# CENTER FOR INDEPENDENT EXPERTS (CIE) INDEPENDENT PEER REVIEW OF NORTH ATLANTIC RIGHT WHALE MODEL PROJECTIONS

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May 2020

# Contents

# Executive Summary

Between 11 March and 13 April 2020, I reviewed background documents and a draft report by Daniel W. Linden of the Greater Atlantic Regional Fisheries Office (GARFO) entitled "*Population projections of North Atlantic right whales under varying human-caused mortality risk and future uncertainty*", dated 16 March 2020. I found the report to be well-written and logically constructed. It described modelling conducted to predict the future population trend of the North Atlantic right whale population under a variety of different scenarios of population demographics and anthropogenic mortalities (from fishing and other causes). The models used are simple, but I believe they are fit for the purpose of assessing future trends. I do not believe that more complex models with greater biological reality and correlated input variables would lead to qualitatively different conclusions. It is my view that the analysis and these simple models consider all of the best available data. I also believe that choosing the period 2010–2018 to represent the likely future productivity of the population in the projections, while simultaneously testing the sensitivity of conclusions to this choice, was defensible and appropriate. The scientific conclusions that I infer from the report's Results and Discussion sections are sound. In summary, I believe the draft report by Daniel Linden entitled "*Population projections of North Atlantic right whales under varying human-caused mortality risk and future uncertainty*" represents the best scientific information available to evaluate how reductions in serious injury and mortality will affect the population trajectory of female North Atlantic right whales.

# Background

The US National Marine Fisheries Service (NMFS) is required to use the best available scientific and commercial fishery data in making determinations and decisions under the US Endangered Species Act (1973, as amended, ESA). Under section 7(a) 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. Formal consultation is underway pursuant to section 7(a) on the continued operation of ten fisheries in the Greater Atlantic Region, including fixed gear fisheries. Formal consultation results in NMFS developing a biological opinion (section 7(b)), the intent of which 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 ten fisheries on North Atlantic right whales (NARW), an ESA-listed species, is being assessed in the current consultation. This includes the impact on the population of entanglements by individuals in vertical lines. 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. NMFS considers it critical that the information, analysis, and determinations in the section 7(a) consultation be based on the best available information on NARW and has therefore engaged, via the Center for Independent Experts (CIE), three reviewers to conduct a peer review of the scientific information in the projection model. This is one of those three independent reviews.

# Role in the Review Activities

I was contracted by the CIE to provide one of three independent peer reviews of the projection model for NARW summarised in the draft report by Daniel Linden (2020). The terms of reference for my review were tightly specified in the performance work statement that was first provided to me on 11 March 2020 and returned to me countersigned on 13 March 2020.

Also on 13 March 2020, I signed and returned the non-disclosure agreement provided by the Greater Atlantic Regional Fisheries Office of NMFS (GARFO) and undertook to keep the draft report confidential (based on its draft, pre-dissemination status).

After reading the two specified background papers (Pace et al. 2017 and Corkeron et al. 2018), I participated with the other CIE reviewers in a 1–hour webinar on the morning of 31 March 2020 (NZDT) where Daniel Linden presented the modelling approach and the key results, and answered questions from the CIE reviewers. I found the webinar to be very helpful in confirming my understanding of the modelling approach and clarifying a few issues for me.

Following the webinar, I reviewed the draft modelling report against the terms of reference and wrote this report, submitting it to CIE and GARFO on Monday 13 April 2020.

# Summary of Findings

## Specified Terms of Reference for this review

It was specified in the Performance Work Statement (PWS, included as Appendix 2) that Reviewers shall have "a working knowledge and recent experience in at least one of the following: (1) population modelling and/or (2) quantitative ecology. In addition, large whale science experience is preferred". My experience is in population modelling (primarily fish stock assessment) and quantitative ecology, including impact and risk assessment. That experience includes commissioning and review of a wide variety of research on seabirds and marine mammals, although I have no direct large whale science experience.

The following terms of reference (TOR) were specified in the PWS by the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), and Center for Independent Experts (CIE) Program:

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.*

I consider each of the terms of Reference separately in the following sections.

## TOR1: use of best scientific information available

*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.*

I believe the projection model uses the best available data appropriate to this type of simple stage-structured population model focussed on predicting likely short- to medium-term trends in NARW population size. The inputs include: statistical distributions of the historical population size of each stage in the projection model (calf, juvenile, adult); estimates of survival probabilities by sex, age, and year; estimates of capture probabilities by sex, year, and individual; estimates of calving rate each year; and estimates of fatalities caused by fisheries and other sources (mostly ship-strikes, I assume) in USA and Canadian waters. These inputs have been drawn from a variety of monitoring programmes and modelling jobs. Those I have examined (admittedly somewhat briefly) appear to be reliable and searches I have conducted have revealed no other studies that would provide more reliable information or data. I think it is appropriate that the projection model relies on the available information described.

Predicting trends over 50 years seems ambitious, and potentially questionable, but the differences between scenarios are so clear in the first few years of the projections that this is really of no significance. I suggest that projections for 10–20 years (a timescale perhaps more in keeping with the patterns in the variability in the key demographic rate, the calving rate) would have led to the same conclusions.

The split of mortalities 1:1 between USA and Canada does not seem to have much supporting evidence in the documentation provided (just a footnote on page 5). I think it would be worthwhile in any subsequent drafts or reports to describe the data and analyses that underpin this assumption and, perhaps, cite some of the key studies. Similarly, it is also assumed without much documented support, that males and females are equally vulnerable to entanglement in pot fisheries (and to all anthropogenic mortality in Canada). Is the evidence for this assumption strong, or is it plausible that the lower survival rate of females is partly due to higher fishing-related or ship-strike mortality than males? Again, I think it would be useful to document the basis for the assumption. In either case, given the simplicity of the model, it would not be very demanding of computer or analyst time to run sensitivity tests to assess the implications of any deviation from the assumed values.

The model runs presented seem to assume that fishing-related mortality is the only anthropogenic threat to NARW that can or will be mitigated within USA waters, and I wondered whether this meant that mitigation of ship strikes (e.g., through speed restrictions (Ebdon et al. 2020), season-area closures (Davis & Brilliant 2019), or more dynamic risk reduction strategies (e.g., Silber et al. 2015 for NARW)) is thought impossible or has not been contemplated for some other reason. I recognise that the numbers are relatively low for ship strikes, about one-quarter of the pot-related incidents, and probably not increasing like pot-related mortality may be, but reducing ship strikes or their severity would certainly give higher chances of population increase. This could be discussed qualitatively or a semi-quantitative assessment could be done by inspecting projections using numbers of saved fatalities by pot reduction. For instance, the reduction of fatalities by increasing the mitigation on fishing from 70 to 80% (5 fewer deaths) is similar to the reduction from a one-third reduction in vessel strikes. So, reducing fishing by 70% combined with reducing shipping-related mortality by 33% has a similar outcome to reducing fishing by 80%. The US non-pot fishing related mortality is very low indeed and can be safely ignored, I believe.

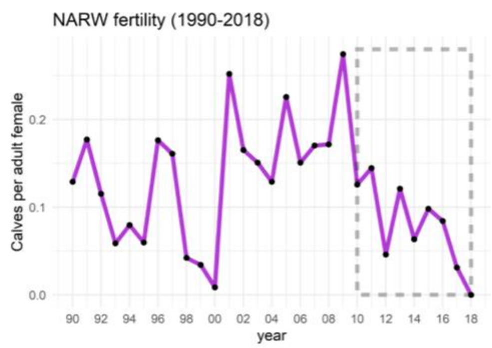
## TOR2: period of the assessment

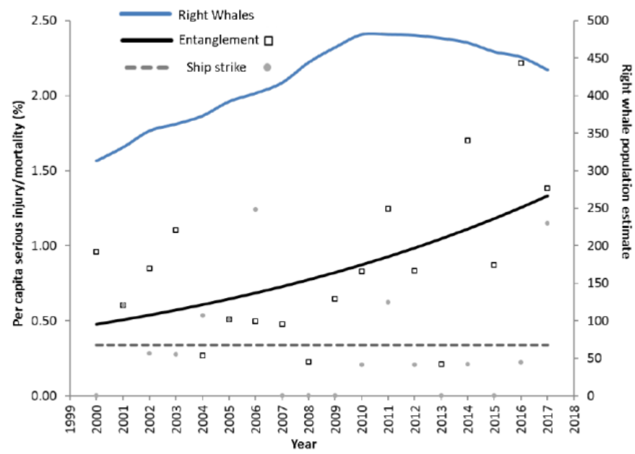
*Is the period (2010-2018), the appropriate period for the assessment? If not, please indicate what period should be used and why that period is more appropriate.*

I interpreted this TOR as referring to the period used to estimate the average fertility / productivity of the NARW population during the projections. The state-space mark-recapture model (which could arguably be considered an assessment) was fitted to data from 1990–2018 data (39 years) and the projections were conducted over the coming 50 years, both much wider time periods.

I believe the use of productivity estimates (calving rates) for NARW between 2010 and 2018 in projections of the population to be appropriate. “Recent average recruitment” is often assumed for forward projections of fish stocks and other populations, and is particularly appropriate if there is reason to believe a “regime shift” occurred in the recent past. If the observed average productivity of the NARW population has been lower since ca. 2010 because of environmental changes, then using recent calving rates as the productivity driver for the modelling should provide more reliable projections of population size than using a different or wider time period when productivity was sometimes higher. Thus, the key questions underpinning the choice of time period for calving rates to go into the projections are: is it likely that there has been a regime shift; and, if so, when did the shift occur?

It is known that NARW rely very heavily on the energy-dense copepod *Calanus finmarchicus* and that changes in the availability of this species are strongly correlated with NARW reproductive success (e.g., Meyer-Gutbrod et al., 2015; Meyer-Gutbrod & Greene, 2018, and references cited in each). In addition, decadal-scale changes in *C. finmarchicus* abundance have been linked to shifts in ecosystem function caused by climate change (MERCINA, 2012; Greene et al., 2013; Hayes et al., 2018; Record et al. 2019). Finally, Davis et al. (2017) showed that the geographical distribution of NARW changed dramatically around 2010 (comparing passive acoustic detections from 2004–2010 with those of 2011–2014). Based on this background, it seems reasonable to conclude that a regime shift had occurred and that there have probably been consequences for NARW in terms of reduced average productivity. The observed fertility rate (Figure 3 from Linden 2020) and the population trends (Figure 1 from Hayes et al. 2018) both suggest that 2010 is a reasonable starting date:




Choosing the whole available time series 1990–2018 to provide productivity inputs for the projections would make the projections optimistic relative to likely performance of the population under recent observed fertility rates. If there was reason to believe that the variability in this time series was cyclical, in response to some environmental cycling, then use of the whole time series, with autocorrelation between years included, would be appropriate. However, given there appears to be reason to believe there has been a more directional change, the use of the recent time period is much more defensible.

Running projections with different assumed years and fertility rates, as conducted by Linden 2020, is useful for teasing out the sensitivity to, and relative contributions of, environmental and anthropogenic drivers of population change.

## TOR3: scientific conclusions

*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.*

The draft report by Daniel Linden (2020) does not include a specific Conclusions section, but I have inferred the following broad conclusions from the Results and Discussion sections.

- Projections indicate that current average (2010–2018) rates of NARW survival, fertility and anthropogenic mortality will lead to a further decline in the population;
- The substantial variability in the 1000 projections for each scenario lead to a non-zero (but very low) probability of population increase after 50 years even for current average rates of NARW survival, fertility and anthropogenic mortality;
- Projections using the 1990–2018 average calving rates are more favourable, with all scenarios suggesting a population increase on average, but these projections are unlikely to be representative of the future fertility rates of the population and are, therefore, optimistic;
- Mitigation involving reduction of up to approximately 80% in fishing-related mortality in the U.S. pot/trap fishery is unlikely to prevent further population decline;

- Even complete elimination of entanglement mortalities in the US pot/trap fishery will leave a relatively high probability (>0.37 over 50 years) of further population decline;
- Both the United States and Canada must implement measures to mitigate NARW mortalities if a positive population trajectory is desired.

In general, I think these conclusions are defensible given the information available, and the modelling and sensitivity runs conducted. The model is simple and could undoubtedly be made more complex, but I do not think that added complexity would lead to qualitatively different conclusions. I do not know of any other, different data that could or should be used in the modelling.

Added complexity to include greater biological reality and correlation structure in the input variables may change quantitative estimates of the likelihood of decline, especially over shorter timeframes than the 50 years covered by these projections, but I suspect these changes would be minor compared with the large differences between the mitigation scenarios. It is very hard for me to imagine how more complex models would alter the final conclusion that reductions in anthropogenic mortalities of NARW in both US and Canadian waters are required if a high probability of an increasing population is desired.

## Conclusions and Recommendations

I think the projection models, although simple, are fit for purpose and provide defensible guidance on the likely population trends for NARW under different levels of anthropogenic mortality. The assumption within the projections that productivity (i.e., fertility or calving rate) will average the same as the low level observed between 2010 and 2018 is clearly a strong one and largely determines the results. However, I think this is realistic given the evidence that a regime shift has occurred and a return to the higher levels of productivity last seen in the early years of this century is not very likely. It would, of course, be prudent to continue monitoring NARW population size and calving rate to assess whether this key assumption remains tenable. Large departures, either positive or negative, might lead to additional modelling to infer the implications. It would also be prudent to continue to monitor and estimate the frequency of interactions and fatalities caused by fisheries and shipping in both US and Canadian waters. Better estimates of the number of fatalities and serious injuries, especially to females, caused in the two jurisdictions may be useful to fine-tune future mitigation approaches.

More complex age-structured models could undoubtedly be developed, and I understand from discussions at the webinar that work towards this is underway. I think a key area in which more complex models would help is in better representing correlations within and between input data sets. For instance, there appears to be temporal autocorrelation in the calving rate (as well as likely regime shifts) and including this autocorrelation (rather than simply sampling with replacement) would probably increase the variability of forward projections of population size. Similarly, it seems likely that reduced availability of a key food item (as suggested for NARW in recent years) would lead to changes in age at maturity as well as the annual fertility of mature females, and these would likely be inversely correlated (an increase in age at maturity together with a decrease in calving rate). I think including this type of correlation structure in projections would increase the variability of forward projections of population size much more than the overall trend, if it affected the trend much at all. Any "implementation error" (variability in success between years or areas) in mitigation approaches applied to fisheries or other sources of mortality in Canada would have a similar effect. In the Bayesian framework already implemented for the NARW models, this could be very elegantly implemented by using parameter pairs from MCMC chains from models fit to the data as inputs for projection models rather than by simply resampling the observed values or unpaired estimates from the chains.

Understanding the variability of potential forward trajectories would be vitally important if the models were being used to estimate the probability of extinction, or the probability of falling below a given population size (for example, a population size below which Allee effects or depensation were thought more likely). The projection models described by Linden (2020) were not used to estimate extinction risk, and I see nothing in the documentation provided to suggest that was required, but future more complex models might be used in that way, at least to make relative estimates between scenarios.

## References cited or consulted other than those provided


Davis, G.E.; Baumgartner, M.F.; Bonnell, J.M.; Bell, J.; Berchok, C.; Thornton, J.B.; Brault, S.; Buchanan, G.; Charif, R.A.; Cholewiak, D.; Clark, C.W. (2017). Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (*Eubalaena glacialis*) from 2004 to 2014. *Scientific reports*, **7**: 1–12. Downloaded from: https://www.nature.com/articles/s41598-017-13359-3.

Davies, K.T.; Brillant, S.W. (2019). Mass human-caused mortality spurs federal action to protect endangered North Atlantic right whales in Canada. *Marine Policy*, **104**: 157–162. Downloaded from: https://doi.org/10.1016/j.marpol.2019.02.019.

Ebdon, P.; Riekkola, L; Constantine, R. (2020). Testing the efficacy of ship strike mitigation for whales in the Hauraki Gulf, New Zealand. *Ocean & Coastal Management*, **184**, 105034. Downloaded from: https://doi.org/10.1016/j.ocecoaman.2019.105034.

Endangered Species Act (1973) as amended through the 108th Congress. Department of the Interior, U.S. Fish and Wildlife Service, Washington, D.C. 20240. Downloaded from: https://www.fws.gov/endangered/esa-library/pdf/ESAall.pdf.

Greene, C.H., Meyer-Gutbrod, E., Monger, B.C., McGarry, L.P., Pershing, A.J., Belkin, I.M., Fratantoni, P.S., Mountain, D.G., Pickart, R.S., Proshutinsky, A., Ji, R., Bisagni, J.J., Hakkinen, S.M.A., Haidvogel, D.B., Wang, J., Head, E., Smith, P., Reid, P.C., Conversi, A. (2013). Remote climate forcing of decadal-scale regime shifts in Northwest Atlantic shelf ecosystems. *Limnology and Oceanography*, **58**, 803–816. Downloaded from: https://doi.org/10.4319/lo.2013.58.3.0803.

Hayes, S.A.; Gardner, S.; Garrison, L.P.; Henry, A.; Leandro, L. (2018). North Atlantic right whales- evaluating their recovery challenges in 2018. NOAA Technical Memorandum NMFS-NE-247. 30 p. Downloaded from: https://repository.library.noaa.gov/view/noaa/19086/noaa_19086_DS1.pdf.

[MERCINA] Marine Ecosystem Responses to Climate in the North Atlantic Working Group (2012). Recent Arctic climate change and its remote forcing of Northwest Atlantic shelf ecosystems. *Oceanography*, **25**: 208–213. Downloaded from: https://doi.org/10.5670/oceanog.2012.64.

Meyer-Gutbrod, E.L., Greene, C.H. (2018). Uncertain recovery of the North Atlantic right whale in a changing ocean. *Global Change Biology*, **24**, 455-464. Downloaded from: https://doi.org/10.1111/gcb.13929.

Meyer-Gutbrod, E.L., Greene, C.H., Sullivan, P.J., Pershing, A.J. (2015). Climate-associated changes in prey availability drive reproductive dynamics of the North Atlantic right whale population. *Marine Ecology Progress Series*, **535**, 243–258. Downloaded from: https://doi.org/10.3354/meps11372.

Record, N.R.; Runge, J.A.; Pendleton, D.E.; Balch, W.M.; Davies, K.T.; Pershing, A.J.; Johnson, C.L.; Stamieszkin, K.; Ji, R.; Feng, Z.; Kraus, S.D. (2019). Rapid climate-driven circulation changes threaten conservation of endangered North Atlantic right whales. *Oceanography*, **32:** 162-169. Downloaded from: https://imr.brage.unit.no/imr-xmlui/bitstream/handle/11250/2635688/32-2_record.pdf?sequence=1.

Silber, G.K.; Adams, J.D.; Asaro, M.J.; Cole, T.V.N.; Moore, K.S.; Ward-Geiger, L.I.; Zoodsma, B.J. (2015). The right whale mandatory ship reporting system: a retrospective. *PeerJ* **3**:e866. Downloaded from: https://doi.org/10.7717/peerj.866.

# Appendix 1: Bibliography

The following document summarising the projection model for NARW was provided by GARFO on 18 March 2020:

Linden, D.W. (2020). Population projections of North Atlantic right whales under varying human-caused mortality risk and future uncertainty. Draft report for peer review dated 16 March 2020 by Daniel W. Linden, NOAA/NMFS/GARFO. 42 pages.

Titles and DOIs allowing me to download the following background reports were provided as part of the SOW by CIE on 11 March 2020 (PDF versions were subsequently provided by GARFO on 18 March 2020 together with the modelling report):

Corkeron, P.J.; Hamilton, P.; Bannister, J.; Best, P.; Charlton, C.; Groch, K.R.; Findlay, K.; Rowntree, V.; Vermeulen, E.; 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**: 180892. DOI: 10.1098/rsos.180892.

Pace III, R.M.; Cockeron, P.; Krause, S.D. (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.

# Appendix 2: Performance Work Statement

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)** Desk Review: 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)** Contract Deliverables - Independent CIE Peer Review Reports: 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:**

Ellen Keane

ellen.keane@noaa.gov

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

**A**

## nnex 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.