

53rd Northeast Regional Stock Assessment Review Committee

November 29 – December 2, 2011

Northeast Fisheries Science Center

Woods Hole, MA

SARC 53

SUMMARY REPORT

December 16, 2011

Review Committee

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INTRODUCTION

Background

The 53rd Stock Assessment Review Committee (hereafter referred to as the Review Committee) convened at the Northeast Fisheries Science Center (NEFSC), Woods Hole, MA from November 29th – December 2nd, 2011 to review the stock assessments of Gulf of Maine cod (*Gadus morhua*) and black sea bass (*Centropristis striata*).

The Review Panel (hereafter referred to as the Panel) comprised of Dr. Thomas J. Miller (Chair of the panel and Vice-Chair of the Mid-Atlantic Fisheries Management Council's Scientific and Statistical Committee) and three scientists appointed by the Center for Independent Experts: Dr. Ewen D. Bell (CEFAS, Lowestoft, Suffolk, UK), Dr. Kenneth Patterson (Brussels, Belgium) and Dr. M. Kurt Trzcinski (DFO, Bedford, Nova Scotia, Canada).

The SARC was supported and assisted by Dr. Jim Weinberg, (SAW Chairman), Dr. Paul Rago, (Branch Chief of the NEFSC's Population Dynamics Branch) and analysts from the NEFSC. The assessment document for the Gulf of Maine cod assessment was prepared by the Northern Demersal Working Group (NDWG). This assessment was presented by Mr. Mike Palmer with support from Drs. Liz Brooks and Chris Legault. The assessment document for black sea bass was prepared by the Southern Demersal Working Group (SDWG). The sea bass assessment was presented by Dr. Gary Shepherd with support from Dr. Mark Terceiro. The support of all of these scientists to the SARC process is gratefully acknowledged.

Review Activities

About two weeks before the meeting, assessment documents and supporting materials were made available to the Panel via an ftp server. On the morning of the meeting, the Panel met with Drs. Weinberg and Rago to discuss the meeting agenda, reporting requirements, and meeting logistics. At that meeting the Panel was made aware of an important error in the assessment model input parameters for black sea bass reported in the document that the Panel had been provided. The specifics of the error are documented later in this summary. After careful discussion, the Panel agreed to review black sea bass as although the error changed specific details of the assessment, the data stream used in the model and the structure of the model itself had not changed. The Panel did not feel that the nature of the error negated all of the previous work the Panel had invested in reviewing the original draft.

The panel also discussed whether to review any late arriving submissions that had not been through the full SAW process. The Panel did not consider such material.

The SARC meeting started on Tuesday morning (December 29th) with a welcome and introductions by Drs. Weinberg and Miller (See page 34 for detailed agenda). The Gulf of Maine cod assessment was presented for the remainder of this first day. At the end of the SARC discussions on Day 1, the Panel requested additional model diagnostics for subsequent review. The black sea bass assessment was presented on December 30th (Day 2). As with the cod assessment, the SARC Panel requested additional model diagnostics be provided. The supplementary information for both species was discussed on December 1st (Day 3). All meetings of the SARC on Days 1-3 were held in open session. On December 2nd, (Day 4), the SARC prepared Assessment Summary Reports for both species in open session. Rapporteurs provided detailed records of all open sessions. For the second half of Day 4, the Panel met in closed session to work on its consensus report.

SARC Process and General Conclusions

The Review Committee agreed unanimously on all the Terms of Reference it was charged to address for both Gulf of Maine cod and black sea bass. It acknowledges the significant work that both the NEFSC assessment analysts and the Northern and Southern Demersal Working Groups had undertaken in preparing and presenting the assessments. It also appreciates the professionalism and cooperation of NEFSC staff at the SARC meeting which significantly assisted the peer review. Here we identify some overall conclusions pertinent to the SARC process for both assessments and highlight the principal conclusions for each assessment. We expand on the principal conclusions for each assessment in the subsequent sections.

General Conclusions

- **Details of the fisheries management framework and policies should be provided**

Given its composition, this SARC panel was less familiar with the former and current framework that guides the management of both species. The Panel recommends that a short document be prepared for reviewers that documents the history of management regimes in reviewed stocks. The Panel believes such a document is important because it would help inform reviewers of changes in policy that might affect the interpretation of input data, model performance and stock dynamics. Currently, each assessment provides some detail on management, but the SARC lacked a general overview.

- **Internal review of assessments should be improved before documents are released to reviewers**

The error that was found in the black sea bass assessment immediately prior to the assessment was unfortunate and the analysts must be credited for bringing it to the Panel's attention as expeditiously as they did. However, the Panel suggests the circumstances of this review may highlight the need for improved internal review of assessments prior to the release of documents.

- **The format of assessment should be more standardized**

The Panel acknowledges that formatting of assessments cannot be so restrictive as to limit the analyst's creativity and individuality, but the Panel recommends that increased attention be paid to the uniformity of assessment documents, and in particular in those sections that link the existing assessment framework to that developed and presented in the document.

Evaluating the details of the equations used in the assessment is an important part of the review activity. The Panel also recommends that every assessment document should, at a minimum, present the structural model equations, the observation error model and (if relevant) process error equations used in the assessment. Although we acknowledge that there are advantages in the familiarity that accrues to the analyst from the repeated application of models in the NEFSC Fisheries Toolbox to multiple stocks, the reviewers do not have this local familiarity and they should not have to rely on software manuals and interpretation of software input file to determine the fundamental assumptions each assessment makes. The assessment documents should be "stand alone" documents that contain the information needed to reproduce the assessment. It is expected that the Fisheries Toolbox will evolve which may make it difficult to

reproduce previous assessments in the future if the specific details of the assessment are not adequately documented.

The Panel also recommends that the assessment document text should be consistent with the model inputs used. There were several instances in both assessments where the description of the input data in the document differed from that in the input files provided. For example, in one case a survey index was rescaled to transform an index value to an area-swept abundance estimate.

- **Pre-analysis of catch at age and survey data should be improved**

The Panel felt that for both Gulf of Maine cod and black sea bass more information could have been derived from the catch at age and survey had additional “screening” analyses been undertaken prior to their use in assessment models. The internal consistency of age-structured data should be routinely evaluated prior to use in a model. For example, correlation plots of abundance of fish of age (a) in year t against abundance of fish of age (a+1) in year t+1 should be evaluated to determine the ability of catch streams and surveys to track year classes. We also suggest that general linear models of survey data may help identify changes in the relative weighting of individual survey strata to the overall abundance index that could indicate changes in distribution or the presence of anomalous survey catches.

- **Responsibility for preparation of the Assessment Summary document**

The Panel recommends that the preparation and finalization of the Assessment Summary documents should not be a part of the SARC review process. The Assessment Summary documents are important management products and it is critical that the people preparing and editing these documents are fully conversant with local protocols – something which the SARC Panel cannot be expected to understand.

Summary of Gulf of Maine Cod

The Panel unanimously recommends that the results of the Gulf of Maine cod assessment be used for management of this stock. All terms of reference for this stock had been fully met. Both catch and survey data have been fully and adequately summarized. The statistical catch at age model (ASAP) was appropriately applied to the data and that the time series of abundance and fishing mortality estimated from the model represent the best scientific estimates available for this stock. In particular, the Panel agrees that the 2005 cod year class in the Gulf of Maine was less strong than suggested by analyses conducted for a prior assessment. The Panel did not accept the revision of the reference points from $F_{40\%}$ to $F_{35\%}$ recommended in the assessment, but rather recommended the continued use of $F_{40\%}$ as the basis for biological reference point proxies. However, regardless of which reference point is selected, results indicate that the Gulf of Maine cod stock is overfished and is experiencing overfishing. Stock projections provided at the SARC indicate that the stock will not be rebuilt by 2014.

Summary of black sea bass

The Panel unanimously rejected the assessment for black sea bass as a basis for management of this species. The Panel identified substantial concerns over the potential for spatial structure and incomplete mixing within the stock area that compromised the ability of the forward projecting catch at age model

to index abundance and fishing mortality reliably based on the data available. Based on the biological reference points and assessment as approved at the Data Poor Species Workshop in 2007, black sea bass is not overfished and overfishing is not occurring.

It was suggested that the assessment team continue to consider alternative methods for assessing black sea bass stock status, perhaps continuing with age-based methods, although achieving a new framework should not be expected in the short term.

GULF OF MAINE COD

The SARC invested considerable time and effort in evaluating the assessment of Gulf of Maine cod, allowing for considerable public input during our open sessions. The Panel concludes it has a good understanding of the important sources of uncertainty relating to this stock. The Panel unanimously recommends that the assessment be accepted as providing the best scientific information for management of Gulf of Maine cod. In the sections that follow, the Panel details its principal findings and recommendations regarding each term of reference identified in the charge to the Panel.

Background Information

- The application of the new length-weight relationships derived in this assessment was appropriate.

The change in the length-weight relationship represents an important improvement to the assessment. Prior assessments had used a relationship that, although having been widely used previously, could not be documented. Accordingly, there is no basis for its continued use. The new relationship is well documented and is based on a large sample of cod collected in NEFSC survey activity between 1992-2010. Separate, seasonal relationships were accepted for spring and fall. The panel notes that the adoption of these new relationships has a substantial impact on the assessment results, because the change in length-weight relationships implies fish are heavier at length than previously estimated.

- The assumed level of $M (=0.2)$ was deemed appropriate.

The Panel accepted the continued use of $M=0.2$ as the best available scientific information for this stock. The reliability of this estimate is important and we recommend continued efforts to refine the estimate of M used in future assessments.

TOR1: 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.

- A general assumption was made that the control systems to monitor catches were adequate and no concerns were raised either by the analysts or by the members of the public attending the meeting that led the review panel to question the validity of the catch reports.
- There was no indication that important sources of catches were not accounted for.
- While the change to a management system based on sector-based ACLs could possibly have motivated over-reporting of catches, there was no evidence for this and, in any event, it would have made little difference to the perception of the state of the stock (which is heavily driven by the surveys).
- **Thus, the Panel concludes that this term of reference was addressed adequately for the purpose of assessment.**

However, the Panel notes that the level of precision of the total commercial and recreational catches should be better documented and the level of uncertainty characterized better. We suggest that this be an increasing issue given the implementation of ABCs and the expansion

recreational catches. This documentation is also important as the uncertainty inherent in catch should be used as the foundation for the weighting of these data in the final assessment model. The Panel believes more information could have been obtained from these data relative to uncertainty.

The Panel viewed the recreational catches in recent years as uncertain because of apparently anomalously high catches in MRFSS Wave 2 in 2010. Substantial concern on this topic was expressed from the floor, but the sensitivity of the overall assessment conclusions to these data has been evaluated and appears to be low.

- The Panel commends the analysts for the full inclusion of and improved estimation of the commercial and recreational discards.

The Panel believes that the inclusion of all sources of discards is an important enhancement to the input data and to the assessment overall. Estimation of discards separately by length-group is a clear methodological improvement. The assumption of 100% discard mortality was appropriate given the nature of the principal fisheries.

The incorporation of the full discard time series is one of the most significant changes to the prior GARM III implementation. It is recommended that future assessments continue to incorporate discard estimates for the commercial and recreational sectors.

TOR 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.

- **The Panel concluded that this term of reference was addressed adequately for the purpose of assessment.**
- The Panel recommends that increased inspection and analysis of survey data be conducted in future prior to inclusion of these data in the model. Examples of such analyses include:
 - Inspection of the distribution of catches within strata to ensure that single catches are not driving survey estimates. In particular, we recommend application of GLMs to check of consistency of survey strata estimates.
 - Routine internal estimates of variance of annual survey estimates.
 - Inspection of relationships between age i and age $i+1$ within individual surveys to ensure cohorts are tracked – such analyses may help identify appropriate designation of plus groups.
 - Inspection of correlations among different surveys to examine information content of individual surveys.
- The Panel notes that the Albatross IV – Henry B. Bigelow conversion factors have important consequences for the interpretation of survey data and for the assessment model. Given the high uncertainty in these conversions, we recommend that methods that do not rely on these conversion factors be implemented as soon as the length of the Bigelow time series permits.
- The latest survey data (Spring 2011 NEFSC survey) were not used in the assessment, but these data do not contradict the model fit.

TO3: 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.

- **The Panel concluded that this term of reference was addressed adequately for the purpose of assessment.**
- The careful and systematic fashion in which a bridge from the existing GARM III assessment to the final ASAP model was built developed a high degree of “comfort” in showing that the change in perception of stock status is data-driven and not model-driven.

The Panel commends the analysts on their work in this area. The sequential introduction of alternative assumptions and data streams into the VPA and ASAP models was very thorough. This approach greatly assisted the Panel in developing an understanding and appreciation of the importance of each alternative. We also note that this careful development of alternatives would have provided intermediate assessment points that could have been accepted had the final ASAP model not been accepted. We suggest that this approach be implemented, where possible in other assessments.

- The performance of the model under a plausible range of different structural assumptions was thoroughly evaluated. We consider that these afford a high level of confidence in the results.
- The Panel examined the scaling of the model results compared to swept-area estimates of biomass, and concluded that these didn’t invalidate the use of the assessment for management purposes.
- **As a result, the Panel accepts the base ASAP model as providing the best scientific foundation for providing management advice.**
- The perception of the stock biomass has changed markedly as a result of changes in the weights at age (resulting from inclusion of complete discard time series) and reductions in the estimated strength of the 2005 year (resulting from observations of this year class recruiting to the surveys and the fishery). These have combined to reduce estimates of current stock size. We view these changes as being well documented and appropriate.

The change in the perceived strength of this year class is central to the revision of the status of this stock. This change highlights the need for increased attention to survey data that as recommended under TOR 2 above. Analysts and managers often have to make decisions based on information from very recent data. Presumably, we should have most confidence in these data. Yet, by their very nature these data cannot be validated by the sequential observations of the year class in catch and survey time series. Thus, every effort must be made to evaluate the reliability of these data from first principles which we believe demands increased attention to the statistical properties of the survey data themselves.

- Model diagnostics were adequate. The Panel appreciated the range of model diagnostics that were presented and evaluated by the analysts. However, we note that three commonly used diagnostics were not presented:
 - Observed vs. predicted scatter plots of survey fits should be routinely provided because they provide a direct test of the precision and accuracy of model estimates.

- Quantile-quantile plots should be presented based on individual observations for the proportions in the catches-at-age and in the surveys, rather than means across ages or years.
- Single index runs should be routinely conducted.

For models, such as GOM cod with multiple survey indices, we believe that runs of the assessment model with single indices input should be routinely conducted. We believe that such runs help to identify the relative importance of different indices and provide a check on the reliability of the overall model estimates. While the assessment program used reports the “weighting” of the objective function by different components, this can be misleading in assessing the contribution of each source of information to the final result, as some likelihood components (typically, catches at age) may be very flat with respect to the parameters of interest near the solution.

- Retrospective patterns were persistent across a wide range of different models. This indicates that there is some degree of model misspecification, but the source of the errors could not be identified.

The Panel cautions managers that they should be cognizant of the additional uncertainty that this pattern introduces into estimation of current stock sizes and in projections.

Considerable concern was shown from the floor that the fishing mortality could not be as high as evidenced by the model fit because of the management measures that had been put in place. The panel considered these concerns and concluded that such an apparent contradiction can appear if:

- The recent decommissioning from the fleet caused an increase in average efficiency as inefficient vessels and operators are withdrawn first.
- An increased economic incentive is created to target cod when days at sea become limited
- Non-linear relationships develop between commercial fleet catchability and abundance, if (as has been seen in surveys) the stock concentrates in a smaller area and becomes more vulnerable.

TO4: Perform a sensitivity analysis which examines the impact of allocation of catch to stock areas on model performance (TOR-3).

- **We conclude that this term of reference was adequately addressed.**
- Sensitivity runs of the accepted ASAP model indicated that model was not sensitive to the reallocation of catches taken either side of the “Hague Line”.

TO5: 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.

- **We conclude that this term of reference was adequately addressed.**
- The spatial distribution of the catch was compared to the spatial distribution of survey catches, leading to the conclusion that distributions were adequately determined.

There was evidence that the stock is more aggregated in the western part of the Gulf of Maine in recent years. In this situation, commercial catches per unit effort can be maintained even in the face of declining abundances.

We recommend that work be undertaken to assess the potential causes and consequences of the observed aggregation.

- There remain concerns over the loss of local spawning aggregations.

TO6: 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.

- The Review Panel did not accept the logic presented within the assessment to justify selection of an $F_{35\%SPR}$ reference point. The stock-recruit relationship fitted to justify the change from $F_{40\%SPR}$ was not appropriate and the Review Panel found no convincing reason to deviate from the previously established $F_{40\%SPR}$ reference points. Reference points were recalculated for $F_{40\%SPR}$ as a basis for stock determination. These reference points were accepted by the Review Panel.

The Panel emphasizes that the recommendation to maintain an $F_{40\%}$ basis for reference point determination was based on the lack of a consistent logic to abandon the existing standard. We do not suggest that $F_{40\%}$ is necessarily the best proxy to use, rather there has yet to be compelling reasons to abandon it.

TO7: 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. 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. Then use the newly proposed model and evaluate stock status with respect to “new” BRPs (from Cod TOR-6).

- **Based on the existing reference points, the updated assessment indicates that the Gulf of Maine cod stock is overfished and overfishing is occurring.**
- The Panel determined that there was insufficient reason to abandon an $F_{40\%}$ foundation for reference point determination. Thus, the Panel rejected the revised reference points provided in the assessment that were based on an $F_{35\%}$ proxy. Instead revised $FMSY$ and $BMSY$ proxies based on an $F_{40\%}$ standard were developed. **Using these new reference points, we conclude that, in 2010, the GOM cod stock was overfished and overfishing was occurring.** Further evaluations indicate that this conclusion remains valid even had an $F_{35\%}$ foundation been adopted for reference points, and regardless of whether a variety of VPA or ASAP formulations were used for the assessment.
- The Panel notes a long history of this stock experiencing overfishing.

TO8: 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.

- The Panel reviewed stock projections. Current projections methods resample from historic recruitment levels independent of stock size. The Review Panel noted that this approach is not consistent with precautionary principles and made the strong recommendation that stock projections be re-calculated to reduce recruitments at low stock sizes.
- This was accepted by the assessment team and new projections were calculated following the SARC.
- The Review Panel also cautions that in cases where managers have attempted to rebuild stocks according to projection scenarios, the outcomes have often performed much worse than the projections, for a variety of reasons including stock depensation poor management implementation. Projections should be used for management purposes as tools to compare the risks of different outcomes and not as forecasts of the future. Regardless of changes recommended to projections, we conclude that the stock will not be rebuilt by 2014.

T09: 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.

1. Stock definition should be re-assessed. The Panel recommends that efforts be undertaken to re-assess the stock definition for Gulf of Maine cod. Cod is a very population-rich species, and matching the scale of the assessment to the spatial scale of the population dynamics is important to achieve reliable, accurate assessments. Several lines of evidence support this recommendation.
 - The assessment under review presents compelling evidence of a change in the distribution of cod within the current stock area. The Panel was not able to determine whether this is solely a demographic response, but comments made during the SARC indicate that it may also relate to a reduction in the diversity of spawning times and locations.
 - There is compelling historical and contemporary evidence from natural history information and tagging studies of movements across stock boundaries that compromises the integrity of existing stock definitions.
 - There is a wealth of historical and more recent genetic information of local stock structure and local adaption in cod and in fish populations general at finer spatial scales than previously admitted.
2. The level, schedule and variability of natural mortality should be evaluated. Currently, the level of fishing mortality, F, estimated in Gulf of Maine cod is substantially higher than the estimated

rate of natural mortality, M . However, as managers begin to regulate harvests more effectively, F will decline and approach M . Under such circumstances the accuracy of the assumed M becomes more important. Accordingly, the Panel recommends that efforts be increased to evaluate size-specific, age-specific and inter-annual variation in M be expanded.

3. Study of the behavior of fishers in response to changes in the distribution of the stock and to changes in management. There was clear evidence presented in the assessment and at the SARC of changes in the distribution of cod within the stock area. The Panel recommends that research and analyses be conducted to:
 - Understand and characterize changes in the distribution of the stock.
 - Understand and characterize changes in the distribution of fishing effort and to evaluate the impacts of such changes on the pattern and biological characteristics of removals from the stock.
 - Evaluate the potential for changes in the distribution of effort to be associated with changes in the distribution of vulnerability of different components of the stock to fishing mortality.

The Panel also reviewed the research recommendations contained in the assessment document itself. We endorse recommendations related to the inclusion of the Maine/NH survey and for the re-evaluation of the maturity condition of fish in local surveys to assess evidence for local spawning aggregations.

BLACK SEA BASS

As with Gulf of Maine cod, the SARC invested considerable time and effort in evaluating the assessment of black sea bass. We note that no industry or Council representatives were present at these discussions and only one independent party attended the meetings for black sea bass. Based on extensive discussions with the analysts who conducted the assessment and NEFSC staff who have considerable insight into this species, the fisheries it supports and the available data to assess it, the Panel concludes it has a thorough understanding of importance sources of uncertainty relating to this stock. The Panel unanimously rejected the assessment brought forward by the Southern Demersal Workgroup as providing a scientific foundation for management.

The effort to complete a revised and age-structured assessment was both important and constructive. The assembly of the age data, the analysis of the regional and broadscale surveys and the attempt to fit a forward projecting statistical catch at age model were all important contributions that will lead to improved black sea bass assessments in the future.

There is substantial information in the age data currently available, and efforts should continue to exploit these data. However, the data in the assessment presented showed significant deviations from the model assumptions. This makes the model presently unsuitable for advisory purposes.

There is also strong evidence of regional stock structure and incomplete mixing within the stock area for black sea bass that may compromise the accuracy and reliability of the current integrated approach.

In the sections that follow, the Panel details its principal findings and recommendations regarding each term of reference identified in the charge to the Panel.

General comments

This assessment represents a reintroduction of age information into the assessment framework for this species. Considerable effort has been expended by NEFSC scientists to develop the required age-based indices and catch data. Despite the Panel's rejection of the assessment overall, age-based assessments offer substantial advantages over the current length-based assessment. However, age-based approaches require confidence in the underlying ageing and resultant age-specific patterns. The assessment would have been strengthened by the provision of supporting information on the reliability of the ageing, the completeness of the age-length keys and resultant growth patterns. We suggest that this information could have been provided in supporting documentation outside of the main assessment document.

The assessment document didn't adequately provide a bridge from the SCALE model to the ASAP model. It would have been desirable to document the point of departure thoroughly and provide more detail on the sequential consequences of assumptions leading from the SCALE model to the final ASAP presented in the assessment document.

A lot of work was done to improve the input data streams to the assessment model.

TOR 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.

- The general assumption was made that the control systems to monitor catches were adequate. No concerns were raised by the analysts that led the review panel to question the validity of the catch reports.
- There was no indication that important sources of catches had not been accounted for.
- **Thus, the Panel concludes that this term of reference was addressed adequately for the purpose of assessment.**

However, the Panel notes that the level of precision of the total commercial and recreational catches should be better documented and the level of uncertainty characterized better. We suggest that this be an increasing issue given the implementation of ABCs and the expansion recreational catches. This documentation is also important as the uncertainty inherent in catch should be used as the foundation for the weighting of these data in the final assessment model. The Panel believes more information could have been obtained from these data relative to uncertainty.

- The reduction in the discard mortality rate from 25 to 15% was poorly justified. The Panel notes that discard mortality is a difficult parameter to estimate. One approach to address this uncertainty would be to explore the implications of miss-specification would be to evaluate the impact on the assessment model results of alternative values of discard mortality on stock status. Such simulations were not presented at the SARC.

Tor 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.

- **The Panel concluded that this term of reference was addressed adequately for the purpose of assessment.**
- The Panel reviewed evidence regarding the presence of stock structure within the stock area.
 - We note that although at the region wide level, no year class structure was apparent in the surveys, evidence was presented that some individual state surveys are better able to track the local abundances of particular year-classes.
 - Tagging data presented at the SARC suggest incomplete mixing among population unit, with homing of the population to specific spawning sites.
 - In combination, we support the conclusion of the assessors that the population is not homogeneously mixed but retains internal population structure, such as a clinal variation from north to south.
- The Panel recommends that increased inspection and analysis of survey data be conducted prior to inclusion in the model as described in the Panel's overview comments. Examples of such analyses include:
 - Inspection of relationships between age i and age $i+1$ within individual local surveys to ensure cohorts are tracked – such analyses may help identify appropriate designation of plus groups.

- Inspection of correlations among different surveys to examine information content of individual surveys.
- Routine internal estimates of variance of annual survey estimates.
- The Albatross IV – Henry B. Bigelow conversion factors have important consequences for the interpretation of survey data and for the assessment model. Given the high uncertainty in these conversions, the Review Panel recommends that methods that do not rely on these conversion factors be implemented as soon as the length of the Bigelow time series permits.

TOR 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. The Panel concludes that this term of reference was addressed adequately.

- The Panel noted that the overlaying of tagging results and the distribution of commercial fishing effort was an attractive feature of the analyses.

TOR 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.

- The Panel felt that the estimate of M used was the best available, but the implications of decisions regarding M require further evaluation.
- **Thus, we conclude that this term of reference was adequately addressed.**
- The implications of assigning M for a protogynous species are not fully understood, and in particular black sea bass' life history response to changes in exploitation rates are equally not fully understood.

TOR 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.

- The Review Panel rejected the ASAP model for black sea bass on the following basis:
 - The Panel had substantial discomfort with the fit of the model to the data.
 - The lack of contrast in recruitments mean that it is difficult to use surveys to estimate recent stock sizes with any level of precision, or even to validate the principle that the surveyed stock and the exploited stock are the same.
 - Because black sea bass enter the fishery at half L_{∞} , catch provides relative little evidence on stock dynamics.
 - Observed vs. expected plots of surveys gave rise to scatter plots that deviated strongly from linear - the apparent non-zero intercepts in these scatter plots give rise to concerns of structural violation within the model.

- A series retrospective problem arose in the middle of the time series as data were peeled away from the terminal end.
- Structural uncertainties gave rise to very large uncertainties in terminal stock sizes and substantial retrospective issues.
- The Panel requested assessment model runs with single indices as a way of revealing the importance of different data sources on model outcomes. We note a discrepancy in the fits of the model to single indices to ones fit to multiple indices. We were not able to determine the source of the inter-model variability.

TOR 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.

- Because the Review Panel rejected the ASAP model, no new reference points were considered.

TOR 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. 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. Then use the newly proposed model and evaluate stock status with respect to “new” BRPs (from black sea bass TOR 6).

- The Review Panel observes that the previously accepted BRPS and SCALE model fit imply that the black sea bass stock is not overfished and overfishing is not occurring.

TOR 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). 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). Comment on which projections seem most realistic. Consider major uncertainties in the assessment as well as the sensitivity of the projections to various assumptions. Describe this stock’s vulnerability (see “Appendix to the SAW TORs”) to becoming overfished, and how this could affect the choice of ABC.

Because the Review Panel rejected the ASAP model, no projections were considered.

TOR 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.

1. The panel recommends multiple age-structured models be evaluated for use in a future model. We recommend these models are selected to span a range of structural assumptions that thereby shed light on the importance of processes that caused us to reject the formulation presented at this SARC. Specifically, we recommend:

- a. A simple model such as a separable model with smoothing on F among years.
- b. A more complex, spatially structured model with 6 month time step within independent stock areas in spring and mixing in winter with natal homing, if the data are adequate to support such a model.
- c. Consideration should be given to including tag return data in an age-structured (and possibly spatially-structured) assessment model.

The Panel notes that the three models suggested above are a major research task and may require additional data. We do not anticipate that such models could be produced within an operational assessment framework.

2. The Panel recommends evaluation of a species specific survey, such as a pot survey to provide increased information on abundances and biological characteristics.
3. Continue and expand the tagging program to provide:
 - a. increased age information.
 - b. increased resolution on mixing rates among putative populations.
4. Continue and expand genetic studies to evaluate the potential of population structure north of Cape Hatteras.
5. Continued research on rate, timing and occurrence of sex-change in this species. Recent research findings discussed at the SARC lead to the hypothesis that protogyny is not obligate in this species – some individuals may never have been female before maturing as a male.
6. The validity of the age data used in the assessment requires further evaluation, in particular the reliability of scale-based ageing needs to be determined. A scale- otolith intercalibration exercise might be of utility.

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APPENDIX 1 Statement of Work

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 and 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 than 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.

Foreign National Security Clearance: 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/>.

Pre-review Background Documents: 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

Panel Review Meeting: 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.

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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, $OFL \geq ABC$.]

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 recommendations should be more precautionary as an assessment moves from level 1 to level 4. Recommendations for ABC may be made for up to 3 years for all of the managed resources except spiny dogfish which may be specified for up to 5 years. The rationale for assigning an assessment to a level will be reviewed each time an ABC determination is made.

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;
- 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;

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

- 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)

**APPENDIX 2:
Agenda**

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

Nov. 29 - Dec. 2, 2011

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

AGENDA (version: 25 Nov. 2011)

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR
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Tuesday, Nov. 29

9:00 – 9:30 AM

Welcome
Introduction
Agenda
Conduct of Meeting

James Weinberg, SAW Chair
Thomas Miller, SARC Chair

9:30 – 11:45

Assessment Presentation (A. GOM Cod)
Mike Palmer **TBD**

Tony Wood

11:45 – 1

Lunch

1 – 3

SARC Discussion w/ presenters (A. GOM Cod)
Thomas Miller, SARC Chair

Tony Wood

3 - 3:15

Break

3:15 - 5:30

Assessment Presentation (B. Black sea bass)
Gary Shepherd **TBD**

**Toni Chute/
Jessica Blaylock**

Wednesday, Nov. 30

- 9:30 – 11:30** SARC Discussion w/ presenters (B. Black sea bass)
Thomas Miller, SARC Chair **Toni Chute/
Jessica Blaylock**
- 11:30 - 12:45** Lunch
- 12:45 – 3:15** Revisit w/ presenters (A. GOM Cod)
Thomas Miller, SARC Chair **Tony Wood**
- 3:15 – 3:30** Break
- 3:30 – 5:00** Revisit w/ presenters (B. Black sea bass)
Thomas Miller, SARC Chair **Toni Chute/
Jessica Blaylock**
- (Evening Social/Dinner – Probably at BBC, Falmouth)

Thursday, Dec. 1

- 8:45 – 9:45** (cont.) Revisit w/ presenters (B. Black sea bass)
Thomas Miller, SARC Chair **Toni Chute/
Jessica Blaylock**
- 9:45 - 10** Break
- 10 – 12:30** Review/edit Assessment Summary Report (B. Black sea bass.)
Thomas Miller, SARC Chair **Toni Chute/
Jessica Blaylock**
- 12:30 – 1:45** Lunch
- 1:45 – 4:30** Review/edit Assessment Summary Report (A. GOM cod.)
Thomas Miller, SARC Chair **Tony Wood**
- 4:45 – 5:30** SARC Report writing. (closed meeting)

Friday, Dec. 2

- 9:00 - 4 PM** (cont.) SARC Report writing. (closed meeting)

*All times are approximate, and may be changed at the discretion of the SARC chair. The meeting is open to the public, except where noted.

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.