A risk classification framework for setting the ABC less than maximum permissible level

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Introduction

An assessment methods workshop was held at the Alaska Fisheries Science Center during June 27-28, 2018. One goal of the workshop was to consider the request of the SSC in its February meeting minutes concerning criteria for reducing ABC from the maximum permissible ABC. "The workshop will also address the topic of adjustments made from the maximum permissible ABC to the recommended ABC. The SSC recommends identification of clear and transparent rules for defining the specific criteria to be used when adjusting the recommended ABC. Stock assessment uncertainty relative to levels upon which the tier system was constructed, atypical data availability or usage (e.g., reliance on only catch-per-unit-effort vs. a survey index), ecosystem considerations, and other factors are potential candidates. It may be helpful for one or more scientists involved with the Ecosystem Considerations report to participate in the workshop."

Although there was good discussion during the workshop, it became apparent that follow-up work would be required in order to adequately address this agenda item, and consequently an informal working group led by Martin Dorn was formed to report back to joint plan teams in September. The goals of working group were to summarize previous plan team recommendations to reduce the ABC below the maximum permissible, and to develop one or more frameworks that would satisfy the objectives articulated by the SSC. Two approaches were developed, a logistic analysis based on the reasons provided historically to reduce the ABC from the maximum permissible, and a risk classification framework (described in this document). The working group met on August 31 to review these proposed approaches. Working group participants included Martin Dorn, Kerim Aydin, Steve Barbeaux, Sandra Lowe, Elizabeth Siddon, Stephani Zador, James Armstrong, Dana Hanselman, Alan Haynie, Lisa Hillier, Grant Thompson, Kalei Shotwell, and Diana Stram. The working group made comments to improve each framework, and recommended that both be forwarded to joint plan teams for consideration in September.

Background

An explicit part of the NMFMC stock assessment process is an evaluation of whether it is appropriate to reduce the ABC from the ABC resulting from application of the control rules in

the tier system. As described in both the BSAI and GOA groundfish FMPs, groundfish stock assessments should "determine whether conditions exist that warrant setting ABC at a value lower than the maximum permissible value (such conditions may include—but are not limited to—data uncertainty, recruitment variability, and declining population trend) and, if so:

a. document those conditions,

b. recommend an ABC lower than the maximum permissible value, and

c. explain why the recommended value is appropriate.

The above steps are undertaken first by the assessment authors in the individual chapters of the SAFE report. The Plan Team then reviews the SAFE report and makes its own recommendation. The SSC then reviews the SAFE report and Plan Team recommendation, and makes its own recommendation to the Council. The Council then reviews the SAFE report, Plan Team recommendation, and SSC recommendation; then makes its own recommendation to the Secretary, with the constraint that the Council's recommended ABC cannot exceed the SSC's recommended ABC."

The NPFMC tier system implements precautionary management in which buffers are already in place to achieve a preferred degree of conservatism. Therefore the rationale for a reduction from the maximum permissible ABC should be that there is either additional uncertainty in the assessment and/or additional risks (probability of something bad happening) to the stock that are not adequately taken into account by the default precautionary settings. The risks generally relate to a loss of fishery sustainability or inability of the stock to perform its role in a functioning ecosystem, such as might occur due to severe decline in stock abundance.

It was noted during the assessment modeling workshop that there are three possible approaches to making reductions from the maximum permissible ABC:

- Making reductions on a case-by-case basis as deemed appropriate with rationale provided concurrently (this is the status quo situation).
- Establishing a framework with guidelines and criteria. Reductions are based on applying the criteria and guidelines in the framework.
- Use of an analytical approach that produces a reduction in the ABC. A simple example is the P* method, in which an increase in uncertainty results in a larger buffer being applied. Other analytical approaches may include models with environmental covariates, multispecies models, or ecosystem models. A management strategy evaluation could be done to provide analysis of explicit goals and tradeoffs.

The case-by-case approach provides maximum flexibility, but justification for the level of reduction in ABC is difficult to provide. The case-by-case approach is also subject to being applied inconsistently across stocks. Use of framework promotes consistency and transparency, but still would not evaluate tradeoffs between potential actions. An analytical approach seems desirable, but the necessary modeling to support such an approach would be complex and time consuming. In addition it would likely to be at least several years before it could be implemented, so an interim approach with clear improvement over status quo seems appropriate.

Proposed Framework

What follows below is a proposed framework for making reductions from the maximum permissible ABC. The intent was to design a framework with the following characteristics:

- The framework should document the criteria that can be used making reductions in ABC.
- ABC reductions should be calibrated, so that a more extreme situation results in a stronger response.
- ABC reductions should be consistent, so that similar situations result in a similar response across different stock assessments.

Although the SSC requested "clear and transparent rules," we think that a more flexible approach is needed to deal with the highly varied situations that could occur, some of which would be difficult to anticipate in advance. Therefore we recommend that the framework be regarded as providing a set of guidelines or defaults about how classify a certain situation and then identify an appropriate response. Deviating from the guidelines is possible if justification is provided, and may be necessary in novel situations.

There are three types of considerations that could be used to support a recommended reduction in the ABC:

1. Assessment-related considerations—
    a. Data-inputs: biased ages, skipped surveys, lack of fishery-independent trend data
    b. Model fits: poor fits to fits to fishery or survey data, inability to simultaneously fit multiple data inputs.
    c. Model performance: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds.
    d. Estimation uncertainty: poorly-estimated but influential year classes.
    e. 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.

Assessment-related considerations are those associated with an increase in the uncertainty of an assessment. Population dynamics and environmental/ecosystem considerations both relate to an increase in risk (i.e., an increase in the probability of something bad happening) beyond what is normally present in stock assessment. This could be a sudden decline in abundance or a series of recruitment failures, though other scenarios could be imagined that also increase risk to the stock. Population-dynamics considerations are not direct observations, but estimates produced by

the stock assessments, so extreme patterns could be either assessment error or an accurate characterization of population dynamics.

This framework assumes that a set of environmental/ecosystem indicators is available for the stock. These could be species-specific indicators such as those in the proposed ESPs (stock-specific ecosystem socio-economic profiles), or indicators in the ecosystem status report that are regarded as important to the stock. Indicators can either be forcing variables on the population dynamics of the stock, or a metric of ecosystem response to the population dynamics. An example of the former is the effect of temperature on recruitment, while an example of the latter is the fledgling success of a bird species that preys on the stock.

We propose as standard part of the stock assessment process that assessment authors initially assign risk levels by evaluating each of the three types of considerations (assessment, population dynamics, and ecosystem). For most stocks this would be a straightforward process of deciding that there are no increased concerns for each type of consideration, but the process would generate documentation of that low level of concern. A calibrated response is achieved by assigning the stock to one of four risk levels that reflect increasing levels of concern about the stock (Table 1). The overall risk level would be obtained by selecting the highest risk level of the three types of considerations, though in practice increases in risk are likely to be strongly correlated across types of considerations.

For each of these risk categories, the framework would establish guidelines for reducing the ABC from the maximum permissible. Several options could be considered, including a fixed percentage buffer that would increase (at either a faster or slower rate) as the overall risk level increased, a range of possible buffers at each risk level, or reduction in the fishing mortality rate with increasing risk (Table 2). The options in Table 2 are intended as examples to facilitate discussion, but are also designed to roughly bracket the ABC reductions that have been made in the past. The percent reduction should be regarded as a policy decision that would need to be endorsed by Council.

Table 1. Risk classification matrix for assessment, population dynamics, and environmental/ecosystem considerations.

	Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations
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
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 an 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, and/or b) up or down trophic levels (i.e., predators and prey of stock)
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

Table 2. Alternative procedures for reducing the ABC from the maximum permissible.

	Specified buffer, restrained response	Specified buffer, robust response	Suggested ranges for buffer	Increase SPR in HCR
Level 1: Normal	No buffer	No buffer	No buffer	F40%
Level 2: Substantially increased concerns	5%	10%	5%-10%	F45%
Level 3: Major concerns	10%	20%	10%-25%	F50%
Level 4: Extreme concerns	15%	30%	15%-40%	F60%