# Peer Review Summary Report:

# Review of the
# North Atlantic Right Whale Decision Support Tool

**December 2019**

## Executive Summary

NMFS developed a decision support tool (DST) to permit a range of mitigation measures expected to reduce lethal entanglements of the North Atlantic Right Whale (NARW) to be examined in terms of risk reduction. The DST uses fishery information obtained from state and Federal fisheries to establish vertical line density, which when combined with modelled whale densities produces a co-occurrence model. The characteristics of gear configurations inform the threat posed by the gear in causing serious injury or mortality to NARW. The Review was focused on assessing the inputs and outputs of the model, providing comment on the DST's appropriateness as a tool for decision-making, and to provide research recommendations for its improvement. Additionally it was to provide comment on the apportionment of unassigned entanglement mortalities and serious injuries of NARW between Canada and the US.

The DST is an appropriate and valuable tool to assess various mitigation measures in a common risk-reduction metric, and has proven useful in determining possible management actions with stakeholders. However, the review panel has a number of concerns over the DST's underlying data, which is coarse (spatially and temporally), stagnant (set years) and does not account for variation in the various data sources. Considerable work should be aimed at improving the inputs to the model across the three major data sources, fishery data, whale distribution, but particularly the assessment of gear threat. A series of recommendations addressing these points are summarised below and expanded upon in the individual reports.

A significant amount of development has occurred on the DST over a relatively short period of time, and the developers should be complimented on their work and its continued development. The parallel development of various components of the DST does present some cause for concern in terms of the provision of up-to-date documentation, stakeholder buy-in or confidence, and dissemination and reproducibility. However, addressing the recommendations of this report through continued development will lead to a valuable tool in mitigating mortailites in the North Atlantic Right Whale and likely other endangered large whales in the region.

## Introduction

The North Atlantic Right Whale Decision Support Tool Review Panel was convened by the NOAA Fisheries on November 19-21, 2019 in Woods Hole, MA. The goal of the review was to assess evaluate a proposed strategy for evaluating management options proposals to reduce the risk of lethal entanglement in fishing gear that include both closures and gear modifications on the same currency. This Decision Support Tool (DST) was designed to address the question: what change or combination of changes reduce the risk of lethal entanglement to a level that will result in mortalities below Potential Biological Removal (PBR)? The review panel evaluated data inputs used in the Decision Support Tool (DST) model and outputs from the model in the context of their appropriateness as an approach to evaluate relative entanglement risk to right whales. The panel also commented on the strengths and weaknesses of using the DST to compare management measures and provided recommendations for improvement of the model.

The work reviewed by the Panel was conducted by Northeast Fisheries Science Center (NEFSC) and NOAA Fisheries scientists, in collaboration with Industrial Economics (IEc) and Duke University. The Panel consisted of Dr. Julie van der Hoop (Chair, Independent), Dr. Jason How (Department of Primary Industries and Regional Development Western Australia) and Dr. Don Bowen (Dalhousie University). The Panel reviewed written materials provided to them (Appendix 1) and presentations on the DST, including the target for risk-reduction and apportionment of mortalities in a transboundary stock, and addressed five terms of reference (TOR; Appendix 4). The terms of reference required the Panel to review the inputs and outputs of the DST, the appropriateness of its use to evaluate relative risk scenarios, and provide research recommendations to strengthen the approach.

## Summary of Findings

TOR 1: Evaluate the data inputs used in the decision support tool.

The inputs to the Decision Support Tool are 1) estimates of the number of active lobster vessels and the gear configuration of those vessels from which the density of traps by location and month from a model prepared by IEc, representing the density of vertical lines from state and Federal fisheries; 2) a whale density estimate model prepared by

Duke University; 3) a gear threat model that estimates the risk of serious injury or mortality as a function of rope breaking strength.

The DST serves to combine these three models to estimate risk, defined by the DST as the product of gear threat per endline, the density of endlines, and the density of whales. The DST is designed to allow for user inputs to simulate management scenarios to assess how risk might be reduced by introducing management measures including seasonal closures, trap reductions, trawl-length regulations, gear characteristics, and buoy-less fishing.

Strengths:

Vertical-line model:

- Use of available information: It appears that all available information on the spatial distribution of and amount of gear used by the northeast Atlantic lobster fishery has been used as data inputs to the decision support tool model. The Panel acknowledges the efforts required to aggregate disparate datasets into a meaningful product.
- Consulting with local management: It appears that, where additional information exist, alternative approaches have been used to improve the spatial accuracy of the predictions (e.g. LMA3), albeit with other considerations. Additionally, the model developers have met with regional management to incorporate additional information from the fisheries, in an attempt to validate regions within the model.

Whale distribution model:

- Rigor: A rigorous and state of the art analysis of systematic ship-based and aerial transect surveys and select oceanographic variables has been used to develop surface density maps of the monthly distribution of right whales.
- Uncertainty: The model of whale density does output a degree of uncertainty, being the model's estimate of the coefficient of variation. This is important in informing the output of the whale model and for input to DST; however, this uncertainty is not propagated forward to the DST in any way.

Support Tool:

- Process: The DST outlines a process to combine gear and whale data. The DST itself imports the gear information (initial density of traps by location and month); implements rules for scenario testing (general trap removals, implementation of new trap caps, spatial closures, vertical line characteristics, and implementation of ropeless or timed-release technology); estimates the density of trawls based on regulations, reporting, and returns, dependent on state; and estimates the number of endlines per trawl by regulations by state, to estimate the density of endlines across the region, by month. The exception is LMA3 where observer data (primarily from 2014-2015), landings, federal VTRs, and bathymetry are leveraged to provide more spatially explicit estimates of gear density. Combined with the whale density estimates at a 10 km resolution, the DST estimates the co-occurrence and the potential risk to right whales posed by vertical lines used particularly in the lobster fishery, as it accounts for most vertical lines in use. The model incorporates relevant new information as it becomes available.
- Purpose: Based on the above, the DST achieves the initial goal of creating a mechanism that allows for direct comparison of different management solutions to reduce lethal entanglement risk.

Concerns:

Vertical-line model:

- The quality and type of information on the distribution and nature of the gear used by the lobster fishery varies greatly among states and between state and federal waters. Although the model uses the best available information, existing inputs to the model are not well suited for the intended purpose which is to estimate the risk to whales from the distribution of vertical lines used on the gear.
- Spatial Resolution: Available data to estimate the spatial and temporal distribution of vertical lines is often dated or absent and collected at coarse geographic resolution (statistical area) for only a portion of the fleet.
- Inconsistent and Incomplete Time Series: The model from IEc assesses effort from different time periods with different methods. As such, there is no comparable time series over which to e.g. test how variable the fishery is from year to year. This seems like an important step and something easy to implement for analysis, so as to quantify the variability of the fishery and how that variability will impact the accuracy of future predictions.

- Unquantified Uncertainty and Sensitivity: The IEc model makes many assumptions about the spatial and temporal distribution of the lobster fleet and the nature of the gear used in both state and Federal waters. Many of these assumptions are needed and seem reasonable given the disparate nature of datasets; however, they are poorly described (the Panel was provided a description for the 2014 methods). Further, IEc reports no quantified uncertainties on the final outputs and overestimates the geographic precision in characterizing gear densities based on the scale of the underlying data. The vertical line model entirely lacks a sensitivity analysis to quantify the effect of various assumptions on the final output.

Whale distribution model:

- Data Sources: Acoustic detection data, opportunistic sighting and right whale satellite-tag tracking data have not been incorporated into the model of right whale habitat use. Although it is not clear how these sources of information can be used in the surface density model, as they differ fundamentally from the systemic surveys used to estimates that model, they do provide insight into gaps in our understanding of right whale movements and point to biases resulting from the use of systematic survey data alone.
- Model fit: Because the model is trained on a subset of survey data, this set of biased coordinates may link whale occurrence to false environmental conditions. The selected oceanographic features may describe the systematic survey observations, but not observations captured in the data sources mentioned above (acoustic, other surveys, opportunistic sightings, and telemetry data). Given that the single most important habitat feature for the NARW in foraging months is the occurrence of concentrated patches of copepod prey (Murison and Gaskin, 1989; Wishner et al., 1995; Mayo et al., 2001; Baumgartner and Mate, 2003) which is largely driven by water-mass structure (Davies et al., 2014, 2015), not included in the whale density model.
- Accuracy: Accuracy of the surface density model has not been validated against alternative datasets mentioned above. This accuracy assessment would highlight areas where density estimates and SPUE estimates from non-standard surveys or acoustic data suggest very different levels of whale occupancy, especially at certain times of year. These highlighted areas and times would be regions to consider for improvement of the model, especially if gear density is high in those regions, i.e., where under-predicted whale density in that area would have a

considerable effect on our estimates of encounter probability in that same area and time of year. The Panel understands the challenges of integrating different datasets, but recommends that an effort to integrate acoustics into density estimation be pursued. However, 1) the density model results must be checked for agreement with these existing alternative data sources, 2) the areas of disagreement must be highlighted (and the reasons why determined), 3) the density model adjusted so that the density in these areas reflect the known presence of whales based on other survey and detection methods, and 4) the sensitivity of the DST output in these cases must be evaluated.

- Acknowledgement of limitations: At any given time of the year, we don't know where at 75% of the population is. Additionally, fewer than half of individuals in the population can be accounted for in any given year. The whale model (as published; Roberts et al. 2016) acknowledges the seasonality in CV (0.45 from Nov-Feb) but these values are not propagated through to the DST. Other fields in spatial ecology and oceanography provide excellent inspiration for how to include and propagate uncertainties from point estimates through to uncertainties in distributions (Meyer et al., 2016; St. John Glew et al., 2019).
- Aggregate monthly history: The whale density models are created on a monthly basis from aggregate survey effort from 1998 to 2017. In this way, they do not represent the density of whales in a given area in a particular year, nor will they provide accurate or precise predictions. This can have significant implications, particularly given a number of historical shifts in right whale distribution, none of which are accurately reflected in a model that takes a long-term average value. The reviewers do however note that the developers plan to create two separate whale density maps based on this recent split which will go partway to addressing these concerns.

Gear threat model:

- The model attempts to assess the risk of entanglement by including an estimate of severity based on the breaking strength of the entangling rope. Three approaches have been used to date, however none are well supported by limited data.
- Entanglement Process: We know little about how a co-occurrence becomes an entanglement. While we do know the characteristics of the gear set in certain regions, and the characteristics of different sets of gear removed from whales, this remains too *n*-limited (<4% all entanglements) to rely on to solely inform a severity model. Even if we were to remove all gear from whales, we would not

know what proportion of the original gear it represents (i.e., what was the original entangling set versus what remained on the whale) and how the characteristics of the gear set affect the entanglement likelihood and/or the outcome.

Recommendations:

Vertical Line Model:

- Many of the concerns raised by reviewers above regarding the nature of the data underlying the vertical line model can be addressed through 1) improved and up-to-date documentation of the model with full transparency on the various assumptions in deriving estimates (and the biases they introduce), and 2) improved reporting requirements for fishers. There was discussion during the panel meeting regarding improved reporting requirements of catch and effort in coming years. These reporting requirements should be fast-tracked such that they can be incorporated into the DST as soon as possible.
- Noting concerns from reviewers over the spatial resolution of data, future reporting requirements should be cognisant of this, such that higher resolution data can be captured and incorporated into the DST. Similarly, the DST is based on a limited set of years of data, with no accounting for interannual variation. Catch and effort data should therefore be captured in such a manner (potentially electronically) to permit easy integration into the DST such that interannual variations can be included into the model. Data reporting should also be mandated so there isn't a significant time lag between the time these data are collected and their integration into the model.
- Uncertainties of the estimates from the Vertical Line Model must be quantified and reported through for propagation into the DST.

Whale Model:

- The limits of the DSM model approach should be acknowledged, and the density estimates should be checked for accuracy with existing complementary datasets that date back decades. These are essential to check 1) how accurate the model is at predicting whale density in areas with low survey density and 2) the effect of this known bias on the output of the DST.
- Propagate uncertainties through to DST inputs to quantify low and high estimates of co-occurrence. Running the DST on the bounds of the density estimates (low

and high) would also suggest the degree to which results are consistent, or areas where confidence regarding risk assessment with this combination of models is high.

Threat:

- The desire to include severity of the entanglement as an element in the assessment of risk, although reasonable, is difficult to support based on current information. Severity will no doubt be the result of multiple factors (e.g., whale size and condition, location of entangling ropes on the whale, weight of gear) acting in a complex way, such that no one factor (e.g., rope breaking strength) is likely to provide the measure sought. Breaking strength may well be important but may be overridden by other factors. Thus, a multivariate approach to severity may be more productive.

TOR 2: Evaluate the data outputs produced by the decision support tool.

A complete list of the outputs from the DST are provided in Appendix 5.

Strengths

- There are a wide range of outputs from the model, but perhaps the most important from a management perspective is the spatial map of risk, currently based on the estimated co-occurrence of vertical lines used in the lobster fishery and right whales.
- Configuration Details: The outputs are thoughtful in that each report contains specific configuration and input settings. This level of documentation allows for reproducibility of the baseline and scenario runs.

Concerns

- A concern is that risk maps are point estimates that do not reflect the underlying uncertainty in the input data on the distribution of lobster fishing gear and the distribution of right whales (Gelman and Price 1999). Estimates of uncertainty in surface density of right whales is available but this uncertainty is not reflected in model outputs of estimated co-occurrence.
- Given the nature of inputs, the estimated outputs from the model are averages over multiple years and therefore may not reflect risk at any one time period. This

concern becomes greater, if as recently observed, the distributions of the fishery and right whales change over time.

- The spatial resolution of the vertical-line model (1 nmi), although needed to reflect inshore jurisdictions, is not supported by the spatial scale (statistical area) input data. The whale density estimates are at 10 km resolution. Given these disparities, the appropriate spatial resolution on which to make decisions is well beyond 1 nmi.
- Consultation with end users should be enhanced, while in-tandem iteration of the DST and its subcomponents should be limited or packaged into specific releases. While as reviewers we can provide suggestions, the end users are the persons who need to evaluate the outputs of the model and therefore are best placed to provide comment on what is required from the model. Constant iteration decreases end-user confidence.
- Precision and accuracy of the estimates: The values reported in output tables give the reader a sense of precision or accuracy that is not the case and could be misleading to the public or the end-users of the tool. Nuances in the model are quickly lost once a final risk-reduction score is produced. The reporting should be to the level of precision that is justifiable from the inputs (van der Bles et al., 2019). Because of how the DST is likely to be used, the degree of certainty must be provided alongside all estimates: automatically rounding up or providing some metric of variability around e.g. mean values.

Recommendations

- A map which details risk reduction would be more effective in communicating the goal: separate default and scenario pdfs do not combine to show a change in risk which would likely be of benefit to the end user. A residual plot on a log scale, with a diverging colour scale would more clearly show areas where a scenario causes increases and decreases in threat, co-occurrence, and risk. Such a residual map would be an effective way of seeing how a scenario's mitigation decisions and geographic reach influence the spatial and temporal distribution of e.g. line density.

TOR 3: Comment on the appropriateness of using the decision support tool to evaluate relative entanglement risk to right whales; advise on the strengths and weaknesses of using it to compare management measures.

Strengths

- Provides a useful tool by which industry and managers could openly assess changes in relative risk to right whales across a suite of management measures and fisheries.
- By design, the DST permits buy-in by stakeholders that, while all parties were undertaking different management measures they were all achieving a similar level of risk reduction and that all industry members were contributing equally to a shared problem.
- Teamwork: The distribution of capacity and ownership to all stakeholders is a major strength of the DST package. Industry members are able to run scenarios on their own, which addresses many issues of transparency. The Information - consequences - choice framework is especially useful for industry members to evaluate options and identify solutions they would like to implement on their own.

Concerns

- With increasing complexity there was an increased run time. Once development of the DST stabilises, effort should be made to reduce run time to increase assessment of more potential management measures. This additionally serves to increase the capacity of individual users to run their own scenarios, mentioned as a strength above.
- The DST currently requires some formatted inputs to run. Initially there was a “shiny-app” interface which is far more user friendly. Again, once the model has settled in its development, implementation of a “shiny-app” interface will permit greater use by stakeholders who may not be as comfortable executing code compared to the model developers.
- Development in Tandem: It is understandable that all elements of the DST endeavour to continue development, especially in light of reviews from many directions. This simultaneous and continuous iteration on the DST, its input models, and its submodels, does poses a real challenge in 1) keeping stakeholders updated, and 2) maintaining trust. For example, especially given that the sensitivity of outputs has not been established, there can be concern that the measures determined to meet a given level of risk reduction in version N.n may be insufficient in version N.n+1. The change in risk reduction between versions N.n and N.n+1 cannot be anticipated (i.e., will it be 5% or 50% different?). The ongoing efforts to iterate on submodels and inputs also creates a challenge for 3) evaluating the DST overall. Currently the DST is integrating components that are under development and construction or reparameterization,

in addition to adding new data. These structural changes in the model between time-frames (specifically IEc) complicates the consistency of the DST output.

- Average Values: A reiterated theme of concern with the tool is that estimates of co-occurrence and therefore risk are average values over rather large areas with respect to the real-time movements of right whales. Estimates of risk from the model also do not account for substantial uncertainty and potential bias in input data. Policy decisions based on model output must bear this in mind.

Recommendations

- Specific improvements in the structure and rigour of the DST and its subcomponents are needed to be sufficiently robust to support the types of decisions being considered.
- The DST should be put in context with literature on risk and decision support tools so as to provide consistent definitions and to leverage a lot of work done on standards in this research area.

TOR 4: Provide research recommendations to improve the decision support tool.

- Sensitivity analysis: This is a central thesis of the report.
- Incorporation of complementary datasets for the whale model: This is essential to inform the areas where the whale DSM is known to be biased low – areas where strategic survey effort is low, but where targeted survey, acoustic, telemetry, and opportunistic data are available.
- Expand the DST structure to incorporate Canadian fishing data and NARW abundance. This will permit an examination of the risk reduction levels throughout the NARW entire distribution ensuring “buy-in” from all stakeholders.
- Consider whale behaviour: Reviewers were divided on whether whale behaviour needed to be considered in the DST. One reviewer suggested that the NARW virtual whale entanglement simulator developed by Howle et al. (2019) could be used to inform the risk posed by different gear configurations to better inform the Gear Threat Model. Other reviewers thought that this was over-simulated as it was an event that has never been observed, and that it would only serve to complicate the framework of the severity model.

TOR 5: Evaluate whether the methods represent the best available scientific approach for apportioning human-caused mortality by country.

The current approach for apportioning human-caused mortality by country may not be the most appropriate approach. There has been a clear recent shift in the spatial distribution of NARW which has been coupled with a shift in the source of known serious injuries or mortalities to more Canadian records. Therefore, a different method from the 50:50 split of unknowns to US and Canadian fisheries should be examined.

One of the key factors in determining the risk-reduction goal or target is the reduction of serious injuries and mortalities to meet PBR. However, one of the major challenges is agreement as to how to apportion serious injuries and mortalities in a transboundary stock. There is strong desire to assign “Canadian” and “US” mortalities, and for the US to reduce risk to a level required for US mortalities to meet PBR. Note that the abundance estimate that defines PBR is calculated for the entire NARW population, not just the US proportion of the population (GAMMS I, 1996).

The NARW is not the first transboundary “stock” where this question has been raised, and precedent is important. Trans-boundary species guidelines already exist (Barlow et al. 1995) and state that: “In trans-boundary situations where a stock’s range spans international boundaries or the boundary of the US EEZ, the best approach is to establish an international management agreement for the species. In the interim, if a stock is migratory and it is reasonable to do so, *the fraction of time in US waters should be noted, and the PBR for US fisheries should be apportioned from the total PBR based on this fraction.*” [emphasis ours]

Strengths:

- The 50/50 apportionment approach for unassigned serious injuries and mortalities between the U.S. and Canada results in similar numbers as the previous approach of assigning based on the location first-seen entangled.

Concerns

- There is concern that the 50/50 apportionment does not reflect the fraction of time the species spends in US waters, given the recent distribution shift. Prior to 2010, right whales likely spent >50% of time in US waters, but it is uncertain if the species is now spending less time in the US and an increasing amount of time in Canada, summer through fall. At least a third of the species' population are resident in Canada from at least June through October, with the Gulf of St

Lawrence supporting ~130 unique whales per year (Crowe et al., NARWC 2019). The whereabouts of the majority of the species during these months is unknown, though the majority of the population is seen in US waters in spring (Ganley et al. 2019), and recent surveys have found right whales persisting in US waters through the summer and fall. A 50/50 split is likely conservative for the time spent in US waters, and the certain data on which to base an a different level of apportionment do not exist.

Recommendations

- Mortalities and serious injuries occur for a single stock in two countries, and that there is some latency in detection of injury and mortality, in which time animals can move between regions. There was some disagreement between reviewers on the best approach; however, the precedent set by the law, and which is likely still be a conservative estimate of residency in US waters, is a 50/50 apportionment for unassigned serious injuries and mortalities.

**Conclusions**

The DST evaluated here is explicitly designed to test combinations of multiple mitigation strategies over small or large scale across a large region, and the resulting effects on gear density, gear characteristics, threat to whales, and resulting risk given whale density. The DST combines diverse data sets and various model types to produce estimates used in its computation. It provides the ability to explore the solution space and allows end users to build their own mitigation strategies, supporting a variety of decision-making styles, cultures, expertise, knowledge, and experience.

However, the DST has some limitations in that it its component models are not sufficiently robust, and it itself has resolved uncertainties through exploring the effects of alternative conceptual models and parameter choices on the decision. The DST is reproducible and is distributed to a wide user base; however, it is not fully transparent or coherent in it and its sub-components' frameworks and assumptions. The accuracy and sensitivity of the predictions are critical as they form the basis for environmental management and conservation.

This is not to say that the tool has to be improved prior to any decision-making. We know that line in the water column poses risk, and that effort throughout the fishery considerably higher than needed. However, given the poor quality of data of the location and configuration of gear and the long-term average estimates of NARW

density, risk reduction scenarios from the DST should be interpreted with some caution.

## References


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Appendix 1:  Bibliography of materials provided for review

NMFS,  2019.  *CIE Review Background: Take Reduction Target.* Greater Atlantic Regional Fisheries Office, Protected Resources Division briefing document.

NMFS, 2019. *CIE Review Background: Decision Support Tool Model Documentation.* NOAA Fisheries Northeast Fisheries Science Center, Protected Resources Division briefing document.

**Appendix 2:**

**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**

# North Atlantic Right Whale Decision Support Tool

## 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) and Marine Mammal Protection Act (MMPA). Right whales, humpback whales, and fin whales are listed as endangered species under the ESA. Pursuant to the ESA and the MMPA, the

National Marine Fisheries Service (NMFS) – with guidance from the Atlantic Large Whale Take Reduction Team (ALWTRT) – is responsible for the development and implementation of measures to reduce the risks of entanglement. These measures are embodied in the Atlantic Large Whale Take Reduction Plan (ALWTRP). The plan seeks to reduce the risks of entanglement through a set of gear modifications and other requirements that affect commercial fishing operations in Atlantic waters.

A continuing concern in the evolution of the ALWTRP is the risk of entanglement in vertical line; i.e., buoy lines associated with lobster trap/pot gear, or other fixed gear. To better understand this risk and, particularly, the potential impact of management measures designed to address it, NMFS requires information on the risks of entanglement and injury associated with vertical line used by various fisheries amount of vertical line used by various fisheries, especially the extent to which that line is fished in areas and during seasons in which whales are likely to be present. An absolute measure of entanglement risk is not feasible, but measures of relative risk are possible. At the most recent ALWTRT meeting in April 2019, NMFS introduced a North Atlantic Right Whale Decision Support Tool (DST) to help understand relative risk of entanglement in different geographic locations, and, most importantly, the reduction in relative risk based on different proposed mitigation scenarios.

The information and analysis contained in the report to be presented will include essential factual elements upon which the agency may base its rule-making determination. Accordingly, it is critical that the reports contain the best available information on the relative risk and reduction in relative risk based on mitigation scenarios, and that all scientific findings be both reasonable and supported by valid information contained in the documents. Therefore, the CIE reviewers will conduct a peer review of the scientific information and mathematical approach in the DST based on the Terms of Reference (ToRs). The CIE reviewers will ensure an independent, scientific review of information for a management process that is likely to be controversial.

The specified format and contents of the individual peer review reports are found in **Annex 1**. The specified format and contents of the summary report are found in **Annex 2**. The Terms of Reference (ToRs) for the review of the North Atlantic Right Whale DST are listed in **Annex 3**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 4**.

**Requirements**

NMFS requires three 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 the application of one or more of the following: 1) Atlantic large whales and entanglement; 2) Co-occurrence risk modeling; 3) Fixed gear/fishing rope strength and the severity of whale entanglements; 4) Lethal and sublethal impacts of interactions with fishing gear on protected species.

**Tasks for Panel Reviewers**

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

Background documents will be provided by NMFS prior to the CIE review.

**2)** Panel Review Meeting: The CIE reviewers 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. The CIE reviewers shall actively participate in a professional and respectful manner as members of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

**3)** Contract Deliverables - Independent CIE Peer Review Report: The CIE reviewers shall complete an independent peer review report in accordance with the PWS. The CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. The CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**.

**4)** Other Tasks – Contribution to Summary Report: The CIE reviewers will assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. The CIE reviewers are not required to reach a consensus, and should provide a brief summary of their views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

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

**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, MA.

**Period of Performance**

The period of performance shall be from the time of award through January 2020. The CIE 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.

| | |
|---|---|
| Within two weeks of award | Contractor selects and confirms reviewers' participation |

| | |
|---|---|
| At least two weeks prior to the panel review meeting | Contractor provides the pre-review documents to the reviewers |
| **November 19-21, 2019** | Each reviewer participates and conducts an independent peer review during the panel review meeting |
| Within two weeks after review | Contractor receives draft reports and summary report |
| 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**

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:**

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## Appendix 3: Panel membership or other pertinent information from the panel review meeting

**Appendix 4: Terms of Reference For the North Atlantic Right Whale Decision Support Tool**

1. Evaluate the data inputs (e.g., spatial and seasonal gear configuration, spatial and seasonal right whale distribution, etc.) used in the Decision Support Tool.

2. Evaluate the data outputs (e.g., vertical line estimates, relative risk to right whales, etc.) produced by the Decision Support Tool.

3. Comment on the appropriateness of using the Decision Support Tool as an approach to evaluate relative entanglement risk to right whales and advise on the strengths and weaknesses of using the DST to compare management measures. The goal is to understand the relative risk of entanglement in different geographic locations and the reduction in relative risk based on different proposed mitigation scenarios.

4. Provide research recommendations for further improvement of the Decision Support Tool.

5. Evaluate whether the methods represent the best available scientific approach for apportioning anthropogenic mortality by country.

## Appendix 5: Outputs from the Decision Support Tool

Model Outputs

1. Low-Resolution Monthly Maps of the following Default conditions:

1.1. Trap density

1.2. Mean trawl length

1.3. Vertical line density

1.4. Mean vertical line strength

1.5. Mean gear threat score

1.6. Total threat score (gear threat * line density)

1.7. Whale density

1.8. Total risk (total threat * whale density).

An .Rdata file with the individual data objects used for creating these maps is also saved to custom maps can be created after the model run.

2. Low-Resolution Monthly Maps of the following Scenario conditions:

2.1. Trap density before scenario effects on traps

2.2. Trap density after trap reduction

2.3. Trap density after implementation of trap caps

2.4. Trap density after implementation of closures

2.5. Map of traps relocated as a result of closures

2.6. Trawl lengths after scenario effects

2.7. Line densities after scenario effects

2.8. Mean line strength after scenario effects

2.9. Mean gear threat after scenario effects

2.10. Total gear threat after scenario effects

2.11. Whale densities

2.12. Total risk scores.

An .Rdata file with the individual data objects used for creating these maps is also saved to custom maps can be created after the model run.

3. Output tables

3.1. Model documentation

3.1.1. Model configuration settings

3.1.2. Contents of the input spreadsheet

These two outputs allow users to fully understand the settings of a model run as well as recreate the model run a later time.

3.2. Tables with monthly values for default and scenario conditions

3.3. Initial and final trap numbers

3.4. Total number of trawls

3.5. Mean trawl length

3.6. Total vertical lines

3.7. Mean vertical line strength

3.8. Mean threat score per vertical line

3.9. Total gear threat

3.10. Seasonal whale density

3.11. Total risk scores

All summary statistics written to the tables are also written to a comma-separated text file for further access.