Acceptable Biological Catch control rule – As Accepted by Scientific and Statistical Committee January 2011

Table 2.3.1. Acceptable Biological Catch Control Rule.

Tier 1 Acceptable Biological Catch Control Rule	
Condition for Use	A quantitative assessment provides both an estimate of overfishing limit based on MSY or its proxy and a probability density function of overfishing limit that reflects scientific uncertainty. Specific components of scientific uncertainty can be evaluated through a risk determination table.
OFL	OFL = yield resulting from applying F_{MSY} or its proxy to estimated biomass.
ABC	The Council with advice from the SSC will set an appropriate level of risk (P*) using a risk determination table that calculates a P* based on the level of information and uncertainty in the stock assessment. ABC = yield at P*.
Tier 2 Acceptable Biological Catch Control Rule	
Condition for Use*	An assessment exists but does not provide an estimate of MSY or its proxy. Instead, the assessment provides a measure of overfishing limit based on alternative methodology. Additionally, a probability density function can be calculated to estimate scientific uncertainty in the model-derived overfishing limit measure. This density function can be used to approximate the probability of exceeding the overfishing limit, thus providing a buffer between the overfishing limit and acceptable biological catch.
OFL	An overfishing limit measure is available from alternative methodology.
ABC	Calculate a probability density function around the overfishing limit measure that accounts for scientific uncertainty. The buffer between the overfishing limit and acceptable biological catch will be based on that probability density function and the level of risk of exceeding the overfishing limit selected by the Council. a. Risk of exceeding OFL = 45% b. Risk of exceeding OFL = 35% c. Risk of exceeding OFL = 25% (default level for unassigned stocks) d. Risk of exceeding OFL = 15% Set ABC = OFL – buffer at risk of exceeding OFL
Tier 3a Acceptable Biological Catch Control Rule	
Condition for Use*	No assessment is available, but landings data exist. The probability of exceeding the overfishing limit in a given year can be approximated from the variance about the mean of recent landings to produce a buffer between the overfishing limit and acceptable biological catch. Based on expert evaluation of the best scientific information available, recent historical landings are without trend, landings are small relative to stock biomass, or the stock is unlikely to undergo overfishing if future landings are equal to or moderately higher than the mean of recent landings. For stock complexes, the determination of whether a stock complex is in Tier 3a or 3b will be made using all the information available, including stock specific catch trends.
OFL	Set the overfishing limit equal to the mean of recent landings plus two standard deviations. A time series of at least ten years is recommended to compute the mean of recent landings, but a different number of years may be used to attain a representative level of variance in the landings.
ABC	Set acceptable biological catch using a buffer from the overfishing limit that represents an acceptable level of risk due to scientific uncertainty. The buffer will be predetermined for each stock or stock complex by the Council with advice from the SSC as: a. ABC = mean of the landings plus 1.5 * standard deviation (risk of exceeding OFL = 31%) b. ABC = mean of the landings plus 1.0 * standard deviation (default) (risk of exceeding OFL = 16%) c. ABC = mean of the landings plus 0.5 * standard deviation (risk of exceeding OFL = 7%) d. ABC = mean of the landings (risk of exceeding OFL = 2.3%)
Tier 3b Acceptable Biological Catch Control Rule	
Condition for Use*	No assessment is available, but landings data exist. Based on expert evaluation of the best scientific information available, recent landings may be unsustainable.
OFL	Set the overfishing limit equal to the mean of landings. A time series of at least ten years is recommended to compute the mean of recent landings, but a different number of years may be used to attain a representative level of variance in the landings.
ABC	Set acceptable biological catch using a buffer from the overfishing limit that represents an acceptable level of risk due to scientific uncertainty. The buffer will be predetermined for each stock or stock complex by the Council with advice from its SSC as: e. ABC = 100% of OFL f. ABC = 85% of OFL g. ABC = 75% of OFL (default level for unassigned stocks) h. ABC = 65% of OFL

*Changes in the trend of a stock's landings or a stock complex's landings in three consecutive years shall trigger a reevaluation of their acceptable biological catch control rule determination under Tiers 2, 3a, or 3b.

Note: There may be situations in which reliable landings estimates do not exist for a given data-poor stock. The approach and methodology for setting OFL and ABC will be determined on a case-by-case basis, based on expert opinion and the best scientific information available.

$$P^* = exp\left[-a - b \sum_{i\ dimension} Dimension\ \ score_i \right]$$

P* = 0.21

S_{hi}= 4
Maximum Risk 0.45 — a= 0.799
Minimum Risk 0.15 — b= 0.2746531

$$a = -ln(0.45) \qquad b = -\frac{a + ln(0.15)}{S_{hi}} \qquad S_{hi} = highest\ \ possible\ \ score$$

Element scores are scaled from zero to a maximum.
In this example the maximum is 2.00, but this can be ch

Dimension	Dimension Wt	Tier No.	Tier Wt	Element Score	Element	Score it	Element Result	Tier Result	Dimension Result
Assessment Information	**1**	1	1	0.00	Quantitative, age-structured assessment that provides estimates of exploitation and biomass; includes MSY-derived benchmarks.		1.33	1.33	1.33
				0.67	Quantitative, age-structured assessment provides estimates of either exploitation or biomass, but requires proxy reference points.				
				1.33	Quantitative, non-age-structured assessment. Reference points may be based on proxy.	x			
				2.00	Quantitative assessment that provides relative reference points (absolute measures of status are unavailable) and require proxies.				
Characterization of Uncertainty	**1**	1	.25	0.0	The OFL pdf provided by the assessment model includes an appropriate characterization of "within model" and "between model/model structure" error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with using Bayesian priors and/or bootstrapping and/or Monte Carlo simulation and the full uncertainty has been carried forward into the projections.	x	0.0	0	1.50
				0.67	The OFL pdf provided by the assessment model includes an approximation of observation and process error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with ***SENSITIVITY RUNS*** and the full uncertainty has been carried forward into the projections.				
				1.33	The OFL pdf provided by the assessment model includes an incomplete approximation of observation and process error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with ***SENSITIVITY RUNS*** but the full uncertainty ***HAS NOT*** been carried forward into the projections.				
				2.0	The OFL provided by the assessment ***DOES NOT*** include uncertainty in important inputs and parameters.				
		2	.25	0.0	"Within Model" retrospective patterns have been described, and are not significant.		2.0	0.5	
				1.0	"Within Model" retrospective patterns have been described and are moderately significant.				
				2.0	"Within Model" retrospective patterns ***have not*** been described ***or*** are large.	X			
		3	.25	0.0	Historical retrospective patterns (examination of past performance of models on the same species) have been examined and are not signficant.		2.0	0.5	
				1.0	Historical retrospective patterns (examination of past performance of models on the same species) have been examined and are moderate.				
				2.0	Historical retrospective ratterns (examination of past performance of models on the same species) have been examined and are large ***or*** have not been examined	z			
		4	.25	0.0	Known environmental covariates are accounted for in the assessment.		2.0	0.5	
				1.0	Known environmental covariates are **partially** accounted for in the assessment.				
				2.0	Known environmental covariates ***are not*** accounted for in the assessment.	X			

2.4 Action 4. Acceptable Biological Catch control rule

Alternative 1. Do not specify an acceptable biological catch control rule. The overfishing limit and acceptable biological catch will be set by the SSC on an ad hoc basis for each stock or stock assemblage individually.

Preferred Alternative 2. Adopt the acceptable biological catch control rule described in Table 2.4.1. The indicated default risk of exceeding overfishing limit for Tier 2, or default acceptable biological catch buffer levels for Tier 3a and 3b, are to be used unless specified otherwise by the Council on a stock by stock basis.

Alternative 3. Adopt an acceptable biological catch control rule where the buffer between the overfishing limit and acceptable biological catch will be a fixed level consisting of:

a. Acceptable biological catch = 75% (or other percentage) of the overfishing limit
b. Acceptable biological catch = the yield at 75% (or other percentage) of F_{MSY}

Table 2.4.1. Acceptable Biological Catch Control Rule.

Tier 1 Acceptable Biological Catch Control Rule	
Condition for Use	A quantitative assessment provides both an estimate of overfishing limit based on maximum sustainable yield or its proxy and a probability density function of overfishing limit that reflects scientific uncertainty. Specific components of scientific uncertainty can be evaluated through a risk determination table.
OFL	OFL = yield resulting from applying F_{MSY} or its proxy to estimated biomass.
ABC	The Council with advice from the SSC will set an appropriate level of risk (P*) using a risk determination table that calculates a P* based on the level of information and uncertainty in the stock assessment. ABC = yield at P*.
Tier 2 Acceptable Biological Catch Control Rule	
Condition for Use*	An assessment exists but does not provide an estimate of MSY or its proxy. Instead, the assessment provides a measure of overfishing limit based on alternative methodology. Additionally, a probability density function can be calculated to estimate scientific uncertainty in the model-derived overfishing limit measure. This density function can be used to approximate the probability of exceeding the overfishing limit, thus providing a buffer between the overfishing limit and acceptable biological catch.
OFL	An overfishing limit measure is available from alternative methodology.
ABC	Calculate a probability density function around the overfishing limit measure that accounts for scientific uncertainty. The buffer between the overfishing limit and acceptable biological catch will be based on that probability density function and the level of risk of exceeding the overfishing limit selected by the Council. a. Risk of exceeding OFL = 45% b. Risk of exceeding OFL = 35% c. Risk of exceeding OFL = 25% (default level for unassigned stocks) d. Risk of exceeding OFL = 15% Set ABC = OFL – buffer at risk of exceeding OFL
Tier 3a Acceptable Biological Catch Control Rule	
Condition for Use*	No assessment is available, but landings data exist. The probability of exceeding the overfishing limit in a given year can be approximated from the variance about the mean of recent landings to produce a buffer between the overfishing limit and acceptable biological catch. Based on expert evaluation of the best scientific information available, recent historical landings are without trend, landings are small relative to stock biomass, or the stock is unlikely to undergo

	overfishing if future landings are equal to or moderately higher than the mean of recent landings. For stock complexes, the determination of whether a stock complex is in Tier 3a or 3b will be made using all the information available, including stock specific catch trends.
OFL	Set the overfishing limit equal to the mean of recent landings plus two standard deviations. A time series of at least ten years is recommended to compute the mean of recent landings, but a different number of years may be used to attain a representative level of variance in the landings.
ABC	Set acceptable biological catch using a buffer from the overfishing limit that represents an acceptable level of risk due to scientific uncertainty. The buffer will be predetermined for each stock or stock complex by the Council with advice from the SSC as: a. ABC = mean of the landings plus 1.5 * standard deviation (risk of exceeding OFL = 31%) b. ABC = mean of the landings plus 1.0 * standard deviation (default) (risk of exceeding OFL = 16%) c. ABC = mean of the landings plus 0.5 * standard deviation (risk of exceeding OFL = 7%) d. ABC = mean of the landings (risk of exceeding OFL = 2.3%)
Tier 3b Acceptable Biological Catch Control Rule	
Condition for Use[Note 1]	No assessment is available, but landings data exist. Based on expert evaluation of the best scientific information available, recent landings may be unsustainable.
OFL	Set the overfishing limit equal to the mean of landings. A time series of at least ten years is recommended to compute the mean of recent landings, but a different number of years may be used to attain a representative level of variance in the landings.
ABC	Set acceptable biological catch using a buffer from the overfishing limit that represents an acceptable level of risk due to scientific uncertainty. The buffer will be predetermined for each stock or stock complex by the Council with advice from its SSC as: e. ABC = 100% of OFL f. ABC = 85% of OFL g. ABC = 75% of OFL (default level for unassigned stocks) h. ABC = 65% of OFL

Note 1: Changes in the trend of a stock's landings or a stock complex's landings in three consecutive years shall trigger a reevaluation of their acceptable biological catch control rule determination under Tiers 2, 3a, or 3b.

Note 2: There may be situations in which reliable landings estimates do not exist for a given data-poor stock. The approach and methodology for setting OFL and ABC will be determined on a case-by-case basis, based on expert opinion and the best scientific information available.

Discussion:

Section 600.310(f)(4) of the National Standard 1 guidelines requires that each Council establish an acceptable biological catch control rule that should be based, when possible, on the probability that an actual catch equal to the stock's acceptable biological catch would result in overfishing.

Under Alternative 2, Table 2.4.1 represents an acceptable biological catch control rule for determining the appropriate level of risk and/or buffer to set between the overfishing limit and acceptable biological catch. In all cases the annual estimate of maximum sustainable yield is the overfishing limit. The acceptable biological catch control rule offers three tiers of guidance for setting acceptable biological catch based on the amount of information for a given stock. With less information there is greater scientific uncertainty, and therefore the buffer between the overfishing limit and acceptable biological catch will be greater.

The top tier, Tier 1, is for stocks that have undergone a quantitative assessment that has produced an estimate of maximum sustainable yield and a probability distribution around the estimate. For these stocks, specific factors related to uncertainty in the assessment can be evaluated through the use of a risk determination table, and converted into an appropriate level of risk, or P*. An example of a risk determination table is given in Table 2.4.4. Different methodologies may be needed for different types of assessments. Therefore, the risk determination table is not part of the ABC control rule, but rather a methodology developed and applied by the SSC to the control rule.

Tier 2 is for stocks that have not had a quantitative assessment that produces a estimate of maximum sustainable yield or maximum sustainable yield proxy. However, an overfishing limit can be calculated using an alternative methodology. The control rule does not specify the methodology to use in setting the overfishing limit, but rather, the buffer between the overfishing limit and acceptable biological catch. The overfishing limit is set by the SSC based on their best judgment of the appropriate method. This could be through the use of less data intensive methods. Examples of such methods include depletion corrected average catch (DCAC), or stock reduction analysis (SRA). The overfishing limit could also be based on a time series of landings. If based on a time series, the overfishing limit might be set conservatively at the mean of the landings, or if the SSC feels that the stock can remain stable at higher fishing levels, at the maximum observed landings, or at some point in between. A probability distribution can be developed around the mean of time-series of landings and used to determine the size of the buffer between the overfishing limit and acceptable biological catch. Although the buffer is based on the standard error around the mean of the landings, if we can determine the mean of a stable annual catch series and the related standard deviation and standard error, we can then add some number to the mean to arrive at a different overfishing limit knowing the standard deviation and standard error should remain the same (personal communication on 7/8/2010 from Elbert Whorton, statistician, University of Texas Medical Branch). Therefore, buffers based on this method can also be used with alternative overfishing limits that are simply some value added to the mean. The level of risk is determined by Council policy from within the previously determined range of 15% to 45%. This level of risk is converted into an appropriate acceptable biological catch based on the overfishing limit minus the buffer determined from the probability distribution.

Tier 3a is for stocks that have not been assessed, but are stable over time, or in the judgment of the SSC the stock or stock complex is unlikely to undergo overfishing at current average levels or at levels moderately higher than current average levels. Under this tier, the average landings are recommended as the annual catch target, and the overfishing limit and acceptable biological catch are set above the current average. Setting the buffer at some multiple of standard deviations allows the buffer size to vary with the amount of variability of the stock since standard deviation is a measure of variability. Stocks with high variability will have a higher buffer while those with less variability will have a lower buffer. If the overfishing limit is set at 2.0 standard deviations above the mean, then at 1.0 standard deviations above the mean, the recommended default for overfishing limit, there is a 16 percent probability that annual landings in any given year will exceed the overfishing limit. At acceptable biological catch levels of 1.5, 1.0, and 0.5 standard deviations above the mean the probability of exceeding the overfishing limit will be 31% and 7% respectively. If the acceptable biological catch is set equal to the mean, the probability of exceeding the overfishing limit will be 2.3%. These probabilities assume that the annual catch target and annual catch limit are set equal to the acceptable biological catch. In reality, the annual catch target is likely to be set at a lower value that

accounts for management uncertainty based on the annual catch limit/annual catch target control rule, which will reduce the probability of overfishing even further.

Tier 3b is for stocks that do not meet the requirements of either Tier 1 or Tier 2, and in the judgment of the SSC the current fishing levels may not be sustainable over time. At this tier, the mean of the landings becomes the overfishing limit, and the acceptable biological catch is set to some percentage of the overfishing limit. A statistically valid probability distribution around the overfishing limit estimate cannot be determined. For these stocks a fixed percentage between the overfishing limit and acceptable biological catch is adopted as a buffer to represent scientific uncertainty. The default buffer level for each stock is to set the acceptable biological catch at 75% of the overfishing limit unless a different risk level is determined by Council policy.

There may be situations when there is not even a reliable time series of recent landings. For example, fisheries that are currently closed in federal waters (e.g., goliath grouper, red drum) have no recent landings from federal waters. If these fisheries are reopened at some future time, none of the above tiers may be applicable. Therefore, note 2 was added to the control rule, which states that in situations where reliable landings estimates do not exist, the approach and methodology for setting OFL and ABC will be determined on a case-by-case basis, based on expert opinion and the best scientific information available.

Testing of Buffer Levels Under Different Tiers

As the tier levels increase from Tier 2 to Tier 3s and Tier 3b, the increasing uncertainty should result in larger buffers between the overfishing limit and acceptable biological catch. However, this is not intuitive from looking at the control rule, particularly since the catch levels under Tier 2 may be either higher or lower than under Tier 3a or Tier 3b depending upon the method selected for determining the overfishing limit in Tier 2 (Tiers 3a and 3b each have a defined fixed method). Scientific uncertainty is reflected in the size of the buffer between the overfishing limit and acceptable biological catch, rather than the absolute values. To test whether Tier 3a and Tier 3b produce a higher buffer between the overfishing limit and acceptable biological catch than Tier 2, the overfishing limit and acceptable biological catch was calculated under each of the methods for two randomly selected stocks, vermilion snapper and lane snapper, using the landings data and P* probability distributions that were available to the SSC at their July 2010 meeting. As shown in Tables 2.4.2 and 2.4.3, in both cases, at the default risk levels, the Tier 3a buffer was greater than Tier 2, and the Tier 3b buffer was greater than Tier 3a, indicating that the control rule does account for greater scientific uncertainty with the more data poor methods.

Table 2.4.2. Tier 2, 3 and 3a calculations of overfishing limit-acceptable biological catch buffer and possible overfishing limit and acceptable biological catch values for vermilion snapper. Catch values and buffers are in millions of pounds. The default values recommended by the SSC for setting the buffer were used for each tier.

Vermilion snapper								
			OFL=mean		OFL=75th percentile		OFL=max	
Method	Value used to Calculate Buffer	**Buffer**	OFL	ABC	OFL	ABC	OFL	ABC
Tier 2	P* = 0.25	**-0.18**	2.77	2.59	3.25	3.07	3.74	3.56
Tier 3a	OFL = 2 standard deviations above mean of landings	**-0.65**	4.08	3.42				
	ABC = 1 standard deviation above mean of landings							
Tier 3b	OFL = mean of landings	**-0.69**	2.77	2.08				

	ABC = 75% of mean of landings				

Table 2.4.3. Tier 2, 3 and 3a calculations of overfishing limit-acceptable biological catch buffer and possible overfishing limit and acceptable biological catch values for lane snapper. Catch values and buffers are in millions of pounds. The default values recommended by the SSC for setting the buffer were used for each tier.

Lane snapper								
			OFL=mean		OFL=75th percentile		OFL=max	
Method	Value used to Calculate Buffer	**Buffer**	OFL	ABC	OFL	ABC	OFL	ABC
Tier 2	P* = 0.25	**-0.012**	0.244	0.232	0.287	0.275	0.330	0.318
Tier 3a	OFL = 2 standard deviations above mean of landings	**-0.057**	0.358	0.301				
	ABC = 1 standard deviation above mean of landings							
Tier 3b	OFL = mean of landings	**-0.061**	0.244	0.183				
	ABC = 75% of mean of landings							

For some data poor stocks it may not be possible to develop an estimate of overfishing limit due to poor data quality, scarcity of landings data, or for other reasons. Such stocks should be made part of a species group where overfishing limit and overfishing limit-acceptable biological catch buffer and possible overfishing limit and acceptable biological catch values will be determined on either the group or on an indicator stock for the group.

Alternative 1, the no action alternative, does not specify an acceptable biological catch control rule. The SSC would set acceptable biological catch for each stock or stock assemblage using their best judgment of where the acceptable biological catch should be set. The National Standard 1 guidelines require that fishery management plans contain an acceptable biological catch control rule, defined as " a specified approach to setting the ABC for a stock or stock complex as a function of the scientific uncertainty in the estimate of OFL and any other scientific uncertainty" (600.310(f)(2)(iii)). Since this alternative does not provide a specified approach, it is not viable under the guidelines.

Preferred Alternative 2 uses the acceptable biological catch control rule described in this section. In Tier 1 the overfishing limit is determined from a quantitative stock assessment, while in Tiers 2 and 3 the SSC will determine the most appropriate methodology for setting an overfishing limit. For data poor stocks subject to one of the Tier 3 rules Tier 3a is the least conservative since it sets the acceptable biological catch and overfishing limit above the observed mean of the landings. However, this is only done if in the judgment of the SSC the stock is unlikely to undergo overfishing at the levels selected. Tier 3b is the most conservative since the overfishing limit is set equal to the current mean landings, and the acceptable biological catch is set at a lower value. This tier will usually require management changes to be effectively implemented.

Alternative 3 establishes a much simpler control rule where a single buffer is used to separate the overfishing limit and acceptable biological catch. **Option a** sets the buffer at 75% of the overfishing limit, which is the buffer used to set the red snapper acceptable biological catch after the 2009 update assessment. **Option b** sets the buffer equal to the current Optimum Yield definition of the yield at 75% of F_{MSY}. Both options set the acceptable biological catch at a

conservative level. However, this one size fits all approach may not be optimum for all stocks, although at least one SSC member has argued that this is appropriate for establishing scientific uncertainty, and it eliminates the subjective evaluations required under **Preferred Alternative 2**.

Table 2.4.4. Example of a risk determination table for use with acceptable biological catch control rule Tier 1.

$$P^* = exp\left[-a - b \sum_{i\,dimension} Dimension\,score_i\right]$$

P* = 0.21

S_{hi} = 4

Maximum Risk 0.45 a= 0.799 $a = -ln(0.45)$

Minimum Risk 0.15 b= 0.2746531 $b = -\frac{a + ln(0.15)}{S_{hi}}$ $S_{hi} = highest\,possible\,score$

Element scores are scaled from zero to a maximum.

In this example the maximum is 2.00, but this can be cha

Dimension	Dimension Wt	Tier No.	Tier Wt	Element Score	Element	Score it	Element Result	Tier Result	Dimension Result
Assessment Information	**1**	1	1	0.00	Quantitative, age-structured assessment that provides estimates of exploitation and biomass; includes MSY-derived benchmarks.		1.33	1.33	1.33
				0.67	Quantitative, age-structured assessment provides estimates of either exploitation or biomass, but requires proxy reference points.				
				1.33	Quantitative, non-age-structured assessment. Reference points may be based on proxy.	x			
				2.00	Quantitative assessment that provides relative reference points (absolute measures of status are unavailable) and require proxies.				
Characterization of Uncertainty	**1**	1	.25	0.0	The OFL pdf provided by the assessment model includes an appropriate characterization of "within model" and "between model/model structure" error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with using Bayesian priors and/or bootstrapping and/or Monte Carlo simulation and the full uncertainty has been carried forward into the projections.	x	0.0	0	1.50
				0.67	The OFL pdf provided by the assessment model includes an approximation of observation and process error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with ***SENSITIVITY RUNS*** and the full uncertainty has been carried forward into the projections.				
				1.33	The OFL pdf provided by the assessment model includes an incomplete approximation of observation and process error. The uncertainty in important inputs (such as natural mortality, discard rates, discard mortality, age and growth parameters, landings before consistent reporting) has been described with ***SENSITIVITY RUNS*** but the full uncertainty ***HAS NOT*** been carried forward into the projections.				
				2.0	The OFL provided by the assessment ***DOES NOT*** include uncertainty in important inputs and parameters.				
		2	.25	0.0	"Within Model" retrospective patterns have been described, and are not significant.		2.0	0.5	
				1.0	"Within Model" retrospective patterns have been described and are moderately significant.				
				2.0	"Within Model" retrospective patterns ***have not*** been described ***or*** are large.	X			
		3	.25	0.0	Historical retrospective patterns (examination of past performance of models on the same species) have been examined and are not signficant.		2.0	0.5	
				1.0	Historical retrospective patterns (examination of past performance of models on the same species) have been examined and are moderate.				
				2.0	Historical retrospective ratterns (examination of past performance of models on the same species) have been examined and are large ***or*** have not been examined	z			
		4	.25	0.0	Known environmental covariates are accounted for in the assessment.		2.0	0.5	
				1.0	Known environmental covariates are **partially** accounted for in the assessment.				
				2.0	Known environmental covariates ***are not*** accounted for in the assessment.	X			

Table 2.4.5. Examples of methodologies that could be applied by the SSC to determine OFL for Tier 2 and 3 stocks. These are examples only, and are not a comprehensive list of methods.

OFL methodologies for data poor species	
Dimensions	**Potential methods and data requirements**
1) Reliable catch history	a > 10 yrs of reliable catch history; reliable estimate of M < 0.2; prior distributions of M, F_{MSY}/M, B_{MSY}/B_0, relative stock status, and $A_{50\% Mat}$ OFL = Depletion-Based Stock Reduction Analysis (DB-SRA) [1] b > 10 yrs of reliable catch history; reliable estimate of M < 0.2; prior distributions of M, F_{MSY}/M, B_{MSY}/B_0, and relative stock status OFL = Depletion Corrected Average Catch (DCAC)[1] **c** Only reliable catch series[3] OFL = average catch of the time series
2) Minimal catch data	Apply dimension 1 based on similar species (i.e., life history, vulnerability) Apply PSA-style adjustment for risk (based on vulnerability) Consider use of stock complex approach with benchmarks based on most data rich/vulnerable species