

GROUND FISH STOCK ASSESSMENT AND REVIEW PROCESS FOR 200~~57~~-200~~68~~

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Introduction

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

STAR Goals and Objectives

The goals and objectives for the groundfish assessment and review process¹ are to:

- a) Ensure that groundfish stock assessments provide the kinds and quality of information required by all members of the Council family.
- b) Satisfy the Magnuson-Stevens Sustainable Fisheries Act (SFA) and other legal requirements.
- c) Provide a well-defined, Council-oriented process that helps make groundfish stock assessments the "best available" scientific information, and facilitates use of the information by the Council. In this context, "well-defined" means with a detailed calendar, explicit responsibilities for all participants, and specified outcomes and reports.
- d) Emphasize external, independent review of groundfish stock assessment work.
- e) Increase understanding and acceptance of groundfish stock assessment and review work by all members of the Council family.
- f) Identify research needed to improve assessments, reviews, and fishery management in the future.
- g) Use assessment and review resources effectively and efficiently.

Shared Responsibilities

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

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

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

a list of deliverables. Coordination means organizing and carrying out review meetings, distributing documents in a timely fashion, and making sure that assessments and reviews are completed according to plan. Leadership and coordination involve costs, both monetary and time, which have not been calculated, but are likely substantial.

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

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

NMFS Responsibilities

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

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

Following any modifications to the stock assessments resulting from STAR panel reviews and prior to ~~SSC review~~ ~~distribution of the stock assessment documents and STAR panel reports to GMT~~, the ~~eStock Assessment Coordinator~~ will review the ~~Executive Summary stock assessments and panel reports~~ for consistency with the ~~Terms of Reference, especially completeness of the stock assessment Executive Summary~~. Inconsistencies will be identified and the authors requested to make appropriate revisions in time for the ~~GMT-SSC meeting at which an assessment is reviewed~~ ~~ABC and OY recommendations are developed~~.

Individuals (employed by NMFS, state agencies, or other entities) ~~that who~~ conduct ~~groundfish stock~~ assessments or ~~associated~~ technical work ~~in connection with groundfish stock assessments~~ are responsible for ensuring ~~that~~ their work is technically sound and complete. ~~The Council's review process is the principal means for review of complete stock assessments, although additional in-depth technical review of methods and data is desirable.~~ Stock assessments ~~conducted by NMFS, State agencies, or other entities~~ must be completed and reviewed in full accordance with the Terms of Reference (Appendices B and C) at the times specified in the calendar (Appendix A).

STAT Team Responsibilities

The STAT, consisting of one or more stock assessment scientists from NMFS, state agencies or academia, is responsible for conducting a complete and technically sound stock assessment that conforms to accepted standards of quality. The STAT will conduct its work and activities in accordance with the Terms of Reference for Groundfish STAT Teams. The final product of the STAT will be a stock assessment document that follows the outline specified in Appendix B: [Outline for Groundfish Stock Assessment Documents](#).

GMT Responsibilities

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

The GMT will not seek revision or additional review of the stock

assessments after they have been reviewed by the STAR Panel. The GMT chair will communicate any unresolved issues to the SSC for consideration. Successful separation of scientific (i.e., STAT Team and STAR Panels) from management (i.e., GMT) work depends on stock assessment documents and STAR reviews being completed by the time the GMT meets to discuss preliminary ABC and OY levels. However, the GMT can request additional model projections, based on reviewed model scenarios, in order to develop a full evaluation of potential management actions.

GAP Responsibilities

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

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

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

SSC Responsibilities

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

~~The SSC representative will also communicate SSC comments or questions to the GMT and other Council advisory bodies.~~ It is the SSC's responsibility to review and endorse any additional analytical work requested by the GMT after the stock assessments ~~has~~ have been reviewed by the STAR Panels. In addition, the SSC will review and advise the GMT and Council on projected ABCs and OYs and, in addition, -

~~The SSC, during their normally scheduled meetings, will serve as arbitrator to resolve disagreements between the STAT Team and the STAR Panel, or GMT. The STAT Team and the STAR Panel may disagree on technical issues regarding an assessment. In this case, a complete stock assessment must include a point by point response by the STAT Team to each of the STAR Panel recommendations.~~

Council Staff Responsibilities

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

Stock Assessment Priorities

Stock assessments for West Coast groundfish are conducted periodically to assess abundance, trends, and appropriate harvest levels for these species. Assessments use statistical population models to analyze and integrate a variety of survey, fishery and biological data. Due to the large number of groundfish species that have never been assessed, it is the goal of the Council to increase substantially the number of assessed stocks. A constraint on reaching that objective, however, is that a multi-year management regime has recently been adopted, which limits assessment activities to odd years only (e.g., ~~2005~~2007). ~~Nonetheless, for the upcoming assessment cycle an ambitious list of 23 stocks will be evaluated, including at least five species that have never been assessed.~~

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

1. Assessments should take advantage of new information, especially indices of abundance from fishery-independent surveys.
2. Overfished stocks that are under rebuilding plans should be evaluated to ensure that progress towards achieving stock recovery is adequate. Guidelines for assessing adequacy of progress in rebuilding of overfished stocks are currently being developed through a Council-based process, which when complete, will result in a revision to the SSC's Terms of Reference for Groundfish Rebuilding Analyses.²
3. In general no more than ~~2-3~~ full assessments (preferably 2) will be reviewed by a STAR Panel, ~~although~~ ~~i~~In exceptional circumstances this number may be exceeded, if ~~in consultation~~ the SSC and NMFS ~~s~~Stock ~~a~~Assessment ~~e~~Coordinator conclude that it is advisable and/or necessary to do so.
4. The SSC encourages attempts to study previously un-assessed stocks, but recognizes that often such efforts will not produce a comprehensive understanding of population dynamics. Even so, updates or reports that fall short of a full assessment are still desirable, in order to summarize whatever information exists that may be useful to the Council in making management decisions.
5. Any stock assessment that is considered for use in management should be submitted through normal Council channels and reviewed at STAR Panel meetings.
6. The proposed stocks for assessment should be discussed by the Council at least a year in advance to allow sufficient time for assembly of relevant assessment data and for arrangement of STAR panels.

²SSC Terms of Reference for Groundfish Rebuilding Analyses (Final Draft). Exhibit F.7, Supplemental SSC Terms of Reference, April 2001. Available from the PFMC, 7700 NE Ambassador Place, Suite 200, Portland, OR, 97220-1384, (503) 820-2280.

Terms of Reference for STAR Panels and Their Meetings

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

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

~~STAR Panels include a chairman appointed from the SSC, at least one external member (i.e., outside the Council family and not involved in management or assessment of west coast groundfish), and at least two other members with experience gained from having conducted stock assessments on the U. S. west coast or elsewhere. The total number of STAR Panel members (including the chair and external reviewer) should be at least "N+2" where N is the number of stock assessments reviewed.~~ STAR Panels normally include a chairman, at least one "external" member (i.e., outside of the Council family and not involved in management or assessment of West Coast groundfish), and one SSC member. The total number of STAR members (including the chair and external reviewer) should be at least "n+1" where n is the number of stock assessments. In addition to Panel members, STAR meetings will include GMT and GAP ~~advisory representatives~~ advisors with responsibilities ~~laid out~~ described in their terms of reference. ~~(Formalize the role of the GMT and GAP here?)~~ STAR Panels normally meet for one week.

~~The number of assessments reviewed by a STAR Panel should not exceed two except in unusual circumstances (see item 3 above).~~

The STAR Panel is responsible for determining if a stock assessment document is sufficiently complete according to Appendix B: ~~Outline for Groundfish Stock Assessments~~. It is the Panel's responsibility to identify assessments that cannot be reviewed or completed for any reason. The Panel's decision that an assessment is complete should be made by consensus. If a Panel cannot reach agreement, then the nature of the disagreement must be described in the Panel's report. Moreover, if a full-stock assessment is deemed to be stable in ~~deemed to have become routine and/or has stabilized~~ its approach to data analysis and modeling, the STAR panel should ~~certify~~ make a recommendation ~~that the assessment is eligible to~~ be considered as an update ~~(see below)~~ during the next stock assessment cycle.

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

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

Recommendations and requests to the STAT Team for additional or revised analyses must be clear, explicit and in writing. A written summary of discussion on significant technical points and lists of all STAR Panel

recommendations and requests to the STAT Team are required in the STAR Panel's report. This should be completed (at least in draft form) prior to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review work that is required.

| The primary goal of the STAR Panel is to complete a detailed evaluation of the results of a stock assessment, which puts the Panel in a good position to advance the best available scientific information to the Council. Under ideal circumstances, the STAT Team and STAR Panel should strive to reach a mutual consensus on a single base model, but it is essential that uncertainty in the analysis be captured and transmitted to managers. A useful way of accomplishing this objective is to bracket the base model along what is deemed to be the dominant dimension of

uncertainty (e.g., spawner-recruit steepness or R_0 , natural mortality rate, survey catchability, recent year-class strength, weights on conflicting CPUE series, etc.). Alternative models should show contrast in their management implications, which in practical terms means that that they should result in different estimates of current stock size, stock depletion, and ABC.

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

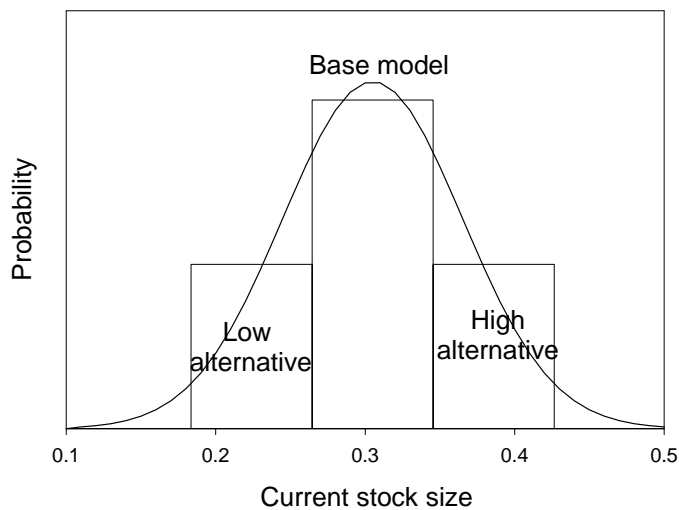


Figure 1. Example of assigning probabilities to alternative models using uncertainty in the estimate of current stock size.

To the extent possible, additional analyses required in the stock assessment should be completed during the STAR Panel meeting. It is the obligation of the STAR Panel chairperson, in consultation with other Panel members, to prioritize requests for additional STAT Team analyses. If follow-up work by the STAT Team is required after the review meeting, then it is the Panel's responsibility to track STAT Team progress. In particular, the chair is responsible for communicating with all Panel members (by phone, e-mail, or any convenient means) to determine if the revised stock assessment and documents are complete and ready to be used by managers in the Council family. If stock assessments and reviews are not complete at the end of the STAR Panel meeting, then the work must be completed prior to the GMT meeting where the assessments and preliminary ABC levels are discussed.

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

STAT Teams and STAR Panels are likely to disagree on certain technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may also request additional analysis based on an alternative approach. However, the STAR Panel's primary duty is to conduct a peer review of the assessment that is presented. In the course of this review, the Panel may ask for a

reasonable number of sensitivity runs, additional details of existing assessments, or similar items from the STAT team. However, the STAR Panel is not authorized to conduct an alternative assessment representing its own views that are distinct from those of the STAT Team, nor can it impose an alternative assessment on the Team. Rather, if the Panel finds that an assessment is inadequate, it should document and report that opinion and, in addition, suggest remedial measures that could be taken by the STAT team to rectify whatever perceived shortcomings may exist. Where fundamental differences of opinion remain between the STAR Panel and STAT Team, which cannot be resolved by mutual discussion, the SSC will review the dispute and will issue its own recommendation.

The ~~SSC representative on the~~ STAR Panel chair is expected to attend GMT and Council meetings where stock assessments and harvest projections are discussed to explain the reviews and provide other technical information and advice. The chair is responsible for providing the Stock Assessment Coordinator and Council staff with a camera ready and suitable electronic version of the Panel's report for inclusion in the annual SAFE report.

Suggested Template for STAR Panel Report

1. Minutes of the STAR Panel meeting containing
 - A. Name and affiliation of STAR Panel members; and
 - B. List of analyses requested by the STAR Panel, the rationale for each request, and brief summary of the STAT response to the request.
 - C. Description of base model and alternative models used to bracket uncertainty.
2. Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies.
3. Explanation of areas of disagreement regarding STAR Panel recommendations:
 - A. A among STAR Panel members (majority and minority reports), and
 - B. B between the STAR Panel and STAT Team
4. Unresolved problems and major uncertainties, e.g.; any special issues that complicate scientific assessment, questions about the best model scenario.
5. Prioritized recommendations for future research and data collection

Terms of Reference for Groundfish STAT Teams

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

~~Each STAT Team will appoint a representative who will attend any data and modeling. All relevant stock assessment workshops should be attended by all STAT team members. The STAT Team is obliged to keep the STAR Panel GAP representative informed of the specific data being used in the stock assessment. The STAT team is expected to initiate contact with the GAP representative at an early stage in the process, and to be prepared to respond to concerns about the data that might be raised. The STAT Team should also contact the GMT representative for information about changes in fishing regulations that may influence data used in the assessment.~~ STAT Teams are encouraged to also organize independent meetings with industry and interested parties to discuss issues, questions, and data.

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

Each STAT Team ~~conducting a full assessment~~ will appoint a representative who will ~~be available to~~ attend the ~~GMT meeting and~~ Council meeting where ~~the SSC is scheduled to review the assessment. preliminary acceptable biological catch (ABC) and optimum yield (OY) levels are discussed.~~ In addition, a representative of the STAT Team should ~~be available to~~ attend the GMT and Council meetings where ~~final preliminary~~ ABC and OY levels are discussed, ~~if requested or necessary.~~ ~~At these meetings, the STAT Team member shall be available to answer questions about the STAT Team report.~~

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

The STAT Team is responsible for bringing computerized data and working assessment models to the review meeting in a form that can be analyzed on site. STAT Teams should take the initiative in building and selecting candidate models and should have several complete models ready to present to the STAR Panel and be prepared to discuss the merits of each. The STAT team should identify a candidate base model, fully documented in the draft assessment, for STAR panel consideration. ~~should not expect the STAR Panel to develop a new Base model during a STAR Panel meeting.~~

~~In most cases, the~~ The STAT Team ~~is responsible for producing a should produce~~ a complete draft of the assessment ~~by within three weeks of~~ the end of the STAR Panel meeting, including any internal agency review. ~~In the any event, that a the STAT Team must finalize the assessment document complete draft is not completed, the Team is responsible for completing the work to the satisfaction of the STAR Panel as soon as possible, but within at least one week before the GMT briefing book deadline for the Council meeting at which meets to discuss the results of the assessment is scheduled for review.~~

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

For stocks ~~which that~~ are projected to fall below overfished thresholds, the STAT Team must complete a rebuilding analysis according to the SSC’s Terms of Reference for Groundfish Rebuilding Analyses ~~(see footnote 2).~~ It is

recommended that this analysis be conducted using the rebuilding software developed by Dr. Andre Punt (aepunt@u.washington.edu). ~~However, authors are also encouraged to present alternative approaches (where appropriate), along with clear justification for why the alternative may be an improvement over the approach described in the SSC's Terms of Reference.~~ The STAT Team is also responsible for preparing a document that summarizes the results of the rebuilding analysis.

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

Terms of Reference for Stock Assessment Updates

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

Qualification

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

~~In principle, an update is reserved for stock assessments that maintain fidelity to an accepted modeling framework, but the SSC does not wish to prescribe in advance what particular changes may or may not be implemented. Such a determination will need to be made on a case-by-case basis.~~

Composition of the Review Panel

The groundfish subcommittee of the SSC will conduct the review of a stock assessment update. A lead reviewer for each updated assessment will be designated by the ~~chairman~~ of the groundfish subcommittee from among its membership, and it will be the lead reviewer's responsibility to ensure the review is completed properly and that a

written report of the proceedings is produced. ~~Other members of the subcommittee will participate in the review to the extent possible, i.e., input from all members will not be required to finalize a report.~~ In addition, the groundfish management team (GMT) and the groundfish advisory panel (GAP) will designate one person each to participate in the review.

Review Format

All stock assessment updates will be reviewed during a single meeting of the SSC Groundfish Subcommittee scheduled early in the assessment cycle. This meeting may precede or follow a normally scheduled SSC meeting. The review process will be as follows. The STAT team preparing the update will distribute the updated stock assessment to the review panelists at least two weeks prior to the review meeting. In addition, Council staff will provide panelists with a copy of the last stock assessment reviewed under the full STAR process, as well as the previous STAR panel report. ~~Notice of the meeting will be published in the *Federal Register* (generally, 23 days in advance of the meeting) and a Meeting Notice will be distributed (generally, 14 days in advance).~~ Review of stock assessment updates is not expected to require analytical requests or model runs during the meeting, although large or unexpected changes in model results may necessitate some model exploration. The review will focus on two crucial questions: (1) has the assessment complied with the terms of reference for stock assessment updates and (2) are new input data and model results sufficiently consistent with previous data and results that the updated assessment can form the basis of Council decision-making. ~~If either of these criteria is not met, then a full stock assessment will be required.~~

STAT Team Deliverables

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

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

- Title page and list of preparers
- Executive Summary (see Appendix C)
- Introduction
- Documentation of updated data sources
- Short description of overall model structure
- Base-run results (largely tabular and graphical)
- Uncertainty analysis, including retrospective analysis, decision table, etc.
- 10 year harvest projections under the default harvest policy

Review Panel Report

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

- Name and affiliation of panelists
- Comments on the technical merits and/or deficiencies of the update
- Explanation of areas of disagreement among panelists and between the panel and STAT team

- Recommendation regarding the adequacy of the updated assessment for use in management

Appendix A: 2005-2008 Stock Assessment Review Calendar

TO BE DETERMINED

Include ~~deadlines~~ ~~drop dead dates~~ for inclusion of all significant data elements.

Include a post-STAR ~~de~~briefing where STAT teams present their findings to GMT, GAP, and the Council. ~~—how is this meeting organized?~~

Include dates ~~w~~hen ~~de~~ STAT Teams provide GAP and GMT representatives with stock assessment data.?

- ~~July 26-30, 2004 Data Workshop (AFSC, Seattle)~~
- ~~Oct. 25-29, 2004 Modeling Workshop (NWFSC, Seattle)~~
- ~~Nov. 1-5, 2004 PFMC adoption of Stock Assessment Terms of Reference (Portland)~~
- ~~Feb. 1-3, 2005 STAR Panel #1: Pacific whiting~~
- ~~April 18-22, 2005 STAR Panel #2: English sole, petrale sole, starry flounder~~
- ~~May 9-13, 2005 STAR Panel #3: California scorpionfish, gopher rockfish, vermilion rockfish, coweed~~
- ~~May 16-20, 2005 STAR Panel #4: Pacific ocean perch, darkblotched rockfish, cabezon~~
- ~~June 20-24, 2005 STAR Panel #5: sablefish, Dover sole, longspine thornyhead, shortspine thornyhead~~
- ~~Aug. 1-5, 2005 STAR Panel #6: widow rockfish, bocaccio, blackgill rockfish, kelp greenling~~
- ~~Aug. 15-19, 2005 STAR Panel #7: lingcod, canary rockfish, yelloweye rockfish, yellowtail rockfish~~
- ~~Sept.-Oct., 2005 Mop-up STAR Panel (if needed)~~
- ~~Sept., 2005 GMT meeting~~
- ~~Sept. 18-23, 2005 PFMC preliminary adoption of ABCs and OYs (Portland)~~
- ~~Nov. 1-4, 2005 PFMC continued adoption of ABCs and OYs (San Diego)~~
- ~~April 3-7, 2006 PFMC preliminary adoption of management measures for 2007-2008 (California)~~
- ~~June 12-16, 2006 PFMC final adoption of management measures for 2007-2008 (???)~~

Appendix B: Outline for Groundfish Stock Assessment Documents

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

- A. Title page and list of preparers – the names and affiliations of the stock assessment team (STAT) either alphabetically or as first and secondary authors
- B. Executive Summary (see attached template and example in Appendices C and D). This also serves as the STAT summary included in the SAFE.
- C. Introduction
 1. Scientific name, distribution, the basis for the choice of stock structure, including regional differences in life history or other biological characteristics that should form the basis of management units.
 2. A map depicting the scope of the assessment and identifying boundaries for fisheries or data collection strata.
 3. Description of fisheries for this species off Canada or Alaska, including references to any recent assessments of those stocks.
 - 2.4. Important features of life history that affect management (e.g., migration, sexual dimorphism, bathymetric demography)
 - 3.5. Important features of current fishery and relevant history of fishery
 - 4.6. Management history (e.g., changes in mesh sizes, trip limits, optimum yields)
 - 5.7. Management performance – a table or tables comparing acceptable biological catches, optimum yields, landings, and catch (i.e., landings plus discard) for each area and year

B. D. Assessment

14. 1. Data

- a. Landings by year and fishery, historical catch estimates, discards (generally specified as a percentage of total catch in weight and in units of mt), catch-at-age, weight-at-age, abundance indices (typically survey and CPUE data), data used to estimate biological parameters (e.g.; growth rates, maturity schedules, and natural mortality) with coefficients of variation (CVs) or variances if available. Include complete tables and figures and date of extraction.
- b. Sample size information for length and age composition data by area, year, gear, market category, etc., including both the number of trips and fish sampled.

15. 2. History of modeling approaches used for this stock – changes between current and previous assessment models

- a. Response to STAR Panel recommendations from the most recent previous assessment.

16. 3. Model description

a. Complete description of any new modeling approaches.

b. Definitions of fleets and areas.

- c. Assessment program with last revision date (i.e., date executable program file was compiled).
- d. List and description of all likelihood components in the model.
- e. Constraints on parameters, selectivity assumptions, natural mortality, assumed level of age reader agreement or assumed ageing error (if applicable), and other assumed parameters.
- f. Description of stock-recruitment constraints or components.
- g. Description of how the first year that is included in the model was selected and how the population state at the time is defined (e.g., B_0 , stable age structure, etc.).
- h. Critical assumptions and consequences of assumption failures.

17. 4. Model selection and evaluation

a. Evidence of search for balance between model realism and parsimony.

b. Comparison of key model assumptions, include comparisons based on Use-nested models where possible (e.g.; asymptotic vs. domed selectivities, constant vs. time-

_____varying selectivities).

~~e.~~ ~~c.~~ ~~Do parameter estimates make sense, are they credible?~~ Summary of alternate model configurations that were tried but rejected.

_____d. Likelihood profile for the base-run configuration over one or more key parameters (e.g., M, h, Q) to show consistency among input data sources.

_____e. Residual analysis (e.g.; residual plots, time series plots of observed and predicted values, or other ~~approach~~ approaches).

~~e.~~ f. Convergence status and convergence criteria for the base-run model.

~~f.~~ g.

Randomization run results or other evidence of search for global best estimates.

- ~~h.~~ h. Evaluation of model parameters. Do they make sense? Are they credible?
- ~~i.~~ i. Are model results consistent with assessments of the same species in Canada and Alaska? Are parameter estimates (e.g., survey catchability) consistent with estimates for related stocks?
- ~~5.~~ 5. Point-by-point response to the STAR Panel recommendations.
- ~~18.~~ 6. ~~_____~~ Base-run(s) results
 - ~~a.~~ a. Table listing all explicit parameters in the stock assessment model used for base runs, their _____ purpose (e.g.; recruitment parameter, selectivity parameter) and whether or not the parameter was _____ actually estimated in the stock assessment model.
 - ~~b.~~ b. Population numbers at age \times year \times sex (~~where if sex-specific M, growth, or selectivity is sex-specific~~) \times year.
 - ~~c.~~ c. Time-series of total, summary, and spawning biomass, depletion relative to B_0 , recruitment and _____ fishing _____ mortality or exploitation rate estimates (table and figures).
 - ~~d.~~ d. Selectivity estimates (if not included elsewhere).
 - ~~e.~~ e. Stock-recruitment relationship.
- ~~7.~~ 7. _____ Uncertainty and sensitivity analyses. The best approach for describing uncertainty and the range of _____ probable biomass estimates in groundfish assessments may depend on the situation. Important factors to consider include:
 - ~~a.~~ a. Parameter uncertainty (variance estimation conditioned on a given model, estimation framework, data set choice, and weighting scheme), including likelihood profiles of important assessment parameters (e.g., natural mortality). This also includes expressing uncertainty in derived outputs of the model and estimating CVs by an appropriate methods (e.g., bootstrap, asymptotic methods, Bayesian approaches, or MCMC).
 - ~~b.~~ b. Sensitivity to data set choice and weighting schemes (e.g., emphasis or λ factors), which may also include a consideration of recent patterns in recruitment.
 - ~~c.~~ c. Sensitivity to assumptions about model structure, i.e., model specification uncertainty.
 - ~~d.~~ d. Retrospective analysis, where the model is fitted to a series of shortened input data sets, with the most recent years of input data being dropped.
 - ~~e.~~ e. Historical analysis (plot of actual estimates from current and previous assessments).
 - ~~f.~~ f. ~~Decision table analysis.~~
 - ~~g.~~ g. Subjective appraisal of the magnitude and sources of uncertainty.
 - ~~h.~~ h. If a range of model runs is used to characterize uncertainty it is important to provide some qualitative or quantitative information about relative probability of each.
 - ~~i.~~ i. If possible, ranges depicting uncertainty should include at least three runs: (a) one judged most probable; (b) at least one that depicts the range of uncertainty in the direction of lower current biomass levels; and (c) one that depicts the range of uncertainty in the direction of higher current biomass levels. The entire range of uncertainty should be carried through stock projections and decision table analyses.
 - ~~j.~~ i. ~~Risk plots (Mohn suggestion)~~

~~C.~~ E. Rebuilding parameters-analyses –

- ~~1.~~ 1. _____ Determine B_0 _____ ~~as the product of spawners per recruit (SPR) in unfished state multiplied by the average recruitment expected while the stock is unfished. This typically is estimated as the average recruitment during early years of fishery. According to the 1999 SAFE report (PFMC 1999, p. 24)³; ~~t~~~~ The values for spawners are preferably measured as total population egg _____ production, but female spawning biomass is a common proxy.

³Pacific Fishery Management Council. 1999. Status of the Pacific Coast Groundfish Fishery Through 1998 and Recommended Biological Catches for 2000: Stock Assessment and Fishery Evaluation. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite, 224, Portland, Oregon 97201.

- ~~15.~~ 2. ~~_____~~ $B_{msy} = 0.4 B_o$;
- ~~16.~~ 3. ~~_____~~ Mean generation time; and
4. ~~_____~~ Forward projection using a Monte Carlo re-sampling of recruitments expected to occur as the stock ~~_____~~ rebuilds, where future recruitments typically are taken from the recent time series of estimated ~~_____~~ recruitments or recruits per spawner. Alternatively, if a credible stock-recruitment relationship can be ~~_____~~ estimated, it could be used to project population growth. Either approach can be conducted using the ~~_____~~ Punt rebuilding software (see above).

D. F. Reference pPoints (biomass and exploitation rate).

1. Unfished spawning stock biomass, summary age biomass, and recruitment.
2. Spawning stock biomass that produces MSY, and the basis for the estimate (SR curve or proxy).
3. SPR_{msy} or F_{msy} (specify which), and the basis for the estimate (SR curve or proxy).
4. Exploitation Rate corresponding to SPR_{msy} or F_{msy} (if available).
5. Estimate of MSY and the basis for the estimate (SR curve or proxy).

G.

E. Harvest projections and decision tables

1. Harvest projections and decision tables (i.e., a matrix of states of nature versus management action) should cover the plausible range of uncertainty about current biomass and the full range of candidate fishing mortality targets used for the stock or requested by the GMT. These should at least include calculation of the ABC based on F_{msy} (or its proxy) and the OY that is implied under the Council's 40:10 harvest policy. Ideally, the alternatives described in the decision table will be drawn from a probability distribution which describes the pattern of uncertainty regarding the status of the stock and the consequences of alternative future management actions. Where alternatives are not formally associated with a probability distribution, the document needs to present sufficient information to guide assignment of approximate probabilities to each alternative.
2. Information presented should include biomass and yield projections of ABC and OY for ten years into the future, beginning with the first year for which management action could be based upon the assessment.

H. Regional management considerations.

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

I.H. Research needs (prioritized).

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

J-K Literature cited.

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

Appendix C: Template for Executive Summary Prepared by STAT Teams

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

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

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

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

Reference points: management targets and definition of overfishing

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

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

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

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

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

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

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

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

Summary Table: as detailed in the attached spreadsheet

|

EXECUTIVE SUMMARY

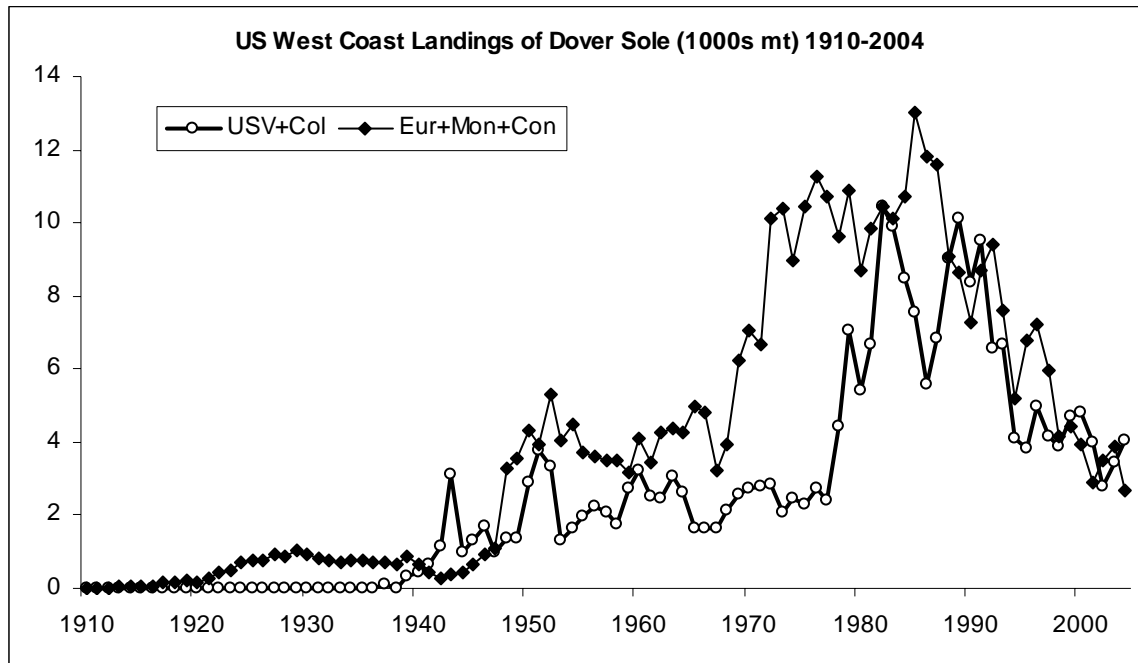
Stock

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

Catches

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

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



Data and Assessment

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

Unresolved Problems and Major Uncertainties

Just before the STAR Panel review, when working up results from the preliminary base model runs with randomized starting parameter values, it became apparent that the likelihood surface was very irregular and that the model often converged to parameter estimates that were not the globally best estimates. During development of the model, while exploring alternative model configurations and fixed parameter values, problems with model convergence lead to the conclusion that small lambda values were needed on the likelihood components for the age composition and mean length-at-age observations. It appears that there are fundamental tensions among some of the different data sources that can be resolved in multiple ways, leading to numerous local extrema on the likelihood surface. After the STAR Panel review experiments were conducted using different sequences of phases in the SS2 control file and some phasing sequences produced much better model convergence. However, none of the sequences that were tried fully solved the problem of convergence to local minima on the negative log-likelihood surface.

The size and sex distributions of Dover sole are highly variable by depth and between INPFC areas and have changed over time. It is difficult to determine whether these variations are due to differences in size-related discarding or to differences in selection, related either to gear or to depth of fishing. The size-discards and size-selection effects are confounded in the fishery size-composition data. Only a few observations are available for the size-distributions of discarded fish.

The West Coast Groundfish Observer Program data indicate considerable latitudinal differences in the pattern of discarding of Dover sole caught in deep water (> 300 fa). In the south (Eureka to Conception) the discarded fish are slightly heavier on average than the retained fish, possibly due to discarding of large "jellied" fish, whereas in the north (US Vancouver and Columbia) the discarded fish are lighter. The pattern in the north is consistent with the assumption that smaller fish are discarded. The current version of Stock Synthesis cannot generate discarded fish that are heavier than the retained fish as was observed in the south.

The available Dover sole age composition data do not appear to be very informative. Plots of the age composition data do not show any obvious evidence of strong or weak year classes. This could be due to age-reading error or because Dover sole exhibit considerable variation in length-at-age with depth. In future assessments it might be worthwhile compiling the data into separate fisheries by depth (as attempted in the 2001 assessment), but this approach will be problematic

because fishing trips can cover multiple depths and depth data are not always available for Dover sole market samples.

Differences in length-at-age, especially for old fish, were evident in the observed data from the AFSC versus the NWFSC slope surveys. The two surveys used different vessels and tow durations that may have resulted in differing trawl selection characteristics. It is plausible that the shorter NWFSC survey tows (15 versus 30 minutes) resulted in greater escapement of larger fish. Differences in mean length-at-age between the two surveys seemed to be a major source of the tension in the data and almost certainly contributed to the model convergence problem.

The current version of Synthesis does not have any options for selection curves in which peak selection occurs at different lengths for females versus males, and yet this seems to be a distinct feature in the Dover sole length composition data from the trawl surveys and the fisheries.

None of the numerous model configurations that were explored were able to resolve the conflicting signals that were evident in the Dover sole length composition data versus the age composition data versus the mean length-at-age data.

None of the numerous model configurations that were explored were able to fit the unusual bimodal length compositions that were observed in the female Dover sole collected during both slope surveys.

Reference Points

In June 2000 the Pacific Fishery Management Council (PFMC) endorsed the recommendation of the West Coast Groundfish Harvest Policy Workshop that F40% be used as the default target rate of fishing mortality for Council-managed flatfish species. The current assessment uses the F40% default to make harvest projections for Dover sole. Based on the Council's default harvest control rule for groundfish, the stock of Dover sole would be considered to be "overfished" whenever the spawning stock biomass (SB) was less than 25% of the unexploited level, SB(0).

The current assessment estimates that the Dover sole stock can support a maximum sustainable yield (MSY) of about 16,500 tons per year, which is considerably larger than the current OY and coastwide catches in any recent years.

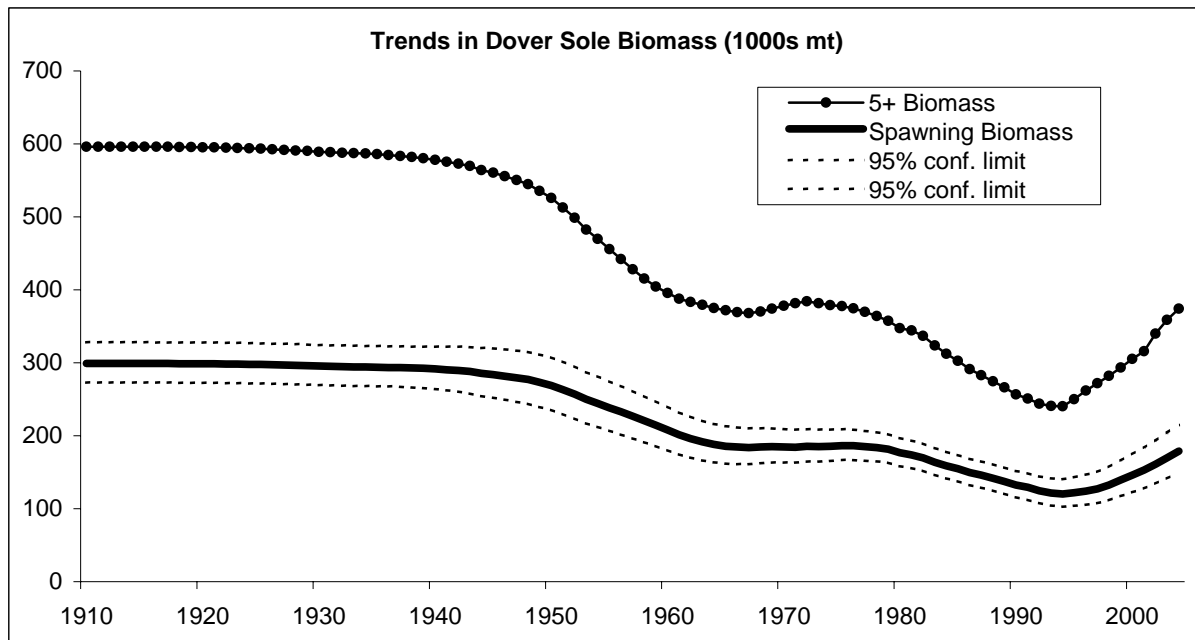
<u>Reference Points</u>	<u>Value</u>	<u>Units</u>
<u>Unfished Stock</u>		
<u>Spawning Biomass, SB(0)</u>	<u>299,054</u>	<u>mt</u>
<u>Spawning Biomass / Recruit</u>	<u>2.15</u>	<u>kg / fish</u>
<u>Annual Recruitment</u>	<u>138,970</u>	<u>1000s fish</u>
<u>F40% Proxy for MSY *</u>		
<u>Spawning Biomass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

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

Stock Biomass

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

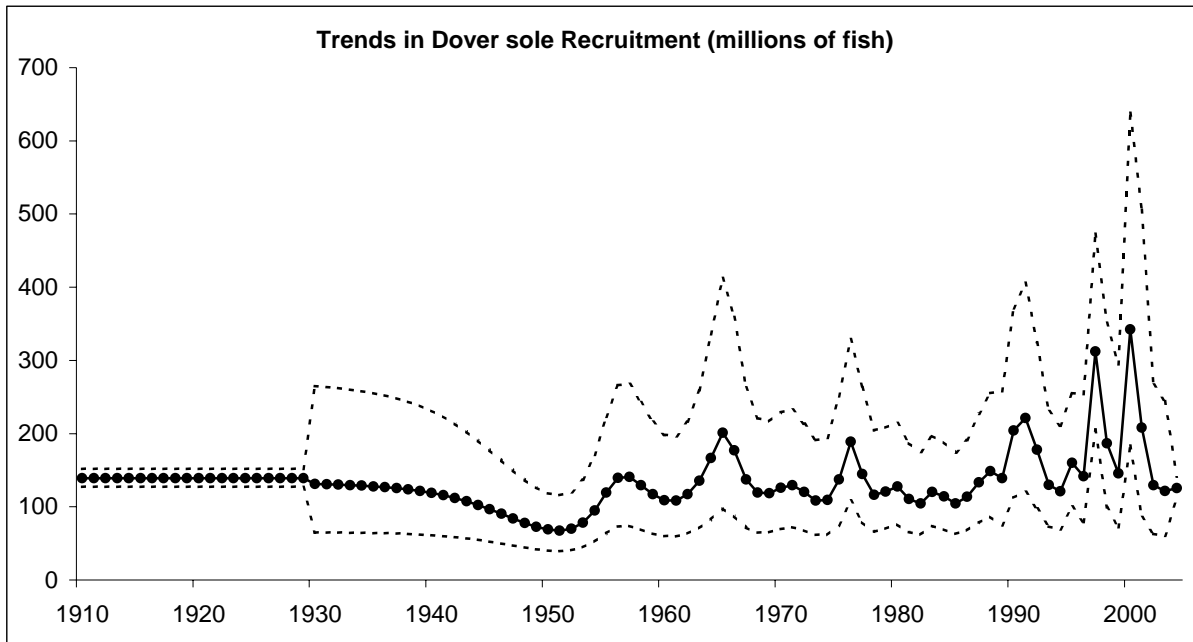
<u>Recent trends in Dover sole spawning biomass and depletion.</u>										
	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>
<u>Spawning Biomass (1000s mt)</u>	<u>121.8</u>	<u>124.3</u>	<u>127.1</u>	<u>132.3</u>	<u>139.4</u>	<u>146.1</u>	<u>153.1</u>	<u>161.0</u>	<u>169.8</u>	<u>178.8</u>
<u>% of Virgin</u>	<u>40.7%</u>	<u>41.5%</u>	<u>42.5%</u>	<u>44.2%</u>	<u>46.6%</u>	<u>48.9%</u>	<u>51.2%</u>	<u>53.8%</u>	<u>56.8%</u>	<u>59.8%</u>
<u>Age 5+ Biomass (1000s mt)</u>	<u>250.1</u>	<u>262.0</u>	<u>272.1</u>	<u>282.0</u>	<u>293.2</u>	<u>305.1</u>	<u>316.0</u>	<u>339.8</u>	<u>358.9</u>	<u>374.2</u>



Recruitment

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

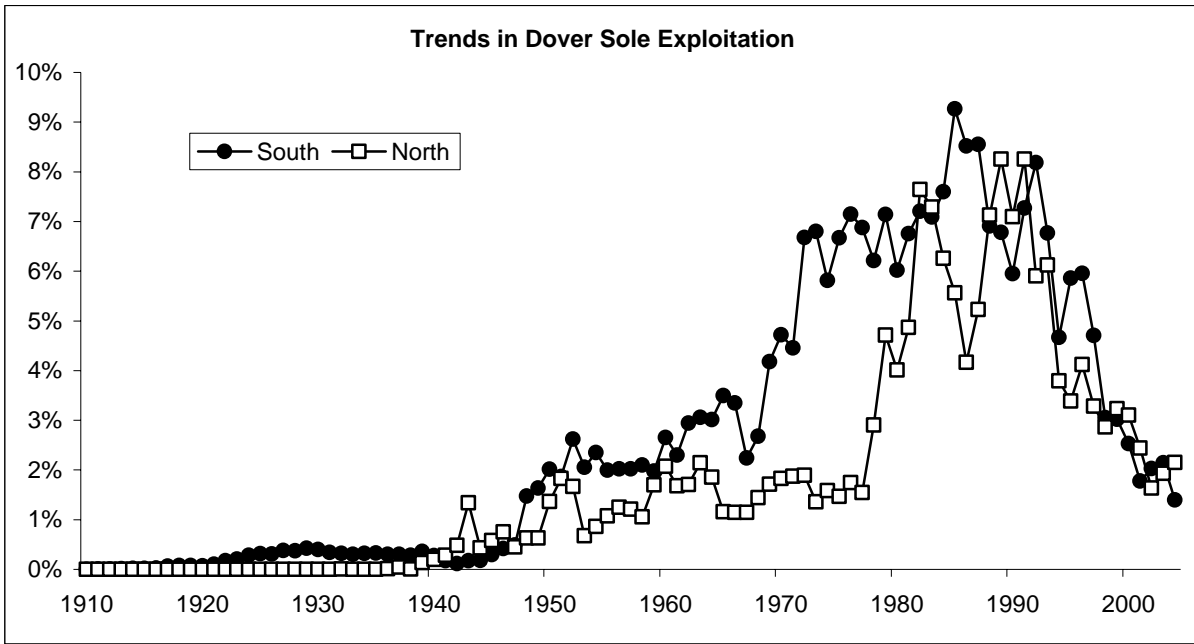
<u>Recent trends in Dover sole recruitment.</u>										
	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>
<u>Recruits (millions)</u>	<u>159.9</u>	<u>141.6</u>	<u>312.0</u>	<u>186.6</u>	<u>145.6</u>	<u>342.5</u>	<u>208.1</u>	<u>129.4</u>	<u>121.4</u>	<u>125.4</u>



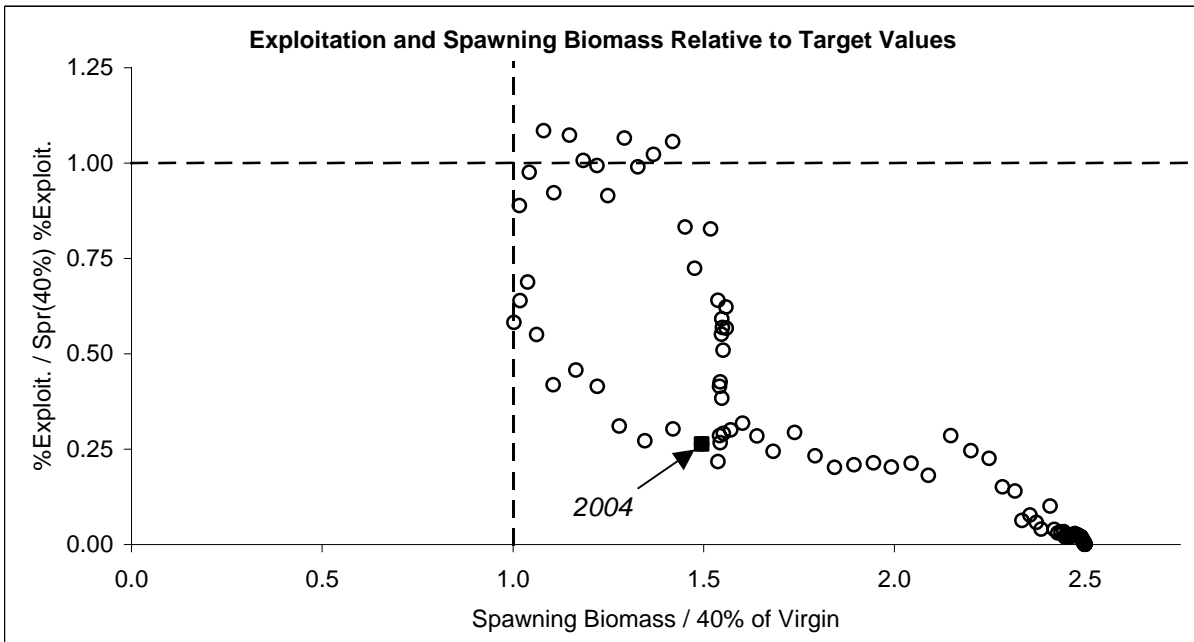
Exploitation Status

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

<u>Recent trends in Dover sole exploitation.</u>										
	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>
<u>South</u>	<u>5.86%</u>	<u>5.95%</u>	<u>4.71%</u>	<u>3.05%</u>	<u>3.02%</u>	<u>2.53%</u>	<u>1.78%</u>	<u>2.03%</u>	<u>2.15%</u>	<u>1.40%</u>
<u>North</u>	<u>3.39%</u>	<u>4.12%</u>	<u>3.28%</u>	<u>2.86%</u>	<u>3.23%</u>	<u>3.11%</u>	<u>2.44%</u>	<u>1.64%</u>	<u>1.93%</u>	<u>2.15%</u>



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



Management Performance

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

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

^a The ABC was specified as a range of values, 818-1565 mt.

^b The ABC was specified as a range of values, 820-1570 mt.

^c The ABC was specified as a range of values, 3164-4363 mt.

Forecasts

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

<u>Forecasts of Optimum Yield catches, biomass, and depletion.</u>										
	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>
<u>Total Catch (mt)</u>	<u>7440</u>	<u>7440</u>	<u>30146</u>	<u>29960</u>	<u>29453</u>	<u>28582</u>	<u>27433</u>	<u>26159</u>	<u>24903</u>	<u>23757</u>
<u>Spawning Biomass (1000s mt)</u>	<u>189.0</u>	<u>199.9</u>	<u>211.4</u>	<u>211.4</u>	<u>210.0</u>	<u>206.8</u>	<u>202.2</u>	<u>196.5</u>	<u>190.4</u>	<u>184.2</u>
<u>% of Virgin</u>	<u>63.2%</u>	<u>66.8%</u>	<u>70.7%</u>	<u>70.7%</u>	<u>70.2%</u>	<u>69.2%</u>	<u>67.6%</u>	<u>65.7%</u>	<u>63.7%</u>	<u>61.6%</u>

Decision Table

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

Decision Table for Dover sole

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

Research and Data Needs

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

Rebuilding Projections

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

Regional Management Concerns

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

Summary Tables for Dover Sole.

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

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

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

Will update with the Executive Summary from the latest round of assessments (Stacey Miller to provide)

Executive Summary

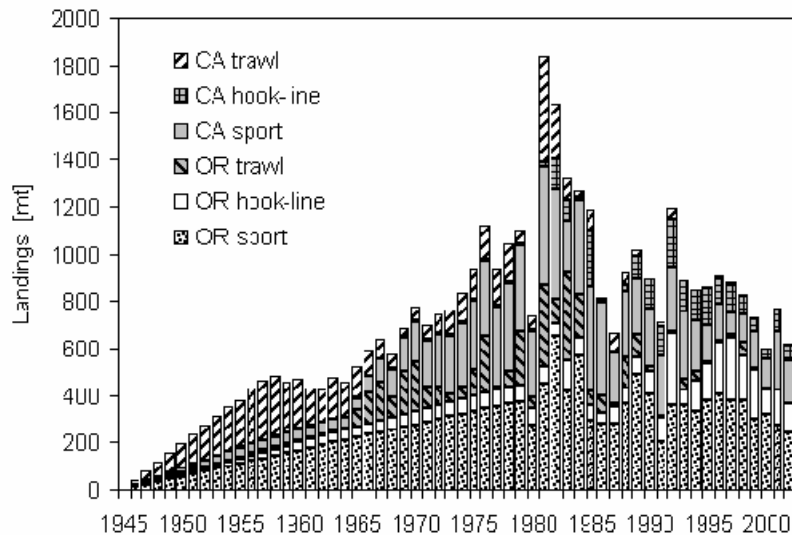
Stock:— This assessment pertains to the black rockfish (*Sebastes melanops*) population resident in waters located off northern California and Oregon, including the region between Cape Falcon and the Columbia River. Genetic information is presented that indicates black rockfish within that area represent a single homogeneous unit. A separate analysis of black rockfish off the coast of Washington and Oregon north of Cape Falcon was conducted by Wallace *et al.* (1999).

Catches:— Catches of black rockfish from Oregon and California were classified into 6 distinct fisheries, i.e., the recreational, commercial hook and line, and trawl sectors from each State. Since 1978, when consistent catch reporting systems began, landings have ranged from 602–1,836 mt. From 1978–2002 recreational catches have been reasonably consistent and have predominated. Concurrently, hook and line landings have increased as trawl landings have decreased. For this assessment, catches from 1945–77 were estimated from fragmented data and were ramped up by linear interpolation to known values in 1978. Discard rates of black rockfish are thought to be negligible, so the catch was assumed equal to the landings.

Recent black rockfish catch statistics [mt] by fishery

Year	Oregon			California			Total
	Sport	Hook	Trawl	Sport	Hook	Trawl	
1993	360.8	65.7	43.7	284.0	129.1	2.2	885.5
1994	330.0	131.2	43.4	210.0	130.9	1.1	846.6
1995	377.4	158.5	4.3	158.0	156.9	2.7	857.8
1996	401.3	225.6	7.7	154.0	103.4	10.5	902.5
1997	375.9	267.6	17.1	91.0	112.8	14.1	878.5
1998	375.2	191.6	58.6	117.0	78.6	6.3	827.3
1999	301.6	207.7	2.3	162.0	49.0	3.9	726.5
2000	320.7	105.6	0.6	129.0	43.7	2.3	601.9
2001	275.4	146.2	0.2	248.0	96.6	2.1	768.5
2002	241.6	125.2	1.2	179.7	67.0	2.0	616.7

Data and Assessment:— A variety of data sources was used in this assessment including: (1) recreational landings, age, and size composition data from the Oregon Department of Fish and Wildlife (ODF&W), (2) recreational landings (all California and Oregon shore based modes) from the RECFIN data base, (3) Oregon commercial landings (trawl and hook and line) from the PACFIN data base, (4) size compositions for the



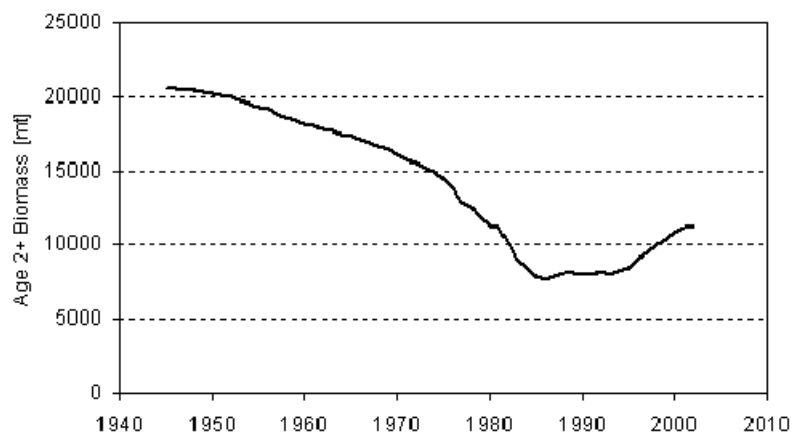
commercial fisheries in Oregon from ODF&W, (5) California commercial landings and length compositions from

the CALCOM database, (6) a recreational catch per unit effort (CPUE) statistic developed from information provided by ODF&W, (7) recreational CPUE statistics for each State derived from the RECFIN data base, and (8) a recreational CPUE statistic developed from the CDF&G central California CPFV data base. These multiple data sources were combined in a maximum likelihood statistical setting using the length-based version of the Stock Synthesis Model (Methot 1990, 2000).

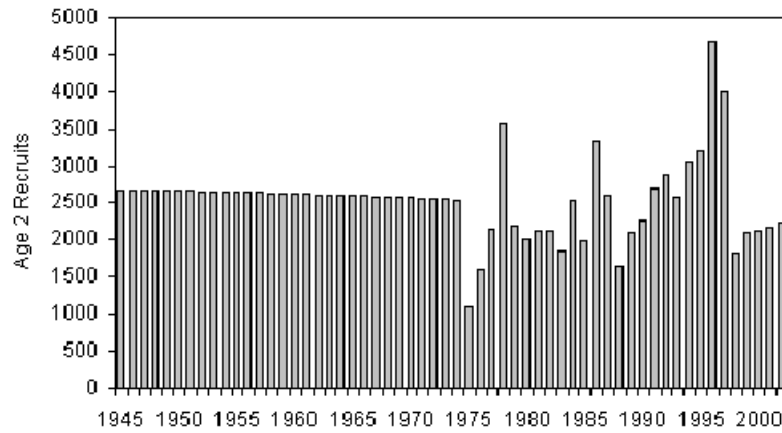
Unresolved Problems and Major Uncertainties:—The major sources of uncertainty in this stock assessment include: (1) the amount of historical landings that occurred prior to the 1978, (2) the assumed natural mortality rate, and (3) the steepness of the spawner recruit curve.

Reference Points:—Based on the Pacific Fishery Management Council's current default harvest rate policy for *Sebastes*, the target harvest rate for black rockfish is $F_{50\%}$. Given the life history of the species, and the prevailing mix of fisheries in 2002 (predominately recreational with some commercial hook and line catches), this corresponds to an exploitation rate of about 7.7%. Moreover, the Council's current target biomass level for exploited groundfish stocks is $B_{40\%}$, i.e., the spawning output of the stock is reduced to 40% of that expected in the absence of fishing. For black rockfish that corresponds to spawning output of 1.258×10^9 larvae.

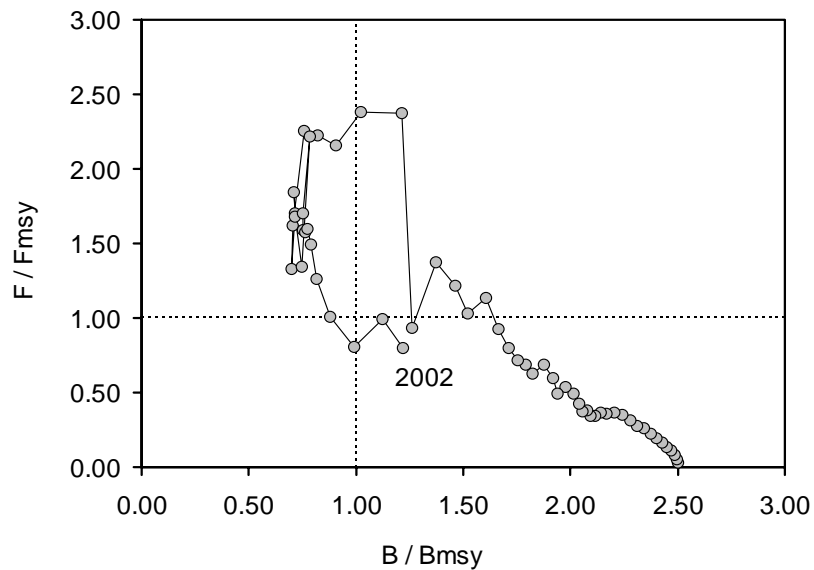
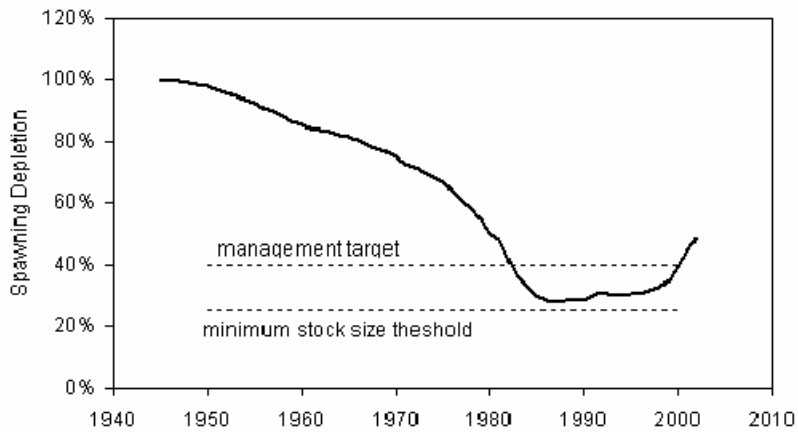
Stock Biomass:—The biomass of age 2+ black rockfish underwent a significant decline from a high of 20,510 mt in 1945 to a low of 7,702 mt in 1986, representing a 62% decline. Since that time, however, the stock has increased and is currently estimated to be 11,232 mt. Most of the population's growth occurred after 1995, due to several large recruitment events, including especially the 1994 and 1995 year classes.



Recruitment:—In the assessment recruitment was treated as a blend of deterministic values (i.e., 1945–1974 & 1999–2002) and stochastic values (i.e., 1975–1998). The Beverton-Holt steepness parameter (h) was fixed at a value of 0.65, based upon on a profile of goodness of fit and results from a prior meta-analysis of rockfish productivity. During the 1975–1998 period there was a significant increasing trend in recruitment, even as spawning output declined. That trend culminated with the recruitment of the 1994 and 1995 year classes, which were about twice as large as expected, based on the predicted value from the spawner-recruit curve.



Exploitation Status: The northern California-Oregon stock of black rockfish is healthy, with 2002 spawning output estimated to be 49% of the unexploited spawning level. This places the stock well above the management target level of $B_{40\%}$. Likewise, age 2+ biomass in 2002 is estimated to be 11,232 mt, which is 55% of that expected in the absence of fishing. In addition, since 1998 the fishing mortality rate has declined to the point where it is now less than the F_{msy} proxy in 2002 (i.e., $F_{50\%}$).



Management Performance:—Black rockfish in the southern area (Eureka & Monterey INPFC areas) have historically been managed as part of the “Other Rockfish” category, with no explicit ABC or OY designated. For 2001 the ABC of all species within that group was 2,702 mt. In contrast, in the northern area (Vancouver & Columbia INPFC areas) black rockfish is managed within the “Remaining Rockfish” category, with a designated 2001 ABC of 1,115 mt.

Forecasts: A forecast of stock abundance and yield was developed under the base model. In this projection there was no 40:10 reduction in OY from the calculated ABC because the stock is estimated to be above the management target ($B_{40\%}$) and annual yields were calculated using an $F_{50\%}$ exploitation rate (see above). Results are shown in the following table:

Year	Age 2+	Spawning	Recruits	ABC Exploitation	Yield [mt]	
	Biomass	Output		Rate	ABC	= OY
2003	11,342	1.63E+09	2,307	7.60%	802	802
2004	11,217	1.66E+09	2,353	7.45%	775	775
2005	11,082	1.65E+09	2,386	7.34%	753	753
2006	10,938	1.62E+09	2,394	7.29%	736	736
2007	10,802	1.57E+09	2,392	7.28%	725	725
2008	10,700	1.53E+09	2,381	7.29%	719	719
2009	10,621	1.50E+09	2,366	7.30%	715	715
2010	10558	1.48E+09	2,354	7.32%	713	713
2011	10505	1.47E+09	2,343	7.34%	711	711
2012	10459	1.46E+09	2,335	7.35%	708	708

Decision Table: The amount of historical catch prior to 1978 was considered a major source of uncertainty in this assessment. Although some catch estimates were available prior to that time, which were not inconsequential, no continuous time series of catches from the sport and trawl fisheries in Oregon and California could be identified. Therefore, the catch record was assumed to begin in 1945, with no historical catches prior to that year. Catches were then made to ramp up to 1978, using whatever external data were available and linear interpolations to fill missing values. To bracket uncertainty in these catches and their effect on the management system: (1) high and low catch scenarios were created, (2) the base assessment model was refitted to each series, and (3) 10-year yield projections run. Results show that if historical catches were lower than in the base model the calculated OY (= ABC) is reduced. Conversely, if historical catches were higher than modeled the OY would be higher. For purposes of comparison, total catches for 2000, 2001, and 2002 were 602, 768, and 617 mt, respectively.

Year	Low Catch Scenario		Base Model		High Catch Scenario	
	OY [mt]	Depletion	OY [mt]	Depletion	OY [mt]	Depletion
2003	757	54.2%	802	51.9%	886	48.1%
2004	729	54.9%	775	52.7%	861	49.0%
2005	706	54.5%	753	52.5%	842	48.9%
2006	688	53.3%	736	51.4%	828	48.2%
2007	676	51.7%	725	50.0%	820	47.1%
2008	668	50.3%	719	48.8%	817	46.2%
2009	663	49.2%	715	47.9%	816	45.6%
2010	660	48.3%	713	47.2%	816	45.1%
2011	657	47.7%	711	46.7%	816	44.9%
2012	654	47.2%	708	46.3%	816	44.7%

Research and Data Needs: The black rockfish review panel identified certain gaps in the available information that hindered the stock assessment. These were: (1) a fishery independent survey should be developed to monitor

~~changes in black rockfish population abundance, (2) the California CPFV data set should be more thoroughly investigated to ascertain whether or not serial depletion of fishing sites has artificially kept catch rates high [see Appendix 1], (3) a standard approach to historical catch reconstructions should be developed, (4) the possibility of time-varying growth should be investigated, and (5) the calculation of the RECFIN catch per unit effort statistic should be more thoroughly analyzed and verified.~~

Appendix E: History of STAR process

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

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

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

The review process for 1997 was further expanded based on a planning meeting in December 1996.³ It was agreed that agencies (including NMFS and state agencies) conducting stock assessments were responsible for making sure assessments were technically sound and adequately reviewed. A Council-oriented review process was developed that included agencies, the GMT, GAP, and other interested members of the Council family. The process was jointly funded by the Council and NMFS, with NMFS hosting the Stock Assessment Review (STAR) Panel meetings and paying the travel expenses of the external reviewers, and the Council paying for travel expenses of the GAP representative and non-federal GMT and SSC members.

The process for 1997 included: 1) goals and objectives; 2) three STAR Panels, including external membership; 3) terms of reference for STAR Panels; 4) terms of reference for Stock Assessment (STAT) Teams; 5) a refined outline for stock assessments; 6) external anonymous reviews; 7) a clearer distinction between science and management; and 8) a calendar of events with clear deliverables, dates and well defined responsibilities. For the first time, STAR Panels and STAT Teams were asked to provide “decision table” analyses of the effects of uncertain management actions and to provide information required by the GMT in choosing harvest strategies. In addition, STAR Panels were asked to prepare “Stock Summaries” that described the essential elements of stock assessment results in a concise, simple format.

At the end of 1997, participants met to discuss events and make recommendations for 1998.⁴ Participants concluded

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

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

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

⁴Jacobson, L.D. (ed.). 1997. Comments, issues and suggestions arising from the groundfish stock assessment

that objectives were, to varying degrees, achieved during 1997. A notable shortfall was in “increasing acceptance and understanding by all members of the Council family.” The most significant issues seemed to be the nature of the STAR Panels’ responsibilities, communicating uncertainty to decision makers, workload, and inexperience in conducting the review process.

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

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

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

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

Other than the changes noted above, the 1999 STAR process was similar to 1997 and 1998. As in previous years, a joint meeting of the SSC, GAP, and GMT was convened to review and evaluate the stock assessment process and to recommend modifications for 2000. There were relatively few concerns about the process in 1999, and they centered mainly ~~around~~ on the difficulty of recruiting sufficient (external and internal) reviewers. Participants did not recommend departing from the current terms of reference regarding STAR panel composition, although they seemed to regard it more as a goal than a strict requirement. A notable continuing concern was the timeliness of STAR team reports prior to the STAR panel meetings.

Requirements for stock rebuilding analyses and monitoring of rebuilding progress and their relationship to the STAR process were also discussed. The group agreed that the terms of reference should be modified to require additional values (e.g., B_{msy}) be tabulated and included in STAR Team report related to an overfished species. There was general agreement that the STAR process should be used to review assessments of overfished species, which are still likely to be on a 3-year cycle. However, the STAR process is not the appropriate process for the "monitoring" reports (required every 2 years), when they are out of phase with the assessment cycle.

and review process during 1997. Report to the Pacific Fishery Management Council (Revised Supplemental Attachment B.9.b, November 1997).

Additionally, it was agreed that certain additional values should be consistently tabulated in the STAT team report in order to build a long-term computerized database of key parameters. The group noted that this would not impose additional work for the STAT team, but would simply require these values to be reported consistently.

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

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

Appendix F: Terms of Reference for Expedited Stock Assessment Updates

—While the ordinary STAR process is designed to provide a general framework for obtaining a comprehensive, independent review of a stock assessment, in other situations a less rigorous review of assessment results is desirable. This is especially true in situations where a “model” has already been critically examined and the objective is to simply update the model by incorporating the most recent data. In this context a model refers not only to the population dynamics model *per se*, but to the particular data sources that are used as inputs to the model, the statistical framework for fitting the data, and the analytical treatment of model outputs used in providing management advice, including reference points, the allowable biological catch (ABC) and optimum yield (OY). When this type of situation occurs, it is an inefficient use of scarce personnel resources to assemble a full STAR Panel for a whole week to evaluate an accepted modeling framework. These terms of reference establish a procedure that can accommodate an abbreviated form of review for stock assessment models that fall into this latter category. However, it is recognized that what in theory may seem to be a simple update, may in practice result in a situation that is impossible to resolve in an abbreviated process. In these cases, it may not be possible to update the assessment — rather the assessment may need to be revised in the next full assessment review cycle.

Qualification

—The Scientific and Statistical Committee (SSC) will determine when a stock assessment qualifies for an expedited update under these terms of reference. To qualify, a stock assessment must carry forward its fundamental structure from a model that was previously reviewed and endorsed by a full STAR panel. In practice this means similarity in: (a) the particular sources of data used, (b) the analytical methods used to summarize data prior to input to the model, (c) the software used in programming the assessment, (d) the assumptions and structure of the population dynamics model underlying the stock assessment, (e) the statistical framework for fitting the model to the data and determining goodness of fit, (f) the procedure for weighting of the various data components, and (g) the analytical treatment of model outputs in determining management reference points, including F_{msy} , B_{msy} , and B_0 . It is the SSC's intention to employ an expedited stock assessment update in situations where no significant change in these 7 factors has occurred, other than extending time series of data elements within particular data components used by the model, e.g., adding information from a recently completed survey with an update of landings. In practice there will always be valid reasons for altering a model, as defined in this broad context, although, in the interests of stability, such changes should be resisted when possible. Instead, significant alterations should be addressed in the next subsequent full assessment and review. In principle, an expedited update is reserved for stock assessments that maintain fidelity to an accepted modeling framework, but the SSC does not wish to prescribe in advance what particular changes may or may not be implemented. Such a determination will need to be made on a case by case basis.

Composition of the Review Panel

—Unless an updated assessment is reviewed during a regular STAR Panel, the groundfish subcommittee of the SSC will conduct the review of an expedited stock assessment update. A review panel chairman will be designated by the chairman of the groundfish subcommittee from among its membership and it will be the panel chairman's responsibility to ensure the review is completed properly and that a written report of the proceedings is produced. Other members of the subcommittee will participate in the review to the extent possible, i.e., input from all members will not be required to finalize a report. In addition, the groundfish management team (GMT) and the groundfish advisory panel (GAP) will designate one person each to participate in the review, although the GMT and GAP panelists will serve in an advisory capacity only.

Review Format

—Typically, a physical meeting will not be required to complete an expedited review of an updated stock assessment, but usually one would be the most efficient way to conduct the review. Rather, if a meeting is not held, materials can be distributed electronically. STAT and panel representatives will

largely be expected to interact by email and telephone. A conference call will be held to facilitate public participation in the review.

—The review process will be as follows. Initially, the STAT team that is preparing the stock assessment update will distribute to the review panelists a document that summarizes the team's findings. In addition, Council staff will provide panelists with a copy of the last stock assessment reviewed under the full STAR process, as well as the previous STAR panel report. Each panelist will carefully review the materials provided. A conference call will be arranged by the panel chairman, which will provide an opportunity to discuss and clarify issues arising during the review, as well as provide for public participation. Notice of the conference call and a list of public listening stations will be published in the *Federal Register* (generally, 23 days in advance of the conference call) and a Meeting Notice will be distributed (generally, 14 days in advance). A dialogue will ensue among the panelists and the STAT team over a period of time that generally should not exceed one week. Interested members of the public may request access to the discussions (typically email), which would be facilitated of Council staff. Upon completion of the interactive phase of the review, the panel chairman may, if necessary, convene a second conference call to reach a consensus among panel members and will draft a report of the panel's findings regarding the updated assessment. The whole process should be scheduled to occur within a two week period and the STAT team and panelists should be prepared to complete their work within that time frame. It will be the chairman's responsibility to insure that the review is completed in a timely manner.

STAT Team Deliverables

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

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

- Title page and list of preparers
- Executive Summary (see Appendix C)
- Introduction
- Documentation of updated data sources
- Short description of overall model structure
- Base-run results (largely tabular and graphical)
- Uncertainty analysis, including retrospective analysis, decision table, etc.
- 10 year harvest projections under the default harvest policy

Review Panel Report

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

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