Mid-Atlantic Fishery Management Council
Science and Statistical Committee
OFL CV Discussion Outline
March 13-14, 2018.

Purpose of this Meeting

This report describes a proposed overall approach of defining the appropriate level of uncertainty to be applied to estimates of the Overfishing Limit (OFL) from a given stock assessment. The report is based on discussions by the SSC that began in May 2017 and continued at subsequent meetings of the SSC in July and September 2017. In addition, the SSC OFL subcommittee convened a conference call on February 22, 2018 to discuss results of an informal meeting with NEFSC staff held on February 15, 2018.

As a result of the Subcommittee work done since September, 2017 four additional recommendations are proposed for consideration by the SSC:

1. Quantify the basis for the CV levels used as cut points, i.e., document the basis for the current 60% and 100% levels used in MAFMC assessments.
2. Include "Data Quality" as a factor in the estimation of an appropriate OFL CV. This would be the first factor considered, resulting in a total of 9 criteria
3. Include an option for a OFL-CV level to be specified by the SSC. This addresses options where the assessment may provide information sufficient for a fully supported estimate. Alternatively, the SSC could decide to increase the CV above a prescribed maximum level.
4. Consider two examples for summer flounder (prepared by Paul Rago) and black sea bass (prepared by Gary Shepherd).

Overall Objectives of the OFL

<u>Recommendations from September 2017 Meeting of SSC</u>

"We intend to elevate confidence in ABCs by establishing a replicable process that meets Council risk policy objectives, and identifies relevant components of assessment uncertainty to be provided to the SSC. The SSC's approach to setting OFL CVs will:

- *Result in prudent decisions for catch advice that are consistent in meeting the objectives of the Council's Risk Policy in considering the trade-offs of biological, social, and economic benefits;*
- *Be based on clear and transparent decision criteria; and*
- *Be supportable with evidence*"

Decision Criteria

The SSC further agreed on the following eight decision criteria to define an appropriate CV.

1. *"Rigor of model identification during the assessment process*
2. *Informed by retrospective analysis*
3. *Informed by empirical estimates of abundance, stock biology, and fishing pressure*
4. *How the reference points are informed by ecosystem factors or comparisons with other species*
5. *Informed by measures of trends in recruitment*
6. *Informed by prediction error*
7. *Informed by simulation analysis or a full management strategy evaluation*
8. *Assessment accuracy under different fishing pressures"*

The rationales for these estimates are summarized below. Note that this list now includes "Data Quality" as one of the criteria.

Revised Factors considered in establishing OFL CV for a specific stock.

1. Data quality
    a. Types and quality of available data are primary determinants of the utility of any assessment model.
    b. Important fishery-independent data considerations include survey design, coverage and efficiency of survey gear.
    c. Consider accuracy and precision of landings and discards
    d. Availability of age data for surveys and removals
    e. Information on natural mortality
2. Rigor of Model identification during the assessment process
    a. Process and tests (model sensitivities within a given model structure)
    b. Comparison with other models with different structures
    c. Much testing with consistency between models could permit a lower OFL CV. Little testing or high divergence between models means higher CV.
3. Informed by Retrospective analysis
    a. Retrospective pattern is direct evidence of model misspecification and suggest directionality of change with respect to "true" or at least improved model rather than an unspecified set of alternative models
    b. Test to see if OFL_adj is outside bounds of OFL_base given 100% CV
4. Informed by comparison with empirical measures of abundance
    a. Swept area biomass or gear comparisons that suggest appropriate minimum scale of population
    b. Other empirical measures, even CPUE for limited cases; e.g. survey Z, Beverton-Holt length based.
5. Informed by ecosystem factors or comparisons with other species
    a. General measures of ecosystem productivity
    b. Evidence of limiting factors—inshore temperatures
    c. Comparisons among relevant species; eg SNEwinter vs SNEyt
    d. Climate vulnerability or other risk assessment could indicate whether uncertainty about productivity or trajectory was increasing or decreasing
6. Informed by measures of trend in recruitment
    a. Stanzas of abundance

   b. Decreasing R/SSB as SSB decreases, death spirals
   c. In NE stocks, poor model performance can be traced to downward trends in recruitment
7. Informed by prediction error.
   a. Comparisons of model performance given prior assessments
   b. Approach applied to summer flounder and scup could be applied to dogfish, and perhaps bluefish.
8. Assessment accuracy under different fishing pressures
9. Informed by simulation analysis or full MSE

Revised General Framework of OFL CV "bins" with Default CVs.

	Default OFL CV=X%, ***Proposal X=60%***	Default OFL CV=Y% ***Proposal: Y=100%***	Default OFL CV=Z%
Data Quality	One or more synoptic surveys over stock area for multiple years. High quality monitoring of landings size and age composition. Long term, precise monitoring of discards.	Low precision synoptic surveys or one or more regional surveys which lack coherency in trend. Lacking or imprecise discard estimates. Incomplete landings estimates.	No reliable abundance indices. Catch estimates are unreliable. Natural mortality rates are unknown or suspected to be highly variable.
Model identification process	Multiple differently structured models agree on outputs, many sensitivities explored	Single model structure with many parameter sensitivities explored	Highly divergent outputs from multiple models or no exploration of alternative model structures or sensitivities
Retrospective adjustment	No retrospective pattern; adjustment not necessary, or OFL estimate includes retrospective adjustment	OFL estimate includes retrospective adjustment only if outside 95% bounds of non-adjusted terminal B and F	No retrospective analysis
Comparison with empirical scale	Assessment B estimate compares favorably with empirical estimates	Both assessment B and empirical estimates highly uncertain	No estimate of scale and or no empirical estimates

Ecosystem factors accounted	Ecosystem productivity and habitat quality stable. Climate vulnerability analysis suggests positive impacts on productivity from changing climate	Ecosystem productivity and habitat quality variable. Climate vulnerability analysis suggests neutral impacts on productivity from changing climate	Ecosystem productivity and habitat quality variable and degrading. Climate vulnerability analysis suggests negative impacts on productivity from changing climate
Trend in recruitment	Recruitment trend considered in OFL estimate	Recruitment trend uncertain	Recruitment trend not considered or no recruitment estimate
Prediction error	3 year error < 25%	3 year error > 25%	No estimate of prediction error
Assessment accuracy under different fishing pressures	High degree of contrast in landings and surveys with apparent response in indices to changes in removals.	Moderate contrast in surveys and catches. "One-way" trips.	Relatively little change in surveys or catches over time. Low precision of estimates.
Simulations/MSE	Can be used to evaluate different combinations of uncertainties and indicate the most appropriate OFL CV for a particular stock assessment		

Example applications of the above criteria are provided in Appendix 1 and 2 for summer flounder and black sea bass, respectively.

Requested Decisions by SSC at March 2018 meeting:

1. Are the 9 proposed criteria acceptable?
2. What is appropriate level of X, Y and Z%? 60, 100 and 150%?
3. Is a "wild card" CV level option desirable? Is this this degree of freedom liberating or debilitating to the efficacy of SSC decisions?

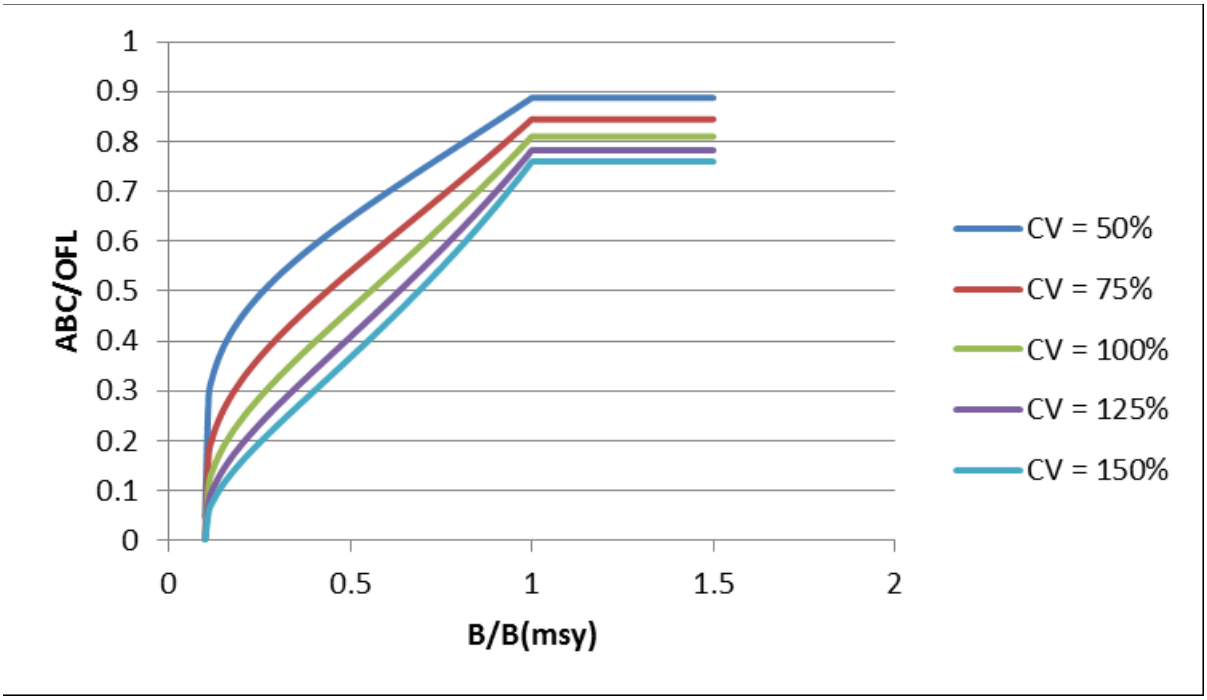

Figure 1. Effect of alternative CV values on the ratio of ABC to OFL for varying levels of biomass relative to the Bmsy.

Appendix 1. Hypothetical application of OFL CV policy for Summer flounder. Repeat…Hypothetical

OFL-CV Summary for Summer Flounder.

1. Data quality
    a. This is a data rich stock assessment. Two synoptic surveys (fall and spring) are available for all years. Additionally, 13 regional surveys are used in model tuning. Age data available for all years in surveys, commercial landings, recreational landings, and commercial discards. Recreational and commercial discards are low and measured with good precision (<8% CV).
    b. Sex specific information available for growth and models incorporating age and sex-specfic growth and mortality rates have been developed and tested.
    c. Data collection program has begun to identify potential variations in sex composition of catch by area.
2. Rigor of Model Identification
    a. Numerous models by multiple assessors have been evaluated. ASAP is preferred assessment model but SS and other statistical catch at age models have been evaluated. These include models with age and sex-dependent rates of natural mortality, growth, and fishery selectivity. More complicated models have, to date, not been judged superior to single sex models.
3. Informed by retrospective analysis
    a. No persistent retrospective patterns have been observed in the model although there have been stanzas of modest underestimation of biomass and underestimation of fishing mortality.
    b. Historical retrospectives indicate that general trends of fishing mortality, stock biomass, and recruitment have been consistent since the 1990s assessments.
4. Informed by empirical measures of abundance
    a. Model catchability estimates compare favorably (i.e., <1) with swept area biomass estimates. Results of gear experiments on relative efficiency have not been applied to model formulation or as check on implied gear efficiency.
5. Informed by ecosystem factors
    a. No formal factors have been incorporated into model. Analyses of annual growth rates at age and condition factor reveal no trends that might be attributable to environmental conditions. Slight downward trend in age at maturity has been observed.
    b. Evaluations of spatial differences in life history attributes have been conducted.
6. Informed by measures of trend in recruitment
    a. Unlike other flatfish species, there does not appear to be any long-term trend in relative abundance of recruiting year classes. Therefore, it is not necessary to make extra considerations for potential effects of environmental trends.
7. Informed by Prediction error
    a. Summer flounder are one of the most frequently assessed species in the northeast. Comparisons of annual forecasts of stock biomass with realized estimates of stock

biomass in subsequent assessments reveal a one-year ahead forecasting error with a CV=14%. For two-year forecasts the CV is 26% and for 3 yr forecastrs the CV= 26%. The average percentage difference between the projection and the subsequent estimate for 1, 2, and 3-yr projections was +12%, +23% and +24%, respectively

8. Informed by simulation analyses or full MSE
    a. Some work has been conducted but incomplete.
9. Accuracy of assessment relative to fishing pressure
    a. This stock has experienced a wide range of fishing mortalities over the past 30 years. This contrast, subsequent fluctuations in total abundance, and success of management changes suggest a high level of confidence in assessment results.

Based on the above 9 factors the SSC recommends a CV of X% be applied to the OFL to estimate an appropriate ABC for summer flounder in 20yy.

Appendix 2. Hypothetical application of OFL CV policy for Black Sea Bass. Repeat…Hypothetical

	Default OFL CV=60%	Default OFL CV=100%	Default OFL CV = 150%
Data quality	Recent sampling improved Survey use justified		
Model identification proces	ASAP combined model, ASAP area model, ASAP		
Retrospective adjustment	Final estimate for combined area adjusted. OFL includes retro adj results		
Comparison with empirical scale	Ratio of q by vessel compared favorably to calibration coefficients		
Ecosystem factors accounted	Effect of winter temp/salinity on survival. Area splits based on ecosystem info		
Trend in recruitment	Recruitment years in projection reduced based on trends in biomass.		
Prediction error	Not evaluated		
Simulations/MSE	Simulations used to determine influence of protogyny on population stability		

Based on the above 8 factors the SSC recommends a CV of X% be applied to the OFL to estimate an appropriate ABC for black sea bass in 20yy.