GROUNDFISH STOCK ASSESSMENT AND REVIEW PROCESS FOR 2009-2010

Introduction

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

STAR Goals and Objectives

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

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

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

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

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

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

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

g) Use assessment and review resources effectively and efficiently.

Shared Responsibilities

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

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

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

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

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

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

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

NMFS Responsibilities

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

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

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

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

STAT Team Responsibilities

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

GMT Responsibilities

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

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

GAP Responsibilities

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

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

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

SSC Responsibilities

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

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

Council Staff Responsibilities

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

Stock Assessment Priorities

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

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

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

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

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

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

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

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

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

Terms of Reference for STAR Panels and Their Meetings

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

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

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

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

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

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

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

The STAR Panel's terms of reference solely concern technical aspects of the stock assessment. It is therefore important that the Panel should strive for a risk neutral perspective in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the panel and excluded from the set upon which management advice is to be developed. It is recognized that a broad range of results should be reported to better define the scope of the accepted model results. The STAR Panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty, and the degree to which the probabilities associated with these scenarios are technically sound. The STAR Panel may also provide qualitative comments on the probability of various model

results, especially if the Panel does not believe that the probability distributions calculated by the STAT capture all major sources of uncertainty.

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

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

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

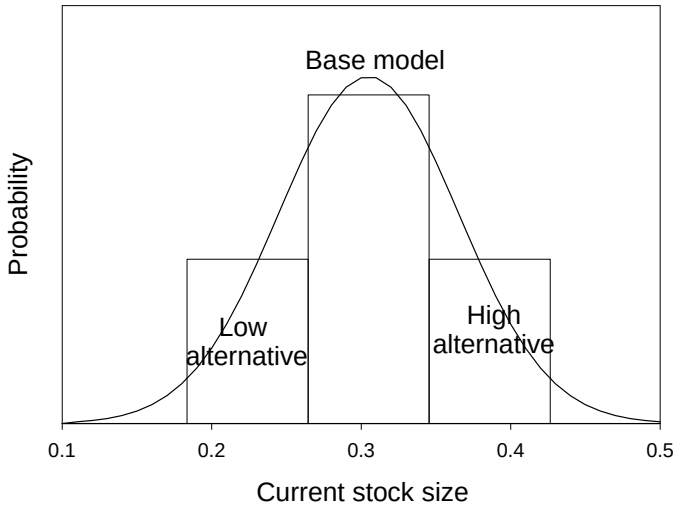


Figure 1. Example of assigning probabilities to alternative models using uncertainty in the estimate of current stock

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

size.

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

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

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

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

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

Suggested Template for STAR Panel Report

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

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

Terms of Reference for Groundfish STAT Teams

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

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

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

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

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

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

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

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

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

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

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

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

Terms of Reference for Stock Assessment Updates

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

Qualification

The Scientific and Statistical Committee (SSC) will determine whether a stock assessment qualifies as an update under these terms of reference. Recommendation by a STAR Panel or the SSC that a full assessment is suitable for an update will be a principal criterion in this determination. To qualify, a stock assessment must carry forward its fundamental structure from a model that was previously reviewed and endorsed by a STAR panel. In practice this means similarity in: (a) the particular sources of data used, (b) the analytical methods used to summarize data prior to input to the model, (c) the software used in programming the assessment, (d) the assumptions and structure of the population dynamics model underlying the stock assessment, (e) the statistical framework for fitting the model to the data and determining goodness of fit, (f) the procedure for weighting of the various data components, and (g) the analytical treatment of model outputs in determining management reference points, including F_{msy}, B_{msy}, and B_0. A stock assessment update is appropriate in situations where no significant change in these seven factors has occurred,

other than extending time series of data elements within particular data components used by the model, e.g., adding information from a recently completed survey and an update of landings. Extending CPUE time series based on fitted models (i.e., GLM models) will require refitting the model and updating all values in the time series. Assessments using updated CPUE time series qualify as updates if the CPUE standardization models follow applicable criteria for assessment models described above. In practice there will always be valid reasons for altering a model, as defined in this broad context, although, in the interests of stability, such changes should be resisted as much as possible. Instead, significant alterations should be addressed in the next subsequent full assessment and review.

Composition of the Review Panel

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

Review Format

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

STAT Team Deliverables

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

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

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

- 10 year harvest projections under the default harvest policy.

Review Panel Report

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

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

Appendix A: 2009-2010 Stock Assessment Review Calendar

TO BE DETERMINED

Include deadlines for inclusion of all significant data elements.

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

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

Appendix B: Outline for Groundfish Stock Assessment Documents

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

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

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

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

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

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

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

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

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

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

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

I. Research needs (prioritized).

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

K Literature cited.

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

Appendix C: Template for Executive Summary Prepared by STAT Teams

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

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

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

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

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

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

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

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

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

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

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

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

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

Summary Table: as detailed in the attached spreadsheet

Executive Summary

Stock

This assessment reports the status of the canary rockfish (*Sebastes pinniger*) resource off the coast of the United States from southern California to the U.S.-Canadian border using data through 2006. The resource is modeled as a single stock. Spatial aspects of the coast-wide population are addressed through geographic separation of data sources/fleets where possible and consideration of residual patterns that may be a result of inherent stock structure. There is currently no genetic evidence that there are distinct biological stocks of canary rockfish off the U.S. coast and very limited tagging data to describe adult movement, which may be significant across depth and latitude. Future efforts to specifically address regional management concerns will require a more spatially explicit model that likely includes the portion of the canary rockfish stock residing in Canadian waters off Vancouver Island.

Catches

Catch of canary rockfish is first reported in 1916 in California. Since that time, annual catch has ranged from 46.5 mt in 2004 to 5,544 in 1982 and totaled almost 150,000 mt over the time-series. Canary rockfish have been primarily caught by trawl fleets, on average comprising ~85% of the annual catches, with the Oregon fleet removing as much as 3,941 mt in 1982. Historically just 10% of the catches have come from non-trawl commercial fisheries, although this proportion reached 24% and 358 mt in 1997. Recreational removals have averaged just 6% of the total catch, historically, but have become relatively more important as commercial landings have been substantially reduced in recent years. Recreational catches reached 59% of the total with 30 mt caught in 2003. Total catches after 1999 have been reduced by an order of magnitude in an attempt to rebuild a stock determined to be overfished on the basis of the 1999 assessment.

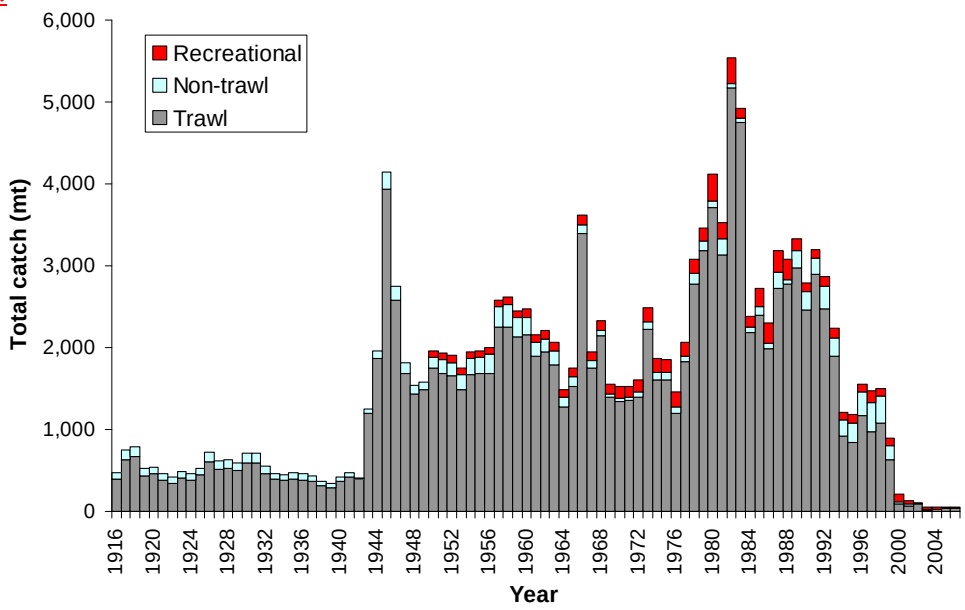


Figure a. Canary rockfish catch history by major source, 1916-2006.

Table a. Recent commercial fishery catches (mt) by fleet.

Year	Southern California trawl	Northern California trawl	Oregon trawl	Washington trawl	Southern California non-trawl	Northern California non-trawl	Oregon-Washington non-trawl	At-sea whiting bycatch
1997	31.96	142.66	589.85	203.44	29.78	73.80	254.42	3.63
1998	8.41	149.45	716.05	203.01	23.33	57.25	250.13	5.47
1999	7.36	96.25	387.85	139.97	8.53	28.59	123.97	5.63
2000	1.71	11.24	46.62	32.66	2.52	5.50	10.25	2.35
2001	1.44	9.43	33.13	19.65	1.60	4.96	11.00	4.05
2002	0.36	14.62	32.60	33.29	0.02	0.08	3.15	5.24
2003	0.23	0.31	5.02	6.24	0.00	0.08	6.89	0.93
2004	0.61	1.95	7.67	7.73	0.02	0.06	4.68	5.22
2005	0.72	2.84	4.91	25.90	0.06	0.09	1.79	1.44
2006	3.57	2.28	2.91	15.64	0.00	0.00	3.11	1.09

Data and Assessment

This assessment used the Stock Synthesis 2 integrated length-age structured model. The model includes catch, length- and age-frequency data from 11 fishing fleets, including trawl, non-trawl and recreational sectors. Biological data is derived from both port and on-board observer sampling programs. The National Marine Fisheries Service (NMFS) triennial bottom trawl survey and Northwest Fisheries Science Center (NWFSC) trawl survey relative biomass indices and biological sampling provide fishery independent information on relative trend and demographics of the canary stock. The Southwest Fisheries Science Center (SWFSC)/NWFSC/Pacific Whiting Conservation Cooperative (PWCC) coast-wide pre-recruit survey provides a source of recent recruitment strength information.

New analysis of the triennial survey data led to separating the series into two parts (1980-1992, 1995-2004) to allow for potential changes in catchability due to timing of survey operations. Accommodation of potential changes in fishery selectivity due to management actions including the adoption of canary-specific trip limits in 1995, small-footrope requirements in 1999, closure of the RCA in 2002 and use of selective flatfish trawl starting in 2005 was also added in this assessment. These and other changes have resulted in a change in the estimate of current stock status and large increase in the perception of uncertainty regarding this quantity in comparison to the most recent 2005 and earlier assessments.

The base case assessment model includes parameter uncertainty from a variety of sources, but underestimates the considerable uncertainty in recent trend and current stock status. For this reason, in addition to asymptotic confidence intervals (based upon the model's analytical estimate of the variance near the converged solution), two alternate states of nature regarding stock productivity (via the steepness parameter of the stock-recruitment relationship) are presented. The base case model (steepness = 0.51) is considered to be twice as likely as the two alternate states (steepness = 0.35, 0.72) based on the results of a meta-analysis of west coast rockfish (M. Dorn, personal communication). In order to best capture this source of uncertainty, all three states of nature will be used as probability-weighted input to the rebuilding analysis.

Stock biomass

Canary rockfish were relatively lightly exploited until the early 1940's, when catches increased and a decline in biomass began. The rate of decline in spawning biomass accelerated during the late 1970s, and finally reached a minimum (13% of unexploited) in the mid 1990s. The canary rockfish spawning stock biomass is estimated to have been increasing since that time, in response to reductions in harvest and above average recruitment in the preceding decade. However, this trend is very uncertain. The estimated relative depletion level in 2007 is 32.4% (~95% asymptotic interval: 24-41%, ~75% interval based on the range of states of nature: 12-56%), corresponding to 10,544 mt (asymptotic interval: 7,776-13,312 mt, states of nature interval: 4,009-17,519) of female spawning biomass in the base model.

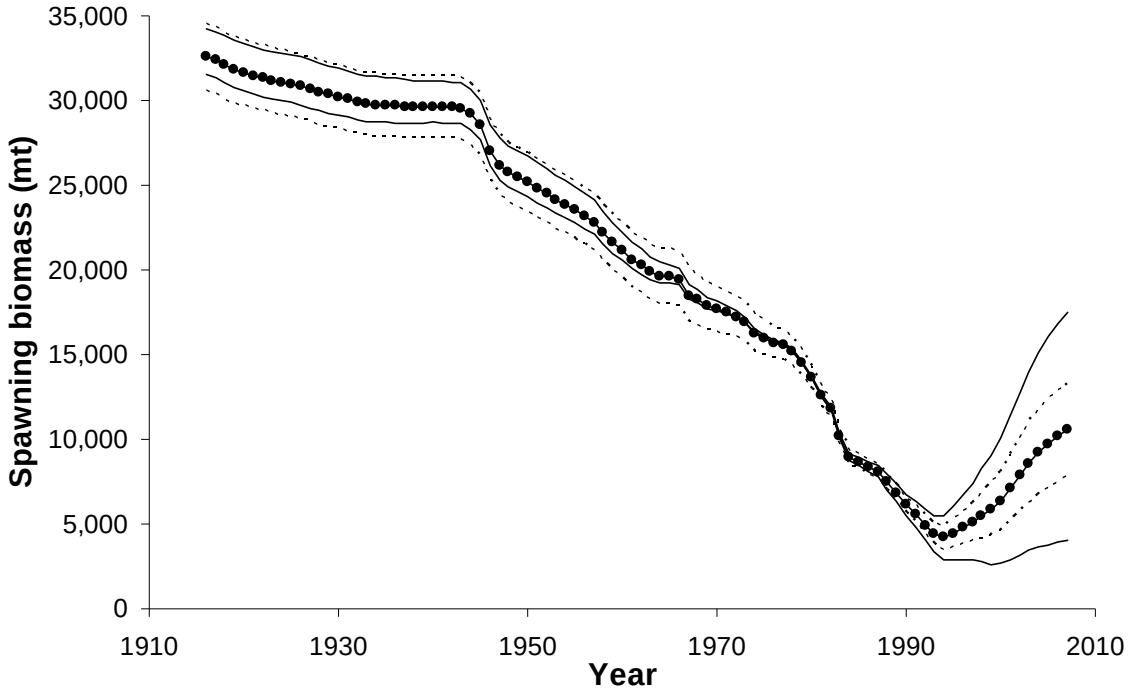


Figure b. Estimated spawning biomass time-series (1916-2007) for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

Table b. Recent trend in estimated canary rockfish spawning biomass and relative depletion level.

Year	Spawning biomass (mt)	~95% confidence interval	Range of states of nature	Estimated depletion	~95% confidence interval	Range of states of nature
1998	5,499	4,177-6,820	2,761-8,241	16.9%	NA	8.1-26.2
1999	5,826	4,296-7,357	2,610-9,073	17.9%	NA	7.6-28.8
2000	6,364	4,618-8,111	2,644-10,144	19.5%	NA	7.7-32.2
2001	7,149	5,190-9,109	2,918-11,477	22.0%	NA	8.5-36.4
2002	7,910	5,750-10,070	3,184-12,779	24.3%	NA	9.3-40.6
2003	8,603	6,264-10,942	3,417-13,985	26.4%	NA	10.0-44.4
2004	9,226	6,736-11,715	3,628-15,076	28.3%	NA	10.6-47.9
2005	9,749	7,140-12,359	3,795-16,019	29.9%	NA	11.1-50.9
2006	10,183	7,482-12,884	3,918-16,825	31.3%	23.1-39.4	11.4-53.4
2007	10,544	7,776-13,312	4,009-17,519	32.4%	24.1-40.7	11.7-55.6

Recruitment

The degree to which canary rockfish recruitment declined over the last 50 years is closely related to the level of productivity (stock-recruit steepness) modeled for the stock. High steepness values imply little relationship between spawning stock and recruitment, while low steepness values cause a strong correlation. After a period of above average recruitments, recent year-class strengths have generally been low, with only 1999 and 2001 producing large estimated recruitments (the 2007 recruitment is based only on the stock-recruit function). There is little information other than the pre-recruit index to inform the assessment model about recruitments subsequent to 2002, so those estimates will likely be updated in future assessments. As the larger recruitments from the late 1980s and early 1990s move through the population in future projections, the effects of recent poor recruitment will tend to slow the rate of recovery.

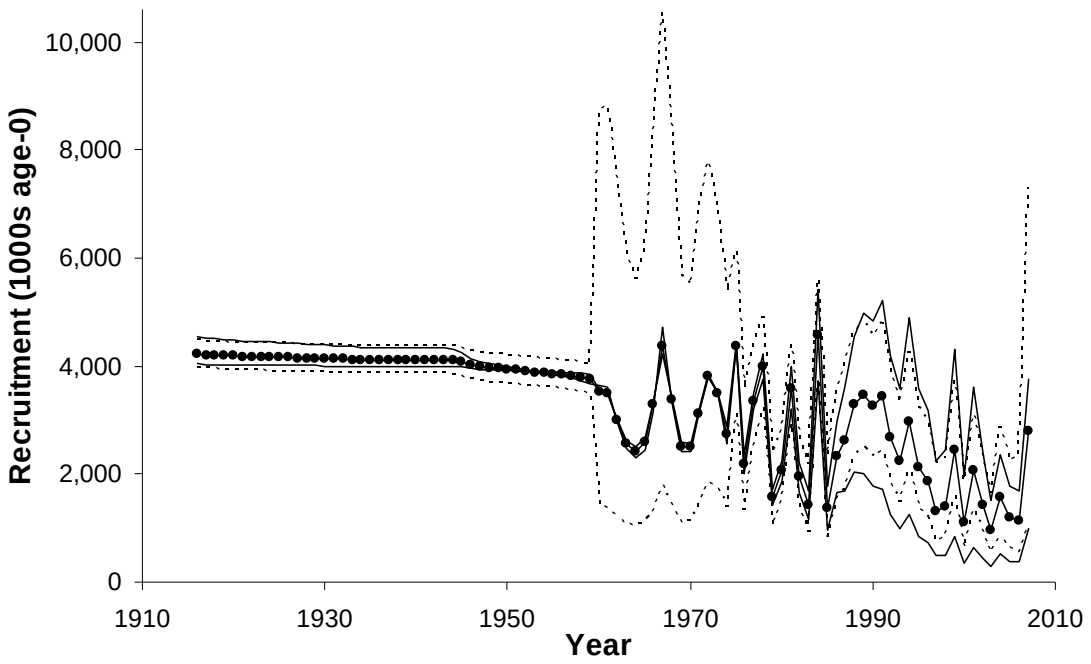


Figure c. Time series of estimated canary rockfish recruitments for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

Table c. Recent estimated trend in canary rockfish recruitment.

Year	Estimated recruitment (1000s)	~95% confidence interval	Range of states of nature
1998	1,391	841-2,299	484-2,453
1999	2,449	1,606-3,735	841-4,318
2000	1,099	638-1,893	351-1,938
2001	2,061	1,359-3,124	643-3,613
2002	1,432	905-2,267	447-2,383
2003	955	547-1,667	302-1,515
2004	1,565	854-2,869	520-2,373
2005	1,182	627-2,231	390-1,771
2006	1,144	548-2,389	367-1,699
2007	2,807	1,078-7,313	991-3,745

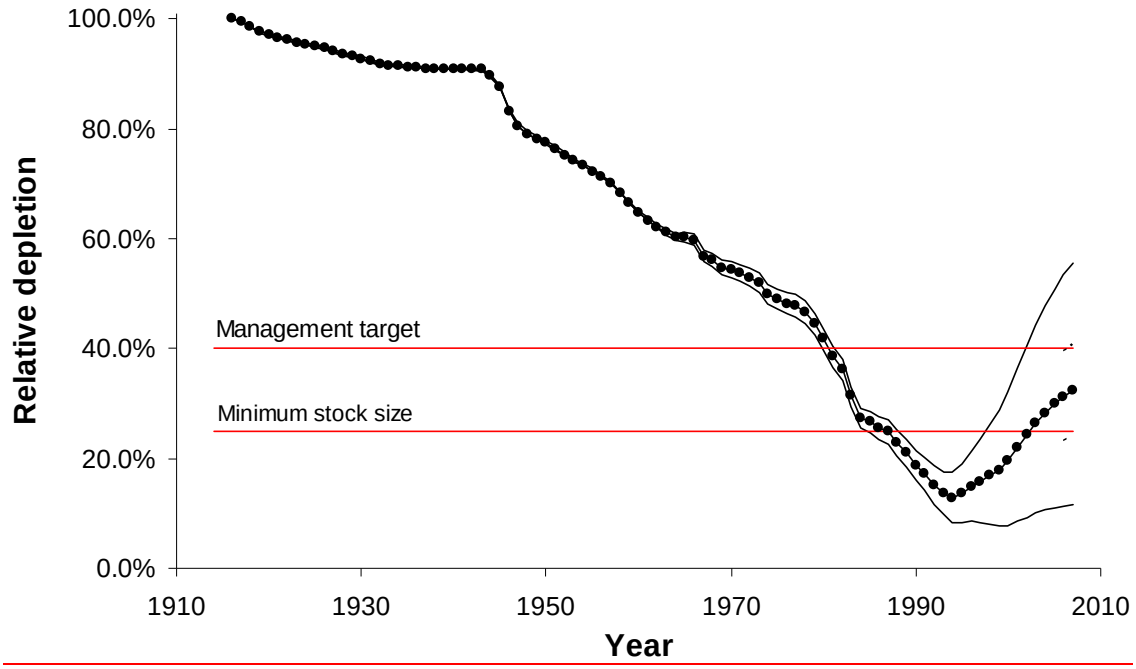


Figure d. Time series of depletion level as estimated in the base case model (round points) with approximate asymptotic 95% confidence interval (2006-2007 only, dashed lines) and alternate states of nature (light lines).

Reference points

Unfished spawning stock biomass was estimated to be 32,561 mt in the base case model. This is slightly smaller than the equilibrium value estimated in the 2005 assessment. The target stock size ($SB_{40\%}$) is therefore 13,024 mt. Maximum sustained yield (MSY) applying current fishery selectivity and allocations (a 'bycatch-only' scenario) was estimated in the assessment model to occur at a spawning stock biomass of 12,394 mt and produce an MSY catch of 1,169 mt (SPR = 52.9%). This is nearly identical to the yield, 1,167 mt, generated by the SPR (54.4%) that stabilizes the stock at the $SB_{40\%}$ target. The fishing mortality target/overfishing level (SPR = 50.0%) generates a yield of 1,161 mt at a stock size of 11,161 mt.

When selectivity and allocation from the mid 1990s (1994-1998) was applied, to mimic reference points under a targeted fishery scenario, the yield increased to 1,578 mt from a slightly smaller stock size (12,211 mt), but a similar rate of exploitation (SPR=52.5%). This is due to higher relative selection of older and larger fish when the fishery was targeting instead of avoiding canary rockfish. These values are appreciably higher than those from previous assessment models due primarily to the difference in steepness.

Exploitation status

The abundance of canary rockfish was estimated to have dropped below the $SB_{40\%}$ management target in 1981 and the overfished threshold in 1987. In hindsight, the spawning stock biomass passed through the target and threshold levels at a time when the annual catch was averaging more than twice the current estimate of the MSY. The stock remains below the rebuilding target, although the spawning stock biomass appears to have been increasing since 1999. The degree of increase is very sensitive to the value for steepness (state of nature), and is projected to slow as recent (and below average) recruitments begin to contribute to the spawning biomass. Fishing mortality rates in excess of the current F-target for rockfish of $SPR_{50\%}$ are

estimated to have begun in the late 1970s and persisted through 1999. Recent management actions appear to have curtailed the rate of removal such that overfishing has not occurred since 1999, and recent SPR values are in excess of 95%. Relative exploitation rates (catch/biomass of age-5 and older fish) are estimated to have been less than 1% since 2001. These patterns are largely insensitive to the three states of nature.

Table d. Recent trend in spawning potential ratio (SPR) and relative exploitation rate (catch/biomass of age-5 and older fish).

Year	Estimated SPR (%)	Range of states of nature	Relative exploitation rate	Range of states of nature
1997	31.6%	16.9-41.9	0.0889	0.0607-0.1652
1998	33.2%	16.8-44.3	0.0873	0.0576-0.1778
1999	48.9%	26.1-61.0	0.0506	0.0323-0.1146
2000	84.0%	65.7-89.7	0.0112	0.0070-0.0271
2001	89.7%	76.5-93.5	0.0067	0.0041-0.0165
2002	92.2%	81.9-95.1	0.0050	0.0031-0.0126
2003	95.4%	88.3-97.2	0.0023	0.0014-0.0058
2004	96.3%	90.6-97.8	0.0020	0.0012-0.0051
2005	96.3%	90.5-97.7	0.0021	0.0013-0.0055
2006	96.5%	90.7-97.9	0.0019	0.0011-0.0049

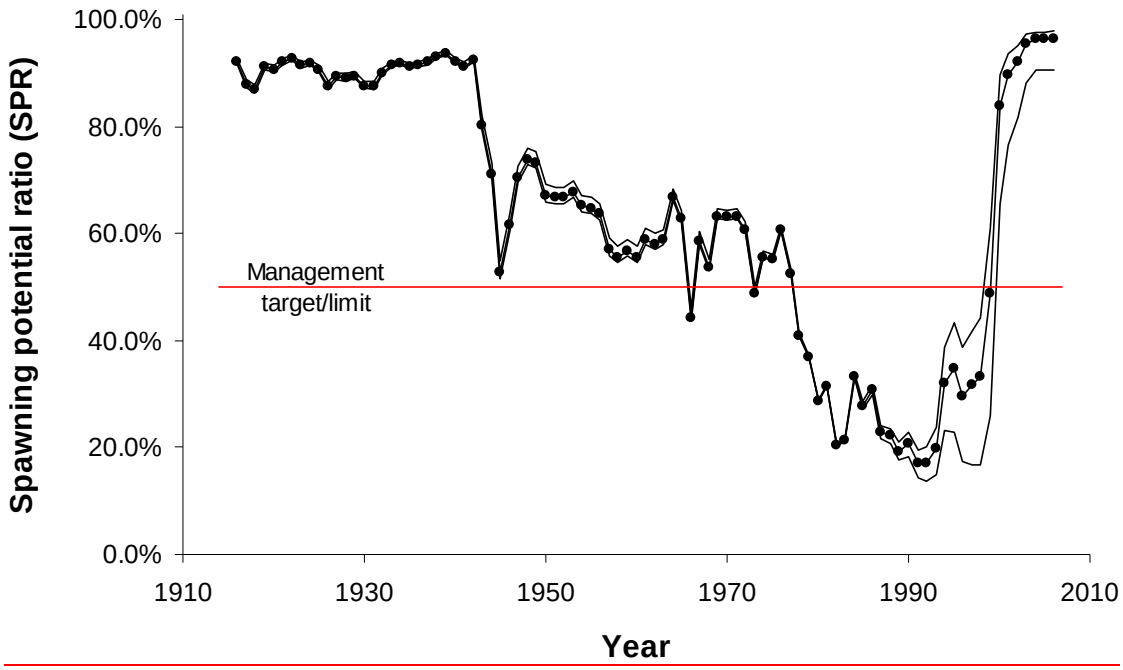


Figure e. Time series of estimated spawning potential ratio (SPR) for the base case model (round points) and alternate states of nature (light lines). Values of SPR below 0.5 reflect harvests in excess of the current overfishing proxy.

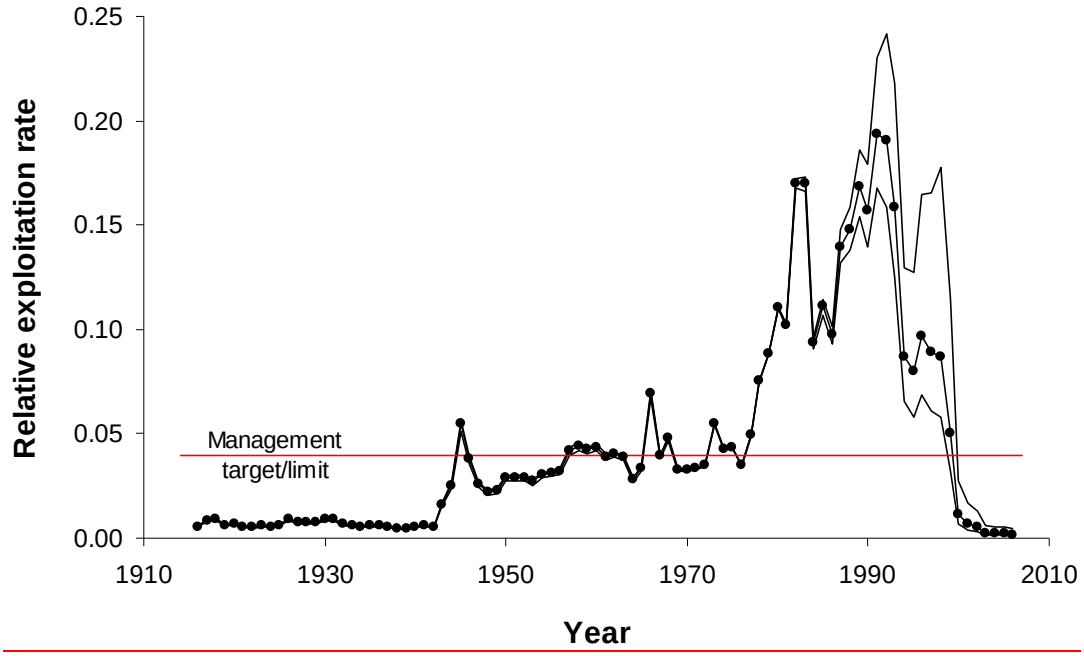


Figure f. Time series of estimated relative exploitation rate (catch/age 5 and older biomass, lower panel) for the base case model (round points) and alternate states of nature (light lines). Values of relative exploitation rate in excess of horizontal line are above the rate corresponding to the overfishing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

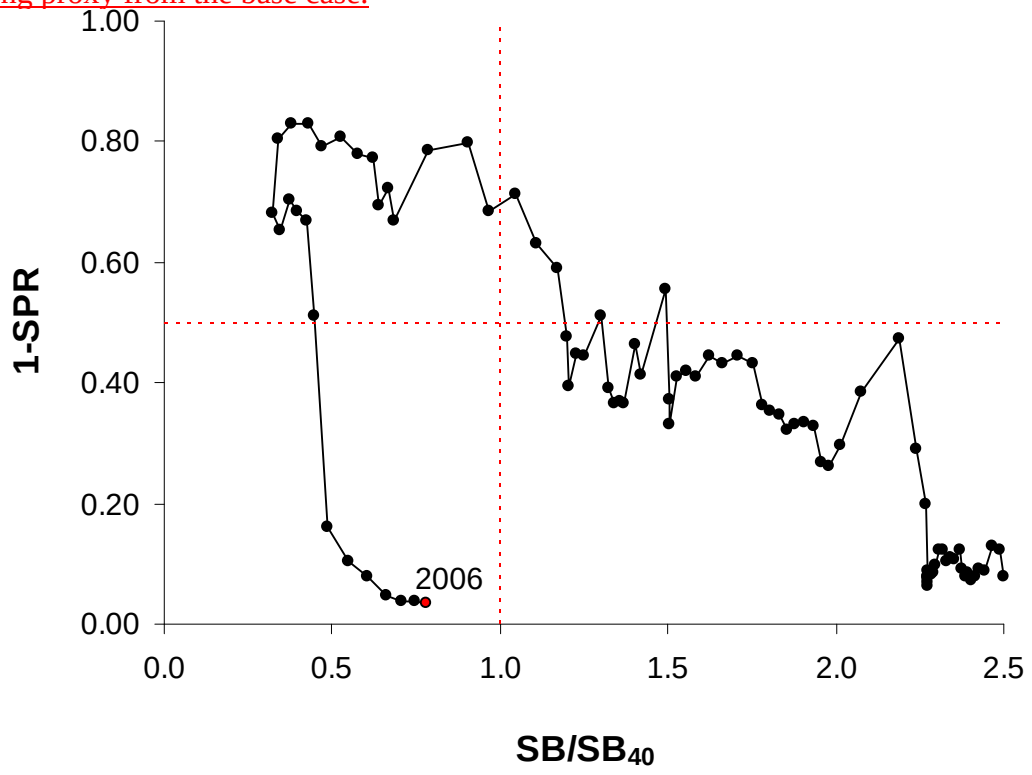


Figure g. Estimated spawning potential ratio relative to the proxy target of 50% vs. estimated spawning biomass relative to the proxy 40% level from the base case model. Higher biomass occurs on the right side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

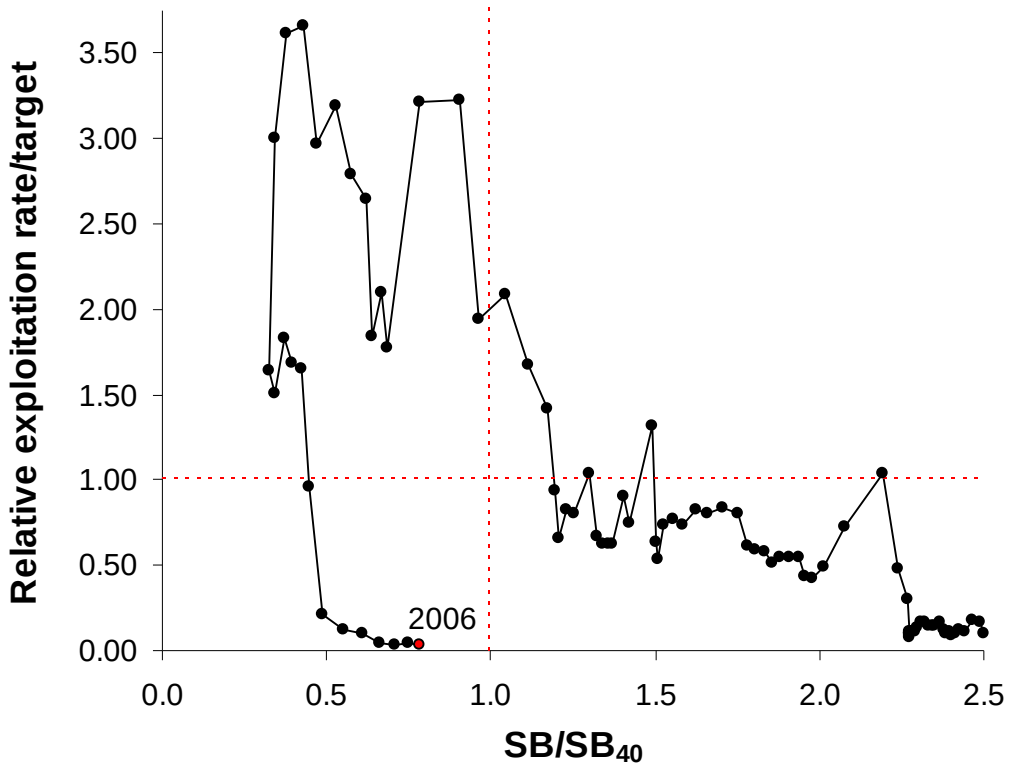


Figure g. Phase plot of estimated fishing intensity vs. relative spawning biomass for the base case model. Fishing intensity is the relative exploitation rate divided by the level corresponding to the overfishing proxy (0.040). Relative spawning biomass is annual spawner abundance divided by the 40% rebuilding target.

Management performance

Following the 1999 declaration that the canary rockfish stock was overfished the canary OY was reduced by over 70% in 2000 and by the same margin again over the next three years. Managers employed several tools in an effort to constrain catches to these dramatically lower targets. These included: reductions in trip/bag limits for canary and co-occuring species, the institution of spatial closures, and new gear restrictions intended to reduce trawling in rocky shelf habitats and the coincident catch of rockfish in shelf flatfish trawls. In recent years, the total mortality has been near the OY, but well below the ABC. Since the overfished determination in 1999, the total 7-year catch (644 mt) has been only 13% above the sum of the OYs for 2000-2006. This level of removals represents only 35% of the sum of the ABCs for that period. The total 2006 catch (47 mt) is <1% of the peak catch that occurred in the early 1980s.

Table e. Recent trend in estimated total canary rockfish catch and commercial landings (mt) relative to management guidelines.

Year	ABC (mt)	OY (mt)	Commercial landings (mt)[1]	Total Catch (mt)
1997	1,220[2]	1,000[2]	1,113.8	1,478.8
1998	1,045[2]	1,045[2]	1,182.4	1,494.2
1999	1,045[2]	857[2]	665.7	898.0
2000	287	200	60.6	208.4
2001	228	93	42.8	133.6
2002	228	93	48.6	106.8
2003	272	44	8.5	51.0
2004	256	47.3	10.7	46.5
2005	270	46.8	10.9	51.4
2006	279	47	8.2	47.1

[1]Excludes all at-sea whiting, recreational and research catches.
[2]Includes the Columbia and Vancouver INPFC areas only.

Unresolved problems and major uncertainties

Parameter uncertainty is explicitly captured in the asymptotic confidence intervals reported throughout this assessment for key parameters and management quantities. These intervals reflect the uncertainty in the model fit to the data sources included in the assessment, but do not include uncertainty associated with alternative model configurations, weighting of data sources (a combination of input sample sizes and relative weighting of likelihood components), or fixed parameters. Specifically, there appears to be conflicting information between the length- and age-frequency data regarding the degree of stock decline, making the model results sensitive to the relative weighting of each. This issue is explored in the assessment, but cannot be fully resolved at this time. The relationship between the degree of dome in the selectivity curves and the increase in female natural mortality with age remains a source of uncertainty that is included in model results, as it has been in previous assessments for canary rockfish. Uncertainty in the steepness parameter of the stock-recruitment relationship is significant and will likely persist in future assessments; this uncertainty is included in the assessment and rebuilding projections through explicit consideration of the three states of nature.
Forecasts

The forecast reported here will be replaced by the rebuilding analysis to be completed in September-October 2007 following SSC review of the stock assessment. In the interim, the total catch in 2007 and 2008 is set equal to the OY (44 mt). The exploitation rate for 2009 and beyond is based upon an SPR of 88.7%, which approximates the harvest level in the current rebuilding plan. Uncertainty in the rebuilding forecast will be based upon the three states of nature for steepness and random variability in future recruitment deviations for each rebuilding simulation. Current medium-term forecasts predict slow increases in abundance and available catch, with OY values for 2009 and 2010 increasing by nearly four times the value of 44 mt from the 2005 assessment. This is largely attributable to the revised perception of steepness, based on meta-analysis of other rockfish species. The following table shows the projection of expected canary rockfish catch, spawning biomass and depletion.

Table f. Projection of potential canary rockfish ABC, OY, spawning biomass and depletion for the base case model based on the SPR= 0.887 fishing mortality target used for the last rebuilding plan (OY) and $F_{50\%}$ overfishing limit/target (ABC). Assuming the OY of 44 mt is met in 2007 and 2008.

Year	ABC (mt)	OY (mt)	Age 5+ biomass (mt)	Spawning biomass (mt)	Depletion
2007	973	44	25,995	10,544	32.4%
2008	978	44	26,417	10,840	33.3%
2009	981	162	26,859	11,072	34.0%
2010	980	162	26,995	11,194	34.4%
2011	992	164	27,018	11,254	34.6%
2012	1,026	169	27,440	11,266	34.6%
2013	1,074	177	27,985	11,260	34.6%
2014	1,124	185	28,656	11,280	34.6%
2015	1,171	193	29,445	11,368	34.9%
2016	1,214	200	30,332	11,545	35.5%
2017	1,253	207	31,297	11,812	36.3%
2018	1,290	213	32,317	12,156	37.3%

Decision table

Because canary rockfish is currently managed under a rebuilding plan, this decision table is only intended to better compare and contrast the base case with uncertainty among states of nature. The results of the rebuilding plan will integrate these three states of nature as well as projected recruitment variability. Further, various alternate probabilities of rebuilding by target and limit time-periods as well as fishing mortality rates will be evaluated in the rebuilding analysis. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

Table g. Decision table of 12-year projections for alternate states of nature (columns) and management options (rows) beginning in 2009. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

			State of nature					
			Low steepness (0.35)		Base case (steepness = 0.51)		High steepness (0.72)	
	Relative probability		0.25		0.5		0.25	
Management decision	Year	Catch (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)
Rebuilding SPR 88.7% catches from low steepness state of nature	2009	56	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	56	12.0%	4,100	34.5%	11,236	60.1%	18,932
	2011	56	11.9%	4,078	34.8%	11,339	60.8%	19,156
	2012	59	11.8%	4,042	35.0%	11,396	61.2%	19,270
	2013	62	11.7%	4,003	35.1%	11,436	61.3%	19,313
	2014	65	11.6%	3,979	35.3%	11,502	61.4%	19,343
	2015	67	11.6%	3,984	35.7%	11,638	61.7%	19,423
	2016	70	11.7%	4,025	36.4%	11,866	62.2%	19,590
	2017	72	12.0%	4,102	37.4%	12,188	63.0%	19,852
	2018	74	12.3%	4,209	38.7%	12,591	64.1%	20,199
Rebuilding SPR 88.7% catches from base case	2009	162	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	162	11.8%	4,058	34.4%	11,194	60.0%	18,890
	2011	164	11.7%	3,994	34.6%	11,254	60.5%	19,069
	2012	169	11.4%	3,914	34.6%	11,266	60.8%	19,138
	2013	177	11.2%	3,831	34.6%	11,260	60.7%	19,135
	2014	185	11.0%	3,762	34.6%	11,280	60.7%	19,118
	2015	193	10.9%	3,719	34.9%	11,368	60.8%	19,150
	2016	200	10.8%	3,710	35.5%	11,545	61.2%	19,266
	2017	207	10.9%	3,733	36.3%	11,812	61.8%	19,475
	2018	213	11.0%	3,781	37.3%	12,156	62.8%	19,767
Rebuilding SPR 88.7% catches from high steepness state of nature	2009	273	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	271	11.7%	4,014	34.2%	11,150	59.8%	18,845
	2011	272	11.4%	3,905	34.3%	11,164	60.3%	18,978
	2012	277	11.0%	3,780	34.2%	11,130	60.3%	19,001
	2013	285	10.7%	3,654	34.0%	11,079	60.2%	18,951
	2014	293	10.3%	3,542	34.0%	11,055	60.0%	18,891
	2015	300	10.1%	3,459	34.1%	11,100	59.9%	18,880
	2016	307	9.9%	3,408	34.5%	11,235	60.2%	18,953
	2017	313	9.9%	3,389	35.2%	11,461	60.7%	19,122
	2018	319	9.9%	3,394	36.1%	11,763	61.5%	19,374
Status quo (catch = 44 mt)	2009	44	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	44	12.0%	4,104	34.5%	11,241	60.1%	18,937
	2011	44	11.9%	4,088	34.9%	11,349	60.8%	19,166
	2012	44	11.8%	4,057	35.0%	11,411	61.2%	19,285
	2013	44	11.7%	4,024	35.2%	11,456	61.4%	19,334
	2014	44	11.7%	4,005	35.4%	11,529	61.5%	19,371
	2015	44	11.7%	4,018	35.8%	11,673	61.8%	19,459
	2016	44	11.9%	4,069	36.6%	11,911	62.3%	19,635
	2017	44	12.1%	4,157	37.6%	12,244	63.2%	19,908
	2018	44	12.5%	4,277	38.9%	12,660	64.3%	20,268

Research and data needs

Progress on a number of research topics would substantially improve the ability of this assessment to reliably and precisely model canary rockfish population dynamics in the future and provide better monitoring of progress toward rebuilding:

1. Expanded Assessment Region: Given the high occurrence of canary rockfish close to the US-Canada border, a joint US-Canada assessment should be considered in the future.
2. Many assessments are deriving historical catch by applying various ratios to the total rockfish catch prior to the period when most species were delineated. A comprehensive historical catch reconstruction for all rockfish species is needed, to compile a best estimated catch series that accounts for all the catch and makes sense for the entire group.
3. Habitat relationships: The historical and current relationship between canary rockfish distribution and habitat features should be investigated to provide more precise estimates of abundance from the surveys, and to guide survey augmentations that could better track rebuilding through targeted application of newly developed survey technologies. Such studies could also assist determining the possibility of dome-shaped selectivity, aid in evaluation of spatial structure and the use of fleets to capture geographically-based patterns in stock characteristics.
4. Meta-population model: The spatial patterns show patchiness in the occurrence of large vs. small canary; reduced occurrence of large/old canary south of San Francisco; and concentrations of canary rockfish near the US-Canada border. The feasibility of a meta-population model that has linked regional sub-populations should be explored as a more accurate characterization of the coast-wide population's structure. Tagging of other direct information on adult movement will be essential to this effort.
5. Increased computational power and/or efficiency is required to move toward fully Bayesian approaches that may better integrate over both parameter and model uncertainty.
6. Additional exploration of surface ages from the late 1970s and inclusion into or comparison with the assessment model, or re-aging of the otoliths could improve the information regarding that time period when the stock underwent the most dramatic decline. Auxiliary biological data collected by ODFW from recreational catches and hook-and-line projects may also increase the performance of the assessment model in accurately estimating recent trends and stock size.
7. Due to inconsistencies between studies and scarcity of appropriate data, new data is needed on both the maturity and fecundity relationships for canary rockfish.
8. Re-evaluation of the pre-recruit index as a predictor of recent year class strength should be ongoing as future assessments generate a longer series of well-estimated recent recruitments to compare with the coast-wide survey index.
9. Meta-analysis or other summary of the degree of recruitment variability and the relative steepness for other rockfish and groundfish stocks should be ongoing, as this information is likely to be very important for model results (as it is here) in the foreseeable future.

Rebuilding projections

The rebuilding projections will be presented in a separate document after the assessment has been reviewed in September 2007.

Table h. Summary of recent trends in estimated canary rockfish exploitation and stock levels from the base case model; all values reported at the beginning of the year.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Commercial landings (mt)[1]	1,182.4	665.7	60.6	42.8	48.6	8.5	10.7	10.9	8.2	NA
Total catch (mt)	1,494.2	898.0	208.4	133.6	106.8	51.0	46.5	51.4	47.1	NA
ABC (mt)	1,045[2]	1,045[2]	287	228	228	272	256	270	279	172
OY	1,045[2]	857[2]	200	93	93	44	47.3	46.8	47.0	44
SPR	33.2%	48.9%	84.0%	89.7%	92.2%	95.4%	96.3%	96.3%	96.5%	NA
Exploitation rate (catch/age 5+ biomass)	0.0873	0.0506	0.0112	0.0067	0.0050	0.0023	0.0020	0.0021	0.0019	NA
Age 5+ biomass (mt)	17,125	17,733	18,659	20,078	21,275	22,333	23,583	24,402	25,317	25,995
Spawning biomass (mt)	5,499	5,826	6,364	7,149	7,910	8,603	9,226	9,749	10,183	10,544
~95% Confidence interval	4,177-6,820	4,296-7,357	4,618-8,111	5,190-9,109	5,750-10,070	6,264-10,942	6,736-11,715	7,140-12,359	7,482-12,884	7,776-13,312
Range of states of nature	2,761-8,241	2,610-9,073	2,644-10,144	2,918-11,477	3,184-12,779	3,417-13,985	3,628-15,076	3,795-16,019	3,918-16,825	4,009-17,519
Recruitment (1000s)	1,391	2,449	1,099	2,061	1,432	955	1,565	1,182	1,144	2,807
~95% Confidence interval	841-2,299	1,606-3,735	638-1,893	1,359-3,124	905-2,267	547-1,667	854-2,869	627-2,231	548-2,389	1,078-7,313
Range of states of nature	484-2,453	841-4,318	351-1,938	643-3,613	447-2,383	302-1,515	520-2,373	390-1,771	367-1,699	991-3,745
Depletion	16.9%	17.9%	19.5%	22.0%	24.3%	26.4%	28.3%	29.9%	31.3%	32.4%
~95% Confidence interval	NA	NA	NA	NA	NA	NA	NA	NA	23.1-9.4	24.1-40.7
Range of states of nature	8.1-26.2	7.6-28.8	7.7-32.2	8.5-36.4	9.3-40.6	10.0-44.4	10.6-47.9	11.1-50.9	11.4-53.4	11.7-55.6

[1]Excludes all at-sea whiting, recreational and research catches.
[2]Includes the Columbia and Vancouver INPFC areas only.

Table i. Summary of canary rockfish reference points from the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

Quantity	Estimate	~95% Confidence interval	Range of states of nature
Unfished spawning stock biomass (SB_0, mt)	32,561	30,594-34,528	34,262-31,498
Unfished 5+ biomass (mt)	86,036	NA	91,980-82,744
Unfished recruitment (R_0, thousands)	4,210	3,961-4,458	4,540-4,035
Reference points based on $SB_{40\%}$			
MSY Proxy Spawning Stock Biomass ($SB_{40\%}$)	13,024	12,237-13,811	12,599-13704.7
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	54.4%	54.4-54.4	45.8-68.5
Exploitation rate resulting in $SB_{40\%}$	0.0457	NA	0.0277-0.0600
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	1,574	1,477-1,672	996-2,034
Reference points based on SPR proxy for MSY			
Spawning Stock Biomass at SPR (SB_{SPR})(mt)	11,161	10,487-11,835	1,654-14,053
$SPR_{MSY\text{-}proxy}$	50.0%	NA	NA
Exploitation rate corresponding to SPR	0.0528	NA	0.0524-0.0539
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	1,572	1,476-1,668	238-1,962
Reference points based on estimated MSY values			
Spawning Stock Biomass at *MSY* (SB_{MSY}) (mt)	12,211	11,529-12,893	9,524-15,042
SPR_{MSY}	52.5%	52.1-52.8	37.0-70.5
Exploitation Rate corresponding to SPR_{MSY}	0.0487	NA	0.0254-0.0794
MSY (mt)	1,578	1,481-1,675	1,002-2,104

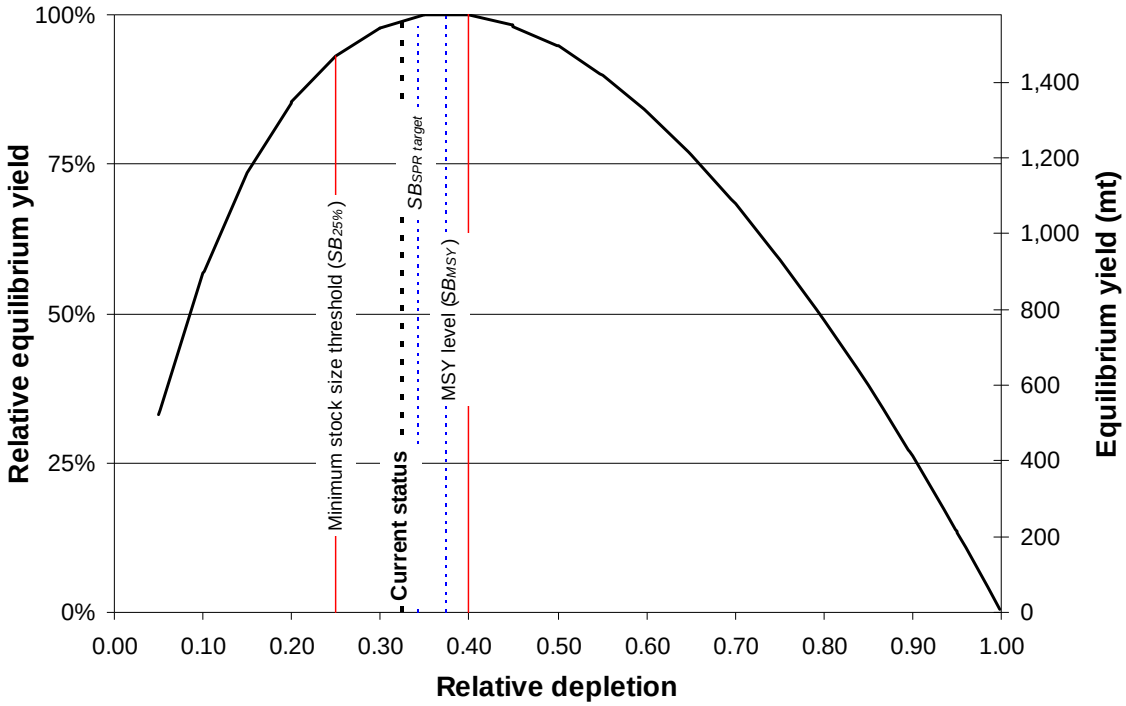


Figure h. Equilibrium yield curve (derived from reference point values reported in table i) for the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

~~Executive Summary~~

~~Stock~~

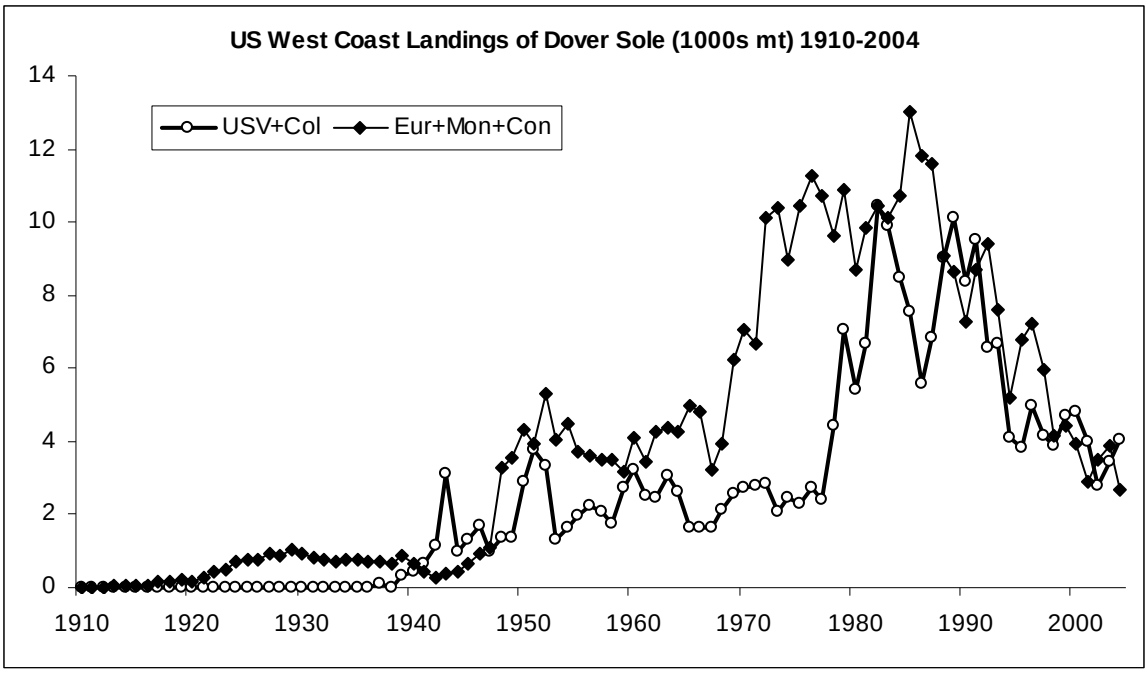
~~This assessment applies to the Dover sole (*Microstomus pacificus*) that reside in the waters off California, Oregon and Washington in the region bounded by the U.S. borders with Canada and Mexico. This assessment treats these fish as a unit stock. Dover sole are also harvested from the waters off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

~~Catches~~

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

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

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



~~Data and Assessment~~

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

~~Unresolved Problems and Major Uncertainties~~

~~Just before the STAR Panel review, when working up results from the preliminary base model runs with randomized starting parameter values, it became apparent that the likelihood surface was very irregular and that the model often converged to parameter estimates that were not the globally best estimates. During development of the model, while exploring alternative model configurations and fixed parameter values, problems with model convergence lead to the conclusion that small lambda values were needed on the likelihood components for the age composition and mean length-at-age observations. It appears that there are fundamental tensions among some of the different data sources that can be resolved in multiple ways, leading to numerous local extrema on the likelihood surface. After the STAR Panel review experiments were conducted using different sequences of phases in the SS2 control file and some phasing sequences produced much better model convergence. However, none of the sequences that were tried fully solved the problem of convergence to local minima on the negative log-likelihood surface. The size and sex distributions of Dover sole are highly variable by depth and between INPFC areas and have changed over time. It is difficult to determine whether these variations are due to differences in size-related discarding or to differences in selection, related either to gear or to depth of fishing. The size-discards and size-selection effects are confounded in the fishery size-composition data. Only a few observations are available for the size-distributions of discarded fish.~~

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

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

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

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

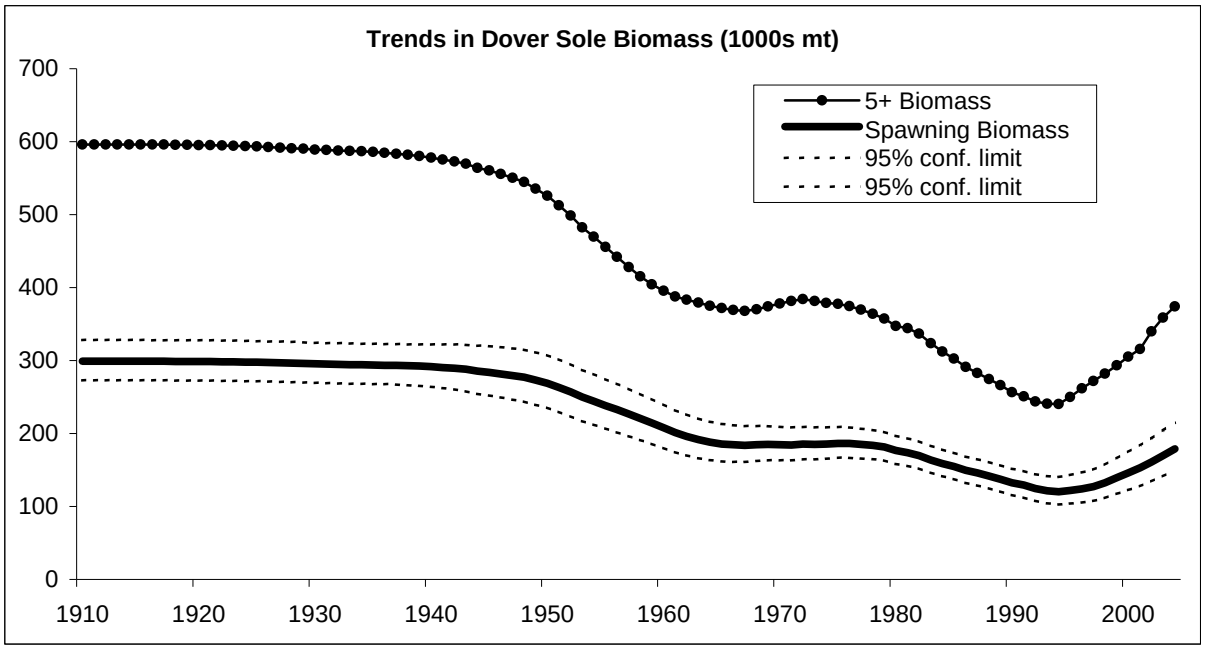
* Based on the current maturity schedule, which differs from the historic schedule.

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

Recent trends in Dover sole spawning biomass and depletion.

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004

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

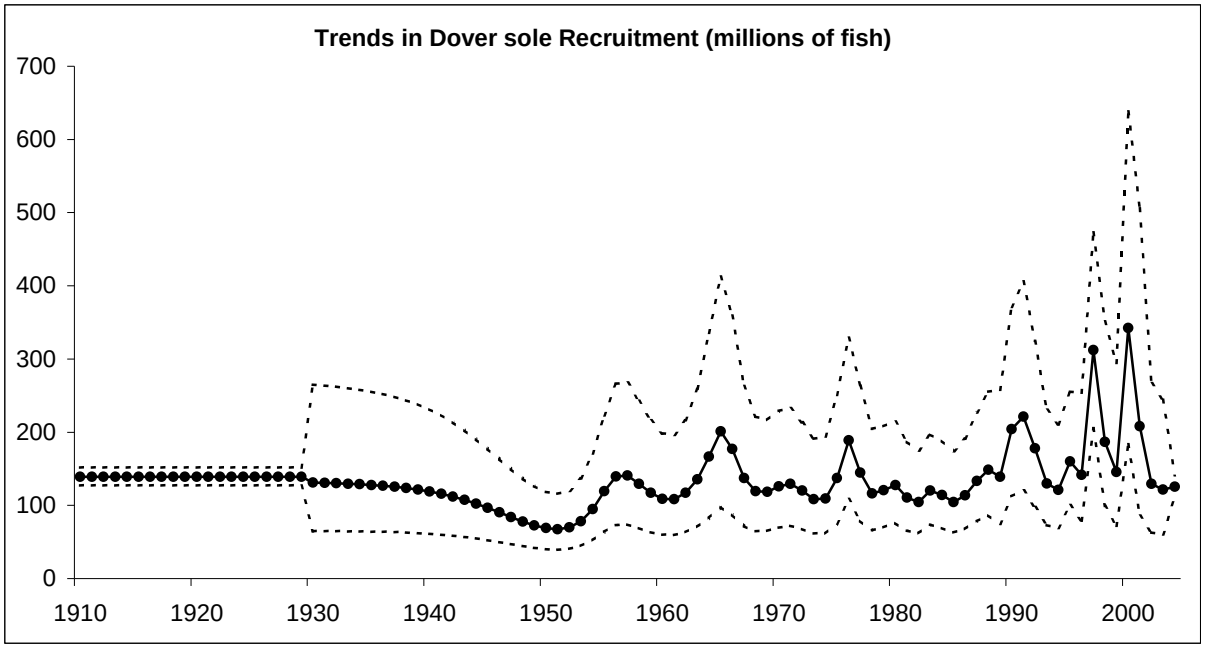


Recruitment

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

Recent trends in Dover sole recruitment.

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

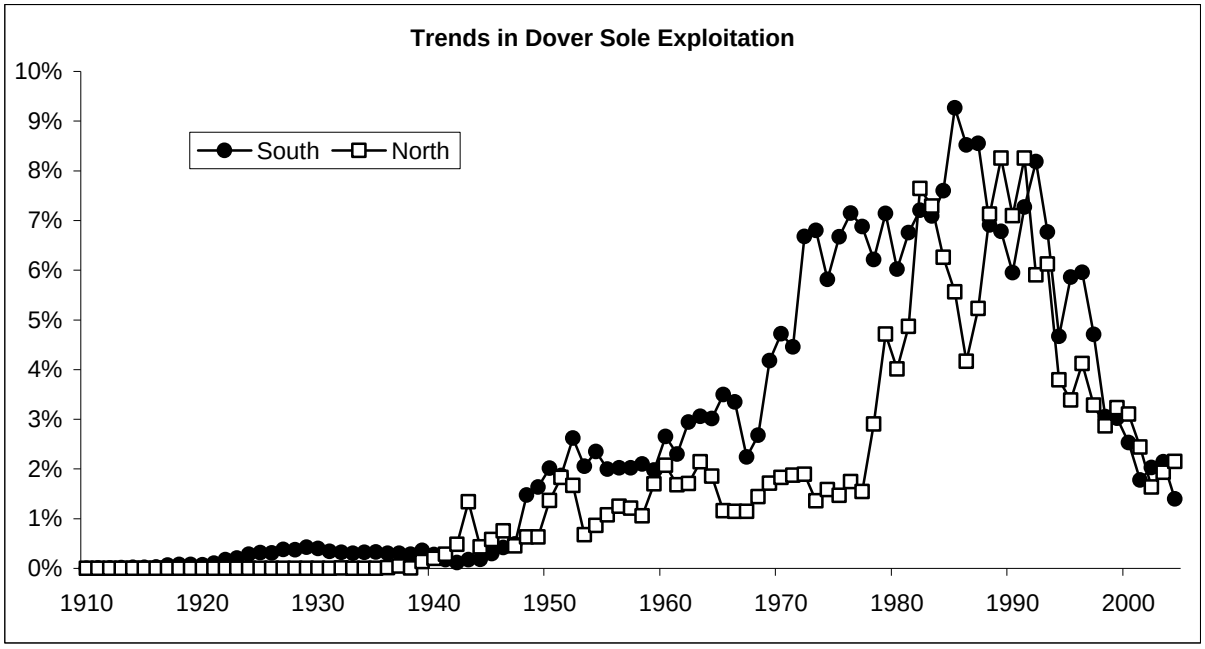


Exploitation Status

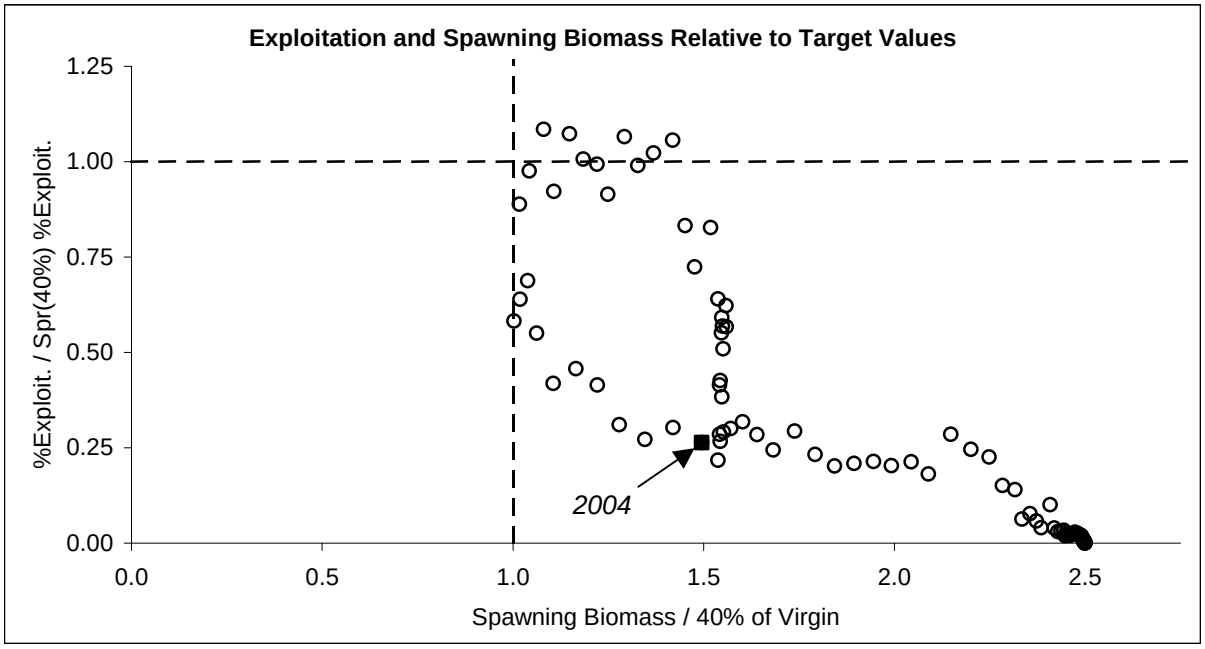
Exploitation of Dover sole was estimated to have reached a peak of 9.3% in 1985 in the southern fishery and a peak of 8.3% in 1991 in the northern fishery. In general, the exploitation rate has been relatively low.

Recent trends in Dover sole exploitation.

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



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



~~Management Performance~~

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

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

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

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

Forecasts

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

Forecasts of Optimum Yield catches, biomass, and depletion.

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

Decision Table

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

Decision Table for Dover sole

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

Research and Data Needs

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

Rebuilding Projections

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

Regional Management Concerns

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

Summary Tables for Dover Sole.

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

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

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

Appendix E: History of STAR process

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

~~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.~~