
TERMS OF REFERENCE

FOR THE

GROUND FISH STOCK ASSESSMENT REVIEW PROCESS FOR 2027-2028



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TABLE OF CONTENTS

Acronyms Used in the Document	4
1. Summary of Major Changes from the 2025 Terms of Reference	5
2. Introduction	5
3. Process for Stock Assessment Reviews	6
3.1 Pre-Assessment (Data and Stakeholder) Workshops	6
3.2 Stock Assessment Types and Reviews	7
3.2.1 Management Track Assessments	10
Benchmark Assessments	10
Update Assessments	10
Catch-only Projections	11
Data-Moderate Assessments	14
Length-based Methods	15
Data-Limited Assessments	16
Empirical Indicators (Survey Index, Catch Reports, or Other Indicators)	16
3.2.2 Research Track Assessments	17
3.3 Transitions to Alternative Assessment Types and Review Pathways	17
3.4 Stock Assessment Categories and Risk tables	20
4. Roles and Responsibilities during the STAR Panel Process	20
4.1 Shared Responsibilities	21
4.2 Stock Assessment Review (STAR) Panel Chair	21
4.3 Stock Assessment Review (STAR) Panel	23
4.4 Stock Assessment Team (STAT)	29
4.5 National Marine Fisheries Service (NMFS)	33
4.6. Council Staff	34
4.7 Groundfish Management Team (GMT)	35
4.8 Groundfish Advisory Subpanel (GAP)	36
4.9 State Agency and Tribal Representatives	37
4.10 Scientific and Statistical Committee (SSC)	37
5. Literature Cited	38
Appendix A: Anticipated Timeline for Groundfish Stock Assessments and Reviews	40
Appendix B: Outline for Stock Assessment Documents	42
Appendix C: Template for Executive Summaries in Stock Assessments	49
Appendix D: Checklist of Elements to be included in Stock Assessments	51
Appendix E: Risk Table Rubric for Groundfish Assessments and Rules for Making Management Track Category Assignments	56
Appendix F: Standard Set of Tables and Figures to be Included in Groundfish Stock Assessment Reports or in Associated Electronic Indices	62

ACRONYMS USED IN THE DOCUMENT

ABC – Acceptable Biological Catch
ACL – Annual Catch Limit
ACT – Annual Catch Target
BSIA – Best Scientific Information Available
CIE – Center for Independent Experts
CPUE – Catch per unit of effort
CV – Coefficient of variation
DB-SRA – Depletion-Based Stock Reduction Analysis
FMP – Groundfish Fishery Management Plan
GAP – Groundfish Advisory Subpanel
GEMM – Groundfish Expanded Mortality Multi-year (data)
GMT – Groundfish Management Team
HG – Harvest Guidelines
MSA – Magnuson-Stevens Fishery Conservation and Management Act
MSY – Maximum Sustainable Yield
NMFS – National Marine Fisheries Service
OFL – Overfishing Limit
OY- Optimum Yield
PacFIN - Pacific Fisheries Information Network
PFMC – Pacific Fishery Management Council
RecFIN – Recreational Fisheries Information Network
SAFE – Stock Assessment and Fishery Evaluation
SPR – Spawning Potential Ratio
SS – Stock Synthesis
SS-CL – Stock Synthesis using Catch and Length
SS-CL+Index – Stock Synthesis using Catch, Length, and Indices of Abundance
SSC – Scientific and Statistical Committee
SSC-GFSC – SSC Groundfish Subcommittee
STAR – Stock Assessment Review
STAT – Stock Assessment Team
TOR – Terms of Reference
WCGOP – West Coast Groundfish Observer Program
XDB-SRA – Extended Depletion-Based Stock Reduction Analysis
XSSS – Extended Simple Stock Synthesis

1. SUMMARY OF MAJOR CHANGES FROM THE 2025 TERMS OF REFERENCE

- First 2027 cycle major change here...
- Formal addition of the category designations and category-specific sigmas
- Addition of the GAP-led document of fishery information anticipated late in even years for use in the stock assessment cycle.
- Provided clarity on roles and responsibilities
- Organized sections to better follow the chronological order of actions in the process
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2. INTRODUCTION

Stock assessments are conducted to estimate the abundance and trends of fish stocks and provide the fundamental basis for management decisions regarding appropriate harvest levels. In most cases, assessments use statistical population models to integrate and simultaneously analyze survey, fishery, and biological data. Environmental and ecosystem data may also be integrated in stock assessments. Hilborn and Walters (1992) define stock assessments as “the use of various statistical and mathematical calculations to make quantitative predictions about the reactions of fish populations to alternative management choices.” In this document, the term “stock assessment” includes activities, analyses, and reports, starting with data collection and continuing through to scientific recommendations presented to the Council and its advisors. To best serve their purpose, stock assessments must attempt to identify and quantify major uncertainties, balance realism and parsimony, and make best use of the available data. Data availability produces a continuum of approaches outlined below.

The review of stock assessments requires a routine, dedicated effort that simultaneously meets the needs of the NMFS, the Council, and others. 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 employed to produce stock assessments. The extended time frame and resources required for such reviews limit the number of assessments reviewable at a given time, thus requiring a stock assessment prioritization and balance of assessment types to review each cycle.

The purpose of this document is to outline the guidelines and procedures for review of Pacific Fishery Management Council’s (Council’s) groundfish stocks, including review of assessments through the Stock Assessment Review (STAR) process, the SSC, and the Center for Independent Experts (CIE). This document applies to stock assessments of species managed under the [Pacific Coast Groundfish Fishery Management Plan](#) (PFMC 2026). The 2006 Reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (RMSA) states that “the Secretary and each Regional Fishery Management Council may establish a peer review process for that Regional Fishery Management Council for scientific information used to advise the Regional Fishery Management Council about the conservation and management of the fishery (see Magnuson-Stevens Act section 302(g)(1)(E)).” [National Standard 2](#) (NS2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (published July 19, 2013) provides guidance and standards to be followed when establishing a peer review process pursuant to MSA section 302(g)(1)(E), including guidance on the timing, scope of work, selection of peer reviewers, and process transparency. The Council’s assessment review process follows the MSA and is fully

compliant with NS2. An overview of the STAR process for groundfishes, including the timing and participation by Council and panel bodies is provided in Appendix A.

Parties involved in the STAR process are Council members, Council staff, members of Council Advisory Bodies, including the Scientific and Statistical Committee (SSC), the Groundfish Management Team (GMT), the Groundfish Advisory Subpanel (GAP), the National Marine Fisheries Service (NMFS), state agencies, and other interested persons. This current version of the terms of reference (TOR) reflects recommendations from previous participants in the assessment process, including STAR panel members, the SSC, stock assessment teams (STATs), representatives from the GMT and GAP, and Council staff. These guidelines cannot be expected to deal with every contingency and all participants should anticipate the need to be flexible and address new issues as they arise. This document underpins scientific advice from the SSC ([Council Operating Procedures](#)). The SSC has developed a separate TOR for [Methodology Review Process](#) for the application of new groundfish and coastal pelagic species methods that might be used in stock assessments, and a separate TOR for [Rebuilding Analyses](#) pertaining to groundfish stocks. The SSC also maintains and [Accepted Practices Guidelines](#) document for groundfish stock assessments.

3. PROCESS FOR STOCK ASSESSMENT REVIEWS

3.1 Pre-Assessment (Data and Stakeholder) Workshops

Pre-assessment workshops are required for all benchmark and update assessments and may be convened for data-moderate assessments when warranted. The primary objectives of these workshops are to review available data sources and potential data gaps, discuss stock dynamics and fishery conditions, evaluate proposed assessment approaches and model structures, and identify key assumptions or issues that may influence the assessment.

Workshops will typically be held between January and April of odd-numbered years to provide STATs sufficient time to conduct preliminary analyses, compile data, and develop assessment plans. Council staff will distribute workshop materials, including relevant supporting documents, at least two weeks prior to the meeting.

The workshops provide an opportunity for stakeholders, fishery participants, managers, and scientists to exchange information and perspectives regarding the stock and fishery. Particular emphasis should be placed on documenting changes in fishery dynamics through time and across geographic areas, as well as identifying information that may improve assessment development and interpretation. To support these discussions, the GAP advisor associated with the assessment will coordinate preparation of a working document describing relevant fishery context, including changes in fishery operations, participation, and spatial and temporal dynamics. The working document will be provided to the STAT prior to the workshop and distributed to workshop participants with other meeting materials at least two weeks before the meeting. This document will serve as the foundation for the GAP appendix included in the draft and final assessment documents, consistent with the timelines and guidance described in Appendix A.

Participants should include the GFSC, the associated STAR Panel Chair, GMT and GAP advisors to the STAR Panel, Council staff, relevant data stewards, and other interested stakeholders. The

workshop serves as a forum for reviewing and critically evaluating available data sources, identifying uncertainties, and considering the treatment of those data and uncertainties within the assessment.

A key objective of the workshop is to enhance data quality, transparency, and stakeholder engagement prior to assessment completion. To the extent practicable, the STAT should present preliminary data summaries, plots, and analyses to facilitate informed discussion. Concerns and recommendations raised during the workshop should be submitted to the STAT in writing by the review chair. Significant concerns and the STAT's responses should be documented in the draft assessment.

3.2 Stock Assessment Types and Reviews

There are several distinct types of stock assessments that are subject to different procedures (Figure 1). Management track assessments are the routine operational assessments that are used to provide scientific advice for fishery management decisions, whereas research track assessments investigate issues or improve upon approaches that require substantially more time than a standard Council assessment cycle can support.

Pacific Fishery Management Council Stock Assessment Workflow

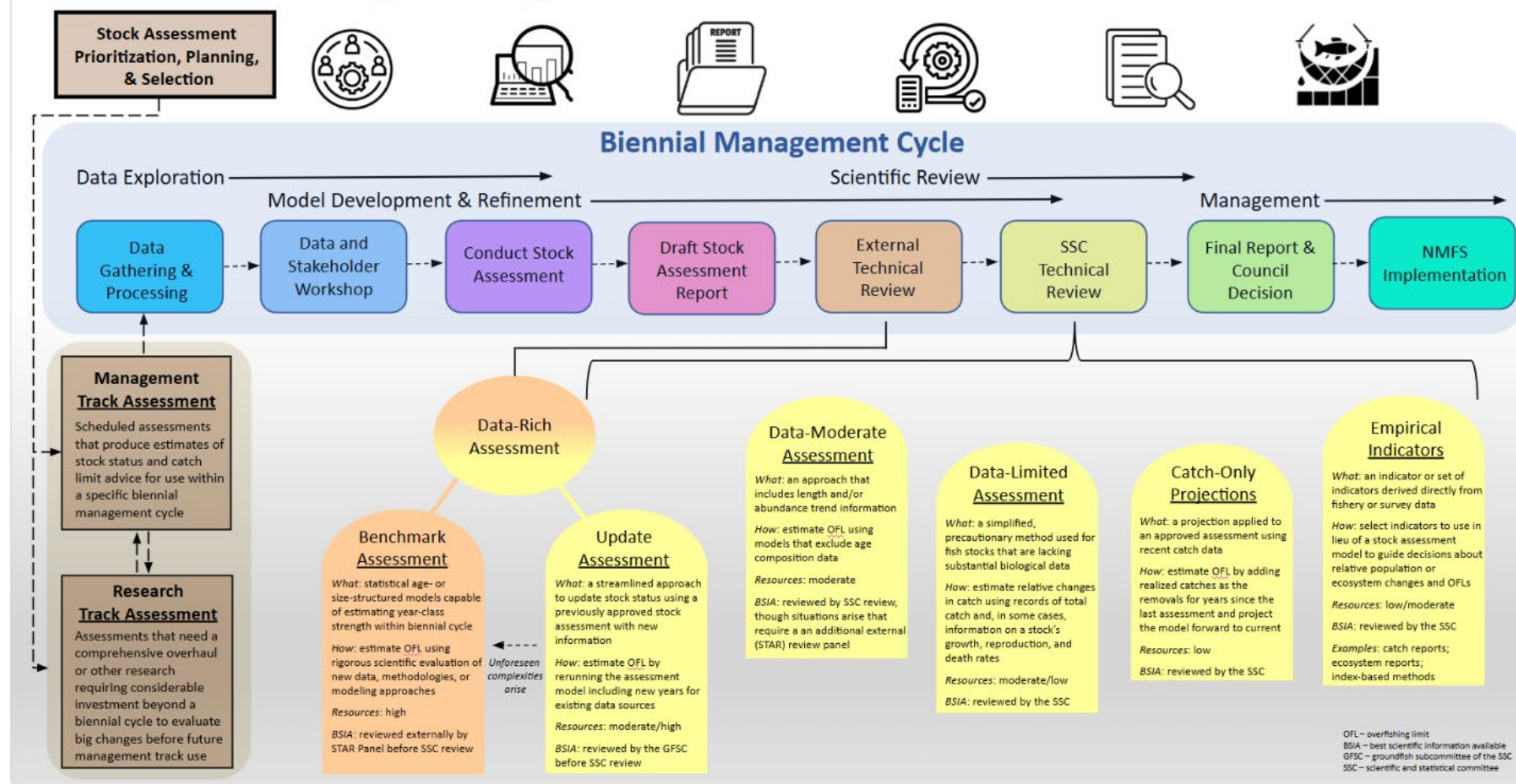


Figure 1. Overview of the stock assessment process for the Pacific Fishery Management Council from planning and prioritization to review to

implementation.

Opportunities for Engagement During Biennial Stock Assessment Development and Review

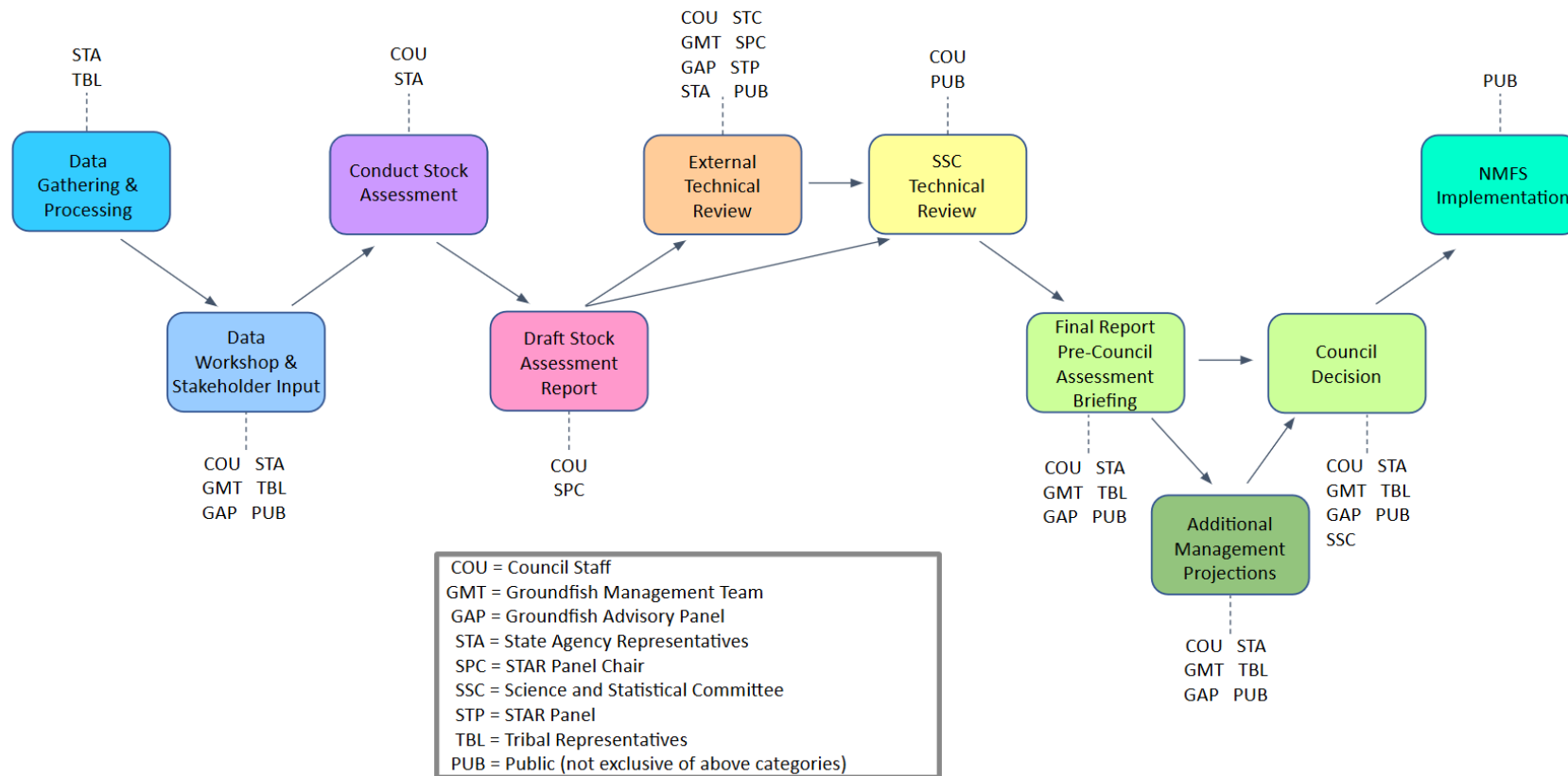


Figure 2. Explicit opportunities for engagement during the biennial stock assessment development and review process. Opportunities identified here are meant to be exemplary, not exhaustive.

3.2.1 Management Track Assessments

Benchmark Assessments

The most flexible type of assessment is a benchmark assessment. Benchmark assessments apply statistical age- or size-structured population models to assess stocks. The available data are adequate to produce estimates of year-class strength and there is information from surveys or fisheries to resolve trends in biomass and estimate stock status. Each benchmark assessment model has underlying equations that mimic the dynamic processes of fish growth, maturation, reproduction, and mortality. The annual estimates of age- or size-specific abundance, biomass, and/or catch from these models are compared to available observational data to allow parameters to be estimated.

- A benchmark assessment can be applied to a stock that has not been previously assessed or to a previously assessed stock, in which case the benchmark assessment involves a re-examination of the underlying assumptions, data inputs and treatment, and other aspects of the model that were previously used to assess the stock.
- Benchmark assessments are reviewed by a STAR panel. During the two-week review period preceding the STAR panel meeting, reviewers are encouraged to communicate any significant concerns to the STAR panel chair. The chair may then relay those concerns to the STAT to raise awareness and provide as much lead time as possible for consideration (as applicable) before the panel convenes.

Update Assessments

Update assessments augment previously reviewed and approved benchmark assessments by including recent data and limiting the number of structural changes relative to the previous models. Thus, update assessments require fewer resources and may be desired for stocks that have relatively few outstanding modeling or data issues and the assessments for which can provide relatively stable results as new data are added. Update assessments should not be conducted if the most recent assessment is 10+ years old, given considerable technical advancements in assessment methodology, revised accepted practices guidelines, and possible changes in the fishery over longer time periods.

- An update assessment is generally restricted to the addition of new data that have become available since the most recent assessment. An update assessment must carry forward the fundamental model structure (i.e., population dynamics model, data sources, statistical platform, and process for how management quantities are used to set harvest specifications) of the most recent assessment reviewed and endorsed by a STAR panel, the SSC, and the Council. Permissible alterations to the most recent assessment model are described in this section of the document.
- Update assessments are reviewed by the SSC-GFSC.

Major changes to the assessment should be postponed until the next benchmark assessment. When an update assessment is developed, no substantial changes should be made to:

- 1) the sources of data used (updating time series of pre-existing data sources, correcting data errors, including additional historical data, and updating priors are permitted when model comparisons before and after making these changes are provided);

- 2) the software used in the most recent assessment (newer versions are permitted as long as similar results are produced when the same model files are used or when the new software version fixes an error in the original version);
- 3) the assumptions and structure of the underlying population dynamics model;
- 4) the statistical framework for fitting models to data and identifying goodness of fit; and
- 5) the analytical treatment of model outputs when determining management reference points.

Alterations such as removing a data source that is no longer consistent with other data can be considered with clear documentation and justification (via sensitivity analysis). Alterations are allowed when there are clear and straightforward improvements to the data and/or how they are processed (e.g., updating the data weighting procedure or modifying time blocks for selectivity). The STAT may change the major axis of uncertainty when conducting an update assessment when adequate rationale is provided. In such an instance, the STAT should submit two versions of the decision table for review, one that assumes the axis of uncertainty from the most recent assessment and one that uses the proposed axis of uncertainty.

Catch-only Projections

Catch-only projections provide a way to update only the catch time series of the most recent stock assessment and provide revised catch recommendations for management. In some cases, only recent catches are added to an approved stock assessment model to generate catch-only projections for the stock.

- Catch-only projections are commonly considered when the following criteria are met:
 - catches are below the ACL;
 - future ACLs are decreasing appreciably due to full attainment assumptions; and
 - future ACLs are anticipated to constrain fishery sector(s).
- The start year for time-varying sigma (i.e., the sigma that increases through time) remains based on the year of the previous assessment and is not “reset” (e.g., is not changed).
- Generally, the Council recommends the species for catch projections during the June Council meeting (in even years) during the stock assessment prioritization agenda item.
 - If errors are identified during the development of harvest specifications and management measures, the SSC-GFSC may request a catch-only projection to correct them and provide updated projections. This situation may occur outside of a Council meeting and requests to the STAT will be coordinated by Council staff, in collaboration with the SSC-GFSC and GMT.
- Catch-only projections are conducted during the spring and summer months of odd years (assessment season) and reviewed by the SSC-GFSC rather than by a STAR panel, with public notice, then subsequently reviewed by the SSC.
- Catch-only projection documents are short, but still require careful review, including ensuring catches are correctly distributed among fleets in fixed and forecasted years. Improved catch-only projection reviews would require a longer time for review, with additional metrics presented, and/or specifically assigned reviewers. The SSC-GFSC (co) Chair and NMFS should make plans that ensure sufficient review.
- In contrast, extended projections do not update assumed removals and only extend existing projections for informing future harvest specifications. These are conducted during the summer months of odd years when requested in writing by the SSC Staff Officer and

reviewed by the SSC or SSC-GFSC before or during the September Council meeting. The time-varying sigma is not reset (e.g., the start year of the sigma increases remains the year of the previous assessment).

- Full ACL or harvest guideline attainment should be assumed for the catch projections within the current biennium (e.g., the current odd year and the following year) in the absence of a strong rationale from the GMT that an alternative assumption is appropriate. Full ACL or harvest guideline attainment should be assumed for all projection years following the current biennium. Additional catch streams that include values lower than full ACL or harvest guideline attainment may be requested by the GAP or GMT representatives for all projection years following the current biennium. Recent average catch distribution among fleets should be used for projections unless the GMT requests an alternative distribution. Additional requests can also be made to the STAT if the amount of uncertainty associated with assessment results (e.g., due to highly variable recruitment) should be evaluated further.

Catch-only projections update the assumed previous removals to actual catches from the Groundfish Expanded Multiyear Mortality (GEMM) report and other sources. The GMT is tasked with allocating GEMM catches to fleets, estimating the final year of catches that are not yet available, specifying removal assumptions for the current biennium, and determining the allocation of catches by fleet for the forecast period.

In the event that in-season adjustments result in fishery management measures that considerably differ from GMT catch assumptions, a written request for reconsideration may be submitted to the GMT. Requests to revise catch assumptions to values that differ from the GMT provided values should differ by an amount such that they would have a demonstrable impact in how the fishery is managed compared to the GMT estimates. A rationale for the differences and details on the methodology for derived values should be provided to the GMT in writing to inform review of the request.

Requested revisions to the catch assumptions for the current biennium should be submitted in writing two weeks before the September Council meeting to PFMC staff for GMT review, assuming that the catch-only projection documentation will be in the advanced briefing book. If the revisions to catch assumptions are approved by the GMT, the SSC Staff Officer will coordinate with the STAT to determine whether the revised projections can be accommodated with sufficient time for SSC review (i.e., two weeks in advance of the November Council meeting).

The GMT will provide catches for catch-only projections using the same fleet stratification as the most recent assessment. Results of these projections, including the OFL, ABC, ACL, spawning biomass or output, and depletion projections, must be provided in the report (e.g., in Table 1). The catch data used in the catch-only projection should be compared to the previous assessment or update and differences from catch estimates in years prior to the end of that previous assessment should be explained. If differences result in substantial changes in model outputs or estimates, a benchmark or update assessment may be preferable. Projections that use climate time series must provide plots or tables of the time series used in the projections.

Table 1. Example of the table to be included in catch-only projections. Table captions should include which default harvest control rule was used and the units represented.

Year	OFL (Previous)	OFL	Buffer	ABC (Previous)	ABC	Actual & Assumed Removals (Previous)	Actual & Assumed Removals	ACL (Previous)	ACL	Spawning Output	Stock Status (Previous)	Stock Status
2017	—	—	—	—	—	245	238	—	—	1419	0.400	0.400
2018	—	—	—	—	—	344	344	—	—	1481	0.418	0.418
2019	—	—	—	—	—	316*	416	—	—	1558	0.440	0.440
2020	—	—	—	—	—	307	342	—	—	1653	0.468	0.466
2021	—	—	—	—	—	479	336	—	—	1755	0.498	0.495
2022	—	—	—	—	—	458	349	—	—	1847	0.521	0.521
2023	894	—	—	820	—	—	302	820	—	1923	0.541	0.542
2024	857	—	—	782	—	—	363	782	—	1987	0.549	0.561
2025	830	—	—	754	—	—	394	754	—	2037	0.554	0.575
2026	810	—	—	732	—	—	394	732	—	2075	0.557	0.585
2027	795	859	0.900	716	773	—	—	716	773	2106	0.558	0.594
2028	784	842	0.896	702	754	—	—	702	754	2106	0.558	0.594
2029	775	828	0.892	691	738	—	—	691	738	2101	0.556	0.593
2030	767	816	0.887	680	724	—	—	680	724	2093	0.554	0.590
2031	761	806	0.883	672	711	—	—	672	711	2082	0.551	0.587
2032	755	797	0.879	664	700	—	—	664	700	2069	0.549	0.584
2033	—	789	0.875	—	690	—	—	—	690	2055	—	0.580
2034	—	782	0.871	—	681	—	—	—	681	2041	—	0.576
2035	—	776	0.867	—	673	—	—	—	673	2026	—	0.572
2036	—	770	0.863	—	665	—	—	—	665	2012	—	0.568

Data-Moderate Assessments

Council-approved methods for data-moderate assessments are limited in that they do not use age composition data (directly), even if available, and often have simplified population dynamics (e.g., deterministic recruitment), which leads to more fixed parameters requiring sensitivity analyses.

- Two approaches have been developed to conduct data-moderate assessment with historical catch data and one or more indices of abundance (or biomass) (e.g., survey data or fishery catch per unit effort [CPUE] indices) referred to as extended DB-SRA (XDB-SRA) and extended Simple Stock Synthesis (XSSS¹); and catch and length-based data-moderate stock assessment methods conducted in Stock Synthesis (SS-CL). Methods incorporating catches, lengths, and indices of relative abundance from fishery-independent surveys in Stock Synthesis have also been adopted by the Council for use in management (SS-CL+Index). Methods using length data do have the potential to estimate recruitment, thus adding more dynamics and complexity to the assessment and the review.
- Data-moderate assessments can be reviewed by a STAR panel or SSC-GFSC if one of the approved methodologies is proposed to be used. They should be reviewed by a STAR panel if a new or non-standard methodology is proposed to be used or if other considerations discussed during the stock assessment prioritization necessitate additional review.

Data-moderate assessments are a refinement over data-limited methods in that a data-moderate assessment includes length and/or abundance trend information. Data-moderate assessments can result in Category 2 (catch and length or catch and index) or Category 1 designations (possible when catches and limited lengths and index data are incorporated). One defining distinction between Category 2 and Category 3 assessments is that the length and/or abundance trend information is incorporated in a Category 2 assessment enabling an estimate of stock status (Appendix E). Although the SS-CL+Index assessments have the potential to be Category 1 assessments, simulation analyses indicate that if there are fewer than ten years of length data for a stock in question, there is substantial uncertainty in the results, potentially leading to designation as a Category 3 assessment.

The continuum of models should be accommodated to allow combinations of catch, lengths, ages and, indices to be applied to both new assessments and length-based extensions of existing benchmark assessments, though review processes may differ. A categorization of each assessment method is provided in Table 2. The SS-CL+Index assessment method includes fishery-independent indices of abundance for which index development methods are well established. Implementation of assessments within the provided specifications allows for standardization and more streamlined review by the SSC-GFSC early in odd years along with update assessments. The depth of potential reviews should increase with the estimation of more parameters. Review of one or more length-based models that use an approved standard methodology can be reviewed within a STAR panel setting, though SSC-GFSC review may be sufficient, depending on the particular assessment.

¹Comparison of alternative methods (XDB-SRA and XSSS) is encouraged, but it is acceptable to present an assessment using a single modeling approach.

Intermediate methods using fishery-dependent indices or age data are subject to review at a STAR panel to allow further evaluation of model fitting and tensions between data sources (see Table 2 for categorization of assessment types).

The use of age data in either type of length-based Stock Synthesis assessment is discouraged to avoid confounding the nature of the assessment, reducing model tension arising from potential conflicts in age and length data, and increasing clarity in the related review process. Due to the complexities and potential data conflicts that can occur from fitting to age data in combination with indices and lengths, assessments that include current age data should be considered benchmark assessments and reviewed in STAR panels.

Table 2. Previously approved standard models, treatments of length, age, and index data, and assessment type. All models assume a known catch history.

Model	Lengths	Ages	Index	Assessment Type
DB-SRA/SSS	Ignore	Ignore	Ignore	Data-limited
XDB-SRA/XSS	Ignore	Ignore	Use	Data-moderate
SS-CL ¹	Use	Ignore	Ignore	Data-moderate
SS-CL+Index	Use	Ignore/unavailable	Fishery-independent indices only (e.g., WCG BTS, H&L)	Data-moderate
SS ² -lite	Use	Ignore	Use	Benchmark or Update
SS ³	Use / update	Use new or ignore unread	Use or update	Update
SS ² -heavy	Use new data sources	Use new data sources or ignore unread	Use new data sources	Benchmark

1: Flow chart for specifications related to fleets, life history parameters, selectivity etc.

2: New specifications for how the assessment is configured.

3: Model specifications are the same as the most recent assessment.

Length-based Methods

The limited scope of SS-CL and SS-CL+Index allow for more limited documentation requirements. For models that go beyond the scope of these focused methods, reporting requirements should be developed in an assessment-specific TOR developed by the Chair of the STAR panel. This would provide flexibility to cover the range of possible applications, while still providing appropriate specificity and thorough evaluation. The reviews are expected to take between a half day and two days depending on the number, type, and novelty of the assessments. It may be beneficial to hold a half day preliminary review during a virtual meeting prior to the SSC-GFSC meeting at which the review will be conducted. The number of SS-CL or SS-CL+Index assessments that can be conducted at a given STAR panel or a SSC-GFSC review in combination with update assessments, depends on the complexity of the models, spatial areas, and novelty of the methods. Two to four data-moderate assessments may be reasonable during a single STAR panel review. Flexibility should be provided to the SSC regarding the exact number of assessments and process for each review.

The critical modeling steps for SS-CL and SS-CL+Index are included in the Accepted Practices Guidelines document, in addition to the following guidance. If there is dimorphic growth, then sex-specific information should be included, given increased uncertainty in simulation results with increasing variance in length at age, which is greater when sex data associated with lengths are not available or included in assessment of sexually dimorphic species. This may be less of a concern if only males or females are predominantly sampled by the survey or caught in the fishery but can be confounding if more equal sex ratios are observed in the catch or survey and sex data are unavailable for measured fish. Fleet consolidation is recommended if selectivity is similar among sectors or surveys to reduce model conflict and confounding effects. If a survey is included in an SS-CL+Index assessment, the length-composition from that survey should also be included, as well as length-composition from other fishery-independent or fishery-dependent data sources. Application of dome-shaped selectivity should be investigated when plausible, in addition to asymptotic selectivity. It is recommended that the model be run with asymptotic selectivity for at least one fleet if natural mortality is being estimated. Simplifying model structure and spatial areas will reduce complexity in the assessments and workload in both the analysis and review.

Data-Limited Assessments

A “data-limited assessment” relies on catch data and basic life history information about the species to determine an OFL for the stock. A data-limited assessment uses catch history but differs from a data-moderate assessment in that it does not include any abundance indices or length data and may assume relative stock status. Given relative stock status is an input, these methods only produce estimates of OFL and no measures of stock status relative to reference points. Three “catch-only” methods have been developed to conduct data-limited assessments: Depletion-Corrected Average Catch (DCAC), Depletion-Based Stock Reduction Analysis (DB-SRA), and Simple Stock Synthesis (SSS).

Data-limited assessment methods to assess groundfish stocks were adopted by the Council in 2011 to inform harvest specifications for Category 3 stocks (Appendix E). Data-limited assessments are reviewed by the SSC-GFSC.

DCAC provides estimates of sustainable yield on long lived species based on catches and associated number of years, as well as the relative reduction in biomass during that period, the natural mortality rate (M), and the assumed ratio of MSY fishing rate (F_{MSY}) to M (MacCall 2009). DB-SRA combines DCAC and stock reduction analysis to produce probability distributions of management reference points concerning yield and biomass (Dick and MacCall 2011).

Empirical Indicators (Survey Index, Catch Reports, or Other Indicators)

Measures derived directly from observed data, with little or no reliance on a population dynamics model. Common empirical indicators are catch reports or an index of abundance from a research survey.

- A “catch report” tabulates fishery removals over recent years to ensure that they are below specified ACLs. A catch report would be produced when little new information is available about the stock to inform the assessment.
- A survey index value or series evaluated relative changes in stock trend.
- Empirical indicators are reviewed by the SSC-GFSC.

In certain cases (e.g., cowcod in 2017) only limited new data are available to inform the assessment. In such cases, it is appropriate for the STAT to examine empirical indicators (e.g., catch reports or survey index values). Catch reports document recent removals and compares them to the ACLs established for the stock. For a catch report, if the estimated removals of a species are near the value projected by the previous assessment/rebuilding analysis, the STAT does not need to conduct model runs since no new insight would be obtained by rerunning the assessment model. Empirical indicators are reviewed by the SSC during a single meeting. The STAT is responsible for producing the empirical indicator and submitting it to Council staff in a timely manner, before the review. The report should be brief and provide enough details on how the indicator values were derived. It should provide only essential information about the stock and refer to the most recent assessment (or other relevant documentation) for complete description of methods, data sources, model structure, etc. used to estimate the status of the stock and generate projections or other stock reference values.

3.2.2 Research Track Assessments

Research track assessments reflect comprehensive, multi-year scientific evaluations that investigate a specific set of features to meet science advancement objectives (similar to those conducted in the [Northeast Region](#)). Research tracks are research intensive assessments which may include extensive management strategy evaluation simulations, complex stock structure evaluations, multi-species complexes, new modeling or data approaches, or investigate other complexities to build foundations for future management track assessments. Research track assessments require extensive review before being implemented into a biennial management track process. Reviews will typically involve a Council- and NMFS-coordinated CIE review, which may be conducted as a standalone review or incorporated into a groundfish methodology review, SSC-GFSC review, or a combination of these prior to SSC consideration, as applicable. After review, the SSC may determine which assessment elements are suitable for incorporation into a future management track assessment, at which point a STAR panel review would generally be conducted. Reviews for research track assessments could be offset from those for management track assessments (e.g., in even years) to provide greater flexibility in timing and to facilitate the adoption of the new approach in future biennia.

3.3 Transitions to Alternative Assessment Types and Review Pathways

The nature, severity, and timing of issues encountered during assessment development can vary considerably such that no single response pathway is appropriate for all situations. Decisions regarding changes in assessment types, review pathway, or assessment timing should be based on the specific circumstances encountered, the anticipated impact on management advice, and the feasibility of resolving issues within existing assessment cycle constraints. Table 3 summarized common transition pathways among assessment types and review processes, along with illustrative justifications and timing considerations that may support such transitions.

Requests for such changes in classification or timing should be submitted with rationale in writing to the Council staff officer for fisheries science (supports the SSC), SSC GFSC chair(s), NMFS WCR Groundfish Branch Chief, NMFS Science Center stock assessment program leads, and the STAR panel chair and GMT/GAP representatives (if applicable). The GFSC will review the request, seek additional information and comment from (minimally) parties aforementioned and

identify a course of action in consultation with the Council/Council Staff. If substantial changes to the assessment are contemplated by the STAT, the SSC-GFSC may recommend that the update be subject to further review at the supplemental review meeting to evaluate the proposed method more thoroughly.

For some stocks selected for benchmark assessments, the available data may prove to be insufficient for a Category 1 assessment (Appendix E). In such cases, the STAT should consider whether simpler approaches appropriate for a Category 2 or Category 3 assessment can be applied. Simpler approaches usually make stronger assumptions and estimate fewer parameters but are less demanding of data. It is the responsibility of the STAR panel, in consultation with the STAT, to consider the strength of inferences that can be drawn from analyses presented and identify major uncertainties. If useful results have been produced, the STAR panel should review the appropriateness and reliability of the methods used to draw conclusions about stock status and/or exploitation rates, and either recommend or reject the analysis on the basis of its ability to provide useful information into the management process. If the STAR panel agrees that important results have been generated, it should forward its findings and conclusions to the SSC and the Council for consideration in setting of OFLs, ABCs, and ACLs. A key section of the assessment is on research needed to improve the assessment. Highlighting research priorities should increase the likelihood that future stocks assessments can be raised to Category 1.

The review of update assessments is not expected to require additional model runs or extensive analytical requests, although changes in assessment outputs may necessitate some model exploration. The review focuses on two main questions:

- 1) Does the assessment meet the criteria of a stock assessment update?
- 2) Can the results of the update assessment form the basis of Council decision making?

If the answer to either of these questions is no, a benchmark assessment should be recommended for the next cycle. If the SSC-GFSC agrees that the update assessment results require additional, but limited exploration before being endorsed for management use, further review at the supplemental review meeting could be recommended. In cases like this, the subcommittee needs to develop a list of requests for the STAT to address before the supplemental review meeting.

Table 3. Anticipated transition pathways among assessment types, with illustrative justifications for each pathway. Alternative transition pathways and supporting justifications may also be appropriate, such as those arising from STAT discretion and subsequent communications during assessment development. All transition plans should be vetted and, at minimum, include communications with Council staff, SSC GFSC chair(s), NMFS WCR and Science Center stock assessment program leads, and the STAR panel chair and GMT/GAP representatives (if applicable). Transitions may not always follow a linear or single-step pathway and, depending on the circumstances, may require multiple iterations as issues are identified, evaluated, and resolved.

Stock Assessment Type

Originally Planned	Transition Result	Transition Window	Justification
Research Track	Management Track	Dependent on research requirements and progress and review (anticipated to last 1 or more management cycles)	Fundamental issues that required extensive research have been reasonably resolved as determined by review. The assessment can now be applied within the appropriate management track assessment type (e.g., benchmark).
Benchmark	Research Track	No later than 2 weeks prior to a STAR panel, but preferably well before to aid STAR panel planning	Fundamental issues are uncovered that critically alter the entire structure of the planned benchmark assessment and require considerable R&D in order to facilitate justifiable decisions that are anticipated to be well beyond the scope of the given assessment cycle.
Benchmark	Benchmark with Supplemental Review post-STAR panel	Conclusion of STAR panel to September Council meeting	Assessment needs additional foundational work, critical assumptions addressed, or data series reconfigured that can be completed in at least 4-6 weeks.
Benchmark/Data Moderate	Delay benchmark/data moderate to another cycle	No later than 2 weeks prior to a STAR panel, but preferably well before to aid STAR panel planning	Critical issue(s) are found that cannot be dealt with adequately in time for a STAR panel or, if sent to Supplemental Review, are not resolved, or if additional post STAR panel work is expected to exceed 4-6 weeks.
Data Moderate	Data moderate with Supplemental Review post-STAR panel	Conclusion of STAR panel to September Council meeting	Assessment needs additional foundational work, critical assumptions addressed, or data series reconfigured that can be completed in at least 4-6 weeks.
Update	Benchmark (with review at in-cycle Supplemental Review meeting)	No later than briefing book deadline for SSC-GFSC review meeting	Changes in the assessment, even under valid update assessment conditions, result in unexpected changes in key management quantities that are not well understood but are likely to be addressed by loosening update assessment restrictions.
Update	Benchmark (delayed to next cycle)	No later than briefing book deadline for SSC-GFSC review meeting	Changes in the assessment, even under valid update assessment conditions, may result in unexpected changes to key management quantities that are not well understood and require substantial additional work and STAR panel review beyond the existing cycle timelines and planning constraints..
Update/ Data Limited/ Empirical Indicator	These with Supplemental Review post-SSC review	Conclusion of SSC, or its advisory body, review meeting	The assessment approach needs additional work of substantive nature to require additional review.

3.4 Stock Assessment Categories and Risk tables

Management track stock assessment products are assigned to one of three categories based on the quantity and quality of information available and model-based estimates of uncertainty. Category assignments are made by the SSC and informed by recommendations from STAR panels. Detailed definitions for each of the three categories are provided in Appendix E and Section 4.4 of the FMP (PFMC 2026).

- Category 1 includes the assessments that have the smallest number of pre-specified parameters and better characterization of uncertainty.
- Category 2 is constrained by data availability, thereby requiring more simplifying assumptions (e.g., no recruitment deviations) and/or a reliance on more pre-specified parameters. Category 2 also tends to underestimate uncertainty (e.g., around $SB_{current}$).
- Category 3 involves the greatest number of pre-specified parameters and tends to underestimate uncertainty given limited data and fixed parameter assumptions.

Stock assessment categories are used to determine the scientific uncertainty (“sigma”) assumed around the OFL. Within each category of assessment there are a wide range of models, some of which are more certain than others (e.g., more data, data with stronger signals to inform parameter estimates, different data sources have consistent signals, etc.). The rubric in Appendix E defines characteristics of stock assessment data and models, model performance, and ecosystem and environmental information that together inform the scientific uncertainty buffer set by the SSC. The rubric provides a continuum where a less uncertain Category 2 assessment assumes a similar uncertainty (and therefore similar buffer between the OFL and ABC) as a more uncertain Category 1 assessment.

The contents of risk tables are reviewed by STAR panels (if applicable) and the SSC-GFSC. Final risk table levels and scientific uncertainty are proposed by the STAT and reviewed by the SSC-GFSC. The SSC-GFSC chair(s) and representatives from the NW/SWFSCs are responsible for ensuring a consistent application of the risk table rubric across assessments each biennial cycle. Risk tables should be developed for all category 1 and 2 benchmark and update assessments. Risk tables should be reevaluated for update assessments when the previous assessment included a risk table, though the two assessment columns may not change appreciably. If insufficient information is available to complete the ecosystem and environment section, that can be left blank.

4. ROLES AND RESPONSIBILITIES DURING THE STAR PANEL PROCESS

The goals and objectives of the STAR panel process are to:

1. provide comprehensive and transparent technical review to ensure that stock assessments represent the best scientific information available (BSIA) and facilitate the use of this information by the Council to adopt OFLs, ABCs, ACLs, harvest guidelines (HGs), and annual catch targets (ACTs);
2. meet the mandates of the MSA and other legal requirements;
3. provide an independent review of stock assessments;
4. increase understanding and acceptance of stock assessments and peer reviews by all participants/members of the Council family;
5. identify research needed to improve assessments, reviews, and fishery management in the

- future; and
6. use assessment and review resources effectively and efficiently.

4.1 Shared Responsibilities

All parties have a stake in assuring adequate technical review of stock assessments. NMFS, as the designee of the Secretary of Commerce, must determine that BSIA has been used when approving fishery management recommendations made by the Council. The Council uses advice from the SSC to determine that the information on which it bases its recommendations represents BSIA as defined by [NS2](#). All participants in the STAR process should be aware of NS2 and the guidance provided in this TOR. These BSIA criteria include inclusiveness, transparency, and openness in communication, which may be hindered by implicit bias. In order to increase awareness of implicit bias in the course of the review, each panel member is encouraged to participate in training (<https://implicit.harvard.edu/implicit/>). Scientists, fishery managers, and other advisors providing technical documents throughout the STAR process should ensure that their work is technically accurate.

The Council, NMFS, and the Secretary of Commerce share primary responsibility to create and foster a successful STAR process. The Council oversees the process and involves its standing advisory bodies, especially the SSC. A staff member from each NMFS Science Center is assigned as the Point of Contact (POC) to facilitate and assist Council staff in overseeing individual STAR panels. Together, NMFS and the Council consult with all interested parties to plan and prepare the TOR and develop a timeline of deliverables for final approval by the Council. NMFS and the Council share fiscal and logistical responsibilities, and should ensure that there are no conflicts of interest throughout the process².

4.2 Stock Assessment Review (STAR) Panel Chair

The STAR panel chair is appointed by the SSC and primarily responsible for:

- 1) coordinating pre-assessment workshops;
- 2) developing a STAR panel meeting agenda;
- 3) ensuring that STAR panel participants follow the Terms of Reference;
- 4) creating opportunities for GMT and GAP representatives to engage in discussions;
- 5) participating as a member of the STAR Panel;
- 6) guiding the STAR panel and STAT to mutually agreeable solutions; and
- 7) coordinating and conducting reviews of revised stock assessment documents.

It is the STAR panel chair's responsibility to ensure that STAR panel participants adhere to the

² The final NS2 guidelines state: a “[A] conflict of interest is any financial or other interest which conflicts with the service of the individual on a review panel because it: (A) Could considerably impair the reviewer’s objectivity; or (B) Could create an unfair competitive advantage for a person or organization; (C) Except for those situations in which a conflict of interest is unavoidable, and the conflict is promptly and publicly disclosed, no individual can be appointed to a review panel if that individual has a conflict of interest that is relevant to the functions to be performed. Conflicts of interest include, but are not limited to, the personal financial interests and investments, employer affiliations, and consulting arrangements, grants, or contracts of the individual and of others with whom the individual has substantial common financial interests, if these interests are relevant to the functions to be performed.”

TOR and that the meeting is run effectively and efficiently. The STAR panel chair should also provide an overview of the meeting expectations to ensure respectful interactions among STAR participants throughout the meeting. This avoids discussing topics beyond the scope of the assessment review to focus efforts on the task at hand.

The STAR panel chair appoints members of the panel to act as rapporteurs and draft the specific sections of the report. The STAR panel chair also solicits questions and comments from GAP and GMT advisors throughout the meeting and provides time each day for public comment. It is the obligation of the STAR panel chair, in consultation with other panel members, to prioritize requests to the STAT for additional analyses and to make certain that STAT responses are thorough and clearly presented. It is the responsibility of the STAR panel reviewers (and a designated rapporteur) to capture the explanation and discussion of each request in the ‘response’ section of the requests, rationale, and responses, and the chair should ensure that sufficient details are captured.

Following the STAR panel meeting, the chair will lead the effort to draft the STAR panel report. In addition to the reviewers, the chair will solicit comments on the draft report from the STAT and the STAR panel advisors. The purpose of this is limited to ensuring that the report is technically accurate and reflects the discussion that occurred at the meeting and should not be viewed as an opportunity to reopen debate on issues. The STAR panel chair is the final arbiter on wording changes suggested by STAT and the STAR panel advisors as the report represents the panel’s recommendations related to the assessment. The STAR panel chair is responsible for providing Council staff with the final version of the STAR panel report within two weeks of the meeting.

The STAR panel chair is also responsible for communicating with the STAT to determine if the revised stock assessment document is complete. In particular, the chair should confirm that the revised stock assessment document includes an accurate description of the final base model that was identified by the panel. Any post-STAR drafts of the stock assessment must be reviewed and approved by the panel chair. The assessment document can only be given to Council staff for distribution after it has been endorsed by the panel chair, and when it is accompanied by a complete and approved panel report. Likewise, the final draft that is published on the Council’s web site (www.pcouncil.org) must also be approved by the panel chair prior to being accepted by Council staff.

The panel chair is responsible for presenting the stock assessment review to the SSC, with any issues raised by the SSC being addressed by the STAT and/or STAR panel chair. If there are areas of disagreement between the STAR panel and the STAT, both sides will present to the SSC-GFSC, and conflict resolution mechanisms in the current TOR will be followed.

The STAR panel chair is also expected to attend the SSC meeting, and, if requested, GMT and relevant portions of the Council meetings, where stock assessments and harvest projections are discussed. The STAR panel chair will explain the reviews and provide technical information and advice. If a stock assessment is sent to the supplemental review, the STAR panel chair should attend the meeting to present the findings of the panel that resulted in the need for further review. In addition, the Chair is expected to participate in the supplemental review to discuss any issues and provide feedback to improve the process for future assessment cycles.

The STAR panel chair is responsible for ensuring that the following schedule is adhered to (as closely as possible, recognizing that exceptional and personal circumstances do arise):

- 1) The STAR panel report should be in complete form, except for minor editing within two weeks of the panel meeting so that the STAT can review and ensure that the post-STAR draft assessment document sent to the panel chair adheres to the STAR panel report (or at least justifies any discrepancies in that version of the assessment).
- 2) Comments on the post-STAR/Pre-SSC draft of the assessment should be returned to the STAT within two weeks after the deadline for that draft.
- 3) Comments on the post-SSC assessment document draft, if there is one, should be returned to the STAT within two weeks after the deadline for that draft, to ensure the STAT has time to complete any changes prior to the relevant briefing book deadline (or as soon as practicable for assessments sent to the supplemental review meeting for further work and review).
- 4) When time is limited between the STAR panel and the briefing book (or SSC-GFSC) submission deadline, an accelerated timeline of intermediate deadlines for the STAT and STAR panel/chair should be decided upon when the STAR panel schedule is approved to ensure an appropriately reviewed and revised version of the assessment will be available by the submission deadline.

4.3 Stock Assessment Review (STAR) Panel

The STAR is a transparent process. STAR panel meetings are open to the public and are announced on the Council's website, through Council meeting notices, and in the Federal Register prior to the STAR panel meeting. The Council posts background materials on an accessible website prior to the meeting and makes hard copies available upon request. A STAR panel normally meets for four to five days.

The number of assessment models reviewed per panel should ideally be two, except in extraordinary circumstances if the SSC and NMFS agree that it is advisable, feasible, and/or necessary, including more than two area models of the same species, or to facilitate review for a greater number of data-moderate assessments. When separate area assessments are conducted for the same species by different STAT members or other analysts, each assessment is considered an independent benchmark assessment for review purposes.

The role of a STAR panel is to conduct a detailed technical evaluation of and BSIA determination for benchmark stock assessments. The specific responsibilities of STAR panel members are to:

- 1) Be familiar with the [Terms of Reference, Accepted Practices Guidelines](#) (for groundfish assessments), and most recent Methodology Reviews.
- 2) Review draft stock assessment documents, data inputs, and analytical models, along with other pertinent information (e.g., previous assessments and STAR panel reports) before the STAR panel.
- 3) Discuss the technical merits and deficiencies of input data and analytical methods during the publicly accessible STAR panel meeting, work with STATs to address deficiencies, and suggest new tools or analyses to improve future assessments.
- 4) Develop STAR panel reports to document meeting discussions and recommendations.
- 5) Resolve disagreement(s) in a respectful manner.

STAR panels include a chair appointed by the SSC and three other reviewers that are knowledgeable about the stock assessment approaches being reviewed. At least one STAR panelist should be appointed from the Center for Independent Experts (CIE) and at least one should be familiar with West Coast stock assessments. Selection of STAR panelists should be based on expertise, independence, and creating a balance between outside expertise and in-depth knowledge of West Coast fisheries, the data available for those fisheries, and modeling approaches applied to West Coast groundfishes. Expertise in ecosystem models or processes is also desirable. An attempt should be made to identify one reviewer who can consistently attend all STAR panel meetings during an assessment cycle. Selected reviewers should not have or recently had financial or personal conflicts of interest with the scientific information, subject matter, or work product under review. STAR panel members who are federal employees should comply with all applicable federal ethics requirements. Reviewers who are not federal employees will be screened for conflicts of interest through existing financial disclosure processes or under the NOAA Policy on Conflicts of Interest for Peer Review Subjects. Reviewers should not have contributed to or participated in the development of the work product or scientific information under review. Reviewer responsibilities should rotate across the available pool of qualified reviewers, when possible.

STAR panel meetings also include representatives of the GMT and GAP, with responsibilities as laid out in these TOR, and a Council staff member to advise the STAR panel and assist in recording meeting discussions and results. The STAR panel, STATs, the GMT and GAP representatives, and the public are all legitimate meeting participants who should be accommodated in discussions.

The STAR panel should thoroughly evaluate each analytical approach, comment on the relative merits of each, and, when conflicting results are obtained, identify the reasons for the differences. The STAR panel should work with the STATs to come to agreement on a base model that will be reviewed by the SSC.

STAR Panel Requests for Additional Analyses

STAR panel meetings are intended as technical reviews of complete assessments rather than workshops for constructing the assessments. In the course of a meeting, the panel may ask the STAT for a reasonable number of sensitivity runs, request additional details on the proposed base model presented, or ask for further analyses of alternative runs. However, it is not unusual for the review to identify technical problems that would result in changes to the assessment results. Resolving technical issues to the mutual satisfaction of the STAR and STAT is an important task of the STAR process. The STAR panel is not authorized to conduct an alternative assessment representing its own views that are distinct from those of the STAT, nor can it impose an alternative assessment on the STAT. Similarly, the panel should not impose their preferred methodologies when this is a matter of professional opinion. Rather, if the panel finds an assessment to be inadequate, it should document its opinion and suggest potential remedial measures for the STAT to take to rectify perceived shortcomings of the assessment. Differences of opinion often may best be addressed by future research, and thus are appropriate to include in the “Future Research Recommendations” sections of the assessment and STAR panel report.

The STAR panels are expected to be judicious in their requests of the STATs. Requests for

substantial changes to data or analytical methods may require a considerable amount of time to complete and may result in changes to the assessment that cannot be adequately evaluated during the course of the STAR panel meeting. In many cases, such changes should be relegated to future research recommendations and/or methodology review. If a STAR panel agrees that considerable changes are necessary, and the assessment is not otherwise acceptable, a recommendation for further examination of the assessment at a supplemental review meeting is warranted. Similarly, if the STAR panel agrees that the assessment results strongly indicate that the current F_{MSY} value or management target and threshold are inappropriate, it should identify this in its report and recommend further analysis to support a change to more appropriate values.

STAR panel requests to the STAT for additional model runs or data analyses must be clear, explicit, and in writing. These requests and recommendations should be listed within the STAR panel's report, along with rationale and the STAT response to each request. To the extent possible, analyses requested by the STAR panel should be completed by the STAT during the STAR panel meeting. If follow-up work by the STAT is required after the review meeting, this should be completed before the briefing book deadline for the Council meeting at which the assessment is scheduled for review.

Uncertainty and Decision Tables in Stock Assessments

The STAR panel review focuses on technical aspects of benchmark stock assessments. It is recognized that no model or data set is perfect or issue-free. Therefore, outputs of a broad range of model runs should be evaluated to better define the scope of the accepted model results. The panel should strive for a risk-neutral perspective in its deliberations and discuss the degree to which the accepted base model describes and quantifies the major sources of uncertainty in the assessment. The STAR panel may also provide qualitative comments on the probability of results from various model runs, especially if the panel does not consider the probability distributions calculated by the STAT capture all major sources of uncertainty. However, as a scientific peer review body, the STAR panel should avoid matters of policy. Assessment results from model runs that are technically flawed or questionable on other grounds should be identified by the panel and excluded from the alternatives upon which management advice is to be developed. Although the decision tables, which include states of nature under the primary axis or axes of uncertainty, the recommended category designation, sigma, and catch projection assumptions, should be completed at the STAR panel, draft tables may be provided soon thereafter and included in the subsequent draft. The decision table is to be completed for the final document adoption shortly after the June or September PFMC meetings (November for those assessments going to supplemental review). Changes thereafter should be provided as addenda.

Once alternative models, which capture the overall degree of uncertainty in the assessment, are formulated, a two-way decision table (alternative models versus management actions) should be developed to illustrate the repercussions of uncertainty to management decisions. The ratio of probabilities of alternative models should be 25:50:25, with the base model being twice as likely as each of the low and high stock size alternatives. There are several ways in which the probabilities can be assigned to each model. One method bases uncertainty in management quantities for the decision table on the asymptotic standard deviation for the OFL in the final year of the model from the base model. Specifically, the current year spawning biomass for the high and low states of nature are given by the base model mean plus or minus 1.15 standard deviations

(i.e., the 12.5th and 87.5th percentiles). A search across fixed values of $\ln R_0$ are then used to attain the current year spawning biomass values for the high and low states of nature. Another method to provide reasonable alternative models uses the 12.5% and 87.5% quantiles of the likelihood profile of an estimated parameter (the value of 0.66 reflects the chi square distribution with one degree of freedom) to identify the major axis of uncertainty. Expert judgment may also be used as long as it is fully explained, justified, and documented.

Assessments can categorize uncertainty by using the model estimated uncertainty, sigma, or the default category-based sigma value (Privitera-Johnson and Punt 2020) if greater than the model estimate to create the low and high alternative states of nature. The above approaches may be an improved representation of the total uncertainty in the model, rather than the uncertainty within a specific model parameter. Secondly, the uncertainty expressed through the decision table is often symmetric. However, the actual uncertainty of a parameter or the spawning biomass is often not symmetric. Development of future decision tables should consider non-symmetric uncertainty in parameter and model uncertainty. Assessments could also explore uncertainty using MCMC. Using MCMC to express the probability of future population states given alternative harvest levels could be informative for the Council. Historically, MCMC has been challenging for West Coast groundfish stock assessments due to long run times and the STAR panel process that requires sub-daily turnaround of exploratory model results. The STAR panel may request that MCMC simulation be applied to the final model to more fully account for uncertainty.

Bracketing of the base model for which the geometric mean biomass in the current year is obtained from alternative models with high and low stock size (indicating that it is evenly distributed in log space) corresponds with the assumption of a lognormal distribution and is the current PFMC approach to identifying scientific uncertainty buffers. This approach is based on the recognition that the distribution of possible stock sizes is necessarily bounded at the low end and can extend much further from the point estimate, and thus the probability density is more log-normal than normal. Explanation and justification of severely non-lognormal structure of alternatives should be given. Similarly, if more than one dimension is used to characterize uncertainty, resulting in, for example, a 3-by-3 decision table, careful consideration and justification of how the complete table brackets the uncertainty should be undertaken. Further guidance on approaches for constructing decision tables will be provided in the Accepted Practices Guidelines document.

There should be text explaining the major uncertainties addressed in the decision table. In addition to a description of the major axis of uncertainty and differences in the catch scenarios evaluated in consultation with the GMT, a clear description of the implications of each alternative in terms of the status and trajectory of the biomass under the various states of nature and harvest levels should be provided. Decision tables must include the harvest control rules that produce the catch streams.

Determination of assessment model uncertainty

The STAR panel and STAT in consultation with Council staff should propose an appropriate method for measuring the scientific uncertainty in the stock assessment, known as “sigma”. Uncertainty should be based on the OFL uncertainty, to correspond to the adopted approach for addressing scientific uncertainty (Privitera-Johnson and Punt 2020). Typically, sigma would be identified as the larger value between the default category-based sigma and the asymptotic estimate of uncertainty (SD, standard deviation) associated with the estimated OFL. The log-space

uncertainty around the OFL value for the first forecast year is calculated as:

$$\sigma_{\text{OFL}} = \sqrt{\log((SD/OFL)(SD/OFL) + 1)}$$

Alternatively, sigma could be based on the spread of uncertainty underlying the decision table where $\sigma = (\log(\frac{\text{Base State of Nature}}{\text{Low State of Nature}}))/1.15$, where 1.15 is the normal quantile corresponding to a 75% two-sided confidence interval. The SSC will determine the appropriate sigma value (e.g., a proxy sigma based on the category designation) to apply to estimates of acceptable biological catch based on these calculations. As of 2019, sigma values account for the increase in scientific uncertainty with time, incorporating a concomitant increase in the buffer between the overfishing limit and acceptable biological catch with each year since the most recent benchmark or update assessment (e.g., time-varying sigma), which should be accounted for in producing projections (Wetzel and Hamel 2023). If changes to the sigma values are proposed (e.g., through risk tables), these should be adopted prior to the April Council meeting in odd years to facilitate their application in stock assessments, to prevent the need for revisions in catch projections due to changes made after completion of the assessments.

Areas of Disagreement

STATs and STAR panels are required to resolve any areas of disagreement during the meeting, if possible. Occasionally, fundamental differences between the STAR panel and STAT cannot be resolved during the STAR panel meeting. In such cases, the STAR panel must document the areas of disagreement in its report. If there are disagreements, the following questions should be discussed at the meeting:

- 1) Are there any differences in opinion about the use or exclusion of data?
- 2) Are there any differences in opinion about the choice of the base model?
- 3) Are there any differences in opinion about the characterization of uncertainty?

The STAT may choose to submit a supplemental report supporting its view, but in that case, an opportunity must be given to the STAR panel to prepare a rebuttal. These documents would then be appended to the STAR panel report as part of the record of the review meeting. In some cases, STAR panel members may have fundamental disagreements among themselves that cannot be resolved during the review meeting. In such cases, dissenting STAR panel members may prepare a report that would also become part of the record of the review meeting. The SSC would then review all information pertaining to STAR panel and STAR panel/STAT disputes and issue its recommendation.

Contested assessments, in which alternative assessments are brought forward by competing STATs using different modeling approaches and assumptions, would typically require additional time (and/or panel members) to review adequately, and should be scheduled accordingly. Historically, the occurrence of contested assessments has been rare. However, there are mechanisms in place to accommodate them within the STAR process. In all cases, competing assessment models should not be proposed to the SSC if they have not undergone a STAR panel review.

During interim periods, new data collection efforts, research surveys, and/or analytical methods in support of stock assessments may be reviewed through the Council's Methodology Review Process for Groundfish (Council Operating Procedure 25). This process provides an independent peer-review process of new methods in advance of the STAR panel process to ensure BSIA is used in stock assessments. The decisions and guidelines documented in endorsed methodology review panel reports are used to inform the Accepted Practices Guidelines for Groundfish Stock Assessments. The Accepted Practices Guidelines are intended to provide STATs with default approaches they should use for dealing with certain stock assessment data and modeling issues. STATs may diverge from the Accepted Practices Guidelines if they provide adequate justification for doing so. Accepted practices endorsed by the SSC should not be re-evaluated during STAR panel, unless there have been changes in the approach or method previously reviewed, or under other extenuating circumstances.

STAR Panel Report

STAR panel reports should pertain to a single stock, even when STAR Panel meetings involve two or more. The STAR panel report should be developed and approved by all panel members no later than two weeks after the STAR panel meeting. The final report should be submitted to the Council by the Briefing Book deadline.

The STAR panel report should include:

- Summary of the STAR panel meeting:
 - Names and affiliations of STAR panel members, STAT, and STAR panel advisors;
 - Brief overview of the meeting (where the meeting took place, what species was assessed, what was the STAR panel recommendation, etc.);
 - Brief summary of the assessment model and the data used;
 - List of analyses requested by the STAR panel, the rationale for each request, and a brief summary of the STAT response to the request;
- Description of the base model and alternative models used to bracket uncertainty;
- Recommended sigma value and the basis for the recommendation;

- Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies;
- Areas of disagreement regarding STAR panel recommendations:
 - Between the STAR panel and STAT(s).
 - Among STAR panel members (including concerns raised by STAR panel advisors);
- Unresolved problems and major uncertainties, e.g., any special issues that complicate the assessment and/or interpretation of results;
- Management, data, or fishery issues raised by the STAR panel advisors during the STAR panel; and
- Prioritized recommendations for future research and data collection, including methodology and ecosystem considerations for the subsequent assessment.

The STAR panel also makes a recommendation on whether the next assessment of the species should be a benchmark assessment or could be an update assessment and should explain reasons for its recommendation.

In addition, the STAR panel should recommend the category for the assessment based on the definitions of species categories in Appendix E and associated rules for relating category designations with sigma (the metric for an assessment's scientific uncertainty) (see Section 4.4 of PFMC 2026). The SSC will consider this recommendation when ultimately deciding the appropriate stock category.

The preliminary STAR panel report should be made available for review by the STAT within two weeks of the conclusion of the review, allowing sufficient time for the STAT to comment on issues of fact or differences in interpretation prior to the briefing book deadline. If the STAT disagrees with topics in the preliminary STAR panel report, the STAR panel and STAT should attempt to resolve them prior to the final STAR panel report. Otherwise, the areas of disagreement must be documented in the final STAR panel report.

If a STAR panel recommends that an assessment undergo further review, the STAR report should document the issues recommended for review at the supplemental review meeting. In the event that an assessment is rejected by the STAR panel or withdrawn by the STAT and a subsequent review at a supplemental review meeting is not possible, the STAR panel report should document the issues that will need to be addressed as part of a subsequent assessment.

4.4 Stock Assessment Team (STAT)

The STAT is responsible for conducting a complete and technically robust stock assessment that conforms to the TOR. For any assessment reviewed at a STAR panel, the STAT is responsible for preparing three versions of the stock assessment document:

- 1) a "draft" for discussion during the STAR panel meeting (often referred to as the "pre-STAR draft"),
- 2) a "revised draft" for presentation to the SSC (or SSC-GFSC), the Council, and GMT and GAP; and (often referred to as the "post-STAR draft"), and
- 3) a "final version" to be posted on the Council's website once adopted.

For assessment products reviewed only by the SSC-GFSC, the STAT is responsible for preparing two versions of the stock assessment document:

- 1) a “draft” for discussion during a SSC-GFSC review; and
- 2) a “final version” to be posted on the Council’s website once adopted.

The draft assessment document for benchmark, update, and data-moderate stock assessments should follow the outline in Appendix B, including an executive summary, as in the template in Appendix C. Where possible, the executive summary should paraphrase the shared content of the body of the report to minimize redundancy.

In the draft document, the STAT should identify a candidate base model, fully-developed and well-documented, for the STAR panel to review. A draft assessment document should be submitted by the STAT to the STAR panel chair, Council staff, and the NMFS stock assessment point of contact for the panel three weeks prior to the STAR panel meeting, to determine whether the document is sufficiently complete to undergo review. If the draft assessment is judged complete, the pre-STAR draft assessment and supporting materials would be distributed to the STAR panel and relevant GMT and GAP advisor representatives two weeks prior to the STAR panel meeting.

If the STAT brings a model to the STAR panel that differs from what was described in the pre-STAR document, the STAT should prepare and distribute a detailed errata sheet and/or list of changes detailing how the pre-STAR draft assessment differs from the version that will be presented at the STAR panel. The STAT should document any major pre-STAR model changes (including a sequential analysis of model changes) and present them at the beginning of the STAR panel to allow as much time as possible for consideration and review as well as providing an errata sheet.

If the assessment document does not meet the minimum criteria of the TOR, the review may be postponed to a supplemental review meeting. The supplemental review meeting generally is not able to review more than two benchmark assessments, though this may depend on the particular issues being addressed. Therefore, the review options are limited for assessments for which review, revision and endorsement are not completed within the anticipated schedule.

The STAT is also responsible for providing model files and data (in digital format) to the review meeting. The set of files provided by the STAT should include all files needed to run the model in its native environment as well as any standard sets of output or summary files as an electronic index of tables and figures. A list of available tables and figures provided in the electronic index should be included as an appendix in the assessment to make the readers aware of what tables and figures are available and where the electronic index can be found. The STAT should include projections for the decision table within one week of the STAR Panel's conclusion but preferably before the end of the STAR Panel meeting, to promote discussion.

The STAT is responsible for providing responses to any formal STAR panel requests with an explanation of how the new analysis affected model results. Figures should be provided with captions and sufficient written explanation to document the analysis and results. The STAT is encouraged to provide extractable tables and/or figures with their responses to STAR panel requests to facilitate their use in STAR panel reports.

In most cases, the STAT should produce a revised draft of the assessment document within three weeks of the end of the review meeting. The revised draft must be finalized before the briefing book deadline for the Council meeting at which the assessment is scheduled for review. Post-STAR drafts must be reviewed and approved by the STAR panel chair prior to being submitted to Council staff. Changes to drafts of data-moderate and data-limited assessment documents must be reviewed and approved by the chair of the meetings at which the reviews took place. These reviews are limited to editorial issues, verifying that all required elements are included, and confirming that the document reflects the discussion and decisions made during the review meeting.

The final version of the assessment document is produced by the STAT after the assessment has been reviewed and endorsed by the SSC, and adopted by the Council. Other than changes recommended by the SSC, only editorial and other minor alterations should be made to the revised draft for the final version. The final adopted category assignment (see Appendix E) should also be explicitly reported or stated in the final version of the document. Electronic versions of the final assessment document, model files, and key output files should be submitted by the STATs to Council staff for inclusion in a stock assessment archive by the end of the calendar year in which the assessment was reviewed. Any tabular data that are inserted into the final documents in an object or image format should also be submitted in alternative forms (e.g., spreadsheets), which allow selection of individual data elements.

A STAT conducting an assessment for which no base model was endorsed by a STAR panel should, in most cases, provide the pre-STAR draft assessment (or corrected/updated version thereof, as agreed upon with the STAR panel) to the Council by the June or September briefing book deadline (November, if the assessment was reviewed at the supplemental review). If the STAR panel, nonetheless, recommends using outputs of certain sensitivity runs to bracket uncertainty in the assessment, the results of those runs should be appended to the draft assessment and provided to the Council and its advisory bodies.

STATs are strongly encouraged to develop assessments in a collaborative environment by forming working groups and consulting with other stock assessment and ecosystem assessment scientists. Required pre-assessment workshops will typically be held between January and March of odd years. This time frame provides STATs with sufficient time to conduct preliminary analyses, gather data and begin initial assessment planning. The workshops allow stakeholders and other interested parties to discuss the available data and the potential data gaps, and have the STATs lead discussions regarding the anticipated foundational assumptions or issues and their treatment within the assessment (e.g., modeled spatial stock structure). Sufficient detail and presentation of considerations should be provided to facilitate informed discussions. The SSC-GFSC, associated STAR panel chair, the GMT and GAP advisors to the STAR panel, Council staff, and relevant data stewards should participate in the workshop to interpret and critically evaluate potential data sources. One goal of the pre-assessment workshop is to provide quality control of the data that will be used in assessments; the STAT should present preliminary data plots and analyses to the extent practicable. Any concerns raised in the pre-assessment workshop should be submitted to the STAT in writing by the STAR panel chair no later than two weeks after the pre-assessment workshop. Major concerns and responses should be documented in the draft assessment.

STATs are encouraged to evaluate alternative models and analyses that incorporate ecosystem considerations and cross-FMP interactions that may affect stock dynamics. Early coordination with the Integrated Ecosystem Assessment team to evaluate ecosystem considerations is recommended and, at a minimum, the predators and food habits of the subject species should be included in the ecosystem considerations section of the assessment. STATs should identify whether such new data sources or methods will be proposed for inclusion in assessments as early as feasible so that it is possible to hold a methodology review if one is needed (Council Operating Procedure 25). When new data sources or methods, which could be used in many assessments or are likely contentious, are planned for inclusion in the assessment, a methodology review should be conducted. Irrespective of whether a methodology review panel takes place, the STAR panel should be provided with model runs with and without the new data sources so that it can evaluate the sensitivity of model outputs to these data sources.

STATs, state agency representatives, the GMT, and other data stewards should coordinate early in the process to ensure timely availability of data. It is particularly pertinent to coordinate with custodians of ageing structures and parties responsible for processing them, which takes substantial time. In addition, the STAT should ensure that all fleets for which catch histories are derived are well defined. The STAT should provide catch histories to data stewards for approval before use. The STAT should consult with the GMT to determine the most suitable projection of mortality to include in the final year of the catch time series and forward projections in addition to the assumption of full attainment. To facilitate these processes, an ageing prioritization and catch estimation meeting will be convened in July of even numbered years and coordinated with members of ageing laboratories, NMFS, and the states. The intent of the meeting is to identify all available samples, plan ageing of available structures, update assessment authors on any changes to catch estimation methods, and for the states to bring forward approved historical and recent catches by species. As data are provided and compiled, the STAT will confirm the final catches at the state level with data providers so that state representatives can better review discrepancies, changes, and outliers prior to final approval.

The STAT should be provided with landings and other time series or demographic data (all but the most recent year of data) by December 1 of the year prior to the assessment year. Final data are due to the STATs at least twelve weeks in advance of the STAR panel meeting, to allow sufficient time for data processing, assessment model development, assessment document preparation, and document review. Council staff are responsible for providing data stewards and providers reminders regarding data delivery by the prescribed deadlines. STATs are not obliged to use data provided after the deadline. Delays in provision by responsible parties may affect the availability of information used in the final assessment. An assessment will not be sent to supplemental review solely due to late arriving data. If there are other substantial concerns raised by the STAR panel leading to the recommendation of a supplemental review, the late arriving data could be considered for inclusion in the model at that time.

STATs should make themselves available for discussions and meetings with industry and interested parties to discuss data and stock assessment issues as needed. The STAT should initiate contact with the GAP representative early during the assessment process, including discussion around on-the-water observations and development of the GAP-led appendix, planning the pre-assessment data workshop, and keep the GAP informed of the data being used and respond to any

concerns that are raised. The STAT should also contact the GMT representative and Council staff early in the process for information about data uses, changes in fishing regulations and spatial management issues that may influence model structure and the way data are used in the assessment. The latter is particularly important for nearshore groundfish stocks, for which each state has different regulatory histories. A GMT representative should also be included on data-related communications and meeting invitations.

Barring exceptional circumstances, STAT members who are not attending the STAR panel meeting (in-person or virtually) should be available remotely to assist with STAR panel requests and responses. A member of the STAT is expected to attend the SSC-GFSC meeting that precedes the Council review. The STAT may be requested by the SSC-GFSC to attend the SSC and/or Council meeting. In this case, each STAT should appoint a representative to attend the Council meeting where the assessment is scheduled to be reviewed. In any case, a member of the STAT should be available to respond to questions during the review, whether in-person or remotely. In addition, the STAT should be prepared to respond to GMT or Council staff requests for model projections to facilitate development of ACL alternatives; these requests will be provided in writing to the STAT by the STAR panel chair.

To produce greater consistency among assessments in the approaches taken to common technical problems, STATs should follow the [Accepted Practices Guidelines for Stock Assessments](#). The STATs may diverge from the guidelines if they provide adequate justification to the STAR panel, SSC-GFSC, and in the assessment document.

Finally, STATs are responsible for conducting model runs requested by the GMT and/or Council staff for use in the harvest specification process. STATs are also responsible for updating assessment model projections upon the Council's request for use in ecosystem, socioeconomic, or other related analyses. The STAT should collaborate with the GMT advisor and Council staff regarding removal assumptions. The default for specifying removals in projections and decision tables (e.g., using ACL or OFL values) is to use projected attainment for the remainder of the regulatory cycle (provided by the GMT advisor) and full attainment for the rest of the projected period.

For a stock identified as needing a rebuilding analysis, a STAT representative is strongly encouraged to attend the SSC-GFSC meeting that precedes the September Council meeting. Rebuilding analyses are typically reviewed at the supplemental review meeting of the SSC-GFSC.

4.5 National Marine Fisheries Service (NMFS)

NMFS assists in organizing stock assessment reviews. NMFS provides a point of contact (POC) for each panel to facilitate and assist in overseeing the STAR process. NMFS works to develop assessment prioritization guidance and a ranking of stocks for assessment that considers a range of factors for consideration by the Council. NMFS also develops a draft STAR panel schedule for Council review. The SSC Chair and Council staff identify STAR panel members based on criteria for reviewer qualifications and make every effort to designate one independent, CIE reviewer who can attend all STAR panel meetings to provide consistency among reviews. The costs associated with these reviewers are borne by NMFS for federal or CIE reviewers and the Council for other reviewers. NMFS also helps organize STAR panel meetings and develops meeting schedules.

NMFS (along with Council staff and the STAR panel chair) coordinates with the STATs to facilitate delivery of required materials by scheduled deadlines and in compliance with this TOR.

NMFS is encouraged to develop stand-alone documentation of key data sources under its purview (e.g., NMFS trawl and hook-and-line surveys) that can be incorporated as references in stock assessment reports. Such documentation should include maps of the areas covered by surveys. There should also be thorough stand-alone documentation of stock assessment software and associated analytical methods (e.g., generalized linear models [GLMs] or generalized additive models [GAMs] used to generate indices of abundance) that have been endorsed by the SSC. Such documentation will aid reviewers at STAR panels who may be unfamiliar with key data sources or modeling approaches and serves to maintain transparency in the STAR process.

4.6. Council Staff

Council staff coordinate, monitor, and document the STAR process to ensure compliance with the TOR. Council staff will also provide STATs with tables of regulatory histories, time series of harvest specifications (e.g., ABCs and ACLs), and relevant database references. This should include the major management measures that are likely to have impacted selectivity or retention parameters to inform time blocking within the assessment. Documentation of regulatory histories should be developed in consultation with the states and the GMT.

Council staff coordinate with the STAR panel chair and NMFS in an early review of assessment documents to assure that they are complete. If an assessment document is not in compliance with the TOR, Council staff returns the assessment document to the STAT with a list of necessary revisions, a notice that the deadline has expired, or both. Council staff also coordinate with the STAR panel chair, STAT, and NMFS in a post-STAR Panel review of the revised assessment document to ensure compliance with the TOR. When inconsistencies are identified, Council staff request appropriate revisions to be made by the STAT in time for briefing book deadlines.

Council staff attend and monitor all STAR panel meetings to ensure adherence to the TOR and independent review requirements of COP4. If inconsistencies with the TOR occur during STAR panel meetings, Council staff coordinate with the STAR panel chair to develop solutions to correct the inconsistencies. Council staff serves as an advisor to the STAT and STAR panel but does not serve as a member of the STAR panel. Council staff also attends and monitors SSC review of stock assessments to ensure compliance with the TOR.

Council staff is responsible for providing STATs with the information needed to conduct projections, including the default harvest control rules and multipliers needed to calculate buffers for scientific uncertainty. Council staff also collaborate with GMT representatives and STATs regarding removal assumptions, particularly for years with approved harvest specifications. Council staff are also responsible for timely issuance of meeting notices and distribution of appropriate documents to relevant groups, including making documents publicly available during STAR panels. Council staff are responsible for constructing timelines that allow for sufficient time to prepare and review documents, and that deadlines for one stock assessment do not overlap with those of another, given that individual Council participants tend to be involved in more than one assessment per cycle. Council staff also collect and maintain electronic copies of assessment

documents, relevant reports (e.g., from the STAR panel, SSC, GMT, GAP, and CIE reviewers), and public comments. These documents are typically posted on the Council’s website. Council staff are also responsible for disseminating information about pre-assessment workshops to facilitate stakeholder engagement early in the stock assessment process.

Council staff will provide the SSC-GFSC with the indicator report, along with a copy of the most recent benchmark stock assessment reviewed via the STAR process, and the associated STAR panel report. The Chair of the subcommittee will designate a lead reviewer from the subcommittee members for each indicator report to document the meeting discussion, produce a review report, and ensure that each review is conducted according to the TOR. The report is subsequently reviewed by the SSC. GMT and GAP representatives, as well as Council staff, also participate in the review.

4.7 Groundfish Management Team (GMT)

The GMT is responsible for identifying and evaluating potential management actions based on BSIA, by using stock assessment results and other information to make ACL, harvest goals (HG), and annual catch target (ACT) recommendations to the Council. The GMT advisor for a given assessment is responsible for assembling catch streams for projections and providing them to the STATs, as well as addressing questions from the STATs about regulatory history or management actions. The GMT is also responsible for coordinating with other agencies in validating catch streams using the agreed upon data source for removals (e.g., GEMM). This is particularly relevant for historical catches in new assessments. The GMT should work with state data stewards for approved catch histories.

GMT participation in the pre-assessment workshop is expected to provide input on directions of the assessment early in the process.

A GMT representative, usually appointed by the GMT chair, attends the STAR panel meeting and serves as an advisor to the STAT and STAR panel on changes in fishing regulations that may influence data used in the assessment and the nature of the fishery in the future. This includes contributing to the “Management, Data, or Fishery Issues raised by the GMT or GAP

Representatives During the STAR Panel Meeting” section of the STAR panel report and working with the STAR panel chair to ensure that GMT concerns are captured in the final STAR panel report. The GMT shall consult with Council staff and the states to document regulatory histories for stock assessments.

The GMT should be involved early in the stock assessment process to provide guidance on fishing regulations to ensure the STAT accommodates regulatory changes as best as possible in the modeling framework. The GMT should provide: 1) catch levels to be used for the projections for which OFLs and ACLs have already been approved by the Council, 2) as appropriate, catch levels for the last year of the model (the year previous to the year in which the assessment is conducted), and 3) projected catch levels for 12-year projections. Any recommended deviations from default removal assumptions should be accompanied by written justification to limit discrepancies between the STAT and GMT that could arise during the STAR process.

Successful separation of science (e.g., STAT and STAR panels) from management depends on assessment reviews being completed by the time the GMT meets to discuss preliminary ACL, HG, and ACT recommendations. The GMT should not seek revision or additional review of the stock assessments after they have been endorsed by the STAR panel. The GMT chair should communicate any unresolved issues to the SSC for consideration. The GMT can request additional model projections from the STAT to thoroughly evaluate potential management actions. Any requests from the GMT or GAP should be conveyed to the STAT through their respective GMT or GAP representatives for the STAR panel and should include Council staff for awareness of the request. Requests from any other outside sources should be conveyed in writing through Council staff. Any proposed changes should be discussed informally between the GMT and the STAT before being made official to avoid duplication of alternatives that are redundant or that are similarly bracketed by prior requests. The GMT should review the "revised draft" assessment to verify that the removal assumptions they requested were used in the assessment and projections provided in the assessment document. Where possible, the GMT should provide potential catch streams to the STAT for evaluation at or before the STAR panel. The GMT advisor to the panel should contribute to the "Management, Data, or Fishery Issues raised by the GMT or GAP Representatives During the STAR Panel Meeting" section of the STAR panel report and should have an opportunity to review the final language in that section of the panel report.

4.8 Groundfish Advisory Subpanel (GAP)

A GAP representative, usually appointed by the GAP chair, attends the STAR panel meeting and serves as an advisor to the STAT and STAR panel. Participation in planning the pre-assessment workshop is expected to facilitate stakeholder engagement and provide input on directions of the assessment early in the process. The GAP representative should review the data sources being used in the assessment prior to development of the stock assessment model and ensure that industry concerns regarding the adequacy of data used by the STAT are communicated and addressed early in the assessment process. Any requests from the GMT or GAP should be conveyed to the STAT through their respective GMT or GAP representatives for the STAR panel and should include Council staff for awareness of the request.

The GAP representative (along with STAT and STAR panel chair, if requested) is expected to attend the GMT meeting at which preliminary ACL, HG, and/or ACT recommendations are developed. The GAP representative is also expected to attend subsequent GMT and Council meetings where the relevant harvest recommendations are discussed.

The GAP representative to the STAR panel should be the lead coordinator of the GAP appendix that will be included in the final stock assessment document. This appendix should describe on-the-water observations over recent years, including specifics about stock dynamics, environmental trends, catch rate trends, socioeconomic considerations, and any other relevant information. The GAP representative will provide a draft, working document, version of the appendix to the STAT prior to the pre-assessment workshop so the STAT has time to consider local ecological knowledge (LEK) early on during assessment development. The GAP representative will deliver the final appendix to the STAT prior to the draft assessment deadline (i.e., 3 weeks prior to the STAR panel; see Appendix A). Additionally, the GAP advisor to the panel should contribute to the "Management, Data, or Fishery Issues raised by the GMT or GAP Representatives During the STAR Panel Meeting" section of the STAR panel report and should have an opportunity to review

the final language in that section of the panel report.

4.9 State Agency and Tribal Representatives

Most stock assessments rely on data collected by state agencies and Tribal staff as part of their routine fishery monitoring and sampling activities. Although these data are generally available in the PacFIN and RecFIN repositories, some data from special collections may only be available directly from the state agencies or Tribes and may require special considerations (e.g., because of unusual sampling protocols). State and Tribal data stewards or other knowledgeable representatives from the state agencies and Tribes should work with the STATs to provide relevant stock assessment data. These individuals should (a) provide the STATs with information on available data that might be relevant to upcoming assessments, (b) provide data requested by the STATs in a timely manner, (c) provide guidance on any special attributes of the data that may need consideration for appropriate analyses and interpretation, (d) provide confirmation that State level data used by the STAT are complete, and (e) attend associated pre-assessment workshops. Data stewards should provide STATs with all landings data and other “near-complete” time series or demographic data by December 1 of the year prior to the assessment, for all but the most recent year of data. The final year of data are due to the STATs at least twelve weeks in advance of the STAR panel meeting. Data stewards must approve catch histories used by the STAT.

4.10 Scientific and Statistical Committee (SSC)

The SSC plays multiple roles within the STAR process and provides the Council and its advisory bodies with technical advice related to the stock assessments and the STAR process. The SSC, in coordination with NMFS, state agencies, Tribes, and Council advisory bodies, is responsible for developing the Terms of Reference, and the SSC provides the Accepted Practices Guidelines ([found here](#)) for data uses and modeling approaches for stock assessments. Participation of members of the SSC-GFSC in the pre-assessment workshop is recommended to provide input on directions of the assessment early in the process.

The SSC is responsible for overseeing the stock assessment review process. To that end, the SSC should help plan and implement pre-assessment workshops and STAR panel meetings. All SSC requests to the STAT should be submitted by the SSC-GFSC (co)Chair. Individual SSC-GFSC members should refrain from making informal suggestions to the STAT during STAR panel reviews.

One SSC member is assigned to act as STAR panel chair. The STAR panel chair attends the pre-assessment workshop and the assigned STAR panel meeting and fulfills responsibilities described in the section “STAR Panel Chair Responsibilities”.

Shortly after the meeting, the SSC-GFSC issues a review report that includes: 1) comments on the technical merits and/or deficiencies of the update assessment; 2) explanation of areas of disagreement between the SSC-GFSC and STAT (if any); and 3) recommendations on the adequacy of the update assessment for use in management. The report may also include SSC-GFSC recommendations for modifications that should be made when the next benchmark assessment is conducted. If the subcommittee review concludes that it is not possible to use the update assessment, the SSC is responsible for providing recommendations on an appropriate fishing level to the Council.

The SSC conducts a final review of all types of stock assessments. Reviews of benchmark stock assessments (either by the relevant subcommittee or the SSC) should not repeat the detailed technical review conducted by the STAR panel. The SSC reviews the stock assessment document, the STAR panel report, and the SSC-GFSC report (when applicable) to ensure the assessment and review followed the TOR and Accepted Practices Guidelines. The SSC should note any concerns for the next assessment and propose changes to an assessment only under exceptional circumstances, such as finding an error or a gross violation of the TOR or Accepted Practices Guidelines. Although the SSC has the discretion to look into concerns it deems critical to evaluate, even if this requires requests for additional model runs, the SSC should strive to limit its attention to issues that were not covered in the TOR and/or Accepted Practices Guidelines or, in some cases, decisions concerning the base model configuration that may not have considered and evaluated all factors and diagnostics associated with the configuration.

The SSC also reviews the STAR panel recommendations and serves as an arbitrator to resolve disagreements between the STAT and the STAR panel if such disagreements occurred during the review meeting. The SSC is responsible for reviewing and endorsing any additional analytical work requested from the STAT by the GMT or Council staff after the stock assessment has been reviewed by the STAR panel. To ensure independence in the SSC review, the SSC members who served on the STAT or STAR panel for the stock assessment being reviewed are required to recuse themselves; their involvement in the review being limited to providing factual information and answering questions. The SSC may request post-STAR analyses and model changes to arrive at an assessment that is acceptable to the SSC, but such requests should be limited and focused.

The SSC is responsible for making OFL recommendations to the Council. The SSC is also responsible for assigning species managed by the Council to a specific category based on definitions of assessment categories in Appendix E, as well as determining the scientific uncertainty in estimating the OFL (i.e., the value for sigma). It is also the SSC's responsibility to determine when it is appropriate to make changes to proxies or use estimated values of F_{MSY} and B_{MSY} .

The SSC (for assessments reviewed by the SSC in June) or SSC-GFSC (for other assessments) reviews the STAR panel report and stock assessment documents and recommends whether an assessment should be further reviewed at the end of the assessment cycle by the SSC-GFSC during a meeting that occurs after all of the STAR panels, primarily to review rebuilding analyses for overfished/rebuilding stocks. Soon after completion of all STAR panels, the SSC-GFSC will meet by teleconference, webinar, or, if needed, in person to recommend which assessments, if any, will be sent to the supplemental review and to prioritize further analyses. At this late-summer meeting, the SSC-GFSC will also review all assessments endorsed by STAR panels, consider their own endorsement of these assessments in advance of the SSC's review in September, and recommend which STATs should attend the SSC review in September.

5. LITERATURE CITED

Dick EJ and AD MacCall. 2011. Depletion-based stock reduction analysis: a catch-based method for determining sustainable yields for data-poor fish stocks. *Fisheries Research* 110:331–341.

- Francis, R.C., 2011. Data weighting in statistical fisheries stock assessment models. *Canadian Journal of Fisheries and Aquatic Sciences*, 68(6), pp.1124-1138.
- Hamel, O.S., and Cope, J.M. 2022. Development and considerations for application of a longevity-based prior for the natural mortality rate. *Fisheries Research* 256: 106477. doi:10.1016/j.fishres.2022.106477.
- Hilborn R and CJ Walters. 1992. *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Chapman and Hall, New York. 570 pp.
- McAllister, M.K. and Ianelli, J.N., 1997. Bayesian stock assessment using catch-age data and the sampling-importance resampling algorithm. *Canadian Journal of Fisheries and Aquatic Sciences*, 54(2), pp.284-300.
- MacCall AD. 2009. Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations. *ICES Journal of Marine Science*. 66:2267–2271.
- Pacific Fishery Management Council (PFMC). 2026. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery through Amendment 27. Pacific Fishery Management Council, Portland, OR. 158 pp.
- Privitera-Johnson KM and AE Punt. 2020. Leveraging scientific uncertainty in fisheries management for estimating among-assessment variation in overfishing limits. *ICES Journal of Marine Science*. 77:515–526.
- Thorson, J.T., Johnson, K.F., Methot, R.D. and Taylor, I.G., 2017. Model-based estimates of effective sample size in stock assessment models using the Dirichlet-multinomial distribution. *Fisheries Research*, 192, pp.84-93.
- Wetzel CR and OS Hamel. 2023. Applying a probability harvest control rule to account for increased uncertainty in setting precautionary harvest limits from past stock assessments. *Fisheries Research*. 262:106659.

APPENDIX A: ANTICIPATED TIMELINE FOR GROUND FISH STOCK ASSESSMENTS AND REVIEWS

Event	Timing	Panel Chair	STAR Panel	STAT	GMT Rep.	GAP Rep.	Council Staff	NMFS POC	SSC-GFSC
Final stock assessment prioritization	Jun (even yr)								
Draft STAR panel schedule	After Jun Council meeting (even yr)							X	
Data Coordination Meeting	Jul or Aug (even yr)	X		X	X	X	X		
Update Accepted Practices Guidelines	Fall (even yr)						X		X
Data deadline (except most recent year)	Dec 1 (even yr)			X	X		X		
GAP working document (draft appendix)	Nov-Dec (even yr)					X			
Pre-assessment workshops	Jan to Apr (odd yr)	X		X	X	X	X		X
Final data deadline	12 wk before review			X	X		X		
Draft stock assessment submitted	3 wk before STAR panel			X		X			
Pre-review for compliance with TOR	3 wk before STAR panel	X					X	X	
Revised draft assessment to STAR panel	2 wk before STAR panel	X					X		
STAR panel	varies	X	X	X	X	X	X		
STAR panel report	2 wk after STAR panel	X	X		X	X	X		
Comments on post-STAR assessment	2 wk after STAR panel	X	X						
Revised assessment	3 wk after STAR panel			X					

Event	Timing	Panel Chair	STAR Panel	STAT	GMT Rep.	GAP Rep.	Council Staff	NMFS POC	SSC-GFSC
Post-STAR review for compliance with TOR	2 wk after revised draft	X					X	X	
Review to verify removal assumptions	2 wk after revised assessment				X	X			
Revised draft assessment	Sep Briefing Book deadline			X					
SSC Review	Sep Council meeting	X					X		X
Supplemental review, as needed	Last wk Sep (odd yr)								
Final stock assessment report	Nov Briefing Book deadline			X					
All files submitted to archive	Dec (odd yr)			X					
Process Review	Dec (odd yr)	X			X	X	X		X

APPENDIX B: OUTLINE FOR STOCK ASSESSMENT DOCUMENTS

This is a general outline of elements that should be included in benchmark, update, and data-moderate stock assessment documents for groundfish managed by the Pacific Fishery Management Council. Not every item listed in the outline is relevant (or available) for every assessment. Therefore, this outline should be considered a guideline on how to organize and communicate stock assessment results. Some items are identified as being optional for draft assessment documents prepared for STAR panel meetings but should be included in the final document. Also, some items are identified as being not applicable for a final assessment document associated with an assessment rejected by the STAR panel or withdrawn by the STAT. A checklist of elements to be included in stock assessment documents is included in Appendix C and a list of tables and figures to include in groundfish assessment documents or associated electronic indices are described in Appendix F.

Tables placed in assessment documents should not use a font-size smaller than 10 point and preferably should be in editable form (i.e., tables that can be copied or converted from the document, not images). Large tables can be provided in electronic form. For assessments undergoing review, all tables should be available upon request in editable, electronic files in text, csv, or spreadsheet format.

A. Title page and list of preparers

The names and affiliations of the STAT either alphabetically or as first and secondary authors. The page after the title page should include text on how to cite the assessment document, based on the following example. This report may be cited as:

Stewart, I.J., Thorson, J.T., Wetzel, C., 2011. Status of the U.S. Sablefish Resource in 2011. Pacific Fishery Management Council, Portland, Oregon. 442 p.

B. Executive Summary (should follow the template in Appendix B).

Where possible, the executive summary should paraphrase the shared content of the body of the report to minimize redundancy.

C. Introduction (expected to be concise: 2 to 5 pages)

An update assessment may include abbreviated information from each of the following items, citing the previous benchmark assessment for additional information, if there has not been new or changed understanding of the following attributes.

- 1) Scientific name, distribution, the basis for the choice of stock structure, including a brief description of regional differences in life history or other biological characteristics that should form the basis of management units.
- 2) A map showing the scope of the assessment and depicting boundaries for fisheries or data collection strata. This is not required for an update assessment.
- 3) Important features of current fishery and relevant history of fishery. Description of fisheries for this species off Canada, Alaska and/or Mexico, including references to any recent assessments of those stocks extending beyond the Council's jurisdiction. STATs are strongly encouraged to include a summary of catches and estimates of stock size and stock status for the most recent ten years if such information can be assembled without excessive difficulty. This is not required for an update assessment.
- 4) Summary of management history (e.g., changes in mesh sizes, trip limits, or other

management actions that may have altered selection, catch rates, or discards) and performance, including a table or tables comparing OFL, ABC, ACL, landings, and catch (i.e., landings plus discard) for each area and year. Assessments that estimate dead discarded catch must include a disclaimer noting that total mortality estimates from the WCGOP and from the stock assessment may differ due to the use of different methods. Investigation into how these methods differ is beyond the scope of a benchmark assessment. The rationale for modeling discard mortality can also be provided. This should be included in all update assessments.

- 5) A brief overview of the stocks assessment history, including a brief description of the category and type of the most recent assessments.
- 6) Ecosystem considerations that include relevant information on how environmental drivers, prey, competition, predation, and/or (habitat requirements/preferences may affect stock's status, vital rates (growth, survival, productivity, recruitment), or range and distribution. Ecosystem considerations may also include how these factors, cross-FMP interactions with other fisheries and human social dynamics that may affect the stock (e.g., reliance and dependence by fishing communities, non-target species constraining harvest rates). The length and depth of this section will depend on availability of information from published studies and Integrated Ecosystem Assessment reports, expertise of the STAT, and whether ecosystem factors contribute quantitative information to the assessment. This is not required for an update assessment if a citation to the previous assessment is provided.

D. Data

Description of all data and sources, used in the assessment; if not all data sources are used, provide the rationale for excluding particular data sources; report on consulting with GAP and GMT representatives regarding the use of various data sources.

- 1) Life History (growth, maturity, fecundity, natural mortality, meristics, etc.) Sources used to estimate biological parameters (e.g., natural mortality, growth, maturity schedules).
- 2) Catch (retained and discarded)
Indices and standardization: Fishery-dependent data: Commercial fisheries landings by state, year, and gear (PacFIN is the standard source for recent domestic commercial landings), historical catch estimates, discards, recreational fisheries catches, foreign removals; sample size information for length- and age-composition data by state, year and gear, including both the number of trips and fish sampled. Description of methods to estimate abundance indices, sample size information by survey and year. Include complete tables and figures and date of data extraction.
- 3) Fishery-independent data: Description of surveys used in the assessment, description of methods to estimate abundance indices, sample size information for length- and age-composition data by survey and year, including both the number of tows (or drops or sites for hook and line data) and fish sampled. Include complete tables and figures and date of data extraction.
- 4) Composition data - age, length (Description, aging error, reweighting)
- 5) Absolute abundance (if applicable)
- 6) Environmental or ecosystem data or model products used in the stock assessment model and/or in the preparation of data or estimation of biological parameters. If environmental or ecosystem data are incorporated in the stock assessment model, provide a report of

consultations with technical teams that evaluate ecosystem data or methodologies used in the assessment.

E. Assessment

Model

- 1) History of modeling approaches used for this stock. This is not required for an update assessment.
- 2) Response to the most recent review panel recommendations.
 - a) If a benchmark assessment, responses should be inclusive of both the STAR panel and SSC recommendations for remedying deficiencies in the most recent previous benchmark assessment.
 - b) If an update assessment, point by point responses to formal SSC-GFSC requests made during the review should be included. This is not required in draft update assessments undergoing review.
- 3) Description of new modeling approaches and changes made from the most recent assessment, with rationale. This should include bridging analyses that highlight the data and model changes that were most influential with respect to changes between the assessment being reviewed and the most recent adopted assessment. This is not required for an update assessment.
- 4) General model specifications: Assessment software/modeling program and its version identifier and access location used for the assessment, description of model structure, and definitions of fleets and areas. 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).
- 5) Model parameters: estimated and fixed parameters, constraints and priors on parameters, selectivity assumptions, natural mortality, treatment of age reading bias and/or imprecision, and other fixed parameters, description of stock-recruitment constraints or components, critical assumptions, and consequences of assumption failures.

Base model(s) selection and evaluation

- 1) Evidence of search for balance between model realism and parsimony. Key model assumptions and structural choices (e.g., asymptotic vs. domed selectivities, constant vs. time-varying selectivities). Summary of alternate model configurations that were examined but rejected. This is not required for an update assessment.
- 2) Briefly describe the bridging analysis performed to the previous assessment. Describe new data and new model changes made from the most recent assessment, with rationale. This should include those changes that were most influential with respect to changes between the assessment being reviewed and the most recent adopted assessment.
- 3) Data weights and extra variability parameters
- 4) Evaluation of model parameters. Likelihood profile for the base model over key parameters (typically natural mortality, stock-recruit steepness, and equilibrium recruitment, or R_0). The profile should indicate all likelihood values for individual components (e.g., indices by survey, compositional data for each type and fleet).
- 5) Model fits, including residual analysis for the base-run configuration, e.g., residual plots, time series plots of observed and predicted values, etc.
- 6) Convergence status and convergence criteria for the base-run model (or proposed base-

run). Randomization of starting parameter value run (e.g., jitter) results or other evidence of search for global best estimates.

Base-model(s) results

- 1) Table listing all explicit parameters in the stock assessment model used for base model, their purpose (e.g., recruitment parameter, selectivity parameter) and whether or not the parameter was actually estimated in the stock assessment model. Include the associated asymptotic standard error estimates.
- 2) Population numbers and biomass at age $\times$ year $\times$ sex (if sex-specific M , growth, or selectivity) (may be provided as a text, csv, or spreadsheet file). This is not required for review. Can be included in electronic appendices (SS report files), should be provided as supplementary material for assessments developed with alternative assessment platforms.
- 3) Time-series of total biomass, summary biomass, and spawning biomass (and/or spawning output), depletion relative to B_0 , recruitment and fishing mortality ($1-SPR$) (or exploitation rate estimates if fishing mortality not available) (table and figures).
- 4) Selectivity and catchability estimates (if not included elsewhere).
- 5) Stock-recruitment relationship.
- 6) Clear description of units for all outputs.
- 7) Description of how discard is included in yield estimates.

Sensitivity Analyses

- 1) Sensitivity to assumptions about model structure, i.e., model specification uncertainty.
- 2) Sensitivity to data set choice (e.g., using emphasis factors to selectively remove data sources) and weighting schemes (e.g., MacAllister & Ianelli weighting versus Francis weighting vs. Dirichlet weighting for compositional data), which may also include a consideration of recent patterns in recruitment.

I. Reference points

- 1) Unfished spawning stock biomass, summary age biomass, and recruitment, along with unfished spawning stock output.
- 2) Reference points based on $B_{40\%}$ for rockfish and round fish and on $B_{25\%}$ for flatfish (spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
- 3) Reference points based on default SPR proxy (spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
- 4) Reference points based on MSY (if estimated) (spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
- 5) Equilibrium yield curve showing various B_{MSY} proxies.

J. Unresolved problems and major uncertainties

Describe any special issues (e.g., unbalanced or questionable data, missing survey data) that complicate scientific assessment, questions about the best model scenario.

K. Harvest projections and decision tables

Decision tables are not required for review; however, harvest projection tables should be included for the candidate base model (with default harvest control rules). Not applicable to assessments that are rejected by a STAR panel or withdrawn by the STAT.

- 1) Decision tables (i.e., a matrix of alternative models (states of nature) versus management actions) should cover the plausible range of uncertainty about current stock biomass and a set of candidate fishing mortality targets used for the stock. See section “*Uncertainty and Decision Tables in Groundfish Stock Assessment*” (this document) on how to define alternative states of nature. Management decisions in most cases represent the sequence of catches including estimates of OFL based on F_{MSY} (or its proxy) and those obtained by applying the Council 40-10 or 25-5 harvest policy to each state of nature; however, the GMT may recommend other alternatives as being more relevant to Council decision making. OFL calculations should be based on the assumption that future catches equal ABCs and not OFLs.
- 2) Harvest projection information presented should include biomass / spawning output, stock depletion, and yield projections of OFL, ABC and ACL for the two years of the current biennial harvest specifications cycle plus ten years into the future. An example template for a table of harvest projections is provided below.
- 3) Include both years of the current biennium in projections / decision tables, so there is no gap shown in the tables between the current biennium and projection years. Do not report model-estimated OFLs and ABCs (and ACLs) for years in the current biennium that have management specifications in place. Instead use the OFLs and ABCs (and ACLs) specified in regulation. For assessed rockfish and roundfish stocks with estimated depletion greater than 40% the ABCs are equal to the ACLs; if less then the 40-10 harvest control rule is applied. For assessed flatfish stocks with estimated depletion greater than 25% the ABCs are equal to the ACLs; if less then the 25-5 harvest control rule is applied.

Table Caption: Projections of estimated OFL (mt), ABC (mt), resulting ACLs (mt) based on the **25-5/40-10** rule, Category **1/2** sigma of **0.50/1.0**, and P* of **0.45/0.40/0.35**, assumed catches in **2023** and **2024** based on recommended values from the GMTm, along with the estimated biomass in mt or spawning output in **trillions of eggs** and the fraction unfished. The adopted OFL, ABC, and ACL harvest specifications for **2023** and **2024** are provided below. Text in **bold** should be revised accordingly based on the species-specific harvest control rule, assumed assessment category and resulting sigma, default P*, years with assumed catches, and appropriate unit descriptions.

Year	Adopted OFL (mt)	Adopted ABC (mt)	Adopted ACL (mt)	As- sumed catch (mt)	OFL (mt)	Buffer	ABC	ACL	Spawn. Out- put	Frac. Un- fished
2023	3763	3485	3485	3485	-	-	-	-	7.69	0.336
2024	3563	3285	3285	3285	-	-	-	-	6.70	0.293
2025	-	-	-	-	2518	0.935	2354	2354	5.85	0.255
2026	-	-	-	-	2424	0.930	2255	2238	5.56	0.243
2027	-	-	-	-	2422	0.926	2242	2217	5.48	0.239
2028	-	-	-	-	2475	0.922	2282	2263	5.55	0.242
2029	-	-	-	-	2549	0.917	2337	2334	5.69	0.248
2030	-	-	-	-	2618	0.913	2390	2390	5.85	0.255
2031	-	-	-	-	2672	0.909	2429	2429	5.99	0.261
2032	-	-	-	-	2709	0.904	2449	2449	6.09	0.266
2033	-	-	-	-	2733	0.900	2460	2460	6.16	0.269
2034	-	-	-	-	2749	0.896	2463	2463	6.20	0.271

Note: Additional columns could be added as needed with area-specific ACLs for assessments that range across multiple management areas (e.g., allocations north and south of 40° 10' N. lat. or state-specific allocations). However, these additional columns are not required in pre-STAR panel draft assessments.

L. Risk Table

Discuss and reference the risk table (if available). Provide guidance on uncertainty captured and not captured in the assessment model.

L. Evaluation of scientific uncertainty

Fully document the calculation of the base model's sigma associated with the current year's OFL value.

M. Regional management considerations

Discuss whether there is biological evidence for a regional management approach. If a regional management approach is desirable for the stock but data are insufficient, identify the research and data needed to address the appropriate spatial scale of management actions. For stocks where the current practice is to allocate harvests by management area, a standard data product (e.g., the proportion of the survey biomass in each management area) can be provided as the

basis for GMT discussions regarding harvest allocation. The GMT advisor and Council staff should be consulted on the appropriate management areas and adopted allocation methods for each stock.

N. Research and data needs

- 1) Describe progress on Research and Data Needs items identified in the most recent previous stock assessment document and associated STAR panel report.
- 2) Describe new research and data needs and specify their priority (high, medium, low).

O. 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 STAT. This is not required for review.

P. Literature cited

Q. Auxiliary files

A list naming the required text files (complete parameter and data files in the native code of the stock assessment program) and any other supplementary electronic files that will accompany the assessment document when archived with the PFMC. For assessments conducted using Stock Synthesis, the following files should be included and archived with the stock assessment document: starter.ss, forecast.ss, the control (.ctl), data (.dat) and report (Report.sso) files, and the Stock Synthesis model executable.

R. Appendices

Include an appendix authored by the GAP that summarizes on-the-water observations. Include any other relevant appendices.

APPENDIX C: TEMPLATE FOR EXECUTIVE SUMMARIES IN STOCK ASSESSMENTS

Items marked with an asterisk (*) are optional for draft assessment documents prepared for STAR panel meetings but should be included in the final document. Items with double asterisks (**) are not applicable for a final assessment document associated with an assessment rejected by its STAR panel or withdrawn by its STAT.

Stock	Species/area, including an evaluation of any potential biological basis for regional management.
Catches	Trends and current levels - include table for last ten years and graph with long term data.
Data and assessment	Date of most recent assessment, type of assessment model, data available, new information, and information lacking.
Stock biomass and dynamics	Trends and current levels relative to unfished or historical levels, description of uncertainty. Include a table for the most recent 10 years and a figure that illustrates long-term estimates.
Recruitment	Trends and current levels relative to unfished or historical levels. Include a table for the most recent 10 years and a figure that illustrates long-term estimates.
Exploitation status	Exploitation rates (i.e., total catch divided by exploitable biomass, or the annual SPR harvest rate) - include a table with the last 10 years of data and a graph showing the trend in fishing mortality relative to the target (y-axis) plotted against the trend in biomass relative to the target (x-axis).
Ecosystem considerations	A summary of reviewed environmental and ecosystem factors that appear to be correlated with stock dynamics. These may include variability in the physical environment, habitat, competitors, prey, or predators that directly or indirectly affects the stock's status, vital rates (growth, survival, productivity/recruitment) or range and distribution. Note which, if any, ecosystem factors are used in the assessment and how (e.g., as background information, in data preparations, as data inputs, in decisions about model structure).
Reference points	Management targets and definitions of overfishing, including the harvest rate that brings the stock to equilibrium at $B_{24\%}$ for flatfishes and $B_{40\%}$ for all other groundfish stocks (B_{MSY} proxies) and the equilibrium stock size that results from fishing at the default harvest rate (the F_{MSY} proxy). Include a summary table that compares estimated reference points for SSB, SPR, Exploitation Rate and Yield based on SSB proxy for MSY, SPR proxy for MSY, and estimated MSY values.

Management performance	Catches in comparison to OFL, ABC, HG, and OY/ACL values for the most recent 10 years (when available), overfishing levels, actual catch and discard. Include OFL (encountered), OFL (retained) and OFL (dead) if different due to discard and discard mortality.
Unresolved problems and major uncertainties	Any special issues that complicate scientific assessment, questions about the best model scenario, etc.
Harvest projections **	Projected yields (OFL, ABC and ACL), spawning biomass / output, and stock depletion levels for each year. OFL calculations should be based on the assumption that future catches equal ABCs and not OFLs.
Decision Table * or **	See section “Uncertainty and Decision Tables in Groundfish Stock Assessment” (this document) on how to define alternative states of nature.
Risk Table	Jointly created between oceanographers and stock assessment scientists, the table outlines the primary oceanographic, assessment data, and assessment model structural features (modeled or unmodeled) that underlie potential decision risks.
Scientific Uncertainty	State the sigma value and the basis for its calculation.
Research and data needs	Identify information gaps that seriously impede the stock assessment.
Rebuilding Projections *	Reference to the principal results from rebuilding analysis if the stock is overfished. For groundfish, see the Rebuilding Analysis Terms of Reference for detailed information on rebuilding analysis requirements.

APPENDIX D: CHECKLIST OF ELEMENTS TO BE INCLUDED IN STOCK ASSESSMENTS

Section	Element description
A	STAT names and affiliations
A	Citation instructions, following the title page.
B	Executive Summary
B	<u>Exec. Summ., Stock description</u> : Species and area; basis for regional management.
B	<u>Exec. Summ., Catches</u> : Table with last 10 years; graph with long term information.
B	<u>Exec. Summ., Data & assessment</u> : Date and type of most recent assessment, model type, ...
B	<u>Exec. Summ., Stock biomass and dynamics</u> : Trends and current levels relative to unfished; ... table with last 10 years; graph with long term information.
B	<u>Exec. Summ., Recruitment</u> : Trends and current levels relative to unfished; ... table with last 10 years; graph with long term information.
B	<u>Exec. Summ., Exploitation status</u> : Exploitation rates ... ; table with last 10 years; Kobe (phase) plot with long term information.
B	<u>Exec. Summ., Ecosystem considerations</u> : Summary of relevant environmental and ecosystem factors ...
B	<u>Exec. Summ., Reference points</u> :
B	<u>Exec. Summ., Management performance</u> : Catches compared to OFLs, ABCs, ... table with values for the most recent 10 years. (Harvest specifications to be provided by Council staff).
B	<u>Exec. Summ., Unresolved problems and major uncertainties</u> : Special issues that complicate the assessment ...
B	<u>Exec. Summ., Decision table and projections (No decision table needed in draft assessments undergoing review; however harvest projection tables should be included for the candidate base model [with default harvest control rules])</u> : Projected yields (OFL/ABC/ACL), spawning biomass / output, depletion ...
B	Exec. Summ., Risk table
B	<u>Exec. Summ., Scientific uncertainty</u> : Sigma value and justification.
B	<u>Exec. Summ., Research and data needs</u> : Identify information gaps ...
B	<u>Exec. Summ., Rebuilding projections</u> : Reference to principal results from the rebuilding analysis (if applicable) ...
C	<u>Introduction</u> : 1. Scientific name, distribution, choice of stock structure, ...
C	<u>Introduction</u> : 2. A map showing the scope of the assessment ... *Not required for update assessments. May refer to the most recent assessment for additional information.

Section	Element description
C	<u>Introduction</u> : 3. Important features of life history . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
C	<u>Introduction</u> : 4. Ecosystem considerations . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
C	<u>Introduction</u> : 5. Important features of current fishery . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
C	<u>Introduction</u> : 6. Summary of management history. *Not required for update assessments. May refer to the most recent assessment for additional information.
C	<u>Introduction</u> : 7. Management performance, including a table with OFLs, ABCs, ACLs, HGs, landings, and catch . . .
C	<u>Introduction</u> : 8. Description of fisheries for this species off Canada, Alaska and/or Mexico . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
D	<u>Data</u> : 1. Fishery-dependent data: Commercial fisheries landings by state, year and gear ... Table with sample size information for length- and age-composition data...including both the number of trips and fish sampled.
D	<u>Data</u> : 2. Fishery-independent data: Description of surveys used . . . Table with sample size information for length- and age-composition data . . . , including both the number of tows and fish sampled.
D	<u>Data</u> : 3. Sources used to estimate biological parameters (e.g., natural mortality) . . .
D	<u>Data</u> : 4. Environmental or ecosystem data used.
E	<u>Model</u> : 1. History of modeling approaches used for this stock. *Not required for update assessments. May refer to the most recent assessment for additional information.
E	<u>Model</u> : 2. Response to most recent past STAR panel recommendations . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
E	<u>Model</u> : 3. (Update assessments only) Response to SSC-GFSC recommendations from the previous assessment accepted for management.
E	<u>Model</u> : 4. Bridging analysis, including description of new modeling approaches and other changes from the most recent assessment. *Not required for update assessments. May refer to the most recent assessment for additional information.
E	<u>Model</u> : 5. General model specifications: assessment program, model structure, area and fleet definitions, initial conditions.
E	<u>Model</u> : 6. Model parameters: estimated and fixed parameters, parameter constraints, priors, selectivity assumptions, ...

Section	Element description
F	<u>Base model selection</u> : 1. Evidence of search for balance between model realism and parsimony . . . *Not required for update assessments. May refer to the most recent assessment for additional information.
F	<u>Base model evaluation</u> : 2. Evaluation of model parameters. Likelihood profile for natural mortality; Likelihood profile for steepness; Likelihood profile for R_0 .
F	<u>Base model evaluation</u> : 3. Residual analysis, residual plots, time-series of observed and predicted values.
F	<u>Base model evaluation</u> : 4. Convergence status and convergence criteria, randomization runs.
G	<u>Base-model results</u> : 1. Table with all explicit parameters in the base model and associated SDs.
G	<u>Base-model results</u> : 2. Table with population numbers at age $\times$ year $\times$ sex, which may be included as a text or spreadsheet file. *Not required in a draft assessment undergoing review.
G	<u>Base-model results</u> : 3. Table with time-series of total biomass, summary biomass, spawning biomass, depletion, recruitment, . . .
G	<u>Base-model results</u> : 4. Selectivity estimates (if not included elsewhere).
G	<u>Base-model results</u> : 5. Stock-recruitment relationship.
G	<u>Base-model results</u> : 6. Clear description of units for all outputs.
G	<u>Base-model results</u> : 7. Description of how discard is included in yield estimates.
H	<u>Evaluation of uncertainty</u> : 1. Sensitivity runs to evaluate assumptions about model structure.
H	<u>Evaluation of uncertainty</u> : 2. Sensitivity to data set choice and weighting schemes: removal of data sources; alternative weighting methods for compositional data.
H	<u>Evaluation of uncertainty</u> : 3. Parameter uncertainty . . . Uncertainty estimates for parameters and derived quantities; basis for sigma; Likelihood profiles (tabular format) for M , h , and R_0 . . .
H	<u>Evaluation of uncertainty</u> : 4. Retrospective analysis, . . .
H	<u>Evaluation of uncertainty</u> : 5. Historical analysis . . .
H	<u>Evaluation of uncertainty</u> : 6. If a range of models runs for characterizing uncertainty . . . information on their relative probability.
H	<u>Evaluation of uncertainty</u> : 7. Ranges depicting uncertainty should include at least three runs . . . for use in the decision table.
H	The following model runs in the table below are required.

Section	Element description			
	Parameter(s) / Issue	Base Model Run	Sensitivity Model Run	Notes
	Natural mortality (M) Prior	Use natural mortality prior (Hamel and Cope, 2022). This prior is defined as a lognormal distribution with median value (corresponding to the mean in log-space) = 5.40/maximum age and log-scale sigma. Both parameters should include three significant digits.	None Required, though exploration of the Lorenzen M for age-varying M is recommended where appropriate.	The maximum age values on which M priors are based should be from fish caught within the area of the assessment, not from Alaska, for example. If the prior for M is used to provide a fixed value for M , the fixed value should be set equal to the median value of the prior (5.40 / maximum age).
	Age- or sex-specific M	If: sex-specific M If: age-varying M	Then: single M Then: age-invariant M	
	Weighting of compositional data	Francis (2011)	McAllister and Ianelli (1997) harmonic mean	STATs may also explore and use the Thorson et al. (2017) Dirichlet multinomial likelihood.
	Selectivity	If: All dome shaped	Then: One fleet asymptotic	
	Rockfish fecundity	Use fecundity relationships from the meta-analysis in Dick et al. (2017), at the appropriate taxonomic scale, if better species-specific relationships are not available.	None required.	
	Rockfish steepness	Use SSC-approved steepness prior for rockfish species in 2019 has a mean value of 0.72 and standard deviation of 0.16. If the assessment model does not estimate steepness, the STAT should fix the steepness value at 0.72.	None required.	
	Confirm	50-100 jitter model	NA	MCMC evaluations

Section	Element description			
	convergence	runs with a strong preference for 100 jitter runs when feasible.		are not required, but offer insights into individual parameter convergence and model stability diagnostics.
I	<u>Reference points</u> : 1. Unfished spawning stock biomass, summary age biomass, . . .			
I	<u>Reference points</u> : 2. Reference points based on $B_{40\%}$ for rockfish and roundfish and on $B_{25\%}$ for flatfish . . .			
I	<u>Reference points</u> : 3. Reference points based on SPR proxy . . .			
I	<u>Reference points</u> : 4. Reference points based on MSY . . .			
I	<u>Reference points</u> : 5. Equilibrium yield curve showing various B_{MSY} proxies.			
J	<u>Unresolved problems and major uncertainties</u> : Describe any special issues . . .			
K	<u>Harvest projections and decision tables</u> : * Decision tables are not required in a draft assessment undergoing review; however harvest projection tables should be included for the candidate base model (with default harvest control rules and default removal assumptions). ** Not applicable to assessments rejected by a STAR panel or withdrawn by the STAT.			
K	<u>Harvest projections and decision tables</u> : 1. Harvest projections and decision tables should include OFL, ABC, and ACL.			
K	<u>Harvest projections and decision tables</u> : 2. Information presented should include biomass / spawning output, stock depletion, . . .			
L	<u>Risk table</u>			
L	<u>Evaluation of scientific uncertainty</u> . Sigma and how it was calculated.			
M	<u>Regional management considerations</u> . Discuss biological evidence for a regional management approach and provide the estimates of survey biomass in each management region using the standard survey index standardization software used in the assessment or the adopted allocation method.			
N	<u>Research and data needs</u> : 1. Describe progress on research and data needs identified in the most recent previous assessment . . .			
N	<u>Research and data needs</u> : 2. Describe new research & data needs and priority . . .			
O	<u>Acknowledgments</u> : Include STAR panel members and affiliations . . . * Not required in a draft assessment undergoing review.			
P	<u>Literature cited</u> :			
Q	<u>Auxiliary files</u> : A list naming the required text files and any other supplementary electronic files . . .			

APPENDIX E: RISK TABLE RUBRIC FOR GROUNDFISH ASSESSMENTS AND RULES FOR MAKING MANAGEMENT TRACK CATEGORY ASSIGNMENTS

Scientific uncertainty is based on the risk table rubric (Table X). Broad categories are defined as follows:

- Category 1: data-rich model-based assessments that include catch, age, and index data;
- Category 2: model-based assessments, but models lack age data or composition data entirely; alternatively, assessments that are based on a complex of species with different life history characteristics. Data-moderate assessments (Section 3.2.1) are generally Category 2 assessments; and
- Category 3: OFL is derived from historical catch. The most data-rich assessments may have approximate values for natural mortality and age at 50% maturity, allowing for a DB-SRA or SSS approach.

Stock assessment categories are further divided into subcategories that are used to determine scientific uncertainty (σ). No assessment will fall wholly into a single subcategory for any factor. The STAT and reviewers should use judgement to determine where the preponderance of evidence lies for determining a level both within and across columns. More weight should be placed on factors that more strongly influence estimation of catch limits. This process should be transparently documented in the assessment report.

Category	Ecosystem and environmental conditions	Assessment data inputs	Assessment model fits and structural uncertainty
1a $\sigma = 0.25$	Indicators not used in the stock assessment show medium to high level of agreement and moderate to strong evidence supporting high species productivity	• Reliable catch reconstruction with good species identification • Informative fishery-independent survey • Age and length composition data for landed fish and bycatch for key fleets across a range of years • Functional maturity data from samples collected across time and the model area • Species-specific fecundity in the	• Solid fits to data, few conflicts among data sources • Productivity parameters across multiple processes (recruitment, natural mortality, growth) are estimated internally • Minimal evidence for temporally and/or spatially varying biology (or non-stationarity is accounted for in the model) • Sensitivity model runs are generally within the estimated parametric uncertainty • No long-term trends in recruitment (or these trends are captured in the forecast) • Steep likelihood profiles and stable jitters indicating

		California Current Ecosystem	parameters are well-estimated Minimal evidence of retrospective bias, or can easily be explained by data availability
1b $\sigma = 0.5$	Majority of indicators show no notable trends and/or no apparent environmental and ecosystem concerns	- Historical catches with moderate uncertainty, but reliable catches over the last 4+ decades - Fishery-independent survey available over full assessment area - Age and length composition data covering landed catch for fleets that account for the majority of removals, may be some gaps in time and/or for bycatch - Species-specific functional maturity - Fecundity may be based across species or regions	- Moderate fits to data, good fit to main data source - Most productivity parameters (recruitment, natural mortality, growth) are estimated internally; fixed parameters based on species-specific information - Possible weak-moderate evidence for temporally and/or spatially varying biology not captured by model Weak-moderate long-term trends in recruitment not captured in the forecast - Likelihood profiles and stable jitters indicate most parameters are well-estimated - Some possible evidence of retrospective bias that cannot be easily explained by data availability
1c $\sigma = 0.75$	Majority of indicators show medium to high level of agreement and moderate to strong evidence supporting low species productivity	- Uncertain catch reconstructions both historically and more recently - Fishery-independent survey over a limited spatial area or only fishery-dependent index available - Limited age composition data mainly to inform growth, or significant ageing error - Maturity and fecundity based on other species and/or regions	- Some problematic fits to data - Most productivity parameters (recruitment, natural mortality, growth) are fixed or estimated externally Although recruitment deviations are estimable for some portion of the time series, they are only weakly informed by composition data - Evidence for temporally and/or spatially varying biology not captured by model - Long-term trends in recruitment not captured in the forecast - Likelihood profiles and stable jitters indicate difficulty estimating parameters and a generally flat likelihood surface

			• Evidence of retrospective bias
2a $\sigma = 0.75$	Indicators not used in the stock assessment show medium to high level of agreement and moderate to strong evidence supporting high species productivity	• Historical catches with moderate uncertainty, but reliable species identification • Reliable catches for key years and areas of the fishery • Informative fishery-independent survey index • Age data may be included in the model • Length composition data covering landed catch for key years and areas of the fishery • Recent species-specific functional maturity data within model area • Species-specific fecundity in the California Current Ecosystem	• Good fit to main data source • Minimal conflicts in data from non-key fleets or minor surveys • Recruitment deviations and/or growth estimated internally • Selectivity for key fleets estimated and selectivity curves are plausible given fishery characteristics • Likelihood profiles informative for R0, prior is not strongly influencing estimation if used • Stable jitters • Minimal evidence of retrospective bias, or can easily be explained by data availability

2b $\sigma = 1.0$	Majority of indicators show no notable trends and/or no apparent environmental and ecosystem concerns	• Historical catches with moderate uncertainty, less reliable species identification • Reliable catches for key years and areas of the fishery • Fishery-independent survey index included, but may have high inter-annual variability or large standard errors that exceed inter-annual variability • Length composition data covering landed catch for key years and areas of the fishery, may be some gaps in time and/or for bycatch • Growth data is for species and area of interest • Species-specific biological maturity data within model area • Borrowed fecundity relationship	• Good fit to main data source, possibly moderate conflicts for data from non-key fleets or minor surveys • Selectivity for key fleets is fixed and selectivity curves are plausible given fishery characteristics • Most productivity parameters (recruitment, natural mortality, growth) are estimated externally; fixed parameters based on species-specific information • Likelihood profiles for R0 and natural mortality show estimates are relatively uninformed by data • Moderately stable jitters • Some evidence of retrospective bias that cannot be easily explained by data availability
2c $\sigma = 1.25$	Majority of indicators show medium to high level of agreement and moderate to strong evidence supporting low species productivity	• Uncertain catch reconstructions both historically and more recently • Limited or no length composition data • Biological maturity borrowed from other region or species • Borrowed fecundity relationship	• Some problematic fits due to conflicts in data • Commonly estimable productivity parameters (natural mortality, growth) are fixed; fixed parameters based on meta-analysis • Uninformed likelihood profiles for natural mortality/R0 • Jitters indicate complex likelihood surface • Strong retrospective bias, or cannot be examined due to limited time series of data

		Species not well sampled by fishery-independent survey; possible use of a fishery-dependent index instead	
3 $\sigma = 2.0$	-	-	-

APPENDIX F: STANDARD SET OF TABLES AND FIGURES TO BE INCLUDED IN GROUND FISH STOCK ASSESSMENT REPORTS OR IN ASSOCIATED ELECTRONIC INDICES

Section	Figure (f) / Table (t)	Main Document	Electronic Index
Executive Summary	t: 10 yr catches	x	
	f: all yr catches	x	
	t: 10 yr SB and depletion	x	
	f: all yr SB	x	
	f: all yr depletion	x	
	t: 10 yr recruits, recruitment deviations	x	
	f: all yr recruitments	x	
	t: 10 yr exploit, SPR	x	
	f: all yr 1-SPR	x	
	t: reference point table	x	
	t: management performance	x	
	t: projections	x	
	t: decision table	x	
Introduction and Data	f: assessment area map	x	
	t: all year landings	x	
	t: management performance (OFL, ABC, ACL, Landings, WCGOP estimates)	x	
	t: number of tows, samples, and N		x
	t: strata for designed-based indices		x
	f: data used in the model for each fleet and across years	x	
	f: catch figures	x	
	f: all indices used in the model	x	
	f: general data figures (compositions)	x	
	f: parameter prior distributions	x	
	f: assorted biology plots	x	
Model	t: model set-up description	x	
	t: parameter estimates/pre-specified and distributions	x	
	t: time-series table	x	
	t: data weights by data type	x	
	t: likelihood and parameters from base and sensitivities	x	
	t: profile likelihoods		x
	t: numbers-at-age		x
	f: estimated biology	x	
	f: stock synthesis version comparison and simple bridging	x	
	f: all fits to data	x	
	f: selectivity estimates	x	
	f: population time series (SSB, recruits, depletion)	x	

Section	Figure (f) / Table (t)	Main Document	Electronic Index
	f: sensitivity results	x	
	f: profiles (Piner plots preferred)	x	
	f: population trajectories by profile parameter values	x	
	f: retrospective results	x	
	f: comparison with previous assessments	x	
	f: equilibrium yield curve	x	
Projection and Decision Table	t: projections	x	
	t: decision table	x	
	t: risk tables	x	
	t: reference points	x	