Independent Peer Review Report on the Benchmark Assessment for Atlantic Mackerel Conducted for the 64th Northeast Regional Stock Assessment Review, Stock Assessment Review Committee (SARC) Meeting

November 28 – 30, 2017
Northeast Fisheries Science Center
Woods Hole, Massachusetts

by

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Executive Summary

The 64th SARC was conducted in order to evaluate a benchmark assessment of Atlantic Mackerel. The SARC meeting was held November 28-30, 2017.

My conclusions are:

The assessment addressed all of the terms of reference adequately;

Concurring with the SARC Panel, the Atlantic Mackerel stock is currently overfished and undergoing overfishing. These conclusions are robust to a large number of sensitivity analyses, alternative model structures, and two alternative modeling approaches;

There were no major weaknesses in the assessment, but improvements could be made in regards to obtaining estimates of unreported catch. Also, the overall characterization of uncertainty and variance in status determination might be developed more fully. This is an overarching subject in many assessments.

A key data element for the assessment is the integrated Canadian-US egg survey. It is extremely important to maintain this project. Implementation of this survey and use of the data in the assessment in 2009 and presently provided a large difference in trends from more historical analyses.

The SARC meeting and the participants were extremely well organized and helpful.

Background Section

The 64th SARC (Stock Assessment Review Committee) met at the National Marine Fisheries Service, Northeast Fisheries Science Center's (NEFSC) Woods Hole Laboratory during 28-30 November 2017. The meeting had been scheduled for more than six months as part of the Center's planning process for internal and external review of critical stock assessments. As such, the objective of the meeting was to evaluate the most recent benchmark assessment of the Northwest Atlantic stock of Atlantic Mackerel. As part of this plan, external reviewers were selected by the Center for Independent Experts (CIE) to assist in the review. The external reviewers (SARC Panel) were: Robin Cook, Kevin Stokes and myself (Joseph Powers). Additionally, the SARC Panel included John Boreman, current chair of the Mid-Atlantic Fishery Management Council Scientific and Statistical Committee, who chaired the meeting and the preparation of the SARC Committee's report.

The SARC Panel were provided access to background documents, assessment reports, and meeting agenda and arrangements several weeks prior to the meeting. This gave the SARC Panel ample opportunity to develop an understanding of the current research related to Atlantic Mackerel and of the assessment and fishery history (bibliography listed in Appendix 1).

The SARC meeting itself commenced on 28 November 2017, and after welcoming and introductions, the day's agenda included presentation and discussion of the Atlantic Mackerel assessment. The SARC was assisted by the NEFSC Stock Assessment Workshop (SAW) Chairman, James Weinberg and Sheena Steiner. Supporting documentation was prepared by the Atlantic Mackerel SAW 64 Working Group (WG), chaired by Gary Shepherd, and the presentation at the meeting was made by the lead assessment scientist Kiersten Curti (NEFSC). Toni Chute, Mark Terceiro, Katherine Sosebee, and Chris Legault, all from the NEFSC, served as rapporteurs. Approximately 20 people participated in the SARC 64 meeting, representing NMFS/NEFSC, the NMFS/Greater Atlantic Regional Office, Fisheries and Ocean Canada, non-governmental organizations, and the fishing industry (see Appendix 3).

Subsequently, the presentation was followed by SARC discussion with the presenter and chair of the WG, carrying over into the afternoon of 29 November. Panel members asked many questions of technical clarification and of a more probing nature about research, modeling, and data sources. Additionally, other attendees were given opportunities to make comments and ask questions, and in some cases provided answers to queries of the Panel. Also, additional model runs were requested and, in response, sensitivity analyses were conducted and presented.

The remainder of the afternoon on 29 November was spent on drafting the Assessment Summary prepared by the WG and editing the text based on the preceding discussions. The SARC spent the final day, 30 November, drafting the Panel responses to the TORs that would be incorporated into the SARC Panel Report and into the individual reports of the CIE experts.

A number of people made important contributions to the success of the meeting: James Weinberg (NEFSC Stock Assessment Workshop Chair) and Sheena Steiner coordinated the meeting and provided assistance in the process.

Summary of Findings for each Term of Reference

The meeting was both informative and efficient, with considerable cooperation of the presenter, chair of the WG, and attendees in general. The stock assessment was well presented and contained thorough documentation. As a member of the SARC Panel, I personally concur with the conclusion that the scientific and statistical analyses conducted by the WG were thorough and of high quality. The assessment was effective in helping to determine the current status of the Atlantic Mackerel stock. Additionally, the structure of the assessment report, in which the TORs were addressed directly, was extremely useful for facilitating discussions and for the understanding of the Panel.

I will now address each Term of Reference, specifically, as to my thoughts and conclusions.

Summary of Findings for Each Term of Reference

TOR-1. *Spatial and ecosystem influences on stock dynamics:*

a. *Evaluate possible spatial influences on the stock dynamics. Recommend any need to modify the current stock definition for future stock assessments.*

b. *Describe data (e.g., oceanographic, habitat, or species interactions) that might pertain to Atlantic mackerel distribution and availability. If possible, integrate the results into the stock assessment (TOR-4).*

Considerable work has been done on the oceanographic distribution and physical of Atlantic Mackerel over the years (see bibliography in Appendix 1). Additionally, there has been a recent concerted effort to advance this research. Some of the original research (Sette, 1943, 1950), as well as more recent confirming results indicate that there are two spawning groups (referred to as "contingents"), a northern and a southern contingent (loosely, Canadian and US). However, mixing and homing parameters are not well known. Additionally, there appears to have been a shift in the distribution of each contingent over the years. The TOR asks the question whether this evidence is sufficient to alter the stock identification. The answer was, correctly, given as no. Experience with other migratory stocks, as well as through simulation work, has shown that incorrectly specifying the nature of the movement/migration can lead to more uncertain assessments of status than a more simple single stock determination. It is expected that as the research evolves and understanding of movements improves, then the two contingents will be incorporated into the assessments. But at the present time, it is not really feasible for a base case assessment model

Predation and temperature effects were investigated, but results are in a preliminary stage and the effects were not pursued in the assessment model. But, while the research results on the environmental/ecological factors were not yet sufficient to include in the model, that research was important in providing the WG and the Panel some guidance on the choice of indices to use in the model and the general interpretation of the results.

This TOR was fully met.

TOR-2. *Estimate catch from all sources including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data.*

This TOR was largely met.

US commercial catches have been well monitored over the years with adequate size and age sampling (of course as with all fisheries, it could be improved). Discards are also monitored and an estimate of their magnitude made. Additionally, observer monitoring provides data on sizes of discarded fish to estimate their size distribution. Locations of catches are monitored, so maps of catch distributions are available.

Estimates of US recreational catch are available since 1981. The assessment report notes that the catch distribution (actually landings locations) appear to have shifted north over time. There are a number of issues with the recreational estimation system nationally, which are currently are under review (alternative new methods, the possible need to adjust historical estimates based on the new methods, addressing shore mode fishing, etc.). However, the changes are not expected to be large enough to alter the current estimates used in the assessment.

Canadian commercial catches and catch at size/age have been monitored over the years. However, there is unreported Canadian catch for the recreational, bait, and commercial discard components. Attempts were made to address this by conducting an assessment using a Catch Censored Assessment Model (CCAM). This method attempts to estimate the unreported catch internal to the assessment model. The results showed that the additional catch was notable, but the trends in abundance were similar. Additionally, the estimates of unreported catches generated were then used as a sensitivity analysis of the base case ASAP model with similar results.

I am somewhat skeptical of the ability of missing catch methods such as CCAM to estimate the magnitude of that missing component, but I am confident that the effects would not change my scientific opinion as to trends and status. It will be important in the future, though, to improve these estimates, especially if there is progress in developing spatial models.

Strictly speaking, the assessment model did not include all sources of catch. But the effects of those sources were investigated, and I am comfortable with the robustness of the assessment.

TOR-3. *Evaluate fishery independent and fishery dependent indices being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Characterize the uncertainty and any bias in these sources of data.*

This TOR was largely met.

There is whole suite of available surveys within the US component of the distribution with individual states having conducted their own surveys for use to meet other scientific objectives. However, the temporal/geographic scope of many of these surveys was not large enough to include these indices in the assessment. I concur with that decision.

Therefore, the focus was on the NEFSC bottom trawl survey (which also provides age and size composition) and on the Canada-US integrated egg survey. The latter survey is extremely important in that it is a more comprehensive indicator of spawning biomass. The development of this index in the late 2000s was a large reason for the differences between 2005 and 2009 assessment results. Thus, it is important as we go forward to maintain this research track.

The bottom trawl surveys appear to be less influential in the assessment than the egg survey, understandably, because these surveys are not as geographically distributed as the egg survey. One concern I have with the bottom trawl survey is how zero catches are handled. In my opinion, this could become important as a stock is depleted and zero catches become more prevalent. This is an ongoing debate that will not be resolved immediately. Even so, I expect the Atlantic Mackerel results to be robust to these issues.

A number of other sensitivity factors relative to the indices were investigated, such as exclusion of indices. This provided an understanding of the robustness of the model and gave the guidance for the selection of a base case.

Despite the lesser influence of the bottom trawl survey on the assessment results, it is important to maintain this source of data. It provides other data sources (sizes, ages, stomach contents, distribution, etc.). Also, if one moves toward spatial modeling, I suspect these indices will become more important in informing the assessment and to the development of management approaches.

CVs on the indices were given in the text and other aspects of index uncertainty were approached in the discussion of data and methods. The significance of these was implied through the model fits, MLE components, and sensitivity analyses. However, it's hard to determine the significance of the CVs because of issues about aggregation scale of the data and other factors.

TOR-4. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Develop alternative approaches which might also be able to estimate population parameters. Include a comparison of new assessment results with those from previous assessment(s).*

This TOR was fully met.

The assessment report coupled with the presentations, discussions, further analysis requests, and public comment provided an extremely informed basis for concluding that this TOR was met. Estimates of fishing mortality, recruitment, and stock biomass were provided. Uncertainty was characterized by using model estimates of precision, an extensive sensitivity analysis, and alternative modeling approaches (State-space Assessment Model and CCAM).

The base model of the Age-Structured Assessment Program (ASAP) is appropriate for determining status. The Panel (and I) agreed with that conclusion after examination of the model, data, and sensitivities. In other fora, alternatives assessment packages are used (such as SS3). However, the basic equations and model structure appropriate to Atlantic Mackerel would be the same between ASAP and SS3. In other words, one could

construct the Atlantic Mackerel assessment model using either platform. Therefore, that choice is not an issue.

MCMC was used to characterize the distributions of critical model outputs, which fed into reference point calculations and projections.

As with most assessments, the choice of natural mortality rate (M) is an issue. As in most instances, the overall M was chosen based on life-history methods and evaluated after the fact using likelihood profiles. This provided enough basis for the Panel to agree with the choice. I would note that in other assessment fora age-specific M's are being used more and more. The WG explored this with sensitivity analyses and concluded that results were robust to this. I concur with that conclusion at this time. But I can foresee situations where a Lorenzen-type curve (where the distribution of Ms at age are based on life history characteristics) would be used. Perhaps as research is developed (as in predation TOR1) this will happen.

Systematic retrospective patterns were not seen. But the variance in the year-to-year change was large in some cases. However, there was not a strong basis for employing a retrospective adjustment.

An historical retrospective evaluation was done (compare this assessment to previous assessments). This assessment shows similar trends to the 2009 assessment (over the overlapping years), but is different than the 2005 assessment. However, note that the 2009 assessment was rejected, largely due to the big changes from 2005, and due to the incorporation of new data sets (the egg index) that were not well understood at the time. The current assessment results provide more confidence as to the historical trends.

TOR-5. *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.*

This TOR was fully met.

Due to the lack of an existing accepted stock assessment from the 2009 analysis, there were no existing BRPs or definitions of stock status.

The stock assessment does not lead to analytic, model-based estimates of MSY BRPs, as no parametric stock recruitment model was available; therefore, the WG proposed $F_{40\%}$ as a proxy for F_{msy}. The proxy for B_{msy} was based on $F_{40\%}$. ($B_{msy} \equiv B_{F40\%}$). A range was provided for the estimate of B_{msy} and MSY. An estimate of $B_{THRESHOLD}$ was provided as $0.5B_{msy}$.

The ASAP approach to estimating recruitment was to estimate an overall recruitment mean over the entire range of imputed SSBs, and then to estimate annual deviations from the mean for each SSB, giving the S-R couplets. Given the lack of basis for selecting a stock-recruitment model, I concur with this approach. It is tantamount to specifying

steepness of 0.999 for a Beverton-Holt model. It is interesting to note that many of the negative deviations are at low SSB, which is, in itself, an indication of a stock recruitment relationship.

The choice of $F_{40\%}$ was largely based on general life history characteristics and simulation work on other stocks, meta-analysis, and standard practices. However, to put this in perspective, I requested the following S-R plot at the meeting:

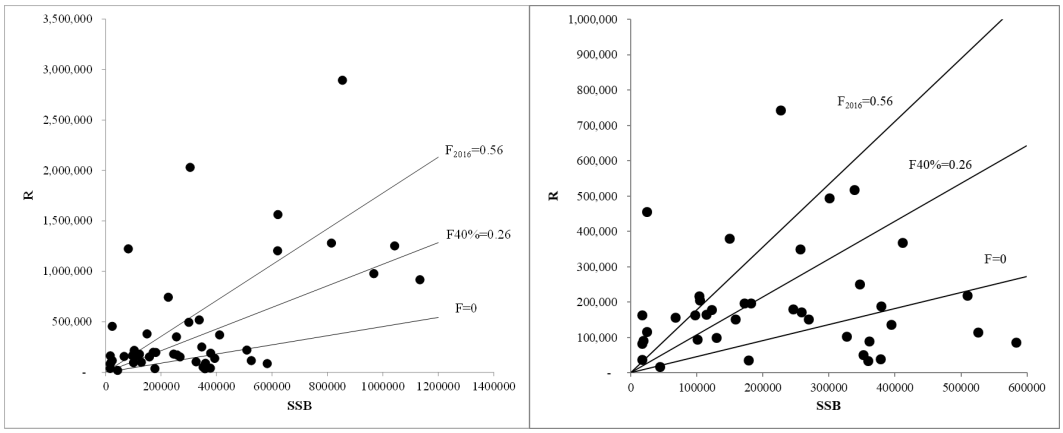

Figure. S-R plot with associated replacement lines (at right the scales are truncated).

This shows that the F40% criterion is not unreasonable and that current replacement slopes are much higher than that, an indication of increased risk to the stock. Of course, the F40% criterion is a proxy, and therefore to some degree uncertain. But in the practical management sense, it is a good interim target for a recovery process.

A number of other criteria for proxies were examined through sensitivity analysis and the results support my conclusions from the Figure above.

TOR-6. *Make a recommended stock status determination (overfishing and overfished) based on new results developed for this peer review. Include qualitative written statements about the condition of the stock that will help to inform NOAA Fisheries about stock status.*

This TOR was fully met.

Based on the accepted stock assessment and the BRP's in TOR5, the stock is defined as overfished and experiencing overfishing:

SSB_{2016} = 43,519 mt, which is less than ½ $SSB_{MSY\ proxy}$ (98,447 mt).
Therefore, the stock is in an overfished status.

F_{2016} = 0.47, which is greater than $F_{MSY\ proxy}$ (0.26).
Therefore, the stock is in an overfishing status.
The stock is currently considerably below MSY conditions.

The status determination is robust across all sensitivity tests and alternative modeling approaches. Alternative ASAP model structures, as well as alternative model platforms, support this conclusion.

TOR-7. *Develop approaches and apply them to conduct stock projections.*

a. *Provide numerical annual projections (3 years) and the statistical distribution (e.g., probability density function) of the catch at F_{MSY} or an F_{MSY} proxy (i.e. the overfishing level, OFL) (see Appendix to the SAW TORs). 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. Identify reasonable projection parameters (recruitment, weight-at-age, retrospective adjustments, etc.) to use when setting specifications.*

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

The stock's vulnerability was not explicitly addressed in the assessment. But if the stock is classified as overfished (as this assessment shows), then the stock is obviously vulnerable to overfishing. Therefore, projections should be viewed in the context of the recovery potential of the stock. Based on general life history and the historical record of periods with lower fishing mortality rates, there is potential for relatively rapid recovery (rapid does NOT mean less than 3 years). It would have been useful to see more discussion of how the biological characteristics of the species affect its vulnerability to the existing fisheries.

Projections are provided under the assumptions of F_0, $F_{40\%}$, and $F_{\text{status quo}}$. Managers may wish to explore other alternatives (e.g., constant TAC over a period of 3 to 5 years), but the current projection template should be what is used.

Interval estimates of the projected SSB are provided for only the base model, but not the probability of exceeding the BRPs. Uncertainty was characterized by using estimates of precision from the base model runs, but this precision excludes the results from alternative models. Hence, the range of uncertainty is likely underestimated. Additionally, since status is determined by the SSB_{current} versus $SSB_{\text{msy proxy}}$ ratio, often these estimates are correlated within a model structure. So, if status results are to be compared through multiple structures/sensitivities, it is important to characterize uncertainty appropriately. The whole subject of how to characterize the pdf of catch at current biomass and Fmsy is complex and under ongoing debate. One can blithely say uncertainty is underestimated, but it is not obvious to me how much this is so.

Note that all projections that are made under constant fishing conditions will have a transitional period reflecting the conditions at the beginning of the projection, followed by a leveling out. In the case of the Atlantic Mackerel assessment, the 2015 year class was estimated to be relatively large. But as is typical for the terminal year recruitment

estimate of most any assessment, that estimate is more uncertain than other recruitment estimates. Thus, the transitional early period of the projections are influenced by the optimism of the 2015 year class. This should be noted.

The TOR used the term "realistic" in regards to examining the projections. It is unclear what realistic means. All projections are unrealistic if the future actions assumed by the projection are not implemented. I believe the assessments and the initial conditions for the projections are based on sound science, so in that sense they are "realistic". However, imperfect implementation and uncertain transitional characteristics (noted in paragraph above) will affect future scenarios.

This TOR was largely met.

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

This TOR was fully met.

A rather extensive slate of research directions was presented. Since research was guided by recommendations of previous SARCs, the reports were very explicit in explaining the progress, noting projects that were no longer needed or did not pan out, current projects that might be improved by additional resources and then future projects that might be considered. I support the general emphasis of the WG's and the assessment report's recommendations. It is a reasonable approach.

Within the WG's framework, I would like to emphasize several areas that I expect to be important for future assessments. Importantly, the integrated egg survey is critical to the understanding of spawning trends under whatever stock identification might be chosen in the future. Therefore, this should be maintained. I also believe that Atlantic mackerel are prime for developing spatial modeling approaches. As this occurs, it will place more pressure on maintaining existing data sources and in developing new ones. If spatial modeling occurs, then spatial management is likely to follow, so regional indices must be maintained (bottom trawl survey) and Canadian unreported catches must be addressed. Any movement projects would be desirable, but these are hard to design/implement/fund.

Conclusions

I have no further recommendations about the review process and the manner in which it was conducted. It was exceptionally organized both in the conduct of the meeting and in written and oral presentations of the assessment.

Appendix 1: Bibliography of Materials Provided for Review

Background Papers

Berg, C.W., and A. Nielsen. 2016. Accounting for correlated observations in an age-based state-space stock assessment model. ICES Journal of Marine Science 73: 1788-1797.

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Department of Fisheries and Oceans. 2014. Assessment of the Atlantic Mackerel stock for the Northwest Atlantic (Subareas 3 and 4) in 2013. Department of Fisheries and Oceans Canada. Science Advisory Report 2014/030. 16p.

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Grégoire, F., M.-H. Gendron, J.-L. Beaulieu, and I. Lévesque. 2013. Results of the Atlantic mackerel (*Scomber scombrus* L.) egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011. Department of Fisheries and Oceans Canada. Science Advisory Secretariat. Research Document 2013/035. v + 57 p.

Kelly, C., M. Ortiz, and D. Robert. 2010. Transboundary Resources Assessment Committee (TRAC) Atlantic Mackerel benchmark and assessment. External review. Fisheries and Oceans Canada Transboundary Resource Assessment Committee. Reference Document 2010-03-12. 6p.

Legault, C. M., and V. R. Restrepo. 1998. A flexible forward age-structured assessment program. ICCAT Working Document SCRS/98/58. 15p.

Nielsen, A., and C. Berg. 2014. Estimation of time-varying selectivity in stock assessments using state-space models. Fisheries Research 158: 96-101.

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Sette, O. E. 1943. Biology of the Atlantic Mackerel (*Scomber scombrus*) of North America. Part I: Early life history, including the growth, drift, and mortality of the egg and larval populations. Fishery Bulletin 50. 91p.

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Migrations and Habits. Fishery Bulletin 51. 110p.

Transboundary Resource Assessment Committee. 2010. Atlantic Mackerel in the Northwest Atlantic [NAFO Subareas 2 - 6]. Transboundary Resource Assessment Committee Status Report 2010/01. 12p.

Van Beveren, E., Castonguay, M., Doniol-Valcroze, T., and Duplisea, D. 2017. Results of an informal survey of Canadian Atlantic mackerel commercial, recreational and bait fishers. Department of Fisheries and Oceans Canada. Science Advisory Secretariat. Research Document 2017/029. v + 26 p.

Van Beveren, E., D. Duplisea, M. Castonguay, T. Doniol-Valcroze, S. Plourde, and N. Cadigan. 2017. How catch underreporting can bias stock assessment of and advice for northwest Atlantic Mackerel and a possible resolution using censored catch. Fisheries Research 194: 146-154.

Working Papers

Adams, C. F. 2017. Appendix 4: Spatial patterns in the spring NEFSC survey for Atlantic Mackerel. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 78p.

Axelson, L., W. K. Bright, L. Bright, G. DiDomenico, G. Goodwin, J. Hoey, J. Kaelin, J. Knight, M. Lapp, J. P. Manderson, G. McCallig, B. P. Mitchell, P. Moore, R. Mullen, G. O'Neill, P. Quinn, W. Reichle, J. Ruhle, and C. Sarro. 2017. Appendix 9: Fishing industry perspectives on the socioecological factors driving catchability and landings of Atlantic Mackerel in US waters. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 33p.

Carter, L., and D. Richardson. 2017. Appendix 2: Development of an egg index for Atlantic Mackerel (*Scomber scombrus*) on the northeast U.S. Continental Shelf. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 17p.

Deroba, J. J. 2017. Appendix 11: A State-Space Stock Assessment Model (SAM) for Northwest Atlantic Mackerel. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 30p.

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Manderson, J. P., J. Kohut, J. Pessutti, D. Politikos, W. K Bright, P. Moore, M. Roffer, L. Nazarro, E. Curchister, and G. Didomenico. 2017. Appendix 5: Changes in the spatial structure of Atlantic Mackerel and thermal habitat during the spring NEFSC bottom trawl survey and a winter habitat model accounting for movement constraints. Part I. changes in spatial structure. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 32p.

Manderson, J., J. Pessutti, L. Nazarro, W. K. Bright, J. Kohut, D. Politikos, P. Moore, M. Roffer, E. Curchister, and G. Didomenico. 2017. Appendix 6: Winter habitat for juvenile and adult North West Atlantic Mackerel and its value for estimating availability to the spring NEFSC bottom trawl survey. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 18p.

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Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 11p.

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Smith, B., and S. Gaichas. 2017. Appendix 3: Mackerel predation estimates from predators sampled in the NEFSC bottom trawl surveys. Stock Assessment Workshop 64. NMFS Northeast Fisheries Science Center. 10p.

Appendix 2: A copy of this 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

64th Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) Benchmark stock assessment for Atlantic mackerel

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 on the CIE program 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 Atlantic States Marine Fisheries Commission (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 mackerel**. 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 CIE reviewers under this contract 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. For mackerel, knowledge of migratory pelagics, spatial elements in a stock assessment, and data-limited assessment methods would be useful.

Tasks 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.

Tasks 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 about stock status recommendations and descriptions of 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, 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/ 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 January 26, 2018. Each reviewer's duties shall not exceed 14 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 October 24, 2017	Contractor sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
No later than November 14, 2017	NMFS Project Contact will provide reviewers the pre-review documents
Nov. 28-30, 2017	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
Nov. 30, 2017	SARC Chair and reviewers work at drafting reports during meeting at Woods Hole, MA, USA
Dec. 14, 2017	Contractor receives draft reports

Dec. 14, 2017	Draft of SARC Summary Report, reviewed by all reviewers, due to the SARC Chair *
Dec. 21, 2017	SARC Chair sends Final SARC Summary Report, approved by reviewers, to NMFS Project contact (i.e., SAW Chairman)
Jan. 4, 2018	Contractor submits final reports to the Government

* 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 $10,000.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact
Dr. James Weinberg, NEFSC SAW Chair
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02543
James.Weinberg@noaa.gov

Appendix 1. *Stock Assessment Terms of Reference for SAW/SARC-64*

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

A. Atlantic mackerel (NAFO Subareas 3-6)

1. Spatial and ecosystem influences on stock dynamics:
    a. Evaluate possible spatial influences on the stock dynamics. Recommend any need to modify the current stock definition for future stock assessments.
    b. Describe data (e.g., oceanographic, habitat, or species interactions) that might pertain to Atlantic mackerel distribution and availability. If possible, integrate the results into the stock assessment (TOR-4).

2. Estimate catch from all sources including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data.

3. Evaluate fishery independent and fishery dependent indices being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Characterize the uncertainty and any bias in these sources of data.

4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Develop alternative approaches which might also be able to estimate population parameters. Include a comparison of new assessment results with those from previous assessment(s).

5. 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.

6. Make a recommended stock status determination (overfishing and overfished) based on new results developed for this peer review. Include qualitative written statements about the condition of the stock that will help to inform NMFS[a] about stock status.

7. Develop approaches and apply them to conduct stock projections.
    a. Provide numerical annual projections (3 years) and the statistical distribution (e.g., probability density function) of the catch at F_{MSY} or an F_{MSY} proxy (i.e. the overfishing level, OFL) (see Appendix to the SAW TORs). 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. Identify reasonable projection parameters (recruitment, weight-at-age, retrospective adjustments, etc.) to use when setting specifications.
    c. Describe this stock's vulnerability (see "Appendix to the SAW TORs") 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 most recent peer reviewed assessment and review panel reports. Identify new research recommendations.

[a]NMFS has final responsibility for making the stock status determination based on best available scientific information.

Clarification of Terms
used in the Stock Assessment Terms of Reference

Guidance to SAW WG about "Number of Models to include in the Assessment Report":

In general, for any TOR in which one or more models are explored by the WG, give a detailed presentation of the "best" model, including inputs, outputs, diagnostics of model adequacy, and sensitivity analyses that evaluate robustness of model results to the assumptions. In less detail, describe other models that were evaluated by the WG and explain their strengths, weaknesses and results in relation to the "best" model. If selection of a "best" model is not possible, present alternative models in detail, and summarize the relative utility each model, including a comparison of results. It should be highlighted whether any models represent a minority opinion.

On "Acceptable Biological Catch" (DOC Nat. Stand. Guidelines. 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.

Appendix 2. Draft Review Meeting Agenda

(Final Meeting agenda to be provided at time of award)

64th Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) Benchmark stock assessment for A. Atlantic mackerel

Nov. 28-30, 2017

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

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Tuesday, Nov. 28

10 – 10:30 AM

Welcome	**James Weinberg**, SAW Chair	
Introduction	**Paul Rago,** SARC Chair	
Agenda		
Conduct of Meeting		

10:30 – 12:30 PM	Assessment Presentation (A. Mackerel)	
	Kiersten Curti	**TBD**
12:30 – 1:30 PM	Lunch	
1:30 – 3:30 PM	Assessment Presentation (A. Mackerel)	
	Kiersten Curti	**TBD**
3:30 – 3:45 PM	Break	
3:45 – 5:45 PM	SARC Discussion w/ Presenters (A. Mackerel)	
	Paul Rago , SARC Chair	**TBD**
5:45 – 6 PM	Public Comments	
7 PM	**(**Social Gathering**)**	

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Wednesday, Nov. 29

9:00 – 10:45	Revisit with Presenters (A. Mackerel) **Paul Rago,** SARC Chair	**TBD**
10:45 - 11	Break	
11 – 11:45	Revisit with Presenters (A. Mackerel) **Paul Rago ,** SARC Chair	**TBD**
11:45 – Noon	Public Comments	
12 – 1:15 PM	Lunch	
1:15 – 4	Review/Edit Assessment Summary Report (A. Mackerel) **Paul Rago ,** SARC Chair	**TBD**
4 – 4:15 PM	Break	
4:15 – 5:00 PM	SARC Report writing	

Thursday, Nov. 30

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; however, during the Report Writing sessions on Nov. 29 and 30, we ask that the public refrain from engaging in discussion with the SARC.

Appendix 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.

Appendix 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: SARC Panel Membership and Attendees List

SARC Panel

John Boreman (Chair)	NC State Univ.	jgboremanjr@gmail.com
Kevin Stokes	stokes.net.nz LTD	kevin@stokes.net.nz
Robin Cook	Univ. Strathclyde	melford@clara.co.uk
Joseph Powers	Joseph Powers Consulting	j.powers.fish@gmail.com

SARC 64 ATTENDEE LIST (Mackerel Assessment Review, Nov. 28-30, 2017)

NAME	AFFILIATION	EMAIL
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