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New England Fishery Management Council
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C. M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

To: Paul J. Howard, Executive Director
From: Scientific and Statistical Committee
Date: 30 January 2012

Subject: Gulf of Maine Cod

The Scientific and Statistical Committee (SSC) was asked to:

1. Review the Gulf of Maine (GOM) cod assessment and become familiar with its assumptions and results. This review is not intended to duplicate the peer review of SARC 53, nor is the SSC being asked to accept or reject this assessment. The intent of this review is to provide the opportunity for SSC members to become familiar with the assessment methodology and result.
2. Identify information that may influence interpretation of the assessment results. Specify whether the possible influence of these elements warrants a closer examination at a future SSC or other meeting. Provide advice on the structure and timing of any future meeting the SSC believes is warranted. Examples of such information might include:
    a. Fishery dependent CPUE;
    b. Natural mortality assumptions in light of evidence of predation mortality;
    c. Recreational catch estimates that may be revised;
    d. Assuming 100% mortality of hook caught and released fish (commercial and recreational);
    e. The assumed stock structure for cod off the Northeastern US and Atlantic Canada and recent information of stock structure;
    f. Uncertainty in survey calibration coefficients;
    g. The assumption of flat-topped survey selectivity;
    h. Report by Butterworth and Rademeyer, Jan. 2012 (item 12 below); and
    i. Any other limitation deemed important.
3. Review a range of catch levels for GOM cod provided by the Groundfish Plan Development Team (PDT) that are based on the following objectives. Approve catch assumptions used to develop these catches. Comment on the impacts of these catch levels on the stock (e.g. likelihood of stock collapse). These example catch levels may not meet legal or policy guidance.
    a. F=0
    b. 75% of F_{MSY}
    c. F_{MSY}
    d. Constant catch that ends overfishing in 2, 3 or 4 years
    e. Catch that allows the current stock (e.g. 2010 or 2011, SSB or Jan-1 B) to grow ~10 percent annually from 2012-2014
    f. Catch that maintains current stock size (e.g. 2010 or 2011, SSB or Jan-1 B)k through 2013
4. Review PDT methods for estimating economic impacts of GOM cod catch levels.

In order to meet these terms of reference, the SSC considered the following:

1. Gulf of Maine Atlantic cod (*Gadus morhua*) stock assessment updated through 2010 (November 11, 2011)
2. SARC 53 Summary Report (December 16, 2011)
3. SARC 53 Report from Center of Independent Experts by reviewer Ewen Bell
4. SARC 53 Report from Center of Independent Experts by reviewer Kenneth Patterson
5. SARC 53 Report from Center of Independent Experts by reviewer M. Kurtis Trzcinski
6. SAW 53 Working Paper 1. A review of factors affecting the survival of Gulf of Maine Atlantic cod (*Gadus morhua*) discarded at-sea; SARC 53 Gulf of Maine Atlantic Cod Data Working Group (Palmer et al., 2011)
7. SAW 53 Assessment Summary Report
8. Context for reaction to the SARC 53 GOM cod assessment by Steve Correia, Chad Demerest, and Tom Nies (Groundfish PDT)
9. Groundfish PDT memo dated January 12, 2012: Gulf of Maine Cod – Projected Catches
10. Framework 47 Draft Economic Analysis
11. An Investigation of Differences Amongst SCAA and ASAP Assessment (including
12. Reference Point) Estimates for Gulf of Maine Cod. Doug S. Butterworth and Rebecca A. Rademeyer (Industry hired consultants)
13. Jan. 11, 2012 Letter from NEMFC to NEFSC re correspondence from David Goethel
14. NEFSC response to letter from NEFMC re correspondence from David Goethel
15. E-mail messages (2) and data from Ted Ligenza
16. Letter from Mark Stettner, Jan. 9, 2012
17. Spatial Ecology of Atlantic Cod in the Gulf of Maine Discussion Paper. Jake Kritzer and Steve Cadrin (NEFMC SSC)
18. Letter from Maggie Raymond, Jan 20, 2012
19. Letter from Mark Stettner, Jan 18, 2012
20. An overview of the 2011 Gulf of Maine Atlantic cod assessment. Presentation by Mike Palmer (NEFSC)
21. Gulf of Maine Cod Example Catch Levels 2012 - 2014. Presentation by Tom Nies (NEFMC)
22. Estimating the economic impacts of FW 47, a model for estimating the effects of non-marginal quota changes. Presentation by Chad Demerest (NEFSC)

In response to term of reference 1, the SSC reviewed the Gulf of Maine cod stock assessment and became familiar with its assumptions and results through the abundant material prepared for the SSC meeting and the presentations and discussions during the meeting. The SSC thanks the assessment team for their professionalism and diligence in presenting both the strengths and limitations of the assessment.

Due to time limitations, the SSC was not able to reach consensus on the majority of topics identified in term of reference 2. While many opinions were expressed by individual SSC members on a wide range of topics that could influence assessment results, consensus could only be achieved regarding four topics as warranting further investigation:

1) stock structure (including spatial aspects),
2) the change from MRFSS to MRIP recreational catch estimates,
3) discard mortality rate, and
4) use of catch per unit effort (CPUE) information.

These four topics can be separated into two groups. The first group contains topics related to stock structure (e.g., management unit boundaries, fine-scale population structure) and will require

significant resources and an approach beyond a typical stock assessment to address. The second group contains the remaining three topics and are issues related to data that could be used within the Gulf of Maine cod stock assessment as currently defined. The SSC created two work groups to draft plans indicating how these topics may be addressed. The plans would include the time, expertise, methods, and other resources needed resolve each issue. The SSC proposes a follow-up meeting in the near future to review and revise the plans developed by the two work groups, after which the plans would be submitted to the Council for its consideration and possible action. The SSC notes the first possibility of delivering these plans is the April Council meeting and requests guidance from the Council regarding how to proceed with these work group reports.

The SSC notes the evaluation of stock structure for Atlantic cod off the Northeastern US and Atlantic Canada will require significant resources and should be conducted as part of a special SARC or the new research track (it is currently listed in the NRCC schedule for 2014, but should be conducted sooner in light of assessment results and implications). Scientists familiar with the Gulf of Maine, Georges Bank, Eastern Georges Bank, and Scotian Shelf cod management units, as well as experts in stock identification disciplines, should participate in this meeting. Addressing stock structure will involve a broad range of behavioral and ecosystem processes (habitat, oceanography, climate, predator and prey fields, etc.) which are necessary for developing spatially-explicit management goals and rebuilding strategies as appropriate. Any reconsideration of spatial units for assessment and management will also need to be attentive to data availability, transition to EBFM, impacts on other stocks caught in the multispecies fishery, and management costs. The SSC reiterates its previous recommendation as a priority for the new 'research track':

- There should be a comprehensive evaluation of scientific information on cod population structure and its management implications, including the possibility of revising management units. This evaluation should occur in time to be taken into account in the next management cycle, beginning with the 2014 fishing year.

Full evaluation of the change from MRFSS to MRIP estimation of recreational catches will require information that is not currently available. Specifically, the MRIP catch estimates are currently only available for years 2004 through 2010. The extrapolation of the MRIP estimates to years 1982 through 2003 will be required for use in the GOM cod assessment. A NMFS-sponsored workshop has been planned for March 2012 to address this aspect of the change from MRFSS to MRIP. Additionally, statistical procedures to expand the historical biological observations collected during trip intercepts will also need to be developed and applied according to the new MRIP estimation process.

On the discard mortality issue, the SSC notes that the assessment team provided an analysis showing that the stock status determinations were robust to the full range of possible assumptions. However, public comment revealed that this remains an important concern among stakeholders, although the concern is related to the application of discard mortality rates to quota tracking at least as much as it is to the assessment results.

The SSC agreed that catch per unit effort (CPUE) information should be evaluated, but how this should be accomplished within an assessment remained a point of contention. Some SSC members thought that CPUE data could be used directly as an index of abundance, and used to tune the stock assessment. Other SSC members thought such a use of CPUE information was inappropriate, and instead recommended that CPUE be used as measure of fishery performance over time or as an indication of spatial structure.

Regarding term of reference 3, the SSC agreed that the assumed 2011 catch used in the Groundfish PDT projections is reasonable. Based on the evidence available to the SSC, the impact of the catch levels on the stock as estimated by PDT projections seems appropriate. However, concerns expressed by the SSC under term of reference 2 have the potential to change conclusions. The SSC supported the PDT's decision to evaluate risk of each option in terms of the probability of the GOM cod spawning stock biomass declining below 7,300 mt. This is not necessarily indicative of "collapse", an ill-defined concept that the SSC felt was not useful in the development of catch advice. The lowest observed biomass of the stock is 7,300 mt, and falling below this represents a state never encountered and therefore in the SSC's judgment presents a significant risk. The SSC noted that extensive work conducted in 2011 by the Augmented Groundfish PDT showed that projections generally have a tendency to be more optimistic than actual stock growth. Furthermore, survey indications of recent recruitment are low, which would also make the projections optimistic.

Regarding term of reference 4, the SSC was complimentary of the proposed approach and preliminary analyses for predicting fleet response and impacts of large cuts in quota. The SSC urged further development of the spatial dimensions of the analytical approach, including where effort is likely to be redistributed to minimize catches of cod, and the identification of other stocks that might be affected by large GOM cod quota changes. The SSC recommends further analyses of group patterns from all vessel size categories and gear types in order to provide insights into questions of fleet diversity and related policy options such as accumulation limits and permit banks being considered by the Council.