

GROUND FISH STOCK ASSESSMENT AND REVIEW PROCESS FOR 2007-2008

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Introduction

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

STAR Goals and Objectives

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

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

Shared Responsibilities

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

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

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 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 multi-year management regime has recently been adopted, which limits assessment activities to odd years only (e.g., 2007).

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 and/or necessary to do so.
4. The SSC encourages attempts to study previously un-assessed stocks, but recognizes that often such efforts will not produce a comprehensive understanding of population dynamics. Even so, updates or reports that fall short of a full assessment are still desirable; in order to summarize whatever information exists that may be useful to the Council in making management decisions.
5. Any stock assessment that is considered for use in management should be submitted through normal Council channels and reviewed at STAR Panel meetings.
6. The proposed stocks for assessment should be discussed by the Council at least a year in advance to allow sufficient time for assembly of relevant assessment data and for arrangement of STAR panels.

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.

STAR Panels include a chairman appointed from the SSC and at least two other members with experience gained from having conducted stock assessments on the U. S. west coast or elsewhere. The total number of STAR Panel members (including the chair) should be 3 unless extenuating circumstances such as a large number of stock assessments scheduled for review at the STAR Panel dictate more reviewers. 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 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. 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 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.

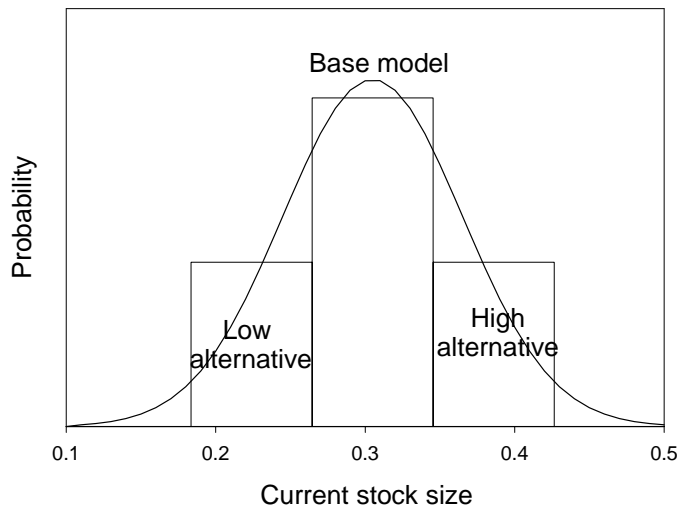


Figure 1. Example of assigning probabilities to alternative models using uncertainty in the estimate of current stock size.

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

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

STAT Teams and STAR Panels are likely to disagree on certain technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may also request additional analysis based on an alternative approach. However, the STAR Panel's primary duty is to conduct a peer review of the assessment that is presented. In the course of this review, the Panel may ask for a reasonable number of sensitivity runs, additional details of existing assessments, or similar items from the STAT team. However, the STAR Panel is not authorized to conduct an alternative assessment representing its own views

that are distinct from those of the STAT Team, nor can it impose an alternative assessment on the Team. Rather, if the Panel finds that an assessment is inadequate, it should document and report that opinion and, in addition, suggest remedial measures that could be taken by the STAT team to rectify whatever perceived shortcomings may exist. Where fundamental differences of opinion remain between the STAR Panel and STAT Team, which cannot be resolved by mutual discussion, the SSC will review the dispute and will issue its own recommendation.

The STAR Panel chair is expected to attend GMT and Council meetings where stock assessments and harvest projections are discussed to explain the reviews and provide other technical information and advice. The chair is responsible for providing the Stock Assessment Coordinator and Council staff with a 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 STAR 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 Team 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 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, and GMT and GAP representatives at least two weeks prior to the STAR Panel meeting.

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

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
- Base-run results (largely tabular and graphical)
- Uncertainty analysis, including retrospective analysis, decision table, etc.
- 10 year harvest projections under the default harvest policy

Review Panel Report

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

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

Appendix A: 2007-2008 Stock Assessment Review Calendar

2007 Groundfish STAR Panel Schedule

| Review Panel | Species | Review Panel Location | Review Panel Dates | Council Approval Dates | Lead Assessment Authors |
|-------------------------|-----------------------|-----------------------|--------------------|------------------------|--------------------------------|
| US-Canadian Joint Panel | Pacific hake | Seattle, WA | Feb. 5-9 | Mar. 5-9 | Tom Helser & Steve Martell |
| STAR Panel #1 | sablefish | Newport, OR | May 7-11 | June 11-15 | Michael Schirripa |
| | skates | | | | Vlada Gertseva |
| STAR Panel #2 | black rockfish (N/S) | Portland, OR | May 21-25 | Sept. 10-14 | David Sampson & Farron Wallace |
| | blue rockfish | | | | Meisha Key |
| STAR Panel #3 | bocaccio | Santa Cruz, CA | June 25-29 | Sept. 10-14 | Alec MacCall & Steve Ralston |
| | chilipepper rockfish | | | | John Field |
| STAR Panel #4 | darkblotched rockfish | Seattle, WA | July 16-20 | Sept. 10-14 | Owen Hamel |
| STAR Panel #5 | canary rockfish | Seattle, WA | July 30-Aug 3 | Sept. 10-14 | Ian Stewart |
| | arrowtooth flounder | | | | Isaac Kaplan & Tom Helser |
| Mop-Up Panel | if needed | Seattle, WA | Oct. 1-5 | Nov. 5-9 | |

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 \times year \times 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. Rebuilding analyses

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.
 2. Information presented should include biomass and yield projections of ABC and OY for ten years into the future, beginning with the first year for which management action could be based upon the assessment.
- H. Regional management considerations.
1. Discuss whether a regional management approach make sense for the species from a biological perspective.
 2. If there are insufficient data to analyze a regional management approach, what are the research and data needs to answer this question?
- I. 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

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

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

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

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

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

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

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

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

Summary Table: as detailed in the attached spreadsheet

Appendix D: Example a Complete Stock Assessment Executive Summary

EXECUTIVE SUMMARY

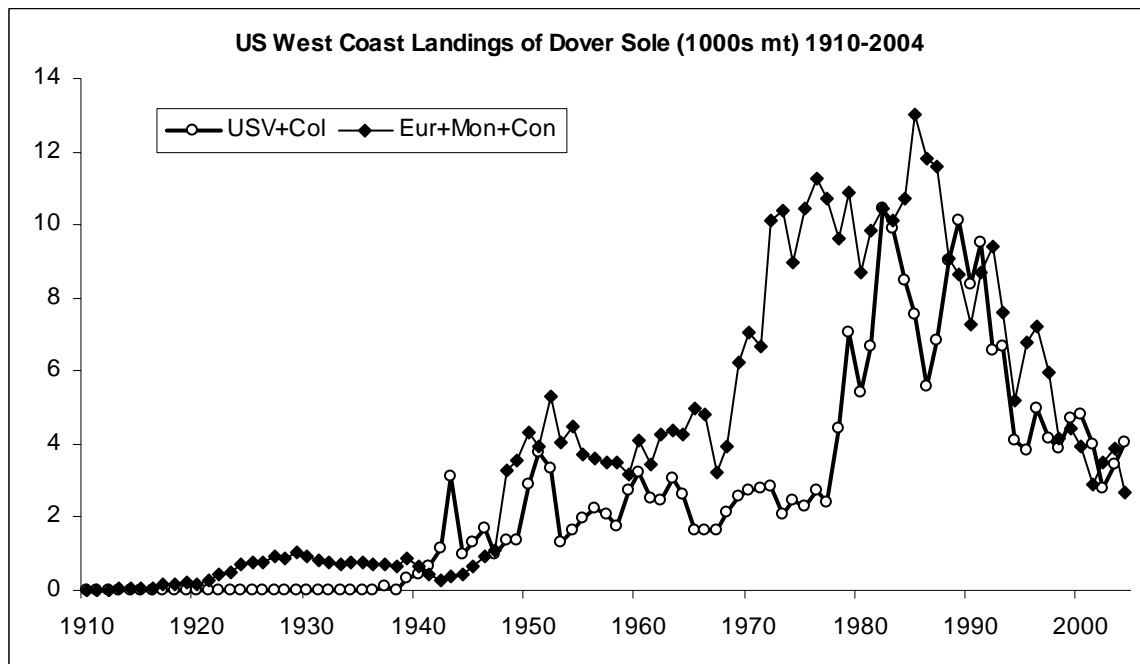
Stock

This assessment 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.

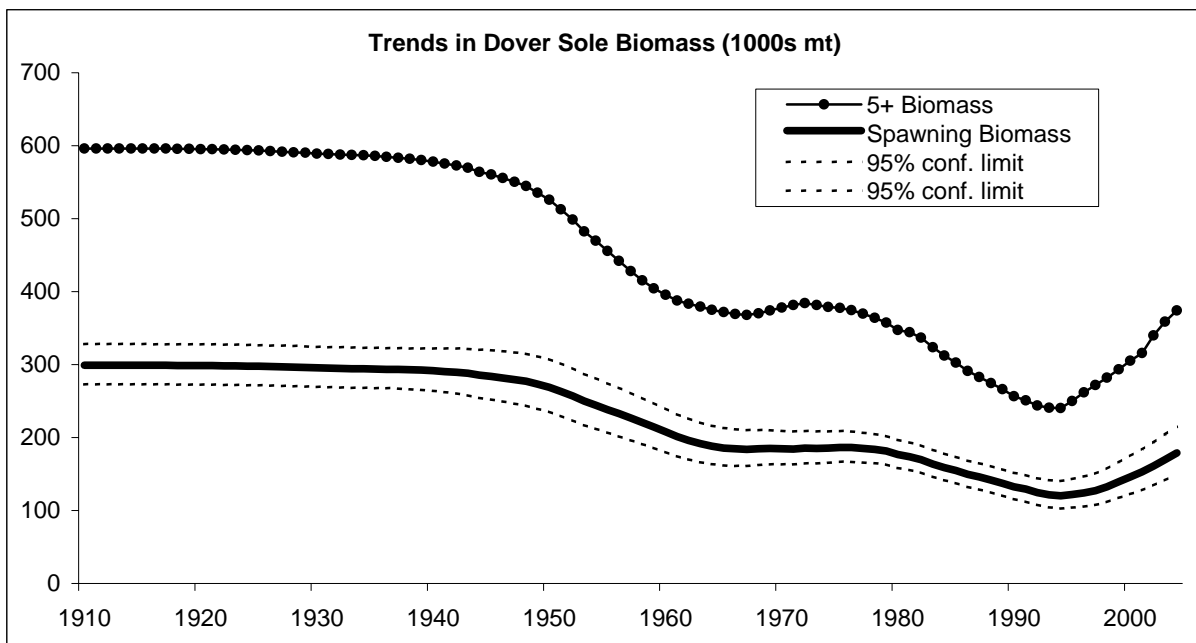
| Reference Points | Value | Units |
|----------------------------|---------|------------|
| Unfished Stock | | |
| Spawning Biomass, SB(0) | 299,054 | mt |
| Spawning Biomass / Recruit | 2.15 | kg / fish |
| Annual Recruitment | 138,970 | 1000s fish |
| F40% Proxy for MSY * | | |
| Spawning Biomass / 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.

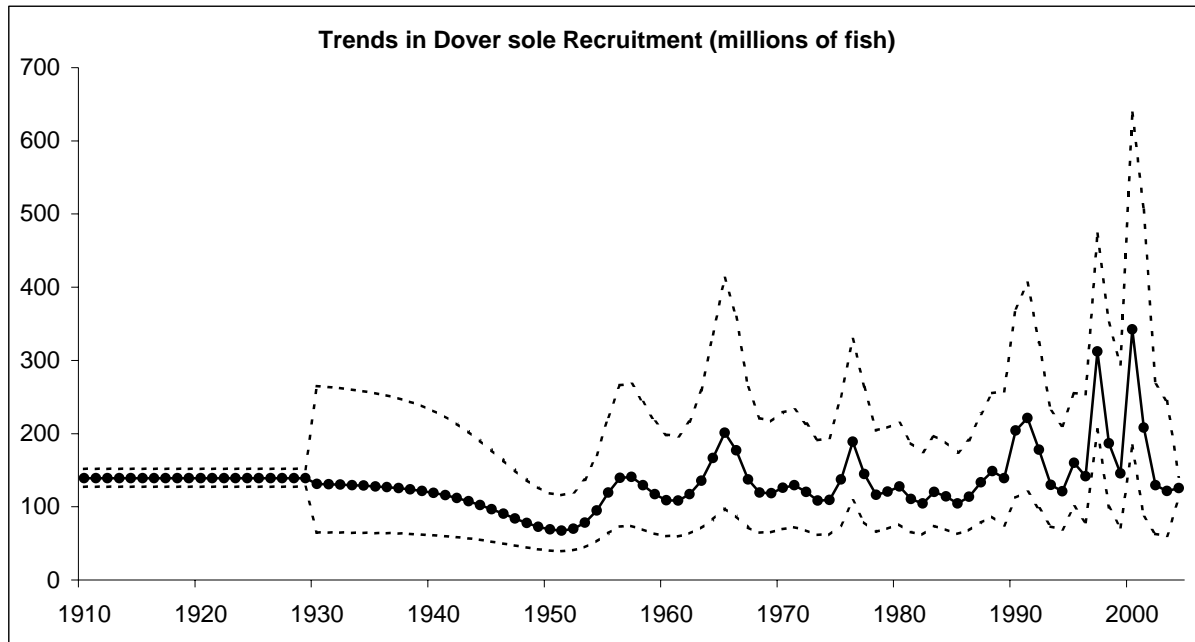
| Recent trends in Dover sole spawning biomass and depletion. | | | | | | | | | | |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
| Spawning Biomass (1000s mt) | 121.8 | 124.3 | 127.1 | 132.3 | 139.4 | 146.1 | 153.1 | 161.0 | 169.8 | 178.8 |
| % of Virgin Age 5+ Biomass | 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.

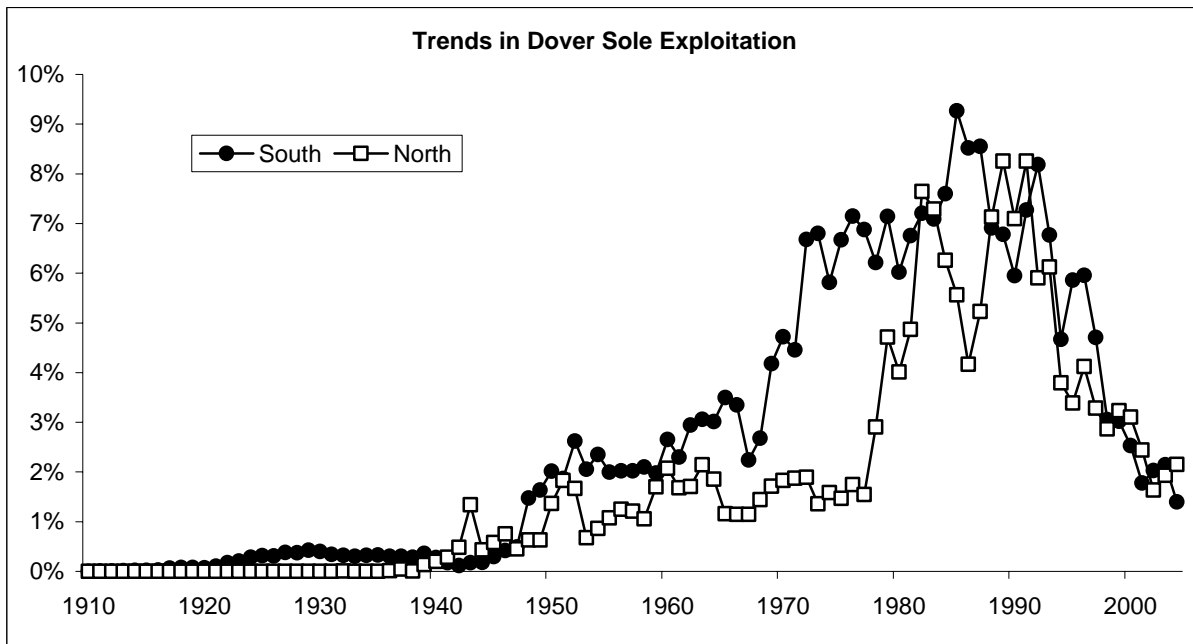
| Recent trends in Dover sole recruitment. | | | | | | | | | | |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
| Recruits (millions) | 159.9 | 141.6 | 312.0 | 186.6 | 145.6 | 342.5 | 208.1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



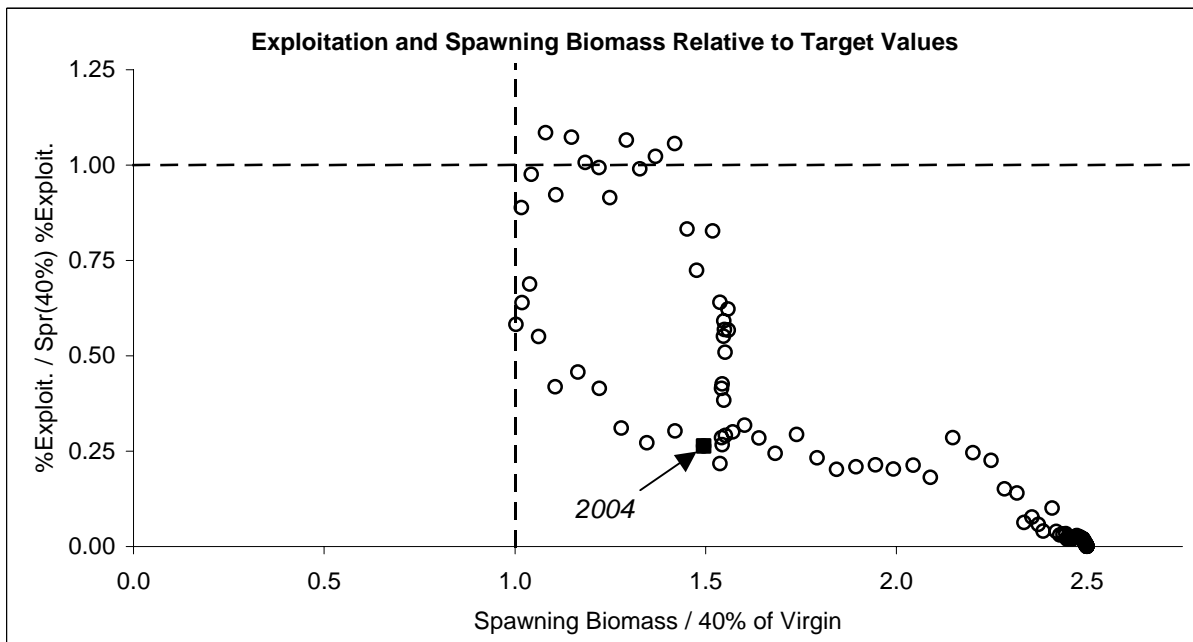
Exploitation Status

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

| <i>Management Action</i> | | Landings (mt) South (47.2%) North (52.8%) | | <i>State of Nature</i> | | | | | | |
|----------------------------|---|--|-------|--|-------|--|-------|---|-------|-------|
| | | | | M = 0.07 <i>Less likely</i> <u>Low Stock Size</u> | | M = 0.09 <i>More likely</i> <u>Base Model</u> | | M = 0.11 <i>Less likely</i> <u>High Stock Size</u> | | |
| | | | | Sp. Bio. (1000s mt) % Virgin | | Sp. Bio. (1000s mt) % Virgin | | Sp. Bio. (1000s mt) % Virgin | | |
| Year | | | | | | | | | | |
| <u>Low Catch</u> | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% | |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% | |
| | 2007 | 3402 | 3811 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% | |
| | 2008 | 3402 | 3811 | 181.6 | 59.9% | 222.7 | 74.5% | 291.5 | 87.7% | |
| | 2009 | 3402 | 3811 | 190.7 | 62.9% | 233.0 | 77.9% | 303.4 | 91.3% | |
| | 2000-2004 Average | 2010 | 3402 | 3811 | 198.7 | 65.6% | 241.8 | 80.9% | 313.2 | 94.2% |
| | 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% | | |
| <u>Medium Catch</u> | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% | |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% | |
| | 2007 | 6803 | 7623 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% | |
| | 2008 | 6803 | 7623 | 177.7 | 58.6% | 218.8 | 73.2% | 287.8 | 86.5% | |
| | 2009 | 6803 | 7623 | 182.7 | 60.3% | 225.2 | 75.3% | 295.8 | 88.9% | |
| | Double the 2000-2004 Average | 2010 | 6803 | 7623 | 186.4 | 61.5% | 229.9 | 76.9% | 301.6 | 90.7% |
| | 2011 | 6803 | 7623 | 188.6 | 62.2% | 232.7 | 77.8% | 305.0 | 91.7% | |
| | 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% | | |
| <u>High Catch</u> | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% | |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% | |
| | 2007 | 13572 | 14950 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% | |
| | 2008 | 13529 | 14913 | 170.1 | 56.1% | 211.4 | 70.7% | 280.4 | 84.3% | |
| | 2009 | 13353 | 14716 | 167.1 | 55.2% | 210.0 | 70.2% | 280.8 | 84.5% | |
| | OY for F40% Including any 40:10 Adjustment | 2010 | 13009 | 14318 | 162.6 | 53.7% | 206.8 | 69.2% | 279.2 | 84.0% |
| | 2011 | 12523 | 13759 | 156.8 | 51.7% | 202.2 | 67.6% | 275.7 | 82.9% | |
| | 2012 | 11959 | 13120 | 150.1 | 49.5% | 196.5 | 65.7% | 270.7 | 81.4% | |
| | 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 “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.

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

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

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

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 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

⁴Jacobson, 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).

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.