

# Comprehensive ABC Control Rule Amendment

## OPTIONS PAPER SSC Review May 2018

### Background

The South Atlantic Fishery Management Council (Council) Scientific and Statistical Committee (SSC) developed an acceptable biological catch (ABC) control rule (CR) in 2008, based on the concept of using uncertainty and risk traits to determine the acceptable risk of overfishing. The acceptable risk of overfishing is specified as the P-Star (P\*) value that is applied through assessment projections to develop the yield values that provide the ABC. During consideration by the Council and development of the Comprehensive Annual Catch Limit Amendment, the SSC added additional levels to the ABC CR to better address unassessed and data limited stocks.

The ABC CR was implemented by the Council through the Comprehensive Annual Catch Limit Amendment that became effective in April 2012. The Comprehensive ACL Amendment included fishery management plans (FMP) for snapper grouper, dolphin wahoo, golden crab, and Sargassum. A revision to the ABC CR for snapper grouper occurred in July 2015 when the Only Reliable Catch Stocks (ORCS) approach was added to the CR for snapper grouper stocks, through Amendment 29 to the Snapper Grouper FMP.

In applying the ABC CRs as specified in the Comprehensive ACL Amendment and snapper grouper Amendment 29 to different stocks and assessments from 2012-2016, the SSC began to express concerns that the rules lacked adequate resolution to distinguish differences in uncertainty levels across assessments, did not address continued developments in data poor assessment methods, and mixed uncertainty evaluation (an SSC role under the Magnuson Stevens Fishery Conservation and Management Act (MSA)) and risk tolerance determination (a Council role under the MSA). Additionally, the existing CR does not provide a means to make use of 2016 revisions to National Standard 1 that increased the flexibility available to regional fishery management councils for managing catch limits by allowing carry-over of unharvested catch and phasing in of catch level changes. While the addition of the ORCS approach to the ABC CR for snapper grouper represented some progress in addressing data poor assessment developments, it did not address the other ABC CR concerns nor the National Standard revisions.

## Actions in this amendment

- **Action 1.** Modify the acceptable biological catch control rule.
- **Action 2.** Specify an approach for determining the acceptable risk of overfishing.
- **Action 3.** Specify an approach for determining the probability of rebuilding success for overfished stocks.
- **Action 4.** Allow phase-in of acceptable biological catch changes.
- **Action 5.** Allow carry-over of unharvested catch.

## Preliminary amendment timing

2014-2017	SSC discusses and reviews ABC control rule performance and developments in data limited methods.
September 2017	Council creates a Committee of the Whole to develop a comprehensive ABC control rule amendment
November 2017	ABC Committee of the Whole meets via webinar to discuss actions and alternatives
December 2017	Further discussion and Guidance. IPT formed
March 2018	Council approves Purpose and Need, FMPs to include.
April/May 2018	SSC and AP reviews
June 2018	Council approves wording of actions and alternatives
September 2018	Council reviews actions and alternatives
October 2018	SSC review
December 2018	Approval for public hearings
March 2019	Final approval

## Purpose and need statement

### Purpose for Actions

The purpose of this amendment is to revise the acceptable biological catch control rule; simplify incorporation of scientific uncertainty; modify the approach used to determine the acceptable risk of overfishing, and address flexibility in specifying catch levels.

### Need for Actions

The need for this amendment is to ensure catch level recommendations are based on the best scientific information available, prevent overfishing while achieving optimum yield, and include flexibility in setting catch limits as allowed per recent changes to the Magnuson-Stevens Fishery Conservation and Management Act implementing regulations.

## Management Plans modified by this Comprehensive Amendment

- Snapper Grouper (Amendment 25)
- Dolphin Wahoo (Amendment 2)
- Golden Crab (Amendment 5)
- Sargassum (Amendment 2)
- Coral (currently does not have a control rule)

# Proposed Actions and Alternatives

## Action 1      **Modify the Acceptable Biological Catch Control Rules**

**Alternative 1 (No Action).** Acceptable biological catch for included species will continue to be specified as per the control rule specified by the Comprehensive Annual Catch Limit Amendment (**Table 2.1**) for the Dolphin Wahoo, Golden Crab, and Sargassum Fishery Management Plans, and Amendment 29 to the Fishery Management Plan for Snapper Grouper (**Table 2.2**). There is no acceptable biological catch control rule for the Coral Fishery Management Plan.

**Alternative 2.** Specify an acceptable biological catch control rule that establishes categories based on the type of information and the scientific uncertainty evaluation available for a stock. The Scientific and Statistical Committee may deviate from the acceptable biological catch control rule when necessary due to data or assessment circumstances that cannot be adequately addressed by the approved acceptable biological catch control rule. In the case of overfished stocks, the acceptable biological catch will be based on the rebuilding plan chosen by the Council.

### Additional Options to consider for **Alternative 2**:

- **Option 1.** Define acceptable biological catch based on the yield available at 75% of the fishing mortality rate that provides maximum sustainable yield for any assessment category if an acceptable overfishing limit distribution cannot be derived.
- **Option 2.** When requested by the Council, the SSC will specify the acceptable biological catch for up to 5 years as both a constant value across years and as individual annual values for the same period of years.

**Alternative 3.** Specify the acceptable biological catch control rule to be consistent with the control rule specified in Amendment 29 to the Snapper Grouper Fishery Management Plan, modified such that the Scientific and Statistical Committee will evaluate scientific uncertainty and determine the values for Tiers 1 and 2 of Level 1, Tiers 3 and 4 of Level 1 will be deleted, and the Council will specify a risk tolerance for overfishing that will provide an  $P^*$  adjustment of 0 to 20% that will be added to the uncertainty adjustment of the SSC. The acceptable biological catch will be based on the accepted probability of overfishing as modified by the total adjustment derived by the Scientific and Statistical Committee and the Council, derived from a stock projection analysis that achieves the appropriate probability of overfishing.

## **DISCUSSION:**

The only difference in the no action tables is that table 2, addressing the snapper grouper ABC CR, includes the ORCS approach as Level 4, and unassessed stocks provisions renumbered as Level 5.

**Table 2.1.** ABC control rule specified by the Comprehensive Annual Catch Limit Amendment for the Snapper Grouper, Dolphin Wahoo, and Sargassum FMPs. Parenthetical values in Level 1 indicate (1) the maximum adjustment value for a dimension; and (2) the adjustment values for each tier within a dimension.

<b>Level 1 – Assessed Stocks</b>	
<b>Tier</b>	<b>Tier Classification and Methodology to Compute ABC</b>
<b>1. Assessment Information (10%)</b>	<ol style="list-style-type: none"> <li>1. Quantitative assessment provides estimates of exploitation and biomass; includes MSY-derived benchmarks. (0%)</li> <li>2. Reliable measures of exploitation or biomass, no MSY benchmarks, proxy reference points. (2.5%)</li> <li>3. Relative measures of exploitation or biomass, absolute measures of status unavailable. Proxy reference points. (5%)</li> <li>4. Reliable catch history. (7.5%)</li> <li>5. Scarce or unreliable catch records. (10%)</li> </ol>
<b>2. Uncertainty Characterization (10%)</b>	<ol style="list-style-type: none"> <li>1. Complete. Key determinant – uncertainty in both assessment inputs and environmental conditions are included. (0%)</li> <li>2. High. Key determinant – reflects more than just uncertainty in future recruitment. (2.5%)</li> <li>3. Medium. Uncertainties are addressed via statistical techniques and sensitivities, but full uncertainty is not carried forward in projections. (5%)</li> <li>4. Low. Distributions of <math>F_{MSY}</math> and MSY are lacking. (7.5%)</li> <li>5. None. Only single point estimates; no sensitivities or uncertainty evaluations. (10%)</li> </ol>
<b>3. Stock Status (10%)</b>	<ol style="list-style-type: none"> <li>1. Neither overfished nor overfishing. Stock is at high biomass and low exploitation relative to benchmark values. (0%)</li> <li>2. Neither overfished nor overfishing. Stock may be in close proximity to benchmark values. (2.5%)</li> <li>3. Stock is either overfished or overfishing. (5%)</li> <li>4. Stock is both overfished and overfishing. (7.5%)</li> <li>5. Either status criterion is unknown. (10%)</li> </ol>
<b>4. Productivity and Susceptibility Analysis (10%)</b>	<ol style="list-style-type: none"> <li>1. Low risk. High productivity, low vulnerability, low susceptibility. (0%)</li> <li>2. Medium risk. Moderate productivity, moderate vulnerability, moderate susceptibility. (5%)</li> <li>3. High risk. Low productivity, high vulnerability, high susceptibility. (10%)</li> </ol>
<b>Level 2 – Unassessed Stocks. Reliable landings and life history information available</b>	
OFL derived from “Depletion-Based Stock Reduction Analysis” (DBSRA). ABC derived from applying the assessed stocks rule to determine the adjustment factor if possible, or from expert judgment if not possible.	
<b>Level 3 – Unassessed Stocks. Inadequate data to support DBSRA</b>	

<p>ABC derived directly from “Depletion-Corrected Average Catch” (DCAC). Done when only a limited number of years of catch data for a fishery are available. Requires a higher level of “informed expert judgment” than Level 2.</p>	
<p><b>Level 4 – Unassessed Stocks.</b></p>	
<p>OFL and ABC derived on a case-by-case basis. Stocks with very low landings that show very high variability in catch estimates (mostly caused by the high degree of uncertainty in recreational landings estimates), or stocks that have species identification issues that may cause unreliable landings estimates. Use “decision tree”:</p>	
<ol style="list-style-type: none"> <li>1. Will catch affect stock?            NO: Ecosystem Species (Council did this already, ACL Amend)            YES: Go to 2</li>   <li>2. Will increase (beyond current range of variability) in catch lead to decline or stock concerns?            NO: ABC = 3rd highest point in the 1999-2008 time series            YES: Go to 3</li>   <li>3. Is stock part of directed fishery or is it primarily bycatch for other species?            Directed: ABC = Median 1999-2008            Bycatch/Incidental: If yes, go to 4.</li>   <li>4. Bycatch. Must judge the circumstance:            If bycatch in other fishery: what are trends in that fishery? What are the regulations?            What is the effort outlook?</li> </ol> <p>If the directed fishery is increasing and bycatch of stock of concern is also increasing, the Council may need to find a means to reduce interactions or mortality. If that is not feasible, will need to impact the directed fishery. The SSC’s intention is to evaluate the situation and provide guidance to the Council on possible catch levels, risk, and actions to consider for bycatch and directed components.</p>	

**Table 2.2.** Acceptable biological catch control rule specified for Snapper Grouper by Amendment 29 to the Snapper Grouper Fishery Management Plan. Parenthetical values in Level 1 indicate (1) the maximum adjustment value for a dimension; and (2) the adjustment values for each tier within a dimension.

<b>Level 1 – Assessed Stocks</b>	
<b>Tier</b>	<b>Tier Classification and Methodology to Compute ABC</b>
<p><b>1. Assessment Information</b> (10%)</p>	<ol style="list-style-type: none"> <li>1. Quantitative assessment provides estimates of exploitation and biomass; includes MSY-derived benchmarks. (0%)</li> <li>2. Reliable measures of exploitation or biomass, no MSY benchmarks, proxy reference points. (2.5%)</li> <li>3. Relative measures of exploitation or biomass, absolute measures of status unavailable. Proxy reference points.</li> </ol>

	<p>(5%)</p> <p>4. Reliable catch history. (7.5%)</p> <p>5. Scarce or unreliable catch records. (10%)</p>
<p><b>2. Uncertainty Characterization (10%)</b></p>	<p>1. Complete. Key determinant – uncertainty in both assessment inputs and environmental conditions are included. (0%)</p> <p>2. High. Key determinant – reflects more than just uncertainty in future recruitment. (2.5%)</p> <p>3. Medium. Uncertainties are addressed via statistical techniques and sensitivities, but full uncertainty is not carried forward in projections. (5%)</p> <p>4. Low. Distributions of <math>F_{MSY}</math> and <math>MSY</math> are lacking. (7.5%)</p> <p>5. None. Only single point estimates; no sensitivities or uncertainty evaluations. (10%)</p>
<p><b>3. Stock Status (10%)</b></p>	<p>1. Neither overfished nor overfishing. Stock is at high biomass and low exploitation relative to benchmark values. (0%)</p> <p>2. Neither overfished nor overfishing. Stock may be in close proximity to benchmark values. (2.5%)</p> <p>3. Stock is either overfished or overfishing. (5%)</p> <p>4. Stock is both overfished and overfishing. (7.5%)</p> <p>5. Either status criterion is unknown. (10%)</p>
<p><b>4. Productivity and Susceptibility Analysis (10%)</b></p>	<p>1. Low risk. High productivity, low vulnerability, low susceptibility. (0%)</p> <p>2. Medium risk. Moderate productivity, moderate vulnerability, moderate susceptibility. (5%)</p> <p>3. High risk. Low productivity, high vulnerability, high susceptibility. (10%)</p>
<p><b>Level 2 – Unassessed Stocks. Reliable landings and life history information available</b></p>	
<p>OFL derived from “Depletion-Based Stock Reduction Analysis” (DBSRA). ABC derived from applying the assessed stocks rule to determine the adjustment factor if possible, or from expert judgment if not possible.</p>	
<p><b>Level 3 – Unassessed Stocks. Inadequate data to support DBSRA</b></p>	
<p>ABC derived directly from “Depletion-Corrected Average Catch” (DCAC). Done when only a limited number of years of catch data for a fishery are available. Requires a higher level of “informed expert judgment” than Level 2.</p>	
<p><b>Level 4 – Unassessed Stocks. Only Reliable Catch Stocks.</b></p>	
<p>OFL and ABC derived on a case-by-case basis. Apply ORCS approach using a catch statistic, a scalar derived from the risk of overexploitation, and the Council’s risk tolerance level.</p>	
<p><b>Level 5 – Unassessed Stocks.</b></p>	
<p>OFL and ABC derived on a case-by-case basis. Stocks with very low landings that show very high variability in catch estimates (mostly caused by the high degree of uncertainty in recreational landings estimates), or stocks that have species identification issues that may cause unreliable landings estimates. Use “decision tree”:</p> <p>5. Will catch affect stock?</p>	

NO: Ecosystem Species (Council did this already, ACL Amend)

YES: Go to 2

6. Will increase (beyond current range of variability) in catch lead to decline or stock concerns?

NO: ABC = 3rd highest point in the 1999-2008 time series

YES: Go to 3

7. Is stock part of directed fishery or is it primarily bycatch for other species?

Directed: ABC = Median 1999-2008

Bycatch/Incidental: If yes, go to 4.

8. Bycatch. Must judge the circumstance:

If bycatch in other fishery: what are trends in that fishery? What are the regulations?

What is the effort outlook?

If the directed fishery is increasing and bycatch of stock of concern is also increasing, the Council may need to find a means to reduce interactions or mortality. If that is not feasible, will need to impact the directed fishery. The SSC's intention is to evaluate the situation and provide guidance to the Council on possible catch levels, risk, and actions to consider for bycatch and directed components.

The Council and SSC have discussed changes in the ABC CR several times. The following bullets summarize the prior recommendations and discussion points made in support of the overall ABC CR modifications proposed in **Action 1**.

- The existing CR is overly prescriptive and formulaic with regard to assessed stocks, Tier 1, thus preventing the SSC from adequately addressing uncertainty differences across stocks or from responding to new methods and techniques.
- The CR is too prescriptive with regard to Tiers 2 and 3 (unassessed stocks), calling upon specific methods, which have in some cases been surpassed by recent developments.
- Some assessment information factors of Tier 1 (assessed stocks) are not appropriate for the stocks addressed under the current rule's Tier 1, 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)
- The current rule mixes uncertainty evaluation (an SSC responsibility) with risk tolerance (a Council responsibility); and relies upon the SSC to make recommendations with regard to both components.
- Language and definitions have become unclear over time, particularly with multiple use of the word "Tiers".
- 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, not a characteristic of the assessment approach or the data, and therefore status is not a component 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.

- 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 CR.
- 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 CR. 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.

### **Alternative 2**

The SSC recommended categorizing assessed stocks based on the information provided to evaluate and characterize assessment uncertainty, which led to **Alternative 2**.

Under Alternative 2, the Council will specify the acceptable risk of overfishing for the stock, considering advice and recommendations from its advisory panels and Scientific and Statistical Committee. The Scientific and Statistical Committee will evaluate the information available and the level of scientific uncertainty for the stock and apply the Council's acceptable risk of overfishing to derive the acceptable biological catch recommendation.

#### **Category Descriptions for Alternative 2:**

- Category 1. The stock is assessed and scientific uncertainty is fully evaluated. Acceptable biological catch is derived by applying the acceptable risk of overfishing to the assessment overfishing limit distribution.
- Category 2. The stock is assessed, but scientific uncertainty is not fully evaluated or some assessment outputs may be lacking. The Scientific and Statistical Committee will adjust the assessment coefficient of variation or overfishing limit distribution as necessary to adequately address scientific uncertainty. Acceptable biological catch is derived by applying the acceptable risk of overfishing to the modified assessment overfishing limit distribution.
- Category 3. The stock is assessed; however, scientific uncertainty is not fully evaluated and no uncertainty distribution for the overfishing limit is available. The Scientific and Statistical Committee will develop a coefficient of variation or overfishing limit distribution as necessary to derive the acceptable biological catch that reflects scientific uncertainty and the Council's risk tolerance, or apply a direct buffer to overfishing limit (or an overfishing limit proxy) to derive the acceptable biological catch recommendation.
- Category 4: No acceptable stock assessment is available. The overfishing limit and acceptable biological catch will be based on the expert judgment of the Scientific and Statistical Committee. The Scientific and Statistical Committee will consider available information and the Council's risk tolerance when applying its expert judgment.

The council may choose any of the Options under Alternative 2 to refine and modify how Alternative 2 is applied. Options do not replace Alternative 2 provisions.

**Option 1** provides an alternative basis for ABC for stocks lacking all the information necessary for the SSC to apply a risk tolerance level to assessment results. If selected, this option would provide additional guidance to the SSC in setting ABC for the Category 3 and 4 stocks described for **Alternative 2**.

**Option 2** is proposed for **Alternative 2** to allow the SSC to specify a constant ABC value for multiple years. Providing the ABC as both annual and fixed values is necessary for the Council to evaluate the effects of the fixed ABC. Under this option, the Council would be expected to request the number of years (up to 5) for which annual and fixed ABC values are desired. To avoid delay in ABC recommendations, such requests should be made prior the SSC considering an ABC recommendation, with enough advance notice for preparing the necessary stock projections.

**Alternative 3**

**Alternative 3** is a slight modification of the existing CR. It adds the ORCS approach, and divides the adjustment factors of the current CR into uncertainty considerations, addressed by the SSC, and risk tolerance considerations, addressed by the Council.

**Other Alternatives Discussed by the Council and SSC**

Establish an Ecosystem Component Category

This alternative would create an additional category to address Ecosystem Component stocks identified by the Council under the MSA guidelines. This approach was opposed by the SSC because these stocks are not subject to the full suite of fishing level specifications, such as OFL and ABC, and therefore would not be subject to the same control rule provisions as other stocks in the FMU. Including them in the ABC CR will add confusion and unnecessary complexity.

Establish and identify categories based on data levels

- Data labels, particularly “Data poor” can be negative, misleading.
- Many stocks defy clear categorization by data – relative quality can vary greatly across the available data types.
- There are no accepted standards for the typical data descriptors: (rich, limited, moderate, poor, complete, etc)
- Characterizing assessments and stocks by data levels may infer inappropriate or undesired quality or reliability conclusions.
- Data availability is not the salient point to determining how ABC is derived: Assessment information and uncertainty evaluations are.

Establish and identify categories based on assessment levels or types

- Assessment science is always changing, so model types and descriptions can become outdated or limiting (as shown in the purpose and need regarding data limited approaches)
- Assessment outputs and their reliability is more important to deriving the ABC than the particular type or class of model.
- There can be considerable overlap in the outputs of various assessment models, as well as variations in which outputs are reliable and useful for any particular assessment.
- Characterizing assessments and stocks by assessment type may infer inappropriate or undesired quality or reliability conclusions, and lead to efforts to simply move stocks “up” the hierarchy.
- The assessment type or label is not the salient point to determining how ABC is derived: Assessment information and uncertainty evaluations are.

### **SSC Recommendations:**

- The SSC supports modifying the ABC CR as described in Alternative 2.
- The SSC recommends against including ecosystem component stocks in the ABC CR provisions.
- The SSC did not support designing the ABC CR solely around data or assessment categories or levels, and recommended that the treatment of uncertainty was a more robust and useful categorization approach.
- The SSC supports allowing constant ABC recommendations for 3-5 years.

**Action 2 Specify an approach for determining the acceptable risk of overfishing.**

**Alternative 1 (No Action).** The acceptable risk of overfishing is determined by the acceptable biological catch control rule criteria that are evaluated by the Scientific and Statistical Committee.

**Alternative 2.** The Council will specify the acceptable risk of overfishing. The existing acceptable biological catch control rule provisions addressing stock status and the productivity and susceptibility analysis (Tier 1, Dimensions 3 and 4), will be deleted, and the Council will specify a risk tolerance for overfishing that will provide an P\* adjustment of 0 to 20% that will be added to the uncertainty adjustment of the SSC, considering advice from the Scientific and Statistical Committee and the Council’s advisory panels.

**Alternative 3.** The Council will specify the acceptable risk of overfishing based on three stock biomass levels and three stock risk ratings, The Scientific and Statistical Committee will evaluate a stock’s risk category each time the stock is assessed.

**Option 1.** Allow the highest risk level when stock biomass exceeds 110% of the biomass at maximum sustained yield, and use 110% of the maximum sustained yield biomass level to evaluate the biomass midpoint for defining the boundary between the moderate and low risk levels.

**Option 2.** Allow the Council to deviate from the default risk levels by 0.1 for an individual stock, based on its expert judgment, new information, or recommendations by the Scientific and Statistical Committee or other expert advisors. Risk tolerance may not exceed 0.5.

**Option 3.** Assign unassessed stocks to the moderate biomass level, unless there is a recommendation from the Scientific and Statistical Committee that justifies a different level.

**Alternative 4.** Specify risk tolerance for each stock directly, considering recommendations of the Scientific and Statistical Committee and the Council’s advisory panels. Risk tolerance may not exceed 0.5.

**DISCUSSION:**

Summary table of risk tolerance levels based on stock-specific risk ratings and biomass levels.

Risk rating (Stock Specific)	Council’s Default Risk Tolerance: accepted risk of overfishing (P* values)		
	<b>High Biomass</b> Biomass exceeds $B_{MSY}$ (or 110% $B_{MSY}$ per Option 1)	<b>Moderate Biomass</b> Biomass is ABOVE the midpoint between $B_{MSY}$ and MSST	<b>Low Biomass</b> Biomass is below the midpoint between $B_{MSY}$ and MSST
low	0.45	0.45	0.4
medium	0.45	0.4	0.3
high	0.4	0.3	0.2

**Alternative 2** represents a slight modification in the existing practices. It would not address the concerns raised by the SSC regarding the information used to determine productivity and susceptibility, and would not address the concern that using a stock’s overfishing status to determine the accepted risk of overfishing for that stock creates an unnecessarily large buffer.

**Alternative 3** would base risk tolerance on stock specific traits, through the assigned risk rating, and on the stocks biomass. It allows the Council to determine the risk level, and provides flexibility for the SSC and FMP APs to provide recommendations for the Council to consider. By including biomass considerations, it addresses National Standard 1 guidance to consider reducing fishing mortality as stock biomass declines.

Under **Alternative 3**, stocks will be assigned a risk rating of high, moderate, or low by the Council, considering the recommendations of the Scientific and Statistical Committee and the Council’s advisory panels. Stock biomass will be based on stock assessment results or the expert judgement of the Scientific and Statistical Committee, and categorized as high, moderate, or low. For all stock risk ratings, the highest risk tolerance will be allowed when biomass exceeds the maximum sustained yield biomass level. The risk tolerance will be reduced to the moderate level when biomass is below the maximum sustained yield biomass level, and further reduced to low risk tolerance when biomass is below the midpoint between the maximum sustained yield biomass level and the minimum stock size threshold. Risk tolerance values for each biomass and stock category will be set by the Council, considering recommendations from the Scientific and Statistical Committee and other Council Advisory Panels.

For all stock risk ratings, the highest risk tolerance will be allowed when biomass exceeds the maximum sustained yield biomass level. The risk tolerance will be reduced to the moderate level when biomass is below the maximum sustained yield biomass level, and further reduced to low risk tolerance when biomass is below the midpoint between the maximum sustained yield biomass level and the minimum stock size threshold. considering recommendations from the Scientific and Statistical Committee and other Council Advisory Panels. The Scientific and Statistical Committee will evaluate a stock’s risk category each time the stock is assessed.

**Option 1** provides a higher degree of precaution, by raising the biomass level at which the highest risk rating is allowed. **Option 2** provides the Council flexibility to deviate from the specified risk levels. **Option 3** provides guidance for assigning risk levels when stock biomass is

unknown. It includes a default value as well as flexibility for an alternative SSC recommendation.

**Alternative 4** is the simplest approach, but also potentially the most difficult to implement as it provides little guidance to the Council on the appropriate risk level. It could be difficult to establish risk levels that adequately reflect stock productivity differences, and risk it not related to stock biomass.

**SSC Recommendation:**

- The SSC supports varying risk tolerance by biomass levels and considering the PSA risk categories for assigning stock risk ratings.

**Action 3. Specify an approach for determining the probability of rebuilding success for overfished stocks**

**Alternative 1 (No Action).** Do not specify an approach for determining the probability of rebuilding success for overfished stocks.

**Alternative 2.** When developing a stock rebuilding plan, the Council will specify a probability of rebuilding success, considering the recommendations of the appropriate fishery management plan advisory panel and the Scientific and Statistical Committee.

**Alternative 3.** When developing a stock rebuilding plan, the Council will specify a probability of rebuilding success based on the stock risk rating. The rebuilding probability will be set at 80% for high risk stocks, 70% for moderate risk stocks, and 60% for low risk stocks. The Council may deviate from these levels by 10% to address unforeseen or unique circumstances. Stocks will be assigned a risk rating of high, moderate, or low by the Council, considering the recommendations of the Scientific and Statistical Committee and the Council’s advisory panels.

**DISCUSSION:**

If the Council took no action (**Alternative 1**) the rebuilding probability would need to be at least 50%, per MSA requirements.

**Alternative 2** provides the most flexibility, as it allows the Council to set the rebuilding probability directly. **Alternative 3** ties the rebuilding probability to stock risk levels.

**SSC Recommendation:**

This is a new Action, and has not been reviewed by the SSC as written. However, the Action is consistent with how rebuilding probabilities are addressed in the existing rule.

#### **Action 4 Allow phase-in of acceptable biological catch changes**

**Sub-Action 5.1:** Establish criteria specifying when phase-in is allowed.

**Alternative 1 (No Action).** No phase-in of ABC changes is allowed.

**Alternative 2.** Allow phase-in when a new acceptable biological catch is less than X% of the existing acceptable biological catch.

**Option 1:** X=70%

**Option 2:** X=80%

**Option 3:** X=90%

**Alternative 3.** Allow phase-in when stock biomass exceeds a specific level

**Option 1:** if stock biomass exceeds the minimum stock size threshold

**Option 2:** if the stock biomass is greater than the midpoint between the biomass that provides maximum sustainable yield and the minimum stock size threshold.

**Sub-Action 5.2.** Specify the approach for phase-in of acceptable biological catch changes.

**Alternative 1 (No Action).** No phase-in of ABC changes is allowed.

**Alternative 2.** Phase-in acceptable biological catch changes over 3 years.

- Year 1: modified acceptable biological catch may not exceed the overfishing limit.
- Year 2: modified acceptable biological catch equals one-half the difference between the overfishing limit and the new acceptable biological catch recommendation.
- Year 3: modified acceptable biological catch equals the original recommended year 3 acceptable biological catch (based on the projections and analyses that triggered the phase-in).
- Subsequent years: acceptable biological catch is based on revised projections that account for the phase-in during years 1-3.

**Alternative 3.** Phase-in acceptable biological catch changes over 2 years.

- Year 1: modified acceptable biological catch may not exceed the overfishing limit.
- Year 2: modified acceptable biological catch equals one-half the difference between the overfishing limit and the new acceptable biological catch recommendation.
- Year 3 and beyond: acceptable biological catch is based on revised projections that account for the phase-in during years 1 and 2.

**Alternative 4.** Phase-in acceptable biological catch changes over 1 year.

- Year 1: modified acceptable biological catch may not exceed the overfishing limit.
- Year 2: acceptable biological catch is based on revised projections that account for the phase-in during year 1.

The IPT recommended adding **Sub-Action 5.2 – Alternative 4** as a shorter phase-in alternative.



IPT QUESTION: Should the details (bullets) of Sub2-Alts 2-4 be considered “process details” and moved to the discussion, as with other earlier actions?

## DISCUSSION:

This action addresses flexibility allowed under the revised NS 1 guidelines.

This is an option the Council can consider to address the social and economic impacts from management changes. Adopting this flexibility does not require the Council to phase-in ABC changes.

The IPT recommended using sub-actions to address criteria and process alternatives separately, so the alternatives under each sub-action can be evaluated relative to each other. The IPT believes this will simplify the analysis and evaluation of alternatives under this action.

Relevant National Standard 1 Guidance:

*Phase-in ABC control rules.* Large changes in catch limits due to new scientific information about the status of the stock can have negative short-term effects on a fishing industry. To help stabilize catch levels as stock assessments are updated, a Council may choose to develop a control rule that phases in changes to ABC over a period of time, not to exceed 3 years, as long as overfishing is prevented each year (*i.e.*, the phased-in catch level cannot exceed the OFL in any year). In addition, the Councils should evaluate the appropriateness of phase-in provisions for stocks that are overfished and/or rebuilding, as the overriding goal for such stocks is to rebuild them in as short a time as possible.

**Sub-Action 5.1** provides guidance for when phase-in will be allowed, addressing the National Standard guidance directing the Council to consider when phase-in is appropriate. **Alternative 2** provides a boundary on the amount of change required in ABC to justify phase-in. This addresses the National Standard language referencing “large changes in catch limits”. Options under **Alternative 2** specify different levels of ABC change. **Alternative 3** address stock biomass considerations. **Option 1** will allow phase-in when a stock is not overfished (biomass exceeds MSST). **Option 2** is more conservative, only allowing phase-in if the biomass is between MSST and the MSY level.

**Sub-Action 5.2** provides alternatives for the time period of the phase-in, and provides guidance on how the higher catch allowed during phase-in is addressed during later years to ensure overfishing does not occur in the later years. The Council could chose multiple alternatives under this Sub-Action to maximize flexibility.

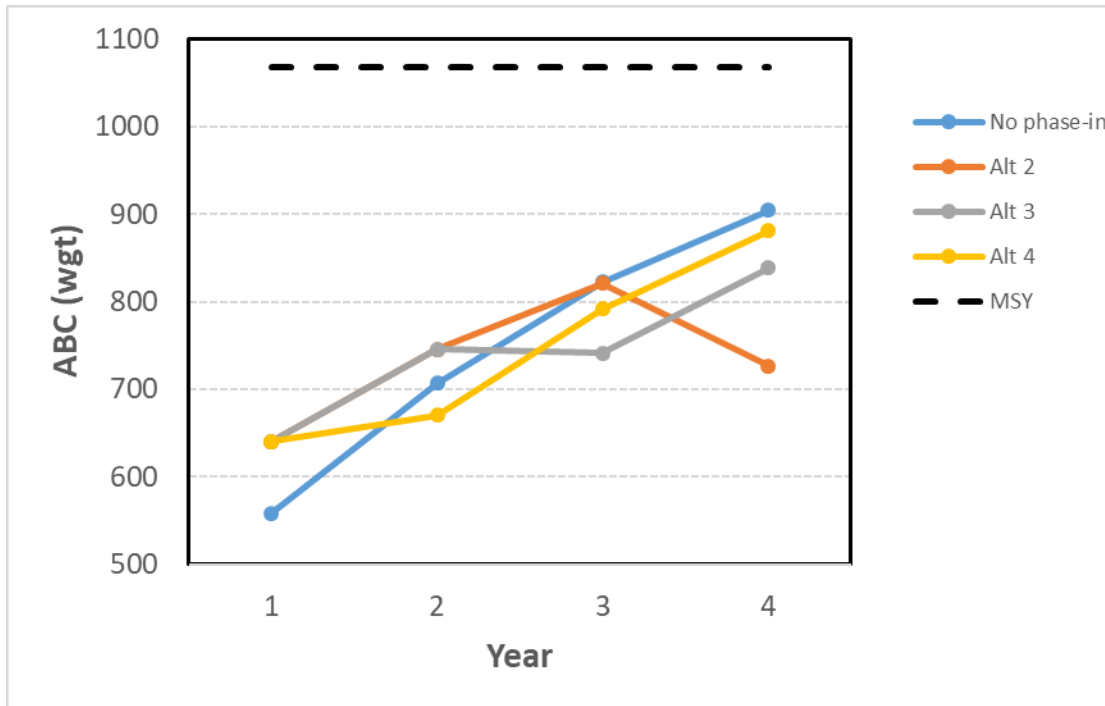
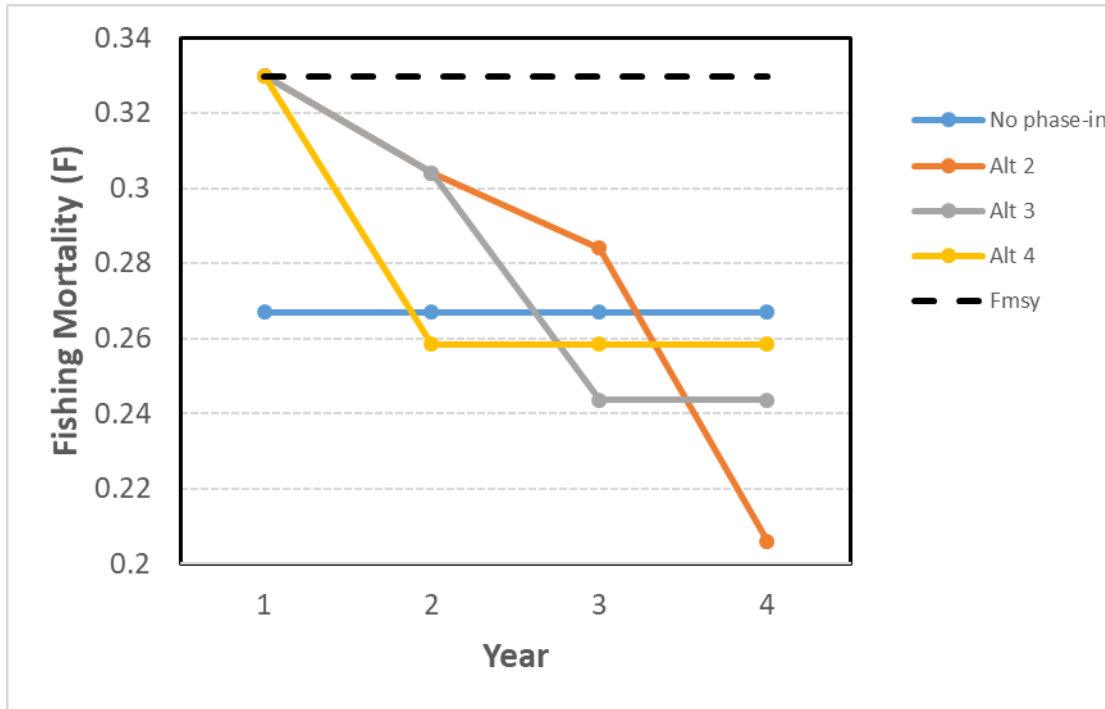
**Alternative 2** provides for a phase in over 3 years, which is the maximum phase in period allowed by the MSA guidelines. The phase in period is shortened for **Alternative 3** (2 years) and **Alternative 4** (1 year). As shown in Table XX, the longer phase in of **Alternative 2** results in the largest reduction of total catch over time. The cost, or reduction in total catch over the 4 year period illustrated, is lowest for the lowest phase in period proposed in **Alternative 4**.

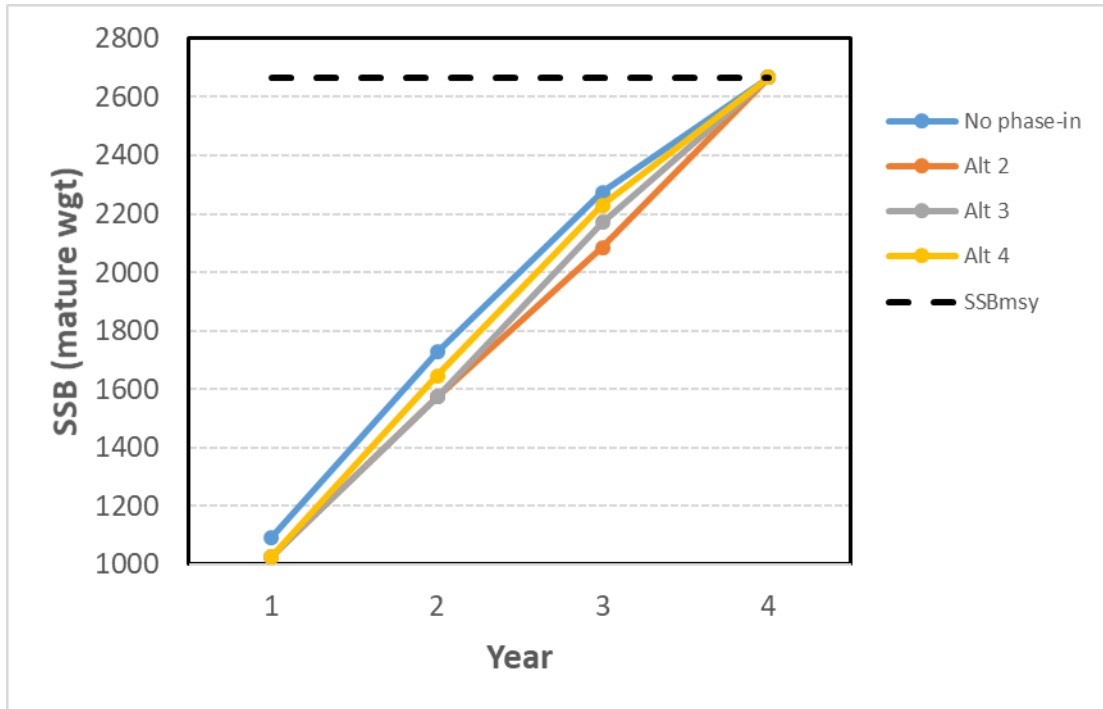
-The SSC liaison and Committee chair may work with Council staff to request the projection analyses necessary for the SSC and Council to evaluate and implement phase-in a timely manner.

Hypothetical example of ABC phase-in for Alternatives 1 through 4 in Sub-Action 5.2 above:

Population dynamics were simulated for a hypothetical fish species. Benchmarks for the stock were determined to be  $F_{msy}$  (OFL) = 0.33, MSY = 1068 (wgt), and  $SSB_{msy}$  = 2668 (mature wgt). Starting conditions for the stock in year 0 were in an overfishing and overfished state ( $F=0.8$  and  $SSB = 645$ ), with landings at 924 (wgt). In this example the stock is rebuilding to  $SSB_{msy}$  by year 4.

<b>Fishing Mortality (F)</b>					
<b>Year</b>	<b>No phase-in</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>F<sub>msy</sub></b>
<b>1</b>	0.267	0.33	0.33	0.33	0.330
<b>2</b>	0.267	0.304	0.304	0.2584	0.330
<b>3</b>	0.267	0.284	0.2435	0.2584	0.330
<b>4</b>	0.267	0.206	0.2435	0.2584	0.330
<b>ABC (wgt)</b>					
<b>Year</b>	<b>No phase-in</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>MSY</b>
<b>1</b>	558	641	641	641	1068
<b>2</b>	707	745	745	670	1068
<b>3</b>	822	821	741	792	1068
<b>4</b>	905	727	839	881	1068
<b>SUM</b>	2993	2934	2966	2984	
<b>SSB (mature wgt)</b>					
<b>Year</b>	<b>No phase-in</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>SSB<sub>msy</sub></b>
<b>1</b>	1092	1026	1026	1026	2668
<b>2</b>	1727	1574	1574	1647	2668
<b>3</b>	2274	2085	2171	2229	2668
<b>4</b>	2668	2667	2668	2668	2668





**SSC Recommendation:**

- The SSC supports phase-in for stocks above MSST.

**Action 6 Allow carry-over of unharvested catch**

**Sub-Action 6.1.** Establish criteria specifying circumstances when unharvested catch can be carried over from one year to increase the available harvest in the next year.

**Alternative 1 (No Action).** No carry over will be allowed.

**Alternative 2.** Carry-over of unharvested catch will be allowed if the stock is neither overfished nor experiencing overfishing.

**Alternative 3.** Carry-over of unharvested catch will only be allowed for a fishery sector that has experienced a regulatory closure due to catch exceeding the SECTOR annual catch limit at least once in the previous 3 years.

**Alternative 4.** Carry-over of unharvested catch will only be allowed for a fishery sector for which total landings of all fishery sectors over the previous 3 years are less than the total annual catch limit of all fishery sectors over those same years.

**Alternative 5.** Do not allow carry-over when ABC changes are phased-in.

**Sub-Action 6.2.** Specify limits on the amount of unharvested catch that may be carried over from one year to increase the available harvest in the next year.

**Alternative 1 (No Action).** There will be no carry-over of unharvested catch.

**Alternative 2.** Allow carry-over of unharvested catch for an individual fishery sector using the buffer between the annual catch limit and the acceptable biological catch.

**Alternative 3.** Allow carry-over of unharvested catch for an individual fishery sector that results in an adjusted annual catch limit that exceeds the original acceptable biological catch for the year for which the unharvested catch is carried-over, . .

**Option 1.** If the overfishing limit is unknown, the revised acceptable biological catch may not exceed 105% of the original acceptable biological catch.

**Option 2.** If the overfishing limit is unknown, the revised acceptable biological catch may not exceed 110% of the original acceptable biological catch.

**Option 3.** If the overfishing limit is unknown, the revised acceptable biological catch may not exceed 120% of the original acceptable biological catch.

**Option 4.** If the overfishing limit is unknown, no carry-over is allowed.

**Alternative 4.** Allow carry-over of unharvested catch for an individual fishery sector of up to 25% of the sector annual catch limit. .

**Sub-Action 6.3.** Specify an approach for implementing acceptable biological catch and annual catch limit modifications to support carrying over unharvested catch from one year into the next year.

**Alternative 1 (No Action).** No carry over is allowed.

**Alternative 2.** Use the framework approaches as provided in each fishery management plan.

**Alternative 3.** Implement an expedited approach to address carry-over of unharvested catch.

**DISCUSSION:**

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This action addresses flexibility allowed under the revised NS 1 guidelines.

Relevant National Standard 1 Guidance:

*Carry-over ABC control rules.* An ABC control rule may include provisions for the carry-over of some of the unused portion of an ACL (*i.e.*, an ACL underage) from one year to increase the ABC for the next year, based on the increased stock abundance resulting from the fishery harvesting less than the full ACL. The resulting ABC recommended by the SSC must prevent overfishing and must consider scientific uncertainty consistent with the Council's risk policy. Carry-over provisions could also allow an ACL to be adjusted upwards as long as the revised ACL does not exceed the specified ABC. When considering whether to use a carry-over provision, Councils should consider the likely reason for the ACL underage. ACL underages that result from management uncertainty (*e.g.*, premature fishery closure) may be appropriate circumstances for considering a carry-over provision. ACL underages that occur as a result of poor or unknown stock status may not be appropriate to consider in a carry-over provision. In addition, the Councils should evaluate the appropriateness of carry-over provisions for stocks that are overfished and/or rebuilding, as the overriding goal for such stocks is to rebuild them in as short a time as possible.

Carry-over that does not exceed the ABC can be accommodated under existing rules, using the buffer between the ACL and OFL. However, for many Council stocks,  $ACL=ABC$ .

Any revised acceptable biological catch resulting from carry-over will remain in place for one year and may not exceed the overfishing limit, and evaluations of carry-over for future years will be based on the original acceptable biological catch, not the temporary revised acceptable biological.

If the carry over results in an annual catch limit that exceeds the original acceptable biological catch for the year for which the unharvested catch is carried-over, the acceptable biological catch for that year will be revised upwards to accommodate the temporary increase in annual catch limit. Evaluations of possible carry-over for future years will be based on the original acceptable biological catch, not the temporary revised acceptable biological catch

Under existing rules, the Council could ask the SSC to consider recommending a temporary, higher ABC to accommodate carry-over. This approach is not particularly efficient, given the timing of Council and SSC meetings. The overall purpose of this action is to develop criteria to guide when carry-over can be allowed while preventing overfishing, and develop an efficient process that will accommodate minor, temporary increases in an ABC to support carry over. Overfishing is prevented as long as the revised ABC stays below OFL, so no increased ABC due to carry over can exceed the annual OFL. As stated in the National Standard guidance, the Council will consider the need for, and consequences of, carry-over, in its justification and request. The Council may consult its scientific and fishery advisors as needed to define and evaluate the justification for carry-over.

The Final Rule addressing carry-over allowances states that Councils must state in its FMP when carry over can and cannot be used. This is addressed through the criteria in **Sub-Action 6.1**. The

FMP must also state how overfishing is prevented. **Sub-Action 6.1** provides guidance on circumstances when carry-over would be allowed. The alternatives address the National Standard guidance requiring Councils to consider the reason for carry-over and the appropriateness of carry-over for different stock status conditions. **Sub-Action 6.2** addresses the amount of unused catch that could be carried over. Alternatives provide limits on the amount of carry-over, thereby addressing the level of risk and uncertainty. **Sub-Action 6.3** address the process by which catch limits would be modified to accommodate carry-over.

For **Sub-Action 6.2, Alternative 2**, The amount of catch that may be carried over is limited by the acceptable biological catch.

For **Sub-Action 6.2, Alternative 3**, The original acceptable biological catch for the carry-over year will be revised upwards to accommodate the temporary increase in annual catch limit. The revised acceptable biological catch will remain in place for one year and may not exceed the overfishing limit, and evaluations of carry-over for future years will be based on the original acceptable biological catch, not the temporary revised acceptable biological catch

The expedited approach of **Sub-Action 6.3-Alternative 3** would operate as follows: The Council will consider the need for and benefits of carry over during a scheduled Council meeting, If the Council decides carry over will be beneficial to the fishery and will not result in overfishing, it will notify the Regional Administrator of the recommendation for carry-over in a letter indicating that the criteria and guidance of this amendment are met, and including the Council's analysis of the relevant biological, economic, and social information necessary to meet the criteria and guidance and support the Council's request. If the Regional Administrator concurs that the Council's recommendations are consistent with the objectives of the fishery management plan, the Magnuson-Stevens Fishery Conservation and Management Act, and all other applicable law, the Regional Administrator is authorized to implement the Council's request through publication of appropriate notification in the *Federal Register*, providing appropriate time for additional public comment as necessary.

#### Hypothetical example of ABC carryover.

Population dynamics were simulated for a hypothetical fish species. Benchmarks for the stock were determined to be  $F_{msy}$  (OFL) = 0.33,  $MSY = 1068$  (wgt), and  $SSB_{msy} = 2668$  (mature wgt). Because stock status is important in determining the constraints for carryover, we simulated the initial stock conditions in two ways.

In the first starting condition the stock in year 0 is in an overfishing and overfished state ( $F=0.8$  and  $SSB = 645$ ), with landings at 924 (wgt). In this example the stock is rebuilding to  $SSB_{msy}$  by year 4. Using a 100 (wgt) carryover from year 1 to year 2, we compare the  $F$  and ABC values to the case where no carryover occurred. In both cases the stock reaches the same target biomass,  $SSB_{msy}$  in year 4.

Original ABC advice				100 (wgt) carryover in year 2			
Year	Full F	ABC (wgt)	SSB	Year	Full F	ABC (wgt)	SSB
1	0.267	558	1092	1	0.203	458	1164
2	0.267	707	1727	2	0.312	807	1748
3	0.267	822	2274	3	0.264	813	2272
4	0.267	905	2668	4	0.264	896	2668
	<b>SUM</b>	2993			<b>SUM</b>	2975	

In the second starting condition the stock in year 0 is at 75% SSB<sub>msy</sub> (F=0.41 and SSB = 2001), with landings at 1057 (wgt). In this example the stock is constrained by the OFL (expressed as the yield provided at MFMT (F=0.33)) in most years. Using a 100 (wgt) carryover from year 1 to year 2, we compare the F and ABC values to the case where no carryover occurred. Under this scenario the full 100 (wgt) carryover is not possible because of the OFL constraint. Instead only 33 (wgt) carryover is allowable for the ABC in year 2, fishing at the OFL level.

Original ABC advice				100 (wgt) carryover in year 2			
Year	Full F	ABC (wgt)	SSB	Year	Full F	ABC (wgt)	SSB
1	0.33	940	2168	1	0.275	840	2290
2	0.33	985	2334	2	0.33	1018	2456
3	0.33	1016	2459	3	0.33	1039	2549
4	0.33	1037	2540	4	0.33	1052	2600
	<b>SUM</b>	3978			<b>SUM</b>	3949	

### SSC Recommendation:

- The SSC supported this action if applied to stocks that are neither overfished nor overfishing, and have catch close to the ACL



## Appendices

### Definitions

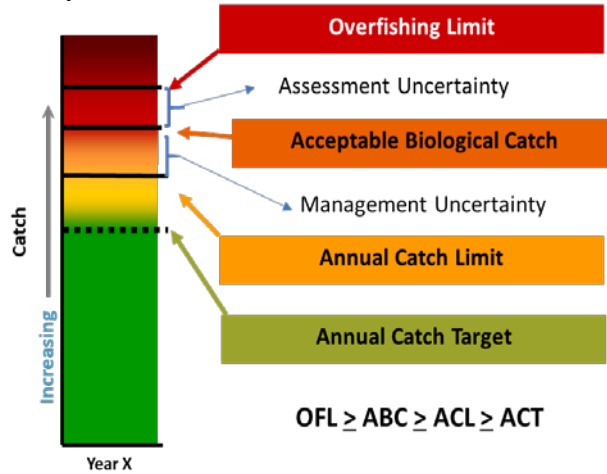
ABC Control Rule (ABC CR)	a policy for establishing a limit or target catch level that is based on the best scientific information available and is established by the Council in consultation with its SSC.
Accountability Measure (AM)	Management controls to prevent ACLs, including sector-ACLs, from being exceeded, and to correct or mitigate overages of the ACL if they occur.
Allowable Biological Catch (ABC)	A level of a stock or stock complex's annual catch, which is based on an ABC control rule that accounts for the scientific uncertainty in the estimate of OFL, any other scientific uncertainty, and the Council's risk policy.
Annual Catch Limit (ACL)	A limit on the total annual catch of a stock or stock complex, which cannot exceed the ABC, that serves as the basis for invoking AMs. An ACL may be divided into sector-ACLs ( <i>see</i> paragraph (f)(4) of this section).
Annual Catch Target (ACT)	An amount of annual catch of a stock or stock complex that is the management target of the fishery, and accounts for management uncertainty in controlling the catch at or below the ACL.
Approaching an Overfished Condition	A stock or stock complex is approaching an overfished condition when it is projected that there is more than a 50 percent chance that the biomass of the stock or stock complex will decline below the MSST within two years.
Buffer	Informal term often used by the SSC when referring to the difference between OFL and ABC. Related to the level of assessment uncertainty. May be expressed in absolute values or as a percentage of OFL.
Catch	The total quantity of fish, measured in weight or numbers of fish, taken in commercial, recreational, subsistence, tribal, and other fisheries. Catch includes fish that are retained for any purpose, as well as mortality of fish that are discarded.
Coefficient of Variation (CV)	Standardized statistical measure of uncertainty, reflecting the dispersion (i.e. spread) of a probability distribution.

Optimum Yield	The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; that is prescribed on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, that provides for rebuilding to a level consistent with producing the MSY in such fishery.
Overfished	A stock or stock complex is considered “overfished” when its biomass has declined below MSST.
Overfishing	Occurs whenever a stock or stock complex is subjected to a level of fishing mortality or total catch that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis.
Overfishing Limit (OFL)	Annual amount of catch that corresponds to the estimate of MFMT applied to a stock or stock complex's abundance and is expressed in terms of numbers or weight of fish.
Management Uncertainty	Uncertainty in the ability of managers to constrain catch so that the ACL is not exceeded, and the uncertainty in quantifying the true catch amounts (i.e., estimation errors). The sources of management uncertainty could include: Late catch reporting; misreporting; underreporting of catches; lack of sufficient inseason management, including inseason closure authority; or other factors.
Maximum Fishing Mortality Threshold (MFMT)	The level of fishing mortality (i.e. F), on an annual basis, above which overfishing is occurring. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.
Maximum Sustainable Yield (MSY)	The largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets.; actual year to year yields will vary with changes in stock size and catch characteristics.
MSY Fishing Mortality Rate	F <sub>msy</sub> ; The fishing mortality rate that, if applied over the long term, would result in MSY.
MSY Stock Size	B <sub>msy</sub> ; The long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at F <sub>msy</sub> .
Minimum Stock Size Threshold (MSST)	The level of biomass below which the capacity of the stock or stock complex to produce MSY on a continuing basis has been jeopardized; used to determine if a stock is overfished.

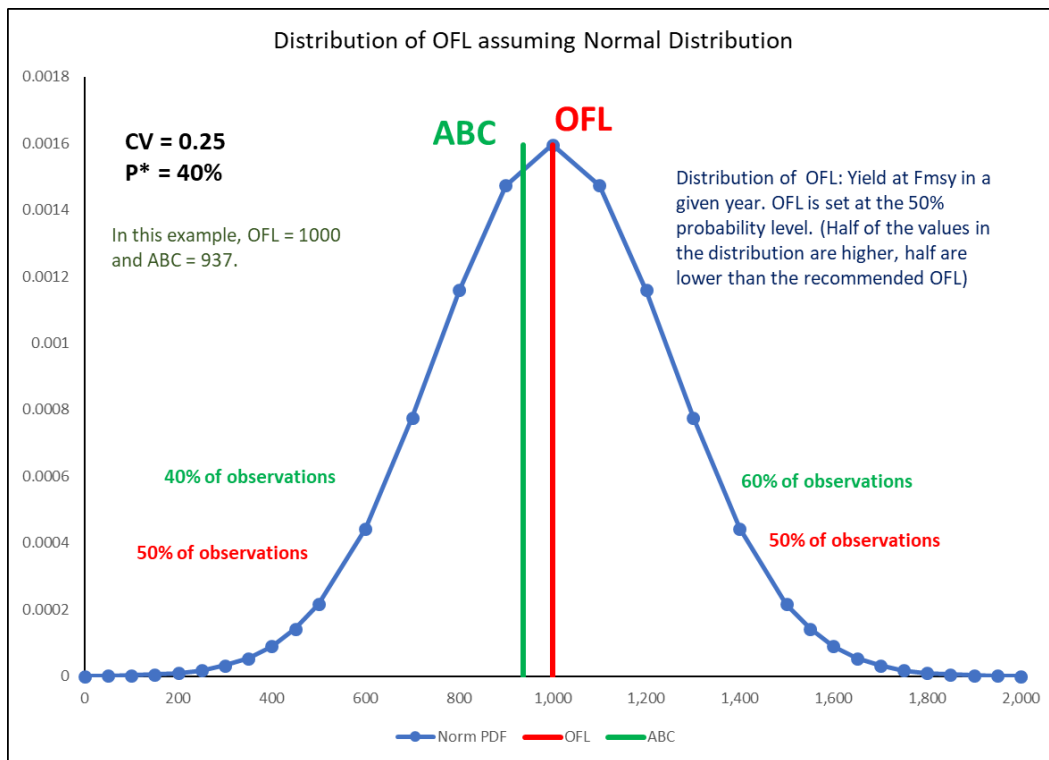
Probability Density Function (PDF)	A function that can be used to determine the likelihood of a particular value. In ABC CR use, it can provide the yield associated with a given P*.
Scientific Uncertainty	uncertainty in the information about a stock and its reference points. Sources of scientific uncertainty could include: Uncertainty in stock assessment results; uncertainty in the estimates of MFMT, MSST, the biomass of the stock, and OFL; time lags in updating assessments; the degree of retrospective revision of assessment results; uncertainty in projections; uncertainties due to the choice of assessment model; longer-term uncertainties due to potential ecosystem and environmental effects; or other factors.

## ABC CONCEPTUAL DIAGRAMS & DESCRIPTION

The following figures illustrate the relationships between reference points and how OFL and ABC are derived from the yield distribution and the chosen risk tolerance ( $P^*$ ).



**Figure 1. Illustrated general relationship between OFL, ABC, ACL, and ACT. The difference between OFL and ABC addresses assessment uncertainty, while the difference between ABC and ACL addresses management uncertainty.**



**Figure 2. Example distribution illustrating OFL and ABC for a hypothetical stock with OFL=1000 pounds, a chosen risk tolerance or  $P^*$  of 40% (40% chance that overfishing occurs), and an assessment CV of 0.25.**

**How is ABC derived for assessed stocks under this rule?**

Three basic items are required to derive an ABC from a stock assessment:

1. Estimates of productivity (i.e. MSY and OFL) and stock assessment uncertainty.

*These are products of an assessment and inputs to the ABC Control Rule. Various proxies can be used for unassessed stocks, such as SPR (spawning potential ratio) levels, or Fmax.*

- a. Estimated yield (OFL) and, ideally, a distribution of its uncertainty or a PDF.
- b. Assessment CV that can be applied to the OFL distribution

2. A risk tolerance for overfishing (e.g., P\*).

*This is set by the Council, as guided by the ABC Control Rule. Typically, the Council will provide risk tolerance guidance for the SSC to use when applying the ABC CR.*

- a. The Council will specify a risk rating for each stock (Action 2).

The SSC and relevant AP will provide guidance and recommendations for consideration by the Council.

- b. The SSC will evaluate the biomass level of the stock, either through the use of assessment results or, in the case of unassessed stocks, application of its best judgement as informed by other information as may be available.

- c. The risk tolerance is determined based on the combination of the stock risk rating and the stock biomass (Action 2).

3. A method for applying the risk tolerance to the assessment results.

*This is addressed by the SSC, guided by the ABC Control Rule, and forms the basis of the ABC recommendation.*

- a. Direct approach: distribution of OFL used to derive ABC

The P\* is applied to the distribution (PDF) of the estimated overfishing level (OFL). MSY or the OFL is based on the midpoint (50<sup>th</sup> percentile) of the estimated stock yield at FMSY. ABC is based on a different percentile, determined by the P\* value. For example, if the risk of overfishing is 30%, P\*=0.3 and ABC is determined by the 30<sup>th</sup> percentile of the OFL yield. The difference between ABC and OFL will vary across assessments, and will depend on the observed OFL distribution.

This is the approach used most often for assessed SAFMC stocks.

(To come: some example OFL distributions)

- b. Indirect approach: CV and assumed distribution of OFL used to derive ABC

If the distribution of OFL is not available, or not considered adequate for determining ABC, the ABC can be derived from a measure of assessment uncertainty (CV) and an assumed distribution of OFL. The type of distribution assumed (e.g., normal or log-normal) determines its shape. The CV determines how widely the distribution spreads. Thus, high CV distributions are broad and

flat, encompassing many values; while low CV distributions are narrow and steep, encompassing fewer values with many more values centered closely around a mode or median.

Once a CV and type of distribution is decided, the buffer between ABC and OFL can be determined for any risk level. In fact, the buffer can be determined in advance for any combination of CV, distribution, and risk tolerance ( $P^*$ ). To derive ABC, the buffer calculated by the CV, distribution, and  $P^*$  is applied to the OFL. For example, if a CV of 0.5 and a log-normal distribution of OFL are assumed, the ABC buffer will be 53%. If the OFL were 100,000 pounds, the OFL would be 47,000 pounds.