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DRAFT MAFMC Assessment Levels - Summary

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INTRODUCTION

During development of the Council's Annual Catch Limit/Accountability Measures (ACL/AM) Omnibus Amendment, the Council worked with its Scientific and Statistical Committee (SSC) to create a system which defines how uncertainty in stock assessments ultimately translates into catch buffers so as to account for that uncertainty in catch specifications. The system assigns assessments to one of four levels, which are based on the information available and approaches used to assess a stock. Level 1 to Level 4 progresses from more robust assessments with greater detail and lower scientific uncertainty to less robust assessments with more scientific uncertainty (measured or unmeasured).

RISK POLICY AND PROCESS

The Council's risk policy is used to describe the Council's tolerance for overfishing, which is informed by the system of levels to derive Acceptable Biological Catch (ABC). The overfishing risk policy states that when a stock is at or above the biomass (B) associated with producing maximum sustainable yield (B_{msy}), the Council's tolerance for the likelihood of overfishing is 40% for typical stocks and 35% for atypical¹ stocks. These can also be thought of as achieving a 60% or 65% likelihood of *not* overfishing for typical or atypical stocks respectively.

B_{msy} is often considered the target or "optimal" stock size from a fishery production point of view. As stock size falls below B_{msy} , the Council's tolerance for overfishing decreases linearly until stock size is one tenth of B_{msy} (i.e. extremely low), at which point the Council requires a 100% chance of not overfishing. The Council's risk policy also includes provisions for stocks in rebuilding plans, although no Council-managed stocks are currently in rebuilding plans.

No assessment is perfect. A variety of uncertainties (but not all) are cataloged and estimated in assessments - allowing calculations of how much to reduce catch to achieve specific probabilities of not overfishing (e.g., 60%, 65%, or even 100%). Restricting to lower catches leads to higher odds of avoiding overfishing.

In general, higher levels of uncertainty in an assessment require larger catch buffers to have confidence that overfishing will be prevented. Uncertainties vary across assessments, as do the documentation and

¹ Generally speaking, an atypical stock has a life history strategy that results in greater vulnerability to exploitation, and whose life history has not been fully addressed through the stock assessment and ACL-setting process. The SSC determines which stocks are typical or atypical based on an evaluation of all available information, and there has been considerable discussion about when to assign atypical status.

accuracy of uncertainty estimates. The assessment level system provides guidelines for the use of different types of assessments at a range of uncertainty levels. The system allows for differences to be accounted for by adjusting (usually expanding) the uncertainty estimated in lower level assessments. Expanding estimates of uncertainty will make buffers for scientific uncertainty larger and thus allowable catches would be lower.

The following text described the four levels system used by the Council and SSC. The level of catch that would achieve the maximum fishing mortality threshold (F_{msy}) for a given biomass is the overfishing limit (OFL) – this is the catch level that has a 50 percent probability of resulting in overfishing (median point estimate for the distribution). Regularly exceeding the OFL is likely to lead to a decline in stock size and could result in an overfished stock. The OFL distribution simply describes how likely various catch levels are to result in overfishing. Lower catch levels are logically associated with lower chances of overfishing (and vice-versa for higher catches).

LEVELS

Level 1: Level 1 represents the highest level to which an assessment can be assigned. Assignment of a stock to this level implies that all important sources of uncertainty are fully and formally captured in the stock assessment model and the probability distribution of the OFL calculated within the assessment provides an adequate description of uncertainty of OFL. Accordingly, the OFL distribution will be estimated directly from the stock assessment.

For a stock assessment to be assigned to Level 1, the SSC must determine that the OFL probability distribution represents best available science. Examples of attributes of the stock assessment that would lead to inclusion in Level 1 are:

- Assessment model structure and any treatment of the data prior to inclusion in the model includes appropriate and necessary details of the biology of the stock, the fisheries that exploit the stock, and the data collection methods;
- Estimation of stock status and reference points integrated in the same framework such that the OFL calculations promulgate all uncertainties (stock status and reference points) throughout estimation and forecasting;
- Assessment estimates relevant quantities including F_{MSY}^2 , OFL, biomass reference points, stock status, and their respective uncertainties; and
- No substantial retrospective patterns in the estimates of fishing mortality (F), biomass (B), and recruitment (R) are present in the stock assessment estimates.

The important part of Level 1 is that the precision estimated using a purely statistical routine will define the OFL probability distribution. Thus, all of the important sources of uncertainty are formally

² With justification, F_{MSY} may be replaced with an alternative maximum fishing mortality threshold to define the OFL.

captured in the stock assessment model. When a Level 1 assessment is achieved, the assessment results are likely unbiased and fully consider uncertainty in the precision of estimates. Under Level 1, the ABC will be determined solely on the basis of an acceptable probability of overfishing (P^*), determined by the Council's risk policy, and the probability distribution of the OFL (*which is directly generated from a statistical assessment model*).

Level 2: Level 2 indicates that an assessment has greater uncertainty than Level 1. Specifically, the estimation of the probability distribution of the OFL directly from the stock assessment model fails to include some important sources of uncertainty, necessitating expert judgment during the preparation of the stock assessment, and the final OFL probability distribution developed during the assessment is deemed best available science by the SSC.

Possible attributes of the Level 2 stock assessment include:

- Key features of the biology of the stock, the fisheries that exploit it, or the data collection methods are missing from the stock assessment;
- Assessment estimates relevant quantities, including reference points (which may be proxies) and stock status, together with their respective uncertainties, but the uncertainty is not fully promulgated through the model or some important sources may be lacking;
- Estimates of the precision of biomass, fishing mortality rates, and their respective reference points are provided in the stock assessment; and
- Accuracy of the MFMT and future biomass is estimated in the stock assessment by using *ad hoc* methods.

For Level 2 assessments, ABCs will be determined by using the Council's risk policy (similar to a Level 1 assessment), but with the OFL probability distribution based on the specified distribution developed in the stock assessment process. *In this case, the typical procedure would be that the assessment team developed a modified OFL distribution which incorporates additional sources of uncertainty not directly incorporated in the assessment model, and that modified characterization of uncertainty is accepted by the SSC.*

Level 3: Assessments in this level are judged to over- or under-estimate the accuracy of the OFL. Attributes of a stock assessment that would lead to inclusion in Level 3 are the same as Level 2, except that the assessment does not contain estimates of the probability distribution of the OFL or the probability distribution provided does not, in the opinion of the SSC, adequately reflect uncertainty in the OFL estimate.

For Level 3 assessments, the SSC adjusts the distribution of the OFL and develops an ABC recommendation by applying the Council's risk policy to the modified OFL probability distribution. The SSC evaluates a set of default or other amounts of uncertainty in the OFL probability distribution

based on literature review and an evaluation of ABC control rules. A control rule of 75 percent of F_{MSY} may be applied as a default if an OFL distribution cannot be developed.

In this case, generally either there is no estimation of uncertainty in the OFL from the assessment, or the uncertainty is insufficiently estimated, whether that came directly from a model or from additional work done by an assessment team. Depending on its evaluation of an assessment, the SSC then decides on the degree by which to modify the uncertainty on a case-by-case basis.

Level 4: Stock assessments in Level 4 are deemed to have reliable estimates of trends in abundance and catch, but absolute abundance, fishing mortality rates, and reference points are suspect or absent. Additionally, there are limited circumstances that may not fit the standard approaches to specification of reference points and management measures set forth in these guidelines (i.e., ABC determination). In these circumstances, the SSC may propose alternative approaches for satisfying the NS1 requirements of the MSA than those set forth in the NS1 guidelines. In particular, stocks in this level do not have point estimates of the OFL or probability distributions of the OFL that are considered best available science. In most cases, stock assessments that fail peer review or are deemed highly uncertain by the SSC will be assigned to this level.

Examples of potential attributes for inclusion in this category are:

- Assessment approach is missing essential features of the biology of the stock, characteristics of data collection, and the fisheries that exploit it;
- Stock status and reference points are estimated, but are not considered reliable;
- Assessment may estimate some relevant quantities including biomass, fishing mortality or relative abundance, but only trends are deemed reliable;
- Large retrospective patterns usually present; and
- Uncertainty may or may not be considered, but estimates of uncertainty are probably substantially underestimated.

In Level 4 the SSC uses all available information to set ABCs on a case by case basis, and generally may not increase ABCs unless the following two circumstances are met:

1. Biomass-based reference points suggest that the stock is greater than B_{MSY} , and the stock biomass is stable or increasing. If biomass-based reference points are not available, best available science indicates that stock biomass is stable or increasing, and,
2. The SSC must provide a determination that, based on best available science, the proposed increase to the ABC is not expected to result in overfishing of the stock. The SSC must provide a description of why the increase is warranted, describe the method used to derive the increased ABC, and provide a certification that the increase in ABC is not likely to result in overfishing on the stock.

ABC SETTING

For all Council-managed stocks, the SSC determines, based on the assessment level to which a stock is classified, the specifics of the control rule to specify ABC that would be expected to attain the probability of overfishing specified in the Council's risk policy (see above). The SSC may deviate from the established control rule methods or level criteria when developing ABCs, but must provide justification for doing so.

CONCLUSION

The assessment level determination process guides evaluation of uncertainty across varied and diverse assessment approaches and provides a system to determine if adjustments to uncertainty estimates are warranted to better reflect what the SSC considers the true extent of uncertainty to be. This has generally taken the form of expanding uncertainty estimates (C.V. - coefficient of variation) from those provided by models, which results in larger buffers for scientific uncertainty (i.e. lower catches) via the risk policy provisions. As assessments are improved, it is anticipated that assessments will progress to better assessment level designations (closer to Level 1). However, an improved assessment that better describes uncertainty could lead to smaller or larger buffers depending on the state of knowledge about the actual uncertainty in the OFL. As improvements are made in data and modeling techniques, uncertainty would be expected to decrease, but in the short term it is always possible that a new assessment discovers that uncertainty is higher than was previously estimated, potentially leading to larger buffers even if it was designated as a “better” assessment level.