48th NORTHEAST REGIONAL STOCK ASSESSMENT REVIEW COMMITTEE (SARC-48)

Report on the 2009 Tilefish, Ocean Quahog and Weakfish Benchmark Stock Assessment

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Prepared for

Center for Independent Experts

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1. Background

This report provides an independent review of the assessments of tilefish, ocean quahog and weakfish carried out at the Stock Assessment Workshops (SAW-48).and presented at the 48th Northeast Regional Stock Assessment Review Committee meeting. The Review Committee was provided with web access to stock assessment reports and background material prior to the meeting. I then participated in the 48th Northeast regional Stock Assessment Review Committee (SARC-48) meeting to review the assessments. This report includes my own review of the assessments. The views amongst panel members were very consistent (see SARC summary report) and varied only in the weighting of the importance to the assessment of specific issues, largely based on the breadth of experiences and expertise between panel members, rather than a fundamental difference in opinion. This report reflects an expansion of the comments given in the main summary report whilst attempting to avoid significant repetition with that report (the two should be read in conjunction). Also included is the required documentation, including the Statement of Work, meeting Agenda and Terms of Reference.

2. Review activities

The Review Committee convened at the Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts, from June 1-4, 2009. The Committee comprised a chair and three panel members. Plenary sessions were open to the public.

A formal presentation of the Stock Assessment Workshop (SAW) results was given by the lead assessors from each of the working groups (Tilefish: Paul Nietshky, Ocean Quahog: Larry Jacobson, weakfish: Jeff Brust) and specific issues were discussed. The assessors returned, when required, for further discussion and clarification of how the SAW Terms of Reference were addressed, including carrying out some additional model runs for clarification.

The panel members were then each required to prepare an independent report indicating for each Term of Reference of the relevant SAW: i) whether the work that was presented is acceptable based on scientific criteria (e.g. consider whether the data were adequate and used properly, the analyses and models were carried out correctly, and whether the conclusions are correct/reasonable); and ii) whether the work provides a scientifically credible basis for developing fishery management advice.

The SARC chair and panel members prepared a first draft of the consensus report during the meeting. The panel members prepared their independent reports following the meeting. There were no disagreements between the panel members on any issues, and therefore my independent review given below to a large extent reflects the consensus report developed at the meeting, with additional comments. Some of the original Consensus Report text has been summarised, or expanded where appropriate, but without changing the Committee's agreed views.

3. Acknowledgements

I would like to thank all the technical working group members contributing to the meeting for their informative presentations of the SAW results and for providing helpful responses to the

SARC's questions. Many thanks also to staff at the Woods Hole Laboratory and particularly to Jim Weinberg and Paul Rago for their hospitality and help throughout the meeting. Thanks also to the other members of SARC for productive discussions on the assessments and the chair for keeping the necessary focus of the meeting.

4. Executive summary for all stocks

Golden Tilefish

I agree with the working group (WG) that the stock is not overfished and that overfishing is not occurring. Whether the stock had recovered to optimal stock levels in recent years is much more uncertain though and given the weaknesses in the assessment model it is scientifically justified to assume that this has not yet occurred, an assertion also supported by recent LPUE trends and length frequency data.

Projections for this stock are uncertain, and in my opinion cannot be relied on to give accurate measures of future ABC's, unless they are set at levels well away from conservative estimates of reference points as the current state of the stock is less certain than the model tends to assume. Levels of stock production on the decadal scale are likely useful measures of average production.

Ocean Quahog

I agree with the steering committee (SC) that the stock is not overfished and that overfishing is not occurring.

Stock projections based on productivity are unlikely to be of any use in this stock currently as we have little or no data to suggest what response the stock might have to exploitation. However F levels are well below any potential reference points and abundance appears to be higher than any potentially plausible biomass reference point.

Weakfish

I agree with the technical committee (TC) that this stock is overfished and that overfishing is occurring, despite the fact that current F levels are relatively low. The state of the stock is unexpectedly low, because of what appears to be a substantial change in the rate of natural mortality. This has reduced productivity to somewhere near zero surplus production.

Assessments assuming constant mortality do not provide quantitatively useful measures of stock status, nor do some of the production based models that are not tied to the assumption of constant M. Despite this, qualitatively all models agree that the stock is in a very poor state and that even in the absence of fishing any recovery of the stock will be slight whilst these higher levels of M remain.

5. Assessment of tilefish

Summary

I agree with the WG that the stock is not overfished and that overfishing is not occurring. Whether the stock had recovered to optimal stock levels in recent years is much more uncertain though and, given the weaknesses in the assessment model, it is scientifically justified to assume that this has not yet occurred, an assertion also supported by recent LPUE trends and length frequency data.

Projections for this stock are uncertain, and in my opinion cannot be relied on to give accurate measures of future ABC's, unless they are set at levels well away from conservative estimates of reference points as the current state of the stock is less certain than the model tends to assume. Levels of stock production on the decadal scale are likely useful measures of average production.

TOR 1: Characterize the commercial catch including landings, effort and discards. Characterize recreational landings. Evaluate utility of study fleet results as improved measures of CPUE.

COMPLETED: Also see SARC report for comments.

Commercial landings time series were presented spanning the period 1915 to 2008. Effort data were available from three sources (the Turner series, the weighout series and VTR series) spanning the period from 1973 to 2008. Particularly interesting were some of the differences between the historic series and the currently available growth and length data.

Longline data generally do not lend themselves very well to the use as CPUE time series. The data suffer from similar difficulties as gill nets relying on the animals' activity and behaviours to interact with the gear. Changes in such behaviour will have a tendency to reduce the correlation between abundance and catch.

Some evidence was provided by industry representatives at the meeting that there are spatial differences in the size distribution of the stock. Areas generally yielding larger fish have not been exploited consistently in the recent time period as the CPUE in the recently exploited area has declined somewhat. Some of this decline was thought to be associated with the presence of large number of dogfish on the grounds (competition for bait), which have now disappeared, seasonally yielding higher CPUE's. Similarly, the industry is convinced that larger tilefish males will have a disproportionately higher catchability due to their aggressive disposition so that to some degree the catchability of smaller tilefish is dependent on the presence or absence of larger fish

It was not possible to quantify the effect nor qualify the severity of the effects of these external factors on the CPUE and tuning fleets based on this gear appear to represent stock trends well historically, but clearly systematic changes in the catchability of the fleet will reduce its utility to the assessment process.

The presentation of the study fleet focused on the issue of effort standardisation (an other important factor in ensuring the utility of the CPUE data), which suggested that it was possible to improve some of the effort aspects of the fleet, but soak times could as yet not be calculated by a standard procedure. Other issues such as those alluded to above could not be addressed with a single year's data.

If the study fleet is to be used as the only tuning information in the assessment, serious consideration should be given to how one could address the spatial distribution of sampling and ensure that the probability of capture of an age is constant irrespective of the presence of other sizes or species.

TOR2: Estimate fishing mortality and total stock biomass for the current year, and for previous years if possible, and characterize the uncertainty of those estimates. Incorporate results of new age and growth studies.

COMPLETED: Also see SARC report for comments.

Two models were presented: one based on productivity (ASPIC), and the other an age structured length based model (SCALE). Neither model was entirely satisfactory, for different reasons, so the WG felt inclined to go with the previously accepted model.

The output of the ASPIC model is unlikely to be sufficient to provide management advice in the short term, because it cannot deal with non-equilibrium conditions, such as an unusually large yearclass passing through the population. However, on larger time scales the model appears to have performed sufficiently well to manage the stock. Requests for short term management options and stock status determination in 2008 are provided, but are likely to be of insufficient precision in that time frame.

Out of the three assessments conducted at the SARC 48, I feel least certain about this assessment, not necessarily because the assessment nor the stock is in a worse state than the others, but because the implications to management differ between the different methods, and there is some potential for the stock to decline to levels where management actions would be triggered in the future.

Cause for concern scientifically is the evidence from the catch data (and the diagnostics from the resultant assessments). There are good indications from the length frequency of catches that a strong yearclass (1998) is currently passing through the stock with what appears to be few other cohorts being discernable till 2008. However the size of the most recently recruited cohort appears to be much smaller than the one currently exploited.

From a long-term management perspective, this questions the suitability of equilibrium reference points as a management tool. If the stock is driven by intermittent strong yearclasses, then it will never reach equilibrium conditions so that an invariant long-term yield is unlikely to be a suitable management framework.

If one still accepts the long-term management targets as a suitable proxy (and this will to some degree depend on the variability of recruitment and the periodicity over which strong year classes appear) then it still needs to be considered as two stocks at the same SSB level, but made up of many cohorts in the one case and a single one in the other that have the resilience to exploitation. My personal opinion is that this is not the case, and management needs to be more precautionary in the latter case. Consequently, I felt one could not argue the stock had been rebuilt to Bmsy levels despite the indication of the ASPIC model (in addition, these values are likely to be revised downwards in a future assessment anyway, see SARC summary report).

The comparison of the historic and new growth study provided by the TC were interesting in a number of ways. They indicated that the major change in the growth of tilefish appears to have been in the instantaneous growth rate, not in Lmax. Also, few older fish were found in the recent study compared to the previous one but no data on relative sample size were provided and hence it was not possible to determine if the age structure was strongly truncated; nor was the sampling design described in any detail, so potential fisheries dependent biases could not be assessed.

The implications of the new study for the assessment are numerous. If the age structure is seriously depleted, as possibly suggested by the commercial length frequencies, then clearly the ASPIC model has failed to capture the true population dynamics of the stock and presents a significant threat to the future management of this stock. In any case, the practice of applying a single growth curve to the entire timeseries seems flawed. If growth has changed, then in the case of the ASPIC model, this should be incorporated in the response in productivity to exploitation implicitly, but in the case of the SCALE model it should be incorporated for the relevant time periods. In addition, the steep growth curve and the extreme flattening of growth at the older ages will allow better definition of younger yearclasses in the length model, but will significantly impede the resolution and detection of older yearclasses so that the model will be very sensitive to the period to which each growth pattern is ascribed.

The current age and growth study is likely to be continued for the next year, and it is vital that the issues of sample size and possible sample bias are addressed, and that a significant effort is made to determine if the apparent cohort (in the length data) is really one cohort, or two as assumed by the SCALE model, or more, which will have implications on the appropriate management strategy.

Lastly, the set up of the SCALE model used in this exploratory analysis does not in my opinion reflect the true uncertainty of possible states of nature, and is therefore likely to produce much greater estimates of precision than the underlying data supports. One example is that fact that few old males are caught in the fishery. The choice of a higher natural mortality rate on the basis that these fish are not encountered in catches is questionable, particularly in light of the supposedly more aggressive nature of the specimens with regards to fishing gear. An alternative hypothesis would be to suggest that catchability is higher and that their absence in the catch is due to higher levels of F rather than M. The industry also suggests that there is spatial differentiation of fish to the east and south where older fish can be encountered, but fishing operations are impeded by the increased distance and static gear. This presents a hypothesis of very low catchability as an explanation of the absence of older males in catches.

TOR3: Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and F_{MSY}). Comment on the scientific adequacy of existing and redefined BRPs.

COMPLETED: see also comments in the SARC summary report.

Reference points were provided by the WG in line with the accepted assessments and estimation of stock status in relation to the reference points were provided. However given the uncertainty in the current assessment or the alternative SCALE model, this estimation was rather more subjective than one would like particularly in view of the decreasing trend in LPUE of the fishery in recent years.

TOR4: Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 3).

COMPLETED: the relevant comparisons were carried out by the WG. See also comments in the SARC summary report

It is doubtful given the uncertainties in the assessment (TOR2) that either model would provide reliable estimates of biological reference points, and given the uncertainty in the stock dynamics (TOR3), whether these reference points have scientific meaning for stocks such as this at all. The panel therefore placed little emphasis on the detailed evaluation of this TOR until progress can be made to better understand the historic stock development. Although precise, short term management quantities, such as future ABC's, were not reliable on the basis of the assessments provided by the WG long-term management quantities such as productivity seemed better defined. Lastly, qualitative estimation of stock status can be made (somewhat subjectively) on the assessments provided and on other information provided by the WG and industry. It seems likely that the stock is not overfished, and that overfishing is not occurring, subject to the caveats underlined in SARC summary document and this document under TOR2.

TOR5: Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

-Provide numerical short-term projections (2-3 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment (alternate states of nature).

-If possible, comment on the relative probability of the alternate states of nature and on which projections seem most realistic.

-For a range of candidate ABCs, compute the probabilities of rebuilding the stock by November 1, 2011.

-Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

COMPLETED: The WG provided deterministic projections based on output of both the ASPIC model and SCALE model. Technically the projections were acceptable, although as described under the discussion of TOR2 the model outputs were of insufficient certainty to provide suitable measures of expected future catch in the short term.

A number of scenarios were presented for the ASPIC model, making predictions on future trends in SSB. This resulted in changes in the estimation of biomass reference points and even significant change in the relative trends of both F and SSB historically. This seemed surprising at first, as one would have thought that predicting future catch should have little impact on historic estimates. The problem is that a "guess" at what might happen in future is inconsistent with the model assumptions, and therefore the model readjusts its parameterisation to compensate, which in turn results in the different outputs. Consequently this represents an investigation of alternative states of nature. The analysis was very susceptible to very small changes in future LPUE, which suggests estimation of reference points are equally susceptible to small measurement errors.

In general then, the analysis indicated that the model does not fit the data with any great certainty so that reference point and stock status estimation are weakly converged. Moreover, projections in theory should be based on the best estimation of current stock size projected forward assuming a trend in F, recruitment and growth, therefore I do not feel one can attach the same qualities to these projections (estimation of a future trajectory in F can be based in theory on future management, whilst LPUE is based on the response to the stock so is much less predictable) and one should probably use a different terminology to avoid confusion.

TOR6: Review, evaluate and report on the status of the research recommendations offered in recent SARC reviewed assessments. Identify new research recommendations, including recruitment estimation.

COMPLETED: The WG provided a good summary of the work that had been conducted in line with the research recommendations made in previous reviews.

In addition to those research objectives that are still outstanding, I would urge the WG to put substantial effort into determining the age composition of the current catch, as well as determining if this is representative of the population as a whole. The study on age and growth is continuing, but it may not collect sufficient samples this year, unless some additional resources are provided. In the short term this will indicate whether concerns regarding the current state of the stock and its relationship with the reference points are unduly optimistic or not. In the long run this will provide much better data for the development of the SCALE model, which ultimately is likely to provide better predictions on the short term time scale than the ASPIC model can.

The investigation of the SCALE model proved very useful in qualifying the results of the accepted ASPIC model. The fact that the model proved insufficient to provide suitable results should not be seen as justification not to pursue this approach in the future. Far from it, ultimately it has been shown that the ASPIC model cannot deal with some of the characteristics

observed in the stock, so a better management tool will greatly benefit the precision of management measures targeted at providing long-term sustainability of the stock.

The study fleet approach has been fruitful in answering some important questions regarding the utility of effort as a measure of F, however it is too early to say if it also provides an unbiased measure of abundance. This is a key question as there is currently no fisheries independent measure of abundance used in this assessment. Serious consideration needs to be given to the purpose and future funding of this work. If it is to provide an independent measure of abundance not subject to the same biases as the catch data itself, then some "survey" like approaches should be incorporated as soon as possible in order to maximise the time series aspect of any future tuning information.

6. Assessment of quahog

Summary:

I agree with the SC that the stock is not overfished and that overfishing is not occurring.

Stock projections based on productivity are unlikely to be of any use in this stock currently as we have little or no data to suggest what response the stock might have to exploitation. However F levels are well below any potential reference points and abundance appears to be higher than any potentially plausible biomass reference point.

TOR1: Characterize commercial catch including landings, effort, and discards.

COMPLETED: Also see comments in SARC summary report

A good presentation of the available data and convincing evidence of the lack of discards and precision of landings information supported the main conclusions that the data for this stock were at least as suitable, if not more so than the data used for assessment purposes in many other stocks.

The presentation also gave a good overview of the development of the fishery and how the southern, probably marginal habitat of the species had been initially fished down and effort had retargeted to the more northern (central to the distribution of the stock) areas. It was suggested by the presenter that LPUE in the southern region has always been considered marginal and that a situation of serial depletion and its consequence, hyperstable CPUE's, are almost inevitable in a fishery with such slow population dynamics. This assumption is pivotal to the status of the stock evaluation and to the argument on whether this constitutes mining or sustainable exploitation (see later discussions below).

An interesting discussion on the effect of the Georges Bank closed area (closed due to the threat of PSP) was also given, and gave much of the necessary background to the assessment evaluation. There is an attempt by the industry to open this area by proving the absence of PSP. This is one of the few remaining areas of the stock where exploitation is financially viable having moved through the stock from a south to north direction. The length frequency data available for the different areas suggests that there has been a relatively recent recruitment event in the LI area of the stock. The recruitment to the fishery occurs over a number of years, but likely represents a single yearclass slowly growing in to the size retained by the fishery.

Indications are that there is effectively no discarding per se, but there is an assumed, unobserved mortality rate associated with damage to clams not retained. For the purposes of the assessment these have been included in the catch matrix.

Length-at-maturity and length in the catch composition indicate that virtually all quahog taken in the main fishery are mature. There are other, much less productive fisheries (much lower LPUE) for the species in Maine, taking smaller individuals (100% immature specimens). The latter fishery is at the northern end of the distribution and account only for a very small portion of the stock so for the purpose of the assessment this has been ignored.

TOR2: Estimate fishing mortality, spawning stock biomass, and stock biomass for the current and previous years. Characterize uncertainty of the estimates.

COMPLETED: The accepted assessment results are a scientifically credible basis for decisions about fishery management, but are sensitive to the assumption of M, the suitability of the replacement values chosen for survey stations not sampled and the assumption of a q of 1.

The accuracy of the assessment almost entirely hinges on the fisheries independent survey. A lot of work has gone into trying to determine effective measures of gear efficiencies including depletion experiments, gear comparisons and fine tuning measures of effective tow length. A comprehensive analysis with conclusions was presented, but there are still further questions regarding how to deal with previous data for which no tow length correction is available, how to deal with the assumed future change in research vessel etc.

There is some indication of the spatial heterogeneity of the population and the fishery, the effects of which on the assessment and productivity estimates of the stock are not entirely clear.

A by area KLAMZ modelling approach was taken and results summed over the area. A stepped reduction in recruitment was considered for two of the areas (constant for the other areas). Because the KLAMZ model deals with age structure implicitly, yet recruitment in this case is a single cohort that recruits over a long period of time (selectivity considered knife-edge) this only represents an approximation, the sensitivity of the results to this assumption to me are unclear, but probably represent more of a problem for projections than the assessment itself. Other modelling approaches taken by the SG indicated that the estimates of biomass were insensitive to the model used, so the KLAMZ model provides the most parsimonious model to assess stock status.

The estimation of uncertainty provided by the model used the delta method and standard error estimates were technically sound. However, the results are conditional on the assumed error distribution being equal to the true error distribution. A better approach would be to bootstrap samples rather than random selection from the error distribution. In this way the variance estimates would be insensitive to the assumption of the error distribution. They are likely to be larger than the ones provided here.

TOR3: Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and F_{MSY}). Comment on the scientific adequacy of existing and redefined BRPs.

COMPLETED: see also comments in SARC summary report

A number of issues with the estimation of the biological reference points were discussed.

- Are equilibrium reference points useful for a stock which is unlikely to ever reach equilibrium conditions in an exploited state, given the extremely sporadic recruitment? It is unlikely that the response in productivity to exploitation can be estimated, or that biomass levels can be kept anywhere near the biomass reference points as this will clearly be a boom or bust situation.
- In addition, what appears to have happened in this fishery is that an area is fished down (incomplete mixing of the stock) and will not become productive again until a further

recruitment event has occurred (not yet observed in the short history of this fishery). Dependent on the scale of the reduced patch and the dispersal distance of recruitment this part may or may not become productive again (mining versus sustainable exploitation). Hence there are no data on which of these options is applicable, nor would we expect to see any for the foreseeable future. Therefore the scientific basis for biological reference points seem far fetched, yet they may well be operationally applicable. The fact that stock size and F estimates are above and below the relevant reference points respectively suggest that management is currently insensitive to the precise estimation of reference points.

- Assuming MSY theory can be applied, then productivity of the unexploited stock is equivalent to M, and recruitment is merely the replacement of the members of the stock that died that year, i.e. surplus production at the unexploited SSB is 0. Assuming M is constant, increases in productivity would either have to come in the form of increasing recruitment or increasing growth. The model chosen here assumes that recruitment has been constant (or is decreasing as a step function) and that growth has not changed. Consequently, it is difficult to see how it can arrive at sensible biomass reference points. I agree that one would not have expected any response to exploitation as yet, but there seems to be significant circularity in the model and different parts in terms of stock status and biological reference point estimation seem to have different assumptions so that they are either inconsistent with each other or estimate parameters in the absence of data.
- Lastly, the question of the closed area for the estimation of biological reference point is one that should be cleared up by the commission. Estimating F reference points on the basis of the whole stock (including the closed area) is conservative, yet futile. If half the stock is outside the closed area then fishing the stock down to zero in the open area (F50), although very expensive in terms of effort, is the recommended solution. Given the spatial segregation and sporadic recruitment this is likely to have severe implications on the sustainability of the fishery (although not the stock). From a fishery sustainability point of view this should apply to the exploited part of the stock.
- The argument for retaining a safe portion of the biomass (B50) is to ensure future recruitment. Therefore this should be applied to the whole stock that contributes to the reproduction in the exploited area, which unfortunately is unknown for this stock. A precautionary reference point would thus be based on the whole stock.
- The biological reference points, both F and SSB, are based respectively above and below the levels of viable economic exploitation. In other words from a precautionary perspective economics are more restrictive than the biology. Consequently, there is little threat to the stock, but there may be significant threat to the fishery and the current reference points do not allow managers to include this information when considering management options.

TOR 4: Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 3).

COMPLETED: see also comments in SARC summary report

The stock was evaluated against the existing and updated BRPs as requested. The evaluation is subject to the discussions and caveats described under TOR3 as well as the uncertainty of the assessment results discussed under TOR2. In general I feel comfortable with the idea that the stock is not overfished and that overfishing is not occurring. However, we know very little about the biology of this stock, particularly its response to exploitation in terms of productivity, since the current assessment methodology bases its variance assumptions on the sampling data, but does not consider well the variability in parameter estimates, see also TOR 5.

The consideration of the Grand Banks stock is important in assessing the sustainability of the operations. It seems we are moving to a time when this is the only remaining area for an economically viable fishery. This is not to say that the other areas are destroyed, but it leaves few options to the fishery if recruitment has not replenished the other stocks by then. The current assessment indicates that this should occur, and we would not expect to have seen it yet (because of the very slow population dynamics), but are we not over-confident in a model based on very little data.

TOR 5: Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

- **a. Provide numerical short-term projections (3-4 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment (alternate states of nature).**
- **b. If possible, comment on the relative probability of the alternate states of nature and on which projections seem most realistic.**
- **c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.**

COMPLETED: The TOR was addressed as well as was possible, given the available information. See also comments in SARC summary report

The projections carried out by the KLAMZ model were the most appropriate form and correctly applied. The predictions are only as good as the model on which they are based though and the concern with the KLAMZ model was that it was unable to deal with the recruitment dynamics of the stock on the short terms scale so that projections over 3-4 years are unlikely to be of much use.

Interestingly, surplus production in the stock is likely to decrease continually over the next decade, even in the absence of fishing. This is merely the response of an aging population (M outstripping growth) in conjunction with very slow and constant recruitment. Different states of nature in the form of different levels of M were also presented, but not discussed. They gave some indication of the sensitivity of the assessment to the assumption, but they did not represent any more meaningful reflections of reality as a model with a decreasing rate of M with age might have had. In the absence of suitable criteria to chose more likely candidate models the current is likely as good as any, particularly since the F estimates are very low in this stock.

TOR 6: Review, evaluate and report on the status of SARC/Working Group research recommendations listed in recent SARC reviewed assessments. Identify new research recommendations.

MOSTLY COMPLETED: see also comments in SARC summary report

Overall, 10 out of the 17 suggested research recommendations emanating from SARC 44 had been addressed in full, and one was rejected as being no longer relevant. The work carried out by the SC was substantial and, given the funding and time restraints the number of points addressed, seem more than adequate for me to accept the TOR as completed.

From my perspective the most important thing to consider is how it may be possible to monitor changes in productivity in the stock in time for management to alter strategy if the expected increases in productivity do not materialise in time to sustain the fishery at current levels. Some suitable approaches were suggested in the research recommendations, but some of these will take time. If GBK is not reopened soon, then the fishery will likely become economically unviable in the not too distant future. If it is reopened, then potentially they will be fishing down the remaining stock to economic extinction, with an expectation to find out if the stock responds positively no earlier than in 50 years, which judging by the rate at which areas have become economically unviable in the past is still too late.

7. Assessment of weakfish

Summary

I agree with the TC that this stock is overfished and that overfishing is occurring, despite the fact that current F levels are relatively low. The state of the stock is unexpectedly low, because of what appears to be a substantial change in the rate of natural mortality. This has reduced productivity to somewhere near zero surplus production.

Assessments assuming constant mortality do not provide quantitatively useful measures of stock status, nor do some of the production based models that are not tied to the assumption of constant M. Despite this, qualitatively all models agree that the stock is in a very poor state and that even in the absence of fishing any recovery of the stock will be slight whilst these higher levels of M remain.

There is a substantial history to the assessment of this stock. Previously used assessment methodologies have been troubled by significant deficiencies, which have not allowed effective management based on their results. I feel the attempts made by the TC to address these uncertainties are scientifically of great interest and merit. One problem is that they are not particularly helpful to managers, not because of the science, but because of the current management structure. The biological reference points are particularly unhelpful in this instance. For example the assessment indicates that overfishing is occurring. This is technically true as it seems any fishing is more than the stock can take at this time. However, F levels are relatively low for a prolific species such as weakfish, and it is apparent that fishing is not the primary cause of the decline. "Blaming" fishermen, which is essentially what the chosen terminology does, is not helpful, which is not to say that fishing is not making the situation worse. Biomass reference points are similarly misleading. There is the assumption that as the stock declines to low levels recruitment will be impaired. Biomass reference points are supposed to avoid this situation. In the current stock SSB is roughly $1/10^{th}$ of the unfished stock size, yet recruitment seems not to be significantly impaired. This came out at the meeting of the SARC, but it is not clear how managers are going to deal with this situation and consequently it is difficult to formulate sensible advice.

The extent to which the assessment programme has addressed each of the Terms of Reference for the SAW is evaluated below.

TOR1: Evaluate biases, precision, uncertainty, and sampling methodology of the commercial and recreational catch (including landings and discards) and effort.

COMPLETED: see also comments in SARC summary report

In general, the data collection schemes are adequate for estimating the quantity and size/age composition of all significant removals due to commercial and recreational fishing; however, their biases and precision are impossible to estimate. From my understanding of the data sources there are considerable differences in the magnitudes of the uncertainties of the data sources. For example, the commercial catch is likely to be the most precise of the catch estimates (assuming

adequate age sampling), whilst the estimates of recreational catch from the MRFSS data often have variance estimates larger than the mean estimate. Least satisfactory is likely to be the estimate of numbers at age associated with commercial discarding.

The "ratio method over the whole time period" as used here to determine commercial discard numbers is flawed. It assumes discard ratios (weakfish discarded for target species landed) are the same across all years ignoring any relative changes in abundance in the target species, or any changes in their regulation (TAC's particularly), as well as ignoring changes in abundance in weakfish. The consequence is a recruiting yearclass signal that is smeared across all recruiting cohorts, making it difficult for the ADAPT-VPA to track cohorts through the younger ages. The degree to which this effects the estimates of catches is impossible to predict or estimate, and unfortunately for the assessment methodology presented here, this is the only way to proceed given the lack of suitable historic data.

No commercial discarding information is available for the early part of the time series; moreover, this coincides with a period where no minimum landing size existed so that regulatory discarding was absent. The TC rescaled historic discards calculated on the basis of current discarding practices to the ration of non regulatory over total discarding. The assumption was that although historically there was no legal requirement to return fish a significant number of fish would have been returned anyway. The danger is that this represents an underestimate of true discarding (bias), as some of the fish discarded on the basis of regulation now, may well have been rejected on a non regulatory basis in the past.

There is some uncertainty regarding the level of release mortality from recreational catches. The TC chose the mean of the estimates from a number of different studies (0.15), which given values used for similar species seems not unreasonable. However, the uncertainty of this estimate is not reflected in the catch matrix, which is treated as exact, at least in the converged part of the VPA.

TOR2: Evaluate precision, geographical coverage, representation of stock structure, and relative accuracy of the fisheries independent and dependent indices of abundance. Review preliminary work on standardization of abundance indices.

COMPLETED: see also comments in SARC summary report

All evidence points to the fact that there is some significant structure at the level below that of the stock, however the fishery and the fish operate at levels wider than the population structure so that it is not possible to draw representative assessment substructures at this point. I would argue that the difficulties in the current assessment cannot be explained by plausible subpopulation effects, and therefore further consideration of the stock structure problem should be at least deferred until the current issue of time variant M has been better addressed.

Substantial work was carried out on examining the various indices. From the presentation it is clear that a number of indices are plagued by bias, i.e. they are not representative of the stock structure as a whole. These issues may be solved by a spatially disaggregated model (see above), which would likely improve precision, but as these have been omitted from the assessment, they have no impact on the current assessment. Another subset of indices appears to have variance

issues, which the TC attributed to spatio-temporal variability in sampling; sampling fish during the migratory phase, the onset of which appears to vary in time.

The choice of indices for the ADAPT-VPA assessment are in my opinion sound choices, but they are partly based on the criterion that their trends agree, which at least will overestimate the precision of the assessment and possibly introduce significant bias. In this case the ADAPT-VPA assessment is not used so it is not an issue, but one might get very different management decisions if the different indices were used in the interim assessment method.

Although not discussed in depth at the meeting, information was provided on a number of modeling approaches to improve and combine survey indices. GLM's and GAM's were seen as the way forward, and in many cases this is a useful approach, if sampling between years and areas is inconsistent. On the other hand the utility of such models is very difficult to ascertain without the use of independent data as the objective function is highly dependent on the choice of an unknown error structure. In addition, the use of spatial variables (longitude in particular) is problematic. The models are essentially regression models, as such they deal with causal variables, but spatial variables are unlikely to be causal. The causes are more likely to be associated with environmental variables such as depth, day length, temperature, etc. which are locally at least correlated to spatial variables. Therefore any shifts in these variables between years will invalidate a model based on spatial variables.

The use of latitude and longitude has further problems particularly in the use of GAMs. Take a situation where a coral reef runs SW to NE. A species associated with this coral reef will then be found in highest abundance on the top of the reef, with a decline to either side (unimodal distribution). Analyzing this data with a GAM model of the form

Abundance ~ s(Latitude,3) + s(Longitude,3)

The predicted distribution will be one of basically a square plateau dropping off towards the edges, with no other contrasting features. The overall abundance is not affected by this, but then neither would it by a straight mean. However, if one were to take a "predictive sample" at a spatial location, which is essentially what one is doing when "correcting" or standardizing CPUE to a common set of conditions then this will produce significant bias, because there is a significant interaction between latitude and longitude. This is often not statistically supported by the data due to small sample sizes and is therefore ignored.

One option to circumvent this is rather than assume a full interactive term to use surface splines of the form:

Abundance ~s(Latitude*Longitude,5)

The methodology then becomes akin to nearest neighbor statistics, but differs from the full kriging methodologies. Both methods acknowledge that there is a change in the variance across distance by down weighting the influence of points further away, but only kriging also takes account of the rate of change in variance (second derivative) on the near scale to interpolate possible rates of change at further distances and vice versa. Neither method is entirely

satisfactory, since they are highly dependent on the choice of scale of sampling in relation to the variation of the distribution of a species and invariably susceptible to large biases in some areas. In addition, neither model can account for changes in the spatial distribution between years (because they cannot determine the underlying causes of such shifts - see above)

This should not deter the use of GAM models, but their interpretation should be carefully considered in relation to the frequent contradictions between assumptions and reality.

TOR3: Evaluate the ADAPT VPA catch at age modeling methods and the estimates of F, Z, spawning stock biomass, and total abundance of weakfish produced, along with the uncertainty and potential bias of those estimates. Review the severity of retrospective pattern.

Clearly there are significant differences in the precision of the various data sources (TOR1 and 2), yet the assessment methodologies as implemented by the TC cannot deal with these differences. This is true of the ADAPT VPA approach as well as the dynamic pool models. A much better approach is a likelihood based approach. Even if not used as the final assessment methodology, developing such an approach in ADModel builder allows for a much better evaluation of the sources of conflict in the data and consequently a better understanding of why certain models react in a specific way. For example why the ADAPT VPA still retained a retrospective pattern even after adjusting M through time? The index model approach accepted as the "best of a suspect bunch" of models to give advice does not deal explicitly with the uncertainty in the data, but is of course subject to the same constraints. In other words one could develop a method where several CPUE series were combined to determine Z. SURBA (Survey only bases assessments implemented by FRS Scotland) have developed such a statistical approach to determining Z, which would at least deal with the uncertainty in the survey information (It would still take catch data as exact when trying to turn this into F's).

TOR4: Evaluate the index-based methods and the estimates of F, ages 1+ stock biomass, surplus production, and time-varying natural mortality of weakfish produced, along with the uncertainty of those estimates. Determine whether these techniques could complement or substitute for age-based modeling for management advice.

COMPLETED: see also comments in SARC summary report

The TC provided a substantial amount of evidence to suggest that a change in M was likely to have occurred. Unfortunately, it seems it is not possible to exclude other causes including fishing for the biomass trajectories in this stock. This seems to have lead to continued criticism of the TC over time. I would argue that the TC has not provided evidence of time variant M beyond all doubt, nor that they have been helped by their historic focus on striped bass as the cause of this time variant mortality. Nevertheless, given the more comprehensive analysis provided this year it seems likely that there has been an increase in the mortality not accounted for in the landed catch, nor does it seem possible that discarding is on a scale that could account for this.

The group presented a number of different models based on varying hypotheses, including some environmental information, choosing a biomass dynamic model with a TYPE III Steel Henderson interaction as the best fit (via AIC). However, I found it difficult to believe that the

decrease in availability of Menhaden (ca 50% of recent average biomass) could result in a 90% decrease in the abundance of weakfish by predation. The disparity could not be explained on the basis of a change in encounter rate, but would have to represent a behavioral change in prey preference for a less abundant species. This does not make a lot of sense, so I would be inclined to reject this hypothesis on the basis of lack of reasonable process grounds. Other analyses suggested similar trends in M but for different causes, indicating that it is likely to be a more general ecosystem shift to a new equilibrium where bass are more abundant and weakfish less so (with predation possibly being one of the factors that is maintaining this new balance).

It is the number of analyses that show the same trend, rather than any analysis in particular that indicates to me that mortality has changed. In fact, in the short term it makes very little difference as to what the exact cause is from a management perspective, as the stock is unlikely to recover soon to any size even in the absence of fishing. Suggesting that bass are the cause of this is not particularly helpful as it seems there is little that can be done about the abundance of bass whilst the bass lobby persists. At the same time there is a significant risk in the sense that if bass were to be culled, and the expected increase in weakfish were not to materialize (e.g. Grand Banks Cod), it would merely serve to discredit the science.

Therefore I agree with the TC, that M has changed, and that it has likely changed in a trajectory consistent with that shown by the biomass dynamic model with a TYPE III Steel Henderson, but generally disagree with the underlying theory of cause.

A new hybrid methodology was produced, that to me represented the best way forward for this assessment. Historically it was based on the converged part of the VPA to estimate catchability coefficients for survey trends, which then allowed stock numbers to be estimated in the present. Using the trajectory in M from the biomass dynamic model exploitation rates were calculated. Unfortunately, this was done on the scale of the population as a whole, not by age (as in the previously employed ADAPT-VPA). Recent stock and catch numbers were dominated by recruits (these seem not to have been impacted by the change in M, nor the reduced SSB) so that F estimates largely reflected F at age 1.

This method of assessing stock trends, whilst the best currently possible, is fraught with a number of significant short comings. Not only does it treat the estimates of catch as exact, but also the recent survey estimates, which clearly they aren't. In addition, it is heavily reliant on unbiased estimates in the historic catch data. The TC felt that because this represented the converged part of the VPA there was little doubt about the historic development of the stock. I would disagree, particularly because the methodology for estimating discarding is likely to have introduced significant bias (rather than just variance), see TOR1. Lastly, in the absence of variance estimates projections from the model are entirely deterministic, so don't reflect the sizeable uncertainty, nor do they provide very useful estimates of possible ABC's, because F is not age-specific.

TOR5: Evaluate testing of fishing and additional trophic and environmental covariates and modeling of hypotheses using biomass dynamic models featuring multiple indices blended into a single index with and without a Steele-Henderson (Type III) predator-prey extension. Evaluate biomass dynamic model estimates of F, ages 1+ stock biomass, surplus

production, time-varying natural mortality, and biological reference points along with uncertainty of those estimates. Advise on burden of proof necessary for acceptance of alternatives to constant M and whether these biomass dynamic techniques could complement or substitute for age-based modeling for management advice.

COMPLETED: Although the analysis was conducted in isolation, the topics and conclusions and the TOR's themselves largely overlapped with TOR 4-7 so that the panel felt it necessary to treat these as a single TOR to avoid substantial repetition. The panel conclusions are given under TOR 4. See also comments in SARC summary report.

TOR6: Evaluate AIC-based hypothesis testing of fishing and additional predation-competition effects using multi-index biomass dynamic models with and without prey-based, predator-based, or ratio dependent predator-prey extensions. Evaluate biomass dynamic model estimates of F, ages 1+ stock biomass, surplus production, time-varying natural mortality, and biological reference points along with uncertainty of those estimates. Advise on burden of proof necessary for acceptance of alternatives to constant M and whether these biomass dynamic techniques could complement or substitute for age-based modeling for management advice.

COMPLETED: Although the analysis was conducted in isolation, the topics and conclusions and the TOR's themselves largely overlapped with TOR 4-7 so that the panel felt it necessary to treat these as a single TOR to avoid substantial repetition. The panel conclusions are given under TOR 4. See also comments in SARC summary report.

TOR7: Review evidence for constant or recent systematic changes in natural mortality, productivity, and/or unreported removals.

COMPLETED: Although the analysis was conducted in isolation, the topics and conclusions and the TOR's themselves largely overlapped with TOR 4-7 so that the panel felt it necessary to treat these as a single TOR to avoid substantial repetition. The panel conclusions are given under TOR 4. See also comments in SARC summary report.

TOR8: Estimate biological reference points using equilibrium and non-equilibrium assumptions and evaluate stock status relative to these BRPs.

COMPLETED: see also comments in SARC summary report

On the practical side of things this was carried out and implemented. However, in reality biological reference points were not very relevant for the any of the stocks assessed at SARC 48 mainly because the assumptions underlying biological reference points were not applicable to the stocks examined. For weakfish in particular they presented a significant problem, in addition to the complications in estimating stock status with the necessary precision to compare the two.

TOR9: Review stock projections and impacts on the stock under different assumptions of fishing and natural mortality.

COMPLETED: see also comments in SARC summary report

The TC also provided stock projections on the basis of several of the models that were presented. Unfortunately, there were so many of these and the projections were rarely consistent in their starting points or model assumptions between them that it was very difficult to provide any quantitative conclusions, nor did any of the assessments themselves hold up to the scrutiny at the level of precision to provide quantitative advice. However, qualitatively all models indicated that the stock was seriously depleted and that any additional pressure (such as fishing) put on the stock would likely decrease stock size further or at the very least delay any marginal recovery significantly.

TOR10: Make research recommendations for improving data collection and assessment. The TC listed previous research recommendations …..

COMPLETED: see also comments in SARC summary report.

The TC committee made good progress on most of the previous research recommendations. Much of this work concentrated on demonstration of time variant mortality, and a wide variety of suggestions why this might be occurring. One important consideration now needs to be the exact estimation of M through time and preferably some indication of where M is going in the future or whether it has stabilized at a new equilibrium level. Tagging experiments, such as those started recently, could aid in providing better estimates of total and fishing mortality.

As indicated under TOR4 the index method accepted as the basis for advice has some significant short comings so the development of a more statistical approach to the estimation of stock status suitable for stocks with time-variant M is of high priority. My personal approach would be to try to develop a model from scratch, starting with a very simple model and including additional complexities as time and data are available. In this way it is possible to examine the consequences of specific assumptions in the model and vagrancies of specific data sets. At the moment the different models start with a number of different assumptions and fundamentally use different datasets so it is never clear which of these differences are responsible for the different model outputs. Such a tailor-made model could then also include information on tagging data which might help to estimate trends in M within the model, rather than having to assume constant M or determine it externally to the model.

Understanding more about the surveys, their basis, their design and any possible changes in catchability both with regards to gear and species distribution would go a long way to develop better more reliable indices. GAM models based on independent variables that drive species distribution (see TOR2) would provide an efficient and useful way to combine indices as well as allow for the estimation of variance components. In the absence of true causal variables, spatial modeling can give some insight as to how one might go about developing better indices, but use of such spatial indices need to be considered with great care (TOR2).

Appendix 1: Review Committee members

Patrick Sullivan, chair
Mike Bell
Jamie Gibson
Sven Kupschus

Appendix 2: Terms of reference (from Annex 2, Statement of Work)

No changes to these were made prior to or during the SARC 48 review meeting.

ANNEX 2:

Assessment Terms of Reference for SAW/SARC-48, June 1-4, 2009

(file: 4/27/09)

A. Tilefish

1. Characterize the commercial catch including landings, effort and discards. Characterize recreational landings. Evaluate utility of study fleet results as improved measures of CPUE.

2. Estimate fishing mortality and total stock biomass for the current year, and for previous years if possible, and characterize the uncertainty of those estimates. Incorporate results of new age and growth studies.

3. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and F_{MSY}). Comment on the scientific adequacy of existing and redefined BRPs.

4. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 3).

5. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    a. Provide numerical short-term projections (2-3 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment (alternate states of nature).
    b. If possible, comment on the relative probability of the alternate states of nature and on which projections seem most realistic.

c. For a range of candidate ABCs, compute the probabilities of rebuilding the stock by November 1, 2011.
d. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

6. Review, evaluate and report on the status of the research recommendations offered in recent SARC reviewed assessments. Identify new research recommendations, including recruitment estimation.

B. Ocean quahog

1. Characterize commercial catch including landings, effort, and discards.

2. Estimate fishing mortality, spawning stock biomass, and stock biomass for the current and previous years. Characterize uncertainty of the estimates.

3. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and F_{MSY}). Comment on the scientific adequacy of existing and redefined BRPs.

4. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 3).

5. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    a. Provide numerical short-term projections (3-4 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment (alternate states of nature).
    b. If possible, comment on the relative probability of the alternate states of nature and on which projections seem most realistic.
    c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

6. Review, evaluate and report on the status of SARC/Working Group research recommendations listed in recent SARC reviewed assessments. Identify new research recommendations.

C. Weakfish (Final weakfish TORs approved by Weakfish Management Board 4-24-09)

1. Evaluate biases, precision, uncertainty, and sampling methodology of the commercial and recreational catch (including landings and discards) and effort.

2. Evaluate precision, geographical coverage, representation of stock structure, and relative accuracy of the fisheries independent and dependent indices of abundance. Review preliminary work on standardization of abundance indices.

3. Evaluate the ADAPT VPA catch at age modeling methods and the estimates of F, Z, spawning stock biomass, and total abundance of weakfish produced, along with the uncertainty and potential bias of those estimates. Review the severity of retrospective pattern.

4. Evaluate the index-based methods and the estimates of F, ages 1+ stock biomass, surplus production, and time-varying natural mortality of weakfish produced, along with the uncertainty of those estimates. Determine whether these techniques could complement or substitute for age-based modeling for management advice.

5. Evaluate testing of fishing and additional trophic and environmental covariates and modeling of hypotheses using biomass dynamic models featuring multiple indices blended into a single index with and without a Steele-Henderson (Type III) predator-prey extension. Evaluate biomass dynamic model estimates of F, ages 1+ stock biomass, surplus production, time-varying natural mortality, and biological reference points along with uncertainty of those estimates. Advise on burden of proof necessary for acceptance of alternatives to constant M and whether these biomass dynamic techniques could complement or substitute for age-based modeling for management advice.

6. Evaluate AIC-based hypothesis testing of fishing and additional predation-competition effects using multi-index biomass dynamic models with and without prey-based, predator-based, or ratio dependent predator-prey extensions. Evaluate biomass dynamic model estimates of F, ages 1+ stock biomass, surplus production, time-varying natural mortality, and biological reference points along with uncertainty of those estimates. Advise on burden of proof necessary for acceptance of alternatives to constant M and whether these biomass dynamic techniques could complement or substitute for age-based modeling for management advice.

7. Review evidence for constant or recent systematic changes in natural mortality, productivity, and/or unreported removals.

8. Estimate biological reference points using equilibrium and non-equilibrium assumptions and evaluate stock status relative to these BRPs.

9. Review stock projections and impacts on the stock under different assumptions of fishing and natural mortality.

10. Make research recommendations for improving data collection and assessment.

Appendix 3: 48th Northeast Regional Stock Assessment Workshop (SAW 48) Stock Assessment Review Committee (SARC) Meeting

June 1-4, 2009

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

AGENDA* (version: 5-27-09)

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR
Monday, 1 June			
10:00 – 10:30 AM			
Opening			
Welcome	**James Weinberg**, SAW Chairman		
Introduction	**Patrick Sullivan**, SARC Chairman		
Agenda			
Conduct of Meeting			
10:30 - Noon	Tilefish Assessment Presentation (A)		
	Paul Nitschke/ Mike Palmer/ Tiffany Vidal	**Jamie Gibson**	**Palmer/Vidal**
Noon – 1:00 PM	Lunch		
1:00 – 2:30 PM	SARC Discussion of Tilefish (A)		
	Patrick Sullivan, SARC Chairman		
2:30 – 3:00 PM	Break		
3:00 - 5:00 PM	Ocean quahog Assessment Presentation (B)		
	Larry Jacobson/ Toni Chute	**Mike Bell**	**Ralph Mayo**
5:00 – 6:00 PM	SARC Discussion of Ocean quahog (B)		
	Patrick Sullivan, SARC Chairman		

Tuesday, 2 June

9:00 – 10:15 AM	Revisit Tilefish Assessment with Presenters (A)
10:15 – 10:30 AM	Break
10:30 - Noon	Revisit Ocean Quahog Assessment with Presenters (B)
Noon – 1:00 PM	Lunch
1:00 – 3:45 PM	Weakfish Assessment Presentation (C) **Jeff Brust/ Vic Crecco/ Jim Uphoff** **Sven Kupschus** **Russ Allen**
3:45 – 4:00 PM	Break
4:00 – 5:30 PM	SARC Discussion of Weakfish (C) **Patrick Sullivan**, SARC Chairman

Wednesday, 3 June

9:00 – 10:15 AM	Revisit Weakfish Assessment with Presenters (C)
10:15 – 10:30 AM	Break
10:30 - Noon	Tilefish follow up + review Assessment Summary Report (A)
Noon – 1:00 PM	Lunch
1:00 – 3:00 PM	Ocean qua. follow up + review Assessment Summary Report (B)
3:00 – 3:15 PM	Break
3:15 – 5:15 PM	Weakfish follow up + review Assessment Summary Report (C)

Thursday, 4 June

9:00 – 10:15 AM	Final Revisits with presenters, if needed (A, B, C)
10:15 – 10:30 AM	Break
10:30 AM – 5 PM	SARC Report writing. (closed meeting)

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

Appendix 5: Bibliography

Working Papers Prepared in Support of SARC 48 Terms of Reference

Stock	Working Paper	Title	Author(s)	Number of Pages	Number of Copies	Copies Completed
Tilefish	A-1	Assessment of Golden tilefish	Southern Demersal Working Group	**121**	25	
Tilefish	A-1, Appendix 1	An overview of the tilefish data collected through the NEFSC Study Fleet Project	Palmer, Ball, Anderson, Conboy, Moser	**37**	18	
Tilefish	A-1, Appendix 2	Evaluating shifts in size and age at maturity of Golden tilefish from the Mid-Atlantic Bight	Vidal	**23**	18	
Tilefish	A-1, Appendix 3	Model Output	Nitschke	**11**	15	
Tilefish	A-2	Golden tilefish Assessment Summary Report	Nitschke	**14**	35	
Tilefish Background Papers						
	A-3	Assessment of Golden tilefish (2005)	Southern Demersal Working Group	**101**	7	
	A-4	Golden tilefish Assessment Summary Report for 2005		**8**	25	
	A-5	SARC 41 Chair's Report to the CIE (2005)	Jones	**29**	18	
Ocean quahog	B-1	Stock Assessment for Ocean quahogs	Invertebrate Subcommittee	**175**	25	
Ocean quahog	B-1a	Ocean quahog Appendix Report	Invertebrate Subcommittee	**100**	20	
	Appendix 1	Invertebrate Working Group				
	Appendix 2	Ocean quahog resources in Maine waters				
	Appendix 3	Clam dredge performanc				
	Appendix 4	2008 Cooperative Industry Surfclam/Ocean quahog survey				
	Appendix 5	Maps of clam survey catches 1980-2008				
	Appendix 6	KLAMZ assessment model details				
	Appendix 7	West Coast Harvest Policy				
	Appendix 8	Updated shell length/meat weight				
Ocean quahog	B-2	Assessment Summary Report for Ocean quahogs			35	

Ocean quahog Background Papers						
	B-3	SARC 44 Assessment Report (2005)	Invertebrate Subcommittee	**271**	5	
	B-4	2006 Ocean quahog Assessment Summary Report		**13**	20	
	B-5	SARC 44 Summary Report for CIE (2006)	Jones	**64**	15	
	B-6	F35% Revisited 10 Years Later	Clark	**7**	18	
Weakfish	C-1	Weakfish Stock Assessment Report	ASMFC Weakfish Technical Committee	**281**	25	
Weakfish Appendixes Report	C1a (App C1-C5) C-1	Weakfish Tech. Committees response to Data Poor Meeting comments	ASMFC Weakfish Technical Committee	**143**	15	
	Appendix C-2	Proportional Stock Density Indices for Weakfish				
	Appendix C-3	SAS-based application of the Harvest Control Model to conduct Weakfish stock projections				
	Appendix C-4	Index Standardization				
	Appendis C-5	Preferred Run ADAPT Output				
Weakfish Appendixes Report	C-2	Weakfish Assessment Summary Report		**10**	35	
Weakfish Background Papers	C-3	2004 Assessment		**419**	4	
		2006 Assessment				
		Estimating Discards				
		Population Structure				
	C-4	Report by the Peer Review Panel for the Northeast Data Poor Stocks Working Group	Miller	**9**	20	

Appendix 5: Statement of Work

Statement of Work

(Subtask T007-05, v 22 December 2008)

External Independent Peer Review by the Center for Independent Experts

SARC 48: Tilefish, Ocean quahog, Weakfish Benchmark Stock Assessments

Meeting Date: June 1-4, 2009

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 to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: The Northeast Regional Stock Assessment Review Committee (SARC) meeting is a formal, multiple-day meeting of stock assessment experts who serve as a panel to peer-review tabled stock assessments and models. The SARC is the cornerstone of the Northeast Stock Assessment Workshop (SAW) process, which includes assessment development (SAW Working Groups or ASMFC technical committees), assessment peer review, public presentations, and document publication.

The SARC48 review panel will be composed of three appointed reviewers from the Center of Independent Experts (CIE), and an independent chair from the Science and Statistics Committee (SSC) of the New England or Mid-Atlantic Fishery Management Council. The panel will convene at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts during June 1-4, 2009 to review three assessments (tilefish (*Lopholatilus chamaeleonticeps*), ocean quahog (*Arctica islandica*), and weakfish (*Cynoscion regalis*)). In the days following the review of the assessment, the panel will write the SARC Summary Report and each CIE reviewer will write an individual independent review report. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel

review meeting is attached in **Annex 3**. The summary report format is attached as **Annex 4.**

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. CIE reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models and Biological Reference Points. Expertise should include statistical catch-at-age and catch-at-length models, traditional VPA approaches, delay-difference models, and the implications of spatial harvesting patterns. Experience with comparative studies of these approaches is especially valuable. Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting. Experience with the biology and population dynamics of species on the agenda would be useful.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Woods Hole, Massachusetts during June 1-4, 2009.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

The CIE's deliverables shall be provided according to the schedule of milestones listed below**.** The CIE reviewers, along with input and leadership from the SARC Chairman, will write the SARC Summary Report. In addition, each CIE reviewer will write an individual independent review report. These reports will provide peer-review information for a presentation to be made by NOAA Fisheries at meetings of the New England and Mid-Atlantic Fishery Management Councils. The SARC Summary Report shall be an accurate representation of the SARC panel viewpoint on how well each SAW Term of Reference was completed (please refer to Annex 2 for the SAW Terms of Reference).

The three CIE reviewers shall conduct an impartial and independent peer review in accordance with the Terms of Reference (ToR) herein. The three SARC CIE reviewers' duties shall occupy a maximum of 14 days per person (i.e., several days prior to the meeting for document review; the SARC meeting in Woods Hole; and several days following the open meeting to contribute to the SARC Summary Report and to produce the Independent CIE Reports).

Not covered by the CIE, the SARC chair's duties should occupy a maximum of 14 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).

Charge to SARC panel

The panel is to determine and write down whether each Term of Reference of the SAW (see Annex 1) was or was not completed successfully during the SARC meeting. 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 chair shall identify or facilitate agreement among the reviewers for each Term of Reference of the SAW.

If the panel rejects any of the current Biological Reference Point (BRP) proxies for B_{MSY} and F_{MSY}, the panel should explain why those particular 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 are the best available at this time.

Roles and responsibilities

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

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, and contact details) 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 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 information concerning other 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 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, 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/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will attempt to provide the CIE reviewers all necessary background information and reports for the peer review. This will be done by electronic mail or an

FTP site. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. 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 ToRs. **Modifications to the SoW and ToRs can 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 ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). 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 Terms of Reference of the SAW are reviewed, control of document flow, and facilitation of discussion. For the assessment, review both the Assessment Report and the 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 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 proxy to be inappropriate, the reviewer should try to recommend an alternative, should one exist.

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 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 Point (BRP) 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 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 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.

(SARC chair and CIE reviewers)
The SARC Chair and CIE reviewers will prepare the SARC Summary Report. Each CIE reviewer and the chair will discuss whether they hold similar views on each 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 or a consensual 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 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 3 for information on contents) should address whether each 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 Point (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 ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report. CIE reviewers are not required to reach a consensus, and should provide a brief summary of their views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

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 Woods Hole, MA from June 1-4, 2009, as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than June 19, 2009, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to David Sampson david.sampson@oregonstate.edu Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each 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.

27 April 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
18 May 2009	NMFS Project Contact will attempt to provide CIE Reviewers the pre-review documents by this date
1-4 June 2009	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
4 June 2009	SARC Chair and CIE reviewers work at drafting reports during meeting at Woods Hole, MA, USA
19 June 2009	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
22 June 2009	Draft of SARC Summary Report, reviewed by all CIE reviewers, due to the SARC Chair *
29 June 2009	SARC Chair sends Final SARC Summary Report, approved by CIE reviewers, to NEFSC contact (i.e., SAW Chairman)
2 July 2009	CIE submits CIE independent peer review reports to the COTR
9 July 2009	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 made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE 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 Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot 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. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the 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 have the format and content in accordance with Annex 1, (2) each CIE report shall address each ToR as specified 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 notification of 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 approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

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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 providing a concise summary of whether they accept or reject the work that they reviewed, and to 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 they read the 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 as separate appendices as follows:

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.

Appendix to the TORs:

Clarification of Terms
used in the SAW/8SARC Terms of Reference

(The text below is from DOC National Standard Guidelines, Federal Register, vol. 74, no. 11, January 16, 2009)

On "Acceptable Biological Catch":

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)

On "Vulnerability":

"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)

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 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 Point (BRP) proxies are considered inappropriate, include recommendations and justification for alternative proxies. If such alternatives cannot be identified, then indicate that the existing BRPs 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 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.