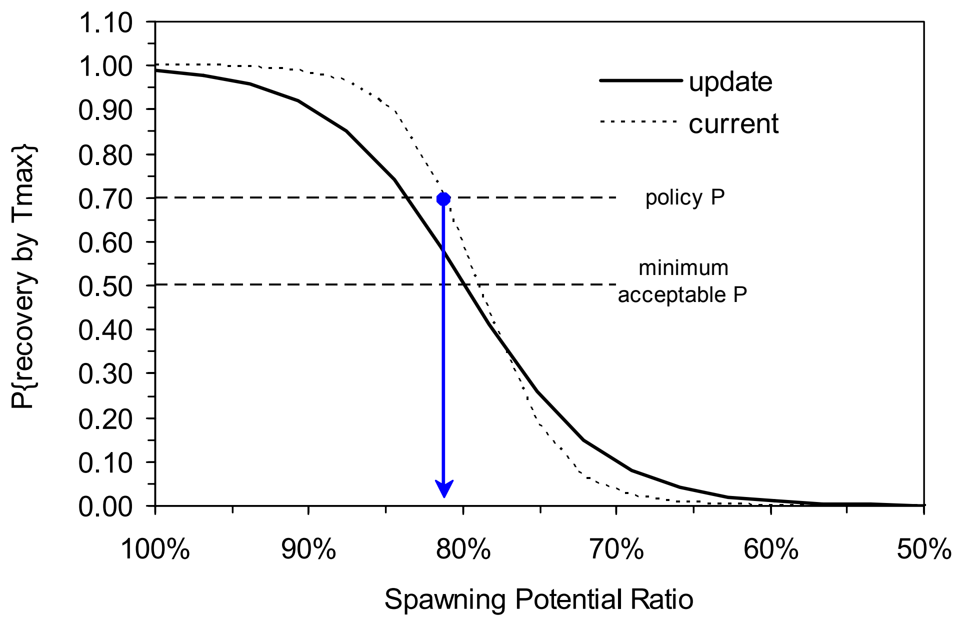


Figure 4. Case B: $0.5 < (\mathbf{P_{t+1}} \mid \mathbf{SPR_t}) \leq \mathbf{P_0}$ – Status deteriorates but rebuilding is still likely to occur if catches are based on the current harvest rate.

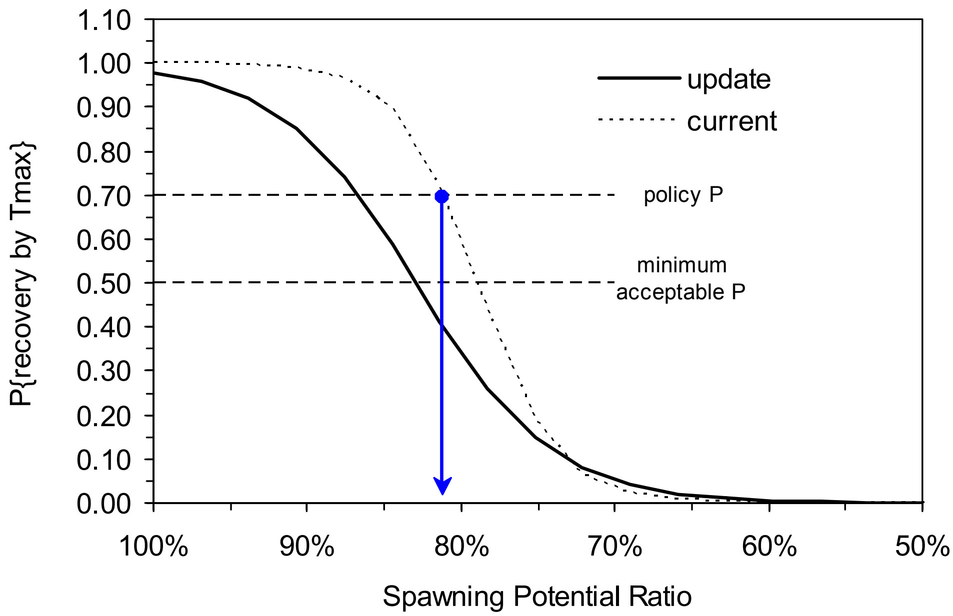


Figure 5. Case C: $0.0 \leq (\mathbf{P_{t+1}} \mid \mathbf{SPR_t}) \leq 0.5$ – Status deteriorates and stock rebuilding is deemed to be inadequate – harvest rate must be lowered.

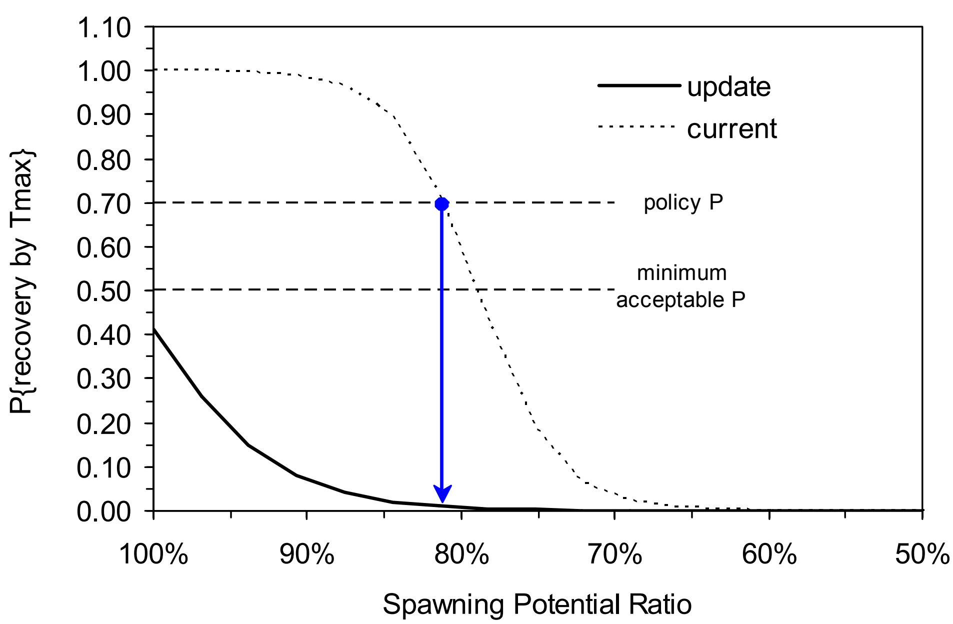


Figure 6. Case D: $\mathbf{P_{t+1}} < 0.5$ for all **SPR** – Rebuilding is unlikely to occur even if harvest rate is reduced to zero.

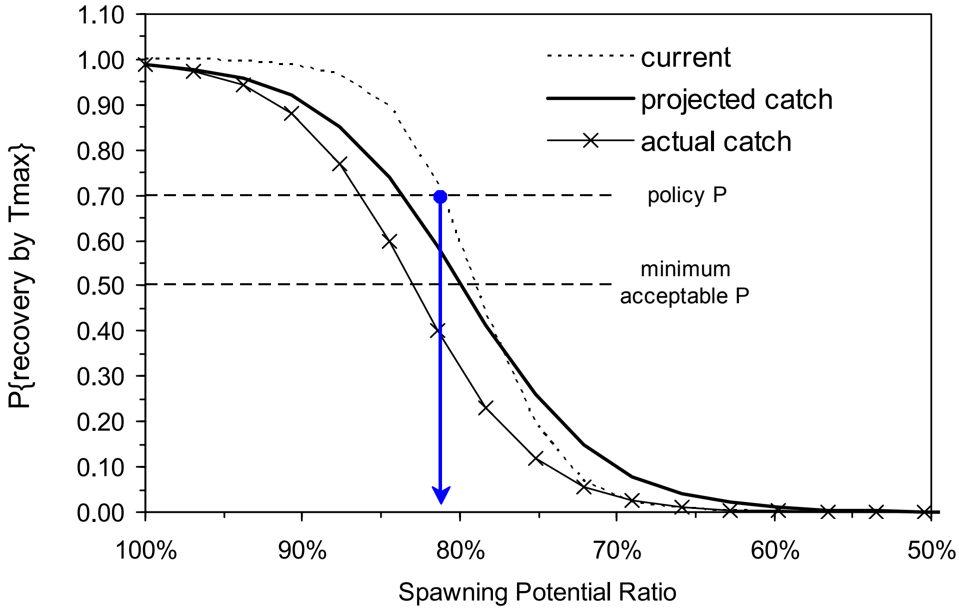


Figure 7. Evaluating the effect of actual catches versus projected catches on rebuilding success. In this example, if projected catches had actually occurred the stock would be recovering at an acceptable pace. However, because actual catches exceeded the allowable catch, recovery has been retarded to the extent that a change in SPR is warranted.

Evaluating Rebuilding Revision Rules for Assessing Progress Towards Rebuilding of OverFished West Coast groundfish

André E. Punt[1] Steve Ralston[2] Richard D. Methot[3] Alec MacCall[2]

1. Introduction

Eight west coast groundfish stocks have been declared overfished and rebuilding plans have been implemented to restore them to levels that can support productive, sustainable fisheries. These stocks are: bocaccio (*Sebastes paucispinis*), cowcod (*S. levis*), canary rockfish (*S. pinniger*), darkblotched rockfish (*S. crameri*), Pacific ocean perch (*S. alutus*), widow rockfish (*S. entomelas*), yelloweye rockfish (*S. ruberrimus*) and lingcod (*Ophiodon elongatus*)[4].

The Pacific Fishery Management Council (PFMC) adopted rebuilding plans for these species in 2004 in the form of Amendments 16-2 and 16-3 to the groundfish FMP, which were approved by NMFS. All these stocks are currently being managed under very restrictive harvest guidelines that have severely constrained the entire west coast groundfish fishery. Moreover, each of these eight stocks will be re-assessed during 2005 and, as a consequence, there will be an opportunity to determine whether or not they have responded to recovery efforts and are on track to rebuild as previously projected.

In developing the rebuilding plans, rebuilding analyses were conducted that were designed to meet the requirements of the NOAA Fisheries National Standard 1 (NS1) guidelines for implementing the 1996 Sustainable Fisheries Act. Specifically, these analyses determined the relationship between a rebuilding fishing mortality rate (F) and the probability (P_0) that a stock would recover to the spawning output capable supporting Maximum Sustainable Yield (SB_{MSY}) within the maximum time allowable (T_{MAX}). Under the NS1 Guidelines, for stocks that cannot rebuild within 10 years, T_{MAX} has been defined to be equal to T_{MIN} plus one mean generation time, where T_{MIN} is the minimum amount of time a stock needs to rebuild (i.e. if fishing mortality were reduced to zero). Moreover, the Council adopted a value of $SB_{40\%}$, equal to 40% of the spawning output that would be expected to occur if there were no fishing, as a proxy for SB_{MSY} based upon Amendment 11 to the groundfish FMP.

It is to be expected that the results of the 2005 groundfish assessments will not conform exactly with the results expected based on the previous assessments (e.g. due to recruitment not being equal to that expected, the consequences of changes to parameter values, and the impact of new data). The question that arises then is whether the fishing mortality rate used to set harvest guidelines specified as part of the rebuilding plan should be changed, and if so how. A further consideration is that data now available may show that the original basis for the rebuilding plan

---

[1] School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195-5020
[2] Southwest Fisheries Science Center, 110 Shaffer Road, Santa Cruz, CA 95060, USA.
[3] NOAA Fisheries, Office of Science & Technology, Northwest Fisheries Science Center, 2725 Montlake Blvd. E, Seattle, WA 98112, USA
[4] A ninth stock, Pacific whiting (*Merluccius productus*), also declined into an overfished state, then quickly recovered

is no longer valid (e.g. because the values assumed for natural mortality or stock recruitment steepness have changed markedly). Although guidelines exist regarding how rebuilding analyses are to be conducted (PFMC, 2001), there no guidelines to determine whether (and to what extent) rebuilding plans are to be updated given new information.

The objectives of this document are to outline: a) a set of possible "rebuilding revision rules" which could be used to measure progress towards rebuilding (and make appropriate adjustments to rebuilding plans as needed), and b) a framework (often referred to as Management Strategy Evaluation or MSE – Smith (1994)) which uses simulation to provide a quantitative means to compare various rebuilding revision rules in terms of their effectiveness at correctly (and adequately) making adjustments to rebuilding plans. The focus of this work is on the consequences of changes to assessments caused by the addition of new data; it being taken for granted that major changes to the assessment (e.g. a change to the stock structure assumption underlying the assessment) will lead to the need for revision to the rebuilding plan.

2. Methods

2.1 Measures of fishing mortality

For ease of comparison among stocks, and to standardize the basis of rebuilding calculations, it is useful to express any specific fishing mortality rate in terms of its effect on Spawning Potential Ratio (SPR = spawning output-per-recruit relative to that in an unfished state), as is being done for the stock assessments to be conducted during 2005. Given fishery selectivity patterns and basic life history parameters, there is a direct inverse relationship between F and SPR. When there is no fishing, each new female recruit is expected to achieve 100% of its spawning potential. As fishing intensity increases, expected lifetime reproduction declines due to this added source of mortality. Conversion of F into the equivalent SPR has the benefit of standardizing for differences in growth, maturity, fecundity, natural mortality, and fishery selectivity patterns.

2.1 The Simulation Protocol

The performances of the various rebuilding revision rules are evaluated by means of simulation. The basic situation being modeled is outlined in Figure 1. A resource is declared overfished based on the results of a stock assessment. As a result, there is a need to develop a Rebuilding Plan based on the results of the assessment[5] and input from the Council (the latter in the form of a value for P_0, the probability of rebuilding to 0.4 SB_0 by T_{MAX}), which, if P_0 is greater than 0.5, is equivalent to choosing a target year to rebuild that is sooner than T_{MAX}.

The stock assessment is updated / revised at some time in the future to include new information. The results of this updated assessment form the input to rules that determine whether progress is adequate. The possible outcomes from these rules are: a) progress is adequate so the harvest guidelines for the forthcoming years can be set based on the SPR in the latest version of the rebuilding plan (it is possible that the SPR was revised between when the rebuilding plan was originally developed and when the current assessment is being undertaken), and b) progress is inadequate. If progress is inadequate, it may be possible to still achieve rebuilding by T_{MAX} with probability of at least 0.5 by adjusting the SPR upwards (F downwards). As stated earlier, if the assessment had led to a major revision to the understanding of the dynamics of the stock, the

[5] The Rebuilding Plan developed when the stock was first declared overfished is referred to as the "original" Rebuilding Plan.

status of the stock relative to 40% of SB_0, or the productivity of the resource, it may be necessary to revise the Rebuilding Plan completely (including, for example, changing T_{MIN} and T_{MAX}).

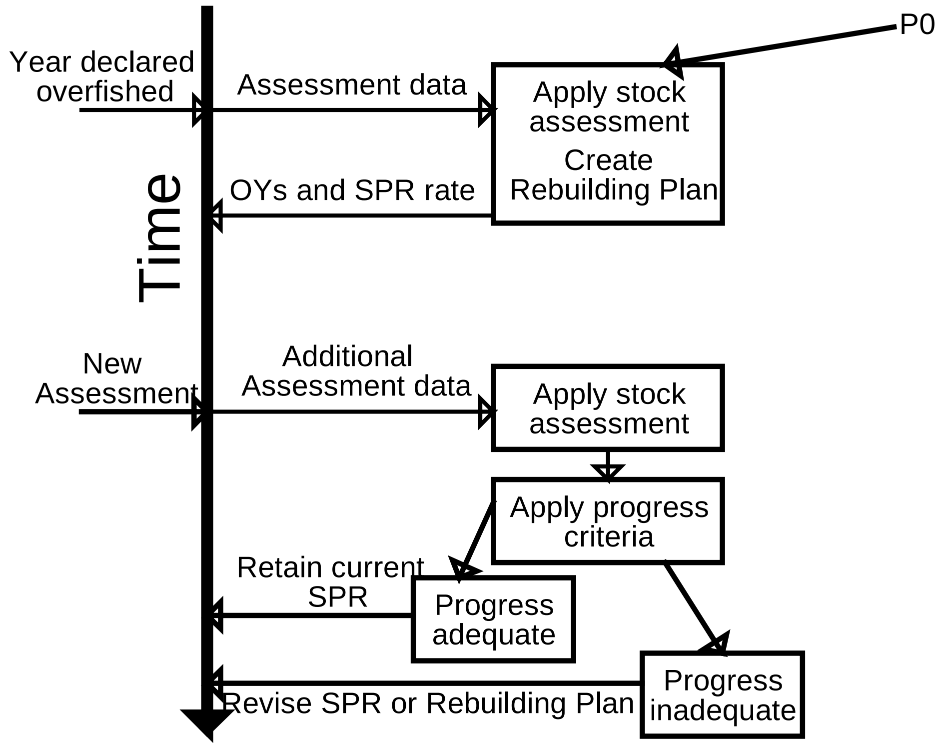


Figure 1. The conceptual basis for the simulations.

The conceptual schema in Figure 1 can be captured within a "Management Strategy Evaluation" (MSE) framework. The MSE framework considered for the analyses of this document is similar to that of Punt (2003). It consists of two components: a) an "operating model" (which mimics the "true" dynamics of the resource and generates the data available for assessment purposes) and b) a "management strategy" which includes how data are used to conduct a stock assessment, how rebuilding analyses are conducted, and the rules used to evaluate progress.

The annual steps when using the MSE approach to evaluate a management strategy are:

a. Generation of the data available for assessment purposes using the operating model.
b. Application of a method of stock assessment to the generated data to determine key assessment-related quantities (e.g. current age-structure, spawning output relative to target and limit levels, historical trends in recruitment) and any other model outputs needed to determine harvest guidelines.
c. Application of the rebuilding revision rules to determine whether it is necessary to revise the rebuilding plan, and to determine a harvest guideline.
d. Determination of the biological implications of this harvest guideline by setting the catch for the 'true' population represented in the operating model based on it. It is assumed that the catch equals the harvest guideline for the purposes of this study.

The operating model used for the analyses of this document is essentially identical to that used by Punt (2003). It includes an age- and sex-structured population dynamics model in which recruitment is governed by a Beverton-Holt stock-recruitment relationship with lognormal deviations ($\sigma_R = 0.6$), natural mortality is independent of age and equal to 0.15yr^{-1}, there is a single fishery, and selectivity is time-invariant and domed shaped. The values for the biological and technological parameters are based (somewhat loosely) on the situation for widow rockfish off the west coast of the U.S. (Williams *et al*., 2000). Figure 2 summarizes selectivity-, weight- and fecundity-at-age and the catches for the years prior to when the stock is first declared overfished and the original Rebuilding Plan is developed.

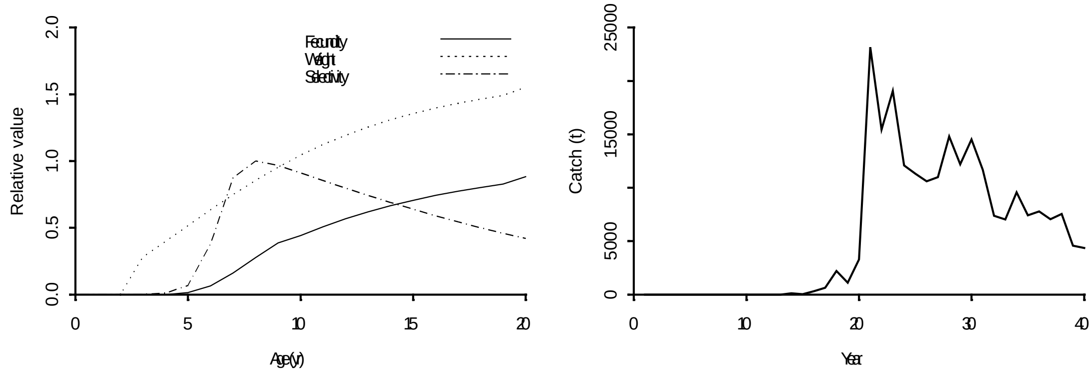


Figure 2 : The biological parameters (left panel) and catch history (right panel) in the operating model.

The data available for assessment purposes are the catches and weight- and fecundity-at-age (assumed known exactly), natural mortality (assumed known exactly for the bulk of the analyses), catch-rate-based indices of abundance, survey indices of abundance, catch age-composition data, and survey age-composition data. The surveys are assumed to be available tri-annually from year 13 (survey CV = 0.5; effective sample size for survey age-composition data = 100) while the catch-rate indices and the catch age-composition data are assumed to be available for all years for which the catch is non-zero. The coefficient of variation for the catch-rate indices is set to 0.4 and the effective sample size for the catch age-composition data is set to 100. These specifications correspond to a "data rich" stock.

Table 1 summarizes the six scenarios related to the values for the parameters of the operating model. These scenarios are based on specifying the depletion when the Rebuilding Plan is first developed (year 41 – either 0.1 SB_0, 0.15 SB_0 or 0.2 SB_0), the steepness of the stock-recruitment relationship (h=0.4 or h=0.7), whether recruitment is auto-correlated or not, and the value of M on which stock assessments prior to year 70 are based.

The harvest guideline is not updated every year in the simulations of this document, but rather every 4th year. This reflects a realistic frequency with which regular assessments for West Coast groundfish species are likely to be conducted. The frequency with which assessments are updated is another factor that could be considered within the framework of an MSE. Each simulation trial (i.e. each combination of an operating model variant and candidate management strategy) involves 10 simulations of an 80-year management period.

2.2 The stock assessment

The method of stock assessment is a statistical catch-at-age analysis (e.g. Fournier and Archibald (1982)). The underlying population dynamics model is essentially identical to the biological component of the operating model. The estimable parameters of the stock assessment model are the annual recruitments, and the parameters of the selectivity function. The values for these parameters are estimated by minimizing an objective function in which the catch rate data and the survey indices of abundance are assumed to be lognormally distributed and the catch and survey age-composition data are assumed to be multinomially distributed. For simplicity, the stock assessment assumes the correct effective sample sizes and coefficients of variation for the data.

2.3 The Rebuilding Revision Rules

Several sets of rules ("options") have been identified based on the intent of a rebuilding plan, as outlined in Section 1. All of the options are based on a value for P_0 (the target probability of rebuilding by $T_{\max}$). Furthermore, it is assumed that a formal stock assessment (see Section 2.2) is conducted every fourth year and forms the basis for the application of the rules. The outcomes from the stock assessment are: a) an estimate of the ratio of the spawning output at the start of year n+1 divided by the pre-fishery spawning output, SB_{n+1}/SB_0, where n is the last year for which catch data are available, and estimates of the spawning output and recruitment time-series. For the purposes of this document, the estimate of SB_{n+1}/SB_0 forms the basis for the harvest guidelines for year n+1 and beyond. In reality, there is a longer time lag between the last year for which data are available and the first year in which the harvest guideline would be changed.

It is assumed that a rebuilding plan was developed in year 41 which led to values for P_0, T_{MAX}, T_{MIN}, and the target SPR (denoted T_{MAX} (current), T_{MIN} (current) and $\text{SPR}_{\text{current}}$) on which harvest guidelines were based. For the purposes of the analyses of this document, T_{MAX} is defined as T_{MIN} + one mean generation time irrespective of whether T_{MIN} is estimated to be less than ten years or not.

The rebuilding revision rules in Table 2 are variants of a "reference" rebuilding revision rule. The reference rule attempts to capture the idea that performance is adequate as long as the probability of rebuilding to T_{MAX} remains above 0.5 and that there is a need to revise the entire rebuilding plan if there is no SPR for which the probability of rebuilding to T_{MAX} is at least 0.5. The value of P_0 is 0.6 for the "reference" rule. The rule operates as follows (the algorithm is based on an update to the stock assessment in year $n+v$).

a. If $SB_{n+v}/SB_0 > 0.4$, the resource has rebuilt so rebuilding is completed[6].
b. Project the population from year $n+v$ until T_{MAX}(current) using $\text{SPR}_{\text{current}}$ to determine future harvest guidelines and to compute the probability, P_{rec}, that the spawning output will rebuild to $0.4SB_0$ at least once by T_{MAX}(current).
c. If P_{rec} is larger than a critical value, P_{critical}, progress is considered to be adequate and the harvest guidelines for the next four years are based on $\text{SPR}_{\text{current}}$. The value of P_{critical} will always lie between 0.5 and P_0.
d. If P_{rec} is less than P_{critical}, progress is inadequate and some measures need to be taken to reduce fishing mortality to improve the chances of achieving the recovery objective. The following represents the specific rules considered in the "reference" rule:
    1. Determine the SPR so that the probability of rebuilding to $0.4SB_0$ from the current state of the stock by T_{MAX}(current) is P_{critical} (this SPR is denoted SPR_1).

---

[6] Note that because this appraisal is based on the results of a stock assessment, the "true" resource may or may not have rebuilt to $0.4SB_0$.

2. If $SPR_1 < 1$ then set $SPR_{current}$ to SPR_1 and base the harvest guidelines for the next four years on SPR_1.
3. If there is no SPR so that the probability of recovery to $0.4SB_0$ from the current state of the stock by T_{MAX}(current) is at least $P_{critical}$, a new rebuilding plan is needed. This involves redefining T_{MIN} and T_{MAX} and hence $SPR_{current}$ based on starting the new rebuilding plan from the stock size in year $n+v$ with a probability of rebuilding by the revised T_{MAX} of P_0. If the new $SPR_{current}$ is less than the previous one (so that the fishing mortality would be higher), $SPR_{current}$ is left unchanged.

The seven options (Table 2) are constructed from the "reference" rule as follows:

1. "No change". This option involves not revising the rebuilding plan but rather sticking with the SPR set when the original rebuilding analysis was conducted. While not necessarily a viable rebuilding revision rule, it sets a standard against which the other options can be compared.
2. "At least P_0". This option involves setting $P_{critical}$ equal to P_0, i.e. the SPR on which future harvest guidelines are based is increased if the probability of rebuilding drops below P_0 (rather than 0.5).
3. "Attain P_0". This option involves adjusting the SPR every time a new assessment is conducted so that the probability of rebuilding is always estimated to be P_0. This option differs from the "At least P_0" option because the SPR can be decreased if the probability of rebuilding exceeds P_0 (P_{high} in Table 2)
4. "MAX-SPR-1". This option involves determining the SPR so that the probability of rebuilding to $0.4SB_0$ by T_{MAX}(current) from the state of the stock in the year the current rebuilding plan started is P_{floor} (this SPR is denoted SPR_{floor}). SPR_{floor} is therefore the SPR which would have been set when the rebuilding plan was originally developed had the information available in year $n+v$ been available in year n). Calculate $SPR_{MAX} = SPR(P_{floor}) + \phi[1-SPR(P_{floor})]$. If $SPR_1 > SPR_{MAX}$ then recovery is highly unlikely. In this case, a new rebuilding plan is needed. Note that the "reference" option corresponds to $\phi=1$.
5. "MAX-SPR-2". This option involves not allowing the SPR to be increased to more than $0.5+0.5\ SPR_{current}$ (i.e. halfway between $SPR_{current}$ and 1). If the probability of rebuilding corresponding to $0.5+0.5SPR_{current}$ is less than $P_{critical}$ a new rebuilding plan is needed.
6. "P_0=0.8". This option is identical to the "reference" option, except that P_0=0.8.
7. "With phase". This option involves not revising a rebuilding plan between years $T_{MAX}-\tau$ and T_{MAX} to avoid making large changes to SPR (and hence catches) when a stock is believed to be close to the target level.

At present, these seven options and the "reference" option are simply technical constructions. They have not been evaluated in terms of their conformance with the current NS1 Guidelines or the draft revisions circulated in 2004.

2.4 Summarizing performance

Three plots (*sensu* Figures 3, 4 and 5) have been developed to summarize the results of a set of simulations.

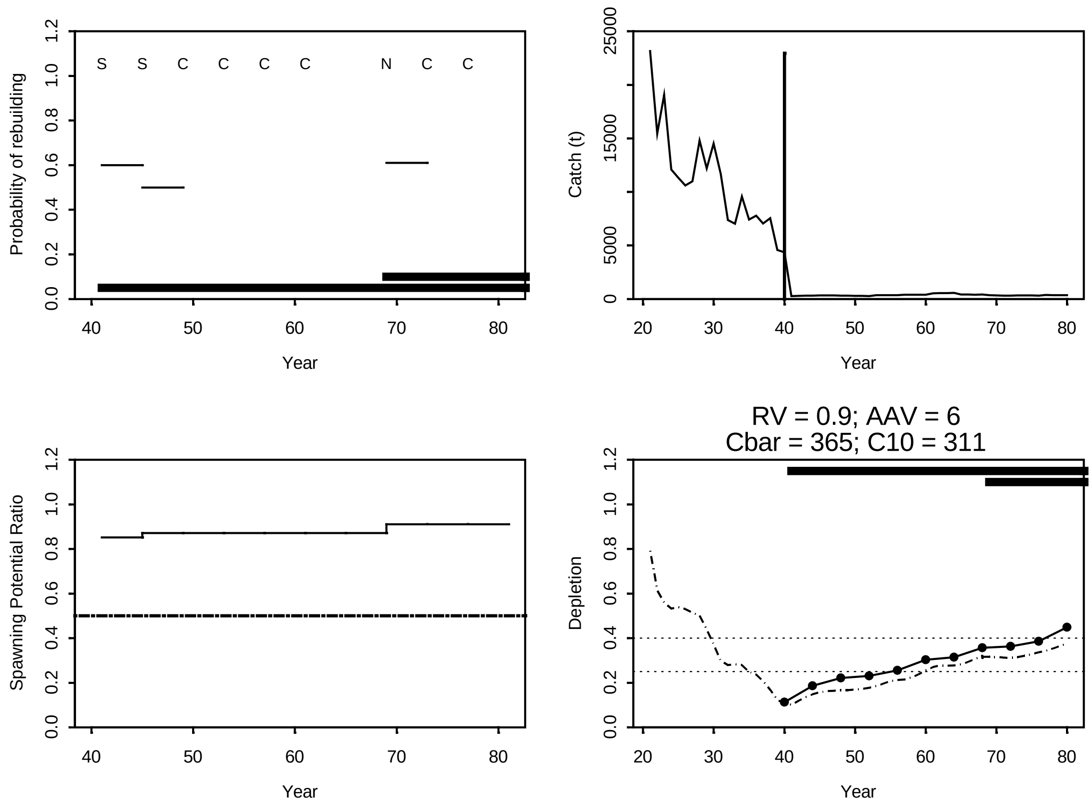


Figure 3. Plot summarizing the detailed results of a single simulation.

A ‘detailed plot’ (e.g. Figure 3) consists of four panels:

Upper left. The behavior of the rebuilding revision rule.

- The wide horizontal bars indicate the duration of the rebuilding plan(s). There may be multiple wide horizontal bars if the original rebuilding plan needed to be revised during the time period considered.
- The narrow horizontal lines indicate the probability of rebuilding each time it is necessary to change the SPR on which the harvest guideline is based (this will occur when the resource is first declared overfished, if it is necessary to change the SPR because the probability of rebuilding by T_{max} is less than $P_{critical}$, or if rebuilding is assessed to be highly unlikely and a new rebuilding plan is required). The gaps between these lines are the years when progress appears satisfactorily.
- An “S” at the top of the panel indicates that the **S**PR needed to be increased to achieve a probability of rebuilding of at least $P_{critical}$.
- A “N” at the top of the panel indicates that a **N**ew rebuilding plan was needed.
- A “C” at the top of the panel indicates that progress was evaluated and found to be adequate. The SPR used to set future harvest guidelines is **C**ontinued at $SPR_{current}$.

Upper right. Catches over time. The vertical line indicates when the stock was declared overfished and the first rebuilding analysis (based on P_0) was conducted.

Lower left. This panel shows the SPRs on which the annual harvest guidelines are based. The dashed line indicates the overfishing level for rockfish species of SPR=50%.

Lower right. The "true" depletion of the population over time (dot-dashed line) and the estimate of the depletion of the resource (as perceived from an assessment conducted every four years) (solid line with dots). The rebuilding revision rule is, of course, based on perceived reality. The two horizontal dotted lines are the overfishing level (0.25) and the target level (0.40). The wide horizontal bars again indicate the duration of the rebuilding plan(s).

The numbers in the title summarize various aspects of the results:

1. RV - the ratio of the number of years before the stock was assessed to have rebuilt divided by the number of years that it was expected that rebuilding would take based on the original rebuilding plan.
2. AAV - a measure of the variability of the catches, defined as:

$$AAV = \frac{\sum_y \left| C_y - C_{y+1} \right|}{\sum_y C_y} \qquad (1)$$

   where C_y is the catch during year *y*.

3. Cbar - the average catch during the years when the resource was under a rebuilding plan.
4. C10 - the average catch during the first ten years of the period during which the resource was under a rebuilding plan

The x-axis in each of the panels is limited to the years that the resource is considered to be under rebuilding (i.e. the years during which the assessment indicates that the spawning biomass is less than $0.4B_0$).

A 'summary plot' (e.g. Figure 4) consists of 16 panels. The 1st and 2nd rows show the time-trajectories of SPR and the 3rd and 4th rows show the bottom right plots from a detailed plot. These plots provide the results for the eight rebuilding revision rules when they are applied to one simulation (i.e. the "true" situation as represented in the operating model is the same for all eight option).

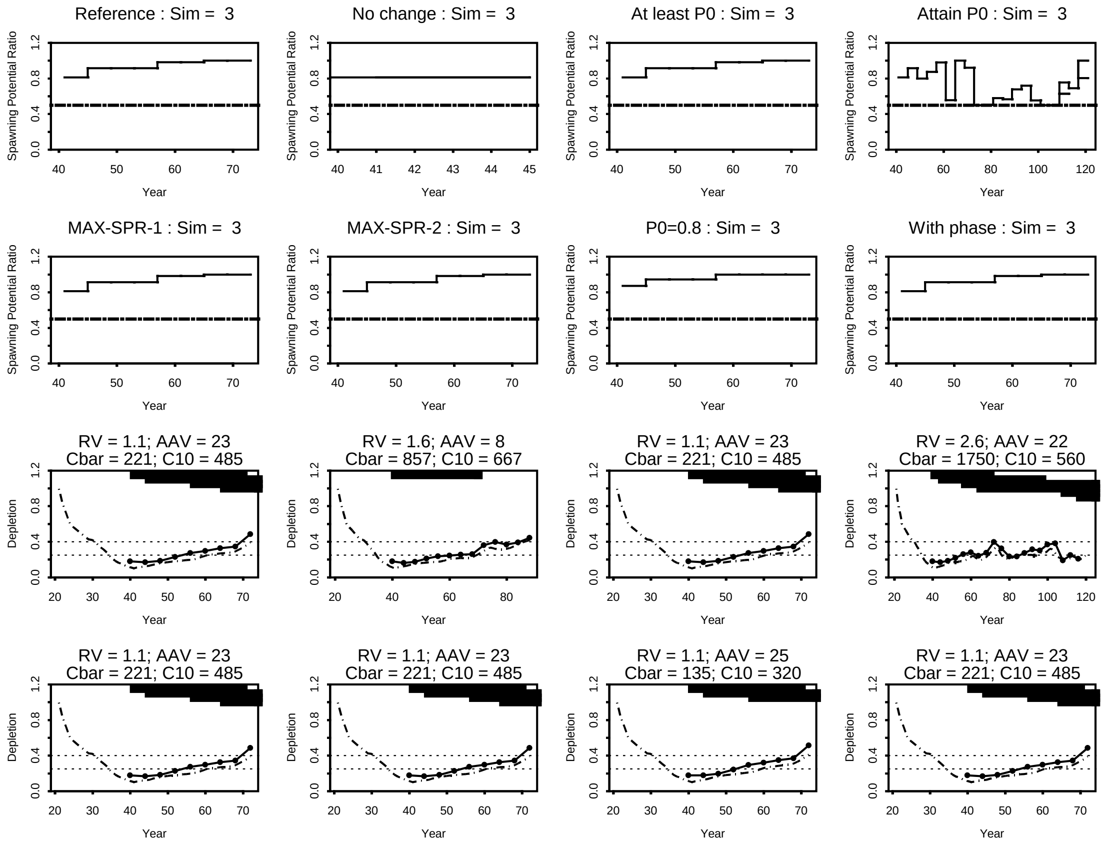


Figure 4. Summary plot for one simulation for operating model A.

The final type of plot (e.g. Figure 5) attempts to summarize the performance of the rebuilding revision rules across all the simulations in terms of three statistics:

- The average catch during the years when the resource was under a rebuilding plan.
- The ratio of the number of years before the stock was assessed to have rebuilt divided by the number of years that it was expected that rebuilding would take based on the original rebuilding plan (solid dots).
- The number of times that the SPR had to be altered during the rebuilding period (open dots; for improved clarity values larger than eight are set to eight and represented in the form of open triangles).

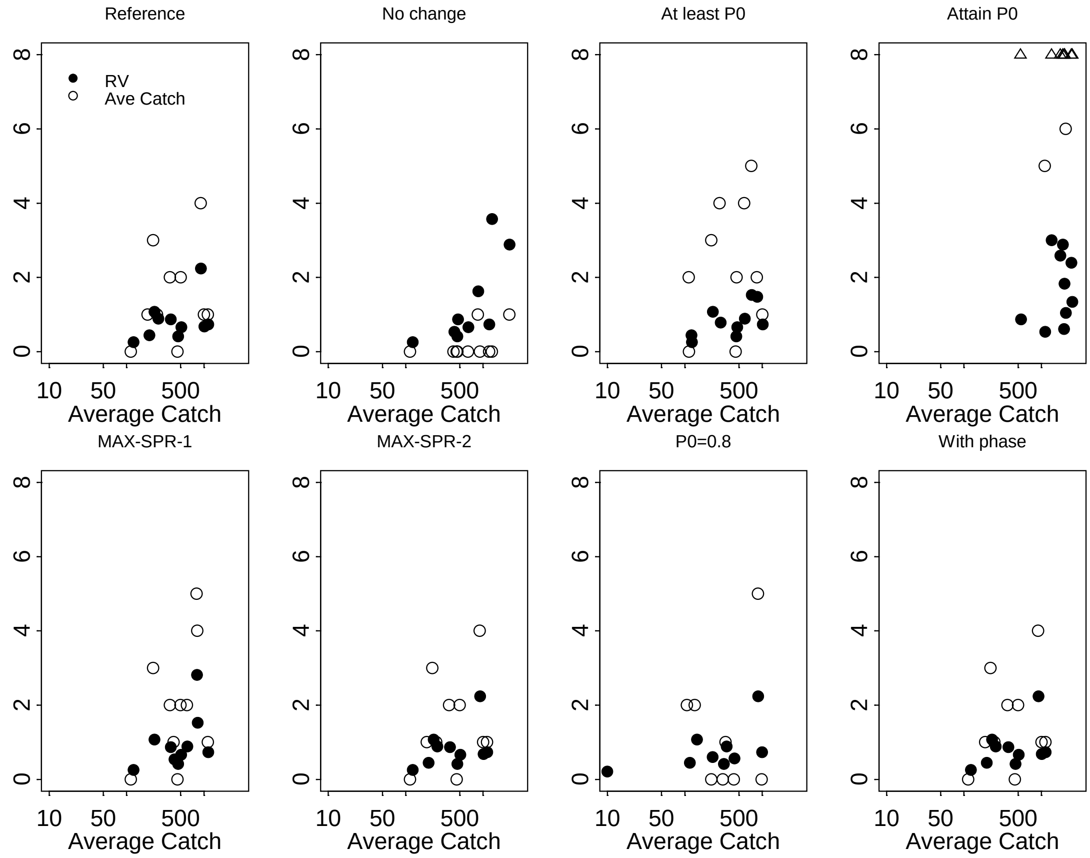


Figure 5. Comparison of the performances of the eight rebuilding revision rules for operating model A.

3. Results and discussion

3.1 Interpreting the plots

The properties of an ideal rebuilding revision rule are that: a) the spawning output rebuilds to $0.4B_0$ in as short a time as possible (the exact rate of rebuilding will depend on the productivity of the resource and the value assumed for P_0), b) catches are relatively stable (or increasing steadily) during the rebuilding period, c) the SPRs on which future harvest guidelines are based are stable, and d) the probability of needing to revise the entire rebuilding plan during the rebuilding period is low.

3.2 Results for the "base case" operating model

Figure 5 provides a summary of the overall performances of the eight rebuilding revision rules for the "base case" operating model while Figure 6 shows summary plots for two of the ten simulations for this operating model.

The "reference" option is able to recover the resource faster than anticipated when the first rebuilding analysis is conducted (the time to rebuild the resource to 0.4 SB_0 is 70% of that anticipated when the first rebuilding analysis is conducted). The median (across simulations) average catch during the rebuilding period is 365t (8.3% of the catch for the year prior to the resource being declared overfished) for this option and the median value of the AAV statistic across simulations is 10%. There is no need to change the SPR determined from the original rebuilding analysis in two of the simulations (e.g. simulation six – Figure 6a), but the number of changes in SPR can be far higher (e.g. simulation one – Figure 6b).

Not modifying the SPR no matter what the monitoring data indicate (the "no change" option) leads (as expected) to longer rebuilding times than those for the "reference" option. However, catches are higher and less variable, and recovery for the "no change" option can occasionally occur as fast as for the "reference" option (e.g. simulation 6). The "at least P_0" option leads, as expected, to shorter rebuilding times (e.g. for simulation 1), but at the expense of the need for more revisions to the SPR on which harvest guidelines are based compared to the "reference" option (Figure 5).

Modifying the SPR each time a new assessment is conducted so that there is always a perceived probability of rebuilding by T_{MAX} of P_0 (the "attain P_0" option) leads to higher average catches, but much more frequent changes to the SPR. This variability in SPR is perhaps most evident for the cases in which sticking to the original SPR would allow rebuilding by T_{MAX} (e.g. simulation 6 in Figure 6). Apart from the administrative disruption caused by changing the SPR every fourth year, the "attain P_0" option would also lead to large inter-annual variation in harvest guidelines (18% compared to 10% for the "reference" option).

The two MAX-SPR options are qualitatively similar, although the "MAX-SPR-1" option leads to more frequent changes to the SPR used to set harvest guidelines. Increasing P_0 from 0.6 to 0.8 leads to shorter rebuilding times, fewer changes to SPR values (because there is a larger "buffer" between the original probability of rebuilding of 0.8 and the "critical" value of 0.5), but lower catches (the median average catch for the "P_0=0.8" option is 85% of that for the "reference" option).

The results for "with phase" option are identical to those for the "reference" option. This result should be considered fortuitous. This would not have been the case had the idea of not changing the SPR when the resource is close to $0.4SB_0$ been combined with, say, the "attain P_0" option.

3.3 Sensitivity to alternative operating model parameters values

Figures 7 - 10 summarize the results for operating models C – G (Table 1). Results are not shown for operating model B because the resource is correctly detected to be depleted to below 0.25 SB_0 (and rebuilding initiated) in only a few simulations when the true spawning output is 20% of SB_0. This is a consequence of the structure of the assessment procedure selected (and the uncertainty associated with the data) and not of the form of the rebuilding revision rules.

The performance of all eight options is generally "better" (fewer changes in SPR, more rapid rebuild and larger average catches) if steepness is 0.7 (rather than 0.4 as is the case for the "base case" operating model) (Figure 7). The "attain P_0" option is again very variable. Unlike the case for "base case" operating model, even the "no change" option always allows rebuilding to occur when steepness is 0.7.

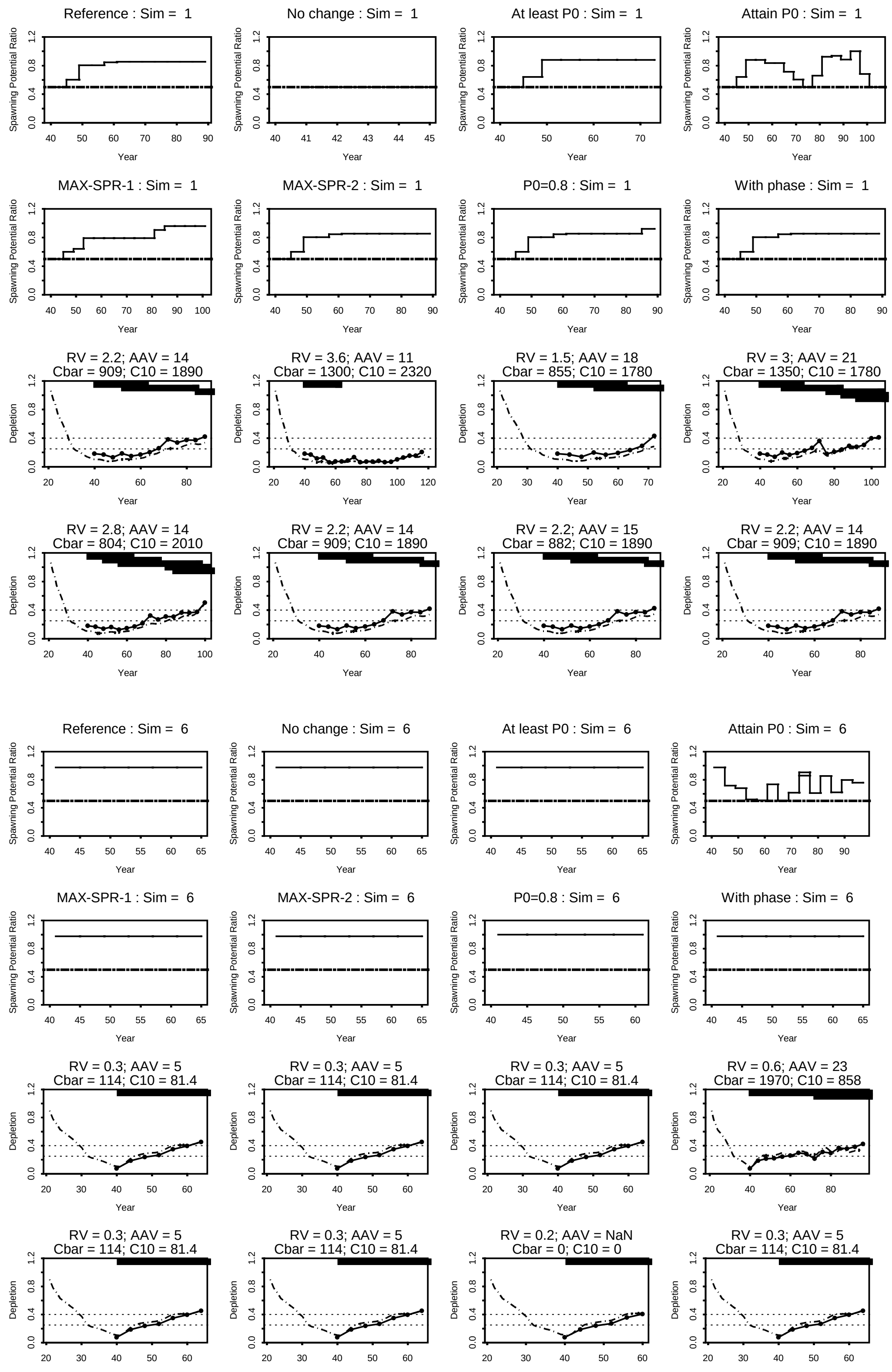


Figure 6. Summary plots for simulations 1 and 6 for operating model A.

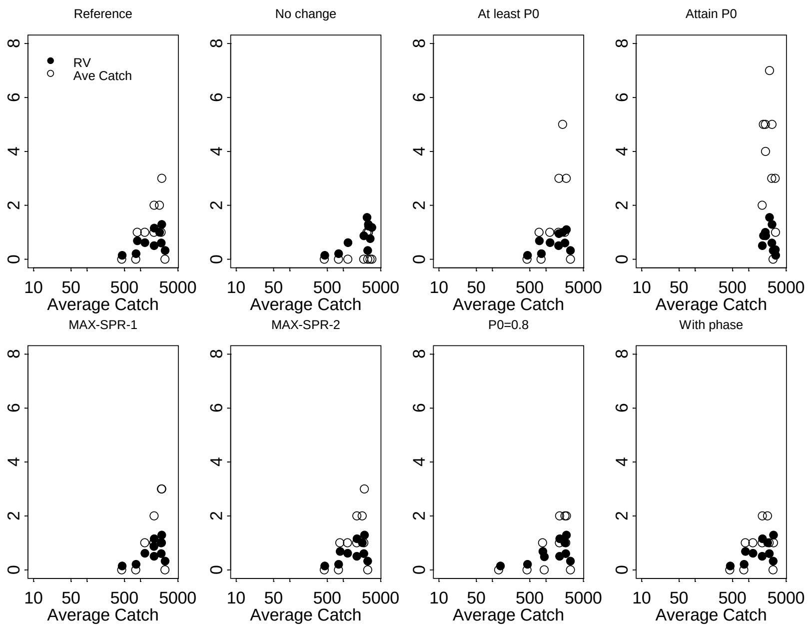


Figure 7. Comparison of the performances of the eight rebuilding revision rules for operating model C.

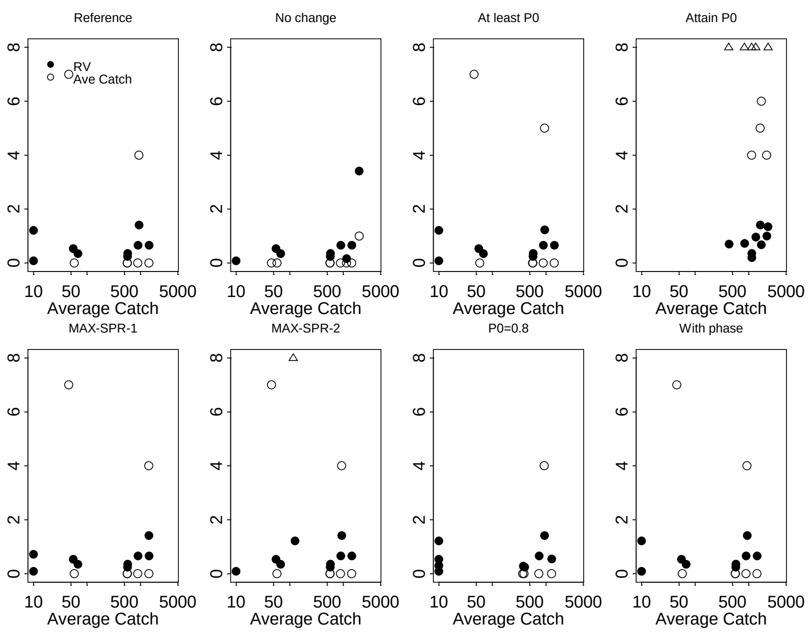


Figure 8. Comparison of the performances of the eight rebuilding revision rules for operating model D.

Allowing for temporal auto-correlation in recruitment (operating model D; Figure 8) increases the time to rebuild (compared to that expected when the original rebuilding analysis was conducted) in a sub-set of the simulations. This results in a substantial increase to the number of times the SPR needs to be adjusted in these simulations. Unfortunately, this problem affects almost all the options equally; a noteworthy exception is the "P_0=0.8" option, presumably because the "buffer" between P_0 and P_{critical} created by selecting a high P_0 increases the robustness to auto-correlation in recruitment. However, the "P_0=0.8" option leads to near zero (<10t) average catches for this operating model for several simulations.

The results for the operating models in which the value of *M* on which assessments are based is wrong during years 41-70 (operating models E and F; Figure 9), while substantially different from those for the "base case" operating model do not perhaps behave as expected. Specifically, major changes to the rebuilding plan often do not occur in year 70. This is because: a) the resource may have rebuilt by then anyway, and b) the probability of being rebuilt by T_{MAX} for $\text{SPR}_{\text{current}}$ may still be larger than P_{critical} even with the change to *M* (this is supported by the fact that the SPR was changed eight or more times in almost all simulations for the "attain P_0" option).

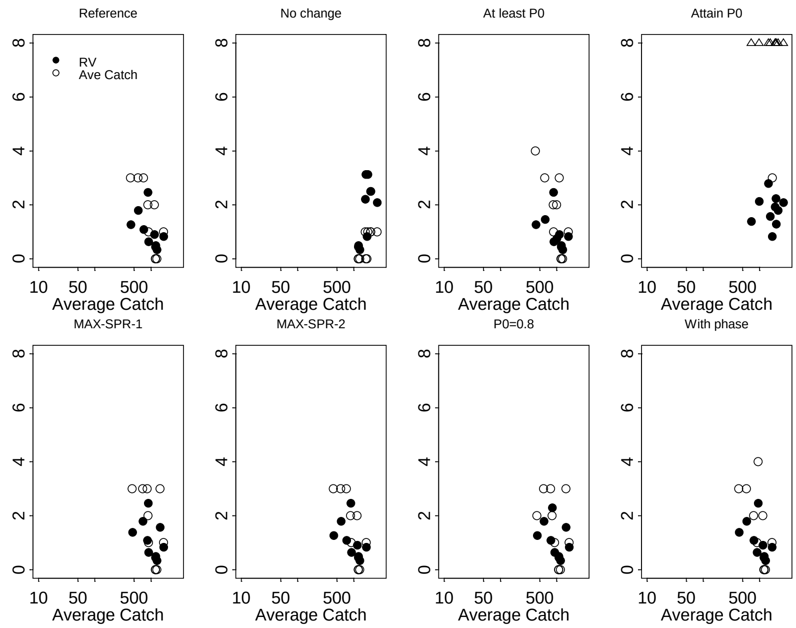
The results for the operating model in which the resource is depleted to 15% of SB_0 (Figure 10) are not noticeably different from those for the "base case" operating model.

3.4. Conclusions / observations

The selection among the options is clearly a policy decision. However, there are some factors which should be taken into account when selecting among the options:

- The structure and viability of the options depends on how NS-1 will be revised. The final wording of NS-1 (and the interpretation of the wording) is not yet final. Changes to NS-1 may preclude some of the options considered in this document.
- Results are only shown for situations in which the "true" status of the stock in year 41 is 0.15 SB_0 or less. This is primarily because the assessment procedure considered in this study was often unable to correctly detect that a stock depleted to (say) 0.2 SB_0 was actually depleted to below 0.25 SB_0. This is almost certainly a consequence of the structure of the assessment procedure selected for this work. This study also did not consider scenarios involving "false positives" (i.e. the stock is assessed to overfished when it isn't).
- The options are all variants of the "reference" option – it is possible that changes to the "reference" option may lead to the performances of the options changing in ways that cannot necessarily be predicted well from the results presented in Figures 5-10.
- Changes to SPR (and revisions to entire rebuilding plans) are likely to be frequent during the rebuilding period – such changes are needed to ensure rebuilding proceeds at a reasonable rate.

(a) M=0.1 yr^{-1} for years 41-70



(b) M=0.2 yr^{-1} for years 41-70

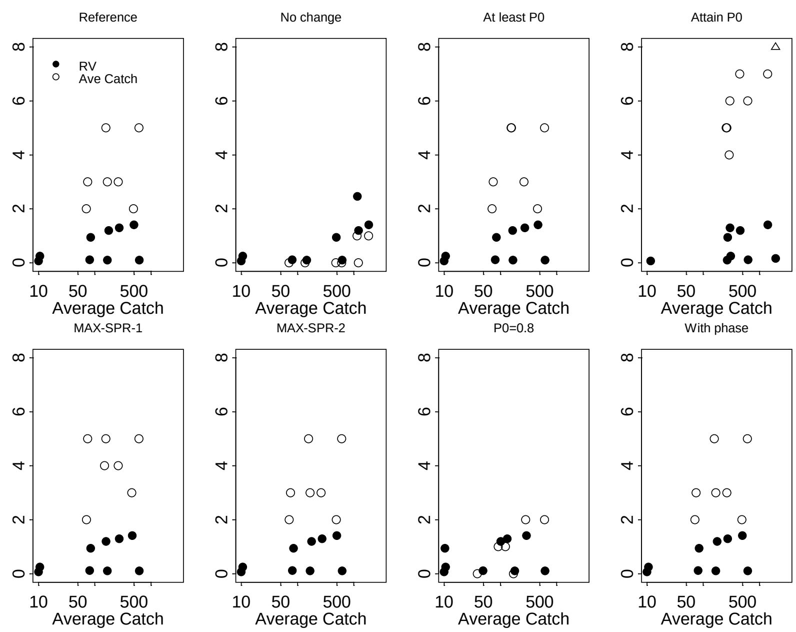


Figure 9. Comparison of the performances of the eight rebuilding revision rules for operating models E and F (upper and lower panels respectively).

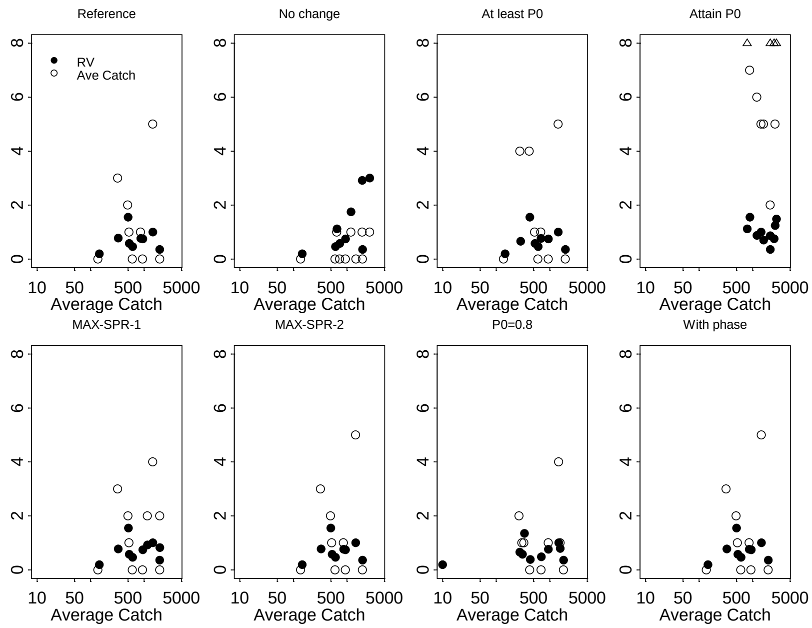


Figure 10. Comparison of the performances of the eight rebuilding revision rules for operating model G.

- The "attain P_0" option tends to follow noise rather than signal, and leads to frequent changes to SPR and hence harvest guidelines. Although average catches are larger for this option, the resource tends to be under rebuilding for longer.
- There were no notable benefits associated with the two SPR-MAX options even though these were more complicated than the "reference" option.
- Setting a "high" P_0 when developing a rebuilding plan can mitigate against uncertainty because there is then a "buffer" between P_0 and the minimum probability of rebuilding to T_{MAX} (P_{critical}=0.5).

4. References

Fournier, D., and C.P. Archibald. 1982. A general theory for analyzing catch at age data. *Canadian Journal of Fisheries and Aquatic Sciences* 39: 1195–1207.

PFMC (Pacific Fishery Management Council). 2001. SSC terms of reference for groundfish rebuilding analysis, 9 p. Pacific Fishery Management Council, 7700 NE Ambassador Place, Portland, OR 97220.

Punt, A.E. 2003. Evaluating the efficacy of managing West Coast groundfish resources through simulations. *Fish Bull, US.* 101: 860-873.

Smith, A.D.M. 1994. Management strategy evaluation: the light on the hill. *Population Dynamics for Fisheries Management*, Perth, Western Australia, Australian Society for Fish Biology.

Williams, E. H., A. D. MacCall, S. V. Ralston, and D. E. Pearson. 2000. Status of the widow rockfish resource in Y2K. In: Appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. Stock assessment and fishery evaluation. Pacific Fishery Management Council. 2130 SW Fifth Avenue, Suite 224, Portland, OR, 97201.

Table 1. The specifications that define the alternative "true" scenarios considered in the simulations.

Scenario	True biomass in year 41	Steepness	Auto-correlation in recruitment	*M* for years 1-70 used in assessments
A – Base case	0.1 SB_0	0.4	0	0.15yr^{-1}
B – Less depletion	0.2 SB_0	0.4	0	0.15yr^{-1}
C – Higher steepness	0.1 SB_0	0.7	0	0.15yr^{-1}
D – With auto-correlation	0.1 SB_0	0.4	0.707	0.15yr^{-1}
E – Low *M* in assessment	0.1 SB_0	0.4	0	0.10yr^{-1}
F – High *M* in assessment	0.1 SB_0	0.4	0	0.20yr^{-1}
G – Less depletion	0.15 SB_0	0.4	0	0.15yr^{-1}

Table 2. The specifications of the eight rebuilding revision rules.

Abbreviation	P_0	$P_{critical}$	P_{floor} / ϕ	P_{high}	Impose Max SPR	τ
0 – Reference	0.6	0.5	N/A	N/A	No	0
1 – No change	0.6	N/A	N/A	N/A	No	0
2 – At least P_0	0.6	0.6	N/A	N/A	No	0
3 – Attain P_0	0.6	0.6	N/A	0.6	No	0
4 – MAX-SPR-1	0.6	0.5	0.5 / 0.5	N/A	No	0
5 – MAX-SPR-2	0.6	0.5	N/A	N/A	Yes	0
6 – P_0=0.8	0.8	0.5	N/A	N/A	No	0
7 – With phase	0.6	0.5	N/A	N/A	No	5

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON TERMS OF REFERENCE FOR GROUNDFISH REBUILDING PLAN REVIEW

There is a need to revise the "Scientific and Statistical Committee (SSC) Terms of Reference for Groundfish Rebuilding Analyses" (see Agenda Item F.3.a, Attachment 1) to fully document current practice. The existing document is now four years old and pre-dates the development of software by Dr. Andre Punt, that has been used to conduct virtually all groundfish rebuilding analyses thus far. The SSC groundfish subcommittee agreed to complete a revision of the document as soon as possible, including an evaluation of compatibility with National Standard 1 Guidelines, when they become available. However, due to the March 16th deadline for the April meeting briefing book, the revision will not be ready until the June meeting. The delay is not anticipated to hamper the stock assessment process.

Discussion by the SSC under this agenda item ranged more broadly to include the operational definitions for determining whether a stock is overfished. Amendment 11 to the fishery management plan established $B_{25\%}$ (i.e., 25% of virgin stock size) as the overfished threshold for groundfish stocks. However, interpretation of results from analytical methods that produce a distribution of values as opposed to a single point estimate could lead to confusion in the application of this criterion. The SSC groundfish subcommittee agreed to address this topic and to recommend a standard approach to status determination, which will be included in the revision at the June meeting.

The SSC also discussed the issue of how to evaluate progress of overfished stocks towards meeting rebuilding targets and the development of a set of policy options that the Council could use to track progress and to implement revisions to rebuilding plans when needed (see Agenda Item F.3.a, Attachments 2 and 3, and Agenda Item F.3.b, Attachments 1 and 2). Substantial progress has been achieved on this topic in the form of developing a Management Strategy Evaluation (MSE) simulation protocol developed by an *ad hoc* working group of SSC, NMFS, and academic scientists. Given an operating model of stock dynamics and a method of assessment, the MSE simulation evaluates the success of a policy option (set by the Council) in achieving a set of objectives. Thus far a range of operating models has been devised and some plausible policy options described. It would also be useful to consider an assessment model with more complexity and to ensure that policies are consistent with National Standard 1 Guidelines.

At this point in the process it is important for the Council to provide guidance back to the SSC to frame the range of policy options that could be evaluated within the context of the MSE. In addition, a discussion and prioritization of management goals and objectives is needed to help define and evaluate management success. For example, high yields, low catch variability, stability of the management regime, and rebuilding certainty are all desirable attributes of a policy, but they often work in opposition to one another. Also, it was noted that a single policy on revisions might not be appropriate for all stocks (e.g., constraining stocks may have different criteria adopted for revisions than non-constraining stocks). To begin to work through these complex issues the SSC recommends that a joint session involving the Council, SSC, Groundfish Management Team, and Groundfish Advisory Subpanel be held on Monday of the April meeting.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON TERMS OF REFERENCE FOR GROUNDFISH REBUILDING PLAN REVIEW

The Groundfish Advisory Subpanel (GAP) reviewed the information provided on establishing Terms of Reference for groundfish rebuilding plans.

As a general statement, the GAP believes the Council should provide for flexibility in the Terms of Reference, to the extent provided by law. As we have seen on several occasions, new stock assessments can reveal substantial changes are warranted based on the best scientific information. The Council must ensure that new data results in more precise rebuilding plans, either positive or negative. We should not lock ourselves into a single standard - for example, a set probability of rebuilding within a specified time period, translating into an immutable harvest rate - when science tells us that a different standard can and should be used.

In a specific comment, the GAP requests that the language in Section 4.5.3.6 of the proposed "Process for Development and Approval of Rebuilding Plans" (Agenda Item F.3.a, Attachment 2) be amended by including in the third bullet point on page 3 a reference to the GAP along with the Scientific and Statistical Committee (SSC) and Groundfish Management Team (GMT).

Finally, albeit slightly off the subject, the GAP notes that the existing Terms of Reference for stock assessment review includes a requirement that Stock Assessment Teams provide a 10-year projection of stock status with stock assessments. While this requirement is logical for many long-lived species, it is highly speculative for other species that experience dynamic recruitment events or highly variable recruitment over a short time frame (e.g., Pacific whiting, some species of flatfish, and bocaccio rockfish). The GAP suggests the SSC be asked to re-examine and modify the Terms of Reference to accommodate species that examine these characteristics.

PFMC
03/08/05

GROUNDFISH MANAGEMENT TEAM REPORT ON
TERMS OF REFERENCE FOR GROUNDFISH REBUILDING PLAN REVIEW

The Groundfish Management Team (GMT) reviewed the draft Scientific and Statistical Committee (SSC) Terms of Reference for Groundfish Rebuilding Analyses, as well as the other attachments for this agenda item, and offers the following comments. The GMT reiterates its request to mandate the inclusion of the following estimates and projections in the Terms of Reference for future rebuilding analyses:

- Estimate of P_{MAX} (P{rebuilding by T_{MAX}}) at F = 0.
- Ten-year acceptable biological catch (ABC)/optimum yield (OY) projections and estimates of the F rate (both SPR and F) and T_{MAX} under rebuilding likelihoods ranging from P_{MAX} = 0.5 to the P_{MAX} under F = 0 (at 10 percentile increments).
- Decision table for all equally plausible assessment/rebuilding models.
- Date of data extraction.

The GMT would also desire to see a regional stratification of the ABC/OY projections if the assessment indicates regional differences in the population dynamics or stock structure of the species. This will enable specification of regional OYs or harvest guidelines and/or regionally variant management measures. The GMT considers this management approach critical to avoid potential problems of localized depletion, geographic concentration of fishing effort, and risks to a stock's age and genetic structure.

Finally, the GMT reviewed "Establishing Quantitative Criteria for Assessing Adequacy of Progress Towards Rebuilding Overfished West Coast Groundfish Stocks (Agenda Item F.3.b, Attachment 1) and "Evaluating Alternative Rebuilding Revision Rules for Assessing Progress Towards Rebuilding of Overfished West Coast Groundfish" (Agenda Item F.3.b, Attachment 2). The first issue paper describes the recommended analyses for evaluating adequacy of an existing rebuilding plan, which focuses on changes in P_{MAX} and the SPR harvest rate relative to the original rebuilding plan. Given the relative scale of the groundfish rebuilding framework and how many different assessment parameters can have a major effect on our understanding current stock status, the GMT believes this is a sensible approach for evaluating rebuilding progress. Therefore, the GMT recommends the evaluation "tool" described in the first paper be adopted and incorporated in the SSC Terms of Reference for Groundfish Rebuilding Analyses at the April Council meeting.

The second issue paper concerns policy choices (termed "revision rules") for modifying rebuilding plans once an evaluation of rebuilding progress is done in a rebuilding analysis. The complexity of potential effects of each of these policy choices is explored in this paper. The GMT would like more time to better understand these dynamics. The GMT recommends that the revision rules described in the second paper take a longer, more deliberative pathway to adoption. It is recommended that the Council adopt revision rules at the September or November 2005 Council meetings prior to adopting the range of 2007-2008 harvest specifications. It would also benefit the process if a joint session on these alternative revision rules were scheduled for the April or June Council meeting to foster a clearer understanding of the implications of these policy choices.

Summary of GMT Recommendations

1. Include the estimates and projections listed above in the Terms of Reference for future rebuilding analysis
2. Consider regional stratification of ABC/OY projections in future rebuilding analysis where differences in population dynamics or stock structure are apparent.
3. Adopt the evaluation approach for assessing the adequacy of rebuilding plans described in Agenda Item F.3.b
4. Hold a joint session on alternative rebuilding plan revision rules at the April or June Council meetings.

TERMS OF REFERENCE FOR GROUNDFISH REBUILDING PLAN REVIEW

The Scientific and Statistical Committee's (SSC's) Terms of Reference for Groundfish Rebuilding Analyses was developed by the SSC in 2001 and adopted by the Council in April 2001 (Agenda Item F.3.a, Attachment 1). This Terms of Reference has guided authors of groundfish rebuilding analyses, which are critical for developing rebuilding plans for overfished groundfish stocks. Sections 4.5.3.3 through 4.5.3.6 of the Pacific Coast Groundfish Fishery Management Plan (FMP) specify the process for development and approval of rebuilding plans, provisions for updating key rebuilding parameters, implementation of actions required under the rebuilding plan, and provisions for periodically reviewing rebuilding plans (Agenda Item F.3.a, Attachment 2). In section 4.5.3.6, the FMP states, "The Council, in consultation with the SSC and GMT, will determine on a case-by-case basis whether there has been a significant change in a parameter such that the chosen management target must be revised."

The first step in evaluating rebuilding plan progress is developing an analytical evaluation tool. The SSC is developing this analytical tool which will be described and incorporated in the Terms of Reference for Groundfish Rebuilding Analyses. The second step in evaluating rebuilding plan adequacy will occur when new rebuilding analyses are considered and approved through the Council process. It is expected that all new rebuilding analyses will be approved by the November 2005 Council meeting. This would be when the SSC, Groundfish Management Team (GMT), and Council will formally review affected rebuilding plans and determine on a case-by-case basis whether rebuilding/management targets need to be revised.

The Council first considered additions or modifications to the SSC Terms of Reference for Groundfish Rebuilding Analyses at their September 2004 meeting and again addressed the issue in November 2004. At that time, the SSC committed to working with the Council to develop the guidelines and tools for evaluating rebuilding status. They anticipated the tool would be Dr. Andre Punt's rebuilding population simulation program, the model endorsed by the SSC for conducting rebuilding analyses (Agenda Item F.3.a, Attachment 3). Since then, a group of stock assessment scientists, including some members of the SSC Groundfish Subcommittee, met to discuss this project and have produced a draft issue paper with their recommendations (Agenda Item F.3.b, Attachment 1). The recommended protocols for evaluating rebuilding progress are further explored in Agenda Item F.3.b, Attachment 2.

The SSC will review these recommendations at the March meeting and consider endorsing these protocols. The Council task for this agenda item is to provide guidance to the SSC for finalizing the Terms of Reference for Groundfish Rebuilding Analyses and adopt this draft Terms of Reference for public review. The Terms of Reference for Groundfish Rebuilding Analyses is scheduled for final adoption at the April Council meeting.

Council Action:

Provide guidance to the SSC on finalizing the Terms of Reference for Groundfish Rebuilding Analyses and adopt a draft Terms of Reference for public review.

Reference Materials:

1. Agenda Item F.3.a, Attachment 1: SSC Terms of Reference for Groundfish Rebuilding Analyses.
2. Agenda Item F.3.a, Attachment 2: Sections 4.5.3.3 – 4.5.3.6 of the Pacific Coast Groundfish Fishery Management Plan.
3. Agenda Item F.3.a, Attachment 3: Punt, A. E., 2003, Evaluating the Efficacy of Managing West Coast Groundfish Resources Through Simulations, Fish. Bull. 101:860-873.
4. Agenda Item F.3.b, Attachment 1: Establishing Quantitative Criteria for Assessing Adequacy of Progress Towards Rebuilding Overfished West Coast Groundfish Stocks.
5. Agenda Item F.3.b, Attachment 2: Evaluating Alternative Rebuilding Revision Rules for Assessing Progress Towards Rebuilding of Overfished West Coast Groundfish.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. SSC Report — Kevin Hill
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action**: Adopt a Draft Terms of Reference for Groundfish Rebuilding Analyses for Public Review

PFMC
02/22/05

5.7 Inseason Procedures for Establishing or Adjusting Specifications and ~~Apportionments~~ (previously 5.9)

5.7.1 Inseason Adjustments to ABCs, OYs, HGs, and Quotas

Under the biennial specifications and management measures process, stock assessments for most species will become available every other year, prior to the November Council meeting that begins the three-meeting process for setting specifications and management measures. The November Council meeting that begins that three-meeting process will be the November of the first fishing year in a biennial fishing period. If the Council determines that any of the ABCs or OYs set in the prior management process are not adequately conservative to meet rebuilding plan goals for an overfished species, harvest specifications for that overfished species and/or for co-occurring species may be revised for the second fishing year of the then current biennial management period. ~~Occasionally, new stock assessment information may become available inseason that supports a determination that an ABC no longer accurately describes the status of a particular species or species group. However, adjustments will only be made during the annual specifications process and a revised ABC announced at the beginning of the next fishing year.~~

~~The only exception is in the case where the ABC announced at the beginning of the fishing year~~ **Beyond this process, ABCs, OYs, HGs, and quotas may only be modified in cases where a harvest specification announced at the beginning of the fishing period** is found to have resulted from incorrect data or from computational errors. If the Council finds that such an error has occurred, it may recommend the Secretary publish a notice in the *Federal Register* revising the ~~ABC~~ **incorrect harvest specification** at the earliest possible date.

NOTE: Gray highlight added for emphasis.

Recent history of stock assessments and rebuilding analyses for overfished West Coast groundfish species.

Stock	Year declared overfished	Assessments	Rebuilding Analyses [a]	Management Response Resulting ABC, OY, or HG (mt) [b]	Year	Depletion (Percent of B_0)	Resulting Tmin	Resulting Tmax
Bocaccio	1999	Bence and Hightower 1990	NA	1,100	1991	NA	NA	NA
		Bence and Rogers 1992	NA	1,540	1993	NA	NA	NA
		Ralston et al. 1996	NA	265	1997	NA	NA	NA
		MacCall et al. 1999	NA	100	2000	2.1%	NA	NA
		MacCall 2002	MacCall and He 2002	<=20	2003	4.8%	2096	2108
		MacCall 2003	MacCall 2003	250	2004	7.4%	2018	2032
Canary	2000	Golden and Demory 1984	NA	2,700	1985	NA	NA	NA
		Golden and Wood 1990	NA	2,900	1991	NA	NA	NA
		Sampson and Stewart 1994	NA	1,250	1995	NA	NA	NA
		Sampson 1996	NA	1,000	1997	NA	NA	NA
		Southern stock: Williams et al. 1999; Northern stock: Crone et al. 1999	NA NA	93	2000	6.6%	2041	2058
		Methot and Piner 2002	Methot and Piner 2002	44	2003	7.9%	2057	2076
Cowcod	2000	Butler et al. 1999	Butler and Barnes 2000	5	2000	7.0%	2061	2098
Darkblotched	2000	Lenarz 1993	NA	NA	1994	NA	NA	NA
		Rogers et al. 1996	NA	260	1997	NA	NA	NA
		Rogers et al. 2000	NA	130	2001	22.0%	NA	NA
			Methot and Rogers 2001	168	2002	14.0%	2014	2047
		Rogers 2003	Rogers 2003	240	2004	11.0%	2011	2044
Lingcod	1999	Adams 1986	NA	7,000	1987	NA	NA	NA
		Jagielo 1994	NA	2,400	1995	NA	NA	NA
		Northern stock: Jagielo et al. 1997	NA	838	1998	NA	NA	NA
		Southern stock: Adams et al. 1999	NA	730	2000	NA	NA	NA
		Jagielo et al. 2000		611	2001	Northern stock: 11%; Southern stock: 14%	NA NA	2009
			Jagielo and Hastie 2001	577	2002	Northern stock: 17%; Southern stock: 15%	Northern stock: 2003; Southern stock: 2004	2009
		Jagielo et al. 2004	Jagielo et al. 2004	2,414	2005-2006	Northern stock: >40%; Southern stock: 31%	Northern stock: rebuilt; Southern stock: 2006	2009

10

Recent history of stock assessments and rebuilding analyses for overfished West Coast groundfish species (continued).

Stock	Year declared overfished	Assessments	Rebuilding Analyses [a/]	Management Response Resulting ABC, OY, or HG (mt) [b/]	Year	Depletion (Percent of B_0)	Resulting Tmin	Resulting Tmax
POP	1999	Westrheim et al. 1972	NA		1973	NA	NA	NA
		Gunderson et al. 1977	NA		1978	NA	NA	NA
		Fraidenburg et al. 1978	NA		1979	NA	NA	NA
		Gunderson 1979	NA		1980	NA	NA	NA
		Gunderson and Sample 1980	NA		1981	NA	NA	NA
		Gunderson 1981	NA		1982	NA	NA	NA
		Wilkens and Golden 1983	NA	1,550	1984	NA	NA	NA
		Ito et al. 1986	NA	0	1987	NA	NA	NA
		Ito et al. 1987	NA	0	1988	NA	NA	NA
		Ianelli et al. 1992	NA	1,550	1993	NA	NA	NA
		Ianelli et al. 1995	NA	750	1996	NA	NA	NA
		Ianelli and Zimmerman 1998	NA	595	1999	13.0%	NA	NA
		Ianelli et al. 2000	Punt and Ianelli 2001	350	2002	21.7%	2012	2042
		Hamel et al. 2003	Punt et al. 2003	444	2004	28.0%	2014	2042
Widow	2001	Lenarz and Hightower 1985	NA	9,300	1986	NA	NA	NA
		Hightower and Lenarz 1986	NA	12,500	1987	NA	NA	NA
		Hightower and Lenarz 1987	NA	12,100	1988	NA	NA	NA
		Lenarz and Hightower 1988	NA	12,400	1989	NA	NA	NA
		Hightower and Lenarz 1989	NA	8,900	1990	NA	NA	NA
		Hightower and Lenarz 1990	NA	7,000	1991	NA	NA	NA
		Rogers and Lenarz 1993	NA	6,500	1994	NA	NA	NA
		Rogers 1994	NA	7,700	1995	NA	NA	NA
		Ralston and Pearson 1997	NA	5,090	1998	NA	NA	NA
		Williams et al. 2000	NA	2,300	2001	23.6%	2006	NA
			MacCall and Punt 2001	856	2002	24.6%	2022	2038
			Punt and MacCall 2002	832	2003	24.6%	2024	2040
		He et al. 2003a	He et al. 2003b	285	2005	22.4%	2028	2042
Yelloweye	2002	Wallace 2001	NA	13.5	2002	7% in N. CA; 13% in OR	NA	NA
		Methot et al. 2003	Methot and Piner 2003	22	2004	24.0%	2027	2071

a/ Formal rebuilding analyses did not exist prior to the development of the SSC Terms of Reference for Groundfish Rebuilding Analyses in April 2001. The one exception is the cowcod rebuilding analysis done in 2000 by Butler and Barnes.

b/ This represents the harvest specification that was the management target, which would typically limit fishing opportunities.

Recent history of stock assessments for non-overfished West Coast groundfish species.

Stock	Assessments	Management Response Resulting ABC, OY, or HG (mt) [a/]	Year	Depletion (Percent of B_0)	Fishery Constraint? [b/]
Arrowtooth Flounder	Rickey 1993	5,800	1994	NA	No
Bank Rockfish	Pearson 1994	NA	NA	NA	No
	Rogers et al. 1996	81	1997	NA	
	Piner et al. 2000	81	2001	25% - 31%	
Black Rockfish	Stewart 1993	NA	NA	NA	No
	Wallace and Tagart 1994	NA	NA	NA	
	Wallace et al. 1999	700	2000	45.0%	
	Ralston and Dick 2003	775	2004	48.8%	Yes
Blackgill Rockfish	Butler et al. 1998	365	1999	40% - 54%	Possibly
Cabezon	Cope et al. 2004	69	2005-2006	34.7%	Possibly
Chilipepper Rockfish	Henry 1985	2,300	1986	NA	No
	Henry 1986	3,600	1987	NA	
	Rogers and Bence 1992	3,600	1993	NA	
	Rogers and Bence 1993	4,000	1994	NA	
	Ralston et al. 1998	3,724	1999	46% - 61%	
Dover Sole	Demory et al. 1984	27,900	1985	NA	Yes
	Methot et al. 1990	22,500	1991	NA	
	Turnock and Methot 1991	19,400	1992	NA	
	Turnock and Methot 1992	17,900	1993	NA	
	Turnock et al. 1994	14,300	1995	NA	
	Brodziak et al. 1997	9,426	1998	NA	
	Sampson and Wood 2002	7,440	2003	29.0%	
English Sole	Jow and Geibel 1985	1,500	1986	NA	No
	Golden 1986	1,900	1987	NA	
	Sampson 1993	3,100	1994	NA	
Longspine Thornyhead	Jacobson 1990	7,900 (for LST and SST combined)	1991	NA	No
	Jacobson 1991	7,000 (for LST and SST combined)	1992	NA	
	Ianelli et al. 1994	7,000	1995	NA	
	Rogers et al. 1997	4,102	1998	NA	
Pacific Whiting	Francis et al. 1982	175,000	1983	NA	Yes
	Francis and Hollowed 1984	175,000	1985	NA	
	Francis 1985	300,000	1986	NA	
	Hollowed and Francis 1986	195,000	1987	NA	
	Hollowed et al. 1987	261,600	1988	NA	
	Hollowed et al. 1988	300,000	1989	NA	
	Dorn and Methot 1989	245,000	1990	NA	
	Dorn et al. 1990	228,000	1991	NA	
	Dorn and Methot 1991	208,800	1992	NA	
	Dorn and Methot 1992	142,000	1993	NA	
	Dorn et al. 1993	260,000	1994	NA	
	Dorn 1994	178,400	1995	NA	
	Dorn 1995	212,000	1996	NA	
	Dorn 1996	232,000	1997	NA	
	Dorn and Saunders 1997	232,000	1998	NA	
	Dorn et al. 1999	232,000	1999	37.0%	
	Helser et al. 2002a	190,400	2001	37.0%	
	Helser et al. 2002b	129,600	2002	20.0%	
	Helser et al. 2004	250,000	2004	47.0%	

Recent history of stock assessments for non-overfished West Coast groundfish species (continued).

Stock	Assessments	Management Response Resulting ABC, OY, or HG (mt) [a/]	Year	Depletion (Percent of B_0)	Fishery Constraint? [b/]
Petrale Sole	Demory 1984	3,200	1985	NA	Yes
	Demory 1987	3,200	1988	NA	
	Turnock et al. 1993	2,700	1994	NA	
	Sampson and Lee 1999	2,950	2000	42.0%	
Sablefish	Francis 1984	12,300	1985	NA	Yes
	Francis 1985	10,600	1986	NA	
	Demory and Golden 1986	12,000	1987	NA	
	McDevitt 1987	10,000	1988	NA	
	Methot and Hightower 1988	9,000	1989	NA	
	Methot and Hightower 1989	8,900	1990	NA	
	Methot and Hightower 1990	8,900	1991	NA	
	Methot 1992	7,000	1993	NA	
	Methot et al. 1994	9,100	1995	NA	
	Crone et al. 1997	5,600	1998	NA	
	Methot et al. 1998	10,160	1999	23% - 41%	
	Hilborn et al. 1998			25% - 44%	
	Hilborn et al. 2001	4,596	2002	31% - 38%	
	Schirrpa and Methot 2001			27% - 37%	
	Schirripa 2002	7,786	2003	31% - 39%	
Sebastes Complex	Rogers et al. 1996				Yes
Shortbelly Rockfish	Pearson et al. 1989	13,000	1990	NA	No
Shortspine Thornyhead	Jacobson 1991	7,900 (for LST and SST combined)	1991	NA	Yes
	Jacobson 1991	7,000 (for LST and SST combined)	1992	NA	
	Ianelli and Lauth 1994	1,500	1995	NA	
	Rogers et al. 1997	1,000	1998	NA	
	Rogers et al. 1998	1,325	1999	26.0%	
	Hillborn et al. 1998			41.0%	
	Piner and Methot 2002	955	2003	25% - 50%	
Splitnose Rockfish	Rogers 1994	NA	NA	NA	No
Yellowtail Rockfish	Weinberg et al. 1984	3,000	1985	NA	Sometimes
	Coleman 1986	4,000	1987	NA	
	Tagart 1988	4,300	1989	NA	
	Tagart 1993	6,740	1994	NA	
	Tagart and Wallace 1996	2,762	1997	NA	
	Tagart et al. 1997	3,118	1998	NA	
	Tagart et al. 2000	3,146	2001	60.5%	
	Lai et al. 2003	4,320	2004	46.0%	

a/ This represents the harvest specification that was the management target, which would typically limit fishing opportunities.
b/ The stock is only considered to constrain a fishery if it is a primary target species or if incidental catch and resulting mortality could

Agenda Item F.4.c
Supplemental GAP Report
March 2005

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON MID-TERM OPTIMUM YIELD ADJUSTMENTS POLICY

The Groundfish Advisory Subpanel (GAP) reviewed the information provided on a mid-term optimum yield (OY) adjustment policy, including the recommendations of the Ad Hoc Groundfish Information Policy Committee (GIPC).

The majority of the GAP agreed with the recommendations of the GIPC that mid-term adjustments not be made, unless the ability to meet rebuilding targets is jeopardized. While concerns were expressed about potential exposure to lawsuits, the GAP believes that scientific information - not fear of litigation - should be the guiding factor in determining appropriate OY levels.

A minority of the GAP argued that if science shows an increase or decrease is warranted, that change should be made at the first available opportunity. They suggested the standard of using the best scientific information available mandates such changes.

PFMC
03/08/05

MID-TERM OPTIMUM YIELD (OY) ADJUSTMENTS POLICY

The Council adopted Groundfish Fishery Management Plan (FMP) Amendment 17 in November 2002 which put in place a new biennial groundfish management process. As part of this action, the Council adopted the Groundfish Management Team (GMT) advice to include a mid-term "best available science" check of harvest specifications. The mid-term check would be responsive to new stock assessments and other scientific information that might compel the Council to consider adjusting optimum yields (OYs) before the second year of the biennial management cycle. For instance, new groundfish stock assessments adopted by the Council in November 2005 might compel the Council to change OYs before the start of the 2006 fishing year.

In September 2004, the Council clarified their original intent during final Council action on Amendment 17 to develop a mid-term OY adjustments policy that enabled consideration of both increases and decreases of an OY for any FMP species of concern, regardless of whether the species was in an overfished condition or not. This was different than the FMP amendatory language approved by the Secretary of Commerce when Amendment 17 was approved, since that language only considered downward adjustments to OYs and only for overfished stocks (Agenda Item F.4.a, Attachment 1). The Council tasked the Groundfish Information Policy Committee (GIPC) to initiate development of a mid-term OY adjustment policy that comports with the Council's original intent.

The GIPC met on January 25 and 26, 2005 to discuss, among other matters, a mid-term OY adjustments policy. NOAA General Counsel and NMFS described a process by which the current FMP language could be corrected without a formal amendment (page 2 in the draft summary minutes of the January 2005 GIPC meeting, Agenda Item F.1.b, GIPC Minutes). After a lengthy discussion detailed in the GIPC meeting minutes, the GIPC recommended a policy to consider only downward mid-term OY adjustments for overfished groundfish species if, absent an OY adjustment, there would be a significant impact to the rebuilding plan. The GIPC rationale centered around a concern that allowing a more flexible policy that considered increases and decreases of OY for any species of concern would subvert the intended stability of the multi-year management process.

The Council action under this agenda item is to consider the advice of the GIPC and other advisors before adopting a mid-term OY adjustments policy for public review. The Council should also determine the next steps in developing a mid-term OY adjustment policy.

Council Action:

1. **Adopt a Mid-Term Optimum Yield Adjustment Policy For Public Review.**
2. **Determine the Next Steps in Developing a Mid-Term OY Adjustment Policy.**

Reference Materials:

1. Agenda Item F.4.a, Attachment 1: FMP Amendment 17 amendatory language (Section 5.7.1 as amended).
2. Agenda Item F.4.a, Attachment 2: Tables summarizing the recent history of West Coast groundfish stock assessments, rebuilding analyses, and management responses.
3. Agenda Item F.1.b, GIPC Minutes: Draft Summary Minutes of the January 25-26, 2005 Groundfish Information Policy Committee Meeting.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. GIPC Report
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action**: Adopt a Mid-Term Optimum Yield Adjustment Policy For Public Review

PFMC
02/08/05

Agenda Item F.5.a
Attachment 1
March 2005

PRELIMINARY REVIEW DRAFT

PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN [EXCERPTS]

FOR THE CALIFORNIA, OREGON, AND WASHINGTON GROUNDFISH FISHERY

AS AMENDED THROUGH AMENDMENT 18 [BASED ON THE BYCATCH MITIGATION PROGRAM FEIS]

PACIFIC FISHERY MANAGEMENT COUNCIL
7700 NE AMBASSADOR PLACE, SUITE 200
PORTLAND, OR 97220
503-820-2280
866-806-7204
WWW.PCOUNCIL.ORG

MARCH 2005

Preface

This document shows proposed changes to the groundfish fishery management plan (FMP) developed by Council/National Marine Fisheries Service (NMFS) staff in response to a Council motion at the November 2004 meeting. Substantive changes address elements of the preferred alternative. As part of this amendment, the FMP has also been updated to better reflect the current management framework. Table 1 shows changes in the organization of chapters. Text has been revised in chapters 1, 2, 6, 9, 10, and 11 of the current FMP. Because of changes in the chapter structure, chapter 8 is renumbered chapter 9 and chapter 12 is renumbered chapter 11, but no other changes are made in these chapters.

Chapter 6, Management Measures, has been substantially reorganized and revised. Material in chapter 9 (Restrictions On Other Fisheries) and chapter 11 (Management Measures That Continue In Effect With Implementation of Amendment 4) have been incorporated into chapter 6, outdated references to foreign and joint-venture fishing have been deleted, and the structure of the chapter has been modified to emphasize the range of management measures available to the Council. Table 2 provides a guide to the disposition of sections in chapters 6 and 11 of the current FMP under the proposed revisions.

In general, deletions are marked by ~~strikethrough~~ and insertions by double underline. Notes, for example requesting advisory body input, are in ***[boldface italic brackets]***. Chapter 6 is an exception, because it is comprehensively reorganized, with much text added and deleted. For this chapter, in most cases, using strikethrough and double underline was deemed too distracting. Instead, the following marks are used to indicate changes:

Annotations at the right-hand margin, like this:

[6.3.2 Standardized Reporting Methodology]

indicate the location in the current FMP, by section number and heading, of the text that follows.

Paragraphs based on text currently in the FMP, but substantially modified, are indicated by a single rule in the left-hand margin, like this:

New paragraphs are indicated by a double rule in the left-hand margin, like this:

Strikethrough and double underline is used in paragraphs where there have been minor changes in the current text. (The paragraphs are annotated with the current section number and heading, as described above.) Copy edits (e.g., changes in punctuation) are not marked.

Readers interested in the substance of deleted sections in chapters 6 and 11 (as indicated in Table 2), or substantially modified text, may refer to the current FMP, using the annotations and Table 2 as guides.

Table 1. Guide to chapter-level changes.

Chapters as Revised by Amendment 18	FMP through Amendment 17 (December 2004)	Notes on Changes Made By Amendment 18
Chapter 1 Introduction	Chapter 1 Introduction	Revised and Updated
Chapter 2 Goals and Objectives	Chapter 2 Goals and Objectives	Objective added, definitions added
Chapter 3 Areas and Stocks Involved	Chapter 3 Areas and Stocks Involved	No changes
Chapter 4 Optimum Yield	Chapter 4 Optimum Yield	No changes
Chapter 5 Specification and Apportionment of Harvest Levels	Chapter 5 Specification and Apportionment of Harvest Levels	No changes
Chapter 6 Management Measures	Chapter 6 Management Measures	Substantially revised and reorganized
	Chapter 7 Experimental Fisheries	Renumbered Chapter 8
	Chapter 8 Scientific Research	Renumbered Chapter 9
Chapter 7 Essential Fish Habitat		Creates new chapter from material in Section 6.6
Chapter 8 Experimental Fisheries		Renumbered and revised
Chapter 9 Scientific Research		Renumbered, no other changes
	Chapter 9 Restrictions on Other Fisheries	Deleted with material incorporated into Chapter 6
Chapter 10 Procedures for Reviewing State Regulations	Chapter 10 Procedures for Reviewing State Regulations	Background section revised
	Chapter 11 Management Measures that Continue in Effect With Implementation of Amendment 4	Deleted with material incorporated into Chapter 6
Chapter 11 Groundfish Limited Entry		Renumbered, no other changes
	Chapter 12 Groundfish Limited Entry	Renumbered Chapter 11
References	References	No changes
Appendices Contents	Appendices Contents	No changes

Table 2. Guide to Revision of Chapter 6 and 11

Current FMP	Location under revision	Notes
6.0 MANAGEMENT MEASURES	6.1 Introduction	Substantially revised to describe chapter organization
6.1 General List of Management Measures	6.1.1 Overview of Management Measures for West Coast Groundfish Fisheries	Substantially revised to describe chapter organization. Old sections 6.1.1-6.1.10 moved.
6.1.1 Permits, Licenses, and Endorsements	6.9 Measures to Control Fishing Effort, Including Permits and Licenses	Moderately revised
6.1.2 Mesh Size	6.6 Gear Definitions and Restrictions	Incorporated into new text
6.1.3 Landing and Frequency Limits	6.7.2 Commercial Fisheries	Text added
6.1.4 Quotas, Including Individual Transferable Quotas	6.7.1 All Fisheries	No changes to text
6.1.5 Escape Ports and Panels	6.6 Gear Definitions and Restrictions	Incorporated into new text
6.1.6 Size Limits	6.7.1 All Fisheries	No changes to text
6.1.7 Bag Limits	6.7.3 Recreational Fisheries	New text added
6.1.8 Time/Area Closures (Seasons and Closed Areas)	6.8 Time/Area Closures	Substantially revised, new text and sections added
6.1.9 Other Forms of Effort Control	6.9 Measures to Control Fishing Effort…	Moderately revised
6.1.10 Allocation	6.3 Allocation	No changes to text
6.2 General Procedures for Establishing and Adjusting Management Measures	6.2 General Procedures for Establishing and Adjusting Management Measures	Moderate revision for readability
6.2.1 Routine Management Measures	6.2.1 Routine Management Measures	List of measures broken out as section 6.2.1.1 and updated
6.2.2 Resource Conservation Issues - The "Points of Concern" Framework	6.2.2 Resource Conservation Issues—The Points of Concern Framework	Moderate revision for readability
6.2.3 Nonbiological Issues--The Socioeconomic Framework	6.2.3 Nonbiological Issues—The Socioeconomic Framework	Moderate revision for readability
6.2.3.1 Allocation	6.3 Allocation	No changes to text
6.3 Bycatch Management	--- [heading only]	--
6.3.1 Bycatch of Nongroundfish Species	6.5.2 Bycatch of Nongroundfish in Groundfish Fisheries	Text added, sections on ESA, MMPA & MBTA added
6.3.2 Standardized Reporting Methodology	6.4 Standardized Total Catch Reporting and …	Substantially revised with new text
6.3.3 Measures to Control Bycatch	6.5 Bycatch Mitigation Program	Substantially revised with new text
6.4 Recreational Catch and Release Management	6.5.3.4 Recreational Catch and Release Management	Moderately revised
6.5 Other Management Measures	-- [Heading only]	--
6.5.1 Generic	-- [Heading only]	--
6.5.1.1 Permits	6.9.1 General Provisions for Permits	No changes to text
6.5.1.2 Observers	6.4.1.1 Monitoring Total Catch At Sea	New text added
6.5.1.3 Habitat Protection (General)	7.0 Essential Fish Habitat	Substantially revised
6.5.1.4 Vessel Safety Considerations	6.10.2 Vessel Safety	Substantially revised
6.5.2 Domestic--Commercial	6.1 Introduction	New text added
6.5.2.1 Permits (General)	6.9.1.1 Commercial Fisheries Permits	Moderately revised
6.5.2.2 Catch Restrictions	6.7 Catch Restrictions, 6.7.2 Commercial Fisheries	Text in 6.7 substantially revised; prohibited species discussion in 6.7.2 moderately revised

Current FMP	Location under revision	Notes
6.5.2.3 Gear Restrictions	6.6.1 Commercial Fisheries	Moderately revised
6.5.2.4 Reporting Requirements	6.4.2 Vessel Reporting Requirements, 6.9 Measures to Control Fishing Effort…	Substantially revised, new text, reorganized
6.5.2.5 Vessel Identification	6.10.3 Vessel Identification	Substantially revised
6.5.3 Domestic - Recreational	-- [Heading only]	--
6.5.3.1 Permits (General)	6.9.1.2 Recreational Fisheries Permits	No changes to text
6.5.3.2 Catch Restrictions	6.7 Catch Restrictions	Original 6.5.3.2 text equivalent to text in original 6.5.2.2; incorporated into new text
6.5.3.3 Gear Restrictions	Deleted	Equivalent text from 11.4 inserted in 6.6.2
6.5.4 Joint Venture--Domestic Vessels	Deleted	Obsolete – no joint venture fisheries
6.5.5 Joint Venture--Foreign Vessels	Deleted	Obsolete – no foreign fisheries
6.5.5.1 Permits	Deleted	Obsolete – no foreign fisheries
6.5.5.2 Target Species	Deleted	Obsolete – no foreign fisheries
6.5.5.3 Incidental Catch	Deleted	Obsolete – no foreign fisheries
6.5.5.4 Prohibited Species	Deleted	Obsolete – no foreign fisheries
6.5.5.5 Season and Area Restrictions	Deleted	Obsolete – no foreign fisheries
6.5.5.6 Reporting and Recordkeeping Requirements	Deleted	Obsolete – no foreign fisheries
6.5.5.7 Dumping	Deleted	Obsolete – no foreign fisheries
6.5.5.8 Fishery Closure	Deleted	Obsolete – no foreign fisheries
6.5.5.9 Observers	Deleted	Obsolete – no foreign fisheries
6.5.5.10 Other Restrictions	Deleted	Obsolete – no foreign fisheries
6.5.6 Foreign-Commercial	Deleted	Obsolete – no foreign fisheries
6.5.6.1 Permits	Deleted	Obsolete – no foreign fisheries
6.5.6.2 Target Species	Deleted	Obsolete – no foreign fisheries
6.5.6.3 Incidental Catch	Deleted	Obsolete – no foreign fisheries
6.5.6.4 Prohibited Species	Deleted	Obsolete – no foreign fisheries
6.5.6.5 Season, Area, and Gear Restrictions	Deleted	Obsolete – no foreign fisheries
6.5.6.6 Reporting and Recordkeeping Requirements	Deleted	Obsolete – no foreign fisheries
6.5.6.7 Dumping	Deleted	Obsolete – no foreign fisheries
6.5.6.8 Fishery Closure	Deleted	Obsolete – no foreign fisheries
6.5.6.9 Observers	Deleted	Obsolete – no foreign fisheries
6.5.6.10 Other Restrictions	Deleted	Obsolete – no foreign fisheries
6.5.7 Foreign-Recreational	Deleted	Obsolete – no foreign fisheries
6.5.8 Access Limitation and Capacity Reduction Programs	6.9.4 Data Collection	No changes to text
6.6 Essential Fish Habitat	7.0 ESSENTIAL FISH HABITAT	No changes to text
6.6.1 Magnuson-Stevens Act Directives Relating to Essential Fish Habitat	7.1 Magnuson-Stevens Act Directives Relating to…	No changes to text
6.6.2 Definition of Essential Fish Habitat for Groundfish	7.2 Definition of Essential…	No changes to text
6.6.2.1 Composite Essential Fish Habitat Identification	7.2.1 Composite Essential…	No changes to text
6.6.3 Management Measures To Minimize Adverse Impacts on Essential Fish Habitat from Fishing	7.3 Management Measures To…	No changes to text

Current FMP	Location under revision	Notes
6.6.4 Review and Revision of Essential Fish Habitat Definitions and Descriptions	7.4 Review and Revision…	No changes to text
9.0 RESTRICTIONS ON OTHER FISEHERIES	6.7.2 Commercial Fisheries	Moderately revised
11.0 MANAGEMENT MEASURES THAT CONTINUE IN EFFECT WITH IMPLEMENTATION OF AMENDMENT 4		Introductory paragraph deleted
11.1 Vessel Identification	Deleted	Substitute reference to regulations, otherwise obsolete
11.2 Gear Restrictions	Deleted	11.2.1.1.1-11.2.1.1.6 moved to Chapter 2-definitions
11.2.1 Commercial Fishing	Deleted	Equivalent definition in Chapter 2
11.2.1.1 Trawl gear	6.6.1 Commercial Fisheries	Substantially revised, incorporated with text from 6.1.2
11.2.1.2 Fixed gear	6.6.1 Commercial Fisheries	Substantially revised, new text
11.2.1.3 Nontrawl gear	6.6.1 Commercial Fisheries	11.2.1.3.1-11.2.1.3.7 moved to Chapter 2-definitions
11.2.2 Recreational Fishing	6.6.2 Recreational Fisheries	Substantially revised
11.2.2.1 Hook-and-line		Moved to Chapter 2-definitions
11.2.2.2 Spears		Moved to Chapter 2-definitions
11.3 Species Managed with a Harvest Guideline or Quota	Deleted	Outdated and incorrect
11.4 Catch Restrictions	6.7 Catch Restrictions	Moderately revised
11.4.1 Commercial Fishing	Deleted	Outdated and incorrect
11.4.2 Recreational Fishing	Deleted	Outdated and incorrect
11.4.3 Restrictions on the Catch of Groundfish in Non-Groundfish Fisheries	Deleted	Outdated and incorrect
11.4.3.1 Pink shrimp	Deleted	Outdated and incorrect
11.4.3.2 Spot and ridgeback prawns	Deleted	Outdated and incorrect
11.5 Joint Ventures	Deleted	Outdated and incorrect
11.5.1 Pacific Whiting	Deleted	Outdated and incorrect
11.5.2 Jack Mackerel (North of 39 N. Latitude)	Deleted	Outdated and incorrect
11.5.3 Shortbelly Rockfish	Deleted	Outdated and incorrect
11.6 Foreign Fishery	Deleted	Outdated and incorrect
11.6.1 Pacific Whiting	Deleted	Outdated and incorrect
11.6.2 Jack Mackerel (North of 39 N. Latitude)	Deleted	Outdated and incorrect
11.7 Prohibitions	Deleted	Substitute reference to regulations in 6.10.4 Prohibitions and Penalties
11.8 Facilitation of Enforcement	Deleted	Substitute reference to regulations in 6.10.4 Prohibitions and Penalties
11.9 Penalties	Deleted	Substitute reference to regulations in 6.10.4 Prohibitions and Penalties

Table of Contents

Preface....ii
Table of Contents....vii
1.0 INTRODUCTION....1
1.1 Evolution of the Management Plan....1
1.2 How This Document is Organized....3
2.0 GOALS AND OBJECTIVES....5
2.1 Goals and Objectives for Managing the Pacific Coast Groundfish Fishery....5
2.2 Operational Definition of Terms....7
4.0 PREVENTING OVERFISHING AND ACHIEVING OPTIMUM YIELD....15
5.0 PERIODIC SPECIFICATION AND APPORTIONMENT OF HARVEST LEVELS....17
6.0 MANAGEMENT MEASURES....19
6.1 Introduction....19
6.1.1 Overview of Management Measures For West Coast Groundfish Fisheries....19
6.2 General Procedures for Establishing and Adjusting Management Measures....20
6.2.1 Routine Management Measures....22
Routine Management Measures as of January 1, 2005:....24
6.2.2 Resource Conservation Issues—The Points of Concern Framework....25
6.2.3 Non-biological Issues—The Socioeconomic Framework....26
6.2.4 Indian Treaty Rights....28
6.3 Allocation....28
6.4 Standardized Total Catch Reporting and Compliance Monitoring Program....29
6.4.1 Total Catch Reporting Methodology....30
6.4.1.1 Monitoring Total Catch At Sea – Observer and Electronic Monitoring Programs....30
6.4.1.2 Commercial Fisheries....31
Monitoring Total and Landed Catch....31
Groundfish Observer Programs....32
6.4.1.2 Recreational Fisheries....32
6.4.2 Vessel Compliance Monitoring Reporting Requirements....33
6.5 Bycatch Mitigation Program....34
6.5.1 Bycatch of Groundfish Species in Groundfish Fisheries....34
6.5.2 Bycatch of Non-Groundfish Species in Groundfish Fisheries....35
6.5.2.1 Endangered Species Act Species....35
6.5.2.2 Marine Mammal Protection Act Species....36
6.5.2.3 Migratory Bird Treaty Act Species....36
6.5.3 Measures to Reduce Bycatch and Bycatch Mortality....36
6.5.3.1 Full Retention Programs....37
6.5.3.2 Sector-specific and Vessel-specific Total Catch Limit Programs....37
6.5.3.3 Catch Allocation to, or Gear Flexibility For, Gear Types With Lower Bycatch Rates 38
Recreational Catch and Release Management....38
6.6 Gear Definitions and Restrictions....38
6.6.1 Commercial Fisheries....39
6.6.1.1 Trawl Gear....39
6.6.1.2 Nontrawl Gear....40
6.6.2 Recreational Fisheries....40
6.7 Catch Restrictions....41
6.7.1 All Fisheries....41
6.7.2 Commercial Fisheries....42

6.7.3 Recreational Fisheries 43
6.8 Time/Area Closures 43
6.8.1 Seasons 44
6.8.2 Rockfish Conservation Areas 44
6.8.3 Groundfish Fishing Areas 45
6.8.4 Marine Protected Areas 45
6.9 Measures to Control Fishing Capacity, Including Permits and Licenses 47
6.9.1 General Provisions For Permits 47
6.9.1.1 Commercial Fisheries Permits 48
6.9.1.2 Recreational Fisheries Permits 48
6.9.2 Sector Endorsements 48
6.9.3 Individual Fishing Quota Programs 48
6.9.4 Capacity Reduction Data Collection 48
6.10 Fishery Enforcement and Vessel Safety 49
6.10.1 Managing Enforcement Risks 49
6.10.2 Vessel Safety 50
6.10.3 Vessel and Gear Identification 50
6.10.4 Prohibitions and Penalties 51
7.0~~6.6~~ Essential Fish Habitat 53
7.1~~6.6.1~~ Magnuson-Stevens Act Directives Relating to Essential Fish Habitat 53
7.2~~6.6.2~~ Definition of Essential Fish Habitat for Groundfish 53
7.2.1~~6.6.2.1~~ Composite Essential Fish Habitat Identification 54
7.3~~6.6.3~~ Management Measures To Minimize Adverse Impacts on Essential Fish Habitat from Fishing 55
7.4~~6.6.4~~ Review and Revision of Essential Fish Habitat Definitions and Descriptions 55
~~7~~8.0 EXPERIMENTAL FISHERIES 57
~~8.0~~9.0 SCIENTIFIC RESEARCH 61
10.0 PROCEDURE FOR REVIEWING STATE REGULATIONS 63
10.1 Background 63
10.2 Review Procedure 64
~~12.0~~11.0 GROUNDFISH LIMITED ENTRY 67

1.0 INTRODUCTION

1.1 Evolution of the Management Plan

The Pacific Coast Groundfish Fishery Management Plan (FMP) was approved by the U.S. Secretary of Commerce (Secretary) on January 4, 1982, and implemented on October 5, 1982. Prior to implementation of the FMP, management of domestic groundfish fisheries was under the jurisdiction of the states of Washington, Oregon, and California. State regulations have been in effect on the domestic fishery for ~~about 90~~more than 100 years ~~and~~with each state ~~acted~~acting independently in both management and enforcement. ~~However~~Furthermore, many fisheries overlapped state boundaries and participants often operated in more than one state. Management and a lack of uniformity of ~~regulation~~regulations had bec~~a~~ome a difficult problem, which stimulated the formation of the Pacific States Marine Fisheries Commission (PSMFC) in 1947. PSMFC had no regulatory power but acted as a coordinating entity with authority to submit specific recommendations to states for their adoption. ~~Between implementation of~~The 1977 Fishery Conservation and Management Act (later amended and renamed the Magnuson-Stevens Fishery Conservation and Management Act ~~(~~or Magnuson-Stevens Act~~, then called the Fishery Conservation and Management Act or FCMA) in~~) established eight regional fishery management Councils, including the Pacific Council. Between 1977 and the implementation of the groundfish FMP in 1982, state agencies worked with the Council to address conservation issues. Specifically, in 1981, ~~the management~~managers proposed a rebuilding program for Pacific ocean perch. To implement this program, the states of Oregon and Washington established landing limits for Pacific ocean perch in the Vancouver and Columbia management areas.

Management of foreign fishing operations began in February 1967 when the U.S. and U.S.S.R. signed the first bilateral fishery agreement affecting trawl fisheries off Washington, Oregon, and California. ~~B~~The U.S. later signed bilateral agreements with Japan and Poland ~~were also signed~~for fishing off the U.S. West Coast. Each of these agreements was renegotiated to reduce the impact of foreign fishing on important West Coast stocks, primarily rockfish, Pacific whiting, and sablefish. When the U.S. extended its jurisdiction to 200 miles (upon signing the Fishery Conservation and Management Act of 1976), the National Marine Fisheries Service (NMFS) developed and the Secretary implemented the preliminary management plan for the foreign trawl fishery off the Pacific Coast. From 1977 to 1982, the foreign fishery was managed under that plan. Many of these regulations were incorporated into the FMP, which provided for continued management of the foreign fishery.

~~Subsequent to initial implementation of~~Joint-venture fishing, where domestic vessels caught the fish to be processed aboard foreign vessels, began in 1979 and by 1989 had entirely supplanted directed foreign fishing. These joint ventures primarily targeted Pacific whiting. Joint-venture fisheries were then rapidly replaced by wholly domestic processing; by 1991 foreign participation had ended and U.S.-flagged motherships, catcher-processors, and shore-based vessels had taken over the Pacific whiting fishery. Since then U.S. fishing vessels and seafood processors have fully utilized Pacific Coast fishery resources. Although the Council may entertain applications for foreign or joint venture fishing or processing at any time, provisions for these activities have been removed from the FMP. Re-establishing such opportunities would require another FMP amendment.

Since it was first implemented in 1982, the Council has amended the groundfish FMP~~, the Council has developed 11 amendments~~ 18 times in response to ~~changing resource and fishery conditions. Early amendments added jack mackerel to the fishery management unit, established a management framework for modifying gear regulations, and responded to new requirements in~~changes in the fishery, reauthorizations of the Magnuson-Stevens Act~~ pertaining to habitat and weather-related vessel safety issues. Amendment 4 was~~, and litigation that invalidated provisions incorporated by earlier amendments. During the first ten years of plan implementation, up to 1992, the Secretary approved six amendments. Amendment 4, approved in 1990, was the most significant early amendment; in addition to a comprehensive update ~~that~~and reorganization of the FMP, it established additional framework procedures for establishing and modifying management measures~~ and streamlining the decision and implementation process. Amendment 5 addressed overfishing standards, and Amendment 6~~. Another important change was implemented in 1992 with Amendment 6, which established a license limitation (limited entry) program intended to address overcapitalization ~~of the fishing sector~~by restricting further participation in groundfish trawl, longline, and trap fisheries.

The next decade, through 2002, saw the approval of another seven amendments. Amendment 9 modified the limited entry program by establishing a sablefish endorsement for longline and pot permits. Amendments 11 ~~was prepared in response~~, 12, 13 were responses to changes in the Magnuson-Stevens Act due to the 1996 Sustainable Fisheries Act~~ amendments to the Magnuson-Stevens Act that, among other provisions,~~. These changes required FMPs to identify essential fish habitat, more actively reduce bycatch and bycatch mortality, and strengthen conservation measures to both prevent fish stocks from becoming overfished~~,~~ and promote rebuilding~~.~~

~~The groundfish FMP has evolved into a document that describes the Council=s and the NMFS's procedures for establishing and modifying management measures. It establishes the authority for and limitations on Council actions, but in general does not include specific fishing regulations; rather, it describes how the Council will develop its recommendations for fishing regulations and the process for public involvement in that process.~~ of any stocks that had become overfished. Amendment 14, implemented in 2001, built on Amendment 9 to further refine the limited entry permit system for the economically important fixed gear sablefish fishery. It allowed a vessel owner to Astack@ up to three limited entry permits on one vessel along with associated sablefish catch limits. This in effect established a limited tradable quota system for participants in the primary sablefish fishery.

Most of the amendments adopted since 2001 deal with legal challenges to the three SFA-related amendments mentioned above, which were remanded in part by the Federal Court. These have required new amendments dealing with overfishing, bycatch monitoring and mitigation, and essential fish habitat. In relation to the first of these three issues, the Magnuson-Stevens Act now requires FMPs to identify thresholds for both the fishing mortality rate constituting overfishing and the stock size below which a stock is considered overfished. Once the Secretary determines a stock is overfished, the Council must develop and implement a plan to rebuild it to a healthy level. Since these thresholds were established for Pacific Coast groundfish, nine stocks have been declared overfished. The Court found that the rebuilding plan framework adopted by Amendment 12 did not comply with the Magnuson-Stevens Act. In response, Amendments 16-1, 16-2, and 16-3 established the current regime for managing these overfished species.[1] Amendment 16-1, approved in 2003, incorporated guidelines for developing and adopting rebuilding plans and substantially revised Chapters 4 and 5. Amendments 16-2 and 16-3, approved in 2004, incorporated key elements of rebuilding plans into Section 4.5.4.

Amendment 17 modified the periodic process the Council uses to establish and modify harvest specifications and management measures for the groundfish fishery. Although not an SFA-related issue, this change did solve a procedural problem raised in litigation. The Council now establishes specifications and management measures every two years, allowing more time for them to be developed during the Council=s public meetings.

Amendment 18, approved in [2005], addresses a remand of elements in Amendment 11 related to bycatch monitoring and mitigation. It incorporated a description of the Council=s bycatch-related policies and

[1] Although the Secretary declared Pacific whiting overfished in 2002, a 2004 stock assessment found that it had recovered to its rebuilt level. Thus, a rebuilding plan for this species was not adopted by these amendments.

programs into Chapter 6. It also effected a substantial reorganization and update of the FMP, so that it better reflects the Council=s and the NMFS=s evolving framework approach to management. Under this framework, the Council may recommend a range of broadly defined management measures for NMFS to implement. In addition to the range of measures, this FMP specifies the procedures the Council and NMFS must follow to establish and modify these measures. When first implemented, the FMP specified a relatively narrow range of measures, which were difficult to modify in response to changes in the fishery. The current framework allows the Council to effectively respond when faced with the dynamic challenges posed by the current groundfish fishery.

1.2 How This Document is Organized

The groundfish FMP is organized into 11 chapters

Chapter 1 (this chapter) describes the development of the FMP and how it is organized.

Chapter 2 describes the goals and objectives of the plan and defines key terms and concepts.

Chapter 3 specifies the geographic area covered by this plan and lists the species managed by it, referred to as the fishery management unit, or FMU.

Chapter 4 describes how the Council determines harvest levels. These harvest limits are related to the maximum sustainable yield (MSY) and allowable biological catch (ABC) for FMU species. Precautionary reductions from these thresholds may be applied, depending on the management status of a given stock. If, according to these thresholds, a stock is determined to be overfished, the Council must recommend measures to end overfishing and develop a rebuilding plan, as specified in this chapter. Based on the thresholds, criteria and procedures described in this chapter, the Council specifies an optimum yield (OY), or harvest limit, for managed stocks or stock complexes.

Chapter 5 describes how the Council periodically specifies harvest levels and the management measures needed to prevent catches from exceeding those levels. Currently, the Council develops these specifications over the course of three meetings preceding the start of a two-year management period. (Separate OYs are specified for each of the two years in this period.) This chapter also describes how the stock assessment/fishery evaluation (SAFE) document, which provides information important to management, is developed.

Chapter 6 describes the management measures used by the Council to meet the objectives of the Magnuson-Stevens Act and this FMP. As noted above, this FMP is a framework plan; therefore, the range of management measures is described in general terms while the processes necessary to establish or modify different types of management measures are detailed. Included in the description of management measures is the Council=s program for monitoring total catch (which includes bycatch) and minimizing bycatch.

Chapter 7 identifies essential fish habitat for groundfish FMU species and the types of measures that may be used to mitigate adverse impacts to essential fish habitat from fishing.

Chapter 8 describes procedures followed by the Council to evaluate and recommend issuing exempted fishing permits (EFPs). Permitted vessels are authorized, for limited experimental purposes, to harvest groundfish by means or in amounts that would otherwise be prohibited by this FMP and its implementing regulations. These permits allow experimentation in support of FMP goals and objectives. EFPs have been used, for example, to test gear types that result in less bycatch.

Chapter 9 provides criteria for determining what activities involving groundfish would qualify as scientific research and could therefore qualify for special treatment under the management program.

Chapter 10 describes the procedures used to review state regulations in order to ensure that they are consistent with this FMP and its implementing regulations.

Chapter 11 describes the groundfish limited entry program.

The original FMP contained an extensive description of the biological, economic, social, and regulatory characteristics of the groundfish fishery. As part of past amendments to the FMP this material was moved to an appendix, which is published under separate cover.

2.0 GOALS AND OBJECTIVES

2.1 Goals and Objectives for Managing the Pacific Coast Groundfish Fishery

The Council is committed to developing long-range plans for managing the Washington, Oregon, and California groundfish fisheries that will promote a stable planning environment for the seafood industry, including marine recreation interests, and will maintain the health of the resource and environment. In developing allocation and harvesting systems, the Council will give consideration to maximizing economic benefits to the United States, consistent with resource stewardship responsibilities for the continuing welfare of the living marine resources. Thus, management must be flexible enough to meet changing social and economic needs of the fishery as well as to address fluctuations in the marine resources supporting the fishery. The following goals have been established in order of priority for managing the West Coast groundfish fisheries, to be considered in conjunction with the national standards of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Management Goals.

Goal 1 - Conservation. Prevent overfishing and rebuild overfished stocks by managing for appropriate harvest levels and prevent, to the extent practicable, any net loss of the habitat of living marine resources.

Goal 2 - Economics. Maximize the value of the groundfish resource as a whole.

Goal 3 - Utilization. Within the constraints of overfished species rebuilding requirements, achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

Objectives. To accomplish these management goals, a number of objectives will be considered and followed as closely as practicable:

Conservation.

Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.

Objective 3. For species or species groups that are overfished, develop a plan to rebuild the stock as required by the Magnuson-Stevens Act.

Objective 4. Where conservation problems have been identified for nongroundfish species and the best scientific information shows that the groundfish fishery has a direct impact on the ability of that species to maintain its long-term reproductive health, the Council may consider establishing management measures to control the impacts of groundfish fishing on those species. Management measures may be imposed on the groundfish fishery to reduce fishing mortality of a nongroundfish species for documented conservation reasons. The action will be designed to minimize disruption of the groundfish fishery, in so far as consistent with the goal to minimize the bycatch of nongroundfish species, and will not preclude achievement of a quota, harvest guideline, or allocation of groundfish, if any, unless such action is required by other applicable law.

Objective 5. Describe and identify essential fish habitat (EFH), adverse impacts on EFH, and other actions to conserve and enhance EFH, and adopt management measures that minimize, to the extent practicable, adverse impacts from fishing on EFH.

Economics.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

Objective 7. Identify those sectors of the groundfish fishery for which it is beneficial to promote year-round marketing opportunities and establish management policies that extend those sectors fishing and marketing opportunities as long as practicable during the fishing year.

Objective 8. Gear restrictions to minimize the necessity for other management measures will be used whenever practicable. Encourage development of practicable gear restrictions intended to reduce regulatory and/or economic discards through gear research regulated by exempted fishing permits.

Objective 9. ~~Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific Coast groundfish resources by domestic fisheries.~~Achieve a level of harvest capacity in the fishery that is appropriate for a sustainable harvest and low discard rates, and which results in a fishery that is diverse, stable, and profitable. This reduced capacity should lead to more effective management for many other fishery problems. For the short term, adjust harvest capacity to a level consistent with the allowable harvest levels for the 2000 fishing year, under the assumption that stock rebuilding will require reduced harvests for at least through 2020. Maintaining a year-round fishery may not be a short-term priority. ***[Strategic Plan Capacity Reduction Goal, 2000]***

Utilization.

Objective 10. Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific Coast groundfish resources by domestic fisheries.

Objective 11. Recognizing the multispecies nature of the fishery and establish a concept of managing by species and gear or by groups of interrelated species.

Objective 12. Develop management programs that reduce regulations-induced discard and/or which reduce economic incentives to discard fish. ~~Strive to reduce the economic incentives and regulatory measures that lead to wastage of fish~~. Develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. Promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

~~Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the optimum yield (OY) not utilized by domestic fisheries while minimizing conflict with domestic fisheries.~~

Social Factors.

Objective 13. When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.

Objective 14. Minimize gear conflicts among resource users.

Objective 15. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and the environment.

Objective 16. Avoid unnecessary adverse impacts on small entities.

Objective 17. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

Objective 18. Promote the safety of human life at sea.

[Amended; 7, 11, 13, 16-1]

2.2 Operational Definition of Terms

Acceptable Biological Catch (ABC) 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.

Biennial fishing period is defined as a 24-month period beginning January 1 and ending December 31.

Bottom (or flatfish bottom) trawl 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. ***[From 11.2.1.1.2]***

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.

Chafing gear is webbing or other material attached to the codend of a trawl net to protect the codend from wear. ***[From 11.2.1.1.5]***

Charter fishing means fishing from a vessel carrying a passenger for hire (as defined in section 2101(21a) of title 46, United States Code) who is engaged in recreational fishing.

Closure, when referring to closure of a fishery, means that taking and retaining, possessing or landing the particular species or species complex is prohibited.

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.

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.

Density dependence is the degree to which recruitment declines as spawning biomass declines. Typically we assume that a Beverton-Holt form is appropriate and that the level of density-dependence is such that the recruitment only declines by ten percent when the spawning biomass declines by 50%.

~~Domestic annual harvest (DAH) is the estimated total harvest of groundfish by U.S. fishermen. It includes the portion expected to be utilized by domestic processors and the estimated portion, if any, that will be delivered to those foreign processors joint venture processing (JVP) that are permitted to receive U.S. harvested groundfish in the exclusive economic zone (EEZ).~~

~~Domestic annual processing (DAP) is the estimated annual amount of U.S. harvest that domestic processors are expected to process and the amount of fish that will be harvested, but not processed (e.g., marketed as fresh whole fish used for private consumption or used for bait).~~

Double-walled codend is a codend constructed of two walls of webbing. ***[From 11.2.1.1.6]***

$F_{x\%}$ is the rate of fishing mortality that will reduce female spawning biomass per recruit to x percent of its unfished level. $F_{100\%}$ is zero, and $F_{35\%}$ is a reasonable proxy for F_{MSY}.

Economic discards means fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, quality, or for other economic reasons.

Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Exploitable biomass is the biomass that is available to a unit of fishing effort. Defined as the sum of the population biomass at age (calculated as the mean within the fishing year) multiplied by the age-specific availability to the fishery. Exploitable biomass is equivalent to the catch biomass divided by the instantaneous fishing mortality rate.

F is the instantaneous rate of fishing mortality. F typically varies with age, so the F values are presented for the age with maximum F. Fish of other ages have less availability to the fishery, so a unit of effort applies a lower relative level of fishing mortality to these fish.

F_{MSY} is the fishing mortality rate that maximizes catch biomass in the long term.

$F_{0.1}$ is the fishing mortality rate at which a change in fishing mortality rate will produce a change in yield per recruit that is ten percent of the slope of the yield curve at nil levels of fishing mortality.

F_{OF} is the rate of fishing mortality defined as overfishing.

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 is defined as January 1 through December 31.

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 (anchored nontrawl gear) includes longline, trap or pot, set net, and stationary hook-and-line gear (including commercial vertical hook-and-line) gears. ***[From 11.2.1.2]***

Gillnet is a single-walled, rectangular net which is set upright in the water. ***[From 11.2.1.3.5]***

Harvest guideline (HG) is an specified numerical harvest objective which is not a quota. Attainment of a HG does not require closure of a fishery.

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). ***[From 11.2.1.3.2]***

Incidental catch or incidental species means groundfish species caught when fishing for the primary purpose of catching a different species.

Individual fishing quota (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.

~~Joint venture processing (JVP) is the estimated portion of DAH that exceeds the capacity and intent of U.S. processors to utilize, or for which domestic markets are not available, that is expected to be harvested by U.S. fishermen and delivered to foreign processors in the EEZ. (JVP = DAH - DAP.)~~

Longline is a stationary, buoyed, and anchored groundline with hooks attached, so as to fish along the seabed. ***[From 11.2.1.3.3]***

Maximum sustainable yield 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.

Midwater (pelagic or off-bottom) trawl is a trawl in which the otter boards may 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. ***[From 11.2.1.1.4]***

MSY stock size means the largest long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule in which the fishing mortality rate is constant. The proxy typically used in this fishery management plan is 40% of the estimated unfished biomass, although other values based on the best scientific information are also authorized.

Nontrawl gear means all legal commercial gear other than trawl gear. ***[From 11.2.1.3]***

Optimum yield means the amount of fish which will provide the greatest overall benefit to the U.S., 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 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 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 (F_{MSY}) or its proxy (e.g., $F_{35\%}$).

Processing or to process 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 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 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 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 means fishing for sport or pleasure, but not for sale.

Regulatory discards are fish harvested in a fishery which fishermen are required by regulation to discard whenever caught or are required by regulation to retain, but not sell.

~~Reserve is a portion of the harvest guideline or quota set aside at the beginning of the year to allow for uncertainties in preseason estimates of DAP and JVP.~~

Roller (or bobbin) trawl is a bottom trawl that has footropes equipped with rollers or bobbins made of wood, steel, rubber, plastic, or other hard material which keep the footrope above the seabed, thereby protecting the net. ***[From 11.2.1.1.3]***

Set net is a stationary, buoyed, and anchored gillnet or trammel net. ***[From 11.2.1.3.4]***

Stock Assessment and Fishery Evaluation (SAFE) document is a document prepared by the Council that provides a summary of the most recent biological condition of species in the fishery management unit, and the social and economic condition of the recreational and commercial fishing industries, and the fish processing industry. It summarizes, on a periodic basis, the best available information concerning the past, present, and possible future condition of the stocks and fisheries managed by the FMP.

Target fishing means fishing for the primary purpose of catching a particular species or species group (the target species).

~~Total allowable level of foreign fishing (TALFF) is the amount of fish surplus to domestic needs and available~~

~~for foreign harvest. It is a quota determined by deducting the DAH and reserve, if any, from a species harvest guideline or quota.~~

Trammel net is a gillnet made with two or more walls joined to a common float line. ***[From 11.2.1.3.6]***

Trap (or pot) is a portable, enclosed device with one or more gates or entrances and one or more lines attached to surface floats. ***[11.2.1.3.7]***

Spawning biomass is the biomass of mature female fish at the beginning of the year. If the production of eggs is not proportional to body weight, then this definition should be modified to be proportional to expected egg production.

Spawning biomass per recruit is the expected egg production of a female fish over its lifetime. Alternatively, this is the mature female biomass of an equilibrium stock divided by the mean level of recruitment that produced this stock.

Spear is a sharp, pointed, or barbed instrument on a shaft. Spears may be propelled by hand or by mechanical means. ***[From11.2.2.2]***

Vertical hook-and-line gear (commercial) is hook-and-line gear that involves a single line anchored at the bottom and buoyed at the surface so as to fish vertically. ***[From 11.2.1.3.1]***

3.0 AREAS AND STOCKS INVOLVED

No changes in this chapter.

4.0 PREVENTING OVERFISHING AND ACHIEVING OPTIMUM YIELD

No Changes in this chapter.

5.0 PERIODIC SPECIFICATION AND APPORTIONMENT OF HARVEST LEVELS

No changes in this chapter.

6.0 MANAGEMENT MEASURES

6.1 Introduction

[6.0 Management Measures]

The FMP, as amended, establishes the fishery management program and the process and procedures the Council will follow in making adjustments to that program. It also sets the limits of management authority of the Council and the Secretary when acting under the FMP. The preceding two chapters describe the procedures for determining appropriate harvest levels and establishing them on a periodic basis. This chapter describes the procedures and methods that may be use to directly control fishing activities so that total catch of a given species or species group does not exceed specified harvest limits. It is organized around five major themes:

- Section 6.2 describes the procedures for establishing and adjusting management measures, including two decision-making frameworks the Council (in conjunction with its advisory bodies) uses to decide whether management measures need adjustment. These framework procedures allow management decisions, as long as they are consistent with the provisions of this FMP (including the frameworks), to be implemented via Federal regulation without first amending the FMP. This section also describes the procedures for promulgating the regulations needed to implement the management measures authorized by this FMP.

- Section 6.3 describes the criteria the Council will consider when establishing management measures intended to directly allocate harvest opportunity.

- Sections 6.4 and 6.5 describe methods to account for all sources of fishing mortality and to reduce bycatch, and especially bycatch mortality. Bycatch is defined in the Magnuson-Stevens Act as “fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards” (16 U.S.C. 1802(2)). Section 6.4 also describes those additional measures necessary to monitor catch and effort or to enforce regulations.

- Section 6.6 through 6.9 inventory the range of management measures available to the Council, as authorized by this FMP. Not all of these management measures will be implemented at any given time.

- Section 6.10 describes those requirements that support the enforcement of management measures.

[6.5.2 Domestic—Commercial]

These procedures, measures, and requirements must be consistent with the goals and objectives of the FMP, the Magnuson-Stevens Act, and other applicable law. All measures, unless otherwise specified, apply to all domestic vessels regardless of whether catch is landed and processed on shore or processed at sea. The procedures by which the Council develops recommendations on revising management measures, and by which NMFS implements those recommendations, are found in Section 6.2.

6.1.1 Overview of Management Measures For West Coast Groundfish Fisheries

[6.1 General List of Management Measures]

In the early stages of fishery development, there is generally little concern with management strategies. As fishing effort increases, management measures become necessary to prevent overfishing and the resulting adverse social and economic impacts. Although recruitment, growth, natural mortality, and fishing mortality affect the size of fish populations, fishery managers only have control over one of these factors—fishing mortality. The principal measures available to the Council to control fishing mortality of the groundfish fisheries in the Washington, Oregon, and California region are:

- Measures to reduce bycatch and bycatch mortality – described in 6.5.
- Defining authorized fishing gear and regulating the configuration and deployment of fishing gear, including mesh size in nets and escape panels or ports in traps—described in Section 6.6.
- Restricting catches by defining prohibited species and establishing landing, trip frequency, bag, and size limits—described in Section 6.7.
- Establishing fishing seasons and closed areas—described in Section 6.8
- Limiting fishing capacity or effort through permits, licenses and endorsements, and quotas, or by means of input controls on fishing gear, such as restrictions on trawl size/shape or longline length or number of hooks or pots—described in Section 6.9. Fishing capacity may be further limited through programs that reduce participation in the fishery by retiring permits and/or vessels.

Although this chapter only discusses in detail the types of management measures outlined above, the Council may recommend and NMFS may implement other useful management measures through the appropriate rulemaking process, as long as they are consistent with the criteria and general procedures contained in this FMP.

6.2 General Procedures for Establishing and Adjusting Management Measures

[6.2 General Procedures for Establishing and Adjusting Management Measures]

This FMP establishes two framework procedures through which the Council is able to recommend the establishment and adjustment of specific management measures for the Pacific Coast groundfish fishery. The *points of concern framework* allows the Council to develop management measures that respond to resource conservation issues; the *socioeconomic framework* allows the Council to develop management measures in response to social, economic, and ecological issues that affect fishing communities. Criteria associated with each framework form the basis for Council recommendations, and Council recommendations will be consistent with them. The process for developing and implementing management measures normally will occur over the span of at least two Council meetings, with an exception that provides for more timely Council consideration under certain specific conditions.

The time required to take action under either framework will vary depending on the nature of the action, its impacts on the fishing industry, resource, and environment, and review of these impacts by interested parties. This depends on the range of biological, social, and economic impacts that may need to be considered at the time a particular change in regulations is proposed. Furthermore, other applicable law (e.g., the National Environmental Policy Act, Administrative Procedures Act, Regulatory Flexibility Act, relevant Executive Orders, etc.) may require additional analysis and public comment before measures may be implemented by the Secretary.

The Secretary will develop management measures recommended by the Council for review and public comment as publications in the *Federal Register*, either as notices or regulations. Generally, management measures of broad applicability and permanent effectiveness should be published as regulations. More narrowly applicable measures, which may only apply for short duration (one biennium or less) and may also require frequent adjustment, should be published as notices.

Management measures are normally imposed, adjusted, or removed at the beginning of the biennial fishing period, but may, if the Council determines it necessary, be imposed, adjusted, or removed at any time during the period. Management measures may be imposed for resource conservation, social, or economic reasons consistent with the criteria, procedures, goals, and objectives set forth in the FMP.

The NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments, and other relevant information and determine whether to approve, disapprove, or partially approve the Council's recommendation. If the recommendation is approved, NMFS will implement the recommendation through regulation or notice, as appropriate. NMFS will explain any disapproval or partial disapproval of the recommendation to the Council in writing.

The procedures specified in this chapter do not affect the authority of the Secretary to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Act if an emergency exists involving any groundfish resource, or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

Four different categories of management actions are authorized by this FMP, each of which requires a slightly different process. Management measures may be established, adjusted, or removed using any of the four procedures. The four basic categories of management actions are described below

A. Automatic Actions

The NMFS Regional Administrator may initiate automatic management actions without prior public notice, opportunity to comment, or a Council meeting. These actions are nondiscretionary, and the impacts must be reasonably accountable, based on previous application of the action or past analysis. Examples include fishery, season, or gear type closures when a quota has been projected to have been attained. The Secretary will publish a single notice in the *Federal Register* making the action effective.

B. Notice Actions Requiring at Least One Council Meeting and One *Federal Register* Notice

These include all management actions other than automatic actions, which are either nondiscretionary or for which the scope of probable impacts has been previously analyzed.

These actions are intended to have temporary effect, and the expectation is that they will need frequent adjustment. They may be recommended at a single Council meeting, although the Council will provide as much advance information to the public as possible concerning the issues it will be considering at its decision meeting. The primary examples are those inseason management actions defined as routine according to the criteria in Section 6.2.1. These include, but are not limited to, trip landing and frequency limits and size limits for all commercial gear types and closed seasons for any groundfish species in cases where protection of an overfished or depleted stock is required and bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements for all recreational fisheries. Previous analysis must have been specific as to species and gear type before a management measure can be defined as routine and acted on at a single Council meeting. If the recommendations are approved, the Secretary ~~will~~ may waive for good cause the requirement for prior notice and comment in the *Federal Register* and will publish a single notice in the *Federal Register* making the action effective. This category of actions presumes the Secretary will find that the need for swift implementation and the extensive notice and opportunity for comment on these types of measures, along with the Council already having analyzed the scope of their impacts, will serve as good cause to waive the need for additional prior notice and comment in the *Federal Register*.

C. Management Measures Rulemaking For Actions Developed Through the Three-Council-Meeting Biennial Specifications Process and Two *Federal Register* Rules

These include (1) management action developed through the biennial specifications process; (2) management measures being classified as routine; or (3) trip limits that vary by gear type, closed seasons or areas, and in the recreational fishery, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements the first time these measures are used. Examples include: changes to or imposition of gear regulations; imposition of landings limits, frequency limits, or limits that differ by gear type; closed areas or seasons used for the first time on any species or species group or gear type. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings (usually April and June) and provide the public advance notice and opportunity to comment on both the proposals and the analysis prior to and at the second Council meeting. If a management measure is designated as routine under this procedure, specific adjustments of that measure can subsequently be announced in the *Federal Register* by notice as described in the previous paragraphs. The Secretary will publish a proposed rule in the *Federal Register* with an appropriate period for public comment followed by publication of a final rule in the *Federal Register*.

The three-Council-meeting process refers to two decision meetings. The Council will develop proposed harvest specifications during the first meeting (usually November). They will finish drafting harvest specifications and develop the management measures during the second meeting (usually April). Finally, at the third meeting, the Council will make final recommendations to the Secretary on the complete harvest specifications and management measures biennial management package (usually June). For the Council to have adequate information to identify proposed management measures for public comment at the first management measures meeting, the identification of issues and the development of proposals normally must begin at a prior Council meeting.

D. Full Rulemaking For Actions Normally Requiring at Least Two Council Meetings and Two *Federal Register* Rules (Regulatory Amendment)

These include any proposed management measure that is highly controversial or any measure that directly allocates the resource. These also include management measures that are intended to have permanent effect and are discretionary, and for which the impacts have not been previously analyzed. Full rulemakings will normally use a two-Council-meeting process, although additional meetings may be required to fully develop the Council's recommendations on a full rulemaking issue. Regulatory measures to implement an FMP amendment will be developed through the full rulemaking process. The Secretary will publish a proposed rule in the *Federal Register* with an appropriate period for public comment followed by publication of a final rule in the *Federal Register*.

Council-recommended management measures addressing a resource conservation issue must be based upon the identification of a point of concern through that decision-making framework, consistent with the specific procedures and criteria listed in Section 6.2.2.

Council-recommended management measures addressing social or economic issues must be consistent with the specific procedures and criteria described in Section 6.2.3.

6.2.1 Routine Management Measures

Routine management measures are those that the Council determines are likely to be adjusted on an annual or more frequent basis. The Council will classify measures as routine through either the specifications and management measures or rulemaking processes (C. or D. above). In order for a measure to be classified as routine, the Council will determine that the measure is appropriate to address the issue at hand and may require further adjustment to achieve its purpose with accuracy.

As in the case for all proposed management measures, prior to initial implementation as routine measures, the Council will analyze the need for the measures, their impacts, and the rationale for their use. Once a management measure has been classified as routine through one of the two rulemaking procedures outlined above, it may be modified thereafter through the single meeting notice procedure (B. above) only if (1) the modification is proposed for the same purpose as the original measure, and (2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine. The analysis of impacts need not be repeated when the measure is subsequently modified if the Council determines that they do not differ substantially from those contained in the original analysis. The Council may also recommend removing a routine classification.

Experience gained from management of the Pacific Coast groundfish fishery indicates that certain measures usually require modification on a frequent basis to ensure that they meet their stated purpose with accuracy. For commercial fisheries, these measures are trip landing limits and trip frequency limits, including cumulative limits, and notification requirements. They have been applied to the commercial fishery either to stretch the duration of the fishery, so as not to disturb traditional fishing and marketing patterns; to reduce discards and waste; or to discourage targeted fishing while allowing small incidental catches when attainment of a harvest guideline or quota is imminent. In cases where protection of an overfished or depleted stock is required, the Council may impose limits that differ by gear type, or establish closed areas or seasons. These latter two measures were not historically imposed through the annual management cycle (now biennial) because of their allocative implications. However, this additional flexibility has become necessary to allow the harvest of healthy stocks as much as possible while protecting and rebuilding overfished and depleted stocks, and equitably distributing the burdens of rebuilding among sectors. The first time a differential trip limit or closed season is to be imposed in a fishery, it must be imposed during the biennial management cycle (with the required analysis and opportunity for public comment) and subsequently may be modified inseason through the routine adjustment process.

For recreational fisheries, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements may be applied to particular species, species groups, sizes of fish and gear types. For the recreational fishery, bag and size limits have been imposed to spread the available catch over a large number of anglers, in order to avoid waste, and to provide consistency with state regulations.

Routine management measures are also often necessary to meet the varied and interwoven mandates of the Magnuson-Stevens Act and FMP. These mandates include: preventing overfishing and rebuilding overfished species in a manner consistent with rebuilding plans, reducing bycatch, allowing the harvest of healthy stocks as much as possible while protecting and rebuilding overfished and depleted stocks, and equitably distributing the burdens of rebuilding among the sectors.

Any measure designated as routine for a particular species, species group, or gear type may not be treated as routine for a different species, species group, or gear type without first having been classified as routine. Each year, the SAFE document will list all measures that have been designated as routine.

The Council will conduct a continuing review of landings of those species for which harvest guidelines, quotas, OYs or specific routine management measures have been implemented and will make projections of the landings at various times throughout the year. If in the course of this review it becomes apparent that the rate of landings is substantially different than anticipated, and that the current routine management measures will not achieve harvest management objectives, the Council may recommend inseason adjustments to those measures. Such adjustments may be implemented through the single-meeting notice procedure (B. above.)

Routine Management Measures as of January 1, 2005:

Commercial limited entry and open access fisheries:

Trip landing and frequency limits, size limits, for all gear types may be imposed: to extend the fishing season; to minimize disruption of traditional fishing and marketing patterns; to reduce discards; to discourage target fishing while allowing small incidental catches to be landed; to protect overfished species; to allow small fisheries to operate outside the normal season; and, for the open access fishery only, to maintain landings at the historical proportions during the 1984-88 window period.

Trip landing and frequency limits have been designated as routine for the following species or species groups: black rockfish, blue rockfish, bocaccio, canary rockfish, chilipepper rockfish, cowcod, darkblotched rockfish, Pacific ocean perch, shortbelly rockfish, splitnose rockfish, widow rockfish, yelloweye rockfish, yellowtail rockfish, minor nearshore rockfish or shallow and deeper minor nearshore rockfish, shelf or minor shelf rockfish, and minor slope rockfish; DTS complex, which is composed of Dover sole, sablefish, shortspine thornyheads, and longspine thornyheads, both as a complex and for the species within the complex; arrowtooth flounder, English sole, petrale sole, Pacific sanddabs, rex sole, and the flatfish complex, which is composed of those species plus any other FMP flatfish species; Pacific whiting; lingcod; cabezon; Pacific cod; and “other fish” as a complex consisting of all groundfish species listed in the FMP and not otherwise listed as a distinct species or species group.

Size limits have been designated as routine for sablefish and lingcod.

Trip landing and frequency limits that differ by gear type and closed seasons may be imposed or adjusted on a biennial or more frequent basis for the purpose of rebuilding and protecting overfished or depleted stocks. To achieve the rebuilding of an overfished or depleted stock, a sector or sectors of the primary Pacific whiting may be closed if a total catch limit of an overfished species has been designated for the whiting fishery and that total catch limit is reached before the sector’s whiting allocation is reached. Total catch limits in the primary Pacific whiting fishery may be established or adjusted as routine management measures.

Recreational fisheries all gear types:

Routine management measures for all groundfish species, separately or in any combination, include: bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements. All routine management measures on recreational fisheries are intended to keep landings within the harvest levels announced by NMFS, to rebuild and protect overfished or depleted species, and to maintain consistency with State regulations, and for the other purposes set forth in this section.

Bag limits may be imposed to spread the available catch over a large number of anglers; to protect and rebuild overfished species; to avoid waste.

Size limits may be imposed to protect juvenile fish; to protect and rebuild overfished species; to enhance the quality of the recreational fishing experience.

Season duration restrictions may be imposed to spread the available catch over a large number of anglers; to protect and rebuild overfished species; to avoid waste; to enhance the quality of the recreational fishing experience.

All fisheries, all gear types:

Depth-based management measures, particularly the setting of closed areas known as Groundfish Conservation Areas may be imposed on any sector of the groundfish fleet using specific boundary lines that approximate depth contours with latitude/longitude coordinates. Depth-based management measures and the setting of closed areas may be used to protect and rebuild overfished stocks.

The current list of routine management measures is published in federal regulations at 50 CFR 660.370.

6.2.2 Resource Conservation Issues—The Points of Concern Framework

[6.2.2 Resource Conservation Issues—The Points of Concern Framework]

The points of concern process is the Council's second major tool (along with setting harvest levels) in exercising its resource stewardship responsibilities. The Council developed the points of concern criteria to assist it in determining when a focused review on a particular species or species group is warranted, which might result in the need to recommend the implementation of specific management measures to address the resource conservation issue. This process is intended to foster a continuous and vigilant review of the Pacific Coast groundfish stocks and fishery to prevent unintended overfishing or other resource damage. To facilitate this process, a Council-appointed management team (the Groundfish Management Team [GMT] or other entity) will monitor the fishery throughout the year, taking into account any new information on the status of each species or species group. By this means they will identify resource conservation issues requiring a management response. The Council is authorized by this FMP to act based solely on evidence that one or more of these points of concern criteria has been met. This allows the Council to respond quickly and directly to a resource conservation issue. In conducting this review, the GMT or other entity will use the most current catch, effort, and other relevant data from the fishery.

In the course of the continuing review, a point of concern occurs when any one or more of the following ~~is found~~ situations occurs or is expected to occur:

1. Catch for the calendar year is projected to exceed the best current estimate of acceptable biological catch (ABC) for those species for which an OY, harvest guideline or quota is not specified.
2. Catch for the calendar year is projected to exceed the current OY, harvest guideline or quota.
3. Any change in the biological characteristics of the species or species complex is discovered, such as changes in age composition, size composition, and age at maturity.
4. Exploitable biomass or spawning biomass is below a level expected to produce MSY for the species/species complex under consideration.
5. Recruitment is substantially below replacement level.
6. Estimated bycatch of a species or species group increases substantially above previous estimates, or there is information that abundance of a bycatch species has declined substantially.
7. Impacts of fishing gear on EFH are discovered and modification to gear or fishing regulations could reduce those impacts.

Once a point of concern is identified, the GMT will evaluate current data to determine if a resource conservation issue exists and will provide its findings in writing at the next scheduled Council meeting. If the GMT determines a resource conservation issue exists, it will provide its recommendation, rationale, and analysis for the appropriate management measures that will address the issue.

In developing its recommendation for management action, the Council will choose an action from one or more of the ~~following categories which include~~categories listed below, although they may also identify other necessary measures. These categories cover the types of management measures most commonly used to address resource conservation issues:

- Harvest guidelines
- Quotas
- Cessation of directed fishing ~~(foreign, domestic or both)~~ on the identified species or species group with appropriate allowances for incidental harvest of that species or species group
- Size limits
- Landing limits
- Trip frequency limits
- Area or subarea closures
- Time closures
- Seasons
- Gear limitations, which include, but are not limited to, definitions of legal gear, mesh size specifications, codend specifications, marking requirements, and other gear specifications as necessary.
- Observer or other monitoring coverage
- Reporting requirements
- Permits
- ~~Other necessary measures~~

~~Direct allocation of the resource between different segments of the fishery is, in most cases, not the preferred response to a resource conservation issue.~~ Council recommendations to directly allocate the resource will be developed according to the criteria and process described in Section 6.2.3, the socioeconomic framework.

After receiving the GMT's report, the Council will take public testimony and, if appropriate, will recommend management measures to the NMFS Regional Administrator, accompanied by supporting rationale and analysis of impacts. The Council's analysis will include a description of (a) how the action will address the resource conservation issue, consistent with the objectives of the FMP; (b) likely impacts on other management measures, other fisheries, and bycatch; (c) economic impacts, particularly the cost to the commercial and recreational segments of the fishing industry; and (d) impacts on fishing communities.

The NMFS Regional Administrator will review the Council's recommendation and supporting information and will follow the appropriate implementation process described in Section 6.2, depending on the amount of public notice and comment provided by the Council and the intended permanence of the management action. If the Council anticipates that the recommended measures will be adjusted frequently, it may classify them as routine through the appropriate process described in Section 6.2.1.

If the NMFS Regional Administrator does not concur with the Council's recommendation, the Council will be notified in writing of the reasons for the rejection.

Nothing in this section is meant to derogate from the authority of the Secretary to take emergency action under Section 305(c) of the Magnuson-Stevens Act.

6.2.3 Non-biological Issues—The Socioeconomic Framework

From time to time, non-biological issues may arise that require the Council to recommend management actions to address certain social or economic issues in the fishery. Resource allocation, seasons, or landing limits based on market quality and timing, safety measures, and prevention of gear conflicts make up only a few examples of possible management issues with a social or economic basis. In general, there may be any number of situations where the Council determines that management measures are necessary to achieve the stated social and/or economic objectives of the FMP.

Either on its own initiative or by request, the Council may evaluate current information and issues to determine if social or economic factors warrant imposition of management measures to achieve the Council's established management objectives. Actions that are permitted under this framework include all of the categories of actions authorized under the points of concern framework with the addition of direct resource allocation.

If the Council concludes that a management action is necessary to address a social or economic issue, it will prepare a report containing the rationale in support of its conclusion. The report will include the proposed management measure, a description of other viable alternatives considered, and an analysis that addresses the following criteria: (a) how the action is expected to promote achievement of the goals and objectives of the FMP; (b) likely impacts on other management measures, other fisheries, and bycatch; (c) biological impacts; (d) economic impacts, particularly the cost to the fishing industry; (e) impacts on fishing communities; and (f) how the action is expected to accomplish at least one of the following, or any other measurable benefit to the fishery:

1. Enable a quota, harvest guideline, or allocation to be achieved.
2. Avoid exceeding a quota, harvest guideline, or allocation.
3. Extend domestic fishing and marketing opportunities as long as practicable during the fishing year, for those sectors for which the Council has established this policy.
4. Maintain stability in the fishery by continuing management measures for species that previously were managed under the points of concern mechanism.
5. Maintain or improve product volume and flow to the consumer.
6. Increase economic yield.
7. Improve product quality.
8. Reduce anticipated bycatch and bycatch mortality.
9. Reduce gear conflicts, or conflicts between competing user groups.
10. Develop fisheries for underutilized species with minimal impacts on existing domestic fisheries.
11. Increase sustainable landings.
12. ~~Increase~~ Reduce fishing ~~efficiency~~ capacity.
13. Maintain data collection and means for verification.
14. Maintain or improve the recreational fishery.
15. ~~Any other measurable benefit to the fishery.~~

The Council, following review of the report, supporting data, public comment, and other relevant information, may recommend management measures to the NMFS Regional Administrator accompanied by relevant background data, information, and public comment. The recommendation will explain the urgency in implementing the measure(s), if any, and reasons therefore.

The NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments, and other relevant information, and, if it is approved, will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

The procedures specified in this chapter do not affect the authority of the Secretary to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Act if an emergency exists involving any groundfish resource, or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

If conditions warrant, the Council may designate a management measure developed and recommended to address social and economic issues as a routine management measure, provided that the criteria and procedures in Section 6.2.1 are followed.

Quotas, including allocations, implemented through this framework will be set for one-year periods and may be modified inseason only to reflect technical corrections to an ABC. (In contrast, quotas may be imposed at any time of year for resource conservation reasons under the points of concern mechanism.)

6.2.4 Indian Treaty Rights

[FMP Appendix (11.7.6) Indian Treaty Rights]

Treaties with a number of Pacific Northwest Indian tribes reserve to those tribes the right of taking fish at their usual and accustomed fishing grounds and stations (U & A) in common with other citizens of the United States. NMFS has determined that the tribes that have U & A in the area managed by this FMP are the Makah, Hoh, and Quileute Tribes, and the Quinault Indian Nation. Several tribal fisheries exist for species covered by the FMP. The Federal government has accommodated these fisheries through a regulatory process, found at 50 CFR 660.324. Until such time as tribal treaty rights are finally adjudicated or the regulatory process is modified or repealed, the Council will continue to operate under that regulatory process to provide recommendations to the Secretary on levels of tribal groundfish harvest.

6.3 Allocation

[6.1.10 Allocation]

Allocation is the apportionment of an item for a specific purpose or to a particular person or group of persons. Allocation of fishery resources may result from any type of management measure, but is most commonly a numerical quota or harvest guideline for a specific gear or fishery sector. Most fishery management measures allocate fishery resources to some degree, because they invariably affect access to the resource by different fishery sectors by different amounts. These allocative impacts, if not the intentional purpose of the management measure, are considered to be indirect or unintentional allocations. Direct allocation occurs when numerical quotas, harvest guidelines, or other management measures are established with the specific intent of affecting a particular group's access to the fishery resource.

Fishery resources may be allocated to accomplish a single biological, social or economic objective, or a combination of such objectives. The entire resource, or a portion, may be allocated to a particular group, although the Magnuson-Stevens Act requires that allocation among user groups be fair and equitable, reasonably calculated to promote conservation, and determined in such a way that no group, person, or entity receives an ~~undue~~ excessive share of the resource. The socioeconomic framework described in Section 6.2.3 provides criteria for direct allocation. Allocative impacts of all proposed management measures should be analyzed and discussed in the Council's decision-making process.

[6.2.3.1 Allocation]

In addition to the requirements described in Section 6.2.3, the Council will consider the following factors when intending to recommend direct allocation of the resource.

1. Present participation in and dependence on the fishery, including alternative fisheries.
2. Historical fishing practices in, and historical dependence on, the fishery.
3. The economics of the fishery.

4. Any consensus harvest sharing agreement or negotiated settlement between the affected participants in the fishery.
5. Potential biological yield of any species or species complex affected by the allocation.
6. Consistency with the Magnuson-Stevens Act national standards.
7. Consistency with the goals and objectives of this FMP.

The modification of a direct allocation cannot be designated as routine unless the specific criteria for the modification have been established in the regulations.

6.4 Standardized Total Catch Reporting and Compliance Monitoring Program

[6.3.2 Standardized Reporting Methodology]

Fishery managers participating in the Council process need accurate estimates of total fishing mortality. Total fishing mortality data are needed to both set accurate harvest specifications and management measures and to adjust management measures inseason so that OYs may be achieved, but not exceeded. Various state, federal, and tribal catch monitoring systems are used in West Coast groundfish management. These are coordinated through the Pacific States Marine Fisheries Commission (PSMFC). PacFIN (Pacific Fisheries Information Network) is the commercial catch monitoring database, and RecFIN (Recreational Fishery Information Network) is the database for recreational fishery catch monitoring.

Total catch has two major components: fish that are retained, landed, and sold or kept for personal use and fish that are discarded, either at sea or on shore.[2] (For obvious economic reasons, most undesired fish are discarded at sea.) This discarded component is what the Magnuson-Stevens Act defines as bycatch.3 Total catch and total fishing mortality may differ because some bycatch may survive capture and subsequent discard, or release. Bycatch mortality varies depending on the physiology of a particular species, the type of fishing gear used, and how fish are handled from the time of capture until they are released back into the water.

Commercial and recreational groundfish fisheries have been managed through a variety of measures intended to limit catch to the level established by an OY. These include cumulative landing limits for commercial fisheries and bag limits for recreational fisheries (see Section 6.7). When these measures are less restrictive, few constraints are imposed on fisheries and fish are primarily discarded for economic reasons. (In recreational fisheries, an economic discard would be a personal assessment of the desirability of a particular fish or fish species). When one stock has a comparatively low landing or bag limit in a multispecies fishery, because it is depleted for example, fish may be discarded once the limit is reached in order to continue fishing for other species. Under these conditions bycatch can be a large portion of total catch and total fishing mortality. With a standardized reporting methodology, managers are better able to track bycatch both inseason and cumulatively, information that is essential to developing management programs to reduce bycatch and bycatch mortality. Therefore, maintaining a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, in addition to being required by the Magnuson-Stevens Act (16 U.S.C. 1853(a)(11)), is an important management task. This FMP meets that requirement through a standardized reporting methodology not just for the amount and type of bycatch occurring in the fishery, but

2 The Magnuson-Stevens Act further defines the term fish to mean “finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds” 16 U.S.C. 1802(12).
3 Using the term bycatch has led to considerable confusion, because many people use the term synonymously with the concept of incidental catch, or that part of the catch which is not the target of the fishery. In single species fisheries, incidental catch and discards may be largely coincident. But in multispecies fisheries there may be multiple targets, and species that might be considered incidental are commonly retained, depending on the market and regulatory environment. In this FMP, the Magnuson-Stevens Act definition of bycatch is used, as distinct from incidentally-caught species.

for total catch (landed catch plus bycatch mortality) in the fishery.

In order to better monitor and manage bycatch, the Council supports accounting for total catch by specified fishery sectors. Beginning with the 2003 fishing year, as part of its evaluation of proposed management measures, the Council has been projecting total catches by fishery sector. Actual landings and estimated bycatch have also been categorized by fishery sector. Methods to accurately estimate sector- and species-specific total catch are needed to support the Council's bycatch mitigation program (Section 6.5). The Council relies on a combination of state, tribal, and federal reporting and monitoring programs to determine total catch. NMFS is responsible for evaluating the adequacy of Federal standardized reporting methodologies for assessing the amount and type of bycatch occurring in a fishery. In 2004, NMFS published *Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs,* which describes Federal standardized bycatch reporting methodologies and evaluates the adequacies of these methodologies, including those used for the West Coast groundfish fisheries. Federal reporting requirements in this fishery are described below.

6.4.1 Total Catch Reporting Methodology

6.4.1.1 Monitoring Total Catch At Sea – Observer and Electronic Monitoring Programs

[6.5.1.2 Observers]

The Magnuson-Stevens Act defines the term "observer" as "any person required or authorized to be carried on a vessel for conservation and management purposes by regulations or permits under this Act." The Act also sets out guidelines for vessels carrying observers, observer training requirements, and observer status as federal employees.

All fishing vessels operating in this management unit, which includes catcher/processors, at-sea processors, and those vessels that harvest in the Washington, Oregon, and California area and land in another area, may be required to accommodate an observer or ~~video~~ electronic-monitoring system for the purpose of collecting scientific data or verifying landings and discard used for scientific data collection. An observer program will be considered only for circumstances where other data collection methods are deemed insufficient for management of the fishery. Implementation of any observer program or electronic monitoring will be in accordance with appropriate federal procedures, including economic analysis and public comment. Any federal program that requires the collection of information from fishery participants is also subject to the requirements of the Paperwork Reduction Act.

The Regional Administrator will implement an observer program through a Council-approved federal regulatory framework. Details of how observer coverage will be distributed across the West Coast groundfish fleet will be described in an observer coverage plan. NMFS will publish an announcement of the authorization of the observer program and description of the observer coverage plan in the *Federal Register*. Development and implementation of an observer program is done through the full rulemaking process at 6.2, D.

Electronic monitoring is an automated alternative to some human data collection systems. Electronic monitoring equipment can provide accurate, timely, and verifiable fisheries data at a lower cost than that provided by an at-sea observer. Electronic monitoring is an integrated assortment of electronic components combined with a software operating system. An electronic monitoring system typically includes one or more video cameras, a CPU with removable hard drive, and software that can integrate data from other components of a vessel's electronic equipment. The system autonomously logs video and vessel sensor data during the fishing trip without human intervention. When the vessel has completed its fishing operations and returned to port, the video and other data are transferred to a separate computer system for analysis. Video records are typically reviewed by human samplers on shore, but electronic techniques are being to developed to automate some of this activity. Electronic monitoring has been tested in various Canadian fisheries and has successfully addressed specific fishery monitoring objectives. NOAA Fisheries began testing electronic monitoring equipment in the 2004 shore-based whiting fishery, in order to determine whether a full-retention program could be adequately monitored by an electronic monitoring system. This FMP authorizes the use of electronic monitoring programs for appropriate sectors of the fishery. Development and implementation of an electronic monitoring program would be done through the full rulemaking process at 6.2, D.

There may be a priority need for observers on at-sea processing vessels to collect data normally collected at shore-based processing plants. Certain information for management of the fishery may be obtained from logbooks and other reporting requirements, but the collection of some types of data would be too onerous for some fishermen to collect. Processing vessels must be willing to accommodate onboard observers and may be required to verify that they are accommodating observers prior to issuance of any required federal permits.

6.4.1.2 Commercial Fisheries

The total catch accounting methodology for commercial groundfish fisheries has two main components: monitoring landed catch through reports by fish processors (fish receiving tickets) and at-sea observer programs to estimate bycatch. Because fishery observers are usually placed aboard only a fraction of the vessels in a given sector, their observations must be expanded using statistical methods in order to estimate total catch across a sector. For some fishery sectors there may not be any direct observation or reporting of bycatch; in such cases standard bycatch rates, developed using the best scientific information, may be used to estimate bycatch. When combined with information on landed catch, this gives an estimate of total catch. The Council uses total catch information in inseason management to determine the relationship between catch at a given point and an annual OY. Management measures within a given year may be adjusted based on total catch information in order to prevent total catch from exceeding OY levels. Fishery managers also use historic total catch data in stock assessments and to develop future harvest specifications and management measures.

[Section 6.5.2.4 Reporting Requirements]

The owner or operator of any vessel that retains fish harvested in the area managed by this FMP whose port of landing is outside the management area may be required to report those catches in a timely manner through a federal reporting program. They also may be required to submit a completed fish landing ticket from Washington, Oregon, or California, or an equivalent document containing all of the information required by the state on that fish ticket.

Monitoring Total and Landed Catch

Federal regulations require fishers to sort all species with trip limits, harvest guidelines, or OYs, including all overfished species. The states also require limited entry groundfish trawl fishermen to maintain logbooks to record the start and haul locations, time, and duration of trawl tows, as well as the total catch by species market category (i.e., those species and complexes with sorting requirements). Landings are recorded on state fish receiving tickets. Fishtickets are designed by the individual states, but there is an effort to coordinate record-keeping requirements with state and federal managers. Catch weight by sorted species category, area of catch, vessel identification number, and other data elements are required on fishtickets. Landings are also sampled in port by state personnel, who collect species composition data, otoliths for ageing, lengths, and other biological data. A suspension of at-sea sorting requirements coupled with full retention of catch is allowed in the whiting fishery under an EFP. Amendment 10 to the FMP authorized this suspension of at-sea reporting requirements through a rulemaking, rather than just through an EFP.

Landings, logbook data, and state port sampling data are reported inseason to the PacFIN database, which is managed by the PSMFC. The GMT and PSMFC manage the Quota Species Monitoring (QSM) dataset reported in PacFIN. All landings of groundfish stocks of concern (overfished stocks and stocks below B_{MSY}) and target stocks and stock complexes in West Coast fisheries are tracked in QSM reports of landed catch. ***[The GMT also recommends incorporation of modeled discards in QSM. The report is being modified to incorporate the discard estimates and to track total catch.]*** The GMT recommends prescribed landing limits and other inseason management measures to the Council to attain, but not exceed, total catch OYs of QSM species. Stock and complex landing limits are modified inseason to control total fishing-related mortality; QSM reports and landed catch forecasts are used to control the landed catch component.

Groundfish Observer Programs

Vessels participating in the at-sea Pacific whiting fishery have been carrying observers voluntarily since 1991. NMFS made observer coverage mandatory for at-sea processors in July 2004 (65 FR 31751). These provisions have not only given fishery managers the tools necessary to allow the at-sea Pacific whiting program to operate efficiently while meeting management goals, but have also provided scientists, through the observer coverage, an extensive amount of information on bycatch species in this fishery.

NMFS first implemented the West Coast Groundfish Observer Program (WCGOP) in August 2001, placing observers aboard commercial groundfish vessels to monitor discards. By regulation (50 CFR 660.360), all vessels that participate in commercial groundfish fisheries must carry an observer when notified to do so by NMFS or its designated agent. These observers monitor and record catch data, including species composition of retained and discarded catch. Observers also collect biological data, such as fish length, sex, and weight. The program currently deploys observers coastwide on the permitted trawl and fixed-gear groundfish fleet, as well as on some vessels that are part of the open-access groundfish fleet. Observers monitor between 10% and 20% of the catch, as a proportion of total landings. Given the skewed distribution of bycatch in West Coast groundfish fisheries, many observations in each sampling strata (gear type and area) are needed to estimate representative bycatch rates.

The FMP does not currently authorize foreign fisheries for groundfish. According to the Magnuson-Stevens Act, observers would be required on any foreign vessels operating in the Exclusive Economic Zone (EEZ).

6.4.1.2 Recreational Fisheries

Recreational catch is monitored by the states as it is landed in port. These data are compiled by the PSMFC in the RecFIN database. The types of data compiled in RecFIN include sampled biological data, estimates of landed catch plus discards, and economic data.

The Marine Recreational Fisheries Statistical Survey (MRFSS) is an integral part of the RecFIN program. The MRFSS uses field-intercept surveys to estimate catch and a random phone survey of coastal populations to estimate effort. The results of these two efforts are combined in the RecFIN database to estimate total fishing effort, fishing mortality, and other estimates useful for management. MRFSS was not designed to estimate catch and effort at the level of precision needed for inseason management or assessment. In recent years, the three states, NMFS, and PSMFC have been revamping the way that West Coast recreational fisheries data are collected so that the data system better supports inseason management. All three states have accelerated their reporting rates into RecFIN. Beginning in 2005, the states plan to provide recreational fisheries data within one month of the fishing activity; for example, fisheries data through the end of January would be available at the end of February.

The California Department of Fish and Game (CDFG), in cooperation with PSMFC, implemented the California Recreational Fisheries Survey (CRFS) in 2004. It employs the sort of comprehensive coverage used in the MRFSS program and the high-quality sampling methodology (for private recreational vessels) used by California's Ocean Salmon Project. The program is intended to produce more timely and accurate recreational catch estimates than were obtained in California by the MRFSS program.

[Ask ODFW & WDFW if they want recreational data systems described here.]

6.4.2 Vessel Compliance Monitoring Reporting Requirements

In addition to authorizing federal and state programs to collect total catch data, this FMP authorizes the collection of fisheries data needed for compliance monitoring. The following types of data may be collected through a regulatory program intended to ensure vessel compliance with fishery management measures:

[6.5.2.4 Reporting Requirements]

1. Vessel name.
2. Radio call sign.
3. Documentation number or federal permit number.
4. Company representative and telephone, fax, and/or telex number.
5. Vessel location including daily positions.
6. Check-in and check-out reports giving the time, date, location of the beginning or ending of any fishing activity.
7. Gear type.
8. Reporting area and period.
9. Duration of operation.
10. Estimated catch by species and area, species disposition (including discards, product type, and weights).
11. Product recovery ratios, products sold (in weight and value by species and product type, and if applicable, size or grade).
12. Any other information deemed necessary for management of the fishery.

Vessels also may be required to maintain and submit logbooks, accurately recording the following information in addition to the information listed above, and for a specified time period: daily and cumulative catch by species, effort, processing, and transfer information; crew size; time, position, duration, sea depth, and catch by species of each haul or set; gear information; identification of catcher vessel, if applicable; information on other parties receiving fish or fish products; and any other information deemed necessary.

Vessels may be required to inform a NMFS enforcement or U.S. Coast Guard office prior to landing or offloading any seafood product. Such vessels may also be required to report prior to departing the Washington, Oregon, and California management area with fish or fish products on board.

This FMP authorizes the use of vessel monitoring system (VMS) programs in order to improve compliance with area and/or season closures. VMS is a tool that is commonly used to monitor vessel activity in relationship to geographical defined management areas where fishing activity is restricted. VMS transceivers installed aboard vessels automatically determine the vessel's location and transmit that position to a processing center via a communication satellite. At the processing center, the information is validated and analyzed before being disseminated for fisheries management, surveillance, and enforcement purposes. VMS transceivers document the vessel's position using Global Positioning System (GPS) satellites. Depending on the defined need, position transmissions can be made on a predetermined schedule or upon request from the processing center. VMS transceivers are designed to be tamper resistant. The vessel operator is unable to alter the signal or the time of transmission and in most cases the vessel operator is unaware of exactly when the unit is transmitting the vessel's position. VMS programs used to improve compliance in several fisheries with differing area and/or season closures may require the use of a declaration system. A declaration system in association with VMS requires fishery participants declare their intended fishing activity, allowing enforcement personnel to differentiate between vessels subject to differing area and/or season closures.

New regulatory requirements for the collection of fishery-related data would need to be implemented through the full rulemaking process detailed at Section 6.2, D. Any federal program that requires the collection of information from fishery participants is also subject to the requirements of the Paperwork Reduction Act.

6.5 Bycatch Mitigation Program

[6.3.3 Measures to Control Bycatch]

Unquantified bycatch increases management risk because harvest limits may be inadvertently exceeded. Regulatory-induced discards are inefficient because society does not benefit from fish with economic value that are discarded to meet regulatory requirements. Bycatch can also include protected species and organisms comprising ecologically important biogenic habitat. Thus, more generally, bycatch may have broader environmental effects. The Magnuson-Stevens Act requires FMPs to include conservation and management measures that, to the extent practicable, minimize bycatch and the mortality of unavoidable bycatch (16 U.S.C. 1853(a)(11)). FMPs may also be subject to bycatch reduction requirements under the ESA, the MMPA, the MBTA, and other federal laws. Federal guidance on assessing the practicability of a potential management program is found at 50 CFR 600.350.

Working with NMFS, the states, and the tribes, the Council uses a three-part strategy to meet the Magnuson-Stevens Act's bycatch-related mandates: (1) gather data through a standardized total catch reporting methodology; (2) use federal/state/tribal agency partners to assess these data through bycatch models that estimate when, where, and with which gear types bycatch of varying species occurs; and (3) develop management measures that minimize bycatch and bycatch mortality to the extent practicable. The FMP's total catch reporting methodology is described in Section 6.4.1. Bycatch models that assess observer and other data to estimate bycatch amounts occurring in the different sectors of the fishery are routinely reviewed through the Council's SSC and GMT as part of the Council's harvest specifications and management measures rulemaking process. These models are intended to continuously improve the Council's use of the best available scientific information on species-to-species catch ratios. This section describes the Council's bycatch mitigation program and the management measures intended to minimize bycatch and bycatch mortality.

6.5.1 Bycatch of Groundfish Species in Groundfish Fisheries

Groundfish bycatch in the groundfish fisheries includes both groundfish that are discarded for regulatory reasons, such as a vessel having achieved a trip limit for one species within an assemblage, and groundfish that are discarded for economic reasons, such as a vessel having taken more fish than can be stored in its hold, or having taken more of a particular species than is desired by a processor. The Council may initiate new and practicable management measures to reduce groundfish bycatch in the groundfish fisheries under either the harvest specifications and management measures rulemaking process (6.2, C.) or full rulemaking process (6.2, D.) It is usually through the harvest specifications development process that the Council is made aware of new data and analyses on groundfish bycatch and bycatch mortality rates. The Council manages its groundfish fisheries to allow targeting on more abundant stocks while constraining the total mortality of overfished and precautionary zone stocks. For overfished stocks, measures to constrain total mortality are primarily intended to reduce bycatch of those stocks. The FMP defines stock status of overfished, precautionary zone, and more abundant stocks at Section 4.5. Management measures the Council has used to reduce total catch of overfished species are detailed for each species at 4.5.4. At Section 4.6, the FMP requires that landed catch OYs be reduced from total catch OYs to account for bycatch mortality.

The Council has all of the management measures detailed in Sections 6.5 – 6.10 at its disposal to manage directed catch and reduce bycatch of groundfish species in the groundfish fisheries. Because of the interaction among the various species and the regular incorporation of new information into the management system, the details of the specific measures will change over the years, or within years, based on the best available science. Management measure will be designed taking into account the co-occurrence ratios of target stocks with overfished stocks. To protect overfished species and minimize bycatch through reducing incidental catch of those species, the Council will particularly use, but is not limited to: catch restrictions detailed in Section 6.7 to constrain the catch of more abundant stocks that commingle with overfished species, in times and areas where higher abundance of overfished species are expected to occur; the appropriate time/area closures detailed in Section 6.8 and designed to prevent vessels from operating during times when or in areas where overfished species are most vulnerable to a particular gear type or fishery; and gear restrictions described in Section 6.6, where that gear restriction has been shown to be practicable in reducing overfished species incidental catch rates.

6.5.2 Bycatch of Non-Groundfish Species in Groundfish Fisheries

[6.3.1 Bycatch of Nongroundfish Species]

Certain non-groundfish species may be taken incidentally in fisheries targeting groundfish. This FMP authorizes management measures to minimize, to the extent practicable, the bycatch of non-groundfish species. Non-groundfish species subject to bycatch minimization measures may be marine fish species managed under another Council FMP, or marine animals or plants not managed with an FMP, yet subject to the protections of the ESA, the MMPA, the MBTA, or other federal laws.

Generally, the Council will initiate the process of establishing or adjusting management measures when a resource problem with a non-groundfish species is identified and it has been determined that groundfish fishing regulations would reduce the total impact on that species or stock. This would usually occur when a state or federal resource management agency (such as the U.S. Department of the Interior, NMFS, or state fishery agency) or the Council's Salmon Technical Team (STT) presents the Council with information substantiating its concern for a particular species. The Council will review the information and refer it to the Scientific and Statistical Committee (SSC), GMT, STT, or other appropriate technical advisory group for evaluation. If the Council determines, based on this review, that management measures may be necessary to prevent harm to a non-groundfish species facing conservation problems or to address requirements of the ESA, MMPA, other relevant federal natural resource law or policy, or international agreement, it may implement appropriate management measures in accordance with the procedures identified in Section 6.2. The intention of the measures may be to share conservation burdens while minimizing disruption of the groundfish fishery, but under no circumstances may the intention be simply to provide more fish to a different user group or to achieve other allocation objectives.

6.5.2.1 Endangered Species Act Species

Marine species protected under the ESA that are not otherwise protected under either the MMPA or the MBTA (see below) include various salmon and sea turtle species. Threatened and endangered Pacific salmon runs are protected by a series of complex regulations affecting marine and terrestrial activities. In the West Coast groundfish fisheries, management measures to reduce incidental salmon take have focused on the Pacific whiting fisheries, which have historically encountered more salmon than the non-whiting groundfish fisheries. Salmon bycatch reduction measures include marine protected areas where Pacific whiting fishing is prohibited (See 6.8.4), an at-sea observer program intended to track whiting and incidental species take inseason (See 6.4.1.1), Sea turtles are rare in areas where groundfish fisheries are prosecuted and the incidental take of a sea turtle has not been documented in any directed groundfish fishery. ***[Discuss ESA consultations when complete.]***

6.5.2.2 Marine Mammal Protection Act Species

Bycatch of marine mammals is addressed under the MMPA and its implementing regulations. Section 118 of the MMPA requires that NMFS place all commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals that occur in each fishery. To implement this requirement, NMFS publishes a list of U.S. commercial fisheries and categorizes their effects on marine mammals. Directed West Coast groundfish fisheries have consistently been categorized as Category III fisheries, meaning that they are "commercial fisher[ies] determined by the [NMFS] Assistant Administrator to have a remote likelihood of, or no known incidental mortality and serious injury of marine mammals." ***[Discuss ESA consultation when complete.]***

6.5.2.3 Migratory Bird Treaty Act Species

Bycatch of seabirds is addressed under the MBTA and its implementing regulations. The MBTA implements various treaties and conventions between the U.S. and Canada, Mexico, Japan, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful. The U.S. Fish and Wildlife Service (FWS) is the federal agency responsible for management and protection of migratory birds, including seabirds. NMFS is required to consult with the FWS if fishery management plan actions may affect seabird species listed as endangered or threatened. In February 2001, NMFS adopted a National Plan of Action (NPOA) to Reduce the Incidental Take of Seabirds in Longline Fisheries. This NPOA contains guidelines that are applicable to the groundfish fisheries and would require seabird incidental catch mitigation if a significant problem is found to exist. In the limited entry groundfish longline fleet off the coast of Washington, Oregon, and California during September 2001 - October 2002, there were no incidental seabird takes documented by West Coast Groundfish Observers. ***[Update with more recent WPGOP data and discuss ESA consultation when complete.]***

6.5.3 Measures to Reduce Bycatch and Bycatch Mortality

Over the life of the FMP, the Council has used a suite of measures to reduce bycatch and bycatch mortality in the groundfish fisheries. Early bycatch reduction measures concentrated on trawl net modifications intended to reduce the bycatch of juvenile groundfish (See Section 6.6.1). In 1993, the Council addressed concerns over potential bycatch of endangered or threatened salmon in the whiting fishery by imposing the Columbia River and Klamath River Conservation Zones (See Section 6.8.4). Since 2000, the Council has concentrated its bycatch reduction efforts on constraining total catch of overfished species through gear restrictions (See Section 6.6), catch restrictions (See Section 6.7), time/area closures (See Section 6.8), and effort restrictions (See 6.9). The Council and NMFS have also used permit restrictions and effort reduction programs (See 6.9) to reduce total and incidental catch in the groundfish fisheries. Effort reduction measures implemented in recent years include the sablefish endorsement and tier program for the limited entry fixed gear fleet and the vessel/permit buyback program for the limited entry trawl fleet.

Any of the measures specified in 6.5 through 6.10 may, where practicable, be used to reduce groundfish or non-groundfish bycatch in the groundfish fisheries. The Council will develop measures to reduce bycatch and bycatch mortality in accordance with the points of concern or the socioeconomic framework provisions of the FMP. The process for implementing and adjusting such measures may be initiated at any time. New bycatch reduction management measures would need to be developed through either the harvest specifications and management measures rulemaking process (6.2, C.) or the full rulemaking process (6.2, D.). In addition, some measures may be designated as routine, which would allow adjustment at a single meeting based on the factors provided for in Section 6.2.1. Beyond the directed catch and bycatch management measures provided in Sections 6.6 through 6.10, this section 6.5.3 provides additional bycatch and bycatch mortality reduction programs available for Council use.

6.5.3.1 Full Retention Programs

A full retention program is a regulatory regime that requires participants in a particular sector of the fishery to retain either all of the fish that they catch or all of some species or species group that they catch. Requiring full retention of all or a portion of a vessel's catch allows more careful enumeration of total catch under appropriate monitoring conditions. Full retention requirements also encourage affected fishery participants to tailor their fishing activities so that they are less likely to encounter non-target species. The Council may develop full retention programs for the groundfish fisheries, when such programs are accompanied by an appropriate monitoring mechanism (See 6.4) and where such programs are sufficiently enforceable (See 6.10) such that they are not expected to increase total mortality of overfished species.

6.5.3.2 Sector-specific and Vessel-specific Total Catch Limit Programs

Total catch limits are described in 6.7.1. A sector-specific total catch limit program is one in which a fishery sector would have access to a pre-determined (probably through the harvest specifications and management measure process, 6.2, C) amount of an overfished species that would be allowed to be taken with the target species or species group for that sector. A sector-specific total catch limit program could be based on either: 1) monitoring of landed catch and inseason modeling of total catch based on past landed catch and bycatch rates, or 2) monitoring of total catch and real-time delivery of total catch data. If a sector-specific total catch limit program is based on inseason monitoring of landed catch, a sector would close when inseason total catch modeling estimated that the sector had achieved an overfished species total catch limit. If a sector-specific total catch limit program is based on inseason monitoring of total catch, a sector would close when inseason total catch monitoring estimated that the sector had achieved an overfished species total catch limit. If inseason monitoring of total catch is possible, sector participants in a sector-specific total catch limit program could either fish in an open competition with each other for total catch limits or could cooperate with each other to keep the total catch of non-target species below total catch limits.

Vessel-specific total catch limits are essentially non-tradable individual vessel quotas (See 6.9.3) of an overfished species and require more intense monitoring than a sector-specific total catch limit program. Under a vessel-specific total catch limit program, the participating vessels would be monitored inseason and each vessel would be prohibited from fishing once it had achieved its total catch limit for a given overfished species. The Council may develop sector- and/or vessel-specific total catch limit programs for the groundfish fisheries, when such programs are accompanied by an appropriate monitoring mechanism (See 6.4) and where such programs are sufficiently enforceable (See 6.10) such that they are not expected to increase vessel detection-avoidance activities.

In developing a sector-specific total catch program, the Council will initially consider the following 10 groundfish fishery sectors for assignment of total catch limits:

1. Limited entry trawl
2. Limited entry longline
3. Limited entry pot
4. At-sea Pacific whiting catcher-processors
5. At-sea Pacific whiting motherships
6. Shore-based Pacific whiting catcher boats

7. Directed open access (defined as vessels other than those in the tribal sector without a groundfish limited entry permit for which *more than 5%* of their total landings, by weight, is groundfish)
8. Incidental open access (defined as vessels other than those in the tribal sector without a groundfish limited entry permit for which *5% or less* of their total landings, by weight, is groundfish)
9. Tribal vessels targeting groundfish (see Section 6.2.4)
10. Recreational vessels, including charter (for hire) vessels

Sector-specific total catch limits may be applied to one or more of these sectors and separate limits may apply to one or more overfished species stock. Two or more of these sectors may be grouped and assigned an overall total catch limit for a given overfished species; similarly, any of the 10 sectors may be further subdivided to create additional sectors for the purpose of assigning a total catch limit for a given overfished species. In considering which sectors should be assigned a total catch limit for a given overfished species, the Council will consider current and/or projected total catch of the overfished species by vessels in that sector and the capacity of current monitoring programs to provide sufficiently accurate and timely data to manage to a total catch limit, or the feasibility of establishing such a monitoring program for the sector in question.

6.5.3.3 Catch Allocation to, or Gear Flexibility For, Gear Types With Lower Bycatch Rates

Catch allocations (Section 6.3), catch limits (Section 6.7), and fishing areas (Section 6.8) may be set so that users of gear types with lower bycatch rates have greater fishing opportunities than users of gear with higher bycatch rates. Increased fishing opportunities for users of gear types with lower bycatch rates could come in the form of increased overall amounts of fish available for directed or incidental harvest, increased landings limits, or increased allowable fishing areas. Increased fishing opportunities made available under this provision may not be provided in such a way that the number of fishing vessels participating in the groundfish fisheries is expected to increase.

Recreational Catch and Release Management

[6.4 Recreational Catch and Release Management]

The Council may develop recreational catch-and-release programs for any groundfish stock through the ~~appropriate rulemaking process~~ <u>either the harvest specifications and management measures rulemaking (6.2, C.) or the full rulemaking (6.2, D.) processes.</u> The Council will assess the type and amount of groundfish caught and released alive during fishing under such a program and the mortality of such fish. Management measures for such a program will, to the extent practicable, minimize mortality and ensure extended survival of such groundfish.

6.6 Gear Definitions and Restrictions

The Council uses gear definitions and restrictions to protect juvenile fish (trawl mesh size), to disable lost gear so that it no longer catches fish (biodegradable escape panels for pots), to slow the rates of catch in particular sectors (recreational fisheries hook limits), to reduce bycatch of non-target species (trawl configuration requirements), and to protect marine habitat (trawl roller gear size restrictions.) Gear types permitted for use in the West Coast groundfish fisheries in Federal waters are listed in Federal regulations at 50 CFR 660.302 and in a nationwide list of fisheries at 50 CFR 600.725. No vessel may fish for groundfish in Federal waters using any gear other than those authorized in Federal regulations. Gear definitions and restrictions for both the commercial and recreational fisheries may be revised using either the specifications-and-management-measures rulemaking process (6.2, C.) or the full rulemaking process (6.2, D.). When developing revisions to gear definitions and restrictions, the Council shall consider the expense of such revisions to fishery participants and the time required for participants to work with gear manufacturers to meet new requirements.

6.6.1 Commercial Fisheries

[6.5.2.3 Gear Restrictions]

This ~~plan~~ FMP authorizes the use of trawls, pots (traps), longlines, hook-and-line (mobile or fixed) and setnets (gillnets and trammel nets) as legal gear for the commercial harvest of groundfish. The use of setnets is prohibited in all waters north of 38E N. latitude.

6.6.1.1 Trawl Gear

[11.2.1.1 Trawl gear and 6.1.2 Mesh Size]

Trawl gear is a cone or funnel-shaped net, which is towed or drawn through the water by one or two vessels. Trawls are used both on the ocean bottom and off bottom. They may be fished with or without trawl doors. They may employ warps or cables to herd fish. Trawl gear includes roller, bottom, and pelagic (mid-water) trawls, and, as appropriate, trawls used to catch non-groundfish species but which incidentally intercept groundfish. Trawl gear is complex, usually constructed from several panels of mesh and engineered with varying ropes, chains, and trawl doors to target particular sizes, shapes, or species of fish. The Council has historically worked with the trawl industry and the states, usually through the issuance of EFPs, to develop new trawl gear restrictions intended to accomplish one or more FMP goals, usually the reduction of bycatch. The following discussion of the Council's efforts to modify trawl gear provides examples of the types of trawl gear modifications that may be made to meet FMP goals, but does not limit the range of future trawl gear restrictions.

In the early-mid 1990s, the Council engaged the trawl industry in a series of discussions on modifying trawl nets to minimize juvenile fish bycatch. Since 1995, bottom trawl nets have been required to be constructed with a minimum mesh size of 4.5 inches, and pelagic trawl nets with a minimum mesh size of 3 inches. Minimum net mesh sizes are intended to allow immature fish to pass through trawl nets. To ensure the success of minimum mesh size restrictions in allowing juvenile fish to escape trawl nets, the Council also developed restrictions preventing trawlers from using a double-walled codend. Further restrictions related to this objective include prohibitions on encircling the whole of a bottom trawl net with chafing gear and restrictions on the minimum mesh size of pelagic trawl chafing gear (16 inches.)

In 2000, the Council began to distinguish between large and small footrope trawl gear. Large footrope gear is bottom trawl gear with a footrope diameter larger than 8 inches, including any material (rollers, bobbins, etc.) encircling the footrope. Small footrope gear is bottom trawl gear with a footrope diameter of 8 inches or smaller. Pelagic trawl gear is required to have unprotected footrope gear and is not permitted to be encircled with chains, rollers, bobbins, or other material. Initially, the Council used the distinction between large and small footrope gear to prohibit large footrope use for less abundant, nearshore, and continental shelf species. Large footrope gear allows trawlers to access rockier areas, by bouncing the bottom of the trawl net over larger obstructions without tearing. Allowing only small footrope gear in nearshore and shelf areas was intended to reduce trawl access to newly-designated overfished species and their rockier habitats.

Since the Council introduced RCAs in 2002 (through emergency rulemaking, later made permanent regulations), large footrope trawl gear has been prohibited inshore of the western boundary of the trawl RCA. RCA boundary lines are set to approximate ocean bottom depth contours and the western boundary of the trawl RCA has not been shallower than a line approximating the 150 fm depth contour. (See 6.8.3 for the use of RCAs as a management tool.) Six of the eight overfished species are continental shelf species and this restriction on the use of large footrope gear continues to reduce trawler access to rocky nearshore habitat. Over time, these footrope size restrictions, coupled with restricted landing limits, have re-configured trawl activities in the nearshore area so that they primarily target the more abundant flatfish species.

In 2005, the Council introduced new trawl gear requirements for small footrope trawl gear north of 40°10.00' N. latitude. Trawlers operating inshore of the Trawl RCA are required to use selective flatfish trawl gear, which is configured to reduce bycatch of rockfish while allowing the nets to retain flatfish. Selective flatfish trawl nets have an ovoid trawl mouth opening that is wider than it is tall and the headropes on these nets are recessed from the trawl mouth. This combination of a flattened oval shape and a recessed headrope herds flatfish into the trawl net while allowing rockfish to slip up and over the headrope, never entering the net. Groundfish trawlers worked with the State of Oregon to develop these nets in order to have greater access to healthy flatfish stocks. The Council is working with the State of California to determine whether the selective flatfish trawl net is also effective at reducing the bycatch of southern overfished species in fisheries targeting more abundant southern stocks.

6.6.1.2 Nontrawl Gear

[11.2.1.3 Nontrawl gear; 11.2.1.2 Fixed gear]

Nontrawl gear includes all legal commercial gear other than trawl gear. Fixed gear (anchored nontrawl gear) includes longline, pot, set net, and stationary hook-and-line gear. Fixed gear must be marked, individually or at each terminal end as appropriate, with a pole, flag, light, and radar reflector attached to each end of the set, and a buoy clearly identifying the owner. In addition, fixed gear shall not be left unattended for more than seven days. Reporting of fixed gear locations is not required, but fixed gear fishermen are encouraged to do so with the U.S. Coast Guard. Reporting of fixed gear will facilitate compensation claims by fishermen who have lost fixed gear.

Since 1982, groundfish traps have been required to be constructed with biodegradable escape panels in such a manner that an opening of at least 8 inches in diameter results when the escape panel deteriorates. These biodegradable panels ensure that, if a trap is lost or not attended for extended periods of time, it will not continue to fish. Gear that has been lost and continues to capture fish while it is unattended is often referred to as ghost fishing gear.

Mesh size in fish pots (traps) also affects the size of fish retained in the trap. By increasing the minimum mesh size in all or part of the trap, small fish may be allowed to escape. There are no minimum mesh size requirements for groundfish pot vessels. However, sablefish is the primary trap gear target species and fishermen are usually paid more per pound for larger-sized sablefish. Thus, there are few incentives for trap fishermen to use smaller mesh sizes. ***[Check with GAP to see if there's a mesh size that's generally considered minimum for sablefish. Also, what about nearshore groundfish (cabezon, kelp greenling) take with traps in the open access fishery?]***

6.6.2 Recreational Fisheries

[11.2.2 Recreational Fishing]

Recreational fishing is fishing with authorized gear for personal use only, and not for sale or barter. The only types of fishing gear authorized for recreational fishing are hook-and-line and spear. The definition of hook-and-line gear for recreational fishing is the same as for commercial fishing. Hook limits, restrictions on the number of hooks that may be used per fishing line, or on the size or configuration of hooks used in a recreational fishery, have been established as routine management measures under 6.2.1. Hook limits are used in the recreational fishery to either constrain recreational fishery effort by limiting the number of hooks per fishing line, or to select for certain species by limiting the size of hooks used.

6.7 Catch Restrictions

[6.5.2.2 Catch Restrictions]

The FMP authorizes the commercial and recreational harvest of species listed in Chapter 3 of this plan, and provides for limiting the harvest of these species in Chapters 5 and 6. The Council uses a variety of management measures to constrain rates of total catch, including direct limits on amounts that may be taken and landed in commercial and recreational fisheries. Trip limits constrain landed catch in the commercial fisheries; bag limits constrain landed catch in the recreational fisheries. Total catch limits constrain incidental catch amounts permitted in a particular fishery or sector and may refer to either amounts of incidentally caught non-target species that are not discarded (not considered bycatch under the Magnuson-Stevens Act), to amounts of non-target species that are discarded, or to both. Designating certain species as prohibited ensures that the FMP complies with international, Federal, and state regulations and management requirements for non-groundfish species.

[11.4 Catch Restrictions]

Groundfish species harvested directly or incidentally in the territorial sea (0-3 nautical miles) will be counted toward any catch limitations established under the authority of this FMP. These catch restrictions apply to domestic fisheries off Washington, Oregon, and California. Procedures for designating and adopting catch restrictions are found in Section 6.2.

6.7.1 All Fisheries

Quotas, size limits, and total catch limits may be applied to either commercial (groundfish or non-groundfish) or recreational fisheries.

[6.1.4 Quotas, Including Individual Transferable Quotas]

Quotas. Quotas are specified harvest limits, the attainment of which causes closure of the fishery for that species, gear type, or individual participant. Quotas may be established for intentional allocation purposes or to terminate harvest at a specified point. They may be specified for a particular area, gear type, time period, species or species group, and/or vessel or permit holder. Quotas may apply to either target species or bycatch species.

[6.1.6 Size Limits]

Size limits. Size limits are used to prevent the harvest of immature fish or fish that have not reached their full reproductive capacity. In some cases, size limits are used in reverse to harvest younger recruit or pre-recruits and to protect older, larger spawning stock. ~~Generally, harvesting the larger members of the population tends to increase the yield by taking advantage of the combined growth of individual fish.~~ Slot limits, which prohibit the retention of fish that are either smaller than a lower size limit or larger than a higher size limit, are used to protect both immature fish and more fecund older fish. Size limits may be applied to all fisheries, but are generally used where fish are handled individually or in small groups such as trap-caught sablefish and recreational-caught fish. Size limits lose their utility in cases where the survival of the fish returned to the sea is low (e.g., rockfish).

Total catch limits. The Council has historically managed total catch of overfished species by monitoring direct and incidental catch inseason, and then making inseason adjustments to catch and other restrictions to ensure that annual total catch does not exceed allowable harvest amounts. Expected bycatch amounts of overfished species are set aside as anticipated incidental take in various fisheries. Total catch limits, by contrast, are sector-specific or vessel-specific limits on total catch (landed and discarded catch) of an overfished or otherwise protected non-target species taken within a fishery targeting a more abundant stock. Total catch is defined as landed catch plus bycatch (discard) mortality. In setting the biennial specifications and management measures, the Council will review the total harvestable surplus of the overfished and/or protected species and determine whether there are fishery sectors that may be managed with total catch limits. If a sector or vessel achieves a total catch limit of an overfished species, the fishery for the target species would be closed inseason, even if the allowable harvest of the target species had not been achieved. Fisheries managed with total catch limits must also be subject to monitoring and requirements that provide real-time or projected total catch reporting (See 6.4).

6.7.2 Commercial Fisheries

[6.5.2.2 Catch Restrictions]

Prohibited Species. It is unlawful for any person to retain any species of salmonid or Pacific halibut caught by means of fishing gear authorized under this FMP, except where a Council approved monitoring program is in effect. State regulations prohibit the landing of crab incidentally caught in trawl gear off Washington and Oregon. However, trawl fishermen may land Dungeness crab in the State of California in compliance with the state landing law. ***[Need to check with CA on whether this is still valid. In Federal regulations, Dungeness crab has the same prohibited status as salmon and halibut.]*** Retention of salmonids and Pacific halibut caught by means of other groundfish fishing gear is also prohibited unless authorized by 50 CFR Part 300, Subparts E or F; or Part 600, Subpart H. Specifically, salmonids are prohibited species for trawl, longline and pot gear. Halibut may be retained and landed by troll and longline gear only during times and under conditions set by International Pacific Halibut Commission and/or other Federal regulations. Salmon taken by troll gear may be retained and landed only as specified in troll salmon regulations. Groundfish species or species groups under this FMP for which the quota has been reached shall be treated in the same manner as prohibited species. Species identified as prohibited must be returned to the sea as soon as practicable with a minimum of injury when caught and brought aboard, after allowing for sampling by an observer, if any. Exceptions may be made for the recovery of tagged fish.

The FMP authorizes the designation of other prohibited species in the future or the removal of a species from this classification, consistent with other applicable law for that species. The designation of other prohibited species or the removal of species from this classification must be made through either the biennial or annual specifications-and-management-measures rulemaking process (6.2, C.) or through the full rulemaking process (6.2, D.)

[6.1.3 Landing and Frequency Limits]

Trip limits. A trip limit is the amount of groundfish that may be taken and retained, possessed, or landed from a single fishing trip. Trip limits, trip frequency limits, and trip limits that vary by gear type or fishery may be applied to either groundfish or non-groundfish fisheries. Trip landing limits and trip frequency limits are used to control landings to delay achievement of a quota or harvest guideline and thus avoid premature closure of a fishery if it is desirable to extend the fishery over a longer time. Trip landing limits may also be used to minimize targeting on a species or species group while allowing landings of some level of incidental catch. Trip landing limits are most effective in fisheries where the fisherman can control what is caught. In a multispecies fishery, trip limits can discourage targeting while, at the same time, providing for the landing of an incidental catch species that requires a greater degree of protection than the other species in the multispecies catch. Conversely, a trip limit may be necessary to restrict the overall multispecies complex catch in order to provide adequate protection to a single component of that catch.

[9.0 Restrictions on Other Fisheries]

Trip limits for non-groundfish fisheries. For each non-groundfish fishery considered, a reasonable limit on the incidental groundfish catch may be established that is based on the best available information (from EFPs, logbooks, observer data, or other scientifically acceptable sources). These limits will remain unchanged unless substantial changes are observed in the condition of the groundfish resource or in the effort or catch rate in the groundfish or non-groundfish fishery. Incidental limits or species categories may be imposed or adjusted in accordance with the appropriate procedures described in Section 6.2. The Secretary may accept or reject but not substantially modify the Council's recommendations. ~~The trip limits for the pink shrimp and spot and ridgeback prawn fisheries in effect when Amendment 4 is implemented will be maintained unless modified based on the above criteria through the management adjustment framework.~~ The objectives of this framework are to:

- Minimize discards in the non-groundfish fishery by allowing retention and sale, thereby increasing fishing income;
- Discourage targeting on groundfish by the non-groundfish fleet; and,
- Reduce the administrative burden of reviewing and issuing EFPs for the sole purpose of enabling non-groundfish fisheries to retain groundfish.

6.7.3 Recreational Fisheries

[6.1.7 Bag Limits]

Bag limits. A bag limit is a restriction on the number of fish that may be taken and retained by an individual angler operating in a recreational fishery, usually within a period of a single day. Bag limits have long been used in the recreational fishery and are perhaps the oldest method used to control recreational fishing. The intended effect of bag limits is to spread the available catch over a large number of anglers and to avoid waste.

Boat limits. A boat limit is a cumulative restriction on the total number of fish that may be taken and retained by all of the persons operating from a recreational fishery vessel. Boat limits restrict the overall per-vessel catch in a recreational fishery. A boat limit may prevent an angler from taking what would otherwise be allowed within an individual bag limit, depending on the number of fish already taken on that boat.

Dressing requirements. Anglers may be subject to requirements that they retain the skin on their filleted catch in order to allow port biologists and enforcement officers to better identify recreational catch by species.

6.8 Time/Area Closures

The Council uses a variety of time/area closures both to control the directed rate of catch of targeted species and to reduce the incidental catch of non-target, protected (including overfished) species. Time/area closures vary by type both in their permanency and in the size of area closed. When the Council sets fishing seasons (Section 6.8.1) it generally uses latitude lines extending from shore to the EEZ boundary to close large sections of the EEZ for part of a fishing year to one or more fishing sectors. Rockfish Conservation Areas (RCAs at 6.8.2), by contrast, are coastwide fishing area closures bounded on the east and west by lines connecting a series of coordinates approximating a particular depth contour. RCAs are gear-specific and their eastern and western boundaries may vary during the year. RCAs also may be polygons that are closed to fishing for a brief period (less than one year) in order to provide short-term protection for the more migratory overfished or other protected species. Groundfish fishing areas (GFAs at 6.8.3) are enclosed areas of high abundance of a particular species or species group and may be used to allow targeting of a more abundant stock within that enclosed area. Marine Protected Areas (MPAs at 6.8.4) are longer-term, discrete closed areas with unchanging boundary lines that may apply to one or more fishing sectors. Because the RCAs, the

Yelloweye Rockfish Conservation Area, and the Cowcod Conservation Areas have all been implemented to protect overfished groundfish species, they are collectively referred to in Federal regulations as Groundfish Conservation Areas or GCAs.

[6.1.8 Time/Area Closures (Seasons and Closed Areas)]

6.8.1 Seasons

Fishing seasons are closures of all or a portion of the West Coast EEZ for a particular period and time of year. Seasons may be used to constrain the rate of fishing on a targeted species, to encourage targeting of a more abundant stock during periods of higher aggregation, or to limit catch of a protected species during its spawning season. Seasons may be for the entire fleet, for particular sectors within the fleet, for regions of the coast, or for individual vessels. Designation and adoption of seasons must be made through either a specifications-and-management-measures rulemaking (6.2, C.) or a full rulemaking (6.2, D.)

Seasons have been used to manage the commercial Pacific whiting trawl and limited entry fixed gear fisheries. The non-tribal whiting fishery is divided into three sectors: catcher boats that deliver to shorebased processing plants, catcher vessels that deliver to motherships at sea, and at-sea catcher-processors. Each of these sectors is managed with its own season. The shorebased sector also includes an early season for waters off California, to allow vessels in that area to access whiting when it is migrating through waters off California. The limited entry, fixed gear sablefish fishery is managed with a seven-month season, April through October. Outside the primary seasons for both whiting and fixed gear sablefish, incidental catch allowances of these species are provided to allow retention of incidental catch.

In addition to the whiting and sablefish seasons, intended to constrain the directed catch of the target stocks within a particular period, commercial fisheries may be constrained by season to protect overfished species. Lingcod are known to spawn and nest in the winter months. Male lingcod guard the nests and are easily caught with hook-and-line gear during the nesting period. Lingcod has a higher rate of discard survival than many other groundfish species; however, lingcod eggs are easy prey if the guarding male is removed from the nest. Commercial non-trawl and recreational fisheries closures during the winter months have been part of the lingcod rebuilding strategy since 2000 and are discussed in the rebuilding plan at 4.5.4.4.

Recreational fisheries also may be managed with fishing seasons, either to constrain the directed catch of target species or to reduce the incidental catch of protected species. Winter recreational fisheries season closures for lingcod, particularly off Washington and Oregon ***[JDD- Washington and California?]*** are part of the lingcod rebuilding strategy. Fishing seasons with one or more closed periods during the fishing year are intended to reduce catch rates of both more abundant and protected stocks. Seasonal closures are used off all three states—in combination with bag limits, RCAs, and other measures—to prevent recreational fisheries from exceeding expected harvest levels.

6.8.2 Rockfish Conservation Areas

In September 2002, NMFS implemented an emergency rule at the Council's request to implement a Darkblotched Rockfish Conservation Area to close continental shelf/slope waters north of 40°10.00' N. latitude. Since January 2003, the Council has used coastwide RCAs to reduce the incidental catch of overfished species in waters where they are more abundant. Of the eight currently overfished species, six are continental shelf species, and RCAs have primarily been designed to close continental shelf waters. Section 4.5.4 describes the role of RCAs play in this FMP's overfished species rebuilding plans.

Different gear types have greater or lesser effects on different overfished species. Thus, RCAs are designed to be gear-specific to better target protection for the species most affected by each gear group. For example, darkblotched rockfish and POP are continental slope species that are most frequently taken with trawl gear, which means that the Trawl RCA must extend out to greater depths in order to protect these species. Yelloweye rockfish, in contrast, is more frequently taken with hook-and-line gear, which means that both the commercial and recreational hook-and-line fisheries require yelloweye rockfish protection measures as part of that species' rebuilding plan. The Non-Trawl RCA is concentrated over the continental shelf, while the recreational fisheries use season closures and an MPA to reduce yelloweye rockfish bycatch.

RCAs are typically bounded on the east and west by lines drawn between a series of latitude/longitude coordinates approximating certain depth contours. An RCA may also be a polygon, designated by lines drawn between a series of latitude/longitude coordinates, which is closed to fishing for some period less than a year in duration. Some RCAs may extend to the shoreline. Although both the eastern and western RCA boundaries have changed over time for all of the gear groups, the area between the trawl RCA boundary lines approximating the 100 fm and 150 fm depth contours has remained closed since January 2003. Adopted potential RCA boundary lines are described in Federal regulations at 50 CFR 660.390-394. The size and shape of the RCAs may be adjusted inseason via the routine management measures process (See 6.2.1) by using previously adopted potential RCA boundary lines. Designation and adoption of new potential RCA boundary lines must be made through either a specifications-and-management-measures rulemaking (6.2, C.) or a full rulemaking (6.2, D.)

6.8.3 Groundfish Fishing Areas

Groundfish Fishing Areas or GFAs are areas of known higher abundance of a particular species or species group, enclosed by straight lines connecting a series of coordinates. A GFA designated for a more abundant species may be used to constrain fishing for that species within that particular GFA. For example, fishing for schooling species, such as petrale sole or chilipepper rockfish, could be allowed within GFAs for those species, but not permitted outside of the GFAs, where fisheries for those species might have higher incidental catches of overfished species.

Designation and adoption of GFAs must be made through either a specifications-and-management-measures rulemaking (6.2, C.) or a full rulemaking (6.2, D.)

6.8.4 Marine Protected Areas

Executive Order 13158 on MPAs was signed on May 26, 2000. This E.O. defines MPAs as "any area of the marine environment that has been reserved by federal, state, territorial, tribal or local laws or regulations to provide lasting protection to part or all of the natural or cultural resources therein." Under this FMP, MPAs include all marine areas closed to fishing for any or all gear group(s), by the FMP or implementing Federal regulations for conservation purposes, and which have stable boundaries over time (thereby providing lasting protection). The Council uses a variety of time/area closures to reduce incidental catch of protected species in fisheries targeting groundfish; as of January 1, 2005, five of those closures were considered MPAs under E.O. 13158:

1. Klamath River Conservation Zone (KRCZ): Established in Federal regulations in 1993 to reduce the bycatch of threatened and endangered salmon stocks taken incidentally in the Pacific whiting fisheries. The KRCZ is closed to trawling for whiting. Its boundaries are defined as the ocean area surrounding the Klamath River mouth, bounded on the north by 41°38.80 N. latitude, on the west by 124°23.00' W. long., and on the south by 41°26.63' N. latitude.

2. Columbia River Conservation Zone (CRCZ): Established in Federal regulations in 1993 to reduce the bycatch of threatened and endangered salmon stocks taken incidentally in the Pacific whiting fisheries. The CRCA is closed to trawling for whiting. Its boundaries are defined as the ocean area surrounding the Columbia River mouth, bounded by a line extending for 6 nautical miles due west from North Head along 46°18.00' N. latitude to 124°13.30' W. longitude., then southerly along a line of 167 True to 46°11.10' N. latitude by 124°11.00' W. longitude, then northeast along Red Buoy Line to the tip of the south jetty.

3. Western Cowcod Conservation Area (CCA): First established via Federal notice in 2001 as an overfished species rebuilding measure. Incorporated into the FMP (Section 4.5.4.6) via Amendment 16-3 and established in Federal regulation in 2005 to reduce the bycatch of cowcod taken incidentally in all commercial and recreational fisheries for groundfish. The Western CCA is an area south of Point Conception defined by the straight lines connecting the following specific latitude and longitude coordinates in the order listed:

33°50.00' N. lat., 119°30.00' W. long.;
33°50.00' N. lat., 118°50.00' W. long.;
32°20.00' N. lat., 118°50.00' W. long.;
32°20.00' N. lat., 119°37.00' W. long.;
33°00.00' N. lat., 119°37.00' W. long.;
33°00.00' N. lat., 119°53.00' W. long.;
33°33.00' N. lat., 119°53.00' W. long.;
33°33.00' N. lat., 119°30.00' W. long.;
and connecting back to 33°50.00' N. lat., 119°30.00' W. long.

4. Eastern CCA: First established via Federal notice in 2001 as an overfished species rebuilding measure. Incorporated into the FMP (Section 4.5.4.6) via Amendment 16-3 and established in Federal regulation in 2005 to reduce the bycatch of cowcod taken incidentally in all commercial and recreational fisheries for groundfish. The Eastern CCA is an area west of San Diego defined by the straight lines connecting the following specific latitude and longitude coordinates in the order listed:

32°42.00' N. lat., 118°02.00' W. long.;
32°42.00' N. lat., 117°50.00' W. long.;
32°36.70' N. lat., 117°50.00' W. long.;
32°30.00' N. lat., 117°53.50' W. long.;
32°30.00' N. lat., 118°02.00' W. long.;
and connecting back to 32°42.00' N. lat., 118°02.00' W. long.

5. <u>Yelloweye Rockfish Conservation Area (YRCA):</u> First established via Federal notice 2003 as an overfished species rebuilding measure. Incorporated in the FMP (Section 4.5.4.8) via Amendment 16-3 and established in Federal regulation in 2005 to reduce the byatch of yelloweye rockfish in the recreational fisheries for groundfish and halibut. The YRCA is a C-shaped area off the northern Washington coast defined by straight lines connecting the following specific latitude and longitude coordinates in the order listed:

48°18.00' N. lat.; 125°18.00' W. long.;
48°18.00' N. lat.; 124°59.00' W. long.;
48°11.00' N. lat.; 124°59.00' W. long.;
48°11.00' N. lat.; 125°11.00' W. long.;
48°04.00' N. lat.; 125°11.00' W. long.;
48°04.00' N. lat.; 124°59.00' W. long.;

48°00.00' N. lat.; 124°59.00' W. long.;
48°00.00' N. lat.; 125°18.00' W. long.;
and connecting back to 48°18.00' N. lat.; 125°18.00' W. long.

New MPAs may be established or these MPAs may be revised through either a specifications-and-management-measures rulemaking (6.2, C.) or a full rulemaking (6.2, D.)

6.9 Measures to Control Fishing Capacity, Including Permits and Licenses

[6.1.1 Permits, Licenses, and Endorsements]

Permits and licenses are used to enumerate participants in an industry and, if eligibility requirements are established or the number of permits is limited, to restrict participation. Participation in the Washington, Oregon, and California groundfish fishery was partially limited beginning in 1994 when the federal vessel license limitation program was implemented (Amendment 6). Subsequently, Amendment 9 further limited participation in the fixed-gear sablefish fishery by establishing a sablefish endorsement. (Chapter 11 describes the groundfish limited entry program in detail.) In December 2003, NMFS reduced participation in the limited entry trawl fleet by buying the fishing rights 91 limited entry trawl vessels and the Federal and state permits associated with those vessels. There is currently no federal permit requirement for other commercial participants (fishers or processors) or recreational participants (private recreational or charter). The Council may determine that effective management of the fishery requires accurate enumeration of the number of participants in these sectors and may establish a permit requirement to accomplish this. In addition, some form of limitation on participation may be necessary in order to protect the resource or to achieve the objectives of the FMP.

[6.1.9 Other Forms of Effort Control]

Other forms of effort control commonly used include vessel length endorsements, restrictions on the number of units of gear, or restrictions on the size of trawls, or length of longlines, or the number of hooks or pots. ~~These measures~~ Effort restrictions related to gear may also be useful in reducing bycatch.

[6.5.2.4 Reporting Requirements]

Permit applications for the domestic groundfish fishery, including, but not limited to exempted fishing permits, are authorized by this FMP. Such applications may include vessel name, length, type, documentation number or state registration number, radio call sign, home port, and capacity; owner and/or operator's name, mailing address, telephone number, and relationship of the applicant to the owner; type of fishing gear to be used, if any; signature of the applicant, and any other information found necessary for identification and registration of the vessel.

6.9.1 General Provisions For Permits

[6.5.1.1 Permits]

Federal permits may be required for individuals or vessels that harvest groundfish and for individuals or facilities (including vessels) that process groundfish or take delivery of live groundfish. In determining whether to require a harvesting or processing permit, and in establishing the terms and conditions for issuing a permit, the Council may consider any relevant factors, including whether a permit:

1. Will enhance the collection of biological, economic, or social data.
2. Will provide better enforcement of laws and regulations, including those designed to ensure conservation and management and those designed to protect consumer health and safety.
3. Will help achieve the goals and objectives of the FMP.

4. Will help prevent or reduce overcapacity in the fishery.
5. May be transferred, and under what conditions.

Separate permits or endorsements may be required for harvesting and processing or for vessels or facilities based on size, type of fishing gear used, species harvested or processed, or such other factors that may be appropriate. The permits and endorsements are also subject to sanctions, including revocation, as provided by section 308 of the Magnuson-Stevens Act.

In establishing a permit requirement, the Council will follow the full-rulemaking procedures in Section 6.2.

6.9.1.1 Commercial Fisheries Permits

[6.5.2.1 Permits (General)]

All U.S. commercial fishing vessels are required by state laws to be in possession of a current fishing or landing permit from the appropriate state agency in order to land groundfish in the Washington, Oregon, and California area. Federal limited entry permits authorize fishing within limits and restrictions specified for those permits. ~~Nonpermitted vessels~~ Vessels without such permits are also subject to the specified limits and restrictions for the open access fishery. Federal permits also may be required for groundfish processors. In the event that a federal fishing or access permit is required, failure to obtain and possess such a federal permit will be in violation of this FMP.

6.9.1.2 Recreational Fisheries Permits

[6.5.3.1 Permits (General)]

All U.S. recreational fishermen are required by state laws to obtain a recreational permit or license in order to fish for groundfish. In the event that a federal license or permit is required, failure to obtain and possess such federal permit will be in violation of this FMP.

6.9.2 Sector Endorsements

The Council may establish sector endorsements, such as with the limited entry fixed gear sablefish fishery. Sector endorsements would limit participation in a fishery for a particular species or species group to persons, vessels, or permits meeting Council-established qualifying criteria. Participants in a sector-endorsed fishery may be subject to sector total catch limit management. A sector endorsement, whether it is applied to vessels that already hold limited entry permits or to those in the open access or recreational fisheries, is a license limitation program.

6.9.3 Individual Fishing Quota Programs

Under the Magnuson-Stevens Act, "an 'individual fishing quota' means a Federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or unites representing a percentage of the total allowable catch of a fishery that may be received or held for exclusive use by a person." The Council may establish individual fishing quota (IFQ) programs for any commercial fishery sector. IFQ programs would be established for the purposes of reducing fishery capacity, minimizing bycatch, and to meet other goals of the FMP. Participants in an IFQ fishery may be subject to individual total catch limit management (See 6.7.1).

6.9.4 Capacity Reduction Data Collection

[6.5.8 Access Limitation and Capacity Reduction Programs]

The current condition of the groundfish fisheries of the Washington, Oregon, and California region is such that further reduction of the limited entry fleet may be required in the near future. Research and monitoring programs may need to be developed and implemented for the fishery so that information required in a capacity reduction program is available. Such data should indicate the character and level of participation in the fishery, including (1) investment in vessel and gear; (2) the number and type of units of gear; (3) the distribution of catch; (4) the value of catch; (5) the economic returns to the participants; (6) mobility between fisheries; and (7) various social and community considerations.

6.10 Fishery Enforcement and Vessel Safety

The enforceability of fishery management measures affects the health of marine resources and the safety of human life at sea. When considering new management measures or reviewing the current management regime, the Council will consider the fishery and its characteristics, assess whether the measures are sufficiently enforceable to accomplish the objective of those management measures, and describe measures to be taken to reduce risks to the measures' enforceability. For example, the Council introduced depth-based management (See RCAs at 6.8.3) in 2003 to protect overfished groundfish species with areas closed to fishing. The Council's subsequent recommendation to implement vessel monitoring system (VMS) requirements improved the enforceability of the closed areas so that the closed areas could accomplish the Council's management objective of reducing overfished species catch by preventing vessels from fishing in areas where overfished species are more abundant.

If new management measures are under development, the Council will determine whether requirements are needed to facilitate the enforcement of new management measures.

During the development of new management measures, the Council will consider what measures are also needed to facilitate enforcement. When assessing if the measures are sufficiently enforceable, information should be obtained from:

- Fish tickets inspections and audits
- Enforcement reports
- Discussions with State and Federal fisheries agents and officers
- USCG input
- Observer program reports
- Stakeholder input
- Other relevant information suggested by the EC and the public

When assessing if the measures are sufficiently enforceable, consideration should be given to enforcement risks from:

- <u>Catch limit evasion:</u> the potential for operators to either not declare, under-declare or report catch as other species or species groups on fish tickets; the potential for fishing vessels to offload to unauthorized processing or tending vessels at sea.
- <u>Unaccounted for bycatch:</u> the potential for vessels to high grade their catch (discard undesirable sizes or species of fish in order to retain desirable sizes or species) in a manner that increases bycatch mortality.
- <u>Unauthorized fishing:</u> the potential for operators to fish undetected in closed areas, in restricted areas with unauthorized gear, or during closed seasons.

[Other suggestions from EC?]

6.10.1 Managing Enforcement Risks

The objective of enforcement is to ensure, in a cost effective way, that all fishing is conducted in accordance with fishery regulations. During the development of new management measures, the Council will consider what measures are also needed to facilitate enforcement. When managing the enforcement risks, consideration should be given to:

- Complexity: Complexity in a management regime can reduce enforceability by making the regime confusing to both fishery participants and enforcement agents. When the Council is developing new management measures, it shall evaluate those measures for their complexity to determine whether management complexity is necessary and whether there are ways to reduce the complexity of new management recommendations.
- Availability and adequacy of surveillance, monitoring, and inspections: What fishery surveillance, monitoring, and inspection methods are available from Federal and State agencies? Are these methods adequate to enforce the measure or measures under Council consideration?
- Compliance behavior: Are the proposed measures adequately enforceable such that they will change fisher behavior in a way that achieves intended results? Are the proposed measures adequately enforceable such that fishers who attempt to evade detection of illegal behavior are not reducing fishing opportunities for those fishers who comply with management measures?
- Unintended consequences: The Council should evaluate the range of behaviors and possible effects that could result if regulations were not adequately enforceable, including: collusion between processors and harvesters, high-value catch recorded as low-value catch, direct sales to retailers without fish tickets being recorded, offloading at-sea to unauthorized vessels, etc.
- Educational programs for public: How does the Council plan to educate the public on new management measures and requirements? Do Council public education efforts, in combination with Federal, State, and Tribe efforts allow adequate time for fishery participants to be made aware of changes to regulations?
- Officer training: Have Federal and State enforcement agents and officers been adequately trained in new fishery management regulations? Does the EC or the Council have training recommendations to ensure that new regulations are clearly understood by those enforcing the regulations?

[Other suggestions from EC?]

6.10.2 Vessel Safety

[6.5.1.4 Vessel Safety Considerations]

The Council will take safety issues into account in developing management recommendations, although some safety issues may not be under Council control. For example, the Council may set a fishing season such that participants are able to choose when they participate, but the Council cannot assure that weather conditions will be favorable to all participants throughout that season. The Council will review any new regulatory or management measures recommendations it makes to determine whether such recommendations;

- Improve the safety of fishing conditions for fishery participants.
- Offer new safety risks for fishery participants that could be remedied with revisions to the proposed requirements that would not otherwise weaken the effects of those requirements.

On safety issues, the Council shall consult with its EC and the public, and particularly with the U.S. Coast Guard on any search-and-rescue issues that might arise through proposed regulatory requirements.

6.10.3 Vessel and Gear Identification

[6.5.2.5 Vessel Identification]

The FMP authorizes vessel and gear identification requirements, which may be modified as necessary to facilitate enforcement and vessel recognition. Vessel marking requirements are described in federal regulations at 50 CFR 660.305 and generally require that each vessel be clearly marked with its vessel number, such that it may be identified from the air or from approaching rescue/enforcement vessels at sea. Vessels may also be identified via transmissions of their position locations under a vessel monitoring system (VMS) program. Federal requirements implementing the Council's VMS program are found in regulation at 50 CFR 660.312. Gear identification requirements are described in federal regulations at 50 CFR 660.382 and 660.383 and generally require that fixed gear be marked with the associated vessel's number so that the gear's owner may be identified.

6.10.4 Prohibitions and Penalties

[11.7 Prohibitions]

Fishery participants are subject both to Federal prohibitions that apply nationwide and to those that apply just to participants in the West Coast groundfish fisheries. Federal regulations on nationwide fishery prohibitions are found at 50 CFR 600.725. Federal regulations on fishery prohibitions specific to the West Coast groundfish fisheries are found at 50 CFR 660.306. Participants in the West Coast groundfish fisheries are also subject to vessel operation and safety requirements of the U.S. Coast Guard. ***[Ask USCG for citation-Title 33?]***

[11.9 Penalties]

Federal regulations at 50 CFR 600.735 state "Any person committing, or fishing vessel used in the commission of a violation of the Magnuson-Stevens Act or any other statute administered by NOAA and/or any regulation issued under the Magnuson-Stevens Act, is subject to the civil and criminal penalty provisions and civil forfeiture provisions of the Magnuson-Stevens Act, to this section, to 15 CFR part 904 (Civil Procedures), and to other applicable law."

7.06.6 Essential Fish Habitat

The Magnuson-Stevens Act (revised in Public Law 104-267) and the Sustainable Fisheries Act (SFA) requires Councils to include descriptions of EFH in all federal FMPs, and also potential threats to EFH. In addition, the Magnuson-Stevens Act requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The Appendix of this FMP includes a description of EFH for the 80-plus groundfish species included in this plan, fishing effects on EFH, nonfishing effects on EFH, and options to avoid or minimize adverse effects on EFH or promote conservation and enhancement of EFH.

7.16.6.1 Magnuson-Stevens Act Directives Relating to Essential Fish Habitat

The Magnuson-Stevens Act defines EFH as Athose waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.@ To clarify this definition, the following interpretations are made: Awaters@ include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; Asubstrate@ includes sediment, hard bottom, structures underlying the waters, and associated biological communities; Anecessary@ means Athe habitat required to support a sustainable fishery and the managed species= contribution to a healthy ecosystem;@ and Aspawning, breeding, feeding, or growth to maturity@ covers the full life cycle of a species. The definition of EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate to the FMP.

The Magnuson-Stevens Act requires Councils to identify in FMPs any fishing activities that may adversely affect EFH. The Magnuson-Stevens Act also requires that, where fishing-related adverse impacts to EFH are identified, FMPs must include management measures that minimize those adverse effects from fishing, to the extent practicable.

The FMP also identifies potential nonfishing threats to EFH. Upon implementation of the FMP amendment, federal agencies will be required to consult with NMFS on all activities, and proposed activities, authorized, funded, or undertaken by the agency that may adversely affect EFH. NMFS must provide recommendations to conserve EFH to federal agencies on such activities. NMFS must also provide recommendations to conserve EFH to state agencies if it receives information on their actions. The Council may provide EFH recommendations on actions that may affect habitat, including EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by that agency. The Council will encourage federal agencies conducting or authorizing work that may adversely affect groundfish EFH to minimize disturbance to EFH.

7.26.6.2 Definition of Essential Fish Habitat for Groundfish

The Pacific Coast Groundfish FMP manages 80-plus species over a large and ecologically diverse area. Research on the life histories and habitats of these species varies in completeness, so while some species are well-studied, there is relatively little information on certain other species. Information about the habitats and life histories of the species managed by the FMP will certainly change over time, with varying degrees of information improvement for each species. For these reasons, it is impractical for the Council to include EFH definitions for each of the managed species in the body of the FMP. Therefore, the FMP includes a description of a limited number of composite EFHs for all Pacific Coast groundfish species. Life histories and EFH designations for each of the individual species are provided in a separate EFH document which will be revised and updated to include new information as it becomes available. Such changes will not require FMP amendment. This framework approach is similar to the Council's stock assessment process, which annually uses the SAFE document to update information about groundfish stock status without amending the FMP. Like the SAFE document, any EFH updates will be reviewed in a Council public forum.

There are substantial gaps in the knowledge of many Pacific Coast groundfish species. This FMP identifies many of those data gaps and makes suggestions regarding future research efforts. The FMP also identifies where research is needed on fishing and nonfishing impacts on groundfish EFH. Protecting, conserving, and enhancing EFH are long-term goals of the Council, and these EFH provisions of the FMP are an important element in the Council=s commitment to a better understanding of Pacific Coast groundfish populations and their habitat needs.

7.2.1~~6.6.2.1~~ Composite Essential Fish Habitat Identification

The 80-plus groundfish species managed by this FMP occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. Some species are widely dispersed during certain life stages, particularly those with pelagic eggs and larvae; the EFH for these species/stages is correspondingly large. On the other hand, the EFH of some species/stages may be comparatively small, such as that of adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate. As a consequence of the large number of species and their diverse habitat associations, the entire EEZ becomes EFH when all the individual EFHs are taken together.

EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish fishery EFH for each of the 80-plus species and their life stages result in over 400 EFH identifications. When these EFHs are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the U.S. EEZ.

This FMP groups the various EFH descriptions into seven units called Acomposite@ EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. Seven major habitat types are proposed as the basis for such assemblages or Acomposites@. These major habitat types are readily recognizable by those who potentially may be required to consult about impacts to EFH, and their distributions are relatively stationary and measurable over time and space.

The seven Acomposite@ EFH identifications are as follows.

1. Estuarine - Those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying rocky areas, including reefs, pinnacles, boulders and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109

fathoms).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fathoms) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fathoms) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than ten meters (5.5 fathoms) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fathoms) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

These composites are shown graphically in the following figures. There is inadequate Information to produce a map of the rocky shelf composite, so the rocky and nonrocky shelf composites are combined in these figures.

7.3~~6.6.3~~ Management Measures To Minimize Adverse Impacts on Essential Fish Habitat from Fishing

The Council may use any of the following management measures to minimize adverse effects on EFH from fishing, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. Such management measures shall be implemented under the Points of Concern Framework, Section 6.2.2.

- Fishing gear restrictions
- Time/area closures
- Harvest limits
- Other

In determining whether it is practicable to minimize an adverse effect from fishing, the Council will consider whether, and to what extent, the fishing activity is adversely impacting EFH, the nature and extent of the adverse effect on EFH, and whether management measures are practicable. The Council will consider the long and short term costs and benefits to the fishery and EFH, along with other appropriate factors, consistent with national standard 7.

7.4~~6.6.4~~ Review and Revision of Essential Fish Habitat Definitions and Descriptions

The Council will periodically review the available information on EFH descriptions, fishing impacts and nonfishing impacts, and include new information in the annual SAFE document or similar document. A review and update of available information will be conducted at least once every five years as appropriate, but the Council may schedule more frequent reviews in response to recommendation by the Secretary or for other reasons.

78.0 EXPERIMENTAL FISHERIES

Among the objectives of this FMP is to provide for the orderly development of the domestic groundfish fisheries, including promotion of new domestic fisheries, or otherwise contribute to effective management of the stock. In order to accomplish this objective, it is desirable to permit limited domestic experimental fishing (recreational or commercial) for groundfish species covered by this plan. This provision is intended to promote increased utilization of underutilized species, realize the expansion potential of the domestic groundfish fishery, and increase the harvest efficiency of the fishery consistent with the Magnuson-Stevens Act and the

Experimental fisheries may be useful to the Council in allowing members of the public to work with government agencies to bring new fishery management ideas into the Council process. For example, there may be some modification to current gear types that will reduce the effects of that gear on habitat, or reduces bycatch rates with that gear in otherwise closed areas. The Council supports the use of exempted fishing permits (EFPs) to promote public and agency innovation in furthering the FMP=s fishery management goals of this FMPgoal and objectives. Experimental fishing will be conducted under Federal exempted fishing permits (EFPs) issued under Section 303(b)(1) of the Magnuson-Stevens Act.

The Regional DirectorAdministrator may authorize, for limited experimental purposes, the direct or incidental harvest of groundfish managed under this FMP whichthat would otherwise be prohibited. No experimental fishing may be conducted unless authorized by an EFP issued by the Regional DirectorAdministrator to the participating vessel in accordance with the criteria and procedures specified in this section. EFPs will be issued without charge. EFPs may be issued to Federal or state agencies, marine fish commissions, or other entities, including individuals. An applicant for an EFP need not be the owner or operator of the vessel(s) for which the EFP is requested. Nothing in this section is intended to inhibit the authority of the Council or any other fishery management entity from requesting that the Regional DirectorAdministrator consider issuance of EFPs for a particular experiment in advance of the Regional Director'sAdministrator’s receipt of applications for EFPs to participate in that experiment.

EFPs that would result in the directed or incidental take of groundfish should be reviewed through the Council process prior to application to NMFS. The Council review process allows the Council determine whether portions of the harvest specifications of any groundfish species or species group would need to be set aside for harvest expected to be taken under EFPs. EFP proposals must contain a mechanism, such as at-sea fishery monitoring, to ensure that the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for. Also, EFP proposals must include a description of the proposed data collection and analysis methodology used to measure whether the EFP objectives will be met.

EFP applicants may have their proposals reviewed through the Council process in accordance with Council Operating Procedure #19, Protocol for Consideration of EFPs for Groundfish Fisheries. This protocol includes requirements for EFP submission, proposal contents, review and approval, and progress reporting. The Council will give priority consideration to those EFP applications that:

1. Emphasize resource conservation and management with a focus on bycatch reduction (highest priority).
2. Encourage full retention of fishery mortalities.
3. Involve data collection on fisheries stocks and/or habitat.
4. Encourage innovative gear modifications and fishing strategies to reduce bycatch.
5. Encourage the development of new market opportunities.
6. Explore the use of higher trip limits or other incentives to increase utilization of underutilized species while reducing bycatch of non-target species.

Criteria and procedures for the issuance of EFPs are: apply nationwide and are found in Federal regulations at 50 CFR 600.745 ***[current as of January 1, 2005]***:

1. Applicants must submit a completed application in writing to the Regional DirectorAdministrator at least 60 days prior to the proposed effective date of the permit. The application must include, but is not limited to, the following information:

   a. The date of the application;
   b. The applicant's name, mailing address, and telephone number;
   c. A statement of the purposes and goals of the experimentexempted fishery for which an EFP is needed, including a general description of the arrangements for disposition of all species harvested under the EFP;
   d. Valid justification for why issuance of the EFP is warranted;
   e. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals;
   f..d For each vessel to be covered by the EFP:
      (1) vessel name;
      (2) (1) A copy of the USCG documentation, state license, or registration of each vessel, or the information contained on the appropriate document;
      (2) The current name, address, and telephone number of owner and master;
      (3) Coast Guard documentation, state license, or registration number;
      (4) home port;
      (5) length of vessel;
      (6) net tonnage;
      (7) gross tonnage;
   g. A description of the
   e. The species (target and incidental) expected to be harvested under the EFP and, the amount(s) of such harvest necessary to conduct the experiment; h.exempted fishing, the arrangements for disposition of all regulations species harvested under the EFP, and any anticipated impacts on marine mammals and endangered species.
   h. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size and amount of gear to be used; and
   i. The signature of the applicant.

   The Regional DirectorAdministrator may request from an applicant additional information necessary to make the determinations required under this section.

2. The Regional DirectorAdministrator will review each application and will make a preliminary determination whether or not the application contains all of the required information and constitutes a valid experimental programn activity appropriate for further consideration. If the Regional DirectorAdministrator finds any application does not warrant further consideration, he shall notify both the applicant and the Council will be notified in writing of the reasons for histhe decision. If the Regional DirectorAdministrator determines that any application warrants further consideration, he will publish a notice ofnotification receipt of the application will be published in the *Federal Register* with a brief description of the proposal, and will give interestedthe intent of NMFS to issue an EFP. Interested persons anwill be given a 15- to 45-day opportunity to comment and/or comments will be requested during public testimony at a Council meeting. The noticenotification may establish a cutoff date for receipt of additional applications to participate in the same or a similar experimentexempted fishing activity.

The Regional ~~Director~~Administrator also will forward copies of the application to the ~~Pacific Fishery Management~~ Council, the United States Coast Guard, and the fishery management agencies of Oregon, Washington, California, and Idaho, accompanied by the following information:

a. ~~The current utilization of domestic annual harvesting and processing capacity (including existing experimental harvesting, if any) of~~The effect of the proposed EFP on the target and incidental species, including the effect on any OY;

b. A citation of the regulation or regulations ~~which~~that, ~~absent~~without the EFP, would prohibit the proposed activity; and

c. Biological information relevant to the proposal~~.~~, including appropriate statements of environmental impacts, including impacts on marine mammals and threatened or endangered species.

3. At a Council meeting following receipt of a complete application, the Regional ~~Director~~Administrator may choose to consult with the Council and the directors of the state fishery management agencies concerning the permit application. The Council shall notify the applicant in advance of the meeting, if any, at which the application will be considered and invite the applicant to appear in support of the application if the applicant desires.

4. As soon as practicable after receiving responses from the agencies identified above, or after consultation, if any, in paragraph 3 above, the Regional ~~Director~~Administrator shall notify the applicant in writing of his decision to grant or deny the EFP, and, if denied, the reasons for the denial. Grounds ~~to deny issuance~~for denial of an EFP include, but are not limited to, the following:

   a. The applicant has failed to disclose material information required, or has made false statements as to any material fact, in connection with his or her application; or

   b. According to the best scientific information available, the harvest to be conducted under the permit would detrimentally affect the well-being of the stock of any regulated species of fish, marine mammal, or threatened or endangered species in a significant way; or

   c. Issuance of the EFP ~~would inequitably allocate fishing privileges among domestic fishermen or~~ would have economic allocation as its sole purpose; or

   d. Activities to be conducted under the EFP would be inconsistent with the intent of ~~this section~~national goals for Magnuson-Stevens Act implementation or the management objectives of this FMP;~~ or~~

   e. The applicant has failed to demonstrate a valid justification for the permit; or

   ~~e.~~f. The activity proposed under the EFP could create a significant enforcement problem.

5. The decision of a Regional Administrator to grant or deny an EFP is the final action of NMFS. If the permit ~~is granted, the Regional Director will publish a notice~~, as granted, is significantly different from the original application, or is denied, NMFS may publish notification in the *Federal Register* describing the ~~experimental~~exempted fishing to be conducted under the EFP or the reasons for denial.

6. The Regional ~~Director~~Administrator may attach terms and conditions to the EFP consistent with the purpose of the ~~experiment~~exempted fishing, including, but not limited to:

a. The maximum amount of each regulated species ~~which~~that can be harvested and landed during the term of the EFP, including trip limitations, where appropriate;-

b. The number, size(s), ~~names~~name(s), and identification ~~numbers~~number(s) of the ~~vessels~~vessel(s) authorized to conduct fishing activities under the EFP;

c. The time(s) and place(s) where ~~experimental~~exempted fishing may be conducted;

d. The type, size, and amount of gear ~~which~~that may be used by each vessel operated under the EFP;

e. The condition that observers, a vessel monitoring system, or other electronic equipment be ~~allowed aboard~~carried on board vessels operated under an EFP~~;~~, and any necessary conditions, such as predeployment notification requirements;

f. Reasonable data reporting requirements;

g. ~~Such other~~Other conditions as may be necessary to assure compliance with the purposes of the EFP consistent with the objectives of this FMP and other applicable law; and,

h. ~~provisions~~Provisions for public release of data obtained under the EFP~~.~~ that are consistent with NOAA confidentiality of statistics procedures. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted fishing as a condition of an EFP.

~~6~~7. Failure of a permittee to comply with the terms and conditions of an EFP shall be grounds for revocation, suspension, or modification of the EFP with respect to all vessels conducting activities under that EFP. Any action taken to revoke, suspend, or modify an EFP shall be governed by ~~50 C.F.R. Part 621, Subpart D~~ Federal regulations.

~~8.0~~9.0 SCIENTIFIC RESEARCH

No changes to the text in this chapter.

10.0 PROCEDURE FOR REVIEWING STATE REGULATIONS

10.1 Background

There are and will continue to be state regulations affecting groundfish fisheries off the West Coast, which are in addition to federal regulations. This potential extends to waters off all three West Coast states, to all gear types, and to both the commercial and recreational fisheries. In some cases, it may be desirable to ensure consistency between state and federal regulations by implementing federal regulations that complement state regulations. In other cases, the Council may determine that federal regulations are not necessary to complement state regulations, but wish to assure a state that its regulations are consistent with the FMP insofar as they are applied to vessels registered in that state when fishing in the EEZ. ~~Amendment 4 addresses this need by establishing a~~ Section 10.2 describes the framework review process by which any state may petition the Council to initiate a review of its regulations, determine consistency with the FMP~~,~~ and~~, if~~ national standards, to ensure that the state regulations are enforceable. If appropriate, ~~recommend the implementation of complementary federal regulations.~~

~~For example, current regulations implementing the FMP prohibit the use of setnets (gill and trammel nets) to catch groundfish in waters north of 38E N latitude. The purpose of this regulation is to prevent the incidental take of salmon. South of 38E N latitude, setnet gear is used primarily by small vessel fishermen to catch California halibut, white croaker, and rockfish. Only rockfish are included in the groundfish fishery management unit. Fishing for these species, which mainly are taken inshore, is regulated by the State of California. Thus, some of the setnet fisheries regulated by the state harvest species of groundfish which are also managed under this FMP.~~

~~When the FMP was developed and approved by the Secretary, the Council acknowledged the State of California was regulating the set net fishery off central and southern California. It was the Council's desire that state regulations regarding setnets also be applicable to vessels fishing in the EEZ to the extent that each state regulation was consistent with the goals of the FMP and the national standards of the Magnuson-Stevens Act. The Council realized that it would be difficult to apply state regulations to non-California registered vessels in the EEZ. However, this was not considered a significant problem because most vessels in the fishery were registered in the State of California and were subject to its regulations even when fishing in the EEZ. Federal regulations were not considered necessary.~~

~~For a variety of reasons, California setnet regulations have changed several times over the years. However none of these changes have been formally reviewed to determine if they remain consistent with the FMP and the national standards of the Magnuson-Stevens Act. A system is required to determine consistency of state regulations with the FMP and the national standards to ensure that the regulations continue to be enforceable against vessels fishing in the EEZ.~~

~~California is not the only state that has regulations which are applicable to its registered vessels fishing in the EEZ but which are not duplicated by federal regulations. Here again, a system is required to determine consistency of these state regulations with the FMP and the national standards to ensure that the state regulations are enforceable.~~

~~Amendment 4 establishes a framework review process by which any state may obtain a determination that its regulations are consistent with the FMP and the national standards. As necessary,~~ the Council may also recommend to the NMFS that duplicate or different federal regulations be implemented in the EEZ. While the Council retains the authority to recommend federal regulations be implemented in the EEZ, the preference is to continue to rely on state regulations in that area as long as they are consistent with the FMP.

While states are not required to submit regulations which they wish to apply in the EEZ to the Council for a consistency determination, regulations which have not received a consistency determination run the risk of being declared inconsistent and invalid if challenged in a state law enforcement proceeding. The Council invites submission of all present and future state fishery regulations relating to the harvest of species managed under this FMP which are to apply in the EEZ.

10.2 Review Procedure

Any state may propose that the Council review a particular state regulation for the purpose of determining its consistency with the FMP and the need for complementary federal regulations. Although this procedure is directed at the review of new regulations, review of existing regulations affecting the harvest of groundfish managed by the FMP also will utilize this process. The state making the proposal will include a summary of the regulations in question and concise arguments in support of consistency.

Upon receipt of a state's proposal, the Council may make an initial determination whether or not to proceed with the review. If the Council determines that the proposal has insufficient merit or little likelihood of being found consistent, it may terminate the process immediately and inform the petitioning state in writing of the reasons for its rejection.

If the Council determines sufficient merit exists to proceed with a determination, it will review the state's documentation or prepare an analysis considering, if relevant, the following factors:

1. how the proposal furthers or is not otherwise inconsistent with the objectives of the FMP, the Magnuson-Stevens Act, and other applicable law;

2. the likely effect on or interaction with any other regulations in force for the fisheries in the area concerned;

3. the expected impacts on the species or species group taken in the fishery sector being affected by the regulation;

4. the economic impacts of the regulation, including changes in catch, effort, revenue, fishing costs, participation, and income to different sectors being regulated as well as to sectors which might be indirectly affected; and,

5. any impacts in terms of achievement of quotas or harvest guidelines, maintaining year-round fisheries, maintaining stability in fisheries, prices to consumers, improved product quality, discards, joint venture operations, gear conflicts, enforcement, data collection, or other factors.

The Council will inform the public of the proposal and supporting analysis and invite public comments before and at the next scheduled Council meeting. At its next scheduled meeting, the Council will consider public testimony, public comment, advisory reports, and any further state comments or reports, and determine whether or not the proposal is consistent with the FMP and whether or not to recommend implementation of complementary federal regulations or to endorse state regulations as consistent with the FMP without additional federal regulations.

If the Council recommends the implementation of complementary federal regulations, it will forward its recommendation to the NMFS Regional Director for review and approval.

The NMFS Regional Director will publish the proposed regulation in the Federal Register for public comment, after which, if approved, he will publish final regulations as soon as practicable. If the Regional Director disapproves the proposed regulations, he will inform the Council in writing of the reasons for his disapproval.

~~12.0~~11.0 GROUNDFISH LIMITED ENTRY

No changes to the text in this chapter, except headings are renumbered.

PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN

FOR THE CALIFORNIA, OREGON, AND WASHINGTON GROUNDFISH FISHERY

AS AMENDED THROUGH AMENDMENT 17

Extract of Chapters 6 and 11

PACIFIC FISHERY MANAGEMENT COUNCIL
7700 NE AMBASSADOR PLACE, SUITE 200
PORTLAND, OR 97220
(503) 820-2280
(866) 806-7204
WWW.PCOUNCIL.ORG

SEPTEMBER 2004

This document is published by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award Number FNA03NMF4410067 and FNA17FC1641.

TABLE OF CONTENTS

TABLE OF CONTENTS v

LIST OF ACRONYMS AND ABBREVIATIONS xi

1.0 INTRODUCTION 1

2.0 GOALS AND OBJECTIVES 3
- 2.1 Goals and Objectives for Managing the Pacific Coast Groundfish Fishery 3
- 2.2 Operational Definition of Terms 5

3.0 AREAS AND STOCKS INVOLVED 9
- 3.1 Species Managed by this Fishery Management Plan 9

4.0 PREVENTING OVERFISHING AND ACHIEVING OPTIMUM YIELD 15
- 4.1 Species Categories 15
- 4.2 Determination of MSY, or MSY Proxy, and B_{MSY} 16
- 4.3 Determination of ABC 18
  - 4.3.1 Stocks with Quantitative Assessments, Category 1 18
  - 4.3.2 Stocks with ABC Set by Nonquantitative Assessment, Category 2 18
  - 4.3.3 Stocks Without ABC Values, Category 3 18
- 4.4 Precautionary Thresholds and Overfishing Status Determination Criteria 19
  - 4.4.1 Determination of Precautionary Thresholds 19
  - 4.4.2 Determination of Overfishing Threshold 19
  - 4.4.3 Determination of Overfished/Rebuilding Thresholds 20
- 4.5 Ending Overfishing and Rebuilding 20
  - 4.5.1 Default Precautionary and Interim Rebuilding OY Calculation 20
  - 4.5.2 Procedures For Calculating Rebuilding Parameters 21
    Calculating Rebuilding Probabilities 22
  - 4.5.3 Stock Rebuilding Plans 23
    - 4.5.3.1 Goals and Objectives of Rebuilding Plans 24
    - 4.5.3.2 Contents of Rebuilding Plans 24
    - 4.5.3.3 Process for Development and Approval of Rebuilding Plans 26
    - 4.5.3.4 Updating Key Rebuilding Parameters 26
    - 4.5.3.5 Implementation of Actions Required Under the Rebuilding Plan 27
    - 4.5.3.6 Periodic Review of Rebuilding Plans 27
    - 4.5.3.7 Precedence of a Recovery Plan or "No Jeopardy" Standard Issued Pursuant to the Endangered Species Act 28
  - 4.5.4 Summary of Rebuilding Plan Contents 28
    - 4.5.4.1 Darkblotched Rockfish 28
    - 4.5.4.2 Pacific Ocean Perch 30
    - 4.5.4.3 Canary Rockfish 31
    - 4.5.4.4 Lingcod 33
    - 4.5.4.5 Bocaccio Rockfish 35
    - 4.5.4.6 Cowcod 37
    - 4.5.4.7 Widow Rockfish 39
    - 4.5.4.8 Yelloweye Rockfish 41
- 4.6 Determination of OY 45
  - 4.6.1 Determination of Numerical OYs If Stock Assessment Information Is Available (Category 1) 46

4.6.2 Determination of a Numerical OY If ABC Is Based on Nonquantitative Assessment (Category 2) 47
4.6.3 Non-numerical OY for Stocks with No ABC Values (Category 3) 48

5.0 PERIODIC SPECIFICATION AND APPORTIONMENT OF HARVEST LEVELS 49
5.1 General Overview of the Harvest Specifications and Management Process 49
5.2 SAFE Document 50
5.3 Authorization and Accounting for Fish Taken as Compensation for Authorized Scientific Research Activities. 52
5.4 Biennial Implementation Procedures for Specifications and Management Measures . 52
5.5 Inseason Procedures for Establishing or Adjusting Specifications 53
5.5.1 Inseason Adjustments to ABCs 53
5.5.2 Inseason Establishment and Adjustment of OYs, HGs, and Quotas 53

6.0 MANAGEMENT MEASURES 55
6.1 General List of Management Measures 56
6.1.1 Permits, Licenses, and Endorsements 56
6.1.2 Mesh Size 57
6.1.3 Landing and Frequency Limits 57
6.1.4 Quotas, Including Individual Transferable Quotas 57
6.1.5 Escape Ports and Panels 57
6.1.6 Size Limits 57
6.1.7 Bag Limits 58
6.1.8 Time/Area Closures (Seasons and Closed Areas) 58
6.1.9 Other Forms of Effort Control 58
6.1.10 Allocation 58
6.2 General Procedures for Establishing and Adjusting Management Measures 59
6.2.1 Routine Management Measures 60
6.2.2 Resource Conservation Issues - The "Points of Concern" Framework 62
6.2.3 Nonbiological Issues--The Socioeconomic Framework 64
6.2.3.1 Allocation 65
6.3 Bycatch Management 65
6.3.1 Bycatch of Nongroundfish Species 66
6.3.2 Standardized Reporting Methodology 66
6.3.3 Measures to Control Bycatch 66
6.4 Recreational Catch and Release Management 67
6.5 Other Management Measures 67
6.5.1 Generic 67
6.5.1.1 Permits 67
6.5.1.2 Observers 68
6.5.1.3 Habitat Protection (General) 68
6.5.1.4 Vessel Safety Considerations 68
6.5.2 Domestic--Commercial 68
6.5.2.1 Permits (General) 68
6.5.2.2 Catch Restrictions 69
6.5.2.3 Gear Restrictions 69
6.5.2.4 Reporting Requirements 70
6.5.2.5 Vessel Identification 71
6.5.3 Domestic - Recreational 71
6.5.3.1 Permits (General) 71
6.5.3.2 Catch Restrictions 71

6.5.3.3 Gear Restrictions . . . 71
6.5.4 Joint Venture--Domestic Vessels . . . 72
6.5.5 Joint Venture--Foreign Vessels . . . 72
6.5.5.1 Permits . . . 72
6.5.5.2 Target Species . . . 72
6.5.5.3 Incidental Catch . . . 72
6.5.5.4 Prohibited Species . . . 73
6.5.5.5 Season and Area Restrictions . . . 73
6.5.5.6 Reporting and Recordkeeping Requirements . . . 73
6.5.5.7 Dumping . . . 74
6.5.5.8 Fishery Closure . . . 74
6.5.5.9 Observers . . . 74
6.5.5.10 Other Restrictions . . . 74
6.5.6 Foreign--Commercial . . . 74
6.5.6.1 Permits . . . 75
6.5.6.2 Target Species . . . 75
6.5.6.3 Incidental Catch . . . 75
6.5.6.4 Prohibited Species . . . 75
6.5.6.5 Season, Area, and Gear Restrictions . . . 76
6.5.6.6 Reporting and Recordkeeping Requirements . . . 76
6.5.6.7 Dumping . . . 76
6.5.6.8 Fishery Closure . . . 77
6.5.6.9 Observers . . . 77
6.5.6.10 Other Restrictions . . . 77
6.5.7 Foreign--Recreational . . . 77
6.5.8 Access Limitation and Capacity Reduction Programs . . . 77
6.6 Essential Fish Habitat . . . 77
6.6.1 Magnuson-Stevens Act Directives Relating to Essential Fish Habitat . . . 78
6.6.2 Definition of Essential Fish Habitat for Groundfish . . . 78
6.6.2.1 Composite Essential Fish Habitat Identification . . . 79
6.6.3 Management Measures To Minimize Adverse Impacts on Essential Fish Habitat from Fishing . . . 80
6.6.4 Review and Revision of Essential Fish Habitat Definitions and Descriptions . . . 80

7.0 EXPERIMENTAL FISHERIES . . . 81

8.0 SCIENTIFIC RESEARCH . . . 85

9.0 RESTRICTIONS ON OTHER FISHERIES . . . 87

10.0 PROCEDURE FOR REVIEWING STATE REGULATIONS . . . 89
10.1 Background . . . 89
10.2 Review Procedure . . . 90

11.0 MANAGEMENT MEASURES THAT CONTINUE IN EFFECT WITH IMPLEMENTATION OF AMENDMENT 4 . . . 93
11.1 Vessel Identification . . . 93
11.2 Gear Restrictions . . . 93
11.2.1 Commercial Fishing . . . 93
11.2.1.1 Trawl gear . . . 93

11.2.1.2 Fixed gear 95
11.2.1.3 Nontrawl gear 96
11.2.2 Recreational Fishing 96
11.2.2.1 Hook-and-line 97
11.2.2.2 Spears 97
11.3 Species Managed with a Harvest Guideline or Quota 97
11.4 Catch Restrictions 97
11.4.1 Commercial Fishing 97
11.4.2 Recreational Fishing 98
11.4.3 Restrictions on the Catch of Groundfish in Non-Groundfish Fisheries 98
11.4.3.1 Pink shrimp 98
11.4.3.2 Spot and ridgeback prawns 99
11.5 Joint Ventures 99
11.5.1 Pacific Whiting 99
11.5.2 Jack Mackerel (North of 39° N. Latitude) 99
11.5.3 Shortbelly Rockfish 100
11.6 Foreign Fishery 100
11.6.1 Pacific Whiting 100
11.6.2 Jack Mackerel (North of 39° N. Latitude) 101
11.7 Prohibitions 102
11.8 Facilitation of Enforcement 103
11.9 Penalties 105

12.0 GROUNDFISH LIMITED ENTRY 107
12.1 Introduction 107
12.1.1 Problem to be Addressed by this Groundfish Limited Entry System 107
12.1.2 Goals and Objectives for Groundfish Limited Entry 108
12.1.3 Achievement of Goal and Objectives and Need for Additional Measures to Reduce Capacity 108
12.1.4 Nature of the Interest Created 109
12.1.5 Fisheries Within the Scope of the Limited Entry Program 109
12.2 Management, Allocation and General Rules on the Issuance and Use of Groundfish LE Permits, Gear Endorsements Size Endorsements, and Fixed Gear Sablefish Endorsements 109
12.2.1 Federal LE Permits Required Only for Gears Fishing on the Limited Access Quota 109
12.2.2 Allocations Between the Limited and Open Access Fisheries and Management of the Open Access Fishery 110
12.2.3 Initial Issuance of LE Permits 112
12.2.4 Ownership Restriction and Changes in Ownership 112
12.2.5 Gear Endorsements 112
12.2.6 Fixed Gear Sablefish Endorsements 114
12.2.7 Size Endorsement Will Specify the Vessel Length 114
12.2.8 An LE Permit and Necessary Gear Endorsements Will Be Held by the Owner of Record of the Vessel 115
12.2.9 Transfer of an LE Permit to Different Owners or Vessels of the Same Owner 115
12.2.10 Loss of a Vessel 116
12.2.10.1 Loss of a Vessel Prior to Permit Issuance 116
12.2.10.2 Loss of a Vessel After Permit Issuance 116
12.2.11 Combining LE Permits 116

12.2.12 Permit Renewal 117
12.2.13 Owner-on-board Requirements 118
12.3 Multilevel Gear Endorsement System 118
12.3.1 "A" Gear Endorsement 118
12.3.1.1 Overview of the "A" Endorsement 118
12.3.1.2 Description, Use and Transferability of the "A" Endorsement 118
12.3.1.3 "A" Endorsement Initial Issuance Criteria 118
12.3.1.4 Incorporation of Small Limited Entry Fleets 120
12.3.1.5 Expiration of the "A" Endorsement 121
12.3.2 Provisional "A" Gear Endorsement 121
12.3.2.1 Overview of the Provisional "A" Endorsement 121
12.3.3 "B" Gear Endorsement 121
12.3.3.1 Overview of the "B" Endorsement 121
12.3.4 Designated Species "B" Gear Endorsements 122
12.3.4.1 Overview of the Designated Species "B" Endorsement 122
12.3.5 Exceptions to the Issuance Criteria and Grounds for Appeal 122
12.4 Fixed Gear Sablefish Endorsement 123
12.5 LE Permit Issuance Review Board 123
12.5.1 Functions 124
12.5.2 Expenses 124
12.5.3 Advisory Role of Group 124
12.5.4 Nominations 124
12.5.5 Membership 124
12.5.6 Majority Vote 124
12.5.7 Terms of Members 124
12.5.8 Review of Sablefish Endorsement Appeals 125
12.6 Implementation, Application and Appeals Process 125
12.7 Council Review and Monitoring 126

REFERENCES 127

APPENDICES CONTENTS 133

LIST OF FIGURES

Figure 3-1. INPFC statistical areas in the U.S. EEZ 13
Figure 4-1. Illustration of default OY rule compared to ABC 21

LIST OF TABLES

Table 3-1. Common and scientific names of species included in this FMP 9
Table 4-1. Specified rebuilding plan parameters at the time of adoption 44

6.0 MANAGEMENT MEASURES

The regulatory measures available to manage the West Coast groundfish fisheries include, but are not limited to, harvest guidelines, quotas, landing limits, frequency limits, gear restrictions (escape panels or ports, codend mesh size, etc.), time/area closures, prohibited species, bag and size limits, permits, other forms of effort control, allocation, reporting requirements, and onboard observers. This section of the FMP describes these measures and their general application for management of the groundfish fisheries in the Washington, Oregon, and California region.

The FMP, as amended, establishes the fishery management program and the process and procedures the Council will follow in making adjustments to that program. It also sets the limits of management authority of the Council and the Secretary when acting under the FMP. Management measures implementing the FMP, which directly control fishing activities, must be consistent with the goals and objectives of the FMP, the Magnuson-Stevens Act, and other applicable law. Since the FMP provides several general framework procedures for making management decisions, not all management measures authorized by the FMP will be implemented at any given time. Management decisions made under the framework procedures outlined in the FMP are intended to be implemented without the need to amend the FMP.

This FMP establishes two framework procedures through which the Council is able to recommend the establishment and adjustment of specific management measures for the Pacific Coast groundfish fishery. The "points of concern" framework allows the Council to develop management measures that respond to resource conservation issues and the "socioeconomic" framework allows the Council to develop management measures in response to social, economic, and ecological issues that affect the fishing community. Associated with each framework are a set of criteria which form the basis for Council recommendations and with which Council recommendations will be consistent. The process for developing and implementing management measures normally will occur over the span of at least two Council meetings, with an exception that provides for more timely Council consideration under certain specific conditions. This process is explained in more detail in Section 6.2.

This FMP contemplates the Secretary will publish management measures recommended by the Council in the *Federal Register* as either "notices" or "regulations." Generally, management measures of broad applicability and permanent effectiveness are intended to be published as "regulations" while those measures more narrow in their applicability and which are meant to be effective only during the current fishing year, or even of shorter duration, and which might also require frequent adjustment, are intended to be published as "notices".

NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments, and other relevant information; and, if it is approved, will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

The procedures specified in this chapter do not affect the authority of the Secretary to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Act if an emergency exists involving any groundfish resource, or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

[Amended: 11]

6.1 General List of Management Measures

In the early stages of fishery development, there is generally little concern with management strategies. As fishing effort increases, management measures become necessary to prevent overfishing and adverse social and economic impacts.

Recruitment, growth, natural mortality, and fishing mortality affect the size of fish populations. Fishing mortality is the only factor which can be effectively controlled in the ocean; and, therefore, marine fishery management has focused primarily on measures which influence fishing mortality. The principal measures which traditionally have been used to control fishing mortality include, but are not limited to, the following:

1. Permits, licenses and endorsements
2. Mesh size
3. Landing limits and trip frequency limits
4. Quotas, including individual transferable quotas (ITQs)
5. Escape panels or ports
6. Size limits
7. Bag limits
8. Time/area closures
9. Other forms of effort control including input controls on fishing gear such as restrictions on trawl size or longline length or number of hooks or pots
10. Allocation

The management measures discussed in this section do not include those additional measures necessary to monitor catch and effort or to enforce regulations. The FMP authorizes the promulgation of regulations necessary to enforce the provisions of the FMP and its implementing regulations through the appropriate rulemaking procedure described in Section 6.2. Although this document only discusses in detail those management measures just listed, other types of management measures may have valid applicability and are intended to be available to the Council providing their consideration is consistent with the criteria and general procedures contained in this FMP. An example of an untried management measure that holds some theoretical promise in addressing bycatch problems is the creation of an incentive program which rewards fishermen by granting access to a reserve quota if they have maintained a documented bycatch rate below a specified level.

6.1.1 Permits, Licenses, and Endorsements

Permits and licenses are used to enumerate participants in an industry and, if eligibility requirements are established or the number of permits is limited, to restrict participation. Participation in the Washington, Oregon, and California groundfish fishery was partially limited beginning in 1994 when the federal vessel license limitation program was implemented (Amendment 6). Subsequently, Amendment 9 further limited participation in the fixed-gear sablefish fishery by establishing a sablefish endorsement. There is currently no federal permit requirement for other commercial participants (fishers or processors) or recreational participants (private recreational or charter). The Council may determine that effective management of the fishery requires accurate enumeration of the number of participants in these sectors and may establish a permit requirement to accomplish this. In addition, some form of limitation on participation may be necessary in order to protect the resource or to achieve the objectives of the FMP.

6.1.2 Mesh Size

In net fisheries, a most common management measure applied world wide has been a minimum mesh size. By increasing or decreasing mesh size, it is possible to increase or decrease the size of fish retained in the net.

Control over the size of entry into the fishery can ensure that sufficient numbers of immature fish pass through the net to protect the long-term productivity. Mesh size also can be adjusted to maximize the yield of certain species.

However, mesh size is not a panacea, because a single mesh size is unlikely to provide the optimal age of recruitment for each species. In a multispecies fishery, a single mesh size will tend to over harvest some species while over protecting others. Ideally, the selected mesh size should tend to maximize the economic yield to the fishery over the longest period possible.

Mesh size in fish pots (traps) also affects the size of fish retained in the trap. By increasing the minimum mesh size in all or part of the trap, small fish may be allowed to escape.

6.1.3 Landing and Frequency Limits

A trip limit is the amount of groundfish that may be taken and retained, possessed, or landed from a single fishing trip. Trip landing limits and trip frequency limits are used to control landings to delay achievement of a quota or harvest guideline and thus avoid premature closure of a fishery if it is desirable to extend the fishery over a longer time. Trip landing limits also can be utilized to minimize targeting on a species or species group while allowing landings of some level of incidental catch. Trip landing limits are most effective in fisheries where the fisherman can control what is caught. In a multispecies fishery, trip limits can discourage targeting while, at the same time, providing for the landing of an incidental catch species which requires a greater degree of protection than the other species in the multispecies catch. Conversely, a trip limit may be necessary to restrict the overall multispecies complex catch in order to provide adequate protection to a single component of that catch.

6.1.4 Quotas, Including Individual Transferable Quotas

Quotas are specified harvest limits, the attainment of which causes closure of the fishery for that species, gear type, or individual participant. Quotas may be established for intentional allocation purposes or to terminate harvest at a specified point. They may be specified for a particular area, gear type, time period, species or species group, and/or vessel or permit holder. Quotas can apply to either target species or bycatch species.

6.1.5 Escape Ports and Panels

Escape ports and panels are used in traps. Escape ports allow small fish to escape once caught in the trap. An escape panel is part of a trap which is constructed of biodegradable material or which is secured with biodegradable material. When the material degrades, it leaves a hole in the trap which allows fish to escape. Thus, the panel prevents continued fishing if gear is lost or not attended for extended periods of time. Similarly, blowout panels could be used in a trawl fishery to limit the catch per haul.

6.1.6 Size Limits

Size limits are used to prevent the harvest of immature fish or those which have not reached their full reproductive capacity. In some cases, size limits are utilized in reverse to harvest younger recruit or pre-recruits and protecting older, larger spawning stock. Generally, harvesting the larger members of the population tends to increase the yield by taking advantage of the combined growth of individual fish. Size limits can be applied to all fisheries, but are generally used where fish are handled individually or in small groups such as trap-caught sablefish and recreational-caught fish. Size limits lose their utility in cases where the survival of the fish returned to the sea is low (e.g., rockfish).

6.1.7 Bag Limits

Bag limits have long been used in the recreational fishery and are perhaps the oldest method used to control recreational fishing. The intended effect of bag limits is to spread the available catch over a large number of anglers and to avoid waste.

6.1.8 Time/Area Closures (Seasons and Closed Areas)

In recent years, overcapacity of the harvesting and processing sectors has lead to more restrictive management. While the Council has tried to maintain year-round fishing and processing opportunities, it has become more difficult to do so without making discard worse. It may be necessary to restrict the amount of time vessels are allowed to fish, and this could take form of seasons for the entire fleet, regions of the coast, or individual vessel seasons. The fixed gear (nontrawl) sablefish fishery is an extreme example of a seasonal approach, with the season restricted to a week or less. Seasons may also be helpful to protect spawning concentrations of certain species in order to avoid times when the fish are most concentrated or particularly vulnerable. In this respect, closure of certain areas to protect spawning lingcod or petrale sole may be advisable.

Time/area closures have also been used in management of the Pacific whiting fishery. In this case, the foreign fishery was controlled by season (June 1 through October 31), area (no fishing within 12 miles off shore or south of 39°N latitude) and quota. The domestic fishery has also been managed with seasons that typically have taken the form of a beginning date, an "unrestricted" period, and closure when the harvest limit is reached. Outside the "unrestricted" season, an incidental catch allowance is typically provided to prevent regulatory bycatch.

6.1.9 Other Forms of Effort Control

Other forms of effort controls commonly used include restrictions on the number of units of gear, or restrictions on the size of trawls, or length of longlines, or the number of hooks or pots. These measures may also be useful in reducing bycatch.

6.1.10 Allocation

Allocation is the apportionment of an item for a specific purpose or to a particular person or group of persons. Allocation of fishery resources may result from any type of management measure, but is most commonly a numerical quota or harvest guideline for a specific gear or fishery sector. Most fishery management measures allocate fishery resources to some degree, because they invariably affect access to the resource by different fishery sectors by different amounts. These allocative impacts, if not the intentional purpose of the management measure, are considered to be indirect or unintentional allocations. Direct allocation occurs when numerical quotas, harvest guidelines, or other management measures are established with the specific intent of affecting a particular group's access to the fishery resource.

Fishery resources may be allocated to accomplish a single biological, social or economic objective, or a combination of such objectives. The entire resource, or a portion, may be allocated to a particular group, although the Magnuson-Stevens Act requires that allocation among user groups be determined in such a way that no group, person, or entity receives an undue share of the resource. The socioeconomic framework described in Section 6.2.3 provides criteria for direct allocation. Allocative impacts of all proposed management measures should be analyzed and discussed in the Council's decision making process.

[Amended: 11 & added 6.1.1 (?)]

6.2 General Procedures for Establishing and Adjusting Management Measures

Management measures are normally imposed, adjusted, or removed at the beginning of the biennial fishing period, but may, if the Council determines it necessary, be imposed, adjusted, or removed at any time during the period. Management measures may be imposed for resource conservation, social or economic reasons consistent with the criteria, procedures, goals, and objectives set forth in the FMP.

Because the potential actions which may be taken under the two frameworks established by the FMP cover a wide range analyses of biological, social, and economic impacts will be considered at the time a particular change is proposed. As a result, the time required to take action under either framework will vary depending on the nature of the action, its impacts on the fishing industry, resource, environment, and review of these impacts by interested parties. Satisfaction of the legal requirements of other applicable law (e.g., the Administrative Procedure Act, Regulatory Flexibility Act, relevant Executive Orders, etc.) for actions taken under this framework requires analysis and public comment before measures may be implemented by the Secretary.

Four different categories of management actions are authorized by this FMP, each of which requires a slightly different process. Management measures may be established, adjusted, or removed using any of the four procedures. The four basic categories of management actions are as follows:

<u>A. Automatic Actions</u> - Automatic management actions may be initiated by the NMFS Regional Administrator without prior public notice, opportunity to comment, or a Council meeting. These actions are nondiscretionary, and the impacts previously must have been taken into account. Examples include fishery, season, or gear type closures when a quota has been projected to have been attained. The Secretary will publish a single "notice" in the *Federal Register* making the action effective.

<u>B. "Notice" Actions Requiring at Least One Council Meeting and One *Federal Register* Notice</u> - These include all management actions other than "automatic" actions that are either nondiscretionary or for which the scope of probable impacts has been previously analyzed.

These actions are intended to have temporary effect, and the expectation is that they will need frequent adjustment. They may be recommended at a single Council meeting, although the Council will provide as much advance information to the public as possible concerning the issues it will be considering at its decision meeting. The primary examples are those inseason management actions defined as "routine" according to the criteria in Section 6.2.1. These include trip landing and frequency limits and size limits for all commercial gear types and closed seasons for any groundfish species in cases where protection of an overfished or depleted stock is required, and bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements for all recreational fisheries. Previous analysis must have been specific as to species and gear type before a management measure can be defined as "routine" and acted upon at a single Council meeting. If the recommendations are approved, the Secretary will waive for good cause the requirement for prior notice and comment in the *Federal Register* and will publish a single "notice" in the *Federal Register* making the action effective. This category of actions presumes the Secretary will find that the need for swift implementation and the extensive notice and opportunity for comment on these types of measures along with the scope of their impacts already provided by the Council will serve as good cause to waive the need for additional prior notice and comment in the *Federal Register*.

C. Management Measures Rulemaking Actions Developed Through the Three Council Meeting Biennial Specifications Process and Two Federal Register Rules - These include (1) management action developed through the biennial specifications process, (2) management measures being classified as “routine,” or (3) trip limits that vary by gear type, closed seasons or areas, and in the recreational fishery, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements the first time these measures are used. Examples include changes to or imposition of gear regulations, or imposition of landings limits, frequency limits, or limits that are differential by gear type, or closed area or seasons for the first time on any species or species group, or gear type. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings (usually April and June) and provide the public advance notice and opportunity to comment on both the proposals and the analysis prior to and at the second Council meeting. If a management measure is designated as "routine" under this procedure, specific adjustments of that measure can subsequently be announced in the *Federal Register* by "notice" as described in the previous paragraphs. The Secretary will publish a "proposed rule" in the Federal Register with an appropriate period for public comment followed by publication of a "final rule" in the Federal Register.

It should be noted that the three Council meeting process refers to two decision meetings. The Council will develop proposed harvest specifications during the first meeting. They will finish drafting harvest specifications and develop the management measures during the second meeting. Finally, at the third meeting, the Council will make final recommendations to the Secretary on the complete harvest specifications and management measures biennial management package. For the Council to have adequate information to identify proposed management measures for public comment at the first meeting, the identification of issues and the development of proposals normally must begin at a prior Council meeting.

D. Full Rulemaking Actions Normally Requiring at Least Two Council Meetings and Two *Federal Register* Rules (Regulatory Amendment) - These include any proposed management measure that is highly controversial or any measure which directly allocates the resource. These also include management measures that are intended to have permanent effect and are discretionary, and for which the impacts have not been previously analyzed. The Council normally will follow the two meeting procedure described for the specifications and management measures rulemaking category. The Secretary will publish a "proposed rule" in the *Federal Register* with an appropriate period for public comment followed by publication of a "final rule" in the *Federal Register*.

Management measures recommended to address a resource conservation issue must be based upon the establishment of a "point of concern" and consistent with the specific procedures and criteria listed in Section 6.2.2.

Management measures recommended to address social or economic issues must be consistent with the specific procedures and criteria described in Section 6.2.3.

6.2.1 Routine Management Measures

"Routine" management measures are those the Council determines are likely to be adjusted on an annual or more frequent basis. Measures are classified as "routine" by the Council through either the full or abbreviated rulemaking process (C. or D. above). In order for a measure to be classified as "routine", the Council will determine that the measure is appropriate to address the issue at hand and may require further adjustment to achieve its purpose with accuracy.

As in the case of all proposed management measures, prior to initial implementation as "routine" measures, the Council will analyze the need for the measures, their impacts, and the rationale for their use. Once a management measure has been classified as "routine" through one of the two rulemaking procedures outlined above, it may be modified thereafter through the single meeting "notice" procedure (B. above) only if (1) the modification is proposed for the same purpose as the original measure, and (2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as "routine." The analysis of impacts need not be repeated when the measure is subsequently modified if the Council determines that they do not differ substantially from those contained in the original analysis. The Council may also recommend removing a "routine" classification.

Experience gained from management of the Pacific Coast groundfish fishery indicates that certain measures usually require modification on a frequent basis to ensure that they meet their stated purpose with accuracy. For commercial fisheries, these measures are trip landing limits and trip frequency limits, including cumulative limits, and notification requirements. Their purpose in application to the commercial fishery has consistently been either to stretch the duration of the fishery so as not to disturb traditional fishing and marketing patterns, to reduce discards and wastage, or to discourage targeted fishing while allowing small incidental catches when attainment of a harvest guideline or quota is imminent. In cases where protection of an overfished or depleted stock is required, the Council may impose limits that differ by gear type, or establish closed areas or seasons. These latter two measures were not historically been imposed through the annual management cycle because of their allocative implications. However, this additional flexibility has become necessary to allow the harvest of healthy stocks as much as possible while protecting and rebuilding overfished and depleted stocks, and equitably distributing the burdens of rebuilding among sectors. The first time a differential trip limit or closed season is to be imposed in a fishery it must be imposed during the biennial management cycle (with the required analysis and opportunity for public comment,) and subsequently may be modified inseason through the routine adjustment process.

For recreational fisheries, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements may be applied to specific species, species groups, sizes of fish and gear types. For the recreational fishery, bag and size limits have been imposed to spread the available catch over a large number of anglers, to avoid waste, and to provide consistency with state regulations.

Routine management measures are also often necessary to meet the varied and interwoven mandates of the Magnuson-Stevens Act and FMP through: achieving the overfished species rebuilding plans, reducing bycatch, preventing overfishing, allowing the harvest of healthy stocks as much as possible while protecting and rebuilding overfished and depleted stocks, and equitably distributing the burdens of rebuilding among the sectors.

The following measures were classified as routine measures through December 21, 2000:

<u>Limited Entry Trip Landing and Frequency Limits</u>

Widow rockfish - all gear
Sebastes complex - all gear
Yellowtail rockfish - all gear
Canary rockfish - all gear
Bocaccio - all gear
Pacific ocean perch - all gear
Sablefish (including size limits) - all gear
Dover sole - all gear
Thornyhead rockfish (separately or combined) - all gear
Pacific whiting - all gear
Lingcod (including size limits) - all gear

<u>Open Access Trip Landing and Frequency Limits</u>

All groundfish species, separately or in any combination - all gear types

All Commercial Fisheries, All Gear Types: In cases where protection of an overfished or depleted stock is required, trip limits may differ by gear type, and time/area closures may be established.

All Recreational Fisheries, All Gear Types: For all groundfish species separately or in any combination, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements. The first time one of these measures is imposed in the fishery, it must be imposed during the biennial management cycle.

Any measure designated as "routine" for one specific species, species group, or gear type may not be treated as "routine" for a different species, species group, or gear type without first having been classified as "routine." Each year the annual SAFE document will list all measures that have been designated as routine.

The Council will conduct a continuing review of landings of those species for which harvest guidelines, quotas, optimum yields (OYs) or specific "routine" management measures have been implemented and will make projections of the landings at various times throughout the year. If in the course of this review it becomes apparent the rate of landings is substantially different than anticipated and that the current "routine" management measures will not achieve the annual management objectives, the Council may recommend inseason adjustments to those measures. Such adjustments may be implemented through the single meeting "notice" procedure.

6.2.2 Resource Conservation Issues - The "Points of Concern" Framework

The "points of concern" process is the Council's second major tool (along with setting harvest levels) in exercising its resource stewardship responsibilities. The process is intended to foster a continuous and vigilant review of the Pacific Coast groundfish stocks and fishery to prevent unintended overfishing or other resource damage. To facilitate this process a Council-appointed management team (the Groundfish Management Team [GMT] or other entity) will monitor the fishery throughout the year, taking into account any new information on the status of each species or species group to determine whether a resource conservation issue exists that requires a management response. The Council developed the "points of concern" criteria to assist it in determining when a focused review on a specific species or species group is warranted which might result in the need to recommend the implementation of specific management measures to address the resource conservation issue. The FMP authorizes the Council to act based solely on the "points of concern," which allows the Council to respond quickly and directly to a resource conservation issue. In conducting this review, the GMT or other entity will utilize the most current catch, effort, and other relevant data from the fishery.

In the course of the continuing review, a "point of concern" occurs when any one or more of the following is found or expected:

1. Catch for the calendar year is projected to exceed the best current estimate of acceptable biological catch (ABC) for those species for which a harvest guideline or quota is not specified.
2. Catch for the calendar year is projected to exceed the current harvest guideline or quota.
3. Any change in the biological characteristics of the species/species complex is discovered such as changes in age composition, size composition, and age at maturity.
4. Exploitable biomass or spawning biomass is below a level expected to produce MSY for the species/species complex under consideration.
5. Recruitment is substantially below replacement level.
6. Estimated bycatch of a species or species group increases substantially above previous estimates, or there is information that abundance of a bycatch species has declined substantially.
7. Impacts of fishing gear on EFH are discovered and modification to gear or fishing regulations could reduce those impacts.

Once a "point of concern" is identified, the GMT will evaluate current data to determine if a resource conservation issue exists and will provide its findings in writing at the next scheduled Council meeting. If the GMT determines a resource conservation issue exists, it will provide its recommendation, rationale, and analysis for the appropriate management measures that will address the issue.

In developing its recommendation for management action, the Council will choose an action from one or more of the following categories which include the types of management measures most commonly used to address resource conservation issues.

- Harvest guidelines
- Quotas
- Cessation of directed fishing (foreign, domestic or both) on the identified species or species group with appropriate allowances for incidental harvest of that species or species group
- Size limits
- Landing limits
- Trip frequency limits
- Area or subarea closures
- Time closures
- Seasons
- Gear limitations, which include, but are not limited to, definitions of legal gear, mesh size specifications, codend specifications, marking requirements, and other gear specifications as necessary.
- Observer coverage
- Reporting requirements
- Permits
- Other necessary measures

Direct allocation of the resource between different segments of the fishery is, in most cases, not the preferred response to a resource conservation issue. Council recommendations to directly allocate the resource will be developed according to the criteria and process described in Section 6.2.3, the socioeconomic framework.

After receiving the GMT's report, the Council will take public testimony and, if appropriate, will recommend management measures to the NMFS Regional Administrator accompanied by supporting rationale and analysis of impacts. The Council's analysis will include a description of (a) how the action will address the resource conservation issue consistent with the objectives of the FMP; (b) likely impacts on other management measures, other fisheries and bycatch; (c) economic impacts, particularly the cost to the commercial and recreational segments of the fishing industry; and (d) impacts on fishing communities.

The NMFS Regional Administrator will review the Council's recommendation and supporting information and will follow the appropriate implementation process described in Section 6.2 depending on the amount of public notice and comment provided by the Council and the intended permanence of the management action. If the Council contemplates the need for frequent adjustments to the recommended measures, it may classify them as "routine" through the appropriate process described in Section 6.2.1.

If the NMFS Regional Administrator does not concur with the Council's recommendation, the Council will be notified in writing of the reasons for the rejection.

Nothing in this section is meant to derogate from the authority of the Secretary to take emergency action under Section 305(c) of the Magnuson-Stevens Act.

6.2.3 Nonbiological Issues--The Socioeconomic Framework

From time to time non-biological issues may arise which require the Council to recommend management actions to address certain social or economic issues in the fishery. Resource allocation, seasons, or landing limits based on market quality and timing, safety measures, and prevention of gear conflicts make up only a few examples of possible management issues with a social or economic basis. In general, there may be any number of situations where the Council determines that management measures are necessary to achieve the stated social and/or economic objectives of the FMP.

Either on its own initiative or by request, the Council may evaluate current information and issues to determine if social or economic factors warrant imposition of management measures to achieve the Council's established management objectives. Actions that are permitted under this framework include all of the categories of actions authorized under the "points of concern" framework with the addition of direct resource allocation.

If the Council concludes that a management action is necessary to address a social or economic issue, it will prepare a report containing the rationale in support of its conclusion. The report will include the proposed management measure, a description of other viable alternatives considered, and an analysis that addresses the following criteria (a) how the action is expected to promote achievement of the goals and objectives of the FMP; (b) likely impacts on other management measures, other fisheries and bycatch; (c) biological impacts; (d) economic impacts, particularly the cost to the fishing industry; (e) impacts on fishing communities; and (f) how the action is expected to accomplish at least one of the following:

1. Enable a quota, harvest guideline, or allocation to be achieved.
2. Avoid exceeding a quota, harvest guideline, or allocation.
3. Extend domestic fishing and marketing opportunities as long as practicable during the fishing year, for those sectors for which the Council has established this policy.
4. Maintain stability in the fishery by continuing management measures for species that previously were managed under the points of concern mechanism.
5. Maintain or improve product volume and flow to the consumer.
6. Increase economic yield.
7. Improve product quality.
8. Reduce anticipated bycatch and bycatch mortality.
9. Reduce gear conflicts, or conflicts between competing user groups.
10. Develop fisheries for underutilized species with minimal impacts on existing domestic fisheries.
11. Increase sustainable landings.
12. Increase fishing efficiency.
13. Maintain data collection and means for verification.
14. Maintain or improve the recreational fishery.
15. Any other measurable benefit to the fishery.

The Council, following review of the report, supporting data, public comment and other relevant information, may recommend management measures to the NMFS Regional Administrator accompanied by relevant background data, information, and public comment. The recommendation will explain the urgency in implementation of the measure(s), if any, and reasons therefore.

The NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments, and other relevant information, and, if it is approved, will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

The procedures specified in this chapter do not affect the authority of the Secretary to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Act if an emergency exists involving any groundfish resource, or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

If conditions warrant, the Council may designate a management measure developed and recommended to address social and economic issues as a "routine" management measure provided that the criteria and procedures in Section 6.2.1 are followed.

Quotas, including allocations, implemented through this framework will be set for one-year periods and may be modified inseason only to reflect technical corrections of acceptable biological catch (ABC). (In contrast, quotas may be imposed at any time of year for resource conservation reasons under the points of concern mechanism.)

6.2.3.1 Allocation

In addition to the requirements described in Section 6.2.3, the Council will consider the following factors when intending to recommend direct allocation of the resource.

1. Present participation in and dependence on the fishery, including alternative fisheries.
2. Historical fishing practices in, and historical dependence on, the fishery.
3. The economics of the fishery.
4. Any consensus harvest sharing agreement or negotiated settlement between the affected participants in the fishery.
5. Potential biological yield of any species or species complex affected by the allocation.
6. Consistency with the Magnuson-Stevens Act national standards.
7. Consistency with the goals and objectives of this FMP.

The modification of a direct allocation cannot be designated as "routine" unless the specific criteria for the modification have been established in the regulations.

[Amended: 13, 17]

6.3 Bycatch Management

6.3.1 Bycatch of Nongroundfish Species

Groundfish fishing activities may directly impact certain non-groundfish species, and this FMP authorizes implementation of measures to control groundfish fishing to share conservation burdens identified under overfishing definitions adopted by the Council, the Endangered Species Act (ESA), or other applicable laws, while minimizing disruption of the groundfish fishery. Specifically, the intention is to reduce bycatch or other direct mortality of any species. Section 6.1 of this FMP lists nine principal measures which traditionally have been found most useful in controlling fishing mortality. Any of these measures may be employed to control fishing impacts on non-groundfish species. However, allocation may not be the primary intention of any such regulation.

The process for implementing and adjusting such measures may be initiated at any time. In addition, some measures may be designated as routine (see Section 6.2.1), which will allow adjustment at a single meeting based on relevant information available at the time if (1) the modification is proposed for the same purpose as the original measure, and (2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine.

Generally, the Council will initiate the process of establishing or adjusting management measures when a resource problem with a non-groundfish species is identified and it has been determined that groundfish fishing regulations will reduce the total impact on that species or stock. It is anticipated this will generally occur when a state or federal resource management agency (such as the U.S. Department of the Interior, NMFS, or state fishery agency) or the Council's Salmon Technical Team (STT) presents the Council with information substantiating its concern for a particular species. The Council will review the information and refer it to the Scientific and Statistical Committee (SSC), GMT, STT, or other appropriate technical advisory group for evaluation. If the Council determines, based on this review, that management measures may be necessary to prevent harm to a non-groundfish species facing conservation problems or to address requirements of the ESA, Marine Mammal Protection Act, other relevant federal natural resource law or policy, or international agreement, it may implement appropriate management measures in accordance with the procedures identified in Section 6.2. The intention of the measures may be to share conservation burdens while minimizing disruption of the groundfish fishery, but under no circumstances may the intention be simply to provide more fish to a different user group or to achieve other allocation objectives.

6.3.2 Standardized Reporting Methodology

Bycatch and discard survival data, information to assess the effects of bycatch and discard on managed populations and the ecosystem, and data on the socioeconomic effects of alternative management measures to reduce bycatch are limited. Due to these limitations, precise estimates of bycatch, bycatch mortality, or associated effects of alternative conservation and management measures in the groundfish fishery are not possible.

Improving estimates for information on total fishing mortality is essential. Sources of this information may include at-sea observer programs, dockside sampling programs, and new technology to monitor fishing activities and catch, as well as better use of industry-reported catch and discard information. Timely summaries of the amount and type of bycatch for each fishery should be collated in annual SAFE reports.

6.3.3 Measures to Control Bycatch

Bycatch and discard create unquantified problems for the groundfish fishery. Solving these problems requires both knowing how much bycatch mortality occurs, and setting management measures to reduce that mortality. Bycatch and bycatch mortality can be measured through observer programs (see below at 6.5.1.2) and through other means. Once it initiates programs to measure bycatch, the Council can better identify and prioritize the bycatch problems in the groundfish fishery, based on the expected benefits to the U.S. and on the practicality of addressing these problems. The Council will develop measures to reduce bycatch and bycatch mortality in accordance with the points of concern or the socioeconomic framework provisions of the FMP. These measures may include but are not limited to:

- Full retention or increased utilization programs.
- Setting a shorter-than-year-round fishing season in combination with higher cumulative landings limits.
- Allowing permit stacking in the limited entry fleet.
- Gear modification requirements.
- Catch allocation to, or gear flexibility for, gear types with lower bycatch rates.
- Re-examining/improving species-to-species landings limit ratios.
- Time/area closures.

[Amended: 7, 11 & added 6.3.2, 6.3.3]

6.4 Recreational Catch and Release Management

The Council may develop recreational catch-and-release programs for any groundfish stock through the appropriate rulemaking process. The Council will assess the type and amount of groundfish caught and released alive during fishing under such a program and the mortality of such fish. Management measures for such a program will, to the extent practicable, minimize mortality and ensure extended survival of such groundfish.

[Amended: 11]

6.5 Other Management Measures

6.5.1 Generic

6.5.1.1 Permits

Federal permits may be required for individuals or vessels that harvest groundfish and for individuals or facilities (including vessels) that process groundfish or take delivery of live groundfish. In determining whether to require a harvesting or processing permit, and in establishing the terms and conditions for issuing a permit, the Council may consider any relevant factors including whether a permit:

1. Will enhance the collection of biological, economic, or social data.
2. Will provide better enforcement of laws and regulations, including those designed to ensure conservation and management and those designed to protect consumer health and safety.
3. Will help achieve the goals and objectives if the FMP.
4. Will help prevent or reduce overcapacity in the fishery.
5. May be transferred, and under what conditions.

Separate permits or endorsements may be required for harvesting and processing or for vessels or facilities based on size, type of fishing gear used, species harvested or processed, or such other factors that may be appropriate. The permits and endorsements are also subject to sanctions, including revocation, as provided by section 308 of the Magnuson-Stevens Act.

In establishing a permit requirement, the Council will follow the full-rulemaking procedures in Section 6.2.

6.5.1.2 Observers

All fishing vessels operating in this management unit including catcher/processors, at-sea processors, and those vessels which harvest in the Washington, Oregon, and California area and land in another area, may be required to accommodate an observer or video-monitoring system for the purpose of collecting scientific data or verifying landings and discard used for scientific data collection. An observer program will be considered only for circumstances where other data collection methods are deemed insufficient for management of the fishery. Implementation of any observer program will be in accordance with appropriate federal procedures, including economic analysis and public comment.

The Regional Administrator will implement an observer program through a Council-approved federal regulatory framework. Details of how observer coverage will be distributed across the West Coast groundfish fleet will be described in an observer coverage plan. NMFS will publish an announcement of the authorization of the observer program and description of the observer coverage plan in the *Federal Register*.

There may be a priority need for observers on at-sea processing vessels to collect data normally collected at shore based processing plants. Certain information for management of the fishery can be obtained from logbooks and other reporting requirements, but the collection of some types of data would be too onerous for some fishermen to collect. Processing vessels must be willing to accommodate onboard observers and may be required to provide the required observers prior to issuance of any required federal permits.

Observers are required on foreign vessels operating in the Exclusive Economic Zone (EEZ) according to the Magnuson-Stevens Act.

6.5.1.3 Habitat Protection (General)

Beginning in January 1989, the Marine Plastic Pollution Research and Control Act of 1987 (PL 100-220, MARPOL) restricted the dumping of gear or other material from domestic vessels. The Secretary, upon the recommendation of the Council, may propose additional management measures restricting disposal of fishing gear by domestic and foreign vessels. A description of the groundfish habitat and effects of habitat alteration, as required by the Magnuson-Stevens Act, appear in the Appendix 11.10. EFH provisions are found in Section 6.6.

6.5.1.4 Vessel Safety Considerations

The Council will consider, and may provide for, temporary adjustments, after consultation with the U.S. Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting, because of weather or other ocean conditions affecting the safety of the vessels. A description of vessel safety considerations, as required by the Magnuson-Stevens Act, appear in Appendix 11.6.

6.5.2 Domestic--Commercial

All measures, unless otherwise specified, apply to all domestic vessels regardless of whether catch is landed and processed on shore or processed at sea.

6.5.2.1 Permits (General)

All U.S. commercial fishing vessels are required by state laws to be in possession of a current fishing or landing permit from the appropriate state agency in order to land groundfish in the Washington, Oregon, and California area. Federal limited entry permits authorize fishing within limits and restrictions specified for those permits. Nonpermitted vessels are also subject to specified limits and restrictions. Federal permits may also be required for groundfish processors. In the event that a federal fishing or access permit is required, failure to obtain and possess such a federal permit will be in violation of this FMP.

6.5.2.2 Catch Restrictions

The FMP authorizes the commercial and recreational harvest of species listed in Chapter 3 of this plan, and provides for limiting the harvest of these species in Chapters 5 and 6. The specific catch restrictions on groundfish currently in effect when Amendment 4 was implemented, including limits on groundfish caught in nongroundfish fisheries, are referenced in Chapter 11. However, some of these catch restrictions have subsequently been modified under the framework provisions.

<u>Prohibited Species.</u> It is unlawful for any person to retain any species of salmonid or Pacific halibut caught by means of fishing gear authorized under this FMP, except where a Council approved monitoring program is in effect. State regulations prohibit the landing of crab incidentally caught in trawl gear off Washington and Oregon. However, trawl fishermen may land Dungeness crab in the State of California in compliance with the state landing law. Retention of salmonids and Pacific halibut caught by means of other groundfish fishing gear is also prohibited unless authorized by 50 CFR Part 300, Subparts E or F; or Part 600, Subpart H. Specifically, salmonids are prohibited species for longline and pot gear. Halibut may be retained and landed by troll and longline gear only during times and under conditions set by International Pacific Halibut Commission and/or other federal regulations. Salmon taken by troll gear may be retained and landed only as specified in troll salmon regulations. Species identified as prohibited must be returned to the sea as soon as practicable with a minimum of injury when caught and brought aboard, after allowing for sampling by an observer, if any. Exceptions may be made for the recovery of tagged fish.

Groundfish species or species groups under this FMP for which the quota has been reached shall be treated in the same manner as prohibited species.

The FMP authorizes the designation of other prohibited species in the future or the removal of a species from this classification, consistent with other applicable law for that species.

6.5.2.3 Gear Restrictions

This plan authorizes the use of trawls, pots (traps), longlines, hook-and-line, and setnets (gillnets and trammel nets) as legal gear for the commercial harvest of groundfish. The use of setnets is prohibited in all areas north of 38° N latitude.

Implementation and modification of specific management measures regarding gear, such as definitions of legal gear, mesh size restrictions, codend size (length, diameter, or volume), chafing gear, gear marking, escape panels and ports, and the length of time gear may be left unattended, are authorized by this FMP. Gear restrictions may be established, modified, or removed under the points of concern or socioeconomic frameworks described in Chapter 6. Any changes in gear regulations should be scheduled so as to minimize costs to the fishing industry, insofar as this is consistent with achieving the goals of the change.

The original FMP and implementing regulations, as amended, specified minimum mesh size and other gear restrictions, which are listed in Chapter 11. Several provisions have subsequently been modified under the procedures outlined in this FMP.

6.5.2.4 Reporting Requirements

This FMP authorizes domestic vessel permit applications and reporting requirements.

<u>Surveys to Determine Domestic Allocation Harvest</u>. Surveys of the domestic industry will be conducted biannually by NMFS, at the appropriate time determined by NMFS, to determine amounts of fish not needed by the domestic processing industry, which then may be made available to joint venture or foreign fishing, as described in Sections 5.8 and 5.9.3.

<u>Permit Applications</u>. Permit applications for the domestic groundfish fishery, including, but not limited to exempted fishing permits, are authorized by this FMP. Such applications may include vessel name, length, type, documentation number or state registration number, radio call sign, home port, and capacity; owner or operator's name, mailing address, telephone number, and relationship of the applicant to the owner; type of fishing gear to be used, if any; signature of the applicant, and any other information found necessary for identification and registration of the vessel.

<u>Other Reporting and Recordkeeping Requirements</u>. Catch, effort, biological, and other data necessary for implementation of this FMP will continue to be collected by the States of Washington, Oregon, and California under existing state data collection provisions. Federal reporting requirements will be implemented only when the data collection and reporting systems operated by state agencies fail to provide the Secretary with statistical information for adequate management.

Several major instances where state reporting requirements may be insufficient have been identified. The first is where a vessel harvests fish within the Washington, Oregon, and California management area, but lands outside the management area. The second case occurs when a vessel (usually a processor) remains at sea for a long period of time before offloading its catch shore side. In the first case, reporting of the harvest may never occur, which could affect stock assessments dependent on accurate catch information. In the second case, reporting frequently is delayed several weeks or even months. Delayed reporting could seriously hamper inseason management of quota and harvest guideline species. Another relates to fish that are captured and discarded at sea; most state programs do not require vessels to report bycatch or other discards.

To address these inadequacies, the FMP authorizes implementation of federal reporting requirements in addition to those of the various states. (Such requirements will be announced in the *Federal Register*.) The owner or operator of any vessel that retains fish harvested in the area managed by this FMP whose port of landing is outside the management area may be required to report those catches in a timely manner. They also may be required to submit a completed fish landing ticket from either Washington, Oregon, or California, or an equivalent document containing all of the information required by the state on that fishticket.

In addition, these vessels, or vessels that remain at sea for long periods of time (in particular, those that process their catch or the catch of another vessel at sea) may be required to report within a specified time period.

1. Vessel name.
2. Radio call sign.
3. Documentation number or federal permit number.
4. Company representative and telephone, fax, and/or telex number.
5. Vessel location including daily positions.
6. Check-in and check-out reports giving the time, date, location of the beginning or ending of any fishing activity.
7. Gear type.
8. Reporting area and period.
9. Duration of operation.
10. Estimated catch by species and area, species disposition (including discards, product type, and weights).
11. Product recovery ratios, products sold (in weight and value by species and product type, and if applicable, size or grade).
12. Any other information deemed necessary for management of the fishery.

These vessels also may be required to maintain and submit logbooks, accurately recording the following information in addition to the information listed above, and for a specified time period. Daily and cumulative catch by species, effort, processing, and transfer information; crew size; time, position, duration, sea depth, and catch by species of each haul or set; gear information; identification of catcher vessel, if applicable; information on other parties receiving fish or fish products; and any other information deemed necessary.

These vessels may be required to inform a NMFS enforcement or U.S. Coast Guard office prior to landing or offloading any seafood product. Such vessels may also be required to report prior to departing the Washington, Oregon, and California management area with fish or fish products on board.

The Council intends that any special reporting requirements will be imposed only if it could be expected to enhance the NMFS's ability to monitor the catch more accurately. It is also understood that any additional collection of information must be consistent with the requirements of the Paperwork Reduction Act (PRA).

6.5.2.5 Vessel Identification

The FMP authorizes vessel identification requirements which may be modified as necessary to facilitate enforcement and vessel recognition.

6.5.3 Domestic - Recreational

6.5.3.1 Permits (General)

All U.S. recreational fishermen are required by state laws to obtain a recreational permit or license in order to fish. In the event that a federal license or permit is required, failure to obtain and possess such federal permit will be in violation of this FMP.

6.5.3.2 Catch Restrictions

This FMP authorizes establishment of catch restrictions on the recreational fishery which are consistent with the goals and objectives of the FMP and the national standards established by the Magnuson-Stevens Act. Any such catch restrictions will be established in accordance with the appropriate procedures in Sections 6.2.1, 6.2.2, or 6.2.3.

6.5.3.3 Gear Restrictions

Legal recreational gear are hook-and-line and spear.

6.5.4 Joint Venture--Domestic Vessels

U.S. vessels operating in joint ventures are domestic vessels and traditionally have been treated the same as U.S. vessels delivering shoreside. However, conditions in the fishery could warrant separate treatment in the future.

Although all U.S. vessels have been subject to the same regulations, joint venture catcher operations may be affected indirectly by restrictions (such as closed areas) placed on the foreign processing vessels that receive U.S. catch at sea.

6.5.5 Joint Venture--Foreign Vessels

These measures apply to joint venture operations in which foreign processing vessels receive U.S.-caught fish at sea.

Management of the joint venture is the same as under the original FMP with the following exceptions (1) in Section 6.3.5.5, the authority to establish, modify, or remove a season for the whiting joint venture is added; (2) in Section 6.3.5.5, the amendment provides the authority for area closures in the whiting joint venture, which may subsequently be modified or removed; (3) Section 6.3.5.5 also clarifies that the 39° N latitude southern boundary applies to joint ventures for species other than Pacific whiting, unless modified, consistent with the procedures in Sections 6.2.2 and 6.2.3; (4) in Section 6.3.5.3, the amendment provides authority for changing the way incidental retention limits are applied, which currently is to 5,000 mt increments of target species received; and (5) in Section 6.3.5.8, provisions for closing the joint venture fishery are changed to reflect the use of harvest guidelines and quotas.

6.5.5.1 Permits

All foreign vessels operating in this management area shall have on board a permit issued by the Secretary pursuant to the Magnuson-Stevens Act.

6.5.5.2 Target Species

A foreign nation may conduct joint venture operations only for species for which there is a JVP and which that nation is authorized to receive by its vessel permit.

6.5.5.3 Incidental Catch

Incidental catch refers to groundfish species which are unavoidably caught while fishing for the authorized target species. It is recognized that catches of species that are fully utilized by the domestic processing industry will occur and are unavoidable in joint venture fisheries for Pacific whiting. The Council has adopted the policy originally established by the trawl preliminary FMP to allow minimal incidental allowances which are consistent with the status of the stocks and the efficiency of the joint venture fisheries. These incidental allowances are not to be considered as surpluses to domestic processing needs (i.e., JVPs) and are allowed to provide for full utilization of the authorized target species.

Unless otherwise specified, incidental allowances for bycatch in the joint venture fishery are percentages that determine the amount that may be retained in the joint venture. Incidental allowances may be established or changed at any time during the year, but are published at least annually, concurrent with the annual specifications of JVP.

The Council may choose to use factors other than percentages in specifying incidental allowances or may change the way incidental allowances are applied (for example, to 5,000 mt increments of Pacific whiting received in the joint venture, or based on specified retention amounts).

The NMFS Regional Administrator may establish or modify incidental species allowances to reflect changes in the condition of the resource and performance of the U.S. industry. The Regional Administrator will consult with the Council, consider public testimony received, and consider the following factors before establishing or changing incidental allowances (1) observed rates in the previous joint venture; (2) current estimates of relative abundance and availability of species caught incidentally; (3) ability of the foreign vessels to take the JVP; (4) past and projected foreign and U.S. fishing effort; (5) status of stocks; (6) impacts on the domestic industry; and (7) other relevant information. Changes will be made following the same procedures as for annual or inseason changes to the specifications in Chapter 5.

The incidental retention percentages that applied to the joint venture for Pacific whiting in 1990 appear in Chapter 11.

6.5.5.4 Prohibited Species

Prohibited species means salmonids, Pacific halibut, Dungeness crab, and any species of fish which that vessel is not specifically authorized to retain, including fish received in excess of any authorization, landing limit, or quota. These species must be immediately returned to the sea with a minimum of injury after allowing for sampling by an observer, if any. This FMP authorizes the designation of other prohibited species in the future, or the removal of a species from this classification if consistent with the applicable law for that species.

6.5.5.5 Season and Area Restrictions

Season. There is no season restriction, unless otherwise specified according to this FMP.

Area. The joint venture fishery for Pacific whiting may not be conducted south of 39° N latitude. Unless otherwise specified, joint venture fisheries for other species are prohibited south of 39° N latitude as well.

Season and area restrictions for foreign vessels operating in a joint venture (including additional area restrictions for the Pacific whiting joint venture) may be established, modified, or removed at any time during the year in accordance with the procedures in Sections 6.2.2 and 6.2.3 or by foreign vessel permit conditions.

Season and area restrictions on the joint venture fishery for Pacific whiting, effective in 1990 appear in Chapter 11.

6.5.5.6 Reporting and Recordkeeping Requirements

Foreign nations receiving U.S. harvested fish in a joint venture are required to submit detailed reports of fishing effort, location, amount, and disposition of species received by species or species group, and transfer of fish or fish products, as needed for monitoring and management of the fishery. Unless otherwise specified, reports of the receipt of U.S. harvested fish must be submitted weekly. The NMFS Regional Administrator may require daily reports when 90% of the JVP or of an incidental allowance is reached. In addition, each country must report the arrival, departure, and positions of each of its vessels, as specified under the regulations and permit conditions, as needed for monitoring deployment of the fleet.

Logbooks are required under 50 CFR Part 611 to fulfill the fishery conservation, management, and enforcement purposes of the Magnuson-Stevens Act. These logs include a communications log, transfer log, and daily joint venture log which record haul by haul and daily receipt, effort, and production information.

6.5.5.7 Dumping

Foreign vessels are prohibited from dumping pollutants and fishing gear which would degrade the environment or interfere with domestic fishing operations.

6.5.5.8 Fishery Closure

The joint venture fishery shall cease each year when (1) the JVP quota for the target species has been received; (2) the overall quota or harvest guideline for the target species is reached; (3) the applicable open season has ended, if any; or (4) as necessary for resource conservation reasons under the points of concern mechanism.

6.5.5.9 Observers

Observers shall be placed on each foreign processing vessel while it is operating in the joint venture, as provided by Title II of the Magnuson-Stevens Act. The law provides for the following exceptions to this requirement:

1. If an observer is aboard the mothership(s) of a mothership/catcher vessel fleet.
2. If the vessel is in the EEZ for such a short time than at observer would be impractical.
3. If facilities for quartering an observer are inadequate or unsafe.
4. For reasons beyond the control of the Secretary an observer is not available.

6.5.5.10 Other Restrictions

The Secretary may impose additional requirements for the conservation and management of fishery resources covered by the vessel permit or for national defense or security reasons. These restrictions include, but are not limited to, season, area, and reporting requirements.

The highest priority of this FMP is to provide for conservation of the resource. Any restriction on the joint venture fishery may be modified under the points of concern mechanism for resource conservation reasons.

6.5.6 Foreign--Commercial

These measures apply to foreign vessels that operate in a fishery directed on an allocated species for which there is a total allowable level of foreign fishing (TALFF). This is a foreign operation in which foreign vessels both catch and process the fish and often is called the "directed foreign fishery" or the "foreign trawl fishery".

Management of the directed foreign fishery is the same as under the original FMP with the following exceptions, (1) Section 6.5.6.5 provides authority for modifying the June 1 through October 31 season for the foreign fishery for Pacific whiting, consistent with the FMP's implementing regulations; (2) Section 6.5.6.5 provides for additional area restrictions in the foreign fishery for Pacific whiting, which subsequently may be modified or removed; (3) Section 6.5.6.5 clarifies that seasons and areas for nonwhiting foreign fisheries are the same as for the Pacific whiting fishery, unless modified, consistent with the FMP's implementing regulations; and, (4) In Section 6.5.6.8, fishery closure provisions have been changed to reflect the use of harvest guidelines and quotas.

6.5.6.1 Permits

All foreign vessels operating in this management area shall have on board a permit issued by the Secretary pursuant to the Magnuson-Stevens Act.

6.5.6.2 Target Species

Target fishing is allowed only for species for which the foreign nation has received an allocation of TALFF.

6.5.6.3 Incidental Catch

Incidental catch refers to groundfish species which are unavoidably caught while fishing for the allocated target species. It is recognized that catches of species that are fully utilized by the domestic fishing industry will occur and are unavoidable in foreign fisheries for Pacific whiting. The Council has adopted the policy originally established by the trawl preliminary management plan to allow minimal incidental allowances which are consistent with the status of the stocks and the efficiency of the foreign fishery. These incidental allowances are not to be considered as surpluses to domestic fishermen's needs (i.e., TALFFs) and are allowed to provide for full utilization of the allocated target species.

Unless otherwise specified, incidental allowances for bycatch in the foreign fishery are percentages that determine the amount that may be caught in the foreign fishery. Incidental allowances may be established or changed at any time during the year, but are published at least annually, concurrent with the annual specifications of TALFF.

The Council may choose to use factors other than percentages in specifying incidental allowances or may change the way incidental allowances are applied (for example, based on specified catch amounts).

The NMFS Regional Administrator may establish or modify incidental species allowances to reflect changes in the condition of the resource and performance of the U.S. industry. The NMFS Regional Administrator will consult with the Council, consider public testimony received, and consider the following factors before establishing or changing incidental allowances (1) observed rates in the previous foreign directed fishery; (2)

current estimates of relative abundance and availability of species caught incidentally; (3) ability of the foreign vessels to take the TALFF; (4) past and projected foreign and U.S. fishing effort; (5) status of stocks; (6) impacts on the domestic industry; and (7) other relevant information. Changes will be made following the same procedures as for annual or inseason changes to the specifications in Chapter 5.

Incidental catch percentages that would have applied to foreign fishing for Pacific whiting in 1990 appear in Chapter 11.

6.5.6.4 Prohibited Species

Prohibited species means salmonids, Pacific halibut, Dungeness crab, and any species of fish which that vessel is not specifically permitted to retain, including fish received in excess of any allocation. These species must be immediately returned to the sea with a minimum of injury after allowing for sampling by an observer, if any. This FMP authorizes the designation of other prohibited species, or the removal of species from this classification if consistent with the applicable law for that species.

6.5.6.5 Season, Area, and Gear Restrictions

Season. The season for the foreign fishery (any species) is June 1 to October 31, unless otherwise specified under the framework procedures of this FMP.

Area. The directed fishery for Pacific whiting may not be conducted in the following areas:

- south of 39° N latitude;
- north of 47°30' N latitude;
- shoreward of 12 nautical miles from shore;
- in the Columbia River Recreational Fishery Sanctuary (described in Chapter 11); or,
- in the Klamath River Sanctuary (described in Chapter 11).

Unless otherwise specified, the area restrictions listed above for the Pacific whiting fishery also apply to foreign fisheries for other species. (The sanctuaries may be removed, renamed, or coordinates refined, as needed.)

Gear. Unless otherwise specified, gear used in the directed foreign fishery (for any species) is an off-bottom (pelagic) trawl with minimum mesh size of 100 mm (3.92 inches) between opposing knots. Chafing gear may be used with this net if: the mesh size of the chafing gear is at least two times the mesh of the inner codend; it is aligned knot-to-knot to the inner net and tied to the straps and riblines; and, it is not connected directly to the terminal end of the codend. Fishing on-bottom or use of liners or any other method which would have the effect of reducing the mesh size in the codend are not allowed.

Season, area, and gear restrictions for a directed foreign fishery (including additional area restrictions on the Pacific whiting fishery) may be established, modified, or removed at any time in accordance with the procedures in Sections 6.2.2 and 6.2.3 or by vessel permit condition.

Season, area, and gear restrictions that would have applied to foreign fishing in 1990 appear in Chapter 11 (no foreign fishery has occurred since 1989).

6.5.6.6 Reporting and Recordkeeping Requirements

Foreign nations operating in the directed fishery are required to submit detailed reports of fishing effort, location, amount and disposition of catch by species or species group, and transfer of fish or fish products, as needed for monitoring and management of the fishery. Unless otherwise specified, catch reports must be submitted weekly. The NMFS Regional Administrator may require daily reports when 90% of a nation's fishing allocation or incidental allowance for any species or species group is reached. In addition, each country must report the arrival, departure and positions of each of its vessels, as specified under the regulations and permit conditions, as necessary for monitoring deployment of the fleet.

Logbooks are required to fulfill the fishery conservation, management, and enforcement purposes of the Magnuson-Stevens Act. These logs may include a communications log, transfer log, and daily catch log which record haul by haul and daily catch, effort, and production information.

6.5.6.7 Dumping

Foreign vessels are prohibited from dumping pollutants and fishing gear which would degrade the environment or interfere with domestic fishing operations.

6.5.6.8 Fishery Closure

The directed foreign fishery shall cease each year when (1) that nation's allocation of TALFF is reached, (2) the maximum incidental catch allowance for that nation of any species or species group is reached, (3) the overall quota or harvest guideline for the allocated species is reached, (4) the applicable open season is ended, or (5) as necessary for resource conservation reasons under the points of concern mechanism.

6.5.6.9 Observers

The requirement to carry observers on foreign catcher vessels is the same as for joint venture processing vessels (Section 6.5.5.9).

6.5.6.10 Other Restrictions

The imposition of additional requirements for the conservation and management of fishery resources covered by the vessel permit, or for national defense or security reasons, is the same as for the joint venture fishery (Section 6.5.5.10).

The highest priority of this FMP is to provide for conservation of the resource. Any restriction on the foreign fishery may be modified under the points of concern mechanism for resource conservation reasons.

6.5.7 Foreign--Recreational

Foreign recreational fishing refers to any fishing from a foreign vessel not operated for profit or scientific research, and may not involve the sale, barter, or trade of any part of the catch. This FMP authorizes establishment of catch restrictions on the foreign recreational fishery which are consistent with the goals and objectives of the FMP and the national standards established by the Magnuson-Stevens Act.

6.5.8 Access Limitation and Capacity Reduction Programs

The current condition of the groundfish fisheries of the Washington, Oregon, and California region is such that further reduction of the limited entry fleet may be required in the near future. Research and monitoring programs may need to be developed and implemented for the fishery so that information required in a capacity reduction program is available. Such data should indicate the character and level of participation in the fishery, including (1) investment in vessel and gear; (2) the number and type of units of gear; (3) the distribution of catch; (4) the value of catch; (5) the economic returns to the participants; (6) mobility between fisheries; and (7) various social and community considerations.

[Amended: 10-6.5.2.2, 11]

6.6 Essential Fish Habitat

The Magnuson-Stevens Act (revised in Public Law 104-267) and the Sustainable Fisheries Act (SFA) requires Councils to include descriptions of EFH in all federal FMPs, and also potential threats to EFH. In addition, the Magnuson-Stevens Act requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The Appendix of this FMP includes a description of EFH for the 80-plus groundfish species included in this plan, fishing effects on EFH, nonfishing effects on EFH, and options to avoid or minimize adverse effects on EFH or promote conservation and enhancement of EFH.

6.6.1 Magnuson-Stevens Act Directives Relating to Essential Fish Habitat

The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this definition, the following interpretations are made: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include 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 the full life cycle of a species. The definition of EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate to the FMP.

The Magnuson-Stevens Act requires Councils to identify in FMPs any fishing activities that may adversely affect EFH. The Magnuson-Stevens Act also requires that, where fishing-related adverse impacts to EFH are identified, FMPs must include management measures that minimize those adverse effects from fishing, to the extent practicable.

The FMP also identifies potential nonfishing threats to EFH. Upon implementation of the FMP amendment, federal agencies will be required to consult with NMFS on all activities, and proposed activities, authorized, funded, or undertaken by the agency that may adversely affect EFH. NMFS must provide recommendations to conserve EFH to federal agencies on such activities. NMFS must also provide recommendations to conserve EFH to state agencies if it receives information on their actions. The Council may provide EFH recommendations on actions that may affect habitat, including EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by that agency. The Council will encourage federal agencies conducting or authorizing work that may adversely affect groundfish EFH to minimize disturbance to EFH.

6.6.2 Definition of Essential Fish Habitat for Groundfish

The Pacific Coast Groundfish FMP manages 80-plus species over a large and ecologically diverse area. Research on the life histories and habitats of these species varies in completeness, so while some species are well-studied, there is relatively little information on certain other species. Information about the habitats and life histories of the species managed by the FMP will certainly change over time, with varying degrees of information improvement for each species. For these reasons, it is impractical for the Council to include EFH definitions for each of the managed species in the body of the FMP. Therefore, the FMP includes a description of a limited number of composite EFHs for all Pacific Coast groundfish species. Life histories and EFH designations for each of the individual species are provided in a separate EFH document which will be revised and updated to include new information as it becomes available. Such changes will not require FMP amendment. This framework approach is similar to the Council's stock assessment process, which annually uses the SAFE document to update information about groundfish stock status without amending the FMP. Like the SAFE document, any EFH updates will be reviewed in a Council public forum.

There are substantial gaps in the knowledge of many Pacific Coast groundfish species. This FMP identifies many of those data gaps and makes suggestions regarding future research efforts. The FMP also identifies where research is needed on fishing and nonfishing impacts on groundfish EFH. Protecting, conserving, and enhancing EFH are long-term goals of the Council, and these EFH provisions of the FMP are an important element in the Council's commitment to a better understanding of Pacific Coast groundfish populations and their habitat needs.

6.6.2.1 Composite Essential Fish Habitat Identification

The 80-plus groundfish species managed by this FMP occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. Some species are widely dispersed during certain life stages, particularly those with pelagic eggs and larvae; the EFH for these species/stages is correspondingly large. On the other hand, the EFH of some species/stages may be comparatively small, such as that of adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate. As a consequence of the large number of species and their diverse habitat associations, the entire EEZ becomes EFH when all the individual EFHs are taken together.

EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish fishery EFH for each of the 80-plus species and their life stages result in over 400 EFH identifications. When these EFHs are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the U.S. EEZ.

This FMP groups the various EFH descriptions into seven units called "composite" EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. Seven major habitat types are proposed as the basis for such assemblages or "composites". These major habitat types are readily recognizable by those who potentially may be required to consult about impacts to EFH, and their distributions are relatively stationary and measurable over time and space.

The seven "composite" EFH identifications are as follows.

1. Estuarine - Those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying rocky areas, including reefs, pinnacles, boulders and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fathoms) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109 fathoms).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fathoms) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fathoms) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than ten meters (5.5 fathoms) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fathoms) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

These composites are shown graphically in the following figures. There is inadequate Information to produce a map of the rocky shelf composite, so the rocky and nonrocky shelf composites are combined in these figures.

6.6.3 Management Measures To Minimize Adverse Impacts on Essential Fish Habitat from Fishing

The Council may use any of the following management measures to minimize adverse effects on EFH from fishing, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. Such management measures shall be implemented under the Points of Concern Framework, Section 6.2.2.

- Fishing gear restrictions
- Time/area closures
- Harvest limits
- Other

In determining whether it is practicable to minimize an adverse effect from fishing, the Council will consider whether, and to what extent, the fishing activity is adversely impacting EFH, the nature and extent of the adverse effect on EFH, and whether management measures are practicable. The Council will consider the long and short term costs and benefits to the fishery and EFH, along with other appropriate factors, consistent with national standard 7.

6.6.4 Review and Revision of Essential Fish Habitat Definitions and Descriptions

The Council will periodically review the available information on EFH descriptions, fishing impacts and nonfishing impacts, and include new information in the annual SAFE document or similar document. A review and update of available information will be conducted at least once every five years as appropriate, but the Council may schedule more frequent reviews in response to recommendation by the Secretary or for other reasons.

[Amended: 11 (added)]

(BLANK)

11.0 MANAGEMENT MEASURES THAT CONTINUE IN EFFECT WITH IMPLEMENTATION OF AMENDMENT 4

[N.B. This chapter was previously numbered 12.0.]

The following management measures from the FMP, as amended, or implementing regulations continue in effect with implementation of Amendment 4, but may be modified in the future. The only changes are technical refinements: (1) commercial fishing is more accurately defined to include persons required by state law to have a commercial fishing license, but who have not obtained such a license; and (2) definitions for fixed gear, nontrawl gear, and commercial vertical hook-and-line gear have been added.

11.1 Vessel Identification

Display. The operator of a vessel which is over 25 feet in length and is engaged in commercial fishing for groundfish must display the vessel's official number on the port and starboard sides of the deckhouse or hull, and on a weather deck so as to be visible from above. The number must contrast with the background and be in block arabic numerals at least 18 inches high for vessels over 65 feet long and at least 10 inches high for vessels between 25 and 65 feet in length. The length of a vessel for purposes of this section is the length set forth in U.S. Coast Guard records or in state records if no U.S. Coast Guard record exists.

Maintenance of numbers. The operator of a vessel engaged in commercial fishing for groundfish shall keep the identifying markings required by paragraph (a) of this section clearly legible and in good repair, and must ensure that no part of the vessel, its rigging, or its fishing gear obstructs the view of the official number from an enforcement vessel or aircraft.

Commercial passenger vessels. This section does not apply to vessels carrying fishing parties on a per-capita basis or by charter.

11.2 Gear Restrictions

These definitions and restrictions are taken from the current FMP, as amended, and its implementing regulations. Reasons for their selection are found in the FMP, its amendments, and associated documents. These restrictions have not been changed by Amendment 4.

11.2.1 Commercial Fishing

Commercial fishing is (a) 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, (b) 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.

Legal Gear. The following types of fishing gear are authorized, with the restrictions set forth in this section: trawl (bottom, pelagic, and roller), hook-and-line, longline, pot or trap, set net, trammel net, and spear.

11.2.1.1 Trawl gear

Trawl gear is a cone or funnel-shaped net which is towed or drawn through the water by one or two vessels. Trawls are used both on bottom and off bottom. They may be fished with or without trawl doors. They may employ warps or cables to herd fish. Trawl gear includes roller, bottom, and pelagic trawls, and, as appropriate, trawls used to catch non-groundfish species but which incidentally intercept groundfish.

11.2.1.1.1 Mesh size

Mesh size is the opening between knots. For all net gear, minimum mesh size means the smallest distance allowed between the inside of one knot to the inside of the opposing knot, regardless of twine size.

The minimum trawl mesh size allowed regionwide is 4.5 inches. Exceptions to accommodate biological differences between species, species distribution, and economic concerns are listed below.

Trawl nets may be used if they meet the minimum sizes set forth below. The minimum sizes apply to the last fifty meshes running the length of the net to the terminal (closed) end of the codend. Minimum trawl mesh size requirements are met if a 20-gauge stainless steel wedge, 3.0 or 4.5 inches (depending on the gear being measured) less one thickness of the metal at the widest part, can be passed with thumb pressure only through 16 of 20 sets of two meshes each of wet mesh in the codend.

MINIMUM TRAWL MESH SIZE (IN INCHES)

	Subarea				
Trawl Type	Vancouver	Columbia	Eureka	Monterey	Conception
Bottom	4.5	4.5	4.5	4.5	4.5
Roller or bobbin	3.0	3.0	3.0	4.5	4.5
Pelagic	3.0	3.0	3.0	3.0	3.0

11.2.1.1.2 Bottom (or flatfish bottom) trawl

A bottom trawl is a trawl in which the otter boards or the footrope of the net are in contact with the seabed, including pair trawls fished on-bottom, and Danish and Scottish seine gear.

All trawl nets used for flatfish which have continuous footrope contact with the bottom shall have a minimum mesh size of 4.5 inches or larger throughout the net. At least two continuous riblines must be sewn to the net, extending from the mouth of the trawl net to the terminal end of the codend, if the fishing vessel is simultaneously carrying aboard a net of less than 4.5 inch mesh size.

Riblines are heavy rope or lines that run down the sides, top, or underside of a trawl net from the mouth of the net to the terminal end of the codend to strengthen the net during fishing.

11.2.1.1.3 Roller (or bobbin) trawl.

A roller trawl has footropes equipped with rollers or bobbins made of wood, steel, rubber, plastic, or other hard material which keep the footrope above the seabed, thereby protecting the net.

In the Eureka, Columbia, and Vancouver subareas, trawl mesh size less than 4.5 inches is permitted provided that: (1) the rollers or bobbins are at least 14 inches in diameter and free to rotate, with at least two rollers or bobbins equally spaced on each side of the footrope within 10 feet of the center of the footrope of the net; and (2) a tickler chain (continuous chain, rope, or cable which contacts the sea floor ahead of the rollers) is not used.

11.2.1.1.4 Pelagic (midwater or off-bottom) trawl

A pelagic trawl is a trawl in which the otter boards may contact the seabed, but the footrope does not. Pair trawls, if fished in midwater, must follow the requirements for pelagic trawls.

Pelagic trawl nets must have unprotected footropes at the trawl mouth (without rollers, bobbins or discs), and codends must be single-walled (one wall of webbing knitted with single or double-ply mesh). Sweeplines, including the bottom leg of the bridle, must be bare. The minimum mesh size is 3.0-inches. (These restrictions apply only to the domestic fishery. Requirements for the foreign trawl fishery appear later in Section 11.5.)

11.2.1.1.5 Codend chafing gear

Chafing gear is webbing or other material attached to the bottom (underside) or around the codend of a trawl net to protect the codend from wear.

On 4.5-inch bottom trawls, encircling chafing gear may not be less than 15 inches minimum mesh. If mesh size is less than 15 inches, only the bottom one-half of the codend may be covered.

On 3-inch roller or pelagic and bobbin trawls, chafing gear is permitted but the upper one-half may not be less than 6-inch minimum mesh.

No chafing gear or chafing gear sections on any trawl may be connected directly to the terminal end of the codend.

11.2.1.1.6 Double-walled codends

A double-walled codend is a codend constructed of two walls of webbing.

Double-walled codends must not be used in any pelagic trawl, or in any other trawl with mesh size less than 4.5 inches. The double-walled portion may not be longer than 25 meshes or 12 feet, whichever is greater. Meshes must coincide knot-for-knot throughout the double-walled portion. Manufactured double-ply mesh (double twine tied into a single knot) is not considered to be double-walled.

11.2.1.2 Fixed gear

Fixed gear (anchored nontrawl gear) includes longline, pot, set net, and stationary hook-and-line gear. (See following section 11.2.1.3 on nontrawl gear.)

Fixed gear must be marked, individually or at each terminal end as appropriate, with a pole, flag, light, and radar reflector attached to each end of the set, and a buoy clearly identifying the owner. In addition, fixed gear shall not be left unattended for more than seven days.

Reporting of fixed gear locations is not required, but fixed gear fishermen are encouraged to do so with the U.S. Coast Guard. Reporting of fixed gear will facilitate compensation claims by fishermen who have lost fixed gear.

11.2.1.3 Nontrawl gear

Nontrawl gear includes all legal commercial gear other than trawl gear.

11.2.1.3.1 Commercial vertical hook-and-line

Commercial vertical hook-and-line gear is hook-and-line gear that involves a single line anchored at the bottom and buoyed at the surface so as to fish vertically.

11.2.1.3.2 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).

11.2.1.3.3 Longline

A longline is a stationary, buoyed, and anchored groundline with hooks attached.

11.2.1.3.4 Set net

A set net is a stationary, buoyed, and anchored gillnet or trammel net.

Fishing for groundfish with set nets is prohibited north of 38°00' N. latitude (Pt. Reyes, California). Set netting for groundfish in the EEZ south of 38°00' N. latitude is governed by California State regulations.

11.2.1.3.5 Gillnet

A gillnet is a single-walled, rectangular net which is set upright in the water.

11.2.1.3.6 Trammel net

A trammel net is a gillnet made with two or more walls joined to a common float line.

11.2.1.3.7 Traps (or pots)

A trap or pot is a portable, enclosed device with one or more gates or entrances and one or more lines attached to surface floats.

Traps must have biodegradable escape panels constructed with #21 or smaller untreated cotton twine in such a manner that an opening at least 8 inches in diameter results when the twine deteriorates.

11.2.2 Recreational Fishing

Recreational fishing is fishing with authorized gear for personal use only, and not for sale or barter.

Legal Gear. The only types of fishing gear authorized for recreational fishing are hook-and-line and spear.

11.2.2.1 Hook-and-line

The definition is the same as above for the commercial fishery. Currently, there are no gear restrictions on recreational use of hook-and-line gear to harvest groundfish.

11.2.2.2 Spears

A spear is a sharp, pointed, or barbed instrument on a shaft. Spears may be propelled by hand or by mechanical means.

11.3 Species Managed with a Harvest Guideline or Quota

As described in Chapter 5, those species or species groups managed with a harvest guideline or quota at the time Amendment 4 is implemented will continue to be managed with a harvest guideline or quota until changed. These species and species groups initially are as follows:

Harvest Guideline:

- The Sebastes complex - north of Coos Bay, Oregon
- Yellowtail rockfish - north of Coos Bay, Oregon

Quota:

- Sablefish - coastwide
- Pacific ocean perch - for Columbia and Vancouver areas separately
- Widow rockfish - coastwide
- Pacific whiting - coastwide
- Shortbelly rockfish - coastwide
- Jack mackerel - north of 39° N. latitude

11.4 Catch Restrictions

Groundfish species harvested in the territorial sea (0-3 nautical miles) will be counted toward the catch limitations in this section. These catch restrictions apply only to domestic fisheries off Washington, Oregon, and California.

11.4.1 Commercial Fishing

California rockfish. The trip limit for a vessel engaged in fishing with a pelagic trawl with mesh size less than 4.5 inches in the Conception or Monterey subareas is 500 pounds or 5 percent by weight of all fish on board, whichever is greater, of the species group composed of bocaccio, chilipepper, splitnose, and yellowtail rockfishes per fishing trip.

Other species. Both annual and inseason catch restrictions have been imposed on the species listed below after implementation of the FMP in 1982. The catch restrictions implemented at the beginning of 1990 were published in the *Federal Register* at 55 FR 1036 (January 11, 1990), 55 FR 3747 (February 5, 1990), and 55 FR 11021 (March 26, 1990). These catch restrictions are likely to change as necessary before Amendment 4 is implemented. Further adjustments are expected when Amendment 4 is implemented, but cannot be announced with certainty at this time. The following general types of restrictions were effective during 1989 and 1990.

- Widow rockfish. Managed by species quota, beyond which landings are prohibited; trip landing and frequency limits, based on weekly landings; options for biweekly and, rarely, twice-weekly landings if state agencies notified in advance; limits generally have been reduced during the year, reaching incidental levels (3,000 pounds) per trip near the end of the season.

- Pacific ocean perch. Managed by species quota beyond which landings are prohibited; very small trip landing limits to allow only incidental catches in other fisheries to be landed.

- Sebastes complex (including yellowtail rockfish). The Sebastes complex includes all rockfish managed by the FMP (see Table 3.1) except widow rockfish, Pacific ocean perch, shortbelly rockfish, and thornyheads (also called idiot or channel rockfish).

North of Coos Bay, Oregon: managed by a harvest guideline that equals the summed ABCs of the species in the complex, with primary goal of not exceeding the ABC for yellowtail rockfish (as it applies north of Coos Bay); trip landing and frequency limits, based on weekly landings; options for biweekly and twice-weekly landings if state agencies notified in advance; trip limits reduced during the year, reaching incidental levels near the end of the season, to minimize landings above the harvest guideline.

South of Coos Bay, Oregon: trip landing limit.

- Sablefish. Trawl fishery: managed by species quota and gear allocation, beyond which landings are prohibited; trip landing and rarely trip frequency limits with biweekly and twice-weekly options; trip limits intended to allow landing predominantly of incidental catch; includes a trip limit on sablefish smaller than 22-inches (total length).

Nontrawl fishery (fixed gear including troll): managed by species quota and gear allocation beyond which landings are prohibited; trip limit on sablefish smaller than 22 inches (total length); otherwise no restriction until an incidental trip limit is imposed near the end of the season.

- Deepwater complex (which consists of sablefish, Dover sole, arrowtooth flounder, and thornyheads). Managed to achieve species quota or trawl allocation for sablefish; for about five months in 1989, trawl trip landing and frequency limits on the complex, including separate landing and frequency limits for sablefish (including a trip limit on sablefish smaller than 22 inches).

11.4.2 Recreational Fishing

The current bag limits for each person engaged in recreational fishing are three lingcod per day and 15 rockfish per day. Amendment 4, at Section 6.2.1, establishes bag and size limits for the recreational fishery as "routine" management measures. As "routine" management measures, Amendment 4 intends for bag and size limits for lingcod and rockfish to be adjustable by the single meeting, single *Federal Register* "notice" process described in Section 6.2. Multi-day limits are authorized by a valid permit issued by the State of California and must not exceed the daily limit multiplied by the number of days in the fishing trip.

11.4.3 Restrictions on the Catch of Groundfish in Non-Groundfish Fisheries

11.4.3.1 Pink shrimp

The trip limit for a vessel engaged in fishing for pink shrimp is 1,500 pounds (multiplied by the number of days of the fishing trip) of groundfish species, excluding catches of Pacific whiting, shortbelly rockfish, or arrowtooth flounder which are not limited.

11.4.3.2 Spot and ridgeback prawns

The trip limit for a vessel engaged in fishing for spot or ridgeback prawns is 1,000 pounds of groundfish species per fishing trip.

11.5 Joint Ventures

These provisions reflect the latest restrictions (as of March 1990) on joint venture fisheries. Many of these restrictions may be modified, as explained in Chapter 6.

11.5.1 Pacific Whiting

● Target amount. JVP is announced with the annual specifications on January 1 each year. (At the beginning of 1990, the JVP for Pacific whiting was 161,000 mt.)

● Incidental allowances. In the Pacific whiting joint venture, the incidental retention limits are applied to 5,000 mt increments of whiting received. If a retention limit is reached, further amounts of that species may not be retained until the full 5,000 mt increment of whiting is received.

Current incidental retention limits for the Pacific whiting joint venture are:

Pacific ocean perch	0.062%
Other rockfish (excluding POP)	0.738%
Sablefish	0.173%
Flatfish	0.1%
Jack mackerel (north of 39° N. lat.)	3.0%
Other species	0.5%

* Unless otherwise specified, shortbelly rockfish are included in the "other rockfish" category.

● Prohibited species. Prohibited species means salmonids, Pacific halibut, Dungeness crab, and any species of fish which that vessel is not specifically authorized to retain, including fish received in excess of any authorization.

● Season. Currently no restriction on season.

● Area. No U.S.-harvested whiting may be received or processed south of 39° N. latitude.

11.5.2 Jack Mackerel (North of 39° N. Latitude)

● Target amount. JVP is announced with the annual specifications on January 1 each year. (In 1990, the JVP for jack mackerel was 5,000 mt.)

● Incidental allowances. If a joint venture for jack mackerel north of 39° N. latitude were to develop, incidental retention allowances provisionally would be the same as for the Pacific whiting joint venture, but could be modified if better information becomes available, and thus could differ from the incidental percentages in the whiting joint venture. Unless otherwise specified, the incidental percentage for Pacific whiting taken in a joint venture for jack mackerel is 3.0 percent, the same as for jack mackerel taken in the Pacific whiting joint venture.

● Prohibited species. The same as for the Pacific whiting joint venture.

● Season. Currently no restriction.

- Area. As long as the FMP manages only that portion of the jack mackerel stock north of 39° N. latitude, a joint venture for jack mackerel south of 39° N. latitude cannot be authorized.

11.5.3 Shortbelly Rockfish

- Target amount. JVP is announced with the annual specifications on January 1 each year. (The JVP for shortbelly rockfish in 1990 was 12,500 mt.)

- Incidental species. To be determined.

- Prohibited species. The same as for Pacific whiting joint venture.

- Season. Currently no restriction.

- Area. No U.S.-harvested shortbelly rockfish may be received or processed south of 39° N. latitude.

Shortbelly rockfish are most concentrated south of 39° N. latitude. A request to conduct a joint venture for shortbelly rockfish in 1989 resulted in a finding that much of the area needed for the fishery would be closed for reasons of national security.

11.6 Foreign Fishery

These provisions reflect the latest restrictions (as of March 1990) on the directed foreign fishery. Many of these restrictions may be modified, as explained in Chapter 6.

11.6.1 Pacific Whiting

These provisions would have been in effect for a directed foreign fishery for Pacific whiting in 1990 if there had been a TALFF and foreign interest.

- Target amount. TALFF is announced with the annual specifications on January 1 each year, and subsequently may be divided into national allocations which may not be exceeded. (In 1990, there was no TALFF for Pacific whiting.)

- Incidental allowances. Current incidental catch percentages for the Pacific whiting directed fishery, if there were such a fishery in 1990, are:

Pacific ocean perch	0.062%
Other rockfish (excluding POP) *	0.738%
Sablefish	0.173%
Flatfish	0.1%
Jack mackerel (north of 39° N. lat.)	3.0%
Other species	0.5%

* Unless otherwise specified, shortbelly rockfish are included in the "other rockfish" category.

- Prohibited species. Prohibited species means salmonids, Pacific halibut, Dungeness crab, and any species of fish which that vessel is not specifically permitted to retain, including fish received in excess of any allocation.

- Season. June 1 - October 31.

- Closed areas.

(a) 47°30' N. latitude to the U.S.-Canada boundary;

(b) U.S.-Mexico border to 39° N. latitude;

(c) area landward of 12 nm;

(d) "Columbia River Pot and Recreational Fishery Sanctuary" -- that area between 46°00' N. latitude and 47°00' N. latitude and east of a line connecting the following coordinates in the order listed: 46°00' N. latitude, 124°55' W. longitude; 46°20' N. latitude, 124°40' W. longitude; and 47°00' N. latitude, 125°20' W. longitude;

(e) "Klamath River Pot Sanctuary" -- that area between 41°20' N. latitude and 41°37' N. latitude and east of a line connecting the following coordinates in the order listed: 41°20' N. latitude, 124°32' W. longitude, and 41°37' N. latitude, 124°34' W. longitude.

- Gear restrictions.

Pelagic trawls with a minimum mesh size of 100 mm (3.94 inches, between opposing knots, stretched when wet) must be used. Codend liners or other devices which have the effect of reducing mesh size or improving ability to fish on the bottom are prohibited. Fishing on the seabed is prohibited.

Chafing gear may be used but must be of a mesh size greater than or equal to two meshes of the codend, i.e. a minimum of 200 mm. The chafing gear must be tied to the straps and riblines and connected so that it is aligned to the codend knot-to-knot. Chafing gear must not be connected directly to the terminal end of the codend. Thread size of the chafing gear shall not be more than four times the diameter of that used in the codend.

11.6.2 Jack Mackerel (North of 39° N. Latitude)

- Target amount. TALFF is announced with the annual specifications on January 1 each year, and subsequently may be divided into national allocations which may not be exceeded. (In 1990, the TALFF for jack mackerel was 4,600 mt.)

- Incidental allowances. To be determined.

- Prohibited species. The same as foreign fishery for Pacific whiting.

- Area. North of 39° N. latitude.

- Gear restrictions. The same as foreign fishery for Pacific whiting.

11.7 Prohibitions

The following prohibitions apply and may be expanded, modified, or removed as needed to implement the FMP, as amended.

Nationwide: It is unlawful for any person to do any of the following --

(a) Possess, have custody or control of, ship, transport, offer for sale, sell, purchase, land, import, or export any fish or parts thereof taken or retained in violation of the Magnuson-Stevens Act or any regulation or permit issued under the Magnuson-Stevens Act.

(b) Transfer or attempt to transfer, directly or indirectly, any U.S.- harvested fish to any foreign fishing vessel, while such vessel is in the EEZ, unless the foreign fishing vessel has been issued a permit under section 204 of the Magnuson-Stevens Act which authorizes the receipt by such vessel of U.S.-harvested fish.

(c) Fail to comply immediately with enforcement and boarding procedures specified in the implementing regulations.

(d) Refuse to allow an authorized officer to board a fishing vessel, or to enter areas of custody for purposes of conducting any search, inspection, or seizure in connection with the enforcement of the Magnuson-Stevens Act.

(e) Dispose of fish or parts thereof or other matter in any manner, after any communication or signal from an authorized officer, or after the approach by an authorized officer or an enforcement vessel.

(f) Forcibly assault, resist, oppose, impede, intimidate, threaten, or interfere with any authorized officer in the conduct of any search, inspection, or seizure in connection with enforcement of the Magnuson-Stevens Act.

(g) Interfere with, delay, or prevent by any means, the apprehension or of another person, knowing that such person has committed any act prohibited by the Magnuson-Stevens Act.

(h) Resist a lawful arrest for any act prohibited under the Magnuson-Stevens Act.

Washington, Oregon, and California: In addition to the nationwide prohibitions listed above, it is unlawful for any person to --

(a) Sell, offer to sell, or purchase any groundfish taken in the course of recreational groundfish fishing.

(b) Retain any prohibited species unless authorized by other applicable law.

(c) Falsify or fail to affix and maintain vessel and gear markings.

(d) Fish for groundfish in violation of any terms or conditions attached to an experimental fishing permit.

(e) Fish for groundfish using gear not authorized under the FMP or under an experimental fishing permit.

(f) Take and retain, possess or land more groundfish than specified under any regulation, notice, permit, or experimental fishing permit implemented under this FMP.

(g) Violate any other provision of the implementing regulations at 50 CFR Parts 620, 663 or 611, the Magnuson-Stevens Act, any notice, or any other regulation or permit promulgated under the Magnuson-Stevens Act.

(h) Make any false statement, oral or written, to an authorized officer concerning the taking, catching, harvesting, possession, landing, purchase, sale, or transfer of any fish.

(i) Interfere with, obstruct, delay, or prevent by any means a lawful investigation or search conducted in the process of enforcing the Magnuson-Stevens Act.

(j) Refuse to submit fishing gear or fish subject to such person's control to inspection by an authorized officer, or to interfere with or prevent, by any means, such as inspection.

(k) Falsify or fail to make and/or file any and all reports of groundfish landings, containing all data, and in the exact manner, required by the applicable state law, provided that person is required to do so by the applicable state law.

(l) Fail to sort, prior to the first weighing after offloading, those groundfish species or species groups for which there is a trip limit, if the weight of the total delivery exceeds 3,000 pounds (round weight or round weight equivalent).

(m) Possess, deploy, haul, or carry onboard a fishing vessel subject to the implementing regulations (50 CFR Part 663) a set net, trap or pot, longline, or commercial vertical hook-and-line that is not in compliance with the gear restrictions, unless such gear is the gear of another vessel that has been retrieved at sea and made inoperable or stowed in a manner not capable of being fished. The disposal at sea of such gear is prohibited by Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 (Annex V of MARPOL 73/78).

11.8 Facilitation of Enforcement

The following provisions currently are included in the FMP's implementing regulations (as of March 23, 1990) and may be expanded, modified, or removed as necessary to facilitate enforcement of the provisions of the FMP, as amended, and the Magnuson-Stevens Act.

(a) General. The operator of, or any other person aboard, any fishing vessel subject to Parts 630 through 699 of this chapter must immediately comply with instructions and signals issued by an authorized officer to stop the vessel and with instructions to facilitate safe boarding and inspection of the vessel, its gear, equipment, fishing record (where applicable), and catch for purposes of enforcing the Magnuson-Stevens Act and this chapter.

(b) Communications.

(1) Upon being approached by a U.S. Coast Guard vessel or aircraft, or other vessel or aircraft with an authorized officer aboard, the operator of a fishing vessel must be alert for communications conveying enforcement instructions.

(2) VHF-FM radiotelephone is the preferred method for communicating between vessels. If the size

of the vessel and the wind, sea, and visibility conditions allow, a loudhailer may be used instead of the radio. Hand signals, placards, high frequency radiotelephone, or voice may be employed by an authorized officer, and message blocks may be dropped from an aircraft.

(3) If other communications are not practicable, visual signals may be transmitted by flashing light directed at the vessel signaled. Coast Guard units will normally use the flashing light signal "L" as the signal to stop. In the International Code of Signals, "L" (.-..) means "you should stop your vessel instantly".

(4) Failure of a vessel's operator promptly to stop the vessel when directed to do so by an authorized officer using loudhailer, radiotelephone, flashing light signal, or other means constitutes prima facie evidence of the offense of refusal to permit an authorized officer to board.

(5) The operator of a vessel who does not understand a signal from an enforcement unit and who is unable to obtain clarification by loudhailer or radiotelephone must consider the signal to be a command to stop the vessel instantly.

(c) Boarding. The operator of a vessel directed to stop must:

(1) Guard Channel 16, VHF-FM if so equipped;

(2) Stop immediately and lay to or maneuver in such a way as to allow the authorized officer and his party to come aboard;

(3) Except for those vessels with a freeboard of four feet or less, provide a safe ladder, if needed, for the authorized officer and his party to come aboard;

(4) When necessary to facilitate the boarding or when requested by an authorized officer or observer, provide a manrope or safety line, and illumination for the ladder; and

(5) Take such other actions as necessary to ensure the safety of the authorized officer and the boarding party.

(d) Signals. The following signals, extracted from the International Code of Signals, may be sent by flashing light by an enforcement unit when conditions do not allow communications by loudhailer or radiotelephone. Knowledge of these signals by vessel operators is not required. However, knowledge of these signals and appropriate action by a vessel operator may preclude the necessity of sending the signal "L" and the necessity for the vessel to stop instantly.

(1) "AA" repeated (.- .-) is the call to an unknown station. The operator of the signaled vessel should respond by identifying the vessel by radiotelephone or by illuminating the vessel's identification.

(2) "RY-CY" (.-. -.-- -.-. -.--) means "you should proceed at slow speed, a boat is coming to you." This signal is normally employed when conditions allow an enforcement boarding without the necessity of the vessel being boarded coming to a complete stop, or, in some cases, without retrieval of fishing gear which may be in the water.

(3) "SQ3" (... --.- ...--) means "you should stop or heave to; I am going to board you."

Note: Period (.) means a short flash of light; dash (-) means a long flash of light.

11.9 Penalties

Any person committing or fishing vessel used in the commission of a violation of the Magnuson-Stevens Act or any regulation issued under the Magnuson-Stevens Act, is subject to the civil and criminal penalty provisions and civil forfeiture provisions of the Magnuson-Stevens Act, to Part 621 of this chapter, to 15 CFR Part 904 (Civil Procedures), and to any other applicable law.

Agenda item F.5.a
Attachment 3
March 2005

Groundfish Bycatch Mitigation Program Work Plan: Preliminary Draft for Council Consideration, March 2005

1. Introduction

In September 2004 NMFS released the Bycatch Mitigation Program Final Environmental Impact Statement (FEIS), containing the Council's preferred alternative. To begin implementing the preferred alternative, at the November 2004 meeting the Council directed staff to (1) prepare a preliminary draft of an amendment to the groundfish FMP to address the policy and future program direction for bycatch mitigation and (2) develop a draft work plan for implementing bycatch mitigation measures described in the preferred alternative.

The preferred alternative contains the following elements:

- Amend the fishery management plan (FMP) to require the use of current bycatch minimization measures.
- Amend the FMP to fully describe the current standardized bycatch reporting methodology.
- Amend the FMP to incorporate the Groundfish Strategic Plan goal of reducing overcapacity in all commercial fisheries.
- Implement a sector-specific bycatch accounting methodology.
- Support the future use of individual fishing quota (IFQ) programs as bycatch reduction tools for appropriate fishery sectors.
- Authorize the use of sector-specific total catch limit programs to reduce bycatch of overfished (depleted) species in appropriate sectors of the fishery. These programs could include monitoring standards, full retention programs, and individual vessel incentives for exemption from sector total catch limits.

This work plan summarizes current and proposed bycatch mitigation measures and programs and discusses those additional steps necessary to implement measures in the FEIS preferred alternative.

2. Bycatch Mitigation Measures and Programs Currently in Place or Under Development

Ongoing management measures and programs implemented by the Council and NMFS that mitigate bycatch include:

- At-sea observer programs in both shore-delivery and sea-delivery groundfish fisheries, including groundfish limited entry trawl, limited entry fixed gear, and open access vessels.
- Large-scale closed areas to reduce protected salmon bycatch: Klamath and Columbia River Conservation Zones.

- Large-scale closed areas to reduce overfished species bycatch: Rockfish Conservation Areas, Cowcod Conservation Areas, Yelloweye Rockfish Conservation Area.
- Vessel Monitoring System (VMS) requirements for the limited entry fleet to ensure compliance with closed area restrictions.
- Season restrictions to reduce directed and incidental catch of overfished species.
- Trawl mesh size, chafing gear, and codend regulations to reduce juvenile fish bycatch.
- Trawl footrope size regulations to reduce access to rocky habitat and rockfish bycatch.
- Selective flatfish trawl regulations to reduce bycatch of rockfish in flatfish fisheries.
- Escape panel requirements for groundfish pots to prevent lost pots from ghost fishing.
- FMP Amendment 14 to reduce capacity in the limited entry fixed gear fleet.
- Trawl buyback to reduce capacity in limited entry trawl fleet.
- Overfished species total catch limits in the whiting fisheries.
- Geographically-based harvest guidelines, especially in recreational fisheries.
- Improving consistency between state and federal regulations.

Bycatch mitigation measures and programs under development by the Council and NMFS include:

- Expanding VMS coverage requirements to open access fisheries that are subject to groundfish closed area restrictions.
- Implementing an IFQ program for the limited entry trawl fishery, which could be used to reduce regulatory bycatch if allowable catch amounts were tradable.
- Implementing measures to mitigate fishing impacts to essential fish habitat (EFH), proposed in a draft EIS under Council consideration, which could also mitigate bycatch.
- Implementing a full retention and electronic monitoring program for the shore-based whiting fishery.

3. Additional Bycatch Mitigation Measures and Programs

3.1. Bycatch Mitigation Measures Described in the Preferred Alternative

Although the Council/NMFS have implemented numerous measures to mitigate bycatch, key elements of the preferred alternative need additional development and planning to implement. As part of developing these elements, the Council/NMFS need to explore the type of monitoring that would be required, the program infrastructure that would have to be put into place, and the cost associated with adequate monitoring. Key measures discussed in the preferred alternative and considered for implementation in this work plan are:

- A sector-specific bycatch accounting methodology.
- Sector-specific total catch limit program.

- Vessel-specific total catch limit program.
- Full retention program(s).

3.1.1. Sector and Vessel-specific Total Catch Limits Implementation Issues

Draft FMP amendment language (Section 6.5.3.2) authorizes the Council to develop sector- and vessel-specific programs with the following characteristics:

- Total catch limits apply to overfished species.

- A total catch limit accounts for total fishing mortality and includes both landed catch and discard mortality.

- Establishing an adequate bycatch (discards) monitoring program would be a prerequisite for implementing a sector total catch limit or an individual vessel total catch limit program. Two approaches to monitoring could be used, based on practicability. First, total catch could be estimated by modeling the expected bycatch associated with the landing of a particular mix of species. With this approach there would be some lag in making estimates, depending on the frequency landing reports (e.g., quota species monitoring [QSM] reports) and the lag time between the end of the monitoring period (e.g., calendar month) and when the report is generated. The second approach could be used in cases where it is practicable to have full at-sea monitoring (as in the at-sea Pacific whiting fishery), which would allow near-real-time monitoring of total catch. The type of monitoring program would likely affect how and whether total catch limits could be implemented, because this reporting would be used to determine when a limit is reached, which would necessitate a fishery closure if it occurred before the end of the limit period (e.g., the fishing year).

- Total catch limits would function like allocated quotas for one or more sectors; once a sector or vessel has attained the catch limit, fishing ceases until the start of the next year, fishing season, or other defined period. Limits could differ from an allocation in that they need not be permanent; they could be established biennially, for example. There is also the question of whether a limit could be changed during a limit period. For example, if total catch in one sector is below its limit, could the "surplus" be reassigned to another sector that is nearing its limit?

- The Council will consider 10 sectors (described in draft FMP language) initially when developing sector limits, but has the flexibility to combine or subdivide these sectors for the purpose of establishing limits.

- An individual-vessel total catch limit program may be established for an already total-catch-limited sector. Vessels would then have the option to gain an exemption from the sector limit and be assigned a limit specific to the vessel. Any limit amount assigned to the vessel would be deducted from the applicable sector limit. Both monitoring requirements and incentives (e.g., higher, differential cumulative landing limits) could apply to participating vessels.

- Depending on legal constraints (anti-trust issues), vessels with their own total catch limits may be permitted to pool limit amounts and then reassign increments of the pooled limits to participating vessels. This mechanism would rely on private contracts, similar to current arrangements for assigning the overall quota to individual vessels in the Pacific whiting catcher/processor sector.

In developing a work plan, the Council needs to consider the implementation mechanism. Procedurally, implementation involves full rulemaking to establish regulations. Since the bycatch mitigation program EIS was programmatic, and did not evaluate the specifics of total catch limit programs, another National Environmental Policy Act (NEPA) analysis would likely be required as part of this rulemaking. Implementing total catch limits could be part of an already planned rulemaking/NEPA processes. Candidates are: (1) the biennial harvest specifications and rulemaking process and associated EIS (or environmental assessment [EA]) and (2) the planned inter-sector allocation EIS proposed as part of the trawl individual quota (TIQ) process. Alternatively, a wholly separate rulemaking/NEPA process could be used. These three procedural options are not mutually exclusive. For example, catch limits, applying to just a few species and sectors, could be implemented as an "interim" measure as part of the harvest specifications process, while permanent—and perhaps more comprehensive—allocated catch limits could be evaluated in the inter-sector allocation EIS.

Timing is a second issue to consider. Catch limit implementation would likely need to coincide with the biennial harvest specifications process, since catch limits represent a reservation of a portion of an OY specification for a given overfished species. This suggests using the 2007-2008 biennial management cycle to establish some comparatively modest interim measures. Permanent, more comprehensive limits would be implemented for the 2009-2010 cycle through the inter-sector allocation EIS. The timing of the TIQ initiative also needs to be considered. Sector and vessel-specific limits and IFQs may be viewed as a conceptual and functional continuum. The allocations and monitoring programs required for sector and vessel-specific limits are prerequisites for an IFQ program. In addition, decisions and design elements for total catch limit programs need to be consistent with parallel issues in the TIQ program. Since allocations—at least *between* the limited entry trawl sector and other sectors collectively and *among* trawl vessels—are a prerequisite for TIQ implementation, a sector/vessel-specific catch limit program affecting the trawl sector should precede or coincide with TIQ implementation. Full implementation of the TIQ program is currently scheduled for the beginning of the 2009-2010 biennial cycle.

3.1.2. Work Plan For Sector/Vessel-specific Total Catch Limit Implementation

Based on the discussion above, the following sector catch limits could be evaluated as part of the 2007-2008 harvest specifications EIS and rulemaking:

- Limited entry trawl sub-sectors (three Pacific whiting sectors and other limited entry trawl) and tribal sector:[1/] separate catch limits for canary and widow rockfish for each sector.

- Sablefish-endorsed limited entry fixed gear sub-sector: canary and yelloweye rockfish.

- Recreational fishery sub-sectors (Oregon and Washington, California): canary and yelloweye rockfish.

Similar to OYs, total catch limits would be established for each year in the two-year management period. Establishing catch limits is contingent on an accurate, sufficiently real-time catch accounting system for participating sectors. The projected status of catch accounting for the 2007-2008 period will be part of the evaluation. The risk of overages—total catch above projections—in sectors not assigned catch limits will also have to be evaluated. A policy for dealing with overages will have to be developed. Related to this, an evaluation would consider whether catch limits can be changed during the year (the limit period). The ability to change limits would anticipate inaccuracies in the catch projections upon which the limits were based, which would result in overages. On the other hand, if fishery participants thought the limit could be adjusted upward, such a policy could weaken the fishers' incentive to adopt bycatch-reducing practices.

The current proposed action to be evaluated in the inter-sector allocation EIS is allocation of a wide range of target and non-target species between the limited entry trawl sector and all other sectors combined. The proposed action would be expanded to include permanent allocations of overfished species—functioning as total catch limits—among sectors other than limited entry trawl. The EIS would evaluate what sectors should be defined for the purpose of establishing catch limits and the catch accounting program necessary to support them. The NEPA and rulemaking processes would be set to a schedule to implement the proposed action at the start of the 2009-2010 management cycle.

A vessel-specific total catch limit program could be developed for implementation beginning in 2011. A separate NEPA (EA or EIS) and rulemaking process would be used to evaluate elements of this program. Phasing it in this way will benefit from considerable experience with sector catch limits, settled allocations for identified sectors, and the implementation of ITQs in the limited entry trawl sector. The preferred alternative in the bycatch program FEIS envisions vessel-specific limits as a modification of current cumulative landing limit regime ("This alternative would modify the definition of trip limits to include catch [mortality] limits….") The two components—landed catch and discard mortality—of a total catch limit would be accounted for and limited, so there would be no need to prohibit retention as a disincentive. Vessels "opting out" of a sector catch limit would be assigned their own limit for each applicable overfished species. Requirements could be established—partial or full payment of observer costs, for example—for vessels to receive a limit. This could be coupled with an incentive, such as higher cumulative landing limits for non-overfished species. A scheme for determining

---

1/ Since the tribal sector operates according to treaty rights, any limit for that sector would have to be consistent with those rights.

vessel-specific limits would have to be developed. In geographically diverse sectors, where participating vessels may encounter overfished species at variable rates, a proportional division of the optimum yield to establish vessel limits would not work very well. One solution would be to make the individual vessel limits tradable; this would represent a special case of an ITQ program if limits (i.e., quotas) applied only to overfished species. Current information suggests the overhead costs of an ITQ system are not justifiable if only applied to a limited range of species. Another approach would be to treat vessel limits similar to the initial allocation in an ITQ program without introducing tradability. Limits could be based on catch history during a specified "window period," for example. Any such formula would have to ensure equitability within a sector between vessels remaining under the sector catch limit and those with vessel-specific limits. A further elaboration of vessel-specific limits would be to allow vessels to pool limits and trade increments of the pooled limit by private contract. Alternatives based on these issues would be evaluated in the EA or EIS associated with the rulemaking process to implement vessel-specific limits. For implementation in 2011, this process would likely have to begin in mid-2009.

3.1.3. Full Retention Programs

The bycatch program FEIS mentions full retention as a sub-component of a sector/vessel-specific catch limit program but contains no details or analysis of sectors that might be subject to full retention. The shore-based Pacific whiting trawl sector has been operating under a full retention policy, using an exempted fishing permit (EFP) issued for each management period. An EA is currently being developed to transition from the EFP to a permanent regulatory framework. Although this retention requirement was established to monitor the incidental capture of listed salmon species, it allows full catch accounting through current dockside monitoring programs. Full retention can be coupled with disposition requirements for landings (such as donation to a food bank of designated species) to discourage targeting. Required retention of selected overfished species in designated sectors could be part of a catch accounting program in support of sector and/or vessel-specific total catch limits. The Council could consider full retention requirements as part of any three of the work plan elements described above.

3.2. Other Bycatch Mitigation Measures the Council May Consider

Although not discussed in the bycatch mitigation program FEIS, the Council could also consider the following bycatch mitigation measures for development:

- Integrating EFH- and bycatch-related groundfish closed areas so that where EFH-related closed areas reduce bycatch, that reduction is accounted for in bycatch rate modeling.

- Expanding VMS coverage requirements to commercial passenger fishing vessels that are subject to groundfish closed area restrictions.

- Hot-spot management to either prevent fishing in an area of overfished species abundance, or to allow fishing in an area of target species abundance.

The Council has the option of adding additional mitigation measures to the work plan.

Agenda Item F.5.c
Attachment 1
March 2005

DRAFT SUMMARY MINUTES

Ad Hoc Allocation Committee

Pacific Fishery Management Council
Embassy Suites Portland Airport Hotel
Cedars I and II Rooms
7900 NE 82nd Avenue
Portland, OR 97220
503-460-3000
January 26-27, 2005

WEDNESDAY, JANUARY 26, 2005 - 1 P.M.

A. Call to Order

1. Roll Call, Introductions, Announcements, etc.

Mr. Hansen called the meeting to order at 1 p.m.

Members Present:
Mr. Phil Anderson, Washington Department of Fish and Wildlife (WDFW)
Dr. Steve Freese, National Marine Fisheries Service Northwest Region
Mr. Don Hansen, Dana Wharf Sportfishing, Pacific Fishery Management Council Chairman
Ms. Cyreis Schmitt, Oregon Department of Fish and Wildlife (ODFW) (designee for Dr. Patty Burke)
Ms. Marija Vojkovich, California Department of Fish and Game

Advisors Present:
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration Northwest Regional Counsel
Ms. Kathy Fosmark, Groundfish Advisory Subpanel (GAP), Open Access Representative
Mr. Pete Leipzig, Fishermen's Marketing Association, Limited Entry Trawl Representative
Ms. Michele Longo-Eder, Limited Entry Fixed Gear Representative
Mr. Rod Moore, West Coast Seafood Processors Association, GAP Chair, Processor/Buyer Representative
Mr. Bob Osborn, United Anglers of Southern California, Recreational Representative

Others Present:
Mr. Steve Bodnar, Coos Bay Trawlers Association, Bandon Submarine Cable Committee
Mr. Mark Cedergreen, Westport Charterboat Association, Pacific Fishery Management Council
Dr. Elizabeth Clarke, National Marine Fisheries Service Northwest Fisheries Science Center
Mr. Brian Culver, Washington Department of Fish and Wildlife, GMT
Ms. Michele Culver, Washington Department of Fish and Wildlife, Chair, Groundfish Management Team (GMT)

Dr. Kit Dahl, Pacific Fishery Management Council, Staff

Mr. John DeVore, Pacific Fishery Management Council, Staff
Mr. Chris Dorsett, The Ocean Conservancy
Mr. Kenyon Hensel, GAP
Mr. John Holloway, GAP
Mr. Peter Huhtula, Pacific Marine Conservation Council (PMCC)
Mr. Bill James, Kaizer, Oregon
Ms. Gway Kirchner, Oregon Department of Fish and Wildlife
Ms. Dorothy Lowman, Environmental Defense
Dr. Don McIsaac, Executive Director, Pacific Fishery Management Council
Mr. Dale Myer, Arctic Storm, Inc., GAP
Mr. Brad Pettinger, Oregon Trawl Commission
Mr. Mark Saelens, Oregon Department of Fish and Wildlife
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative
Mr. Frank Warrens, Pacific Fishery Management Council
Dr. Ed Waters, Pacific Fishery Management Council, Staff
Mr. Dan Wolford, Coastside Fishing Club

2. Opening Remarks and Agenda Overview

Dr. McIsaac reviewed the agenda. Agenda item B was deferred to a future Ad Hoc Allocation Committee (Committee) meeting because Dr. Patty Burke had to attend a funeral in Minnesota and could not be available today. Mr. Leipzig wanted clarification on the role of Trawl Individual Quota (TIQ) advisors to the Committee. Dr. McIsaac said the role was to provide advice to the Committee on sector allocation needs to support the TIQ initiative and to participate in discussion. However, the TIQ advisors do not vote on Committee matters. Mr. Moore asked if the advisors had a role in non-TIQ matters. Mr. Hansen said no, other than general public comment. The Committee agreed the advisors would openly participate in TIQ matters.

3. Approve Agenda

The agenda was approved by the Committee.

B. Allocation Incentive/Disincentive Mechanisms

Item deferred until the next meeting.

C. Lingcod Allocation for 2005 and 2006

This item was discussed at the behest of various Council members who were interested in exploring ways to access more lingcod, given that about 1,500 mt are projected to go unharvested this year due to canary rockfish constraints. Mr. Anderson asked which groundfish species were allocated this year. Mr. DeVore said sablefish and whiting were allocated according to provisions in the fishery management plan (FMP) and as specified in federal regulations. There have also been some shorter-term allocations made for the current management cycle. Lingcod were divided at the Oregon/California border and allocated to recreational fisheries north and south of there. Similar recreational harvest guidelines with this geographic split were decided for allocating yelloweye and canary rockfish. Canary rockfish were further allocated to commercial trawl sectors to accommodate unavoidable bycatch mortality with 7.3 mt shared by the whiting trawl sectors and 8.0 mt reserved for the non-whiting trawl sector.

Ms. Schmitt indicated ODFW had received a number of requests from industry to change lingcod allocations, and the department did not want to proceed with this until full observer data analysis was complete. (Dr. Patty Burke later in the meeting indicated Council member Bob Alverson had made a motion at a previous Council meeting to have the Committee consider lingcod allocation options, and that is why it is on the agenda at this meeting.) Ms. Schmitt stated that, since new observer data reports are not yet available, it is premature to discuss this.

Ms. Cooney explained the legal constraints for making allocation decisions. Mr. Moore asked about the FMP constraints for allocation decision-making. Ms. Cooney said the FMP is not really specific about allocation decisions other than a two- or three-meeting process is required, which is the Council's normal decision-making process. The Council needs to be clear regarding the intended allocation and differentiate whether this is a direct allocation or an ad hoc allocation for the next management cycle.

D. Amendment 18 - Programmatic Bycatch Reduction

1. Defining Sector Total Catch Limits
2. What Sectors Should Have Total Catch Limits?
3. What Species Should Have Total Catch Limits?

Dr. Dahl reviewed the issues that are part of the Amendment 18 bycatch reduction initiative. He noted the intersection of many Council initiatives involving bycatch reduction and managing with sector total catch limits. This is the management direction for deciding biennial specifications and management measures, developing a trawl individual quota (TIQ) program, and the intersector allocation process. The two tasks for the Council in March are adopting final Amendment 18 FMP language and determining an implementation strategy. This agenda item focuses on the implementation strategy with respect to managing the groundfish fishery using total catch limits. He reviewed the often confused definitions surrounding the terms, "bycatch," "total catch," and "total fishing mortality." The Magnuson-Stevens Fishery Management and Conservation Act (MSA) defines bycatch as all catch not sold or retained for personal use. The recommended term consistent with how the Council manages the West Coast groundfish fishery is total catch, which represents landed catch + at-sea discards. Total fishing mortality is total catch – those fish discarded at sea that survive. Concepts in the Council's preferred alternative for Amendment 18 include vessel-specific catch limits and sector catch limits. These would be harvest limits at the vessel and sector level. The Amendment 18 Environmental Impact Statement (EIS) describes eight commercial fishing sectors: limited entry trawl, limited entry fixed gear longline, limited entry fixed gear pot, three whiting sectors (catcher/processors, motherships, and shore-based), open access, and tribal. Additionally, the recreational fishery is considered a sector.

The Committee's task is to recommend what species should be capped with a total catch limit and what sectors should be managed with total catch limits. An intersector allocation EIS is contemplated to support development and implementation of the TIQ program and other Council initiatives.

Dr. Dahl introduced the proposal from PMCC, the Natural Resources Defense Council, The Ocean Conservancy, and Oceana (PMCC *et al.*) regarding managing with total catch limits. They propose a new concept, whereby members of a sector can opt out of the sector and manage by pooling their total catch caps.

Mr. Moore asked about the definition of "non-target species." He brought up the fact that yellowtail rockfish is a target species for midwater trawl, but an incidental (non-target) species in a flatfish trawl operation. Dr. Dahl said he was not sure, although most of the focus in bycatch reduction is on overfished species. Dr. Freese said the term (target vs. non-target) could be characterized by sector. A non-target species in one sector can be a target in another sector. Mr. Anderson understood non-target species would be overfished species that are clearly not a target in any groundfish fishery. Mr. Moore asked what is meant by vessel-specific total catch limits being non-tradable individual vessel quotas. Dr. Dahl said this does not preclude tradable quotas which is also a foreseeable management tool adopted by the Council under their preferred Amendment 18 alternative.

Mr. Dorsett reviewed the proposal from PMCC *et al.* Their proposal is similar to the Council's preferred alternative. One key difference in their proposal is the concept of pooled vessel catch limits by a segment of any sector. Mr. Huhtula thought their would be a market-based incentive to pool total catch limits as well as an efficiency in monitoring at-sea discards. Dr. Dahl asked if fishermen participating in a pool could act like a cooperative where they could contract who fishes in the pool. Ms. Cooney said the legal issue here is anti-trust law. Unlike an individual fishing quota (IFQ) program where the Council assigns quota and establishes a set of rules for transferring/trading quota, a pooled "cooperative" could run afoul of anti-trust law if it is not structured carefully. The Pacific Whiting Conservation Cooperative received advice from the Department of Justice on how they could operate and avoid anti-trust problems. Ms. Longo-Eder said pooling bycatch caps may necessitate regulatory changes to allow pooling of limited entry permits. Ms. Vojkovich asked what pooling means. Is this a private contract among a limited number of boats to pool their bycatch caps and allow just one or more vessels in the pool? Mr. Dorsett said yes. However, vessels operating in the pool would opt out of their assigned sector and would, therefore, have to hire their own observers, etc. Mr. Moore asked Mr. Dorsett how to decide allocation of total catch limits for a pool from a specified sector catch limit. Mr. Dorsett said this is simply a concept at this point. Mr. Huhtula said there could be an allocation scheme based on catch histories or allocation along geographic lines.

Dr. McIsaac recommended the Committee take up the charge on sectors or species which should be considered for total catch limits. Dr. Freese said any allocation discussion should include catch histories, the instruments used, and the principles for deciding allocation. Dr. Dahl said the Committee should also consider the duration of any allocation decision (biennial, permanent until changed, etc.). Ms. Cooney said the Committee should also consider explicit allocations of target and non-target species. Dr. McIsaac encouraged the Committee to define catch limits, the sectors that should have catch limits, and those species so limited.

Mr. Anderson recommended we define catch limits in terms of total fishing mortality. He also recommended the overfished species should have total fishing mortality caps (or total catch limits). He recommended each of the nine defined sectors be managed with total catch limits for overfished species. There might be consideration for redefining the open access sector into directed and incidental groundfish sectors. He cautioned we need to be careful with how this management strategy is characterized for the tribal sector given treaty rights, etc. Vessel-specific caps should be considered on a sector-by-sector basis. An important consideration in establishing vessel-specific total catch limits is the availability of observer coverage and the ability to enhance observer coverage. Ms. Longo-Eder was confused with the term total fishing mortality. Does this include latent mortality? Mr. Anderson said his intent was to use landings + discard mortality, but not latent mortality (fish that encounter fishing gear, but are lost and suffer mortality). Latent mortality is not included, since it is unquantifiable in the groundfish fishery. The definition of total catch limit was approved by the Committee.

Mr. Moore questioned how to split the open access sector further. Mr. DeVore recommended the Council consider establishing directed groundfish and incidental groundfish open access sectors. Ms. Longo-Eder recommended a further sector split of limited entry fixed gear longline and pot sectors into sablefish-endorsed and non-sablefish-endorsed sectors. Ms. Vojkovich wondered if a private vs. charter recreational sector split or a shore-based vs. at-sea recreational sector split should also be considered. Mr. Anderson said it is a WDFW policy to avoid such recreational sector splits and was not in favor of this idea. Mr. Leipzig asked what if one sector is better than another at avoiding overfished species' bycatch? Ms. Schmitt remarked another possible open access sector split may be nearshore vs. the offshore component of the fishery primarily targeting sablefish.

Dr. McIsaac asked about observer coverage in the open access fleet. For instance, is there separate coverage for pink shrimp vessels? Dr. Clarke said she was not sure, but there is less observer coverage with a greater number of commercial sectors. Dr. Dahl said another mechanism is for the Council to broadly define sectors (i.e., fewer sectors) and allow members of a sector to split out from that sector with the implication they would have to pay for observers (i.e., the PMCC *et al.* proposal). Ms. Longo-Eder said she recommended further subdividing the limited entry fixed gear sector by gear and whether they have sablefish endorsements because she envisions potential problems with allocation between these smaller sectors. For instance, the sablefish-endorsed fleet could shut down the non-sablefish-endorsed fleet. Dr. Clarke said these two fleets are separately observed with data reports thusly stratified. She also said there are confidentiality issues to contend with when data are reported for a sector that has only a few vessels. Ms. Vojkovich asked if it would be valuable to sort sectors by the amount of bycatch historically observed. Why cap fisheries with a negligible groundfish bycatch? Dr. McIsaac recommended a practicability standard where sectors that have a negligible bycatch do not need caps. He thought that was consistent with the Council preferred Amendment 18 alternative. Mr. Osborn agreed there should be de minimus standards. Mr. Leipzig wondered how any sector that catches species of concern can be excused when the fishery in total can attain an optimum yield (OY). Ms. Cooney thought the issue may be species-specific by sector. We could have more discriminant caps for constraining species. Mr. Anderson asked how it would be possible to monitor individual sectors. For which sectors do we have the ability to do real-time monitoring? He agreed that caps should be species-specific by sector. For low bycatch sectors, it is less crucial to have real-time monitoring, since corrections could be made on an annual basis. He recommended using the Groundfish Management Team's (GMT's) bycatch scorecard as a basis for deciding how different sectors are managed. Mr. Moore thought the open access sector should be divided by directed and incidental groundfish, but not as disaggregated as the GMT's bycatch scorecard is for the incidental open access sector. Ms. Longo-Eder said the limited entry fixed gear fleet has vessels with both longline and pot gear. Splitting this sector out by gear type may encourage fishermen to use the gear with the least bycatch. Mr. Leipzig said other sector splits to consider could be dividing the recreational fishery along state lines and dividing the non-whiting trawl fishery by deep vs. shallow strategies or north and south of Cape Mendocino. Dr. Clarke recommended starting at higher levels of aggregation and then consider breaking out sectors into smaller components later. Mr. Anderson recommended for initial analysis that we go with the initial nine sectors with open access split out into directed and incidental groundfish. The analyses could then explore observer coverage by these sectors and whether vessel-specific caps are warranted.

The Committee discussed whether these allocation decisions would be in the FMP or in regulations and the duration of ultimate allocation decisions. Some of this discussion is scheduled for tomorrow. Ms. Vojkovich asked if total catch limits would be an allocation decision, or something else. Mr. DeVore said the preferred alternative under Amendment 18 committed the Council to add tools such as total catch limits to the management system. Specifying total catch limits is part of an anticipated intersector allocation process that is needed to develop a TIQ program. Ms. Vojkovich asked if the Committee was talking about allocating total catch limits in the FMP or are these recommendations to be considered guidelines. Ms. Cooney answered that, so far, none of these decisions/recommendations have been made. It is up to the Council how these limits would be characterized. Ms. Vojkovich asked how the GMT's bycatch scorecard would be used. Mr. DeVore said that is another decision, but the GMT will need some tool to track total mortality by sector. Mr. Moore recommended specific language should be added to the FMP via Amendment 18 rather than the general framework language that describes available management tools. Mr. Anderson asked if we could identify primary sectors in the FMP and specify that further subdivision can be done subsequently. Ms. Cooney said yes. The Committee then recommended listing the ten primary sectors in the FMP under Amendment 18 and defining the total catch limit standard as total mortality (landings + discard mortality).

Ms. Longo-Eder asked about tradability and the need to consider amendment language now. Mr. DeVore said the IQ language in the Amendment 18 preferred alternative already includes the concept of tradability. Dr. Freese agreed the IQ language implies tradability. Otherwise, a total catch limit in the context of this Committee's discussion would be considered a "restricted bycatch quota."

<u>THURSDAY, JANUARY 27, 2005 - 8:30 A.M.</u>

Members Present:
Mr. Phil Anderson, Washington Department of Fish and Wildlife
Dr. Steve Freese, National Marine Fisheries Service Northwest Region
Mr. Don Hansen, Dana Wharf Sportfishing, Pacific Fishery Management Council Chairman
Dr. Patty Burke, Oregon Department of Fish and Wildlife
Ms. Marija Vojkovich, California Department of Fish and Game

Advisors Present:
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration Northwest Regional Counsel
Ms. Kathy Fosmark, Groundfish Advisory Subpanel (GAP), Open Access Representative
Mr. Pete Leipzig, Fishermen's Marketing Association, Limited Entry Trawl Representative

Ms. Michele Longo-Eder, Limited Entry Fixed Gear Representative
Mr. Rod Moore, West Coast Seafood Processors Association, GAP Chair, Processor/Buyer Representative
Mr. Bob Osborn, United Anglers of Southern California, Recreational Representative

Others Present:
Mr. Steve Bodnar, Coos Bay Trawlers Association, Bandon Submarine Cable Committee
Mr. Mark Cedergreen, Westport Charterboat Association, Pacific Fishery Management Council
Dr. Elizabeth Clarke, National Marine Fisheries Service Northwest Fisheries Science Center
Mr. Brian Culver, Washington Department of Fish and Wildlife, GMT
Ms. Michele Culver, Washington Department of Fish and Wildlife, Chair, GMT
Dr. Kit Dahl, Pacific Fishery Management Council, Staff
Mr. John DeVore, Pacific Fishery Management Council, Staff
Mr. Chris Dorsett, The Ocean Conservancy
Mr. Kenyon Hensel, GAP
Mr. Peter Huhtula, Pacific Marine Conservation Council (PMCC)
Mr. Bill James, Kaizer, Oregon
Mr. Steve Joner, Makah Fisheries Management
Ms. Gway Kirchner, Oregon Department of Fish and Wildlife
Ms. Dorothy Lowman, Environmental Defense
Dr. Don McIsaac, Executive Director, Pacific Fishery Management Council
Mr. Dale Myer, Arctic Storm, Inc., GAP
Mr. Brad Pettinger, Oregon Trawl Commission
Mr. Mark Saelens, Oregon Department of Fish and Wildlife
Mr. Jim Seger, Pacific Fishery Management Council Staff
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative
Dr. Ed Waters, Pacific Fishery Management Council, Staff
Mr. Dan Wolford, Coastside Fishing Club

Mr. Hansen called the meeting to order at 8:35 a.m. Dr. McIsaac briefed the Committee on the budget outlook and reviewed today's agenda. Last year the TIQ program was funded at a $250,000 level. The funding for developing the TIQ program and an Intersector Allocation initiative is not yet available. Therefore, until this funding is decided and available, there is unlikely to be substantial progress. The Committee is charged with recommending intersector allocations for a TIQ program and the companion Intersector Allocation initiative. Today's agenda is devoted to these two initiatives. He cautioned the Committee to avoid the minute details of these initiatives and to take a big picture look. Mr. Hansen remarked that the Office of Management and Budget (OMB) has put in a funding request for developing IQ programs in 2006. There may be a funding gap this year. The OMB request will be incorporated in the President's budget. This funding is for all Councils to further fishery rationalization initiatives.

E. Consideration of Intersector Allocations

1. The Needs for Intersector Allocations
2. How Should the Advisors to the Allocation Committee Conduct Their Work?
3. Should Council Staff Initiate Development of an Intersector Allocation Environmental Impact Statement?
4. Which Species and Areas Are Intersector Allocations Needed to Support a TIQ Program?
5. Which Species and Areas Are Intersector Allocations Needed to Support Other Management Aspects (Non-TIQ)?
6. In What Order Should Intersector Allocations Be Resolved?

Mr. Anderson said part of this decision is to recommend whether there is a need for Intersector Allocation. If the answer is no, is it necessary to continue this agenda? There was a deliberative decision that allocation decisions would be undertaken by the Allocation Committee. We need to simultaneously initiate the TIQ and Intersector Allocation processes. He believes an intersector allocation process is needed regardless of whether the TIQ initiative is forwarded or not. This will benefit the biennial specifications decision-making process. This will be helpful to the Council in the long term. Mr. Leipzig agrees given the contentious nature of biennial allocation decisions. This will add stability to the Council process. The TIQ process is also important. The intersector allocation decision-making process is needed to make progress in the TIQ process. However, the TIQ process also requires allocation of trawl target species. The GMT bycatch scorecard only addresses overfished species. Ms. Longo-Eder agreed with the need for an intersector allocation. Members of the limited entry fixed gear fleet were polled and agree this intersector allocation process is needed for stability. For instance, thornyheads are a major trawl target; however, this is an important target for the non-sablefish-endorsed limited entry fixed gear fleet. The fleet believes this Committee is the key body for making these allocation decisions. She also presented a request that the current trawl/fixed gear sablefish allocation be revisited as part of this process. Mr. Osborn said recreational fishermen strongly support intersector allocation, but questioned whether a fixed allocation would contribute to stability of the management system. He believes strong harvest control rules are needed to achieve stability. Dr. McIsaac asked Mr. Osborn if he was opposed to long-term allocations for the recreational fishery. Mr. Osborn said no. He wants to examine allocation guidelines and processes, but not necessarily end up with long-term hard allocations. He said fishery rationalization also needs to occur between sectors with available mechanisms to deal with such issues as increasing demand for fish and cultural change such that these risks are not merely transferred from one sector to another. He wants to examine allocation guidelines, but not necessarily long-term allocations. Mr. Moore partially disagreed and stated intersector allocation is the key to stability. The whiting allocation process was contentious, but it brought stability to that sector. Fishermen and processors are better able to develop business plans with a hard allocation. Mr. Hensel was concerned with intersector allocations. He believes hard allocations create a loss of flexibility to a management system in flux. New stock assessments can change the balance, and allocation may need to be changed. Mr. Cedergreen agreed that we need to maintain flexibility given the changes in stock status and to weather the effect of court decisions in a litigious atmosphere. Dr. McIsaac concluded from the discussion the Committee agrees with the need to proceed with an intersector allocation process. The Committee agreed. Mr. Joner remarked the tribes may in the future seek more formal allocations for other groundfish species (there is already a hard tribal allocation for whiting and sablefish). Such tribal allocation decisions involve intertribal negotiations and biological constraints such as stock structure and regional distribution. Mr. Anderson said he has been thinking about tribal allocation issues and how to proceed on that front. There are some species where there are specific tribal allocations. Other species have become more prevalent in tribal fisheries, and we need to keep this in mind. The tribal fishery has grown a lot in the last five years which changes the fishery allocation landscape. This creates the impetus for more regional OYs than the current practice of specifying coastwide OYs for many of the FMP species. Dr. McIsaac said it would be helpful to identify the sectors and species that should be considered in an intersector allocation process. Mr. Moore was not sure the sectors identified yesterday during the Amendment 18 discussion for consideration of total catch limits of overfished species would be the same for intersector allocation of more traditional target species. Mr. Anderson said, as we discuss all the fishery sectors, the species which require an intersector allocation decision should fall out. We will find some species do not need to be allocated and others will, but perhaps not across all sectors. Mr. Leipzig agreed and pointed out some species are caught only in trawl fisheries while others are caught across many or all sectors. Ms. Longo-Eder said we should focus on landings for many years, not just 2002 landings (the handout identified 2002 landings by sector) given the annual variability in fisheries. Ms. Vojkovich recommended we keep in mind that trawl gear may not be the most desirable way to harvest some species that have been trawl targets. Mr. Saelens agreed and recommended we take a forward look and try to reach a common vision on how we want the fishery to look like in the future. It would be wrong to perpetuate all elements of the current management regime. He stated that attention needs to be given to the degree to which groups might be able to change gears over time. Dr. Freese recommended we look forward five years. Looking too far forward will complicate the process and analyses. Mr. Anderson said another way to proceed is to look at annual trawl trip limits and the acceptable biological catch (ABC)/OY table as a place to start. The first step for advancing the TIQ initiative would be to focus on the species assemblages and allocations we currently have. We could go down the trawl trip limit table to determine the species we need to focus on to do intersector allocation. Mr. Leipzig said we also need to look at the fishery itself.

Mr. Anderson said the first sector cut for allocation is limited entry trawl, limited entry fixed gear, open access, and recreational. The Committee proceeded to develop Table 1 (appended to this report) of groundfish FMP species caught by these sectors. An "X" in the cell denotes a species considered for allocation to a particular sector. An "X" in the Incidental column signifies the need to allocate some yield for that species to accommodate incidental bycatch in sectors not already noted.

Mr. Anderson stated the next order of business is to decide which species need to be allocated to the limited entry trawl sector in order to develop a TIQ program. Mr. Moore said any species with trawl landings probably need IQs. Mr. Leipzig pointed out that some species, such as English sole, are probably not taken by non-trawl sectors. Ms. Culver asked if there are species that could be managed with trip limits rather than IQs. Mr. Leipzig said yes, but is that the right approach? The decision on which species get IQs has not yet been made. Ms. Vojkovich remarked the table contains the longest list of species considered for allocation. Mr. Leipzig said we need to pick some time periods to generate tables depicting catch history by sector. Dr. Freese recommended looking at a limited set of years. Mr. Moore said the 2000-2004 period includes years with and without Rockfish Conservation Areas during management under the Sustainable Fisheries Act. Ms. Culver recommended inclusion of years prior to 1999 when trawl targeting of rockfish was allowed. She thought the early- to mid-1990s would be an important period to capture the changing management structure with respect to incentives and disincentives to retain certain species. Ms. Longo-Eder recommended three periods be looked at using period averages: 1990-1995, 1996-2000, and 2001-2004. Dr. Freese recommended against using period averages and instead suggested taking annual “snapshots” of the fishery every five years (i.e., 1990, 1995, 2000, and 2004). Ms. Vojkovich pointed out there was a problem with missing Recreational Fishery Information Network data in 1990. Mr. Anderson said there was a similar problem with 1999 recreational fishery data. After some discussion, the Committee agreed the years to look at should be 1988, 1994, 1998, and 2004.

The Committee briefly discussed how advisors to the Committee should conduct their work. Ms. Vojkovich hoped the advisors could help flesh out some of the issues that will be deliberated prior to future Committee meetings. This would help committee members be more prepared to discuss ideas the advisors would be presenting. Ms. Fosmark recommended an outreach program be developed given the fragmentation of the open access sector. Mr. Moore asked if the advisors should meet independently from the Allocation Committee. Ms. Vojkovich said not necessarily. Mr. Leipzig remarked that each advisor has constituents. The advisors can take issues back to them and get their feedback. The Committee agreed that was their expectation.

The Committee then continued discussing the species and areas for allocations needed to support a TIQ program. Mr. Anderson agreed on the need to look forward when making allocation decisions. We need to determine how we want to shape the fishery. Therefore, using catch histories and the structure of past fisheries are important considerations, but we do not need to perpetuate past problems. For instance, trawl gear may be the most efficient way to harvest many of our flatfish species like petrale sole, but, in his opinion, not the best way to harvest nearshore species. This is the kind of perspective he recommends this Committee should have. Allocation for obvious trawl target species can probably be decided in the next step. There will likely be a need to allocate overfished species to accommodate incidental take. Dr. Burke thought this was an encouraging perspective. She is concerned with the current management system and the unbalanced incentives/disincentives inherent in how allocation decisions have been made in the annual/biennial specifications decision-making process. Mr. Leipzig also urged a certain amount of flexibility be maintained in how we decide allocation in the future. He envisions sliding scale and percentage mechanisms to structure future allocations. Ms. Longo-Eder suggested there should be MSA and Strategic Plan concepts and goals in front of the Committee for how to decide future allocations. Is the goal bycatch reduction or fishery stability? We need to understand our MSA and Strategic Plan goals. Mr. Dorsett recommended habitat impacts also be on the forefront of Committee members’ minds.

Ms. Vojkovich asked about the expected time frame for making allocation decisions. Mr. Seger said it depends on what is driving the process. Developing a TIQ program requires allocations, but Amendment 18 requires consideration of allocation issues if hard caps are to be used for bycatch reduction. A TIQ program could be implemented by 2008 or 2009. Ms. Vojkovich asked if we need to make intersector allocation decisions as part of the 2007-2008 management decision-making process. Mr. DeVore said the formal process of developing an intersector allocation EIS will take too long to be implemented by 2007, but progress can be made in the interim. He recommended that allocations made for the 2007-2008 management cycle should accommodate or be consistent with the longer-term processes of intersector allocation and development of a TIQ program to the extent practicable. Dr. Burke encouraged the use of sustainable, incentive-based management measures for the 2007-2008 management cycle.

The Committee then discussed the species and areas for allocations needed to support other management aspects (non-TIQ). Ms. Fosmark said open access fishermen who direct their efforts on groundfish are concerned with the lack of permitting in their sector. They feel they are losing control of their fishery. Ms. Vojkovich agreed and said this is a priority with the State of California. The nearshore fisheries within the state's jurisdiction are limited entry now. The lack of a federal permitting system for open access has severely hampered fishery rationalization. Mr. Moore remarked that the Amendment 18 discussion covered part of this agenda item. He asked if there are interactions between the recreational and open access fisheries in California that ought to be looked at by this committee. Mr. Osborn said hard allocations may make those types of issues more difficult. Ms. Vojkovich asked if communities could buy IQ. There are some California ports that are losing income by the change in fishery management in the last five years. A TIQ program could further erode their economic base. Ms. Cooney said this is possible and there are some community IQs in Alaska. Mr. Anderson said the California recreational species need allocations, especially for the overfished species. However, not all species caught in recreational fisheries need to be allocated to that sector. For example, sablefish, widow rockfish, and other shelf rockfish species may simply need a set-aside to accommodate incidental bycatch. Ms. Vojkovich said the future needs of fisheries are uncertain, so she was reluctant to conclude that certain fisheries do not need an allocation of certain species. Mr. Anderson said the Committee should consider a five-year future time frame, not an indefinite future.

F. Elements of an Allocation Decision

1. Frequency (Biennial, Limited Duration, Until Changed, Other)
2. Structure (Percentages, Sliding Scales, Tables, Rules for Suspension)
3. Criteria

Mr. Leipzig recommended a more permanent allocation for the trawl fishery (i.e., allocation maintained until changed) would provide stability for the industry. He thought a percentage of the total yield would be a reasonable way to go in structuring allocation of target species. A sliding scale makes sense for many of the overfished species. By sliding scale, he means that, as biomass changes, the allocation percentage changes according to the needs of the affected fishing sectors. This sliding scale would probably need to be specific to each species. Ms. Vojkovich asked for some examples of sliding scale allocation formulae for the next Committee meeting. Mr. DeVore explained the tribal whiting allocation formula uses a sliding scale structure. Mr. Seger added that allocation guidelines could be used to resolve some of the allocation issues while preserving some of the flexibility of the current biennial allocation system. Ms. Vojkovich remarked long-term allocations vs. biennial allocations are in conflict in terms of the stated goals (stability vs. flexibility). She likes the idea of allocation decisions lasting for two to three biennial management cycles. Mr. Moore said imposing a five-year checkpoint on the allocation decision may be a good compromise. Mr. Leipzig said allocations of the trawl-dominant species could be of longer duration than for the other species. This is another example of how to reach a compromise relative to the goals of stability and flexibility. Ms. Longo-Eder also stated there was general agreement in the limited entry fixed gear fleet that they want the ability to buy trawl quota share and use it in their fishery. The TIQ process could allocate a portion of their overall quota for the limited entry fixed gear fleet. Dr. Freese said five years seems to be a consensus recommendation as a checkpoint for some allocated species. This is also the checkpoint for evaluating the strategic plan.

G. Interactions Between Limited Entry Trawl and Open Access

1. How Should Trawl Catch With Open Access Gear Be Managed?
   (See Issue Summary in Section A.1.0 of "Scoping Results On Dedicated Access Privileges For The Pacific Coast Limited Entry Trawl Groundfish Fishery": Agenda Item E.6.a, Attachment 5 in the November 2004 Briefing Book)

Mr. Seger said a recommendation on this issue will be needed by the June Council meeting. This is an issue identified in the TIQ program that needs a more thorough discussion. What trawl gear harvest would TIQ be needed for? Does everything caught in the limited entry trawl fleet need to be covered with an IFQ? Or do you only need IFQ for trawl gear landings? He referred to the issue summary in Section A.1.0 of "Scoping Results On Dedicated Access Privileges For The Pacific Coast Limited Entry Trawl Groundfish Fishery" (TIQ scoping document): Agenda Item E.6.a, Attachment 5 in the November 2004 Briefing Book. Option 1 in this section of the TIQ scoping document requires limited entry trawl vessels to use TIQ to land groundfish when using open access gear. Option 2 does not require the use of TIQ for limited entry trawl vessel open access gear landings. Option 1 has implications for vessels using TIQ to catch quotas using open access gear. Mr. Moore asked if there was an option to use any legal gear to catch the quota. Mr. Seger stated that Option 1 provided that flexibility. Ms. Cooney said the options were structured to cover the possibilities based on the limited entry rules. Ms. Vojkovich pointed out that allocations into the open access sector become competitive and could result in an increase in the number of open access participants. Mr. Seger suggested, by the June Council meeting, the Committee should try to reach a consensus recommendation on its preferred alternative for this issue. It is not known what is needed as an allocation to open access to cover the shift.

The Committee requested electronic copies of all handouts from this meeting.

H. Effects of Overages or Underages in One Sector on Other Sectors

Mr. Seger explained this issue is driven by the MSA constraints not to exceed ABC. Would a TIQ program convert to a derby-like fishery to keep from being shut down before attaining quota if another sector or sectors causes the ABC to be exceeded? Would we need buffers in the allocation to prevent this? Canadians have a rollover provision, but are also not subject to the same legal constraints as American fishermen with the MSA. Ms. Cooney said a system could be developed that allows overages and underages. The plan would have to be carefully constructed to keep from going over harvest limits on a longer-term average basis. The problem is especially acute for managing overfished species. Dr. Burke asked about administrative costs associated with some of these more complex issues. Mr. Seger said such costs are typically addressed in NEPA analyses. Dr. Burke said this should be a priority element in any TIQ analyses. Mr. Moore remarked the GAP recommended one two-year OY under multi-year management. Such a system allowed rollover and could help in this potential problem. Was there a legal reason to not adopt this recommendation? Ms. Cooney said the Council decided against this option because there was a potential of running out of OY early in a biennial cycle. There are also provisions in the MSA regarding annual harvest targets that may or may not be a legal impediment to multi-year OYs. Ms. Vojkovich recommended developing a matrix to indicate MSA constraints on allowing overages, by species. This would be helpful in deciding

Council policy such as setting buffers. Ms. Cooney said this information should be laid out generically, since the future management system will certainly change. For instance, we may need to restructure rebuilding plans to accommodate new policy. Mr. Leipzig said the greatest concern is for constraining species where the likelihood of exceeding OY is greater. We need to be thoughtful on how different policies may play out. Dr. Freese reminded folks that full recovery of costs is mandated in establishing a TIQ program. Mr. DeVore noted that catch by sector is not equally well monitored.

I. Other Issues

Committee members scoped their calendars for the next meeting. They were asked to protect May 2-3, 2005 for the next Allocation Committee meeting.

TABLE 1. FMP groundfish species considered for allocation by sector. An "X" in the cell denotes a species considered for allocation to a particular sector. An "X" in the Incidental column signifies the need to allocate some yield for that species to accommodate incidental bycatch in sectors not already noted.

Species	**LE Trawl**	**LE Fixed Gear**	**Open Access**	**Recreational**	**Tribal**	**Incidental**
Bank	X	X	X			X
Blackgill	X	X	X			X
Darkblotched	X				X	X
Splitnose	X	X	X		X	X
POP	X				X	X
Minor slope RF	X	X	X		X	X
Longspine thornyheads	X				X	X
Shortspine thornyheads	X	X	X		X	X
Shortbelly						X
Widow	X	X	X	X	X	
Yelloweye	X	X	X	X	X	
Canary	X	X	X	X	X	
Bocaccio	X	X	X	X		
Cowcod						X
Chilipepper	X	X	X	X		X
Vermilion		X	X	X		X
Yellowtail	X	X	X	X	X	
Other shelf RF	X	X	X	X	X	
Black RF		X	X	X	X	X
CA Scorpionfish		X	X	X		
Gopher		X	X	X		X
Minor Nearshore RF		X	X	X	X	X
Arrowtooth	X				X	X
Dover	X				X	X
English	X		X		X	X
Petrale	X		X		X	X
Sanddabs	X	X	X	X	X	
Other Flatfish	X	X	X	X	X	
Kelp greenling		X	X	X	X	X
Lingcod	X	X	X	X	X	
Cabezon		X	X	X	X	X
Sablefish	X	X	X	X	X	
Whiting	X				X	X
Pacific Cod	X			X	X	X
Dogfish	X	X	X		X	X
Other Fish	X	X	X	X	X	

Summary of Allocation Committee Recommendations

Amendment 18 - Programmatic Bycatch Reduction

- The management standard should be a total catch limit defined as landed catch + discard mortality.
- Initial analyses of sector total catch limits should be done using the following ten sectors: limited entry trawl, limited entry fixed gear- longline, limited entry fixed gear- pot/trap, whiting- motherships, whiting- catcher/processors, whiting shore-based, open access- directed groundfish, open access- incidental groundfish, tribal, and recreational.
- The above recommendations should be included in the Amendment 18 FMP amendatory language.

Consideration of Intersector Allocations

- An intersector allocation process should proceed, regardless of the progress in developing a TIQ program.
- Initial analyses of intersector allocations should be done using the following sectors: limited entry trawl, limited entry fixed gear, open access, recreational, and tribal.
- The groundfish FMP species noted in Table 1 should be the focus of intersector allocations. Some yield should be set aside to accommodate incidental bycatch in sectors not noted in Table 1.
- Landings by sector in the years 1988, 1994, 1998, and 2004 should be reviewed to analyze intersector allocations needed to support a TIQ program.
- TIQ advisors to the Allocation Committee should solicit feedback from their constituents on relevant intersector allocation and TIQ program issues.
- The processes to decide intersector allocations and develop a TIQ program should maintain a five-year outlook when shaping the future of the groundfish fishery.

Elements of an Allocation Decision

- Allocations based on a percentage of the OY make the most sense for target species, while a sliding scale structure (the allocation percentage by sector varies with biomass) for allocating overfished species is recommended.
- Allocations of some target species, especially target species that are predominant in a single sector, should be of longer duration than allocations of more constraining species, such as the overfished species.
- Allocation decisions should be reviewed at least every five years.

Interactions Between Limited Entry Trawl and Open Access

- An Allocation Committee recommendation is needed by the June Council meeting.

Effects of Overages or Underages in One Sector on Other Sectors

- A matrix indicating MSA constraints on allowing overages by species should be developed for the next Allocation Committee meeting.

Other Issues

- The next Allocation Committee meeting is tentatively scheduled for May 2-3.

PFMC
02/18/05

Agenda Item F.5.c
Supplemental GAP Report
March 2005

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON FISHERY MANAGEMENT PLAN AMENDMENT 18 - BYCATCH

The Groundfish Advisory Subpanel (GAP) met with Council staff to discuss the preliminary language for FMP Amendment 18 and the preliminary Council Work Plan. The GAP also reviewed the recommendations of the Ad Hoc Allocation Committee on this subject.

In regard to the preliminary fishery management plan (FMP) language, the GAP identified several technical issues that deserve further discussion and review. Due to the minimum time available and the sheer volume of the proposed FMP amendment, GAP members agreed to review the document over the next two to three weeks and provide individual comments to the GAP Chairman, which will be compiled into a comprehensive statement for discussion at the April GAP meeting. Following that discussion, a final set of GAP comments will be forwarded to Council staff.

The GAP also discussed three major issues that were reviewed by the Ad Hoc Allocation Committee and makes the following recommendations:

1. Sectors - While the GAP generally agrees with the fisheries sectors identified by the Ad Hoc Allocation Committee, they note that the language in the preliminary FMP needs to be modified. There is a need to clarify the difference between “limited entry trawl” vessels and “shore-based Pacific whiting boats,” as the latter are a subset of the former in the context of the FMP. The reference to “at-sea Pacific whiting motherships” should be a reference to “vessels delivering to at-sea Pacific whiting motherships.” There is a need for further discussion on how open access vessels are defined, as the “5% of total catch” limit is arbitrary and may put larger directed open access vessels that also fish crab or tuna into the incidental vessel category. Finally, the reference to recreational “vessels” needs to be expanded to encompass recreational anglers fishing from shore or docks, as they too encounter bycatch.

2. Application to species groups - The GAP believes that total catch limits (TCLs) should apply to all species, not just overfished species. If the intent of the Council is to proceed with individual quota (IQ) plans, then potentially every species would have to meet a TCL.

3. Tradeability - The current preliminary language refers to the potential establishment of non-tradeable, vessel-specific TCLs. It makes no sense to have individual TCLs be non-tradeable, especially if an individual quota plan is implemented. Even absent an IQ plan, allowing trading of TCLs would promote efficiency in the fisheries without exceeding OY levels. The GAP believes this language should be modified.

In regard to the preliminary Council Work Plan (Agenda Item F.5.a, Attachment 3), the GAP suggests two changes:

1. In Section 3.1.2 (page 5), add "Open Access sub-sector: canary rockfish" to the bulleted list. The GAP notes that observer coverage has been extended to the open access fleet and, thus, there should be data available to analyze establishing TCLs for this species, which is the most constraining coastwide.

2. Add as a priority task completion of the Council's efforts to identify and potentially cap the number of participants in the groundfish open access fishery. Regardless of whether the Council pursues an IQ system, TCLs, or just status-quo management, we need to get a handle on this sector of the fishery. The development by California and Oregon of nearshore fisheries management plans makes this task much easier than it was several years ago. We need to finish the job already begun.

PFMC
03/09/05

GROUNDFISH MANAGEMENT TEAM REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 18-BYCATCH

The Groundfish Management Team (GMT) received a presentation from Ms. Yvonne de Reynier (National Marine Fisheries Service [NMFS]) and Dr. Kit Dahl (Council Staff) at our February meeting on the preliminary draft documents to implement Amendment 18. After reviewing the preliminary draft Pacific Coast Groundfish Fishery Management Plan (FMP) as Amended through Amendment 18 (Agenda Item F.5.a, Attachment 1) and the preliminary draft Groundfish Bycatch Mitigation Program Work Plan (Agenda Item F.5.a, Attachment 3) the GMT has the following comments and suggestions for consideration:

Preliminary Draft FMP Amendment 18

It is our understanding that the groundfish FMP is being amended to "authorize the use of section-specific total catch limit programs to reduce bycatch of overfished (depleted) species in appropriate sectors of the fishery." However, as one purpose of the FMP amendment is to provide a framework for future program direction, the GMT recommends that the Council's authority to develop and use specific total catch limit programs to reduce bycatch be broadened to cover all species in the groundfish FMP management unit. Even though the preferred alternative at this point is specific to overfished stocks, this change would provide the Council with the flexibility to consider other groundfish species through future management action.

In Section 2.2, Operational Definition of Terms, the GMT suggests adding a definition for the term "total catch limits" as is used in the preliminary draft FMP Amendment. The GMT notes that an explanation of "total catch limits" is in the preliminary draft Work Plan (Section 3.1.1.) and refers to "total fishing mortality and includes both landed catch and discard mortality," and suggests this same language be used in the draft FMP Amendment.

Preliminary Draft Work Plan

Consistent with the Allocation Committee recommendations, the GMT anticipates that the work plan includes analyses of total catch limit implementation for overfished species and ten fishery sectors. Under Section 3.1.2., the Draft Work Plan states that Sector/Vessel-specific Total Catch Limit Implementation could be evaluated as part of the 2007-08 specification process. The GMT notes that some elements may be addressed most quickly and efficiently in these specifications, whereas other elements may be intended to apply over a longer period and may be best implemented through an alternative process. If the total catch limit implementation is addressed in the 2007-08 specification process, the GMT recommends the following options for analysis and anticipates that other species and sub-sectors may be added to this list as we progress through the analyses**:**

- *Limited entry trawl sub-sectors (three Pacific whiting and other limited entry trawl) and tribal sector: separate catch limits for canary and widow rockfish for each sector.* The GMT recommends adding darkblotched rockfish to the list. The GMT notes that there are likely legal issues surrounding whether tribal fisheries could be subject to total catch limits for overfished species and, if so, under what circumstances. Therefore, the GMT recommends the Council receive legal guidance on this issue before pursuing total catch limits for tribal fisheries.

- *Sablefish-endorsed limited entry fixed gear sub-sector: canary and yelloweye rockfish.* The GMT recommends including the non-sablefish-endorsed limited entry fixed gear fleet either separately or in combination with the sablefish-endorsed fleet. The GMT notes that a portion of the limited entry fixed gear fleet largely targets other groundfish species than sablefish. As such, the different bycatch rates among sub-sectors should be considered before establishing bycatch caps for a combined or separate sector.

- *Recreational fishery sub-sectors (Oregon and Washington, California): canary and yelloweye rockfish.* The GMT recommends removing the recreational fishery sub-sector definitions to provide flexibility to consider any combination of sub-sectors. The GMT recommends adding lingcod to the list. If the Council chooses to broaden the authority to include non-overfished species, then the GMT recommends adding black rockfish and cabezon to the list.

Mr. Chairman,

Regarding both the “Preliminary Review Draft” of the Groundfish FMP and the Preliminary Draft of the Groundfish Bycatch Mitigation Program Work Plan, The tribes have serious concerns with proposals to constrain treaty fisheries with total catch limits for overfished species. I am referring primarily to Section 6.5.3.2 of the Draft FMP, Agenda F.5.a, Attachment 1 and Section 3.1.2 of the Draft Work Plan, Agenda F.5.a, Attachment 3.

Tribal fisheries have substantially changed in response to the overfished designation for several rockfish species and lingcod. Time and area management, observer programs to verify catch levels, and restrictive trip limits and gear requirements are just some of these responses. Given the measures taken by the tribes to conserve overfished species, application of total catch limits to treaty fisheries appears to violate the conservation necessity principle as defined in U.S. v. Washington. Therefore, treaty fisheries would not be an appropriate sector for total catch limits on overfished or other bycatch species.

FISHERY MANAGEMENT PLAN AMENDMENT 18–BYCATCH

The National Marine Fisheries Service (NMFS) published the Pacific Coast Groundfish Fishery Management Plan Bycatch Mitigation Program Final Environmental Impact Statement (Bycatch Mitigation Program FEIS) in September 2004, containing the Council's preferred alternative for this action. At their November 2004 meeting, the Council reviewed the substance of the preferred alternative and directed Council and NMFS staff to prepare preliminary drafts of (1) amendatory language to implement the bycatch program (Amendment 18) and (2) a work plan for implementing the management measures described in the preferred alternative.

As discussed at the November 2004 meeting, in addition to incorporating material related to the Bycatch Mitigation Program FEIS into the fishery management plan (FMP), the FMP would be updated to better reflect the current management framework. Attachment 1 is the draft amendatory language; pages ii through vii contain detailed information explaining and guiding the reader through the proposed changes. Highlights include:

- Reorganizing Chapter 6 (Management Measures) and incorporating material from Chapter 9 (Restrictions on other Fisheries) and Chapter 11 (Management Measures That Continue In Effect With Implementation of Amendment 4).

- Adding new bycatch monitoring and mitigation measures found mainly in Sections 6.4 and 6.5.

- Moving material in Chapter 6 relating to essential fish habitat into a new chapter.

Attachment 2 reproduces Chapters 6 and 11 of the current FMP in order to allow a detailed comparison of the reorganization and changes to the text.

Attachment 3 is the preliminary draft work plan. It focuses on implementing sector- and vessel-specific total catch limits for overfished species over the next five years.

At their February 26-27, 2005 meeting, the Ad Hoc Allocation Committee discussed total catch limits and the species and sectors to which they should be applied. Their recommendations were incorporated into the draft amendatory language and work plan. The meeting minutes are attached (Agenda Item F.5.c, Allocation Committee Minutes) for reference.

At this meeting the Council should recommend desired changes to the draft amendment language. Revised language would be brought back before the Council in June 2005, after which, subject to Council approval, it would be released for public review. This would allow final action by the Council at their September 2005 meeting. The amendment package would then be submitted to NMFS for review, with a final response expected by early 2006. (The Bycatch Mitigation Program FEIS satisfies National Environmental Policy Act requirements for this action.)

No similar legal/procedural requirement is attached to the work plan. In its final form it should assist the Council in planning future bycatch mitigation activities and serve to inform the public about the Council's intentions. The Council may wish to consider procedures and a timeline for public review and finalization of this document.

Council Task:

1. Provide guidance on preliminary draft amendment language and draft work plan.

Reference Materials:

1. Agenda Item F.5.a, Attachment 1: Preliminary Review Draft Pacific Coast Groundfish Fishery Management Plan [Excerpts], as amended through Amendment 18.
2. Agenda Item F.5.a, Attachment 2: Chapters 6 and 11 excerpted from the current Groundfish FMP.
3. Agenda Item F.5.a, Attachment 3: Preliminary Draft Groundfish Bycatch Mitigation Work Plan.
4. Agenda Item F.5.c, Allocation Committee Minutes.

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. NMFS Report — Yvonne de Reynier
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. Council Guidance on Preliminary Draft Amendment Language and Draft Work Plan

PFMC
02/16/05

Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004

Thomas E. Helser[1]
Guy W. Fleischer[1]
Steve Martell[2]
Nathan Taylor[2]

[1]*Northwest Fisheries Science Center*
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Blvd., East
Seattle, WA 98112, USA

[2]*University of British Columbia*
Fisheries Centre
2259 Lower Mall
Vancouver, B.C. Canada
V6T 1Z4

February 16, 2005
Version 2
Revised as per STAR Panel Review

Summary of Stock Status

The coastal population of Pacific hake (*Merluccius productus*, also called Pacific whiting) is distributed off the west coast of North America from 25˚ N. to 51˚ N. latitude and was assessed using an age-structured assessment model. The U.S. and Canadian fisheries were treated as distinct fisheries. The primary indicator of stock abundance is the acoustic survey, and a midwater trawl juvenile survey provides an indicator of recruitment. New data in this assessment included only updated catch at age through 2004 and recruitment indices from the Santa Cruz juvenile survey in 2004. The US/Canadian acoustic survey, which is the primary index of hake abundance, was last conducted in summer of 2003, but another is planned for the summer of 2005. As in last year's assessment, uncertainty in model results is represented by a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, *q*=1.0, while the higher end of the range represents the *q*=0.6 assumption.

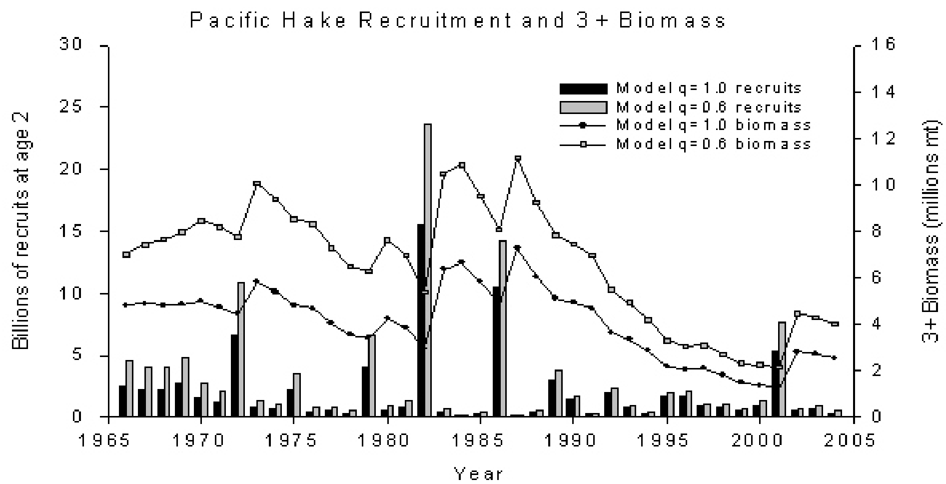
Status of Stock: The hake stock in 2004 was estimated to range from 2.5 to 4.0 million mt (age 3+ biomass) for the *q*=1.0 and *q*=0.6 model scenarios, respectively. Stock biomass increased to a historical high in 1987 due to exceptionally large 1980 and 1984 year classes, then declined as these year classes passed through the population and were replaced by more moderate year classes. Stock size stabilized briefly between 1995-1997, but then declined continuously to its lowest point in 2001. Since 2001, stock biomass has increased substantially as the strong 1999 year class has entered the population. The mature female biomass in 2004 was estimated to range from 50% to 55% (*q*=1.0 and *q*=0.6) of an unfished stock. Thus the stock can be considered to be rebuilt to the target level of abundance

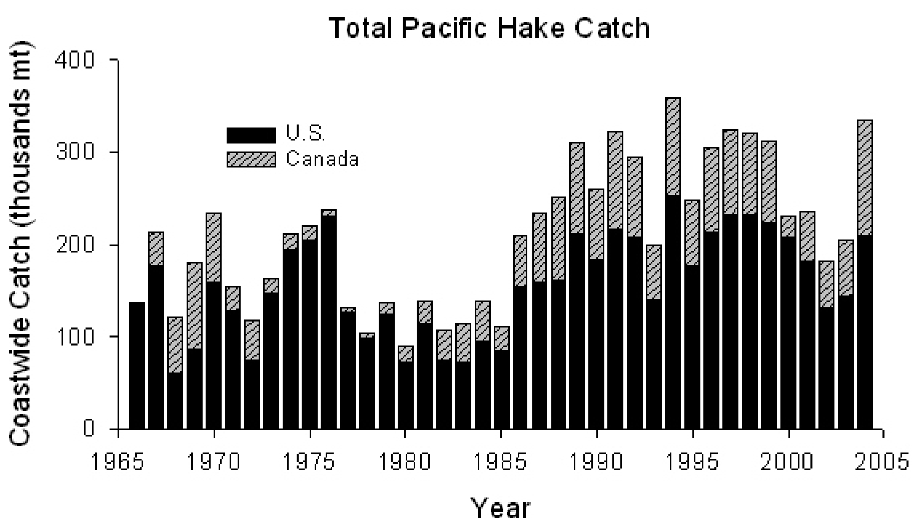
Pacific hake (whiting) catch and stock status table (catches in thousands of metric tons, biomass in millions of metric tons and Age 2 recruits in billions of fish):

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
U.S. landings	253	178	213	233	233	225	208	182	132	144	211
Canadian landings	106	70	93	92	89	87	22	54	51	62	124
Total	359	248	306	325	321	312	230	236	183	206	335
ABC	325	223	265	290	290	290	290	238	208	235	514
Model (q=1.0)											
Age 3+ stock biomass	2.8	2.2	2.1	2.1	1.8	1.5	1.4	1.3	2.9	2.7	2.5
Female mature biomass	1.5	1.2	1.1	1.0	0.9	0.8	0.7	0.7	1.2	1.3	1.2
Age 2 recruits	0.33	1.71	1.72	0.90	0.85	0.55	0.93	5.34	0.53	0.72	0.34
Total F	0.24	0.22	0.27	0.26	0.30	0.36	0.29	0.34	0.19	0.20	0.32
Depletion level (%B0)	58%	47%	42%	41%	36%	30%	28%	29%	46%	51%	50%
Exploitation rate	12.6%	11.4%	14.9%	15.4%	17.5%	20.9%	16.8%	18.5%	6.5%	7.6%	13.2%
Model (q=0.6)											
Age 3+ stock biomass	4.2	3.3	3.1	3.1	2.7	2.3	2.2	2.1	4.5	4.3	4.0
Female mature biomass	2.2	1.8	1.6	1.6	1.4	1.2	1.2	1.2	1.9	2.1	2.0
Age 2 recruits	0.39	2.03	2.05	1.13	1.10	0.74	1.37	7.60	0.72	0.89	0.51
Total F	0.18	0.16	0.19	0.19	0.22	0.25	0.18	0.20	0.11	0.11	0.17
Depletion level (%B0)	60%	50%	44%	43%	38%	33%	32%	34%	52%	57%	55%
Exploitation rate	9.4%	8.2%	10.8%	11.2%	12.6%	14.3%	11.0%	11.8%	4.4%	5.1%	8.7%

The coastwide ABC and OY for 2005 are estimated to be 364,000 mt and 598,000 mt (*q*=1.0 and *q*=0.6) based upon a F40% harvest rate and 302,000 mt and 483,300 mt mt (*q*=1.0 and *q*=0.6) based upon the F45% harvest rate. With biomass above 40% unfished biomass level, the 40:10 OY adjustment would not be applied. Projections beyond 2005 are for a decline in stock biomass and ABC-OY as the 1999 year class passes through its age of peak abundance. At this time there is no evidence of sufficiently large recruitments after 1999 to maintain the stock at a high abundance level. Preliminary results from pre-recruit surveys suggest a larger than average 2003 year-class, but this remains unconfirmed until the 2005 acoustic survey. As such, spawning stock biomass is projected to again decline within the precautionary zone (25% - 40% unfished) by 2006-2007.

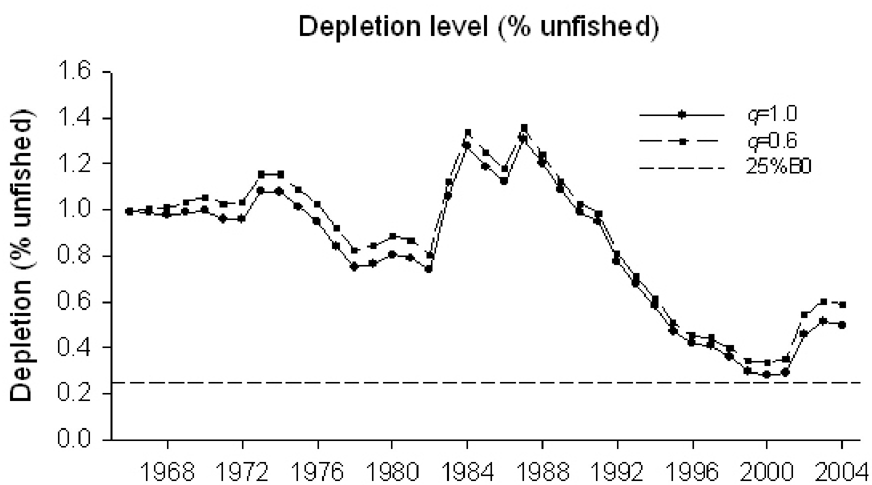
Data and Assessment: An age-structured assessment model was developed by Dorn et al. (1998) using AD model builder, a modeling environment for developing and fitting multi-parameter non-linear models. Data used in this assessment included: 1) U.S. and Canadian commercial landings data (discards included in the at sea component, 2) age composition and weight at age from both fisheries, 3) Santa Cruz larval rockfish survey as an index of age 2 recruitment, and 4) U.S.-Canada triennial acoustic survey data as an index of total stock biomass. The most recent assessment presented here represents an update based on the same model configuration used in the 2003 assessment. This included a revised 1977-1992 acoustic survey biomass estimates based on new deep-water and northern expansion factors. New data for this assessment includes 2004 fishery removals and age compositions and the 2004 Santa Cruz pre-recruit hake index.

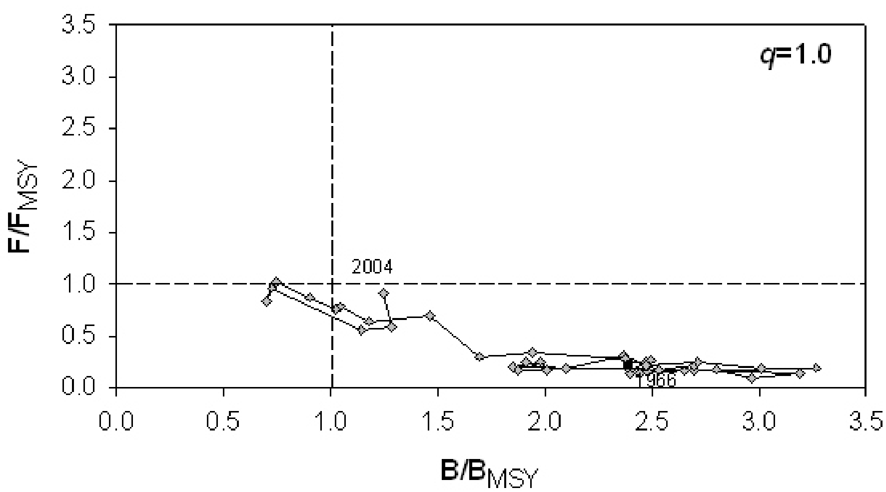


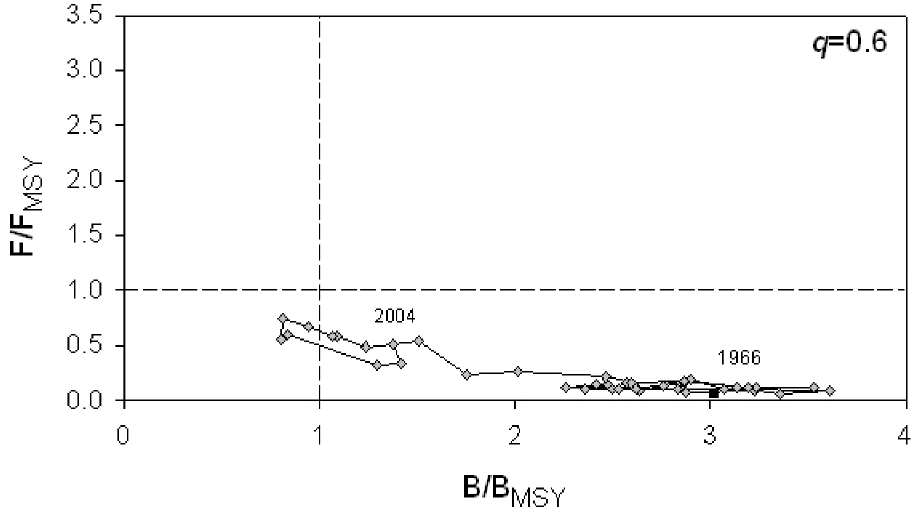


Reference points and Management Performance: Management targets for Pacific hake are based on proxy measures of F_{MSY} and B_{MSY} corresponding to 40% (i.e. $F_{40\%}$ and $B_{40\%}$) of spawning stock biomass-per-recruit in the absence of fishing (B0=SSB/R*ave.R), with the 40-10 policy implemented when biomass falls below 40% unfished**.** Overfishing is defined to occur when spawning stock biomass falls below 25% B0 (uncertainty in the table below is expressed as 10th and 90th percentiles of the MCMC posterior distribution).

Pacific hake/Whiting	Model (q =1.0)	Model (q =0.6)
Unfished Spawning Stock Biomass (SB_0)	2.5 million mt	3.65 million mt
Age 3+ Unfished Population Biomass (B_0)	4.8 million mt	7.0 million mt
Unfished Recruitment (R_0)	1.9 billion	2.8 billion
Spawning Stock Biomass at MSY (SB_{msy})	1.0 million mt	1.46 million mt
Basis for SB_{msy}	SB40% proxy	SB40% proxy
F_{msy}	0.35	0.34
Basis for F_{msy}	F40% proxy	F40% proxy
MSY	374,000 mt	537,000 mt
2004 Spawning Stock Biomass w/ uncertainty	1.17 (1.03-1.34) mt	1.94 (1.48-2.42) mt







Major Uncertainties: The hake assessment is highly dependent on acoustic survey estimates of abundance. Since 1993, the assessment has relied primarily on an absolute biomass estimate from the joint US-Canadian acoustic survey. The acoustic target strength of Pacific hake, used to scale acoustic data to biomass, is based on a small number of *in situ* observations. While the fit to the acoustic survey time series has improved with revision of past survey biomass estimates (1977-1992) these are still uncertain with poor fits in some years.

Uncertainty in the assessment result is characterized in terms of variability in model parameters and in terms of the assumption regarding the acoustic survey catchability coefficient, *q*. All past assessment results and recommendations have been based upon fixing the acoustic survey *q*=1.0; thus asserting that the acoustic survey estimate of biomass is an absolute measure of biomass and not just a relative measure. The past several assessments have explored relaxation of this assumption, but final results have been based upon the *q*=1.0 scenario. The ability to relax the *q*=1.0 assumption in this year's assessment is based upon: 1) continued lengthening of the acoustic survey time series, thus allowing the survey to be treated as an index of relative abundance in the model; 2) relatively better model fits to the data when *q* is less than 1.0; and 3) high quality of expertise in the STAR Panel to allow critical examination of the *q*=1.0 assertion. Uncertainty in the final model result is therefore represented by a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, *q*=1.0, while the higher end of the range represents the *q*=0.6 assumption. Even lower *q* values are indicated by some model runs, but these are considered by the STAT team and STAR panel to be implausibly low. The relative probability of the range of plausible *q* levels was discussed extensively. The two endpoints are considered as less likely than intermediate points and an equal blending of results from the two endpoints is not unreasonable.

Target Fishing Mortality Rates: Target fishing mortality rates used in projections were based on F40% and F45% the fishing mortality rate corresponding to the corresponding F %B0 of unfished spawning stock biomass-per-recruit, with the 40-10 policy implemented when biomass falls below 40% unfished. Bayesian credibility intervals generated from 2,500,000 Markov Chain Monte Carlo samples were used to evaluate uncertainty in biomass, spawning biomass, depletion rates and coastwide yield. An estimate of stock productivity (e.g. ABC) that equally blends the two model endpoints is reasonable as a risk-neutral best estimate. An OY that is closer to the *q*=1.0 result would be risk-averse, would not constrain the expected short-term fishery demands and would reduce the magnitude of the projected short-term stock decline.

Coastwide and U.S. yield in 2005 (in metric tons):

	2005 Coastwide OY	2005 U.S. OY
Model q =1.0		
F40% (40-10)	364,197	269,069
F45% (40-10)	302,305	223,343
Model q =0.6		
F40% (40-10)	597,625	441,525
F45% (40-10)	482,899	356,766

Projection table of coastwide yield (thousands of tons), spawning biomass (millions of tons), and depletion rates under different harvest rate policies and model alternatives. Percentiles shown (10%, 50% and 90%) are based on 2,500,000 Markov chain Monte Carlo simulations:

Model q =1.0

		3+ Bioimass (millions mt)			SpawningBioimass (million mt)			Age-2 Recruits (billion)			Depletion Rate			Coastwide yield (t)		
	Year	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%
	2005	1.638	1.952	2.338	0.842	0.997	1.184	0.092	0.259	0.736	0.324	0.383	0.455	294,258	364,197	438,815
	2006	1.042	1.252	1.554	0.577	0.696	0.850	0.477	1.448	4.631	0.222	0.268	0.327	192,114	258,507	345,172
	2007	1.051	1.418	2.484	0.542	0.707	1.064	0.285	1.134	4.000	0.208	0.272	0.409	159,956	248,323	425,987
F40% (40-10)	2008	0.993	1.619	3.019	0.535	0.779	1.335	0.249	1.114	4.731	0.206	0.300	0.513	150,452	278,576	529,730
Harvest Policy	2009	1.061	1.742	3.558	0.539	0.838	1.578	0.232	0.954	3.906	0.207	0.322	0.607	154,230	321,665	641,017
	2010	1.103	1.860	3.829	0.598	0.921	1.723	0.336	1.087	4.593	0.230	0.354	0.663	180,131	353,427	682,167
	2011	1.211	1.949	3.867	0.606	0.936	1.798	0.292	0.931	3.717	0.233	0.360	0.691	190,821	371,392	713,404
	2012	1.155	1.944	3.675	0.589	0.934	1.736	0.303	1.035	3.853	0.227	0.359	0.667	190,315	369,845	705,711
	2013	1.177	1.877	3.727	0.612	0.909	1.704	0.240	0.989	4.313	0.235	0.350	0.655	200,654	363,418	689,173
	2014	1.171	1.864	3.948	0.607	0.919	1.818	0.197	1.099	4.732	0.234	0.353	0.699	194,951	365,660	725,154
	2005	1.638	1.952	2.338	0.842	0.997	1.184	0.092	0.259	0.736	0.324	0.383	0.455	244,229	302,305	363,377
	2006	1.093	1.315	1.629	0.605	0.729	0.887	0.477	1.448	4.631	0.233	0.280	0.341	172,562	230,359	304,634
	2007	1.125	1.505	2.574	0.580	0.753	1.119	0.285	1.134	4.000	0.223	0.289	0.430	149,984	225,028	368,429
	2008	1.080	1.723	3.154	0.580	0.831	1.408	0.249	1.114	4.731	0.223	0.319	0.541	142,603	251,998	457,461
F45% (40-10)	2009	1.138	1.853	3.724	0.577	0.896	1.676	0.232	0.954	3.906	0.222	0.345	0.645	145,064	290,260	560,357
Harvest Policy	2010	1.193	2.003	4.044	0.643	0.997	1.853	0.336	1.087	4.593	0.247	0.383	0.713	166,897	318,141	604,656
	2011	1.309	2.115	4.157	0.658	1.020	1.942	0.292	0.931	3.717	0.253	0.392	0.747	179,031	336,497	639,758
	2012	1.265	2.123	3.991	0.644	1.022	1.900	0.303	1.035	3.853	0.248	0.393	0.730	179,943	338,863	639,545
	2013	1.289	2.062	4.048	0.674	1.008	1.869	0.240	0.989	4.313	0.259	0.388	0.719	189,901	336,312	632,219
	2014	1.303	2.065	4.256	0.673	1.018	1.965	0.197	1.099	4.732	0.259	0.391	0.756	190,028	338,300	650,107

Model *q* =0.6

		3+ Bioimass (million mt)			SpawningBioimass (million mt)			Age-2 Recruits (billion)			Depletion Rate			Coastwide yield (t)		
	Year	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%
F40% (40-10) Harvest Policy	2005	2.445	3.356	4.323	1.287	1.673	2.151	0.106	0.349	1.034	0.320	0.437	0.562	418,345	597,625	791,728
	2006	1.587	2.123	2.771	0.900	1.185	1.500	0.661	2.054	6.483	0.226	0.298	0.377	278,998	422,115	590,706
	2007	1.640	2.240	3.652	0.861	1.140	1.662	0.342	1.428	6.156	0.216	0.286	0.418	242,757	382,138	640,772
	2008	1.588	2.399	4.580	0.840	1.192	2.063	0.340	1.537	6.902	0.211	0.300	0.519	218,160	408,865	794,166
	2009	1.520	2.520	5.330	0.772	1.225	2.318	0.324	1.267	6.336	0.194	0.308	0.583	202,578	450,905	939,578
	2010	1.561	2.706	5.810	0.841	1.330	2.663	0.436	1.553	6.743	0.211	0.334	0.669	225,978	489,969	1,057,915
	2011	1.597	2.752	6.115	0.819	1.334	2.819	0.409	1.414	5.790	0.206	0.335	0.709	228,525	515,007	1,126,446
	2012	1.604	2.802	5.895	0.816	1.370	2.729	0.419	1.405	5.540	0.205	0.344	0.686	230,474	530,105	1,110,600
	2013	1.599	2.796	5.710	0.827	1.377	2.697	0.387	1.612	7.898	0.208	0.346	0.678	241,298	540,436	1,102,727
	2014	1.671	2.902	6.391	0.845	1.430	2.843	0.318	1.473	5.701	0.212	0.359	0.715	248,666	564,831	1,139,945
F45% (40-10) Harvest Policy	2005	2.472	3.232	4.165	1.287	1.673	2.151	0.122	0.340	1.015	0.319	0.414	0.533	355,660	482,899	632,026
	2006	1.664	2.169	2.781	0.935	1.207	1.530	0.694	2.135	7.248	0.232	0.299	0.379	253,660	370,917	507,664
	2007	1.730	2.398	4.040	0.911	1.245	1.802	0.408	1.733	7.614	0.226	0.309	0.447	218,786	366,140	581,201
	2008	1.675	2.801	5.184	0.896	1.365	2.292	0.408	1.562	7.092	0.222	0.338	0.568	210,534	410,192	737,894
	2009	1.707	2.896	5.674	0.886	1.409	2.563	0.334	1.330	5.102	0.219	0.349	0.635	218,179	453,579	860,214
	2010	1.845	3.102	5.859	0.979	1.523	2.686	0.367	1.335	7.304	0.243	0.377	0.665	246,014	479,357	888,422
	2011	1.850	3.129	6.044	0.950	1.519	2.758	0.415	1.407	4.989	0.235	0.376	0.683	241,460	488,955	917,727
	2012	1.814	2.972	5.839	0.928	1.461	2.756	0.375	1.408	4.984	0.230	0.362	0.683	236,900	479,261	916,826
	2013	1.800	2.937	5.725	0.932	1.440	2.730	0.340	1.539	6.115	0.231	0.357	0.676	237,814	472,026	941,087
	2014	1.790	2.976	5.865	0.916	1.463	2.735	0.311	1.378	5.373	0.227	0.363	0.678	236,545	474,799	922,979

Research and Data Needs: The STAR Panel concluded that the major source of uncertainty lies in the assumption regarding the acoustic survey catchability, *q*. In particular, the target strength relationship should be re-evaluated for possible biases and additional in situ measurements are needed. Moreover, an informed prior on *q* should be developed when estimating this parameter freely in the model.

INTRODUCTION

This assessment has been developed in the spirit of a treaty signed in November 2003 between the U.S. and Canada for the sharing of this trans-boundary resource. Under this agreement, not yet ratified by Congress, the stock assessment is to be reviewed by a Scientific Review Group (SRG), appointed by both parties. Prior to 1997, separate Canadian and U.S. assessments were submitted to each nation's assessment review process. In the past, this has resulted in differing yield options being forwarded to managers. Multiple interpretations of stock status made it difficult to coordinate overall management policy for this trans-boundary stock. To address this problem, the working group agreed in 1997 to present scientific advice in a single assessment, while that agreement was officially formalized in 2003. To further coordinate scientific advice, this report was submitted to a joint Canada-U.S. SRG for technical review in fulfillment of the agreement and to satisfy management responsibilities of both the U.S. Pacific Fisheries Management Council (PFMC) and the Canadian Pacific Stock Assessment Review Committee (PSARC). The Review Group meeting was held in Seattle, WA at the Northwest Fisheries Science Center, during Feb 2-4, 2005. While this report forms the basis for scientific advice to managers, final advice on appropriate yield is deferred to Canadian DFO managers by the PSARC Groundfish Sub-committee and the PSARC Steering Committee, and to the U.S. Pacific Fisheries Management Council by the Groundfish Management Team.

Stock Structure and Life History

Pacific hake (*Merluccius productus*), also called Pacific whiting, is a codlike species distributed off the west coast of North America from 25˚ N. to 51˚ N. lat. It is among 11 other species of hakes from the genus, *Merluccidae*, which are distributed in both hemispheres of the Atlantic and Pacific Oceans and constitute nearly two millions t of catches 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 hake 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 typically ranges from southern California to Queen Charlotte Sound. Spawning occurs off south-central California during January-March. Due to the difficulty of locating major spawning concentrations, 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, hake form extensive midwater aggregations near the continental shelf break, with highest densities located over bottom depths of 200-300 m (Dorn et al. 1994). The prey of hake include euphausiids, pandalid shrimp, and pelagic schooling fish (such as eulachon and herring) (Livingston and Bailey 1985). Larger hake become increasingly piscivorous, and herring are large component of hake diet off Vancouver Island. Although 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 greatest northern migration each season. During El Niños, a larger proportion of the stock migrates into Canadian waters, apparently due to intensified northward transport during the period of active migration (Dorn 1995). Range extensions to the north also occur during El Niños, as evidenced by reports of hake from S.E. Alaska during warm water years. During the warm period experienced in 1990s, there have been changes in typical patterns of 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. Because of this, juveniles may be subjected to increased predation from cannibalism and to increased vulnerability to fishing mortality. Subsequently, La Niña conditions apparently caused a southward shift in the center of the stock's distribution and a smaller portion was found in Canadian water 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, but offshore extensions of fishing activity have occurred. 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 on Pacific hake. During the mid 1970's, the 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 motherships. 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 entire quota, and no foreign fishing was allowed. Canada allocates a portion of the catch to joint-venture operation once shore-side capacity if filled.

Historically, the foreign and joint-venture fisheries produced fillets and headed and gutted products. In 1989, Japanese motherships began producing surimi from Pacific hake, using a newly developed process to inhibit myxozoan-induced proteolysis. In 1990, domestic catcher-processors and motherships 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 made Pacific hake a viable alternative. In 1991, joint-venture fishery for Pacific hake ended because of the high level of participation by domestic catcher-processors and motherships, 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 led to a rapid expansion of shore-based landings in the early 1990's.

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. experience. 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 former Soviet Union caught the majority of hake in the Canadian zone, with Poland and Japan harvesting much smaller amounts. 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. Since the demand of Canadian shore-based processors remains below the available yield, the joint-venture fishery will continue 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 are processed into surimi, fillets, or mince by processing plants at Ucluelet, Port Alberni, and Delta. 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 lat. 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 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 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 U.S. and Canadian fisheries lead to quota overruns; 1991-1992 quotas summed to 128% of the ABC, while in 1993-1999 the 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 a recent preliminary agreement between the United States and Canada (2003) 73.88% and 26.12%, respectively, of the coastwide allowable biological catch is to be allocated to the two countries. Furthermore, the agreement, yet to be ratified, states that a Joint Technical Committee will exchange data and conduct stock assessments which will be reviewed by a Scientific Review Group. This document represents the efforts of the joint US-Canada Technical Committee.

United States

Prior to 1989, catches in the U.S. zone were substantially below the harvest guideline, but since 1989 the entire harvest guideline has been caught with the exception of 2000, 2001 and 2003 which were 90%, 96% and 96% of the quota, respectively. The total U.S. catch has not significantly exceeded the harvest guideline for the U.S. zone (Table 2), indicating that in-season management procedures have been very 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. More recently, yields in the U.S. zone have been restricted to level below optimum yields due to widow bycatch in the hake fishery. At-sea processing and night fishing (midnight to one hour after official sunrise) are prohibited south of 42˚ N lat. Fishing is prohibited in the Klamath and Columbia River Conservation zones, and a trip limit of 10,000 pounds is established for 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 moved to May 15. Shore-based fishing is allowed after April 1 south of 42˚ N. lat. 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. A new allocation agreement, effective in 1997, divided the U.S. non-tribal harvest guideline between factory trawlers (34%) , vessels delivering to at-sea processors (24%), and vessels delivering to shore-based processing plants (42%).

Shortly after this 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 between 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 conducts research to support hake stock assessment. As part of this effort, PWCC sponsored a juvenile recruit survey in summer of 1998 and 2001, which is presently ongoing in collaboration with NMFS scientists.

Canada

The Canadian Department of Fisheries and Oceans (DFO) is responsible for managing the Canadian hake fishery. Prior to 1987, the quota was not reached due to low demand for hake. In subsequent years the quota has been fully subscribed, and total catch has been successfully restricted to ±5% of the quota (Table 2).

Domestic requirements are given priority in allocating yield between domestic and joint-venture fisheries. During the season, progress towards the domestic allocation is monitored and any anticipated surplus is re-allocated to the joint-venture fishery. The Hake Consortium of British Columbia coordinates the day-to-day fleet operations within the joint-venture fishery. Through 1996, the Consortium split the available yield equally among participants or pools of participants. In 1997, Individual Vessel Quotas (IVQ) were implemented for the British Columbia trawl fleet. IVQs of Pacific hake were allotted to licence holders based on a combination of vessel size and landing history. Vessels are allocated proportions of the domestic or joint-venture hake quota. There is no direct allocation to individual shoreside processors. Licence holders declare the proportion of their hake quota that will be landed in the domestic market, and shoreside processors must secure catch from vessel licence holders.

Overview of Recent Fishery and Management

United States

In 1998, the GMT recommended a status quo ABC of 290,000 mt for 1998 (i.e. the same as 1997). The ABC recommendation was based on a decision table with alternative recruitment scenarios for the 1994 year class, which was again considered a major source of uncertainty in current stock status. Recommendations were based on the moderate risk harvest strategy. The PFMC adopted the recommended ABC and allocated 80 percent of the ABC (232,000 mt) to U.S. fisheries.

The GMT recommended a status quo ABC of 290,000 mt for 1999 and 2000. This coastwide ABC was roughly the average coastwide yield of 301,000 mt and 275,000 mt projected for 1999 and 2000, respectively based on F40% (40-10 option) harvest policy.

In 2000, a Pacific hake assessment update was performed by Helser et al. (2001). While additional catch and age composition data were available at the time of the assessment, the 2001 coastwide acoustic survey which serves as the primary index of hake abundance was not. Using the same configuration with the updated fishery composition data and recruitment indices the assessment model showed consistent projections with the 1998 assessment. Based on this, the GMT recommended that the ABC in 2001 be set to the projected yield of 238,000 mt based on the F40% (40-10 option) harvest policy. Allowable biological catches in 2002 and 2003 were based the 2001 Pacific hake stock assessment (Helser et al. 2001) with updated fishery data and a new acoustic survey biomass estimated for 2001. Due to declining biomass and an estimated depletion level of 20% unfished biomass in the 2001 assessment the ABC in 2002 was 208,000 mt and based the F45% (40-10) harvest policy. However, the ABC in 2003 was adjusted upward to 235,000 mt under the same harvest policy to reflect projected increases in biomass from the relatively strong 1999 year class. In 2004, the coastwide ABC was estimated to be 514,441 mt based on the Fmsy proxy harvest rate of F40% applied to the model in which acoustic survey 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 very strong 1999 year-class. The final commercial US OY was set at 250,000 mt due to constraints imposed by bycatch of widow rockfish in the hake fishery. The Makah tribe was allocated 32,500 mt in 2004.

Landings of the at-sea fishery constituted roughly 54% of the total U.S. fishery catches since 1999. Significant distributional shifts in the Pacific hake population, presumably due to oceanographic conditions, has caused major fluctuations in the center of the at-sea harvesting sector. Most notable in recent years was the northward shift in 1999 at-sea fleet activity in which most catches were distributed North of the Columbia River (roughly 91% of the at-sea catches) and coincided with a strong El Nino the preceding year. At sea catches returned to more normal spatial distribution patterns in the 2000 fishing season with roughly 60% occurring north and 40% occurring south of the Columbia River. In 2001, the pattern of the at-sea catches were opposite of those seen in 1999 with only roughly 22% north of the Columbia River (Fig. 2). This coincided with a relatively strong La Nina. The at sea catch distributions for 2002 and 2003 were representative of more normal patterns with roughly 60% and 40% of the catches south and north of Newport, OR. In 2003, the at-sea catch of hake was 67,473 mt, with Motherships harvesting 39% (26,021m t) while the catcher/processor sector harvesting 61% (55,389 mt) of the hake allocation. At sea distribution of catch in 2004 showed a slightly stronger northward pattern with roughly 50% of the catch occurring north and south of Newport. The total at sea sector harvested approximately 43% (90,200 mt) of the total U.S. catch of 210,400 mt.

The total shore-based U.S. landings in 2002 and 2003 were 46,000 mt and 45,000 mt, respectively. The primary ports harvesting Pacific hake in 2002 were Newport, Oregon (18,553m t), Astoria, Oregon (12,171 mt), Coos Bay, Oregon (1,580 mt), Washington coastal ports (primarily Westport) (10,610 mt) , and Eureka, California (2,773 mt). In 2003, landings from Eureka were down roughly 50% from 2002, but up by over 2,000 mt in the Washington coastal port of Ilwaco. In aggregate, these ports accounted for more than 99% of all shore-based hake landings. The shore-based fishery began in mid June and ended on July 14 when the harvest guideline was attained. In 2004, the shore-based fishery harvested 46% (96,200 mt) of the total U.S. catch of 210,400 mt. As in previous years, the dominate ports were Newport (38,800 mt) followed by Westport (30,000 mt) and Astoria (16,000 mt).

Since 1996, the Makah Indian Tribe has conducted a separate fishing in its" Usual and Accustomed Fishing Area." The tribal fishery was allocated 15,000 mt of hake in 1996 with an increase to 25,000 mt in 1997- 1999, 32,500 mt in 1999-2000, and 20,000 mt in 2001-2003. The tribe harvested essentially all of its allocated catch between 1996-1999, however, in 2000 and 2001 the Makah Tribe only harvested 6,500 mt and 6,774 mt, respectively. In 2003, the Makah fishery began in June 13 and harvested roughly 90% of its allocated 25,000 mt. In 2004, pacific hake distribution provided a favorable fishery in the Makah tribal fishing area; the Makahs harvested approximately 74% (24,000 mt) of the Tribal allocation and 11% of total US catch.

Canada

DFO managers allow a 15% discrepancy between the quota and total catch. The quota may be exceeded by up to 15%, which is then taken off the quota for the subsequent year. 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. Between 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 the Canadian zone 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.

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 survey estimates of absolute abundance at age (Hollowed et al. 1988a). Since 1989, a stock synthesis model that utilizes fishery catch-at-age data and 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). The conversion from stock synthesis to AD model builder consisted of programming the population dynamics and likelihood equations in the model implementation language (a superset of C++). In that assessment, Dorn et al. (1999) provided model validation using a side-by-side comparison of model results between stock synthesis and ADMB, and then extended the approach to take advantage of AD model builder's post-convergence routines to calculate 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. Helser et al. (2001), using the same AD model builder modeling framework, conducted the Pacific hake stock assessment for 2001. That assessment included updated fishery and new survey biomass estimates, with exploration of numerous alternative model structures and assumptions. The hake assessment conducted in 2003 (Helser et al. 2004) incorporated information from a joint US/Canadian acoustic survey in the summer of 2003, which confirm the large 1999 year-class. That assessment employed several important modifications including: 1) revision of acoustic survey biomass estimates from 1977-1992 to reflect new deep-water and northern expansion factors; 2) initialization of the population age composition in 1966 (vs. 1972) including estimates of recruitment at age 2 from 1966-2003; and 3) discrete temporal changes in the acoustic survey selectivity. Due to the lengthened acoustic survey biomass trends the assessment model was able to freely estimate the acoustic survey catchability coefficient (q); on the order of .4-.5 and substantially below the assumed q=1.0 from earlier assessments. The ability to relax the q=1.0 assumption was based upon: 1) continued lengthening of the acoustic survey time series, thus allowing the survey to be treated as an index of relative abundance in the model; 2) relatively better model fits to the data when q is less than 1.0; and 3) high quality of expertise in the 2003 STAR Panel to allow critical examination of the q=1.0 assertion. As such, the 2003 assessment presented uncertainty in the final model result as a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, q=1.0, while the higher end of the range represents the q=0.6 assumption. The assessment presented in this document represents an update based on the same model configurations the 2003 assessment. New information used in the modeling include total fishery removals, fishery age compositions, and a hake pre-recruit index through 2004. The joint US/Canadian acoustic survey is planned for the summer of 2005.

Data Sources

The data used in the stock assessment model included:

- Total catch from the U.S. and Canadian fisheries (1966-2004).

- Catch at age and average weights at age from the U.S. (1973-2004) and Canadian fisheries (1977-2004).

- Biomass and age composition from the Joint US-Canadian acoustic/midwater trawl surveys (1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, and 2003). Note: the 1986 acoustic survey biomass index was omitted due to transducer and calibration problems.

- Indices of young-of-the-year abundance from the Santa Cruz Laboratory larval rockfish surveys (1986-2004). In this, as in the previous 2001 and 2003 assessment, the Santa Cruz Laboratory indices of young -of-the-year were used as an age-2 tuning index for stock reconstruction and for future projections (two years out from the terminal year in the assessment, i.e. 2003 and 2004).

The model also uses biological parameters to characterize the life history of hake. These parameters are used in the model to estimate spawning and population biomass, and obtain predictions of fishery and survey biomass from the parameters estimated by the model:

- Proportion mature at age.

- Weight at age and year by fishery and by survey

- Natural mortality (M)

Total catch

Table 1 gives the catch of Pacific hake for 1966-2004 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 1981-2003, 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 1991-2003 are estimated by the North Pacific Groundfish Observer Program (NPGOP).

At-sea discards are included in the foreign, joint-venture, at-sea domestic catches in the U.S. zone. Discards have not been estimated for the shore-based fishery. 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.

Fishery age composition

Catch at age for the foreign fishery in the U.S. zone during 1973-1975 is given in Francis and Hollowed (1985), and was reported by Polish and Soviet scientists at bilateral meetings. Estimates of catch at age for the U.S. zone foreign and joint-venture fisheries in 1976-1990, and the at-sea domestic fishery in 1991-2003, were derived from length-frequency samples and length-stratified otolith samples collected by observers. Sample size information is provided in Table 3. In general, strata were defined by the combination of three seasonal time periods and three geographic areas. Methods and sample sizes by strata are given in Dorn (1991, 1992). During 1992-2004, at-sea catch was generally restricted to between May and August in the early part of the year (April-June) north of 42˚ N. lat., so only two spatial strata were used, and no seasonal strata were defined. Due to the migratory nature of hake spatial strata are defined each fishing year on the basis of marked changes in size/age compositions. For instance, during the 2004 fishing year, the 1999 year-class (age 5) was so ubiquitous in the at sea fishery that average size and age of hake were consistent until about 47º N latitude. North of 47º the average size/age and their variance increased. The Makah fishery (1996-2003) was defined as a separate strata because of its restricted geographic limits and different seasons.

Biological samples from the shore-based fishery were collected by port samplers at Newport, Astoria, Crescent City, and Westport from 1997-2004. A stratified random sampling design is used to estimate the age composition of the landed catch (sample size information provided in Table 3). Shore-based strata are defined on the basis of port of landing. In 1997- 2004, four strata were defined: 1) northern California (Eureka and Crescent City), 2) southern Oregon (Newport and Coos Bay), 3) northern Oregon (Astoria and Warrenton), and 4) Washington coastal ports (Illwaco and Westport). No seasonal strata have been used for the shore-based fishery due to the general brevity of the fishery; however, port samplers are instructed to distribute their otolith samples evenly throughout the fishing season.

Biological samples from the Canadian joint-venture fishery were collected by fisheries observers, placed on all foreign processing vessels in 1997-2004. Shore-based Canadian landings are sampled by port samplers. The Canadian catch at age is estimated from random otoliths samples.

Figure 3 shows the estimated age composition for the shore-based fishery by port in the U.S. zone from the three most recent years, 2002-2004. In most years, in the absence of a single dominant strong year-class, the shore-based age compositions show both temporal and spatial variation; age compositions are composed of older fish in the more northerly fishing ports, particularly Washington coastal ports. However, port specific age compositions for 2002-2004 clearly reflect the prominence of the 1999 year-class as seen as age 3, age 4, and age 5 fish in 2002, 2003 and 2004, respectively.

Figure 4 shows the estimated age composition for the at sea fishery by stratum (including Makah tribal fishing area) in the U.S. zone from 2002-2004. As in the shore-based fishery, age compositions comprise older fish in the northern stratum and the Makah area. Again, this pattern is due to the further northward migration of older/larger hake. The 1999 year class is also the dominate age in the at sea fishery catches in 2002-2004.

Table 4 (Figs. 5-6) give the estimated U.S. fishery (1973-2004) and Canadian fishery catch at age (1977-2004). The U.S. fishery catch at age was compiled from the NORPAC database maintained by the North Pacific Groundfish Observer Program, and from an additional database of shore-based biological sampling maintained by the NWFSC Age and Growth Laboratory in Newport, OR. The Canadian catch at age for 1997-2004 was compiled from a database at the Pacific Biological Station. The 1980 and 1984 year classes appear as the dominant year classes in both the U.S. fishery and Canadian fishery age compositions (Figs. 5-6). The 1970 and 1977 year classes, and more recently the 1999 year class, are also evident.

Since aging Pacific hake was transferred 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 197 otoliths from the 2003 acoustic survey between the Northwest Fisheries Science Center (NWFSC) and Department of Fisheries and Oceans (DFO). Overall agreement between NWFSC/DFO was 50%, and for ages assigned that were aged within one and two years, the agreement was 86% and 96%, respectively. As would be expected, agreement between the three labs was better for younger fish than for older fish. These cross-calibration results were somewhat better than 2001 comparisons between NWFSC/DFO, but poorer than 1998 comparisons between AFSC (Alaska Fishery Science Center) and DFO. It should be noted, however, that agreement between two age readers at NWFSC was closer to 87%, with 98% agreement within one year of age. Agreement for ages 3-4 and ages 5-7 was 82% and 40%, respectively, for NWFSC between reader comparisons, with similar results for NWFSC/DFO comparisons. Also, when ages did not agree between the three labs agers at the NWFSC tended to assign older ages than DFO. Additional comparisons are needed to further calibrate ageing criteria between agencies.

Triennial Acoustic Survey (Biomass and Age Composition)

The integrated acoustic and trawl surveys, used to assess the distribution, abundance and biology of coastal Pacific hake, *Merluccius productus*, along the west coasts of the United States and Canada have been historically conducted triennially by Alaska Fisheries Science Center (AFSC) since 1977 and annually along the Canadian west coast since 1990 by Pacific Biological Station (PBS) scientists. The triennial surveys in 1995, 1998, and 2001 were carried out jointly by AFSC and DFO. Following 2001, the responsibility of the US portion of the survey was transferred to Fishery Resource Analysis and Monitoring (FRAM) Division scientists at the Northwest Fisheries Science Center (NWFSC). The joint 2003 survey was conducted by FRAM and PBS scientists, marking not only the change in the US participants but also shortens the frequency between surveys.

The 2003 survey was conducted by joint US and Canadian science teams aboard the vessel CCGS *W.E. Ricker* from 29 June to 1 September 2003, covering the length of the west coast from south of Monterey California (36.1° N) to the Dixon Entrance area (54.4° N). A total of 115 line transects, generally oriented east-west and spaced at 10 nm intervals, were completed (Fig. 7). During the 2003 acoustic survey, aggregations of hake were found along the continental shelf break from just north of San Francisco Bay (38° N) to Queen Charlotte Sound (52° N). Peak concentrations of hake were observed north of Cape Mendocino, California (ca. 43° N), in the area spanning the US-Canadian border off Cape Flattery and La Perouse Bank (ca. 48.5° N), and in Queen Charlotte Sound (ca. 51° N). Along transect 44 (42.9° N), hake were found in a continuous aggregation that extended to over 2500 meters of water and 20 nm further offshore than seen previously in this area. By contrast, no hake were found north of transect 98 in Queen Charlotte Sound (52° N). As revealed by the associated midwater and bottom trawl samples, the majority of the coastal stock is currently dominated by the 1999 year-class (age 4), with most fish at an average size of 43-44 cm in tows south of 48° N, are larger hake found further north.

Hake distribution during the 2003 acoustic survey appeared to be more representative of normal years. Aggregations of Pacific hake showed a marked contrast in 1998 and 2001 relative to the 2003 acoustic survey (Fig. 7 continued). In 1998, major aggregations were observed off Oregon between Cape Blanco and Coos Bay; near the US-Canada border, between northern Vancouver Island and southern Queen Charlotte Sound, and to lesser extent along the west side of the Queen Charlotte Islands, northern Hecate Strait, and Dixon Entrance. Hake were found as far north as 58° N. lat. in the Gulf of Alaska. There was also a large northward shift in the distribution of biomass compared to previous surveys. In contrast, most of the biomass of hake in the 2001 acoustic survey was distributed south of Newport, Oregon (Fig 7). Aggregations of hake in the 2001 acoustic survey were observed off northern California between Cape Mendocino and San Francisco Bay and off southern Oregon near Cape Blanco. The most notable differences between the 1998 and 2001 survey was the presence of hake aggregations south of Cape Blanco and the absence of hake off the Washington coast in the 2001 survey.

The 2001 and 2003 acoustic survey were similar in that 80% and 86%, respectively, of the total hake biomass occurred south of 47˚30'N (i.e., Monterey, Eureka, and Columbia INPFC areas). In contrast, only 35% of the total biomass in 1998 was observed south of 47˚30'N. The biomass in Canadian waters in 1998 was nearly triple the level reported in 1995. In 2001 and 2003, age 3+ hake biomass was split 80/20 between the U.S. and Canadian zone.

The 1998 survey results indicate a moderate decline of about 15% in hake biomass relative to the previous coastwide survey in 1995, however the 2001 acoustic survey dropped 62% relative to the 1998 survey. In contrast, the 2003 biomass estimate (1843 million mt) increased 120% over the 737,000 mt of the 2001 survey. The strong 1999 year class shown entering the population as age 4 fish in 2003 is principally responsible for the increase.

Revision of the Acoustic Survey Biomass and Age Composition

In 1996, research on hake acoustic target strength (Traynor 1996) resulted in a new target strength model of TS = 20 log L - 68. Target strength (TS) is a measure of the acoustic reflectivity of the fish and is necessary to scale measured backscattering to produce absolute estimates of abundance. Biomass estimates for the 1977-89 acoustic surveys were re-estimated using the new target strength. Relative to the more recent surveys (1992-2003) in which hake aggregations were found further offshore and in more northerly latitudes, the 1977-1989 surveys were corrected for the limited geographic coverage by calculating deep water and northern expansion factors used to adjust the total acoustic backscatter (Dorn 1996). Dorn's (1996) revised acoustic time series, which averaged 31% higher than the original time series for 1977-89, had been used in subsequent stock assessments until 2001. The 2003 assessment included a revision of deepwater and northern expansion factors (See Helser et al. 2004 for details) which were based on additional acoustic surveys not included in Dorn's analysis. In addition, the Helser et al. (2004) analysis also included adjusted age compositions that reflect changes in biomass and thus numbers at age. Comparison of acoustic survey biomass trends shown in Figure 8 illustrate the relative differences between the analyses, along with the final age compositions used in the assessment (Table 5). Despite attempts to corrected for incomplete spatial coverage of the earlier acoustic surveys, these years are still uncertain than compared to more recent surveys. As such, larger coefficient of variation s (CVs) as assigned to reflect additional levels of uncertainty in the earlier surveys and time averaged expansion factors (CV~0.5). Overall CVs, calculated by application of post survey stratification of the 2003 acoustic survey, was in the 0.35 range (Fleischer et al. 2004).

Triennial Shelf Trawl Survey (Hake distribution)

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. More over, bottom trawl used in the survey is limited in its effectiveness at catching mid-water schooling hake. In the context of this assessment we examine the spatial distribution of hake in this survey relative to that found in the acoustic survey.

The most recent survey conducted by the NWFSC was carried out from May 5 to July 28, 2004 from south of Point Conception (33° N. lat.) to the U.S./Canadian border (approx. 48°30′ N. lat.) aboard four chartered commercial trawlers (See Turk et al. 2001 for details). The vessels were equipped with the FRAM Division's standardized Aberdeen bottom trawls and net mensuration equipment. Pacific hake were caught at 353 of the 383 successfully sampled stations. Catch rates of hake were highest in the Columbia and Vancouver INPFC areas followed by Eureka (Figure 9). Catch rates over the entire survey area increased with depth.

Santa Cruz Laboratory Midwater Trawl Recruit Survey

The Santa Cruz Laboratory of the Southwest Fisheries Science Center has conducted annual surveys since 1983 to estimate the relative abundance of pelagic juvenile rockfish off central California. Although not specifically designed to sample juvenile hake, young-of-the-year juvenile hake occur frequently in the midwater trawl catches. In this assessment as in the previous 2001 assessment, the index is used as a tuning index for recruitment to age-2 and to project the relative strength of recruitment two years into the future (Table 8, fig 10). This index was obtained using from a generalized linear model (GLM) fit to the log-transformed CPUEs (Ralston et al. 1998; Sakuma and Ralston 1996). Specifically, the year effect from the GLM was back-transformed to obtain an index of abundance. Only the Monterey outside stratum was used because of its higher correlation with hake recruitment. Also, Dorn et al. (1999) showed that the juvenile index was significantly correlated to the predicted recruitment two years later in the stock assessment model. The index in 1999 suggested that age-2 recruitment in 2001 may be above average, which has largely been confirmed by other data sources such as numbers at age in the fishery catches and acoustic survey. Except for the 2001 larval index (representing age 2 recruitment in 2003) which appears to be average, the most recent 2002 and 2003 indexes are among the lowest observed since 1986. As will be discussed below, the PWCC recruit survey shows a marked contrast to the 2003 survey index. Most recently, the 2004 index, which appears to be about the same strength as 1999, also indicates the potential for a larger than average recruitment in 2006. The PWCC pre-recruit survey is also consistent with the Santa Cruz survey for 2004. The Santa Cruz series average CV, estimated from the GLM, was calculated to be approximately 0.50. Relative accuracy of the Santa Cruz and PWCC pre-recruit surveys will be evaluated following the 2005 coastwide acoustic survey.

PWCC-NMFS midwater trawl survey

The Pacific Whiting Conservation Cooperative (PWCC) and the National Marine Fisheries Service, Northwest Science Center (NWFSC) and Santa Cruz Laboratory (SCL), Southwest Fisheries Science Center has been conducting a cooperative survey of juvenile hake and rockfish relative abundance and distribution off Oregon and California since 1999. This survey is an expansion of the Santa Cruz Laboratory's juvenile survey conducted in between Monterrey Bay and Pt. Reyes, California. Prior to 2001 results between the PWCC survey and the SCL survey were not comparable because of trawl gear differences. Since 2001, the gear has been comparable and side-by-side comparisons were made between the PWCC vessel *Excalibur* and the SCL vessel *David Starr Jordan.*

The PWCC Pacific whiting prerecruit survey is conducted in May at stations across the continental shelf between Newport Oregon (44º30'N) and Point Arguello California (34º 30' N). Several stations were sampled on transects located at 30 nm intervals. Transect stations were located over waters between 50 m and approximately 1200 m depth. A total of 113 trawl samples were taken during the survey.

A modified anchovy midwater trawl with an 86' headrope and ½" codend with a 1/4" liner was used to obtain samples of juvenile hake and rockfish. Trawling was done at night with the head rope at 30 m at a speed of 2.7 kt. Some trawls were made prior to dusk to compare day/night differences in catch. Trawls sets of 15 minutes duration at target depth were conducted along transects located at 30 nm intervals along the coast (Figure 1). Stations were located along each transect from 50m bottom depth seaward to 700 m with hauls taken over bottom depths of 50, 100, 200, 300, and 500 meters at each transect.

The hake YOY were primarily distributed between 40 and 41 N. Lesser amounts of YOY hake were encountered in the Monterey Bay area relative to earlier years, and fewer hake YOY were captured at the southern extreme of the survey area. The total number of YOY hake captured in the 2003 PWCC/NMFS survey was much greater than in prior years. In 2001, 5,610 hake YOY were captured, and in 2002 a total of 6,359 were captured, while in 2003 the number increased to 42,541. The absolute variance was higher in 2003 with a high proportion of YOY hake in a few hauls; however the coefficient of variation was nearly similar between years, indicating that 2003 results were not anomalous. Abundance of YOY hake from the most recent 2004 survey indicated a 3-fold increase over 2003.

The Santa Cruz survey results indicate that 2001 hake year class is near the long-term mean of the index, but that 2002 is a relatively weak year class, and 2003 estimated abundance is the lowest observed. The PWCC index, on the other hand, indicates that the 2001 and 2002 are both near average year-classes and 2003 a strong year class. The conclusion of two near average year classes is based on a comparison of 2001 and 2002 results. In 2001, the Santa Cruz index was average and the PWCC coast wide distribution of hake YOY showed Monterrey Canyon as the center of abundance. However, in 2002, the center of abundance in the PWCC survey was further north, and proportionally less hake YOY occurred in the Monterrey Bay area.

In 2003 the difference in number of hake YOY between the PWCC and Santa Cruz surveys was more pronounced, although both surveys were relatively consistent in 2004. The PWCC survey had a nearly seven fold increase in estimated abundance over the previous two years, while the Santa Cruz survey found the lowest number in the time series. This discrepancy may in large part be due to the fact that the PWCC survey encountered numerous pre-recruit hake above 40º N latitude; above the northern-most boundary of the Santa Cruz survey.

The PWCC hake prerecruit survey results are interesting in that they show an inconsistent trend in some years than the Santa Cruz survey over the same time period. The PWCC survey indicates 2001 and 2002 abundance to be about the same magnitude and 2003 to be significantly higher. The Santa Cruz Survey, on the other hand, suggests that the 2003 index to be the least abundant year class of the series, while the index for 2004 somewhat consistent between the two surveys. However, until a longer time series is established, or a calibration can be achieved with the Santa Cruz juvenile rockfish survey it is difficult to determine what the results mean in terms of future abundance levels of the measured year class. As the year classes in question accrue to the catch the question of relative year class size will be established. The expansion of the hake recruitment index beyond the traditional NMFS Santa Cruz Lab survey area raises questions of consistency in hake larval distribution. The results of the 2003, and particularly 2004 PWCC survey suggest that transport of larvae may be spatially varying with larvae reaching the outer shelf, north of the Monterey index area in some years. However, it is possible that the larvae follow a set transport pattern, but vary temporally. If there is a temporal component there may be some evidence in larval daily growth or an environmental signal. With additional data, it may be possible to model and predict the distribution of YOY and better deploy survey effort.

Weight at age

Year-specific weights at age are used in all years for each fishery and survey and for the population because significant variation in Pacific hake weight at age has been observed (Table 9) (Dorn 1995). In particular, weight at age declined substantially during the 1980's, then remained fairly constant to 1998. Interestingly, average weights at age increased substantially in 2000 and 2001 in both the fishery and surveys, suggesting more favorable growth in recent years. Weights at age, however, have declined in both the fishery and survey in 2003. Weight at age is inversely correlated with sea-surface temperature and (to a lesser extent) adult biomass (Dorn 1992). Weight at age estimates for 1977-87 are given in Hollowed et al. (1988b). Weight-at-age vectors since 1987 were derived from the length-weight relationship for that year and unbiased length at age calculated using age length keys (Dorn 1992). In some cases, a linear interpolation of the weight at age of the strong year classes was used for the weaker year classes whose weight at age was poorly estimated or not available due to small sample sizes. This was necessary only for the older or less abundant age groups. Population weight at age, used to calculate spawning biomass, was assumed to be equal to the nearest AFSC acoustic survey weight-at-age.

Age at Maturity

Dorn and Saunders (1997) estimate female maturity at age with a logistic regression using ovary collections and visual maturity determinations by observers as

							Age							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.000	0.176	0.661	0.890	0.969	0.986	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

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 for Merluciids worldwide, 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).

Model Development

Population dynamics

The age-structured model for hake describes the relationships between population numbers by age and year. The modeled population includes individuals from age 2 to age 15, with age 15 defined as a "plus" group, i.e., all individuals age 15 and older. The model extends from 1966 to 2003. The Baranov (1918) catch equations are assumed, so that

$$c_{ijk} = N_{ij} \frac{F_{ijk}}{Z_{ij}} [1 - \exp(-Z_{ij})]$$

$$N_{i+1\ j+1} = N_{ij} \exp(-Z_{ij})$$

$$Z_{ij} = \sum_k F_{ijk} + M$$

except for the plus group, where

$$N_{i+1,15} = N_{i,14} \exp(-Z_{i,14}) + N_{i,15} \exp(-Z_{i,15})$$

where N_{ij}= population abundance at the start of year *I* for age *j* fish, F_{ijk} = fishing mortality rate in year *I* for age *j* fish in fishery *k*, and c_{ijk} = catch in year *I* for age *j* fish in fishery *k*. A constant natural mortality rate, *M*, irrespective of year and age, is assumed.

The U.S. and Canadian fisheries are modeled as distinct fisheries. Fishing mortality is modeled as a product of year-specific and age-specific factors (Doubleday 1976)

$$F_{ijk} = s_{jk} f_{ik}$$

where s_{jk} = age-specific selectivity in fishery *k*, and f_{ik} = the annual fishing mortality rate for fishery *k*. To ensure that the selectivities are well determined, we require that $\max(s_{jk}) = 1$ for each fishery. Following previous assessments, a scaled double-logistic function (Dorn and Methot 1990) was used to model age-specific selectivity

$$s_j^{/} = \left(\frac{1}{1 + \exp[-\beta_1(j - \alpha_1)]}\right)\left(1 - \frac{1}{1 + \exp[-\beta_2(j - \alpha_2)]}\right)$$

$$s_j = s_j^{/} \;/\; \max_j \,(s_j^{/})$$

where α_1 = inflection age, β_1 = slope at the inflection age for the ascending logistic part of the equation, and α_2 , β_2= the inflection age and slope for the descending logistic part. The subscript k , used to index a fishery or survey, has been suppressed in the above and subsequent equations in the interest of clarity.

Measurement error

Model parameters were estimated by maximum likelihood (Fournier and Archibald 1982, Kimura 1989, 1990, 1991). Fishery observations consist of the total annual catch in tons, C_i, and the proportions at age in the catch, p_{ij}. Predicted values from the model are obtained from

$$\hat{C}_i = \sum_j w_{ij}\, c_{ij}$$

$$\hat{p}_{ij} = c_{ij} \;/\; \sum_j c_{ij}$$

where w_{ij} is the weight at age j in year I . Year- and fishery-specific weights at age are used because of the changes in weight at age during the modeled time period.

Log-normal measurement error in total catch and multinomial sampling error in the proportions at age give a log-likelihood of

$$\log\, L_k = -\sum_i [\log(C_i) - \log(\hat{C}_i)]^2 \;/\; 2\sigma_i^2 + \sum_i m_i \sum_j p_{ij} \log(\hat{p}_{ij} \;/\; p_{ij})$$

where σ_i is standard deviation of the logarithm of total catch (~ CV of total catch) and m_i is the size of the age sample. In the multinomial part of the likelihood, the expected proportions at age have been divided by the observed proportion at age, so that a perfect fit to the data for a year gives a log likelihood value of zero (Fournier and Archibald 1982). This formulation of the likelihood allows considerable flexibility to give different weights (i.e. emphasis) to each estimate of annual catch and age composition. Expressing these weights explicitly as CVs (for the total catch estimates), and sample sizes (for the proportions at age) assists in making reasonable assumptions about appropriate weights for estimates whose variances are not routinely calculated.

Survey observations from age-structured survey (acoustic survey) consist of a total biomass estimate, B_i, and survey proportions at age π_{ij}. Predicted values from the model are obtained from

$$\hat{B}_i = q \sum_j w_{ij} \; s_j \; N_{ij} \; \exp[-\phi_i \; Z_{ij}]$$

where q= survey catchability, s_j = selectivity at age for the survey, and ϕ_i = fraction of the year to the mid-point of the survey. Survey selectivity was modeled using a double-logistic function of the same form used for fishery selectivity. The expected proportions at age in the survey in the ith year are given by

$$\hat{\pi}_{ij} = s_j \; N_{ij} \; \exp[-\phi_i \; Z_{ij}] \; / \; \sum_j s_j \; N_{ij} \; \exp[-\phi_i \; Z_{ij}]$$

Log-normal errors in total biomass and multinomial sampling error in the proportions at age give a log-likelihood for survey k of

$$\log \; L_k = -\sum_i [\log(B_i) - \log(\hat{B}_i)]^2 \; / \; 2\sigma_i^2 + \sum_i m_i \sum_j \pi_{ij} \log(\; \hat{\pi}_{ij} \; / \; \pi_{ij})$$

where σ_i is the standard deviation of the logarithm of total biomass (~ CV of the total biomass) and m_i is the size of the age sample from the survey.

For surveys that produce only an index of recruitment at age 2, R_i , predicted values from the model are

$$\hat{R}_i = q \; N_{i2}$$

Log-normal measurement error in the survey index gives a log-likelihood of

$$\log \; L_k = -\sum_i [\log(R_i) - \log(\hat{R}_i)]^2 \; / \; 2\sigma_i^2$$

where σ_i is the standard deviation of the logarithm of recruitment index. Since the recruitment surveys occur several years before recruitment at age 2, the indices need to be shifted forward the appropriate number of years.

Process error and Bayes priors

Process error refers to random changes in parameter values from one year to the next. Annual variation in recruitment and fishing mortality can be considered types of process error (Schnute and Richards 1995). In the hake model, these are estimated as free parameters, with no additional error constraints. We use a process error to describe changes in fisheries selectivity over time using a random walk (Gudmundsson 1996).

To model temporal variation in a parameter γ , the year-specific value of the parameter is given by

$$\gamma_i = \bar{\gamma} + \delta_i$$

where $\bar{\gamma}$ is the mean value (on either a log scale or linear scale), and δ_i is an annual deviation subject to the constraint $\sum \delta_i = 0$. For a random walk process error where annual *changes* are normally distributed, the log-likelihood becomes

$$\log L_{Proc.\ Err.} = -\sum \frac{(\delta_i - \delta_{i+1})^2}{2\sigma_i^2}$$

where σ_i is the standard deviation of the annual change in the parameter. We use a process error model for all four parameters of the U.S. fishery double-logistic curve. For the Canadian fishery double-logistic curve, a process error model was used only for the two parameters of the ascending part of the curves. Since the descending portion is almost asymptotic, little improvement in fit can be obtained by including process error for those parameters.

Bayesian methods offer a number of conceptual and methodological advantages in stock assessment (Punt and Hilborn 1997). We adopt an incremental approach of adding Bayes priors to what is essentially a maximum likelihood model. In non-linear optimization, the usual practice is to place upper and lower bounds on estimated parameters (a feature of both stock synthesis and AD model builder). From a Bayesian perspective, placing bounds on the possible values of a parameter corresponds to using a uniform prior for that parameter. Additional constraints are imposed on a parameter γ by adding the log likelihood for a log-normal prior,

$$\log L_{Prior} = \frac{-[\log(\gamma) - \log(\tilde{\gamma})]^2}{2\sigma^2}$$

where $\tilde{\gamma}$ is the prior mean, and σ is the standard deviation of the logarithm of the prior. In this assessment, we continue to use a prior for the slope of the ascending part of the acoustic survey double-logistic function.

The total log likelihood is the sum of the likelihood components for each fishery and survey, plus terms for process error and priors,

$$Log\ L = \sum_k Log\ L_k + \sum_p Log\ L_{Proc.\ Err.} + Log\ L_{Prior}\ .$$

Likelihood components and variance assumptions for the base-run assessment model are given in the following table:

Likelihood component	Error model	Variance assumption
U.S. fishery total catch	Log-normal	CV = 0.05
U.S. age composition	Multinomial	Sample size = 300
Canadian fishery total catch	Log-normal	CV = 0.05
Canadian fishery age composition	Multinomial	Sample size = 130
Acoustic survey biomass (q=1.0) Acoustic survey biomass (q=0.6)	Log-normal Log-normal	CV = 0.10, CV = 0.20 for 1977-89 CV = 0.30, CV = 0.50 for 1977-89
Acoustic survey age composition	Multinomial	Sample size = 60 (77-04)
Santa Cruz Laboratory larval rockfish survey	Log-normal	CV = 1.1
Fishery selectivity random walk process error	Slope: Log-normal Inflection age: Normal	CV = 0.25 SE = 1.0
Prior on acoustic survey slope	Log-normal	Prior mean = 0.9, Prior CV = 0.2

Ageing error

The model was configured to accumulate the marginal age groups at different ages to prevent obvious instances of aging error from affecting the model fit. This approach was used most frequently when a portion of an incoming strong year classes was misaged into an adjacent year class. We also used this approach to obtain reliable estimates of initial age composition. Marginal age groups were combined in the following situations:

- Accumulate the older fish at age 13 in 1973 at age 14 in 1974. Rationale: an age 12+ group is estimated for the initial age composition in 1972 (or 1966 with the 2003 basemodel).

- Accumulate the older fish in the fishery and survey data at age 7 in 1978, age 8 in 1979, age 9 in 1980, etc.. The Canadian age data was only accumulated in 1978 and 1979, but not in subsequent years. Rationale: large numbers of the strong 1970 year class were misaged into the 1971 year class starting in 1978.

- Accumulate the younger fish at age-3 fish in 1979. Rationale: The strong 1977 year class appeared as 3-year-old fish in 1979 due to a small sample size in the age-length key for that year.

- Accumulate the younger fish to age 4 in 1984 and age 5 in 1985 in the Canadian fishery age composition. Rationale: The strong 1980 year class was misaged into the 1981 year class.

- Accumulate the younger fish to age 3 in the 1986 U.S. fishery age composition. Rationale: The strong 1984 year class (2-year-old fish) was misaged into the 1983 year class (3-year-old fish).

- Accumulate the younger fish to age 5 in 1995 and age 6 in 1996 in the Canadian fishery age composition. Rationale: In the 1995 Canadian age composition, the number of 4-year-old fish was greater than the number of 5-year-old fish. In 1996, the age 5-fish were 75% as abundant as the age-6 fish in the Canadian fishery age composition, but only 35% as abundant in the U.S. fishery age composition. The 1991 year class (4-year-old fish in 1995) has been much less common in U.S. fishery samples than the 1990 year class (5-year-old fish in 1995) in each year during 1992-95. It is likely that the 4-year-old fish in the Canadian age composition data are misaged fish from the 1990 year class.

Optimization algorithm and convergence criteria

The optimizer in AD model builder is a quasi-Newton routine that uses auto-differentiation to obtain the gradient (Press et al. 1972). The model is determined to have converged when the maximum gradient component is less than a small constant (set to 1 x 10^{-4} for the hake model). Optimization occurs over a number of phases, in which progressively more parameters are estimated. Typically the initial phase consists of a catch curve analysis (Ricker 1973) to obtain rough estimates of mean recruitment and fishing mortality. The intermediary stages correspond to separable age-structured models (Deriso et al 1987), while the final stages also include the parameters for time varying selectivity. Thus the model mimics the entire historical development of quantitative stock assessment during a single estimation run. Identical parameter estimates (to 5 decimal places) were obtained when the initial values for mean recruitment and mean fishing mortality were halved and doubled (R = 0.5, 1.0, 2.0 billion, F = 0.1, 0.2, 0.4), suggesting that final parameter estimates were independent of initial values. After the model converges, the Hessian is estimated using finite differences. Standard errors are obtained using the inverse Hessian method. We also assess uncertainty using AD model builder routines for obtaining likelihood profiles and Markov chain Monte Carlo samples from the likelihood function.

Model parameters, as in the previous 2003 assessment model, can be classified as follows:

Population process modeled	Number of parameters estimated	Estimation details
Initial age structure (1966)	Age 2 recruitment dev in 1966 = 1 Age 3-12 (not estimated)	Estimated as log deviance from the log mean. Age 3-12 = ave.Re$^{-M+initF}$ (note: ave R is bias corrected).
Recruitment	Years 1967-04 = 39 (38 devs + 1 log mean)	Estimated as log deviances from the log mean
Average selectivity to fisheries and age-structured surveys	4 * (No. of fisheries + No. of surveys) = 4 * (2 + 1) = 12	Slope parameters estimated on a log scale, a prior is used for the acoustic survey ascending slope parameter.
Annual changes in fishery selectivity	4 * (No. of fisheries) * (No. of yrs -1) = 4 * 1.5 * 32(28) = 184	Estimated as deviations from mean selectivity and constrained by random walk process error

Year and age-specific selectivity for the 1994 & 1997 year class	U.S fishery: 1996 & 1997 = 2 Canadian fishery: 1999- 2002 = 4	Bounded by (0,1)
Survey catchability	No. of surveys = 2	Acoustic survey catchability not estimated, SWFSC catchabilities estimated on a log scale
Natural mortality	Age- and year-invariant = 1	Not estimated
Fishing mortality	No. of fisheries * (No. of yrs) + means = 2 * 39 + 2 = 80	Estimated as log deviances from the log mean
Total	134 conventional parameters + 190 process error parameters + 3 fixed parameters = 327	

Model Structure and Assumptions

This assessment presents only an update of the 2003 model. As such, it includes updated 2004 fishery removals, 2004 fishery weights at age and age composition data, and indices of Santa Cruz pre-recruit abundance 1986-2004 inclusive. The model structure and assumptions used are identical to that of the 2003 assessment model. The only exception was the addition of a bias correction added to average recruitment for calculation of unfished spawning biomass (Bzero). Since bias correction was applied to average recruitment for calculation of initial equilibrium conditions in 1966, we felt it should be applied to calculation of Bzero as well for consistency. This reconciled the somewhat small difference between calculation of Bzero and the initial year's calculated female spawning biomass. Comparative runs with and with out application of bias correction to the calculation of Bzero using only data from last year's assessment show only nominal differences. For instance, without bias correction: Bzero=2.7, 1966 B/Bzero=.93 and 1993B/Bzero=0.48. With bias correction: Bzero=2.6, 1966 B/Bzero=1.0 and 1993B/Bzero=0.50. As can be seen from these numbers, biomass during 1966 starts out in equilibrium with Bzero (1966B/Bzero=1.0) in comparison to 0.93 without bias correction. Moreover, application of bais correction had little impact of estimates of 2003 spawning biomass and depletion.

This assessment, as the previous assessment models, were built upon the AD model builder software and Dorn et al. (1999) confirmed consistency with the previous assessment prior to 1998 which used the stock synthesis program. Until the 2003 assessment, all past assessment results and recommendations have been based upon fixing the acoustic survey q=1.0; thus asserting that the acoustic survey estimate of biomass is an absolute measure of biomass and not just a relative measure. This was in large part based upon the best expert opinions and inability to quantitatively estimate it. This assessment, as well as the 2003 assessment, have explored relaxation of this assumption. The ability to relax the q=1.0 assumption was based upon: 1) continued lengthening of the acoustic survey time series, thus allowing the survey to be treated as an index of relative abundance in the model; 2) relatively better model fits to the data when q is less than 1.0; and 3) high quality of expertise in the 2003 STAR Panel to allow critical examination of the q=1.0 assertion. Accordingly, two models (q=0.6 and q=1.0 as specified in the 2003 assessment) are asserted as representing plausible extremes in the state of nature and therefore uncertainty in the final model result is represented by a range of biomass. The lower biomass end of the range is based upon the conventional assumption that the acoustic survey catchability coefficient, q=1.0, while the higher end of the range represents the q=0.6 assumption.

The basic model structure and assumptions, as shown in the above table, included: 1) initialization of the 1966 age composition (first year in assessment) as deviation from mean log recruitment for age 2, with numbers at ages 3-12 decayed from mean recruitment (bias corrected) as a function of M and initial F (not estimated), 2) recruitments estimated 1966-2004 as deviations from mean log recruitment, 3) acoustic survey biomass series with higher CVs during 1977-1989 to better reflect uncertainty in the earlier years, 4) an index of recruitment to age 2 based on the Santa Cruz larval rockfish survey, 1986-2004, with a CV=1.1, 5) use of time varying fishery selectivity functions modeled as a random walk process error, and 6) use of a prior on the ascending limb slope parameter of the acoustic survey selectivity. The addition of the random walk process error was to account for changes in fishery selectivity which was strongly influenced by El Niño (1983, 1992, 1997-98) driven distribution changes in the hake population as well as aperiodic strong year classes in the fishery (while not necessarily biased, this formulation may represent an over-parameterization based on a recent simulation-estimation study, See Appendix A). In addition, it was clear that the 1997 year class was unusually abundant as age-2 and age-3 fish in the 1999 and 2000 Canadian catch at age data, respectively (fig. 6). This pattern in the age composition data was unlike any other year and apparently due to the extreme northward extension of juvenile hake in 1997. Since age-specific selectivity is estimated as smooth functions over time the model was unable to accommodate this rapid shift in catch at age. Thus, we estimated year- and age-specific selectivity patterns for the 1997 year class in the 1999 - 2002 Canadian fishery. Dorn et al. (1999) provided similar model accommodation by estimating year- and age-specific selectivity parameters for the 1994 year class in the 1996 and 1997 U.S. fishery. The remaining differences between model configuration used are:

Model q=1.0: Acoustic survey is fixed at 1.0, but acoustic survey CV=0.2 (1977-1989) and CV=0.1 (1992-2003). The 1986 acoustic survey biomass omitted.

Model q=0.6: Acoustic survey is fixed at 0.6, but acoustic survey CV=0.5 (1977-1989) and CV=0.3 (1992-2003). The 1986 acoustic survey biomass omitted.

Model Results

Parameter estimates and model output for model assumption q=10 and q=0.6 are presented in a series of tables and figures. Results of both models are presented to bracket the uncertainty in model configurations, specifically related to different assumptions of acoustic survey q. Residual plots were prepared to examine the goodness of fit of the model to the age composition data. The Pearson residuals for a multinomial distribution are

$$r_i = \frac{p_i - \hat{p}_i}{\sqrt{(\hat{p}_i(1-\hat{p}_i)/m)}} ,$$

where p_i is the observed proportion at age, and m is the nominal sample size (McCullagh and Nelder 1983). Figures 11-13 show Pearson residuals of the fit to the U.S. fishery, Canadian fishery, and acoustic survey age compositions. Although there are large residuals for some ages and years, no severe pattern of residuals is evident in the fishery age composition. There is a moderate residual pattern of positive residuals for the strong year classes and negative residuals for the weak year classes, particularly for the older fish. This pattern is strongest in the Canadian fishery age composition, but is also present to some degree in the U.S. fishery age composition. A tendency for age readers to prefer the strong year classes as fish become older and more difficult to age could account for this pattern (Kimura et al. 1992).

Estimated selectivity for the U.S. and Canadian fisheries is shown in Figure 14 and Table 10. U.S. fishery selectivity was strongly dome-shaped in the early years (<1980) with ages 6-12 being fully selected by the fishery. Over time the age-specific selectivity in the U.S. fishery increased on both younger and older fish. Average selectivity in recent years (1998-2004) is 20% on age-2, 70% on age-3 and 90% on age-4 fish. Changes in Canadian fishery selectivity is equally pronounced over time and generally shows the same pattern with increasing selectivity toward younger fish. The descending limb of the Canadian fishery selectivity was time-invariant and thus selectivity on the oldest age groups remained constant through time. Both models were q=1.0 and q=0.6 show qualitatively the same fishery selectivity and hence only those patterns associated with model q=1.0 are shown.

Selectivity of the acoustic survey is given in Table 10 and shown in Figure 15. Selectivity in the acoustic survey was high on age-2 through age-4 fish relative to the fishery selectivity, but both reached maximum selectivity on ages 5-9. Acoustic survey selectivity from model q=1.0 was higher on younger ages relative to model q=0.6, and is in part due to the lower value of survey q assumed. Expected acoustic survey biomass from both models fit the observed biomass values relatively well between 1992 and 2003 (Figure 15). Relatively poorer fits were observed for the remaining acoustic survey biomasses, except for 1980 where the q=1.0 model had a slightly better fit than the q=0.6 model. This may not be unexpected since model q=0.6 had slightly larger CVs for the early survey years comparted to Model q=1.0 and thus expected values allowed to deviated from the observed values to a greater degree.

Expected acoustic survey age compositions fit the observed survey age compositions fairly well (Figure 16). More notable discrepancies between the predicted and observed age compositions appeared to occur in the 1995 and 1998 survey years, with pattern of residuals generally opposite between models q=1.0 and q=0.6.

Results of the above model runs are given in Tables 11-13 and Figure 17-18. Although not directly comparable because of different weights on the data components, Model q=0.6 fit better compared to the model q=1.0 because it assumes a lower fixed value of q (Note: equal weight with both models still results in an improvement of approximately 13 likelihood units just by assuming different q) (Table 11). Improvement in model fits appears to occur in the acoustic survey biomass and age composition data with qs less than one (Table 11). As in previous model runs, the alternative models fit poorly to the early acoustic biomass due to the large CVs on the earlier surveys (1977-1989) and also because the age composition data predict greater biomass during the mid 1980s (due to the strong 1980 and 1984 year class) than would be predicted by the trend in survey biomass. Models fits (i.e. q=0.6 or freely estimated) with lower values of q attempt to better reconcile the difference in expected biomass between the age composition data and the trend in acoustic biomass better because a q less than 1.0 would allow for biomass to be scaled higher than the observed trend. Thus, the acoustic survey biomass would be considered a relative index.

Table 12 provides estimated time series of population 3+ biomass, female spawning biomass, age-2 recruitment, and percent utilization of the total age 3+ biomass by the U.S. and Canadian fisheries for 1966-2004 for models q=1.0 and q=0.6 (see also Fig. 17). Both models show largely the same biomass and recruitment trajectories through time with the exception that model q=0.6 has absolute estimates elevated above those of model q=1.0. In the early 1970s to early 1980s biomass was relatively stable with low levels of recruitment punctuated infrequently by more moderate year classes (Fig. 17). Biomass increased substantially during the middle 1980s as the 1980 (1982 recruitment) and 1984 (1986 recruitment) year classes recruited to the population. The time series peak 1987 biomass ranges between 7 and 11 million mt for model q=1.0 and q=0.6, respectively. During this period spawning biomass briefly exceeded unfished biomass levels and as such, depletion levels at this period in time were in excess of 100% unfished (this can happen when recruitment events that are substantially above average recruit into the spawning biomass). Population biomass then declined after 1987 as the 1980 and 1984 year class were replaced by more moderate year classes and the 1980 and 1984 year classes were exploited. In more recent years (1997 -2001), biomass declined to its lowest level in the time series of 1.3 and 2.7 million mt in 2001 for models q=1.0 and q=0.6, respectively. As such, depletion levels (percent unfished) approached 25% unfished levels in 2000-2001. However, as the 1999 year class, estimated to be the fourth largest, recruited into the population biomass increase substantially since 2001. While slightly lower than 2003, spawning biomass is currently (as of 2004) estimated to be above 40% of an unfished stock; ranging between 1.6 million mt and 2.0 million mt for model q=1.0 and q=0.6, respectively.

Uncertainty and Sensitivity Analyses

Uncertainty in current stock size and other state variables were explored using a Markov Chain Monte Carlo 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. It has the advantage of producing the true marginal likelihood (ore marginal distributions) of the parameter, rather than the conditional mode, as with the likelihood profile. We ran the MCMC routine in ADMB drawing 2,500,000 samples in which the first 25% of the samples were discarded (as the burn-in) and every 1000th sample saved to reduce autocorrelation in the chain sequence. Initial MCMC runs revealed significant autocorrelation among sequential draws of the chain even after a lag of 100. Results of the MCMC simulation were evaluated for nonconvergence to the target posterior distribution. The final samples from the MCMC were used to develop the probability distributions of the target marginal posterior. MCMC diagnostic results are only shown for model q=1.0 since results were qualitatively similar for both final models.

Convergence diagnostics of selected parameters from the MCMC simulation suggests that no severe problems of non-convergence is present for the 2004 q=1.0 model (Fig. 19 and 20). Trace plots (panels A) of two selected model state variables, Bzero or unfished biomass and 2004 spawning biomass, illustrate that these variables are quite stable over the thinned chain sequence and that the percentiles (panels C) shown suggest reasonable stationarity. In addition, autocorrelations between 1000th draws of the chain sequence drop below +/- 0.10 after the first lag indicating that thinning the chain at a rate of every 1000th draw should substantially reduce between draw correlation. Kernel density plots for these variables are also shown in Figure 19 (panel D). Figure 20 provides a more thorough summary of 46 parameters (and state variables) from the MCMC simulation. Except for a few parameters with autocorrelation above 0.15, most of the 46 parameters examined achieve autocorrelations of less than 0.10 after chain sequence thinning rate of every 1000th draw. Furthermore, most of the 46 parameters examined have a Geweke statistic of less than +/- 1.96 indicating stationarity of the mean of the parameter. Finally, all 46 parameters passed the Heidelberger-Welch statistic test. If passed the retained sample is deemed to estimate the posterior mean with acceptable precision, while if failed, it 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.

Sensitivity to survey catchability assumptions

A decision analysis was conducted to evaluate the consequences of assuming a harvest rate policy associated with lower or higher acoustic survey q (assumed state on nature) when in fact the converse was true (true state on nature). This analysis defines a 2x2 matrix with two assumed states of nature (q=1.0 and q=0.6) and two true states of nature (q=1.0 and q=0.6) under both the F 40%(40-10) and F45%(40-10) harvest rate policy. It should be noted that *q*=1.0 and *q*=0.6 have slightly different specifications in terms of CVs assumed for the acoustic survey biomasses. Projected spawning biomass, depletion level (% unfished biomass), and exploitation rates in 2005-2014 were examined (Table 14). Results of this analysis suggest that more dire consequences occur when assuming harvest rate policies consistent with the *q*=0.6 model assumption when in fact the *q*=1.0 model assumption turns out to be the true state of nature (lower left diagonal of Table14), than when the converse is the case. For instance, if yields consistent with the *q*=0.6 harvest rate policy were assumed under a *q*=1.0 "true state of nature", then female spawning biomass declines to 521 million mt in 2007 with a corresponding depletion level of 20% of an unfished stock (lower left diagonal). In contrast, female spawning biomass declines to 1.1 million mt (29% unfished) when the harvest rate of *q*=0.6 is assumed and is the true state of nature. Under the more conservative scenario when harvest rates are consistent with the *q*=1.0 model assumption and the *q*=0.6 model assumption turns out to be the true state of nature (upper right diagonal of Table 14) the depletion level reaches 31% compared to 27% when the harvest policy assumed is consistent with the true state of nature. In general, these results suggest rather significant differences between which model is assumed for setting harvest rates and the resulting risks involved because survey acoustic *q* determines directly the assumed absolute level of harvest from the exploitable stock biomass.

To further evaluate uncertainty, models *q*=1.0 and *q*=0.6 were run in which acoustic survey Q was freely estimated (Note: here q is freely estimated with the only difference in models being the CVs on acoustic survey biomasses). To explore the uncertainty from these configurations acoustic survey *q* was freely estimated and then uncertainty was characterized using the samples drawn from a Markov Chain Monte Carlo simulation of the posterior distribution. Acoustic survey Q was estimated to be much lower for Final Models *q*=1.0 and *q*=0.6; *q*=0.38 and *q*=0.26, respectively, than has been assumed from past assessments. In the case of model *q*=0.6, a lower emphasis on the acoustic survey biomass for all years caused survey *q* to be lower in order to scale biomass up to a level of magnitude consistent with that predicted by the age compositions. Correspondingly when higher emphasis was placed on survey biomass (i.e. model *q*=1.0) survey *q* was estimated to be higher because greater weight was given to the model to fit the survey biomass relative to the age compositions. It should be noted that estimated biomass and recruitment translate into substantially higher biomass for models when q is assumed to be less than 1.0. (Both the STAT and STAR conceded that acoustic survey catchability substantially less than 0.6 seems unplausible).

Uncertainty in 2004 stock size and female spawning biomass

The results of the MCMC based on 2,500,000 simulations was then plotted to evaluate the uncertainty of the state variables of interest. Results show that 2004 female spawning biomass was estimated to be 1.2 million mt and 2.0 million mt for final models *q*=1.0 and *q*=0.6, respectively (Fig. 22). Based on the marginal posterior distributions 2004 female spawning biomass has greater than a 70% probability of exceeding the 40% unfished biomass level for both model alternatives (Fig. 22). Uncertainty in the 2004 depletion level was also examined. The posterior mode of the depletion level (B_{2004}/B_{zero}) was estimated to be approximately 50% of unfished biomass for both models *q*=1.0 and *q*=0.6, with less than a 5% chance of being below 40%B0 (Fig. 22).

TARGET FISHING MORTALITY RATES

To evaluate harvesting strategies and target fishing mortality rates for projections, we employed the 40-10 option that provides a more gradual response to declining stock sizes by reducing *catches* linearly, rather than fishing mortality. The 40-10 option can be expressed approximately in fishing mortality as

$$F_{ABC} = F_{40\%} \frac{B_{40\%}}{B} \left[\frac{B - B_{10\%}}{B_{40\%} - B_{10\%}} \right],$$

Dorn et al. (1999) evaluated the 40-10 option relative to the hybrid F strategy (Shuter and Koonce, 1985) that was formerly used to manage the hake stocks and found approximately the same overall reduction in harvest rates. In general, they concluded that as a control law the general form of 40-10 policy was an improvement over the hybrid F strategy. Moreover, using a Bayesian meta-analysis of Merluciid stock recruit relationships, Dorn et al. (1999) showed that F40-F45% may be appropriate proxies for F_{MSY} depending of the level of risk aversion.

The following estimates of F40% and F45% under the 40-10 option were obtained using the life history vectors in Table 15. The Canadian F multiplier is used to scale the Canadian fishing mortality so that the mean yield per recruit for the U.S. and Canadian fisheries corresponds to the historical distribution of catches (~26%). Previous work has demonstrated that overall yield per recruit is relatively insensitive to the allocation of yield within the range in dispute. Unfished spawning biomass was based on mean (bias adjusted) 1966-2004 recruitment (1.9 and 2.8 billion for models *q*=1.0 and *q*=0.6, respectively) and SPR at F=0 (1.233 kg/recruit).

Model *q*=1.0

SPR rate	U.S. Fishing mortality	Canadian F	Equilibrium harvest rate
F40%	0.225	0.122	13.0%
F45%	0.181	0.098	11.0%
Unfished female spawning biomass	2.5 million t		
B40%	1.0 million t		

Model *q*=0.6

SPR rate	U.S. Fishing mortality	Canadian F	Equilibrium harvest rate
F40%	0.217	0.118	13.1%
F45%	0.177	0.096	10.1%
Unfished female spawning biomass	3.7 million t		
B40%	1.5 million t		

HARVEST PROJECTIONS

For harvest projections, model estimates of population numbers at age in 2004 and their variance were projected forward for the years 2005-2014. Estimates of future recruitment, N_{i2}, are also needed for the projections. Survey indices of age-0 abundance in 2003 and 2004 available from the Santa Cruz Laboratory larval rockfish survey are used to represent projected recruitment in 2005 and 2006. Recruitment estimates projected in future years were modeled to account for two sources of variability: random variation in recruitment (process error), and sampling variability of the index (measurement error). For example, if recruitment itself is not highly variable, an index that shows an extremely low or high value should be shrunk towards the mean, particularly if it is known that sampling variability for that index is large. The appropriate tradeoff between these different sources of uncertainty is obtained by adding a log likelihood term for future recruitments in the final estimation phase. Assuming that both recruitment variability and sampling variability are log normal,

$$\log L_{Fut.\ Recr.} = -\frac{1}{2\sigma_r^2}\sum_i\left[\log(N_{i2}) - \overline{\log(N_2)}\right]^2 - \sum_k \frac{1}{2\sigma_k^2}\sum_i\left[\log(q_k N_{i2}) - \log(R_i)\right]^2$$

where $\overline{\log(N_2)}$ is the mean log recruitment as estimated by the base-run model, σ_r is the standard deviation of log recruitment, and σ_k is the standard deviation of the log index from survey k, which can be estimated using the prediction error of the index in the assessment model. These parameters were fixed at the values estimated by the two final model alternatives. The standard deviations for log recruitment ($Model1b{:}\sigma_r = 1.15 Model1c{:}\sigma_r = 1.23$) and the log index ($Model1b{:}\sigma_k = 1.41 Model1c{:}\sigma_k = 1.48$) of the Santa Cruz Laboratory recruitment survey were similar implying that estimates of future recruitment should be roughly an average of the log mean recruitment from the assessment model run and the Santa Cruz Laboratory survey prediction. In years when no indices are available, as in 2007-2014, the estimated log recruitment will be drawn toward the mean log recruitment from the assessment model and thus uncertainty will be equal to the process error in recruitment. As with other state variables, the uncertainty in short-term projections were evaluated using MCMC simulation. Use of MCMC for projections would be particularly appropriate since the MCMC draws from a log-normal distribution and, as such, produces biomass levels more like that generated from the arithmetic mean recruitment.

Results of projections are given in Table 16 and state variables are summarized in terms of 10%, 50% and 90% of 2,500,000 MCMC samples for each of the harvest rates policies (Also see Fig. 23-24). Under both model alternatives q=1.0 and q=0.6 (and under F40% and F45% harvest rates policies), female spawning biomass is projected to decline to within the precautionary zone of 25%-40% unfished biomass between 2006 and 2010, due to attrition of the 1999 year-class and lower than average recruitment expected from the Santa Cruz Laboratory recruit index. Both model alternatives q=1.0 and q=0.6 show essentially the same levels of projected depletion, although their actual biomass levels differ. However, the decline in spawning biomass is somewhat dependent upon the harvest policy chosen; under the F45% (40-10) option the 2006 depletion level falls to 28%B0 as compared to 27%B0 under the F40% option for the q=1.0 model (Table 16). Despite the short- term decline, spawning biomass is projected to increase slightly to between 35% and 40%B0 by 2014 depending upon the model and harvest rate policy, as the assumed low 2002 and 2003 year classes are replaced by long-term average recruitment. Information on recruitment from the NMFS-PWCC survey is not yet of sufficient duration to include in this assessment, but it suggests that the 2003 year class may not be as low as indicated by the Tiburon index.

Projected 2005 Coastwide yield varies substantially between the two model alternatives *q*=1.0 and *q*=0.6. Under model *q*=1.0, 2005 coastwide yield ranges from a low of 302,300 mt to 364,100 mt under the F45% (40-10) and F40% (40-10) harvest rate policy, respectively (Table 16, Fig. 24). Contrastingly, higher 2005 coastwide yields are estimated from model *q*=0.6 ranging from 482,800 mt to 597,600 mt under the F45% (40-10) and F40% (40-10) harvest rate policy, respectively (Table 16, Fig. 24). As with spawning biomass, coastwide yield is projected to decline in the short-term (2006-2008), but increase over the medium term (2011-2014), with higher expected gains in yield from the F45%(40-10) harvest rate policy.

ACKNOWLEDGMENTS

Stock assessments draw upon many sources. The following individuals contributed information, data, or ideas: Mark Blaisdell, Julie Pearce, Mike Guttormsen, Chris Wilson, and Mark Wilkins (NMFS, Alaska Fisheries Science Center); Steven Ralston (NMFS, Southwest Fisheries Science Center); Lara Hutton, Patrick McDonald (Oregon Department of Fish and Wildlife) Robert LeGoff (Washington Department of Fish and Wildlife); Larry Quirollo (California Department of Fish and Game); Vidar Wespestad (Pacific Whiting Conservation Cooperative); Andre Punt and Ian Stewart (University of Washington); John Wallace (NMFS; Northwest Fisheries Science Center); Robert Kronlund and Ken Cooke (DFO, Pacific Biological Station). Their assistance is gratefully acknowledged. Special thanks to Larry Hufnagle, Rebecca Thomas, Steve Deblois, and Patrick Ressler for the timely production of the 2003 acoustic survey biomass data. The STAT team also extends its thanks to the STAR panel for insightful suggestions and discussion.

LITERATURE CITED

Alheit J. and T.J. Pitcher. 1995. Hake: biology, fisheries, and markets. Chapman and Hall. London. 477 p.

Bailey, K. M., R. C. Francis, and E. R. Stevens. 1982. The life history and fishery of Pacific whiting, *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep. 23:81-98.

Baranov, F.I. 1918. On the question of the biological basis of fisheries. Nauchn. Issed. Ikhtiologicheskii Inst. Izv. 1:81-128.

Buckley, T. W. and P. A. Livingston. 1997. Geographic variation in the diet of Pacific hake, with a note on cannibalism. Calif. Coop. Oceanic Fish. Invest. Rep. 38:53-62.

Deriso, R.B., T.J. Quinn II, and P.R. Neal. 1985. Catch-age analysis with auxiliary information. Can. J. Fish. Aquat. Sci. 42: 815-824.

Dorn, M. W. 1991. Spatial and temporal patterns in the catch of Pacific whiting in the U.S. management zone during 1978-88. U.S. Dep. Commer. , NOAA Tech. Memo. NMFS-F/NWC-205, 68 p.

Dorn, M. W. 1992. Detecting environmental covariates of Pacific whiting (*Merluccius productus*) growth using a growth-increment regression model. Fish. Bull. U.S. 90: 260-275.

Dorn, M. W. 1995. The effects of age composition and oceanographic conditions on the annual migration of Pacific whiting *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep. 36:97-105

Dorn, M. W. 1996. Status of the coastal Pacific whiting resource in 1996. In Pacific Fishery Management Council, Appendix Volume I: Status of the Pacific Coast groundfish fishery through 1996 and recommended acceptable biological catches in 1997, p. A1-A77. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Dorn, M. W., and R. D. Methot. 1991. Status of the coastal Pacific whiting resource in 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-204, 97 p.

Dorn, M. W., E. P. Nunnallee, C. D. Wilson and M. E. Wilkins. 1994. Status of the coastal Pacific whiting resource in 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/AFSC-47, 101 p.

Dorn, M. W. and M. W. Saunders. 1997. Status of the coastal Pacific whiting stock in U.S. and Canada in 1997. In Pacific Fishery Management Council, Appendix: Status of the Pacific Coast groundfish fishery through 1997 and recommended acceptable biological catches in 1998: Stock assessment and fishery evaluation. Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Dorn, M. W., M. W. Saunders, C. D. Wilson, M. A. Guttormsen, K. Cooke, R. Kieser, and M. E. Wilkins. Status of the coastal Pacific hake/whiting stock in U.S. and Canada in 1998. In Pacific Fishery Management Council, Appendix: Status of the Pacific Coast groundfish fishery through 1998 and recommended acceptable biological catches in 1999: Stock assessment and fishery evaluation. Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Doubleday, W.G. 1976. A least-squares approach to analyzing catch at age data. Res. Bull. Int. Comm. Northw. Atl. Fish. 12:69-81.

Fleischer, G.W., K.D. Cooke, P.H. Ressler, R.E. Thomas, S.K. de Blois, L.C. Hufnagle, A.R. Kronlund, J.A. Holmes, and C.D. Wilson. In Review. Integrated Acoustic and Trawl Survey of Pacific Hake, Merluccius productus, in U.S. and Canadian Waters off the Pacific Coast in 2003. NOAA Technical Memorandum.

Fournier, D. and C. P. Archibald. 1982. A general theory for analyzing catch at age data. Can. J. Fish. Aquat. Sci. 39:1195-1207.

Fournier, D. 1996. An introduction to AD model builder for use in nonlinear modeling and statistics. Otter Research Ltd. PO Box 2040, Sidney, B.C. V8L 3S3 Canada.

Francis, R.C., G.L. Swartzman, W.M. Getz, R. Harr, and K. Rose. 1982. A management analysis of the Pacific whiting fishery. U.S. Dep. Commer., NWAFC Processed Report 82-06. 48 p.

Francis, R. C., and A. B. Hollowed. 1985. History and management of the coastal fishery for Pacific whiting, *Merluccius productus*. Mar. Fish. Rev. 47(2):95-98.

Gelman, A., Carlin, J.B., Stern, H.S., and Rubin, D.B. 1995. Bayesian data analysis. Chapman and Hall, New York.

Gudmundsson, G. 1994. Time series analysis of catch-at-age observations. Appl. Statist. 43:117-126.

Helser, T.E, M.W. Dorn, M.W. Saunders, and R.D. Methot. 2001. Pacific whiting assessment update for 2000. In Pacific Fishery Management Council, Status of the Pacific Coast groundfish fishery through 2001 and recommended acceptable biological catches in 2002 (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Helser, T.E, R.D. Methot, and G. W. Fleischer. 2004. Pacific whiting assessment update for 20003 In Pacific Fishery Management Council, Status of the Pacific Coast groundfish fishery through 2001 and recommended acceptable biological catches in 2002 (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Hollowed, A. B., S. A. Adlerstein, R. C. Francis, M. Saunders, N. J. Williamson, and T. A. Dark. 1988a. Status of the Pacific whiting resource in 1987 and recommendations to management in 1988. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-138, 54 p.

Hollowed, A.B., R. D. Methot, and M. W. Dorn. 1988b. Status of the Pacific whiting resource in 1988 and recommendation to management in 1989. In Pacific Fishery Management Council, Status of the Pacific Coast groundfish fishery through 1988 and recommended acceptable biological catches in 1989, p. A1-A50. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Kimura, D.K. 1989. Variability, tuning, and simulation for the Doubleday-Deriso catch-at-age model. Can. J. Fish. Aquat. Sci. 46:941-949.

Kimura, D.K. 1990. Approaches to age-structured separable sequential population analysis. Can. J. Fish. Aquat. Sci. 47:2364-2374.

Kimura, D.K. 1991. Improved methods for separable sequential population analysis. Unpublished. Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, Washington 98115.

Kimura, D.K., J.J. Lyons, S.E. MacLellan, and B.J. Goetz. 1992. Effects of year-class strength on age determination. Aust. J. Mar. Freshwater Res. 43:1221-8.

Livingston, P.A. and K. M. Bailey. 1985. Trophic role of the Pacific whiting, Merluccius productus. Mar. Fish. Rev. 47(2):16-22-34.

McCullagh, P., and J. A. Nelder. 1983. Generalized linear models. Chapman and Hall, London. 261 p.

Methot, R.D. 1989. Synthetic estimates of historical abundance and mortality for northern anchovy. In E.F. Edwards and B.A. Megrey, (eds.), Mathematical Analysis of Fish Stock Dynamics: Reviews. Evaluations, and Current Applications, p. 66-82. Am. Fish. Soc. Symp. Ser. No. 6.

Press, W.H., S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery. 1992. Numerical recipes in C. Second ed. Cambridge University Press. 994 p.

Punt, A. E. and R. Hilborn. 1997. Fisheries stock assessment and decision analysis: the Bayesian approach. Rev. Fish. Biol. Fish. 7:35-63.

Ralston, S., Pearson, D., and Reynolds, J. 1998. Status of the Chillipepper Rockfish stock in 1998. In Pacific Fishery Management Council, Appendix: Status of the Pacific Coast groundfish fishery through 1998 and recommended acceptable biological catches in 1999: Stock assessment and fishery evaluation. Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

Ricker, W. E. 1975. Computation and interpretation of biological statistic of fish populations. Bull. Fish. Res. Board. 191:382 p.

Sakuma, K. M. and S. Ralston. 1996. Vertical and horizontal distribution of juvenile Pacific whiting (*Merluccius productus*) in relation to hydrography of California. Calif. Coop. Oceanic Fish. Invest. Rep. 38:137:146.

Saunders, M.W. and G.A. McFarlane. 1997. Observation on the spawning distribution and biology of offshore Pacific hake. Calif. Coop. Oceanic Fish. Invest. Rep. 38:147:160.

Schnute J.T. and L.J. Richards. 1995. The influence of error on population estimates from catch-age models. Can. J. Fish. Aquat. Sci. 52:2063-2077.

Shuter, B. J., and J. F. Koonce. 1985. A review of methods for setting catch quotas on fish stocks. Unpubl. manuscr., 78 p. Research Section Fisheries Branch, Ontario Ministry of Natural Resources, P.O. Box 50, Maple, Ontario, L0J 1E0. (Contribution to Assessment of Stock and Prediction of Yield Workshop, Thunder Bay, Ontario, Canada, August 1985.)

Traynor, J. J. 1996. Target-strength measurements of walleye pollock (*Theragra chalcogramma*) and Pacific whiting (*Merluccius productus*). ICES Journal of Marine Science 53:253-258.

Utter, F.M. 1971. Biochemical polymorphisms in Pacific hake (*Merluccius productus*). Cons. Perm. Int. Explor. Mer Rapp. P.-V. Reun. 161:87-89.

Vrooman, A.M. and P.A. Paloma. 1977. Dwarf hake off the coast of Baja California, Mexico. Calif. Coop. Oceanic Fish. Invest. Rep. 19:67-72.

Wespestad V. G. and A. M. Shimada. 1998. Pacific Whiting Conservation Cooperative National Marine Fisheries Service 1998 Pacific whiting cooperative survey report. Pacific Whiting Conservation Cooperative, 1200 Westlake N. Suite 900, Seattle WA 98109.

Wilkins, M. E. 1998. The 1995 Pacific west coast bottom trawl survey of groundfish resources: estimates of distribution, abundance, and length and age composition. NOAA Tech. Memo. NMFS-AFSC-89.

Wilson, C. D. and M. A. Guttormsen. 1997. Echo integration-trawl survey results for Pacific whiting (*Merluccius productus*) along the Pacific coast of the US and Canada during summer, 1995. NOAA Tech. Memo. NMFS-AFSC-74.

Table 1. Annual catches of Pacific whiting (1,000 t) in U.S. and Canadian management zones by foreign, joint venture (JV), domestic at-sea, domestic shore-based, and tribal fisheries, 1966-2004.

	U.S.						Canada				U.S. and Canada
			Domestic								
Year	Foreign	JV	At-sea	Shore	Tribal	Total	Foreign	JV	Shore	Total [1]	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	90.490	251.188
1989	0.000	203.578	0.000	7.418	0.000	210.996	29.753	62.618	2.563	99.532	310.528
1990	0.000	170.972	4.713	8.115	0.000	183.800	3.814	68.313	4.022	76.680	260.480
1991	0.000	0.000	196.905	20.600	0.000	217.505	5.605	68.133	16.178	104.522	322.027
1992	0.000	0.000	152.449	56.127	0.000	208.576	0.000	68.779	20.048	86.370	294.946
1993	0.000	0.000	99.103	42.119	0.000	141.222	0.000	476.422	12.355	58.783	200.005
1994	0.000	0.000	179.073	73.656	0.000	252.729	0.000	85.162	23.782	106.172	358.901
1995	0.000	0.000	102.624	74.965	0.000	177.589	0.000	26.191	46.193	70.418	248.007
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	55.335	20.684	143.492	0.000	0.000	62.090	62.090	205.582
2004	0.000	0.000	90.258	96.229	23.997	210.484	0.000	58.892	65.345	124.237	334.721
Average 1966-2004						156.909				53.642	210.551

[1] Canadian fishery total catch revised 1996-2001.

Table 2. Harvest strategies, coastwide ABCs, quotas or havest guidelines for U.S. and Canadian zones, and Pacific whiting catches (t) in the U.S. and Canadian zone (1978-2004).

Year	Harvest strategy	Acceptable Biological Catch (t) (coastwide)	U.S. harvest guideline or quota (t)	U.S. catch (t)	% of U.S. harvest guideline utilized	Canadian scientific recommendations, low to high risk (t), (CAN) = Canadian zone only	Canadian quota (t)	Canadian catch (t)	% of Canadian quota utilized	Total Catch (t)	% of ABC harvested
1978	N/A	---	130,000	98,372	75.7	NA	NA	5,267	NA	103,639	---
1979	N/A	---	198,900	124,681	62.7	35,000 (CAN)	35,000	12,435	35.5	137,116	---
1980	N/A	---	175,000	72,353	41.3	35,000 (CAN)	35,000	17,584	50.2	89,937	---
1981	N/A	---	175,000	114,762	65.6	35,000 (CAN)	35,000	24,361	69.6	139,123	---
1982	N/A	---	175,500	75,578	43.1	35,000 (CAN)	35,000	32,157	91.9	107,735	---
1983	N/A	---	175,500	73,151	41.7	35-40,000 (CAN)	45,000	40,774	90.6	113,925	---
1984	N/A	270,000	175,500	96,381	54.9	35-40,000 (CAN)	45,000	42,109	93.6	138,490	51.3
1985	N/A	212,000	175,000	85,440	48.8	45-67,000 (CAN)	50,000	24,962	49.9	110,402	52.1
1986	N/A	405,000	295,800	154,963	52.4	75-150,000 (CAN)	75,000	55,653	74.2	210,616	52.0
1987	N/A	264,000	195,000	160,449	82.3	75-150,000 (CAN)	75,000	73,699	98.3	234,148	88.7
1988	Variable effort	327,000	232,000	160,690	69.3	98-176,000 (CAN)	98,000	90,490	92.3	251,180	76.8
1989	Variable effort	323,000	225,000	210,992	93.8	87-98,000 (CAN)	98,000	99,532	101.6	310,524	96.1
1990	Variable effort - high risk	245,000	196,000	183,800	93.8	32-70,000 (CAN)	73,500	76,680	104.3	260,480	106.3
1991	Hybrid -mod. risk	253,000	228,000	217,505	95.4	175-311,000	98,000	104,522	106.7	322,027	127.3
1992	Hybrid -mod. risk	232,000	208,800	208,576	99.9	160-288,000	90,000	86,370	96.0	294,946	127.1
1993	Hybrid -mod. risk	178,000	142,000	141,222	99.5	122-220,000	61,000	58,783	96.4	200,005	112.4
1994	Hybrid-low risk	325,000	260,000	252,729	97.2	325-555,000	110,000	106,172	96.5	358,901	110.4
1995	Hybrid-low risk	223,000	178,400	176,107	98.7	223-382,000	76,500	70,418	92.0	246,525	110.5
1996	Hybrid-low risk	265,000	212,000	212,900	100.4	161-321,000	91,000	88,240	97.0	301,140	113.6
1997	Hybrid-moderate risk	290,000	232,000	233,423	100.6	161-321,000	99,400	90,630	91.2	324,053	111.7
1998	Hybrid-moderate risk	290,000	232,000	232,509	100.2	116-233,000	80,000	86,738	108.4	319,247	110.1
1999	40-10 option-moderate risk	290,000	232,000	242,522	104.5	90,300	90,300	86,637	95.9	329,159	113.5
2000	40-10 option-moderate risk	290,000	232,000	208,418	89.8	90,300	90,300	22,257	24.6	230,675	79.5
2001	40-10 option-moderate risk	238,000	190,400	182,377	95.8	81,600	81,600	53,257	65.3	235,634	99.0
2002	40-10 option-moderate risk	208,000	129,600	129,993	100.3			50,796		180,789	86.9
2003	40-10 option-moderate risk	235,000	148,200	141,506	95.5			62,090		203,596	86.6
2004	40-10 option-moderate risk	514,441	250,000	210,500	84.2	134,475	134,475	124,237	92.4	334,737	65.1

Table 3. Length and age sample sizes for estimates of Pacific whiting age composition for U.S. surveys and fisheries. A. Triennial acoustic survey, B. U.S. shore-based fishery, C. U.S. at-sea fishery.

A. Triennial acoustic survey

Year	No. hauls	No. lengths	No. aged
1977	116	11,695	4,262
1980	72	8,296	2,952
1983	38	8,614	1,327
1986	48	12,702	2,074
1989	25	5,606	1,730
1992	62	15,852	2,184
1995	95	22,896	2,118
1998	108	33,347	2,417
2001	90	16,442	2,536
2003	106	19,357	3,007

B. U.S. shore-based fishery

Year	No. samples	No. aged
1990	15	660
1991	26	934
1992	47	1,062
1993	36	845
1994	50	1,457
1995	51	1,441
1996	34	1,123
1997	58	1,759
1998	66	2,021
1999	61	1,452
2000	75	1,314
2001	39	1,983
2002	71	1,582
2003	79	1,561
2004	72	1,440

C. U.S. at-sea fishery

Year	No. hauls	No. lengths	No. aged
1973		NA	
1974		NA	
1975		NA	
1976	279	53,429	4,077
1977	1,103	142,971	7,698
1978	832	124,771	5,839
1979	1,156	173,356	3,124
1980	682	102,248	5,336
1981	905	135,740	4,268
1982	1,145	171,816	4,258
1983	1,112	166,858	3,232
1984	1,625	243,684	3,310
1986	3,161	474,107	3,070
1987	2,876	431,454	3,175
1988	2,801	420,144	3,043
1989	2,666	368,807	3,041
1990	2,101	268,083	3,112
1991	1,022	112,477	1,335
1992	848	78,626	2,175
1993	423	33,100	1,196
1994	645	47,917	1,775
1995	434	30,285	690
1996	530	33,209	1,333
1997	632	49,592	1,147
1998	744	47,789	998
1999	284	49,246	1,047
2000	237	48,143	1,257
2001	287	48,426	1,104
2002	258	23,433	1,970
2003	264	24,420	1,770
2004	337	30,019	1,667

Estimation methods:
A. Acoustic survey. Age-length keys by geographic strata (Wilson and Guttormsen 1997)
B. U.S. shore-based fishery. Stratified random design with strata based on port groups.
C. U.S. at-sea fishery. Age-length keys by geographic strata (Dorn 1991). Number of hauls are those where length samples were taken.

Table 4. Catch at age (millions of fish) for the Pacific whiting fisheries, 1973-2004. Separate tables are given for U.S. and Canadian fisheries. The aggregate catch from all foreign, joint venture, domestic fisheries is included in these estimates.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
								U.S. fisheries								
1973	0.00	0.00	55.92	9.67	21.72	40.22	25.16	23.01	21.51	10.33	4.51	1.94	1.08	0.00	0.00	215.07
1974	29.31	1.30	0.98	150.14	20.52	35.50	44.29	25.73	11.40	3.58	1.63	0.98	0.33	0.00	0.00	325.69
1975	0.00	88.43	2.69	3.70	128.11	21.86	23.54	38.00	17.15	7.40	3.70	1.35	0.34	0.00	0.00	336.27
1976	0.00	0.33	36.85	29.29	29.62	185.27	27.65	13.82	4.93	0.99	0.33	0.00	0.00	0.00	0.00	329.09
1977	0.00	1.81	3.80	54.35	11.23	19.93	68.11	11.05	5.80	2.72	1.45	0.73	0.18	0.00	0.00	181.16
1978	0.01	0.02	4.56	8.58	51.87	9.48	20.32	38.57	5.74	2.48	1.28	0.52	0.20	0.05	0.01	143.69
1979	0.00	4.34	8.74	17.41	10.15	48.01	15.47	29.48	20.82	4.25	1.70	0.50	0.22	0.05	0.03	161.17
1980	0.00	0.13	24.67	2.16	6.90	7.16	20.11	9.57	11.99	9.92	1.74	1.35	1.01	0.59	0.14	97.44
1981	13.38	1.25	2.30	97.62	6.89	9.64	6.77	23.33	6.26	7.24	7.05	0.95	0.48	0.12	0.13	183.41
1982	0.00	27.51	1.93	1.57	57.88	5.02	5.78	5.02	11.96	2.43	2.53	4.64	0.34	0.13	0.03	126.77
1983	0.00	0.00	86.60	7.22	3.63	36.79	4.68	3.72	3.32	5.24	1.62	1.00	1.00	0.16	0.14	155.12
1984	0.00	0.00	2.59	164.97	7.18	5.18	17.54	2.17	1.24	0.82	1.34	0.21	0.20	0.31	0.03	203.78
1985	2.27	0.55	1.32	12.36	113.50	9.74	4.30	6.75	0.61	0.34	0.24	0.36	0.00	0.00	0.00	152.34
1986	0.00	62.92	12.88	1.85	9.34	171.79	21.55	10.76	12.45	1.53	1.05	0.38	0.79	0.15	0.05	307.49
1987	0.00	0.00	124.20	6.58	1.68	2.72	151.56	7.89	3.09	14.87	0.57	0.15	0.15	1.25	0.00	314.71
1988	0.00	1.22	1.31	172.76	8.02	1.40	2.60	96.93	5.16	0.72	8.32	0.15	0.24	0.00	0.65	299.48
1989	0.00	8.65	9.57	3.88	257.20	7.80	2.46	2.74	106.63	6.62	0.87	5.37	0.03	0.12	0.57	412.51
1990	0.00	5.69	85.34	10.97	1.92	152.02	2.56	1.14	0.71	95.97	0.47	0.00	6.07	0.00	0.41	363.27
1991	0.00	0.95	43.96	98.32	19.35	6.00	151.49	6.63	1.31	0.93	60.10	2.11	0.00	9.74	0.65	401.54
1992	0.97	18.53	9.94	51.95	109.58	10.27	5.09	131.94	4.84	2.38	0.79	42.06	0.63	0.20	1.88	391.05
1993	0.00	1.90	70.49	9.07	42.90	59.65	3.75	3.06	81.86	1.81	0.43	0.20	20.95	0.12	2.47	298.66
1994	0.00	0.23	16.48	121.89	4.82	76.93	104.64	3.29	2.04	115.38	0.46	2.06	0.22	29.13	3.65	476.31
1995	0.20	1.02	0.41	19.96	114.38	3.32	27.40	66.22	3.09	0.53	58.19	1.09	0.91	0.10	18.55	315.36
1996	0.00	102.26	71.90	6.75	34.60	97.87	1.81	17.17	46.84	0.90	0.17	50.38	0.00	0.49	14.81	445.94
1997	0.00	2.00	173.73	163.98	3.01	27.17	48.41	3.05	10.71	18.59	0.39	0.77	17.33	0.47	8.38	477.97
1998	0.00	26.97	117.63	103.21	133.25	16.56	20.27	41.66	4.83	2.35	17.29	1.52	0.48	11.85	3.32	501.20
1999	0.00	47.58	112.329	100.72	91.74	54.50	16.20	19.69	19.86	3.94	6.16	9.99	1.34	1.68	9.92	495.66
2000	2.13	15.24	34.58	50.95	46.19	62.31	40.85	21.48	13.48	7.83	6.52	6.74	2.83	2.72	7.44	321.30
2001	0.00	52.82	59.10	40.31	59.74	29.69	25.99	15.21	3.99	4.54	3.64	2.31	1.80	1.55	2.86	303.57
2002	0.00	0.00	156.354	36.31	15.63	12.58	8.08	6.75	5.32	1.26	1.16	1.36	0.50	0.32	1.04	246.68
2003	0.03	1.40	9.57	198.18	30.70	6.74	8.30	7.00	4.18	2.86	1.42	0.59	0.88	0.31	0.62	272.78
2004	0.03	1.71	33.32	39.09	272.09	21.39	5.85	12.72	5.38	1.91	1.83	1.26	0.63	0.18	0.94	398.33

Table 4. Continued. Canadian catch at age.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
							Canadian fisheries									
1977	0.00	0.01	0.01	0.25	0.09	0.30	1.83	0.53	0.50	0.42	0.40	0.35	0.16	0.00	0.00	4.85
1978	0.00	0.00	0.00	0.20	0.35	0.28	1.06	1.31	1.12	0.62	0.48	0.21	0.18	0.09	0.00	5.90
1979	0.00	0.00	0.00	0.21	0.62	1.30	1.14	2.10	3.02	1.10	0.79	0.37	0.25	0.17	0.12	11.19
1980	0.00	0.00	0.00	0.00	0.47	0.62	2.46	0.92	1.18	6.74	1.27	0.62	0.62	0.20	0.00	15.10
1981	0.00	0.00	0.00	1.01	0.27	1.41	1.38	4.28	0.85	2.36	6.18	1.49	0.60	0.85	0.00	20.68
1982	0.00	0.00	0.00	0.69	13.35	1.10	1.44	1.41	4.41	1.00	0.78	6.04	0.59	0.47	0.00	31.28
1983	0.00	0.06	14.02	1.03	1.80	32.15	1.29	1.87	1.67	5.59	0.77	0.26	3.41	0.26	0.13	64.31
1984	0.00	0.00	1.11	13.27	1.73	9.26	20.86	2.04	2.35	1.54	4.81	0.93	0.80	2.65	0.37	61.72
1985	0.00	0.06	0.06	2.45	8.03	1.65	3.25	9.62	0.49	0.55	0.55	1.65	0.37	0.00	1.59	30.32
1986	0.00	0.14	0.14	0.28	3.97	38.41	2.41	2.41	11.48	1.28	0.57	0.99	1.42	0.43	1.42	65.35
1987	0.00	0.00	0.90	0.60	0.15	2.56	70.71	2.86	2.86	10.38	0.60	0.45	1.20	0.90	1.20	95.37
1988	0.00	0.00	0.31	15.28	0.62	1.13	2.36	66.66	2.26	1.44	7.90	0.51	0.21	0.21	0.62	99.51
1989	0.00	0.00	0.20	0.59	35.55	0.20	0.39	0.59	69.34	1.76	1.37	8.59	0.39	0.20	1.17	120.34
1990	0.00	0.00	2.80	2.08	0.21	48.67	0.73	0.21	0.00	27.50	0.42	0.00	1.25	1.04	2.08	86.99
1991	0.00	0.00	0.11	6.11	2.46	0.43	70.60	0.54	0.00	0.21	47.47	0.21	0.11	2.25	0.11	130.61
1992	0.00	0.00	0.67	7.63	17.81	3.55	0.40	56.83	0.27	0.00	0.13	30.79	0.07	0.13	1.21	119.49
1993	0.00	0.07	0.77	2.52	12.91	17.54	1.89	0.21	40.62	0.21	0.14	0.14	12.49	0.21	0.21	89.93
1994	0.00	0.00	0.70	2.87	3.07	15.20	26.86	4.20	0.80	67.45	0.87	0.27	0.13	22.73	1.33	146.48
1995	4.88	0.04	0.53	6.31	5.03	3.21	10.72	15.96	3.25	0.67	33.81	0.68	0.04	0.15	9.41	94.70
1996	0.00	12.46	2.89	1.44	12.03	16.06	4.31	14.28	17.05	2.84	1.10	34.27	0.06	0.00	10.01	128.80
1997	0.00	0.81	22.17	19.19	2.52	17.21	16.22	2.25	11.08	14.42	3.24	0.54	18.65	1.35	4.06	133.73
1998	0.14	0.14	9.15	39.39	38.25	3.56	13.74	14.27	1.64	7.74	7.17	0.99	0.67	5.50	1.91	144.26
1999	1.45	26.28	9.65	18.35	40.74	25.71	1.94	8.39	8.47	2.65	3.66	4.26	0.56	0.19	4.05	156.36
2000	0.00	0.11	9.45	1.96	2.38	7.03	4.16	0.53	1.94	1.07	0.34	0.79	0.49	0.25	0.79	31.28
2001	0.00	0.04	0.86	12.32	3.24	5.06	14.31	7.54	1.70	2.37	2.72	0.95	1.69	1.41	1.61	55.81
2002	0.00	0.00	0.55	4.24	14.59	4.85	5.37	10.57	5.81	0.85	1.15	1.53	0.20	0.59	1.68	51.98
2003	0.00	0.00	0.54	28.66	16.21	6.24	10.16	5.88	6.52	4.63	1.60	0.65	0.96	0.24	0.53	82.81
2004	0.00	0.08	3.89	3.80	116.69	24.77	7.36	12.77	7.19	5.33	4.14	1.10	0.68	0.68	0.51	188.98

Table 5. AFSC 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 $50^{o}30'$ 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 no age one fish were captured in survey trawls.

	Total biomass at 20 log l - 68 (1,000 t)	Number at age (million)														
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1977	1596.422	0.22	135.48	121.24	718.01	63.29	87.41	745.78	106.23	78.20	40.90	39.47	21.80	8.49	2.18	2.25
1980	1701.482	0.00	14.45	1641.32	151.15	91.20	70.79	326.83	110.38	248.08	97.65	60.94	9.71	16.66	3.71	2.89
1983	1364.656	0.00	1.23	2918.17	50.86	20.64	304.29	31.84	34.78	26.00	51.01	12.46	13.39	14.84	2.69	0.00
1986	2397.386	0.00	3610.65	91.38	17.56	112.09	1701.85	179.58	131.65	181.21	21.62	21.03	1.47	10.37	2.35	0.00
1989	1805.603	0.00	571.25	200.82	39.29	1864.35	38.91	15.27	24.54	626.89	30.64	2.77	53.71	0.00	0.00	2.00
1992	1417.327	190.54	227.03	45.97	235.77	502.09	57.21	19.85	994.22	28.52	16.85	6.93	323.37	17.19	0.00	14.81
1995	1385.205	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	1185.932	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	737.743	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	1842.627	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

Estimates of numbers at age based on year-specific deep-water and northern expansion factors applied to 1977-1992.

	Total biomass at 20 log l - 68 (1,000 t)	Number at age (million)														
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1977	1915.01	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	2115.09	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	1646.68	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	2857.06	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	1237.69	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	2169.20	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	1385.00	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	1185.00	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	737.00	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	1840.00	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

Table 6. AFSC trawl survey estimates of Pacific whiting biomass (1,000 t) and age composition (million). The biomass estimates for 1977 and 1986, when the trawl survey did not extend into the Canadian zone, were adjusted as described in Dorn et al. (1991). In 1995, 53,730 t of age-1 fish is not included in the biomass estimate. In 1998, 20,658 t of age-1 fish is not included in the biomass estimate. Age composition data for 2001 should be considered preliminary. AFSC acoustic survey age-length key was applied to trawl survey length compositions to derive numbers and biomass at age.

	Area-swept biomass estimate (1,000 t)	Number at age (million)														
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1977	76.307	0.57	7.96	4.05	16.87	3.28	7.46	33.45	7.70	6.11	3.96	2.21	1.14	0.41	0.02	0.08
1980	188.299	0.30	1.80	234.42	6.91	12.53	11.37	22.31	14.32	16.93	11.96	4.63	2.28	1.20	0.99	1.43
1983	128.808	0.11	0.27	201.77	7.40	1.43	34.06	8.53	6.63	8.57	10.71	4.36	3.16	2.20	0.24	0.43
1986	254.566	0.00	203.50	8.95	2.81	1.33	202.20	10.37	5.21	59.96	2.23	2.20	0.55	8.88	0.20	0.69
1989	379.810	114.10	44.57	14.09	11.93	172.32	10.24	15.84	4.97	270.64	9.69	1.43	36.48	0.14	0.33	2.65
1992	352.538	56.14	47.95	5.72	28.12	78.63	9.10	3.32	202.78	3.60	3.25	2.61	74.35	3.43	0.00	4.85
1995	529.527	592.70	171.38	22.12	20.88	97.14	6.48	49.25	233.89	0.00	0.00	181.53	0.00	4.61	0.00	142.41
1998	476.459	212.14	442.40	285.14	132.36	151.01	12.48	34.31	72.23	12.36	7.24	46.03	0.68	4.55	33.74	14.03
2001	379.276	36.74	398.62	93.26	50.07	78.97	45.24	55.03	27.47	11.10	12.92	6.52	4.31	4.46	1.30	0.86
2003	Not Available															

Table 7. DFO acoustic survey estimates of Pacific whiting biomass (1,000 t) and age composition (proportion in numbers) in the Canadian zone. The biomass and age composition in 1995 are from the U.S.-Canadian joint survey of the Canadian zone, and is reported in Wilson and Guttormsen (1997).

Year	Total biomass at -35 dB/kg (1,000 t)	Number at age (million)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1990	317.338	0.00	0.00	37.40	10.33	0.98	287.37	2.95	0.00	0.00	145.16	1.97	0.00	3.94	0.00	0.98
1991	563.308	0.00	0.00	2.96	54.46	10.69	1.48	448.06	1.48	0.00	1.48	346.79	3.49	1.48	23.97	0.00
1992	1101.328	0.00	0.00	8.58	88.95	214.54	54.69	1.04	840.57	3.24	0.00	0.00	351.39	0.52	4.29	7.77
1993	638.906	0.00	0.35	12.34	14.79	97.23	154.49	24.32	9.55	421.22	4.03	1.86	2.49	173.32	1.44	7.66
1994	224.907	0.00	1.44	5.96	7.87	8.34	36.86	53.37	10.35	2.33	138.50	1.08	0.00	0.00	37.16	0.74
1995	374.400	112.05	0.00	0.00	1.49	71.19	7.40	29.33	144.78	2.84	0.00	181.00	0.00	10.15	0.00	38.41
1996	447.410	1.18	77.89	21.83	7.08	79.07	61.96	29.51	57.83	92.06	18.88	8.26	175.26	17.11	3.54	41.31
1997	649.793	0.00	1.30	179.48	143.06	15.61	120.95	115.75	13.01	72.83	94.94	10.40	5.20	146.97	1.30	24.71

Table 8. Tiburon Midwater trawl laval rockfish survey estimates of log whiting abundance (Sakuma and Ralston 1997).

		All Strata		Monterey outside stratum only	
Year class	Year of recruitment	log(numbers)	SE	log(numbers)	SE
1986	1988	1.679	0.192	3.131	0.501
1987	1989	3.129	0.172	6.258	0.481
1988	1990	3.058	0.161	4.921	0.468
1989	1991	0.979	0.170	2.008	0.481
1990	1992	1.323	0.173	3.553	0.481
1991	1993	2.134	0.167	3.769	0.481
1992	1994	0.583	0.166	2.507	0.501
1993	1995	3.095	0.173	7.048	0.481
1994	1996	2.152	0.177	3.470	0.481
1995	1997	0.768	0.173	1.940	0.481
1996	1998	1.968	0.174	4.594	0.501
1997	1999	1.487	0.197	3.034	0.532
1998	2000	0.602	0.177	1.557	0.501
1999	2001	-	-	4.589	0.481
2000	2002	-	-	2.584	0.501
2001	2003	-	-	3.415	0.481
2002	2004	-	-	2.089	0.520
2003	2005	-	-	0.508	0.481
2004	2006	-	-	4.547	0.481

Table 9. Weight at age (kg) used in the stock assessment model.

U.S. fishery weight at age [1]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1966-78	0.119	0.264	0.407	0.514	0.610	0.656	0.696	0.743	0.812	0.880	0.956	0.993	1.065	1.093	1.125
1979	0.143	0.264	0.456	0.570	0.667	0.734	0.793	0.831	0.905	0.944	1.016	1.088	1.156	1.071	1.208
1980	0.141	0.298	0.470	0.559	0.646	0.722	0.790	0.825	0.867	0.899	0.995	1.046	1.050	1.040	1.159
1981	0.137	0.286	0.429	0.547	0.632	0.697	0.760	0.809	0.858	0.888	0.934	1.000	1.055	1.075	1.176
1982	0.143	0.253	0.396	0.509	0.605	0.669	0.730	0.788	0.856	0.877	0.901	0.976	1.053	1.061	1.016
1983	0.150	0.253	0.328	0.447	0.525	0.589	0.637	0.680	0.721	0.791	0.806	0.850	0.878	1.005	0.999
1984	0.187	0.293	0.387	0.434	0.550	0.607	0.658	0.712	0.753	0.798	0.863	0.906	0.934	0.952	1.113
1985	0.213	0.321	0.412	0.491	0.545	0.619	0.679	0.796	0.777	0.831	0.920	0.961	1.023	1.004	1.111
1986	0.192	0.294	0.386	0.464	0.518	0.538	0.617	0.663	0.735	0.755	0.816	0.877	0.919	0.928	1.094
1987	0.187	0.297	0.394	0.460	0.517	0.546	0.563	0.627	0.681	0.720	0.748	0.834	0.856	0.893	0.975
1988	0.197	0.303	0.395	0.466	0.520	0.570	0.572	0.596	0.641	0.702	0.733	0.803	0.874	0.886	0.955
1989	0.192	0.232	0.320	0.402	0.454	0.502	0.538	0.565	0.577	0.584	0.668	0.752	0.826	0.900	0.854
1990	0.195	0.248	0.364	0.418	0.515	0.522	0.553	0.559	0.542	0.589	0.616	0.759	0.707	0.779	0.851
1991	0.195	0.291	0.374	0.461	0.505	0.527	0.576	0.629	0.604	0.566	0.641	0.601	0.802	0.866	0.887
1992	0.216	0.275	0.367	0.472	0.513	0.554	0.579	0.581	0.600	0.581	0.600	0.617	0.763	0.521	0.797
1993	0.196	0.283	0.348	0.402	0.468	0.511	0.509	0.524	0.557	0.556	0.569	0.603	0.587	0.636	0.615
1994	0.196	0.236	0.357	0.428	0.458	0.518	0.562	0.613	0.563	0.612	0.566	0.638	0.765	0.656	0.645
1995	0.120	0.277	0.468	0.488	0.493	0.514	0.591	0.590	0.601	0.619	0.636	0.617	0.651	0.655	0.669
1996	0.120	0.278	0.378	0.451	0.519	0.547	0.568	0.574	0.599	0.583	0.760	0.629	0.625	0.647	0.630
1997	0.097	0.340	0.421	0.471	0.536	0.532	0.572	0.584	0.603	0.625	0.746	0.657	0.684	0.623	0.716
1998	0.204	0.238	0.364	0.452	0.490	0.506	0.535	0.549	0.560	0.780	0.620	0.719	0.630	0.689	0.687
1999	-	0.244	0.338	0.414	0.505	0.527	0.548	0.572	0.638	0.582	0.722	0.698	0.846	0.750	0.780
2000	0.184	0.401	0.478	0.556	0.630	0.687	0.707	0.730	0.810	0.782	0.825	0.770	0.883	0.818	0.906
2001	-	0.319	0.485	0.591	0.632	0.681	0.740	0.749	0.767	0.826	0.780	0.823	0.838	0.801	0.825
2002	-	0.435	0.443	0.547	0.679	0.684	0.743	0.847	0.810	0.756	0.876	0.813	0.821	0.929	0.925
2003	0.429	0.420	0.472	0.500	0.539	0.585	0.609	0.620	0.641	0.664	0.669	0.697	0.674	0.685	0.760
2004	0.385	0.419	0.448	0.491	0.525	0.585	0.639	0.633	0.657	0.702	0.677	0.692	0.712	0.808	0.985

[1] U.S. Fishery mean weights age age revised 1998-2001.

Canadian fishery weight at age [2]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1972-76	0.135	0.370	0.606	0.742	0.827	0.861	0.905	0.987	1.221	1.111	1.163	1.206	1.222	1.213	1.247
1977	0.143	0.355	0.570	0.744	0.824	0.871	0.875	0.957	1.020	1.104	1.164	1.222	1.240	1.207	1.273
1978	0.133	0.313	0.502	0.658	0.783	0.818	0.825	0.858	0.922	0.992	1.072	1.153	1.171	1.132	1.205
1979	0.141	0.332	0.532	0.701	0.830	0.916	0.935	0.969	0.989	1.046	1.137	1.175	1.266	1.237	1.299
1980	0.140	0.319	0.496	0.655	0.780	0.869	0.979	0.955	0.970	1.037	1.073	1.180	1.229	1.225	1.301
1981	0.136	0.309	0.479	0.660	0.741	0.829	0.891	0.985	0.961	0.977	1.137	1.096	1.172	1.204	1.272
1982	0.126	0.288	0.449	0.584	0.674	0.779	0.842	0.902	0.904	0.959	0.987	1.028	1.097	1.127	1.269
1983	0.120	0.264	0.399	0.515	0.607	0.630	0.730	0.785	0.824	0.789	0.890	0.926	0.883	0.960	1.091
1984	0.137	0.296	0.439	0.557	0.643	0.710	0.723	0.816	0.856	0.896	0.911	0.975	0.987	0.957	1.076
1985	0.142	0.311	0.465	0.584	0.712	0.740	0.792	0.871	0.889	0.931	0.978	1.048	1.037	1.012	1.067
1986	0.125	0.281	0.431	0.548	0.633	0.659	0.742	0.795	0.888	0.880	0.932	0.986	1.143	0.988	1.048
1987	0.149	0.314	0.457	0.566	0.643	0.692	0.706	0.768	0.801	0.827	0.877	0.919	0.943	0.940	0.978
1988	0.120	0.315	0.655	0.608	0.754	0.652	0.767	0.801	0.909	1.066	1.054	0.766	1.159	1.111	1.305
1989	0.192	0.315	0.521	0.666	0.657	0.690	0.924	0.807	0.806	1.071	0.950	1.049	0.779	0.852	1.515
1990	0.195	0.315	0.567	0.603	0.598	0.659	0.709	0.660	0.753	0.745	0.738	0.805	0.938	0.852	1.225
1991	0.195	0.315	0.521	0.629	0.751	0.777	0.712	0.891	0.753	0.782	0.758	0.794	0.779	0.957	0.923
1992	0.216	0.315	0.550	0.561	0.633	0.684	0.689	0.713	0.710	0.782	0.722	0.754	0.779	0.890	0.958
1993	0.196	0.315	0.440	0.515	0.530	0.558	0.588	0.567	0.600	0.589	0.834	0.805	0.619	0.852	0.923
1994	0.196	0.315	0.557	0.594	0.648	0.692	0.714	0.745	0.719	0.772	0.720	0.788	0.779	0.792	0.921
1995	0.120	0.315	0.668	0.652	0.663	0.728	0.741	0.766	0.800	0.909	0.805	0.757	0.779	0.852	0.847
1996	0.120	0.329	0.481	0.568	0.628	0.632	0.671	0.676	0.693	0.762	0.676	0.739	0.779	0.852	0.786
1997	0.120	0.496	0.536	0.574	0.658	0.700	0.687	0.717	0.739	0.746	0.754	0.811	0.782	0.836	0.819
1998	-	0.351	0.448	0.570	0.580	0.607	0.676	0.667	0.669	0.699	0.717	0.756	0.809	0.794	0.775
1999	-	0.284	0.413	0.494	0.620	0.616	0.645	0.715	0.713	0.729	0.778	0.810	0.779	0.850	0.802
2000	-	0.528	0.524	0.604	0.695	0.782	0.764	0.831	0.851	0.837	0.811	0.931	0.882	0.892	0.951
2001	-	0.315	0.766	0.812	0.842	0.909	1.020	1.016	1.047	1.099	1.102	1.120	1.053	1.045	1.150
2002	-	0.315	0.697	0.897	0.980	0.953	1.058	1.113	1.091	1.119	1.124	1.104	1.367	1.149	1.192
2003	-	0.400	0.606	0.656	0.709	0.848	0.785	0.813	0.898	0.84	0.9	0.982	0.845	0.899	1.134
2004	-	0.253	0.467	0.571	0.619	0.662	0.789	0.764	0.783	0.833	0.813	0.795	0.816	0.965	0.958

Table 9. Weight at age (kg) used in the stock assessment model (cont).

	AFSC acoustic survey weight at age [1]														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1977	0.123	0.256	0.388	0.492	0.589	0.662	0.724	0.796	0.860	0.892	0.949	1.008	1.057	1.093	1.119
1980	0.107	0.261	0.455	0.561	0.672	0.759	0.861	0.894	0.948	1.003	1.081	1.122	1.170	1.176	1.205
1983	0.122	0.228	0.308	0.457	0.570	0.667	0.723	0.776	0.826	0.891	0.917	0.935	0.985	1.034	1.032
1986	0.165	0.262	0.367	0.465	0.532	0.558	0.658	0.715	0.815	0.823	0.865	0.908	1.006	0.995	1.069
1989	0.143	0.321	0.387	0.461	0.521	0.561	0.599	0.621	0.634	0.638	0.682	0.729	0.870	0.984	1.069
1992	0.119	0.205	0.357	0.508	0.554	0.578	0.654	0.642	0.688	0.655	0.758	0.705	0.697	0.734	0.800
1995	0.097	0.220	0.344	0.438	0.548	0.605	0.639	0.624	0.630	0.682	0.717	0.701	0.727	0.752	0.728
1998	0.081	0.189	0.343	0.527	0.534	0.587	0.658	0.631	0.645	0.766	0.709	0.830	0.735	0.744	0.790
2001	-	0.250	0.419	0.505	0.617	0.708	0.795	0.845	0.894	1.211	1.038	1.101	0.941	0.875	1.056
2003	0.139	0.264	0.411	0.515	0.544	0.716	0.687	0.728	0.788	0.754	0.769	0.820	0.780	0.815	0.841
	AFSC bottom trawl survey weight at age														
1977	0.123	0.256	0.388	0.492	0.589	0.662	0.724	0.796	0.860	0.892	0.949	1.008	1.057	1.093	1.119
1980	0.107	0.261	0.455	0.561	0.672	0.759	0.861	0.894	0.948	1.003	1.081	1.122	1.170	1.176	1.205
1983	0.122	0.228	0.308	0.457	0.570	0.667	0.723	0.776	0.826	0.891	0.917	0.935	0.985	1.034	1.032
1986	0.165	0.262	0.367	0.465	0.532	0.558	0.658	0.715	0.815	0.823	0.865	0.908	1.006	0.995	1.069
1989	0.143	0.321	0.387	0.461	0.521	0.561	0.599	0.621	0.634	0.638	0.682	0.729	0.870	0.984	1.069
1992	0.119	0.205	0.357	0.508	0.554	0.578	0.654	0.642	0.688	0.655	0.758	0.705	0.697	0.734	0.800
1995	0.091	0.204	0.279	0.408	0.476	0.530	0.609	0.659	0.682	0.704	0.727	0.730	0.733	0.706	0.679
1998	0.097	0.189	0.339	0.480	0.502	0.532	0.534	0.575	0.583	0.655	0.669	0.639	0.762	0.670	0.710
2001	-	0.189	0.339	0.480	0.502	0.532	0.534	0.575	0.583	0.655	0.669	0.639	0.762	0.670	0.710
	DFO acoustic survey weight at age														
1990	0.119	0.205	0.533	0.575	0.592	0.647	0.623	0.646	0.646	0.669	0.656	0.957	0.957	0.957	0.957
1991	0.119	0.205	0.533	0.560	0.592	0.641	0.615	0.633	0.633	0.650	0.656	0.657	0.657	0.657	0.657
1992	0.119	0.205	0.629	0.600	0.653	0.685	0.686	0.705	0.657	0.698	0.698	0.739	0.744	0.744	0.810
1993	0.196	0.283	0.541	0.595	0.624	0.641	0.688	0.718	0.704	0.827	0.847	0.624	0.741	0.685	0.995
1994	0.196	0.567	0.585	0.614	0.654	0.694	0.720	0.782	0.775	0.761	1.083	0.935	0.935	0.787	0.810
1995	0.098	0.235	0.371	0.508	0.642	0.778	0.739	0.740	0.691	0.739	0.787	0.769	0.752	0.771	0.790
1996	0.330	0.403	0.482	0.582	0.655	0.650	0.665	0.693	0.686	0.688	0.684	0.705	0.779	0.798	0.671
1997	0.330	0.488	0.572	0.598	0.673	0.710	0.722	0.731	0.746	0.785	0.749	0.713	0.761	0.689	0.742
	Population weight at age														
1972-78	0.123	0.256	0.388	0.492	0.589	0.662	0.724	0.796	0.860	0.892	0.949	1.008	1.057	1.093	1.119
1979-81	0.107	0.261	0.455	0.561	0.672	0.759	0.861	0.894	0.948	1.003	1.081	1.122	1.170	1.176	1.205
1982-84	0.122	0.228	0.308	0.457	0.570	0.667	0.723	0.776	0.826	0.891	0.917	0.935	0.985	1.034	1.032
1985-87	0.165	0.262	0.367	0.465	0.532	0.558	0.658	0.715	0.815	0.823	0.865	0.908	1.006	0.995	1.069
1988-90	0.143	0.321	0.387	0.461	0.521	0.561	0.599	0.621	0.634	0.638	0.682	0.729	0.870	0.984	1.069
1991-93	0.119	0.205	0.357	0.508	0.554	0.578	0.654	0.642	0.688	0.655	0.758	0.705	0.697	0.734	0.800
1994-96	0.097	0.220	0.344	0.438	0.548	0.605	0.639	0.624	0.630	0.682	0.717	0.701	0.727	0.752	0.728
1997-99	0.081	0.189	0.343	0.527	0.534	0.587	0.658	0.631	0.645	0.766	0.709	0.830	0.735	0.744	0.790
1999-01	-	0.250	0.419	0.505	0.617	0.708	0.795	0.845	0.894	1.211	1.038	1.101	0.941	0.875	1.056
2002-04	0.139	0.264	0.411	0.515	0.544	0.716	0.687	0.728	0.788	0.754	0.769	0.820	0.780	0.815	0.841
	Female multiplier for spawning biomass														
All yrs.	0.511	0.510	0.511	0.510	0.512	0.522	0.525	0.535	0.543	0.547	0.569	0.568	0.572	0.581	0.589

[1] Mean weights at age from 2001 acoustic survey revised.

Table 10. Selectivity at age for Pacific whiting fisheries and surveys for final models 1b and 1c (See text for description). The fisheries and surveys were modeled using double logistic selectivity functions, with random walk process error for the U.S. and Canadian fisheries. The fishery selectivity coefficients reported below are the average of the annual selectivity coefficients for all years (1966-2004), and for the last ten years (1995-2004) under acoustic survey assumption *q* =1.0 and *q* =0.6.

Age	U.S. fishery, all years		U.S. fishery, 1995-04		Canadian fishery, all years		Canadian fishery, 1995-04		Acoustic survey (all years)	
Model	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*
2	0.100	0.104	0.127	0.134	0.016	0.018	0.042	0.047	0.320	0.414
3	0.405	0.437	0.506	0.549	0.062	0.075	0.162	0.204	0.518	0.661
4	0.765	0.805	0.866	0.902	0.140	0.169	0.256	0.332	0.728	0.860
5	0.937	0.963	0.985	1.000	0.359	0.421	0.538	0.674	0.893	0.966
6	0.986	0.996	1.000	0.999	0.629	0.690	0.721	0.833	0.982	1.000
7	0.990	0.983	0.999	0.975	0.855	0.891	0.906	0.962	1.000	0.989
8	0.963	0.935	0.992	0.931	0.957	0.972	0.976	0.994	0.961	0.947
9	0.900	0.845	0.977	0.860	0.991	0.997	0.996	1.000	0.876	0.876
10	0.792	0.705	0.948	0.752	1.000	1.000	1.000	0.997	0.755	0.776
11	0.629	0.517	0.889	0.610	0.996	0.985	0.995	0.980	0.611	0.653
12	0.441	0.325	0.776	0.451	0.963	0.920	0.961	0.915	0.463	0.517
13	0.275	0.185	0.572	0.305	0.815	0.719	0.813	0.715	0.330	0.384
14	0.145	0.104	0.316	0.193	0.449	0.376	0.448	0.374	0.224	0.270
15	0.066	0.058	0.141	0.116	0.132	0.126	0.132	0.125	0.146	0.180

Table 11. Configuration, error assumptions and output (likelihoods and derived parameters) from various final model alternatives explored in the 2004 Pacific hake assessment. See text for description of model configurations.

	Model			
Parameters	Q=1.0	Q=0.6	Free Q	Free Q
q	1.000	0.600	0.370	0.276
Sigmas				
Acoustic: 77-89	0.20	0.50	0.20	0.50
Acoustic: 92-03	0.10	0.30	0.10	0.30
Tiburon	1.10	1.10	1.10	1.10
US Fishery effective sample	300	300	300	300
Canada Fishery effective sample	130	130	130	130
Acoustic survey effective sample	60	60	60	60
Likelihoods				
US Fishery: catch	-0.10	-0.01	-0.04	0.00
US Fishery:age	-252.19	-249.84	-247.56	-247.62
Canadian Fishery: catch	-0.02	0.00	0.00	0.00
Canadian Fishery: age	-171.49	-162.07	-165.16	-161.06
Acoustic survey biomass	-32.47	-6.36	-33.94	-5.71
Acoustic survey age	-39.28	-31.58	-33.16	-29.95
Tiburon survey index	-8.95	-9.49	-9.50	-10.11
Acoustic survey slope	-0.39	-0.01	-0.09	0.00
Recruits	-19.44	-20.59	-18.76	-19.67
Random walk	-32.54	-32.24	-32.38	-32.55
Forecast	-2.09	-2.16	-2.15	-2.15
Total likelihood	-558.95	-514.34	-542.73	-508.83
Derived Parameters				
B0 (millions mt)	2.69	3.50	4.07	6.03
Spawning Biomass 2004 (millions mt)	1.26	1.92	3.07	4.25
Ratio	46.7%	54.9%	75.4%	70.5%
US Fishery 2005 catch (X1000 mt)	258.9	406.7	610.2	858.8
US Fishery 2005 F	0.20	0.21	0.21	0.22
Canada Fishery 2005 catch (X 1000 mt)	91.5	143.8	215.8	303.6
Canada Fishery 2005 F	0.08	0.07	0.06	0.06
Total Catch 2005 (X 1000 mt)	350.4	550.5	826.0	1162.4

Table 12. Time series of estimated biomass, recruitment, and utilization for 1966-2004 for models *q* =1.0 and *q* =0.6 (See text for description). U.S. and Canadian exploitation rate is the catch in biomass divided by the total biomass of age 3+ fish at the start of the year. Population biomass is in millions of tons of age-3 and older fish at the start of the year. Recruitment is given in billions of age-2 fish.

Year	Population biomass (million t)		Female spawning biomass		Recruits (billion)		U.S. exploitation rate		Canada exploitation rate		Total exploitation rate		Depletion	
Model	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*	*q=1.0*	*q=0.6*
1966	4.813	7.008	2.489	3.643	2.502	4.495	2.8%	2.2%	0.0%	0.0%	2.9%	2.2%	99.2%	99.8%
1967	4.875	7.423	2.482	3.751	2.276	4.040	3.6%	2.8%	0.8%	0.6%	4.4%	3.3%	98.9%	102.8%
1968	4.817	7.648	2.449	3.856	2.264	4.018	1.3%	0.9%	1.3%	1.0%	2.5%	1.9%	97.6%	105.7%
1969	4.868	7.961	2.484	4.034	2.736	4.865	1.8%	1.3%	1.9%	1.4%	3.7%	2.7%	99.0%	110.5%
1970	5.010	8.448	2.502	4.188	1.567	2.717	3.2%	2.3%	1.5%	1.1%	4.7%	3.4%	99.7%	114.7%
1971	4.736	8.186	2.405	4.139	1.239	2.068	2.7%	2.0%	0.6%	0.4%	3.3%	2.4%	95.8%	113.4%
1972	4.429	7.758	2.407	4.196	6.593	10.849	1.7%	1.2%	1.0%	0.7%	2.7%	1.9%	95.9%	115.0%
1973	5.815	10.056	2.706	4.707	0.782	1.294	2.5%	1.8%	0.3%	0.2%	2.8%	2.0%	107.8%	129.0%
1974	5.385	9.390	2.703	4.726	0.712	1.139	3.6%	2.6%	0.3%	0.2%	3.9%	2.8%	107.7%	129.5%
1975	4.829	8.524	2.538	4.485	2.237	3.582	4.3%	3.1%	0.3%	0.2%	4.6%	3.3%	101.1%	122.9%
1976	4.687	8.317	2.375	4.238	0.488	0.801	4.9%	3.6%	0.1%	0.1%	5.1%	3.6%	94.6%	116.1%
1977	4.031	7.292	2.108	3.828	0.517	0.856	3.2%	2.2%	0.1%	0.1%	3.3%	2.3%	84.0%	104.9%
1978	3.545	6.480	1.880	3.450	0.302	0.505	2.8%	2.0%	0.1%	0.1%	2.9%	2.1%	74.9%	94.5%
1979	3.408	6.292	1.918	3.534	4.026	6.670	3.7%	2.6%	0.4%	0.3%	4.0%	2.8%	76.4%	96.8%
1980	4.226	7.630	2.018	3.691	0.554	0.901	1.7%	1.2%	0.4%	0.3%	2.1%	1.5%	80.4%	101.1%
1981	3.862	6.976	1.982	3.609	0.823	1.299	3.0%	2.1%	0.6%	0.4%	3.6%	2.6%	79.0%	98.9%
1982	2.973	5.395	1.855	3.298	15.484	23.597	2.5%	1.8%	1.1%	0.8%	3.6%	2.6%	73.9%	90.4%
1983	6.357	10.481	2.657	4.486	0.461	0.683	1.2%	0.8%	0.6%	0.5%	1.8%	1.3%	105.9%	122.9%
1984	6.655	10.865	3.198	5.276	0.145	0.211	1.4%	1.1%	0.6%	0.5%	2.1%	1.5%	127.4%	144.5%
1985	5.819	9.521	2.977	4.900	0.329	0.462	1.5%	1.1%	0.4%	0.3%	1.9%	1.4%	118.6%	134.3%
1986	4.914	8.078	2.812	4.576	10.485	14.176	3.2%	2.3%	1.1%	0.8%	4.3%	3.2%	112.0%	125.4%
1987	7.272	11.154	3.278	5.149	0.173	0.226	2.2%	1.7%	1.0%	0.8%	3.2%	2.4%	130.6%	141.1%
1988	6.041	9.229	3.018	4.665	0.463	0.586	2.7%	2.0%	1.5%	1.1%	4.2%	3.1%	120.2%	127.8%
1989	5.106	7.836	2.724	4.191	3.053	3.754	4.1%	3.1%	1.9%	1.5%	6.1%	4.6%	108.5%	114.8%
1990	4.940	7.435	2.481	3.794	1.420	1.683	3.7%	2.8%	1.6%	1.2%	5.3%	4.0%	98.8%	103.9%
1991	4.691	6.965	2.382	3.598	0.282	0.329	4.6%	3.5%	2.2%	1.7%	6.9%	5.2%	94.9%	98.6%
1992	3.656	5.478	1.948	2.945	2.018	2.352	5.7%	4.2%	2.4%	1.8%	8.1%	6.0%	77.6%	80.7%
1993	3.348	4.939	1.698	2.559	0.770	0.921	4.2%	3.1%	1.8%	1.3%	6.0%	4.5%	67.7%	70.1%
1994	2.846	4.198	1.467	2.204	0.328	0.390	8.9%	6.6%	3.7%	2.8%	12.6%	9.4%	58.4%	60.4%
1995	2.178	3.302	1.182	1.813	1.709	2.032	8.2%	5.9%	3.2%	2.3%	11.4%	8.2%	47.1%	49.7%
1996	2.060	3.056	1.050	1.595	1.718	2.046	10.3%	7.5%	4.5%	3.3%	14.9%	10.8%	41.8%	43.7%
1997	2.109	3.086	1.029	1.553	0.903	1.128	11.1%	8.1%	4.4%	3.2%	15.4%	11.2%	41.0%	42.6%
1998	1.813	2.695	0.904	1.379	0.850	1.104	12.8%	9.2%	4.8%	3.5%	17.7%	12.6%	36.0%	37.8%
1999	1.495	2.315	0.747	1.185	0.550	0.739	15.0%	10.3%	5.8%	4.0%	20.9%	14.3%	29.8%	32.5%
2000	1.371	2.243	0.705	1.174	0.933	1.366	15.2%	9.9%	1.6%	1.1%	16.8%	11.0%	28.1%	32.2%
2001	1.272	2.151	0.729	1.226	5.336	7.605	14.3%	9.1%	4.2%	2.7%	18.5%	11.8%	29.0%	33.6%
2002	2.819	4.474	1.149	1.889	0.530	0.721	4.7%	3.1%	1.8%	1.2%	6.5%	4.4%	45.8%	51.8%
2003	2.710	4.297	1.289	2.074	0.718	0.890	5.3%	3.5%	2.3%	1.5%	7.6%	5.1%	51.3%	56.8%
2004	2.535	4.024	1.248	2.015	0.344	0.507	8.3%	5.5%	4.9%	3.2%	13.2%	8.7%	49.7%	55.2%
Avg. 1966-04	4.059	6.631	2.051	3.375	2.016	3.016	5.1%	3.6%	1.7%	1.2%	6.8%	4.8%	81.7%	92.5%

Table 13. Numbers at age (billions of fish) for the coastal stock of Pacific whiting estimated by the base-run model, 1966-2004.

	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1966	2.54	1.54	1.23	0.97	0.77	0.61	0.49	0.39	0.31	0.24	0.19	0.15	0.12	0.42
1967	2.30	2.01	1.21	0.95	0.74	0.58	0.46	0.37	0.29	0.23	0.19	0.15	0.12	0.43
1968	2.29	1.82	1.57	0.93	0.71	0.55	0.43	0.34	0.27	0.21	0.17	0.14	0.12	0.44
1969	2.76	1.82	1.44	1.23	0.72	0.55	0.42	0.32	0.26	0.20	0.16	0.13	0.11	0.44
1970	1.58	2.19	1.43	1.12	0.94	0.54	0.41	0.31	0.24	0.19	0.15	0.12	0.10	0.43
1971	1.25	1.25	1.72	1.10	0.84	0.70	0.40	0.30	0.22	0.18	0.14	0.12	0.10	0.42
1972	6.63	0.99	0.98	1.33	0.84	0.63	0.52	0.30	0.22	0.17	0.13	0.11	0.09	0.41
1973	0.79	5.26	0.78	0.77	1.03	0.64	0.48	0.40	0.23	0.17	0.13	0.10	0.09	0.40
1974	0.72	0.62	4.13	0.60	0.58	0.77	0.48	0.36	0.30	0.17	0.13	0.10	0.08	0.38
1975	2.25	0.57	0.49	3.14	0.45	0.43	0.57	0.36	0.27	0.23	0.13	0.10	0.08	0.37
1976	0.49	1.71	0.43	0.37	2.36	0.34	0.32	0.43	0.27	0.21	0.18	0.10	0.08	0.36
1977	0.52	0.39	1.32	0.31	0.26	1.69	0.24	0.24	0.33	0.21	0.16	0.14	0.08	0.35
1978	0.30	0.41	0.30	1.00	0.23	0.20	1.27	0.18	0.19	0.26	0.17	0.13	0.11	0.34
1979	4.05	0.24	0.32	0.23	0.75	0.17	0.15	0.96	0.14	0.15	0.21	0.13	0.10	0.36
1980	0.56	3.21	0.19	0.24	0.17	0.55	0.13	0.11	0.72	0.11	0.11	0.16	0.10	0.37
1981	0.83	0.44	2.53	0.15	0.18	0.13	0.41	0.10	0.08	0.55	0.08	0.09	0.13	0.37
1982	15.59	0.66	0.35	1.92	0.11	0.14	0.09	0.30	0.07	0.06	0.42	0.07	0.07	0.40
1983	0.46	12.37	0.52	0.27	1.46	0.08	0.10	0.07	0.22	0.05	0.05	0.32	0.05	0.37
1984	0.15	0.37	9.74	0.40	0.21	1.10	0.06	0.08	0.05	0.17	0.04	0.04	0.25	0.33
1985	0.33	0.12	0.29	7.58	0.31	0.16	0.84	0.05	0.06	0.04	0.13	0.03	0.03	0.46
1986	10.54	0.26	0.09	0.23	5.91	0.24	0.12	0.64	0.04	0.04	0.03	0.10	0.02	0.38
1987	0.17	8.31	0.20	0.07	0.17	4.48	0.18	0.09	0.48	0.03	0.03	0.02	0.08	0.32
1988	0.46	0.14	6.49	0.15	0.05	0.13	3.35	0.13	0.07	0.36	0.02	0.03	0.02	0.32
1989	3.06	0.37	0.11	4.98	0.12	0.04	0.10	2.51	0.10	0.05	0.27	0.02	0.02	0.26
1990	1.42	2.42	0.28	0.08	3.69	0.09	0.03	0.07	1.83	0.07	0.04	0.21	0.01	0.22
1991	0.28	1.12	1.85	0.21	0.06	2.73	0.06	0.02	0.05	1.36	0.06	0.03	0.16	0.19
1992	2.02	0.22	0.85	1.37	0.16	0.04	1.97	0.05	0.02	0.04	0.99	0.04	0.02	0.26
1993	0.77	1.59	0.17	0.62	0.98	0.11	0.03	1.39	0.03	0.01	0.03	0.72	0.03	0.22
1994	0.33	0.61	1.20	0.12	0.45	0.70	0.08	0.02	1.00	0.02	0.01	0.02	0.54	0.20
1995	1.70	0.26	0.47	0.84	0.08	0.29	0.45	0.05	0.01	0.64	0.02	0.01	0.01	0.55
1996	1.72	1.35	0.20	0.35	0.57	0.05	0.19	0.29	0.03	0.01	0.42	0.01	0.00	0.42
1997	0.90	1.27	1.01	0.14	0.23	0.36	0.03	0.12	0.18	0.02	0.01	0.27	0.01	0.32
1998	0.84	0.71	0.85	0.66	0.09	0.14	0.22	0.02	0.07	0.11	0.01	0.00	0.18	0.25
1999	0.55	0.64	0.46	0.52	0.39	0.05	0.08	0.13	0.01	0.04	0.07	0.01	0.00	0.32
2000	0.94	0.39	0.40	0.27	0.29	0.22	0.03	0.05	0.07	0.01	0.02	0.04	0.00	0.24
2001	5.31	0.74	0.27	0.25	0.17	0.18	0.13	0.02	0.03	0.04	0.00	0.01	0.02	0.19
2002	0.53	4.17	0.53	0.16	0.16	0.10	0.10	0.07	0.01	0.02	0.02	0.00	0.01	0.16
2003	0.76	0.42	3.17	0.38	0.11	0.11	0.07	0.07	0.05	0.01	0.01	0.02	0.00	0.13
2004	0.60	0.60	0.32	2.31	0.27	0.07	0.07	0.04	0.04	0.03	0.00	0.01	0.01	0.10

Table 14. Decision table evaluating the consequences of assuming a harvest rate policy associated with lower or higher acoustic survey Q (assumed state on nature) when in fact the converse was true (true state on nature). This analysis defines a 2x2 matrix with two assumed states of nature (*q*=1.0 and *q*=0.6, respectively) and two true states of nature (*q*=1.0 and *q*=0.6) under both the F40%(40-10) and F45%(40-10) harvest rate policies. Projected spawning biomass (millions mt), depletion level (% unfished biomass), and exploitation rates in 2005-2014 are given.

			True State of Nature					
Assumed State of Nature			***q = 1.0***			***q = 0.6***		
	Year	**OY Assumed**	**Spawning Biomass**	**Percent Unfished**	**Exploitation Rate**	**Spawning Biomass**	**Percent Unfished**	**Exploitation Rate**
q = 1.0								
	2005	364,197	0.997	0.383	0.185	1.673	0.414	0.113
	2006	258,507	0.696	0.268	0.198	1.268	0.314	0.113
	2007	248,323	0.707	0.272	0.164	1.382	0.343	0.092
	2008	278,576	0.779	0.300	0.166	1.557	0.386	0.087
F40% (40-10)	**2009**	321,665	0.838	0.322	0.173	1.621	0.402	0.096
	2010	353,427	0.921	0.354	0.177	1.824	0.452	0.096
	2011	371,392	0.936	0.360	0.179	1.833	0.454	0.099
	2012	369,845	0.934	0.359	0.183	1.800	0.446	0.101
	2013	363,418	0.909	0.350	0.185	1.824	0.452	0.099
	2014	365,660	0.919	0.353	0.182	1.862	0.461	0.097
q = 0.6								
	2005	597,625	0.997	0.383	0.306	1.673	0.414	0.113
	2006	422,115	0.578	0.222	0.413	1.185	0.298	0.195
	2007	382,138	0.521	0.200	0.361	1.140	0.286	0.159
	2008	408,865	0.550	0.212	0.350	1.192	0.300	0.163
F40% (40-10)	**2009**	450,905	0.594	0.229	0.350	1.225	0.308	0.171
	2010	489,969	0.641	0.246	0.367	1.330	0.334	0.172
	2011	515,007	0.639	0.246	0.364	1.334	0.335	0.174
	2012	530,105	0.623	0.240	0.385	1.370	0.344	0.179
	2013	540,436	0.577	0.222	0.433	1.377	0.346	0.184
	2014	564,831	0.562	0.216	0.445	1.430	0.359	0.179

Table 14. Continued……

Assumed State of Nature	Year	OY Assumed	True State of Nature q = 1.0 Spawning Biomass	Percent Unfished	Exploitation Rate	q = 0.6 Spawning Biomass	Percent Unfished	Exploitation Rate
q = 1.0								
	2005	302,305	0.997	0.383	0.154	1.673	0.414	0.094
	2006	230,359	0.729	0.280	0.168	1.300	0.322	0.098
	2007	225,028	0.753	0.289	0.141	1.428	0.354	0.081
	2008	251,998	0.831	0.319	0.141	1.609	0.399	0.077
F45% (40-10)	**2009**	290,260	0.896	0.345	0.146	1.675	0.415	0.084
	2010	318,141	0.997	0.383	0.149	1.896	0.470	0.084
	2011	336,497	1.020	0.392	0.152	1.909	0.473	0.086
	2012	338,863	1.022	0.393	0.154	1.881	0.466	0.089
	2013	336,312	1.008	0.388	0.156	1.910	0.473	0.088
	2014	338,300	1.018	0.391	0.155	1.955	0.485	0.086
q = 0.6								
	2005	482,899	0.997	0.383	0.247	1.673	0.414	0.149
	2006	370,917	0.637	0.245	0.327	1.207	0.299	0.167
	2007	366,140	0.601	0.231	0.301	1.245	0.309	0.139
	2008	410,192	0.625	0.240	0.312	1.365	0.338	0.138
F45% (40-10)	**2009**	453,579	0.655	0.252	0.322	1.409	0.349	0.148
	2010	479,357	0.697	0.268	0.334	1.523	0.377	0.149
	2011	488,955	0.689	0.265	0.324	1.519	0.376	0.151
	2012	479,261	0.677	0.260	0.326	1.461	0.362	0.154
	2013	472,026	0.648	0.249	0.340	1.440	0.357	0.154
	2014	474,799	0.656	0.252	0.342	1.463	0.363	0.152

Table 15. Life history and fishery vectors used to estimate spawning biomass per recruit (SPR) fishing mortalities.

Age	Natural mortality	U.S. fishery selectivity (Avg. 1995-2004)		Canadian fishery selectivity (Avg 1995-2004)		U.S. fishery weight at age (kg) (Avg. 1978-2004)	Canadian fishery weight at age (kg) (Avg. 1976-2004)	Population weight at age (kg) (Avg. 1977-2004)	Proportion of mature females	Multiplier for female weight at age
		q =1.0	*q* =0.6	*q* =1.0	*q* =0.6					
2	0.23	0.1300	0.1361	0.042	0.040	0.299	0.334	0.300	0.176	0.510
3	0.23	0.5154	0.5389	0.162	0.173	0.403	0.530	0.430	0.661	0.511
4	0.23	0.8744	0.8858	0.256	0.289	0.482	0.627	0.552	0.890	0.510
5	0.23	0.9890	0.9998	0.538	0.610	0.548	0.702	0.655	0.969	0.512
6	0.23	1.0000	1.0000	0.721	0.812	0.590	0.749	0.843	0.986	0.522
7	0.23	0.9985	0.9810	0.906	0.959	0.632	0.789	0.716	0.996	0.525
8	0.23	0.9939	0.9486	0.976	0.995	0.666	0.826	0.834	1.000	0.535
9	0.23	0.9838	0.8965	0.996	1.000	0.694	0.858	0.965	1.000	0.543
10	0.23	0.9620	0.8151	1.000	0.994	0.722	0.894	0.753	1.000	0.547
11	0.23	0.9138	0.6933	0.995	0.969	0.765	0.919	1.042	1.000	0.569
12	0.23	0.8080	0.5269	0.961	0.881	0.793	0.954	1.076	1.000	0.568
13	0.23	0.6007	0.3424	0.813	0.650	0.840	0.970	0.833	1.000	0.572
14	0.23	0.3330	0.1933	0.448	0.322	0.843	0.985	0.827	1.000	0.581
15+	0.23	0.1479	0.1020	0.132	0.108	0.906	1.086	1.255	1.000	0.589

Table 16. Projections of Pacific hake biomass, yield and depletion rates for 2005-2014 under different harvest rate policies from final models *q* =1.0 and *q* =0.6. Shown are Bayesian credibility intervals (10%, 50%, and 90%) generated from 2,500,000 MCMC samples.

Model *q* =1.0

		3+ Bioimass (millions mt)			SpawningBioimass (million mt)			Age-2 Recruits (billion)			Depletion Rate			Coastwide yield (t)		
	Year	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%
	2005	1.638	1.952	2.338	0.842	0.997	1.184	0.092	0.259	0.736	0.324	0.383	0.455	294,258	364,197	438,815
	2006	1.042	1.252	1.554	0.577	0.696	0.850	0.477	1.448	4.631	0.222	0.268	0.327	192,114	258,507	345,172
	2007	1.051	1.418	2.484	0.542	0.707	1.064	0.285	1.134	4.000	0.208	0.272	0.409	159,956	248,323	425,987
F40% (40-10)	2008	0.993	1.619	3.019	0.535	0.779	1.335	0.249	1.114	4.731	0.206	0.300	0.513	150,452	278,576	529,730
Harvest Policy	2009	1.061	1.742	3.558	0.539	0.838	1.578	0.232	0.954	3.906	0.207	0.322	0.607	154,230	321,665	641,017
	2010	1.103	1.860	3.829	0.598	0.921	1.723	0.336	1.087	4.593	0.230	0.354	0.663	180,131	353,427	682,167
	2011	1.211	1.949	3.867	0.606	0.936	1.798	0.292	0.931	3.717	0.233	0.360	0.691	190,821	371,392	713,404
	2012	1.155	1.944	3.675	0.589	0.934	1.736	0.303	1.035	3.853	0.227	0.359	0.667	190,315	369,845	705,711
	2013	1.177	1.877	3.727	0.612	0.909	1.704	0.240	0.989	4.313	0.235	0.350	0.655	200,654	363,418	689,173
	2014	1.171	1.864	3.948	0.607	0.919	1.818	0.197	1.099	4.732	0.234	0.353	0.699	194,951	365,660	725,154
	2005	1.638	1.952	2.338	0.842	0.997	1.184	0.092	0.259	0.736	0.324	0.383	0.455	244,229	302,305	363,377
	2006	1.093	1.315	1.629	0.605	0.729	0.887	0.477	1.448	4.631	0.233	0.280	0.341	172,562	230,359	304,634
	2007	1.125	1.505	2.574	0.580	0.753	1.119	0.285	1.134	4.000	0.223	0.289	0.430	149,984	225,028	368,429
	2008	1.080	1.723	3.154	0.580	0.831	1.408	0.249	1.114	4.731	0.223	0.319	0.541	142,603	251,998	457,461
F45% (40-10)	2009	1.138	1.853	3.724	0.577	0.896	1.676	0.232	0.954	3.906	0.222	0.345	0.645	145,064	290,260	560,357
Harvest Policy	2010	1.193	2.003	4.044	0.643	0.997	1.853	0.336	1.087	4.593	0.247	0.383	0.713	166,897	318,141	604,656
	2011	1.309	2.115	4.157	0.658	1.020	1.942	0.292	0.931	3.717	0.253	0.392	0.747	179,031	336,497	639,758
	2012	1.265	2.123	3.991	0.644	1.022	1.900	0.303	1.035	3.853	0.248	0.393	0.730	179,943	338,863	639,545
	2013	1.289	2.062	4.048	0.674	1.008	1.869	0.240	0.989	4.313	0.259	0.388	0.719	189,901	336,312	632,219
	2014	1.303	2.065	4.256	0.673	1.018	1.965	0.197	1.099	4.732	0.259	0.391	0.756	190,028	338,300	650,107

Model *q* =0.6

		3+ Bioimass (million mt)			SpawningBioimass (million mt)			Age-2 Recruits (billion)			Depletion Rate			Coastwide yield (t)		
	Year	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%
	2005	2.445	3.356	4.323	1.287	1.673	2.151	0.106	0.349	1.034	0.320	0.437	0.562	418,345	597,625	791,728
	2006	1.587	2.123	2.771	0.900	1.185	1.500	0.661	2.054	6.483	0.226	0.298	0.377	278,998	422,115	590,706
	2007	1.640	2.240	3.652	0.861	1.140	1.662	0.342	1.428	6.156	0.216	0.286	0.418	242,757	382,138	640,772
F40% (40-10)	2008	1.588	2.399	4.580	0.840	1.192	2.063	0.340	1.537	6.902	0.211	0.300	0.519	218,160	408,865	794,166
Harvest Policy	2009	1.520	2.520	5.330	0.772	1.225	2.318	0.324	1.267	6.336	0.194	0.308	0.583	202,578	450,905	939,578
	2010	1.561	2.706	5.810	0.841	1.330	2.663	0.436	1.553	6.743	0.211	0.334	0.669	225,978	489,969	1,057,915
	2011	1.597	2.752	6.115	0.819	1.334	2.819	0.409	1.414	5.790	0.206	0.335	0.709	228,525	515,007	1,126,446
	2012	1.604	2.802	5.895	0.816	1.370	2.729	0.419	1.405	5.540	0.205	0.344	0.686	230,474	530,105	1,110,600
	2013	1.599	2.796	5.710	0.827	1.377	2.697	0.387	1.612	7.898	0.208	0.346	0.678	241,298	540,436	1,102,727
	2014	1.671	2.902	6.391	0.845	1.430	2.843	0.318	1.473	5.701	0.212	0.359	0.715	248,666	564,831	1,139,945
	2005	2.472	3.232	4.165	1.287	1.673	2.151	0.122	0.340	1.015	0.319	0.414	0.533	355,660	482,899	632,026
	2006	1.664	2.169	2.781	0.935	1.207	1.530	0.694	2.135	7.248	0.232	0.299	0.379	253,660	370,917	507,664
	2007	1.730	2.398	4.040	0.911	1.245	1.802	0.408	1.733	7.614	0.226	0.309	0.447	218,786	366,140	581,201
	2008	1.675	2.801	5.184	0.896	1.365	2.292	0.408	1.562	7.092	0.222	0.338	0.568	210,534	410,192	737,894
F45% (40-10)	2009	1.707	2.896	5.674	0.886	1.409	2.563	0.334	1.330	5.102	0.219	0.349	0.635	218,179	453,579	860,214
Harvest Policy	2010	1.845	3.102	5.859	0.979	1.523	2.686	0.367	1.335	7.304	0.243	0.377	0.665	246,014	479,357	888,422
	2011	1.850	3.129	6.044	0.950	1.519	2.758	0.415	1.407	4.989	0.235	0.376	0.683	241,460	488,955	917,727
	2012	1.814	2.972	5.839	0.928	1.461	2.756	0.375	1.408	4.984	0.230	0.362	0.683	236,900	479,261	916,826
	2013	1.800	2.937	5.725	0.932	1.440	2.730	0.340	1.539	6.115	0.231	0.357	0.676	237,814	472,026	941,087
	2014	1.790	2.976	5.865	0.916	1.463	2.735	0.311	1.378	5.373	0.227	0.363	0.678	236,545	474,799	922,979

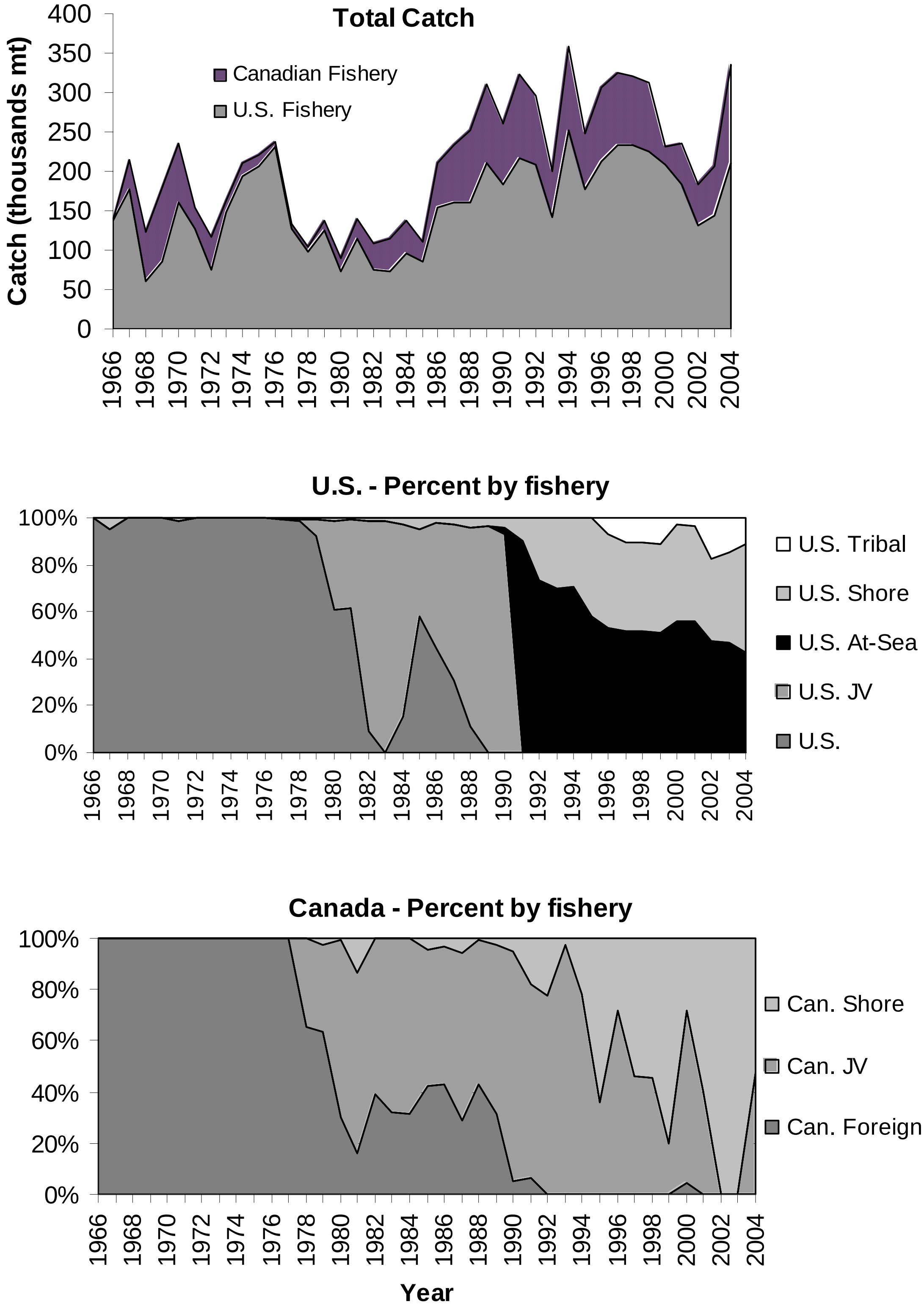


Figure 1. Total catch of Pacific hake in the U.S. and Canadian zones (1966-2004) (upper panel). Percent catch by fishery within each zone (lower panels).

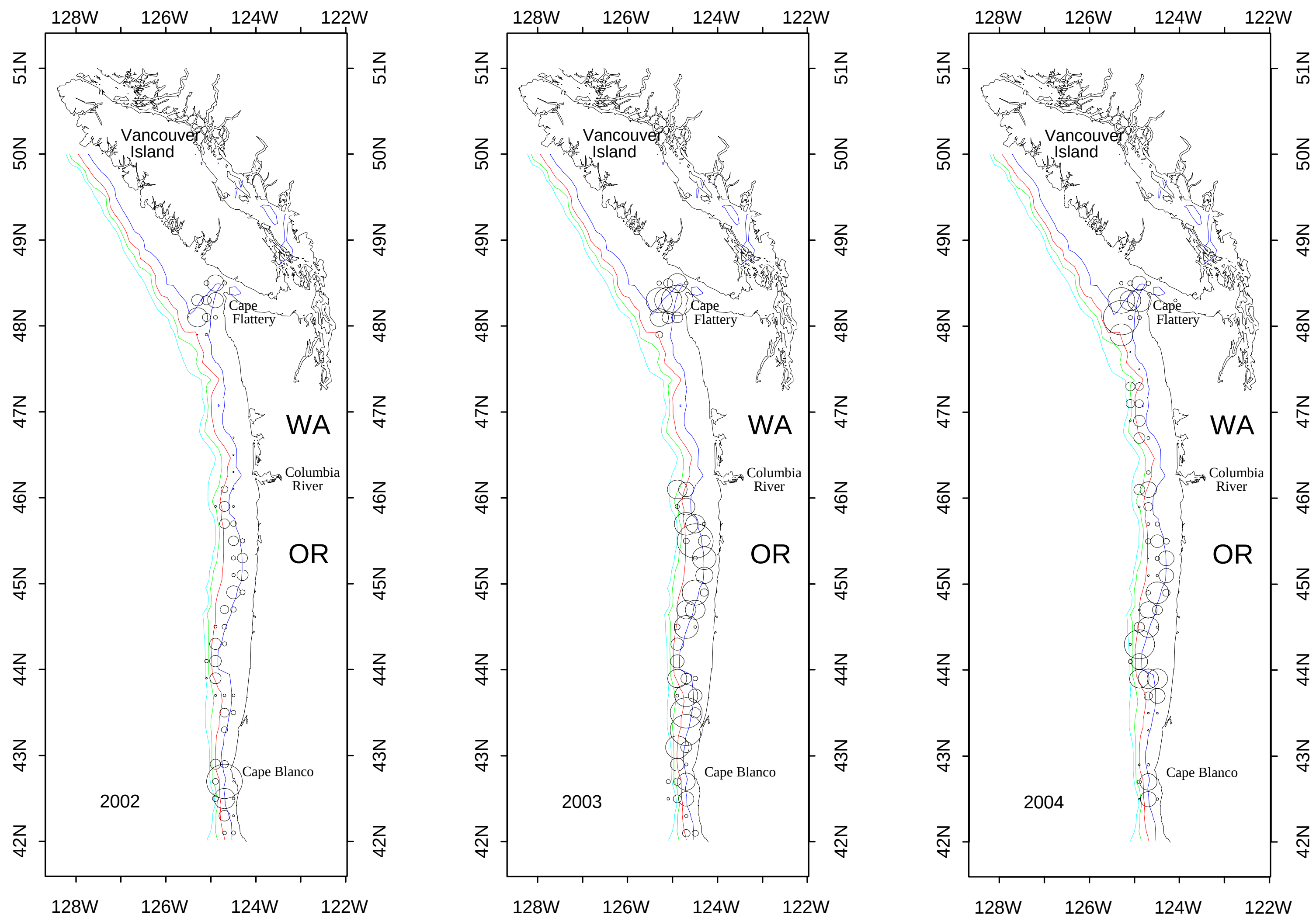


Figure 2. Catch by 20 km^2 block for factory and catcher boats in the 2002-2004 at-sea fishery for Pacific hake. Area of circle is proportional to the total catch within the block.

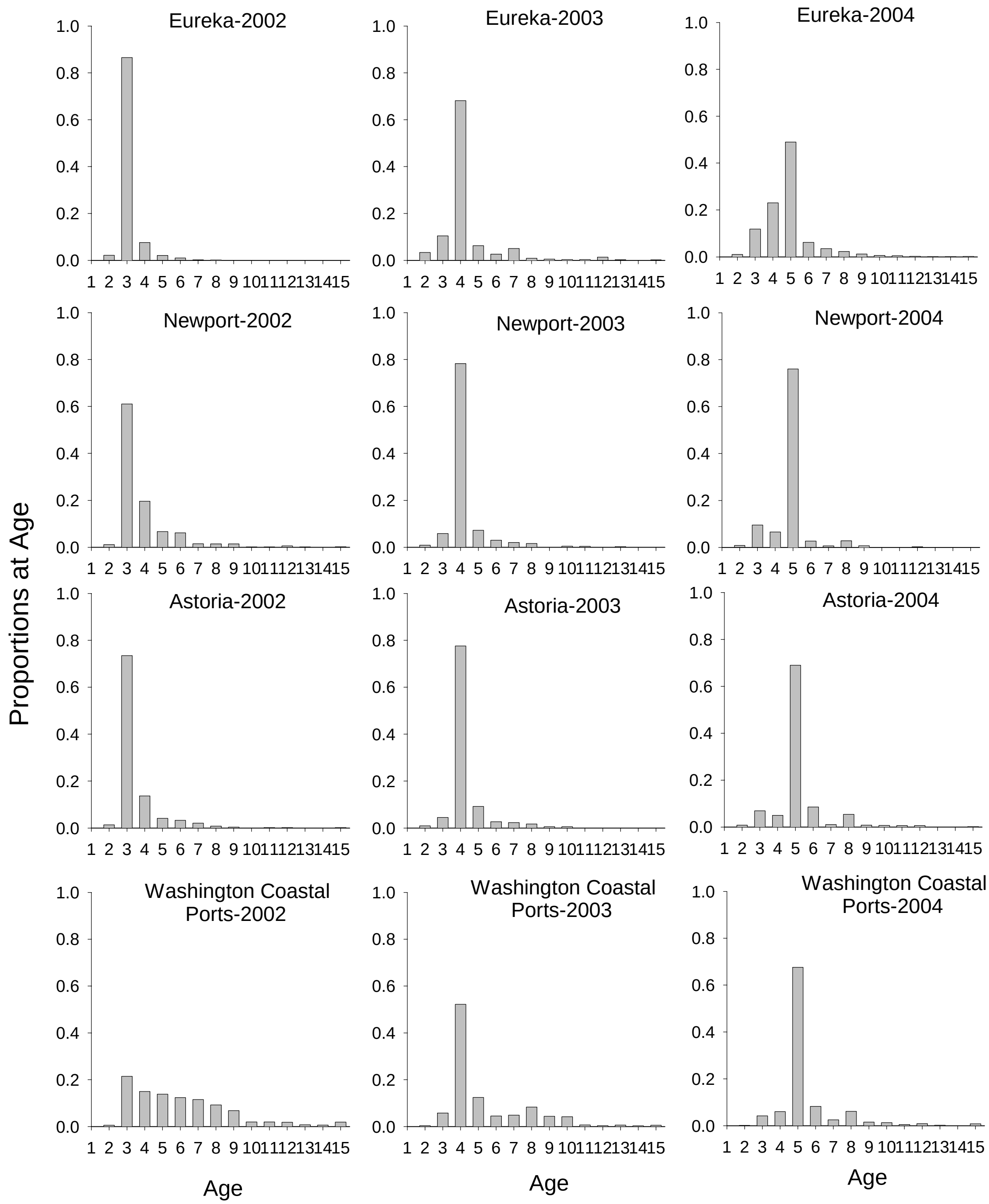


Figure 2. Pacific whiting proportion by age from shore-based landings in the U.S. zone, 1999-2001.

Figure 3. Pacific hake proportion by age from shore-based landings in the U.S. zone, 2002-2004.

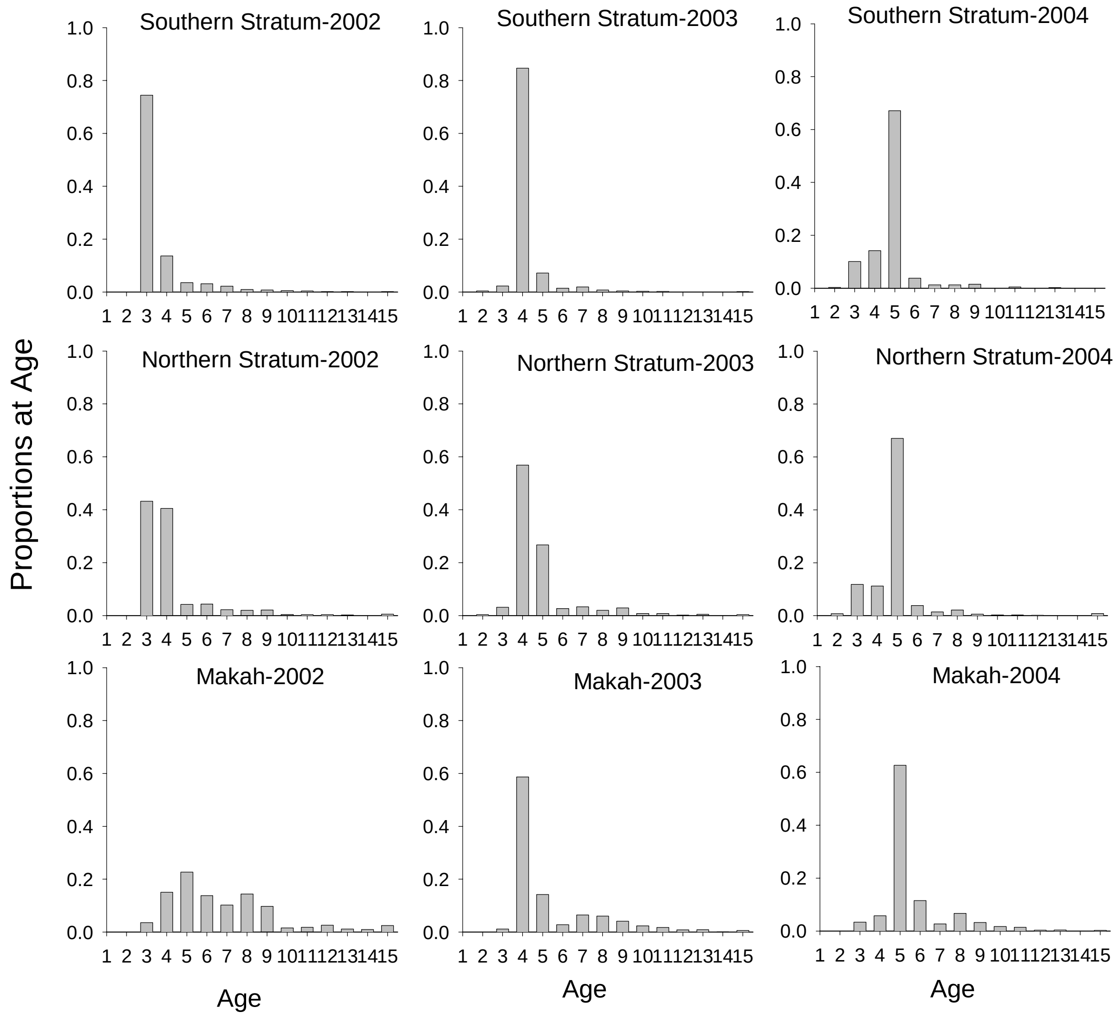


Figure 4. Pacific hake proportion by age from at sea fishery catches in the U.S. zone, 2002-2004.

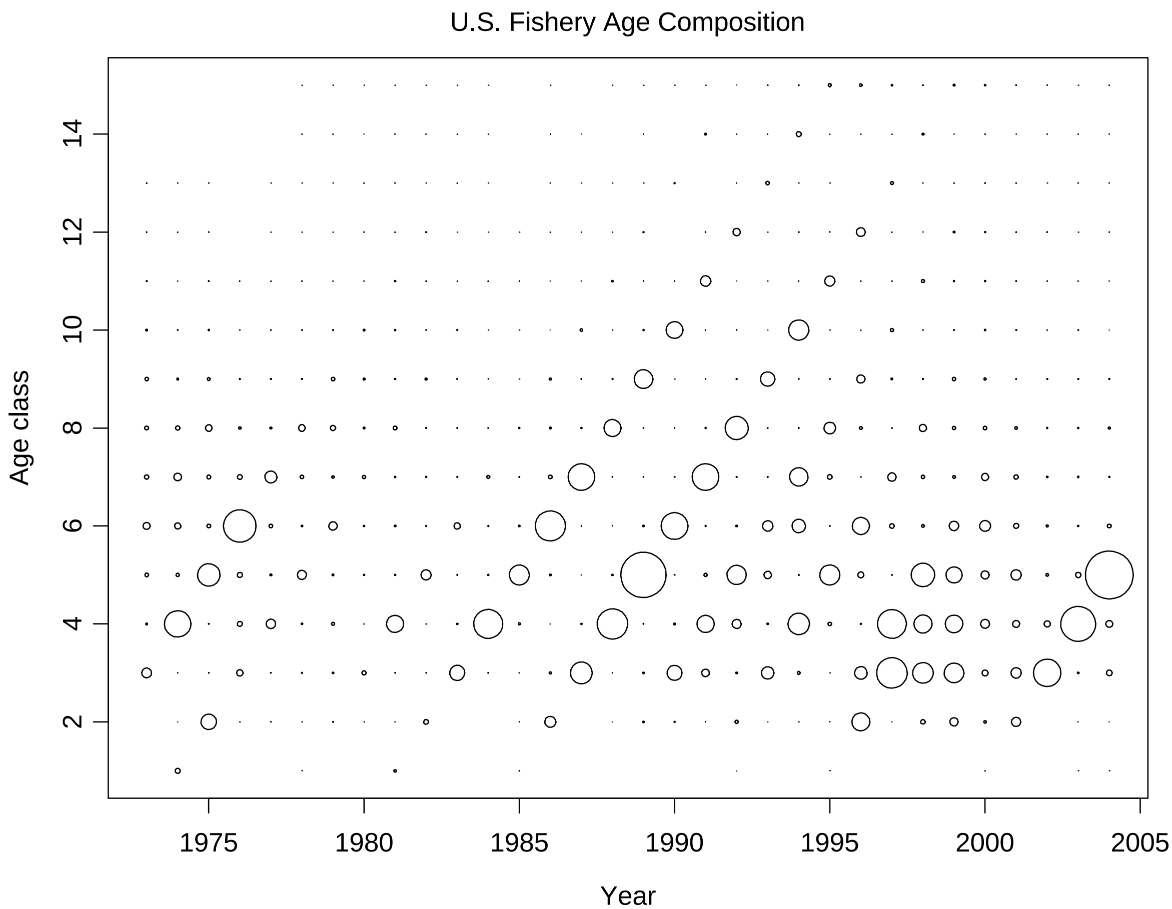


Figure.5. Catch at age of Pacific hake in the U.S. fisheries during 1973-2004. The diameter of the circle is proportional to the catch at age

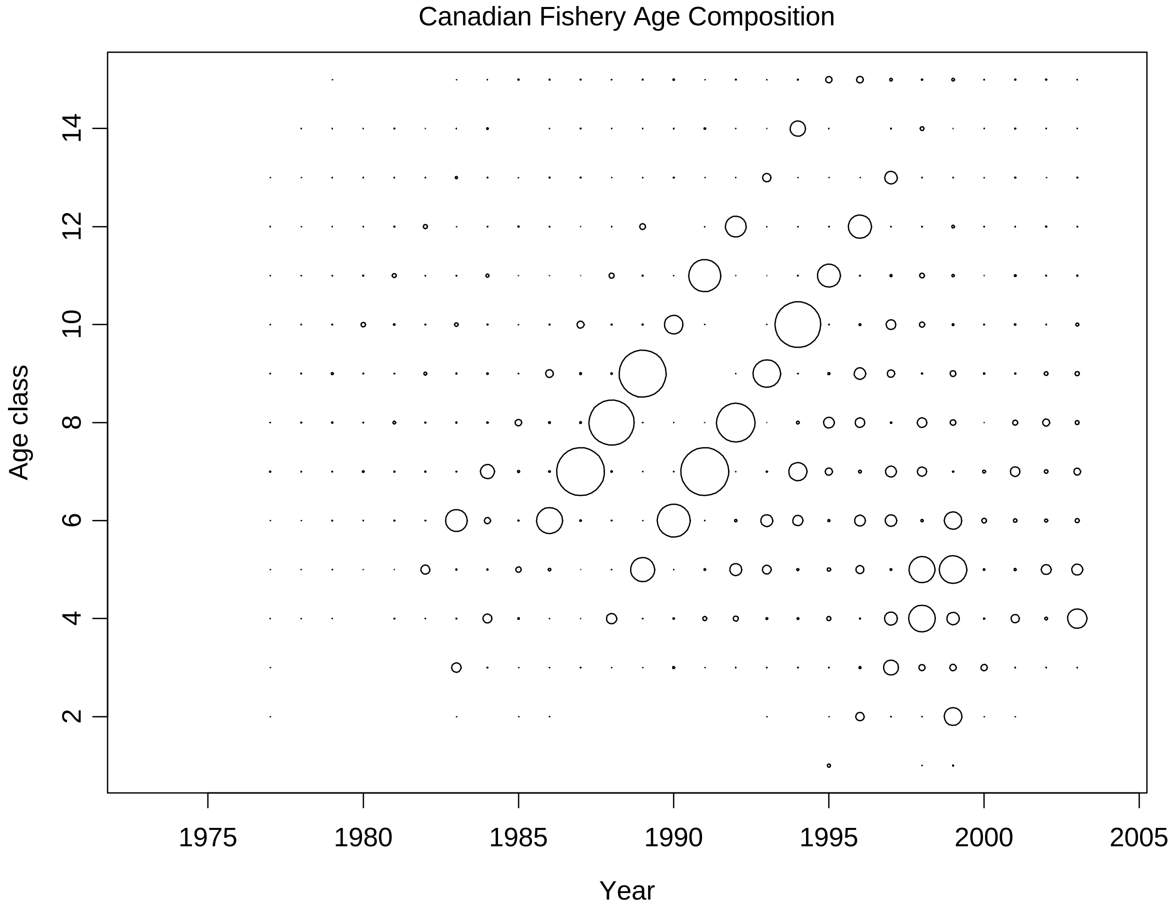


Figure 6. Catch at age of Pacific hake in the Canadian fisheries during 1977-2004. The diameter of the circle is proportional to the catch at age

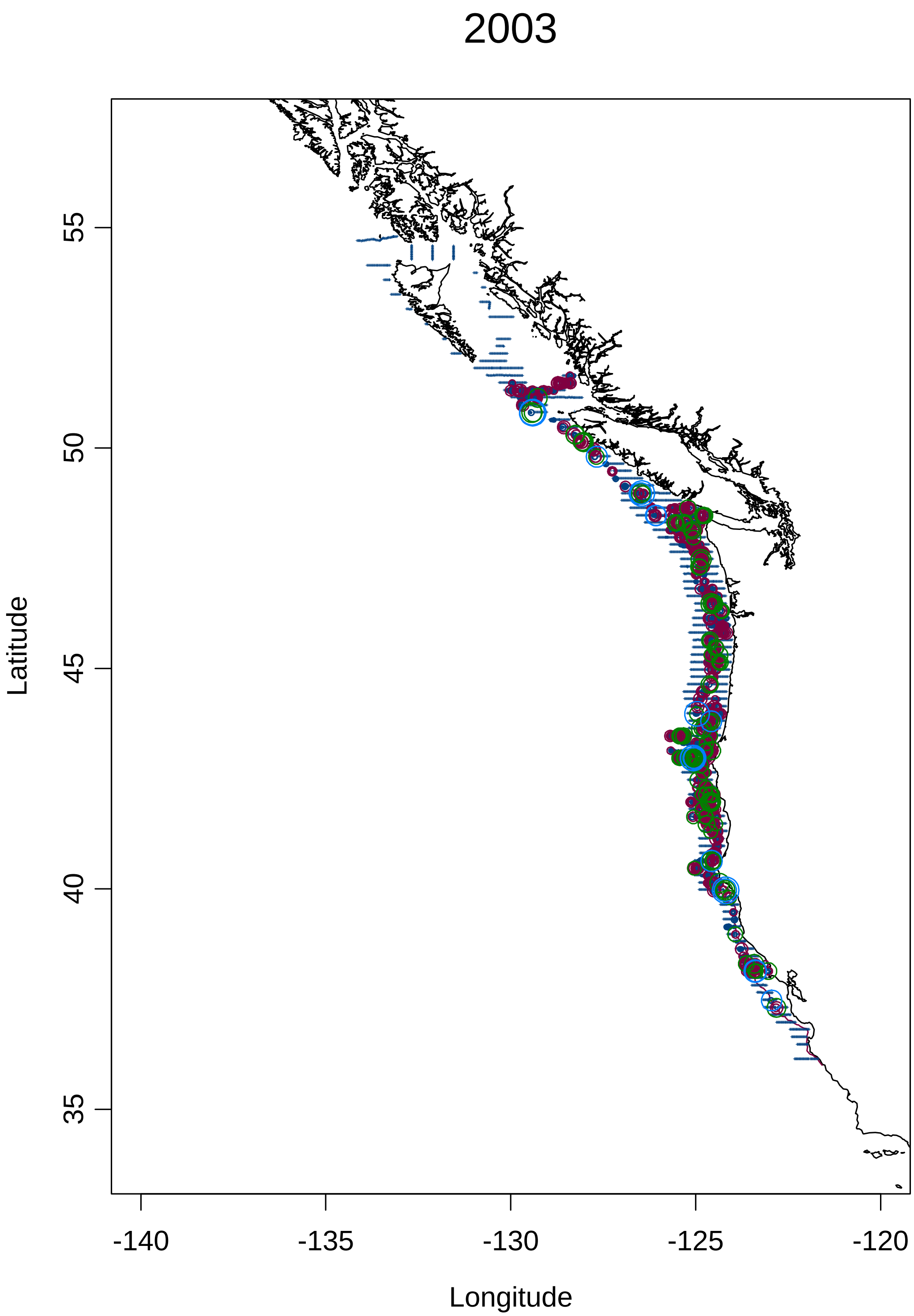


Figure 7. Acoustic backscattering (SA) attributed to Pacific hake along transects off the U.S. and Canada west coast shelf and slope between Monterey, CA, and Newport, OR, during the 2003 acoustic echo integration-trawl survey.

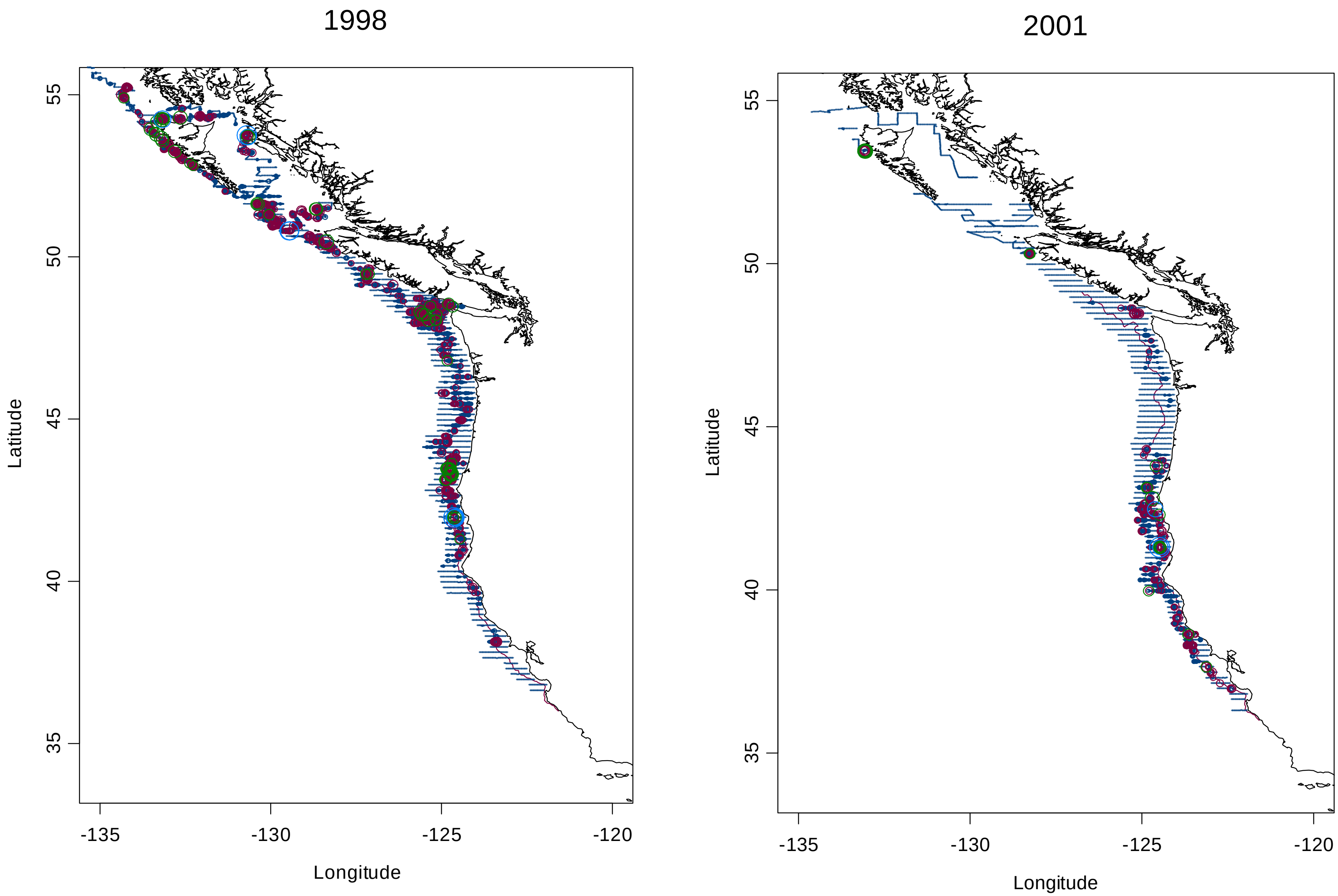
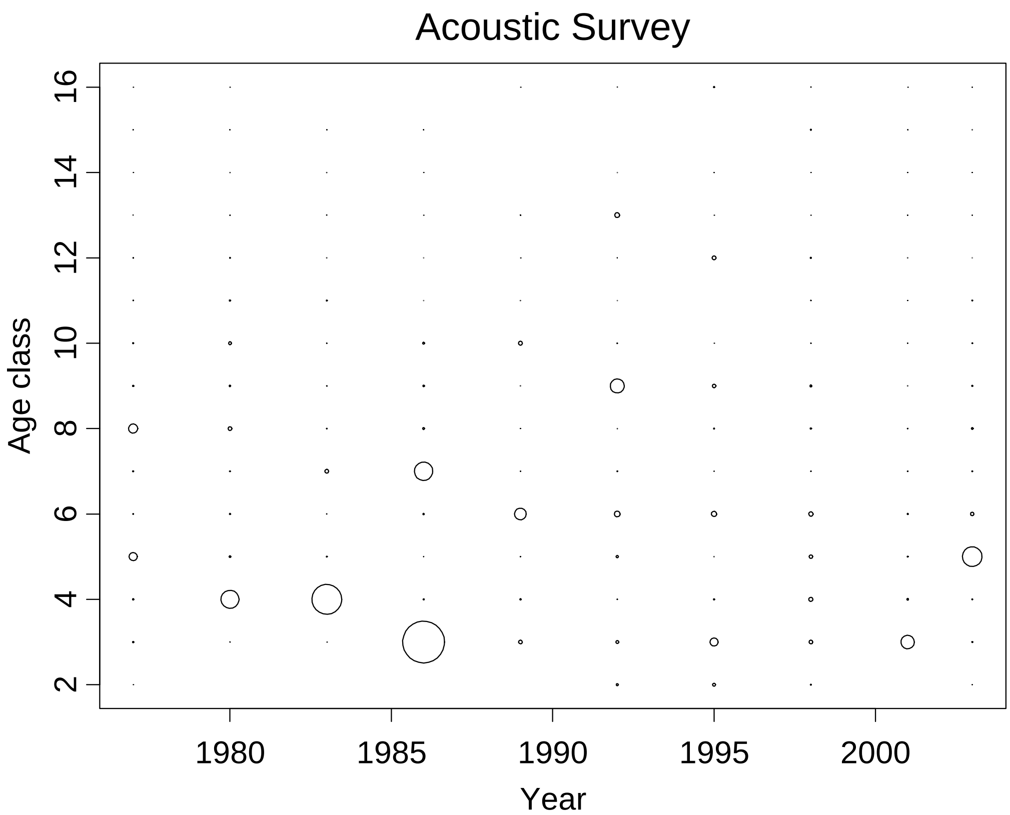


Figure 7 continued. Acoustic backscattering (SA) attributed to Pacific hake along transects off the U.S. and Canada west coast shelf and slope between Monterey, CA, and Newport, OR, during the 1998 and 2001 acoustic echo integration-trawl survey.



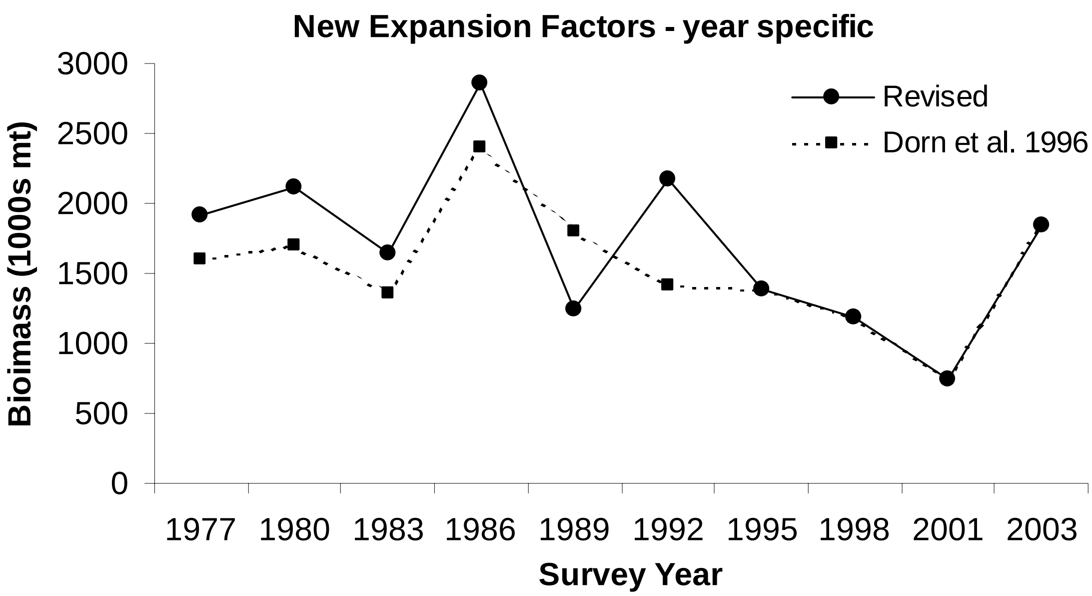


Figure 8. Top Panel) Trends in Pacific hake biomass in the acoustic survey based of revised deep water and northern expansion factors (See Helser et al. 2003). Bottom Panel) Catch at age of Pacific hake from the acoustic survey, 1977-2003. The diameter of the circle is proportional to the catch at age

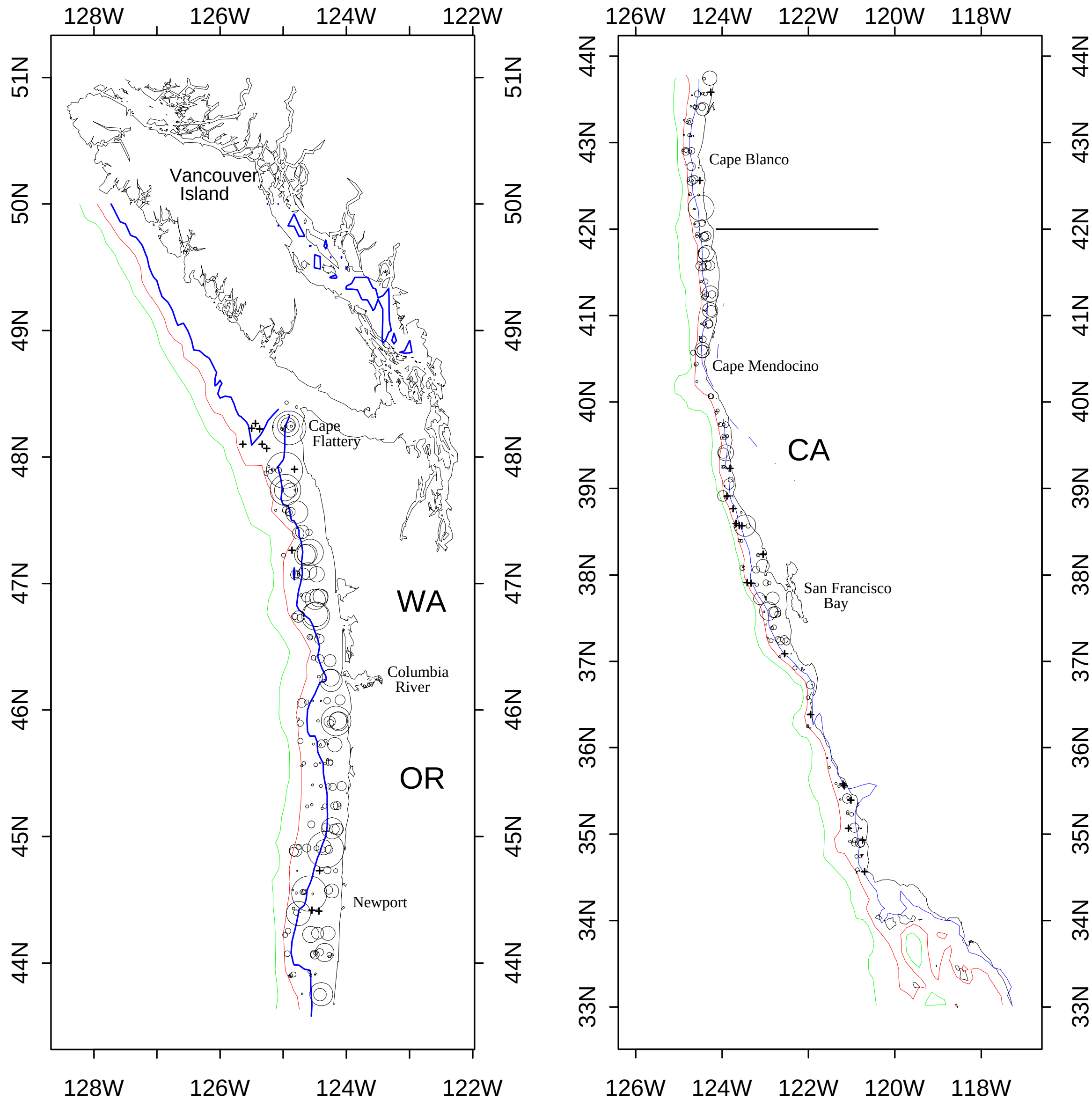


Figure 9. Spatial distribution of age 1+ Pacific hake in the NWFSC 2004 bottom trawl (Triennial) survey.

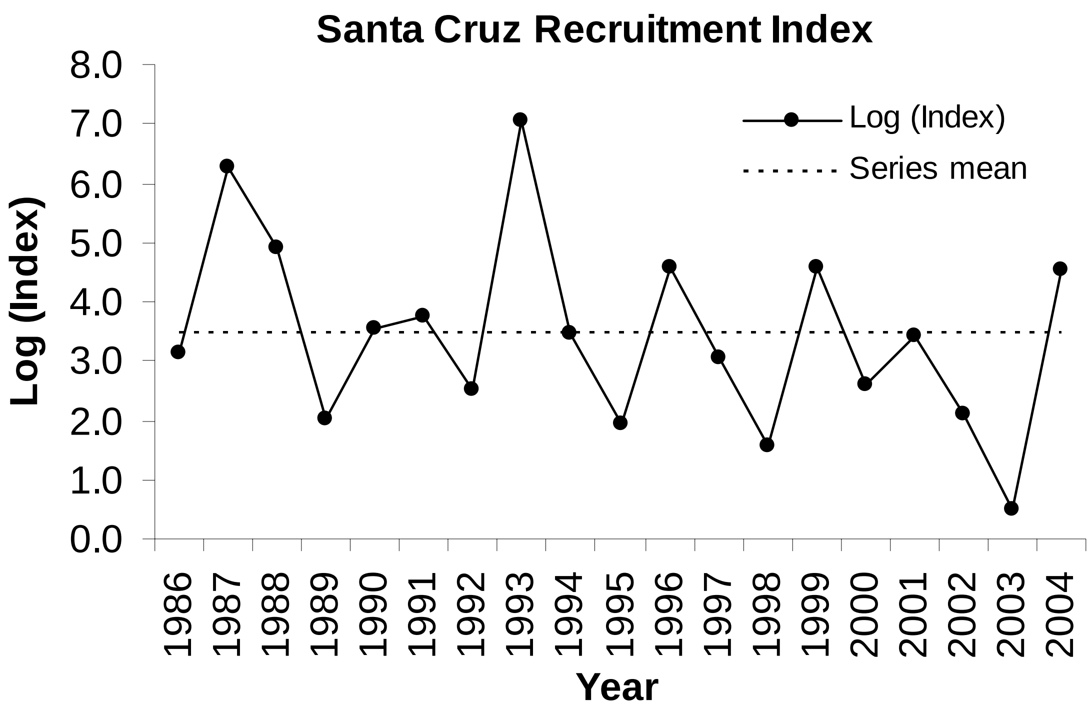


Figure 10. Santa Cruz Laboratory juvenile recruitment index (Monterey inside stratum only), 1986-2004. Index is obtained from a generalized linear model fit to the log-transformed CPUEs (Ralston et al. 1998). The juvenile index is projected two years in advance and is used as an index of age 2 hake recruitment, i.e., 1986 juvenile index represents age 2 hake recruitment in 1988.

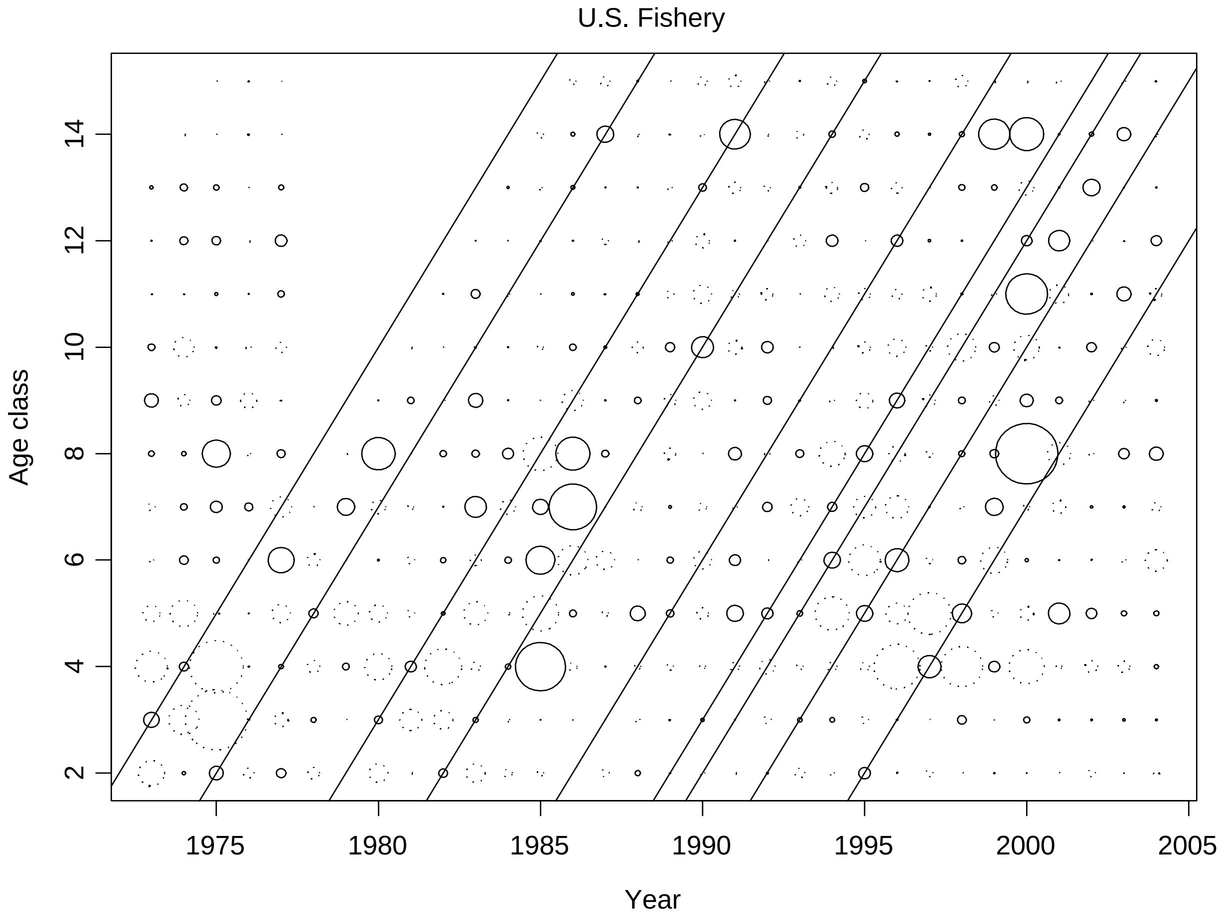


Figure 11. Pearson residuals from Models q=1.0 for the U.S. fishery age composition (q=0.6 are qualitatively similar and not shown). Circle areas are proportional to the magnitude of the residual. Circles drawn with dotted lines indicate negative residuals. The largest residual in absolute value is 3.7 for the age-2 fish in 1975. Diagonal lines show strong year classes (1970, 1973, 1977, 1980, 1984, 1988, 1990, and 1993).

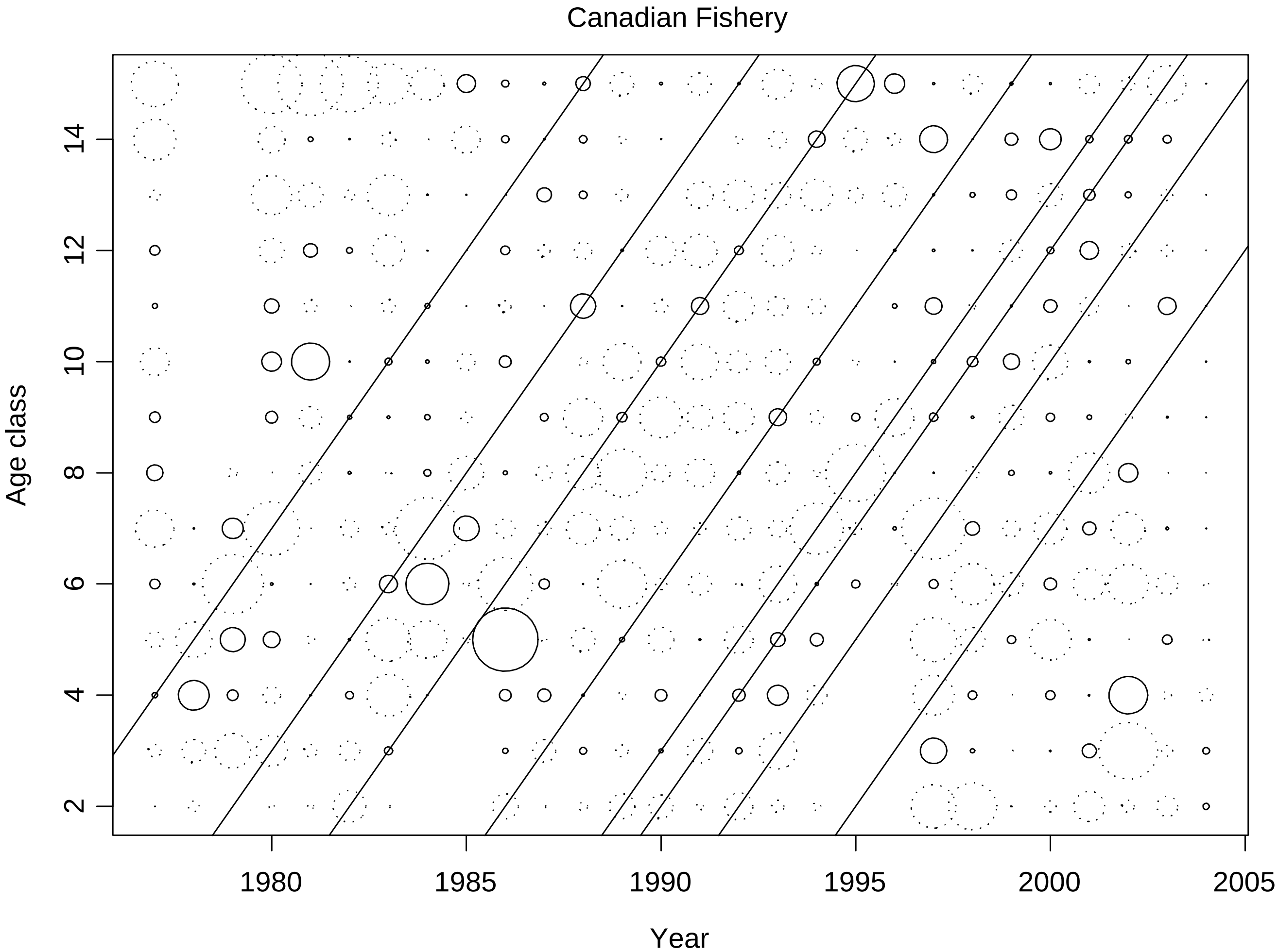
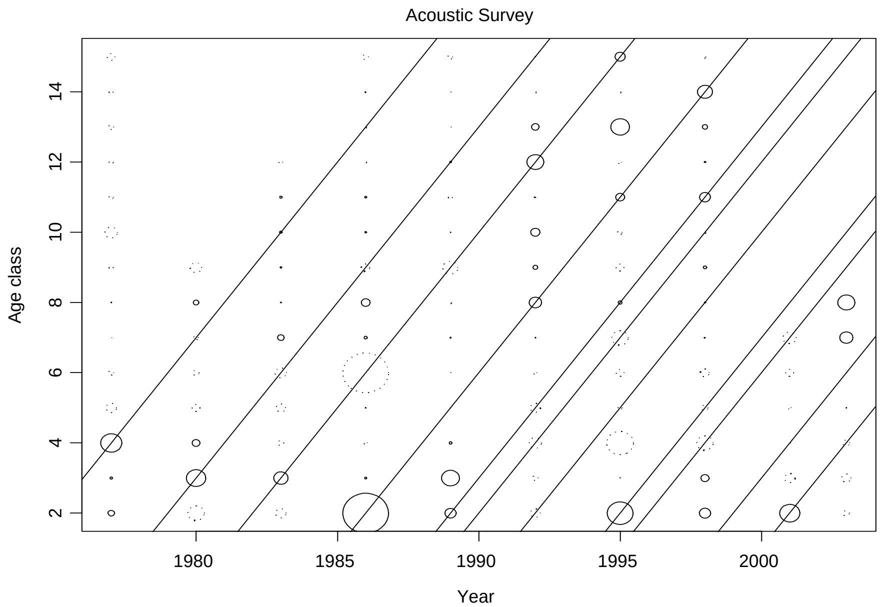


Figure 12. Pearson residuals from Models q=1.0 for the Canadian fishery age composition (q=0.6 are qualitatively similar and not shown). Circle areas are proportional to the magnitude of the residual. Circles drawn with dotted lines indicate negative residuals. The largest residual in absolute value is 5.1 for the age-5 fish in 1986. Diagonal lines show strong year classes (1973, 1977, 1980, 1984, 1987, 1988, 1990, and 1993).



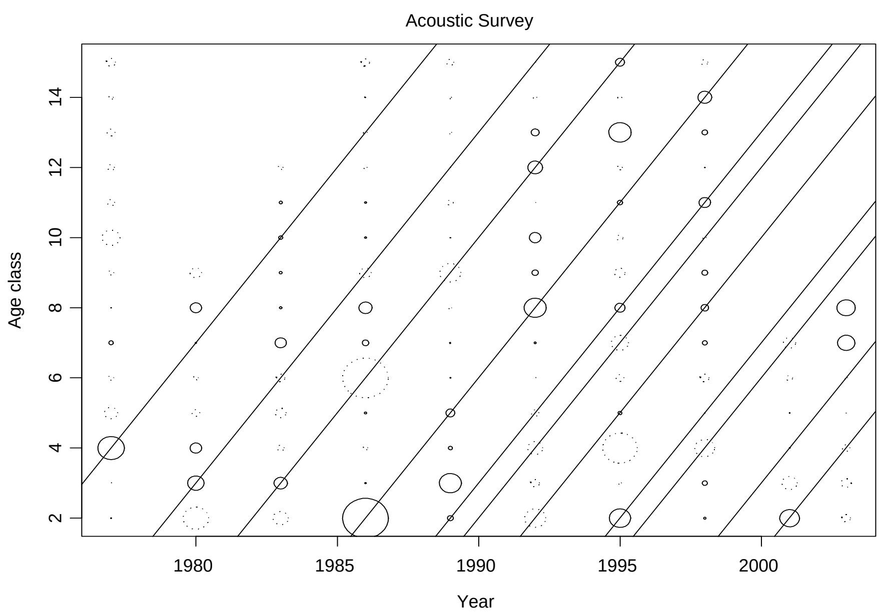


Figure 13. Pearson residuals from Models q=1.0 (top panel) and q=0.6 (bottom panel) for the acoustic survey age composition. Circle areas are proportional to the magnitude of the residual. Circles drawn with dotted lines indicate negative residuals. The largest residual in absolute value is -2.9 for the age-6 fish in 1986. Diagonal lines show strong year classes (1973, 1977, 1980, 1984, 1988, 1990, and 1993).

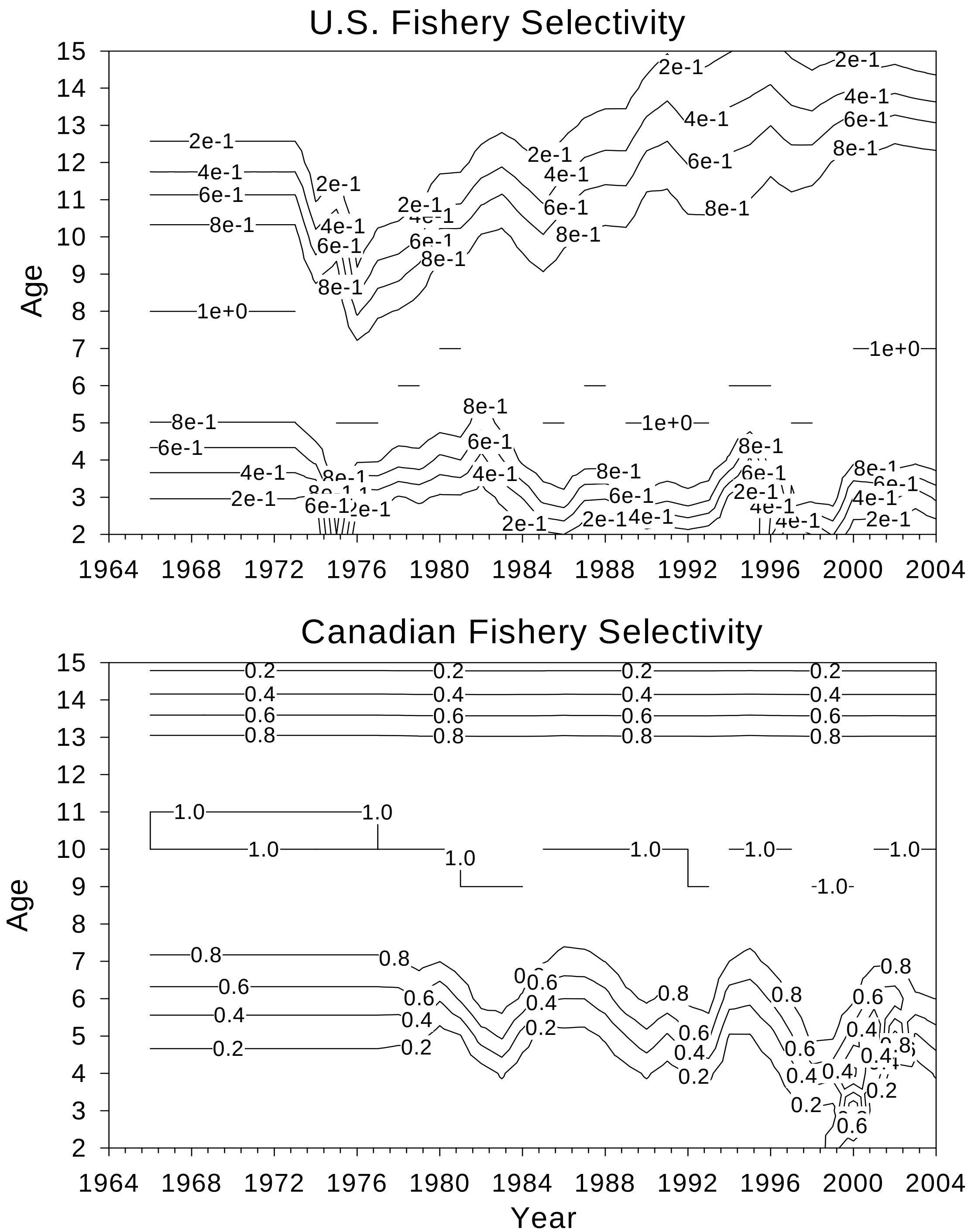
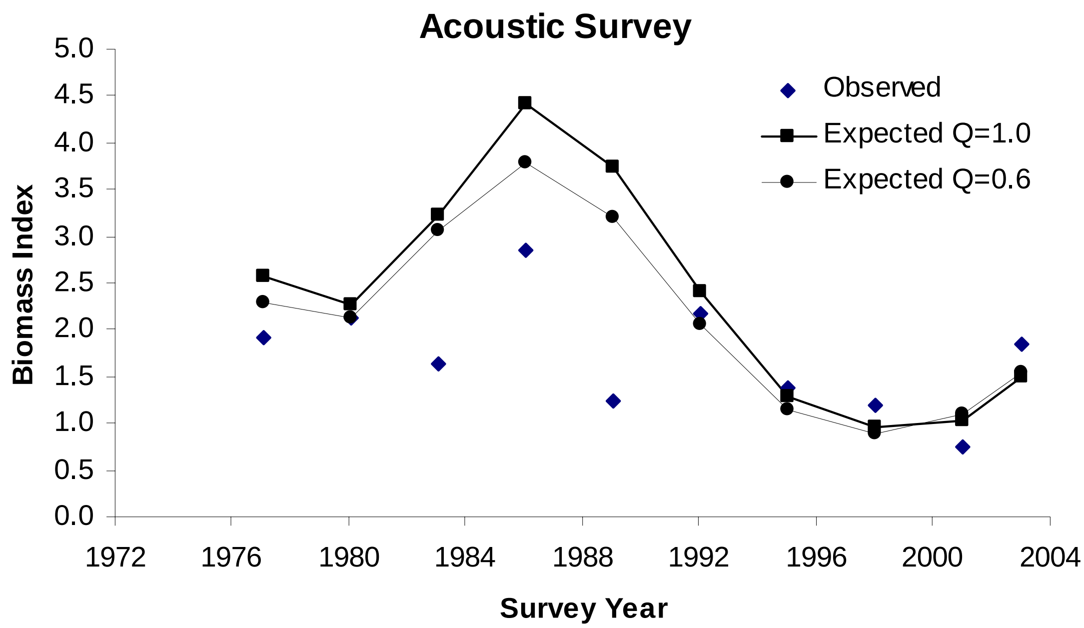


Figure 14. Contour plot showing annual changes in the U.S. and Canadian fishery selectivity at age estimated by Model q=1.0 (Fishery selectivity from model q=0.6 is qualitatively similar and not shown). Time varying selectivity was estimated using a random walk process error for parameters associated with both the ascending and ascending limb of the selectivity function in the U.S. fishery. In the Canadian fishery annual variation was assumed for only the ascending portion of the double logistic function.



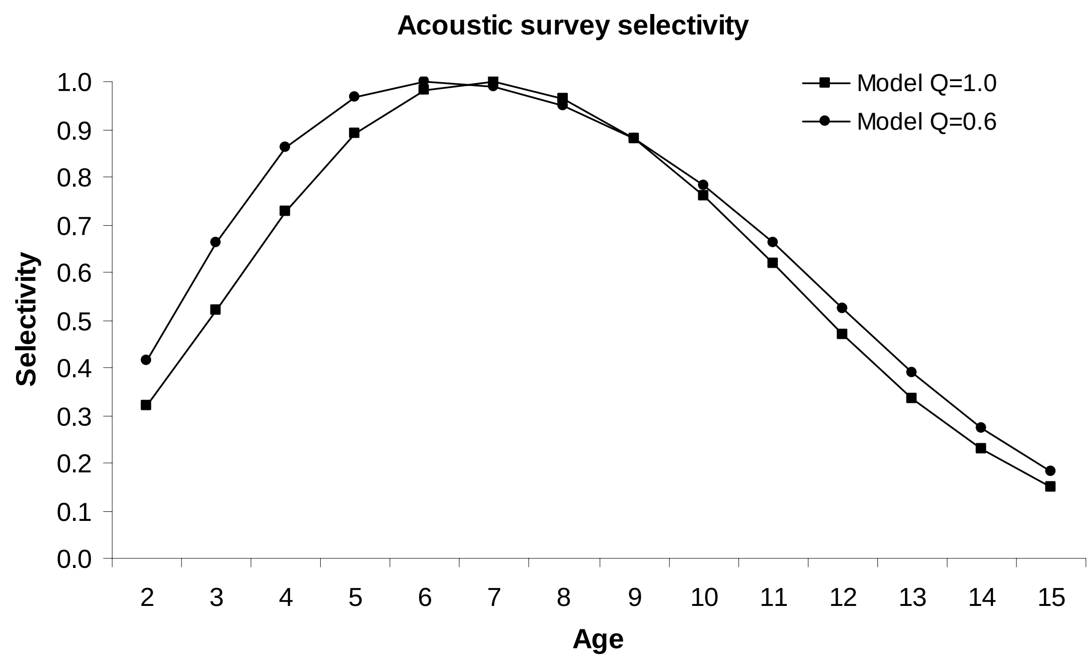


Figure 15. Fit of the expected to observed (revised 1977-1992 year-specific expansion factors) acoustic survey biomass and acoustic survey selectivity from models q=1.0 and q=0.6. See text for description of model configurations.

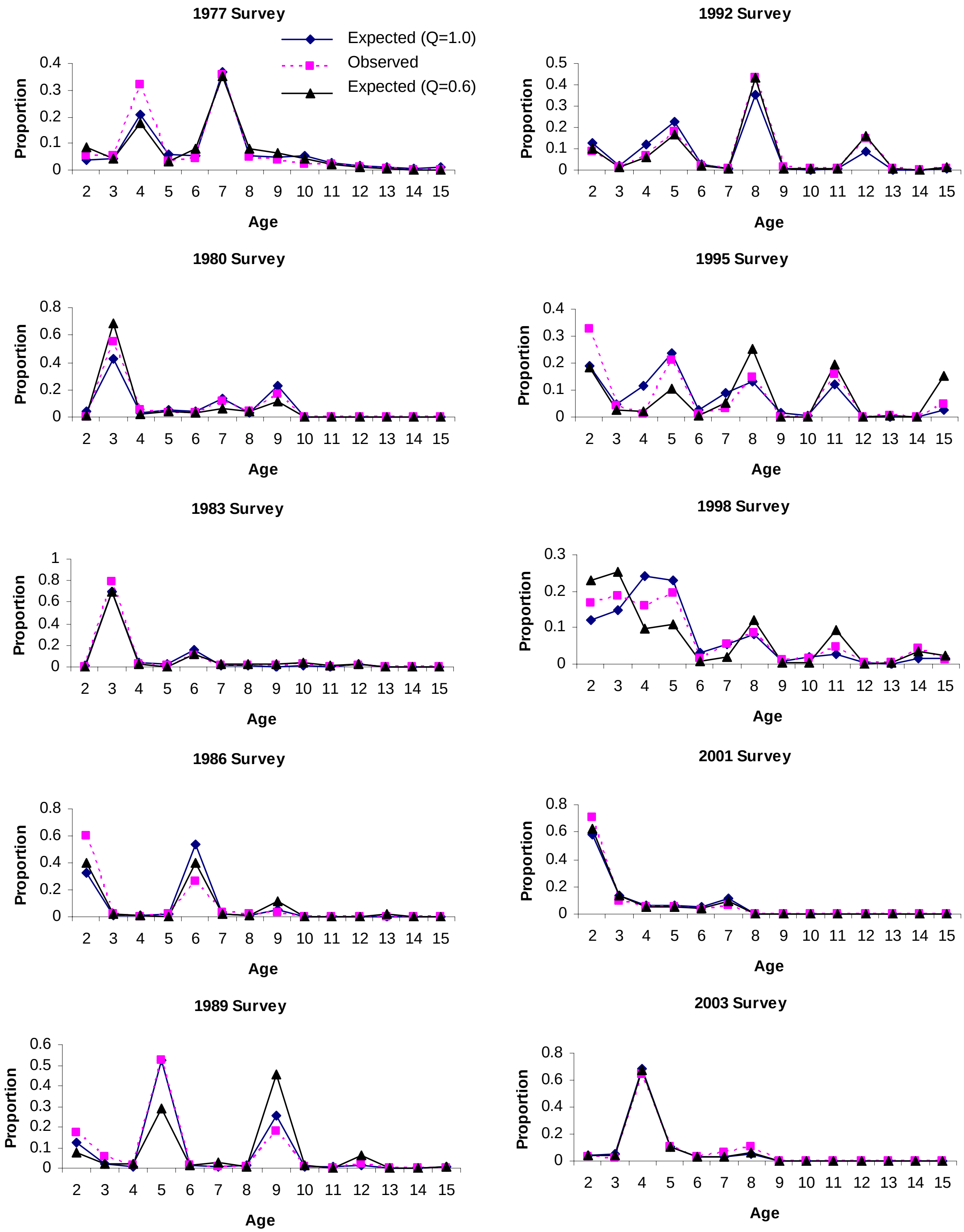


Figure 16. Fit of the expected to the observed acoustic survey age compositions, 1977-2003, for Models q=1.0 and q=0.6 (See text for description of model configuration).

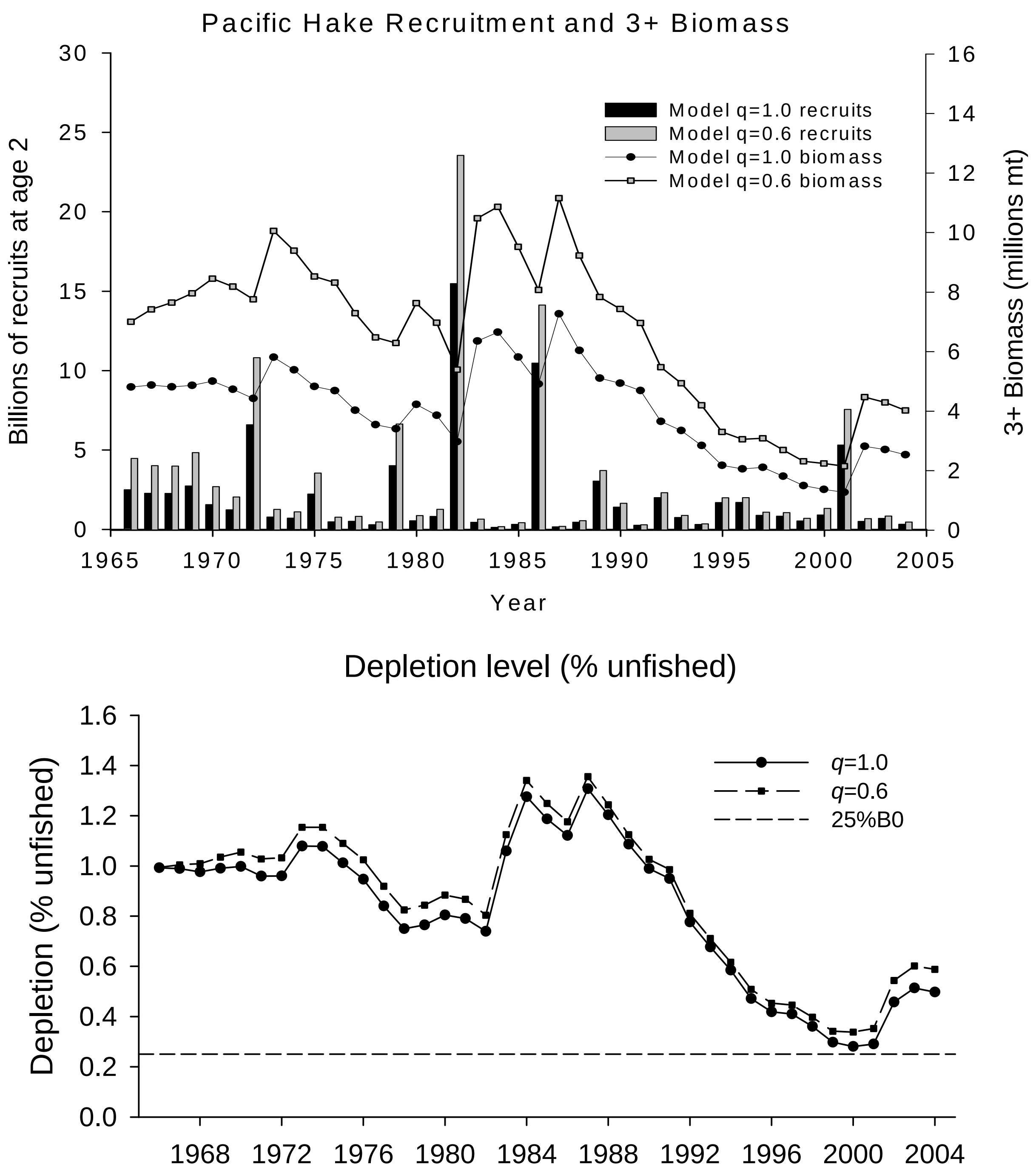
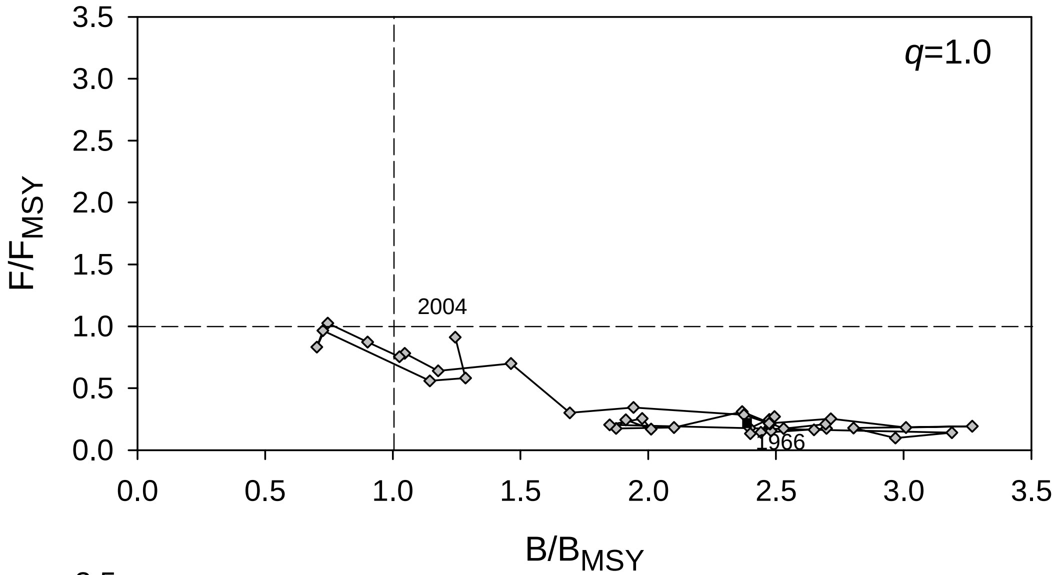
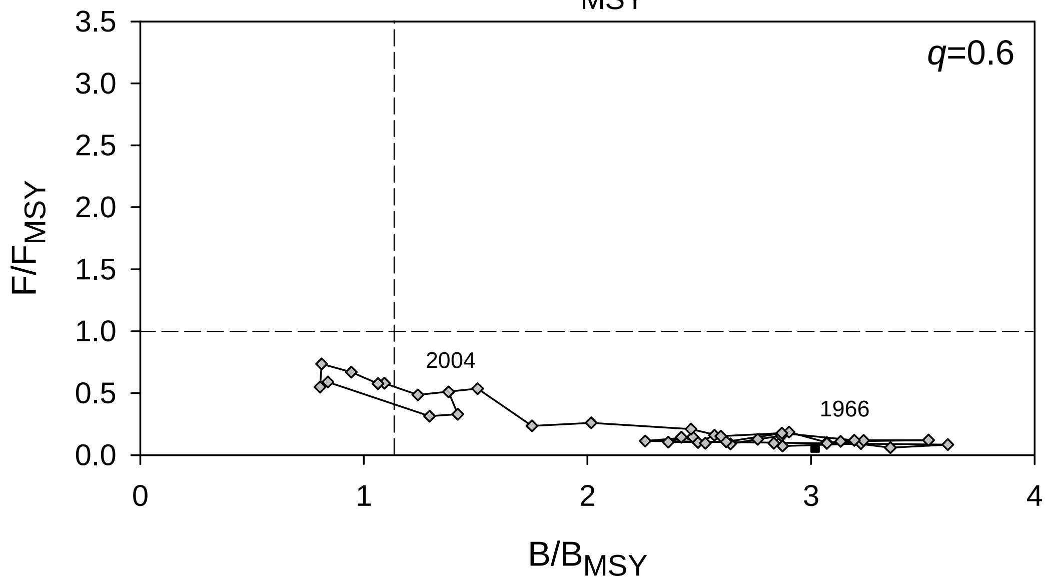


Figure 17. Estimated time series of Pacific hake age 3+ biomass (million mt) and age-2 recruitment (billions of fish) during 1966-2004 from Models *q*=1.0 and *q*=0.6. Lower panel shows trends in depletion levels relative to unfished biomass (See text for description of model configurations).

Figure 18. Historical levels of the instantaneous fishing mortality rate and biomass of Pacific hake relative to the F_{MSY} and B_{MSY} proxies, respectively.





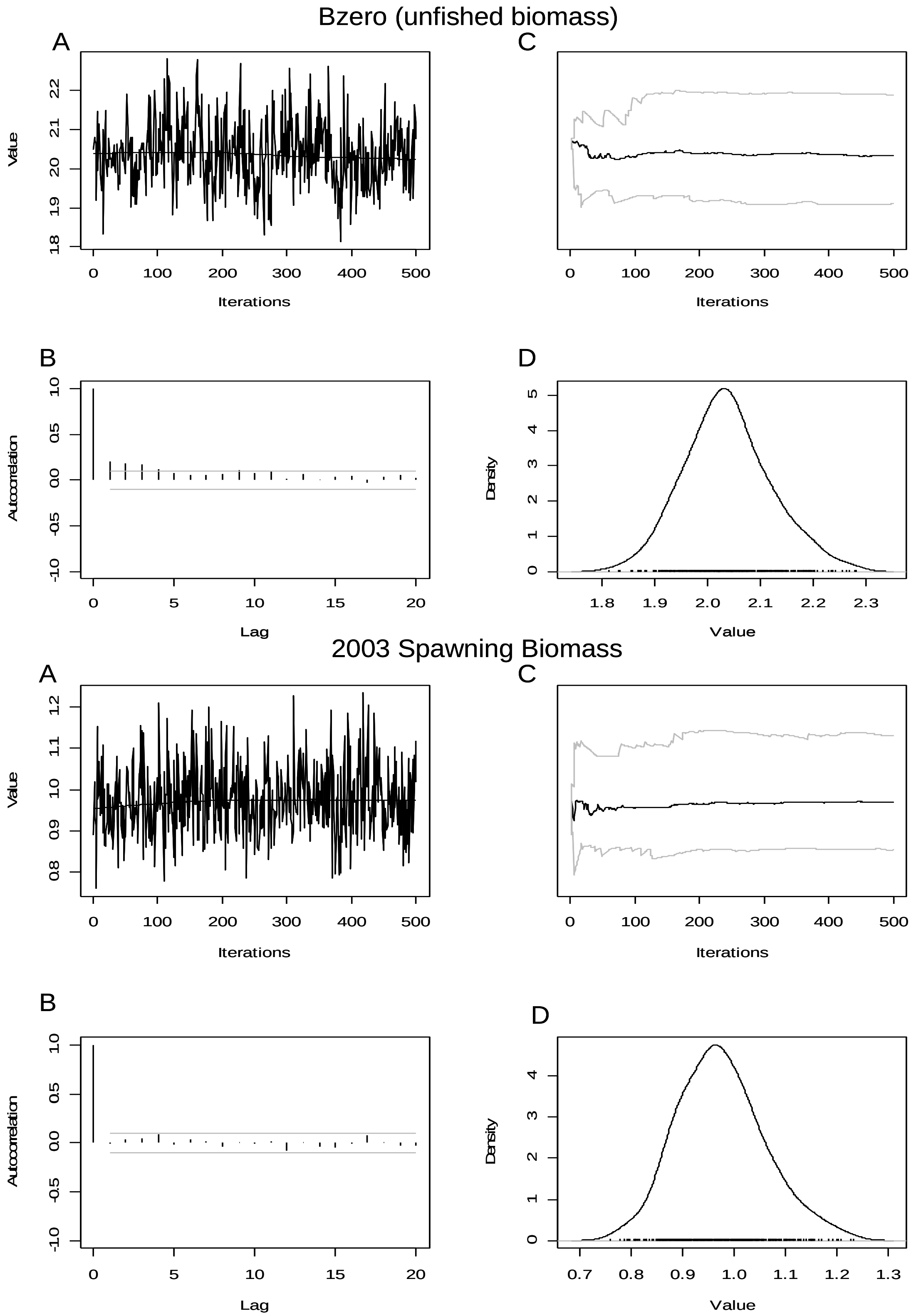


Figure 19. Results of Markov Chain Monte Carlo simulation diagnostics for selected parameters, Bzero (top) and spawning biomass (bottom), from Model q=1.0 showing: A) trace plots (with running average), B) chain sequence autocorrelation, C) 5%, 50% and 95% of the chain sequence, and D) kernel density. MCMC diagnostics were qualitatively similar for Model q=0.6 and are not shown.

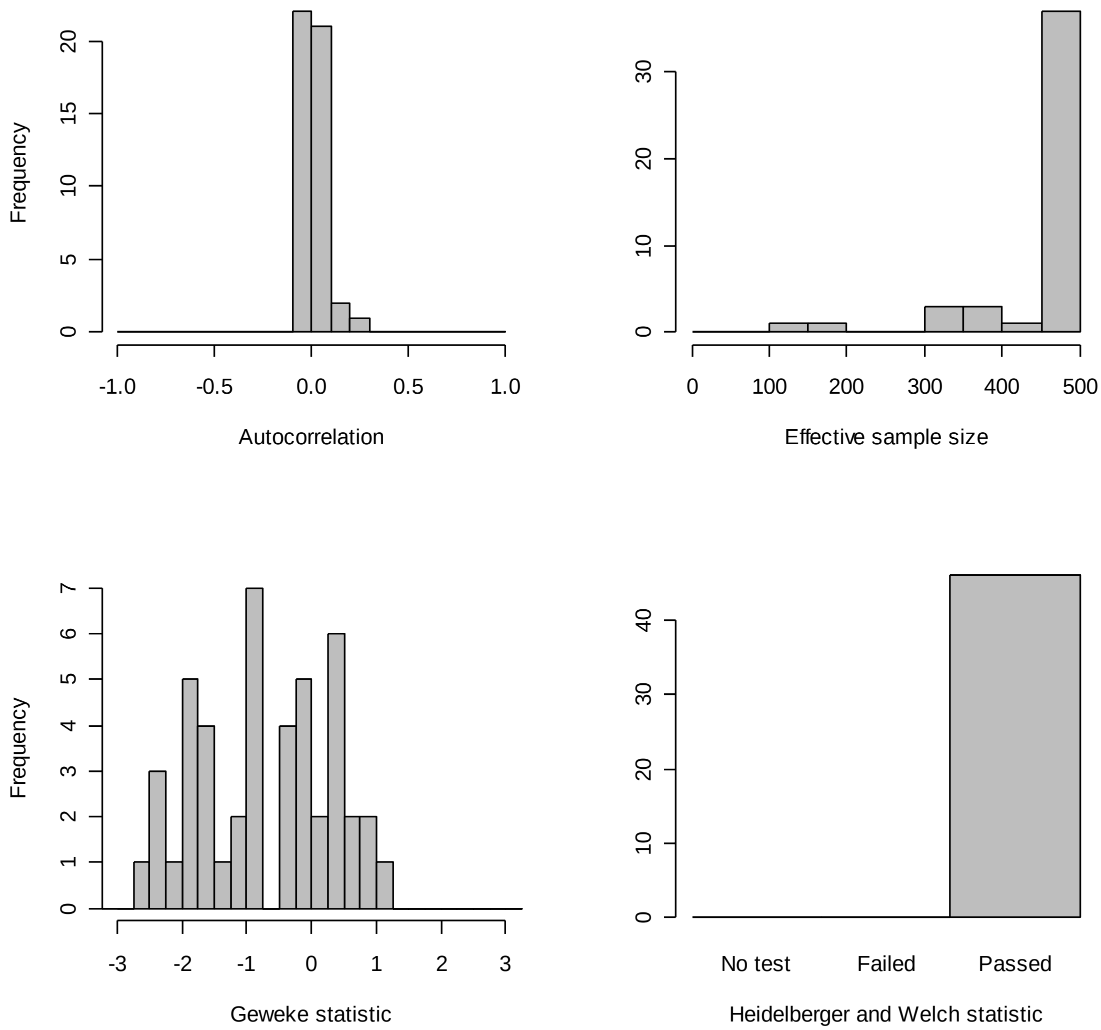


Figure 20. Summary diagnostics for 46 parameters from Model q=1.0 based on 1,000 draws (after discarding first 20% of samples and thinned at every 1000th sample) from the Markov Chain Monte Carlo simulation of the posterior distribution. Plots shown are autocorrelation, effective sample size (x10), Geweke statistics of convergence of the mean (should be < |2|), and Heidelberger and Welch statistic. MCMC diagnostics were qualitatively similar for Model q=0.6 and are not shown.

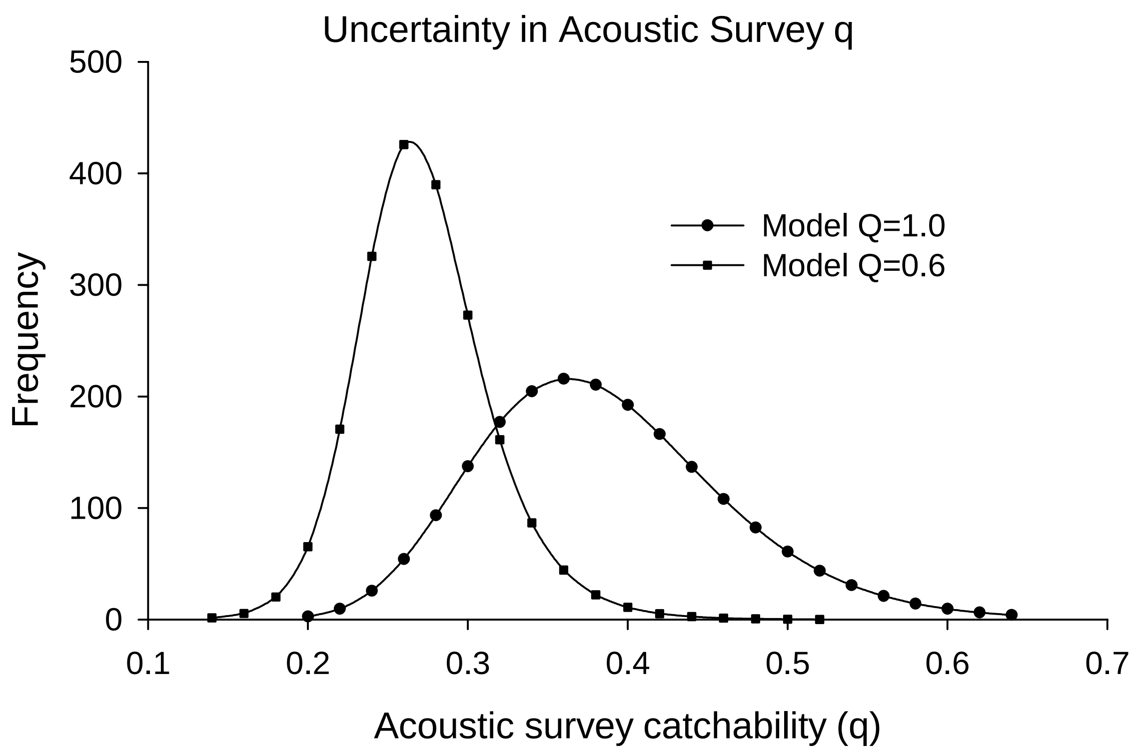


Figure 21. Uncertainty in acoustic survey catchability (q) for two models with different CVs associated with acoustic survey biomass time series. Marginal posterior distributions are based on 2,500,000 MCMC samples. Model q=1.0 (CV=0.2 1977-1989, CV = 0.1 1992-2003) and Model q=0.6 (CV=0.5 1977-1989, CV = 0.3 1992-2003).

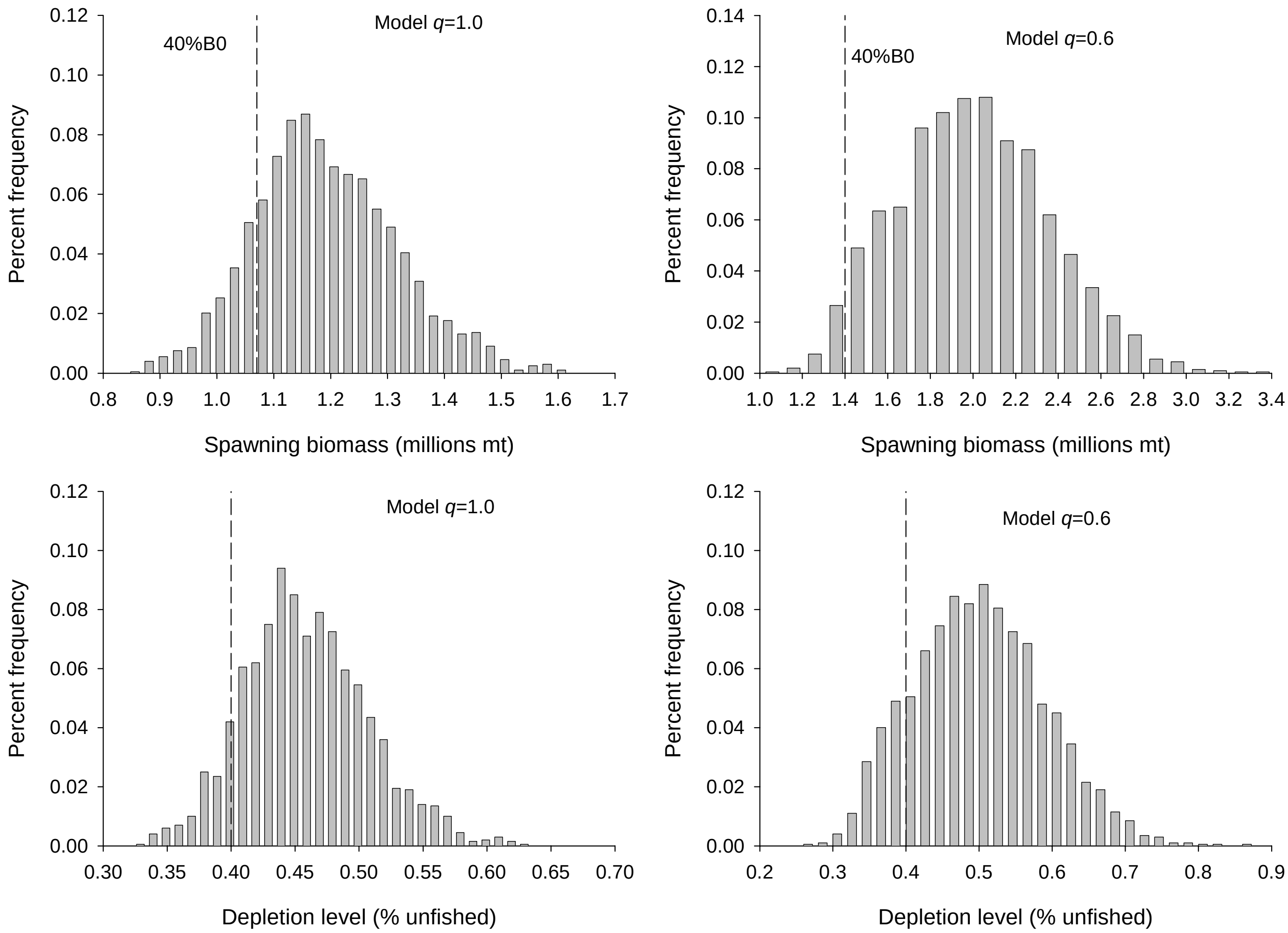


Figure 22. Uncertainty in the 2004 female spawning biomass and the corresponding depletion rate (% unfished biomass) for Models *q*=1.0 and *q*=0.6 as shown by marginal posterior distributions based on 2,500,000 Markov Chain Monte Carlo samples.

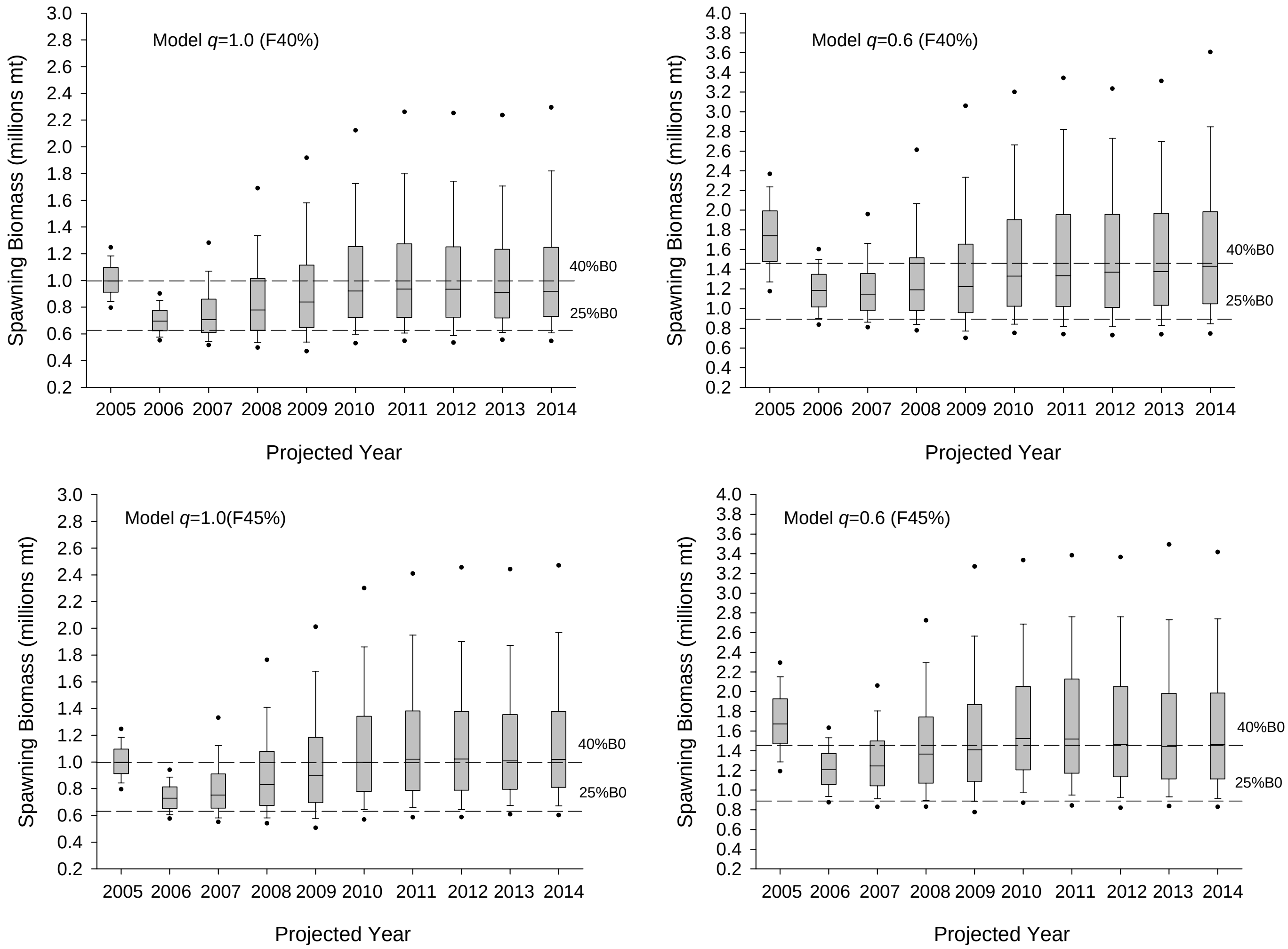


Figure 23. Uncertainty in projected 2005-2014 female spawning under the F40% (40-10) and F45% (40-10) harvest rate policy from models *q*=1.0 and *q*=0.6. Boxplots shown are based on 2,500,000 Markov Chain Monte Carlo samples.

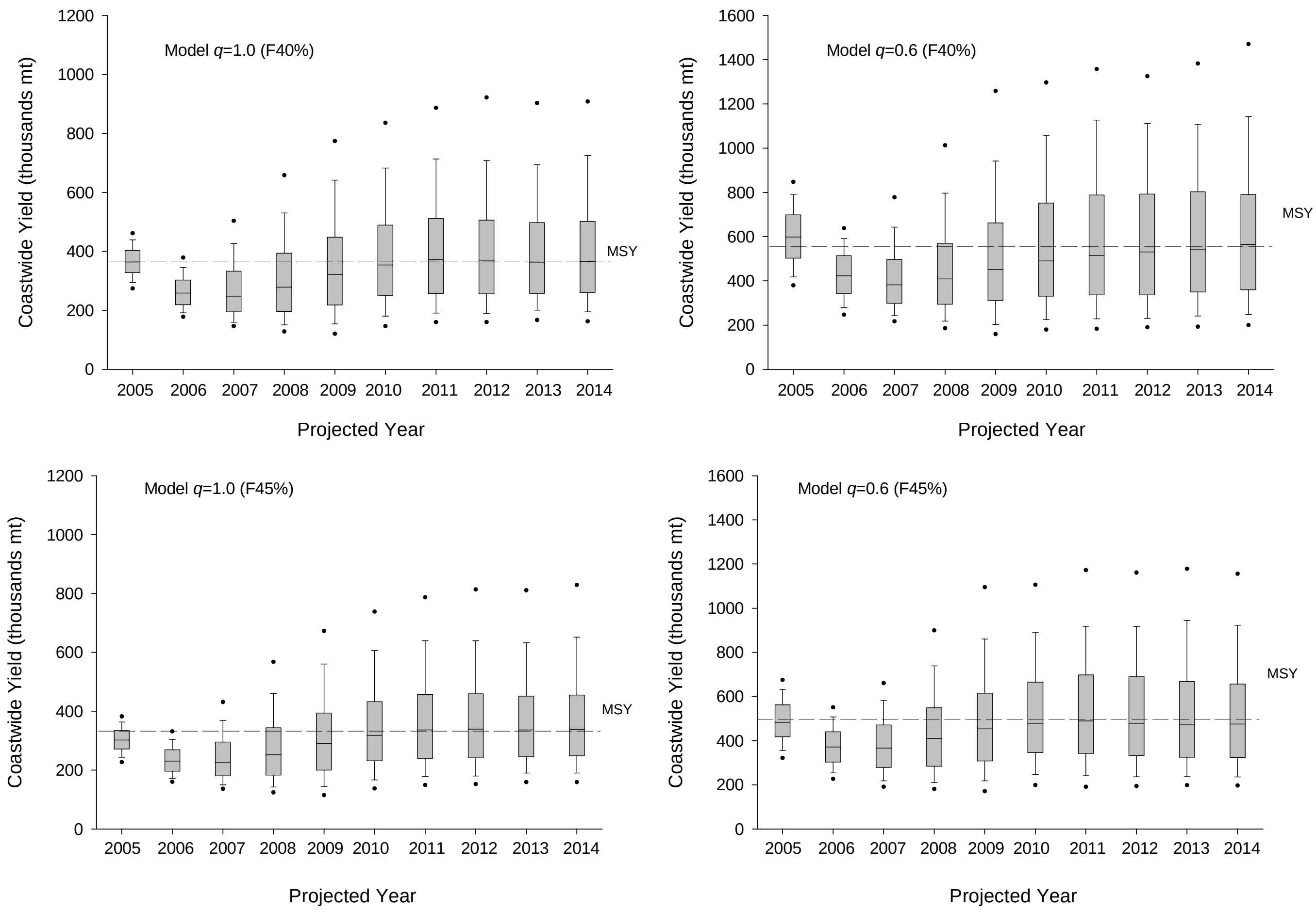


Figure 24. Uncertainty in projected 2005-2014 coastwide yield under the F40% (40-10) and F45% (40-10) harvest rate policy for Models q=1.0 and q=0.6. Boxplots shown are based on based on 2,500,000 Markov Chain Monte Carlo samples.

Appendix A

Summary

In the Helser et al. (2004) assessment of Pacific Hake, the STAR review panel identified seven possible model enhancements that may or may not reduce the uncertainty in parameter estimates, and ultimately improve information that is used in quota allocations. In this document, we investigate the interaction of the dome-shaped selectivity function with the fixed value of M and discuss the necessary requirements for estimating and age-specific M. We also examine if the current assessment model is over-parameterized by way of estimating deviations in parameters that describe size selectivity and determine if an oceanographic index could be used to aid in the estimation of variable selectivity. We explore the interaction between M and selectivity and the use of covariates for explaining changes in selectivity using simulation-estimation experiments. A reference model was constructed from the current statistical catch-at-age model structure to generate simulated relative abundance indices and age-composition information from surveys. We used the existing commercial catch observations and estimated recruitment from Helser et al. (2004) to generate time series data.

Results from the simulation-estimation experiments clearly demonstrated a confounding problem between M and the descending portion of the dome-shaped selectivity curve. Specifically, the age-independent natural mortality rate M was negatively correlated with the shape parameter (g_2) that describes how rapidly selectivity drops with older individuals. If a dome-shaped selectivity is the true reality for all fisheries harvest and survey sampling gears, then there is no real information in the age composition data to estimate age-specific M's, thus the model is over-parameterized. Results from the variable selectivity simulations suggests that data are not informative about deviations in selectivity parameters therefore and a reasonable variance for the prior distribution for deviations in random walk parameters is required. The use of an environmental correlate to describe variability in selectivity parameters greatly improves precision in estimated parameters and reduces bias in all estimated parameters including survey selectivity parameters (q's).

Contents

Summary ii

Contents iii

1 Introduction 1

2 Methods 3
2.1 Statistical catch-at-age model 4
2.1.1 Observation errors 5
2.1.2 Process errors 6
2.2 Reference model 7
2.2.1 Bias M and other key parameters across a range of true and fit selectivity shapes 8
2.2.2 Variability in fishery selectivity 10

3 Results 13
3.1 Bias M and other key parameters across a range of true and fit selectivity shapes 13
3.2 Key parameter bias with increasing age at 50% vulnerability (lh) 16
3.3 Variation in fisheries selectivity 18
3.3.1 Incorporating oceanographic indices in selectivity 23

4 Discussion 27
4.1 Natural mortality 27
4.2 Estimating selectivity 29
4.3 Explicit representation of hake movement 30
4.4 Alternatives to priors on q 32

References 33

5 ADMB code for reference model 34

6 ADMB code for assessment model 41

1 Introduction

The objective of this review of the assessment model is to examine 2 model enhancements identified by the STAR panel: 1) investigate the interaction of the dome-shaped selectivity function and the instantaneous natural mortality rate, and 2) investigate alternative methods to model annual variability in selectivity. To examine these issues we develop a reference model that generates simulated observations (relative abundance indices and age-composition information) using historical estimates of recruitment and fishing mortality as input data to the reference model. We then use the existing statistical catch-at-age model structure to evaluate estimation performance of M and changes in selectivity.

The STAR panel report identified the following enhancements to the assessment model:

1. Add in bias correction for log-normal distribution in appropriate likelihoods.

2. Recode the model so that projections are done as a post-MCMC procedure.

3. Develop an informed prior for the acoustic q. This prior should be used in the model when estimating the q parameter

4. Consider the development of a sex-structured model.

5. Investigate alternative methods to model annual variability in fishery selectivity. Identify the covariates that influence fishery selectivity.

6. Investigate the interaction of the dome-shaped selectivity functions with the fixed value of M. This investigation should include determining whether there is a trade-off between M and the declining limb of the selectivity function. Investigate the possibility of age-specific M.

7. Investigate alternatives to applying a single estimated acoustic selectivity based on trawl samples to the acoustic biomass indices.

Given the limited time constraints, we were not able to investigate all of these issues and we focused primarily on points 5 and 6. However, during the course of our analysis, we also estimate survey catchability coefficients q, and examine how well q is determined given alternative model assumptions.

The current assessment model suggests there must be many more large/older hake in the population under the assumption of an age/time-independent M, but these predictions are not supported by field observations (Helser et al. 2004). There are two alternative explanations to explain this discrepancy: a) larger/older fish are not as vulnerable to the sampling gear, and/or b) larger/older hake are fully vulnerable to the sampling gear but have a higher instantaneous natural mortality rate than younger individuals. An alternative modeling approach is to use age-specific natural mortality rate, but there is still some concern about the sampling process being representative of the true population age composition. Hake size segregate in the water column as well as over there range; larger hake are found in deeper in the water column and also migrate further to the north during the summer months (Sakuma and Ralston 1996; Dorn 1995; Helser et al. 2004). The commercial fisheries all use mid-water trawls and the acoustic survey uses both mid-water and bottom trawls to sample Pacific hake. Older hake are primarily sampled in the Canadian zone and older age-classes in the age-composition data from the acoustic trawl survey does not reflect the same proportions as those found in the commercial fisheries. In previous assessments the apparent non-representative sampling in the acoustic trawl survey data has been dealt with by using a strong dome-shape selectivity curve. It is possible that M is not independent of age and it may be more appropriate to use an age-specific M_a (e.g., Hampton 2000).

Pacific hake undergo seasonal migrations, and the extent of these migrations is probably influenced by oceanographic conditions and anomalous events such as el Niño and la Niña (Dorn 1992). Again, larger/older hake migrate further north in the summer months and evidence of this is reflected in the age-composition information between the US and CAN zones. Given the inter-annual variability in oceanographic conditions the vulnerability of each age-class to US and CAN fisheries also varies. Previous assessments have included additional time-dependent parameters to capture the changes in selectivity associated with variability in the distribution of the Pacific hake stock. Specifically, time varying selectivity was modeled as a random walk process where the ages at 50% vulnerability and shape parameters deviate around a mean on an annual basis (Helser et al. 2004). Is this model structure over-parameterized? Is it possible to incorporate oceanographic indices as a covariate for inter-annual changes in selectivity?

2 Methods

We conduct a series of simulation-estimation experiments using two models written in C++ using the AD Model Builder libraries (Otter Research 2001). Simulated observations are produced using a reference model, where the true parameter values and states are known. We then attempt to estimate these parameters using a statistical catch-at-age model based on the data generated by the reference model. To increase computational efficiency, we have re-written a condensed version of the original assessment model (essentially removed code associated with producing output files and projections), and because we were fitting this model to simulated data, we opted to omit much of the complex data massaging for dealing with suspect data. As a consequence of this decision, we have provided the source code (AD Model Builder template files) for both the reference model and the assessment model in the appendixes.

2.1 Statistical catch-at-age model

The assessment model is a statistical catch-at-age model, where numbers-at-age over time are based on the following equations:

$$\begin{aligned} N_{i,2} &= R_i, \\ N_{i+1,j+i} &= N_{i,j}\exp(-Z_{i,j}) \quad \ldots \quad 2 < j < J, \\ N_{i+1,J} &= N_{i,j-1}\exp(-Z_{i,j-1}) + N_{i,J}\exp(-Z_{i,J}), \end{aligned}$$

where the age-2 recruitment in year i (R_i) is an estimated parameter. Predicted catch-at-age in year i for fishery k was calculated using the Baranov catch equation,

$$\hat{c}_{i,j,k} = \frac{F_{i,j,k}}{Z_{i,j}}\left[1 - \exp(-Z_{i,j})\right] N_{i,j}$$

where $F_{i,j,k}$ is the fishing mortality rate in year i for age j in fishery k. Annual fishing mortality rates for each fishery ($f_{i,k}$) were treated as estimated parameters and age-year-specific fishing mortality rates are calculated as:

$$F_{i,j,k} = f_{i,k}v_{j,k}$$

where $v_{j,k}$ is the proportion of age j individuals that are vulnerable to fishery k. We adopted the same scaled-double-logistic selectivity function for calculating $v_{j,k}$ terms, i.e.,

$$\acute{v}_{j,k} = \left[(1 + e^{-g_1(j-lh_1)})(1 + e^{g_2(j-lh_2)})\right]^{-1}$$

$$v_{j,k} = \acute{v}_{j,k}/\max(\acute{v}_{j,k})$$

A set of 4 parameters (lh_1, lh_2, g_1 and g_2) were estimated for each fishery and each of the fishery independent surveys. Due to the rescaling of the $v_{j,k}$ terms we found it necessary to set a lower bound for the length at 50% vulnerability parameter (lh_2) to values greater than lh_1.

Vulnerable biomass in each year was calculated as the product of vulnerable numbers times the mean weight-at-age for year i:

$$B_{i,k} = \sum_j N_{i,j} v_{j,k} w_{i,j}.$$

It was necessary to calculate vulnerable biomass for each of the survey gears k in order to compare with relative abundance indices derived from different sampling gears.

2.1.1 Observation errors

Fisheries dependent observations consisted of total catch (tons) for each fishery (C_i), and catch-at-age proportions. Errors in reported catch were assumed to be log-normally distributed with a mean 0 and unknown σ_C. Unless otherwise stated, the standard deviation in σ_C was assumed constant over all years. Predicted total catch for each fishery in year i was calculated as:

$$C_{i,k} = \sum_j \hat{c}_{i,j,k} w_{i,j,k}$$

where $w_{i,j,k}$ is the observed mean weight-at-age in year i for fishery k. Predicted proportions-at-age were calculated as

$$\hat{p}_{i,j,k} = \hat{c}_{i,j,k} / \sum_j \hat{c}_{i,j,k}.$$

and observed proportions-at-age were assumed to be drawn at random from a mulitnomial distribution with probabilities $\hat{p}_{i,j,k}$. We also assumed aging is done without error. The combined negative log-likelihood for the observed total catch and age-proportions results in

$$\log L_{F,k} = \frac{1}{2\sigma_C^2} \sum_i \left(C_{i,k} - \hat{C}_{i,k} \right)^2 - \sum_i m_{i,k} \sum_j p_{i,j,k} \log \left(\frac{\hat{p}_{i,j,k}}{p_{i,j,k}} \right)$$

where $m_{i,k}$ is the multinomial sample size in fishery k.

Fisheries independent survey data consisted of a relative abundance index ($Y_{i,k}$), assumed to be proportional to biomass, and survey proportions-at-age. For simplification, it was assumed that each of the 3 surveys were independent and conducted just prior to the start of each fishing season. The predicted biomass index was calculated as

$$\hat{B}_{i,k} = q_k \sum_j N_{i,j} v_{j,k} w_{i,j}$$

where the catchability coefficient for each survey is unknown and estimated from the data. Predicted proportions-at-age in the survey samples were calculated from numbers-at-age and selectivity for survey k

$$\hat{\pi}_{i,j,k} = N_{i,j} v_{j,k} / \sum_j N_{i,j} v_{j,k}$$

The negative log-likelihood for the survey data is

$$\log L_{S,k} = \frac{1}{2\sigma^2_{Y,k}} \sum_i \left(Y_{i,k} - \hat{B}_{i,k} \right)^2 - \sum_i m_{i,k} \sum_j \pi_{i,j,k} \log \left(\frac{\hat{\pi}_{i,j,k}}{\pi_{i,j,k}} \right)$$

where $\pi_{i,j,k}$ is the observed proportion-at-age in the survey sample.

Unlike the Helser et al., (2004) assessment model, we did not consider the juvenile survey indices, as the additional information would not aid in the technical issues in this evaluation of model enhancements. Specifically, the juvenile survey index is only informative about estimates of age-2 recruits.

2.1.2 Process errors

There are 3 different process errors in this assessment model. Both annual estimates of recruitment and fishing mortality rates for each fishery are considered process error terms. The present Helser et al. (2004) assessment model does not use informative priors or constraints for these parameters. The only constrained process error term is on the deviations in the selectivity parameters. In this assessment model we also implement a constraint on the deviations in selectivity using a first differences in the δ_i terms

$$\log L_{p,l} = \sum \frac{(\delta_i - \delta_{i-1})^2}{2\sigma_\delta^2}$$

for each of l selectivity parameters in the commercial fisheries only. The details of this constraint is further discussed in section 2.2.2. The overall objective function to minimize is the sum of all negative log-likelihoods plus constraints

$$\log L = \sum_k \log L_{F,k} + \sum_k L_{S,k} + \sum_l \log L_{p,l}$$

2.2 Reference model

The reference model is the same age-structured model used in the statistical catch-at-age assessment model and is conditioned on the estimated historical recruitment and fishing mortality rates from the previous Pacific hake assessments. The reference model generates simulated age-composition data and total catches for each commercial fishery, relative abundance indices and age-composition data for each year that the surveys were conducted. We have set up this model such that data can be generated with zero measurement error in the abundance indices and age-proportions to determine if the assessment model is over-parameterized. To examine bias in parameter estimates coefficients of variation in the relative abundance indices and multinomial sample sizes for age-composition information are set to non-zero values. The code for the reference model ("simCAA.tpl") and the data file ("simCAA.dat") is presented in the appendixes. Note that this reference model creates the data file "CAA.dat" to be used in the statistical catch-at-age model: "CAA.tpl".

2.2.1 Bias M and other key parameters across a range of true and fit selectivity shapes

We did a broad range of simulations examining the direction and magnitude of the bias in M and other key parameters across a range of 'true' (simulated) and fit selectivity functions. The objective of this was to evaluate the performance of the model at estimating M and other key parameters. The key model parameters identified were the instantaneous natural mortality rate (M), initial selectivity parameters for the commercial fisheries, the survey selectivity parameters and the survey catchability coefficients q. We asked what the bias was in these key parameters in the following scenarios numbered 1-4:

1. data simulated with dome shaped vulnerability fit with dome vulnerability

2. data simulated with dome shaped vulnerability fit with aymptotic shaped vulnerability

3. data simulated with aymptotic shaped vulnerability fit with dome shaped vulnerability

4. data simulated with aymptotic shaped vulnerability fit with aymptotic shaped vulnerability

For each of these four scenarios we tested the model across of a range of slope g and lh parameters that is, we increased the steepness of the dome in the reference model and the age at 50 % selectivity for both the descending limb (lh_2) in the case of scenarios 1 and 2 or, the ascending limb (lh_1) in the case of scenarios 3 and 4. To do so we simultaneously increased the g_1 and g_2 parameter for all the surveys and both fisheries in increments of 0.25 starting with the first value listed in table 1. This made the dome progressively steeper with each increment. Note that the dome was made steeper for both fishery and the survey selectivity.

In a separate set of simulations we also tested the model across a range of lh_2 and lh_1 values. In scenarios 1 and 2 the initial lh_2 was increased in increments of 1 from the values listed in table 1. For scenarios 3 and 4 where data were generated with asymptotic vulnerabilities, lh_1 was increased in increments of 1 instead of lh_2. Starting values for this series are also listed in table 1.

The starting values of the g and lh parameters were chosen slightly below the existing maximum likelihood estimate for the parameters so that when the shape increment was 0.75 and the lh increment 3, the data were generated using vulnerability parameters that produced approximately the same mean vulnerabilities observed by Helser et al. (2004) in their scenario 1 c). Accordingly, the survey q's were set to 0.6 in the reference model and freely estimated in the assessment model. The survey CV for the US acoustic survey was set to 0.4 averaging between the 0.5 from years 1977-1989 and 0.3 for years 1992-2003 in this scenario.

For each scenario and shape or lh_2 increment we ran 100 simulations. We then made boxplots of the bias ratio calculated as $(Estimated - True)/True$ for M, the three survey q's, and the selectivity parameters of fisheries and surveys. We examined the biases in these parameters because they co-vary with estimates of the natural mortality in each simulation scenario. For clarity the proportional bias for those parameters not estimated (when asymptotic vulnerability shape is fit for example to data generated with dome shaped vulnerability) or not used in the reference model are not included. Starting parameter combinations used to simulate the data including the multinomial sample sizes and coefficients of variation for the survey and fishery catch at age sampling are list in table 1. To prevent errors due to starting parameter values being too far from true values, all parameter values in the stock assessment model were set to the same initial values listed in table 1.

Table 1: Reference model starting parameter values for increasing dome steepness (g) and lh

Parameters common to all scenarios

Survey Q's CV's	*US (A)*	*US trawl*	*Can (A)*
Mulitinomial sample size	60	60	60
CV in indices	0.4	0.3	0.3
catchability coefficients	0.6	0.6	0.6

Fishery Sample and CV's	*US*	*Canada*
CV in total catches	0.3	0.3
Mulitinomial sample size	300	130

Natural Morality	
M	0.23

	Varying Dome Steepness			**Varying lh2**		
Survey selectivity	*US (A)*	*US trawl*	*Can (A)*	*US (A)*	*US trawl*	*Can (A)*
lh1	3	3	3	3	3	3
shp1	1	1.85	1	1	1.85	1
lh2	12	13.3	12	11	12.3	11
shp2	0.2	0.48	0.2	0.7	0.98	0.7
Fishery selectivity	*US*	*Canada*		*US*	*Canada*	
lh1	3	4.65		3	4.65	
shp1	1.85	1.15		1.85	1.15	
lh2	13.3	13.45		11.3	11.45	
shp2	0.5	0.8		0.98	1.37	

2.2.2 Variability in fishery selectivity

We investigate if the use of a random walk for the selectivity parameters is over-parameterized, meaning that all model parameters cannot be uniquely determined from the data, and if it is possible to use oceanographic indices as a covariate for inter annual changes in fisheries selectivity. The use of prior distributions or constraints is common practice in mixed-error models because there is usually no independent information or measures of observation errors or process errors. In the hake assessment model, the inter annual variability in size selectivity is treated as a process error, and the use of the first difference acts as a prior (in a Bayesian sense) or a constraint (in a maximum likelihood sense) in the estimation process. Here we use a set of simulation-estimation experiments to examine the following questions:

- In the absence of measurement errors, are the data alone sufficient enough to allow for the estimation of the δ_i terms without the use of any constraint in the model?

- Is the first difference constraint required for the estimation of δ_i terms when there are measurement errors?

- Is it possible to use oceanographic data to model systematic changes in selectivity?

The 2004 assessment model implements a “pseudo random walk model” for simulating changes in selectivity over time as:

$$\gamma_i = \bar{\gamma} + \delta_i$$

where $\bar{\gamma}$ represents a mean value of a specific parameter in the selectivity function and δ_i is a random variable with a mean 0 and σ_δ. We term this a ”pseudo random walk model” because the objective function minimizes the first differences in the δ_i terms

$$\sum \frac{(\delta_i - \delta_{i-1})^2}{2\sigma_\delta^2},$$

which implies an autocorrelated series in the δ_i terms and σ_δ^2 limits the changes in γ_i around an overall mean. This is not the same as a continuous random walk model in which γ_i is updated according to

$$\gamma_i = \gamma_{i-1} + \delta_i.$$

The main difference between the two approaches is that the “pseudo random walk” constrains all values of γ_i around a mean $\bar{\gamma}$ and the “continuous random walk” only constrains the rate at which γ_i can change from year to year. Data sets from the reference model were generated using the continuous random walk model and the continuous random walk model was also implemented in the assessment model.

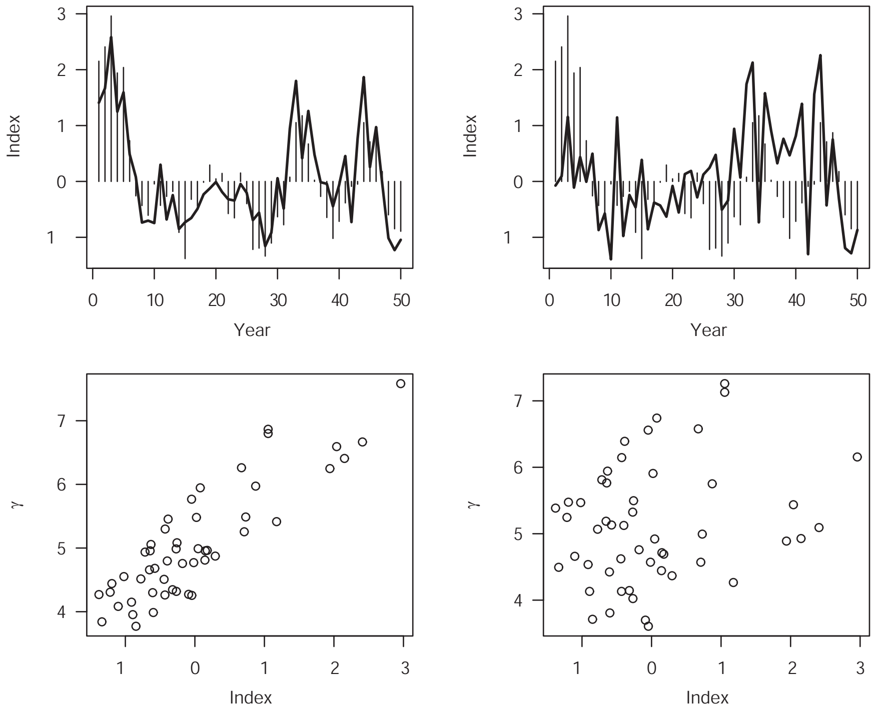


Figure 1: Two contrasting examples with strong (a-b) and weak (c-d) correlation between γ and the oceanographic index x. As the ratio of $\varrho : \sigma_\epsilon$ approaches 1, changes in γ perfectly track the index (as shown by the solid line in panel a), and as this correlation breaks down (d) the index x explains less of the variation in γ (c).

Due to time constraints we did not search for correlations between environmental or oceanographic indexes and changes in size selectivity in the commercial fisheries. Alternatively, we assume for the time being that there is a single index that is well correlated with the latitudinal distribution of the stock during the fishing season and investigate whether such an index could be used to estimate systematic changes in fisheries selectivity. Oceanographic indexes were generated from a random uniform distribution with an autocorrelation coefficient = 0.8 (e.g., Figure 1). The simulated oceanographic index x_i is standardized to have a mean = 0 and σ_x=1 by subtracting $\bar{x}$ from x_i and dividing by standard deviation in x_i. Time varying changes in selectivity parameters were treated as:

$$\gamma_i = \bar{\gamma} + \varrho x_i + \sigma_\epsilon \epsilon_i$$

where ϱ is the rate at which $\bar{\gamma}$ changes relative to the index x (assuming a linear relationship between x and γ) and ϵ_i is the residual error or additional variation in γ_i not explained by x. This approach markedly reduces the number of estimated parameters but assumes a constant relationship between x and γ. It is identical to the "pseudo random walk" approach defined earlier, but the estimated δ_i terms are replaced with the oceanographic index terms x_i and only ϱ and the mean selectivity parameter $\bar{\gamma}$ are treated as unknowns. The key question is how well correlated must x be with γ, or the ratio of ϱ to σ_ϵ, to consider using such an index to model changes in selectivity?

To address the question about if it is possible to use an index of some sort to model changes in size selectivity, we generated simulated data over a range correlation coefficients between the index and changes in selectivity parameters.

3 Results

3.1 Bias M and other key parameters across a range of true and fit selectivity shapes

The model performed reasonably well at producing estimates of M in all scenarios where dome steepness was increased except scenario 2 (Fig. 2). For scenario 1, the mean bias in M tended to be positive with a maximum mean bias of approximately 30 %. In addition, the variance about these estimates tended to be very large, and increasing with dome steepness. The worse bias in M occurred in scenario 2 when the data were generated with dome shaped vulnerability but fit with asymptotic vulnerability. In this case the model attributed the absence of older fish to increased natural mortality because it did not have the capacity to attribute it to decreased vulnerability of older fish. The bias in M was small in scenario 3 when data were generated with asymptotic selectivity yet fit with a dome shaped function (row 3 Fig. 2). In this case the mean bias was small, a maximum of 0.05 and there was a small increase this bias with the steepness of the ascending

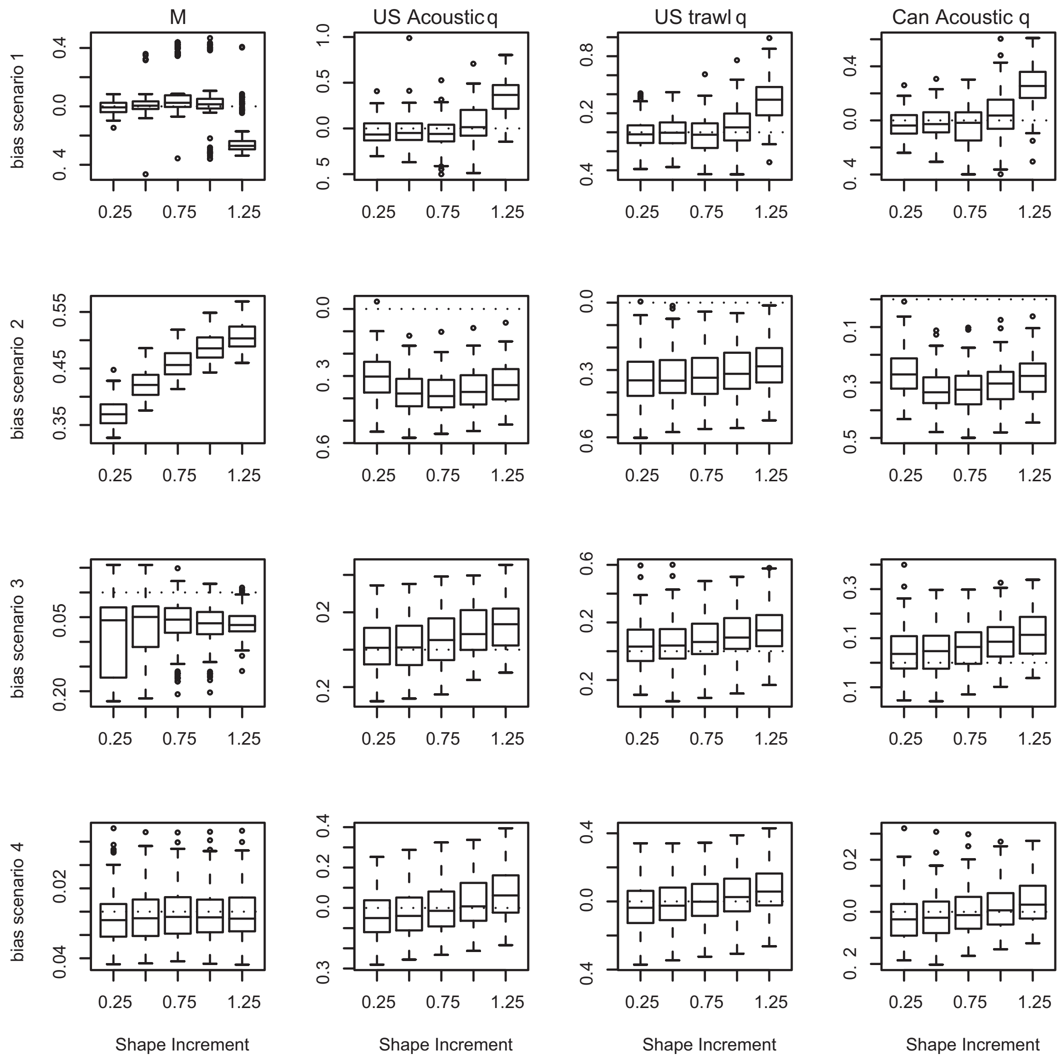


Figure 2: Box plots of parameter bias ratio's for 100 realized data sets for M and survey q's for U.S. acoustic, U.S. trawl ,Canadian acoustic across a range of dome steepness

limb. When data were generated with asymptotic vulnerability and fit with asymptotic vulnerability in scenario 4 (row 4 Fig. 2), the bias in M was on average slightly negative (0.02) and essentially invariant to the shape of the vulnerability function.

The bias in the estimated survey q's followed the inverse pattern to the bias in M across all scenarios (Fig. 2). In scenario 1 (row 1 Fig. 2), as the bias in M grew more positive at intermediate dome steepness the bias in all three survey q's became more negative, eventually approaching a mean 0 bias as the mean bias in M approached 0. For scenario 2 the bias in all three survey q's was unbiased at low dome steepness but then consistently unbiased at higher dome steepness (row 2 Fig. 2). The pattern observed in scenario 1 was also observed for scenarios 3 and 4, where increasingly positive bias in M. In this case the mean bias was relatively small for scenario 3 where the maximum bias ratio was approximately 10% at the maximum steepness values of the ascending limb. For scenario 4 the bias in q tended to be larger with a maximum bias ratio of approximately 40%.

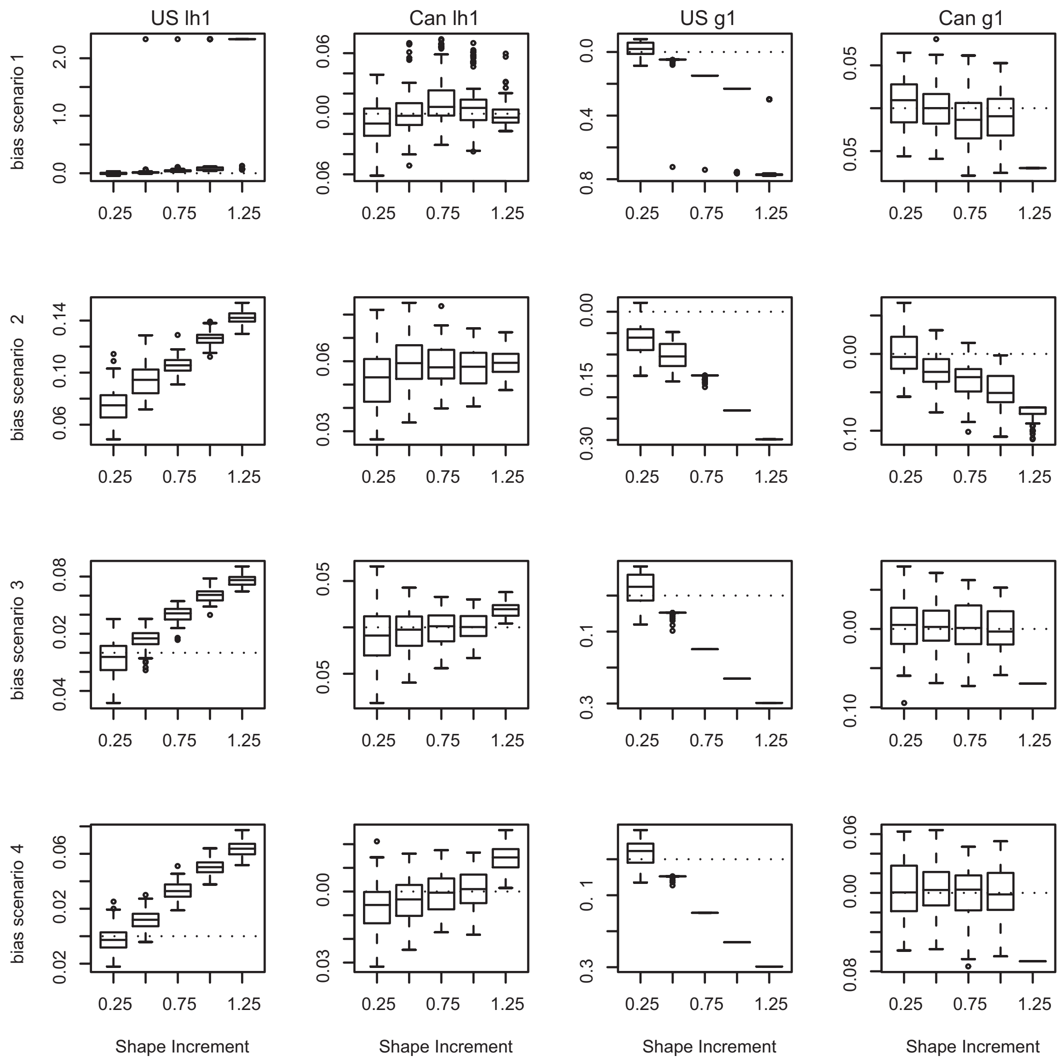


Figure 3: Box plots of parameter bias ratio's for 100 realized data sets for fishery selectivities lh_1 and $g1$ across a range of dome steepness

The fishery selectivity parameters describing the ascending limb of the selectivity were precisely estimated across almost all scenarios (Fig. 3) but parameter estimates were biased for the U.S. g_1 parameter at high steepness. Again the largest bias was observed under the conditions of fitting an asymptotic model to dome-shaped data (scenario 2). Even in this case however, the maximum bias observed in the U.S. lh_1 parameter was 12% at the maximum dome steepness. The bias in the Canadian lh_1 increased with dome steepness but only marginally ($\approx 5\%$). Values of the simulated U.S. g_1 were poorly defined for any scenario where the dome (or ascending limb in the case of scenarios 3 and 4) steepness increment was greater than 0.75. Similar results were also observed for selectivity parameter in the research surveys.

3.2 Key parameter bias with increasing age at 50% vulnerability (lh)

In the scenarios where the age at 50 % vulnerability (lh_2 or lh_1) was increased estimates of natural mortality M were essentially unbiased for all scenarios except scenario 2 (Fig. 4). As in section 3.1 above, M was over estimated for scenario 2, accounting for those fish not captured due to the 'real' dome shaped selectivity with increased natural mortality. Scenarios 3 and 4 had only very slight biases in M except when the lh_1 increment was very high in scenario 3 where the dome shaped vulnerability function had a difficult time fitting simulated data with a high lh_1 values.

The survey q's were well determined and unbiased except in scenarios 2 and 4, where asymptotic selectivity was fit (Fig. 4). For scenarios 1 and 3 estimates of q were on average unbiased, but with maximum bias of 0.10 in scenario three at the maximum lh_1 increment. For scenarios 2 and 4, the bias in survey q followed a pattern similar to that observed in section 3.1 that is as bias in M became negative, the bias in q became more positive. Here the maximum positive bias observed was in scenario 4 (row 4 of Fig. 4) where for the simulated acoustic q it was in the order of 0.5.

The fisheries selectivity parameters describing the ascending limb of the vulnerablity function were estimated fairly precisely with little bias for all scenarios except in scenario

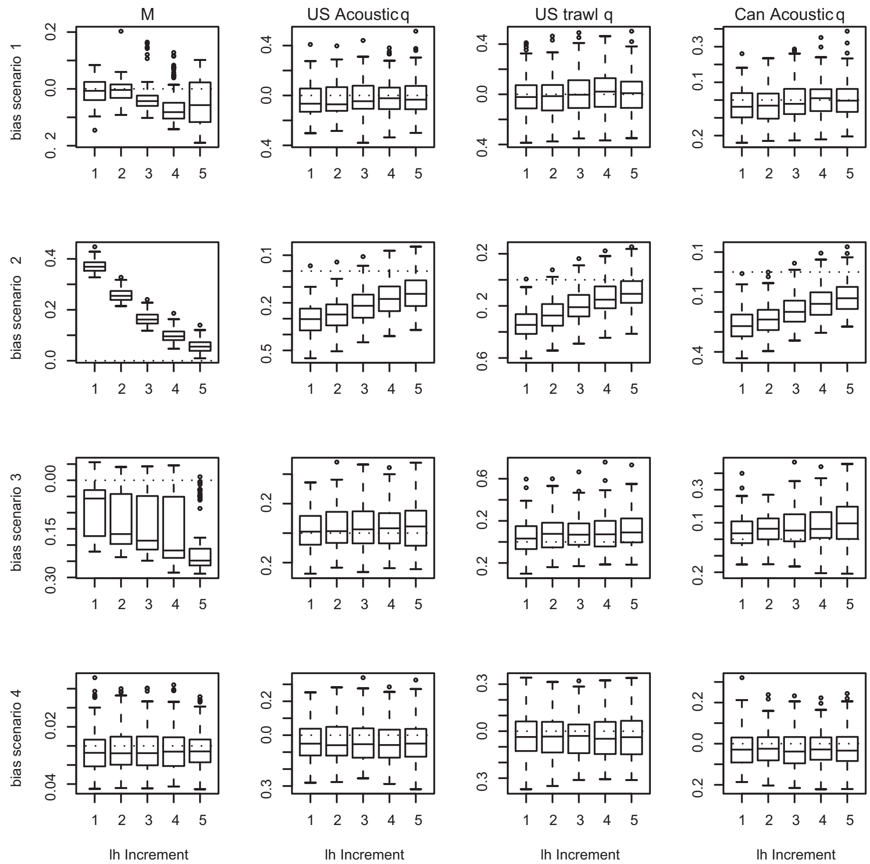


Figure 4: Proportional bias in estimates of M and survey q's for U.S. acoustic, U.S. trawl, Canadian acoustic over a range of increasing lh values

2 (Fig. 5). Here the maximum bias in the U.S. and Canadian lh_1, which like M decreased as lh_2 increased, was in the order of 6.5%. Otherwise the model performed very well across scenarios and lh increments.

The survey selectivity lh_1 for the Canadian acoustic surveys and both the lh_1 and g_1 parameters for U.S. trawl and were well determined for all scenarios (not shown). Unfortunately, the Canadian acoustic lh_1, g_1, and the U.S. g_1 were poorly determined for scenarios 2 and 4. In this case, the Canadian lh_1 parameter was over-estimated by nearly a factor of 2 in scenario 2 and was very poorly determined for scenario 4. This was expected for scenario 2, but is somewhat surprising for scenario 4, where data were generated with an asymptotic selectivity function and fit to a model that assumes asymptotic selectivity. The Canadian and U.S. g_1 parameters were negatively biased for

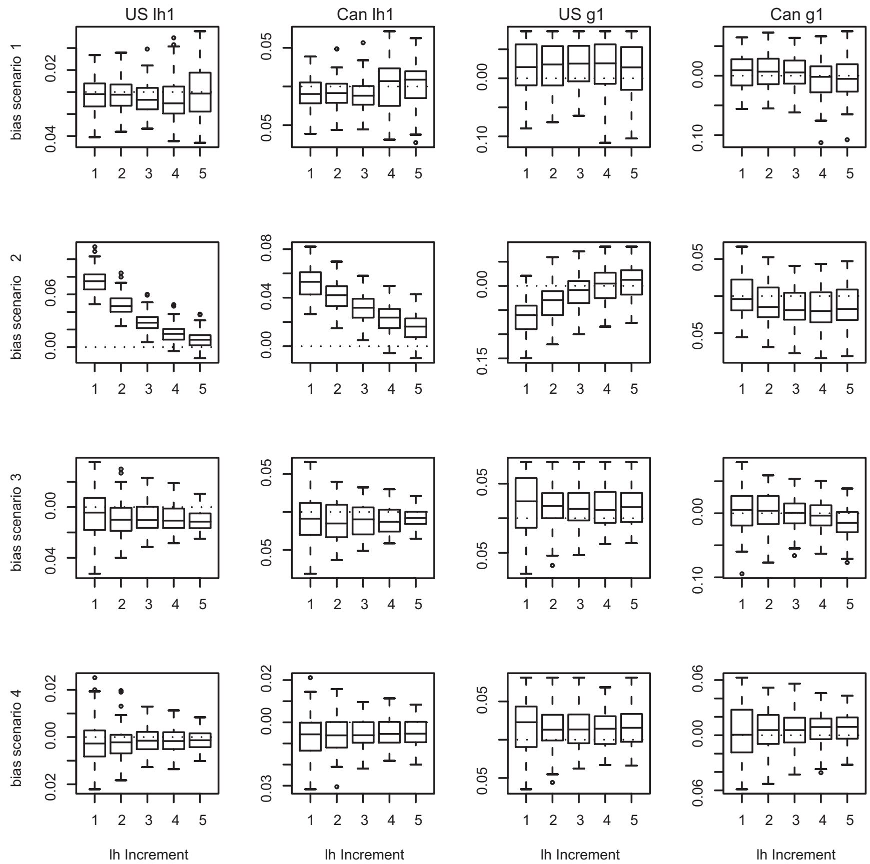


Figure 5: Proportional bias in estimates of lh_1 and g_1 for the U.S. and Canadian fisheries with varying simulated lh values

scenario 2, with mean biases of -50% and in scenario 4 a maximum bias of 0.8 which decreased at higher lh increments.

3.3 Variation in fisheries selectivity

To determine if the statistical catch-at-age model with time varying changes in the selectivity parameters is over-parameterized, 100 realized data sets were generated with no measurement errors to determine if the data alone are sufficient for estimating key model parameters. Input parameters used to generate simulated observations were constant and only the random number sequences used to generate process and observation errors differed. The key model parameters were identified as the instantaneous natural mortality rate, initial selectivity parameters for commercial fisheries and the survey catchability coefficients. For this example, we assumed that *survey* selectivity was time invariant and each realized data set contains a different sequence of random numbers for the variability in fisheries selectivity. No constraints were used for the deviations in selectivity parameters to determine if the data alone are sufficient for estimating the true parameter values.

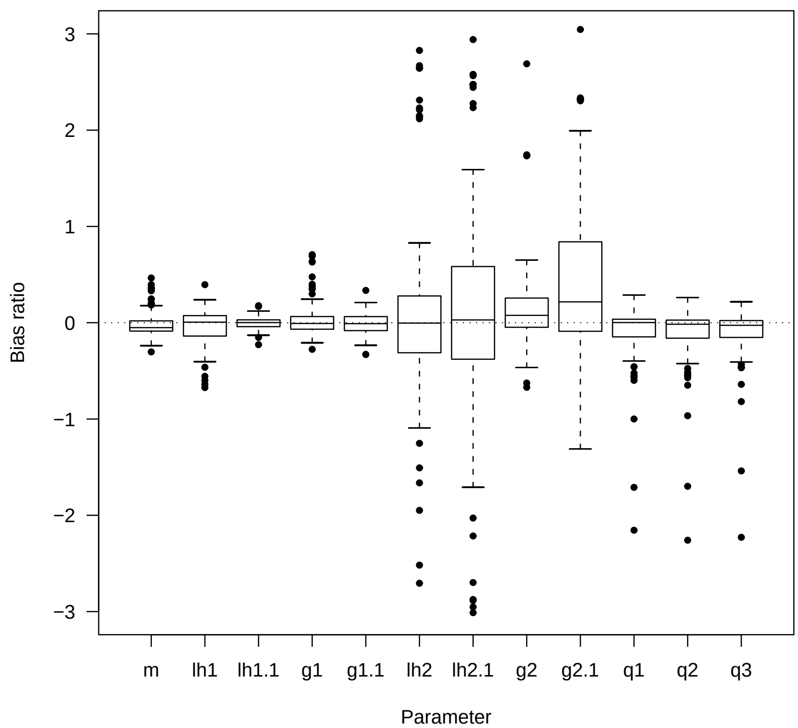


Figure 6: Box plots of parameter bias ratio's for 100 realized data sets with no measurement errors. Bias ratio's are represented on a $\log_2$ scale where a bias ratio value of 1 indicates over-estimation of the true parameter value by a factor of 2.

Resulting parameter estimates from 100 realized data sets (with no measurement errors) are shown in Figure 6. For each simulation-estimation experiment, a total of 445 parameters were estimated. The natural mortality rate M, survey catchabilities and the parameters for the ascending limb of the fisheries selectivity are well determined in the absence of measurement errors. Parameters for the descending limb of the selectivity function were less well determined and survey catchabilities are slightly biased downwards.

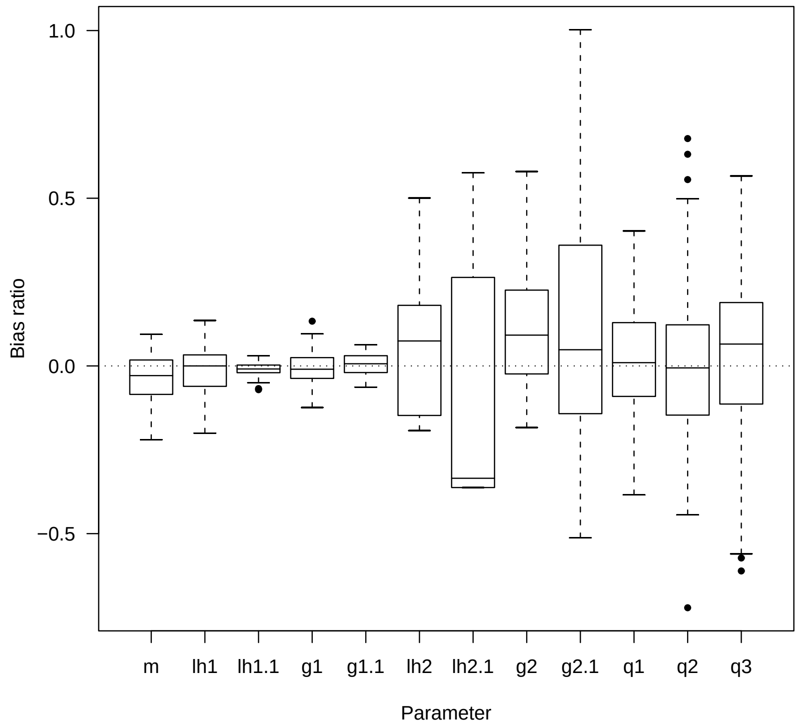


Figure 7: Box plots of parameter bias ratio's for 100 realized data sets with measurement errors and constant size selectivity.

As expected, uncertainty in estimates for M and q's increases when measurement errors are included into the simulated data sets (Figure 7). The results in Figure 7 were generated with time invariant selectivity functions for commercial fisheries and surveys in both the reference and assessment models. The largest uncertainty was observed in parameters that describe the descending limb of the selectivity curves for each fishery, particularly for the simulated Canadian fishery where larger/older fish are more vulnerable to the fishing gear. There is a tendency for the for lh_2 parameters to hit there lower bound in the Canadian fishery, and when estimated with no bounding constraints $lh_2 < lh_1$ for many of the simulated data sets. Survey catchability coefficients tend to be unbiased and the range of parameter estimates is within 50% of the true value.

Table 2: Correlations between natural mortality and bounded US and CAN selectivity parameters among the 100 simulated data sets with no inter annual variability in selectivity.

US fishery

	M	lh_1	g_1	lh_2	g_2
M	1.00	0.38	0.23	-0.28	-0.65
lh_1	0.38	1.00	-0.60	-0.90	-0.76
g_1	0.23	-0.60	1.00	0.38	0.10
lh_2	-0.28	-0.90	0.38	1.00	0.83
g_2	-0.65	-0.76	0.10	0.83	1.00

CAN fishery

	M	lh_1	g_1	lh_2	g_2
M	1.00	0.11	0.32	-0.13	-0.48
lh_1	0.11	1.00	-0.59	-0.68	-0.61
g_1	0.32	-0.59	1.00	0.02	-0.15
lh_2	-0.13	-0.68	0.02	1.00	0.88
g_2	-0.48	-0.61	-0.15	0.88	1.00

Estimates of natural mortality are slightly biased downward (Figure 7) and are negatively correlated with the shape parameter (g_2) of the descending limb of the selectivity curves (Table 2). Note that the correlations in Table 2 are biased due to the bounding constraints for the shape parameter lh_2, as shown in Figure 8. There is additional confounding among the selectivity parameters themselves. For parameters that describe the ascending portion of the selectivity curve, there is a tradeoff between the age at 50% vulnerable and how steep the selectivity curve is. For the descending portion of the selectivity curve there is a positive correlation in the shape parameter and the age at 50% vulnerable. The strongest negative correlation exist between the inflection points between the ascending portion and descending portions of the selectivity curves (lh_1 and lh_2). This strong negative correlation, as well as, the frequent occurrence of estimating $lh_2 < lh_1$ arises due to the renormalization of the selectivity curve to a maximum of 1.

Figure 8 demonstrates the confounding between estimates of M and the shape parameters for the descending portion of the selectivity curve for the US fishery assuming constant selectivity over time. There appears to be little correlation between the age at

50% selectivity on the descending limb (lh_2) and natural mortality as well as parameters for the ascending limb of the selectivity function (lh_1 and γ_1). Similar correlation patterns in parameter estimates were observed in simulated data sets with time-varying changes in size selectivity.

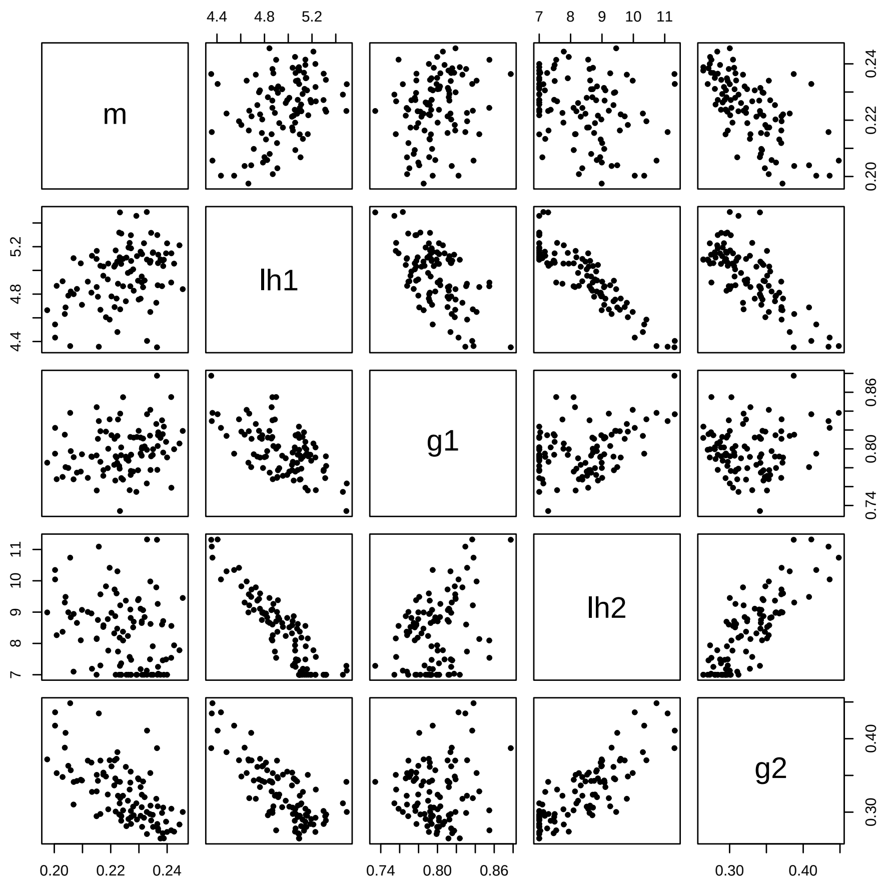


Figure 8: Coplot of parameter estimates for 100 simulated data sets comparing estimates of natural mortality and selectivity parameters with constant size selectivity.

Uncertainty in selectivity and survey catchability parameters increases substantially under conditions of time-varying changes in commercial fishery selectivity (Figure 9). Natural mortality and selectivity parameters for the ascending limb are fairly well defined and unbiased. There is a slight downward bias in the estimates of survey catchability (note that no priors were assumed for the survey q parameters). Overall, the full estimation method is able to capture trends in abundance but fails to estimate the absolute abundance much of the time.

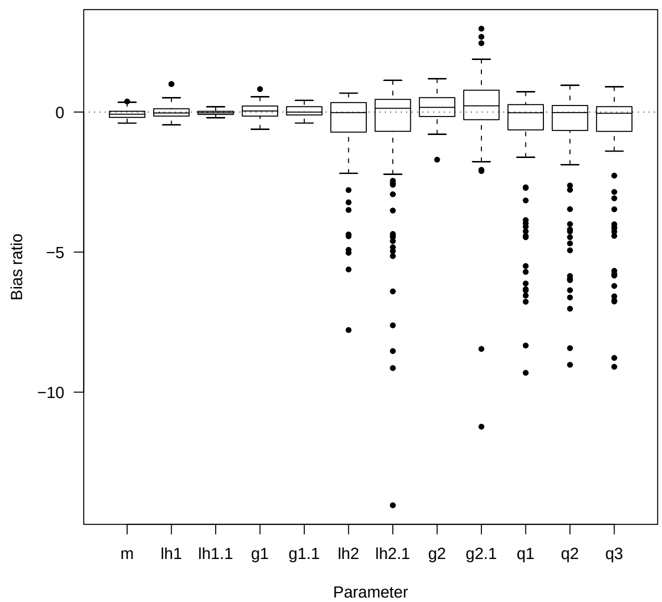


Figure 9: Box plots of parameter bias ratio's for 100 realized data sets with measurement errors and time-varying size selectivity in the commercial fisheries.

Estimates of the deviation parameters in the random walk model δ_i appear to be unbiased provided that the proper σ_δ is specified in the penalty or prior distribution (Figure 10a). If an over-dispersed or no prior is used, the variance of estimated δ terms increases (Figure 10b). Uncertainty in other key model parameters (selectivity and survey catchability coefficients) increases dramatically without the use of constraints on the δ_i terms. There is a slight tendency to underestimate the survey catchability coefficients, although the median of the 100 simulated data sets appears to be unbiased.

3.3.1 Incorporating oceanographic indices in selectivity

If the oceanographic index explains 100% of the variation in selectivity parameters, estimated parameters are unbiased (Fig. 12 and the range in estimates is much less than that of estimating annual deviations in selectivity parameters (compare Fig. 12 with Fig. 9). Overall, the range of uncertainty decreases for all estimated parameters, however, on

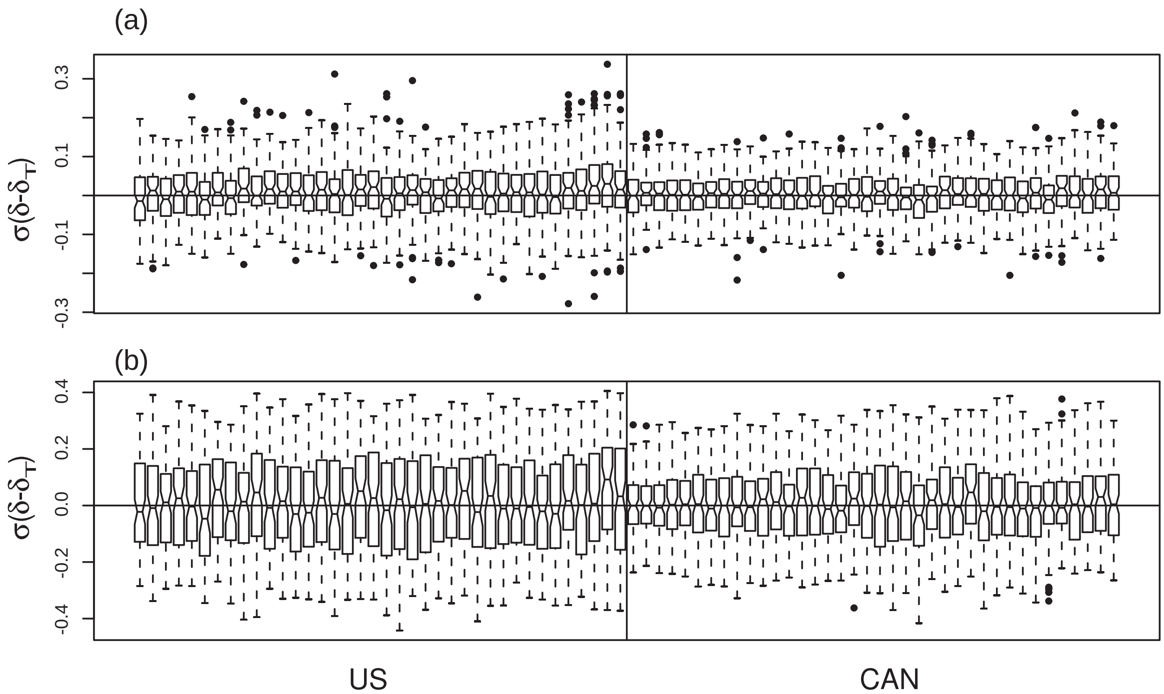


Figure 10: Distribution of differences between in estimated and true δ_i parameters from 100 simulated data sets for the random walk in lh_1 for the commercial US and Canadian selectivity. The true $\sigma = 0.25$ was used in the first differences constraint (a), and no constraint in (b).

a few occasions the estimation routine was not able to estimate all model parameters, leading to some extreme values. This was largely a result of the different oceanographic indices used for each simulation.

There is a substantial improvement in parameter estimates, especially M and selectivity parameters that describe the ascending limb, if the index explains only a small fraction of the variation in selectivity (Fig. 13b). The bias in selectivity and survey catchability parameters is greatly reduced, and the uncertainty in these estimates is further reduced as correlation between the index and γ increases. The oceanographic index needs to explain greater than 50% of the variation in selectivity in order to improve estimates of the selectivity parameters that describe the descending limb.

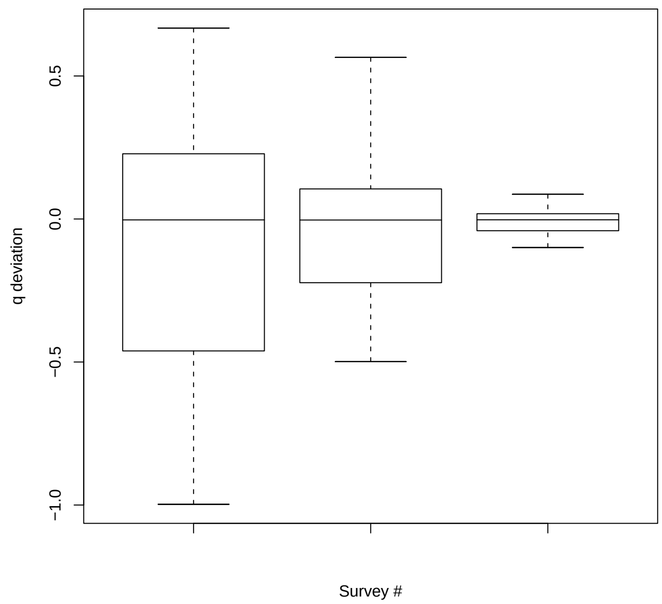


Figure 11: Deviations in the estimate of the survey catchability coefficients. True survey q's from left to right are 1.0, 0.5, and 0.1.

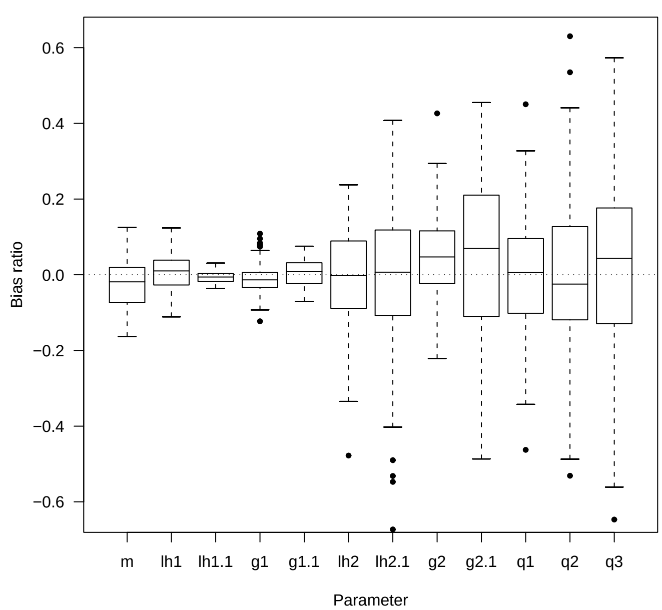


Figure 12: Box plots of parameter bias for 100 realized data sets with measurement errors and variability in size selectivity parameters are 100% explained by the oceanographic index x. Note that a different index x was used in each of the simulations.

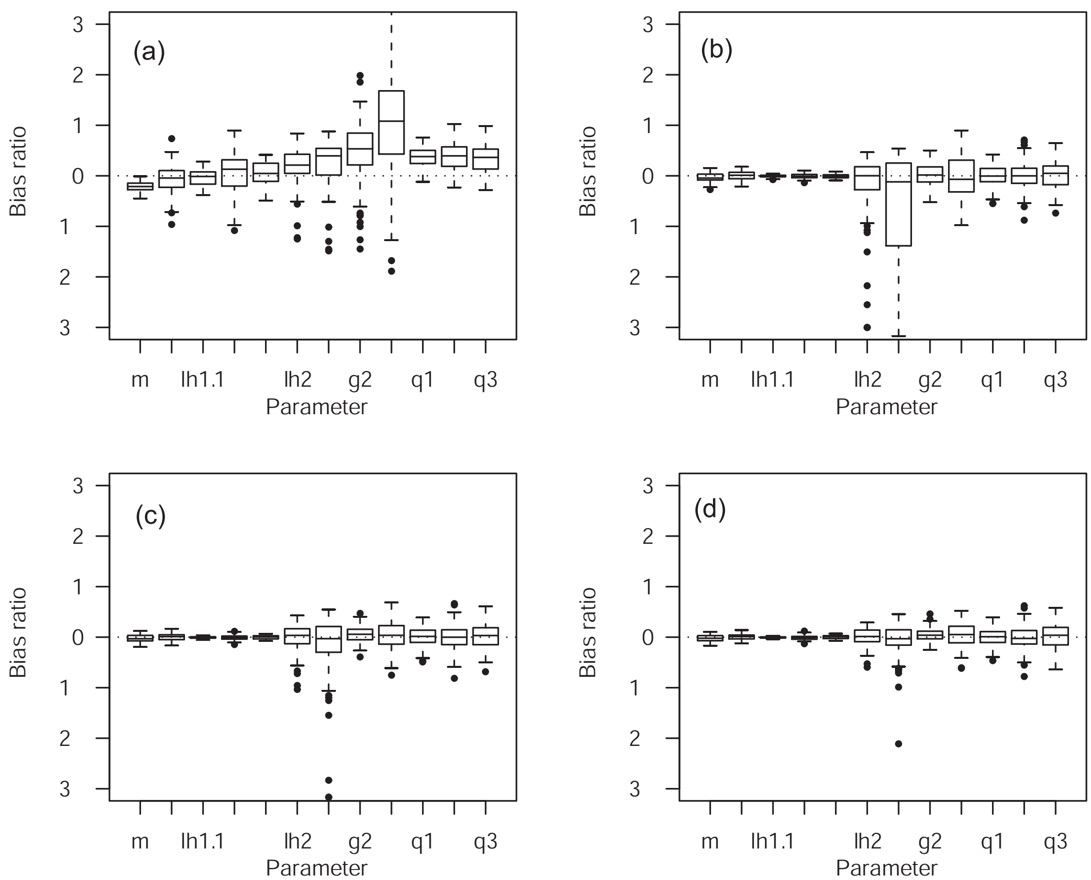


Figure 13: Comparison of parameter estimates from 100 realizations where (a) there is no relationship between the environmental index x and selectivity parameters, (b) correlation between the index x and $\gamma = 0.25$, (c) correlation $= 0.5$, and (d) correlation $= 0.75$. Note that all figures are plotted on the same y-axis scale.

4 Discussion

The statistical catch-at-age model precisely estimates natural mortality M and all other model parameters when under circumstances of no measurement error (i.e., perfect information). This was not the case when estimating parameters to describe temporal variation in selectivity. This suggests that the random walk model for changes in fishery selectivity is over-parameterized. It was still possible to obtain reasonable parameter estimates, with minimal bias, when introducing the previously assumed observation errors; however, the use of constraints were necessary to prevent unreasonable estimates of certain parameters, primarily the selectivity parameters for the descending portion of the selectivity curve. Furthermore, in nearly all of the results from simulation-estimation experiments the greatest uncertainty was observed in the selectivity parameters that describe the descending portion of the selectivity curve. We did not explore the relative influence of recruitment survey data on the over-all estimation performance; however, we do not feel such an index would contribute much information on changes in selectivity for older age animals.

4.1 Natural mortality

Results from the simulation-estimation experiments involving changes in the selectivity parameters have clearly defined that trade-offs exist between estimate of an age-independent M and parameters for a dome-shaped selectivity curve. Previous assessments have indicated that the assessment model suggest that there should be a large number of older-aged fish in the population; however, this contradicts the observations from the acoustic trawl survey age-proportions (Helser et al. 2004). Age independent natural mortality appears to trade-off negatively with the decline rate of the descending portion of the selectivity curve, and the use of an age-independent M would increase this confounding even further. One potential way to reduce this confounding of parameters is to assume a sigmoid selectivity curve and reduce the plus group-age to an age that is fully vulnerable to all sampling gears. This is nearly equivalent to scenario 2 (where data were generated with a dome-shaped selectivity curve and estimated with a sigmoid curve) and increased bias was observed for many of the parameters, especially the natural mortality rates.

Examples of assessment models that estimate age-specific M's all share 2 common elements: 1) the oldest age-class is fully vulnerable to at least one of the fisheries or sampling gears, and 2) a constraint or prior is used on relative changes in age-specific M's to discern between real changes in M and errors in age/size composition sampling (see e.g., Hampton 2000; 2002). It may be possible to estimate age-specific M's, or parameters for a function that describe changes in M as a function of age, but one would have to assume that the research trawl survey data or acoustic surveys are fully sampling the oldest age classes.

One of the key findings in the simulation experiments was that M is negatively correlated with the shape parameters (g), and the real danger is over-estimating M (this leads over-optimistic estimates of biomass). All of the scenarios involving fitting an asymptotic or sigmoid selectivity function to data that were sampled from a dome-shaped selectivity function (Scenario 3) lead to an under-estimate of M. This results in a conservative estimate of biomass and the survey catchability coefficient will be biased upwards. In contrast, fitting a dome-shaped model to data that were sampled from a sigmoid selectivity function (i.e., scenario 2), tends to over-estimate M, which tends to over-estimate biomass and the survey q's are biased downward. In recent assessments of Pacific hake when q is allowed to be estimated freely there is a strong tendency for q to be much less than 1 (i.e., Helser et al. 2004). This is thought to be biased downward and fixed $q = 1$ and $q = 0.6$ options have been used for presenting projections to decision makers. Although we have not ruled out other potential sources of bias in q, it could be that the fisheries selectivities (at least in the Canadian zone) are actually sigmoid.

4.2 Estimating selectivity

It appears that it is possible to estimate annual deviations in selectivity parameters given independent information on natural mortality and some prior information about variability in selectivity parameters. In cases where selectivity varies from year-to-year, we observed that estimates for the length at 50% vulnerability for the descending limb were often less than that of the ascending limb. Thinking about this further, we noticed that the scaled double logistic function (which re-calculates the age-specific selectivities) would still produce a reasonable dome-shaped curve when $lh_2 << lh_1$. There are very few older-age individuals in the catch-at-age proportions relative to younger individuals and therefore much of the information to estimate parameters for the dome-shaped selectivity curve comes from the few strong cohorts that survive to an older age. Furthermore, there is strong confounding between the shape parameter for the descending portion of the selectivity curve and the natural mortality rate. This negative relationship between M and g_2 implies that the data just as likely to have come from a population with a high natural mortality rate and a nearly asymptotic selectivity curve or a low natural mortality rate and a more dome-shaped selectivity curve. At this moment, we cannot think of a reasonable way to resolve this confounding issue other than to use constraints or priors for M or g_2 or simply assume a sigmoid selectivity function. Since it is not possible to estimate all model parameters using simulated data with no observation errors the present statistical catch-at-age model with the random walk in selectivity parameters is over-parameterized. In contrast to the real data, the simulated data sets were much more informative (lower CV's, and relative abundance indices are proportional to B_t), and it was still difficult to estimate time-varying selectivity parameters.

It should also be noted that the manner in which we dealt with changes in selectivity parameters differed slightly from the previous hake assessment models. We used a continuous random walk model to model changes in selectivity parameters, whereas, Helser et al. (2004) used a constrained random walk model. We did not conduct any simulation experiments to examine the difference, but note that the constrained random walk model will tend to allow selectivity parameters to wander around a mean, and the continuous model permits systematic changes in selectivity. Other than estimating one less parameter, we suspect the differences are very minor.

Previous work on the migration of hake populations, catch-age observations from the commercial fisheries, the distribution of hake during the triennial acoustic surveys and variation in hake diets, clearly demonstrates inter annual variability in the distribution of the hake stock (Dorn 1991; 1992; 1995; Buckley and Livingston 1997). There appears to be a relationship between mean January-February sea level height and the proportion of the hake stock that migrates into the Canadian zone (Mark Saunders, Pers. Comm.), as well as a relationship between temperature (Dorn 1995). These dynamic changes in distribution obviously affect the availability of certain age-classes to US and Canadian fishing fleets, and hence the need to develop a method to capture these dynamic changes in selectivity. The results from including an oceanographic index to model changes in selectivity parameters were quite surprising. Including an oceanographic index, even one that was only slightly correlated ($r^2 = 0.25$), greatly improved estimation precision for all parameters, including survey q's and selectivity parameters for the descending limb. Dorn (1995) found significant correlations ($r^2 \geq 0.8$) between an estimated migration coefficient and sea-temperature anomalies at 100m depth; however, this strong correlation has broken down recently. Adding to the difficulty of finding an appropriate index will be the uncertainty in estimated changes selectivity. By comparison, the contour plots for changes in selectivity between this years assessment and the previous year differ slightly as a result of the new catch-at-age data for 2004 fishing season.

4.3 Explicit representation of hake movement

The present assessment model (Helser et al. 2004) implicitly represents the spatial variation in the hake distribution through the use of a series of dome-shaped selectivity curves that vary over time. An alternative approach is to explicitly represent the spatial variation in hake distribution relative to the Canadian zone through the use of an age-specific movement model, where in each year the fraction of each age-class in the Canadian zone is calculated or estimated. A similar model was constructed by Dorn (1995) to estimate what fraction of the stock was in the Canadian zone for years in which surveys were not conducted. Dorn (1995) documented a high positive correlation exists between the mean sea-water temperature at 100m depth between 30º–42ºN and a migration coefficient ($p_{3,i}$) implying that intensified poleward flowing currents (as index by temperature-at-depth) results in a higher fraction of the hake stock in the Canadian zone.

It may be possible to eliminate the use of dome-shaped selectivity curves in the commercial fisheries if the assessment model includes explicit terms for the fraction of the total stock that is in the US and Canadian zones. This involves a simple modification to the catch equations, namely:

$$\hat{c}_{i,j,k} = \frac{F_{i,j,k}}{Z_{i,j}} \left[1 - \exp(-Z_{i,j})\right] p_{i,j,k} N_{i,j},$$

and

$$F_{i,j,k} = \frac{f_{i,k}}{1 + e^{-g_k(j - lh_k)}},$$

where $p_{i,j,k}$ is the fraction of the total $N_{i,j}$ that is in zone k. Dorn (1995) suggested a simple logistic curve to calculate the proportion-at-age in the Canadian zone:

$$p_{i,j,k} = \frac{\gamma_{1,i}}{1 + e^{-\gamma_2(j - \gamma_3)}}$$

and the proportion in the US zone is $1 - p_{i,j,k}$. Note the vector $\gamma_{1,i}$ implies inter-annual variation in the fraction of hake in the Canadian zone, and it is this term that is positively correlated with mean sea water temperature. The shape parameter γ_2 is roughly proportional to the size-specific swimming speeds, that is, it reflects the between cohort differences in annual migration distances. There is a serious limitation in this model, in that the constant γ_3 parameter implies that the center of the hake distribution is fixed over time. For example, if $\gamma_3 = 5$ and $\gamma_1 = 1$, then a maximum of 50% of age-5 individuals could ever enter the Canadian zone. This is inconsistent with 1998 observations, where hake were spawning in the Canadian zone. An alternative model that is more consistent with recent observations would be to estimate a vector of $\gamma_{1,i}$ and $\gamma_{3,i}$ parameters, which implies both variation in the northward extent of the migration as well as variation in the center of the hake distribution.

4.4 Alternatives to priors on q

The greatest source of uncertainty, or conflict, is trying to scale the biomass to the acoustic survey data, or q. In the present assessment model, there appears to be sufficient information to estimate q, however, the estimates are believed to be seriously biased downward. One of the model enhancements recommended by the STAR review panel was to develop an informed prior on q. What basis should this prior be built upon? As we noted in the above simulation-estimation experiments, the information in q was confounded with parameters such as natural mortality rates and selectivity parameters. An alternative to developing priors for q would be to re-parameterize the model to reduce confounding (i.e., reduced the number of estimated nuisance parameters) or build in a production function, such as a stock-recruitment relationship, where we do have information to construct priors (e.g., Myers and Barrowman 1996; Myers et al. 1999).

References

Buckley, T. W. and Livingston, P. A. (1997). Geographic variation in the diet of pacific hake, with a note on cannibalism. *Calif. Coop. Oceanic Fish. Invest. Rep*, 38:53–62.

Dorn, M. W. (1992). Detecting environmental covariates of pacific whiting (merluccius productus) growth using a growth-increment regression model. *Fish. Bull. U.S.*, 90:260–275.

Dorn, M. W. (1995). The effects of age composition and oceanographic conditions on the annual migration of pacific whiting *Merluccius productus. Calif. Coop. Oceanic Fish. Invest. Rep*, 36:97–105.

Dorn, M. W. . U. D. C. (1991). Spatial and temporal patterns in the catch of pacific whiting in the u.s. management zone during 1978-88. *NOAA Tech. Memo. NMFS-F/NWC-205,*, page 68.

Hampton, J. (2000). Natural mortality rates in tropical tunas: size really does matter. *Can. J. Fish. Aquat. Sci.*, 57:1002–1010.

Hampton, J. (2002). Stock assessment of skipjack tuna in the western and central pacific ocean. *In 15th Meeting of the Standing Committee on Tuna and Billfish. Working paper SKJ–1, Ocean Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia (http:www.spc.org.nc/Oceanfish).*

Helser, T. E., Methot, R. D., and Fleischer, G. W. (2004). Stock assessment of pacific hake (whiting) in u.s. and canadian waters in 2003. *Northwest Fisheries Science Center National Marine Fisheries Service National Oceanic and Atmospheric Administration 2725 Montlake Blvd., East Seattle, WA 98112, USA.*

Myers, R. A. and Barrowman, N. J. (1996). Is fish recruitment related to spawner abundance? *Fish. Bull.*, 94:707–724.

Myers, R. A., Bowen, K. G., and Barrowman, N. J. (1999). Maximum reproductive rate of fish at low populations sizes. *Can. J. Fish. Aquat. Sci.*, 56:2404–2419.

Otter Research (2001). An introduction to ad model builder version 6.0.2 for using in nonlinear modeling and statistics. *Otter Research Ltd, Box 2040, Sidney B.C., V8L 3S3*, 2001.

Sakuma, K. M. and Ralston, S. (1996). Vertical and horizontal distribution of juvenile pacific whiting *(Merluccius productus)* in relation to hydrography of california. *Calif. Coop. Oceanic Fish. Invest. Rep.*, 38(137-146).

5 ADMB code for reference model

```
//*****************************************************
// Programmer: Steve Martell
// Project Name: simCAA.tpl
// Date:   Dec 16, 2004
// Version:1.0
// Comments: A reference model for Pacific Hake stocks
//
//*****************************************************/
DATA_SECTION
    //Error distribution parameters

    init_number cv_catch;
    init_vector cv_yt(1,3);
    init_ivector fsh_multn(1,2);    //multinomial fisheries
    init_ivector sur_multn(1,3);    //multinomial survey

    //standard deviations for fisheries selectivity parameters
    init_vector sel_rwlk_std(1,2);

    //scaler for oceanographic index
    init_vector varrho(1,2);

    //random number seed comes from a file.
    int seed;
    !!ifstream ifs("seedno.txt");
    !!ifs>>seed;

    init_int syr;                         //starting year
    init_int nyr;                         //ending year
    init_int rcrage;                      //recruitment age
    init_int trmage;                      //+group age
    vector age(rcrage,trmage);
    !!age.fill_seqadd(rcrage,1);
    init_number m;                        //instantaneous natural mortality

    init_vector mat(rcrage,trmage)      // Proportion mature
    init_vector femmult(rcrage,trmage)  // Multiplier to get spawning biomass


    //Selectivity parameters for fisheries.
    init_vector lh1(1,2);
    init_vector shp1(1,2);
    init_vector lh2(1,2);
    init_vector shp2(1,2);


    //Selectivity parameters for surveys.
    init_int nsurveys;
    init_vector sur_q(1,nsurveys);
    init_vector sur_lh1(1,nsurveys);
    init_vector sur_shp1(1,nsurveys);
    init_vector sur_lh2(1,nsurveys);
```

```
    init_vector sur_shp2(1,nsurveys);

    //survey number and year
    //number of survey years
    init_ivector nsurv_year(1,nsurveys);
    init_imatrix surv_years(1,nsurveys,1,nsurv_year);//actual survey years


    //Driving variables for reference model
    init_vector recruits(syr,nyr);
    init_matrix f(1,2,syr,nyr);

    init_3darray fsh_wt(1,2,syr,nyr,rcrage,trmage);

    init_matrix wt_pop(syr,nyr,rcrage,trmage)// Population weight at age
    //++++++++++++++++++++++END OF DATA INPUT+++++++++++++++++++++++++


    vector bio(syr,nyr);                        //total pop biomass
    vector x(syr,nyr);                      //Oceanographic index

    matrix z(syr,nyr,rcrage,trmage);            //instantaneous total mortality
    matrix n(syr,nyr,rcrage,trmage);            //numbers-at-age matrix
    matrix sur_yt(1,nsurveys,1,nsurv_year);//survey indicies
    matrix tot_catch(1,2,syr,nyr);          //total catch by fishery
    matrix nu(1,2,syr,nyr);                     //random variables for catch error
    matrix delta(1,nsurveys,1,nsurv_year);  //Random variable for survey errors
    matrix shp1_dev(1,2,syr,nyr);           //random walk variables for shp1
    matrix lh1_dev(1,2,syr,nyr);            //random walk variables for lh1
    matrix shp2_dev(1,2,syr,nyr);           //random walk variables for shp2
    matrix lh2_dev(1,2,syr,nyr);            //random walk variables for lh2


    3darray fsh_c(1,2,syr,nyr,rcrage,trmage);       //catch-at-age matrix
    3darray fsh_p(1,2,syr,nyr,rcrage,trmage);       //catch-at-age proportions matrix
    3darray fsh_sel(1,2,syr,nyr,rcrage,trmage);     //selectivity for commercial fisheries
    3darray sur_sel(1,nsurveys,1,nsurv_year,rcrage,trmage); //selectivity for the surveys.
    3darray sur_p(1,nsurveys,1,nsurv_year,rcrage,trmage);   //proportions-at-age for the surveys.


PARAMETER_SECTION

    objective_function_value func;
    LOC_CALCS
        cout<<"________SIMULATING DATA_________"<<endl;
        generate_error_dists();
        get_selectivities();
        get_mortality();
        numbers_at_age();
        get_catch_at_age();
        survey_data();
        write_data_file();

        cout<<"RANDOM SEED NO. = "<<seed<<endl;
```

```
        cout<<"********DONE SIMULATION********"<<endl;
        exit(1);
    END_CALCS

PROCEDURE_SECTION


FUNCTION generate_error_dists
    random_number_generator rng(seed);

    nu.fill_randn(rng);     //errors in total catch
    delta.fill_randn(rng);
    x.fill_randu(rng);      //uniform oceanographic index
    for(int i=syr;i<nyr;i++)x[i+1]=0.8*x[i]+0.2*x[i+1]; //autocorrelated
    x=(x-mean(x))/sqrt(var(x));


    //selectivity deviations
    shp1_dev.fill_randn(rng);
    lh1_dev.fill_randn(rng);
    shp2_dev.fill_randn(rng);
    lh2_dev.fill_randn(rng);
    for(int j=1;j<=2;j++)
    {
        shp1_dev(j)*= 0.25*sel_rwlk_std[j];
        lh1_dev(j)*= sel_rwlk_std[j];
        shp2_dev(j)*= 0.25*sel_rwlk_std[j];
        lh2_dev(j)*= sel_rwlk_std[j];
    }




FUNCTION get_selectivities
    int i,j;
    double g1, g2, h1, h2;
    //This is the fisheries selectivities only.
    for(j=1;j<=2;j++)
    {
        //initialize random walks for selectivity parameters in fishery j
        g1=shp1[j];
        g2=shp2[j];
        h1=lh1[j];
        h2=lh2[j];

        for(i=syr;i<=nyr;i++)
        {
            if(i>syr&&varrho(j)==0)
            {//update random walk parameters for year i
                g1+=shp1_dev(j,i);
                h1+=lh1_dev(j,i);
                g2+=shp2_dev(j,i);
                h2+=lh2_dev(j,i);
            }
```

```
            if(varrho(j)>0)
            {   //NEED TO IMPLEMENT OCEANOGRAPHIC INDEX
                g1=shp1[j]+varrho[j]*x[i]+(1.-varrho[j])*shp1_dev(j,i);
                h1=lh1[j]+varrho[j]*x[i]+(1.-varrho[j])*lh1_dev(j,i);
                g2=shp2[j]+varrho[j]*x[i]+(1.-varrho[j])*shp2_dev(j,i);
                h2=lh2[j]+varrho[j]*x[i]+(1.-varrho[j])*lh2_dev(j,i);

            }
            fsh_sel(j)(i)=selectivity(g1,h1,g2,h2,age);
        }
    }
    //cout<<fsh_sel<<endl;

FUNCTION get_mortality
    int i;

    for(i=syr;i<=nyr;i++)
    {
        z(i)=m+(f(1,i)*fsh_sel(1)(i))+(f(2,i)*fsh_sel(2)(i));
    }
    //cout<<z<<endl;


FUNCTION numbers_at_age
    int i;

    //initialize recruitment vector
    n.colfill(rcrage,recruits);

    //initialize numbers at age
    n(syr)=recruits(syr)*pow(exp(-m),age-1.);
    n(syr,trmage)/=(1-exp(-m));

    for(i=syr;i<nyr;i++)
    {
        //numbers at age in year i
        n(i+1)(rcrage+1,trmage)=++elem_prod(n(i)(rcrage,trmage-1),
                                    exp(-z(i)(rcrage,trmage-1)));
        n(i+1,trmage)+=n(i,trmage)*exp(-z(i,trmage));

        //total biomass
        bio(i)=sum(elem_prod(n(i),wt_pop(i)));
        if(i==nyr-1)bio(nyr)=sum(elem_prod(n(nyr),wt_pop(nyr)));
    }


FUNCTION get_catch_at_age
//get catch-at-age then p at age from multinomial sample
    int i,j;
    fsh_p.initialize();
    dvector pdf(rcrage,trmage);

    for(i=syr;i<=nyr;i++)
    {
```

```
        for(j=1;j<=2;j++)   //loop over fisheries
        {
            //catch-at-age in numbers (millions)
            fsh_c(j)(i)=elem_prod(n(i),elem_prod(
                            elem_div(f(j,i)*fsh_sel(j)(i),z(i)),1.-exp(-z(i))));

            //get total catch for each fishery
            tot_catch(j,i)=sum(elem_prod(fsh_c(j)(i),fsh_wt(j)(i)));
            tot_catch(j,i)*=exp(nu(j,i)*cv_catch);

            pdf=fsh_c(j)(i);    //make a shallow copy for multinomial sample.
            fsh_p(j)(i)=multinomial(fsh_multn(j),seed+2*i+j,pdf);
            fsh_p(j)(i)/=sum(fsh_p(j)(i));  //turn into proportions
            if(fsh_multn(j)==1) //no multinomial sampling sampling error.
                fsh_p(j)(i)=pdf/sum(pdf);
        }
    }


FUNCTION survey_data
    //simulate survey data
    //Acoustic units are in biomass

    int i,j,k;
    double vul_bio;
    dvector pdf(rcrage,trmage);
    for(j=1;j<=nsurveys;j++)
        {
        for(k=1;k<=nsurv_year(j);k++)
        {
            i=surv_years(j,k);

            //survey selectivity
            sur_sel(j)(k)=selectivity(sur_shp1[j],sur_lh1[j],
                                sur_shp2[j],sur_lh2[j],age);


             //biomass vulnerable to survey gear.
            vul_bio=sum(elem_prod(elem_prod(n(i),
                            wt_pop(i)),sur_sel(j)(k)));
            sur_yt(j,k)=sur_q(j)*vul_bio;
            sur_yt(j,k)*=mfexp(delta(j,k)*cv_yt(j));

            //survey catch at age data
            pdf=elem_prod(n(i),sur_sel(j)(k));
            sur_p(j)(k)=multinomial(sur_multn(j),seed+j+i,pdf);
            sur_p(j)(k)/=sum(sur_p(j)(k));
            if(sur_multn(j)==1)
                sur_p(j)(k)=pdf/sum(pdf);  //use for exact data.
        }
    }
    //cout<<sur_q<<endl;

FUNCTION write_data_file
```

```
    ofstream ofs("CAA.dat");

    ofs<<"#Simulation years"<<endl;
    ofs<<syr<<" "<<nyr<<endl;
    ofs<<"#Ages"<<endl;
    ofs<<rcrage<<"  "<<trmage<<endl;
    ofs<<"#Maturity"<<endl<<mat<<endl;
    ofs<<"#Female multiplier"<<endl<<femmult<<endl;
    ofs<<"#sel_rwlk_std"<<endl<<sel_rwlk_std<<endl;
    ofs<<"#CV in total catch"<<endl<<cv_catch<<endl;
    ofs<<"#total catch (tons)(US)"<<endl;
    ofs<<1000000*tot_catch(1)<<endl;
    ofs<<"#total catch (tons)(CAN)"<<endl;
    ofs<<1000000*tot_catch(2)<<endl;
    ofs<<"#multinomial sample sizes for commercial fisheies"<<endl;
    ofs<<fsh_multn<<endl;
    ofs<<"#US catch-at-age proportions"<<endl;
    ofs<<fsh_p(1)<<endl;
    ofs<<"#CAN catch-at-age proportions"<<endl;
    ofs<<fsh_p(2)<<endl;
    ofs<<"#US weight-at-age proportions"<<endl;
    ofs<<fsh_wt(1)<<endl;
    ofs<<"#CAN weight-at-age proportions"<<endl;
    ofs<<fsh_wt(2)<<endl;

    ofs<<"#***************SURVEY DATA***************"<<endl;
    ofs<<"#nsurveys"<<endl<<nsurveys<<endl;
    ofs<<"#CV in surveys"<<endl<<cv_yt<<endl;
    ofs<<"#multinomial sample sizes for surveys"<<endl;
    ofs<<sur_multn<<endl;
    ofs<<"#nsurv_year"<<endl<<nsurv_year<<endl;
    ofs<<"# years for survey 1"<<endl;
    ofs<<surv_years<<endl;
    ofs<<"#survey indices"<<endl;
    ofs<<sur_yt<<endl;
    ofs<<"#Mean population weight at age"<<endl<<wt_pop<<endl;

    for(int i=1;i<=nsurveys;i++)
    {
        ofs<<"#Age proportions in survey "<<i<<endl;
        ofs<<sur_p(i)<<endl;
    }
    ofs<<"#Oceanographic index"<<endl<<x<<endl;

    //True states
    ofs<<"#lh1_dev"<<endl<<lh1_dev<<endl;

//************************CALLED FUNCTIONS*************************
//Return Selectivity curve_____________________________________________________
FUNCTION dvector selectivity(double g, double h, double g2, double
h2,dvector x)
    //Dome shaped selectivity option when g2>0
    {
        dvector sel;
```

```
        if(g2!=0){

            sel = pow(elem_prod(1.+exp(-g*(x-h)),1.+exp(g2*(x-h2))),-1);
        }else{
            sel=1./(1.+exp(-g*(x-h)));
        }
        sel/=max(sel);
        return sel;
    }


//________________________________________________________________________________
FUNCTION dvector multinomial(long nobs, int seed, dvector& PDF)
    /**__Returns a vector of sampled frequencies from a PDF distribution__**/
    {
        //Convert PDF to cummulative distribution
        PDF/=sum(PDF);                      //normalize to sum=1.
        int ni=PDF.indexmin();
        int nb=PDF.indexmax();
        double xx;
        dvar_vector dist(ni-1,nb);
        dist.initialize();
        for(int i=ni;i<=nb;i++)
        {
            dist(i)=sum(PDF(ni,i));
            //cout<<i<<"    "<<dist(i)<<endl;
        }
        //Now Sample from the distribution and bin Frequencies
        random_number_generator rng(seed);
        dvector freq(ni,nb);
        freq.initialize();
        //cout<<dist.fill_multinomial(rng,dist)<<endl;
        for(int j=1;j<=nobs;j++)
        {
            xx=randu(rng);
            i=ni-1;
            do
            {
                i++;
                if(dist(i)>xx) freq(i)++;
            } while(dist(i)<=xx && i<nb);
        }

        return(freq);
    }
//=========================================================================
```

6 ADMB code for assessment model

```
//*****************************************************
//  Programmer: Steve Martell
//  Project Name: simCAA.tpl
//  Date:   Dec 16, 2004
//  Version:1.0
//  Comments: A reference model for Pacific Hake stocks
//
// To Do List: add time-varying changes to selectivities
//                  catch-at-age data
//
//*****************************************************/
DATA_SECTION
    !!system("simCAA.exe");


    init_int syr;                           //starting year
    init_int nyr;                           //ending year
    init_int rcrage;                        //recruitment age
    init_int trmage;                        //+group age
    vector age(rcrage,trmage);
    vector yrs(syr,nyr);

    !!age.fill_seqadd(rcrage,1);
    !!yrs.fill_seqadd(syr,1);

    init_vector mat(rcrage,trmage)      // Proportion mature
    init_vector femmult(rcrage,trmage)  // Multiplier to get spawning biomass

    init_vector sel_rwlk_std(1,2);      //std in selectivity parameter deviations

    init_number cv_catch;
    init_matrix tot_catch(1,2,syr,nyr); //total catch by fishery

    init_vector fsh_multn(1,2);

    init_3darray fsh_p(1,2,syr,nyr,rcrage,trmage);  //catch-at-age proportions matrix
    init_3darray fsh_wt(1,2,syr,nyr,rcrage,trmage);
    //Read in survey information
    init_int nsurveys;
    init_vector cv_yt(1,nsurveys);
    init_ivector sur_multn(1,nsurveys);
    init_ivector nsurv_year(1,nsurveys);
    init_imatrix surv_years(1,nsurveys,1,nsurv_year);   //survey years
    init_matrix sur_yt(1,nsurveys,1,nsurv_year);            //survey indicies
    init_matrix wt_pop(syr,nyr,rcrage,trmage);          //weight at age

    //proportions-at-age from the surveys.
    init_3darray sur_p(1,nsurveys,1,nsurv_year,rcrage,trmage);

    //oceanographic index
    init_vector x(syr,nyr);
```

```
    //input true states
    init_matrix true_lh1_dev(1,2,syr+1,nyr);
    //++++++++++++++++++++++END OF DATA INPUT+++++++++++++++++++++++++++++


PARAMETER_SECTION
    init_bounded_number m(0.1,0.8,2);   //instantaneous natural mortality

    init_bounded_vector varrho(1,2,0.,1.,1);

    //Selectivity parameters for fisheries.
    init_bounded_vector lh1(1,2,0,10,2);
    init_bounded_vector shp1(1,2,0,2,2);
    init_bounded_vector lh2(1,2,1.,99.,2);
    init_bounded_vector shp2(1,2,0,2,2);


    //Selectivity parameters for surveys.
    init_vector sur_q(1,nsurveys,1);
    init_bounded_vector sur_lh1(1,nsurveys,0,10,2);
    init_bounded_vector sur_shp1(1,nsurveys,0,2,2);
    init_bounded_vector sur_lh2(1,nsurveys,1.,99.,2);
    init_bounded_vector sur_shp2(1,nsurveys,0,2,2);


    //population recruits
    init_vector log_recruits(syr,nyr);


    //fishing mortality
    init_bounded_matrix f(1,2,syr,nyr,0.,0.5);


    //Random walk parameters for fisheries selectivities
    !!int phz=3;
    !!if(sel_rwlk_std(1)==0)phz=-3;
    !!if(active(varrho))phz=-3;
    init_bounded_matrix lh1_dev(1,2,syr+1,nyr,-1,1,phz);
    init_bounded_matrix shp1_dev(1,2,syr+1,nyr,-1,1,phz);
    init_bounded_matrix lh2_dev(1,2,syr+1,nyr,-1,1,phz);
    init_bounded_matrix shp2_dev(1,2,syr+1,nyr,-1,1,phz);

    //Objective function variable
    objective_function_value func;

    vector loglik(1,15);
    vector bio(syr,nyr);                    //total pop biomass

    matrix z(syr,nyr,rcrage,trmage);    //instantaneous total mortality
    matrix n(syr,nyr,rcrage,trmage);    //numbers-at-age matrix
    matrix pred_sur_yt(1,nsurveys,1,nsurv_year);
    matrix pred_tot_catch(1,2,syr,nyr);

    3darray fsh_c(1,2,syr,nyr,rcrage,trmage);   //catch-at-age matrix
```

```
    3darray pred_fsh_p(1,2,syr,nyr,rcrage,trmage);  //predicted proportions at age in catch
    3darray fsh_sel(1,2,syr,nyr,rcrage,trmage);     //selectivity for commercial fisheries

    //selectivity for the surveys.
    3darray sur_sel(1,nsurveys,1,nsurv_year,rcrage,trmage);

    // predicted catch-at-age for survey
    3darray pred_sur_p(1,nsurveys,1,nsurv_year,rcrage,trmage);


PROCEDURE_SECTION
    //_________MAIN_________

        get_selectivities();
        get_mortality();
        numbers_at_age();
        get_catch_at_age();
        survey_data();
        calc_objective_func();

    //**********************


FUNCTION get_selectivities
    int i,j;
    dvariable g1, g2, h1, h2;
    //This is the fisheries selectivities only.
    for(j=1;j<=2;j++)
    {
        //initialize random walks for selectivity parameters in fishery j
        g1=shp1[j];
        g2=shp2[j];
        h1=lh1[j];
        h2=lh2[j];

        for(i=syr;i<=nyr;i++)
        {
            if(i>syr && active(lh1_dev))
            {//update random walk parameters for year i
                g1+=shp1_dev(j,i);
                h1+=lh1_dev(j,i);
                g2+=shp2_dev(j,i);
                h2+=lh2_dev(j,i);
            }
            //
            if(active(varrho))
            {
                g1=shp1[j]+varrho[j]*x[i];
                h1=lh1[j]+varrho[j]*x[i];
                g2=shp2[j]+varrho[j]*x[i];
                h2=lh2[j]+varrho[j]*x[i];
            }
            fsh_sel(j)(i)=selectivity(g1,h1,g2,h2,age);
        }
```

```
    }
    //cout<<fsh_sel<<endl;

FUNCTION get_mortality
    int i;

    for(i=syr;i<=nyr;i++)
    {
        z(i)=m+(f(1,i)*fsh_sel(1)(i))+(f(2,i)*fsh_sel(2)(i));
    }
    //cout<<z<<endl;


FUNCTION numbers_at_age
    int i;

    //initialize recruitment vector
    n.colfill(rcrage,mfexp(log_recruits));

    //initialize numbers at age
    n(syr)=mfexp(log_recruits(syr))*pow(exp(-m),age-1.);
    n(syr,trmage)/=(1-exp(-m));

    for(i=syr;i<nyr;i++)
    {
        n(i+1)(rcrage+1,trmage)=++elem_prod(n(i)(rcrage,trmage-1),
                                    exp(-z(i)(rcrage,trmage-1)));
        n(i+1,trmage)+=n(i,trmage)*exp(-z(i,trmage));

        //total biomass
        bio(i)=sum(elem_prod(n(i),wt_pop(i)));
        if(i==nyr-1)bio(nyr)=sum(elem_prod(n(nyr),wt_pop(nyr)));
    }

    //cout<<bio<<endl;

FUNCTION get_catch_at_age
//get catch-at-age then p at age from multinomial sample
    int i,j;
    //fsh_p.initialize();
    //dvector pdf(rcrage,trmage);

    for(i=syr;i<=nyr;i++)
    {
        for(j=1;j<=2;j++)   //loop over fisheries
        {
            //catch-at-age in numbers (millions)
            fsh_c(j)(i)=elem_prod(n(i),elem_prod(elem_div
                            (f(j,i)*fsh_sel(j)(i),z(i)),1.-exp(-z(i))));
            pred_fsh_p(j)(i)=fsh_c(j)(i)/sum(fsh_c(j)(i));



            //get total catch for each fishery
```

```
            pred_tot_catch(j,i)=1000000*sum(elem_prod(fsh_c(j)(i),fsh_wt(j)(i)));

        }
    }

FUNCTION survey_data
    //simulate survey data
    //Acoustic units are in biomass

    int i,j,k;
    dvariable vul_bio;
    //dvector pdf(rcrage,trmage);
    for(j=1;j<=nsurveys;j++)
        {
        for(k=1;k<=nsurv_year(j);k++)
        {
            i=surv_years(j,k);

            //survey selectivity
            sur_sel(j)(k)=selectivity(sur_shp1[j],sur_lh1[j],
                                    sur_shp2[j],sur_lh2[j],age);


             //biomass vulnerable to survey gear.
            vul_bio=sum(elem_prod(elem_prod(n(i),wt_pop(i)),sur_sel(j)(k)));
            pred_sur_yt(j,k)=sur_q(j)*vul_bio;


            //get predicted survey age proportions
            pred_sur_p(j)(k)=elem_prod(n(i),sur_sel(j)(k));
            pred_sur_p(j)(k)/=sum(pred_sur_p(j)(k));

        }
    }
    //cout<<sur_yt<<endl;

FUNCTION calc_objective_func
    int j,k;
    double o=1.e-10;
    dvar_vector prior(1,2);

    loglik.initialize();
    prior.initialize();
    dvariable std;

    //Likelihoods for total catches
    if(cv_catch==0)std=1; else std=cv_catch;
    for(j=1;j<=2;j++)
    {
        loglik[j]=0.5*norm2((log(tot_catch(j)+o)-log(pred_tot_catch(j)+o))/std);
    }

    //Likelihoods for the fishery catch at data
    //NB set multinomial sample size to 1 when using error free data.
```

```
    for(j=1;j<=2;j++)
    {
        loglik[j+2]=-sum(elem_prod(fsh_multn(j)*(fsh_p(j)+o),
                        log(elem_div(pred_fsh_p(j)+o,fsh_p(j)+o))));
    }

    //Likelihoods for relative abundance data.
    for(j=1;j<=nsurveys;j++)
    {
        if(cv_yt(j)==0)std=1;else std=cv_yt(j);
        loglik[j+4]=0.5*norm2((log(sur_yt(j)+o)-log(pred_sur_yt(j)+o))/std);
        loglik[nsurveys+j+4]=-sum(elem_prod(sur_multn(j)*(sur_p(j)+o),
                                log(elem_div(pred_sur_p(j)+o,sur_p(j)+o))));
    }

    //Priors on deviations in selectivity parameters
    for(j=1;j<=2;j++)
    {
        if(sel_rwlk_std[j]!=0)prior[j]=0.5*
                    norm2(first_difference(lh1_dev(j))/sel_rwlk_std[j]);
        if(sel_rwlk_std[j]!=0)prior[j]+=0.5*
                    norm2(first_difference(shp1_dev(j))/0.25*sel_rwlk_std[j]);
    }

    func=sum(loglik)+sum(prior);
    cout<<sum(prior)<<endl;

//****************************CALLED FUNCTIONS***************************
//Return Selectivity curve_____________________________________________________
FUNCTION dvar_vector selectivity(dvariable g, dvariable h, dvariable
g2, dvariable h2,dvector x)
    //Dome shaped selectivity option when g2>0
    {
        dvar_vector sel;
        if(g2!=0){
            sel = pow(elem_prod(1.+exp(-g*(x-h)),1.+exp(g2*(x-h2))),-1);
        }else{
            sel=1./(1.+exp(-g*(x-h)));
        }
        sel/=max(sel);
        return sel;
    }

//_______________________________________________________________________
FUNCTION dvector pearson_residuals(long m, dvector obs_p, dvector
pred_p)
    {
        obs_p/=sum(obs_p);
        pred_p/=sum(pred_p);

        dvector var=elem_prod(pred_p,(1.-pred_p))/m;
        dvector r=elem_div(obs_p-pred_p,sqrt(var));
        return(r);
    }
```

```
//==========================================================================


RUNTIME_SECTION
  convergence_criteria 1.e-4 1.e-9 1.e-15 1.e-15
  maximum_function_evaluations 500 1000 2000 2000


REPORT_SECTION
    report<<"#Years"<<endl<<yrs<<endl;
    report<<"#Age"<<endl<<age<<endl;
    report<<"#Fish_sel"<<endl<<fsh_sel<<endl;
    report<<"#Pearson residuals"<<endl;
    for(int j=1;j<=2;j++){
        for(int i=syr;i<=nyr;i++){
            report<<pearson_residuals(long(fsh_multn(j)),
                    value(fsh_p(j)(i)),value(pred_fsh_p(j)(i)))<<endl;
        }}

    report<<"Age-2 recruits"<<endl<<exp(log_recruits)<<endl;
    report<<"F"<<endl<<f<<endl;
    report<<"Negative Log Likelihoods"<<endl<<loglik<<endl;
    report<<"Predicted survey indices"<<endl<<pred_sur_yt<<endl;


    if(last_phase()) write_par_rep();


FUNCTION write_par_rep
    //append selected parameters for repeated simulations
    ofstream rep("ParDevs.rep",ios::app);
    rep<<m<<lh1<<shp1<<lh2<<shp2<<sur_q<<endl;


    ofstream rep2("lh1dev.rep",ios::app);
    rep2<<(lh1_dev(1)-true_lh1_dev(1))<<"   "
        <<(lh1_dev(2)-true_lh1_dev(2))<<endl;
```

Report

of the

Joint Canadian and U.S. Pacific Hake/Whiting Stock Assessment Review Panel

conducted on

February 1-3, 2005

Northwest Fisheries Science Center
2725 Montlake Blvd. East, Seattle Washington, 98112.

Overview

On February 1st-3rd a joint Canada-US Pacific Hake/Whiting STAR Panel met in Seattle, WA to review the stock assessment by Helser et al. (2005). The Panel operated according toTerms of Reference for STAR Panels (SSC 2004), but the Panel attempted to adhere to the spirit of the Treaty on Pacific Hake/Whiting. As was the case in 2004, both a Panel member and Advisor from Canada participated in the review (see List of Attendees). The revised stock assessment and the STAR Panel review will be forwarded to the Pacific Fishery Management Council, council advisory groups, and to Canadian DFO managers and the PSARC Groundfish Sub-committee. The STAT Team was represented at the meeting by Thomas Helser, Guy Fleischer, Nathan Taylor and Steve Martell. Public comment was entertained during the meeting.

The STAR Panel members received a draft of the assessment 13 days prior to the meeting, which was sufficient time to adequately review the assessment. The meeting commenced on February 1, 2005 with introductions followed by a presentation by Guy Fleischer reviewing the 2003 acoustic survey. No new acoustic survey data was available since the last assessment. After the acoustic survey presentation, Tom Helser presented a detailed description of the stock assessment. Following that, Steve Martell presented the results of an analysis entitled "Estimating selectivity and natural mortality in the statistical catch-at-age model for Pacific hake *Merluccius productus* " (Martell et al 2005). On the second day, a presentation was given by Vidar Wespestad on the Pacific Whiting Conservation Cooperative pre-recruit survey. Panel discussion continued until the meeting was adjourned on February 3rd. The Panel recognized and appreciated the contributions of the STAT team.

The 2005 assessment used the same age structured assessment model developed in AD Model Builder and used in 2004. Major differences between the 2004 assessment and the 2005 assessment included the addition of 2004 fishery age composition and catch, and 2004 Santa Cruz juvenile rockfish survey data. While there is room for improvement in the assessment model, as detailed below (see Research Recommendations) the Panel concurred that the assessment conforms to the Terms of Reference for Expedited Stock Assessment Updates (SSC 2004) and is suitable for use by the Council and advisory bodies for ABC projections. As done previously in 2004, the two models carried forward for ABC projections were defined by differences in assumed acoustic survey catchability (q=0.6 and q=1.0) and were intended to serve as plausible lower and upper bounds on stock status. STAR Panel viewed both models (q=0.6 and q=1.0) as equally likely.

The STAR Panel commends the STAT team for the quality of the document provided for review and their cooperation in performing additional analyses requested during the meeting (see List of New Analyses Requested by the STAR Panel).

Summary of stock assessment

Stock size in 2004 was estimated to range from 2.5 to 3.8 million mt (age 3+ biomass) for the q=1.0 and q=0.6 model scenarios, respectively (Figure 1-Top). Both model scenarios allowed dome-shaped selectivity to be fit for the acoustic survey, thus allowing for even lower effective Q levels for young and old fish. Stock depletion in 2004 was estimated to range from 50% to 59% of an unfished stock (q=1.0 and q=0.6, respectively) (Figure 1-Bottom). Primarily due to the decay of the stronger than average 1999 year class, the spawning stock biomass is projected to again decline within the precautionary zone (25% - 40% of the unfished spawning biomass level) by 2006-2007. A sharp increase followed by a gradual decline in biomass is a pattern typical of stocks like Pacific whiting, with highly variable recruitment.

List of New Analyses Requested by the STAR Panel

The following list describes each request made of the STAT team, followed by the reason for the request and outcomes of the analysis:

Request: The Panel requested that the STAT team de-emphasize the Santa Cruz juvenile rockfish survey for the stock projections.
Reason: The results of a similar survey conducted jointly by the Northwest Fisheries Science Center (NWFSC) and the Pacific Whiting Conservation Cooperative (PWCC) (which covers a larger geographic area) appeared to conflict with the Santa Cruz survey. The PWCC survey results were presented to the STAR Panel but were not used in the assessment. The Santa Cruz survey was de-emphasized to examine the sensitivity to the projection results to this data source.
Outcome: With the Santa Cruz survey de-emphasized, the projections become driven by log mean recruitment. The result is a somewhat more optimistic projection trajectory.
Conclusion: The Panel recommends using the results with the Santa Cruz survey included, and to report the de-emphasized projection model runs as a sensitivity analysis. Due to uncertainty in this data source, the projections should be treated with caution. The Panel noted that, as the time series lengthens, the PWCC survey could serve as an additional data source that could be used in the future to improve model projections.

Request**:** Examine using an alternative time period to derive average weight-at-age to use in forecasting. The panel requested using, as the alternative, the most recent 10 years of data.
Reason**:** The panel wanted to determine how sensitive the projections were to the length of time used to estimate mean weight-at-age. The panel noted that the weight-at-age for some age-classes indicated that 1-2 year older fish were lighter. This may be biologically plausible if there were density-dependent or cohort-specific influences on growth.
Outcome**:** Spawning biomass increased modestly when the 10 year averaging period was employed for weight at age.
Conclusion**:** The panel agrees with using the average of the last 3 years of data from the fishery and the most contemporary survey data to estimate the weight-at-age for

projections. This approach is the most consistent with past forecasting and is likely to be more representative of recent growth.

Request: The STAR Panel requested that the final document should include a table showing the results of the MCMC uncertainty analysis for harvest projections under the assumption of F40% (in addition to the F45% table provided in the draft assessment document).
Reason: This table is required for use by managers as per Article III.1 of the Treaty on Pacific Hake/Whiting.
Outcome: The STAT team assured the Panel that the table will be provided in the final stock assessment document.

Request: The STAR Panel requested that a sensitivity analysis be conducted to examine alternative time periods of recruitment history in the calculation of B_0.
Reason: The Panel noted that the value of B_0 has changed over the course of several assessments.
***Outcome**:* Time constraints prevented this from being done during the meeting. It was recommended as an item for future research (see Research Recommendations).

Technical merits and deficiencies

Acoustic survey

As noted in the 2004 STAR Panel report, the acoustic-trawl survey data were used in the assessment to provide biomass indices and estimates of proportion at age. The surveys are triennial from 1977 to 2001, with the latest survey in 2003. The surveys from 1977 to 1989 cover a smaller depth range than the later surveys and the 1977 to 1992 surveys do not go as far north as the later surveys. Deep water and northern expansion factors were applied to the appropriate surveys in an attempt to make the whole time series consistent. Otherwise, the survey design appeared to have been relatively consistent from year to year. Transects were typically east to west generally running between 50 m and 1500 m depth contours. Transects were allowed to be extended to deeper water if fish densities were high near the normal stopping point. Transects were done during the day with most trawling also conducted during the day for target identification and collection of biological samples.

Catch and catch at age

Total catch was available from 1966-2004 by nation and fishery. The Panel discussed the sensitivity of the model to the combined coastwide catch at age data. The Panel made a recommendation for future research on this topic (see Research Recommendations).

Recruitment indices

The Santa Cruz juvenile rockfish survey was used to provide a recruitment index from 1983 to 2004 and was also used as the basis for stock projections for 2005 and 2006. The results of a similar survey conducted jointly by the Northwest Fisheries Science Center (NWFSC) and the Pacific Whiting Conservation Cooperative (PWCC), which covers a larger geographic area, were presented to the STAR Panel but were not used in this stock assessment update.

The Panel noted that the data from the 2003 surveys were markedly different in the two data sources, which could be the result of a more northern spawning incident in that year. The Panel explored discarding the 2003 data from the Santa Cruz juvenile rockfish survey, but decided not to do so as: 1) the Terms of Reference for Expedited Stock Assessment Updates (SSC 2005) precludes introduction of new data sources, 2) the Santa Cruz juvenile rockfish survey covers more years, and 3) these data do not affect the estimate of current whiting abundance. However, because these data have a major influence on future stock size projections, the Panel recommends that managers exercise caution in relying on the future year projections presented in the assessment. The Panel concluded that, as new data are added from future surveys, the PWCC index (with greater spatial coverage than the Santa Cruz juvenile rockfish survey) should be evaluated for use in future stock assessments.

Biological parameters
Year specific weights at age were used in all years for each fishery and survey. A constant female maturity at age vector was also used. The Panel made a recommendation to explore year specific maturity at age in future assessments (see Research Recommendations).

Stock assessment model and estimation procedure
The single-sex age structured model uses standard population dynamics equations. The Canadian and U.S. fisheries are modeled as distinct year-round fisheries. Fishing selectivity patterns are year specific (constrained by a random walk) to allow for changes in fleet composition and shifts of fish distribution (across the border). The acoustic time series is modeled using a single selectivity pattern which applies to both the biomass indices and the estimated proportions at age. The estimation procedure is essentially maximum likelihood with Bayesian extensions for estimating parameter uncertainty. The Panel supported the use of the general modeling and estimation procedure and had some recommendations for future improvement. The Panel supported the development of a more parsimonious model as an alternative (see Research Recommendations).

The STAT team and STAR Panel noted that the present model differed from the 2004 model in that the value of initial F was previously set at 0.001, which did not result in a starting year biomass completely in equilibrium with B_0. Correction of this oversight resulted in a nominal positive effect on contemporary depletion levels.

Areas of Major Uncertainty
While there is uncertainty in both data and the model structure, the Panel concluded that the major source of uncertainty lies in the assumption of acoustic survey q. Future work is needed to help resolve the q issue (see Research Recommendations). Following the recommendation of the 2004 STAR Panel, the 2005 Panel and STAT team again bounded uncertainty with q=0.6 and q=1.0 and assigned the differential survey CV values used in 2004. The Panel and STAT team concluded that sufficient information was not available at the meeting to determine q more precisely.

The STAT team provided a simulation analysis exploring the estimability of dome-shaped selectivity concurrently with age-specific M (Martell et al. 2005). After considerable discussion on this topic, the Panel concluded that the true form of the selectivity function remains unclear. Results from the Martell et al. (2005) simulation experiments demonstrated a confounding problem between M and the descending portion of the dome-shaped selectivity curve. The age-specific natural mortality rate (M) was negatively correlated with the selectivity shape parameter that describes how rapidly selectivity drops with older age groups. Thus, if dome-shaped selectivity is the true state of nature, for all fisheries harvest and survey sampling gears, there is not sufficient information in the age composition data to reliably estimate age-specific natural mortality. The use of an environmental correlate in the model simulations reduced bias and greatly improved precision in estimated parameters. The Panel recommended future work to resolve the shape of the selectivity function (see Research Recommendations).

Areas of Disagreement

There were no substantial areas of disagreement between the STAT team and the STAR Panel.

Research Recommendations

The Panel considered the topic of research recommendations in two parts: 1) review of status of old recommendations (made by the 2004 STAR Panel) and 2) development of new recommendations. The Panel prioritized each of the old recommendations as "S" (short term; to be addressed in the 2006 assessment), "M" (medium term; to be addressed by the 2007 assessment), and "L" (long term; to be addressed by the 2008 assessment and beyond).

I. Recommendations from the 2004 STAR Panel

1. Acoustic survey recommendations:

a. Determine whether there are differences in survey performance between the WE Ricker & Miller Freeman. These include differences in mid-water and bottom trawl efficiency as well as differences in acoustic capabilities between the vessels. Analyze the available data to determine if we can continue to accept the null hypothesis that there is no difference in survey performance between these vessels. **(L)**

b. Perform a detailed meta-analysis across all survey years: compare spatial distributions of hake across all years and between bottom trawl and acoustic surveys to estimate changes in catchability/availability across years. **(M-in progress)**

c. Generate appropriate estimates of variability for every survey year. **(S-in progress)**

d. Review the methods used to estimate proportions at age for the acoustic survey with particular regard to the representativeness of trawl samples. **(S-will help to resolve the asymptotic vs. dome-shaped selectivity issue)**

2. Estimation of target strength:

a. Evaluate the current target strength for possible biases, particularly the use of nighttime experiments which are applied to daytime survey transects. Explore alternative methods for estimating target strength. **(S)**

b. Assess the value of the recent Canadian hake target strength observations and, if these are assessed to be useable, add these into the target strength model. **(S-in progress)**
c. Commission the acquisition of additional in-situ observations to increase the model sample size. **(S)**
3. Model enhancements:
a. Add in bias correction for log-normal distribution in appropriate likelihoods. **(Remove)**
b. Recode the model so that projections are done as a post-MCMC procedure. **(Completed)**
c. Develop an informed prior for the acoustic q. This prior should be used in the model when estimating the q parameter. **(M)**
d. Consider the development of a sex-structured model. **(M-investigate via simulation)**
e. Investigate alternative methods to model annual variability in fishery selectivity. Identify the covariates that influence fishery selectivity. **(Completed)**
f. Investigate the interaction of the dome-shaped selectivity functions with the fixed value of M. This investigation should include determining whether there is a trade-off between M and the declining limb of the selectivity function. Investigate the possibility of age-specific M. **(Completed)**
g. Investigate alternatives to applying a single estimated acoustic selectivity based on trawl samples to the acoustic biomass indices. **(Remove)**
4. The STAR Panel had difficulty completing its assigned task during a three day review. At least a full week is needed for a more thorough review of the input data and the assessment model. **(The Panel concurred that a full week would likely be required to review a new (full) assessment. The three day meeting provided adequate time to review the present stock assessment update.)**

New Research

1) 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. **(M)**

2) 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. **(S-in progress)**

3) Deconstruct the existing stock assessment model to investigate the factors that are most strongly affecting survey q. Examine what happens to the model parameters and biomass trends if the age-structure data is removed from the analysis. Attempt to reconcile the effects of the two main data sources, acoustic data versus age composition data. **(S)**

4) Review hake abundance data available from trawl surveys to assess the relative abundance of older fish in the population. The intent is to address the appropriateness of the asymptotic versus dome-shaped selectivity function. **(S)**

5) Investigate the efficacy of the current management procedure (F40%/F45%) through simulation/evaluation to examine whether the current harvest policy is robust to highly variable recruitment and the uncertainties with the Pacific hake assessment and whether alternative approaches are more robust to the uncertainties. This addresses the 2004 STAR Panel harvest policy issue that "a new examination of the harvest policy that takes into account this [high recruitment variability]". **(M-important)**

6) Investigate aspects of the life history characteristics for Pacific hake and their possible effects on the interrelationship of growth rates and maturity at age. **(L)**

7) Investigate modeling the hake stock with a more parsimonious parameterization. For example, investigate the possibility of combining Canadian and US catch at age data and modeling the stock with one fishery. **(S)**

8) In future assessments, down-weight effective sample sizes of the multinomial age data in the early years of the acoustic survey to make them consistent with the higher CV's used for the biomass estimates in early years, to account for the spatial expansion factor. **(S)**

Panel Findings

1) For whiting, with its particularly high recruitment variability, it would be advisable to utilize projections with time horizons shorter than 10 years. A reasonable projection time frame would be 3-4 years.

2) The STAR Panel agrees with the recommendation of the 2004 STAR Panel that a full week is needed to conduct a through review for a full stock assessment. The three day meeting provided adequate time to review the present stock assessment update.

List of Attendees

2005 Whiting/Hake STAR Panel

Name	Affliation	Role
Tom Jagielo	SSC, WDFW	Panel Chair
Jake Schweigert	DFO	Panel Participant
Kevin Piner	SWFSC	Panel Participant
Graham Pilling	CEFAS	CIE Reviewer
Jeff Fargo	DFO	Advisor
Rod Moore	GAP	Advisor
Jim Hastie	GMT	Advisor
Tom Helser	NWFSC	Lead Author
Guy Fleischer	NWFSC	Co-Author
Steve Martell	UBC	Co-Author
Nathan Taylor	UBC	Co-Author

Brad Pettinger (Oregon Trawl Commission)
Jim Colbert (Oregon State University)
Vera Agostini (University of Washington)
Ian Stewart (University of Washington)
Vidar Wespestad (Pacific Whiting Conservation Cooperative)
Rick Dunn (Hake Consortium of BC)
Steve Joner (Makah Tribe)
Mike Buston (Leader Fishing)
Stacey Miller (NWFSC, Stock Assessment Coordinator)
Elizabeth Clarke (NWFSC)
Dan Waldeck (Pacific Whiting Conservation Cooperative)
Bruce Turris (CGRCS)
Joe Bersch (SAS)
Bill Clingan (Ocean Gold)
Barry Ackerman (DFO)
Carrie Nordeen (NMFS/NWR)
Mark Saelens (ODFW/GMT)

References

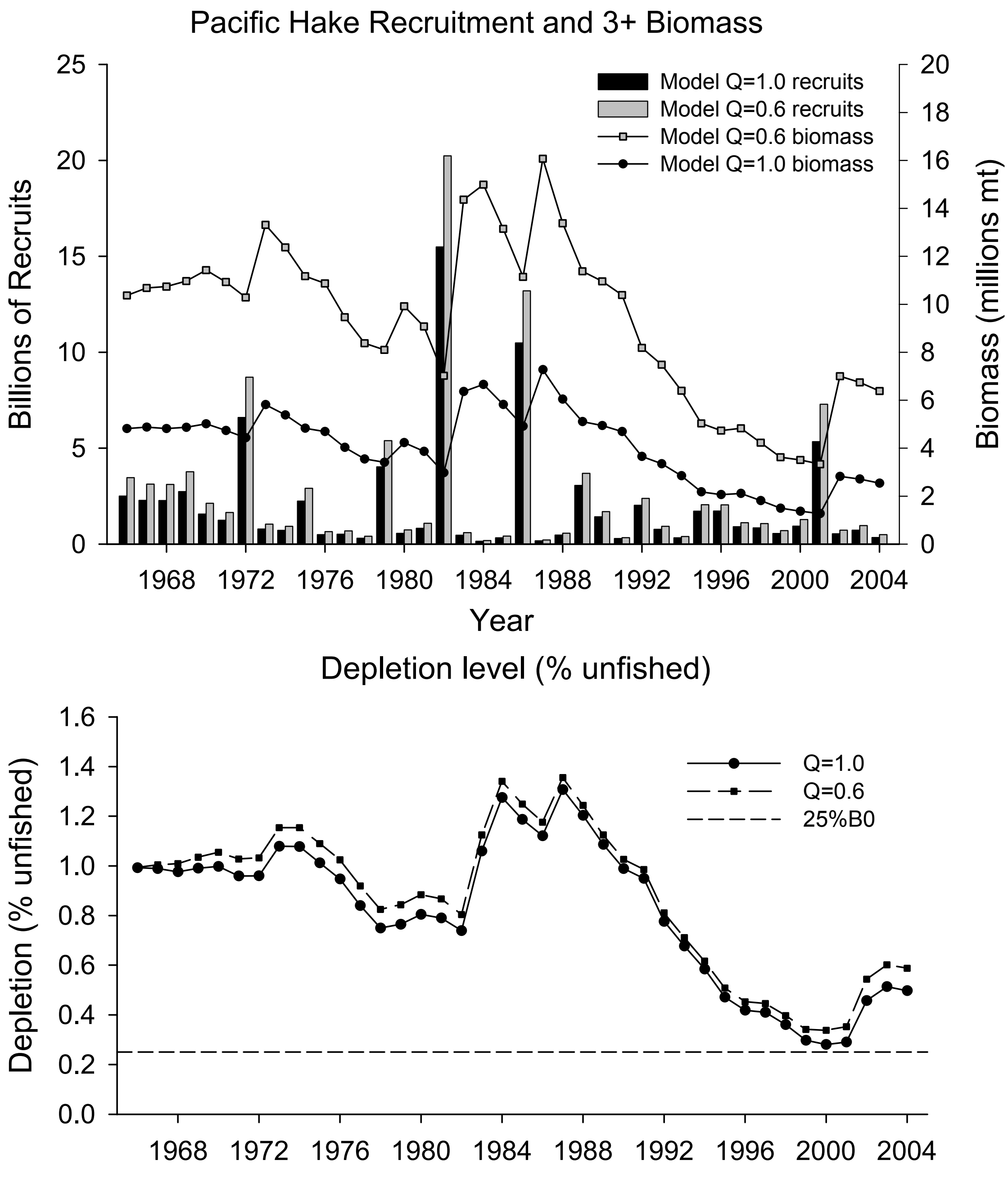
Martell, S., Taylor, N., Helser, T. and Guy Fleischer. 2005. Estimating selectivity and natural mortality in the statistical catch-at-age model for Pacific hake *Merluccius productus.* Appendix A to: Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004.

Helser, T.E., Fleischer, G.W., Martell, S., and Nathan Taylor. 2005. Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004.

SSC. 2005. Groundfish stock assessment and review process for 2005-2006. Pacific FisheryManagement Council.

STAR Panel. 2004. STAR Panel report on the stock assessment of Pacific Hake (Whiting) in US and Canadian Waters in 2003.

Figure 1. (Top) Model estimates of Pacific Hake recruitment and age 3+ biomass. (Bottom) Trend in depletion level under model scenarios where q=1.0 and q=0.6.



ERRATA
This figure replaces figure 1.

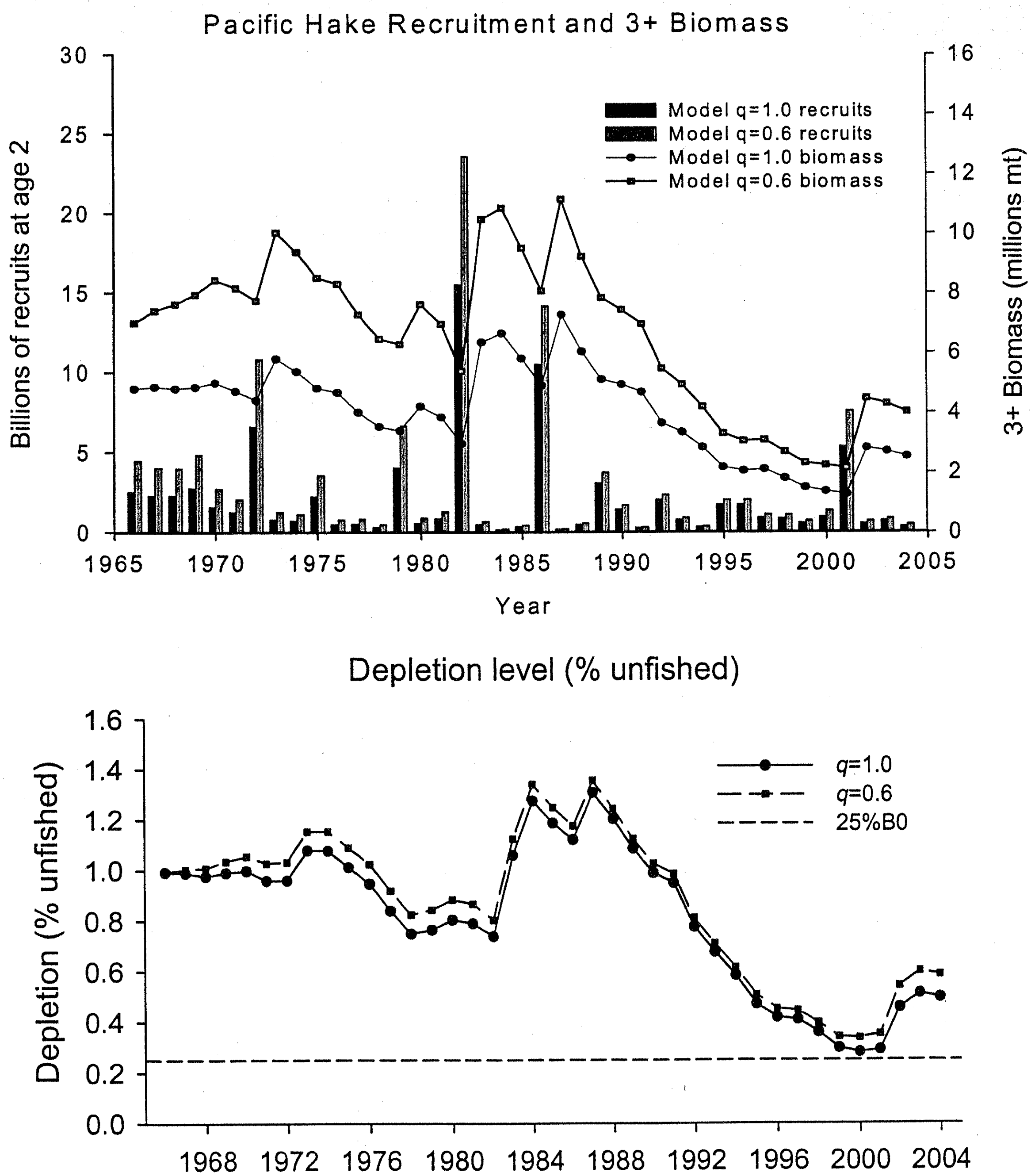


Figure 17. Estimated time series of Pacific hake age 3+ biomass (million mt) and age-2 recruitment (billions of fish) during 1966-2004 from Models q=1.0 and q=0.6. Lower panel shows trends in depletion levels relative to unfished biomass (See text for description of model configurations).

AGREEMENT

BETWEEN

THE GOVERNMENT OF THE UNITED STATES OF AMERICA

AND

THE GOVERNMENT OF CANADA

ON PACIFIC HAKE/WHITING

THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF CANADA (hereinafter referred to as "the Parties"),

RECOGNIZING the transboundary nature of the offshore hake/whiting (*Merluccius productus)* resource off the Pacific coast of Canada and the United States,

MINDFUL of the importance of this resource to the social and economic sustainability of fishing communities, including harvesters, processors, license holders, and other stakeholders reliant on the offshore hake/whiting fishery, .

DESIRING to cooperate in the stewardship of this resource and to benefit the industries involved in this fishery, and

RECOGNIZING the desirability of maintaining existing levels of scientific research with respect to the offshore hake/whiting resource,

HAVE AGREED as follows:

ARTICLE I

Definitions

For the purposes of this Agreement:

"Catch" means all fishery removals from the offshore hake/whiting resource, including landings, discards, and bycatch in other fisheries;

"F-40 percent" means a fishing mortality rate that would reduce the biomass, calculated on a per recruit basis, to 40 percent of what it would have been in the absence of fishing mortality;

"40/10 adjustment" means an adjustment to the overall total allowable catch (TAC) that is triggered when the biomass falls below 40 percent of its unfished level. This adjustment reduces the TAC on a straight-line basis from the 40 percent level such that the TAC would equal zero when the stock is at 10 percent of its unfished level;

"Offshore hake/whiting resource" means the transboundary stock of *Merluccius productus* that is located in the offshore waters of the United States and Canada. The hake/whiting located in Puget Sound and the Strait of Georgia is not included in the offshore hake/whiting resource; and

"Potential yield" means the range of results obtained from applying the harvest rate established pursuant to paragraph 1 of Article III to a range of forecasted biomass estimates.

ARTICLE II

1. A Joint Technical Committee (JTC) is hereby established comprising up to five scientific experts, with up to two appointed by each Party and one independent member jointly appointed by the Parties from a list supplied by the Advisory Panel established pursuant to paragraph 4 of this Article. The Parties shall jointly bear the independent member's travel expenses associated with the work of the JTC. JTC members may seek advice from others as they deem appropriate. The JTC shall meet annually, and more often as necessary, to:

   (a) propose its terms of reference for approval by the Joint Management Committee (JMC) established in paragraph 3 of this Article;

   (b) develop stock assessment criteria and methods, and design survey methods;

   (c) exchange survey information, including information on stock abundance, distribution, and age composition;

   (d) exchange and review relevant annual catch and biological data, including information provided by the public;

   (e) provide, by no later than February 1 of each year unless otherwise directed by the JMC, a stock assessment that includes scientific advice on the annual potential yield of the offshore hake/whiting resource that may be caught for that fishing year, taking into account uncertainties in stock assessment and stock productivity parameters and evaluating the risk of errors in parameter estimates produced in the assessment;

   (f) take into account any adjustments pursuant to paragraph 5 of this Article as part of its stock assessment; and

   (g) perform other duties and functions that may be referred to it by the Scientific Review Group (SRG) established in paragraph 2 of this Article and by the JMC.

2. A Scientific Review Group (SRG) is hereby established to provide independent peer review of the work of the JTC. The SRG shall comprise up to six scientific experts, with up to two appointed by each Party and two independent members appointed jointly by the Parties from a list supplied by the Advisory Panel. All SRG members shall be different individuals than those who serve on the JTC. The Advisory Panel may also nominate, for appointment by the Parties, two public advisors to participate in SRG meetings. The public advisors shall have the right to provide their views on all aspects of the work of the SRG, both orally and in writing. The Parties shall jointly bear the travel expenses of the independent members and the public advisors for meetings of the SRG. In addition, SRG members may seek advice from others as they deem appropriate. SRG meetings shall be open to the public. The SRG shall meet annually, and more often as necessary, to:

(a) propose its terms of reference for approval by the JMC;

(b) review the stock assessment criteria and methods and survey methodologies used by the JTC;

(c) provide, by no later than March 1 of each year, unless otherwise directed by the JMC, a written technical review of the stock assessment and its scientific advice on annual potential yield; and

(d) perform other duties and functions that may be referred to it by the JMC.

3. A Joint Management Committee (JMC) is hereby established comprising eight members, four appointed by each Party. The members appointed by each Party shall comprise the national section of that Party. Recommendations of the JMC shall be made by agreement of the two national sections. JMC meetings shall be open to the public, unless the JMC determines that, due to extraordinary circumstances, a closed session is necessary. The JMC shall meet at least once per year and more often as necessary to:

(a) adopt its terms of reference and approve the terms of reference of the JTC and SRG;

(b) provide the SRG and JTC the direction necessary to guide their deliberations;

(c) refer any technical issues or other duties to the SRG or JTC as it deems appropriate;

(d) consider information on management measures employed by the Parties; and

(e) review the advice of the JTC, the SRG, and the Advisory Panel and, by no later than March 25 of each year, recommend for approval of the Parties the overall total allowable catch (TAC) for that year, calculate each Party's individual TAC pursuant to paragraph 2 of Article III, and identify any adjustments pursuant to paragraph 5 of this Article.

4. An Advisory Panel on Pacific Hake/Whiting (Advisory Panel) is hereby established comprising members appointed by each Party. The members appointed by each Party shall comprise the national section of that Party. Decisions of the Advisory Panel shall be made by agreement of the two national sections. Members of the Advisory Panel shall be individuals knowledgeable or experienced in the harvesting, processing, marketing, management, conservation, or research of the Pacific hake/whiting fisheries and may not be employees of either Party. Meetings of the Advisory Panel shall be open to the public. The Advisory Panel shall meet annually prior to the meeting of the JMC, or more often as necessary, to:

(a) establish its terms of reference;

(b) compile and provide to the Parties, by no later than March 25 of each year, the names of at least three scientific experts as candidates for the JTC and the names of at least five scientific experts as candidates for the SRG, for appointment in the following year;

(c) review the advice of the SRG and JTC;

(d) review the management of the fisheries of the two Parties during the previous year; and

(e) make recommendations to the JMC regarding the overall TAC.

5. Adjustments:

(a) If, in any year, a Party's catch exceeds its individual TAC, an amount equal to the excess catch shall be deducted from its individual TAC in the following year.

(b) If, in any year, a Party's catch is less than its individual TAC, an amount equal to the shortfall shall be added to its individual TAC in the following year, unless otherwise recommended by the JMC. Adjustments under this sub-paragraph shall in no case exceed 15 percent of a Party's unadjusted individual TAC for the year in which the shortfall occurred.

6. In any year in which the JMC has made recommendations pursuant to sub-paragraph 3(e) of this Article, paragraph 5 of this Article or paragraph 1 of Article III, the Parties shall manage their respective fisheries for the offshore hake/whiting resource consistent with such recommendations of the JMC as the Parties have approved.

ARTICLE III

1. For the purposes of this Agreement, the default harvest rate shall be F-40 percent with a 40/10 adjustment. Having considered any advice provided by the JTC, the SRG or the Advisory Panel, the JMC may recommend to the Parties a different harvest rate if the scientific evidence demonstrates that a different rate is necessary to sustain the offshore hake/whiting resource. If the Parties approve such a recommendation, they shall so inform the JMC.

2. The United States' share of the overall TAC shall be 73.88 percent. The Canadian share of the overall TAC shall be 26.12 percent. This division shall apply for an initial nine-year period, and thereafter unless the Parties agree in writing to adjust it. Any such adjustment shall take effect in the following year, unless the Parties agree otherwise.

ARTICLE IV

The Parties agree to conduct scientific research to support the effective implementation of this Agreement, including trawl, acoustic, and recruit surveys to provide adequate data on the offshore hake/whiting resource. The Parties should, where appropriate, conduct such research using private vessels.

ARTICLE V

1. This Agreement shall enter into force upon an exchange of written notifications by the Parties, through diplomatic channels, that they have completed their respective internal procedures.

2. This Agreement may be amended at any time by written agreement of the Parties.

3. Either Party may terminate this Agreement by notice in writing to the other Party through diplomatic channels. Unless such notice has been withdrawn, this Agreement shall terminate on December 31 of the calendar year following that in which such notice was received by the other Party.

IN WITNESS WHEREOF, the undersigned, duly authorized by their respective Governments, have signed this Agreement.

DONE at Seattle, this 21st day of November 2003 in duplicate in the English and French languages, both texts being equally authentic.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:	**FOR THE GOVERNMENT OF CANADA:**
[signature]	[signature]

ACCORD

RELATIF AU MERLU DU PACIFIQUE

ENTRE

LE GOUVERNEMENT DES ÉTATS-UNIS D'AMÉRIQUE

ET

LE GOUVERNEMENT DU CANADA

LE GOUVERNEMENT DES ÉTATS-UNIS D'AMÉRIQUE ET LE GOUVERNEMENT DU CANADA (ci-après dénommés « les Parties »),

RECONNAISSANT le caractère transfrontalier du stock de merlu du Pacifique (*Merluccius productus*) au large des côtes du Pacifique du Canada et des États-Unis,

CONSCIENTS de l'importance de ce stock pour la viabilité sociale et économique des communautés de pêcheurs, notamment les pêcheurs eux-mêmes, les entreprises de transformation, les titulaires de permis et les autres parties dépendantes de la pêche du merlu du Pacifique au large des côtes,

DÉSIREUX de coopérer pour la gestion de ce stock et de faire profiter les industries concernées, et

RECONNAISSANT le bien-fondé d'un maintien des niveaux actuels de recherche scientifique relativement au stock de merlu du Pacifique,

SONT CONVENUS de ce qui suit :

ARTICLE PREMIER

Définitions

Aux fins du présent accord :

« Prise » s'entend de toute ponction du stock de merlu du Pacifique au large des côtes, y compris le débarquement, le rejet à la mer et les prises accessoires lors de la pêche d'autres espèces;

« Pourcentage F-40 » s'entend d'un taux de mortalité halieutique qui réduirait la biomasse, calculé sur la base des recrues, à 40 pour cent de ce qu'elle aurait été s'il n'y avait aucune mortalité halieutique;

« Ajustement 40/10 » s'entend de tout ajustement du total autorisé des captures (TAC) global effectué lorsque le niveau non exploité de la biomasse tombe sous 40 pour cent. Cet ajustement réduit le TAC de façon linéaire à compter du niveau de 40 pour cent de telle façon que le TAÇ serait égal à zéro si le niveau non exploité du stock correspondait à 10 pour cent;

« Stock de merlu du Pacifique au large des côtes » s'entend du stock transfrontalier de *Merluccius productus* qui vit dans les eaux hauturières des États-Unis et du Canada. Le merlu du Pacifique qui vit dans le Puget Sound et dans le détroit de Georgie n'est pas considéré comme faisant partie du stock de merlu du Pacifique au large des côtes; et

« Rendement potentiel » s'entend de la série des résultats obtenus après avoir appliqué le taux d'exploitation établi conformément au paragraphe 1 de l'Article III à une série de prévisions de la biomasse.

ARTICLE II

1. Un Comité technique mixte (CTM) est constitué par la présente et compte jusqu'à cinq experts scientifiques, soit jusqu'à deux experts nommés par chaque Partie et un membre indépendant qu'elles nomment conjointement à partir d'une liste fournie par le Groupe consultatif institué conformément au paragraphe 4 du présent article. Les Parties supportent conjointement les frais de déplacements engagés par le membre indépendant dans l'exercice de ses fonctions au sein du CTM. Les membres peuvent consulter d'autres personnes lorsqu'ils le jugent nécessaire. Le CTM se réunit une fois par année, et plus souvent au besoin, pour :

   a) proposer l'approbation de son mandat au Comité de gestion mixte (CGM) institué en vertu du paragraphe 3 du présent article;

   b) élaborer des critères et des modes d'évaluation de la ressource halieutique, et concevoir les méthodes à suivre pour les campagnes d'évaluation;

   c) échanger les informations que rapportent les campagnes d'évaluation, notamment sur l'abondance de la ressource halieutique, sa distribution et sa composition par âge;

   d) échanger et examiner les données annuelles pertinentes sur les prises et les données biologiques, y compris les renseignements fournis par le public;

   f) fournir, au plus tard le 1er février de chaque année sauf indication contraire du CGM, une évaluation de la ressource halieutique, dont des données scientifiques sur le rendement potentiel annuel du stock de merlu du Pacifique au large des côtes pour l'année de pêche en cours, qui tienne compte des incertitudes entourant les évaluations de ressources halieutiques et les paramètres de productivité de la ressource et mesure les possibilités d'erreurs dans les paramètres de l'évaluation;

   g) tenir compte de tout ajustement décrété conformément au paragraphe 5 du présent article dans le cadre de son évaluation de la ressource halieutique; et

   h) exercer toute autre fonction et assumer toute autre responsabilité que lui a déléguées le Groupe d'examen scientifique (GES) institué en vertu du paragraphe 2 du présent article et le CGM.

2. Un Groupe d'examen scientifique (GES) est constitué par la présente pour procéder à un contrôle indépendant par les pairs des travaux du CTM. Le GES comprend jusqu'à six experts scientifiques, deux experts au plus nommés par chaque Partie et deux membres indépendants qu'elles nomment conjointement à partir d'une liste fournie par le Groupe consultatif. Les membres du GES ne peuvent siéger au CTM. Le Groupe consultatif peut également proposer aux Parties la nomination de deux conseillers représentant le public devant participer aux réunions du GES. Ces conseillers peuvent faire connaître leurs vues, oralement et par écrit, sur tous les aspects des travaux du GES. Les Parties supportent conjointement les frais de déplacements engagés par les membres indépendants et des conseillers représentant le public pour assister aux réunions du GES. De plus, les membres du GES peuvent consulter d'autres personnes lorsqu'ils le jugent nécessaire. Les séances du GES sont publiques; il se réunit une fois par année, et plus souvent au besoin, pour :

a) proposer l'approbation de son mandat au CGM;

b) examiner les critères et les modes d'évaluation de la ressource halieutique ainsi que les modes des campagnes d'évaluation du CTM et les méthodes utilisées;

c) fournir, au plus tard le 1er mars de chaque année, sauf indication contraire du CGM, un compte rendu technique écrit de l'évaluation de la ressource halieutique et son avis scientifique sur le rendement potentiel annuel; et

d) exercer toute autre fonction et assumer toute autre responsabilité que lui a déléguées le CGM.

3. Un Comité de gestion mixte (CGM) est constitué par la présente et comprend huit membres, quatre membres étant nommés par chaque Partie. Les membres nommés par chaque Partie forment la section nationale de cette Partie. Les deux sections nationales conviennent des recommandations faites par le CGM. Les séances du CGM sont publiques, sauf s'il juge le huis clos nécessaire en raison de circonstances extraordinaires. Le CGM se réunit au moins une fois par année, et plus souvent au besoin, pour :

a) adopter son mandat et approuver celui du CTM et du GES;

b) donner au GES et au CTM l'orientation nécessaire à la tenue de leurs délibérations;

c) déléguer les questions techniques ou d'autres responsabilités au GES ou au CTM lorsqu'il le juge nécessaire;

d) examiner des renseignements sur les mesures de gestion adoptées par les Parties; et

e) revoir les recommandations du CTM, du GES et du Groupe consultatif et, au plus tard le 25 mars de chaque année, recommander aux Parties l'approbation du TAC global pour l'année, calculer le TAC propre à chaque Partie conformément au paragraphe 2 de l'Article III et préciser tout ajustement à apporter en vertu du paragraphe 5 du présent article.

4. Un Groupe consultatif sur le merlu du Pacifique (Groupe consultatif) formé de membres nommés par chaque Partie est constitué par la présente. Les membres nommés par une Partie forment la section nationale de cette Partie. Les deux sections nationales conviennent des décisions prises par le Groupe consultatif. Les membres du Groupe consultatif doivent avoir des connaissances ou de l'expérience en matière de prise, de transformation, de commercialisation, de gestion, de conservation ou de recherche relativement à la pêche du merlu du Pacifique et ne peuvent être des employés ni de l'une des Parties ni de l'autre. Les séances du Groupe consultatif sont publiques. Le Groupe consultatif se réunit une fois par année avant la réunion du CGM, ou plus souvent au besoin, pour :

a) établir son mandat;

b) obtenir et fournir aux Parties, au plus tard le 25 mars de chaque année, le nom d'au moins trois experts scientifiques comme candidats au CTM et d'au moins cinq autres comme candidats au GES, en vue des nominations de l'année suivante;

c) revoir les recommandations du GES et du CTM;

d) passer en revue la gestion qu'ont faite de la pêche les deux Parties au cours de l'année précédente; et

e) faire des recommandations au CGM relativement au TAC global.

5. Ajustements :

a) Si, pour une année donnée, les prises d'une Partie dépassent son TAC individuel, une quantité égale à la quantité excédentaire doit être soustraite de son TAC individuel de l'année suivante.

b) Si, pour une année donnée, les prises d'une Partie sont inférieures à son TAC individuel, une quantité égale au nombre de prises toujours permises est ajoutée à son TAC individuel de l'année suivante, à moins d'une recommandation contraire du CGM. Les ajustements effectués en vertu du présent alinéa ne doivent en aucun cas dépasser 15 pour cent du TAC individuel non ajusté d'une Partie pour l'année au cours de laquelle des prises lui sont toujours permises.

6. Pour toute année durant laquelle le CGM fait des recommandations en vertu de l'alinéa 3*e)* du présent article, du paragraphe 5 du présent article ou du paragraphe 1 de l'Article III, les Parties gèrent leur pêche respective du stock de merlu du Pacifique au large des côtes conformément aux recommandations du CGM qu'elles ont approuvées.

ARTICLE III

1. Aux fins de cet accord, le taux d'exploitation par défaut correspond à F-40 pour cent avec un ajustement de 40/10. Après avoir pris en considération les recommandations du CTM, du GES ou du Groupe consultatif, le CGM peut recommander aux Parties un taux d'exploitation différent si des preuves scientifiques démontrent qu'un tel taux est nécessaire à la viabilité du stock de merlu du Pacifique au large des côtes. Si les Parties approuvent la recommandation, ils en informent le CGM.

2. La portion du TAC global applicable aux États-Unis est de 73,88 pour cent, tandis que celle applicable au Canada est de 26,12 pour cent. Cette répartition s'applique pour une période initiale de neuf ans, et par la suite, à moins que les Parties ne conviennent par écrit d'un ajustement. Un tel ajustement prend effet au cours de l'année suivante, à moins que les Parties n'en conviennent autrement.

ARTICLE IV

Les Parties conviennent de procéder à des recherches scientifiques pour assurer une mise en œuvre efficace du présent accord, notamment à des campagnes d'évaluation de la pêche au chalut et acoustique ainsi que des recrues, afin d'obtenir des données pertinentes sur le stock de merlu du Pacifique au large des côtes. Les Parties devraient, s'il y a lieu, utiliser des bateaux privés pour procéder à de telles recherches.

ARTICLE V

1. Le présent accord entrera en vigueur à la suite de l'échange par les Parties de notifications écrites, par la voie diplomatique, attestant qu'elles ont respectivement rempli les formalités internes applicables à cet effet.

2. Le présent accord peut être amendé à tout moment par accord écrit entre les Parties.

3. L'une des Parties peut mettre fin au présent accord par avis écrit donné à l'autre par la voie diplomatique. À moins de rétractation de l'avis, le présent accord prend fin le 31 décembre de l'année civile qui suit celle où l'avis a été reçu par la Partie contractante.

EN FOI DE QUOI, les soussignés, dûment autorisés par leur gouvernement respectif, ont signé le présent accord.

FAIT à Seattle, le 21 novembre 2003, en double exemplaire, en anglais et en français, les deux textes faisant également foi.

POUR LE GOUVERNEMENT DES ÉTATS-UNIS D'AMÉRIQUE :	**POUR LE GOUVERNEMENT DU CANADA :**
John F. Turner	[signature]

PERSPECTIVES OF THE CANADIAN GOVERNMENT REGARDING THE 2005 PACIFIC HAKE(WHITING) FISHERY

The Government of Canada presents its compliments to the Pacific Fishery Management Council (PFMC) and would like to thank the PFMC for this opportunity to express its views on the 2005 Pacific hake (whiting) fishery.

The Government of Canada is pleased that Canada and the United States signed a new treaty for the joint management of this important shared resource in Seattle on November 21, 2003. As was the case last year, Canada hopes that both countries will be able to manage their 2005 fishery within the spirit of the treaty pending its entry-into-force.

Canada would like to thank the members of the STAT team, the STAR Panel and the STAR Panel Advisors for their work in preparing the *Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004* and the *Report of the Joint Canadian and U.S. Pacific Hake/Whiting Stock Assessment Review Panel* on the stock assessment. Canada has used these documents as part of its internal procedures for developing its views on the 2005 fishery, and has the following comments to offer.

With respect to the harvest rate, Canada is of the view that the F-40 percent rate should continue to be used in 2005. This would be consistent with the treaty, which specifies F-40 with a 40/10 adjustment as the default harvest rate, and would be the most appropriate choice given the current status of the resource.

Canada is also of the view that the coast-wide total allowable catch (TAC) should be derived from the model using a value that falls between the range of the two values of Q (0.6 and 1.0) used in the assessment. At this point and based on the information available, Canada believes that: 1) a TAC value using the value of Q=1.0 would be too conservative; and 2) a TAC value using the value of Q=0.6 may be too bold. Canada therefore believes that the risk-neutral approach would be to adopt a 2005 coast-wide TAC consistent with a Q value of 0.8. Finally, Canada would also like to apply the harvest sharing provisions of the treaty to the 2005 fishery, with Canada taking of 26.12 percent of a commonly adopted coast-wide TAC.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON
PACIFIC WHITING MANAGEMENT

After discussion with the Groundfish Management Team (GMT), review of pertinent assessment documents, and receipt of comments from the public, including informal remarks from a representative of Canada's Department of Fisheries and Oceans, the Groundfish Advisory Subpanel (GAP) makes the following recommendations for management specifications for Pacific Whiting in 2005:

1. Establish a coastwide acceptable biological catch (ABC) based on an assessment modeling result using an assumption of a value of acoustic q=.8 and a harvest rate of $F_{40\%}$.

2. Establish a U.S. total catch optimum yield (OY) using the same principles (estimated by the GMT as 316,904 mt).

3. Maintain the published "caps" on the 2005 whiting fishery **only** of 7.3 mt of canary rockfish and 231.8 mt of widow rockfish.

4. Allow the whiting fishery to proceed as normal using the existing fishing sector allocations and starting dates until either the OY is reached, or one of the two rockfish caps is reached, at which point the entire fishery will be closed.

5. Encourage fisheries participants to take all steps necessary to avoid incidental catch of non-whiting species, to voluntarily regulate incidental take of non-whiting species, and to establish an informal reporting system that provides as near as possible real-time information on incidental catch to fisheries managers.

SETTING THE ABC AND OY

Scientific advice provided by the Scientific and Statistical Committee and the Pacific Whiting Stock Assessment Review Panel indicates that the value of acoustic "q" is bounded by values of 1 and .6, with neither likely to be the true value. This was the same advice provided in 2004 when the last full assessment and assessment review of Pacific whiting were undertaken. The Council did not need to make a choice of q values in 2004, as the U.S. OY level was already artificially constrained by the analysis of the whiting fishery provided under the National Environmental Policy Act. We now need to make a choice, at least for this year. For management purposes, it is logical to choose a value in between the bounds, which is q=.8. This same choice is being recommended by Canada's Department of Fisheries and Oceans in their analysis of the assessment results.

The agreement on Pacific Hake/Whiting between the U.S. and Canada calls for joint establishment of a coastwide ABC. That agreement also mandates the use of a harvest rate of $F_{40\%}$ unless scientific advice indicates use of an alternative rate. Such scientific advice has not been forwarded to our two governments. Although the agreement has been signed by the U.S., but not ratified and implemented through domestic procedures, the U.S. has committed to comply with the provisions of the agreement to the extent possible. Setting the ABC at the level recommended by the GAP is a scientifically sound decision and fulfills our commitment under the agreement.

The GAP notes that concerns have been expressed about future biomass predictions using the decision table provided in the whiting stock assessment. The Council should be aware that these predictions are largely based on a single year's result of the NMFS Southwest Fisheries Science Center juvenile survey. A companion survey conducted cooperatively by the NMFS Northwest Fisheries Science Center and the Pacific Whiting Conservation Cooperative yielded a different, higher value for that year (2003), due to an apparent northward movement of juvenile whiting. Because this year's assessment was an update assessment, the alternative value could not be considered, as it would have represented a new data source and a substantial change in the assessment model. In reality, the results from that single year using an alternative survey provide a much more optimistic view of the near future of the whiting biomass. Further, as noted in the GAP comments under Agenda Item F.3, trying to provide a 10-year biomass prediction for a species such as whiting with highly variable recruitment is an exercise in wishful thinking. We believe the Council can and should proceed with setting an ABC as we recommend.

MAINTAINING BYCATCH CAPS

There are many members of the GAP and the public who believe that setting caps for the entire whiting fishery is impractical, and realistic sub-caps should be set for each sub-sector of the fishery. There is also concern the caps on canary rockfish and widow rockfish that were set this year will somehow become fixed, and thus, not induce efforts to reduce bycatch. Nevertheless, the legal, analytical, and regulatory work necessary to change the caps this year or to convert them to sub-sector caps cannot be accomplished prior to the start of the whiting season in approximately three weeks. The GAP, therefore, believes the caps should stand, and the industry should find ways to stay within them. The GAP notes that in the 2004 fishery, in spite of the well-known "disaster tow" early in the year, the entire whiting fishery stayed within these numbers (see Agenda Item F.2.a, Supplemental NMFS Report, "2004 Pacific Whiting Fishery Summary, All Sectors").

INDUSTRY EFFORTS

The Pacific whiting fishery has for several years adopted voluntary measures to reduce or avoid bycatch, including a modern reporting system and observers in the at-sea sector; observers and real counts in the tribal sector; and a "penalty box," and more recently, a camera monitoring system to bolster shoreside sampling in the on-shore sector. Much of this is paid for by the industry itself. Informal discussions with major participants in the on-shore processing sector indicate that rapid reporting of bycatch could be accomplished if a regulatory entity could be identified to receive the reports. The GAP encourages establishing such a system. While we run the risk of a race for fish based on a desire to avoid a shut-down due to bycatch caps, existing industry practices, scheduling in conjunction with other fisheries, and the demonstrated ability to stay with the caps established all indicate that the risk will be minimal.

In sum, the GAP believes that its recommendations are both reasonable and scientifically sound. We urge the Council to adopt them

GROUNDFISH MANAGEMENT TEAM REPORT ON
PACIFIC WHITING MANAGEMENT

At its February meeting, the GMT reviewed results of the 2005 STAR panel for Pacific whiting. As with the 2004 and prior assessments, the value of the coefficient for acoustic survey catchability (**q**) remains the major source of uncertainty in determining the status of and appropriate harvest levels for this stock. The STAR panel identified a range of values for **q** of 0.6 to 1.0, and was unable to reach consensus that any portion of this range had a higher likelihood of including the true value. Model runs with **q** set at 0.8 were developed by the STAT team following the STAR panel meeting. Although the results of these runs were not included in the assessment or the STAR panel report, the GMT has included the 2005 whiting yields from these runs as additional points of comparison in its ranging of estimated bycatch impacts in the whiting fishery. Additionally, the STAT team included model projections based on an F45% harvest rate, as well as F40%, which is harvest rate specified in the U.S.-Canada whiting treaty. The GMT is not promoting use of F45%, but we have also included the 2005 whiting yields from these runs in examining potential bycatch implications of alternative whiting OYs because they have been presented previously.

Range of ABCs and OYs

The assessment reports that current spawning biomass ranges from 38.3% of the unfished level if **q**=1.0 to 41.4% if **q**=0.6. A matrix of OYs associated with three **q** assumptions and two harvest rates is provided in Table 2. Coastwide yields are shown on the left side of the table, with the corresponding U.S. shares on the right side. Table 2 also includes ABC values for F40% for the three values of **q**. The U.S. share of the ABC ranges from 269,545 mt, with **q**=1.0, to 441,525 mt, with **q**=0.6. Using an F40% harvest rate, the U.S. yields range from 269,069 mt, with **q**=1.0, to 441,525 mt, with **q**=0.6. Using an F45% harvest rate, the U.S. yields range from 223,343 mt, with **q**=1.0, to 356,766 mt, with **q**=0.6. The F 40% OYs for **q** values of 1.0 and 0.8 are slightly lower than the corresponding ABCs, because current spawning biomasses in these scenarios are somewhat less than the target biomass.

Whiting Stock Trajectories and Risk Assessment

Two Decision Tables are presented in Table 1 (Table 14 in the assessment): one for F40% and one for F45%. The upper left and lower right panels in each table reflect use of a harvest policy that is consistent with the true value of **q**. Results for a state of nature where **q**=1.0 are shown on the left, and those for **q**=0.6 are shown on the right. The short-term biomass projections in these tables are influenced heavily by the below-average amount of whiting observed in the NMFS SW Center (Santa Cruz) juvenile survey in 2003. This survey is used to determine whiting recruitment during the first two years of projections, producing a projected 2005 age-2 recruitment level that is well below average. As a result, spawning biomass is currently projected to dip below 30% of the unfished level by 2006 if the correct **q** is assumed, regardless of which harvest rate is selected. Furthermore, if 2005 harvest is set using a **q** of 0.6 and **q** is really equal to 1.0, spawning biomass is projected to fall below the overfished threshold by 2006.

The STAR panel was presented with an alternative view of the strength of the 2005 recruitment from findings of the northern juvenile survey, which was initiated more recently through a joint effort by the NMFS NW Center and the Pacific Whiting Conservation Cooperative. However, this index could not be included in the modeling, since the current assessment was viewed as an update of the 2004 assessment. The upcoming 2005 NMFS acoustic survey will afford the first comprehensive look at the strength of this year-class.

Sector Allocations and Estimated Bycatch Impacts

For each of the six U.S. OYs presented in Table 2, Table 3 reports the sector allocations of whiting, as well as estimated amounts of bycatch. Bycatch estimates for the 2005 whiting season were developed using the approach adopted for 2004, but with updated data from the 2004 fishery. A weighted average of incidental catch ratios (calculated as a ratio of species X to whiting) from years 2001 – 2004 was used, based on the following formula: [.4*2004 ratio]+[.3*2003 ratio]+[.2*2002 ratio]+[.1*2001 ratio]. For two species—canary and darkblotched—the non-tribal catch ratio during 2004 was the highest value observed during this four-year period. Graphs of bycatch ratios for these two species from 1998 to 2004 are provided in Figures 1 and 2.

In 2004, the estimated bycatch of widow rockfish was most constraining, relative to amounts of each overfished species that had previously been included in the bycatch scorecard for the whiting fishery. In this year's analysis, estimated widow bycatch under the highest whiting OY in Table 2 (230 mt) is less than the whiting fishery limit (231.8 mt) on bycatch (landings + discard mortality) published in federal regulations. Due to the high bycatch ratio in the 2004 fishery, canary is now the most constraining species. Even for the lowest whiting OY in Table 3 (223,000 mt), the estimated canary bycatch (7.7 mt) exceeds the whiting fishery bycatch limit (7.3 mt) in federal regulations. If the whiting OY were set using F40% and **q**=1.0 (269,000 mt), the estimated canary impact would be 9.22 mt. For informational purposes, the GMT has also included, at the bottom of Table 2, a panel showing the Whiting OY, and sector allocations, that produces an estimated 7.3 mt of canary bycatch. The higher bycatch rate for darkblotched during the 2004 fishery also produces higher amounts of estimated 2005 bycatch than the 9.5 mt included in the current scorecard. The highest whiting OY is estimated to produce 26 mt of darkblotched bycatch, which would be an increase of 16.5 mt. However, roughly 190 mt of darkblotched remain unassigned to any fishery in the current scorecard. Therefore, this magnitude of increase can be easily accommodated given expectations for darkblotched catch in other fisheries.

Sector Bycatch Limits

In March 2004, the GMT recommended, and the Council approved, the inclusion of bycatch limits as management tools to be considered in 2005 and 2006. Each sector of the whiting fishery is subject to unique catch monitoring protocols, which imply a range of monitoring capabilities for catches that would count against a bycatch limit. Currently, the at-sea sector is the only sector with a catch tracking system in place that can provide estimated catch totals in a near real-time manner. The GMT explored the legality and feasibility of having bycatch limits for the at-sea sector, while allowing that sector to access their full allocation of the U.S. whiting OY (as opposed to only allowing the at-sea sector to access a portion of their whiting allocation based on assumed bycatch rates). After discussions with NOAA General Counsel, it is the

GMT's understanding that setting sector specific bycatch limits in the whiting fishery would require a formal allocation, which involves a two meeting process and full rulemaking (proposed and final), as specified in the Groundfish FMP. This would effectively rule out sector specific bycatch limits for 2005. However, the GMT understands that this may be available for 2006 and beyond if the process for establishing sector specific bycatch limits and an analysis of the necessary monitoring and tracking of catch (in all sectors of the whiting fishery) is started this year.

The GMT also discussed the possibility of setting a whiting harvest guideline below the OY, and releasing additional whiting later in the year if bycatch was low enough to warrant such a release. However, it is the GMT's understanding that NMFS does not have a mechanism in 2005 for implementing such a process, but that this could also be an option for 2006 and beyond if the two meeting, full rulemaking process was followed.

Management Considerations for the 2005 Whiting Fishery

The GMT would like to draw the Council's attention to two options for setting the 2005 U.S. OY for Pacific Whiting.

- Option 1: Set a U.S. whiting OY of 208,306 mt, which is expected to result in a canary bycatch of 7.3 mt.

- Option 2: Set a U.S. whiting OY that is higher than 208,306 and close the whiting fishery when the OY is reached or when a whiting fishery bycatch limit is attained – whichever comes first. If current bycatch limits remain in place, the fishery would close when total catch of canary reaches 7.3, or when the total catch of widow reaches 231.8, or when the OY of Whiting is attained – whichever comes first.

These two options reflect differing levels of risk, with regard to bycatch and fishery revenue. The GMT feels that the risk of exceeding bycatch limits in the whiting fishery is less with Option 1. Under Option 2, delays in processing catch data from the shorebased and tribal sectors could lead to the fishery exceeding bycatch limits before managers have the opportunity to close the fishery. Additionally, the whiting sectors may have an increased incentive to achieve attainment of their whiting allocation before a bycatch limit is reached. If this results in an incentive to race for fish, participants may focus more on whiting catch than on bycatch reduction, potentially leading to an earlier closure than if a lower whiting OY was specified. Due to the differential season timing among sub-sectors, and the fact that sub-sector bycatch caps cannot be specified in 2005, higher OYs pose an increased risk to the shorebased fleet that an overall bycatch limit will be reached before their whiting allocation has been achieved.

In addition to concerns involved with option 2, other questions identified by the GMT for consideration are the following:

- Could the tribal whiting fishery be closed if the whiting fishery attains the sector bycatch limit?
- Is it possible for shorebased processors to feed near real-time landings data to NMFS so that NMFS can better monitor the shorebased whiting sector?

- Is verification of catch in the shorebased and mothership sectors of the whiting fishery adequate to monitor and close the fishery in a timely manner? And if not, can it be made so for the 2005 fishery?

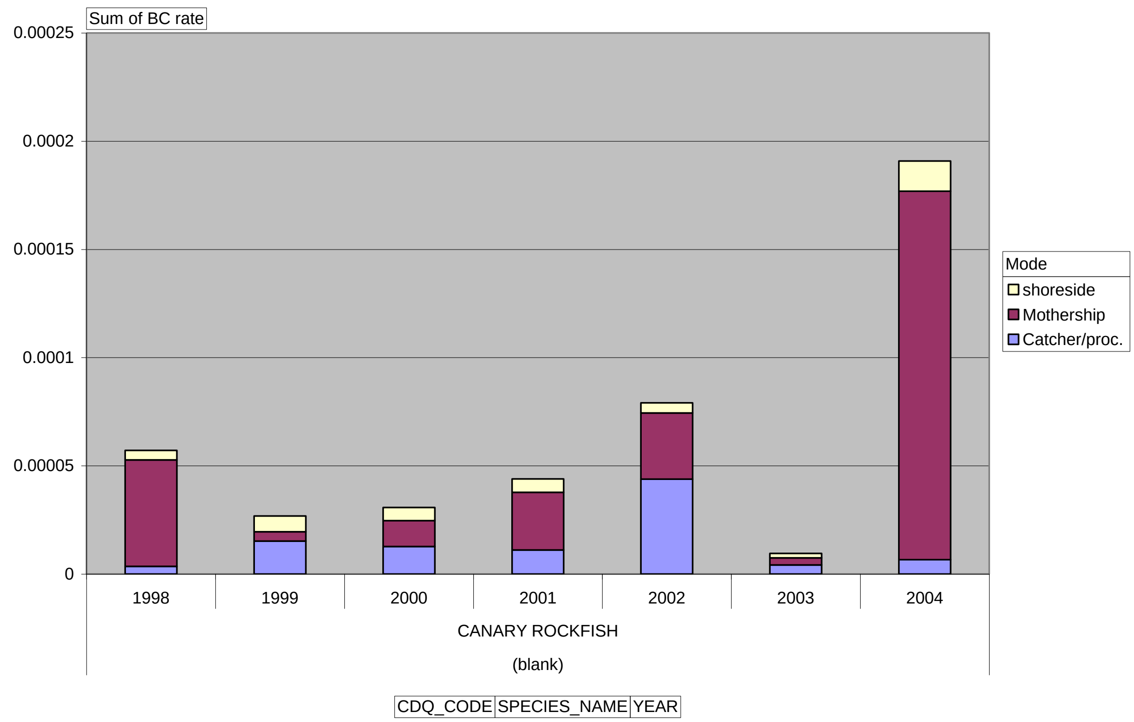


Figure 1. Non-Tribal Incidental Catch Rate of Canary in Hake Fisheries

---

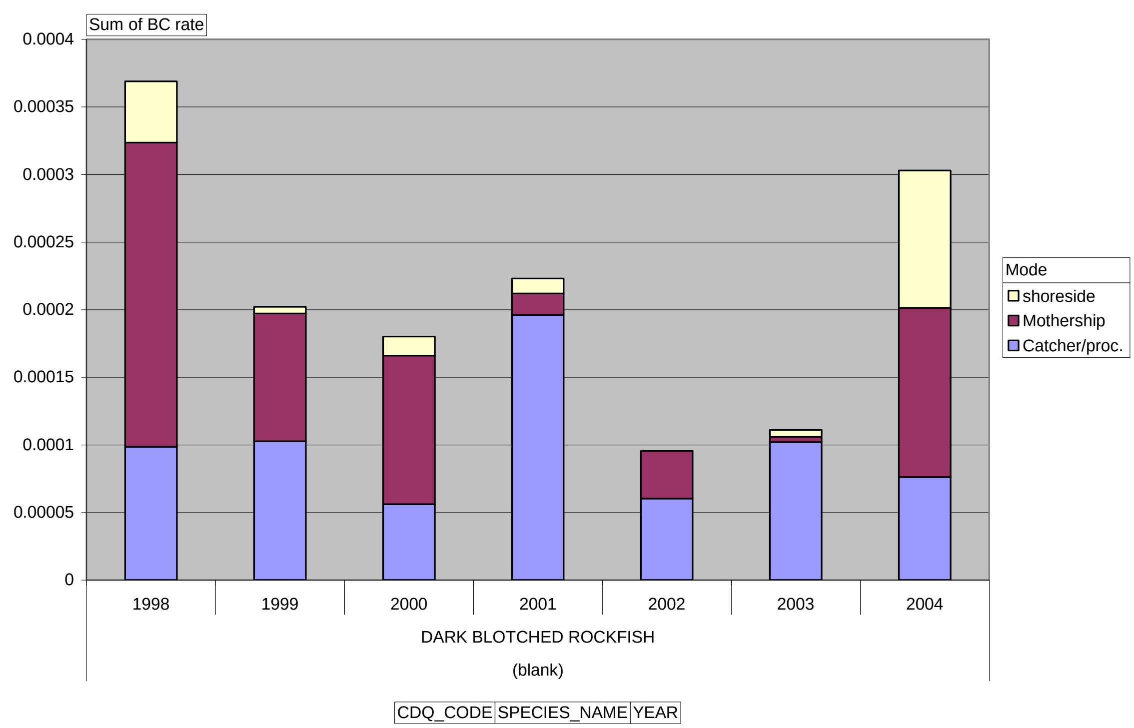


Figure 2. Non-Tribal Incidental Catch Rate of Darkblotched in Hake Fisheries

Table 1 (Assessment Table14). Decision Table evaluating the consequences of setting OY based on a correct or incorrect assumption regarding acoustic survey catchability (q). Results in the upper left and lower right panels reflect harvests that are correctly specified using the true value of **q**. Projected spawning biomass (millions mt), depletion level (% unfished biomass), and exploitation rates in 2005-2014 are given.

Assumed State of Nature	Year	OY Assumed	True State of Nature: *q = 1.0* Spawning Biomass	Percent Unfished	Exploitation Rate	*q = 0.6* Spawning Biomass	Percent Unfished	Exploitation Rate
q = 1.0								
	2005	364,197	0.997	0.383	0.185	1.673	0.414	0.113
	2006	258,507	0.696	0.268	0.198	1.268	0.314	0.113
	2007	248,323	0.707	0.272	0.164	1.382	0.343	0.092
	2008	278,576	0.779	0.300	0.166	1.557	0.386	0.087
F40% (40-10)	**2009**	321,665	0.838	0.322	0.173	1.621	0.402	0.096
	2010	353,427	0.921	0.354	0.177	1.824	0.452	0.096
	2011	371,392	0.936	0.360	0.179	1.833	0.454	0.099
	2012	369,845	0.934	0.359	0.183	1.800	0.446	0.101
	2013	363,418	0.909	0.350	0.185	1.824	0.452	0.099
	2014	365,660	0.919	0.353	0.182	1.862	0.461	0.097
q = 0.6								
	2005	597,625	0.997	0.383	0.306	1.673	0.414	0.113
	2006	422,115	0.578	0.222	0.413	1.185	0.298	0.195
	2007	382,138	0.521	0.200	0.361	1.140	0.286	0.159
	2008	408,865	0.550	0.212	0.350	1.192	0.300	0.163
F40% (40-10)	**2009**	450,905	0.594	0.229	0.350	1.225	0.308	0.171
	2010	489,969	0.641	0.246	0.367	1.330	0.334	0.172
	2011	515,007	0.639	0.246	0.364	1.334	0.335	0.174
	2012	530,105	0.623	0.240	0.385	1.370	0.344	0.179
	2013	540,436	0.577	0.222	0.433	1.377	0.346	0.184
	2014	564,831	0.562	0.216	0.445	1.430	0.359	0.179

Assumed State of Nature	Year	OY Assumed	True State of Nature: *q = 1.0* Spawning Biomass	Percent Unfished	Exploitation Rate	*q = 0.6* Spawning Biomass	Percent Unfished	Exploitation Rate
q = 1.0								
	2005	302,305	0.997	0.383	0.154	1.673	0.414	0.094
	2006	230,359	0.729	0.280	0.168	1.300	0.322	0.098
	2007	225,028	0.753	0.289	0.141	1.428	0.354	0.081
	2008	251,998	0.831	0.319	0.141	1.609	0.399	0.077
F45% (40-10)	**2009**	290,260	0.896	0.345	0.146	1.675	0.415	0.084
	2010	318,141	0.997	0.383	0.149	1.896	0.470	0.084
	2011	336,497	1.020	0.392	0.152	1.909	0.473	0.086
	2012	338,863	1.022	0.393	0.154	1.881	0.466	0.089
	2013	336,312	1.008	0.388	0.156	1.910	0.473	0.088
	2014	338,300	1.018	0.391	0.155	1.955	0.485	0.086
q = 0.6								
	2005	482,899	0.997	0.383	0.247	1.673	0.414	0.149
	2006	370,917	0.637	0.245	0.327	1.207	0.299	0.167
	2007	366,140	0.601	0.231	0.301	1.245	0.309	0.139
	2008	410,192	0.625	0.240	0.312	1.365	0.338	0.138
F45% (40-10)	**2009**	453,579	0.655	0.252	0.322	1.409	0.349	0.148
	2010	479,357	0.697	0.268	0.334	1.523	0.377	0.149
	2011	488,955	0.689	0.265	0.324	1.519	0.376	0.151
	2012	479,261	0.677	0.260	0.326	1.461	0.362	0.154
	2013	472,026	0.648	0.249	0.340	1.440	0.357	0.154
	2014	474,799	0.656	0.252	0.342	1.463	0.363	0.152

Table 2.--Alternative 2005 ABCs and OYs for whiting, for ranges of accoustic survey catchability (q) values and harvest rates.

Model q assumption	Coastwide F40% ABC	Coastwide F40% OY	Coastwide F45% OY	U.S. Share (73.88%) F40% ABC	U.S. Share (73.88%) F40% OY	U.S. Share (73.88%) F45% OY	
0.6	597,625	597,625	482,899	441,525	441,525	356,766	
0.8	432,100	428,944	357,737	319,235	316,904	264,296	— Ralph's proposal
1.0	364,842	364,197	302,305	269,545	269,069	223,343	— Phil's proposal

Table 3.-- Whiting sector allocations and estimated bycatch of selected groundfish species for the U.S. OY alternatives presented in Table 1.

q	F-Rate	Sector	Whiting allocation	Estimated bycatch (mt) Bocaccio	Canary	Dark-blotched	Lingcod	POP	Widow	Yellow-eye	Sablefish
0.6	F40%	Tribal	35,000	0.00	3.04	0.04	0.41	1.34	10.02	0.00	0.26
		Mothership	97,086	0.00	7.55	5.82	1.62	1.88	41.63	0.01	15.83
		CP	137,539	0.00	1.90	12.75	0.92	11.65	139.02	0.02	55.87
		Shoreside	169,901	0.00	1.32	7.35	4.09	4.17	39.38	0.01	297.97
		Total	**441,525**	**0.00**	**13.81**	**25.96**	**7.03**	**19.04**	**230.05**	**0.03**	**369.93**
0.6	F45%	Tribal	35,000	0.00	3.04	0.04	0.41	1.34	10.02	0.00	0.26
		Mothership	76,744	0.00	5.97	4.60	1.28	1.48	32.91	0.01	12.51
		CP	108,720	0.00	1.50	10.08	0.72	9.21	109.89	0.01	44.17
		Shoreside	134,302	0.00	1.04	5.81	3.23	3.30	31.13	0.00	235.53
		Total	**356,766**	**0.00**	**11.55**	**20.53**	**5.64**	**15.33**	**183.95**	**0.02**	**292.47**
0.8	F40%	Tribal	35,000	0.00	3.04	0.04	0.41	1.34	10.02	0.00	0.26
		Mothership	67,177	0.00	5.23	4.02	1.12	1.30	28.81	0.00	10.95
		CP	95,167	0.00	1.31	8.83	0.63	8.06	96.19	0.01	38.66
		Shoreside	117,560	0.00	0.91	5.09	2.83	2.89	27.25	0.00	206.17
		Total	**316,904**	**0.00**	**10.49**	**17.97**	**4.99**	**13.59**	**162.27**	**0.02**	**256.04**
0.8	F45%	Tribal	35,000	0.00	3.04	0.04	0.41	1.34	10.02	0.00	0.26
		Mothership	54,551	0.00	4.24	3.27	0.91	1.05	23.39	0.00	8.89
		CP	77,281	0.00	1.07	7.17	0.51	6.54	78.11	0.01	31.39
		Shoreside	95,464	0.00	0.74	4.13	2.30	2.34	22.12	0.00	167.42
		Total	**264,296**	**0.00**	**9.09**	**14.60**	**4.13**	**11.29**	**133.65**	**0.02**	**207.97**
1	F40%	Tribal	35,000	0.00	3.04	0.04	0.41	1.34	10.02	0.00	0.26
		Mothership	55,696	0.00	4.33	3.34	0.93	1.08	23.88	0.00	9.08
		CP	78,903	0.00	1.09	7.32	0.53	6.68	79.76	0.01	32.05
		Shoreside	97,469	0.00	0.76	4.22	2.35	2.39	22.59	0.00	170.94
		Total	**269,069**	**0.00**	**9.22**	**14.91**	**4.21**	**11.49**	**136.25**	**0.02**	**212.33**
1	F45%	Tribal	30,000	0.00	2.61	0.03	0.35	1.15	8.59	0.00	0.22
		Mothership	45,922	0.00	3.57	2.75	0.77	0.89	19.69	0.00	7.49
		CP	65,057	0.00	0.90	6.03	0.43	5.51	65.76	0.01	26.43
		Shoreside	80,364	0.00	0.62	3.48	1.94	1.97	18.63	0.00	140.94
		Total	**223,343**	**0.00**	**7.70**	**12.29**	**3.48**	**9.52**	**112.67**	**0.01**	**175.08**
Whiting OY that produces 7.3 mt of canary		Tribal	30,000	0.00	2.61	0.03	0.35	1.15	8.59	0.00	0.22
		Mothership	42,313	0.00	3.29	2.54	0.71	0.82	18.14	0.00	6.90
		CP	59,944	0.00	0.83	5.56	0.40	5.08	60.59	0.01	24.35
		Shoreside	74,048	0.00	0.57	3.20	1.78	1.82	17.16	0.00	129.86
		Total	**208,306**	**0.00**	**7.30**	**11.33**	**3.24**	**8.86**	**104.49**	**0.01**	**161.34**

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON PACIFIC WHITING MANAGEMENT

Mr. Tom Jagielo from the Scientific and Statistical Committee (SSC), and Chair of the Joint Canadian and U.S. Stock Assessment and Review (STAR) Panel for Pacific whiting, presented the SSC with an overview of the STAR Panel report. Dr. Thomas Helser, lead author of the Stock Assessment Team report, responded to questions arising during the SSC discussions.

The new stock assessment is an update of the 2004 assessment that includes additional data for catch, catch-at-age, and juvenile pre-recruit abundance in 2004, but otherwise uses the same model structure and configuration. As in the previous assessment the major source of uncertainty in the updated assessment is the value of the catchability coefficient (q) for the acoustic survey. Both the 2004 assessment and the 2005 update developed stock size estimates and catch projections based on assumed values for the acoustic survey q. The SSC concurs with the views of the STAT Team and STAR Panel that the two alternative models (q = 1.0 versus q = 0.6) are equally likely and provide plausible lower and upper bounds on stock status.

The age-3+ stock biomass in 2004 was estimated to range from 2.5 to 4.0 million metric tons, with the 2004 fishery supported primarily by the very strong 1999 year-class. Although spawning biomass was estimated to be 50% to 59% of the unfished level in 2004, it is projected to decline after 2005 because of relatively weak year-classes in 2000-2002. Optimum yield (OY) is projected to decline in 2006 relative to 2005, with further declines in 2007.

The SSC recommends that the decision table (Table 14 in the stock assessment document, Agenda Item F.6.a, Attachment 1) be used to evaluate the alternative OY options for 2005. This table shows the consequences for stock biomass when OYs are taken based either on the q = 1.0 or q = 0.6 model, given that the true situation is consistent with one or the other model. The entries in the lower left and upper right boxes show the “penalties” for using the incorrect model. If the OY is incorrectly based on the q = 0.6 model, greater harvests could accrue (1.4 million tons during 2005-2007), but there is a 50:50 chance that the stock would be reduced to 20% of the unfished biomass in 2007 and declared overfished. If the OY is incorrectly based on the q = 1.0 model, there is much less of a chance the stock would be declared overfished, but smaller harvests would accrue (0.87 million tons during 2005-2007).

The SSC also received a brief verbal report from Dr. Vidar Wespestad, Chief Scientist of the Pacific Whiting Conservation Cooperative (PWCC). Since 2001 the PWCC, in conjunction with the NMFS Northwest Fisheries Science Center (NWFSC), has conducted surveys of juvenile Pacific whiting and rockfish off Oregon and California using gear and survey protocols that are comparable to the pre-recruit survey conducted by the Southwest Fisheries Science Center (SWFSC) Santa Cruz Laboratory. Pacific whiting assessments since 2001 have used the SWFSC pre-recruit survey results as a recruitment index. The PWCC survey, which may in the future be incorporated into the whiting assessment, has broader geographic coverage than the SWFSC survey and could provide information on year-class strength that would supplement the SWFSC survey and improve model projections. The 2005 coastwide acoustic survey will measure the strength of the 2002 and 2003 year-classes and corroborate the relative accuracy of the two surveys.

Pacific Whiting Conservation Cooperative

Alaska Ocean Seafoods • American Seafoods • Glacier Fish Co. • Trident Seafoods

A Partnership to Promote Responsible Fishing

Mr. Donald K. Hansen, Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220

February 16, 2005

Re: 2005 Pacific Whiting Fishery Harvest Levels

Dear Chairman Hansen,

The Pacific Whiting Conservation Cooperative (PWCC) offers the following comments for consideration by the Pacific Fishery Management Council (Council) in deciding harvest levels for the 2005 Pacific whiting fishery. The PWCC sees strong evidence that the current Pacific whiting stock is healthy and that, supported by recent recruitment, the resource will remain abundant. The PWCC recognizes the Council decision about whiting harvest levels is also driven by the need to rebuild depleted rockfish species, notably canary rockfish and widow rockfish. In response to this concern, rockfish bycatch caps were established by the Council and National Marine Fisheries Service (NMFS) has authority to close any or all whiting fishery sectors if the bycatch caps are reached. Moreover, the whiting fishery has a proven ability to avoid rockfish bycatch areas. For these reasons, the PWCC recommends the Council consider setting the U.S. portion of the Pacific whiting optimum yield (OY) in line with the medium value analyzed in the 2005-2006 groundfish specifications, that is, above 350,000 mt. This letter and the attached cruise report summary provide detailed information to bolster our recommendation.

Factors that will influence Council decision making are similar to those in 2004: namely, (1) appropriate estimate of acoustic survey selectivity (i.e., “q”), (2) recruitment strength and future stock status, and (3) bycatch of depleted rockfish. Additionally, the Council’s ability to set the 2004 whiting OY was further constrained because harvest levels above 250,000 mt were not analyzed in the federal rulemaking documents. This procedural constraint is not a factor in 2005.

Acoustic Survey Selectivity – q

As in 2004, the 2005 Pacific whiting Stock Assessment Review (STAR) Panel provided two versions of the whiting assessment model: one based on q = 1.0 and a second based on q = 0.6. The differential q values produce starkly different estimates of acceptable biological catch (ABC). In 2004, the Scientific and Statistical Committee (SSC) noted their concern that –

> “emphasis on upper and lower bounds does not take into account the greater likelihood that the true value is in the center of the range.”

PWCC – Portland
205 SE Spokane Street, Suite 338
Portland, Oregon 97202
Phone: 503-238-7492
Fax: 503-238-7499

The 2005 STAR Panel discussed at length the appropriateness of the competing q values and the steps necessary to determine a single point estimate for q. To help inform management decision making, the STAR Panel requested the assessment author produce harvest projections based on a q = 0.8 model scenario. This mid-range harvest projection was to be provided to the Groundfish Management Team (GMT) and Council prior to the March 2005 Council meeting.

We estimate that harvest projections based on a q = 0.8 model would produce a U.S. Pacific whiting OY of approximately 355,298 mt. (This value was obtained by averaging the two ABC values produced by the current q = 1.0 and q = 0.6 models, i.e., 364,197 mt and 597,625 mt, respectively; which results in an coastwide ABC of 480,911 mt. Finally, the U.S. allocation percentage agreed upon in the Pacific Whiting Treaty, i.e., 73.88%, was applied.)

Recruitment and Stock Status

Pacific whiting recruitment and future stock status must also be considered in the Council's decision. In 2004, based on pessimistic recruitment estimates from the NMFS-Santa Cruz Lab (SCL) surveys for the 2002 and 2003 whiting year classes, the Council believed it was prudent to take a risk-averse course to dampen impacts on what was perceived to be a declining stock. However, cooperative research conducted by NMFS-Northwest Fisheries Science Center and PWCC provides evidence that, in 2002 and 2003, the SCL survey might have underestimated whiting year class strength. It is possible that SCL's low estimates of year class strength resulted from the more northerly distribution of juvenile whiting during those years coupled with the limited geographic range of the SCL survey. (See attached NMFS-PWCC Cruise Report Summary for additional details.)

Moreover, in their report to the Council the 2005 STAR Panel specifically recommended that –

> "managers exercise caution in relying on the future year projections presented in the assessment. The Panel concluded that, as new data are added from future surveys, the PWCC index (with greater spatial coverage than the Santa Cruz juvenile rockfish survey) should be evaluated for use in future stock assessments."

In 2004, both the SCL and NMFS-PWCC surveys estimated 2004 year class strength that was above average, potentially equal to the large 1999 year class (see Table 1 in attached summary report). Based on this research, PWCC believes recent Pacific whiting recruitment has been at least average (possibly well above average in 2004) and that the whiting stock will remain well above the precautionary 40-10 policy threshold.

Bycatch Avoidance

In 2004, (in addition to those factors discussed above) the Pacific whiting OY was set well below ABC because of the Council's concern about minimizing impacts on depleted rockfish species. Completed catch statistics for the 2004 fishery are not currently available to compare the actual impacts to those projected by the GMT. However, data from the PWCC fleet of vessels (each of which carry two observers and all hauls are observed) documents very low bycatch of canary rockfish, widow rockfish, and other overfished species. Less than 0.5 mt of canary rockfish and approximately 8.25 mt of widow rockfish were caught be PWCC vessels during the 2004 whiting fishery. In addition to this demonstrated ability to avoid rockfish bycatch, the Council has established hard caps on bycatch for the 2005 whiting fishery (7.3 mt of canary rockfish and 238.1 mt of widow rockfish). If these caps are reached NMFS has the authority to close any or all sectors of the whiting fishery.

Therefore, given the fleets demonstrated ability to avoid rockfish bycatch, the established hard caps on canary rockfish and widow rockfish, and NMFS authority to close any or all sectors of the whiting fishery, PWCC believes rockfish bycatch concerns have been addressed and should not be the basis for further reductions of 2005 whiting harvest levels.

Summary

The new Pacific whiting assessment shows an abundant whiting biomass, new information lends credence to moving away from the assumed q = 1.0 acoustic survey selectivity, recruitment information from the NMFS-PWCC pre-recruit survey shows several strong year classes entering the fishery, and concerns about rockfish bycatch should be allayed because of the hard caps on canary rockfish and widow rockfish. Moreover, NMFS has authority to close the whiting fishery if the bycatch caps are approached. Finally, the whiting fishery has a demonstrated ability to fish cleanly by avoiding areas of high bycatch concentrations. For these reasons, the PWCC recommends the Council consider setting the U.S. portion of the Pacific whiting optimum yield (OY) in line with the medium value analyzed in the 2005-2006 groundfish specifications, that is, above 350,000 mt.

Thank you for your consideration of this information and our recommendations.

Sincerely,

Daniel A. Waldeck
Executive Director

Enclosures
NMFS-PWCC Cruise Report Summary

Pacific Whiting Recruitment Trends Based on the NMFS-PWCC and NMFS Santa Cruz Lab Juvenile Pre-Recruit Surveys

Vidar G. Wespestad, Chief Scientist
Pacific Whiting Conservation Cooperative

The National Marine Fisheries Service (NMFS)-Northwest Fisheries Science Center and Pacific Whiting Conservation Cooperative (PWCC) and NMFS-Southwest Fisheries Science Center-Santa Cruz Laboratory (SCL) conduct surveys of juvenile (termed "young-of-the-year" or YOY) Pacific whiting and rockfish relative abundance and distribution off Oregon and California. The NMFS-PWCC survey, which started in 1998, is an expansion of the SCL juvenile rockfish survey. Prior to 2001, results between the PWCC survey and the SCL survey were not comparable because of trawl gear differences. Since 2001, the gear has been comparable and side-by-side comparisons have been made between the NMFS-PWCC vessel *Excalibur* and the SCL vessel *D.S. Jordan*.

Results from NMFS-PWCC and SCL surveys indicate a strong 2004 Pacific whiting year class.

Pacific Whiting Year Class Strength and Recruitment

In 2004, estimates of year class strength in the PWCC-NMFS survey were similar to the SCL survey. Both indicated that the 2004 year class is an above average year class (Table 1). Based on the SCL survey results, it may be equal to the large 1999 year class. The surveys also achieved similar results in 2001, which (based on the SCL survey) appears to have been an average year class. However, for 2002 and 2003 the two surveys had markedly different results. That is, the SCL survey exhibited a declining trend from 2001 to 2003, while the NMFS-PWCC survey showed an increasing trend.

Year	NMFS-Santa Cruz	PWCC-NMFS
1999	558.7	No Survey
2000	75.2	No Survey
2001	172.8	100.2
2002	45.8	102.8
2003	9.4	376.4
2004	535.6	1,211.70

Table 1. Mean number of YOY Pacific whiting per haul in the NMFS Santa Cruz survey and the NMFS-PWCC survey, 1999-2004.

This difference is likely due to the geographical distribution of YOY whiting coupled with the different geographic scope of the two surveys. In 2001 and 2004, there was overlap in the distribution of whiting between the two survey areas. In 2002 and 2003, whiting YOY appear to have been distributed north of the SCL survey area (Figure 1).

From 2001-2003, the NMFS-PWCC survey was conducted at stations across the continental shelf between Newport, Oregon (44º 30'N latitude) and Point Arguello, California (34º 30' N latitude). For 2004, the survey was expanded to the north to 46º 30'N latitude (approximately Willapa Bay, Washington).

Through 2003, the SCL survey was conducted between Cypress Point, California and Point Reyes, California. In 2004, the survey was expanded farther south and north, running from San Clemente Island, California to Delgada, California.

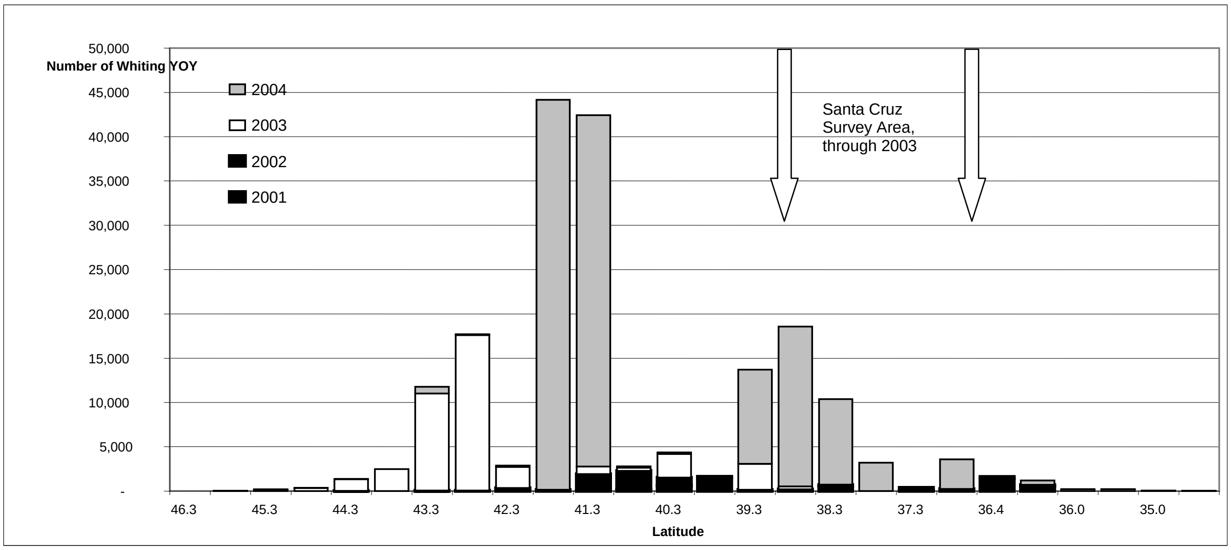


Figure 1. Distribution of YOY whiting by latitude in the 2001-2004 NMFS-PWCC prerecruit survey.

Pacific Whiting Length Frequency

Samples from the NMFS-PWCC survey show that the length frequency of YOY whiting trended slightly smaller in 2004 than in previous years. Modal length was similar to the 2003 survey (3 cm), but the mean length was less because of a greater proportion of 2 cm fish in the 2004 survey. The modal length was greater in 2002 at 4 cm. Mean length showed a slight increase from 2.6 cm in 2001, to 2.9 cm in 2002, and to 3.2 in 2003; but a decrease to 3.0 cm in 2004. In the 2001 NMFS-PWCC survey, YOY whiting were present up to 14 cm, but in subsequent years there were no YOY larger than 7 cm. It is not clear if YOY length distributions are a result of density dependence or environmental factors. However, the size decrease in correspondence with high abundance of YOY whiting could be indicative of density dependence.

Relative to past years, the 2004 length frequency of whiting indicated a greater number of 15-28 cm fish, which represent lengths typical for age 1 and age 2 whiting (Figure 2). As these age classes would correspond to 2002 and 2003 YOY fish, respectively, this could also be an indication that the 2002 and 2003 year classes are greater than previously estimated in the SCL survey.

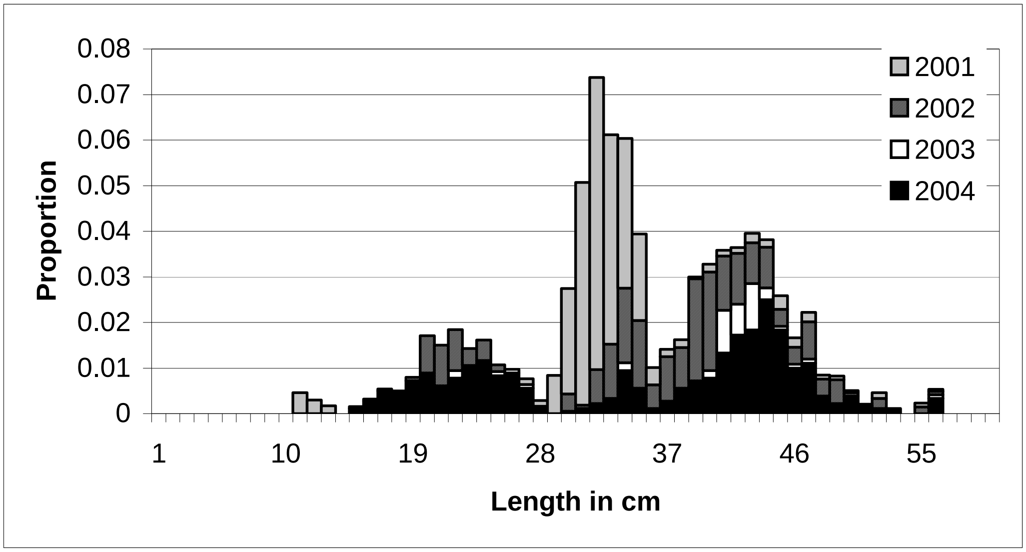


Figure 2. Comparison of juvenile and adult whiting length frequency in 2001-2004 in the NMFS-PWCC cooperative whiting prerecruit survey.

Comparative trawling between the RV *D.S. Jordan* and the FV *Excalibur*

In 2004, comparative trawling was conducted for four nights between the FV *Excalibur* used in the NMFS-PWCC whiting prerecruit survey and the RV *D.S. Jordan* used by SCL for its juvenile rockfish survey. The vessels occupied the same stations and covered the same course at approximately 0.25-0.5 nm distance separation. Trawls were set simultaneously and each hauled back after 15 minutes. The nets, trawl doors, and trawl warps were similar. In prior years, comparative trawls were conducted, generally for two nights, but results were unclear due to problems with trawl monitoring devices aboard the *D.S. Jordan*.

Generally, the number of juvenile rockfish has been greater in *D.S. Jordan* hauls compared to *Excalibur* hauls (Table 2). For whiting, between vessel catch has been variable. For example, in 2002, one large haul by the *D.S. Jordan* had about five times more whiting than the *Excalibur*, otherwise the capture of whiting were similar in the remaining hauls in 2002. Rockfish captures by the *D.S. Jordan* are about twice that of the *Excalibur* in 2001-2003, but were more similar in 2004.

	YOY Whiting		YOY Rockfish	
Year	*D.S. Jordan*	*Excalibur*	*D.S. Jordan*	*Excalibur*
2001	415	773	332	150
2002	1,118	355	165	72
2003	20	40	131	75
2004	6,609	4,167	544	443

Table 2. Number of YOY whiting and rockfish captured by the RV *D.S. Jordan* and FV *Excalibur* during side-by-side comparative tows off central California, 2001-2004. *Excalibur* – mean number per haul for all PWCC hauls; *D.S. Jordan* – mean number per haul for SCL within their hake strata.

In 2004, the *D.S. Jordan's* gear mensuration equipment was functional; thus, the operational depth of the net could be observed and the net maintained at depth. The *D.S. Jordan* continued to have a 20% higher overall catch of rockfish. However, on a haul-by-haul basis the results were generally comparable. For juvenile rockfish, **catch per haul** was nearly equal between vessels (Figure 3), as was the number of rockfish **species per haul**. (Figure 4).

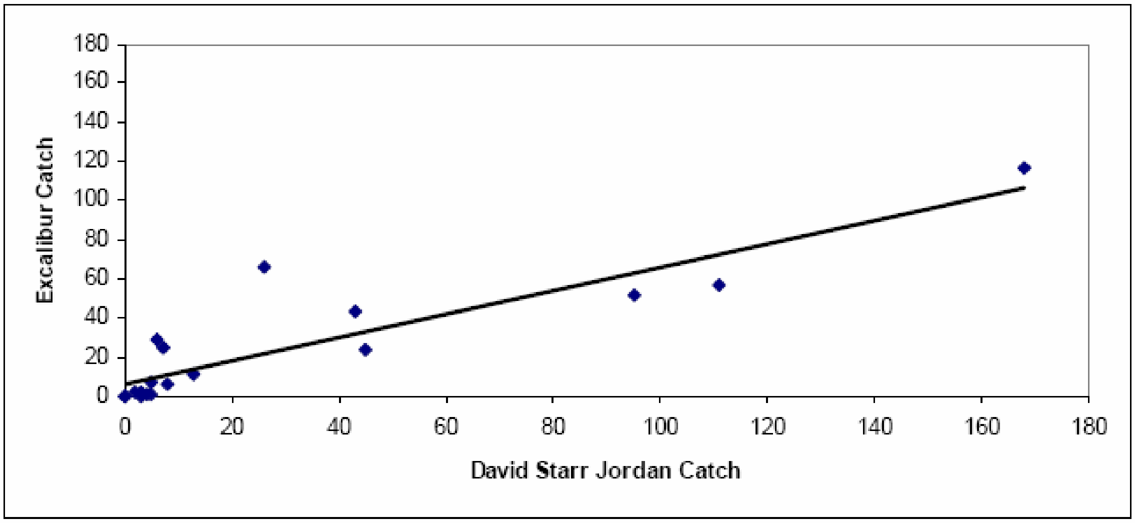


Figure 3. Comparison of the **catch** of juvenile rockfish in 18 side-by-side comparative hauls made by the RV *D.S. Jordan* and the FV *Excalibur* in 2004 using comparable gear and methods.

Thirteen species of rockfish were captured during comparative trawls (Figure 4). The predominate species of rockfish were chilipepper and shortbelly rockfish. The remaining species were present in fewer numbers. Species composition was similar between *D.S. Jordan* and *Excalibur* hauls, with similar high and low species diversity hauls between vessels.

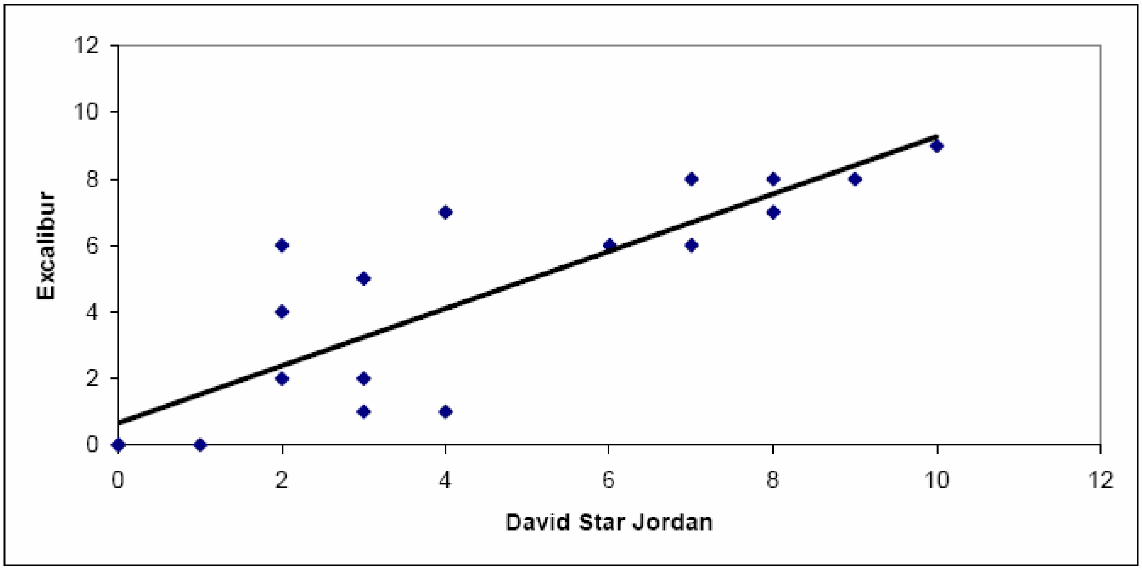


Figure 4. Comparison of the number of juvenile rockfish **species** in 18 side-by-side comparative hauls made between the RV *D.S. Jordan* and the FV *Excalibur* in 2004 using comparable gear and methods.

The accumulation of comparative results between the NMFS-PWCC and SCL surveys are starting to provide data that suggest transport of larvae may vary spatially, with larvae reaching the outer shelf north of the Monterey index area in some years, but not others. For example, the distribution of YOY whiting by latitude indicates a northward distributional shift from 2001 to 2004. In 2001, YOY whiting distribution was concentrated between 40º and 36º 30' N latitude. In 2003, catch was similar to 2001, but most of the YOY whiting captured in the NMFS-PWCC survey were north of the SCL survey area. In 2003, whiting were farther north, i.e., between 43º and 43º 30' N latitude in the area of Cape Blanco, California. In 2004, whiting were the most widespread of all the years. Whiting YOY were captured throughout the NMFS-PWCC survey area, but very large concentrations occurred from the Monterey Bay area northward to the California-Oregon border. In all years, very few YOY whiting were captured south of Monterey Bay. It is possible that Pacific whiting larvae follow a set transport pattern, but that migration varies temporally. With additional data, it may be possible to model and predict the distribution of YOY, and better deploy survey effort.

The relative accuracy of the surveys results is pending verification by the 2005 coastwide Pacific whiting acoustic survey.

Discussion

Results from both the NMFS-PWCC and SCL surveys indicate that the Pacific whiting stock produced a strong 2004 year class. Similarly, results from 2001 suggest a, generally, average year class. However, for 2002 and 2003 there is a significant difference in the indices of year class abundance between the two surveys. The SCL survey exhibits a declining trend from 2001 to 2003, while the NMFS-PWCC survey shows an increasing trend. Thus, for the 2002 and 2003 year classes estimates range from above average (NMFS-PWCC) to below average (SCL). This is most likely due to differences in the geographic range of the surveys combined with the variable geographic distribution of YOY whiting. In 2001 and 2004, there was overlap in the distribution of whiting between the two surveys. However, in 2002 and 2003, whiting YOY appear to have been distributed north of the SCL survey area. The relative accuracy of the two surveys is pending the results of the 2005 coast wide acoustic survey. However, as illustrated in Figure 2 (above), it is interesting to observe that the amount of whiting in the size range corresponding to the 2002-2003 year classes was greater in the 2004 NMFS-PWCC survey than for similar sized fish in prior years. This suggests greater numbers of 2002 and 2003 year class fish and, thus, stronger recruitment than estimated by the SCL survey.

Based on comparative hauls the *D.S. Jordan* appears to have a higher catchabilty for juvenile rockfish than the *Excalibur*, but overall the two surveys are highly comparable. For several species the trend shows an increase in rockfish production in 2002 and 2004. Three of the rockfish species listed as overfished (widow, canary and darkblotched rockfish) all showed increased numbers in 2002 and 2004 *Excalibur* samples. Similar results were observed in the *D.S. Jordan* samples (Dr. Steve Ralston, NMFS-Santa Cruz, Pers. Comm.). This suggests that the 2002 and 2004 year classes may be above average for these species and stock rebuilding may be occurring at a more rapid rate than model estimates suggest.

PACIFIC WHITING MANAGEMENT

The Pacific whiting fishery management process is unlike other federally-managed West Coast groundfish for 2005 fisheries, for which catch specifications and management measures were adopted by the Council at the June 2004 Council meeting for the two-year period 2005-2006. The Council deferred a decision on setting harvest specifications and management measures for the 2005 Pacific whiting fisheries pending the development and review of a new stock assessment to occur during February 2005. An updated Pacific whiting assessment was prepared this winter (Agenda Item F.6.a, Attachment 1) and reviewed by a Stock Assessment Review (STAR) Panel during February 2005 (Agenda Item F.6.a, Attachment 2). The Council should consider the advice of the STAR Panel, the Scientific and Statistical Committee (SSC), and other advisors before adopting the assessment for use in management decision-making. The assessment, once approved, will be used to set 2005 Pacific whiting harvest specifications and management measures.

In 2004, 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 by both countries and is currently awaiting ratification by the U.S. Senate and passage of implementing legislation by the U.S. Congress (Agenda Item F.6.a, Attachment 3). The primary tenets of the treaty include a joint U.S.-Canada annual assessment and management process, a research commitment, and a harvest sharing agreement providing 73.88% for U.S. fisheries and 26.12% for Canadian fisheries.

The Council is tasked with setting an acceptable biological catch (ABC) and optimum yield (OY) for Pacific whiting that will be used to manage 2005 fisheries. Considerations for this decision include the stock's current and projected status with respect to the overfishing threshold, the international agreement with Canada, and overfished species' bycatch concerns.

Council Action:

1. **Adopt the 2005 Pacific whiting stock assessment.**
2. **Adopt a 2005 ABC and OY for Pacific whiting.**
3. **Adopt 2005 management measures for Pacific whiting fisheries.**

Reference Materials:

1. Agenda Item F.6.a, Attachment 1: Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004.
2. Agenda Item F.6.a, Attachment 2: STAR Panel Report on the Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2004.
3. Agenda Item F.6.a, Attachment 3: Agreement Between the Government of the United States of America and the Government of Canada on Pacific Hake/Whiting.
4. Agenda Item F.6.d, Public Comment.

Agenda Order:

a. Agenda Item Overview John DeVore
b. Perspectives of the Canadian Government
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Adopt Stock Assessment, Final 2005 Acceptable Biological Catch and Optimum Yield, and Management Measures

PFMC
02/22/05

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) met with the Groundfish Management Team (GMT) to discuss recommendations for minor inseason adjustments.

In general, the GAP supports the changes being recommended by the GMT, along with the recommendation to maintain the limited entry fixed gear sablefish tier limits at the level originally proposed. The GAP does note that, given the recent observer data, maintaining these limits will result in an increase in the estimated incidental take of canary rockfish of about .2 mt. Some GAP members suggest that the fixed gear fleet examine its fishing practices in light of this new data to try to reduce canary impacts as other fisheries sectors have tried to do.

In regard to changes in way-point coordinates for the Rockfish Conservation Area (RCA) boundaries, the GAP urges state and federal regulatory and enforcement personnel to coordinate with the industry to ensure the changes are correctly published. Informal working groups of this sort have been used successfully in the past, when changes in RCA boundaries have been made.

In regard to changes in regulatory language affecting the use of trawl gear north of 40E10', the GAP has no objection to the language being suggested by the GMT and the Enforcement Consultants (EC). However, efforts to develop appropriate language showed there are different approaches taken to establishing trip limits and associated regulations by the GMT, the EC, and the GAP. There is a need for better coordination to mesh the desires of each group for regulations that work for them. We suggest that representatives of the EC, the GMT, and the GAP meet during one of the next two Council meetings to resolve issues and prepare for the 2007 - 2008 biennial specifications.

PFMC
03/09/05

Agenda Item F.7.b
Supplemental GMT Report
March 2005

Susan Ashcraft

GROUNDFISH MANAGEMENT TEAM REPORT ON CONSIDERATION FOR INSEASON ADJUSTMENTS

The Groundfish Management Team (GMT) reviewed several inseason management issues consisting primarily of clarification of current regulations, consistency between state and federal regulations, and minor corrections of existing Rockfish Conservation Area (RCA) management lines. In addition, the GMT reviewed the results of the limited entry fixed gear sablefish model and corresponding tier limits. The discussions and recommendations for Council consideration are outlined below.

CLARIFYING LANGUAGE TO LE TRAWL CUMULATIVE LIMITS

The GMT recommends modifying the language addressing the "more than one trawl gear on board" allowance (50 CFR 660.381) to restore the original intent as the current language has led to more liberal interpretations. Limited entry trawl regulations for the area between the U.S./Canada border and 40°10' N. lat. were intended to allow fishers to have more than one than one type of trawl gear on board their vessel. Under this requirement, if fishers have more than one type of trawl gear on board, at any time during the cumulative limit period, they are limited to harvesting (for the entire cumulative limit period) the more restrictive trip limit associated with the gear they had on board. This requirement provides flexibility to fishers while taking into consideration what is modeled in the trawl bycatch model and what is enforceable. The original intent of the regulation is as follows:

1. If a vessel only has selective flatfish gear on board during a cumulative limit period, the vessel can only access selective flatfish limits during the entire cumulative limit period.
2. If a vessel has only has large or small footrope gear on board during a cumulative limit period, the vessel can only access large or small footrope limits during the entire cumulative limit period.
3. If a vessel has both selective flatfish and large or small footrope gear on board during a cumulative limit period (either simultaneously or successively), the vessel can only access the lower limits during the entire cumulative limit period.

The GMT recommends the following language to restore the original intent of the requirement:

North of 40º 10' N. lat., a vessel may have more than one type of limited entry trawl gear on board, either simultaneously or successively, during a cumulative limit period. If only the selective flatfish trawl gear is on board during the entire cumulative limit period, then a vessel is only permitted to access the selective flatfish trawl gear cumulative limits, regardless of whether the vessel is fishing shoreward or seaward of the RCA. If only large or small footrope trawl gear is on board during the entire cumulative limit period, a vessel is only permitted to access the small or large footrope trawl gear cumulative limits and that vessel must fish seaward of the RCA. If more than one type of bottom trawl gear (selective flatfish, large footrope, small footrope) is on board, either simultaneously or successively, during the entire cumulative limit period, a vessel is only permitted to access the most restrictive cumulative bottom trawl limit associated with *any of these gears. The most restrictive cumulative bottom trawl limit associated with any gear applies for that trip and for the entire cumulative limit period, regardless of whether the vessel is fishing shoreward or seaward of the RCA.*

The GMT also recommends that a multiple bottom trawl gear category be added to Trip Limit Table 3 (North) to specify these lower limits associated with multiple bottom gears on board (See Attachment 3). The GMT discussed these changes with the Enforcement Consultants and they support these changes.

ROCKFISH CONSERVATION AREA (RCA) BOUNDARIES

Several RCA boundaries implemented in the 2005 – 2006 Groundfish Specifications and Management Measures (Spex) require minor corrections to individual coordinates in order to align the boundaries more closely to their respective depth contours and to prevent boundaries from crossing each other. For these reasons, minor corrections to individual coordinates for the RCA boundaries approximating the 40 fm, 100 fm, 150 fm, 200 fm, and 200 fm petrale boundary may be necessary. Staff from the state agencies and NMFS will work together the week following the March Council meeting to evaluate the need for minor corrections. If necessary, the states will develop coordinate corrections.

The GMT also recommends that California staff work with NMFS to clarify the intent of RCA boundaries around the Channel Islands and, if necessary, correct individual coordinates.

OTHER ISSUES

CORRECTION OF BOCACCIO IN ABC/OY TABLE

In the ABC/OY table, the GMT is recommending the correction of a mathematical error in the percentage allocation specified for limited entry bocaccio. This percentage had previously been listed as 52.7 but is should be listed as 55.7. Section 5.3.2 of Groundfish FMP states that *for any stock that has been declared overfished, the open access/limited entry allocation shares may be temporarily revised for the duration of the rebuilding period by amendment to the regulations in accordance with the normal allocation process described in this FMP.* This is true for bocaccio. Therefore, this is not a substantive change because it does not affect the quantity of fish available to the limited entry fleet. The commercial harvest guideline for bocaccio remains at 75.2 mt.

MODIFICATION TO FEDERAL TRIP LIMIT FORMAT

The GMT discussed how best to inform the public about species or species groups for which a state has adopted more restrictive cumulative trip limits than specified in federal regulations. The GMT is recommending that a banner be added to the top of the federal trip limit tables stating that state trips limits may be more restrictive than federal trip limits in the waters off Oregon and California. In addition, the GMT recommends that language be added to the Federal Regulations preamble and public notice to specify which species currently have more restrictive trip limits in place. These changes will alert fishers that when fishing in state waters off Oregon and California, they may be subject to more conservative state trip limits.

<u>RECREATIONAL FISHERIES</u>

Following the adoption of the 2005-06 Management Measures, the Oregon Fish and Wildlife Commission and the California Fish and Game Commission adopted changes to the recreational fishery regulations, as specified below. The GMT recommends that the Council adopt these changes, including those modified under Agenda Item D.1., to ensure consistency between federal and state regulations.

OREGON RECREATIONAL FISHERY

A reduction in the daily catch limit of marine fish (all marine fish species except Pacific halibut, lingcod, sanddab, surf perch, bait fish, offshore pelagic species, striped bass, hybrid bass, and salmonids) from 10 fish to 8 fish in aggregate. This change is designed to keep catch within harvest guidelines and does not affect the current estimated impacts.

The Oregon Fish and Wildlife Commission adopted regulations to prohibit retention of all marine fish (except sablefish, herring, anchovy, smelt, sardine, striped bass, hybrid bass, and offshore pelagic species) when Pacific halibut is retained by the vessel during open days for the all-depth sport fishery for Pacific halibut in the area between lines extending west of Leadbetter Point, Washington and Humbug Mountain, Oregon to the EEZ boundary. This management measure adjustment is expected to provide additional harvest reduction of overfished species and other species with harvest guidelines such as black rockfish by discouraging secondary targeting of such species. This provision also applies during all-depth halibut days in June through September when groundfish retention is prohibited seaward of the RCA boundary approximating the 40 fm depth contour. The GMT recognizes that this regulation will need to be modified to be consistent with the Council's action taken for the halibut regulations under Agenda Item D.1 at this meeting.

CALIFORNIA RECREATIONAL FISHERY

The California Fish and Game Commission adopted regulations in October 2004 that changed the cabezon sub-bag limit from three fish to one fish and the greenlings (all species of the genus *Hexagrammos* combined) sub-bag limit from two fish to one fish. These changes are intended to help keep total fishing mortality within their respective 2005 harvest targets.

CALIFORNIA RECREATIONAL ESTIMATES

The GMT had a discussion about the California recreational fishery projected impacts shown in the scorecard in light of the release of CRFS data, and how to reflect the best estimate of impact to overfished species. Except for widow rockfish, the values presented in the scorecard for the California recreational fishery were not changed. The GMT decided that until the ramifications of the newly released 2004 CRFS estimates on the 2005 projected total mortality could be more fully evaluated, it was best to retain the values derived from California's catch projection model. Given that the 2005 management regulations are more constraining than the 2004 regulations and that the CRFS estimates were generally lower than the California harvest targets for these species, the resulting mortality for 2005 may be lower than what is presented in this table. However, given that CRFS is a new program, the GMT believes that the higher values in the 2005 scorecard (for all species except widow rockfish) should be kept as placeholders to cover uncertainties in the CRFS catch estimates.

Widow rockfish was the only overfished species with a catch estimate in excess of the target. While strides have been taken by CDFG and California's CPFV fleet to reduce catch of widow rockfish, the GMT decided to change the widow rockfish scorecard value. Given the sporadic 2004 incidental take of widow rockfish, the GMT expects that the widow rockfish total mortality will likely be greater than the 0.9 mt derived from the projected model catch but less than the 14.6 mt taken in 2004. The GMT chose 8.2 mt, which was the projected mortality for 2004, again covering uncertainty in catch estimates.

INSEASON TRACKING TOOLS

At its February meeting, in response to Council guidance, the GMT explored several tools to aid with tracking of total catch inseason. (See Attachment 1.)

The GMT updated the Bycatch Scorecard to reflect changes in estimated impacts for the California recreational fishery, the Limited Entry Fixed Gear fishery in light of modified sablefish fishery projections, and the withdrawal of EFP proposals for Oregon and Washington. An updated Bycatch Scorecard is contained in Attachment 2.

In general, the GMT identified a policy issue relative to inseason tracking that we would like to highlight for the Council. The GMT discussed the uncertainties in catch projections (as reflected in the scorecard) and that fish resulting from updated estimates may not necessarily be "available" for other fisheries to access (i.e., those fish could be held in reserve to cover uncertainties in catch estimates). These reserves could be fishery-specific or held in a general reserve (without a specific purpose). The GMT recognizes that some overfished species are more constraining than others for a given fishery, and that fish held in reserve will likely reduce fishing opportunity; however, the benefits of offering additional fishing opportunities needs to be weighed against ensuring that management measures provide for fisheries that, collectively, will stay within the Council-adopted OYs.

GROUNDFISH MANAGEMENT TEAM (GMT) REPORT ON TIER LIMITS, BYCATCH, AND DISCARD IN THE 2005 LIMITED-ENTRY FIXED-GEAR FISHERY FOR SABLEFISH

The GMT received a report from Dr. Jim Hastie of the NW Fisheries Science Center on updated analysis of the 2005 limited-entry fixed-gear fishery for sablefish. This analysis was conducted using the same modeling approach as used for the 2004 fishery. Preliminary analysis of tier limits in the primary fishery and bycatch associated with all limited-entry fixed-gear sablefish fishing was conducted during 2004. Since then, an additional year of observer and fishticket data has been incorporated into the model. The model now uses data from 2001 to 2004, with progressively lower weights applied to earlier years.

As in 2004, coast-wide annual ratios of sablefish discard and overfished-species bycatch were calculated for two depth strata: greater than 100 fm, and greater than 150 fm. These strata reflect the seaward boundaries of the fixed-gear RCAs, as currently specified for the areas north and south of 40°10' N. lat., respectively. A comparison of ratios used in the 2004 and 2005 models is provided in Table 1. Sablefish discard, as a percentage of estimated total catch, increased for pot gear and decreased for line gear with the inclusion of data from the 2004 fishery. For most overfished species, bycatch ratios remained roughly the same. However, bycatch of lingcod increased for both gear types within both depth strata. This result is not surprising, given the increasing biomass trend for northern lingcod in the last assessment and the fact that most observed sablefish trips occurred off Oregon and Washington. The expected distribution of sablefish catch between gear types and the northern and southern areas is estimated using a similar weighting of fishticket data from 2001-04.

Table 2 summarizes bycatch and discard estimates from the analysis, along with revised tier-limit calculations. The table also includes a column containing summary values from the preliminary 2005 analysis, conducted in 2004. The opposing line and pot changes in sablefish discard ratios, which accompanied inclusion of the 2004 observer data, largely offset each other, resulting in a minor change in the available tier cumulative limits. Projected bycatch of lingcod changes by the largest amount of any of the depleted species, increasing by 2.4 mt. Canary bycatch is estimated to increase by 0.2 mt. Entering this meeting, the bycatch scorecard had 2.5 mt of the canary OY that was not attributed to any fishery. As published in the 2005 regulations, half of this amount was specified as being available for commercial fisheries. None of the remaining bycatch estimates change by more than 0.1 mt from the original projections for this fishery. If the Council finds the reported increases in bycatch to fall within an acceptable range, the GMT recommends that the management measures specified for the primary fishery in the 2005 regulations remain unchanged, with the exception of lowering the Tier-1 limit from 64,100 lb to 64,000 lb. The bycatch scorecard would then be updated to reflect the bycatch amounts identified in Table 2.

Table 1.--Comparison of rates for sablefish discard and bycatch of overfished species used in modeling the limited-entry fixed-gear sablefish fishery in 2004 and 2005.

	Depths greater than 150 fm				Depths greater than 100 fm			
	Model rates for 2004 [4]		Model rates for 2005 [5]		Model rates for 2004 [4]		Model rates for 2005 [5]	
	Longline	Pot	Longline	Pot	Longline	Pot	Longline	Pot
Observed sablefish discard rate	19.2%	17.8%	16.0%	22.6%	14.1%	18.0%	13.3%	22.5%
Discard mortality percentage of landed mt + discarded mt [1]	**4.5%**	**4.2%**	**3.7%**	**5.5%**	**3.2%**	**4.2%**	**3.0%**	**5.5%**
Bycatch ratios [2]								
Lingcod	0.183%	0.059%	0.228%	0.272%	0.400%	0.151%	0.420%	0.355%
Widow rockfish	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	0.001%	0.000%
Canary rockfish	0.005%	0.000%	0.008%	0.000%	0.042%	0.000%	0.053%	0.000%
Yelloweye rockfish	0.034%	0.000%	0.030%	0.000%	0.089%	0.000%	0.085%	0.000%
Bocaccio rockfish [3]	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Cowcod rockfish [3]	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Pacific ocean perch	0.024%	0.000%	0.017%	0.000%	0.017%	0.000%	0.015%	0.001%
Darkblotched rockfish	0.068%	0.009%	0.068%	0.018%	0.041%	0.009%	0.043%	0.017%

[1] As in previous years, the rate of mortality for discarded sablefish in the fixed-gear fishery is assumed to be 20%.

[2] The bycatch ratios are calculated by dividing the total catch of each species by the total poundage of sablefish that was caught.

[3] Please note that the observer data on which these rates are based on minimal observations from south of Ft. Bragg, CA, so these are likely underestimates of true bycatch.

[4] Rates used in the 2004 model were calculated by applying weights of 0.4, 0.35, 0.25 to data from 2003, 2002, and 2001, respectively.

[5] Rates used in the 2005 model were calculated by applying weights of 0.37, 0.27, 0.21, 0.15 to data from 2004, 2003, 2002, and 2001, respectively.

Table 2.--2005 sablefish primary fishery tier limits and projected bycatch of depleted species associated with all sablefish catch in the limited entry fixed-gear fishery.

	Seaward boundary of RCA at 100 fm North of 40o10' and at 150 fm South of 40o10'				Values from 2004 analysis of 2005
	Coastwide summary	Gear rates and bycatch		Combined bycatch	
		Longline	Pot		
Total catch allocated (mt)	**2,538**				
Observed sablefish discard rate	16.46%	13.67%	22.51%		15.91%
Discard mortality percentage of landed mt + discarded mt [1]	3.79%	3.07%	5.491%		3.65%
Assumed discard mortality (mt)	96				93
Landed catch target (mt)	**2,442**				**2,443**
Amount allocated to:					
DTL (mt)	366				367
Primary fishery (mt)	**2,075**				**2,077**
					As publ. in 2005 reg.s
Primary fishery tier limits (lb)					
Tier 1	63,989				64,100
Tier 2	29,086				29,100
Tier 3	16,621				16,600
Percent of total catch, by area	100%				
Percent of area catch, by gear		68.5%	31.5%		
Estimated distribution of total catch, by gear	2,538	1,739	799		
Bycatch ratios [2]					
Lingcod		0.393%	0.352%		
Widow rockfish		0.001%	0.000%		
Canary rockfish		0.047%	0.000%		
Yelloweye rockfish		0.078%	0.000%		
Bocaccio rockfish [3]		0.000%	0.000%		
Cowcod rockfish [3]		0.000%	0.000%		
Pacific ocean perch		0.015%	0.001%		
Darkblotched rockfish		0.046%	0.017%		
Projected bycatch impacts (mt)					
Lingcod		6.8	2.8	**9.7**	**7.3**
Widow rockfish		0.0	0.0	**0.0**	**0.0**
Canary rockfish		0.8	0.0	**0.8**	**0.6**
Yelloweye rockfish		1.4	0.0	**1.4**	**1.3**
Bocaccio rockfish [3]		0.0	0.0	**0.0**	**0.0**
Cowcod rockfish [3]		0.0	0.0	**0.0**	**0.0**
Pacific ocean perch		0.3	0.0	**0.3**	**0.3**
Darkblotched rockfish		0.8	0.1	**0.9**	**0.8**

[1] As in previous years, the rate of mortality for discarded sablefish in the fixed-gear fishery is assumed to be 20%.

[2] Bycatch ratios are calculated by dividing the total catch weight of each species by the total catch weight of sablefish.

[3] Please note that the observer data include few observations from south of Ft. Bragg, CA, so these rates may underestimate the true bycatch of these species.

GMT RECOMMENDATIONS:

1. Adopt changes to the limited entry trawl language and trip limit Table 3 (North).
2. Adopt the correction to the bocaccio limited entry percentage in the ABC/OY Table.
3. Adopt changes to Oregon recreational fisheries.
4. Adopt changes to California recreational fisheries.
5. Reduce the sablefish tier 1 limit from 64,100 mt to 64,000 mt.

motion # 16

Attachment 1

GMT UPDATE ON INSEASON TOTAL CATCH ESTIMATION AND DEVELOPMENT OF INSEASON TRACKING MECHANISMS

INSEASON TRACKING TOOLS

At the GMT meeting in February, we identified tables that we would develop to track catch estimates by fishery, harvest targets, commercial landings, recreational catches, and comparisons of total catch with harvest targets. Specifically, the GMT would be developing and using the following tools:

1. Scorecard – The GMT would continue to use this table to describe the GMT's best estimate of total mortality of overfished species, by fishery. These estimates will be updated inseason as new catch data becomes available and/or as a result of Council inseason action.

2. Harvest Target Table – This table would capture the harvest targets for species and fisheries that have harvest guidelines and/or harvest targets. These values are adopted preseason by the Council and will remain static throughout the fishing year.

3. PacFIN Commercial Best Estimate Report (BER, ~~formerly~~ also known as the QSM) – This table would be downloaded from PacFIN prior to GMT meetings and tracked on a monthly basis. All species and species categories with OYs and/or harvest guidelines are listed in this table.

4. RecQSM – The GMT will update this table on a monthly basis to reflect recreational catches throughout the previous calendar month (hard data) and projections through current month (soft data), similar to the commercial BER. The key species and species categories for recreational fisheries will be listed in this table.

5. Interstate OYs and HGs Tracking Table (subset of Table # 2) – This table will include all species with harvest guidelines and/or harvest targets and would be completed by the appropriate states. This table would be reviewed by the GMT, but not necessarily presented to the Council unless inseason management concerns are identified.

UPDATE ON QSM REVISION FOR TOTAL CATCH ESTIMATES

Since December of 2004, the PacFIN office, state data managers, and NMFS have been working to update the QSM system to include commercial discards from the shorebased sector, and total mortality from the whiting commercial at-sea fleet. In January 2005, the inclusion of the at-sea sector into the QSM system was completed, and as of early March, the inclusion of shorebased discard estimates was nearly complete. It is anticipated that the new QSM system will be fully operational following the April Council meeting, and at that time the system will be recording total mortality from the non-tribal commercial fleet using data available from GMT bycatch models, the West Coast Groundfish Observer Program, and GMT assumptions regarding discard-induced mortality.

an accountable component.

Attachment 2

Estimated Total Mortality Impacts Prior to Inseason Adjustments at the March 2005 Council Meeting

3/10/2005 9:51

Fishery	Bocaccio a/	Canary	Cowcod	Dkbl	Lingcod	POP	Widow	Yelloweye
Limited Entry Trawl- Non-whiting b/	49.1	8.0	0.5	67.5	86.2	75.3	1.7	0.4
Limited Entry Trawl- Whiting								
At-sea whiting motherships		7.3		1.4	0.3	1.7	231.8	0.0
At-sea whiting cat-proc				7.6	0.4	10.1		0.4
Shoreside whiting				0.5	0.7	0.4		0.0
Tribal whiting				0.0	0.5	1.5		0.0
Tribal								
Midwater Trawl		1.3		0.0	0.1	0.0	40.0	0.0
Bottom Trawl		0.5		0.0	9.0	0.0	0.0	0.0
Troll		0.5		0.0	1.0	0.0		0.0
Fixed gear		0.3		0.0	15.0	0.0	0.0	2.3
Limited Entry Fixed Gear	13.4	1.1	0.1	1.3	20.0	0.4	0.5	2.6
Open Access: Directed Groundfish	10.6	1.0	0.1	0.2	70.0	0.1		0.6
Open Access: Incidental Groundfish								
CA Halibut	0.1	0.1		0.0	2.0	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 c/		0.0	0.0	0.0				
Pacific Halibut c/	0.0		0.0	0.0		0.0	0.0	0.5
Pink shrimp	0.1	0.1	0.0	0.0	0.5	0.0	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salmon troll	0.2	1.6	0.0	0.0	0.3	0.0	0.0	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spot Prawn (trap)								
Recreational Groundfish e/								
WA		8.5			206.0			6.7
OR							1.4	
CA	43.0	9.3	0.6		422.0		8.2	3.7
Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs.								
	0.4	3.0		3.8	4.5	3.6	0.9	1.0
Non-EFP Total	117.8	42.6	1.3	82.3	838.5	93.1	284.6	18.6
EFPs f/								
CA: NS FF trawl	10.0	0.1	0.5		20.0			0.5
EFP Subtotal	10.0	0.1	0.5	0.0	20.0	0.0	0.0	0.5
TOTAL	127.8	42.7	1.8	82.3	858.5	93.1	284.6	19.1
2005 OY	307	46.8	4.2	269	2,414	447	285	26
Difference	179.2	4.1	2.4	186.7	1,555.5	353.9	0.4	6.9
Percent of OY	41.6%	91.2%	42.9%	30.6%	35.6%	20.8%	99.9%	73.3%
Key	(shaded)	= either not applicable; trace amount (<0.01 mt); or not reported in available data						

a/ South of 40°10' N. lat.

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

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). In 2001, out of 84,000 mt total landings 1 mt was groundfish. This suggests that total bocaccio was caught in trace amounts.

e/ Values for canary, lingcod, and yelloweye represent specified harvest guidelines. California recreational estimates have yet to be

f/ Values are proposed EFP bycatch caps, not estimates of total mortality. The EFP is terminated inseason if the cap is projected to be

Table 3 (North) to Part 660, Subpart G -- 2005-2006 Trip Limits for Limited Entry Trawl Gear North of 40°10' N. Lat.

Other Limits and Requirements Apply -- Read § 660.301 - § 660.390 before using this table

122004

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
	Rockfish Conservation Area (RCA) 6/: North of 40°10' N. lat.	75 fm - modified 200 fm 7/	100 fm - 200 fm				75 fm - modified 200 fm 7/

Selective flatfish trawl gear is required shoreward of the RCA; all trawl gear (large footrope, selective flatfish trawl, and small footrope trawl gear) is permitted seaward of the RCA. Midwater trawl gear is permitted only for vessels participating in the primary whiting season.

See § 660.370 and § 660.381 for Additional Gear, Trip Limit, and Conservation Area Requirements and Restrictions. See § 660.390 for Conservation Area Descriptions and Coordinates.

		JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
1	**Minor slope rockfish** 2/ **& Darkblotched rockfish**	4,000 lb/ 2 months					
2	**Pacific ocean perch**	3,000 lb/ 2 months					
3	**DTS complex**						
4	Sablefish						
5	large & small footrope gear	9,500 lb/ 2 months		17,000 lb/ 2 months			8,000 lb/ 2 months
6	selective flatfish trawl gear	1,500 lb/ 2 months	10,000 lb/ 2 months				1,500 lb/ 2 months
7	multiple bottom trawl gear 8/	1,500 lb/ 2 months	9,500 lb/ 2 months	10,000 lb/ 2 months			1,500 lb/ 2 months
8	Longspine thornyhead						
9	large & small footrope gear	15,000 lb/ 2 months		23,000 lb/ 2 months			15,000 lb/ 2 months
10	selective flatfish trawl gear	1,000 lb/ 2 months					
11	multiple bottom trawl gear 8/	1,000 lb/ 2 months					
12	Shortspine thornyhead						
13	large & small footrope gear	3,500 lb/ 2 months		4,900 lb/ 2 months			3,500 lb/ 2 months
14	selective flatfish trawl gear	1,000 lb/ 2 months		3,000 lb/ 2 months			1,000 lb/ 2 months
15	multiple bottom trawl gear 8/	1,000 lb/ 2 months		3,000 lb/ 2 months			1,000 lb/ 2 months
16	Dover sole						
17	large & small footrope gear	69,000 lb/ 2 months		30,000 lb/ 2 months			69,000 lb/ 2 months
18	selective flatfish trawl gear	20,000 lb/ 2 months	35,000 lb/ 2 months	50,000 lb/ 2 months			20,000 lb/ 2 months
19	multiple bottom trawl gear 8/	20,000 lb/ 2 months	35,000 lb/ 2 months	30,000 lb/ 2 months			20,000 lb/ 2 months
20	**Flatfish** (except Dover sole)						
21	Other flatfish 3/, English sole & Petrale sole						
22	large & small footrope gear for Other flatfish 3/ & English sole	110,000 lb/ 2 months	Other flatfish, English sole, & Petrale sole: 110,000 lb/ 2 months, no more than 42,000 lb/ 2 months of which may be petrale sole.				110,000 lb/ 2 months
23	large & small footrope gear for Petrale sole	Not limited					Not limited
24	selective flatfish trawl gear	100,000 lb/ 2 months, no more than 25,000 lb/ 2 months of which may be petrale sole.	100,000 lb/ 2 months, no more than 35,000 lb/ 2 months of which may be petrale sole.				100,000 lb/ 2 months, no more than 25,000 lb/ 2 months of which may be petrale sole.
25	multiple bottom trawl gear 8/	100,000 lb/ 2 months, no more than 25,000 lb/ 2 months of which may be petrale sole.	100,000 lb/ 2 months, no more than 35,000 lb/ 2 months of which may be petrale sole.				100,000 lb/ 2 months, no more than 25,000 lb/ 2 months of which may be petrale sole.
26	Arrowtooth flounder						
27	large & small footrope gear	Not limited	150,000 lb/ 2 months				Not limited
28	selective flatfish trawl gear	70,000 lb/ 2 months					
29	multiple bottom trawl gear 8/	70,000 lb/ 2 months					

TABLE 3 (North)

Table 3 (North). Continued

30	**Whiting**	Before the primary whiting season: 20,000 lb/trip -- During the primary season: mid-water trawl permitted in the RCA. See §660.373 for season and trip limit details. -- After the primary whiting season: 10,000 lb/trip		
31	**Minor shelf rockfish[1/], Shortbelly, Widow & Yelloweye rockfish**			
33	midwater trawl for Widow rockfish	Before the primary whiting season: CLOSED -- During primary whiting season: In trips of at least 10,000 lb of whiting, combined widow and yellowtail limit of 500 lb/ trip, cumulative widow limit of 1,500 lb/ month. Mid-water trawl permitted in the RCA. See §660.373 for primary whiting season and trip limit details. -- After the primary whiting season: CLOSED		
	large & small footrope gear	300 lb/ 2 months		
34	selective flatfish trawl gear	300 lb/ month	1,000 lb/ month, no more than 200 lb/ month of which may be yelloweye rockfish	300 lb/ month
35	multiple bottom trawl gear 8/	300 lb/ month	300 lb/ 2 months, no more than 200 lb/ month of which may be yelloweye rockfish	300 lb/ month
36	**Canary rockfish**			
37	large & small footrope gear	CLOSED		
38	selective flatfish trawl gear	100 lb/ month	300 lb/ month	100 lb/ month
39	multiple bottom trawl gear 8/	CLOSED		
40	**Yellowtail**			
42	midwater trawl	Before the primary whiting season: CLOSED -- During primary whiting season: In trips of at least 10,000 lb of whiting: combined widow and yellowtail limit of 500 lb/ trip, cumulative yellowtail limit of 2,000 lb/ month. Mid-water trawl permitted in the RCA. See §660.373 for primary whiting season and trip limit details. -- After the primary whiting season: CLOSED		
	large & small footrope gear	300 lb/ 2 months		
43	selective flatfish trawl gear	2,000 lb/ 2 months		
44	multiple bottom trawl gear 8/	300 lb/ 2 months		
45	**Minor nearshore rockfish & Black rockfish**			
46	large & small footrope gear	CLOSED		
47	selective flatfish trawl gear	300 lb/ month		
48	multiple bottom trawl gear 8/	CLOSED		
49	**Lingcod[4/]**			
50	large & small footrope gear	500 lb/ 2 months		
51	selective flatfish trawl gear	800 lb/ 2 months	1,000 lb/ 2 months	800 lb/ 2 months
52	multiple bottom trawl gear 8/	500 lb/ 2 months		
53	**Other Fish [5/] & Pacific cod**	Not limited		

TABLE 3 (North) con't

1/ Bocaccio, chilipepper and cowcod are included in the trip limits for minor shelf rockfish.
2/ Splitnose rockfish is included in the trip limits for minor slope rockfish.
3/ "Other flatfish" are defined at § 660.302 and include butter sole, curlfin sole, flathead sole, Pacific sanddab, rex sole, rock sole, sand sole, and starry flounder.
4/ The minimum size limit for lingcod is 24 inches (61 cm) total length.
5/ "Other fish" are defined at § 660.302 and include sharks, skates, ratfish, morids, grenadiers, and kelp greenling. Cabezon is included in the trip limits for "other fish."
6/ The Rockfish Conservation Area is a gear and/or sector specific closed area generally described by depth contours but specifically defined by lat/long coordinates set out at § 660.390.
7/ The "modified 200 fm" line is modified to exclude certain petrale sole areas from the RCA.
8/ If a vessel has both selective flatfish gear and large/small footrope gear on board during a cumulative limit period (either simultaneously or successively), the vessel can only access these more restrictive limits during the entire cumulative limit period.

To convert pounds to kilograms, divide by 2.20462, the number of pounds in one kilogram.

Agenda Item F.7.c
Public Comment
March 2005

Proposal to exempt Pot gear from 100 fa Line

I propose to exempt pot/trap fisheries for Sablefish from the 100 fathom line that is set up for Rockfish protection. The reason being is that pots/traps are very selective and have very little incidence of bycatch of any species including protected Rockfish .(Yellow eye ,Canary ,etc.) The observer data demonstrates this. I propose to let pots fish any depth and this can be monitored with the vms or just exempt them altogether from VMS. A the very least you could let the pots go into the 75 fathom line that is already established for the Draggers. If there are concerns to the south you could make the allowance for the North area only.

This would not be a large undertaking as there are relatively few pot /trap permits(28?) Again there is no valid argument to deny this proposal.

Thank you

Lawrence Demmert

Protect Your
Right to Fish

CCFCC

Central Coast Fisheries Conservation Coalition
1239 Higuera Street
San Luis Obispo, California 93401
(805)544-2424

February 28, 2005

Sonke Mastrup
Department of Fish & Game
1416 Ninth Street
Sacramento, CA 95814

Re: Emergency Reopening

Dear Mr. Mastrup:

You and I have talked many times about the terrible "data poor" condition of your department concerning nearshore groundfish along the coast of California. You have claimed that your department has its hands tied by the impact of unreliable MRFSS data. You blamed the 5-month rockfish season proposed for 2005-2006 on the MRFSS data suggesting that we would exceed quotas for 2004. I am sure that you have carefully reviewed the recently-released CRFS data concerning 2004 catch data. This data wipes out all those excuses.

Here on the South-Central Coast, we have an absurd requirement that all groundfish angling this year be in waters between 20-40 fathoms. The inherent dangers caused by such a draconian regulation are enormous. Our county's kayak fishermen are outraged. Now your department has the tools and data to correct this problem.

In 2004, we fished for nine (9) months here on the Central Coast. The statewide CRFS data suggests that we did not <u>exceed</u> our quotas as projected. In fact, we came in substantially <u>below quotas.</u> All of this data supports the anecdotal evidence we have been supplying to your department. It is time for your department to swing into gear and do something to substantially increase fishing opportunity.

Ryan Broddrick told us when he was appointed that he was a "friend of fishermen". Now CDFG has the ammunition to go back to the PFMC and demonstrate that indeed Director Broddrick is a friend of fishermen. If we did not reach quotas with 9 months of fishing, this strongly suggests that a 12 month season starting in 2006 is appropriate. It is also appropriate that the CDFG immediately apply to the PFMC for an <u>emergency reopening</u> of the closed months scheduled for 2005. You now have the data and there is no contrary data. Your department should also strongly petition to remove the 0-20 fathom fishing ban in the south-central zone.

Please contact me ASAP so that we can discuss moving forward on this urgent matter. Of course, we will do everything we can to marshal all fishing interests to support an effort to increase fishing opportunity.

Sincerely,

Melvin A. de la Motte, Jr.
President of CCDCC

CC: Ryan Broddrick, Director
Patricia Wolf
Tom Barnes
Marija Vojkovich
Deb Wison-Vandenberg
Robert Treanor
Darryl Ticehurst
Don Hansen
Roger Thomas
Dr. Donald McIsaac
Martin Golden

Agenda Item F.7.c
Supplemental Public Comment 3
March 2005

MARIO DEIRO
President

DAN KIRKPATRICK
Secretary

PATRICK A. BAILEY
Commissioner

JOHN YINGST
Commissioner

GARRY YOUNG
Commissioner

Board of Harbor Commissioners
of the
Crescent City Harbor District
Phone (707) 464-6174 Fax (707) 465-3535
101 Citizens Dock Road
Crescent City, California 95531
www.ccharbor.com
E-mail cc.hd@verizon.net

RICHARD D. YOUNG
CEO/Harbormaster

March 4, 2005

State of California
Fish and Game Commission
1416 Ninth Street
Sacramento, California 95814

Dear Sirs,

We are writing in regard to the 2005 Recreational Groundfish Season regulations for Northern California. Crescent City is the Northern most port in California. We are located about twenty-two miles from the Port of Brookings, Oregon. The two ports have similar weather patterns and local economies, and we share the same stocks of fish. Our recent experience with fishing regulations and catches is, however, very different.

In 2003 Brookings rented nearly all their 376 recreational vessel slips during their summer season. In Crescent City, we rented an average of 46 slips for our season, and had a peak of only 84 vessels during the month of July. Imagine our surprise when the Black Rockfish catch for Brookings was estimated at about 66 metric tons, while the catch for the Northern California area was estimated at 432 metric tons!

Of course, the Northern California area contains the ports of Eureka and Trinidad as well as Crescent City, and some rockfish fishing takes place in all three ports. But Crescent City is by far the best suited for recreational rockfish fishing. We have what is arguably the safest harbor on the Northwest coast for vessels to enter and exit, and much rocky habitat is located near the port. Because of these advantages the majority of recreational rockfish fishing in Northern California probably took place from this port. But even if more fishing occurred in Trinidad or Eureka than in Crescent City, and even if we added all the vessels from the three ports together, it is unlikely that we would have as many vessels fishing in the Northern California area as are fishing in Brookings.

So it was very surprising when the 2003 estimated Black Rockfish catch in Northern California was six and one half times the estimated catch in Brookings, Oregon. Just as surprising, the 2003 catch in Northern California was estimated at almost five times the 2002 catch. Surely, it would have been remarkable if the 2003 catch were five times the catch of the year before and over six times the catch in an adjacent port. But we heard no such reports from local fishermen.

This huge increase in estimated catch became the justification for reducing the recreational rockfish season in 2005 from 7 months to 4 months. When local fishermen learned of the reduced season in California last summer they immediately began making plans to go to Brookings this year. Here at the Harbor District office we constantly heard fishermen say, "I love coming to Crescent City, but next year I am going to Brookings where I can fish." Of course, when they get to Brookings, they are going to be fishing on the same stocks that they would fish on from Crescent City, but the regulations in Oregon potentially allow a year round fishery. There will be no conservation benefit from the reduced season in Northern California, there will just be a shift in fishing effort and the associated revenue from Crescent City to Brookings.

Because these regulations may have a devastating impact on our area we were anticipating the results of the 2004 season with great interest. When the results arrived in the form of a report titled *California Recreational Fishery Survey Catch and Effort Estimates for 2004, California Department of Fish and Game*, March, 2005, we were pleased to see that the estimated catch for Black Rockfish in the Northern California area in 2004 was only about 53 metric tons. This was well within the harvest target in our area of 72 metric tons. We also note that this catch was achieved with a seven month groundfish season.

Since a seven month recreational groundfish season in 2004 did not result in a catch exceeding the target harvest, it is difficult to understand why our fishing season has been reduced to four months in 2005. We note that you will consider the report on the California Recreational Fishery Survey as Item 12 on your March 18 agenda. We also note that Item 13 is a consideration of possible in season adjustments to allow for more angling opportunities in 2005.

Because the reduction in our groundfish season will have a devastating impact on our port and local community, and because we have significant new information indicating the reduced season is neither justified nor needed, the Board of Harbor Commissioners of the Crescent City Harbor District respectfully requests that you open the season for recreational Rockfish on May 1 and allow it to remain open until October 31.

Sincerely,

Richard Young

Richard Young
CEO/Harbormaster
For the Board of Harbor Commissioners

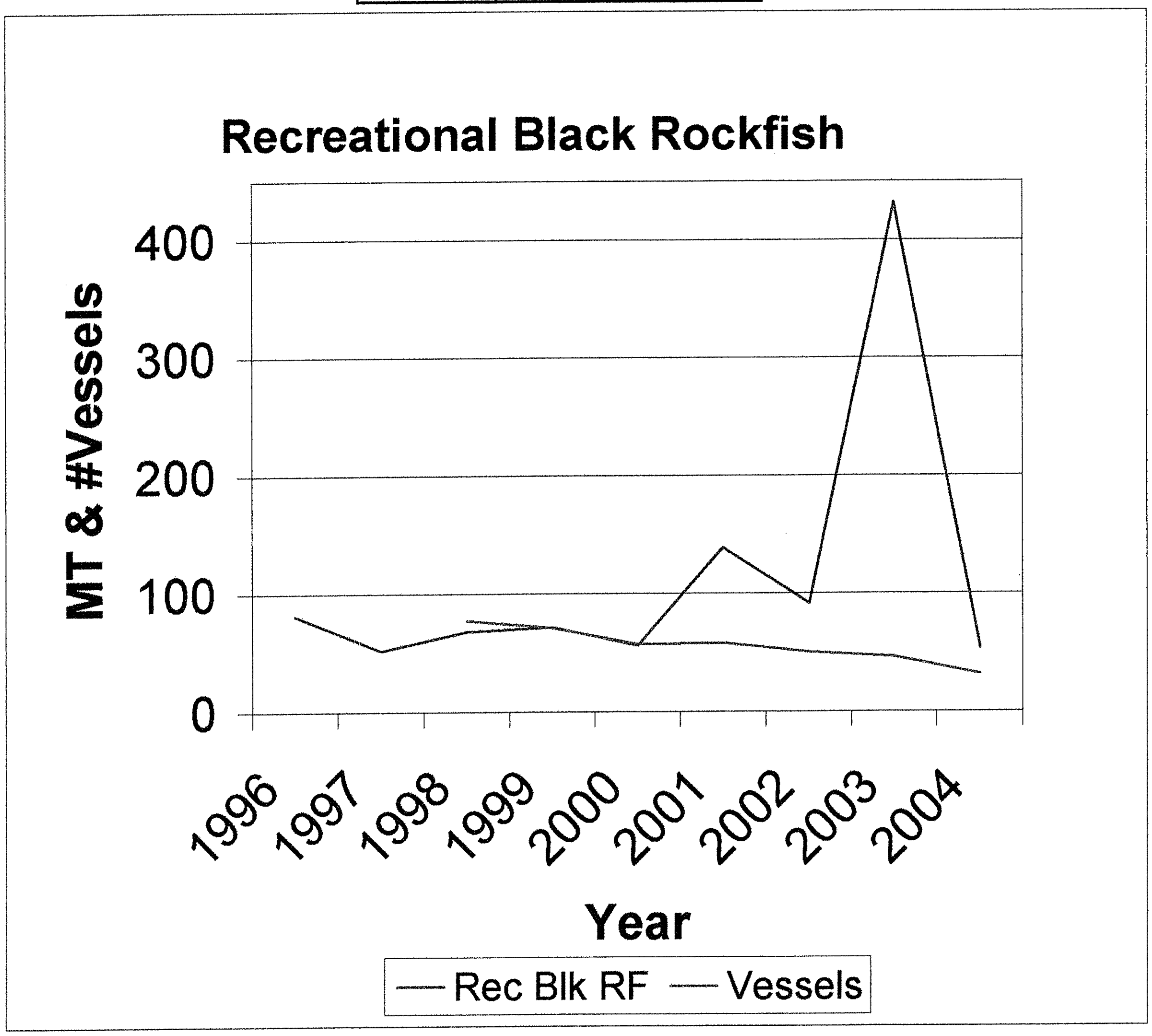
Cc Harbor Commissioners
Pacific Fishery Management Council

Vessels = Annual Average number of recreational vessels in Crescent City Harbor outer basin

Rec Blk RF = Recreational catch of Black Rockfish between OR/CA border and 40 10' Lat. (in MT)

Year	Rec Blk RF	Vessels
1996	81	
1997	52	
1998	68	77
1999	71	71
2000	56	57
2001	138	58
2002	91	50
2003	432	46
2004	53	31

Vessels = annual average number of vessels in CC outer basin.
Rec Blk RF = estmated catch of Black Rockfish by recreationa vessels 1996-2003 from MRFSS 2004 from CRFS



CONSIDERATION OF INSEASON ADJUSTMENTS

The Council set optimum yield (OY) levels and various management measures for the 2005 groundfish management season with the understanding these management measures will likely need to be adjusted periodically through the year with the goal of attaining, but not exceeding, the OYs.

Under this Agenda Item, the Council is to consider advice from Council advisory bodies and the public on the status of ongoing fisheries and recommended inseason adjustments prior to adopting final changes as necessary.

Anticipated inseason adjustments for Council consideration are more conservative bag limits for California and Oregon recreational fisheries to match federal regulations with state regulations, and consideration for a modification of the limited entry fixed gear sablefish tier limits based on a new observer data report that will be available by the March Council meeting. It is unknown how new observer data might affect sablefish tier limits since the data report was not available in time for the March briefing book.

Council Action:

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

Reference Materials:

1. Agenda Item F.7.c, Public Comment.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action**: Adopt Appropriate Adjustments for 2005 Fisheries

PFMC
02/08/05