

TERMS OF REFERENCE FOR GROUND FISH REBUILDING PLAN REVIEW
AND STOCK ASSESSMENT REVIEW PANELS

The Council has annually considered updates to the Scientific and Statical Committee's (SSC's) Terms of Reference for developing and reviewing groundfish stock assessments. Now, with the multi-year management process in place, stock assessments will be conducted every other year. In 2005, 22 groundfish stock assessments are planned, which will require a significant overhaul of the Terms of Reference for the Groundfish Stock Assessment and Review (STAR) Process (Agendum C.8.b, Attachment 1). Additionally, the Groundfish Management Team and the National Marine Fisheries Service Northwest Regional staff have requested complete estimation and reporting of all necessary management parameters and reference points in groundfish stock assessments. The SSC Groundfish Subcommittee has begun considering modifications to the Terms of Reference for the Groundfish STAR Process. The Council should consider recommended changes to this Terms of Reference and provide guidance to the SSC for finalizing this document.

The SSC's Terms of Reference for Groundfish Rebuilding Analyses was developed by the SSC in 2001 and adopted by the Council in April 2001 (Agendum C.8.b, Attachment 2). This Terms of Reference has guided authors of groundfish rebuilding analyses, which are critical for developing rebuilding plans for overfished groundfish stocks. Groundfish Fishery Management Plan Amendment 16-1, which set the process and standards by which the Council specifies rebuilding plans for overfished groundfish stocks, provided for the development of species-specific standards for determining when progress has been adequate for each rebuilding plan. The SSC, other advisors, and the Council should consider modifications to the SSC Terms of Reference for Groundfish Rebuilding Analyses to incorporate species-specific standards for rebuilding plan reviews. The Council task is to provide guidance to the SSC for finalizing this Terms of Reference.

Both Terms of Reference are scheduled for final Council adoption at the November 2004 meeting. Council guidance at this meeting will be an important step in developing complete Terms of Reference which will guide the development of scientific elements necessary for accomplishing Council groundfish management objectives.

Council Task:

- 1. Provide guidance on finalizing the Groundfish Stock Assessment and Review Process Terms of Reference.**
- 2. Provide guidance on finalizing the SSC Terms of Reference for Groundfish Rebuilding Analyses.**

Reference Materials:

1. Agendum C.8.b, Attachment 1: Groundfish Stock Assessment and Review Process for 2005-2006.
2. Agendum C.8.b, Attachment 2: SSC Terms of Reference for Groundfish Rebuilding Analyses.
3. Agendum C.8.d, Public Comment.

Agenda Order:

- a. Agendum Overview
- b. Scientific and Statistical Committee Report
- c. Reports and Comments of Advisory Bodies
- d. Public Comment
- e. Council Guidance on Finalizing Terms of Reference

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GROUND FISH STOCK ASSESSMENT AND REVIEW PROCESS FOR 2005-2006

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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), Groundfish Management Team (GMT), 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 process[†] are:

- 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

[†] 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 Teams) and STAR Panels, and make sure that work is carried out in a timely fashion according to the calendar and terms of reference. NMFS will provide a senior scientist to coordinate these tasks with assistance from Council staff. To initiate the assessment cycle, NMFS will convene data and modeling workshops so that STAT teams and interested parties (e.g., the GMT) can discuss upcoming stock assessments, external reviews, data sources, and modeling approaches. To promote consistency, representatives from each STAT team are expected to attend both the data and modeling workshops.

The Stock Assessment coordinator, in consultation with the SSC, will select STAR Panel chairs, and will coordinate the selection of external reviewers following criteria for reviewer qualifications, nomination, and selection. The public is welcome to nominate qualified reviewers. Following any modifications to the stock assessments resulting from STAR panel reviews and prior to distribution of the stock assessment documents and STAR panel reports to GMT, the coordinator will review the stock assessments and panel reports for consistency with the terms of reference, especially completeness of the stock assessment Executive Summary. Inconsistencies will be identified and the authors requested to make appropriate revisions in time for the GMT meeting at which ABC and OY recommendations are developed.

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

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 representative(s) of the GMT will serve as a liaison to each STAR Panel, but will not serve as a member of the Panel. 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 participate in review discussions as an advisor to the STAR Panel, in the same capacity as the GMT advisor.

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

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

SSC Responsibilities

The Scientific and Statistical Committee (SSC) will participate in the stock assessment review process and provide the GMT and Council with technical advice related to the stock assessments and the review process. The SSC will assign one member from its Groundfish Subcommittee to each STAR Panel. This member is expected to attend the assigned STAR Panel meeting, the GMT meeting at which ABC recommendations are made, and the Council meetings when groundfish stock assessment agenda items are discussed (see calendar in Appendix A). The SSC representative on the STAR Panel will present the STAR Panel report at GMT, SSC, and at Council meetings. The SSC representative will communicate SSC comments or questions to the GMT and STAR Panel chair. It is the SSC's responsibility to review and endorse any additional analytical work requested by the GMT after the stock assessments have been reviewed by the STAR Panels. In addition, the SSC will review and advise the GMT and Council on projected ABCs and OYs.

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

Council Staff Responsibilities

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

Stock Assessment Priorities

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

assessment activities to odd years only (e.g., 2005). Nonetheless, for the upcoming assessment cycle an ambitious list of 23 stocks will be evaluated, including at least five species that have never been assessed.

In establishing stock assessment priorities an 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.
3. ~~Generally, no more than 2 assessments will be reviewed by a STAR Panel when these assessments involve new types of data or assessment methods.~~ (THIS POINT OF REVISION IS OF CONCERN TO SOME MEMBERS OF THE SSC. HOWEVER THE SCHEDULE FOR 2005 ALREADY HAS STAR PANELS ASSIGNED WITH UP TO 4 STOCK ASSESSMENTS. THE SSC WILL NEED TO ARRIVE AT A CONSENSUS ON THIS ISSUE)
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 responsibility of the STAR Panel is to carry out these terms of reference according to the calendar for groundfish assessments. Most groundfish stocks are assessed infrequently and each assessment and review should result in useful advice to the Council. The STAR Panel's work includes:

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

STAR Panels normally include a chairman, at least one "external" member (i.e., outside of the Council family and not involved in management or assessment of West Coast groundfish), and one SSC member. The total number of STAR members should be at least "n+2" where n is the number of stock assessments and "2" counts the chair and external reviewer. In addition to Panel members, STAR meetings will include GMT and GAP advisory representatives with responsibilities laid out in their terms of reference. STAR Panels normally meet for one week. (DISCUSSION POINT: IS THE "N+2" RULE STILL DESIRABLE?)

~~The number of assessments reviewed per Panel should not exceed two. (SEE ITEM #3 ABOVE)~~

The STAR Panel is responsible for determining if a stock assessment document is sufficiently complete according to Appendix B: Outline for Groundfish Stock Assessments. It is the Panel's responsibility to identify assessments that cannot be reviewed or completed for any reason. The Panel's decision that an assessment is complete should be made by consensus. If a Panel cannot reach agreement, then the nature of the disagreement must be described in the Panel's report.

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 a full assessment 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 implausible 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 some of these implausible results may need to be reported in the STAT Team document in order 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, natural mortality rate, survey catchability, year-class strength, etc.).

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. Bracketing of assessment results could be accomplished in a variety of ways, including ambiguity in the data, statistical precision, or model specification uncertainty, but as a matter of practice the STAR Panel should strive to identify a single preferred model when possible, so that averaging of extremes doesn't become the *de facto* choice of management.

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 analysis. 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.

(DISCUSSION POINT: HOW DO WE HANDLE PROGRESS TOWARDS REBUILDING?)

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

STAT Teams and STAR Panels are likely to disagree on certain technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may also request additional analysis based on an alternative approach. However, the STAR Panel's primary duty is to conduct a peer review of the assessment that is presented. In the course of this review, the Panel may ask for a reasonable number of sensitivity runs, additional details of existing assessments, or similar items from the STAT team. However, the STAR Panel is not authorized to conduct an alternative assessment representing its own views that are distinct from those of the STAT Team, nor can it impose an alternative assessment on the Team. Rather, if the Panel finds that an assessment is inadequate, it should document and report that opinion and, in addition, suggest remedial measures that could be taken by the STAT team to rectify whatever perceived shortcomings may exist. Where fundamental differences of opinion remain between the STAR Panel and STAT Team, which cannot be resolved by mutual discussion, the SSC will review the dispute and will issue its own recommendation.

The SSC representative on the STAR Panel 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 Council staff with a camera ready and suitable electronic version of the Panel's report for inclusion in the annual SAFE report.

Suggested Template for STAR Panel Report

1. Minutes of the STAR Panel meeting containing
 - A. Name and affiliation of STAR Panel members; and
 - B. List of analyses requested by the STAR Panel.
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 (majority and minority reports), 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. Prioritized recommendations for future research and data collection

Terms of Reference for Groundfish STAT Teams

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

Each STAT Team will appoint a representative who will attend any data and modeling workshops. STAT Teams are encouraged to also organize independent meetings with industry and interested parties to discuss issues, questions, and data.

Each STAT Team will appoint a representative to coordinate work with the STAR Panel and attend the STAR Panel meeting.

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

The STAT Team is responsible for preparing three versions of the stock assessment document: 1) a “draft” for discussion at the stock assessment review meeting; 2) a revised “complete draft” for distribution to the GMT, SSC, GAP, and Council for discussions about preliminary ABC and OY levels; 3) a “final” version published in the SAFE report. Other than authorized changes, only editorial and other minor changes should be made between the “complete draft” and “final” versions. The STAT Team will distribute “draft” assessment documents to the STAR Panel, Council, and GMT and GAP representatives at least two weeks prior to the STAR Panel meeting. (DISCUSSION POINT: WILL 2 WEEKS BE SUFFICIENT IF A PANEL REVIEWS 3-4 ASSESSMENTS?)

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 is responsible for producing a complete draft of the assessment by the end of the STAR Panel meeting. In the event that a complete draft is not completed, the Team is responsible for completing the work to the satisfaction of the STAR Panel as soon as possible, but within at least one week before the GMT meets to discuss the results of the assessment.

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, reviewed, and commented on by the SSC.

For stocks which 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 Analyses². It is recommended that this analysis be conducted using the rebuilding software developed by Dr. Andre Punt (aepunt@u.washington.edu). However, authors are also encouraged to present alternative approaches (where appropriate), along with clear justification for why the alternative may be an improvement over the approach described in the SSC’s Terms of Reference. The STAT Team is also responsible for preparing a document that summarizes the results of the rebuilding analysis. .

Electronic versions of final assessment documents, rebuilding analyses, parameter files, data files, and key output files will be sent to the Stock Assessment Coordinator for inclusion in a stock assessment archive.

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

Appendix A: 2005-2006 Stock Assessment Review Calendar

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

Appendix B: Outline for Groundfish Stock Assessment Documents

This is an outline of items that should be included in stock assessment reports for groundfish managed by the Pacific Fishery Management Council. The outline is a working document meant to provide assessment authors with flexible guidelines about how to organize and communicate their work. All items listed in the outline may not be appropriate or available for each assessment. In the interest of clarity and uniformity of presentation, stock assessment authors and reviewers are encouraged (but not required) to use the same organization and section names as in the outline. It is important that time trends of catch, abundance, harvest rates, recruitment and other key quantities be presented in tabular form to facilitate full understanding and followup 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, stock structure, management units
 2. Important features of life history that affect management (e.g., migration, sexual dimorphism, bathymetric demography)
 3. Important features of current fishery and relevant history of fishery
 4. Management history (e.g., changes in mesh sizes, trip limits, optimum yields)
 5. 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.
 - 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.
 2. History of modeling approaches used for this stock – changes between current and previous assessment models
 3. Model description
 - a. Complete description of any new modeling approaches.
 - b. Assessment program with last revision date (i.e., date executable program file was compiled).
 - c. List and description of all likelihood components in the model.
 - d. Constraints on parameters, selectivity assumptions, natural mortality, assumed level of age reader agreement or assumed ageing error (if applicable), and other assumed parameters.
 - e. Description of stock-recruitment constraints or components.
 - f. 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.).
 - g. Critical assumptions and consequences of assumption failures.
 4. Model selection and evaluation
 - a. Evidence of search for balance between model realism and parsimony.
 - b. Use nested models where possible (e.g.; asymptotic vs. domed selectivities, constant vs. time varying selectivities).
 - c. Do parameter estimates make sense, are they credible?
 - d. Residual analysis (e.g.; residual plots, time series plots of observed and predicted values, or other approach).
 - e. Convergence status and convergence criteria for the base-run model.
 - f. Randomization run results or other evidence of search for global best estimates.

5. Base-run(s) results
 - a. Table listing all 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.
 - c. Time-series of total 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.
6. 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, Bayesian approaches, or MCMC).
 - b. Sensitivity to data set choice and weighting schemes (e.g., emphasis or λ factors), which may also include a consideration of recent patterns in recruitment.
 - c. Sensitivity to assumptions about model structure, i.e., model specification uncertainty.
 - d. Retrospective analysis.
 - e. Historical analysis (plot of actual estimates from current and previous assessments).
 - f. Decision table analysis.
 - g. Subjective appraisal of the magnitude and sources of uncertainty.
 - h. If a range of model runs is used to characterize uncertainty it is important to provide some qualitative or quantitative information about relative probability of each.
 - i. 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 parameters –
 1. Determine B_0 as the product of spawners per recruit (SPR) in unfished state multiplied by the average recruitment expected while the stock is unfished. This typically is estimated as the average recruitment during early years of fishery. According to the 1999 SAFE report (PFMC 1999, p. 24)³, 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)
- g. Harvest projections and decision tables

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

- a. 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.
 - b. 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.
8. Research needs (prioritized).
 9. 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.
 10. Literature cited.
 11. Complete parameter and data in the native code of the stock assessment.

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Appendix C: Template for Executive Summary Prepared by STAT Teams

Stock: species/area

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 table for last 10 years and graph with long term estimates.

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 forecasts of catch, biomass, and depletion

Decision table:

Research and data needs:

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

Appendix D: Example a Complete Stock Assessment Executive Summary

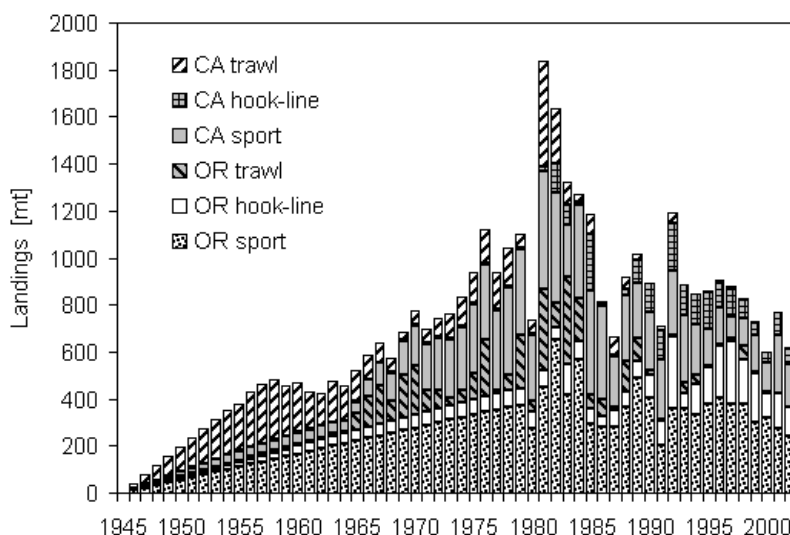
Executive Summary

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

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

Recent black rockfish catch statistics [mt] by fishery

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



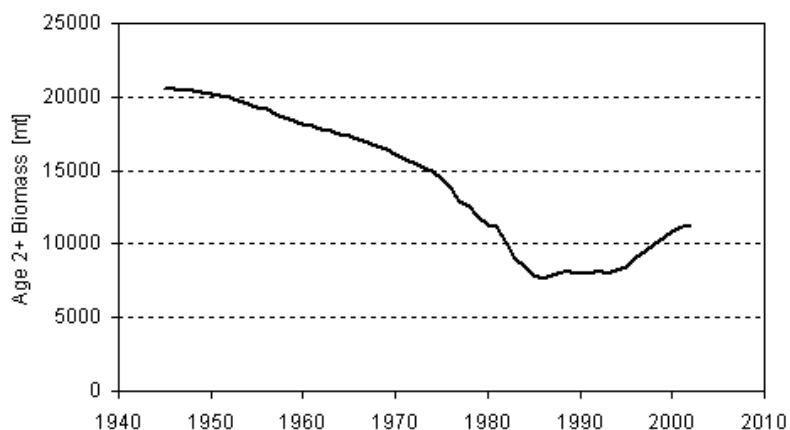
Data and Assessment: A variety of data sources was used in this assessment including: (1) recreational landings, age, and size composition data from the Oregon Department of Fish and Wildlife (ODF&W), (2) recreational landings (all California and Oregon shore-based modes) from the RECFIN data base, (3) Oregon commercial landings (trawl and hook-and-line) from the PACFIN data base, (4) size compositions for the commercial fisheries in Oregon from ODF&W, (5) California commercial landings and length compositions from

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

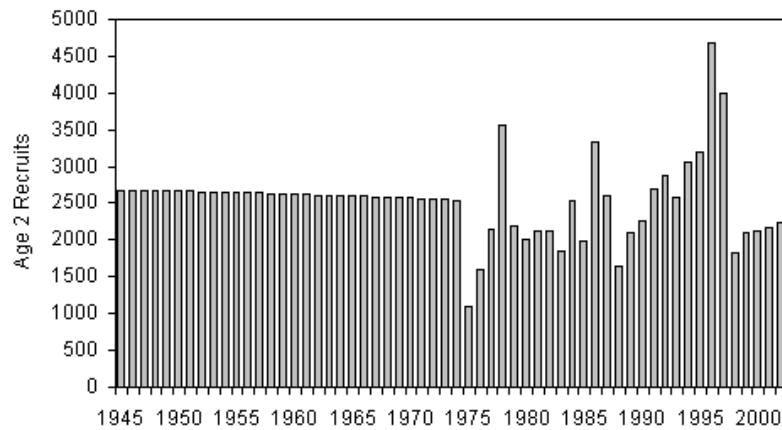
Unresolved Problems and Major Uncertainties: The major sources of uncertainty in this stock assessment include: (1) the amount of historical landings that occurred prior to the 1978, (2) the assumed natural mortality rate, and (3) the steepness of the spawner-recruit curve.

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

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

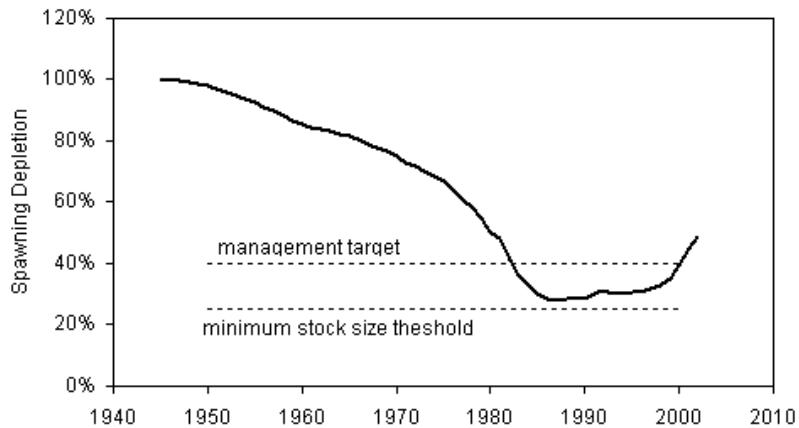


Recruitment: In the assessment recruitment was treated as a blend of deterministic values (i.e., 1945-1974 & 1999-2002) and stochastic values (i.e., 1975-1998). The Beverton-Holt steepness parameter (h) was fixed at a value of 0.65, based upon a profile of goodness-of-fit and results from a prior meta-analysis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



Exploitation Status: The northern California-Oregon stock of black rockfish is in healthy condition, with 2002 spawning output estimated to be 49% of the unexploited spawning level. This places the stock well above the management target level of $B_{40\%}$. Likewise, age 2+ biomass in 2002 is estimated to be 11,232 mt, which is 55% of that expected in the absence of fishing.

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



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

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

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

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

Research and Data Needs: The black rockfish review panel identified certain gaps in the available information that hindered the stock assessment. These were: (1) a fishery-independent survey should be developed to monitor changes in black rockfish population abundance, (2) the California CPFV data set should be more thoroughly investigated to ascertain whether or not serial depletion of fishing sites has artificially kept catch rates high [see Appendix 1], (3) a standard approach to historical catch reconstructions should be developed, (4) the possibility of time-varying growth should be investigated, and (5) the calculation of the RECFIN catch-per-unit-effort statistic should be more thoroughly analyzed and verified.

Rebuilding Projections: The assessment indicates that black rockfish is well above the limit overfished threshold ($B_{25\%}$). Therefore, no rebuilding calculations were conducted.

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 around 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 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.

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).

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.

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Appendix F: Terms of Reference for Expedited Stock Assessment Updates

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

Qualification

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

Composition of the Review Panel

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

Review Format

Typically, a physical meeting will not be required to complete an expedited review of an updated stock assessment, but usually one would be the most efficient way to conduct the review. Rather, if a meeting is not held, materials can be distributed electronically. STAT and panel representatives will largely be expected to interact by email and telephone. A conference call will be held to facilitate public participation in the review.

The review process will be as follows. Initially, the STAT team that is preparing the stock assessment update will distribute to the review panelists a document that summarizes the team’s findings. In addition, Council staff will provide panelists with a copy of the last stock assessment reviewed under the full STAR process, as well as the previous STAR panel report. Each panelist will carefully review the materials provided. A conference call will be

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

STAT Team Deliverables

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

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

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

Review Panel Report

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

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

SSC Terms of Reference for Groundfish Rebuilding Analyses

Final Draft
April 2001

Introduction

Amendment 11 to the Groundfish Fishery Management Plan (FMP) established a harvest control rule for determining optimum yields (OY). The 40:10 policy was designed to prevent stocks from falling into an overfished condition. Part of the amendment established a default overfished threshold equal to 25% of the unexploited population size¹ (B_0). By definition, groundfish stocks falling below that level are overfished ($B_{25\%} = 0.25 \times B_0$). To prevent stocks from deteriorating to that point, the policy also specifies a precautionary threshold equivalent to 40% of B_0 . At stock sizes less than $B_{40\%}$ the policy requires that OY, when expressed as a fraction of the allowable biological catch (ABC), be progressively reduced. Because of this linkage, $B_{40\%}$ has sometimes been interpreted to be a proxy measure of B_{MSY} , i.e., the stock biomass that results when a stock is fished at F_{MSY} . In fact, theoretical results support the view that a robust biomass-based harvesting strategy would be to simply maintain stock size at about 40% of the unfished level (Clark 1991, In review). In the absence of a credible estimate of B_{MSY} , which can be very difficult to estimate (MacCall and Ralston, In review), $B_{40\%}$ is a suitable proxy to use as a rebuilding target.

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

Presented here are guidelines for conducting a basic groundfish rebuilding analysis that meets the minimum requirements that have been established by the Council's Scientific and Statistical Committee (SSC). These basic calculations are required of all rebuilding analyses in order to provide a standard set of base case computations, which can then be used to compare and standardize rebuilding analyses among stocks. However, the SSC also encourages rebuilding analysts to explore alternative calculations and projections that may more accurately capture uncertainties in stock rebuilding, and which may better represent stock-specific concerns. In the event of a discrepancy between the generic calculations presented here and a stock-specific result developed by an individual analyst, the SSC groundfish subcommittee will review the issue and recommend which projections to use.

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

Estimation of B_0

For the purpose of estimating B_0 empirically, analysts have selected a sequence of years, wherein recruitment is believed to be reasonably representative of the natality from an unfished stock. These recruitments, in association with growth, maturity, fecundity, and natural mortality estimates, can then be used to calculate equilibrium unfished spawning output. In selecting the appropriate temporal sequence of recruitments to use, investigators have generally utilized years in which stock size was relatively large, in recognition of the paradigm that groundfish recruitment is positively related to spawning stock size (Myers and Barrowman 1996). Moreover, due to the temporal history of exploitation in the west coast groundfish fishery (see Williams, In review), this has typically led to a consideration of the early years from an assessment model time series². Thus, for example, in the case of bocaccio the time period within which recruitments were selected was 1970-79 and for canary rockfish it was 1967-77.

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

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

² Individual recruitments estimated from age-structured stock assessment models do not all exhibit the same precision or accuracy. Recruitments estimated at the very beginning of the modeled time period may suffer from mis-specification of the initial condition of the population (e.g., an assumed equilibrium age structure). Likewise, recruitments estimated at the end of the sequence may be imprecise due to partial recruitment of recent year-classes. Thus it may be advisable to trim the beginning and/or ending years classes to address this problem.

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

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

Population Projections During Rebuilding

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

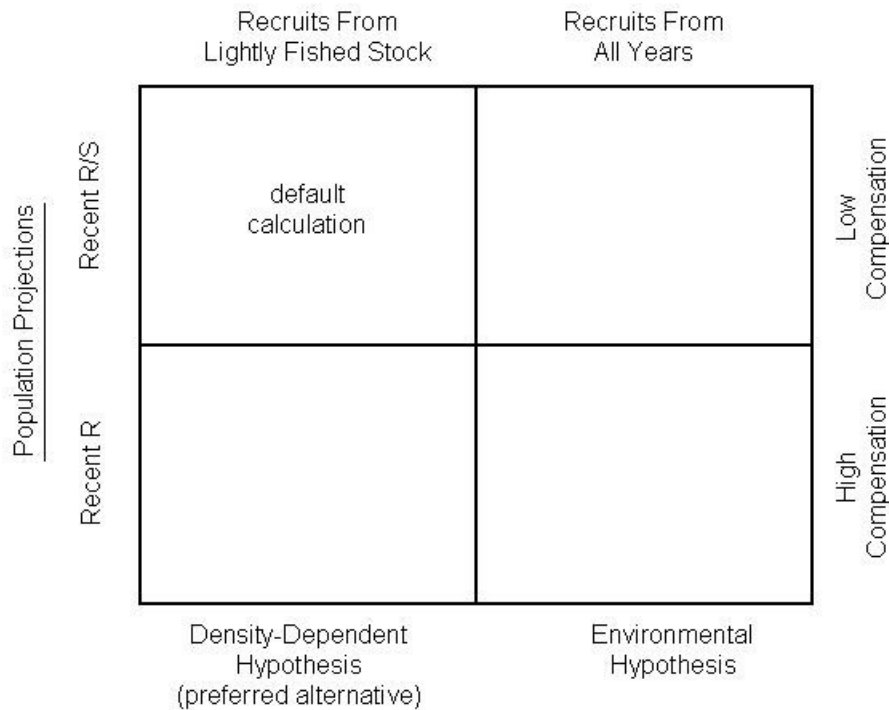
being equal. As the stock rebuilds this becomes an increasingly untenable assumption because there is no reduction in reproductive success at very high stock sizes, which is to say there is no compensation (i.e., steepness = 0.20)³.

Another way of projecting the population forward is to use recent recruitments, rather than recruits per spawner, as was done in the lingcod analysis. This approach, however, errs in the opposite direction. Namely, recruitment does not increase as stock size increases, as would be expected of most rebuilding stocks. This type of calculation effectively implies perfect compensation (spawner-recruit steepness = 1.00). Thus, these two ways of projecting the population forward, by using re-sampled R_i or re-sampled R/S_i , includes a range of alternatives that is likely to encompass the real world.

Because stocks that have declined into an overfished condition are more likely to be unproductive (i.e., low spawner-recruit steepness), in the absence of any other information, rebuilding projections based on re-sampling recruits-per-spawner are generally to be favored over projections based on absolute recruitment. Note that the implied lack of compensation in rebuilding projections using this method is not likely to be a serious liability over the long term because it is based on re-sampling contemporary recruits-per spawner. As progress toward rebuilding is evaluated in the future, the set of R/S_i will be revised based on a new set of recent recruitments obtained from the latest stock assessment. If the stock actually demonstrates a compensatory response during the course of rebuilding the R/S_i series will tend to a lower mean value. Although projections based on R/S_i represent a standard default way of proceeding, projections that use absolute recruitments (R_i) would be quite useful in establishing the overall uncertainty in the rebuilding analysis by providing an alternative model specification scenario. Moreover, a credible argument that a stock is relatively productive, as evidenced perhaps by observed high recruitment at low spawning biomass, may serve as a basis for favoring projections that utilize recent absolute recruitments (see figure).

³The “steepness” of a spawner-recruit curve is related to the slope at the origin and is a measure of a stock’s productive capacity. It typically is expressed as the proportion of virgin recruitment that remains when a stock has been reduced to $B_{20\%}$.

Calculation of B_0 Reference Point



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

Harvest During Rebuilding

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

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

Documentation

It is important for analysts to document their work so that any rebuilding analysis can be repeated by an independent investigator at some point in the future. Therefore, all stock assessments and rebuilding analyses should include tables containing specific data elements that are needed to adequately document the analysis. Namely, information is needed on: (1) the time course of population spawning output and recruitment, (2) biological data on life history characteristics, and (3) initial values for projecting the stock into the future under exploitation. Therefore, two tables should include:

Table 1. Stock Population Trajectory

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

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

Table 2. Age-specific Population Characteristics.

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

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

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

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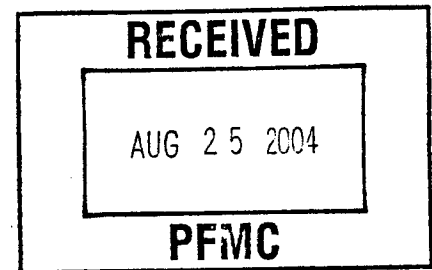
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August 25, 2004

Mr. Don Hansen, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384



Dear Mr. Hansen:

The Washington Department of Fish and Wildlife and the Northwest Indian Fisheries Commission on behalf of its member tribes are writing to urge the Pacific Fishery Management Council to direct stock assessment teams to incorporate regional differences in stock abundance, distribution, and genetics as appropriate during the upcoming stock assessment cycle. The tribes and the state believe that identifying and managing for regional differences are required for us to meet our obligations as co-managers of the fisheries resources within the tribes usual and accustomed fishing grounds and stations and to fulfill the tribes treaty rights.

The PFMC has implemented regional management for certain selected species based on results of stock assessments that indicated a biological difference between stocks or portions of coastwise stocks. In the case of black rockfish, genetic differences have been noted between northern and southern stocks. Lingcod in the north and south have demonstrated differing responses to rebuilding efforts as well as displaying differences in key biological parameters such as size at age and maturity schedules. For both of these species, the Council has developed management regimes that delineate two separate regions. The rationale for managing these stocks on a regional basis is to allow differences in management measures, contingent upon the abundance or health of the stock within each respective region, that achieve utilization to the degree possible while meeting conservation and rebuilding goals. We understand that there are data for other species that would provide the needed information to manage other groundfish stocks in a similar manner, and we are encouraging that information to be incorporated in future stock assessments if it is available.

We are specifically requesting that the Council have its Scientific and Statistical Committee add a consideration of regional management to the Terms of Reference for Stock Assessments and STAR Panel reviews. As such, each stock assessment author would be asked to evaluate, based on the available data, whether a biological or

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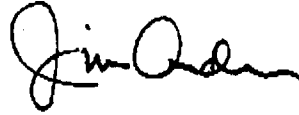
ecological rationale exists to manage the stock on a regional basis, make regional boundary recommendations, as appropriate, or, if there is insufficient information to evaluate regional management for the species, identify the data gaps and/or research needed to facilitate a regional management approach.

We appreciate the Council's consideration of our proposal. We understand that the Terms of Reference will be reviewed at the September Council meeting with final approval taking place at the November meeting. We will come prepared to discuss our proposal further at the September meeting.

Sincerely,



Phil Anderson
Special Assistant
Washington Department of Fisheries



Jim Anderson
Executive Director
Northwest Indian Fisheries Commission

cc: NWIFC Member Tribes