Center for Independent Experts (CIE) External Independent Peer Review for "Predictive Modeling of North Atlantic Right Whale Population"

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Executive Summary

To meet their requirements to use the best scientific information available, and to strengthen scientific quality assurance on issues related to fishery conservation and management action, the National Marine Fisheries Service (NMFS) has sought external, independent review of their predictive model exploring the effects of mortality due to entanglement in fishing gear on North Atlantic right whales (*Eubalaena glacialis*). The Terms of Reference requested that reviewers consider whether NMFS has used the best available data, chose to use an appropriate time period (2010-2018), and whether the scientific conclusions and interpretations were sound.

NMFS has used the best available data in their assessment, although it should be acknowledged that assumptions that were made regarding an independent relationship between a female's fecundity and entanglement represent a worst case scenario. While currently there are no data available on this topic that could be incorporated into NMFS' model, so there is no need change the current approach in this regard, it is something that needs to be made explicit in the report as it may result in overly pessimistic conclusions.

The time-period NMFS has chosen, 2010-2018, is in many ways the most appropriate. However, the assumption that the conditions of those eight years will continue for 50 years into the future is a strong one, especially given the observed variability in calving from 1990-2018. NMFS partially addresses this assumption in Supplement 4 of their report (which contained the population projections using fertility rates from 1990-2018), but it needs to be explored more fully through explicit scenarios.

The scientific conclusions and interpretations in the report are sound, but need to be better supported analytically in order to have greater confidence in their use within the Section 7 consultation. Model validation and testing (i.e., asymptotic, ergodic and perturbation analyses) need to be conducted, and the uncertainty inherent in the estimates of the number of whales to die as a result of entanglement in fishing gear needs to be accounted for in the model.

Overall, NMFS has used the best scientific information available to inform their predictive model of the North Atlantic right whale population. All the recommendations are to add information that will strengthen NMFS' science and increase the transparency of the assessment.

Background

The North Atlantic right whale (*Eubalaena glacialis*; NARW) is a listed species under the Endangered Species Act (ESA) in the US. Under Section 7 of the ESA, federal agencies must consult with the National Marine Fisheries Service (NMFS) regarding any actions that will affect the NARW, since NMFS has the responsibility to conserve, protect and manage the nation's living marine resources, as mandated by the Marine Mammal Protection Act, the ESA and the Magnuson-Stevens Fishery Act. This has led to NMFS currently taking part in the formal consultation on the continued operation of ten fisheries in the Greater Atlantic Region.

The effect of entanglement in vertical lines from fixed gear fisheries is of particular concern for NARW, as it is believed to not only cause direct mortality, but also to have long term effects on survival (e.g., Robbins et al. 2015). Furthermore, a population decline and reduced fecundity has been observed in recent years (e.g., Pace et al. 2017). Therefore, to aid in the assessment of the effect of the fixed gear fisheries on the NARW population, NMFS has developed a predictive model to evaluate how reduction in mortality due to entanglements might affect the population trajectory for NARW. To help ensure that NMFS is basing their consultation on the best scientific information available, they have sought external, independent scientific peer review of the model they have developed.

Description of the Individual Reviewer's Role in the Review Activities

As a reviewer in this process, my role was to 1) review the provided background materials (Pace et al. 2017, Corkeron et al. 2018), 2) actively participate in the review meeting that occurred on 30 March 2020, and 3) to perform a desk review of the report (Linden 2020) that was provided to me by the Center for Independent Experts Program. I also attended and participated in a March 30, 2020 webinar and Q and A session with NMFS scientists involved in the review. This document forms the Independent Peer Review Report, which is my contracted deliverable, and is completed according to the required format and content described in Annex 1 of the agreed upon Performance Work Statement (Appendix 2) and addresses each of the Terms of Reference as outlined in Annex 2 of the aforementioned Statement.

Summary of Findings

Consideration of Best Available Data

The analysis did use the best available data to estimate population size, mortalities due to entanglements in pot and trap gear, and survival and fecundity for the North Atlantic right whale. However, the discussion of the results would be improved by consideration of what is known about the link between entanglements and energetic stress, and energetic stress and reproduction (e.g., Pettis et al. 2017). I understand that this information cannot be incorporated into the model because of the lack of direct information. However, if there is a synergistic relationship between

entanglement and fecundity, then the results of the analysis may be overly pessimistic. It should be made clear that what is presented is a worst-case scenario.

Appropriateness of 2010-2018 Time Period

The 2010-2018 time period is appropriate as a starting point for the assessment in order to investigate the worst-case scenario. However, given the uncertainty around the regime shift in the Gulf of Maine and Georges Bank, the assessment could benefit from greater exploration of how pre-2010 data might affect the analysis. Supplement 4 did use the fertility rates from the longer time series of 1990-2018, which does demonstrate how sensitive the model results can be to the assumptions inherit in the use of the 2010-2018 time period. More explicit scenarios investigating the effects of using the data from periods of low, moderate or high fecundity may also provide useful information regarding the potential trajectories for the population.

Scientific Conclusions and Interpretations

The interpretation of what has been presented in the report is correct, but it would benefit from additional analytical support, particularly in the form of validation and sensitivity analyses. The validation could be achieved by investigating whether the projections are able to recreate the observed trends in different time periods. For example, using the survival and fecundity data from 1990-2000 or 2000-2010, should result in the average trend estimated by the projections coinciding with the observed trends. Another useful check would be if whether the information from 1990-2000 is capable of estimating the trends observed in 2000-2010. A key assumption of the approach is that the demographic information from 2010-2018 is appropriate for making inferences about what will happen in the next 50 years. Therefore, knowing whether the approach is capable of reproducing the broad patterns in observed dynamics will be helpful and may aid in the assessment of how important it is to explore the issue I raised under the section on the appropriateness of the 2010-2018 time period.

In addition to the validation, I would like to see more in the way of asymptotic, ergodic[1] and perturbation (i.e., sensitivity) analyses, as laid out in Caswell (2001). The ergodic and perturbation analyses are particularly important given the assumption that the projections were starting with a stable-age distribution, and a formal sensitivity analysis would help readers understand how the assumptions made during the course of the assessment may be affecting the conclusions and interpretations drawn.

There are some other components of the assessment that would benefit from clarification and further explanation in order to further ensure sound conclusions that have been interpreted properly. In particular, the estimated mortalities due to pot and trap fisheries is treated as a constant, even though there is uncertainty surrounding the cryptic mortalities. The lower bound on the estimate of mortality from the state-space model should always be greater than the observed mortalities, since Pace et al. (2017) took account of the minimum number of whales

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[1] Ergodic analyses should be a standard part of any use of matrix population modelling, as their purpose is to ensure that the dynamics of the model are not affected by the starting conditions.

known to be alive. Therefore, using a random draw from the posterior distribution on total deaths to calculate cryptic mortalities, as opposed to just using the median, should be possible without ever calculating a biologically implausible negative number of deaths. A negative number of deaths might be calculated if the draw from the posterior distribution of mortalities was less than the observed number of mortalities to have occurred. Given how Pace et al. (2017) constructed their model, this should not actually be an issue in this case. However, if it is it could be handled in different ways, including by using a truncation value if necessary. The assessment would then be able to more fully incorporate the uncertainty in the number of pot and trap related deaths. I recognize that increasing the uncertainty in this component of the model will have the overall effect of increasing the uncertainty in the results. However, a major part of the message appears to be that to reduce fatalities enough to allow for the possibility of the recovery of the NARW population, both the US and Canada need to take action, but to me, the strength of that argument is undermined by the fact that we don't actually know the true number of deaths occurring in both countries. Even if a fully stochastic inclusion of mortality isn't possible, scenarios looking at different quantiles of estimated entanglement mortality would help to strengthen the conclusions and interpretations that are being drawn.

Conclusions and Recommendations

Overall, I feel that the assessment has used the best available data and made a series of assumptions regarding the use of the 2010-2018 data that can be considered biologically appropriate. There are also no blatant errors or misinterpretations in the results or conclusions. However, the conclusions and interpretations could be much better supported than they currently stand. The incorporation of model validation and model testing, particularly with regards to the sensitivity of the results to the assumptions made in the analysis, would greatly strengthen the report, and I think are required in order for the scientific conclusions and interpretations included in the report to be compelling and useful in the context of informing the Section 7 formal consultation.

References

Caswell H. 2001. *Matrix Population Models: Construction, Analysis, and Interpretation* 2nd edition: Sinauer Associates, Inc., Sunderland, MA.

Corkeron P, Hamilton P, Bannister J, Best P, Charlton C, Groch KR, Findlay K, Rowntree V, Vermeuelen E and Pace RM III. 2018. The recovery of North Atlantic right whales, *Eubalaena glacialis,* has been constrained by human-caused mortality. Royal Society of Open Science 5: 180892.

Linden D. 2020. Population projections of North Atlantic right whales under varying human-caused mortality risk and future uncertainty. NOAA/NMFS/GARFO, draft. 41 pp.

Pace RM III, Corkeron PJ and Kraus SD. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution 7: 8730-8741.

Pettis HM, Rolland RM, Hamilton PK, Knowlton AR, Burgess EA and Kraus S. 2017. Body condition changes arising from natural factors and fishing gear entanglements in North Atlantic right whales *Eubalaena glacialis*. Endangered Species Research 32: 237-249.

Robbins J, Knowlton AR and Landry S. 2015. Apparent survival of North Atlantic right whales after entanglement in fishing gear. Biological Conservation 191: 421-427.

Appendix 1: Bibliography of Materials Provided for Review

Corkeron P, Hamilton P, Bannister J, Best P, Charlton C, Groch KR, Findlay K, Rowntree V, Vermeulen E and Pace RM III. 2018. The recovery of North Atlantic right whales, *Eubalaena glacialis,* has been constrained by human-caused mortality. Royal Society of Open Science 5: 180892.

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Appendix 2: Copy of CIE Performance Work Statement

Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

Center for Independent Experts (CIE) Program

External Independent Peer Review

Predictive Modeling of North Atlantic Right Whale Population

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

NMFS is required to use the best available scientific and commercial data in making determinations and decisions under the Endangered Species Act (ESA). Under section 7 of the ESA, federal agencies must consult with NMFS when any project or action they take might affect an ESA-listed marine species or designated critical habitat. We are currently undergoing section 7 formal consultation on the continued operation of ten fisheries in the Greater Atlantic Region. These fisheries include fixed gear fisheries. Formal consultation results in NMFS developing a biological opinion. The intent of a biological opinion is to ensure that the proposed project or action will not reduce the likelihood or survival and recovery of an ESA-listed species.

The effect of these fisheries on North Atlantic right whales, an ESA-listed species, is being assessed in the current consultation. This includes the impact of entanglement in vertical lines on the population. To help in this analysis, NMFS has developed a predictive model to evaluate how reductions in serious injury and mortality will affect the population trajectory of female North Atlantic right whales. It is critical that the information, analysis, and determinations in the section 7 consultation be based on the best available information on North Atlantic right whales. Therefore, the CIE reviewers will conduct a peer review of the scientific information in the North Atlantic right whale model based on the Terms of Reference (TORs). Given the public interest, it will be important for NMFS to have a transparent and independent review process of the model used in the consultation.

Requirements

NMFS requires three (3) reviewers to conduct an impartial and independent peer review in accordance with the PWS, OMB guidelines, and the TORs below. The reviewers shall have a working knowledge and recent experience in at least one of the following: (1) population modeling and/or (2) quantitative ecology. In addition, large whale science experience is preferred.

Tasks for Reviewers

1) Review the following background materials and reports prior to the review meeting:

Pace III, R.M., P.J. Cockeron, S. D. Krause. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution. 7:8730-8741 . DOI: 10.1002/ece3.3406

Corkeron, P., Hamilton, P., Bannister, J., Best, P., Charlton, C., Groch, K.R., Findlay, K., Rowntree, V., Vermeulen, E. and Pace III, R.M., 2018. The recovery of North Atlantic right whales, *Eubalaena glacialis,* has been constrained by human-caused mortality. *Royal Society open science*, 5(11), p.180892. DOI: 10.1098/rsos.180892

2) <u>Desk Review</u>: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role unless specified herein. Modifications to the PWS and TORs cannot be made during the peer review, and any PWS or TORs modifications prior to the peer review shall be approved by the NMFS Project Contact.

3) <u>Contract Deliverables - Independent CIE Peer Review Reports</u>: Each CIE reviewer shall complete an independent peer review report in accordance with the PWS. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each TOR as described in **Annex 2**.

4) Deliver their reports to the Government according to the specified milestones dates.

Place of Performance

Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Period of Performance

The period of performance shall be from the time of award through May 2020. The CIE reviewers' duties shall not exceed 10 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.

Schedule	Deliverables and Milestones
Within two weeks of award	Contractor selects and confirms reviewers
No later than two weeks prior to the review	Contractor provides the pre-review documents to the reviewers
March 2020	Each reviewer conducts an independent peer review as a desk review
Within two weeks after review	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final reports to the Government

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; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

Since this is a desk review travel is neither required nor authorized for this contract.

Restricted or Limited Use of Data

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

Project Contact:

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NMFS, Greater Atlantic Region
55 Great Republic Drive, Gloucester, MA 01930

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether or not the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role 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.

3. The reviewer report shall include the following appendices:

   1. Appendix 1: Bibliography of materials provided for review

   2. Appendix 2: A copy of the CIE Performance Work Statement

Annex 2: Terms of Reference for the Peer Review

1. Based on the scientific information presented in the report, does this analysis consider all of the best available data? If not, please indicate what information is missing and if possible, provide sources. When considering this question, please keep in mind the context in which the model was developed as provided in the model documentation. The model is not designed to consider all factors that may impact the population.

2. Is the period (2010-2018), the appropriate period for the assessment? If not, please indicate what period should be used and why that period is more appropriate.

3. In general, are the scientific conclusions in the reports sound and interpreted appropriately from the information? If not, please indicate why not and if possible, provide sources of information on which to rely.