New England Fishery Management Council

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John Pappalardo, *Chairman* ┃ Paul J. Howard, *Executive Director*

To: Paul J. Howard, Executive Director
From: Jean-Jacques Maguire, Vice-Chair, Scientific and Statistical Committee
Date: April 11, 2011

Subject: **Terms of reference for the March 30-31, 2011 for the SSC review of the report *Economic and Scientific Conditions in the Massachusetts Multispecies Groundfishery***

The Scientific and Statistical Committee (SSC) was asked by the New England Fishery Management Council to review the Massachusetts Marine Fisheries Institute report titled "*Economic and Scientific Conditions in the Massachusetts Multispecies Groundfishery*", dated November 5, 2010 with the following terms of reference to help inform the Council about the use of best available science with respect to the proposals outlined in the report and in the future.

1. *Did the direct or proxy estimates of F_{MSY} and B_{MSY} as status determination criteria for the groundfish stocks assessed in GARM III represent the best available science? Was the subsequent use of these status determination criteria to determine OFLs and rebuilding plans appropriate?*

2. *If the direct estimates of F_{MSY} and B_{MSY} represent the best available science, but proxy estimates were chosen, did that decision reflect an explicit precautionary decision that led to "double-counting" when the SSC recommended buffers for scientific uncertainty?*

3. *Comment on other GARM decisions discussed in the MFI Report, exclusive of the F_{MSY} proxies, that are relevant to assessing multispecies stocks, providing information for OFLs, and setting ABCs. This question should be considered in terms of the ABCs recommended for 2010 and 2011, as well as those that will be developed for 2012-2013.*

4. *In light of the MFI Report, are there recommendations concerning additional information needed by the SSC to gauge uncertainty and risk, and therefore to set buffers?*

On March 30 – 31, 2011, the SSC reviewed several sources of information:

1. A Report on Economic and Scientific Conditions in the Massachusetts Multispecies Groundfishery (report itself, a PowerPoint presentation on ACLs by Steve Cadrin and Cate O'Keefe and one on Economics by Daniel Georgianna and Emily Keiley)

2. Background and Observations on MFI Report on Economic and Scientific Conditions in the Massachusetts Multispecies Groundfishery (report and PowerPoint presentation by Robert O'Boyle)

3. Multispecies ABCs Science and Statistical Committee New England Fishery Management Council April 30 – May 1, 2008 (PowerPoint presentation)

4. Multispecies Acceptable Biological Catches (ABCs) for 2011 – 2014, SSC memo dated August 6, 2010

5. Examples of applying the Groundfish PDT's proposed ABC rules to several species as assessed at GARM II. CASE 1: Gulf of Maine Cod, Steven Correia, Massachusetts Division of Marine Fisheries

6. Amendment 16 to the Northeast Multispecies Fishery Management Plan: Review of Rebuilding Programs for Newly Overfished Stocks and Further Development of ABC Guidance, SSC memo dated June 23, 2009

7. 50th Northeast Regional Stock Assessment Workshop (50th SAW): Assessment Report

8. Appendix to the Report of the 3rd Groundfish Assessment Review Meeting (GARM III)

9. Assessment of 19 Northeast Groundfish Stocks through 2007

10. Quantifying Uncertainty in Catch Forecasts - from a SSC perspective by Steve Cadrin

11. Re-Evaluation of Biological Reference Points for New England Groundfish by Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish, NEFSC 2002

Executive Summary

The report of the Massachusetts Fisheries Institute states that "Scientifically valid alternative references points have been identified which can trigger increases in annual catch limits (ACLs) without sacrificing conservation" specifically, if:

- Stock specific 'direct' estimates of F_{MSY} had been used instead of 'proxy' estimates for F_{MSY};
- Several stock assessments had not been adjusted for retrospective patterns;
- A "buffer" of 0.75 between estimates of OFL and ABC had not been applied. It suggested that ABCs would have been higher if the buffer was calculated to correspond to an agreed probability of ABC exceeding OFL (referred to as the p* approach).

The report argues that not doing the above implies that the allowable catches of some stocks are substantially under-caught because of low allowable catches and management restrictions on other stocks that are caught in the same mixed stock fishery.

The Scientific and Statistical Committee (SSC) concluded that the information in the MFI report does not justify revision of the ABCs recommended by the SSC and adopted by the Council. However, the MFI report raised important issues and the SSC concluded that additional research on the following topics would be valuable:

- Characteristics of F_{MSY} proxies with respect to risk;
- Causes of retrospective patterns and the performance of alternative methods for mitigation of these;
- Performance of alternative risk tolerance in the face of scientific (e.g. buffers between OFL and ABC) and management uncertainty, and
- Options for managing mixed stock fisheries that address trade-offs between net benefits for the Nation and protection of "weak" stocks.

Although not explicitly included in the SSC's ToR, the SSC also discussed the economic analyses in the MFI report.

SSC Response to Terms of Reference.

1. **Did the direct or proxy estimates of F_{MSY} and B_{MSY} as status determination criteria for the groundfish stocks assessed in GARM III represent the best available science? Was the subsequent use of these status determination criteria to determine OFLs and rebuilding plans appropriate?**

    - The SSC reviewed the approach used by GARM III to derive biological reference points (BRPs). Direct estimation of reference points as suggested in the MFI report requires the specification of a model relating recruitment as a function of spawning stock biomass (SSB). GARM III carefully examined the stock – recruitment data where sufficient data were available to evaluate if direct estimates of F_{MSY} and B_{MSY} were scientifically warranted. Only in one instance (white hake) did GARM III judge that the stock-recruitment relationship was informative; mean recruitment was similar for both the direct and proxy approach, but the BRPs varied widely among the different direct approaches dependent upon the assumed stock-recruitment relationship (Ricker vs Beverton & Holt). In cases where the stock-recruitment relationship was judged not to be scientifically warranted, $F_{40\%}$ was used as the F_{MSY} proxy ($F_{50\%}$ in the case of redfish) and the B_{MSY} proxy was computed using the stochastic projection approach. The proxy approach was also adopted for white hake because of the wide difference in BRPs depending on what stock-recruitment relationship was assumed.

    - The SSC notes that these GARM III determinations were made through an extensive, transparent and well documented peer review process.

    - The SSC concluded that the approach to estimate the BRPs during GARM III was appropriate and represented best scientific information available. The SSC notes that the approach used by GARM III recognizes the uncertainties in the stock-recruitment relationship, provides BRPs that are robust to these uncertainties and allows for future use of the direct approach as information on the stock-recruitment-relationship accumulates and direct estimation is evaluated to be scientifically warranted.

    - In implementing the proxy approach, GARM III examined the stock-recruitment relationships to choose the stream of recruitment to be used in stochastic projection to estimate B_{MSY}. GARM III evaluated whether or not there was a spawning biomass below which recruitment would be diminished and determined whether or not exceptionally large year-classes occurred which were unrelated to the size of spawning biomass (e.g. environmentally driven rather than related to SSB). The SSC did not examine the calculation of B_{MSY} by GARM III stock by stock but notes that excluding periods of low SSBs corresponding to low recruitment, in the calculation of $B_{MSY,}$ would be scientifically appropriate if the low recruitments are indeed due to low SSBs and thus not characteristic of B_{MSY}.

2. **If the direct estimates of F_{MSY} and B_{MSY} represent the best available science, but proxy estimates were chosen, did that decision reflect an explicit precautionary decision that led to "double-counting" when the SSC recommended buffers for scientific uncertainty?**

- Recognizing the inherent limitations of the stock-recruitment data and models for most GARM III stocks to estimate F_{MSY} and B_{MSY}, the SSC considers that the proxy estimates based on percentage of maximum spawning potential represent best scientific information available (as discussed in response to ToR 1). The SSC notes that the F_{MSY} proxies were lower than the direct estimates in 6 of the 7 cases where direct estimates were available. As discussed above, this was considered to be more scientifically valid and did not reflect an explicit precautionary decision. While the proxies are generally lower than the direct estimates, and in this sense less "risky", their absolute risk characteristics are not known. The SSC could not conclude whether their use was risk-neutral or averse and if the latter "double accounting" for uncertainty would have been a consequence. This would depend on the relationship between the proxies to the true (but unknown) stock specific MSY reference points. The proxy approach was chosen because it resulted in more scientifically sound and robust estimates, not because of its risk properties. The SSC's response to ToR 4 addresses the need for further analysis about the risk implications of commonly used proxies.

3. **Comment on other GARM decisions discussed in the MFI Report, exclusive of the F_{MSY} proxies, that are relevant to assessing multispecies stocks, providing information for OFLs, and setting ABCs. This question should be considered in terms of the ABCs recommended for 2010 and 2011, as well as those that will be developed for 2012-2013.**

The "other" decisions discussed in the MFI report (i.e., exclusive of F_{MSY} proxies) revolved around two topics, 1) the treatment of retrospective patterns in assessments, and 2) the appropriateness of applying buffers.

- The MFI report suggests that alternative assessments would allow increases in groundfish ACLs. It states (page 14, paragraph 2) "*Base case models (with no retrospective adjustment or revised survey assumptions) estimated greater stock sizes. For example if 'base case' stock assessments were used to determine stock status of Gulf of Maine winter flounder, the stock would not be considered overfished. Although 'base case' models have diagnostic problems, they are the simplest analyses of all available data, and they were the method used to assess principal groundfish stocks for decades.*" The MFI PowerPoint presentation is less affirmative and recommends that Over Fishing Limits (OFLs) should be based on risk neutral stock assessments (slide 66 of 66). The SSC agrees that OFLs should be based on risk neutral stock assessments. GARM III concluded that the base case models were risk-prone (not risk-neutral) and the SSC agreed; therefore they cannot be used as the basis for increasing ACLs.

- The SSC concluded that it was appropriate to adjust for the retrospective bias in model outputs. Retrospective adjustments are used as a sound scientific method aimed at producing unbiased stock assessments, not to adjust in the face of a persistent retrospective pattern where biomass is consistently overestimated and fishing mortality is consistently underestimated would likely be risk prone. Similarly, not to adjust in the face of a persistent retrospective pattern where biomass is consistently underestimated and fishing mortality is consistently

overestimated would likely be risk averse. In either case, not to adjust is not risk neutral.

- In its June 23, 2009 memorandum on buffers between OFL and ABC, the SSC noted that 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, and 4) the available data are inadequate to conduct probabilistic projections for some stocks. The SSC recommended that the Council consider ABC methods that are robust to these four points and that such an approach could be derived from the guidance provided by the National Standard Guidelines' provision for a stock or stock complex that "… *has not rebuilt by T_{max} [the end of the rebuilding period], then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75 percent of the MFMT [maximum fishing mortality threshold; i.e., FMSY], whichever is less*" (NOAA 2009). Considering that seventeen of the twenty groundfish stocks were rebuilding, and many are not achieving the scheduled rebuilding, the SSC anticipated that the prescribed ABC specification would be applicable to many groundfish stocks. The SSC concluded that in the absence of better scientific information on stock specific appropriate buffers between the OFL and the ABC, a relatively straightforward ABC and robust specification could be applied to all groundfish stocks, in all stages of rebuilding or long-term maintenance of optimum yield. Given the guidance for specifying ABC as the lesser of 75% of F_{MSY} or $F_{rebuild}$, and the definition of optimum yield in the current Multispecies Fishery Management Plan as that associated with 75% of F_{MSY}, the SSC recommended to the Council that this ABC specification be applied to all groundfish stocks. The SSC reiterates this approach given current information and considers that the ABCs recommended for 2010 and 2011 still apply.

- The SSC agrees with the MFI report that there is a need for a more explicit discussion of risk tolerance with the Council and that the size of future buffers could be different for different stocks, depending on the uncertainties associated with each assessment and potentially different risk tolerance among stocks. The SSC's role is to advise the Council on biological, ecological, social and economic elements of risk associated with overfishing a given stock, it is the Council's role to determine a risk policy based on that technical guidance. The SSC would then set ABCs in light of this risk policy. This approach is consistent with the SSC's 2010 review of ABC control rule for all Council-managed fisheries. Progress is unlikely to be rapid enough on this issue for the development of ABCs for 2012-2013, but could be considered in the future.

4. **In light of the MFI Report, are there recommendations concerning additional information needed by the SSC to gauge uncertainty and risk, and therefore to set buffers?**

The SSC considers that the MFI report raised a number of issues that merit attention in the future. Some of these are National in scope and will require additional scientific work and potentially modification of the National Standard 1 (NS1) guidelines, thus requiring the attention of the Agency.

- Proxies: The biological, social and economic risk implications of commonly used F_{MSY} and B_{MSY} proxies (i.e., risk prone, risk neutral, risk averse) need to be further investigated and reported on. The practice of re-evaluating the appropriateness of existing reference points (direct estimates or proxies) at benchmark assessments should be continued using criteria such as those in GARM III to choose between direct estimates and proxies.

- Retrospective patterns: Retrospective patterns are a common problem with stock assessments worldwide. In general, they are caused by temporal changes in model parameters that are not taken into account in the assessments. Retrospective patterns can be in both directions - they can systematically overestimate or underestimate stock size. Retrospective patterns have been addressed by:
    1. allowing catchability coefficients to change over time;
    2. modeling time varying unaccounted for mortality (e.g., additional natural mortality, unreported catches including discards);
    3. alternative assumptions about selectivity (relative fishing mortality at age);
    4. alternative models;
    5. empirical adjustments (Mohn's Rho).

    Approaches 1 and 5 have been explored extensively and applied in some GARM III assessments. The management implications of retrospective patterns are sufficiently important that research on the causes and mitigation methods should be given a high priority. The risk implications of alternative mitigation methods need to be evaluated.

    Retrospective patterns are a source of uncertainty even if corrections are made to mitigate the pattern. This additional uncertainty needs to be considered in setting buffers.

- The two issues above address the reliability and risk characteristics associated with the methodologies used to assess stocks and set BRPs. In light of these, guidance is needed on the magnitude of the buffer between OFL and ABC, which is intended to take account of scientific uncertainty. ABC control rules, which are the responsibility of the Council, should specify the buffers, but the Council needs to be informed by scientific evaluations of the implications of a range of buffer options. The implicit management strategy described by NS1 Guidelines should be subjected to a Management Strategy Evaluation (MSE) designed to

accommodate the range of assessment and management situations confronted. The MSE should consider performance in terms of biological, economic and social impacts. Further, the SSC recommends that the Council consider additional social and economic information in the development of ABC control rules and in setting ABCs (rather than relegated to secondary impact analyses). Such an evaluation would also identify potential problems of misspecification or inconsistencies in the Guidelines. While this is a significant research undertaking, it is both critically important and achievable.

- The mixed stock nature of the New England groundfish fishery makes management difficult and potentially results in forgone benefits. The MFI report raised the mixed stock fishery management problem when it refers to "choke stocks" preventing some ACLs from being harvested. The NS1 Guidelines address circumstances under which an exception to the requirement to prevent overfishing is allowed for some stocks in a mixed stock fishery to increase net benefits to the nation. The Council has considered application to NE groundfish, but the exception was deemed not to apply.

- The SSC considered the NS 1 Guidelines on the mixed stock exception and additional guidance from the Agency brought to the attention of the SSC. This is a complex issue that involves science, policy and the law. However, the SSC understands that there are few, if cases, where the mixed stock fishery exception, as currently interpreted, could be applied.

- The mixed stock nature of NE groundfish and many other fisheries is a reality. Preventing overfishing of each individual stock in a mixed stock fishery is likely to result in forgone yield and potentially loss of net benefits to the Nation. In order to mitigate potential losses while maintaining safeguards to prevent irreversible damage to any individual stock, scientific analysis of the biological, economic, and social dimensions of the mixed stock exemption should be explored.

- The SSC recommends that the reasons for the unharvested commercial ACLs be explored.

Comment on the Economic Analyses in the MFI Report

The MFI report compared the magnitude and distribution of revenues among vessels since Sector Management began in May 2010 to revenues in previous years. The SSC discussed these comparisons, but because a review of the economic information was not included in the SSC's Terms of Reference, there was no basis for framing a review and no firm conclusions were drawn. However, SSC members noted instances in which available data were not used correctly and others where the baseline for comparisons made interpretation of the economic impacts difficult.

References:
NOAA (National Oceanic and Atmospheric Administration). 2009. Magnuson-Stevens Act Provisions; Annual Catch Limits; National Standard Guidelines; Final Rule. (74 FR 3178).