A Guide to the Preparation of Alaska   
Groundfish SAFE Report Chapters

Alaska Fisheries Science Center

October 9, 2020

# Introduction

The BSAI and GOA Groundfish FMPs require that separate drafts of the SAFE reports be produced each year in time for the October and December meetings of the North Pacific Fishery Management Council. These drafts are assembled at meetings of the Groundfish Plan Teams held in September and November.

To ensure adequate time for internal review of stock assessments, a pair of due dates will be established annually. These due dates typically will precede the respective Plan Team meetings by two to three weeks.

The following guidelines govern the preparation of individual stock assessment chapters for the two drafts.

Please note that the Plan Teams expect sufficient documentation for any potential action item to be provided at least 7 days prior to the start of the meeting. If exceptional circumstances make it impossible to meet this deadline, the Teams expect such documentation to be provided as soon as possible, and in no case later than 5:00 p.m. on the day before the presentation is to be given.

## Guidelines Pertaining to the September SAFE Report

It is not always necessary to produce a chapter for the September SAFE report. In general, it is assumed that authors will be able to discern whether any changes in the stock assessment resulting from incorporation of the available new information are substantial enough to require review by the Plan Teams and SSC. Authors are strongly encouraged to collect and analyze new information prior to the relevant due date to ensure that the implications of such information are thoroughly evaluated.

A chapter may not be necessary for the September SAFE report if the above conditions do not apply, if no new information is available, or if preliminary analyses of new information fail to indicate any substantial changes from the previous assessment.

If a stock is being considered for upgrading to Tiers 1-3, or if a new assessment model or analysis is being recommended, a chapter should be produced that provides enough information for the Plan Team(s) to make a decision about what new models or analyses should be included in the November assessment.

In all cases, consideration should be given to **all** applicable SSC and Plan Team comments from the previous assessment(s). Chapters should be submitted by the relevant due date.

## Guidelines Pertaining to the November SAFE Report

A chapter should be produced for the November SAFE report in all cases except for stocks or stock complexes that the AFSC, after consultation with the Plan Teams and SSC, has placed on a biennial assessment cycle. The chapter should include all sections listed in the "Outline of SAFE Report Chapters" below. The Outline is intended to provide a consistent structure and logical flow for stock assessments conducted at the AFSC for the groundfish fisheries of the BSAI and GOA. Some variation from this outline is permissible if warranted by limitations of data or other extenuating circumstance. However, it is particularly important that all of the items listed under "Projections and Harvest Alternatives" be included to the maximum extent possible, in that many of these are critical to the fishery management process. Consideration should be given to **all** applicable SSC and Plan Team comments from the previous assessment(s). Chapters should be submitted by the relevant due date.

Please **omit** any headers, page numbers, and footers on the version of drafts submitted for dissemination to the Plan Teams or Council. They will be added afterwards. Use of section heading styles in Word (heading 1, heading 2, etc.) and “normal” style[[1]](#footnote-1) for main text is encouraged. Please allow 1 inch margins (72 points) and be sure the tables or figures don’t overlap the margins. Please use the chapter numbers as they appear in the tasking memo.

SAFE chapters should be outlined as follows:

Title

Please use the following convention: “Assessment of the *Myfish* stock in the *Gulf of Alaska*” for single-stock assessments and “Assessment of the *Myfish* stock complex in the *Gulf of Alaska*” for multi-stock assessments (replacing italicized text appropriately).

# Executive Summary

## Summary of Changes in Assessment Inputs

List of changes (if any) in the input data, including estimated catches assumed for the current year and projected catches for current year + 1 and current year + 2.

List of changes (if any) in the assessment methodology. **This is one of the most important sections of the SAFE report.** Common mistakes in this section include: 1) listing something that *has not* changed, and 2) *not* listing something that *has* changed.

## Summary of Results

Text table showing *M*; recommended Tier; projected total biomass (give age range); female spawning biomass; equilibrium female spawning biomass values for *B0* and *BMSY* (Tier 1 only) or *B100%*, *B40%*, and *B35%* (Tier 3 only); *FOFL*; the maximum allowable value for *FABC*; the recommended value for *FABC*; OFL; the maximum allowable ABC, and the recommended ABC. State whether the stock or complex is being subjected to overfishing, is currently overfished, or is approaching a condition of being overfished. Compare all of the above to the corresponding values from last year’s final assessment (or final specifications, if different from the assessment values). Tier-specific templates for this table are shown on the following pages (**notes: 1) the rows labeled “Female spawning biomass (t)” and “Projected” for Tiers 1 and 3 and the row labeled “Biomass (t)” for Tier 5 are headers, so please do not put anything in those rows; 2) the “x” in “age x+” should be replaced with the appropriate value for stocks in Tiers 1 or 3; and 3) cells with “current year…” should be replaced with the appropriate number, where “current year” means *this year***). A brief discussion of substantial changes in results from last year may be included if it helps explain the summary table.

# Tier 1 Template

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quantity** | As estimated or  *specified last* year for: | | As estimated or*recommended this* year for: | |
| current year | current year + 1 | current year\* + 1 | current year\* + 2 |
| *M* (natural mortality rate) |  |  |  |  |
| Tier |  |  |  |  |
| Projected total (age x+) biomass (t) |  |  |  |  |
| Projected Female spawning biomass )t\_(t) |  |  |  |  |
| *B0* |  |  |  |  |
| *BMSY* |  |  |  |  |
| *FOFL* |  |  |  |  |
| *maxFABC* |  |  |  |  |
| *FABC* |  |  |  |  |
| OFL (t) |  |  |  |  |
| maxABC (t) |  |  |  |  |
| ABC (t) |  |  |  |  |
| **Status** | As determined *last* year for: | | As determined *this* year for: | |
| current year − 2 | current year − 1 | current year − 1 | current year |
| Overfishing |  | n/a |  | n/a |
| Overfished | n/a |  | n/a |  |
| Approaching overfished | n/a |  | n/a |  |

\*Projections are based on estimated catches of xx,xxx t and xx,xxx t used in place of maximum permissible ABC for current year + 1 and current year + 2.

# Tier 3 Template

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quantity** | As estimated or  *specified last* year for: | | As estimated or  *recommended this* year for: | |
| current year | current year + 1 | current year\* + 1 | current year\* + 2 |
| *M* (natural mortality rate) |  |  |  |  |
| Tier |  |  |  |  |
| Projected total (age x+) biomass (t) |  |  |  |  |
| Projected Female spawning biomass )t\_(t) |  |  |  |  |
| *B100%* |  |  |  |  |
| *B40%* |  |  |  |  |
| *B35%* |  |  |  |  |
| *FOFL* |  |  |  |  |
| *maxFABC* |  |  |  |  |
| *FABC* |  |  |  |  |
| OFL (t) |  |  |  |  |
| maxABC (t) |  |  |  |  |
| ABC (t) |  |  |  |  |
| **Status** | As determined *last* year for: | | As determined *this* year for: | |
| current year − 2 | current year − 1 | current year − 1 | current year |
| Overfishing |  | n/a |  | n/a |
| Overfished | n/a |  | n/a |  |
| Approaching overfished | n/a |  | n/a |  |

\*Projections are based on estimated catches of xx,xxx t and xx,xxx t used in place of maximum permissible ABC for current year + 1 and current year + 2.

# Tier 5 template

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quantity** | As estimated or  *specified last* year for: | | As estimated or  *recommended this* year for: | |
| current year | current year + 1 | current year + 1 | current year + 2 |
| *M* (natural mortality rate) |  |  |  |  |
| Tier |  |  |  |  |
| Biomass (t) |  |  |  |  |
| *FOFL* |  |  |  |  |
| *maxFABC* |  |  |  |  |
| *FABC* |  |  |  |  |
| OFL (t) |  |  |  |  |
| maxABC (t) |  |  |  |  |
| ABC (t) |  |  |  |  |
| **Status** | As determined *last* year for: | | As determined *this* year for: | |
| current year − 2 | current year − 1 | current year − 1 | current year |
| Overfishing |  | n/a |  | n/a |

# Tier 6 template

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quantity** | As estimated or  *specified last* year for: | | As estimated or  *recommended this* year for: | |
| current year | current year + 1 | current year + 1 | current year + 2 |
| Tier |  |  |  |  |
| OFL (t) |  |  |  |  |
| maxABC (t) |  |  |  |  |
| ABC (t) |  |  |  |  |
| **Status** | As determined *last* year for: | | As determined *this* year for: | |
| current year − 2 | current year − 1 | current year − 1 | current year |
| Overfishing |  | n/a |  | n/a |

Text table of area apportionments (if any) for the recommended one- and two-year ahead ABCs and OFLs, with a brief description of the apportionment methodology.

## Responses to SSC and Plan Team Comments on Assessments in General

Responses to SSC and Plan Team comments on assessments in general (for each comment that is addressed in the main text, list comment, and reference the section where it is discussed). **If the SSC or Plan Team did not make any comments on assessments in general, say so.**

## Responses to SSC and Plan Team Comments Specific to this Assessment

Responses to SSC and Plan Team comments specific to this assessment (for each comment that is addressed in the main text, list comment and reference the section where it is discussed). **If the SSC or Plan Team did not make any comments specific to this assessment, say so**.

# Introduction

Scientific name

Description of general biology and distribution

Description of key life history characteristics specific to stock assessments (e.g., special features of reproductive biology)

Evidence of stock structure, if any

# Fishery

Brief description of fishery history

Description of management measures/unit(s)

* Management history (including key changes which may have influenced assessment procedures; selectivity of commercial fishing gear; or distribution of catch by gear, area, or season.
* Include a table of total catch, total ABC, total OFL, and total TAC, and associated management measures

Description of the current directed fishery (including gear types, seasons, major fishing locations)

Description of effort and CPUE

Information on discards of this stock or stock complex (from directed fishery for this stock or stock complex)

# Data

(If the data for any particular component described here are so voluminous that the corresponding tables would comprise more than 2 pages, the tables may be placed on an ftp site referenced in the chapter.)

For Tiers 1-3, insert a text table summarizing the data used in the assessment model (source, type, years included). The following is a typical example:

|  |  |  |
| --- | --- | --- |
| **Source** | **Data** | **Years** |
| NMFS Groundfish survey | Survey biomass | 1984-1999 (triennial), 2001-2013 (biennial) |
|  | Age Composition | 1984, 1987, 1990, 1993, 1996, 1999, 2003, 2005, 2007, 2009, 2011 |
| U.S. trawl fisheries | Catch | 1961-2013 |
|  | Age Composition | 1990,1998-2002, 2004, 2005, 2006, 2008, 2010 |
|  | Length Composition | 1963-1977, 1991-1997 |

Data which should be presented as time series (starting no later than 1977, if possible):

## Fishery:

Catch as used in the model (by area and gear if that is how it is used in the model). This table may omitted if this table simply duplicates the catch table shown under “Management units/measures”)

In an appendix, present removals from sources other than those that are included in the Alaska Region’s official estimate of catch (e.g., removals due to scientific surveys, subsistence fishing, recreational fishing, fisheries managed under other FMPs)

Catch at age or catch at length (including sample sizes), as appropriate

## Survey:

Survey biomass estimates, including at least one measure of sampling variability such as standard error, CV, or 95% confidence interval (for stocks managed as complexes, be sure to report the sampling variability for the complex-wide survey biomass estimate, not just the individual stocks). Complex-wide variance could be computed simply by summing the variances from the survey estimates.

Survey numbers at age or numbers at length (including sample sizes), as appropriate

## Other time series data used in the assessment:

If biological data are time-varying in the assessment model (e.g., annual weight at age, length at age), these data should be included for stocks/complexes managed under Tiers 1-3.

# Analytic Approach

## General Model Structure

Description of overall modeling approach (e.g., age/size structured versus biomass dynamic, maximum likelihood versus Bayesian)

If standardized software (e.g., Stock Synthesis) is used, give reference to technical documentation where variables and equations are described. If standardized software is not used, then list variables and equations used in the assessment model(s) in tables or appendices as appropriate.

## Description of Alternative Models

Description of alternative models included in the assessment, if any (e.g., alternative *M* values or likelihood weights); **note that the base model (i.e., the model most recently accepted by the SSC, either after reviewing the previous year’s final assessment or the current year’s preliminary assessment) must be included**

Per recommendation of the SSC (10/15), please use the following convention for numbering models:

When a model constituting a “major change” from the original version of the base model is introduced, it is given a label of the form “Model *yy.j*,” where *yy* is the year (designated by the last two digits) that the model was introduced, and *j* is an integer distinguishing this particular “major change” model from other “major change” models introduced in the same year.

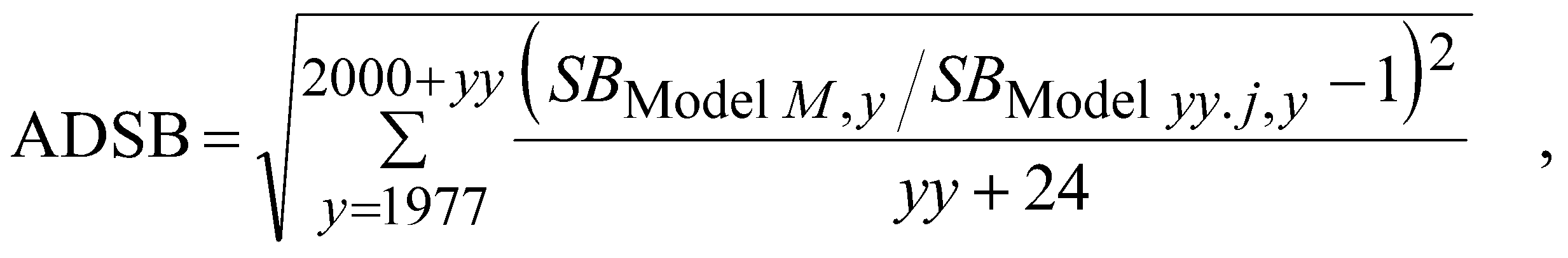
When a model constituting only a “minor change” from the original version of the base model is introduced, it is given a label of the form “Model *yy.jx*,” where “*x*” is a letter distinguishing this particular “minor change” model from other “minor change” models derived from the original version of the same base model.

Specifically, please use one of the following four options to distinguish “major” from “minor” changes:

*Option A*

The *original version of the base model* is the base model from the earliest year relative to which the current base model constitutes only a minor change.

If Model *yy.j* is the original version of the base model and some other model (provisionally labeled “Model *M*”) is introduced in year 20*zz*, define the “average difference in spawning biomass” (ADSB) between Model *M* and Model *yy.j* as:



where both models are run with data through year 20*yy* only (i.e., the year in which the original version of the base model was introduced). If ADSB<0.1, the final name of Model *M* should be of the form “Model *yy.jx*,” where “*x*” is a letter. If ADSB≥0.1, the final name should be of the form “Model *zz.i*,” where “*i*” is an integer. For Tiers 4-5, survey biomass may be used in place of spawning biomass in the above.

*Option B*

Same as Option A, except that the model approved by the SSC in 2014 is considered to be the original version of the base model in all cases. **The SSC noted that Option B can be used if Option A “poses a significant time commitment for the analyst.”**

*Option C*

Same as Option A, except that the distinction between “major” and “minor” model changes is determined subjectively by the author on the basis of qualitative differences in model structure rather than the performance-based criterion described in Option A. **The SSC noted that Option C can be used “where needed.”**

*Option D*

Options B and C combined.

## Parameters Estimated Outside the Assessment Model

(Use the above heading for Tiers 1-3)

## Parameter Estimates

(Use the above heading for Tiers 4-6)

List of parameters that are estimated independently of others (e.g., the natural mortality rate, parameters governing the maturity schedule, parameters governing growth [length at age, weight at length or age]—if not estimated inside the assessment model)

Description of how these parameters are estimated (methods do not necessarily have to be statistical; e.g., *M* could be estimated by referencing a previously published value)

## Parameters Estimated Inside the Assessment Model

(This section should be omitted for Tiers 4-6)

List of parameters that are estimated conditionally on those described above (e.g., full-selection fishing mortality rates, parameters governing the selectivity schedule, parameters governing growth if estimated inside the assessment model)

Description of how these parameters are estimated (e.g., error structures assumed, prior distributions used, list of likelihood components)

# Results

## Model Evaluation

(This section should be omitted for Tiers 4-6)

Conduct within-model retrospective analysis by rerunning each model successively, dropping data one year at a time. Specifically:

1. Include retrospective analysis extending back 10 years, plot spawning biomass estimates and error bars, plot relative differences, and report Mohn's “rho” statistic (see [Retrospective Working Group report](http://www.afsc.noaa.gov/REFM/stocks/Plan_Team/2013/Sept/Retrospectives_2013_final3.pdf) for formula, *not* Mohn’s 1999 paper).
2. Communicate the uncertainty implied by retrospective variability in biomass estimates.
3. For the time being, *do not* disqualify a model on the grounds of poor retrospective performance alone.
4. *Do* consider retrospective performance as one factor in model selection.

Description of other criteria used to evaluate the model or to choose between alternative models, including the role (if any) of uncertainty

Evaluation of the model, if only one model is presented; or evaluation of alternative models and selection of final model, if more than one model is presented

List of final parameter estimates, **with confidence bounds** or other statistical measures of uncertainty if possible (if the set of parameters includes quantities listed in the “Time Series Results” section below, the values of these quantities should be presented in the “Time Series Results” section rather than here)

Schedules, if any, defined by final parameter estimates

## Time Series Results

(This section should be omitted for Tiers 4-6. For Tiers 1-3, items in this section pertain to the authors’ recommended model.)

Include a table that has a set of parallel key results) for the previously accepted assessment, compared with new results. At a minimum this table should include spawning biomass and recruitment.

Definition of biomass measures used (e.g., age range used in the “age+” biomass)

Definition of recruitment measures used (e.g., numbers at age 3)

Table of estimated biomass time series, including age+ biomass and spawning biomass, **with confidence bounds** or other statistical measure of uncertainty if possible. The time series included in this **table should end with estimates for the projection year**. Include estimates from previous SAFE for retrospective comparison.

Table of estimated recruitment time series, including average of year classes spawned after 1976, **with confidence bounds** or other statistical measure of uncertainty if possible. Include estimates from previous SAFE for retrospective comparisons

Table of estimated numbers at age.

Graph of estimated biomass time series, with confidence bounds if possible

Graph of estimated fishing mortality versus estimated spawning stock biomass (phase-plane plot), including applicable OFL and maximum *FABC* definitions for the stock. Biomass should be scaled relative to *BMSY* for Tier 1 stocks and *B35%* for Tier 3 stocks. Fishing mortality should be scaled relative to the arithmetic mean of *FMSY*for Tier 1 stocks and *F35%* for Tier 3 stocks. Include 2 years of projected F and B in the phase-plane plot.

## Harvest Recommendations

(Items in this section pertain to the authors’ recommended model or approach. If the structure of the recommended model or approach differs substantively from the model or approach most recently accepted by the SSC after reviewing either last year’s final SAFE report or the current year’s preliminary SAFE report, a set of parallel results for the previously accepted model or approach should be included in an attachment.)

### Amendment 56 Reference Points

List of parameter and stock size estimates (or best available proxies thereof) required by limit and target control rules specified in the fishery management plan

For stocks managed under Tiers 4-5, in addition to estimates of stock size based on last year’s estimation procedure, include stock size estimates using the random effects model code provided by the Survey Averaging Working Group. Also, for the biomass estimate used in the harvest control rule, include at least one measure of uncertainty such as standard error, CV, or 95% confidence interval (for stocks managed as complexes, be sure to report the uncertainty for the complex-wide survey biomass estimate, not just the individual stocks).Document how this measure of uncertainty is calculated.

### Specification of OFL and Maximum Permissible ABC

Specification of *FOFL* (Tiers 1-5 only), OFL, and the maximum permissible *FABC* (Tiers 1-5 only) or maximum permissible ABC (Tier 6 only)

For Tiers 1-3, include:

* List of standard harvest scenarios and description of projection methodology
* Table of 13-year projected catches corresponding to the alternative harvest scenarios, using stochastic methods if possible (mean values or other statistics may be shown in the case of stochastic recruitment scenarios)
* Table of 13-year projected spawning biomass corresponding to the alternative harvest scenarios, using stochastic methods if possible (mean values or other statistics may be shown in the case of stochastic recruitment scenarios)
* Table of 13-year projected fishing mortality rates corresponding to the alternative harvest scenarios, using stochastic methods if possible (mean values or other statistics may be shown in the case of stochastic recruitment scenarios)

Include a section on how current and two future year catches are estimated. These catches should be included in the harvest scenario table under Scenario 2.

### Risk Table and ABC Recommendation

#### Overview

Copy and paste all of the text in this subsection, including the template:

“The following template is used to complete the risk table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Assessment-related considerations* | *Population dynamics considerations* | *Environmental/ecosystem considerations* | *Fishery Performance* |
| Level 1: Normal | Typical to moderately increased uncertainty/minor unresolved issues in assessment. | Stock trends are typical for the stock; recent recruitment is within normal range. | No apparent environmental/ecosystem concerns | No apparent fishery/resource-use performance and/or behavior concerns |
| Level 2: Substantially increased concerns | Substantially increased assessment uncertainty/ unresolved issues. | Stock trends are unusual; abundance increasing or decreasing faster than has been seen recently, or recruitment pattern is atypical. | Some indicators showing adverse signals relevant to the stock but the pattern is not consistent across all indicators. | Some indicators showing adverse signals but the pattern is not consistent across all indicators |
| Level 3: Major Concern | Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias. | Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns. | Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock) | Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types |
| Level 4: Extreme concern | Severe problems with the stock assessment; severe retrospective bias. Assessment considered unreliable. | Stock trends are unprecedented; More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns. | Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock; Potential for cascading effects on other ecosystem components | Extreme anomalies in multiple performance indicators that are highly likely to impact the stock |

“The table is applied by evaluating the severity of four types of considerations that could be used to support a scientific recommendation to reduce the ABC from the maximum permissible. These considerations are stock assessment considerations, population dynamics considerations, environmental/ecosystem considerations, and fishery performance. Examples of the types of concerns that might be relevant include the following:

1. “Assessment considerations—data-inputs: biased ages, skipped surveys, lack of fishery-independent trend data; model fits: poor fits to fits to fishery or survey data, inability to simultaneously fit multiple data inputs; model performance: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds; estimation uncertainty: poorly-estimated but influential year classes; retrospective bias in biomass estimates.
2. “Population dynamics considerations—decreasing biomass trend, poor recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance.
3. “Environmental/ecosystem considerations—adverse trends in environmental/ecosystem indicators, ecosystem model results, decreases in ecosystem productivity, decreases in prey abundance or availability, increases or increases in predator abundance or productivity.
4. “Fishery performance—fishery CPUE is showing a contrasting pattern from the stock biomass trend, unusual spatial pattern of fishing, changes in the percent of TAC taken, changes in the duration of fishery openings.”

#### Assessment considerations

Aim for 1-2 paragraphs. The following is an example, from the 2019 GOA pollock assessment:

The GOA pollock assessment does not show a strong retrospective bias, and fits to the age composition data for the fishery and surveys are generally adequate. The pollock assessment is one of a handful of assessments in the North Pacific that is fit to multiple abundance indices. In the last several years, there have been strongly contrasting trends in the survey abundance indices, with bottom trawl indices showing a steep decline, while acoustic surveys showing record highs (Figures 1.33 and 1.34). Since the model is unable to fit strongly contrasting trends, this has resulted in very poor model fits to the most recent survey indices. Although this divergence in trend is a recent phenomenon, it is worth mentioning a similar problems have been seen in past. Specifically, in the 1980s a major assessment issue was the difficulty in reconciling acoustic and bottom trawl estimates. We rated the assessment-related concern as level 2, a substantially increased concern, because the contrasting trends in survey indices add to the uncertainty of the assessment relative to other North Pacific assessments where this is not an issue. Last year we also gave this element a score of 2 for the same reason, and it is worthwhile noting that the survey inconsistencies are continuing to persist.

#### Population dynamics considerations

Aim for 1-2 paragraphs. The following is an example, from the 2019 GOA pollock assessment:

The age structure of pollock in the Gulf of Alaska has been strongly perturbed recruitment of the very strong 2012 year class that was followed very weak recruitment until 2017. Because of this sequence of events, the age-diversity of pollock dropped rapidly (Fig 1.15), and up until last year both the fishery and population were dominated by a single large year class. There are been other unusual phenomena associated with 2012 year class, including reduced growth, early maturation, and apparent reduced natural mortality (Fig 1.16). Last year we rated the population dynamics concern as level 2, a substantially increased concern. This situation has changed by the recruitment of a strong 2018 year class, which showed up consistently in the surveys conducted this year. The fishery age-diversity remained low in

2018, but we expect this to return to typical levels as the 2018 year class and the average 2017 year class start to enter the fishery. Therefore we reduced the concern level for population dynamics to level 1—no increased concerns.

#### Environmental/Ecosystem considerations

Aim for 1-2 paragraphs. The following is an example, from the 2019 GOA pollock assessment:

Last year, there were concerns about the fate of the 2018 year class based on warm temperatures and predictions of poor recruitment. Surveys conducted this year are consistent in indicating a strong 2018 year class, so these concerns appear to have been unwarranted. A review of new ecosystem information suggests that over-winter survival may have been aided by favorable prey abundance as indicated by the record high abundance of euphausiids observed on the Seward Line during September 2018 and potentially lower natural mortality due to reduced stock sizes of juvenile pollock groundfish predators such as Pacific cod, arrowtooth flounder and adult pollock. An additional positive sign for the 2018 year class is that the condition of age-1 pollock sampled during the bottom trawl survey was at long-term mean, indicating sufficient prey resources.

Spring and late summer young of the year surveys and other evidence suggest low abundance of the 2019 year class, but we did not consider a this a concern given that the 2018 year class (and to a lesser extent the 2017 year class) seems strong. For pollock in the GOA, it is not unusual for a strong year class to be followed by 3-4 years of weak year classes.

Overall, foraging conditions for the current pollock stock appear neither strong or weak, but slightly below average. Age-2+ pollock sampled during the summer bottom trawl survey showed slightly negative anomalies in condition (length-weight residuals) relative to long-term mean. There appeared to be an eastto-west trend in condition with heavy pollock per length in the eastern areas of the GOA relative to the western areas. Further supporting evidence of below average foraging conditions is the negative anomalies in condition of POP, which have similar diets to pollock.

Indicators of zooplankton abundance suggest moderate-to-low abundance of prey for pollock. The abundance of large copepods during spring along the Seward Line large copepod was low, and notably lower than in previous years 2015-2018. Similarly, Seward Line euphausiid abundance during spring was low (although but very high in September 2018 as described above). The abundance of pandalid and nonpandalid shrimp, another important pollock prey group, has been trending upwards in the NMFS bottom trawl survey. Acoustically-determined estimates of euphausiid biomass during summer was slightly lower than average. Also, parakeet auklet reproductive success was moderate, indicating sufficient zooplankton (primarily euphausiid) prey to support chick-rearing. However, the bottom trawl survey encountered high abundances of jellyfish, which may act as competitors of zooplankton. Stock sizes of another zooplankton predator, pink salmon, have been lower in 2019 than recent odd-numbered years.

The western GOA shelf area largely experienced heatwave conditions from September 2018 to October 2019. While the increased temperatures of the past year likely increased their metabolic demands as well as the metabolic demands of their groundfish predators, the conditions are not as concerning for pollock relative to other groundfish. The GOA pollock stock fared reasonably well during the 2014-2016 heatwave. This was likely due to the continued availability of sufficient zooplankton prey abundance, although prey quality (i.e., copepod community size) appeared to be lower. Although recently the heatwave as appeared to abate somewhat (S. Barbeaux, pers. comm., Nov 5, 2019), the North American Multi-Model Ensemble forecast is for warm conditions to persist throughout the North Pacific in the upcoming winter.

Taken together, we consider the current level of concern to be 1—no apparent environmental/ecosystem concerns, though we were very much on the fence as to whether score should be 1 or a 2. There are several indicators need to be closely watched, such as whether the heatwave intensifies, whether conditions remain unfavorable for pollock recruitment, and whether indicators of prey availability for pollock become more strongly negative. These may trigger a higher level of concern next year or in subsequent years.

#### Fishery performance

Aim for 1-2 paragraphs. The following is an example, from the 2019 GOA pollock assessment:

Trends in fishery CPUE were examined in the ESP (Appendix 1A) for two seasons, the pre-spawning fishery (A and B seasons) and the summer/fall fishery (C and D seasons). CPUE has been relatively high in recent years (up until the A and B seasons of 2019), and consistent with the abundance trend of exploitable biomass from the assessment. No concerns regarding fishery performance were identified.

#### Summary and ABC recommendation

Summarize the results of the previous subsections in a table. The following is example, from the 2019 GOA pollock assessment:

|  |  |  |  |
| --- | --- | --- | --- |
| *Assessment-related considerations* | *Population dynamics considerations* | *Environmental/*  *ecosystem considerations* | *Fishery Performance considerations* |
| Level 2: Substantially increased concerns | Level 1: no increased concerns | Level 1: no increased concerns | Level 1: no increased concerns |

Explain whether the above either warrants or does not warrant a reduction from the maximum permissible ABC under the relevant harvest control rule. If a reduction is warranted, authors may choose either to recommend a specific amount, or to recommend that the SSC determine the amount. If a specific reduction is recommended and the stock or complex is managed under Tier 3, the *FABC* and ABC recommendations should correspond to Scenario 2, where current catch and catches for the next two years were estimated as described in the preceding section.

### Area Allocation of Harvests

If area apportionment of ABC or OFL is used or recommended, include a subsection titled “Area Allocation of Harvests,” with results and details of the apportionment scheme(s) for upcoming year and the next.

### Status Determination

State whether:

1. The stock/complex is being subjected to overfishing (determined by comparing the catch from the most recent complete year to the specified OFL for that year),
2. The stock/complex is overfished (Tiers 1-3 only), and
3. The stock/complex is approaching a condition of being overfished (Tiers 1-3 only).

For full assessments of stocks/complexes managed under Tiers 1-3 only: Report the *F* (based on the author’s recommended model) that would have produced a catch for last year equal to last year’s OFL. Here are two simple options for making this calculation, but authors are feel free to write their own code if they prefer:

1. Use [this spreadsheet](https://docs.google.com/spreadsheets/d/1AeaVCSJqnh0kV6_zSPbK41Z2fBsxmsHsY66B36FTPoY/edit#gid=907492102) (note that separate tabs provide options for models with one sex and one gear, two sexes and two gears, and two sexes and two gears with sex-specific M). The units are kt for OFL, kg for weight at age, and millions of fish for numbers at age. Zeros can be inserted for unused ages.
2. For models developed in Stock Synthesis, replace last year’s catch in the data file with last year’s OFL, set maximum phase to 0 in the starter file, and re-run SS from the \*.par file (the answer will be listed in the report file as “F\_20yy,” where 20yy is the previous year). A similar procedure will likely work for many non-SS assessment models programmed in ADMB.

# Ecosystem Considerations

(Authors are encouraged to use information contained in the Ecosystem Status Report to assist them in developing stock-specific analyses and to recommend new information for inclusion in future versions of the Ecosystem Status Report. Time series currently contained in the Ecosystem Status Report may simply be referenced rather than duplicated here. In cases where stock-specific time series or relationships are used, this information should be included here rather than in the Ecosystem Status Report. In the event that an Ecosystem and Socioeconomic Profile is provided, this section can be omitted entirely.)

## Ecosystem Effects on the Stock

The following factors should be discussed:

Prey availability/abundance trends (historically, in the present, and in the foreseeable future). These prey trends could affect growth or survival of a target stock.

1. Predator population trends (historically, in the present, and in the foreseeable future). These trends could affect stock mortality rates over time.
2. Changes in habitat quality (historically, in the present, and in the foreseeable future). Changes in the physical environment such as temperature, currents, or ice distribution could affect stock migration and distribution patterns, recruitment success, or direct effects of temperature on growth.

## Fishery Effects on the Ecosystem

The following factors should be discussed:

1. Fishery-specific contribution to bycatch of prohibited species, forage (including herring and juvenile pollock), HAPC biota (in particular, species common to the target fishery), marine mammals, birds, and other sensitive non-target species (including top predators such as sharks, expressed as a percentage of the total bycatch of that species.
2. Fishery-specific concentration of target catch in space and time relative to predator needs in space and time (if known) and relative to spawning components.
3. Fishery-specific effects on amount of large-size target fish.
4. Fishery-specific contribution to discards and offal production.
5. Fishery-specific effects on age at maturity and fecundity of the target species.
6. Fishery-specific effects on EFH non-living substrate (using gear specific fishing effort as a proxy for amount of possible substrate disturbance).

# Data Gaps and Research Priorities

List areas where a significant improvement in the amount of available information would likely result in a significant improvement in the quality of the assessment and the estimates of critical parameters.

# Literature Cited

List all references cited in the assessment (and make sure that the current assessment cites appropriate previous assessments containing any analyses that are still mentioned but no longer included in the current assessment).

Omit all references not cited in the assessment (i.e., vestigial references from previous assessments).

# Tables

# Figures

1. Normal style should default to 11 point times new roman and is found under style options (under menu or by ctrl-shift-s) [↑](#footnote-ref-1)