3. In the context of Objectives above, to consider the health of the herring resource and the important role of herring as a forage fish and a predator fish throughout its range.

3.0 PROPOSED MANAGEMENT ACTION

This section describes the two management measures proposed to be implemented in Amendment 4 to the Atlantic herring FMP. The first measure would establish ACLs and has four sub-components which address new definitions of fishery-related terms, fishery specification changes, the division of the ACL into sub-ACLs, and the process for setting the specifications. The changes to the fishery specifications sub-component had two options for the Council to choose between; the option which was chosen is presented in this section, and the other option, which can be seen in Section 4.0.

While there is only one alternative proposed to modify the specifications process to ensure compliance with the MSA, there are two options which were chosen by the council for establishing accountability measures (AMs) in the context of the administrative changes that are proposed.

3.1 ESTABLISHING ANNUAL CATCH LIMITS (ACLS)

3.1.1 The ACL/AM Process (Fishery Specifications)

The Proposed Action will modify the current fishery specification process for Atlantic herring to ensure the Herring FMP's compliance with the new requirements of the MSA relative to the requirement to establish ACLs and AMs in the fishery. New definitions, proposed changes to the administrative process for establishing fishery specifications, and new provisions, including consideration of accountability measures as part of the specification process, are discussed in detail in the following subsections.

3.1.1.1 Definitions

The following definitions define new terms used in this section.

Catch: Catch is defined in the NS1 Guidelines as 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. The ACLs established for the herring fishery should relate to total catch in the fishery, including landings and discards.

Stocks in the Fishery: Stocks in a fishery may be grouped into stock complexes as appropriate, and NMFS suggests groupings of "target stocks," "non-target stocks," and "ecosystem component (EC) species," as appropriate. Target stocks are defined as stocks that fishers seek to catch for sale or personal use, including "economic discards" as defined in the MSA. Any stocks that are formally identified as "stocks in the fishery" should be managed under the FMP and will require status determination criteria, other reference points, ACLs, and AMs.

The final NS1 Guidelines do not require the Council or the Secretary to include all target and non-target species as "stocks in a fishery." They do not mandate the use of EC species and do not require inclusion of particular species in an FMP. The determination as to how a particular fishery should be defined remains within the authority and discretion of the Council.

For the purposes of this amendment and the Atlantic Herring FMP, the stock in the fishery is the target stock – **Atlantic herring**. While there are other species that are caught incidentally when fishing for Atlantic herring, the focus of the ACL/AM process in this amendment will be the stock directly managed by the Atlantic Herring FMP. Bycatch in the herring fishery will continue to be addressed and minimized to the extent possible, consistent with other requirements of the MSA.

There may be non-target stocks that warrant consideration in the future when developing ACLs and AMs for the herring fishery, and the Council retains the ability to consider these for inclusion in this management program at a later date. At this time, the Herring FMP will not identify non-target species for management through ACLs until the primary FMP that manages the species in question identifies a sub-ACL that should be considered for the herring fishery.

OFL: Overfishing Level. The catch that results from applying the maximum fishing mortality threshold to a current or projected estimate of stock size. When the stock is not overfished and overfishing is not occurring, this is usually F_{MSY} or its proxy. Catches that exceed this amount would be expected to result in overfishing. The annual OFL can fluctuate above and below MSY depending on the current size of the stock. This specification will replace the current specification of *allowable biological catch* in the herring fishery.

ABC: Acceptable Biological Catch. The maximum catch that is recommended for harvest, consistent with meeting the biological objectives of the management plan. ABC can equal but never exceed the OFL. ABC should be based on F_{MSY} or its proxy for the stock if overfishing is not occurring and/or the stock is not in a rebuilding program, and should be based on the rebuilding fishing mortality (F_{reb}) rate for the stock if it is in a rebuilding program. The specification of ABC will consider scientific uncertainty and will be recommended to the Council by its Scientific and Statistical Committee.

OFL>=ABC>=ACL

OFL – Scientific Uncertainty = ABC (Determined by SSC)

ABC Control Rule. The specified approach to setting the ABC for a stock or stock complex as a function of scientific uncertainty in the estimate of OFL and any other scientific uncertainty. The ABC control rule will consider uncertainty in factors such as stock assessment issues, retrospective patterns, predator-prey issues, and projection results.

The ABC control rule will be specified and may be modified based on guidance from the SSC during the specifications process. Modifications to the ABC control rule can be implemented through the specifications package or framework adjustments to the Herring FMP (in addition to future amendments), as appropriate.

Background (2010-2012 Specifications)
The ABC control rule will be contingent on the stock assessments providing adequate information. During the 2010-2012 specifications process the SSC pointed out two of sources of considerable scientific uncertainty:

> *(1) The assessment has a strong 'retrospective pattern' in which estimates of stock size are sequentially revised downward as new data are added to the assessment; and (2) Maximum sustainable yield reference points estimated from the biomass dynamics model are inconsistent with the age-based, stochastic projection; such that fishing at the current estimate of F_{MSY} is expected to maintain equilibrium biomass that is less than the current estimate of B_{MSY}.*

Given this magnitude of uncertainty the SSC was unable to provide final guidance. As such, an interim ABC has been set until a new benchmark assessment can be produced, and an interim ABC control rule has been set to reflect the decision.

The SSC recommended that the ABC be set based on recent catch, and asked that the Council determine the desired risk tolerance in setting the ABC. The Council considered the SSC advice, and, consistent with it, considered three options for defining recent catch:

- One-year (most recent, 2008) – 90,000 mt; and
- Three-year (2006 – 2008) average – 106,000 mt; and
- Five-year (2004 – 2008) average – 108,000 mt.

The three-year average catch (2006-2008, 106,000 mt) was selected by the Council to form the basis of the ABC specification for 2010-2012 for several reasons:

- A three-year average is commonly used to reflect "recent" levels of landings, biomass, fishing mortality, trawl survey results, and other factors that are utilized to evaluate trends in a fishery or stock status. The Council's approach is consistent with this approach and appears to be technically-sound. It also falls within the range of approaches suggested by the SSC and is therefore consistent with SSC advice and the best available scientific information.
- A one-year approach was not utilized because 2008 catch was one of the lowest on record for many years and may not adequately or accurately address the true level of "recent" catch. While there may be a variety of reasons that 2008 catch was lower, the specific reasons remain unknown (market conditions, fish availability, lower Area 1A TAC, etc.). Canadian catch (NB weir fishery) was particularly low in 2008, while 2007 landings were the highest of the time series. Variability in catch from year to year should be considered when defining recent catch, and variability is not addressed through a one-year approach.
- The Council considered other factors identified by the SSC, including recruitment, biomass projections, and the importance of herring as a forage species. The three-year approach was chosen instead of a five-year approach with consideration of these and other factors. The Council's proposed approach for specifying ABC provides for a technically-sound way to address annual variability in catch and fishing effort while remaining consistent with SSC advice and slightly more conservative than the five-year option that was considered.

- The proposed specification of ABC (106,000 mt) provides a 27% buffer from the proposed F_{MSY}-based catch in 2010 (145,000 mt) to account for scientific uncertainty associated with the 2009 TRAC updated herring assessment, particularly the retrospective pattern in the assessment model. This should ensure that the risk of exceeding F_{MSY} for the stock complex is minimized, despite any uncertainties associated with the assessment results. The Council supports the SSC recommendation that a benchmark assessment for Atlantic herring is needed as soon as possible and will revisit this issue with the SSC when such an assessment occurs. Until then, the proposed approach is consistent with SSC advice and based on the best available and most recent information.

Interim ABC Control Rule

On January 25th, 2010, the Council decided that the interim control rule for ABC would be based on the SSC recommendations. **The interim ABC control rule is:**

ABC = Average Catch (2006-2008)

The interim control rule serves as a placeholder until a more appropriate control rule is developed. In addition to the ABC advice, the SSC also recommended that a new benchmark assessment should be scheduled as soon as possible, preferably in advance of the next management cycle. This would allow the SSC to create an ABC control rule for the next specifications process. In the future the SSC will develop the ABC control rule when further information becomes available.

ACL: Annual Catch Limit. The catch level selected such that the risk of exceeding the ABC is consistent with the management program. ACL can be equal to but can never exceed the ABC. ACL should be set lower than the ABC as necessary due to uncertainty over the effectiveness of management measures. The ACL serves as the level of catch that determines whether accountability measures (AMs) become effective.

ABC – Management Uncertainty = Stock-wide ACL = OY

AM: Accountability Measure(s). Management measures established to ensure that (1) the ACL is not exceeded during the fishing year; and (2) any ACL overages, if they occur, are mitigated and corrected.

Table 3 Overview of New Definitions used in Proposed ACL Process

Acronym	Definition	Considerations
OFL	Catch at F_{MAX}	Current stock size
ABC	Catch at F_{MSY} or $F_{rebuild}$ <=OFL	Biological uncertainty over current stock size, estimate of F, or other parameters (stock mixing ratios, recruitment, etc.)
ACL	<=ABC	Uncertainty from other sources, evaluation of risk to achieving management goals if ABC is exceeded
AM	Accountability Measures	(1) minimizing risk of exceeding ACL during the fishing year; (2) addressing ACL overages, if they occur

Section 303(a)(4) of the MSA also requires FMPs to assess and specify:

- The capacity and the extent to which fishing vessels of the U.S., on an annual basis, will harvest the optimum yield specified in the FMP (domestic annual harvest, DAH);
- The portion of OY which, on an annual basis, will not be harvested by fishing vessels of the U.S. and can be made available for foreign fishing (total allowable level of foreign fishing, TALFF); and
- The capacity and extent to which U.S. fish processors, on an annual basis, will process that portion of OY that will be harvested by U.S. fishing vessels (domestic annual processing, DAP).

Part of OY may be held as a reserve to allow for factors such as uncertainties in estimates of stock size and DAH.

3.1.1.2 Elimination of JVP, IWP, TALFF, and Reserve Specifications

According to the Atlantic Herring FMP, Joint Venture Processing (JVP) and Internal Waters Processing (IWP) operations are very similar; in each, a foreign processing vessel is contracted to process fish which are harvested by domestic vessels. The only difference is where the processing vessel is located and under whose authority the JVP or IWP is granted. JVP vessels process fish in federal waters while IWP vessels process fish in state waters. The amount available for use by foreign processing vessels is the total joint venture allocation—JVPt. TALFF is essentially self explanatory; when the specification is set Total Allowable Level of Foreign Fishing dictates how much fish is removable from US waters by foreign vessels.

The Proposed Action would retain the general provisions for establishing specifications for the Atlantic herring fishery but would eliminate the specification of JVP, IWP, and a TAC reserve, as well as eliminate the need to specify TALFF on an annual basis. While TALFF would not have to be considered by the Council during the specifications process, countries interested in foreign fishing for herring may still request TALFF allocations from NMFS, and these requests would be addressed as they arise. Minor adjustments would be made to bring the additional specifications into compliance with the new provisions of the MSA, consistent with Option 1 above. The only difference between this Proposed Action and the non-preferred action (Section

4.1.2) is that the preferred eliminates the need for the Council to specify JVP, IWP, TALFF, and a TAC reserve on an annual basis.

The most notable changes to the specifications in this preferred action include the addition of a specification for OFL, elimination of the current abc (allowable biological catch) specification and addition of the MSA-defined ABC specification (acceptable biological catch), and the adjustments to AMs. The Atlantic herring fishery is and will continue to be managed by hard TACs. A stock-wide ACL will be established, and the specification of sub-ACLs will relate to the management area TACs (see Table 4).

Table 4 Proposed Changes to Atlantic Herring Fishery Specifications

CURRENT SPECIFICATIONS	PROPOSED (AMENDMENT 4) SPECIFICATIONS
Allowable Biological Catch (abc)	Overfishing Limit (OFL)
	Acceptable Biological Catch (ABC)
U.S. Optimum Yield (OY)	U.S. Optimum Yield (OY) (Stock-Wide ACL)
Domestic Annual Harvesting (DAH)	Domestic Annual Harvesting (DAH)
Domestic Annual Processing (DAP)	Domestic Annual Processing (DAP)
Total Joint Venture Processing (JVPt)	
Joint Venture Processing (JVP)	
Internal Waters Processing (IWP)	
U.S. At-Sea Processing (USAP)	U.S. At-Sea Processing (USAP)
Border Transfer (BT)	Border Transfer (BT)
Total Allowable Level of Foreign Fishing (TALFF)	
RESERVE	
TAC Area 1A	TAC Area 1A (sub-ACL)
TAC Area 1B	TAC Area 1B (sub-ACL)
TAC Area 2	TAC Area 2 (sub-ACL)
TAC Area 3	TAC Area 3 (sub-ACL)
Research Set-Aside	Research Set-Aside (and/or Other Set-Aside)

In the process proposed to establish ACLs in this amendment, catch in the Canadian (NB) weir fishery will be subtracted or removed from consideration after specifying ABC and before establishing ACLs for the U.S. fishery. Uncertainty related to future catch from the NB weir fishery, state waters landings, and discards may be factored into "management uncertainty."

Furthermore, Section 201(d) of the MSA states that:

> The total allowable level of foreign fishing, if any, with respect to any fishery subject to the exclusive fishery management authority of the United States, is that portion of the optimum yield of such fishery which cannot, or will not be harvested by vessels of the United States, as determined in accordance with this Act. Allocations of the total allowable level of foreign fishing are discretionary, except that the total allowable level shall be zero for fisheries determined by the Secretary to have adequate or excess domestic harvest capacity.

The Council developed a limited access program for the Atlantic herring fishery in Amendment 1 because it determined that harvesting capacity in the fishery is more than adequate to fully utilize the available yield. While markets and other factors may influence the actual catch on an annual basis, capacity exists in the fishery to fully utilize the OY.

The rationale for a limited access program in the herring fishery is provided in Section 6.1 of the Amendment 1 document. The capacity analysis in Amendment 1 suggests that keeping the fishery open-access would result in potential landings ranging from 170,087 metric tons to 209,368 mt (currently, the TACs for the herring fishery total 145,000 mt across all management areas). The limited access program implemented in Amendment 1 was projected to allow harvesting capacity to range from 161,030 mt to 198,710 mt, which is still higher than the total available OY for the fishery. This capacity will likely remain in the fishery, therefore eliminating the need to consider specifications for TALFF on a continuing basis.

The Proposed Action would make it so the Council would still specify DAH and DAP as part of the multi-year fishery specifications. The Council, however, has determined that DAH will be high enough that regular consideration of TALFF is not necessary, and DAP will be high enough that regular consideration of JVP is not necessary. Information to support DAH and DAP specifications will continue to be provided in the specifications package.

3.1.1.3 Sub-ACLs

While it is widely recognized that the herring resource is composed of different stock components (primarily inshore Gulf of Maine and offshore Georges Bank/southern New England components), assessment of the Atlantic herring resource remains complex-wide; data are not available at this time to generate a biomass estimate, apply a target fishing mortality rate, and estimate an appropriate level of yield specifically from the inshore component of the resource. Therefore, an ACL for the Atlantic herring stock complex as a whole should be established, which is based on the most recent stock assessment, accounts for scientific uncertainty, and is intended to prevent overfishing.

However, once an ACL for the Atlantic herring resource is specified, the Council may divide the ACL into ***sub-ACLs***. These sub-ACL will facilitate management of the catch of the resource and its stock components across the range of the stock. This will allow catch limits to be established to ensure that overfishing does not occur on individual stock components. This is the intent of the current process for establishing management area TACs in the herring fishery. These TACs will be rolled over into the definition of sub-ACLs. The sub-ACLs can also provide for accountability measures to be implemented in the specific portions of the fishery that may be

Table 13 - Numerical estimates of revised status determination criteria from GARM III assessment meetings and the Data Poor Working Group

Species	Stock	Model	Bmsy or proxy (mt)	Fmsy or proxy	MSY (mt)
Cod	GB	VPA	148,084	0.25	31,159
Cod	GOM	VPA	58,248	0.24	10,014
Haddock [(1)]	GB	VPA	153,329	0.35	33,604
Haddock	GOM	VPA	5,900	0.43	1,360
Yellowtail Flounder	GB	VPA	43,200	0.25	9,400
Yellowtail Flounder	SNE/MA	VPA	27,400	0.25	6,100
Yellowtail Flounder	CC/GOM	VPA	7,790	0.24	1,720
American Plaice	GB/GOM	VPA	21,940	0.19	4,011
Witch Flounder		VPA	11,447	0.20	2,352
Winter Flounder	GB	VPA	16,000	0.26	3,500
Winter Flounder	GOM	VPA	3,792	0.28	917
Winter Flounder	SNE/MA	VPA	38,761	0.25	9,742
Redfish		ASAP	271,000	0.04	10,139
White Hake	GB/GOM	SCAA	56,254	0.13	5,800
Pollock	GB/GOM	AIM	2.00 kg/tow	5.66 c/i	11,320
Windowpane Flounder	GOM/GB	AIM	1.40 kg/tow	0.50 c/i	700
Windowpane Flounder	SNE/MA	AIM	0.34 kg/tow	1.47 c/i	500
Ocean Pout		Index Method	4.94 kg/tow	0.76 c/i	3,754
Atlantic Halibut		Replacement Yield	49,000	0.07	3,500
Atlantic Wolffish[(2)]		SCALE	1747 – 2202 mt	< 0.35	278 – 311 mt

(1) GB haddock values for B_{MSY} and MSY reflect corrected values reported in Dr. Nancy Thompson's (Northeast Fisheries Science Center) letter to the New England Fishery Management Council dated November 14, 2008. GARM III reported BMSY as 158,873 mt (SSB) and MSY as 32,746 mt.
(2) Atlantic wolffish values are based on the revised Atlantic wolffish working paper prepared after the Data Poor Working Group. Values in this document differ from those in the summary report of the review panel.

4.1.2 ABC Control Rules

Background: After adoption of the Sustainable Fishery Act amendments to the M-S Act in 1996, the National Standard Guidelines (NSGs) suggested that management plans should include MSY control rules. The control rules specified the fishing mortality rates used to manage the fishery. Amendment 9 (NEFMC 1998) adopted MSY control rules for the Northeast Multispecies FMP. These control rules were modified in Amendment 13 (NEFMC 2003). When the M-S Act was reauthorized in 2006, additional requirements were imposed for Councils to adopt Annual Catch Limits (ACLs) (see section 4.2.1 for additional details). As part of this process, the Science and Statistical Committee (SSC) of the Council first specifies an acceptable biological catch, or ABC. The ACL set by the Council cannot exceed the ABC established by the SSC.

When Amendment 16 was initiated, the Council did not intend to modify the MSY control rules adopted by Amendment 13. The draft Amendment 16 document assumed that the Amendment 13 control rules would

continue to guide the fishery management plan. The existing MSY control rules were incorporated into the setting of ACLs.

Two events occurred during the development of the amendment that led the Council to reconsider this decision. First, the NMFS published revised National Standard guidelines to implement the changes to the M-S Act that were adopted when it was reauthorized in 2006 (see 50 CFR 600.310 published in 73 *Federal Register* 32526). Published just before the Council approved the draft amendment document, the revised guidelines outline the implementation of requirements to set ABCs and ACLs in all management plans. The guidelines revise and expand the concept of control rules and suggest that management plans should adopt ABC control rules. These are similar to the original MSY control rules, and it is feasible that the plan could follow the new guidelines simply by renaming the Amendment 13 MSY control rules.

The second event was the SSC review of the plan for setting ABCs and ACLs. The draft amendment proposed that ABCs would be based on the fishing mortality called for by the control rule or Frebuild (for stocks in a formal rebuilding program). The ABC would also consider elements of scientific uncertainty. The Council's Plan Development Team (PDT) proposed an approach to evaluate these uncertainties and presented it to the SSC in July 2008. The SSC agreed with the concept but suggested the PDT test the approach by applying it to several stocks based on assessments completed in 2005. The results of this test (reviewed by the SSC in May, 2009) indicated that the PDT's approach would not have ended overfishing if used for three stocks to set catch levels for 2005 through 2007. As summarized by the SSC, the PDT's review highlighted the following (Cadrin, pers. comm.):

1. Medium to long term probabilistic stock projections are highly uncertain,
2. Accurately estimating probabilities at the tails of probability distributions (either high or low probabilities) is particularly difficult,
3. Even if projections are unbiased and probabilities are accurately estimated, some fish stocks will not be rebuilt by the end of the rebuilding period.
4. The available data is inadequate to conduct probabilistic projections for some stocks.

As a result, the SSC recommended a simpler approach to take into account scientific uncertainty when setting ABCs in the absence of better information that more accurately describes scientific uncertainty. To quote the SSC recommendation: "The SSC concluded that in the absence of better information on what an appropriate buffer should be between the OFL and the ABC, a relatively simple ABC and robust specification could be applied to all groundfish stocks, in all stages of rebuilding or long-term maintenance of optimum yield." The SSC recommended modifying the control rules used in the fishery from those adopted in Amendment 13. The Council accepted the SSC's recommendation at its June, 2009 Council meeting.

Action: The MSY control rules adopted by Amendment 13 are replaced by the ABC control rules listed below. These ABC control rules will be used in the absence of better information that may allow a more explicit determination of scientific uncertainty for a stock or stocks. If such information is available – that is, if scientific uncertainty can be characterized in a more accurate fashion -- it can be used by the SSC to determine ABCs. These ABC control rules can be modified in a future Council action (an amendment, framework, or specification package):

a. ABC should be determined as the catch associated with 75% of F_{MSY}.
b. If fishing at 75% of F_{MSY} does not achieve the mandated rebuilding requirements for overfished stocks, ABC should be determined as the catch associated with the fishing mortality that meets rebuilding requirements ($F_{rebuild}$).

c. For stocks that cannot rebuild to B_{MSY} in the specified rebuilding period, even with no fishing, the ABC should be based on incidental bycatch, including a reduction in bycatch rate (i.e., the proportion of the stock caught as bycatch).
d. Interim ABCs should be determined for stocks with unknown status according to case-by-case recommendations from the SSC.

4.1.3 Revised mortality targets for formal rebuilding programs

Amendment 13 adopted formal rebuilding programs for overfished groundfish stocks. The amendment also called for an evaluation of rebuilding progress and an adjustment in mortality targets to achieve rebuilding, if necessary. Mortality targets are adjusted as necessary to meet the rebuilding dates and probability of success adopted by Amendment 13 and Framework 42. This section assumes that there will not be any changes in the rebuilding time period or probability of success used to determine the target fishing mortality rates.

According to the GARM III assessments, the following stocks achieved their B_{MSY} level (or its proxy) prior to submission of this document, and this action acknowledges completion of the rebuilding programs in the year shown:

- GB haddock (2006)
- GOM haddock (2000)

4.1.3.1 Revised Rebuilding Mortality Targets

After the assessments of all regulated groundfish stocks were completed in August 2008, an evaluation was made as to whether adjustments to the rebuilding fishing mortality targets are necessary. For the draft amendment, revised rebuilding fishing mortality targets were calculated based on estimates of stock status in 2008, revisions to status determination criteria (if any), and the rebuilding timelines and probabilities of success adopted by Amendment 13 and FW 42. These revised mortality targets are shown in Table 14. In the case of GOM cod and American plaice, the rebuilding fishing mortality exceeded $F_{MSY.}$ Since fishing at a higher level than F_{MSY} constitutes overfishing, the mortality target for these stocks was shown as F_{MSY} in the draft amendment.

Subsequent to Council approval of the draft amendment, the Council adopted new ABC control rules recommended by the SSC. A full description is provided in section 4.1.2. With the Council's adoption of the new ABC control rules, some of the mortality targets for this action were changed from those proposed in the draft amendment. If Frebuild is higher than 75% of FMSY, the latter is used for the target. This changed the mortality targets for GOM cod, plaice, witch flounder, GB haddock, GOM haddock, CC/GOM yellowtail flounder, and redfish. Revised mortality targets guiding this management action are reflected in Table 15.

It should be noted that in the case of overfished stocks these fishing mortality targets implement a particular rebuilding strategy. The strategy consists of the time period for rebuilding and the probability of success used to determine a rebuilding fishing mortality rate. When stock status is determined it can be compared to the rebuilding program and the rebuilding fishing mortality can be recalculated. While this is normally done every few years based on the assessment cycle and changes are included in a management action, if assessments are available more frequently and a mechanism exists to implement a different fishing mortality rate then the revised rate can be implemented without a management action. At present, this is a possibility for GB yellowtail flounder since the stock is assessed every year through the TRAC and is managed through a hard TAC. It may be possible in the future to use this approach for other stocks.

5.0 MANAGEMENT ALTERNATIVES

The selection of the preferred alternatives within section 5.0, taken in conjunction with those existing measures in the FMPs, will provide a comprehensive framework for the catch limit and accountability system recommended in the revised NS1 guidelines provided by NMFS. Each suite of potential options is composed of a status quo/no action alternative, and one or more action alternatives that the Council considered when identify preferred alternatives. In the case of proactive accountability and performance review alternatives, the Council may identify more than one action alternative as preferred.

5.1 No Action

Section 5.03(b) of NOAA Administrative Order (NAO) 216-6, "Environmental review procedures for implementing the National Environmental Policy Act," states that "an EA must consider all reasonable alternatives, including the preferred action and the no action alternative." Consideration of the "no action" alternative is important because it shows what would happen if the proposed action is not taken. Defining exactly what is meant by the "no action" alternative is often difficult. The President's Council on Environmental Quality (CEQ) has explained that there are two distinct interpretations of the "no action:" One interpretation is essentially the *status quo*, i.e., no change from the current management; and the other interpretation is when a proposed project, such as building a railroad facility, does not take place. In the case of the proposed action alternatives contained within this document to specify mechanisms to set ABC, ACLs, and AMs, and future review and modification of those actions for the managed resources of this Omnibus Amendment, it is slightly more complicated than either of these interpretations suggest. There is no analogue for these fisheries to the railroad project described above, where no action means nothing happens. The management regimes and associated management measures within the FMPs (section 4.2) for the managed resources have been refined over time and codified in regulation. The *status quo* management measures for the managed resources, therefore, each involve a set of indefinite (i.e., in force until otherwise changed) measures that have been established. These measures will continue as they are even if the actions contained within this document are not taken (i.e., no action). The no action alternative for these managed resources is therefore equivalent to *status quo*. On that basis, the status quo and no action are presented in conjunction (i.e., Status quo/no action alternative) for comparative impact analysis relative to the action alternatives.

5.2 Specifying Acceptable Biological Catch

This section is comprised of two subsections which address the establishment of ABC controls rule methods in the FMP and a Council risk policy. Box 5.2 provides a brief overview of the alternatives contained within this section.

Box 5.2. Brief description of the alternatives included in section 5.2.				
Issue	**Sub-Issue**	**Alternative**	**Status**	**Description of Action**
Acceptable Biological Catch (ABC) (Section 5.2)	*ABC Alternatives (Section 5.2.1)*	ABC-A	Status quo/no action	No action to establish ABC control rule methods in FMP
		ABC-B (Council-Preferred)	Proposed	Council establishes ABC control rule methods in FMP
	Council Risk Policy (Section 5.2.2)	RISK-A	Status quo/no action	No action to establish formal risk policy in FMP
		RISK-B	Proposed	Constant probability of overfishing = 25 Percent
		RISK-C	Proposed	Stock Status, Replenishment Threshold, with Inflection at B/B_{MSY} = 1.0
		RISK-D	Proposed	Stock Status/Assessment Level Offset, Replenishment Threshold, with Inflection at B/B_{MSY} = 1.5
		RISK-E	Proposed	Stock Status/Assessment Level Offset, Replenishment Threshold, with 2 Inflection Points at B/B_{MSY} = 1.0 and B/B_{MSY} = 2.0
		RISK-F	Proposed	Categorical (4 x 4) with stock history, life history, and assessment level
		RISK-G (Council-Preferred)	Proposed	Stock Status/Life History, Inflection at B/BMSY = 1.0

5.2.1 Acceptable Biological Catch Alternatives

Alternative ABC-A: Status quo/no action

Under this status quo alternative, the process used by the SSC for developing ABC recommendations for the Council would continue. There would be no formalization of the process to address scientific uncertainty and the SSC would continue to apply ad hoc methods to develop ABC recommendations. ABC would continue to be specified for up to three years for each of the managed resources, except spiny dogfish which may be specified up to five years and bluefish specified annually. This ad hoc process would not establish ABC control rules in the FMP for the managed resources consistent with NS1 guidelines (§ 600.310(f)(4)).

Alternative ABC-B (Council-Preferred): ABC Control Rule Methods – Four Assessment Levels

A multi-level approach will be used for setting an ABC for each Mid-Atlantic stock, based on the overall level of scientific uncertainty associated with its assessment. The stock assessment will be required to provide estimates of the maximum fishing mortality threshold (MFMT) and future biomass, the probability distributions of these estimates, the probability distribution of the overfishing limit (OFL; level of catch that would achieve MFMT given the current or future biomass), and a description of factors considered and methods used to estimate their distributions. The multi-level approach defines four levels of overall assessment uncertainty defined by characteristics of the stock assessment and determination

by the SSC that the uncertainty in the probability distribution of OFL adequately represents best available science. The procedure used to determine ABCs is different in each level of the methods framework. The SSC will determine to which level the assessment for a particular stock belongs when setting single or multi-year ABC specifications and a description of the justification for assignment to a level will be provided with the ABC recommendation. The ABC recommendations should be more precautionary as an assessment moves from level 1 to level 4. Recommendations for ABC may be made for up to 3 years for all of the managed resources except spiny dogfish which may be specified for up to 5 years. The rationale for assigning an assessment to a level will be reviewed each time an ABC determination is made.

The levels of stock assessments, their characteristics, and procedures for determining ABCs are defined as follows:

Level 1: Level 1 represents the highest level to which an assessment can be assigned. Assignment of a stock to this level implies that all important sources of uncertainty are fully and formally captured in the stock assessment model and the probability distribution of the OFL calculated within the assessment provides an adequate description of uncertainty of OFL. Accordingly, the OFL distribution will be estimated directly from the stock assessment. In addition, for a stock assessment to be assigned to Level 1, the SSC must determine that the OFL probability distribution represents best available science. Examples of attributes of the stock assessment that would lead to inclusion in Level 1 are:

- Assessment model structure and any treatment of the data prior to inclusion in the model includes appropriate and necessary details of the biology of the stock, the fisheries that exploit the stock, and the data collection methods;
- Estimation of stock status and reference points integrated in the same framework such that the OFL calculations promulgate all uncertainties (stock status and reference points) throughout estimation and forecasting;
- Assessment estimates relevant quantities including F_{MSY}[4], OFL, biomass reference points, stock status, and their respective uncertainties; and
- No substantial retrospective patterns in the estimates of fishing mortality (F), biomass (B), and recruitment (R) are present in the stock assessment estimates.

The important part of Level 1 is that the precision estimated using a purely statistical routine will define the OFL probability distribution. Thus, all of the important sources of uncertainty are formally captured in the stock assessment model. When a Level 1 assessment is achieved, the assessment results are likely unbiased and fully consider uncertainty in the precision of estimates. Under Level 1, the ABC will be determined solely on the basis of an acceptable probability of overfishing (P*), determined by the Council's risk policy (see alternatives in section 5.2.2), and the probability distribution of the OFL.

Level 2: Level 2 indicates that an assessment has greater uncertainty than Level 1. Specifically, the estimation of the probability distribution of the OFL directly from the stock assessment model fails to include some important sources of uncertainty, necessitating expert

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

judgment during the preparation of the stock assessment, and the OFL probability distribution is deemed best available science by the SSC. Examples of attributes of the stock assessment that would lead to inclusion in Level 2 are:

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

In this level, ABC will be determined by using the Council's risk policy (see alternatives in section 5.2.2), as with a Level 1 assessment, but with the OFL probability distribution based on the specified distribution in the stock assessment.

Level 3: Attributes of a stock assessment that would lead to inclusion in Level 3 are the same as Level 2, except that

- The assessment does not contain estimates of the probability distribution of the OFL or the probability distribution provided does not, in the opinion of the SSC, adequately reflect uncertainty in the OFL estimate.

Assessments in this level are judged to over- or underestimate the accuracy of the OFL. The SSC will adjust the distribution of the OFL and develop an ABC recommendation by applying the Council's risk policy (see alternatives in section 5.2.2) to the modified OFL probability distribution. The SSC will develop a set of default levels of uncertainty in the OFL probability distribution for this level based on literature review and a planned evaluation of ABC control rules. A control rule of 75 percent of F_{MSY} may be applied as a default if an OFL distribution cannot be developed.

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

- Assessment approach is missing essential features of the biology of the stock, characteristics of data collection, and the fisheries that exploit it;
- Stock status and reference points are estimated, but are not considered reliable;

- Assessment may estimate some relevant quantities including biomass, fishing mortality or relative abundance, but only trends are deemed reliable;
- Large retrospective patterns usually present; and
- Uncertainty may or may not be considered, but estimates of uncertainty are probably substantially underestimated.

In this level, a simple control rule will be used based on biomass and catch history and the Council's risk policy.

The SSC will determine, based on the assessment level to which a stock is classified, the specifics of the control rule to specify ABC that would be expected to attain the probability of overfishing specified in the Council's risk policy. The SSC may deviate from the above control rule methods framework or level criteria and recommend an ABC that differs from the result of the ABC control rule calculation, but must provide justification for doing so.

5.2.2 Risk Policy Alternatives

The Council risk policy alternatives given below would be applied all to the managed resources under MAFMC management jurisdiction. Under any of the action risk alternatives selected below, which excludes alternative RISK-A, the following would also apply.

For managed resources that are under rebuilding plans, the upper limit on the probability of exceeding $F_{REBUILD}$ would be 50 percent unless modified to a lesser value (i.e., higher probability of not exceeding $F_{REBUILD}$) through a rebuilding plan amendment. For example, the Council may conclude through a rebuilding plan Amendment that setting catch limits at the 25th percentile of catch associated with $F_{REBUILD}$ would rebuild the stock more quickly (i.e., provide for 75 percent probability of not exceeding $F_{REBUILD}$). In instances where the SSC derives a more restrictive ABC recommendation, based on the application of the ABC control rule methods framework and risk policy, than the ABC derived from the use of $F_{REBUILD}$ at the MAFMC-specified overfishing risk level, the SSC shall recommend to the MAFMC the lower of the ABC values.

In addition, if no OFL is available (i.e., No F_{MSY} or F_{MSY} proxy provided through the stock assessment to identify it) and no OFL proxy is provided by the SSC at the time of ABC recommendations, then an upper limit (cap) on allowable increases in ABC will be established. ABC may not be increased until an OFL has been identified. This policy is designed to prevent catch limits from being increased when there are no criteria available to determine if overfishing will be occurring for the upcoming fishing year. To reduce the risk of overfishing, the Council policy would be to not increase ABC in the absence of an OFL.

It should be noted in the alternatives below that if the ratio of biomass (B) to biomass at maximum sustainable yield (B_{MSY}) is less than 1.0, then the current stock biomass is less than B_{MSY}; if the ratio of B to B_{MSY} is greater than or equal to B, then the current stock biomass is B_{MSY} or greater.

Alternative Risk-A: Status quo/no action

Under this status quo alternative, there would be no formalization of a Council risk policy which expresses the Council tolerance for overfishing. Under this alternative, no policy

would be established and provided to the SSC prior to ABC recommendations being developed for the Council. The ad hoc Council process to address risk guided by past precedent would continue. Past precedent from *NRDC et al. versus Daley* (USDC, 1999) identifies catch levels must have at least a 50 percent probability of not overfishing. A 50 percent probability of overfishing is, therefore, the upper limit on the risk of overfishing and serves as the precedent-based default in the absence of any Council action to establish a risk policy. Consistent with the status quo, the Council could recommend catch be reduced to achieve a lower probability of overfishing on an ad hoc basis after ABC recommendation have been provided by the SSC to the Council.

Alternative Risk-B: Constant Probability of Overfishing = 25 Percent

Under this alternative, the probability of overfishing will be 25 percent under all circumstances (i.e., irrespective of stock condition, rebuilding status, life history, etc.).

Alternative Risk-C: Stock Status, Inflection at B/B_{MSY} = 1.0

Under this alternative, a stock replenishment threshold defined as the ratio of B/B_{MSY} = 0.10, will be utilized to ensure the stock does not reach low levels from which it cannot recover. The probability of overfishing will be 0 percent if the ratio of B/B_{MSY} is less than or equal to 0.10. Probability of overfishing increases linearly as the ratio of B/B_{MSY} increases, until the inflection point of B/B_{MSY} = 1.0 is reached and a 40 percent probability of overfishing is utilized for ratios equal to or greater than 1.0.

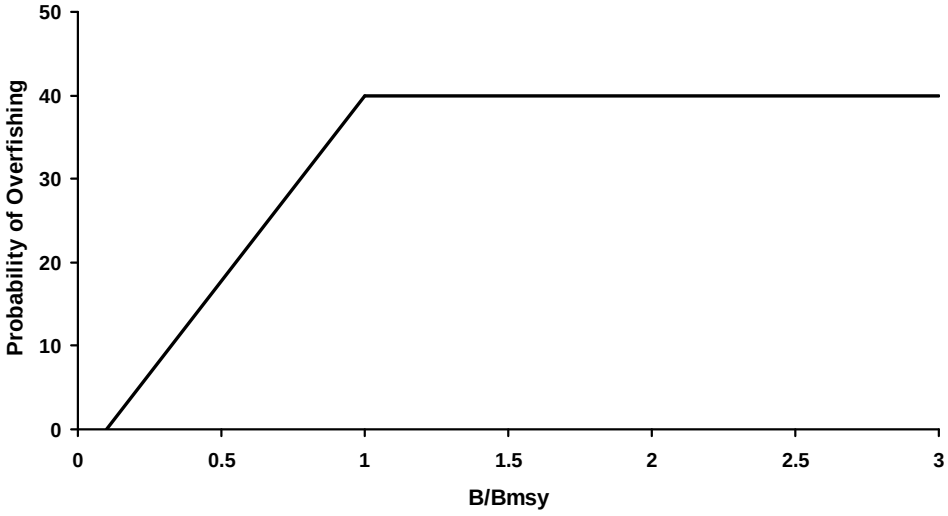

Figure 1. Risk Policy C.

Alternative Risk-D: Stock Status/Assessment Level, Inflection at B/B_{MSY} = 1.5

Under this alternative, a stock replenishment threshold defined as the ratio of B/B_{MSY} = 0.10, will be utilized to ensure the stock does not reach low levels from which it cannot recover. The probability of overfishing will be 0 percent if the ratio of B/B_{MSY} is less than or equal to

0.10. Probability of overfishing increases linearly at similar rates as the ratio of B/B_{MSY} increases; until the inflection point of $B/B_{MSY} = 1.5$ is reached and a 50 percent probability of overfishing is utilized for assessment level 1 (see section 5.2.1), 45 percent for level 2, 40 percent for level 3, and 35 percent for level 4.

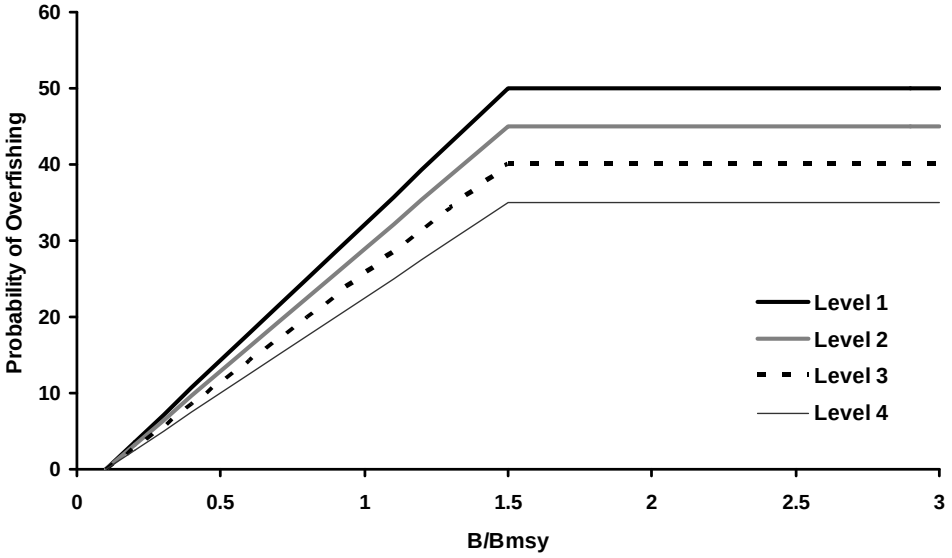

Figure 2. Risk Policy D.

Alternative Risk-E: Stock Status/Assessment Level, 2 Inflection Points at $B/B_{MSY} = 1.0$ and $B/B_{MSY} = 2.0$

Under this alternative, a stock replenishment threshold defined as the ratio of $B/B_{MSY} = 0.10$, will be utilized to ensure the stock does not reach low levels from which it cannot recover. The probability of overfishing will be 0 percent if the ratio of B/B_{MSY} is less than or equal to 0.10. Probability of overfishing increases linearly at similar rates as the ratio of B/B_{MSY} increases; until the inflection point of $B/B_{MSY} = 1.0$ is reached and a 45 percent probability of overfishing is utilized for assessment level 1 (see section 5.2.1), 40 percent for level 2, 35 percent for level 3, and 30 percent for level 4. Probability of overfishing then continues to increase to the inflection point of $B/B_{MSY} = 2.0$, where the probability of overfishing is for level 1 is 50 percent, 45 percent for level 2, 40 percent for level 3, and 35 percent for level 4, for all B/B_{MSY} ratios equal to or greater than 2.0.

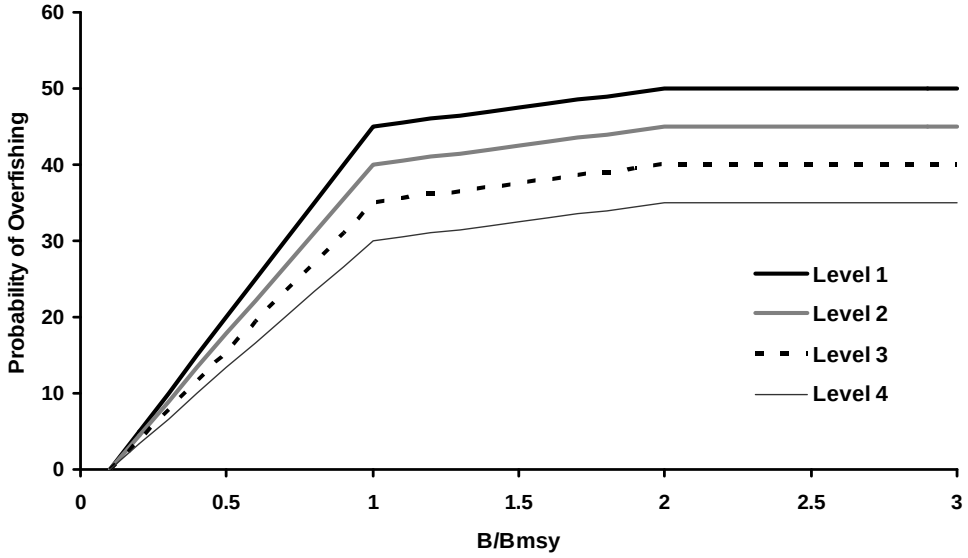

Figure 3. Risk Policy E.

Alternative Risk-F: Categorical, Range from 10 - 50 percent

Under this alternative, specification of the probability of overfishing incorporates assessment level (see section 5.2.1), stock history, and life history patterns. Probability of overfishing is higher for stocks which have not been overfished (either currently or previously based on best available scientific information). Probability of overfishing is also higher for stocks which have typical life history patterns, when compared to atypical life history patterns (e.g., spiny dogfish and black sea bass). In addition, as the assessment level decreases, the probability of overfishing decreases. The SSC will determine whether a stock is typical or atypical each time an ABC is recommended. Generally speaking, an atypical stock has a life history strategy that results in greater vulnerability to exploitation, and whose life history has not been fully addressed through the stock assessment and biological reference point development process.

Table 7. Risk Policy F.

Probability of Overfishing				
Assessment Level	**Stock History (Previously Overfished?)**			
	Has Never Been Overfished		***Has Been Overfished***	
	Life History Pattern		***Life History Pattern***	
	Typical	**Atypical**	**Typical**	**Atypical**
1	50	45	45	40
2	40	35	35	30
3	30	25	25	20
4	20	15	15	10

Alternative Risk-G (Council-Preferred): Stock Status/Life History, Inflection at B/B_{MSY} = 1.0

Under this alternative, a stock replenishment threshold defined as the ratio of B/B_{MSY} = 0.10, will be utilized to ensure the stock does not reach low levels from which it cannot recover. The probability of overfishing will be 0 percent if the ratio of B/B_{MSY} is less than or equal to 0.10. Probability of overfishing increases linearly for stock defined as typical as the ratio of B/B_{MSY} increases, until the inflection point of B/B_{MSY} = 1.0 is reached and a 40 percent probability of overfishing is utilized for ratios equal to or greater than 1.0. Probability of overfishing increases linearly for stock defined as atypical as the ratio of B/B_{MSY} increases, until the inflection point of B/B_{MSY} = 1.0 is reached and a 35 percent probability of overfishing is utilized for ratios equal to or greater than 1.0. The SSC will determine whether a stock is typical or atypical each time an ABC is recommended. Generally speaking, an atypical stock has a life history strategy that results in greater vulnerability to exploitation, and whose life history has not been fully addressed through the stock assessment and biological reference point development process.

In addition, under this alternative for managed resources that are under rebuilding plans, the upper limit on the probability of exceeding $F_{REBUILD}$ would be 50 percent unless modified to a lesser value (i.e., higher probability of not exceeding $F_{REBUILD}$) through a rebuilding plan amendment. In instances where the SSC derives a more restrictive ABC recommendation, based on the application of the ABC control rule methods framework and risk policy, than the ABC derived from the use of $F_{REBUILD}$ at the MAFMC-specified overfishing risk level, the SSC shall recommend to the MAFMC the lower of the ABC values.

In addition, if no OFL is available (i.e., No F_{MSY} or F_{MSY} proxy provided through the stock assessment to identify it) and no OFL proxy is provided by the SSC at the time of ABC recommendations, then an upper limit (cap) on allowable increases in ABC will be established. ABC may not be increased until an OFL has been identified.

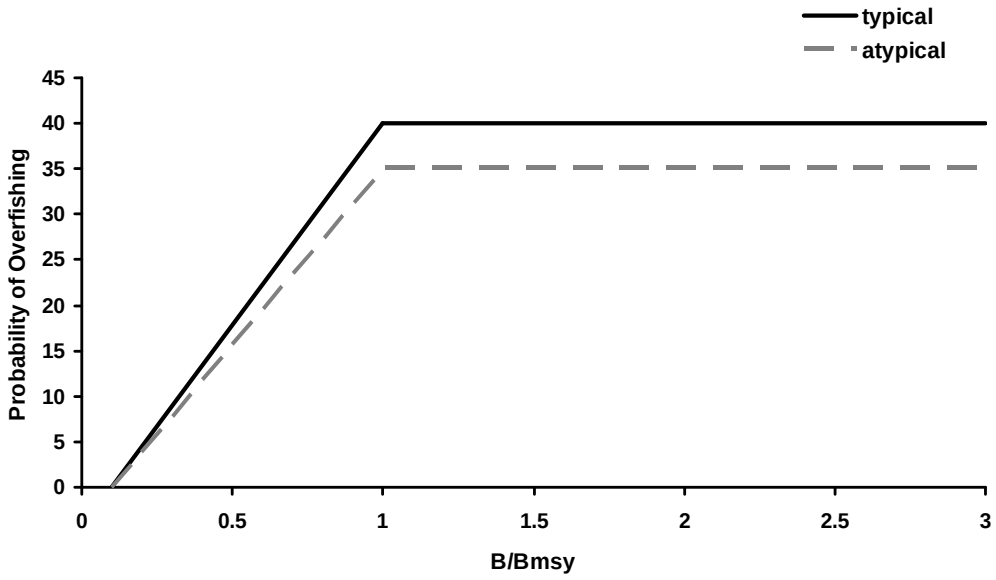

Figure 4. Risk Policy G.

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 = 50% b. Risk of exceeding OFL = 40% c. Risk of exceeding OFL = 30% (default) 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) 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 scientific risk is determined by Council policy from within a range of 30% to 50% to match the range of risk used in Tier 1. 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* = 0.410

S_{hi} = 3.998

Maximum Risk **0.50** a= 0.693

Minimum Risk **0.30** b= 0.1277703

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

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

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.		0.67	0.67	0.67
				0.67	Quantitative, age-structured assessment provides estimates of either exploitation or biomass, but requires proxy reference points.	x			
				1.33	Quantitative, non-age-structured assessment. Reference points may be based on proxy.				
				2.00	Quantitative assessment that provides relative reference points (absolute measures of status are unavailable) and require proxies.				
Characterization of Uncertainty	**1**	1	.333	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.		0.67	0.223	0.89
				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.	x			
				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	.333	0.0	Retrospective patterns have been described, and are not significant.		2.0	0.666	
				1.0	Retrospective patterns have been described and are moderately sig.				
				2.0	Retrospective patterns ***have not*** been described ***or*** are large.	X			
		3	0				0	0	
					NOT USED				
						z			
		4	.333	0.0	Known environmental covariates are accounted for in the assessment.	x	0.0	0	
				1.0	Known environmental covariates are **partially** accounted for in the assessment.				
				2.0	Known environmental covariates ***are not*** accounted for in the assessment.				

3.2.3.1.3 Process and Timeline of Council Recommendations, Public Review, and Secretarial Decision

The Council will develop its harvest specifications recommendations for Secretarial consideration using the following: 1) recommendations of the Groundfish Plan Team and SSC and information presented by the Plan Team and SSC in support of these recommendations; 2) information presented by the Advisory Panel and the public; and 3) other relevant information.

In consultation with the Council, the Secretary will establish harvest specifications, including TACs and apportionments thereof, and reserves for each target species category, by January 1 of the new fishing year, or as soon as practicable thereafter, by means of regulations published in the Federal Register. Harvest specifications may be effective for up to two fishing years. Final harvest specifications are implemented by mid-February each year to replace those already in effect for that year, based on new information contained in the latest SAFE report.

As soon as practicable after its October meeting, the Council will recommend proposed harvest specifications to the Secretary. The Council's recommendation will include proposed harvest specifications for each stock or stock complex within the "target species" category, the basis for each proposed harvest specification, and a description of developing information that may be relevant to the final harvest specifications. As soon as practicable after the October meeting and after considering the Council's recommended proposed harvest specifications, the Secretary will publish in the Federal Register a notice of proposed harvest specifications and make available for public review and comment all information regarding the basis for the harvest specifications. The notice of proposed harvest specifications will identify whether and how harvest specifications are likely to be affected by developing information unavailable at the time the notice is published. The public review and comment period on the notice of proposed harvest specifications will be a minimum of 15 days.

At its December meeting, the Council will review the final SAFE report, recommendations of the Groundfish Plan Team, SSC, AP, and comments received. The Council will make final harvest specification recommendations to the Secretary. As soon as practicable thereafter and after considering the Council's recommendation, the Secretary will publish final harvest specifications for the groundfish fishery. New final harvest specifications will supercede current harvest specifications on the effective date of the new harvest specifications. However, if the Secretary determines that the notice of final specifications would not be "a logical outgrowth" of the notice of proposed harvest specifications (i.e., the notice of proposed harvest specifications was inadequate to afford the public opportunity to comment meaningfully on the issues involved), the Secretary will either: (1) publish a revised notice of proposed harvest specifications in the Federal Register, solicit public comment thereon, and publish a notice of final harvest specifications, as soon as is practicable; or (2) if "good cause" pursuant to the Administrative Procedure Act exists, waive the requirements for notice and comment and 30-day delayed effectiveness and directly publish a notice of final harvest specifications with a post-effectiveness public comment period of 15 to 30 days.

3.2.3.2 Overfishing Limit

Specification of OFL begins with the MFMT (also known as the OFL control rule). The MFMT is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations.

For tier (1), a "pdf" refers to a probability density function. For tiers 1 and 2, if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers 1 to 5, if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers 1 to 3, the coefficient α is set at a default value of 0.05. This default value was established by applying the 10 percent rule suggested by Rosenberg et al. (1994) to the 1/2 B_{MSY} reference point. However, the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific

information. For tiers 2 to 4, a designation of the form "$F_{X\%}$" refers to the fishing mortality rate (F) associated with an equilibrium level of spawning per recruit equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view spawning per recruit calculations based on a knife-edge maturity assumption as reliable. For tier 3, the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

Tier 1 Information available: reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY} .

1a) Stock status: $B/B_{MSY} > 1$
$F_{OFL} = mA$, the arithmetic mean of the pdf

1b) Stock status: $\alpha < B/B_{MSY} \leq 1$
$F_{OFL} = mA \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

1c) Stock status: $B/B_{MSY} \leq \alpha$
$F_{OFL} = 0$

Tier 2 Information available: reliable point estimates of B, B_{MSY} , F_{MSY} , $F_{35\%}$, and $F_{40\%}$.

2a) Stock status: $B/B_{MSY} > 1$
$F_{OFL} = F_{MSY}$

2b) Stock status: $\alpha < B/B_{MSY} \leq 1$
$F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

2c) Stock status: $B/B_{MSY} \leq \alpha$
$F_{OFL} = 0$

Tier 3 Information available: reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.

3a) Stock status: $B/B_{40\%} > 1$
$F_{OFL} = F_{35\%}$

3b) Stock status: $\alpha < B/B_{40\%} \leq 1$
$F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) Stock status: $B/B_{40\%} \leq \alpha$
$F_{OFL} = 0$

Tier 4 Information available: reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.
$F_{OFL} = F_{35\%}$

Tier 5 Information available: reliable point estimates of B and natural mortality rate M.
$F_{OFL} = M$

Tier 6 Information available: reliable catch history from 1978 through 1995.
OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information

With the exception of Tier 6, the MFMT is applied to the best estimate of stock size (which may or may not be age structured) for the coming year to produce the OFL, which is expressed in units of catch biomass. In the case of Tier 6, the MFMT is already expressed in units of catch biomass, meaning that the MFMT and the OFL are identical.

3.2.3.3 Acceptable Biological Catch and Annual Catch Limit

3.2.3.3.1 Acceptable Biological Catch

Specification of ABC is similar to specification of OFL, in that both involve harvest control rules with six tiers relating to various levels of information availability. However, somewhat more flexibility is allowed in specifying ABC, in that the control rule prescribes only an upper bound. The steps are as follow:

1. Determine the appropriate tier (this will be the same tier used to specify OFL).
2. Determine the maximum permissible ABC fishing mortality rate from the appropriate tier of the ABC control rule (see below).
3. Except for stocks or stock complexes managed under Tier 6, compute the maximum permissible

ABC by applying the maximum permissible ABC fishing mortality rate to the best estimate of stock size (which may or may not be age structured); for stocks and stock complexes managed under Tier 6, the control rule automatically produces a maximum permissible ABC, so application of a fishing mortality rate is unnecessary.

4. Determine whether conditions exist that warrant setting ABC at a value lower than the maximum permissible value (such conditions may include—but are not limited to—data uncertainty, recruitment variability, and declining population trend) and, if so:

   a. document those conditions,

   b. recommend an ABC lower than the maximum permissible value, and

   c. explain why the recommended value is appropriate.

The above steps are undertaken first by the assessment authors in the individual chapters of the SAFE report. The Plan Team then reviews the SAFE report and makes its own recommendation. The SSC then reviews the SAFE report and Plan Team recommendation, and makes its own recommendation to the Council. The Council then reviews the SAFE report, Plan Team recommendation, and SSC recommendation; then makes its own recommendation to the Secretary, with the constraint that the Council's recommended ABC cannot exceed the SSC's recommended ABC.

The ABC control rule is as follows (definitions of terms and information requirements for the six tiers are identical to those used in the OFL control rule):

Tier 1 Information available: reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.

1a) Stock status: $B/B_{MSY} > 1$
$maxF_{ABC} = mH$, the harmonic mean of the pdf

1b) Stock status: $\alpha < B/B_{MSY} \leq 1$
$maxF_{ABC} = mH \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

1c) Stock status: $B/B_{MSY} \leq \alpha$
$maxF_{ABC} = 0$

Tier 2 Information available: reliable point estimates of B, B_{MSY} , F_{MSY} , $F_{35\%}$, and $F_{40\%}$.

2a) Stock status: $B/B_{MSY} > 1$
$maxF_{ABC} = F_{MSY} \times (F_{40\%} /F_{35\%})$

2b) Stock status: $\alpha < B/B_{MSY} \leq 1$
$maxF_{ABC} = F_{MSY} \times (F_{40\%} /F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

2c) Stock status: $B/B_{MSY} \leq \alpha$
$maxF_{ABC} = 0$

Tier 3 Information available: reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.

3a) Stock status: $B/B_{40\%} > 1$
$maxF_{ABC} = F_{40\%}$

3b) Stock status: $\alpha < B/B_{40\%} \leq 1$
$maxF_{ABC} = F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) Stock status: $B/B_{40\%} \leq \alpha$
$maxF_{ABC} = 0$

Tier 4 Information available: reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.
$maxF_{ABC} = F_{40\%}$

Tier 5 Information available: reliable point estimates of B and natural mortality rate M.
$maxF_{ABC} = 0.75 \times M$

Tier 6 Information available: reliable catch history from 1978 through 1995.
maxABC= 0.75 × OFL

The above control rule is intended to account for scientific uncertainty in two ways: First, the control rule is structured explicitly in terms of the type of information available, which is related qualitatively to the amount of scientific uncertainty. Second, the size of the buffer between $maxF_{ABC}$ in Tier 1 of the ABC control rule and F_{OFL} in Tier 1 of the OFL control rule varies directly with the amount of scientific

uncertainty. For the information levels associated with the remaining tiers, relating the buffer between $maxF_{ABC}$ and F_{OFL} to the amount of scientific uncertainty is more difficult because the amount of scientific uncertainty is harder to quantify, so buffers of fixed size are used instead.

For groundfish species identified as key prey of Steller sea lions (i.e., walleye pollock, Pacific cod, and Atka mackerel), directed fishing is prohibited in the event that the spawning biomass of such a species is projected in the stock assessment to fall below $B_{20\%}$ in the coming year. However, this does not change the specification of ABC or OFL.

3.2.3.3.2 Annual Catch Limit

The ACL is equal to the ABC for each stock and stock complex in the "target species" category.

3.2.3.4 Total Allowable Catch, Reserves, and Apportionments

3.2.3.4.1 Total Allowable Catch

The following procedure is used to specify TACs for every groundfish stock and stock complex managed by the FMP:

1. Determine the ABC for each managed stock or stock complex. ABCs are recommended by the SSC based on information presented by the Plan Team.
2. Determine a TAC based on biological and socioeconomic information. The TAC must be lower than or equal to the ABC. The TAC may be lower than the ABC if warranted on the basis of bycatch considerations, management uncertainty, or socioeconomic considerations; or if required in order to cause the sum of the TACs to fall within the OY range.
3. Sum TACs for "target species" to assure that the sum is within the optimum yield range specified for the groundfish complex in the FMP. If the sum falls outside this range, the TACs must be adjusted.

3.2.3.4.2 Reserves

The groundfish reserve at the beginning of each fishing year shall equal the sum of 15 percent of each stock or stock complex in the "target species" category TACs, except for pollock, fixed-gear sablefish, Atka mackerel, AI Pacific ocean perch, flathead sole, rocksole, yellowfin sole, and Pacific cod. When the TACs for the groundfish complex are determined by the Council, 15 percent of the sum of the TACs is set aside as a reserve. This reserve is used for: a) correction of operational problems in the fishing fleets, to promote full and efficient use of groundfish resources; b) adjustments of species TACs according to the condition of stocks during the fishing year; and c) apportionments.

The reserve is not designated by stock or stock complex and will be apportioned to the fisheries during the fishing year by the Regional Administrator in amounts and by species that s/he determines to be appropriate. The apportionment of the reserve to target species or to the "other species" category must be consistent with the most recent assessments of resource conditions unless the Regional Administrator finds that the socioeconomic considerations listed above or specified fishery operational problems dictate otherwise. Except as provided for in the National Standard Guidelines, the Regional Administrator must also find that the apportionment of reserves will not result in overfishing as defined in the guidelines. The Regional Administrator may withhold reserves for conservation reasons.

3.2.3.4.3 Apportionment of Total Allowable Catch

When the TAC has been determined for each stock or stock complex in the "target species" category—except for pollock, fixed-gear sablefish, Atka mackerel, AI Pacific ocean perch, flathead sole, rocksole, yellowfin sole, and Pacific cod—it is reduced by 15 percent to form the reserve, as described in Section 3.2.3.4.2. The remaining 85 percent of each TAC is then apportioned by the Regional Administrator.

Stock or Stock Complex	Harvest Specifications Used in Management	Proposed Amendment 23 Action
Other Flatfish	ABC/OFL & OY/ACL	
Butter sole		
Curlfin sole		
Flathead sole		
Pacific sanddab		
Rex sole		
Rock sole		
Sand sole		
Other Fish	ABC/OFL & OY/ACL	
Big skate		
California skate		
Leopard shark		
Soupfin shark		
Spiny dogfish		
Finescale codling		
Pacific rattail		
Ratfish		
Cabezon (WA)		
Kelp greenling		

2.1.4 *Species Categories*

Species are categorized in the FMP relative to the amount of data informing a stock's harvest specifications. For the purpose of setting MSY, ABC, the maximum fishing mortality threshold (MFMT), the MSST, OY, and rebuilding standards, three categories of species are identified. The first are those species for which a relatively data-rich quantitative stock assessment can be conducted on the basis of catch-at-age, catch-at-length, or other data. ABCs and overfished/rebuilding thresholds can generally be calculated for these species. The second category includes a large number of species for which some biological indicators are available, including a relatively data-poor quantitative assessment or a non-quantitative assessment. It is difficult to estimate overfished and overfishing thresholds for the second category of species a priori, but indicators of long-term, potential overfishing can be identified. ABCs for species in this category are typically set at a constant level and some monitoring is necessary to determine if this level of catch is causing a slow decline in stock abundance. The third category includes minor species which are caught, but for which there is, at best, only information on landed biomass. For species in this category, there is limited data to quantitatively determine MSY, ABC, or an overfished threshold. Typically, average catches are used to determine the ABC for category 3 species.

Precautionary adjustments to OYs to account for scientific and management uncertainty are typically specified for category 2 and 3 species with a greater reduction of the OY from the ABC for category 3 species than for category 2 species. Typically, 25% and 50% OY reductions have been specified for category 2 and 3 species, respectively.

2.3 The Preferred Action Alternative 2: Include The P* ABC Control Rule Alternative with the Alternative 2 ACL Harvest Control Rule

The action alternatives analyzed in this EA incorporate the new NS1 guidelines for a harvest specification framework that is designed to better account for uncertainty in estimating the MSY harvest level and to prevent overfishing in the FMP. The two action alternatives adopt the same Amendment 23 harvest specification framework and are identical except for how the "40-10" harvest control rule is defined under the new framework. Both action alternatives contemplate a new "25-5" harvest control rule for assessed flatfish species.

2.3.1 *Harvest Specifications*

The Amendment 23 harvest specifications described in section 2.2.1 are incorporated in the FMP under the Council's preferred Amendment 23 Alternative 2.

2.3.2 *Harvest Control Rules*

2.3.2.1 ABC Control Rule

Under Alternative 2, the ABC for Category 1 stocks is decided by the Council based on its preferred level of overfishing risk aversion and the recommendations of the SSC regarding the quantification of scientific uncertainty. Under this approach (referred to as the P* approach), scientific uncertainty associated with estimating an OFL (σ) is quantified by the SSC and the percentage reduction that defines the scientific uncertainty buffer and the ABC can be determined by translating the estimated σ to a range of P* values. Each P* value is then mapped to its corresponding buffer fraction[1]. The Council then determines the preferred level of risk aversion by selecting an appropriate P* value, accordingly. In cases where the P* approach is used, the upper limit of P* values considered will be 0.45.

For Category 2 and 3 stocks, the ABC control rules under Alternative 2 include either a straight percentage reduction of the OFL (25% for category 2 and 50% for category 3) that is recommended by the SSC and adopted by the Council or one that incorporates an estimated probability of overfishing (P*) based on the uncertainty in the estimation of the OFL. Because there is more scientific uncertainty regarding category 2 and 3 stocks, the buffer between OFL and ABC for these stocks will generally be greater than that for category 1 stocks. In general, the buffer for category 3 stocks will be the greatest.

The Alternative 2 ABC control rule allows for the Council's preferred level of overfishing risk aversion to be a factor in the determination of the ABC. In addition, it provides flexibility for the SSC to modify their recommendations for quantifying scientific uncertainty (sigma) as they develop new methodologies and new information becomes available. The ABC control rule for category 2 and 3 stocks reflects the fact that there is more scientific uncertainty regarding these stocks than for category 1 stocks, and therefore likely more variability in the SSC's recommendations for quantifying scientific uncertainty.

2.3.2.2 40-10 Harvest Control Rule

Under Alternative 2, the translation of the 40-10 harvest control rule is depicted on page 23 (Figure 2-4). This approach is also proposed for the new 25-5 harvest control rule for assessed flatfish species.

Alternative 2 adjusts the ACL relative to the ABC by progressively reducing the ACL from the ABC as depletion decreases below the $B_{40\%}$ target (Figure 2-4). Alternative 2 for translating the existing 40-10 rule under the new Amendment 23 alternative is more precautionary than the Alternative 1 harvest control rule since the ABC is applied before the 40-10 ACL adjustment is made.

[1] Since estimated OFLs are median estimates, there is a 50% probability that the OFL is overestimated. Therefore, a P* of 0.5 equates to no scientific uncertainty or, in other words, the ABC is set equal to the OFL.

3.1.1 Calculation of the Acceptable Biological Catch

This section describes how the ABC will be calculated and set compared to the OFL using ABC control rules that account for the level of scientific knowledge about the stock or stock complex, scientific uncertainty in the estimate of OFL, and other scientific information. This section also discusses how the acceptable risk of overfishing (P*) is factored into the ABC control rule and how P* is determined.

3.1.1.1 Tiered System of ABC Control Rules

Under the preferred alternative, for stocks and stock complexes required to have an ABC, the Council will utilize a five-tiered system of ABC control rules that allows for different levels of scientific information to be considered when calculating ABC. The control rules are organized from data rich down to data poor, with Tier 1 being the highest (data rich) and Tier 5 being the lowest (data poor). Tiers 1-2 involve data rich to data moderate situations and include levels of uncertainty derived from model-based stock assessments. Tiers 3-5 involve data poor situations and include levels of uncertainty derived from ad-hoc procedures including simulation models or expert opinion.

When calculating an ABC for a stock or stock complex, the SSC must first evaluate the information available for the stock and assign the stock or stock complex into one of the five tiers. The SSC must then apply the control rule assigned to that tier to determine the ABC. The SSC may recommend an ABC that differs from the result of the control rule calculation based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors determined relevant by the SSC, but must explain their rationale. The tiered system of ABC control rules are described below.

Tier 1. Model-Based Probabilistic Approach to Estimating ABCs

In this tier, the data used are reliable and complete enough to be able to utilize statistical-based stock assessment models (e.g., Stock Synthesis 2 (or 3), Multifan-CL (MFCL), C++ Algorithmic Stock Assessment Laboratory (CASAL), and Bayesian production models). From these stock assessments, reliable estimates of MSY, F_{MSY}, B_{MSY}, and B_t are available. Of special relevance to being included in this tier, measures of the uncertainty of F_{MSY}, B_t and B_{t+k} and OFL_{t+k} must be available directly.

In plain English:

> ABC is the maximum value for which the probability "p" of exceeding OFL is less than P*.

Or, in conceptual mathematical terms:

> ABC = max (x | p(x > OFL) < P*)

Or, as commonly estimated:

> ABC = P_{P*}(OFL)
>
> Where:
>
> - OFL is estimated as $\text{OFL} = B_y \left[\frac{F_{\text{MSY}}}{F_{\text{MSY}}+M}\right][1 - \exp(F_{\text{MSY}} + M)]$;
> - B_y is forecasted estimate of B in year y, the year for which the harvest limit is set;
> - M is natural mortality coefficient;

- P_{P*} is the P* percentile of the probability distribution of OFL such as in Figure 2;
- OFL is not necessarily normally distributed; and
- the shape and particularly the width of the distribution reflect the uncertainty in the estimate of OFL.

The Council must advise the SSC on the acceptable P* (see section 3.1.1.2 for a discussion on determining P*) to use prior to calculating and recommending the ABC. If the SSC determines that the uncertainty of OFL is underestimated (due to underestimating the uncertainty of F_{MSY} and/or the forecasted estimated B_t), the SSC could appropriately rescale the width of the OFL distribution.

Tier 2. Quasi-Probabilistic Approach to Estimating ABCs

The key difference between assessments in Tier 1 and Tier 2 is that in Tier 2, measures of uncertainty of OFL are not as reliable or are not available from a single, integrated stock assessment model. Reliable data must still be available to be in included in this tier, but those used are obtained through some separate analysis or analyses. The methods often involve re-sampling or ad hoc methods. While the statistical-based model characteristic of Tier 1 can occur here, the common assessments are Yield-per-Recruit (Y/R) and Spawning-per-Recruit (SPR). Such assessments involve the use of F_{MSY} proxies, usually $F_{30\%}$ and $F_{60\%}$. The data in Tier 2 may not be as reliable or complete as in Tier 1, though still of sufficient quality to provide fully usable stock assessments.

$F_{30\%}$ = Fishing at the rate that reduces spawning biomass per recruit to 30% of the unfished value. Used as a substitute for F_{MSY} when using Y/R and SPR stock assessments. $F_{60\%}$, as well as others, has also commonly been used.

ABC is estimated using the equation in Tier 1 above, with the uncertainty estimates coming from re-sampling (i.e. method for estimating and re-estimating probability distributions such as bootstrapping). The Council must advise the SSC on the acceptable P* (see section 3.1.1.2 for a discussion on determining P*) to use prior to calculating and recommending the ABC.

Tier 3. Data-poor Probabilistic Approach to Setting ABCs

In this tier, the available data are not sufficient for the use of model-based assessment tools. Data are sufficient to apply the Depletion-Corrected Average Catch – Stock Reduction Analysis (DCAC-SRA) (McCall 2009) with information on the biology of the stock, or DCAC, in which there is some estimate of natural mortality (M), but other life history information is lacking. In these circumstances, the uncertainty of OFL (the probability distribution of OFL) can be estimated using the Monte Carlo simulation (i.e. a technique that uses algorithms that rely on repeated random sampling to compute results) . These tools are to be applied to long-lived species where the natural mortality coefficient M should be less than 0.20 and recruitment should not be highly episodic.

ABC is estimated using the equation in Tier 1 above, with the uncertainty estimates established by the Monte Carlo simulation. Again, the Council must advise the SSC on the acceptable P* (see section 3.1.1.2 for a discussion on determining P*) to use prior to calculating and recommending the ABC.

Tier 4. ABC Control Rule for Species without Current Harvest
This ABC control rule is for species or species assemblages with stock assessments and/or MSY estimates, but no current harvest, such as deepwater shrimp (*Heterocarpus*). The ABC is set at 0.70 F_{MSY} (= yield 91% OFL = 91% MSY = ABC; see Walters et al. 2005) as a precautionary measure to maximize yield while minimizing biomass impacts and accounting for scientific uncertainty. An alternative target fishing mortality value may be specified if additional data or modeling is available to support it, or the Council chooses to be more precautionary.

Walters et al. (2005) provided an example through the modeling tool, ECOSIM, in which k = 0.7 represents a precautionary factor in setting the target fishing mortality (F_{MSY}), which is predicted to have little impact on yield. When k = 0.7, the ECOSIM simulations implied a sustainable yield of around 0.9 MSY. "k" is a factor that a fishery modeler can vary to represent varying levels of precaution for F_{MSY} within the ECOSIM model. Similarly, NMFS Technical Guidance on implementing NS1 by Restrepo et al. (1998) recommended a default fishing mortality target of 25% below MFMT, or 0.75 F_{MSY}, which results in an equilibrium yield of 94% MSY or higher. This Tier 4 control rule adopted by the WPFMC is more precautionary than the control rule recommended by Restrepo et al. (1998) and in line with the results of Walters et al. (2005). As Tier 4 involves a fishery with no current harvest, this ABC control rule does not include consideration of P*; however if harvest occurs, the fishery may be moved into higher tier where P* would be need to be considered.

Tier 5. Data-poor Ad-hoc Approach to Setting ABCs
In this tier, catches may be small and/or the catch history may contain gaps or be too variable. Catch history may also be lacking in consistently stable periods or periods with consistent trends for using DCAC-SRA or DCAC. Hence, there is no basis for estimating a reliable MSY or OFL.

For these data poor fisheries, a multiplier of the long-term median catch history will be used. The multiplier will be determined by the biological knowledge of the stock or stock complex, in light of the guidance provided by Restrepo et al. *(Section 2.2.2: Data Poor Situations*). The guidance recommends that the default control rule be implemented by multiplying the average catch from a time period where there is no quantitative or qualitative evidence of declining abundance ("Recent Catch") by a factor based on a qualitative estimate of relative stock size. The following guidelines were provided:

Above B_{MSY}	Limit catch = 1.00*Recent Catch
Above MSST but below B_{MSY}	Limit catch = 0.67*Recent Catch
Below MSST (i.e. overfished)	Limit catch = 0.33*Recent Catch

However, Restrepo et al. (1998) advises that because it will probably not be possible to analytically determine stock status relative to B_{MSY} for data poor stocks, an approach based on informed judgment will be necessary. The authors further state (*Section 3.3.1: Data Poor Defaults*) that "in cases of severe data limitations, qualitative approaches may be necessary, including expert opinion and consensus-building methods." As Tier 5 involves data poor situations, this ABC control rule does not include consideration of P*.

3.1.1.2 Determining the Acceptable Probability of Overfishing used in the ABC Control Rule

The ABC control rule for Tier 1-3 fisheries requires the Council to advise the SSC on the acceptable probability of overfishing (P*) in order for the SSC to calculate and recommend the ABC. As discussed above, P* refers to the acceptable probability or risk that actual catch equal to the ABC would exceed the OFL and thus, result in overfishing. NS1 guidelines require that the probability that overfishing will occur cannot exceed 50% and should be a lower value. Consequently, the Council adopted a maximum P* value of 50%; however, under the preferred alternative, where adequate scientific information is available on the stock or stock complex, the Council will utilize a qualitative method for determining an appropriate P* that is lower than the maximum of 50%. This qualitative approach is described below.

Qualitative Analysis for Determining P*

The Council developed a process by which the risk of overfishing can be reduced from the 50% maximum P*. This approach, based on the approach developed by the South Atlantic FMC, is a qualitative method of determining P* that considers the amount of information available on the stock or stock complex, including scientific uncertainty, for the following dimensions: 1) assessment information, 2) assessment uncertainty, 3) stock status, and 4) productivity and susceptibility. Information on the four dimensions will be complied and analyzed by a team that may include Council and SSC members, Council staff, and other individuals knowledgeable in the fishery, including stock assessment experts. Team members will use their knowledge and expertise to assign a single score for each dimension based on the criteria below. The maximum value for each dimension is 12.5 and the sum of the four dimensions has a maximum value of 50. The scores for each dimension will be added together for a final score, then be reduced from the maximum risk of overfishing (P^*_{MAX}) of 50. The team's analysis will be vetted through the Council process with the Council ultimately deciding the final P* value. The Council-approved P* would then be utilized in the calculation of the recommended ABC. An example of the qualitative analysis is provided below, but the exact criteria and scoring values used may change as deemed appropriate by the team for each assessed stock.

1) Assessment Information

Criteria	Score	
Quantitative assessment provides estimates of exploitation and B; includes MSY-derived benchmarks	0.0	
Reliable measures of exploitation or B, no MSY benchmarks, proxy reference points	2.5	X
Relative measures of exploitation or B, absolute measures of stock unavailable, proxy reference points	5.0	
Reliable catch history	7.5	
Scarce or unreliable catch records	12.5	

2) Assessment Uncertainty

Criteria	Score	
Complete. Key determinant – uncertainty in both assessment inputs and environmental conditions included	0.0	
High. Key determinant – reflects more than just uncertainty in future recruitment	2.5	
Medium. Uncertainties are addressed using statistical techniques and sensitivities, but full uncertainty is not carried forward in projections	5.0	X
Low. Distributions of F_{MSY} and MSY are lacking	7.5	
None. Only single point estimates; no sensitivities or uncertainty evaluations	12.5	

3) Stock Status

Criteria	Score	
Neither overfished nor overfishing. Stock is at high B and low exploitation relative to benchmark values	0.0	
Neither overfished nor overfishing. Stock may be in close proximity to benchmark values	2.5	X
Stock is either overfished or overfishing is occurring	5.0	
Stock is overfished and overfishing is occuring	7.5	
Either status criterion is unknown	12.5	

4) Productivity and Susceptibility

Criteria	Score	
Low risk. High productivity, low vulnerability, low susceptibility	0.0	
Medium risk. Moderate productivity, vulnerability, and susceptibility	5.0	X
High risk. Low productivity, high vulnerability, high susceptibility	12.5	

SCORE SUMMARY

Dimensions	Score
Assessment information	2.5
Assessment uncertainty	5.0
Stock status	2.5
PSA	5.0
Total Score	**15.0**
Risk of overfishing: **(P*=50 minus Total Score, where 50 equals P^*_{MAX})**	**35**

In the example above, the resulting P* of 35 could then be used in the ABC control rule equations available for stocks in any of the tiers 1 through 3, presented in section 3.1.1.1. Benefits of this alternative include the following: 1) it brings together multiple experts to

determine the risk of overfishing based on their diverse knowledge; 2) it can be applied in both data rich and data poor situations, i.e. whether formal stock assessments can be conducted or not; and 3) it need not be repeated annually unless information suggests that circumstances have changed significantly.

Other Options Considered but Rejected for Determining P*

Two other methods for determining P* were discussed but ultimately rejected by the SSC and Council, including a graphical approach that plots B/B_{MSY} ratios against the probability of overfishing, and a tabular approach using catch from which the Council could see the resulting ABCs and the associated levels of risk. These two approaches were not agreed upon because they are more appropriate for tier 1 situations and possibly tier 2, but data quality may call into question the results in the 3rd tier.

3.1.2 Setting the Annual Catch Limit

NS1 guidelines require the Council to determine an ACL that may not exceed the SSC-recommended ABC; however, NS1 does not provide guidance on how to set an ACL below the SSC-recommended ABC. This section describes the methods the Council will use to set ACLs starting in 2011.

Under the preferred alternative, ACL will be set by the Council after considering the ABC provided by the SSC, as well as social and economic factors, pertinent ecological considerations, and management uncertainty. Management uncertainty stems from insufficient information about true catch (e.g. late reporting, underreporting and misreporting of landings), lack of management precision, and/or the ability to close a fishery before a catch limit is exceeded. NS1 guidelines suggest management uncertainty be accounted for during the establishment of AMs for a fishery, including ACTs; however, nothing precludes the Council from accounting for management uncertainty at the ACL step.

Method 1: Qualitative Construct for Setting an ACL

The ACL qualitative construct uses an approach similar to the P* qualitative construct outlined in Section 3.1.1.2. While the P* qualitative construct considers the amount of biological information (scientific uncertainty) available on the stock or stock complex, the ACL qualitative construct considers the amount of socio-economic information (management uncertainty) on the fishery that targets the stock or stock complex. Specifically, the dimensions that will be used for the ACL qualitative construct would include the following factors: 1) Social; 2) Economic; 3) Ecological; and 4) Management uncertainty (SEEM). Aspects of the SEEM dimensions could include the importance of the fishery both socially and economically; consideration of the ecological importance of the stock or stock complex targeted by the fishery (e.g., is the stock a key indicator species of ecological health of the ocean), and whether managers can effectively constrain catch to planned levels.

Information on the SEEM dimensions will be compiled and analyzed by a team that may include Council and SSC members, Council staff, and other individuals knowledgeable in the fishery. This team will also be responsible for developing the criteria and scoring values regarding the quality and completeness of the information for each dimension. Like the P* qualitative construct, the scores for each dimension will be added together so that the total score is