ABC Control Rule Modifications Decision Document II

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I. Background

- The initial ABC Control Rule (CR) was developed in 2008. It includes "Dimensions" that address uncertainty parameters; "tiers" within each dimension provide scores based on assessment information such as uncertainty, stock status, and risk. The sum of the scores is used to adjust the P* for defining ABC. The CR was intended to be comprehensive and applicable to all stocks, including those assessed and those not assessed, and all FMPs.
- In 2010 the CR was modified, by addenda to the CR, to include a higher level "Tier" system, with the first Tier addressing assessed stocks (for which the initial rule applies), two intermediate Tiers addressing data limited evaluations developed at the time (DCAC and DBSRA), and a final Tier addressing stocks for which only catch information is available. Note that the word "tier" is used differently in 2 places in the CR. For now, lower case "tier" will be used to refer to the categories of Dimensions in the original CR, and the upper case "Tier" to refer to the higher level divisions created in 2010.
- In April 2011 the fourth Tier (catch only) was modified by another addenda adding a decision tree approach intended to provide a consistent and objective means to evaluate data and stock conditions. At this time, the Tiers created through the 2010 modification began to be called "Levels" in some circumstances, to reduce confusion caused by the use of the term tier in two different ways in the CR.
- In November 2011 the SSC proposed a process for including the ORCS (Only Reliable Catch Stocks) workgroup recommendations for addressing unassessed stocks. The ORCS approach was added as another option for evaluating Tier 4 (or Level 4) stocks, initially categorized as "catch only".
- The ORCS approach was implemented by the Council through an amendment to the Snapper Grouper FMP. Therefore, the ORCS method is available for stocks in that FMP but not to stocks in other FMPs.
- In October 2014 the SSC held an ABC Control Rule Workshop to evaluate performance and application of the CR. Objective evaluation of performance was hindered by a lack of assessments that provide status determinations during times when fishing levels based on the CR were in effect.
- In April 2015 the SSC reviewed the report of the October 2014 Workshop. The SSC did not recommend any CR modifications at the time, although suggestions were made to add flexibility that would allow consideration of individual stock situations. An ABC Control Rule Workgroup (Workgroup) including a subset of SSC members was formed to pursue the topic.

- The Workgroup was formed to update the evaluations and consider if changes were necessary. The Workgroup reported preliminary findings to the SSC in May 2016, noting limited progress in evaluation information. The group recommended removing the stock status dimension from the assessed stocks Tier (Level) because status determination is made by the agency. Because the agency determination is not made until the SSC makes its recommendations on an assessment, the final status determination is not available when the SSC reviews the assessment and applies the CR.
- In June 2016 the Council recommended that the SSC consider removing status from consideration in the CR. The Council cited two considerations in support of this request. The first is the fact that status determinations are made by the agency, not the SSC, as noted. The second is because status is an assessment output and not a characteristic of the assessment approach or data that contributes to the underlying assessment uncertainty that is supposed to be addressed by the CR. The Council considers that stock status is more appropriately considered when it, the Council, considers its risk tolerance for a stock.
    - *Council Recommendation to remove status from the uncertainty consideration.*
- In October 2016 the SSC reviewed proposed revisions to the ABC control rule and provided the following recommendations:
    - *Stock status is determined by NMFS, and is a factor that the SSC considers appropriate for the Council to consider when determining the acceptable risk of overfishing. As such, the SSC recommends removing stock status from the ABC control rule.*
    - *The Productivity and Susceptibility Assessment (PSA) information is also a factor that the SSC recommends the Council should consider when determining the acceptable risk of overfishing. The SSC recommends removing the PSA consideration from the ABC control rule. However, the SSC recommends that the current PSA information should be updated and reviewed by the SSC if the Council wishes to use it to establish risk levels.*
    - *Modifications to the ABC control rule as a result of the above recommendations will require changes to the overall scoring system. The SSC requests that staff work with the SSC leadership to develop some possible options for modifying scores to maintain the range of adjustments.*
    - *The SSC recommends that P* values based on the existing ABC control rule be compared to recommendations based on the modified ABC control rule.*

This document builds upon the principles proposed in the October 2016 ABC Control Rule Decision Document reviewed by the SSC. It incorporates recommendations from the Council and SSC based on earlier discussions. Because an FMP amendment will be required to implement ABC control rule changes, the alternatives and issues are presented in the FMP format of "ACTIONS" with various

"ALTERNATIVES". Specific values and criteria are proposed for illustration and example purposes – the SSC is free to suggest alternatives.

Summary of ACTIONS:

1) Simplified control rule with 3 stock categories for assessing uncertainty

2) Details and Criteria for ABC for data rich stocks (Category 1 of Action 1)

3) Details and Criteria for ABC for data moderate stocks (Category 2 of Action 1)

4) Criteria for establishing risk tolerance

5) Multi-Year ABC specification

6) ABC phase-in

7) Rebuilding stocks clarification

8) Carry-over of unused ABC

9) Deviation allowance

Actions 1 – 4 are related, and provide a revision of the overall ABC control rule.
Actions 5 – 8 are general provisions that can be applied to the existing rule or a modified rule. Each is a stand-alone action.
Actions 5, 6, and 8 are allowed under the recent NS-1 revisions.

Timeline
Two SAFMC amendments are under development to address control rule changes:

- Dolphin Wahoo 10: carry over (Action 8). Initially scheduled for approval in late 2017; placed on hold, March 2017, until revised MRIP estimates are available due to the large recreational component in these fisheries.
- Snapper Grouper 43 (Tilefish overfishing): Council risk tolerance specification (Actions 2 & 4). Final approval of Tilefish actions is required by mid-2018 to address the timeline for ending overfishing.

In addition, a comprehensive ABC Control rule amendment is planned for the future, potentially in 2018. Given recent amendment workload and timing changes, the Council may choose to pursue the comprehensive amendment in lieu of the separate amendments noted.
SSC guidance provided at this meeting will be used to develop a draft ABC control rule for further review and consideration at the Fall 2017 SSC meeting.
Recommendations from the Fall 2017 meeting will likely form the basis of the comprehensive ABC control rule amendment.

II. ABC Control Rule Alternatives and Issues for Consideration

Action 1. Simplify the Control Rule to 3 *Categories*: assessed stocks, data limited stocks, data poor stocks. Specify *Criteria* within these categories to define and guide application and ABC development.

Justification - Concerns with the current rule:

a. too prescriptive with regard to Tiers 2 and 3;
b. Assessment Information factors of Tier 1 (assessed stocks) are not appropriate for these stocks and overlap with stocks assigned to other tiers (e.g., includes an adjustment for 'scarce or unreliable catch records' that is inappropriate now that the rule includes tiers addressing catch-only stocks)
c. out of date, not including advances in data limited methods and not flexible enough to address future advance
d. somewhat disjointed due to several addenda added over the years to address advancements and emerging science.
e. Language has become unclear over time, particularly with multiple use of "Tiers".

1. Alternative 1: Proposed Category Descriptions
    a. Category 1: Data Rich Stocks (Quantitatively assessed stocks)
        i. Broadly include species for which "data rich" quantitative assessments (e.g., based on catch-age, catch-length, comprehensive survey data) that passed independent peer review are available. Assessments estimate mortality rates and reference points, and provide uncertainty around the estimates.
        ii. Working Definition: *Comprehensive data-rich, catch-based assessments including ancillary data such as length, age, and survey information. Examples of model categories for this tier are catch-age, catch-length and surplus production.*
        iii. Other traits or defining characteristics? Or, what is the dividing line between this and data limited assessments?
            1. Ability to use uncertainty in biomass estimates within an assessment, or variance in biomass estimates between assessments, to derive ABC.
                a. Similar to MAFMC and PFMC approaches (and maybe others)
            2. Some rules impose multiple levels based on how OFL uncertainty is estimated.
        iv. Current control rule Tier 1.
    b. Category 2: Data Moderate Stocks (Qualitatively assessed stocks)

i. stocks that have reliable catch data and some other auxiliary or biological information to inform the SSC on fishing levels; available data has been analyzed through a structured modeling process and accepted by independent peer review.
    1. *Models that consider a range of information available for a stock that is evaluated through some type of quantitative framework which provides a proxy for ABC or OFL. DCAC, DBSRA, and the DLM toolbox approaches would fall under this Level. Stocks in this category have reliable catch information.*
ii. Current control rule Tiers 2 and 3.
iii. Should this Category be further divided? If so, how?

c. Category 3: Data Poor stocks
    i. Remaining stocks.
        1. Stocks with reliable landings, now addressed by ORCS
        2. Stock for which landings were deemed inadequate for ORCS.
        3. May include stocks which are rarely caught
    ii. ABC may be based on the best judgement of the SSC, using the information it considers reliable for the particular stock.
    iii. Similar to current control rule Tier 4, including the Decision Tree and ORCS addenda.

2. Alternative 2: ORCS
    a. Should ORCS fall in category 2, perhaps to subdivide Category 2?

3. Alternative 3: Address Ecosystem Component Species explicit**ly**
    a. Based on the PFMC Groundfish FMP:
        i. *A fourth category of species is identified as ecosystem component (EC) species. These species are not "in the fishery" and therefore not actively managed. EC species are not targeted in any fishery and are not generally retained for sale or personal use. EC species are not determined to be subject to overfishing, approaching an overfished condition, or overfished, nor are they likely to become subject to overfishing or overfished in the absence of conservation and management measures. While EC species are not considered to be "in the fishery," the Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery. If necessary, they should be reclassified as "in the fishery."*

Action 2: Details & Criteria for Category 1 – assessed stocks

- How to evaluate uncertainty and develop ABC adjustments that appropriately reflect uncertainty?
- Includes modifications to the existing approach and alternatives to significantly modify the approach.
- Need to consider some changes in Category 1 (existing Tier 1) even if the existing tiers are retained.

Justification - Prior recommendations that are addressed with this action:

a. Remove stock status from the uncertainty consideration.
b. Remove the PSA evaluation from the uncertainty consideration
c. Transfer determination of acceptable risk to the Council
d. Adjust CR scoring accordingly

Overview of the existing CR approach for describing and characterizing uncertainty for deriving ABC values: based on directly adjusting the P* value for various criteria.

a. Original range of P* = .1 to .5 based on total adjustment of 0.4
b. adjustment applied by specific criteria, defined *a priori*
c. included items now recommended for Council consideration (PSA and status) as risk components, so if retained, scoring will need adjusting
d. Concerns that the criteria are not robust, do not provide flexibility for SSC to adequately and appropriately account for uncertainty; particularly across assessments
    i. due to few factors considered in the scoring adjustment, stocks with perceived different levels of uncertainty can receive similar scores
    ii. Somewhat prescriptive, and limiting, given the range of assessment uncertainties and situations.
    iii. Cannot foresee future assessment changes
    iv. include some scoring metrics that are incompatible with other parts of the current rule.
e. requires separate projections for each P* value, as each is associated with a particular F rate. Typically results in many projections scenarios before action is final.

1. Alternative 1 – Retain the existing approach
   This alternative does not change the approach to evaluating and quantifying uncertainty for determining the buffer between ABC and OFL.
   NOTE: Not recommended due to the concerns noted and incompatibility with the prior recommendations.
    - Would not be compatible with the biomass based risk tolerance approach described below – but could work if the risk tolerance schedule is rescaled.

- Does not resolve the issues with lack of resolution discussed previously by the SSC
- Does not resolve issues that the current 'assessment information' factors are not appropriate for assessed stocks.
- Provides the council .2 of P* adjustment for risk and the SSC .2 of P* adjustment for uncertainty

2. Alternative 2: modify the existing approach to address SSC and Council concerns.
   This alternative retains the general concept of modifying the P* by preset criteria and values. ABC would be provided by an F-based P* analysis.
   NOTE: If the SSC decides to apply an entirely different approach, such as one of those discussed below, there is no need to address the specifics of this item.
   a. revise the scoring for dimension 1 (assessment information) of tier 1.
      i. remove 4 and 5 addressing catch history
      ii. add additional criteria to retain the scoring approach
      iii. adjust the scoring approach to maintain 10 points of adjustment
   b. Revise scoring for dimension II – uncertainty characterization
      i. Are the categories and specified scoring too prescriptive?
      ii. Would the SSC be able to better balance uncertainty characterizations with a more flexible, generalized approach?
      iii. Would a list of criteria to consider (without specific scoring applied) help?

3. Alternative 3: apply an approach similar to the MAFMC – ABC derived from the OFL PDF with uncertainty adjustments
   This alternative provides a different approach to OFL-ABC separation, based on the SSC modifying the uncertainty around the overfishing level to account for assessment uncertainty. The SSC address assessment uncertainty and the Council selects a P* based on its overfishing tolerance.

   a. analytically-based category: CV for deriving PDF is estimated in the assessment, includes all important uncertainties. (No MAFMC stocks meet this criteria.)
   b. Expert-based: CV estimated, some uncertainties lacking or inadequately represented. OFL based on specified distribution from the assessment.
   c. Empirically based: either no PDF of OFL, or provided PDF does not adequately address uncertainty and is therefore modified by the SSC. Working now on defining particular criteria for modifying.
   d. Adjusting PDF of OFL avoids need for multiple projection scenarios for every P* value that may be considered.

4. Alternative 4: Apply an approach similar to the PFMC: ABC derived from biomass PDF and uncertainty adjustments.
   This alternative is based on the method described in the PFMC Groundfish FMP. The SSC address assessment uncertainty and the Council selects a P* based on its overfishing tolerance. ABC is based on a % reduction of OFL.

a. Category 1 – assessed:
    i. Percentage buffer based on translating OFL uncertainty to a range P* values, and each P* is mapped to its corresponding buffer %.
    ii. Use the greater of variance estimated across assessments or estimated within a particular assessment.
b. Category 2
    i. similar approach to Category 1, with a higher uncertainty applied.
    ii. Other approaches
        1. buffer of 0.25
        2. assumed uncertainty of 2 times the CV for category 1.
c. Category 3
    i. applies even higher uncertainty than category 1 or 2.
    ii. other approaches
        1. buffer of 0.5
        2. assumed uncertainty of 3 times the CV for category 1.

5. Alternative 5: Apply a different approach to uncertainty evalution: The GMFMC approach – *a priori* criteria with specific scores and P* adjustments applied to a PDF. This alternative is somewhat of a hybrid between the SAFMC and MAFMC approaches. It is similar to the SAFMC status quo in having defined criteria and classification of risk factors that provide specific P* adjustments, and similar to the MAFMC approach in that the adjustments are applied to a PDF.
    a. P* range of .3 to .5

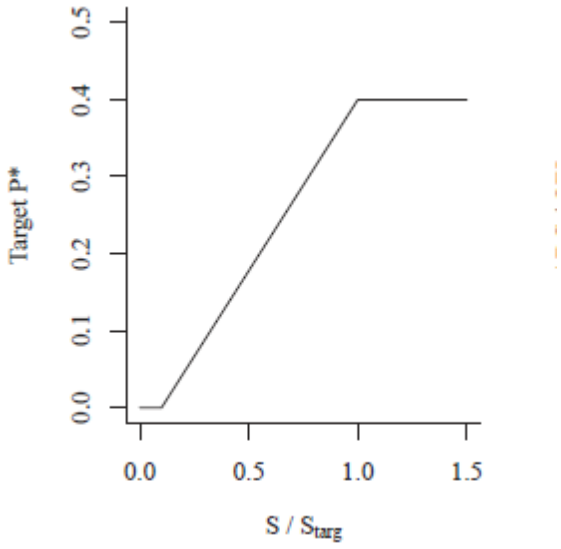
Action 3. Criteria considerations for Category 2.

1. Alternative 1: overall penalty for Category 2 stocks applied by the SSC in addressing the uncertainty,
2. Alternative 2: overall penalty for Category 2 stocks applied by the Council in addressing the risk tolerance?
3. Alternative 2: No overall penalty for Category 2 stocks.
4. Considerations
    a. For example, if Level 1, the assessed stocks, allows an overfishing tolerance of 10 to 50 percent, should Level 2 reduce the maximum to 40%?
    b. Note this may not be appropriate of one of the alternative approaches is chosen for establishing the buffer
    c. Tiers 2 and 3 in the existing rule (DCAC and DBSRA) do not provide an explicit, detailed adjustment and evaluation framework as included for Level 1.
    d. Is it adequate to allow the evaluation and criteria to depend on the specific analyses conducted and outputs provided, so category 2 adjustments are judged on a stock by stock basis?

Action 4. Approaches for the Council consideration and evaluation or risk.

1. Alternative 1: Existing CR approach
    a. Council determines risk from the PSA analysis and stock status determination
        i. Pros
            1. familiarity
        ii. Cons
            1. Dissatisfaction expressed in the past with PSA scoring
            2. SSC/Council not involved in scoring approach
            3. Lenfest approach used in the current CR merges "Productivity" and "Susceptibility" traits. Results in potential for double accounting of productivity for assessed stocks where productivity is actually estimated.
            4. Lenfest scores used were published in 2007, data is likely 2006 or earlier.

2. Alternative 2: Biomass-dependent P* rule
    a. used by the MAFMC, figure to illustrate from Wiedenmann et al 2017.
    b. Similar in concept to the existing SAFMC rule consideration of status – tied to biomass status only, not overfishing status as in the current rule.
        i. Pros
            1. resolves the issues experienced by the SSC in applying a rule before the agency has determined status (recall SSC provides a recommendation, not a determination)
            2. resolves the arguably double-jeopardy situation where experiencing overfishing reduces the risk of overfishing and thus results in even lower acceptable harvest.
            3. resolves issues of dissatisfaction with some PSA results
            4. simpler and more direct – easier to understand and apply
            5. Decisions
                a. maximum at 0.4? 0.5? 0.45?



b. go to 0 at 0? .01? .02?

3. Alternative 3: PSA-informed Biomass dependent approach

   Applies the biomass-target relationship, with the maximum risk tolerance scaled by the PSA results

   a. Scaling – Maximum tolerance
      i. PSA "low risk" stocks: .45 maximum tolerance
      ii. PSA "medium risk" stocks: .40 maximum tolerance
      iii. PSA "high risk" stocks: .35 maximum tolerance
      iv. Other values?

4. Alternative 4: Council derives a risk tolerance directly for each stock or for groups of stocks.
   a. To ensure consistency and objectivity, specific criteria and considerations should be developed
   b. Examples (type of stock = risk tolerance)
      i. Annual crops = 50%
      ii. Short lived, high variability = 45%
      iii. Moderate or typical stocks = 40%
      iv. Long lived, low variability stocks = 35%
      v. High risk stocks = 30

5. Alternative 5. Council establishes an F-based tolerance that establishes ABC at 75% of F_{LIMIT} for assessed stocks.
   a. Approach used as basis for rebuilding plans and ABCs for several stocks
   b. Robust to overfishing (see Wiedenmann et al 2017), could result in slightly lower long-term yields
   c. Convenient for developing stock projections
   d. SSC could consider criteria or situations where this approach is appropriate.
   e. If yield is estimated from a probabilistic approach, will assessment uncertainty be adequately addressed?

Action 5. Allowing multi-year specification with a fixed ABC.

Justification

- Council desire to increase fishery stability and decrease regulatory changes.
- Allowed under the NS-1 guidelines
- Simple averaging of SSC ABCs by the Council does not work, because the average will be above some of the individual annual ABCs.

1. Alternative 1: Allow the SSC to provide a fixed, multi-year ABC specification.
   a. Conditions
      i. always?
      ii. when requested by the Council?

1. If so, to avoid delay, request should be made to the SSC before ABC is considered.

b. Method: (when requested by the council?) The SSC will provide a multi-year ABC specification for X years, based on an appropriate method (as deemed by the SSC) of averaging yield across years.
    i. Years (X) = fixed (3, 4, 5); vary by species or assessment?

Action 6. Allowing phase-in of catch changes based on revised ABC recommendations.

Justification

- Council desire to moderate economic and social impacts from unexpected or major ABC changes
- allowed under the NS-1 guidelines
- Overfishing restrictions apply : Phase ins may not exceed the OFL.

1. Option: Allow the Council to phase in changes to the ABC.
    a. Conditions
        i. Always
        ii. when requested by the Council
        iii. When trigger criteria met – perhaps related to the difference between ABC and current landings.
    b. Method: If a new or revised ABC value results in a 25% or greater reduction in landings from current levels, the ABC control rule will allow a phased-in approach over 2 years.
        i. In year 1 the phase in ABC will be set at the OFL level.
            1. or 90, 95% of that level
        ii. In year 2, the phase in ABC will be established half way between the year 1 ABC and the original year 2 ABC.
        iii. No further phase-in, the originally recommended ABC is in effect for year 3 and beyond.
        iv. Other criteria or triggers based on magnitude of reduction can be considered.

Action 7. Clarify ABC control rule application to rebuilding stocks.

Justification

a. The existing ABC control rule provides a means to develop an alternative probability of rebuilding success for consideration by the Council. It does not clearly state how ABC is derived for rebuilding stocks.
b. In practice, ABCs for rebuilding stocks have been based on the rebuilding strategy chosen by the Council, which is based on a chosen rebuilding period, rebuilding approach, and probability of success.

1. Alternative 1: The ABC control rule will specify that ABC values for overfished stocks are based on the approved rebuilding strategy, and OFL values are based on the annual yield at MFMT.
    a. Assuming other provisions are implemented, this would also apply: ABCs based on the rebuilding strategy may be provided as fixed values for multiple years or phased-in as allowed in the rebuilding plan.

Action 8. Allowing carry over of unused or unharvested ABC.

Justification

- Council intent is to fully utilize available ABC. If a portion goes unharvested in a year, it could be harvested in the following year.
- Allowed in NS-1 revisions.
- Overfishing restrictions apply : Phase ins may not exceed the OFL.

1. **Alternative 1: Allow the carry-over of unused ABC**.
    a. Conditions
        i. The stock is determined to be neither overfished nor overfishing
            1. Require that this be based on an assessment?
    b. Method: Add a provision to the ABC control rule to allow carry-over of unused harvest
        i. If the OFL is known and defined, the Acceptable Biological Catch (ABC) can be revised upwards based on carrying over unused ABC from the previous year. The revised ABC will remain in place for no more than one year and may not exceed X percentage of the OFL.
            1. X = 85, 90, 95%
        ii. If the Overfishing Limit (OFL) is unknown, then the Acceptable Biological Catch (ABC) can be revised upwards based on carrying over unused ABC from the previous year. The revised ABC will remain in place for no more than one year and may not exceed X percentage of the original ABC.
            1. X = 102.5%, 105%, 110%

Action 9. Clarify that the SSC may deviate from the ABC control rule

Justification

c. SSC has used this flexibility in the past. No control rule is likely to accommodate all foreseeable situations or future changes.
d. allowed under the NS guidelines.
e. Overfishing restrictions apply : No deviations may exceed the OFL.

1. Alternative 1: Add a provision to the ABC control rule that clearly states the SSC may deviate from the rule when necessary.
    a. Is it necessary to explicitly state this in the Councils ABC control rule, or does the NS guidelines language provide adequate clarity?

III. Supplemental information and potential criteria considerations

The following information may be useful for defining assessment categories and how to quantify uncertainty. It is based on items discussed by the SSC during prior assessment reviews and ABC control rule discussions.

1.1 Potential considerations or criteria for judging stock assessment uncertainty

1. The assessment provides reliable estimates of exploitation and biomass, including a stock-recruit relationship and MSY benchmarks, and fishery dependent surveys (other expectations?), freely estimated parameters – no adjustment.
2. Productivity - MSY - SRR concerns
    a. Proxy reference points required
    b. Estimates unstable, uncertain, sensitive, retrospective
    c. Based on indirect or assumed productivity parameters (steepness)
    d. Is the SRR reasonable
3. Only provides relative measures of exploitation, biomass, and status
4. Removals
    a. Catch history complete or Incomplete – may not cover entire fishery period
    b. Reliability concerns – e.g., species ID, reporting, levels of uncertainty
    c. Can the model accommodate the observed or estimated level of uncertainty in removal components?
    d. Are there unusual uncertainties associated with the removals (species ID problems, regulatory restrictions (no or low harvest), large proportion of discards, gaps in reporting or annual inconsistencies, excessively high CV,
5. Catch Characteristics Evaluation
    a. Length and age sampling of each fishery – adequacy
    b. Are major removal components adequately sampled (age, length)?
        i. If not, what proportion of removals is adequately sampled ?
6. Surveys/Indices – multiple entries or range
    a. Are any available?
    b. Fishery independent or dependent?
    c. Coverage concerns – time or space?
    d.
7. Life History Evaluation
    a. Reproductive info concerns e.g. coverage, timeliness, N, specific to the stock vs inferred, assumed or derived from meta analysis
    b. Age/growth concerns

    c. Concerns with Age determination?
    d. Movements/migrations/stock ID concerns
8. Model Parameters & Performance
    a. Consideration of parameters fixed vs estimated
    b. Signs of instability, lack of robustness in base configuration
    c. Wide swings between assessments/new data additions
    d. Outlier estimates
    e. retrospective patterns
9. Uncertainty evaluation
    a. Is there a PDF (or CV) for the OFL and productivity measures?
    b. Does the SSC consider the PDF (CV) adequate?
    c. Are all major sources of uncertainty evaluated?
    d. Do sensitivity analyses address key concerns?
    e. Are reasons for major changes in outcomes or results, when compared with prior assessments, adequately described and explained?
10. Model type, category, or approach
    a. Statistical catch at age
    b. Production model
    c. Other categories?
11. Projections
    a. Is the SRR used for estimating recruitment for projections? Is it considered reliable for this purpose?

1.2 Uncertainty Characterization Criteria

1. Uncertainty in both assessment inputs and environmental conditions included, carried through projections, model specification uncertainty considered, results of sensitivities incorporated in overall uncertainty evaluation, distributions of benchmarks based on statistical calculation. (0%)
2. Distributions of benchmarks lacking (Fmsy, MSY) or *ad hoc*
3. Point estimates only, no quantitative uncertainty evaluation
4. Limited to no uncertainty carried through to projections
5. Sensitivities provided, but results not included in quantified uncertainty
6. Model specification or (misspecification) uncertainty not considered
7. Key uncertainties not included in quantitative evaluation (ie bootstrap)
8. Uncertainty in inputs lacking, incomplete or inadequate