External Independent Peer Review

Center for Independent Experts

50th Northeast Regional Stock Assessment Workshop (SAW 50)
Stock Assessment Review Committee (SARC) Meeting

Monkfish, Sea Scallop and Pollock

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Executive Summary

- This report is a peer review of assessments for monkfish, sea scallop and pollock presented at the 50th SARC meeting.
- In an update of the 2007 assessment, SCALE, a length-tuned model was applied to data for monkfish. Uncertainties about catch quantities and size composition, uninformative survey data and poorly understood biological parameters combine to make the SCALE assessment highly uncertain, although it was accepted as the current best scientific basis for development of management decisions. The biggest uncertainties concern the linear growth model that underpins the assessment, and the associated perspective on natural mortality. It is highly likely that the ages of larger individuals in the catches and surveys are underestimated and that natural mortality is overestimated. This is a high priority for future research.
- Satisfactory approaches were taken to developing BRPs, stock status determination and stock projections for monkfish, but the outcomes are contingent on the quality of the SCALE assessment on which they are based. According to the current status determination the monkfish stock is not overfished and overfishing is not occurring.
- A catch at size model (CASA) was applied to data for sea scallop. The assessment was well supported by the data. It is a particular strength that swept-area biomass estimates were able to provide information on both trend and scale in the scallop stock. Retrospective patterns in the Mid Atlantic Bight (MAB) assessment appear to result at least partly from a failure of the model to account for the mortality experienced by a recent high recruitment event evident in the surveys. Current productivity in MAB is at unprecedently high levels. This may be due to a stock recruitment relationship, but it will be important to understand the basis for this given the possibility that the situation could revert to the previous lower productivity regime if it is based on temporary environmental factors.
- Innovative approaches were taken to characterizing uncertainty around BRPs, facilitating the incorporation of risk assessment into ABC decisions. Current status is determined to be not overfished. Overfishing is not occurring, but current fishing mortality is close to F_{MSY}. This is not surprising given that current harvest levels are close to MSY, i.e. the stock is being harvested at full productivity levels.
- There are many and complex management options for scallops given the possibilities for spatial management. A spatially-structured projection model (SAMS) was presented that can be used as part of comprehensive management planning.
- A statistical catch at age model (ASAP) was applied to pollock. This is a great improvement on the previous index-based assessment approach (AIM), particularly given that there is now a mismatch in size selection between the fall survey index and the commercial catch which has selected larger sizes of pollock in recent years. In general the assessment is reasonably well supported by the data. The main contentious issue is the estimation of domed selectivity curves for both surveys and the commercial fishery, implying the existence of a large cryptic biomass of pollock unobserved by the fishery or surveys. Validation of the existence of this biomass will be a high priority for the future. Stock structure is another assessment issue. In the absence of unequivocal evidence for any of several different hypotheses concerning pollock in US and Canadian waters, the pragmatic decision was taken to assess the US pollock fishery.

- Satisfactory approaches were taken to developing BRPs, stock status determination and stock projections for pollock. The stock is assessed to be not overfished with overfishing not occurring. This conclusion is not sensitive to the validity of domed selection patterns in the surveys, but assessment outcomes are re-scaled if survey selectivity is constrained to be flat-topped. This includes a lower value of MSY, relevant to management decisions about catch levels. This model uncertainty is not included in risk assessments performed as part of stock projections under possible management scenarios.

Background

The Northeast Regional Stock Assessment Review Committee (SARC) meeting is a formal meeting of stock assessment experts serving as a panel to peer-review tabled stock assessments and models. This report is an independent peer review of benchmark stock assessments for monkfish, sea scallop and pollock presented at the SARC 50 meeting. The SARC panel consisted of a chairman, three reviewers appointed by the Center for Independent Experts (CIE) and one additional reviewer. This report constitutes my own personal review of the assessments. It is designed to be read as a stand-alone document, but there are strong overlaps with the Summary Report of the SARC panel, to which I contributed. The report also contains the Statement of Work for the review (Appendix II), which includes Terms of Reference (TOR) for each assessment and a meeting agenda.

Description of Review Activities

Stock assessment reports and background working papers for SARC 50 (see Appendix I) were made available to the SARC Review Panel on the NEFSC website at least two weeks before the meeting. This allowed sufficient time for reviewers to become familiar with the overall context of the SARC process and with the material to be covered at the meeting. Terms of Reference and a draft agenda were also available before the meeting.

The SARC 50 meeting was held at the Northeast Fisheries Science Center (NEFSC) at Woods Hole, Massachusetts, starting at 8:45 am on Tuesday 1 June and finishing at 3:00 pm on Saturday 5 June 2009. Stock assessment presentations for monkfish and sea scallop were made by the lead assessment scientists on Tuesday 1 June. Questions of clarification from the SARC panel were taken during the presentations, and each presentation was followed by a discussion period with members of the assessment team responding to questions from the review panel. The morning of Wednesday 2 June was taken up with stock assessment presentations and discussion on pollock, with further discussion and presentation of responses to panel requests on monkfish and sea scallop in the afternoon. Further discussions and presentation of responses to panel requests on pollock were completed on the morning of Thursday 3 June. The remainder of Thursday was taken up with review and editing of the Assessment Summary Reports for pollock and monkfish. Review and editing of the scallop Assessment Summary Report was completed on the morning of Friday 4 June. The remainder of the meeting was spent in closed session, with panel members compiling information for the SARC Panel Summary Report during Friday afternoon, completing by 3.00 pm on Saturday 5 June. The whole panel agreed the main points to be covered in this report, and the three CIE reviewers each took responsibility for drafting the text for one of the species covered: the monkfish summary was drafted by John Wheeler, the sea scallop summary was drafted by Mike Bell and the pollock summary was drafted by Kurtis Trzcinski. The remaining sections were drafted by Bob O'Boyle and Pat Sullivan. Drafts were completed by 14 June and collated into an overall SARC summary report by the SARC Chairman, to be agreed by all panel members before submission of the report by 28 June.

Drafting and discussion of the SARC summary report was undertaken in closed session, but all other parts of the meeting were open to other interested parties. Industry representatives, Management Council members and university scientists were present for some of the open sessions.

No consensus among SARC panel members was required or sought, but there was a broad level of agreement about the extent to which the TORs for each assessment were met. Panel members made their views clear during the open sessions, so that the teams responsible for each assessment were aware of the likely conclusions with respect to each TOR.

Summary of Findings

A. Monkfish

1. *Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.*

This TOR was met in full in the sense that the commercial catch data sources and their uncertainties were satisfactorily characterized. This does not, of course, imply that the data sources themselves were an adequate description of current and historical landings. The Southern Demersal Working Group (SDWG) reported that there is in fact considerable uncertainty in the landings data. This applies particularly to the early part of the time-series (prior to 1990) owing to unreported and under-reported landings, partly associated with the by-catch nature of the fishery at this time. The landings data are also affected by uncertainties about the conversions of weights in some landings categories (e.g. tails, 'head-on, gutted') to whole live weights, but I accept that this is probably not a serious source of error in the assessment. The SDWG also gave details of other uncertainties in the landings data sources, such as mismatches between the weight-out and general canvass databases and difficulties in matching VTR records with dealer landings. Trends in landings needs to be interpreted in the light of these uncertainties, but it seems safe to conclude that the decline in reported landings seen since the mid-1990s is a fair representation of reality

The SDWG described changes in the gear used to land monkfish over time and between the northern and southern parts of the stock area. Gill net landings have increased over time, especially in the southern area, as dredge landings have declined (partly due to allocation of 'scallop days'), and the trawls and gill nets now account for roughly equal proportions of the total landings.

Discard data are also highly uncertain, owing to low sampling rates, no samples taken before 1989 and the nature of the fishery in the northern region where monkfish are primarily a by-catch in the ground-fish fisheries. The type of information also varies widely between regions and gear types. Time-series used in the analytical assessment model (TOR 4) extend back to 1980, and it was assumed that 1989-91 discard rates are representative of the period prior to 1989. It seems likely that this provides an underestimate of discards in the 1980s when a market for monkfish had not yet been developed. However, there appears to be no defensible basis for revising the current estimates for these years, and I would concur with the view that this is likely not a serious source of bias in the assessment as a whole. It is nevertheless recommended[1] that continuing effort be directed towards improving current and historical discard estimates.

Length-frequency data for the commercial catch are very important in this assessment given the emphasis placed on this as an information source for the analytical model (TOR 4). It would have been useful to have seen a more comprehensive presentation during the SARC 50 meeting of information relating to length-sampling and how sampling data were raised to total catch. The primary concern expressed by the SDWG was that the length-frequency distribution (LFD) of the commercial catch has not expanded to a greater representation of larger size-classes in recent years, as would be expected given the decline in catch since the mid-1990s. This expectation of expanded LFD depends in part on the current view of monkfish growth. In this context it is worth noting that age and growth is one of the biggest uncertainties in the whole assessment, and it is probable that growth rates are overestimated,

[1] Note that all recommendations within the text are collected together in a Recommendations section on p.30.

particularly for larger size-classes (see below). However, on its own, growth overestimation probably does not account for the lack of expansion in the LFD, and other hypotheses are necessary (e.g. migration of large individuals to deeper water, less accessible to the fishery). Given the importance of this data source in the assessment, it is strongly recommended that there be detailed exploration of hypotheses to account for the observed patterns in LFDs, supported if necessary by new research and survey effort.

The method of age-determination using assumed growth marks in the vertebrae has not been validated. Given uncertainties about age determination, age composition data were not directly included in the assessment and no age composition for the catch was estimated for 2007-09. This is a correct decision in my view, although it does not circumvent the problems associated with inferring ages from lengths, implicit within the analytical assessment model.

Given difficulties in defining directed effort for the monkfish fisheries, particularly because monkfish are often caught as by-catch in trawls, CPUE and effort series were not used as a primary information source in the assessment. There appear also to be difficulties owing to changes in data collection methods. CPUE data for 1992-2009 were presented but did not appear to be informative of stock trends. It is recommended that the SDWG consider the possibilities for defining gill net fishing effort targeted at monkfish and for associated CPUE measures.

2. *Report results of 2009 cooperative monkfish survey and describe sources of uncertainty in the data and results.*

This TOR was met in full, given the available information. Further analyses undertaken and presented during the SARC 50 meeting provided additional illumination on the interpretation of cooperative survey results.

Cooperative surveys involving fishing industry participation were undertaken in 2001, 2004 and 2009. The surveys were commissioned, in part, owing to very low catch rates seen in the NEFSC spring and fall bottom trawl surveys (prior to 2009 – see TOR 3), and also in anticipation of impending management measures. In addition to comparisons with the NEFSC surveys, the cooperative survey had multiple aims, including quantifying abundance, distribution, population structure and biological parameters. The SDWG made a comprehensive presentation of the 2009 survey results, highlighting issues relating to vessel and gear performance, differences in these between years and regions, implications for the calculation of swept-area population estimates and differences between years in survey timing in relation to seasonal migration. The 2009 results were also set in the context of the previous two surveys.

A striking aspect of the survey results was that the highest catch rates appeared to be clustered along the deep water (eastern) boundary of the survey area. Apparently, it had originally been intended that the fishing industry vessels would demonstrate the existence of a deep water monkfish resource, outside the NEFSC survey areas. Unfortunately this intention was not realized in practice owing to the difficulties of fishing in deep water (maximum depths fished were 260 m in the northern region and 500 m in the southern region, most hauls being taken in much shallower waters), but the geographical distributions of catch rates in all three surveys are highly suggestive of the existence of significant stocks outside the survey boundaries. It is recommended that future research effort be directed towards verifying (or otherwise) the existence of a deep water component to the monkfish stock in the US EEZ.

This does not necessarily imply that the cooperative survey should be repeated in future, as other specifically directed research approaches (e.g. tagging, particularly with data storage tags that provide geo-location information, and targeted fishing effort) may be more rewarding in this respect.

In general, the SDWG placed a low emphasis on the cooperative surveys in this assessment. In exploratory runs of the analytical assessment model (TOR 4), the cooperative survey was used to contribute information on relative trends and length composition, but information on the absolute scale of population biomass and abundance was not used. The final model did not include the cooperative survey data because of difficulties in fitting the survey trends. Given the uncertainties associated with quantifying gear and vessel performance, this approach seems justified. However, further analyses undertaken and presented during the meeting showed that efficiency-corrected swept-area biomass estimates from the cooperative survey have some highly suggestive correspondences with equivalent estimates from the analytical assessment model. In the case of the 2009 estimate, the correspondence was only apparent after the model output was adjusted for retrospective pattern. Whilst it is not suggested that correspondence of estimates between model and survey represents validation (in *either* direction), it is recommended that there be future exploration of the possibilities for including both trends and scaling information from the cooperative surveys in the analytical assessment model.

The scientific justification for future cooperative surveys rests largely on the ability to provide an assessment of the monkfish resource independent of the NEFSC surveys (which appear to perform poorly for monkfish) and independent of all the assumptions underlying the analytical assessment model and the interpretation of commercial data on catch composition and quantity. If analysis of existing cooperative survey data is able to establish that it contributes reliable information on population trend and scale (deep water component notwithstanding), then this should be taken as favorable for the continuation of the survey. At present, as highlighted by the SDWG, the NEFSC surveys prior to 2009 provide little such information. This may change in future with further surveys undertaken using *RV Henry Bigelow* (see TOR 3), but it will be some years before a significant time-series of stock index values is established; in the interim, it will be worth giving serious consideration to continuation of the cooperative survey, addressing the question of whether the surveys contribute useable information on population trend and scale.

3. *Characterize other survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, length data, state surveys). Describe the uncertainty in these sources of data.*

This TOR was completed in full.

The SDWG described several sources of survey data relevant to monkfish. NEFSC spring and fall bottom trawl survey data are available for both southern and northern regions, covering depths down to 300 m. These are the most spatially comprehensive surveys, but unfortunately catch rates have historically been very low (c.100 fish per year in each of the southern and northern region). The surveys were taken forward into the analytical assessment model (TOR 4), in the form of both abundance indices and LFDs, but there was a clear recognition that because of the low catch rates there is very limited capacity to track stock trends. In 2009 the previously used survey vessel *RV Albatross* was replaced by *RV Henry Bigelow*; cross-calibration experiments indicated that for equivalent tows the *Bigelow* catches more than seven times more monkfish per tow than the *Albatross*, and more than eight times more biomass.

In addition to the *Albatross-Bigelow* calibration, the SDWG highlighted statistical uncertainties around survey indices and differences in survey coverage between the years.

Several other sources of survey data were considered in the assessment, with higher catch rates but shorter time-series and less comprehensive spatial coverage. In the northern region, monkfish catch data were available from the Northern Shrimp Technical Committee summer shrimp surveys (1991 onwards), which cover the western Gulf of Maine. State surveys were considered. The ME/NH survey covers inshore areas in spring and fall, starting in 2000. Fall survey data (why not spring?) were taken forward into the analytical assessment model (TOR 4). The implicit assumption that inshore survey trends are representative of population processes occurring at much larger spatial scales appears to be weakly justified by some correspondence with shrimp and NEFSC surveys. Massachusetts surveys had previously been rejected because they were considered not to represent abundance trends for the northern region as a whole. In the southern region the NEFSC spring and fall surveys were supplemented by monkfish data from the NEFSC scallop survey, which extends back to the mid-1980s but does not provide comprehensive spatial coverage, and the NEFSC winter flatfish survey, which extends back to the early 1990s but did not sample deep water strata before 1998.

Similar to the commercial LFD data, the NEFSC spring and fall surveys show no evidence of improved survivorship to larger sizes since the mid-1990s as would be expected from the reduction in the commercial catch. Again, the expectation of expanded LFDs depends on the growth model (see TOR 1, above), but it is notable that the surveys in the northern region show truncation of LFDs between the 1980s and the 1990s, and this has not since been reversed.

In conclusion, the SDWG has successfully characterized the available survey data and their uncertainties, albeit to show that, because of very low catch rates and/or incomplete spatial coverage, these data are unlikely to be strongly informative about stock trends. Increased catch rates in the NEFSC spring and fall bottom trawl surveys after the change in survey vessel to the *RV Henry Bigelow* offers good prospects for improved survey assessments in future, but it will be several years before this benefit accrues.

4. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.*

This TOR was completed, but current biomass and fishing mortality were not unequivocally determined. The assessment outcomes represent the current best scientific understanding of the state of the monkfish stock. This represents an improvement on the 2007 assessment, but it should be clearly understood that even the 2010 assessment is not well supported by the data. If there had been a viable alternative for development of fishery management advice, it is likely that the current assessment would have been rejected. This is primarily due to limitations in the data available for assessment and an imperfect understanding of crucial biological parameters relating to growth and natural mortality. Poor performance of the assessment model should not be taken as criticism of the SDWG, although it is true that the SDWG could have gone further in exploring the sensitivity of the assessment to biological parameter inputs.

The NOAA Toolbox model SCALE (Statistical-Catch-At-LEngth-analysis) was used as the analytical assessment model. Catch-at-length data are the primary substrate for SCALE, although the underlying dynamics of this forward-projecting model are age-based. The 2007 assessment undertaken by the Data Poor Stocks Working Group (DPSWG) also used SCALE, selected after trials with various other model

classes such as a two-stage DeLury-type model (Collie-Sissenwine Analysis), index-based methods and Bayesian stock production models. The alternative models were rejected because they could not deal with the poor correspondence between survey trends and catch data. SCALE is considered to be suited to data-poor situations, presumably because it is very flexible in the ways it can be used to extract biologically credible estimates of stock biomass and fishing mortality from multiple data sources. This does not, of course, mean that the model reconciles conflicting data signals; rather, it steers a compromise course between the competing data sources, each weighted according to credibility and statistical uncertainty.

Given the three main elements of the assessment – the SCALE model, the available catch and survey data and the choice of biological parameter input values – the SDWG have derived estimates of fishing mortality and stock biomass that are the best possible. Note, however, the caveat implied by 'given': the assessment is the best *given* these fixed circumstances of model, data and inputs, but this does not mean that the assessment is in any sense a good one, nor that the SDWG should have regarded at least the first and last of these circumstances as fixed.

As acknowledged by the SDWG, there were many problems with the SCALE model fit, such as the difficulty in fitting the catch LFDs for recent years. The problems were most evident in strong retrospective patterns in stock biomass and fishing mortality, especially in the northern region, possibly a result of model difficulties in tracking a strong recruitment pulse in this area. The assessment placed most emphasis (greatest belief) in the catch data as opposed to the survey data, which is fair given the very low monkfish catch rates achieved in the NEFSC bottom trawl surveys. As first pointed out by one panel member (Kurtis Trzcinski), however, model estimates of stock biomass show a trend that cannot clearly be demonstrated in any data index. Notably, the model indicates recent increases in biomass for which there is no clear supporting evidence. The estimates are driven, presumably, by the model trying to reconcile outputs with the decline in catch. In common with the rest of the review panel, I was generally uncomfortable with assessment outcomes that could be regarded as model-driven rather than data-driven. There was discussion during the SARC 50 meeting about whether to apply retrospective adjustments to the final biomass and fishing mortality estimates (respectively downwards and upwards), as has been applied in some Groundfish assessments. Some support for an adjusted final year estimate was given from swept-area biomass estimates from cooperative survey data (see above, TOR 2), but I agree with the general conclusion of the meeting that, without an understanding of the sources of the retrospective pattern, the assumption that the pattern represents an ongoing bias is not justified. Given all the uncertainties in the assessment, it would be difficult to justify adjusted estimates as being in any sense more 'correct'. At the panel's request, the SDWG compiled a list of potential pitfalls in the assessment that might give rise to the retrospective pattern. In my opinion this provides a very useful summary of potential sources of observation error (e.g. change in survey catchability or change in availability of monkfish to the survey) and process error (e.g. wrong growth model, wrong M value, emigration of monkfish from the survey or catch area), together with an assessment of probability and available evidence. This list should serve as a context for future research and exploration of the data.

Given the nature of the data, SCALE is an appropriate choice of model for the assessment. However, it would have been useful if other assessment methods had been explored. Even if, as is likely, these had been rejected, the results of using alternative model formulations, with different types and levels of dependency on the various data sources and biological parameter inputs, might have been informative about likely sources of bias and pattern in the assessment outcomes. Arguably, the SDWG was justified in treating the model exploration stage as having been adequately completed by the DPSWG in 2007, given that the SCALE model was formally accepted as a basis for developing fishery management advice.

In this sense, the 2010 assessment could have been treated simply as an update. It is beyond the remit of the current review to provide a critique of the 2007 assessment, but there is at least a strong impression that the SCALE model was accepted at that time not because it was strongly supported by the available data but because all available alternatives were unviable. Given this situation, it would have been appropriate for the SDWG in 2010 to have explored different model types as well as different SCALE model formulations. Stock Synthesis 3 (SS3) and Catch At Size Analysis (CASA) were mentioned during discussions, but perhaps it would have been most appropriate to use simple methods, close to the data, in which the effects of different biological assumptions could most transparently be explored. This might include simple catch-curve analysis or Beverton-Holt estimators of fishing mortality based on mean size (equilibrium estimator, but an extension has been developed for dynamic situations – Gedamke & Hoenig 2006).

It is recommended that further model exploration be conducted for monkfish in the future, but I recognize that a change of model is unlikely to be a panacea for poor data and inappropriate biological parameters. Poor data are, unfortunately, unavoidable at present, although higher monkfish catch rates in the NEFSC bottom trawls by the new survey vessel *RV Henry Bigelow* offers hope of improved survey indices for the future. Otherwise, the main focus for improvement should be the biological parameters. The linear growth model used in the assessment, with growth up to at least 10 years old at a rate of about 10 cm per year, is on the face of it implausible (although the analysis of diet under TOR 7 shows that monkfish are voracious predators and offers at least some support for continuing high growth rates). These ages are based on interpreting marks in monkfish vertebrae as annual, a method of age determination which has not been validated. Ongoing research into otolith microchemistry shows fluctuations in strontium/magnesium ratios, which if interpreted as annual in periodicity would indicate that a monkfish aged as eight years old by vertebra reading could in fact be 14 years old. Of course, this interpretation is also unvalidated, and much more data would be needed to develop a revised growth model, but such results are at least indicative of how current inferences about age and growth may be mistaken. A changed growth model, particularly one in which ages at larger sizes are revised substantially upwards, is likely to have a large effect on assessment model outcomes. This aspect of assessment sensitivity was not explored by the SDWG, and there was a general unwillingness to pursue this further during the SARC 50 meeting, largely on the grounds that any alternative growth model formulation would be arbitrary and impossible to justify. It is beyond the remit of this review to evaluate the availability and quality of alternative growth parameters, but it is worth noting that the FAO FishBase information resource lists a number of different von Bertalanffy growth parameter estimates for *Lophius americanus* and closely related species such as *L. piscatorius*, all of which show slower growth at older ages than the current linear growth model. Presumably, given the general uncertainty about age determination, the SDWG has good reasons for rejecting these alternative growth models, but these reasons should have been made clear and it would have been good to have seen what the implications of these models would have been for the assessment. Further research into age determination of monkfish is clearly a very high priority, but even before the results of such research are available it is strongly recommended that future assessments include a rigorous analysis of sensitivity to growth model formulation.

A change in growth model cannot be separated from changes in assumptions about natural mortality. At present, a value for M of 0.3 is chosen, based on a longevity of 13 years (from the linear growth model applied to the maximum length of monkfish observed in surveys of 138 cm). If, as is likely, the ages of older individuals are much underestimates, M is probably much less than 0.3. Based on the growth parameters listed in FishBase, a fish of 138 cm length could be as old as 30 years (which is also the longevity value listed in FishBase); given 1% survivorship to this age, M is estimated at about 0.15.

Lower values of M were explored in the 2007 assessments and it would have been good to see similar sensitivity runs for the 2010 assessment, perhaps choosing values of M consistent with alternative growth models.

Changes in M and growth model are not the only possibilities for future sensitivity runs of the assessment model. Other areas to be explored include sex-specific population dynamics and emigration from the fishery area. Given the available options for populating assessment models with data, these possibilities would most likely need to be explored in a simulation context.

In summary, the analytical assessment for monkfish performed poorly but nevertheless must be considered the best available scientific basis for the development of fishery management advice. The main strength of the assessment is that the SCALE model allowed a biologically realistic compromise to be achieved between multiple and often conflicting data sources. The major weaknesses include uninformative survey data, failings in the commercial LFD data, possible emigration of monkfish outside the assessed area and, particularly, imperfect understanding of growth, age and natural mortality. The SDWG could (and should) have gone further in exploring the implications particularly of different growth patterns, but it is unlikely that this would result in an improved final assessment outcome that could be objectively defensible.

5. *Update or redefine biological reference points (BRPs; estimates or proxies for BMSY, BTHRESHOLD, and FMSY; and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.*

This TOR was completed in full, within the limitations inherent in the assessment model on which the BRPs are based.

BRPs were provided for northern and southern regions separately. F_{MAX} from a yield per recruit analysis was used as a proxy F_{MSY}. Long-term biomass projections at the F_{MSY} proxy were used to estimate the B_{MSY} proxy and $B_{THRESHOLD}$ was taken as half this value. This methodology has previously been used to derive BRPs for Groundfish stocks (GARM III). I would endorse the new BRPs as an improvement over the existing ones (based on an improved assessment and estimated using an improved methodology). However, it should be stressed that all the uncertainties associated with the assessment model (see TOR 4) propagate through to the BRPS, which means that they must be regarded as highly uncertain. The assessment model uses data for 1980 onwards. A longer perspective would be desirable, extending back to the 1960s and '70s when commercial landings were much lower.

6. *Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 5).*

This TOR was met in full, within the limitations inherent in the assessment model on which both current estimates and BRPs are based.

Using the current assessment and new BRPs, monkfish stocks in both southern and northern regions are considered not to be overfished and overfishing is considered not to be occurring. This conclusion is robust to adjustment for retrospective pattern. However, this appreciation of stock status must be taken as contingent on the current growth model and the current value of M being correct, both of

which are highly uncertain. Without seeing the results of sensitivity runs involving these parameters it is impossible to assess the risk of mistaken conclusions about stock status.

7. *Evaluate monkfish diet composition data and its implications for population level consumption by monkfish.*

This TOR was met in full.

Ecosystem considerations are a welcome addition to the standard TOR for fish stock assessments. The analyses presented made it clear that monkfish is a dominant piscivore within the assessed area, with very significant consumption of a number of commercially important species. The scale of consumption and estimated trends over years depend, of course, on the validity of the assessment model (TOR 4). It is recommended that this type of analysis be continued (and refined) in future assessments of this and other species, with a view to determining the impacts of energy flow and predator-prey relationships on population dynamics.

8. *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 (through 2016). 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 to examine important sources of uncertainty in the assessment.*
   b. *Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.*
   c. *Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.*

This TOR was completed in full, within the limitations inherent in the assessment model outcomes from which the projections were made.

Again, it should be emphasized that all the uncertainties attached to the assessment model apply also to the analyses based on this model, including the projections. The stochastic projection methodology (AGEPRO) has been extensively reviewed and validated elsewhere; the choice of this method is appropriate and this particular application by the SDWG appears to be correct in all respects. The projections suggest that there are appreciable risk (>50%) of overfishing or of overfished status by 2016, especially in the northern region. It is worth noting that the assessment uncertainties may translate to higher risks than represented by the projection stochasticity alone.

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

This TOR was met in the sense that progress was reviewed against previous research recommendations.

Lack of time and emphasis given to other TOR meant that it was not possible to undertake a thorough evaluation of the research recommendations, but it is possible to make some broad statements. The SDWG reported progress against nine recommendations from SAW 34, nine from SAW 40 and eight from the 2007 Data Poor Workshop (DPW). The majority of these recommendations had not been addressed, presumably because of limitations of time and resources. In general, I agree with the priorities placed on these recommendations by the SDWG, but some inadequate reasons are given for not addressing some. For example, SCALE model configurations are taken as preventing progress with some of the DPW recommendations, whereas there seems no real reason why the model should not be re-configured (e.g. to bin lengths into 2 cm or 5 cm groups), even if this requires some programming.

However, the most important issue is the recommendations that should be addressed in future. I agree with the SDWG's assessment presented at the meeting that growth and age validation, movement studies and stock structure studies are high priorities for the future. This is reflected in the recommendations given at the end of this review (see below, p.30).

B. Sea Scallop

1. *Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.*

This TOR was completed in full. Commercial catch and effort data were characterized to the extent possible given the available information sources, and the uncertainty in the data was adequately described.

The Invertebrate Subcommittee (IS) presented long time-series of sea scallop landings data for Georges Bank (GB) and the Mid Atlantic Bight (MAB). Trends in landings show a close correspondence with the management history, clearly showing a recovery from overfishing in the early 1990s after the introduction of limited access licenses and closed area management in the 1990s. Landings data appear to be well determined, although there are some concerns about the quality of data for earlier years in the time-series. In contrast, discard quantities and LFDs are not well determined. Discarding occurs owing to capture of undersized scallops together with some highgrading in special access areas. Some discard information is available for recent years, but discards are poorly characterized (low sampling intensity) for years prior to 2003 and data are not available for years prior to 1992. There is also uncertainty regarding discard mortality. For the purposes of the analytical assessment model (TOR 3), discarding is subsumed into a single incidental mortality estimate along with other non-yield mortality sources. Improvements in the incorporation of discarding practices and discard mortality in the assessment model are a priority for the future.

Fishing effort data are available in the form of days fished, and time-series were presented extending back to the mid-1940s. Directed effort data appear to be reasonably well determined, although there have been some difficulties in matching dealer reports with vessel trip reports since 1994. LPUE patterns were described, showing particularly high levels in the special access areas.

Recent data on shell heights in the commercial catch appear to be good, but there are concerns about the quality of data in some years. Port sample data collected after 1984 (when meat weight regulations were in force) were not included in the assessment because of non-random sampling. Shell height data

for both landings and discards have been collected by observers at sea since 1992 and are most reliable for 2003 onwards. The data demonstrate a substantial upwards shift in the sizes selected by the fishery; scallops less than 90 mm shell height were rarely taken from 2002 onwards, but were an important component of the landings up to the late 1990s.

In conclusion, commercial catch data were reasonably well characterized and provide a good basis for this assessment.

2. *Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, length data, etc.). Describe the uncertainty in these sources of data. Document the transition between the survey vessels and their calibration. If other survey data are used in the assessment, describe those data as they relate to the current assessment (Exclude consideration of future survey designs and methods).*

This TOR was completed in full.

The most important source of fishery-independent data is the annual NEFSC dredge survey which has been undertaken annually using a lined dredge since 1979. Data for surveys using an unlined dredge are also available for 1975, 1977 and 1978. The *RV Albatross* was used in most (but not all) years, but *RV Hugh Sharp* was the survey vessel for 2008 onwards. Calibration between the *Albatross* and a commercial vessel, and between that vessel and the *Hugh Sharp* indicate that the survey is robust to changes in vessels and some dredge modifications. Based on an analysis of sensor data and the results of a GLMM applied to paired tow data, catches by the *Hugh Sharp* were adjusted downwards to account for longer than nominal tow distances. Account was also taken of the use of rock chains on hard ground. Uncertainty around abundance and biomass estimates from the dredge survey was represented by confidence intervals calculated using standard statistical methods for stratified random surveys. Scallop abundance and biomass estimates and their uncertainty are considered to be very well characterized for the dredge survey. The availability of this survey is a great strength for the assessment. It is particularly valuable that it was possible to use efficiency-corrected swept area biomass estimates to provide information on absolute scale to be incorporated into the assessment model (TOR 3). Dredge efficiency was estimated from tows for which scallop densities were independently estimated using the HabCam towed digital camera. In addition to information on population trends and scale, LFDs from the survey catches (for scallops ≥40 mm shell height) were included in the assessment model.

Underwater video survey data were also included in the assessment, contributing information on trends, scale and size composition. In an improvement on the 2007 assessment, the SMAST 'large camera' survey data were included in the analytical assessment. The 'large camera' has the advantage of a bigger field of view than the 'small camera'. Data from the SMAST 'small camera' survey were used primarily to estimate the selectivity of the 'large camera' which was then taken as fixed in the assessment. Video survey data were adjusted for potential sources of bias owing to edge effects in the camera field of view. Uncertainties owing to errors in measuring shell heights from video images were rigorously characterized and incorporated in the assessment (TOR 3). Video survey data were available for 2003 onwards.

One other survey was incorporated into the assessment model for MAB, namely the NEFSC winter bottom trawl survey for 1992-2007. The results of this survey were not reported or discussed during SARC 50, so it is not possible to comment on data quality or appropriateness for this assessment.

Overall, the available survey data are considered to provide a very sound basis for the assessment: they provide a reasonably long time perspective over contrasting periods of the fishery; the surveys are well designed to capture scallops, hence survey catch rates are high enough to be considered a reliable measure of scallop densities; statistical uncertainties and other sources of error and bias are well characterized and accounted for; provision of information on population scale is a particular strength.

3. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.*

This TOR was met in full. The final assessment results provide a sound basis for the development of fishery management decisions.

Particular attention was paid to crucial biological input parameters, including shell height/meat weight relationship, age and growth and natural mortality. Parameters were updated using recent data and there were rigorous analyses of uncertainties and sources of parameter variability. The shell height/meat weight relationship for commercial scallop catches was adjusted for commercial shucking practices and yearly meat weight anomalies were calculated based on seasonal variation in the relationship. These are important adjustments because there is substantial seasonal variation in meat weights owing to spawning cycles and food availability, and differences between research survey and commercial shucking practices and treatment of meats may also cause significant differences in measured meat weight for a given shell height. Depth-adjusted relationships were also estimated and used in calculating survey biomass metrics. However, the analytical assessment model is not spatially explicit, so that it was not possible to use depth-adjusted shell height/meat weight relationships in this context. This seems unlikely to be a significant source of bias in the assessment.

Natural mortality has been assumed to take a value of M=0.1 in previous assessments. This is based on observations on the relative incidence of articulated scallop shells on the sea bed, together with estimates of the time taken post-mortality for shells to separate. This information was re-evaluated in the 2010 assessment, taking into account that estimates of separation time are highly uncertain. This resulted in an upwards revision of natural mortality to M=0.12 for GB. A higher value of M=0.15 was inferred for MAB, consistent with theory on life-history invariants (the ratio of von Bertalanffy K to M was assumed to be constant). The new M estimates are well supported by data and theory, and I agree that this important revision was appropriate.

Inferences about age and growth depend crucially on the interpretation of shell rings as annual growth marks. Other workers have considered the possibility that two rings are laid down per year, consistent with semi-annual spawning periodicity. However, evidence presented by the IS clearly demonstrated that annual growth rings are overwhelmingly more likely and that the hypothesis of twice-yearly rings is untenable. This validation is important because of the growth relationships that drive the size-based analytical assessment model. For the purposes of the model, growth was described in terms of transition probabilities between 5 mm shell height classes based on observed increment data. This empirical description of growth has two benefits: (i) it does not depend on any growth model; and (ii) it depends only on the ability to determine relative ages (increments considered over one year) as

opposed to absolute ages, which may be important given that early growth rings may be obscure. Of course these benefits are only relevant if there are sufficient measurements to populate the growth transition matrix reliably. This does seem to be the case, and an alternative parametric matrix formulated on the basis of a growth model showed almost identical transition properties as the empirical matrix. The parametric matrix was estimated using the results of a mixed effects growth model that allowed individual growth variability to be quantified. One panel member raised the question of whether, given more than one growth increment measured on each individual scallop shell, overestimation of effective sample size was an issue for this aspect of the assessment, but I agree with the view of the IS that this is not a concern.

As in the 2007 assessment (SARC 45), Catch At Size Analysis (CASA) was used as the analytical model for scallops, applied separately to GB and MAB stocks. This is a purely size-based model, based on modeling transitions between shell height classes over annual time steps. As described above, age determination of scallops enters the model only in the construction of the size transition matrix, and there is no dependence on determining absolute ages. The model was tuned using the survey series described above (TOR 2), and informative priors on the absolute scale of abundance and biomass was included in the assessment. The assessment was based on the same ADMB implementation as was used in 2007, but 14 significant changes to the model specification were reported during the SARC 50 meeting. these included changes in the biological parameters (see above), use of empirical rather than model-based plus group weights, changes in incidental fishing mortality estimates, changes to the treatment of NEFSC survey data, extended time-series for GB, dropping the use of LPUE for tuning the model, reduction in prior CVs for the survey data, a change from 1st January to mid-year as the basis for reporting abundance and biomass estimates (consistent with the timing of the scallop fishing season), changes in the selectivity stanzas and the use of domed selectivity for the first stanza for MAB, and tuning of the assumed CV for surveys to residual variance. The use of yearly meat weight anomalies (see above) had the most substantial effect on assessment results. I agree that all these changes are improvements to the assessment. Reporting of these changes during the meeting was very useful, and it is recommended that all model changes be documented in the assessment, along with information on their rationale and impacts on assessment outcomes.

Selectivity stanzas in the assessment were based on management changes and observed changes in commercial practices, and this aspect of the assessment appears to be satisfactorily defined. Model fits to the survey and commercial data were generally good, in terms of both LFDs and trends. One diagnostic feature that was of some concern was the moderate retrospective patterns for MAB, where fishing mortality estimates were revised upwards and biomass estimates were revised downwards as years were added to the assessment. This feature was much discussed during the SARC 50 meeting and several sensitivity runs were requested to help identify the source of pattern. Two possible sources were considered: (i) the difficulty in the model reconciling strong recruitment apparent in the surveys in 2003 (2001 year-class) with the commercial catch trends and LFD; and (ii) the difficulty of accounting for the declining trend in the SMAST 'large camera' survey abundance, which conflicts with an increasing trend in NEFSC dredge survey abundance. The retrospective pattern could be reduced considerably by halving the 2003 survey abundance value and removing the 2009 video survey estimate, and eliminated entirely by also increasing the survey prior CVs. In terms of source (i) of retrospective pattern, the most likely causal hypotheses involve unaccounted mortality of large year-classes, owing either to density-dependence of natural mortality or discarding/incidental fishing mortality. In addition to the 2001 year-class in MAB, there appears to be a more general tendency for the early stages of some large recruitments apparent in the dredge surveys to be under-represented in the model. The data conflict involved in source (ii) of retrospective pattern remains unresolved. It will be important to keep a close

check on whether this conflict resolves as new survey data enter the assessment in future. If the conflict persists it will be important to identify its sources. I recommend that spatial correspondence of dredge and video survey trends be investigated in detail.

Retrospective patterns in MAB aside, the CASA assessments are well supported by the data, and it is good to see the effective validation of fishing mortality, abundance and biomass estimates against simple data-based estimators. Changes in commercial selectivity represented in the selectivity stanzas are consistent with what would be expected given management actions and commercial fishery changes. The changes provide a challenge for defining a consistent metric of fishing mortality to represent changes in exploitation over the whole time-series.

Uncertainty was adequately characterized in both inputs to and outputs from the assessment, although it would have been useful to have more information on why the standard errors around model estimates were considered to have been underestimated (inflated values were used in the stock projections – TOR 6). Presentation of likelihood profiles was very useful in illustrating the tensions between data sources and providing support for input values such as the increase value for M.

In summary, the analytical assessment for sea scallops was characterized by a rigorous treatment of data, input values and assumptions. That the assessment is very well supported by the data is testament to both the high quality of the data and the rigor with which they were treated. The main strength of the assessment is that an appropriate assessment model was used, well populated with good data and supported by well chosen input values and assessment options. The main weaknesses are that discard data were not included, non-yield mortality was only crudely characterized within the model and that the model dynamics operate on a larger spatial scale than many biological processes for a sedentary population.

4. *Update or redefine biological reference points (BRPs; estimates or proxies for BMSY, BTHRESHOLD, and FMSY; and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.*

This TOR was met in full. The BRPs provide a sound basis for use in fishery management decisions.

New BRPs were derived, based on a Stochastic Yield Model (SYM). This uses a Monte Carlo approach to derive yield curves, incorporating information on uncertainty among the input parameters (including correlation structure when appropriate). Probability density functions were calculated for all relevant parameters, including M, selectivity, growth parameters, shell height/meat weight relationships, discard and incidental mortality, and stock-recruitment relationship (Beverton-Holt parameters). Parameters were drawn from their distributions for each run, and yield curves were calculate by combining yield per recruit and stock-recruitment relationships. The IS took the view that, given uncertainty, MSY is best represented by the maximum of the median yield curve rather than the mean of individual MSY estimates. Outputs from SYM were used to characterize uncertainty in the BRPs, allowing the trade-off to be measured between the probability of overfishing and the expected yield, facilitating the incorporation of risk assessment into fishery management decisions (see TOR 6).

The SYM model provides F_{MSY} and B_{MSY} estimates, improving on the proxy-based (F_{MAX}) used in 2007. In particular, the new BRPs address concerns about locating F_{MAX} on a yield per recruit curve that is becoming increasingly flat as commercial selectivity shifts towards larger scallops. As noted above, the

SYM approach also meets the need for a risk-based approach to fishery management. The innovative approach to incorporating uncertainty in BRPs is a great strength of this analysis (this approach could usefully be applied to other stocks).

BRPs were developed for GB and MAB separately and for the stock as a whole. Status determination (TOR 5) used the combined stock BRPs. I agree that these provide a sound basis for fishery management. The only real caveat is that the BRPs are derived in the context of unprecedentedly high productivity levels currently prevailing in MAB. This may be due to a stock-recruitment relationship (stock biomass is currently high), but without understanding the biological or environmental basis there can be no certainty that productivity will not revert to the lower levels previously seen, in which case the current estimate of MSY would be an overestimate. This topic is a priority area for future research.

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

This TOR was met in full, providing a sound basis for concluding that the sea scallop stock is not overfished and that overfishing is not occurring.

As noted above, stock status was determined for GB and MAB combined into a single management unit. Given the strengths of the assessment model (TOR 3) and the BRPs (TOR 4), it is reasonable to conclude that status determination is also strongly supported by the available information. The conclusion that there is negligible chance that the stock is overfished is thus safe. It is notable, however, that the current fishing mortality estimate is only fractionally below F_{MSY}, and that, consistent with this observation there is just less than a 50% chance that overfishing is occurring. Under current definitions, the status determination is still justified as 'overfishing not occurring', and it is worth noting that the fishery is currently harvesting the stock at close to MSY levels, i.e. at maximum productivity levels, which is consistent with fishing at F_{MSY}. Given the dependence on current high productivity on MAB noted above, I believe this situation requires careful monitoring.

6. *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 (through 2014). 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 to examine important sources of uncertainty in the assessment.*
   b. *Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.*
   c. *Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.*

This TOR was met in full.

There are many and complex possibilities for spatial management, based on opening and closing different areas of the management unit to the commercial fishery. This has two implications: (i) any projection of future stock trends must take into account the different spatial units that may be opened

or closed to the fishery; and (ii) projections for the purposes of fishery management decisions are more properly conducted as part of a planning process by managers. The projection model used in this assessment incorporates the necessary spatial structure, and the IS have conducted example projection runs to demonstrate how this tool can be used. The Scallop Area Management Simulator (SAMS) model has been used and refined since 1999. The SAMS model simulates size-based population dynamics (consistent with the CASA model) and also incorporates spatial structure in the form of two regions (GB and MAB) and 16 sub-regions, each of which can be involved in rotational or long-term closures to the fishery. Initial conditions for the projections were based on the 2009 NEFSC dredge survey, with dredge efficiency chosen to match the 2009 CASA biomass estimates. Bootstrapping of survey data was used to describe stochasticity around starting conditions. Growth was modeled using area-specific increment data. Other parameters were modeled using the same approach as the SYM model. Given that the CASA model was considered to underestimate the uncertainty in fishing mortality, standard errors were doubled for the purpose of the SAMS model (I would like to have seen a more detailed justification of this rationale). Example projections were conducted using a combination of permanent and rotational closures and with an allocation of fishing effort to areas aiming at achieving an overall fishing mortality of 0.24, consistent with ABC policy. Projections under this status quo management scenario indicate that landings and biomass would be expected to increase slightly from 2009 levels and that (under current selectivity patterns) the stock is at a low risk of being overfished.

This spatially structured projection method is a sophisticated solution to a complex problem. I see it as a downside to this approach that there is a mismatch of spatial scale between the CASA (and SYM) model and the SAMS model, which means that there is also a mismatch in definition between estimated parameters and their application in the projections. This, however, is a minor caveat; the spatial structure is required in the projection model and not currently possible in the assessment model. In my opinion, the SAMS model and its set up developed during SARC 50 provide a sound basis for management planning, although it is of course not possible to comment on how realistic the example projections may be.

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

This TOR was met in full.

Lack of time and emphasis given to other TOR meant that it was not possible to undertake a thorough evaluation of the research recommendations, but it is possible to make some broad statements. The IS reported progress against eleven research recommendations from SARC 45. Some of these recommendations were not addressed, presumably because of lack of time or other resources and because they were not considered high priority. Good progress was made against refining estimates of natural mortality and evaluation of the SAMS model. A seasonal growth model was considered for CASA, but this was not implemented in the current assessment owing to poor model performance.

The IS drew up a list of eleven further research recommendations for the future. Several of these address priority areas already highlighted above, notably discarding, historical spatial patterns and stock-recruitment relationships, and I support this new list of recommendations. Several aspects of the work presented as part of the 2009 assessment are innovative, notably the treatment of uncertainty in

the BRPs and the uncertainty in M. It is important that these methods and analyses are made accessible to a wider scientific readership by publishing in the peer-reviewed scientific literature.

In my view, explicit inclusion of discarding in the assessment model is a major priority for future assessments, particularly given concerns about the failure of the assessment model to account for the levels of mortality experienced by strong recruitments. I would also identify research into the biological and environmental basis for scallop productivity as another priority, given the need to understand and predict whether current high productivity levels on MAB will be sustained.

C. Pollock

1. *Characterize the commercial and recreational catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data, including consideration of stock definition.*

This TOR was completed in full. Commercial catch and effort data were characterized to the extent possible given the available information sources, and the uncertainty in the data was adequately described.

Long time-series of pollock landings data were presented, dating back to the 1960s. These data appear to be well determined. The assessment was based on pollock in US waters. Several hypotheses about stock structure of pollock off New England were outlined, including the possibility of up to three stocks. Evidence in support of any given hypothesis is equivocal, however, and I support the pragmatic decision to base the assessment on pollock in US waters. The main difficulty this poses is in attributing transboundary catches prior to and after the establishment of the Hague Line in 1985. Rather than pro-rating landings, the Northern Demersal Working Group (NDWG) either included or excluded all landings from certain reporting areas. Sensitivity of the assessment to this issue was explored during the meeting (see TOR 3).

Sampling intensity for size and age composition of landings has been good since the early 1980s. This aspect of the commercial data appears to be well determined. The NDWG revised the plus group from ages 12+ to ages 9+ on the basis that it would not be meaningful to attempt tracking of year-classes through the somewhat noisy data for the sparsely represented older age-classes.

Discard data, relating mainly to undersized fish, are reasonably well determined for years 1989 onwards (although not yet available for 2009). Pollock discard data are not available prior to 1989 and discards are assumed zero for this period. I agree that this is probably not a major source of bias, although the NDWG noted that given the lack of a market for small pollock before the mid-1980s it is likely that some discarding of undersized fish occurred. I support their recommendation that methods for hindcasting historical discard data should be investigated based on analysis of survey and landings LFDs.

There are some uncertainties regarding the recreational catch and the survival of recreational discards. The recreational catch was assumed negligible for years prior to 1981, there being no basis for assuming otherwise. Recreational catches are a minor component of the total catch, so that this assumption is unlikely to have introduced significant biases.

In summary, despite some limitations with the recreational and discard components of the catch, and uncertainties associated with the allocation of transboundary catches, I believe that the catch data for pollock are adequate to support the 2010 assessment.

2. *Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data, including consideration of stock definition.*

This TOR was met in full.

The NEFSC spring and fall bottom trawl surveys provide the main support for this assessment. Data series extend back to the 1960s, but age data are only available for 1970 onwards. Catch rates of pollock are generally low, and there are some uncertainties owing to changes in gear design and vessels. Owing to poor calibration information (few fish caught in paired tows), no adjustment was made when the *RV Henry Bigelow* replaced the previously used *RV Albatross* in 2009, but there are indications that the *Bigelow* may have a lower catchability for pollock than the *Albatross* because of slower towing speed. If confirmed, this reduced effectiveness of sampling would have serious implications for the utility of the NEFSC survey data in future pollock assessments. Even before the introduction of the *Bigelow*, very low catch rates of large pollock were achieved during the NEFSC surveys. Dome-shaped selectivity curves are estimated in the assessment model (TOR 3), with implications for estimation of 'cryptic' biomass.

Several other surveys covering part of the assessed area were considered in sensitivity runs of the assessment model. These include the ME/NH inshore survey (potential juvenile index), an ichthyoplankton survey (pollock larvae as a potential proxy for spawning stock biomass), a Massachusetts inshore survey (very low catch rates) and a summer shrimp survey.

In summary, I believe that all potential sources of survey data for pollock were adequately reviewed and characterized by the NDWG, and that there was proper consideration of sources of variability and uncertainty. Nevertheless, it must be said that the surveys provide a somewhat slender basis for tuning the assessment.

3. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.*

This TOR was met in full and the assessment outcomes provide an adequate basis for the development of fishery management decisions. This is despite major issues related to domed selectivity curves for commercial and survey fleets and their implications for the existence of pollock biomass which is never directly observed.

Previous assessments have used VPA models in the 1990s and an index-based method (AIM) in 2000-08. The latest AIM assessment, based on NEFSC fall indices, appeared to indicate both overfishing and overfished status on the basis of a sharp decline in the fall index. An update of the AIM assessment conducted during the meeting indicated that the US pollock stock would continue to be assessed as being overfished with overfishing occurring. This appears to result from a disconnect between the fall survey index and the shift of commercial fishery selectivity towards older age-classes. The previous AIM

assessment was rejected as a basis for fishery management and it was essential that a new assessment approach was attempted. The NDWG adopted a forward-projecting statistical catch-at-age method, using the ASAP model (Age Structured Assessment Program) from the NOAA Toolbox. The model incorporates a separability assumption for fishing mortality within selectivity stanzas, allows input-specific weighting factors, includes discards explicitly and estimates a stock-recruitment relationship. Recreational and commercial fleets are considered separately. ASAP represents a great advance on the AIM assessment and I fully support its adoption.

Unlike AIM, the explicit population dynamics underlying the ASAP model require a value for natural mortality. The estimate of M=0.2 is well supported by the observations of a maximum age of 24 in surveys during the 1970s (although this should perhaps be treated as a lower estimate for longevity given the low selection for older ages in the surveys).

There was considerable exploration of alternative ASAP model formulations and the final assessment model was selected with due regard for uncertainties, residual patterns and retrospective patterns. An alternative SCAA assessment contributed by Doug Butterworth and Rebecca Rademeyer gave broadly comparable results in terms of trend, but not scale (note that it would have been useful to have included more information on this alternative model in the assessment, as this might have shed interesting side-lights on the ASAP outcomes). 'Envelope' analyses based on swept-area survey biomass corroborated that the ASAP assessment outcomes were within credible bounds. One feature of the model outcomes is highly contentious, namely the estimation of domed selectivity curves for both survey and commercial catches. Aside from the statistical evidence provided by the assessment model itself, the main support for such selectivity patterns is circumstantial: pollock are strong swimmers, and domed selectivity could result from large individuals being able to outpace the trawl gear. This is certainly plausible, and has actually been observed in a related species, saithe, in Scottish waters (Main & Sangster 1981, 1983). However, without direct evidence that there exists a large biomass of fish unavailable to the fishery and the survey, it is, in my view, uncomfortable to base fishery management advice on an assessment dominated by such patterns. Previous guidance (GARM III) has been to assume flat-topped selectivity curves unless there is strong evidence to suggest otherwise. This would seem to be applicable to the current assessment. However, a sensitivity run conducted during the SARC 50 meeting demonstrated that the assumption of flat-topped selectivity curves for the survey scales the assessment outcomes, but does not change the appreciation of stock status in relation to management thresholds. Thus I agree it seems reasonable to go cautiously forward on the premise that the current assessment, domed selectivities included, represents the current best scientific understanding of the state of the pollock stock in US waters.

Obviously, however, I believe that it will be important to undertake research to attempt to verify the existence of the missing biomass. Further, I recommend that there be thorough examination of the sources of retrospective patterns in the assessment with a view to establishing whether these might be connected with the cryptic biomass/domed selectivity issues.

Sensitivity was explored to the allocation of transboundary landings. Ad hoc pro-ration tended to scale biomass estimates downwards and fishing mortality upwards. However, the effect was not large and did not affect estimated trends. I nevertheless recommend that serious consideration be given to improved methods of allocating landings to the assessed fishery.

In summary, I believe that this assessment has gone as far as currently possible towards a satisfactory appreciation of the current state of the pollock stock in US waters, and that many of the uncertainties

around assessment outcomes have been comprehensively described. Strengths of the assessment include the full use of available information resources (unlike AIM), a proper inclusion of stock dynamics in the ASAP model (unlike AIM) and good exploration of alternative model formulations, diagnostics and sources of uncertainty. Weakness include survey data that are only weakly informative of stock trends and the dominance of biomass estimates by older fish the existence of which cannot directly be verified.

4. *Update or redefine biological reference points (BRPs; estimates or proxies for BMSY, BTHRESHOLD, and FMSY; and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.*

This TOR was met in full. I believe that the new BRPs represent a great improvement over the old ones and can be considered a sound basis for development advice, with 'health warnings' relating to the presumed existence of unobserved pollock biomass.

Previous BRPs were proxies based on the AIM model. As noted above, the AIM model cannot be regarded as a sound basis for the development of fishery management advice. The new BRPs are based on $F_{40\%}$ as a proxy for F_{MSY} and standard projection methodology (AGEPRO) to estimate an associated B_{MSY} proxy. The approach is sound, and I support the decision not to use the stock-recruitment relationship based on uncertainty about steepness. The BRPs are, of course, heavily dependent on the dome-shaped selection curves. As noted above, a change to assumption of flat-topped survey selectivities does not change the appreciation of stock status in relation to BRPs. However, re-scaling of management values includes MSY, which changed from 16,200 t under domed selectivity to 11,200 t under flat-topped survey selectivity. This is a substantial change, and must be of some concern if decisions about absolute TAC levels are to be made.

The NDWG provided a very useful plot of historical fishing mortality in relation to $F_{40\%}$, taking into account the changes in selection pattern over time. This showed very clearly how overfishing had occurred in the past but was not occurring more recently. An equivalent plot was requested involving the B_{MSY} proxy. It was suggested during the SARC 50 meeting that, because a stock-recruitment relationship was not used, it was valid to use the entire time-series of recruitments for all years. It is recommended that these plots be included in future assessments for pollock (and other species, as appropriate).

In summary, I accept the new BRPs based on ASAP with domed survey selectivity as the best currently available, but urge that these must be treated with due regard to the risk of overestimation of MSY and the B_{MSY} proxy.

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

This TOR was met in full and the pollock stock was assessed as being not overfished and not subject to overfishing.

As noted above (TOR 4), the conclusions about stock status are independent of the assumed shape of the survey selectivity curves. This provides some reassurance about current status, but difficulties arise in setting absolute catch levels for the future. In my view, future stock status needs to be carefully

monitored following fishery management decisions based on the current BRPs and appreciation of stock status. As also noted above (TORs 3 and 4), an AIM assessment and BRPs would have resulted in the pollock stock being considered as overfished with overfishing occurring. However, I agree that assessment outcomes, BRPs and appreciation of stock status based on AIM are clearly untenable given problems with the survey indices and with the change in commercial selection towards larger sizes not selected by the NEFSC fall survey.

6. *Evaluate pollock diet composition data and its implications for population level consumption by pollock.*

This TOR was met in full.

Ecosystem considerations are a welcome addition to the standard TOR for fish stock assessments. The analyses presented made it clear that pollock is a relatively minor piscivore within the assessed area.. The scale of consumption and estimated trends over years depend, of course, on the validity of the assessment model (TOR 3). I recommend that this type of analysis be continued (and refined) in future assessments of this and other species, with a view to determining the impacts of energy flow and predator-prey relationships on population dynamics.

7. *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 (through 2017). 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 to examine important sources of uncertainty in the assessment.*
   b. *Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.*
   c. *For a range of candidate ABC scenarios, compute probabilities of rebuilding the stock by 2017.*
   d. *Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.*

This TOR was met in full.

Projections of stock biomass and landings based on ASAP model results were undertaken under various fishing scenarios involving fishing mortalities up to $F_{40\%}$. Under no scenario did the pollock stock become overfished up to 2017. I believe that the projections are correctly performed and that valid conclusions have been drawn about the risk of overfished status given the starting model. However, given the uncertainties about the model, in particular the contrast between model outcomes from domed versus flat-topped assumptions about survey selectivities, this risk may be understated. I recommend that such model uncertainties should be included in the projection scenarios, to help inform managers about the risks involved in basing management decisions on any given combination of assessment outcomes and fishing scenarios.

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

Presuming that there were no previous research recommendations against which progress could be reported, it appears that this TOR was met in full.

As already implied, no previous research recommendations were listed, but the NDWG did list eleven new research recommendations. Lack of time and emphasis given to other TOR meant that it was not possible to undertake a thorough evaluation of these research recommendations. However, I would agree with the NDWG's list and would place particular emphasis on those recommendations relevant to determining the existence of 'cryptic' stock biomass. This might include gear selectivity studies, underwater TV observations of trawl gear, particularly during surveys (is it possible to target 'hot spots' for pollock for such observations), use of industry vessels in cooperative surveys, and tagging studies.

NMFS Review Process

The Statement of Work for CIE reviewers (Appendix II) asks for a critique of the NMFS review process, with suggestions for improvements of both process and products. From a reviewer's point-of-view the process generally worked well during SARC 50. The review process strikes a good balance between defining the structure and requirements of the assessment and review and allowing the space for creative science, effective outcomes and constructive discussion. I have previously (SARC 48) commented on the process and will re-iterate those points here. Strengths that should be emphasized include:

- availability of documentation well in advance of the review meeting;
- effective chairmanship of the review meeting, ensuring that discussions remained on-topic and included the views of all interested parties;
- effective guidance by the SAW chairman, ensuring that the required outcomes of the review were kept in mind;
- early availability during the meeting of presentation material and effective rapporteur reports;
- willingness of assessment scientists to undertake additional analyses when required;
- an atmosphere of scientific rigor coupled with a pragmatic, 'real world' approach to producing required outputs;
- precise terms of reference for the meeting and precisely defined requirements for reviewer outputs.

A number of these strengths are primarily indicative of a constructive attitude among meeting participants, but the existence of well-defined requirements and review structure created the necessary conditions for this to happen.

Weaknesses associated with the process are primarily to do with a lack of time. Two of the assessments (monkfish and pollock) generated some important discussion points that it was not possible to address fully before the end of the open part of the meeting. Aside from reducing the number of species to be dealt with in one SARC, one possibility for dealing with this would be to ensure that closed meeting time was included at an earlier stage in the agenda. This would mean that points arising from private discussions among the panel members could be brought before the full meeting for Working Group responses. For the assessment scientists, it would be helpful to have considered in advance the implications of alternative model formulations on all stages of analysis, including BRPs, status determination and projections. At present, the tendency is to identify a single best assessment model and proceed on this basis. The review panel need to know what would be the assessment scientists' preferred model options, but if properly considered in a risk management framework these preferred assessment options do not need to be defended in an adversarial atmosphere. For some species, notably (in this case) monkfish, assessments are necessarily somewhat limited by the quality and availability of existing data sources and by biological knowledge, but panel members will be fully aware that this does not represent a failure on the part of the assessment scientists.

Finally, a comment is needed on the availability of 'fall back' options. Clearly, it is the responsibility of the review panel not to reject assessments out of hand, leaving managers with no basis for the development of fishery management decisions. However, if previously accepted assessments are now shown to be unsatisfactory, it leaves the panel in a very difficult position in relation to updated assessments that are also poorly supported by the data but are not *as* unsatisfactory as the previous

assessment. Given an awareness of the likely acceptability of a new assessment, it would be good to see some early consideration given to possible fall back options. This may require policy guidelines to be formulated.

Recommendations

Monkfish

- Continuing effort should be devoted to improving current discard estimates and to hindcasting historical discards.
- There should be detailed exploration of hypotheses related to the lack of large size-classes in the commercial catches over recent years, with particular emphasis on verifying the existence or otherwise of a deep water component to the monkfish stock. Research into this topic might include tagging of monkfish, especially the use data storage tags that allow estimates of geo-location and reconstruction of inferred movements. Deep water surveys using industry vessels are another possibility.
- The highest priority research recommendation for monkfish is a re-evaluation of age and growth. Ongoing work on otolith microchemistry should be continued, with validation of findings in terms of determining annual periodicities. Systematic tagging should also be undertaken with a view to determining growth increments during times at liberty. To the extent possible, any new information on growth should be cross-calibrated with vertebra readings, potentially allowing either validation or recalibration of previously determined ages.
- Any new findings about age and growth should be considered in terms of its implications for assumed levels of natural mortality.
- Notwithstanding progress on research into age and growth, the sensitivity of analytical assessment model outcomes to different (plausible) growth scenarios should be *exhaustively* explored, giving due consideration also to associated values of M. Other sensitivity analyses might address the implications of sex-specific dynamics and emigration from the assessment area, perhaps in a simulation context.
- Catch and effort data for the gill net fishery should be explored with a view to defining targeting behavior and developing CPUE indices.
- There should be consideration of the possibility of using the cooperative survey results to provide information on population trend and scale in the assessment.
- Given the likely importance of NEFSC survey information for monkfish in future assessments, every effort should be made to characterize the performance of *FV Henry Bigelow* in catching monkfish.
- Continuing consideration should be given to alternative assessment models besides SCALE. This should include simple methods, close to the data and transparent in their assumptions, which would offer support or otherwise to the outcomes of more sophisticated assessment approaches.
- Work should be continued into the incorporation of energy flows, predator-prey dynamics and ecosystem considerations into assessments.
- Previous recommendations involving re-configuration of the SCALE model should be addressed, involving programming changes as necessary.

Sea Scallop

- Discard information should be included explicitly in future assessments, which may require further consideration of methods for hindcasting discards and their LFDs and of appropriate values for

discard mortality. The same applies to other sources of non-yield mortality. The sensitivity of CASA model outcomes to assumptions about discarding and incidental mortality should be explored.

- Spatial structure is included in the SAMS model for projection, but not the CASA model for assessment, nor the SYM model for deriving BRPs. Consideration should be given into whether any mismatches are likely to be significant sources of bias.
- Continuing effort should be directed towards estimating M (e.g. using information from closed areas) and refining estimates of its uncertainty.
- Future assessment reports should clearly document any changes to the CASA model, giving information on the rationale for the changes and the likely impacts on the assessment outcomes.
- Spatial correspondences should be explored in detailed statistical analyses of dredge and video survey data series, with a view to determining sources of uncertainty in both survey trends and the possible reasons for differences between the surveys in recent stock trends.
- Research is needed into the possibility of unaccounted mortality in large year-classes. Possibilities include density-dependent mortality (e.g. due to attraction of predators) and increased discard and incidental mortality. Analysis of existing survey data may shed some light on existing patterns, but it is likely that new survey observations will be needed to test any hypotheses that arise about causal factors.
- Members of the IS should be encouraged to publish their innovative approaches to dealing with uncertainty in BRPs with a view to making the methods known and accessible for application to other stocks and species.
- Research is needed into the basis for current high scallop productivity levels in MAB, and the risks of returning to a lower productivity regime. Recruitment patterns should be considered in relation to stock biomass, environmental and climatic factors. Modeling of larval transport mechanisms may shed light on the factors required for retention of scallop larvae over suitable settlement substrates.
- Consideration should be given to appropriate metrics for fishing mortality to be included in plots of historical overfishing status, given changes over time in selection patterns (c.f. pollock assessment).

Pollock

- Consideration should be given to improved approaches for the pro-ration of transboundary pollock catches in the assessed stock.
- Continuing attention should be paid to stock structure of pollock in the NW Atlantic with a view to refining stock definitions for future assessments. This is likely to require systematic tagging, possibly alongside genetics studies and modeling of larval transport.
- Methods for hindcasting historical discard estimates (especially before the mid-1980s) should be investigated based on analysis of survey and landings LFDs.
- Particular attention should be paid to validating the existence or otherwise of a 'cryptic' component of the pollock stock composed of large individuals. This might involve underwater video observations of trawl gear (especially in the NEFSC surveys), gear selectivity studies, systematic tagging and targeted fishing trips involving industry vessels. It will be interesting to establish a relationship between tow speed and catch LFD.
- There should be further investigation into the possibilities of including ME/NH survey data, and data from similar surveys, as a recruitment index in the assessments.

- Further investigations should be made into the possible sources of retrospective patterns in the assessment, with particular regard to issues relating to domed selectivity curves.
- Plots giving an historical perspective into overfishing/overfished status should be included in the assessment.
- Work should be continued into the incorporation of energy flows, predator-prey dynamics and ecosystem considerations into assessments.
- Model uncertainties (e.g. domed versus flat-topped survey selection patterns) should be included as a component of the risk analysis for possible management options.

Acknowledgments

I would like to thank all members of the Southern Demersal Working Group, Invertebrate Subcommittee and Northern Demersal Working Group for their hard work before and during the SARC 50 meeting and for their willingness to respond to questions and requests for analyses during the meeting. Thanks to NEFSC staff for hospitality and meeting arrangements, especially to Jim Weinberg, Paul Rago and Andrea Toran. I am grateful to fellow review panel members Bob O'Boyle, Pat Sullivan, Kurtis Trzcinski and John Wheeler for being a pleasure to work with, and particularly to Bob for his good humored and efficient chairmanship that got us through the meeting. Grateful thanks also to Manoj Shivlani for his usual excellent job of making all the necessary administrative and logistic arrangements, and particularly for getting me home on time!

References

Gedamke, T. & Hoenig, J.M., 2006. Estimating mortality from mean length data in nonequilibrium situations, with application to the assessment of goosefish. Transactions of the American Fisheries Society, **135**, 476–487.

Main, J. & Sangster, G.I., 1981. A study of the fish capture process in a bottom trawl by direct observations from a towed underwater vehicle. *Scottish Fisheries Research Report*, No. 23, 24 pp.

Main, J. & Sangster, G.I., 1983. Fish reactions to trawl gear – a study comparing light and heavy ground gear. *Scottish Fisheries Research Report*, No. 27, 17 pp.

APPENDIX I: Bibliography of materials provided for review

Monkfish background documents

A1. Northeast Data Poor Stocks Working Group, 2007. *Monkfish Assessment Report for 2007.* Northeast Fisheries Science Center Reference Document 07-21.

A2. Northeast Fisheries Science Center, 2010. *Cooperative Monkfish Surveys.* Unpublished background document.

A3. Northeast Data Poor Stocks Working Group, 2007. *Monkfish Assessment Summary for 2007.* Northeast Fisheries Science Center Reference Document 07-13.

A4. Northeast Fisheries Science Center, 2009. *Goosefish Bigelow-Albatross Calibration Factor Analyses.* Unpublished background document.

A5. Haring, P. & Maguire, J-J., 2008. The monkfish fishery and its management in the northeastern USA. *ICES Journal of Marine Science*, **65**, 1370–1379.

A6. Richards, A., Nitschke, P., Cadrin, S., Rago, P. & Maguire, J-J., 2007. Population assessment of monkfish (*Lophius americanus*) in the northeastern USA. *ICES CM 2007/K:15*.

A7. Johnson, A., Richards, A., Place, A. & Nguluwe, B., 2010. *The use of DNA markers to evaluate US fishery management areas and effective population size of monkfish, Lophius Americanus.* Unpublished background document.

A8. Richards, R.A., Nitschke, P.C. & Sosebee, K.A., 2008. Population biology of monkfish *Lophius americanus*. *ICES Journal of Marine Science*, **65**, 1291–1305.

A9. Sherwood, G. & Grabowski, J., 2010. *Critical diet and habitat shifts in New England monkfish (Lophius americanus): insights from stable isotopes and relation to biological condition.* Unpublished background document.

A10. Sherwood, G., Grabowski, J., Tallack, S., Stephens, N., Platz, T. & Caldwell, T., 2008. *A tagging study to assess monkfish (Lophius americanus) movements and stock structure in the northeastern United States.* 2007 Monkfish Research Set Aside Program, Final Report. Gulf of Maine Research Institute.

A11. Rago, P.J., Weinberg, J.R. & Weidman, C., 2006. A spatial model to estimate gear efficiency and animal density from depletion experiments. *Canadian Journal of Fisheries and Aquatic Sciences*, **63**, 2377-2388.

Monkfish working papers

WP1. Southern Demersal Working Group, 2010. *A. Monkfish (Goosefish) Stock Assessment for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Report.

WP1-Appendices. Southern Demersal Working Group, 2010. *Appendices to the Monkfish Assessment Report.* 50th Northeast Stock Assessment Workshop, Appendices to Assessment Report.

WP2. Southern Demersal Working Group, 2010. *A. Monkfish Assessment Summary for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Summary Report.

Sea Scallop background documents

B1. Northeast Fisheries Science Center, 2007. *Sea Scallop Assessment Summary for 2007.* pp. 24-37 in: *45th Northeast Regional Stock Assessment Workshop (45th SAW): 45th SAW Assessment Summary Report.* Northeast Fisheries Science Center Reference Document 07-11.

B2. Northeast Fisheries Science Center, 2007. *Assessment of Atlantic Sea Scallops.* pp. 139-370 in: *45th Northeast Regional Stock Assessment Workshop (45th SAW): 45th SAW Assessment Report.* Northeast Fisheries Science Center Reference Document 07-16.

B3. Northeast Fisheries Science Center, 2004. *Sea Scallop Assessment Summary for 2004.* pp. 14-16 in: *39th Northeast Regional Stock Assessment Workshop (39th SAW): Assessment Summary Report.* Northeast Fisheries Science Center Reference Document 04-10a.

B4. Northeast Fisheries Science Center, 2004. *Sea Scallop Assessment Summary for 2004.* pp. 87-211 in: *39th Northeast Regional Stock Assessment Workshop (39th SAW): Assessment Report.* Northeast Fisheries Science Center Reference Document 04-10b.

B5. Hart, D.R., 2001. Individual-based yield-per-recruit analysis, with an application to the Atlantic sea scallop, *Placopecten magellanicus*. *Canadian Journal of Fisheries and Aquatic Sciences*, **58**, 2351-2358.

B6. Hart, D.R., 2001. Yield- and biomass-per-recruit analysis for rotational fisheries, with an application to the Atlantic sea scallop (*Placopecten magellanicus*). *Fishery Bulletin*, **101**, 44-57.

B7. Hart, D.R. & Chute, A.S., 2009. Verification of Atlantic sea scallop (*Placopecten magellanicus*) shell growth rings by tracking cohorts in fishery closed areas. *Canadian Journal of Fisheries and Aquatic Sciences*, **66**, 751-758.

B8. Hart, D.R. & Chute, A.S., 2009. Estimating von Bertalanffy growth parameters from growth increment data using a linear mixed-effects model, with an application to the sea scallop *Placopecten magellanicus*. *ICES Journal of Marine Science*, **66**, 2165–2175.

B9. Hart, D.R. & Rago, P.J., 2006. Long-term dynamics of U.S. Atlantic sea scallop *Placopecten magellanicus* populations. *North American Journal of Fisheries Management*, **26**, 490–501.

B10. Jacobsen, L.D., Hart, D., Stokesbury, K.D.E., Jaffarian, T., Allard, M.A., Marino II, M.C., Chute, A., Nogueira, J.I., Harris, B.P. & Rago, P., 2010. *Fishery Bulletin*, **108**, 233-247.

Sea Scallop working papers

WP1. Invertebrate Subcommittee, 2010. *B. Atlantic Sea Scallop Stock Assessment for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Report.

WP1-Appendices. Invertebrate Subcommittee, 2010. *Appendices to the Sea Scallop Assessment Report for 2010.* 50th Northeast Stock Assessment Workshop, Appendices to Assessment Report.

WP2. Invertebrate Subcommittee, 2010. *B. Sea Scallop Assessment Summary for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Summary Report.

Pollock background documents

C1. Northeast Fisheries Science Center, 2008. *Pollock in subareas 5 and 6.* pp. 642-657 in: *Assessment of 19 Northeast Groundfish Stocks through 2007 Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008.* Northeast Fisheries Science Center Reference Document 08-15.

C2. Thompson, N., 2009. *Update on status of pollock, including Autumn 2008 NEFSC survey data.* Unpublished memo to Pat Kurkul.

C3. Mayo, R.K., 1998. *Pollock.* pp. 67-69. in: *Status of Fishery Resources off the Northeastern US for 1998.* Northeast Fisheries Science Center.

C4. Northeast Fisheries Science Center, 1993. *Pollock.* pp. 7-38 in: *Report of the 16th Northeast Regional Stock Assessment Workshop (16th SAW): Stock Assessment Review Committee (SARC) Consensus Summary of Assessments.* Northeast Fisheries Science Center Reference Document 93-18.

C5. Mayo, R.K., 2001. *Scotian Shelf/Georges Bank/Gulf of Maine Pollock.* pp. 155-161. in: *Assessment of 19 Northeast Groundfish Stocks through 2000: A Report to the New England Fishery Management Council's Multi-Species Monitoring Committee.* Northeast Fisheries Science Center Reference Document 01-20.

C6. Mayo, R.K., Col, L. & Traver, M., 2005. *Georges Bank/Gulf of Maine Pollock.* pp. 359-371 in: *Assessment of 19 Northeast Groundfish Stocks through 2004: 2005 Groundfish Assessment Review*

Meeting (2005 GARM), Northeast Fisheries Science Center, Woods Hole, MA, 15-19 August 2005. Northeast Fisheries Science Center Reference Document 05-13.

C7. NOAA, 1989. *Stock Assessment Information for Pollock, Pollachius virens (L.), in the Scotian Shelf, Georges Bank, and Gulf of Maine Regions.* NOAA Technical Memorandum NMFS-F/NEC-65.

C8. Neilson, J.D., Stobo, W.T. & Perley, P., 2006. Pollock (*Pollachius virens*) stock structure in the Canadian Maritimes inferred from mark-recapture studies. *ICES Journal of Marine Science*, **63**, 749-765.

C9. North East Fisheries Science Center, 2010. *Pollock Data Meeting.* Unpublished background document.

C10. Clay, D., Stobo, W.T., Beck, B. & Hurley, P.C.F., 1989. Growth of juvenile pollock (*Pollachius virens* L.) along the Atlantic coast of Canada with inferences of inshore-offshore movements. *Journal of Northwest Atlantic Fishery Science*, **9**, 37-43.

C11. Chase, P., Brown, R., Politis, P., Sherman, S. & King, J., 2010. *Comparison of surveys.* North East Fisheries Science Center, unpublished background document.

C12. North East Fisheries Science Center, 2008. *Technical Documentation for ASAP Version 2.0.* NOAA Fisheries Toolbox.

C13. Stone, H., Nelson, C., Clark, D. & Cook, A., 2009. *2008 Assessment of Pollock in 4VWX+5.* Canadian Science Advisory Secretariat, Research Document 2009/001.

C14. Nies, T.A., 2010. *Management of the Northeast Multispecies Fishery 1977-2009.* New England Fishery Management Council, Pre-Decisional Information.

Pollock working papers

WP1. Northern Demersal Working Group, 2010. *C. Stock Assessment of Pollock in US Waters for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Report.

WP2. Northern Demersal Working Group, 2010. *C. Pollock Assessment Summary for 2010.* 50th Northeast Stock Assessment Workshop, Assessment Summary Report.

APPENDIX II: CIE Statement of Work

Statement of Work

(v. 5 April 2010)

External Independent Peer Review by the Center for Independent Experts

50th Stock Assessment Workshop/ Stock Assessment Review Committee (SAW/SARC)
Monkfish, Sea scallop, and Pollock

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

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

Project Description: The purpose of this SARC50 meeting will be to provide an external peer review of benchmark stock assessments for monkfish (also called goosefish, *Lophius americanus*), sea scallop (*Placopecten magellanicus*), and pollock (*Pollachius virens*). Goosefish are piscivorous, and they rest partially buried on soft bottom substrates and attract prey using a modified fin ray that resembles a fishing pole and lure. Sea scallops are relatively large filter-feeding bivalves that rest on the bottom. Pollock are fast swimming, schooling fish. This review determines whether the scientific assessments are adequate to serve as a basis for developing fishery management advice. Results form the scientific basis for fishery management in the northeast region. This meeting satisfies Prioritization criteria 1-3. 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 SARC Summary Report format is attached as **Annex 4.**

The SARC50 review panel will be composed of three appointed reviewers from the Center of Independent Experts (CIE), a reviewer from the New England Fishery Management Council's Science and Statistics Committee (SSC) and an independent chair from SSC of the New England or Mid-Atlantic Fishery Management Council. The reviewer from the NEFMC SSC is expected

to perform duties similar to those described herein for CIE reviewers and on a similar schedule. The SARC panel will write the SARC Summary Report and each CIE and SSC reviewer will write an individual independent review report.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. In general, CIE reviewers for SARC meetings shall have working knowledge and recent experience in the application of modern fishery stock assessment models (e.g., statistical catch-at-age, delay-difference, and traditional VPA). Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting, as well as in development and application of biological reference points. Direct experience with the biology and population dynamics of species on the agenda would be beneficial.

Specifically for the monkfish assessment, reviewers should be familiar with length-based statistical assessment models and methods for experimentally estimating trawl capture efficiency, and survey trawl calibration studies. Familiarity with statistical methods for ageing fish, and monkfish in particular, is desirable.

For the scallop assessment, reviewers should be familiar with methods for assessing invertebrates, especially length-based approaches. Expertise in the implications of spatially distinct harvest patterns for stock dynamics and implications for appropriate harvest rates and biological reference points is essential.

For the pollock assessment, reviewers should be familiar with methods for estimating relative abundance of a schooling fish, statistical catch at age models, and potentially methods for model averaging.

Each CIE reviewer's duties shall not exceed a maximum of 17 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the SARC chair's duties should not exceed a maximum of 17 days (i.e., several days prior to the meeting for document review; the SARC meeting in Woods Hole; several days following the open meeting for SARC Summary Report preparation).

Location and Date of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts during June 1-5, 2010.

Charge to SARC panel: The panel is to determine and write down whether each Term of Reference of the SAW (see **Annex 2**) 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.

Statement of Tasks:

1. Prior to the meeting

(SARC chair and CIE reviewers)

Review the reports produced by the Working Groups and read background reports.

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

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) 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 other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

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

Pre-review Background Documents: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Open meeting

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **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 herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

(SARC chair)
Act as chairperson, where duties include control of the meeting, coordination of presentations and discussion, making sure all 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 draft Assessment Summary Report.

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

(SARC CIE reviewers)
For each stock assessment, participate as a peer reviewer in panel discussions on assessment validity, results, recommendations, and conclusions. From a reviewer's point of view, determine whether each 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 Points (BRP) or their proxies are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRPs are the best available at this time.

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

The Independent CIE Report can also be used to provide greater detail than the SARC Summary Report on specific 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 (see **Annex 4**).

(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 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 4** 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 SARC Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. CIE reviewers are not required to reach a consensus, and should provide a brief summary of the reviewer's 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 in Woods Hole, Massachusetts during June 1-5, 2010, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 18 June 2010, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each 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.

30 April 2010	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
18 May 2010	NMFS Project Contact will attempt to provide CIE Reviewers the pre-review documents by this date
1-5 June, 2010	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
4-5 June 2010	SARC Chair and CIE reviewers work at drafting reports during meeting at Woods Hole, MA, USA
18 June 2010	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
21 June 2010	Draft of SARC Summary Report, reviewed by all CIE reviewers, due to the SARC Chair *
28 June 2010	SARC Chair sends Final SARC Summary Report, approved by CIE reviewers, to NEFSC contact (i.e., SAW Chairman)
2 July 2010	CIE submits CIE independent peer review reports to the COTR
9 July 2010	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

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

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

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

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

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

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with 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 acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-713-2363 ext 136

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

Key Personnel:

Dr. James Weinberg, NEFSC Stock Assess. Workshop (SAW) Chair, (NMFS Project Contact)
National Marine Fisheries Service, NOAA
Northeast Fisheries Science Center
166 Water St., Woods Hole, MA 02543
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Dr. Nancy Thompson, NEFSC Science Director
National Marine Fisheries Service, NOAA
Northeast Fisheries Science Center
166 Water St., Woods Hole, MA 02543
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Annex 1: Format and Contents of CIE Independent Peer Review Report

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

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

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

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

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

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

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

3. The reviewer report shall include 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.

ANNEX 2:

Assessment Terms of Reference for SAW/SARC50 (June 2010)

(file vers.: 12/22/09-c)

A. Monkfish

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

2. Report results of 2009 cooperative monkfish survey and describe sources of uncertainty in the data and results.

3. Characterize other survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, length data, state surveys). Describe the uncertainty in these sources of data.

4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

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

6. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 5).

7. Evaluate monkfish diet composition data and its implications for population level consumption by monkfish.

8. 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 (through 2016). 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 to examine important sources of uncertainty in the assessment.
    b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

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

B. Sea scallop

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, length data, etc.). Describe the uncertainty in these sources of data. Document the transition between the survey vessels and their calibration. If other survey data are used in the assessment, describe those data as they relate to the current assessment (Exclude consideration of future survey designs and methods).

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

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

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

6. 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 (through 2014). 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 to examine important sources of uncertainty in the assessment.
    b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

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

C. Pollock

1. Characterize the commercial and recreational catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data, including consideration of stock definition.

2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data, including consideration of stock definition.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

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

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

6. Evaluate pollock diet composition data and its implications for population level consumption by pollock.

7. 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 (through 2017). 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 to examine important sources of uncertainty in the assessment.
    b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    c. For a range of candidate ABC scenarios, compute probabilities of rebuilding the stock by 2017.
    d. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

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

Appendix to the SAW TORs:

Clarification of Terms
used in the SAW/SARC Assessment 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 3: Meeting Agenda (Preliminary)

50th Northeast Regional Stock Assessment Workshop (SAW 50)
Stock Assessment Review Committee (SARC) Meeting

June 1-5, 2010

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

This is a Preliminary AGENDA (version: 2 Feb 2010)

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Tuesday, June 1

8:45-9 AM

Opening			
Welcome	**James Weinberg**, SAW Chairman		
Introduction	**TBD**, SARC Chairman		
Agenda			
Conduct of Meeting			
9-11	Assessment Presentation (A. Monkfish)		
	TBD	**TBD**	**TBD**
11-11:15	Break		
11:15 -Noon	SARC Discussion w/ presenters (A. Monkfish)		
	TBD, SARC Chairman		
Noon – 1:15	Lunch		
1:15 – 3:30	Assessment Presentation (B. Sea Scallop)		
	TBD	**TBD**	**TBD**
3:30-3:45	Break		
3:45-5:30 PM	SARC Discussion w/ presenters (B. Sea Scallop)		
	TBD, SARC Chairman		

Wednesday, June 2

8:45-10:45 Assessment Presentation (C. Pollock)
TBD **TBD** **TBD**

10:45-11 Break

11 -Noon SARC Discussion w/ presenters (C. Pollock)
TBD, SARC Chairman

Noon – 1:15 Lunch

1:15 – 3:15 Revisit w/ presenters (A. Monkfish)
TBD, SARC Chairman

3:15-3:30 Break

3:30-5:30 PM Revisit w/ presenters (B. Sea Scallop)
TBD, SARC Chairman

Thursday, June 3

8:45-10:45 Revisit w/ presenters (C. Pollock)
TBD, SARC Chairman

10:45 – 11 Break

11 - Noon Review/edit Assessment Summary Report (A. Monkfish)
TBD, SARC Chairman

Noon – 1:15 Lunch

1:15 – 2:30 cont. Review Assessment Summary Report (A. Monkfish)
TBD, SARC Chairman

2:30 – 2:45 Break

3 – 5:30 PM Review/edit Assessment Summary Report (B. Sea Scallop)
TBD, SARC Chairman

Friday, June 4

9 - 11:30 Review/edit Assessment Summary Report (C. Pollock)
TBD, SARC Chairman

11:30 – 1:00 Lunch

1 – 5:30 PM SARC Report writing. (closed meeting)

Saturday, June 5

9:00 – 5:30 PM SARC Report writing. (closed meeting)

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

ANNEX 4: Contents of SARC Summary Report

1. The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the SARC. Following the introduction, for each assessment reviewed, the report should address whether each Term of Reference of the SAW 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.

APPENDIX III: Panel Membership

SARC Chair

Bob O'Boyle
Beta Scientific Inc.
Bedford
Nova Scotia
Canada

SARC Reviewer

Patrick Sullivan
Department of Natural Resources
Cornell University
Ithaca
New York

CIE Reviewers

Mike Bell
International Centre for Island Technology
Heriot-Watt University
Orkney
Scotland
UK

Kurtis Trzcinski
Bedford Institute of Oceanography
Department of Fisheries and Oceans
Dartmouth
Nova Scotia
Canada

John Wheeler
Science, Oceans and Environment Branch
Department of Fisheries and Oceans
St John's
Newfoundland
Canada