53rd NORTHEAST REGIONAL STOCK ASSESSMENT REVIEW COMMITTEE (SARC-53)

Reviewer Report to the Center for Independent Experts on the Gulf of Maine Cod and Black Sea Bass Stock Assessment Review (SARC 53) held Nov. 29 – Dec. 2, 2011, Woods Hole, Massachusetts.

Prepared for:
Center for Independent Experts

By:
M. Kurtis Trzcinski
3 Catelina Ct.
Dartmouth, Nova Scotia, Canada
B2X 3H1

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Executive Summary

This document is an independent review of the activities and findings of the 53rd Northeast Regional Stock Assessment Review Committee Meeting (SARC 53), held Nov. 29 – Dec. 2, 2011 at the Northeast Fisheries Science Center in Woods Hole, Massachusetts. Benchmark assessments for two stocks were reviewed at the meeting: Gulf of Maine cod and black sea bass. The Gulf of Maine cod assessment provided a sound basis for management advice and all ToRs were met, but I had serious concerns about the black sea bas assessment. Several of the ToRs were not met and I rejected the assessment along with the review panel.

The assessment of Gulf of Maine cod was well done. A new assessment model was presented and the assessment team did a very good job of making a bridge between the old assessment model (VPA) and the new one. The new assessment takes a statistical catch at age approach implemented in the Age Structured Assessment Program (ASAP), which is available through NOAA's Fisheries Toolbox (http://nft.nefsc.noaa.gov). There was a thorough re-analysis of much of the input data. In particular, the length-weight equation was re-estimated which had a large impact on the estimated catch at age. Overall, the data and assessment model were thoroughly explored, lending confidence to the present model formulation and assessment of Gulf of Maine cod stock status. The estimated stock status and fishing mortality in the last two years hinge on the survey estimates from a new vessel with new gear. There is always uncertainty when starting a new survey, and I think that this key uncertainty should both guide future research and caution management. All ToRs were met.

I have some significant concerns with the black sea bass assessment. The assessment team did a good job of compiling all the data available and has a high level of understanding of the data's strengths and weaknesses. However, despite the quantity of data, some are of poor quality and contain little signal. A new age-structured model (ASAP) was presented integrating all the data. The model did not fit the data well and was highly sensitive to assumptions about data inputs and model structure. The ToRs regarding data inputs and life-history data (ToRs 1-4) were met, but the ToRs using the assessment model and its derived output (ToRs 5-8) were not.

This meeting was a 'Tale of Two Assessments'. The Gulf of Maine cod assessment was thoroughly examined in all aspects, and built a high level of confidence in the analysis and results. The results were dire, the stock is in bad shape and all this is being done in what must be a difficult political environment. The black sea bass assessment, on the other hand, had significant difficulties. I felt there was a good understanding of the data, but the right model and assumptions given the data has not yet been found. The Gulf of Maine cod benefits from a long history of study and critical thinking. The science on black sea bass is relatively immature by comparison, and in my view, needs to be given greater attention in both data collection and model development. The assessment leads, Mike Palmer and Gary Shepard, and the larger assessment teams are to be commended for their work. They conducted themselves in a highly professional manner, which is not always easy given the high level of criticism.

1.0 Background

This document contains my independent review of the activities and findings of the 53rd Northeast Regional Stock Assessment Review Committee Meeting (SARC 53), held Nov. 29 – Dec. 2, 2011 at the Northeast Fisheries Science Center in Woods Hole, Massachusetts. Benchmark assessments for two stocks were reviewed at the meeting: Gulf of Maine cod and black sea bass. Prior to the meeting, the review committee (Appendix 1), was provided with a Statement of Work (Appendix 2), including the Terms of Reference (ToR) for each assessment as well as for the review committee (referred to as the Panel). Assessment documents (Appendix 3) and background material were provided via a website during the two weeks before the meeting. A day or two before the meeting a serious error was discovered in the black sea bass assessment and a revised document was provided at the meeting. The Panel decided to continue with its review of the black sea bass assessment. During the meeting there was a general consensus among the Panel on nearly all of the main discussion points and findings of the Panel as outlined in the Summary Report. The Panel concluded that i) all ToR for Gulf of Maine cod were met, and ii) the assessment model and derived output for black sea bass were inadequate, so ToRs 5, 6 and 8 were not met. I have made an effort not to repeat the findings of the Panel, which can be found in the SARC 53 report, but rather present my own views about these assessments.

2.0 Individual Reviewer Activities

Prior to the meeting, I reviewed the assessment and background documents provided for the review. All three reviewers equally shared the responsibility of a complete and thorough review of both Gulf of Maine cod and black sea bass.

I participated in the SARC meeting in Woods Hole, Massachusetts, from Nov. 29 to Dec. 2, 2011. The main sessions were open to the public, who contributed constructively to the review, particularly on points of clarification and in discussions about fishery activities. Assessment leads from previous stock assessment workshops presented the assessment results. The Gulf of Maine cod assessment was led by Mike Palmer, and the black sea bass assessment by Gary Shepard. During the meeting, the Panel asked questions of clarification and critiqued the work. For both stocks the Panel requested further analyses and diagnostic plots, which were presented later in the meeting. After this interchange, the Panel worked with the assessment team to review and edit the Assessment Summary Reports and agreed to the major points to be made in the co-authored SARC 53 report.

Panel members were required to prepare their individual, independent reports after the meeting. As outlined in Appendix 2, these reports should state in the reviewers' own words whether each ToR of the Stock Assessment Workshop was completed successfully, should state whether they accepted or rejected the work that they reviewed, and should include an explanation of their decisions (strengths, weaknesses of the analyses, etc.) and recommendations for each ToR. A key determinant of whether a ToR

had been met was the extent to which it provided a scientifically credible basis for developing fishery management advice. The following two sections contain my review for each assessment.

3.0 Gulf of Maine Cod Review

Gulf of Maine cod was assessed using a new assessment model: Age Structured Assessment Program (ASAP). The stock had been assessed for many years using the ADAPT VPA model. The assessment report did a nice job of reviewing the assessment history, which is particularly valuable when switching to a new model. The last assessment used a VPA and was reviewed at the 2008 GARM III benchmark review. The VPA model was re-run with updated input and new data to spring 2011. A description of the models runs examined and the effect of each data change on some key model output were summarized in Tables A.57 and 58. Large decreases in the estimated spawning stock biomass (SSB) occurred when the updated weights at age were used (30% decrease from 33,877t to 23,577t) and when the data was extended from 2008 to 2010 (57% decrease from 23,577t to 10,207t). When the VPA with updated data was compared to the ASAP model, the SSB_{2010} was 14% larger for the ASAP model (11,868 MT vs. 10,207 MT) and F_{2010} was 27% lower (1.14 vs. 1.56). I discuss these results further in ToR 3 below, as well as provide comments on all the other ToRs. I concluded along with the Panel that all ToRs were met.

1. *Estimate catch from all sources including landings and discards. Characterize the uncertainty in these sources of data. Evaluate available information on discard mortality and, if appropriate, update mortality rates applied to discard components of the catch.*

This ToR was met. The estimation of the catch was done using standard methods and I have no major concerns with how it has been done. In general the catch seems to be well monitored and sampled. The current assumption about discard mortality is reasonable, but further work should be done to get a better estimate.

I think it is always important to incorporate as much catch data as possible. It is unfortunate that the catch sampling was so sparse prior to 1982, and I presume every effort was made to incorporate all sampling data including any data that may have been collected by state agencies.

There have been steady changes in the fishery. Back in the 1960s and 1970s, 60-70% of the catch was by otter trawl gear. The percent caught by otter trawl has declined steadily to ~50%. Sink gillnets only caught 10-20% in the 1960s and 1970s, but now comprise ~50% of the catch. Tables A.9. through A.12. show the sampling by market category. I think it is also important to show the intensity of sampling by gear and I hope that the proportion of samples from the gillnet fishery has increased. I assume these gears select for different size fish and since the catch is not modeled separately by gear, there is a potential for a biased catch at age if the gillnet fishery is under-sampled and not properly

weighted when combining the catch at age from all gears. The next assessment should consider estimating the catch at age separately for otter trawl (+ everything else) and gillnets.

Similar comments hold for the recreational and commercial fishery. Figure A.11. shows that recreational landings comprise ~25% of the catch and as much as 50% of the catch when recreational discards are included, but when the sampling intensity (metric tons /100 ages) in Tables A.10 and A.30 are compared, there is about an order of magnitude greater sampling of the commercial versus the recreational catch over the past 10 years. This should be noted as a source of uncertainty and potential bias. It may be harder to sample the recreational catch, but given it is now a high proportion of the total catch, I think sample effort should increase. Breaking out the catch at age into components and modeling them separately in the ASAP or SCAA approach could be useful, but the added complexity should be carefully balanced with the information gain. Leaving as one combined catch-at-age could still be best.

2. *Present the survey data being used in the assessment (e.g., indices of abundance, recruitment, state surveys, age length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.*

This ToR was met. The surveys are highly standardized and in general provide a reliable index of abundance for this species. I do have a few cautionary notes. The first is the Bigelow to Albatross conversion factors. It looks like this is as well done as can be, but we will only really know the difference in catchability when separate catchability coefficients (q's) can be estimated from the time series, which will require at least 5 years of data. In the mean time we have to assume the conversion factors are correct, but need to note that this is a source of uncertainty in the current stock status. It should be noted that SSB goes down somewhat dramatically in the last two years (where the Bigelow to Albatross conversion factors are applied) and the fishing mortality goes up, also somewhat dramatically. These trends hinge on these conversion factors being correct.

The maps presented at the meeting and the Gini Index (Fig. A27) show a contraction of the cod population. While I think this is very important to know, it is hard to make the link as to what this means in terms of the impact of the fishery and population productivity. It can't be good, but it is an effect which is difficult to quantify. These maps were compared to maps of the spatial distribution of the fishery. I understand it has been difficult or meaningless to calculate catch per unit effort (cpue) for this fishery, because historically effort controls were in place. The recent move to a total allowable catch should allow for the estimation of cpue, and I encourage that this be done to further understand the impact of the fishery on the stock.

3. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Include a historical retrospective analysis to allow a comparison with previous assessment*

results. Review the performance of historical projections with respect to stock size, catch recruitment and fishing mortality.

This ToR was met. This ToR is the heart of the stock assessment. The assessment team is to be commended for the thoroughness and quality of their work. In this section data inputs were updated and an assessment using a new model was presented. Careful steps between the previous assessment and the current assessment were documented. First the assessment team updated the VPA and systematically showed the effects of their changes. The update of the catch equation and the landings and discards had little effect on the 2007 estimate of SSB. A reanalysis of cod length and weight showed that in previous assessments the weight at length was overestimated. The changes of weight at length decreased the estimated SSB by 30%, from 33,877t to 23,577t. This is a very large decrease and changes our perception of the resource. The change is justified and well documented, and I find this scientifically defensible. An even larger drop in spawning stock biomass occurred when the VPA model was updated through 2010. The estimated SSB decreased by another 57%, from 23,577t to 10,207t. This was caused by a large over-estimate of the 2003 and 2005 year-class. It is now obvious that high catch rates in the survey were caused by one or two large tows and I wonder why this was not noticed in the last assessment. Examining the distribution of survey catch rates should be standard practice. Further, I am concerned that this overestimate indicates a larger problem. There is evidence that the stock is becoming increasingly concentrated, which can be a sign of stress and can lead to an increasing impact of the fishery as was the case in the northern cod stock in Newfoundland. The distribution of the stock and fishing effort should continue to be monitored.

After showing the effects of changes to the VPA, the assessment team compared these results to those of a forward projecting, statistical catch at age model using an Age Structured Assessment Program (ASAP). This modeling approach has the advantage that the uncertainty in the catch and surveys can be incorporated. The BASE (preferred) model gave similar results to the updated VPA with 14% higher SSB but 27% lower F (VPA 10g vs. ASAP BASE). These differences would be large and significant in a different context, but they do not change the conclusion that the stock is overfished and overfishing is occurring. Although, I have a preference for Statistical Catch at Age models because of their ability to incorporate uncertainty, others may not have this preference, and I felt that the argument for using the ASAP BASE over the VPA should have been stronger. Nonetheless, I concluded along with the Panel that the results were similar enough and that the results of the ASAP BASE run should be accepted. It would have been very informative to see if the ASAP model produced similar drops in SSB when the weights at age were updated (which presumably it would) and the model was run to 2007 vs. 2010. A comparison between Figures A.86 and A.145 shows that the retrospective bias caused by the 2003 and 2005 cohorts was less for the VPA than the ASAP BASE run, which could be an argument for choosing the VPA model.

This section refers to some comparisons between the ASAP model and a statistical catch at age (SCAA) model developed by Drs. Doug Butterworth and Rebecca Rademeyer. Although the decision was made not to review their work as the working paper arrived

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~two days before the meeting, I will take the opportunity to make a few comments. First, scientific scholarship and peer review are to be encouraged whenever possible. I was happy to see that Doug and Rebecca participated in the working groups (Appendix A) and I am willing to guess that all involved benefited from the experience. I find it unfortunate that their work could not be reviewed at this meeting, and perhaps future efforts could be made to clearly outline a process for unsolicited contributions such that all relevant models are reviewed. Several differences between the SCAA and ASAP models are listed in the working paper which are a bit vague but appear worthy of further exploration. The SCAA model included a 'new' likelihood function that should receive proper peer-review before being widely applied.

4. *Perform a sensitivity analysis which examines the impact of allocation of catch to stock areas on model performance (TOR-3).*

The ToR was adequately examined and was met. There was little sensitivity to the allocation of the catch to stock area. I am not sure this needed to be a separate ToR, but could have fallen under ToR #1.

5. *If time permits, consider the small-scale distribution of cod (e.g., spawning sites, resource distribution, fishing effort) in the Gulf of Maine and advise on its management implications.*

It was acknowledged by the assessment team that the time and effort spent on this ToR was limited. I concluded along with the Panel that this ToR was met, but encourage further exploration on the distribution of cod as it relates to the impact of the fishery and stock definition. Could the overestimate of the 2003 and 2005 year-classes be related to cod movement and an incorrect stock definition?

6. *State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for BMSY, BTHRESHOLD, FMSY, and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the appropriateness of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.*

This ToR was met. Estimates of biological reference points and their associated uncertainty were presented. The assessment team concluded that given the data there was little or no support for a stock-recruit relationship and that MSY proxies should be used. They showed that the estimates of SSB and recruitment covered only a small segment between the origin and carrying capacity, and used this as justification for not using a stock-recruit curve to calculate MSY. The statistical fit to the data was not presented. I feel a stronger justification for MSY proxies should be given and perhaps further reviewed, but at the same time, I understand their logic and accept it. I am not (yet) convinced that the proxies chosen are better, but the working paper does cite an extensive literature on the use of F40% as a proxy, which I think is an acceptable framework. The

logic for F35% as a proxy for Fmsy was rejected at the meeting and as a consequence F40% was retained as the proxy for Fmsy. The work by Butterworth and Rademeyer (2008), briefly alluded to on page 41 of the working paper, suggests to me that a deeper discussion about the advantages and disadvantages of incorporating older data and model starting assumptions needs to occur. In my view, extending the time period examined is a laudable thing to do, but the advantages of estimating stock sizes further back in time must be carefully weighed against the structural assumptions that are required to use the data. The information gain, if any, may be low given the uncertainty in the data. Such questions may form part of a long-term research program.

7. *Evaluate stock status with respect to the existing model (from the most recent accepted peer reviewed assessment) and with respect to a new model developed for this peer review. In both cases, evaluate whether the stock is rebuilt.*
a. *When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.*
b. *Then use the newly proposed model and evaluate stock status with respect to "new" BRPs (from Cod TOR-6).*

This ToR was met. In addition, the reference points and stock status from previous assessments were presented in Table A.2. It is interesting to note that the biomass estimates were quite variable among assessments leading to alternate designations of whether the stock was overfished, but the F reference levels were much more stable and all previous assessments since 2001 concluded that overfishing was occurring. It should be noted that *all* updated VPA and ASAP model runs show that the stock is overfished and that overfishing is occurring.

8. *Develop and apply analytical approaches to conduct single and multi-year stock projections to compute the pdf (probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).*
a. *Provide numerical annual projections (3-5 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).*
b. *Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions.*
c. *Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.*

This ToR was met. I was concerned, along with the Panel, that projections were being made using average recruitment levels, when the stock size in 2012 was projected to go lower than ever observed. The Panel recommended that a linear decrease in recruitment as stock size decreases below observed levels (something like a hockey-stick stock-

recruit curve) be used for projections as this was more precautionary than assuming that recruitment would remain at average levels. Projections show that the stock is highly likely to be overfished if any fishing occurs.

9. *Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.*

Little to no time was devoted to this ToR. In my view many of the research recommendations listed are of lesser importance than addressing questions raised by this review.

4.0 Black Sea Bass Assessment Review

1. *Estimate catch from all sources including landings and discards. Characterize the uncertainty in these sources of data. Evaluate available information on discard mortality and, if appropriate, update mortality rates applied to discard components of the catch. Describe the spatial and temporal distribution of fishing effort.*

This ToR was met. There was a thorough examination of the sampling effort and samples collected by state agencies were incorporated into the estimated catch at age. Uncertainty in the catch was quantified and discard mortalities appeared to be reasonable, however, no primary publications were cited and this area could be researched more thoroughly. The spatial and temporal distribution of fishing effort was well described, but given the life history of black sea bass finer resolution could be useful to developing future assessment models.

2. *Present the survey data being used in the assessment (e.g., indices of abundance, recruitment, state surveys, age-length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.*

This ToR was met. The survey data were presented. I have large concerns about the usefulness of these trawl-based surveys given the life history of the organism. Black sea bass prefer structured rocky habitat and move very little during the breeding season. I think the assessment and management advice would greatly benefit by developing a sea bass survey.

There was some examination of CPUE, but it was given little attention in the working paper. Given that the trawl surveys do not appear to be effectively sampling the population, due to low catchability and high mixing, I suggest that further effort be put on developing a good CPUE index of abundance. The uncertainty and bias in these data were characterized and discussed.

3. *Consider known aspects of seasonal migration and availability of black sea bass, and investigate ways to incorporate these into the stock assessment. Based on the*

known aspects, evaluate whether more than one management unit should be used for black sea bass from Cape Hatteras north and, if so, propose unit delineations that could be considered by the Mid-Atlantic Fishery Management Council and for use in future stock assessments.

This ToR was met. The seasonal migration and availability of black sea bass was described using tagging data. It is very difficult to incorporate this type of life history into stock assessment models. This was given consideration at the meeting, and should be an important area of future research, but there is little guidance on how to proceed. The genetic data taken together with the tagging data supports the current scenario, which assumes one large management unit with stock sub-structure. It appears that the assessment team will either have to figure out how to incorporate seasonality and stock sub-structure or the management unit needs to be divided up and become smaller. The discussions at the meeting supported the former over the latter, but both are possibilities and should continue to be critically evaluated.

4. *Investigate estimates of natural mortality rate, M, and if possible incorporate the results into TOR-5. Consider including sex- and age-specific rate estimates, if they can be supported by the data.*

This ToR was met. The assumed natural mortality rate is plausible. It would not be advisable to use a sex- or age-specific rate until the transition rate from female to male is known. To do so would unnecessarily complicate the model with potentially confounding factors that could confuse the results.

5. *Estimate annual fishing mortality, recruitment and appropriate measures of stock biomass (both total and spawning stock) for the time series (integrating results from TOR-4), and estimate their uncertainty. Include a historical retrospective analysis to allow a comparison with most recent assessment results.*

This ToR was not met. In this ToR, the structure of the assessment model is described and the fit to the data evaluated. I concluded, along with the Panel, that the model did not fit the data well and can not be used to generate advice. This was based on several factors (not in order):

1. The surveys do not track cohorts well, which means that there is little information in the survey as currently used. This is a result of local population structure and seasonal movements. As presented, the model is little better than the overall survey mean.
2. The observed vs. predicted survey catch was far from the 1:1 line and did not go through the origin, indicating that some bias was occurring.

As a result, the previous assessment model should be updated and used for the determination of stock status. We did not review the previous model and therefore I am not in the position to say whether it is better. In fact, I am inclined to think that it has all the same problems as the ASAP model without the added benefit of age information. The

cod assessment compared and contrasted the old and new models in a much more thorough manner and consequently the review panel could have accepted either model. I suggest that future review of black sea bass assessment models be done in a similar fashion. Although the first attempt at an age-based model was rejected, there is some information in the catch at age as shown by Figure B.68, and I suggest that further model development consider age-based methods. Given the life history and seasonal dynamics, I think it would be wise to custom build an assessment model.

Other methods should be considered as well (not in order):

1. estimating population size and fishing mortality using tagging data.
2. trap based surveys similar to lobster surveys.
3. depletion methods for estimating stock size.
4. fixed station survey designs (trawl or trap based).

6. State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, F_{MSY}, and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the appropriateness of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

Because the assessment model was not accepted, the biological reference points from the previous assessment should be used.

7. Evaluate stock status with respect to the existing model (from the most recent accepted peer reviewed assessment) and with respect to a new model developed for this peer review.
a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.
b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs (from black sea bass TOR 6).

This ToR was met. Stock status with respect to the existing (SCALE) model with updated data was used to determine stock status. The conclusions were that the stock is not overfished and overfishing is not occurring.

8. Develop and apply analytical approaches to conduct single and multi-year stock projections to compute the PDF (probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).
a. Provide numerical annual projections (3-5 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties

in the assessment are considered (e.g., terminal year abundance, variability in recruitment, and definition of BRPs for black sea bass).

b.   *Comment on which projections seem most realistic. Consider major uncertainties in the assessment as well as the sensitivity of the projections to various assumptions.*

c.   *Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.*

This ToR was not met as projections were not made using the existing (SCALE) model.

9.   *Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.*

This ToR was not met. Little time was devoted to directly discussing this ToR, but research recommendations were made throughout the meeting. In my view, the most important areas of future research is in developing better indices of abundance and developing a better assessment model. Age-based methods should continue to be explored. Aging should continue and studies of age validation should occur, be peer-reviewed and published.

5.0 Acknowledgements

I thank Jim Weinberg and Paul Rago for facilitating the meeting, their scientific insight and for peppering my stay at Woods Hole with a few good laughs. Thanks to Tom Miller for chairing the meeting, and the other panel members, Ken Patterson and Ewen Bell for stimulating discussions during the meeting and after hours. I thank Manoj Shivlani for his work coordinating the review and his assistance with travel arrangements. This is no small task and it is greatly appreciated. I thank the assessment teams led by Mike Palmer (cod) and Gary Shepard (black sea bass) for providing clear and thorough assessment documents and presentations at the meeting. They are both to be commended for their professionalism in responding to the review panel in what was a highly critical and difficult meeting.

6.0 Appendices

Appendix 1: Review Panel Membership

Appendix 2: CIE Statement of Work

Appendix 3: Bibliography of Materials Provided for Review

Appendix 1: Review Panel Membership.

Review Panel Membership

Member	Primary Affiliation
Tomas J. Miller, chair	MAFMC SCC & University of Maryland, USA
Ewen Bell	CIE Reviewer, CFAS, Lowestoft, UK
Kenneth Paterson	CIE Reviewer, Brussels, Belgium
Kurtis Trzcinski	CIE Reviewer, Department of Fisheries and Oceans, Dartmouth, Nova Scotia, Canada

Appendix 2: CIE Statement of Work.

Attachment A: Statement of Work for Dr. Kurtis Trzcinski

External Independent Peer Review by the Center for Independent Experts

53rd Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC): Black sea bass and Gulf of Maine cod.

Statement of Work (SOW) for CIE Panelists
(including a description of SARC Chairman's duties)

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The purpose of this meeting will be to provide an external peer review of stock assessments for black sea bass (*Centropristis striata*) and Gulf of Maine Atlantic cod (*Gadus morhua*). Black sea bass occupy reefs, wrecks and shell bed habitats. They may attain lengths up to 60 cm with maximum age of 10-12 years. Black sea bass change sex from female to male between ages 2 to 5. Black sea bass are jointly managed by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council. The last peer reviewed assessment of black sea bass was in 2008 as part of the Data Poor Stocks Working Group, with annual updates since then. The Atlantic cod is a demersal gadoid species found on both sides of the North Atlantic. Cod may attain lengths up to 130 cm with maximum age in excess of 20 years. Commercial and recreational fisheries for cod are managed by the New England Fishery Management Council. The last peer reviewed assessment of Gulf of Maine cod was in 2008 as part of the GARM III. Results of the 2011 peer review will form the scientific basis for fishery management in the northeast region.

Duties of reviewers are explained below in the "**Requirements for CIE Reviewers**", in the "**Charge to the SARC Panel**" and in the "**Statement of Tasks**". The stock assessment Terms of Reference (ToRs), which are carried out by the SAW Working Groups, are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**. The SARC Summary Report format is described in **Annex 4.**

The SARC 53 review panel will be composed of three appointed reviewers from the Center of Independent Experts (CIE), and an independent chair from the SSC of the New England or Mid-Atlantic Fishery Management Council. The SARC panel will write the SARC Summary Report and each CIE reviewer will write an individual independent review report.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review of the stock assessments that are provided, and this review should be in accordance with this SoW and stock assessment ToRs herein. CIE reviewers shall have working knowledge and recent experience in fish stock assessments. For sea bass, knowledge of complex life histories and their implications for Biological Reference Points is desirable. For GOM cod, familiarity with forward projecting models and estimation is desirable.

In general, CIE reviewers for SARCs shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Expertise shall include statistical catch-at-age, state-space and index methods. Reviewers shall also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting. Reviewers shall have experience in development of Biological Reference Points that includes an appreciation for the varying quality and quantity of data available to support estimation of BRPs.

Each CIE reviewer's duties shall not exceed a maximum of 15 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the SARC chair's duties should not exceed a maximum of 15 days (i.e., several days prior to the meeting for document review; the SARC meeting in Woods Hole; several days following the open meeting for SARC Summary Report preparation).

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Woods Hole, Massachusetts during November 29 – December 2, 2011.

Charge to SARC panel: During the SARC meeting, the panel is to determine and write down whether each stock assessment Term of Reference of the SAW (see **Annex 2**) was or was not completed successfully. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions

are correct/reasonable. Where possible, the SARC chair shall identify or facilitate agreement among the reviewers for each stock assessment Term of Reference of the SAW.

If the panel rejects any of the current Biological Reference Points (BRP) or BRP proxies (for B_{MSY} and F_{MSY} and MSY$_)$, the panel should explain why those particular BRPs or proxies are not suitable <u>and</u> the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing BRPs or BRP proxies are the best available at this time.

Statement of Tasks:

1. Prior to the meeting
      (SARC chair and CIE reviewers)
      Review the reports produced by the Working Groups and read background
      reports.

Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein:

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email, and FAX number) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and stock assessment ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

<u>Foreign National Security Clearance</u>: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide by FAX the requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/.

<u>Pre-review Background Documents</u>: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site)

to the CIE reviewers the necessary background information and reports (i.e., working papers) for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Open meeting
<u>Panel Review Meeting</u>: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and stock assessment ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs shall not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the stock assessment ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

> (SARC chair)
> Act as chairperson, where duties include control of the meeting, coordination of presentations and discussion, making sure all stock assessment Terms of Reference of the SAW are reviewed, control of document flow, and facilitation of discussion. For each assessment, review both the Assessment Report and the draft Assessment Summary Report.
>
> During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of their analyses. It is permissible to discuss the stock assessment and to request additional information if it is needed to clarify or correct an existing analysis and if the information can be produced rather quickly.
>
> (SARC CIE reviewers)
> For each stock assessment, participate as a peer reviewer in panel discussions on assessment validity, results, recommendations, and conclusions. From a reviewer's point of view, determine whether each stock assessment Term of Reference of the SAW was completed successfully. Terms of Reference that are completed successfully are likely to serve as a basis for providing scientific advice to management. If a reviewer considers any existing Biological Reference Point or BRP proxy to be inappropriate, the reviewer should try to recommend an alternative, should one exist. Review both the Assessment Report and the draft Assessment Summary Report.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of their analyses. It is permissible to request additional information if it is needed to clarify or correct an existing analysis and if the information can be produced rather quickly.

3. After the Open meeting
(SARC CIE reviewers)
Each CIE reviewer shall prepare an Independent CIE Report (see **Annex 1**). This report should explain whether each stock assessment Term of Reference of the SAW was or was not completed successfully during the SARC meeting, using the criteria specified above in the "Charge to SARC panel" statement.

If any existing Biological Reference Points (BRP) or their proxies are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRPs are the best available at this time.

During the meeting, additional questions that were not in the Terms of Reference but that are directly related to the assessments may be raised. Comments on these questions should be included in a separate section at the end of the Independent CIE Report produced by each reviewer.

The Independent CIE Report can also be used to provide greater detail than the SARC Summary Report on specific stock assessment Terms of Reference or on additional questions raised during the meeting.

(SARC chair)
The SARC chair shall prepare a document summarizing the background of the work to be conducted as part of the SARC process and summarizing whether the process was adequate to complete the stock assessment Terms of Reference of the SAW. If appropriate, the chair will include suggestions on how to improve the process. This document will constitute the introduction to the SARC Summary Report (see **Annex 4**).

(SARC chair and CIE reviewers)
The SARC Chair, with the assistance from the CIE reviewers, will prepare the SARC Summary Report. Each CIE reviewer and the chair will discuss whether they hold similar views on each stock assessment Term of Reference and whether their opinions can be summarized into a single conclusion for all or only for some of the Terms of Reference of the SAW. For terms where a similar view can be reached, the SARC Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the SARC Summary Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The chair's objective during this SARC Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The chair will take the lead in editing and completing this report. The chair may express the chair's opinion on each Term of Reference of the SAW, either as part of the group opinion, or as a separate minority opinion.

The SARC Summary Report (please see **Annex 4** for information on contents) should address whether each stock assessment Term of Reference of the SAW was completed successfully. For each Term of Reference, this report should state why that Term of Reference was or was not completed successfully. The Report should also include recommendations that might improve future assessments.

If any existing Biological Reference Points (BRP) or BRP proxies are considered inappropriate, the SARC Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRP proxies are the best available at this time.

The contents of the draft SARC Summary Report will be approved by the CIE reviewers by the end of the SARC Summary Report development process. The SARC chair will complete all final editorial and formatting changes prior to approval of the contents of the draft SARC Summary Report by the CIE reviewers. The SARC chair will then submit the approved SARC Summary Report to the NEFSC contact (i.e., SAW Chairman).

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each stock assessment ToR listed in **Annex 2**.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting at the Woods Hole, Massachusetts during November 29 – December 2, 2011.
3) Conduct an independent peer review in accordance with this SoW and the assessment ToRs (listed in **Annex 2**).
4) No later than December 16, 2011, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to

Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and to David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each assessment ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

24 October 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
15 November 2011	NMFS Project Contact will attempt to provide CIE Reviewers the pre-review documents by this date
Nov. 29 – Dec. 2 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
1-2 December 2011	SARC Chair and CIE reviewers work at drafting reports during meeting at Woods Hole, MA, USA
16 December 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
19 December 2011	Draft of SARC Summary Report, reviewed by all CIE reviewers, due to the SARC Chair *
23 December 2011	SARC Chair sends Final SARC Summary Report, approved by CIE reviewers, to NEFSC contact (i.e., SAW Chairman)
30 December 2011	CIE submits CIE independent peer review reports to the COTR
6 January 2012	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

* The SARC Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the SARC chair prior to, during, and after the meeting in ensuring that documents are distributed in a timely fashion.

NEFSC staff and the SAW Chairman will make the final SARC Summary Report available to the public. Staff and the SAW Chairman will also be responsible for production and publication of the collective Working Group papers, which will serve as a SAW Assessment Report.

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any

permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall be completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each stock assessment ToR listed in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, Program Manager, COTR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov   Phone: 301-713-2363 ext 136

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net   Phone: 305-383-4229

Roger W. Peretti, Executive Vice President
Northern Taiga Ventures, Inc. (NTVI)
22375 Broderick Drive, Suite 215, Sterling, VA 20166
RPerretti@ntvifederal.com   Phone: 571-223-7717

Key Personnel:

NMFS Project Contact:

Dr. James Weinberg, NEFSC SAW Chairman
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02543
James.Weinberg@noaa.gov   (Phone: 508-495-2352) (FAX: 508-495-2230)

Mr. Frank Almeida, Acting NEFSC Science Director
National Marine Fisheries Service, NOAA
Northeast Fisheries Science Center
166 Water St., Woods Hole, MA 02543
frank.almeida@noaa.gov   Phone: 508-495-2233

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Findings of whether they accept or reject the work that they reviewed, and an explanation of their decisions (strengths, weaknesses of the analyses, etc.) for each ToR, and Conclusions and Recommendations in accordance with the ToRs. For each assessment reviewed, the report should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, the Independent Review Report should state why that Term of Reference was or was not completed successfully. To make this determination, the SARC chair and CIE reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the SARC Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not others read the SARC Summary Report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Stock Assessment Terms of Reference for SAW/SARC53
(to be carried out by SAW Working Groups) (file vers.: 5/20/11)

A. Black sea bass

1. Estimate catch from all sources including landings and discards. Characterize the uncertainty in these sources of data. Evaluate available information on discard mortality and, if appropriate, update mortality rates applied to discard components of the catch. Describe the spatial and temporal distribution of fishing effort.

2. Present the survey data being used in the assessment (e.g., indices of abundance, recruitment, state surveys, age-length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.

3. Consider known aspects of seasonal migration and availability of black sea bass, and investigate ways to incorporate these into the stock assessment. Based on the known aspects, evaluate whether more than one management unit should be used for black sea bass from Cape Hatteras north and, if so, propose unit delineations that could be considered by the Mid-Atlantic Fishery Management Council and for use in future stock assessments.

4. Investigate estimates of natural mortality rate, M, and if possible incorporate the results into TOR-5. Consider including sex- and age-specific rate estimates, if they can be supported by the data.

5. Estimate annual fishing mortality, recruitment and appropriate measures of stock biomass (both total and spawning stock) for the time series (integrating results from TOR-4), and estimate their uncertainty. Include a historical retrospective analysis to allow a comparison with most recent assessment results.

6. State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, F_{MSY}, and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the appropriateness of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

7. Evaluate stock status with respect to the existing model (from the most recent accepted peer reviewed assessment) and with respect to a new model developed for this peer review.
   a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.
   b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs (from black sea bass TOR 6).

8. Develop and apply analytical approaches to conduct single and multi-year stock projections to compute the pdf (probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).
   a. Provide numerical annual projections (3-5 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment, and definition of BRPs for black sea bass).
   b. Comment on which projections seem most realistic. Consider major uncertainties in the assessment as well as the sensitivity of the projections to various assumptions.
   c. Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.

9. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

B. Cod (Gulf of Maine Stock)

1. Estimate catch from all sources including landings and discards. Characterize the uncertainty in these sources of data. Evaluate available information on discard mortality and, if appropriate, update mortality rates applied to discard components of the catch.

2. Present the survey data being used in the assessment (e.g., indices of abundance, recruitment, state surveys, age-length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Include a historical retrospective analysis to allow a comparison with previous assessment results. Review the performance of historical projections with respect to stock size, catch recruitment and fishing mortality.

4. Perform a sensitivity analysis which examines the impact of allocation of catch to stock areas on model performance (TOR-3).

5. If time permits, consider the small-scale distribution of cod (e.g., spawning sites, resource distribution, fishing effort) in the Gulf of Maine and advise on its management implications.

6. State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, F_{MSY}, and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the appropriateness of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

7. Evaluate stock status with respect to the existing model (from the most recent accepted peer reviewed assessment) and with respect to a new model developed for this peer review. In both cases, evaluate whether the stock is rebuilt.
    a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.
    b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs (from Cod TOR-6).

8. Develop and apply analytical approaches to conduct single and multi-year stock projections to compute the pdf (probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).
    a. Provide numerical annual projections (3-5 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).
    b. Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions.
    c. Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.

9. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

Annex 2 (cont)
Appendix to the Assessment TORs:

Explanation of "Acceptable Biological Catch" (DOC Natl. Standard Guidelines, Fed. Reg., vol. 74, no. 11, 1/16/2009):

Acceptable biological catch (ABC) is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of [overfishing limit] OFL and any other scientific uncertainty…" *(p. 3208) [In other words, OFL ≥ ABC.]*

ABC for overfished stocks. For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan. *(p. 3209)*

NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. (p. 3180)

ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, [optimal yield] OY does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. (p. 3189)

Explanation of "Vulnerability" (DOC Natl. Standard Guidelines, Fed. Reg., vol. 74, no. 11, 1/16/2009):

"Vulnerability. A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality)." (p. 3205)

Rules of Engagement among members of a SAW Assessment Working Group:

Anyone participating in SAW assessment working group meetings that will be running or presenting results from an assessment model is expected to supply the source code, a compiled executable, an input file with the proposed configuration, and a detailed model description in advance of the model meeting. Source code for NOAA Toolbox programs is available on request. These measures allow transparency and a fair evaluation of differences that emerge between models.

Annex 2 (cont)
Appendix to the Assessment TORs (cont.):

ABC Control Rule Methods Proposed by the Mid-Atlantic Fishery Management Council:

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 receeommdations 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.

Levels of stock assessments, 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}[1], 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 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;

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

- 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 Magnuson-Stevens Act 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.

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(END OF ANNEX 2)

Annex 3: Draft Agenda

53rd Northeast Regional Stock Assessment Workshop (SAW 53)
Stock Assessment Review Committee (SARC) Meeting

November 29 – December 2, 2011

Stephen H. Clark Conference Room – Northeast Fisheries Science Center
Woods Hole, Massachusetts

(A meeting agenda will be provided approximately 2 months before the meeting.
Reviewers must attend the entire meeting.)

Annex 4: Contents of SARC Summary Report

1.

The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the SARC. Following the introduction, for each assessment reviewed, the report should address whether each Term of Reference of the SAW Working Group was completed successfully. For each Term of Reference, the SARC Summary Report should state why that Term of Reference was or was not completed successfully.

To make this determination, the SARC chair and CIE reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable. If the CIE reviewers and SARC chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

The report may include recommendations on how to improve future assessments.

2.

If any existing Biological Reference Points (BRP) or BRP proxies are considered inappropriate, include recommendations and justification for alternatives. If such alternatives cannot be identified, then indicate that the existing BRPs or BRP proxies are the best available at this time.

3.

The report shall also include the bibliography of all materials provided during the SAW, and any papers cited in the SARC Summary Report, along with a copy of the CIE Statement of Work.

The report shall also include as a separate appendix the assessment Terms of Reference used for the SAW, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice.

Appendix 3: Bibliography of Materials Provided for Review
(additional background material is not listed)

Stock assessment workshop (SAW 53) A. Gulf of Maine Atlantic cod (*Gadus morhua*) stock assessment updated through 2010. A report of the Northern Demersal Working Group.GoM cod WP#1 (GoM cod Assessment). Nov. 14, 2011

Stock assessment workshop (SAW 53) B: Black Sea Bass. Demersal Working Group. Black Sea Bass (BSB) WP#1 BSB Assessment. Nov. 11, 2011.

Stock assessment workshop (SAW 53) B: Black Sea Bass. Demersal Working Group. Black Sea Bass (BSB) WP#1 Corrected BSB Assessment. Revised Nov. 29, 2011.