SARC 61 (Atlantic Surfclam): NEFSC, Woods Hole MA, 19-21 July 2016
Center for Independent Experts (CIE) Independent Peer Review Report

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Executive Summary

This report summarises my notes and conclusions on the SARC 61 assessment of Atlantic surfclam, presented during the SARC 61 meeting at the Northeast Fisheries Science Center (NEFSC), Woods Hole MA, during 19-21 July 2016. I found the background reading and the meeting itself to be extremely informative and well-structured, and that the ToRs had all been met to the extent possible and necessary for the assessment. The assessment was well-presented by the lead scientist and SAW working group chair and contained a great deal of relevant information, and I was happy to accept it as a valid representation of stock status. I did not identify any serious weaknesses, but there are a number of issues that I think could improve the assessment still further if addressed which I cover below. Overall, I would like to commend the NEFSC team for their open, accommodating and non-defensive discussion of the material, and for all the help they gave me and my fellow reviewers during the process.

Reviewer Background

I am an applied mathematician and modeller by training, and I have worked in quantitative fisheries science since 1996. Having served as the Chair of the ICES Working Groups on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK, 2004—2006) and Methods of Stock Assessment (WGMG, 2007—2009), I now lead the Sea Fisheries Programme of Marine Scotland (around 60 staff), which is part of the Scottish Government based at the Marine Laboratory in Aberdeen, Scotland. One of our key roles is the analysis and interpretation of data from the fishing industry, and the provision of advice on fisheries and fish stocks to managers in Scotland, the UK and Europe. I also still lead on the ICES assessments of Northern Shelf haddock and North Sea lemon sole.

Role in the Review Activities

Prior to the SARC 61 meeting in Woods Hole (19-21 July 2016), I thoroughly reviewed the background documents provided for the review panel, along with the extant versions of the stock assessment report and summary report for Atlantic surfclam (see References below for a document list). During the SARC 61 meeting, I participated in full in the plenary discussions during and after the presentations provided, as well as intersessionally with the other review panel members and the SARC chair. I took copious notes during these discussions, which form the basis of my comments below. Finally, I contributed in full to the writing of the SARC Summary Report, and wrote this Individual Independent Review Report.

Overall Conclusions and Suggestions for Improvements to the SARC Process

In general, I found the process to be very well-organised and conducive to the review. The NEFSC team were extremely helpful and responsive to our requests, and presented the results of their hard work in an open, non-defensive manner and with good humour throughout. It's true that the assessment report could have been made available a little earlier to give the reviewers time to go through it in sufficient detail prior to the meeting, and I would have appreciated a short reading-list guide to explain how (or if) each of the background documents was relevant to the assessment report, but these are relatively minor issues.

I found the LaTeX-generated layout of the stock assessment report to be excellent: I would always recommend the use of this document markup system for reports of this kind (Lamport 1994), and the clear presentation and frequent hyperlinks certainly facilitated reviewing. However, there are several places in the document where essential details were missed or the treatment became slightly cursory. For example, the implementation of the SS3 model could have been more fully detailed. There are some plots that were included yet were barely commented on in the text, which begs the question of

why they are there. Furthermore, in some cases there is no mention made of the software used for analyses – whereas in others the system is quite fully specified. It might be helpful to make this specification a general rule, if only to help the reader understand more completely what has been done. These issues would be fine in an update assessment for which a detailed stock annex exists, but in this case this document is all there is so it does need to be complete. I would argue this would include a short introduction to the SS3 model.

Comments regarding each ToR

ToR 1. Estimate catch from all sources including landings and discards. Map the spatial and temporal distribution of landings, discards, fishing effort, and gross revenue, as appropriate. Characterize the uncertainty in these sources of data.

This ToR was met, and I concur with the conclusions of the Panel Review.

However, there are a number of issues that I consider important to raise here. The total weight of surfclam landings, and the location from which those landings originated, are based entirely on skippers' logbooks. There appeared to be no independent external verification of either of these datasets, which I found to be concerning. It may indeed be the case that landings are very accurate – the quota is not restrictive and there would be little to be gained from either area misreporting or weight underreporting – but without any independent confirmation it is very difficult for a reviewer to conclude that the landings data are reliable. It was also quite difficult to have a full and frank discussion of the potential of misreporting with industry representatives present at the meeting.

Similarly, discards in recent years are *assumed* to be zero, on the basis that a) the quota is not restrictive with the fishery limited more by market considerations, and b) commercial dredges are thought to be sufficiently selective to avoid capture of undersized surfclams (historical discarding was thought to have arisen from restrictive landing size limits). However, without independent observations (either from at-sea personnel or remote electronic monitoring such as CCTV) it is impossible to be fully confident that discarding really is not a problem. NEFSC have commenced an onboard observer programme this year, so as this matures it should be able to provide this confidence in future years.

I also asked whether discarding is in fact legal in this fishery, and whether it is considered to be a problem (both environmentally and societally)? It seems that while not illegal, and while there are not societal pressures to ban discarding as we have in Europe, there are pressures from other fisheries – a related example would be scallop fishers being pressurised by groundfish fishers if they take too many flounders, and one can envisage something of this sort happening in the surfclam fleet.

The distribution of fishing effort was also completely based on skippers' logbooks. This can lead to considerable uncertainty, as skippers may not be appropriately diligent in recording fishing locations, or they may be inclined towards deliberate falsehood if encouraged by a perception of financial gain. Mention was made during the meeting of cases in which vessels with quota to fish in state waters were apprehended fishing in federal waters, and vice versa, so such misreporting is probably not unheard of. I enquired about the availability of technology such as Vessel Monitoring Systems (VMS), which are a legal requirement for all vessels over 12 m fishing in European waters, and it transpired that VMS is indeed installed on all vessels of the Atlantic surfclam fleet and that VMS data are available to government scientists. I would strongly recommend the extended use of such data to map and characterise the fishing dynamics of the surfclam fleet, over and above the perceptions provided by skippers' logbooks.

There was some discussion during the meeting on the assumed incidental mortality rate of 12%, which is applied to all landings regardless of the size of the surfclams involved. The rate is intended to

account for surfclams which are damaged by the passage of the dredge without being caught, but it is quite a blunt tool and takes no account of size or other potentially relevant factors. A theoretical treatment was provided to the reviewers which explained how the 12% rate was determined and provided support for its use, but I would prefer to have seen the results of a ground-truthing experiment (using, for example, divers following dredges) to determine empirically what a suitable rate would be, and (crucially) whether it would be size-dependent. Furthermore, the addition of a constant rate only serves to scale the estimated fishing mortality, and if the relevant biological reference point is a) based on a full F time-series that is all scaled in this way, and b) expressed as relative trends rather than absolute estimates, it is hard to see what difference the multiplier makes. Without empirical support, its use is not particularly scientific and it could easily be removed.

Finally, I have two minor observations. Firstly, surfclam cage tags are valid across the entire stock management area and can be transferred up and down the coast, so even localised depletion will not result in quotas being exhausted. In other words – the quota cannot prevent localised depletion. Secondly, the plots and tables of prices did not clarify the distinction between real and nominal prices, although this was explained during the meeting - real prices are corrected for inflation, while nominal prices are those reported on sales tickets. A small point, but this explanation would help for the clarity of the next stock assessment report.

ToR 2. Present the survey data being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Use logbook data to investigate regional changes in LPUE, catch and effort. Characterize the uncertainty and any bias in these sources of data. Evaluate the spatial coverage, precision, and accuracy of the new clam survey.

This ToR was met, and I concur with the conclusions of the Panel Review.

Fishing mortality rates for Atlantic surfclam are far lower than the assumed natural mortality, and in this situation the survey data is always a much greater driver of the stock assessment than commercial catch data. As the survey was the key to understanding the assessment and what it concluded about stock dynamics, it was very important that it be generated and used in an appropriate manner.

Initially, on reading the report, my main concern about the entire assessment was the use of the extremely short time-series of the new survey (the MCD survey, using commercial fishing gear). This had only two years of data in the south, and only one in the north, and in the standard VPA-type assessment structure this certainly could not be used – we would generally recommend 4 or 5 data points before implementing a new survey in an assessment. The use of the survey data was not particularly well-described in the assessment report, but it became clear during the meeting that it was only included to provide a prior on selectivity and efficiency (or "catchability") parameters that would otherwise be much less informative, and that serves to constrain the parameter estimation (the solution surface is very flat – see Figure 105, without priors you can get dramatically different scales – quite common with a very low F fishery). The MCD survey selectivities are *not* estimated in the model (this wouldn't make sense with only two data points), but rather through field experiments. This is all acceptable, but it remains a concern (as also expressed by the assessors) that the inclusion of the new survey can have such a significant effect on the "scale" of the biomass estimate (what I would think of as the absolute estimate). On balance, it is probably reasonable to include the new survey in the way that it has been done. However, it was also interesting to note that the new survey did not lead to the expected improvement in abundance estimation precision, and it is clear that further work needs to be done on this aspect.

I was also concerned about the use of hauls from different years to fill-in gaps in survey data. The use of closely-adjacent hauls from the same survey is often justifiable, but the wholesale use of data from completely different years to plug holes in survey coverage does seem very questionable. One result would be (possibly) an over-smoothing of the survey indices from year-to-year. In the Panel, we

concluded that the area of the survey that had been missed (and which subsequently had been filled in this way) was actually relatively small, so that the impact of the fill-ins may not have been all that significant, but I would still recommend the use of model-based interpolation to circumvent this difficulty.

Reading the report, it was not clear why the older ("RD") survey had been split into "trend" and "scale" (swept area absolute abundance estimates) components. The Panel questioned this approach during the meeting, but I have to say I did not find the offered explanation convincing, and it is still not clear to me exactly what was done, nor what advantage is conferred. I felt this aspect could have been presented with more clarity.

During the meeting, it transpired that the 2016 Georges Bank section of the survey was due to commence two weeks after the end of the SARC 61 meeting. It does seem strange that the meeting was scheduled before the survey, and not after it so as to make best use of the most recent data. There is no mechanism in the management system to permit assessment updates following surveys, such as we use in ICES, and this means that any indications of year-class strength from this year's survey will not be included in the stock assessment until the next surfclam SAW and SARC (which may not be for three years).

ToR 3. Determine the extent and relative quality of benthic habitat for surfclams in the Georges Bank ecosystem to refine estimates of stock size based on swept area calculations.

This ToR was met (although the time and space devoted to it was limited), and I concur with the conclusions of the Panel Review. During the meeting (and in the Summary Report), I emphasised the fact that the assessment is only providing estimates for the fishable part of the stock, as that is all that can be observed through commercial and survey fishing. This is of course the same situation as pertains in many assessments, and is only really significant if absolute biomass estimates are to be used subsequently in ecosystem models – I'm not aware that this is the case here.

During the meeting, I mentioned that, in the UK at least, hydraulic dredges are thought to be fairly damaging to the local benthos, and that their use is considerably restricted as a result. The response to this was that there is no problem with such damage in the US, but I wonder if this is just because it has not been considered or studied in detail – hydraulic dredges are very similar the world over. This suggests that there are not environmental pressure groups working against their use in the US, which I find surprising.

ToR 4. Quantify changes in the depth distribution of surfclams over time. Review changes over time in surfclam biological parameters such as length, width, and growth.

This ToR was met, and I concur with the conclusions of the Panel Review.

It is clear, from the available evidence, that surfclams have been moving into deeper water over time, and that their distribution now overlaps with that of the ocean quahog. There have also been corresponding changes in growth parameters, which also are likely to be influential on current and future biomass. The only aspect that I would have changed in this section is the length distribution plots, which have subsequent years next to each other – I would suggest that these plots be oriented in portrait mode and that the time-series of length distributions be stacked vertically. To me, this is always an easier way to compare distributions across years.

ToR 5. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series (integrating results from TOR 3, as appropriate) and estimate their

uncertainty. Include a historical retrospective analysis to allow a comparison with previous assessment results and previous projections.

This ToR was met, and I concur with the conclusions of the Panel Review.

This is certainly the ToR that occupied the bulk of the time set aside for the meeting. The issue, I think, was that the Stock Synthesis 3 model that was used for the assessment is potentially very complicated and difficult to interpret. None of the reviewers had much experience with it, and it wasn't very well described in the report, so it was necessary to explore the model settings in considerable detail during the meeting in order to comment cogently on it.

The justification for the use of SS3 is clear – there is a great deal of length data for this stock, but only enough ages to characterise growth (rather than generate full age-length keys as would be required for a complete age-based assessment). SS3 allows the assessor to utilise this mix of data, but it is also a very comprehensive assessment system that can be implemented in very large number of ways. The reviewers in the Panel were insufficiently familiar with SS3 to be able to comment or advise in very much detail on the way in which the model had been set up, and this was unfortunate.

While the trends in biomass and recruitment are relatively consistently estimated across different sensitivity runs, it was clear that the absolute values (the "scales") of these measures were highly dependent on runtime settings and which surveys were included, to the extent that the absolute abundance could not be determined with any certainty. The assessment team (and the fishery manager present) therefore focused correctly on trend-based stock summaries, but maintained that a scale estimate was still required to specify catch limits. I noted that one doesn't really need a scale estimate to provide catch advice to managers – the harvest control rule can be based on proportional changes in the survey index (or, equivalently, a scale-free assessment estimate).

I found the report and discussion on the use of depletion experiments (repeated fishing on a marked area until there are no clams left) to estimate priors on dredge efficient to be very interesting. This approach must rely on the ability to position a dredge extremely accurately, which is more practicable now with the new MCD dredge (it proved to be very problematic with the old dredge). I suggested that cameras on the dredge could be used to ensure that the track is exactly the same each time. While the issue is probably not critical for the assessment as a whole, I did appreciate the discussion.

The report section about the domed selectivity curve was rather less illuminating. It is important to clarify the terms used, especially for European reviewers who may well be used to different terms, and it required some discussion to determine that the capture efficiency is the probability of capture when the gear passes over an animal, whereas selectivity is the probability of retention in the gear. This was not very well explained, and also didn't cover "availability" (which we can define as the probability of encountering the gear in the first place). Regarding the "dome" itself, for the new survey it did seem that this was more of an artefact of small sample sizes of larger clams. There was also a reasonable explanation given for the significant dome estimated for the older survey.

The assumed value of natural mortality (M = 0.15) had been set according to the expected longevity of the species. There is probably no good empirical way to estimate an annually varying value (although the possibility of predation estimation through stomach-content analysis wasn't discussed), and in this case one could argue that it may be better to manage on the basis of total mortality Z, rather than keep a fixed M which doesn't achieve very much (and which in any case tends to overwhelm F).

The total catch is assumed to be known without error in this implementation. To me, this is a rather retrograde step – most assessments in Europe have now moved away from this assumption as it is not generally very tenable. During the discussion, it was stated that the catch is thought to be better estimated than the survey, although this was contradicted both earlier and later in the meeting. In short, the decision to assume exact catch data wasn't very well supported.

Appendix XXV of the assessment report (SAW 61, 2016) presented the results of a series of empirical (or relatively model-free) summaries of the development of the surfclam stock, using approaches such as catch-curve analysis, swept area biomass estimates and survey-based recruitment trends. I found these to be extremely useful, particularly in a situation (such as this) where the principal assessment model is quite complicated and could quite readily be implemented non-optimally. The empirical summaries serve to confirm (or otherwise) the stock dynamics perceptions arising from the main model, and either build confidence that the correct implementation has been used, or suggest ways in which it might have deviated from the correct setup. Empirical analyses are widely used in ICES assessments for this purpose.

One common example is the SURBAR method, a quasi-empirical separable model based on age indices from research vessel surveys (Needle 2016). As the model developer, I thought it would be instructive to apply SURBAR to age-based indices for surfclam kindly provided by the assessment team: both to see if the survey alone would lead to the same stock conclusions as the main assessment, but also to see if SURBAR would handle the sporadic nature of the survey data (with only one survey every two or three years). For this run, the following settings were used, based as far as possible on information in SAW 61 (2016):

Ages for mean Z	1-10
Reference age	5
Lambda smoother	10.0
Catchability q	0.01 on age 1; 0.5 on ages 2, 9, 10; otherwise 1.0

Only the earlier (RD) survey was used for this run, as SURBAR needs at least 5 years of data to be able to estimate the age effect of mortality from a survey.

Figure Needle.1 shows the four-panel summary plot from this run, while Figure Needle.2 compares the SURBAR run with the corresponding output from the main SS3 assessment model. The first plot shows that the SURBAR estimates are relatively precise, with narrow confidence intervals – this indicates that there is good contrast in the survey data to allow for effective parameter estimation. The second plot shows that the mortality estimates are not very similar between SS3 and SURBAR, and that recruitment estimates follow the same trend but are offset by a year (roughly); these differences could be the result of different definitions of mortality and recruitment between length- and age-based assessments. Finally, the biomass comparison is more comforting – this shows that the SSB trend estimates are similar between SS3 and SURBAR, which supports the conclusion regarding biomass in the main assessment.

Although there are differences between the SS3 and SURBAR assessments, the very act of presenting a simpler alternative model is (I think) an important step in full understanding the dynamics of the main model, and I would recommend that empirical analyses be continued and developed further in future assessments.

Figure Needle.1. SURBAR summary for the Atlantic surfclam stock, based on the RD survey. Biomass (spawning and total) and recruitment are on a relative scale determined by mean-standardisation of the original survey data. The grey bands give the 90% confidence interval around each estimate.

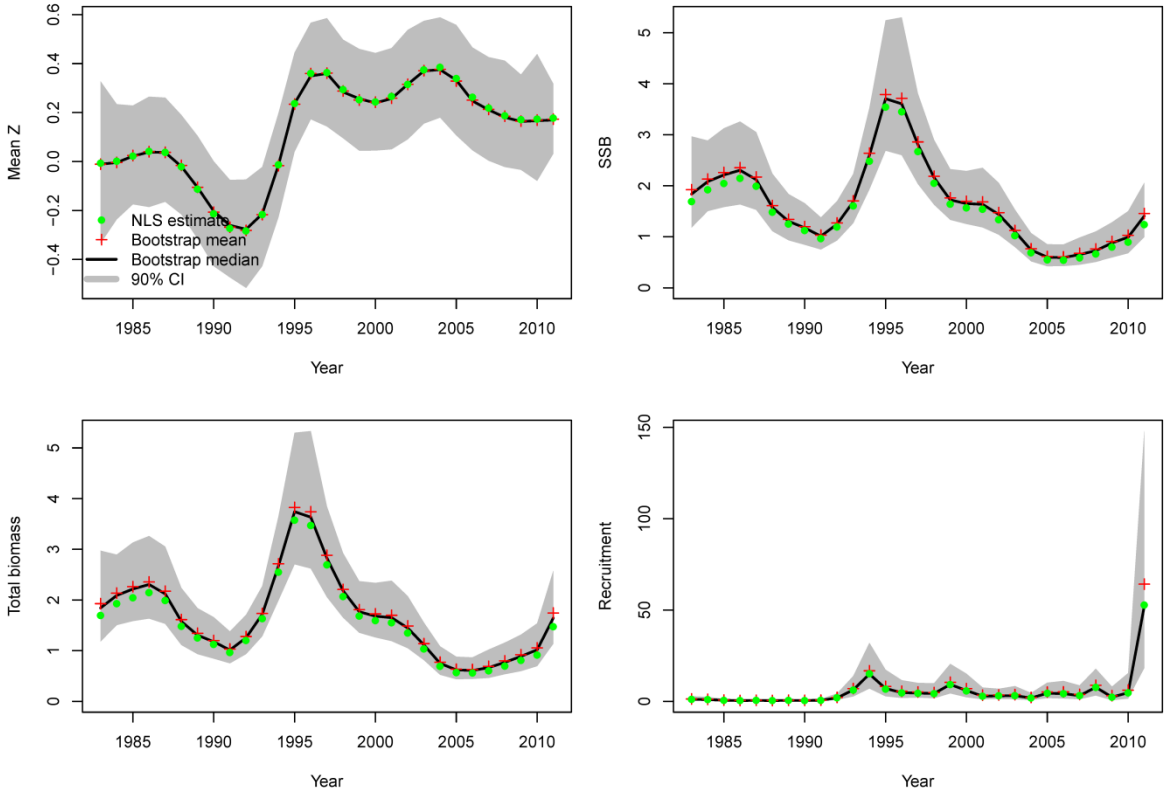
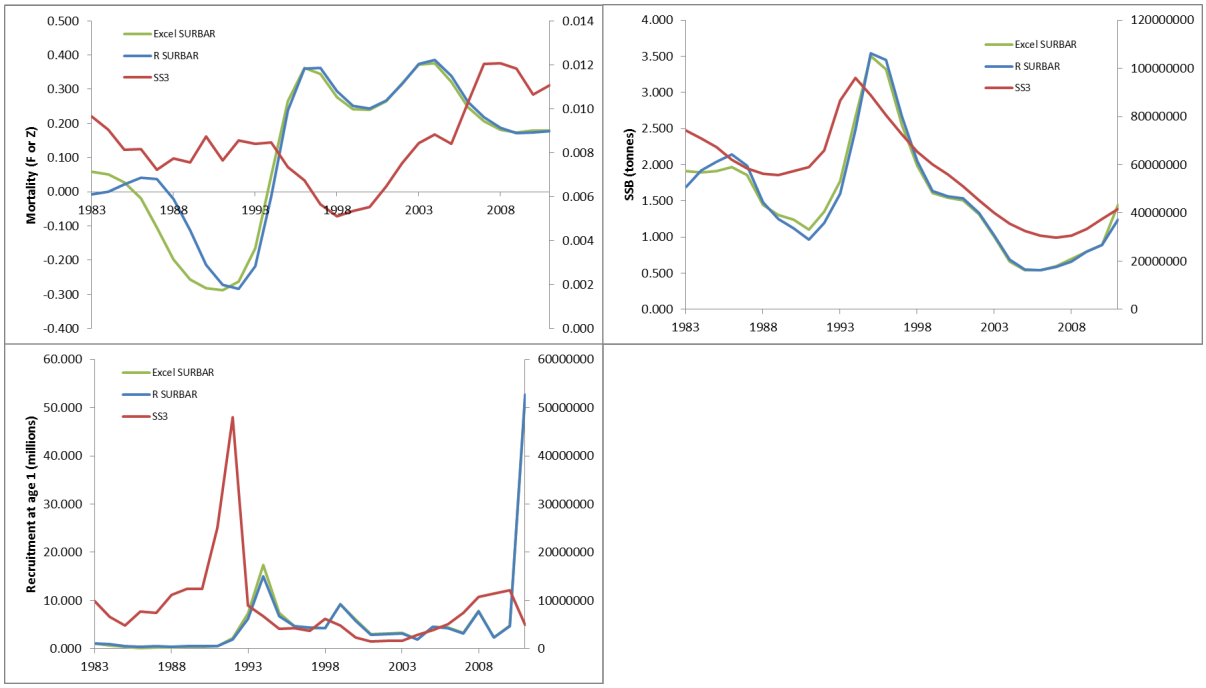


Figure Needle.2. Comparison of mortality, biomass and recruitment estimates from SS3 and SURBAR (both the usual R version and a simple Excel version used here to check that the missing years wouldn't cause problems).



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

This ToR was met, and I concur with the conclusions of the Panel Review.

I found that the presentation on reference points was clear and helpful to the Panel in determining the utility and appropriateness of the reference points. My view is that simpler reference points are better, in which sense the approach taken by the assessment team has much merit – ICES have gone far too far in complicating reference point estimation, to the extent that it is almost impossible to a) implement and b) explain.

I also very much concur with the assessment teams focus on trend-based assessment and advice where possible. In a situation where an absolute estimate of abundance is not forthcoming (or at least highly uncertain), the use of the relatively well-known trends must be preferable.

My simplistic summary of the MSE comparing stock-structure assumptions was that single-stock management gives a higher average return, due to less likelihood of management action, while two-stock management leads to action more in line with the stocks, but probably less overall yield.

ToR 7. Evaluate stock status with respect to the existing model (from previous peer reviewed accepted assessment) and with respect to any new model or models developed for this peer review.

> **a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.**
>
> **b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs and their estimates (from TOR-5).**

This ToR was met, and I concur with the conclusions of the Panel Review. It seems very clear that the stock is not being overfished, and that overfishing is not occurring. Following a request from the Panel, the assessment team provided a further analysis which demonstrated convincingly that the commercial fishery operates over less than 1% of the survey area, which is used as a proxy for surfclam distribution. This very low spatial coverage supports the conclusion of a very low fishing mortality. I did find this surprising initially, given the value of the product, but it would appear that market forces drive the low exploitation (few processors near the fishing areas, and limited landings to retain high value per surfclam).

ToR 8. Develop approaches and apply them to conduct stock projections.

> **a. Provide numerical annual projections (five years) and the statistical distribution (e.g., probability density function) of the OFL (overfishing level) (see Appendix to the SAW TORs). Consider cases using nominal as well as potential levels of uncertainty in the model. Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).**
>
> **b. Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions.**

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

This ToR was met, and I concur with the conclusions of the Panel Review. I did consider that the projections presented were very long, well beyond the scope of the available data on year-class strength, but I accept the explanation that longer projections are generally appropriate a) for a long-lived species such as surfclam, and b) in the current situation in which assessments (and management advice) are only considered in detail every three years or so. However, I still find it surprising that annual update assessments are not considered – stock dynamics can change significantly in the three-year periods between these major assessment efforts. The update approach has problems too (cf. Northern Shelf haddock), but it is strange to me that moves have not been made in that direction.

I also found that it was not very clear (without considerable questioning) exactly what the advice was – there seemed to be no equivalent to the standard ICES catch option table in the report, and it took some digging to determine what was being recommended.

The Panel noted that forecast stochasticity is assumed to apply only to recruitment, with all other parameters treated deterministically. However, recruitment is not the main source of uncertainty in this assessment. I would suggest that to do these forecasts in a way that would be more useful, it would be important to do parametric resamples over all the output parameters from the model (catch, biomass, F, recruitment, etc.) for each projection iteration.

ToR 9. Evaluate the validity of the current stock definition. Determine whether current stock definitions may mask reductions in sustainable catch on regional spatial scales. Make a recommendation about whether there is a need to modify the current stock definition.

This ToR was met in part. The north-south split in federal waters had been considered in detail at the last SARC for this stock, and there wasn't a great deal of information presented to SARC 61 to support it. Although the conclusions were not particularly clear, I noted that the MSE that was presented did suggest that a two-stock assumption reduced overall yield while also reducing risk, while a one-stock assumption increased both yield and risk. It was also noteworthy that the MSE concluded that the same stock structure should be used in management as in the assessment, and I would heartily agree with that – trying to manage the stock as a unit whole while assessing on the basis of two biological-distinct units will generally cause difficulties.

The other stock structure issue, which was not addressed in detail either, was the extant split between State waters (within 3 nm of the coast) and federal waters. These two zones are assessed and managed separately – indeed, the State waters are further subdivided along State lines. I suggested that the SARC meeting was a good opportunity to recommend that the State areas be included in the main federal EEZ area for assessment and advice purposes – there are clear biological links and no real reason to keep them separate. The assumed structure just seems to be a historical accident that should certainly be re-addressed.

ToR 10. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports. Identify new research recommendations.

This ToR was met, and I agree with the findings of the Panel Review. Most of the new research recommendations that I noted before and during the meeting were either picked up in the Panel Review, or were addressed by the assessment team during the SARC discussions. My remaining suggestions (most of which I have covered above) would be:

- Determine through observation (or other means) more realistic discard estimates – these may be zero as assumed in the current assessment, but that should be justified.

- Consider whether a combined state-federal assessment would be more appropriate, if it is possible to do so.
- Consider the use of alternative, exploratory assessment models (in a confirmatory sense).
- Is there a better way to deal with gaps in survey data – filling between years can't be right?
- Consider the use of other indicators of fishing effort location than skippers' reports. Examples would include VMS, AIS, CCTV, etc.

The other issue that I would highlight is that adding a new area to the survey (Nantucket Shoals) or restratifying the survey needs to be done very carefully, probably along with revision of the previous MCD surveys (or, if necessary, some kind of spatial borrowing). It is vital to try not to break the survey time-series, which although currently very short should not be allowed to get any shorter.

Appendix 1: Bibliography of materials provided for review and references

References

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Needle, C. L. (2015). Using self-testing to validate the SURBAR survey-based assessment model, *Fisheries Research* **171**: 78–86. DOI: 10.1016/j.fishres.2015.03.001.

Materials provided for review

Methot RD. 2015. User Manual for Stock Synthesis—Model Version 3.24s. NOAA Fisheries Toolbox. 152p.

Methot RD, Wetzel C. 2013. Appendix A: Technical Description of the Stock Synthesis assessment program. NOAA Fisheries Toolbox. 37p.

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Weinberg JR. 2005. Bathymetric shift in the distribution of Atlantic surfclams: response to warmer ocean temperature. ICES Journal of Marine Science 62: 1444-1453. 10p.

Zhang X et al. 2015. Modeling larval connectivity of the Atlantic surfclams within the Middle Atlantic Bight: Model development, larval dispersal and metapopulation connectivity. Estuarine, Coastal and Shelf Science 153: 38-53. 16p.

Zhang X et al. 2016. Atlantic surfclam connectivity within the Middle Atlantic Bight: Mechanisms underlying variation in larval transport and settlement. Estuarine, Coastal and Shelf Science 173: 65-78. 14p.

Working Papers

Working Group, Stock Assessment Workshop (SAW 61) 2016. Stock Assessment Report of Atlantic Surfclam. SAW/SARC 61. July 19-21, 2016, NOAA Fisheries, Northeast Fisheries Science Center. Woods Hole, MA. 474p.

Working Group, Stock Assessment Workshop (SAW 61) 2016. Stock Assessment Summary Report of Atlantic Surfclam. SAW/SARC 61. July 19-21, 2016, NOAA Fisheries, Northeast Fisheries Science Center. Woods Hole, MA. 12p.

Presentations

Working Group, Atlantic Surfclam. 2016. Atlantic Surfclam Assessment 2016. PowerPoint presentation. 78 slides.

Jacobson L. 2016. Surfclam Swept Area Data. PowerPoint presentation. 7 slides.

Jacobson L. 2016. Overfishing Limits Based on Trends. PowerPoint presentation. 3 slides.

Appendix 2: Statement of work

Statement of Work

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

61st Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC)
Benchmark stock assessment for Atlantic surfclam

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf).
Further information may be obtained from www.ciereviews.org.

Scope

The Northeast Regional Stock Assessment Review Committee (SARC) meeting is a formal, multiple-day meeting of stock assessment experts who serve as a panel to peer-review tabled stock assessments and models. The SARC peer review is the cornerstone of the Northeast Stock Assessment Workshop (SAW) process, which includes assessment development and report preparation (which is done by SAW Working Groups or ASMFC technical committees), assessment peer review (by the SARC), public presentations, and document publication. This review determines whether or not the scientific assessments are adequate to serve as a basis for developing fishery management advice. Results provide the scientific basis for fisheries within the jurisdiction of NOAA's Greater Atlantic Regional Fisheries Office (GARFO).

The purpose of this meeting will be to provide an external peer review of a benchmark stock assessment for **Atlantic surfclam** *(Spisula solidissima)*. The requirements for the peer review follow. This Statement of Work (SOW) also includes Appendix 1: TORs for the stock assessment, which are the responsibility of the analysts; Appendix 2: a draft meeting agenda; Appendix 3: Individual Independent Review Report Requirements; and Appendix 4: SARC Summary Report Requirements.

Requirements

NMFS requires three reviewers under this contract (i.e. subject to CIE standards for reviewers) to participate in the panel review. The SARC chair, who is in addition to the three reviewers, will be provided by either the New England or Mid-Atlantic Fishery Management Council's Science and Statistical Committee; although the SARC chair will be participating in this review, the chair's participation (i.e. labor and travel) is not covered by this contract.

Each reviewer will write an individual review report in accordance with the SOW, OMB Guidelines, and the TORs below. All TORs must be addressed in each reviewer's report. No more than one of the reviewers selected for this review is permitted to have served on a SARC panel that reviewed this same species in the past. The reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Expertise should include forward projecting statistical catch-at-age models. Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting. Reviewers should have experience in development of Biological Reference Points (BRPs) that includes an appreciation for the varying quality and quantity of data available to support estimation of BRPs. Knowledge of sedentary invertebrates, their fishery management and ecosystem issues would be useful.

Requirements for Reviewers

- Review the background materials and reports prior to the review meeting
- Attend and participate in the panel review meeting
    - The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers
- Reviewers shall conduct an independent peer review in accordance with the requirements specified in this SOW and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.
- Each reviewer shall assist the SARC Chair with contributions to the SARC Summary Report
- Deliver individual Independent Review Reports to the Government according to the specified milestone dates
- This report should explain whether each stock assessment Term of Reference of the SAW was or was not completed successfully during the SARC meeting, using the criteria specified below in the "Requirements for SARC panel."
- If any existing Biological Reference Points (BRP) or their proxies are considered inappropriate, the Independent 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 Report produced by each reviewer.
- The Independent Report can also be used to provide greater detail than the SARC Summary Report on specific stock assessment Terms of Reference or on additional questions raised during the meeting.

Requirements for SARC panel

- During the SARC meeting, the panel is to determine whether each stock assessment Term of Reference (TOR) of the SAW was or was not completed successfully. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable. If alternative assessment models and model assumptions are presented, evaluate their strengths and weaknesses and then recommend which, if any, scientific approach should be adopted. Where possible, the SARC chair shall identify or facilitate agreement among the reviewers for each stock assessment TOR of the SAW.
- If the panel rejects any of the current BRP or BRP proxies (for B_{MSY} and F_{MSY} and MSY), the panel should explain why those particular BRPs or proxies are not suitable, and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing BRPs or BRP proxies are the best available at this time.
- Each reviewer shall complete the tasks in accordance with the SOW and Schedule of Milestones and Deliverables below.

Requirements for SARC chair and reviewers combined:

Review both the Assessment Report and the draft Assessment Summary Report. The draft Assessment Summary Report is reviewed and edited to assure that it is consistent with the outcome of the peer review, particularly statements that address stock status and assessment uncertainty.

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

The chair's objective during this SARC Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The chair will take the lead in editing and completing this report. The chair may express the chair's opinion on each Term of Reference of the SAW, either as part of the group opinion, or as a separate minority opinion. The SARC Summary Report will not be submitted, reviewed, or approved by the Contractor.

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

Foreign National Security Clearance
When 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 reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, country of birth, country of citizenship, country of permanent residence, country of current residence, dual citizenship (yes, no), passport number, country of passport, travel dates.) to the NEFSC SAW Chair 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/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance
The place of performance shall be at the contractor's facilities, and at the Northeast Fisheries Science Center in Woods Hole, Massachusetts.

Period of Performance
The period of performance shall be from the time of award through August 31, 2016. Each reviewer's duties shall not exceed 12 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

No later than June 13, 2016	Contractor sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
No later than July 5, 2016	NMFS Project Contact will provide reviewers the pre-review documents

July 19-21, 2016	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
July 21, 2016	SARC Chair and reviewers work at drafting reports during meeting at Woods Hole, MA, USA
August 4, 2016	Reviewers submit draft independent peer review reports to the contractor's technical team for review
August 4, 2016	Draft of SARC Summary Report, reviewed by all reviewers, due to the SARC Chair *
August 11, 2016	SARC Chair sends Final SARC Summary Report, approved by reviewers, to NMFS Project contact (i.e., SAW Chairman)
August 18, 2016	Contractor submits independent peer review reports to the COR and technical point of contact (POC)
August 25, 2016	The COR and/or technical POC distributes the final reports to the NMFS Project Contact and regional Center Director

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

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $23,000.

Restricted or Limited Use of Data

The contractors may be required to sign and adhere to a non-disclosure agreement.

Project Contacts

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Annex 1. Terms of Reference for the SAW Working Group (61st SAW/SARC Stock Assessment)

The SARC Review Panel shall assess whether or not the SAW Working Group has reasonably and satisfactorily completed the following actions.

A. Atlantic surfclams

1. Estimate catch from all sources including landings and discards. Map the spatial and temporal distribution of landings, discards, fishing effort, and gross revenue, as appropriate. Characterize the uncertainty in these sources of data.

2. Present the survey data being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Use logbook data to investigate regional changes in LPUE, catch and effort. Characterize the uncertainty and any bias in these sources of data. Evaluate the spatial coverage, precision, and accuracy of the new clam survey.

3. Determine the extent and relative quality of benthic habitat for surfclams in the Georges Bank ecosystem to refine estimates of stock size based on swept area calculations.

4. Quantify changes in the depth distribution of surfclams over time. Review changes over time in surfclam biological parameters such as length, width, and growth.

5. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series (integrating results from TOR 3, as appropriate) and estimate their uncertainty. Include a historical retrospective analysis to allow a comparison with previous assessment results and previous projections.

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

7. Evaluate stock status with respect to the existing model (from previous peer reviewed accepted assessment) and with respect to any new model or models developed for this peer review.
    a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.
    b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs and their estimates (from TOR-5).

8. Develop approaches and apply them to conduct stock projections.
    a. Provide numerical annual projections (five years) and the statistical distribution (e.g., probability density function) of the OFL (overfishing level) (see Appendix to the SAW TORs). Consider cases using nominal as well as potential levels of uncertainty in the model. Each projection should estimate and report annual probabilities of

exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).

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

9. Evaluate the validity of the current stock definition. Determine whether current stock definitions may mask reductions in sustainable catch on regional spatial scales. Make a recommendation about whether there is a need to modify the current stock definition.

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

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

On "Acceptable Biological Catch" (DOC Nat. Stand. Guidel. Fed. Reg., v. 74, no. 11, 1-16-2009):

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

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

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

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

On "Vulnerability" (DOC Natl. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16-2009):

"Vulnerability. A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce Maximum Sustainable Yield (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)

Participation among members of a Stock Assessment Working Group:

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

Annex 2. Draft Review Meeting Agenda

{Final Meeting agenda to be provided at time of award}

61st Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC): Benchmark stock assessment for A. Atlantic surfclam

July 19-21, 2016

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

AGENDA* (version: Dec. 31, 2015)

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Tuesday, July 19

10 – 10:30 AM

Welcome	**James Weinberg**, SAW Chair		
Introduction	**TBD,** SARC Chair		
Agenda			
Conduct of Meeting			
10:30 – 12:30 PM	Assessment Presentation (A. Surfclam)		
	Dan Hennen		**TBD**
12:30 – 1:30 PM	Lunch		
1:30 – 3:30 PM	Assesssment Presentation (A. Surfclam)		
	Dan Hennen		**TBD**
3:30 – 3:45 PM	Break		
3:45 – 5:45 PM	SARC Discussion w/ Presenters (A. Surfclam)		
	TBD, SARC Chair	**TBD**	
5:45 – 6 PM	Public Comments		
7 PM	**(**Social Gathering**)**		

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Wednesday, July 20

9:00 – 10:45 Revisit with Presenters (A. Surfclam)
TBD, SARC Chair **TBD**

10:45 - 11 Break

11 – 11:45 Revisit with Presenters (A. Surfclam)
TBD, SARC Chair **TBD**

11:45 – Noon Public Comments

12 – 1:15 PM Lunch

1:15 – 4 Review/Edit Assessment Summary Report (A. Surfclam)
TBD, SARC Chair **TBD**

4 – 4:15 PM Break

4:15 – 5:00 PM SARC Report writing

Thursday, July 21

9:00 AM – 5:00 PM SARC Report writing

*All times are approximate, and may be changed at the discretion of the SARC chair. The meeting is open to the public. During "SARC Report writing", on July 20 and 21, the public should not engage in discussion with the SARC.

Annex 3. Individual Independent Peer Review Report Requirements

1. The independent peer review 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 report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs. The independent report shall be an independent peer review, and shall not simply repeat the contents of the SARC Summary Report.

   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, but especially where there were divergent views.

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

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

3. The report shall include the following appendices:

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

Annex 4. SARC Summary Report Requirements

1. The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background and 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 or not each Term of Reference of the SAW Working Group was completed successfully. For each Term of Reference, the SARC Summary Report should state why that Term of Reference was or was not completed successfully.

   To make this determination, the SARC chair and reviewers should consider whether or not the work provides a scientifically credible basis for developing fishery management advice. If the reviewers and SARC chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

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

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

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

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

Appendix 3: Review Panel Membership

- Dr Michael Wilberg, University of Maryland, Solomons MD, USA (Council member and Panel chair)
- Dr Martin Cryer, Fisheries Management Directorate, Wellington, New Zealand (CIE reviewer).
- Dr Michael Bell, Heriot-Watt University, Orkney, Scotland (CIE reviewer).
- Dr Coby Needle, Marine Scotland Science, Aberdeen, Scotland (CIE reviewer).