North Atlantic Right Whale
(*Eubalaena glacialis*)

5-Year Review:
Summary and Evaluation

National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office
Gloucester, Massachusetts

October 2017

5-YEAR REVIEW

Species reviewed: North Atlantic Right Whale (*Eubalaena glacialis*)

Cover photo image collected under Marine Mammal Protection Act Research permit number MMPA 17355
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5-YEAR REVIEW
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1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Greater Atlantic Regional Fisheries Office – Kimberly Damon-Randall, Assistant Regional Administrator for Protected Resources, 978-282-8485

Cooperating Regional Office(s): Southeast Regional Office – David Bernhart, Assistant Regional Administrator for Protected Resources, 727-824-5312

Cooperating Science Center(s): Northeast Fisheries Science Center – Sean Hayes, Protected Species Branch Chief, 508-495-2347

Cooperating Headquarters Office: Office of Protected Resources – Therese Conant, National Recovery Coordinator, 301-427-8456

1.2 Methodology used to complete the review:

The Greater Atlantic Regional Fisheries Office led the 5-year review and requested review by the Northeast Fisheries Science Center, Office of Protected Resources, and Southeast Regional Office. The Recovery Plan for the North Atlantic Right Whale (*Eubalaena glacialis*), Marine Mammal Stock Assessment Reports, and a review of the scientific literature provided the information in this document. The literature review included publications related to the North Atlantic right whale made available through August 2017. We published a notification in the *Federal Register* on July 29, 2016 (81 FR 49957) initiating this review and requesting the submission of relevant scientific literature. Documents received through this submission process were included in this review. This included four submissions containing peer-reviewed literature.

In addition, Section 4.0, Recommendations for Future Actions, contains recommendations resulting from this review and a right whale recovery monitoring workshop convened by the Greater Atlantic Regional Fisheries Office on June 1-2, 2016 at Maritime Gloucester in Gloucester, Massachusetts. The workshop was organized by the NOAA Fisheries Greater Atlantic Regional Fisheries Office and included participation by the Southeast Regional Office and Office of Protected Resources.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

81 FR 49957, July 29, 2016 – Endangered and Threatened Species; Initiation of 5-Year Review for the North Atlantic Right Whale

1.3.2 Listing history

Original Listing
FR notice: 35 FR 18319
Date listed: December 2, 1970
Entity listed : Northern right whale (*Eubalaena spp.*)
Classification : Endangered (Under the Endangered Species Conservation Act of 1969)

Revised Listing
FR notice: 73 FR 12024
Date listed: March 6, 2008
Entity listed: North Atlantic right whale (*Eubalaena glacialis*)
Classification: Endangered

1.3.3 Associated rulemakings

Atlantic Large Whale Take Reduction Plan: 62 FR 39157, July 22, 1997; Taking of Marine Mammals Incidental to Commercial Fishing Operations; Atlantic Large Whale Take Reduction Plan Regulations *and subsequent amendments.* See 50 CFR 229.32.
Federal Regulations Governing the Approach to North Atlantic Right Whales: 69 FR 69536, November 30, 2004. See 50 CFR 222.32 and 217.12.
Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales: 73 FR 60173, October 10, 2008. Endangered Fish and Wildlife; Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales. See 50 CFR 224.105.
Revised Critical Habitat Designation: 81 FR 4838, January 27, 2016. Endangered and Threatened Species; Critical Habitat for Endangered North Atlantic Right Whale. See 50 CFR 226.203

1.3.4 Review History

Review of the Status of the Right Whales in the North Atlantic and North Pacific Oceans. December 2006. Available at: http://www.fisheries.noaa.gov/pr/pdfs/statusreviews/rightwhale2006.pdf
Classification recommendation: Endangered

North Atlantic Right Whale (*Eubalaena glacialis*) 5-Year Review: Summary and Evaluation. August 2012. Available at: http://www.fisheries.noaa.gov/pr/pdfs/species/narightwhale_5yearreview.pdf
Classification recommendation: Endangered

1.3.5 Species' Recovery Priority Number at start of 5-year review

North Atlantic right whales have a species' recovery priority number of THREE (3), based on the criteria in the Recovery Priority Guidelines (55 FR 24296, June 15, 1990)(2014 Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species, October 1, 2012–September 30, 2013).

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the North Atlantic Right Whale (*Eubalaena glacialis*), Revision. Available at: http://www.fisheries.noaa.gov/pr/pdfs/recovery/whale_right_northatlantic.pdf

Date issued: May 2005
Dates of previous revisions, if applicable: December 1991

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__X_ **Yes**, go to section 2.1.2.
____ **No**, go to section 2.2.

2.1.2 Is the species under review listed as a DPS?

____ ***Yes****, go to section 2.1.3.*
_X_ ***No****, go to section 2.1.4*

2.1.3 Was the DPS listed prior to 1996?

____ ***Yes****, give date and go to section 2.1.3.1.*
____ ***No****, go to section 2.1.4.*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____ ***Yes,*** *provide citation and go to section 2.1.4.*
____ ***No****, go to section 2.1.3.2.*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____ ***Yes****, discuss how it meets the DPS policy, and go to section 2.1.4.*
____ ***No****, discuss how it is not consistent with the DPS policy and consider the 5-year review completed. Go to section 2.4., Synthesis.*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

____ ***Yes****, provide citation(s) and a brief summary of the new information; explain how this new information affects our understanding of the species and/or the need to list as DPSs. This may be reflected in section 4.0, Recommendations for Future Actions. If the DPS listing remains valid, go to section 2.2, Recovery Criteria. If the new information indicates the DPS listing is no longer valid, consider the 5-year review completed, and go to section 2.4, Synthesis.*

_X___ ***No****, go to section 2.2., Recovery Criteria.*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X__ ***Yes****, continue to section 2.2.2.*

____ ***No****, consider recommending development of a recovery plan or recovery criteria in section IV, Recommendations for Future Actions, and go to section 2.3., Updated Information and Current Species Status.*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

__X__ ***Yes,*** *go to section 2.2.2.2.*
____ ***No****, go to section 2.2.3, and note why these criteria do not reflect the best available information. Consider developing recommendations for revising recovery criteria in section 4.0.*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

__X__ ***Yes****, go to section 2.2.3.*
____ ***No****, go to section 2.2.3, and note which factors do not have corresponding criteria. Consider developing recommendations for revising recovery criteria in section 4.0.*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

The following are the Downlisting Criteria excerpted from the 2005 Recovery Plan for the North Atlantic Right Whale:

North Atlantic right whales may be considered for reclassifying to threatened when all of the following have been met:

1. The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population.

Although trends in population abundance are an important measure of a population's viability, a population can increase in abundance and still face very high risks of extinction because other aspects of its population ecology are unstable. To avoid reaching an erroneous conclusion based on changes in the population size of right whales, this criterion includes multiple measures that would indicate a right whale population that is growing and that the growth will probably be sustained.

This criterion has not been met. Please see sections 2.3.1.2, 2.3.1.3, 2.3.1.5, and 2.3.1.6 of this document for further information.

2. The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2% per year.

A 2% increase is generally accepted as the minimum detectable rate of growth of a long-lived, slow-growing large mammal. Thirty-five years is the estimated amount of time it would take for right whale population to double in size if the population grows at an average of 2 percent per year.

This criterion has not been met. Please see section 2.3.1.2 of this document for further information.

3. None of the known threats to North Atlantic right whales (summarized in the five listing factors) are known to limit the population's growth rate (for thorough discussion, see Appendix C).

Listing/Recovery Factor A*: The Present or Threatened Destruction, Modification or Curtailment of a Species Habitat or Range.*

In order to ensure the long-term recovery needs of the North Atlantic right whale and provide adequate assurance of population stability, threats to right whale habitat or range must be reduced or removed. Habitat degradation may occur from oil spills, noise pollution from shipping or oil and gas development, dredging, and contaminants.

- *Habitat degradation from oil spills, noise pollution, dredging and contaminants are not limiting the recovery of` the species.*

This criterion has not been met. Please see section 2.3.2.1 of this document for further information.

Listing/Recovery Factor B*: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes.*
There are no data at this time to indicate that these issues are limiting the recovery of the North Atlantic right whale. However, prior to downlisting, the effects of commercial harvest, research activities, and recreational and educational activities such as whale-watching must be considered.

- *Recreational and educational activities are adequately regulated by the permitting process.*
- *No right whales are allowed to be harvested for commercial purposes.*

This criterion has been met. Please see section 2.3.2.2 of this document for further information.

Listing/Recovery Factor C*: Disease or Predation.*
At this time, there are no data indicating that predation is limiting right whale recovery. However, results of body condition analysis and the occurrence of skin lesions on North Atlantic right whales may be indicative of health issues within the population.

- *Disease is not appreciably affecting the recovery of the species and is not likely to do so in the foreseeable future.*

This criterion has not been met. Please see section 2.3.2.3 of this document for further information.

Listing/Recovery Factor D*: The Inadequacy of Existing Regulatory Mechanisms.*

Regulations may be insufficient to adequately protect the population. In particular, it may be necessary to enhance existing regulations, or promulgate new regulations to reduce or eliminate the threat of ship strikes and fishing gear entanglement.

- *Adequate regulations or other means to minimize ship strikes are in place and being implemented and the criterion set forth under Factor E is met.*
- *Adequate regulations, gear, or other means to minimize entanglement in fishing gear exist and are being implemented and the criterion set forth under Factor E is met.*

This criterion has not been met. Please see section 2.3.2.4 of this document for further information.

***Listing/Recovery Factor E**: Other Natural or Manmade Factors Affecting Its Continued Existence.*

No natural factors are known to be limiting the recovery of North Atlantic right whales at this time. The most significant threat to North Atlantic right whale recovery remains human-related mortality, most notably, ship collisions and entanglement in fishing gear. Additionally, other factors may be identified as direct or indirect threats in the future, such as habitat degradation, coastal development, undersea noise, and contaminant loads (covered under Factors A-D).

- *Human-caused mortality and serious injury from ship strikes and fishery interactions result in a level of mortality considered to be biologically insignificant.*

This criterion has not been met. Please see section 2.3.2.5 of this document for further information.

To support and confirm a reclassification determination generated by the above criteria, the following criteria must also be met:

4. Given current and projected threats and environmental conditions, the right whale population has no more than a 1% chance of quasi-extinction in 100 years (see Angliss et al. 2002). Criteria, i.e., population numbers, structure and trends, have not yet been developed; however, a top priority in the recovery action narrative of this plan is to conduct analyses to derive such criteria. These analyses should expressly indicate the assumptions, goals, uncertainties and approximations of the model used, and include sensitivity analyses of parameters and assumptions. In addition to being useful in examining the population viability analysis, sensitivity analyses can be useful in management of the species, and subsequent revisions or updates of this recovery plan. Finally, the analysis should be peer reviewed before being accepted as criteria.

This criterion has not been met. Please see section 4.0 of this document for further information.

2.3 Updated Information and Current Species Status

The North Atlantic Right Whale Recovery Plan contains the most comprehensive data on the biology of and threats to the North Atlantic right whale. This section contains a summary of relevant research on the status of the North Atlantic right whale since the completion of the most recent 5-year review in 2012.

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Past studies on right whale life history have focused mainly on feeding grounds in Cape Cod Bay, Great South Channel, and the Bay of Fundy. In recent years, a continuous presence of right whales has been documented in winter months in the central Gulf of Maine (Cole *et al.* 2013; Brillant *et al.* 2015; Bort *et* al. 2015). In addition, developments in passive acoustic monitoring (PAM) have increased the understanding of right whale distribution throughout the Atlantic (Morano *et al.* 2012; Mussoline *et al.*2012; Parks *et al*. 2012; Trygonis *et al.* 2013; Urazghildiiev 2014; Hodge *et al.* 2015; McCordic *et al.*2016; Esfahanian *et al*. 2017).

During early development periods of juvenile right whales, rapid postnatal growth occurs. This occurs at the expense of the stored blubber of the whale's mother during lactation (Fortune *et al.* 2012). Such a significant energetic stressor is an important life history factor to be considered amongst other energetic stressors facing right whales, including chronic entanglement in commercial fishing gear (van der Hoop *et al.* 2017b), foraging, and mate selection (Fortune *et al.* 2013), and others. These factors contribute to the developing literature on assessing the declining health of the right whale population, particularly in the face of taxing environmental stressors (Schick *et al.*2013; Rolland *et al.* 2016; Kraus *et al.* 2016).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Little is known about pre-exploitation North Atlantic right whale abundance, but it has been previously estimated to be more than 1,000 whales (Reeves *et al.* 1992). Monsarrat *et al.* (2015a) estimated pre-exploitation abundance of right whales to be 9,075-21,328 whales.

Pace et al. (2017) provided results from a new model for estimating right whale abundance that indicates that the right whale population has been declining starting in 2010 and at least through 2015. From 1990-2010, right whale abundance increased from an estimated 270 to 483 whales. Since then, the population has declined to a best estimate of 458 whales (Pace *et al.* 2017). More recent years are unlikely to have reversed this trend. The methods established in Pace *et al.* (2017) represent a statistical advancement in assessing right whale abundance. Previously, a census of the population collected through aerial surveys provided an annual minimum count of abundance (Hayes *et al.* 2017). However, the reduced likelihood of re-sighting right whales in

traditionally observed areas in recent years has required statistical methods to address these changes to right whale habitat use and distribution. While the estimate of 458 right whales is higher than the abundance reported in Hayes *et al.* (2017) of 440 whales using the now outdated method, it represented a steady decline in right whales since 2010 (Pace *et al.* 2017). Pace *et al.* (2017) also estimated that in 2015 the right whale population consisted of 272 males and 186 females. This uneven sex ratio has been exacerbated by reduced survivability for female right whales compared to males, 0.97 and 0.98, respectively.

In 2017, at least 15 known right whale deaths occurred. This included a mortality event of at 12 right whales in the Gulf of St. Lawrence during June and July.[1] Additional right whale deaths included a known juvenile death in April 2017,[2] a dead right whale off Martha's Vineyard in August 2017[3], and a dead right whale observed offshore, east of Cape Cod in August 2017.[4] On August 25, 2017, we declared an unusual mortality event (UME) under the Marine Mammal Protection Act (MMPA), throughout the entire range of the species.[5] Once a UME is declared, additional resources and expertise are martialed to study the cause of the mortality event.

Right whale productivity over the past several decades has been highly variable, with a period of low calf production occurring in recent years (Hayes *et al.*2017; Pace *et al.* 2017). From 1990-2014, 411 right whale calves were observed born, an average of 16.4 per year (with a standard deviation of 9.2). From 2010 through 2016, calf production has been near or below this average in all but 2 years (22 calves in 2011 and 20 calves in 2013) (Hayes *et al.*2017; Pace *et al.* 2017). The right whale population generally grew at a rate of about 2.8% during the period 1990-2010. Since then, the population has experienced a decline of about 1% during the period 2010-2015 (Pace *et al.* 2017).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Recent evaluation of a single right whale bone at a known 16th and 17th century whaling site revealed that low genetic variation in the present population may date back as far as four centuries, and may not have been caused by whaling activities (McLeod *et al.* 2010). Although whaling reduced the population size, there is evidence that genetic variability among North Atlantic right whales was already low when the peak of Basque whaling occurred (McLeod *et al.*

[1] "Right whale deaths in the Gulf of St. Lawrence." Retrieved from http://dfo-mpo.gc.ca/science/environmental-environnement/narightwhale-baleinenoirean/index-eng.html on August 15, 2017.
[2] "Update on right whale found dead in Cape Cod Bay," Retrieved from https://www.greateratlantic.fisheries.noaa.gov/mediacenter/2017/04/Update%20on%20Right%20Whale%20Found%20Dead%20in%20Cape%20Cod%20Bay.html on August 15, 2017.
[3] "Dead right whale found on Martha's Vineyard." Retrieved from http://www.capecodtimes.com/news/20170808/dead-right-whale-found-on-marthas-vineyard on August 10, 2017.
[4] "Another right whale found dead." Retrieved from http://www.capecodtimes.com/news/20170817/another-right-whale-found-dead on August 17, 2017.
[5] "2017 North Atlantic right whale unusual mortality event." Retrieved from http://www.we.noaa.gov/pr/health/mmume/2017northatlanticrightwhaleume.html on August 25, 2017.

2010). However, Frasier *et al.* (2013) identified a post-copulatory mechanism in North Atlantic right whales over a 25-year study period that has slowly increased genetic diversity among right whale calves, despite this population's relatively homogeneous genepool.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There is no change in taxonomic classification nor are there changes in nomenclature. Northern right whales have been listed as endangered under the Endangered Species Act (ESA) since its passage in 1973. At the time of its listing, Northern right whales included right whales in both the North Pacific (*Eubalaena japonica*) and North Atlantic (*Eubalaena glacialis*). Genetic data provided support for distinguishing three right whale lineages as separate phylogenetic species (Rosenbaum *et. al*. 2000), and three separate species of right whale are now recognized:

1. The North Atlantic right whale (*Eubalaena glacialis*), ranging in the North Atlantic Ocean
2. The North Pacific right whale (*Eubalaena japonica*), ranging in the North Pacific Ocean
3. The southern right whale (*Eubalaena australis*), ranging throughout the Southern Hemisphere

The North Atlantic right whale and the North Pacific right whale were listed as distinct species under the ESA in 2008 (73 FR 12024, March 6, 2008).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc.):

Prior to extensive exploitation, the North Atlantic right whale was found distributed in temperate, subarctic, coastal and continental shelf waters throughout the North Atlantic Ocean rim (Perry *et al.* 1999). The post-exploitation distribution is largely limited to the western North Atlantic Ocean (i.e., Florida to Canada). Based on whaling records, right whales in the eastern North Atlantic likely migrated along the coast from northern Europe to northwest Africa. Teixeira *et al.* (2014) presented archaeological evidence of the presence of right whales off the coast of Portugal in the sixteenth and seventeenth centuries. Sighting surveys from the eastern Atlantic Ocean suggest that right whales are currently rare in this region and this population may be functionally extinct (Best *et al.* 2001). Monsarrat *et al.* (2015b) estimated the pre-exploitation range of right whales to include feeding groups off the Grand Banks near Newfoundland and into the Norwegian Sea. Historical summer distribution included the waters south of Greenland and Iceland, and off the British Isles.

In the western North Atlantic, right whales migrate along the North American coast from Nova Scotia to Florida. Data have revealed five major habitats or congregation areas for right whales in the western North Atlantic: Georgia-North Florida coast; the Great South Channel and northern edge of Georges Bank; Massachusetts Bay and Eastern Cape Cod Bay; the Bay of Fundy; and the southeastern Scotian Shelf (Winn *et al.* 1986). The Georgia-Florida region is

used in winter as the only known calving area. The other four areas are recognized as important feeding areas.

Cole *et al.* (2013) presented evidence of a winter mating ground in central Gulf of Maine and Roseway Basin. Roseway Basin, a known foraging area for right whales, was the subject of research by Davies *et al.* (2015). In this study, right whale presence in Roseway and Grand Manan basins was compared to annual variations in *Calanus finmarchicus* abundance in these areas. Right whales abandoned Roseway Basin during times of low *C. finmarchicus* abundance, but remained in Grand Manan Basin during similar conditions, suggesting the importance of Grand Manan Basin habitat beyond its use for foraging (Davies *et al.* 2015). In the mid-Atlantic, Oedekoven *et al.* (2015) contributed to evidence of a year-round right whale presence. In the southeast U.S. calving grounds, Hain *et al.* (2013) reported on the work of citizen scientists to observe and document the inshore movement of resting, playing, and nursing mother right whales and calves in northeastern Florida. Gowan and Ortega-Ortiz (2014) modeled a series of environmental variables, including depth and sea surface temperature, showing that right whale habitat use in calving grounds varies based on changing annual environmental conditions.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

These are discussed in-depth in Section 2.3.2, below. On January 27, 2016 (81 FR 4837), we designated critical habitat for North Atlantic right whales under the ESA (Figure 1).

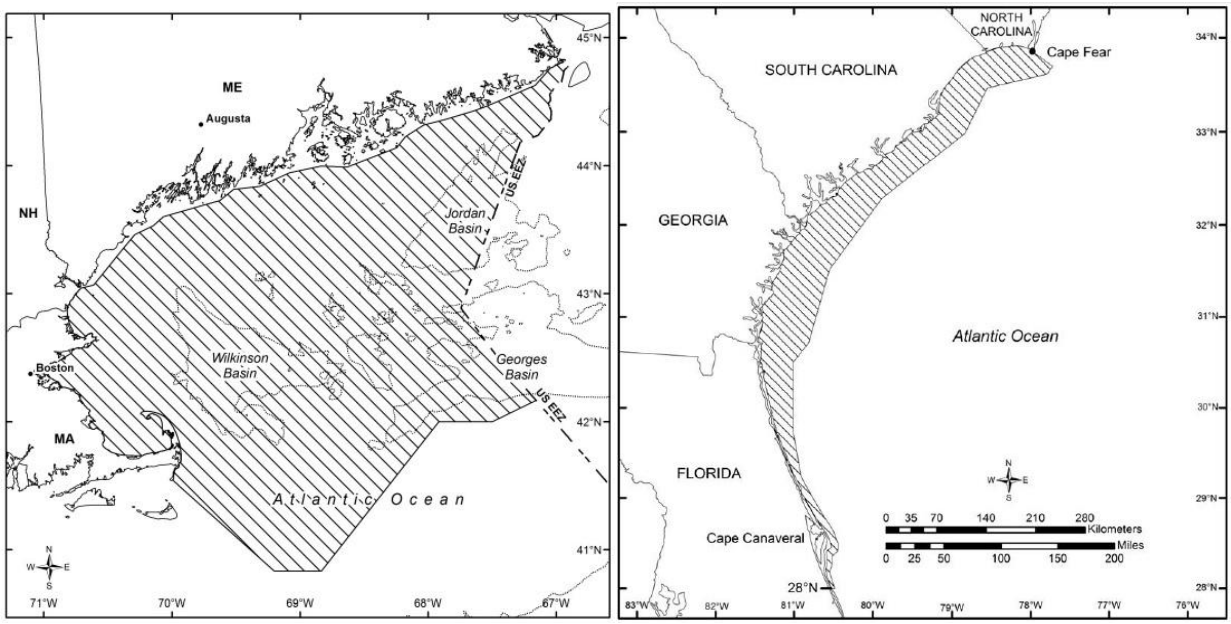

Figure 1: North Atlantic right whale critical habitat off the northeast U.S. (left) and southeast U.S. (right) coasts.

2.3.2 Five-Factor Analysis
(threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Oil and Gas Development

A continued threat to the coastal habitat of right whales in the western North Atlantic is the undersea exploration and development of mineral deposits. Offshore oil and gas activities have been proposed off the coast of the mid and south Atlantic U.S., but after the Deepwater Horizon oil spill in 2010, all lease plans were cancelled. There is a ban in effect through 2017 for drilling in federal waters off the Atlantic coast. However, seismic exploration is allowed. If drilling activities are allowed to occur in the future, there may be consequent adverse effects to the right whale population by vessel movements, noise, spills, or effluents. These activities (energy exploration and development) may possibly result in disturbance of the whales or their prey, and/or disruption of the habitat. Future oil and gas exploration and development activities will be subject to consultations under Section 7 of the Endangered Species Act.

Noise Pollution

Right whales, like many large cetaceans, communicate over large distances in the open ocean using low-frequency, long-wavelength sounds, which are subject to masking by human activities (Rolland *et al.* 2012; Rice *et al.* 2014). Studies have indicated that whales may respond to increased noise by leaving certain habitats, changing behavior, and changing their vocalization patterns (Rolland *et al.* 2012; citing Nowacek *et al.* 2007; Weilgart 2007).

Right whales use vocal calls for social communication, including mate attraction (Parks and Tyack 2005). Right whales increase their call amplitude linearly with the rise of background noise, indicating that the whales are able to modify their vocalizations to compensate for the increased noise of their environment (Parks *et al.* 2011; Tennessen and Parks 2016). The cost of this behavior modification may include increased energy expenditure or modification of the original information of the signal, but more data are needed to fully understand the effects of anthropogenic sound on right whale communication (Parks *et al.* 2011).

Noise pollution has been correlated to an increase in stress-related fecal hormone metabolites in North Atlantic right whales (Rolland *et al.* 2012). Chronic elevations of these fecal hormone metabolites have been shown to negatively affect growth, immune system response, and reproduction in a variety of vertebrate species (Rolland *et al.* 2012 citing Sapolsky *et al.* 2000; Romero and Butler 2007). Rolland *et al.* (2012) suggested that anthropogenic noise pollution may have negative consequences for the North Atlantic right whale's continued viability. Ocean noise is one of many chronic stressors facing right whales, both natural and human-caused that may be limiting recovery. The study of stress hormones in right whales, particularly reproductive females undergoing the energetically costly and stress-inducing life history stages of reproduction and lactation is a critical area of research. Hunt *et al.* (2016) analyzed female right baleen plates to identify elevated progesterone levels during pregnancy periods. Hunt *et al.*

(2014) analyzed vapor from right whale respiratory "blow" as a developing form of hormone sampling. Corkeron *et al.* (2017) analyzed fecal hormones using classification trees as a method of conducting multivariate analysis of hormone datasets.

Dredging

Right whales frequent coastal waters where dredging and its associated disposal operations occur on a regular basis. Dredging and dredge spoil disposal generally increases sedimentation and turbidity of the water column, which can affect the early life stages and adults of some highly sensitive species (Newcombe and Jensen 1996; Wilber and Clarke 2001). The U.S. Army Corps of Engineers (ACOE) has responsibility and oversight for many of these dredging and disposal operations and consults with us under Section 7 of the ESA on these activities. We have concluded in past consultations that dredging and dredge spoil disposal are not likely to affect right whales adversely.

Contaminants

The contaminant levels found in right whales are considered low relative to those found in other marine mammals, such as seals, sea lions, and dolphins (Montie *et al.* 2010). The copepods on which right whales feed tend to have lower concentrations of these contaminants than the levels found in prey items of other marine mammals (Montie *et al.* 2010).

There is evidence that some contaminants, particularly those in flame retardants (polybrominated diphenyl ethers), detergents and pesticides (alkylphenol ethoxylates), disrupt endocrine pathways and reproduction in animals (Colborn and Smolen 1996; Meerts *et al.* 2001). Montie *et al.* (2010) analyzed blubber samples taken from five North Atlantic right whales that stranded along the eastern U.S. and Canada, and detected the presence of organochlorines, PCBs, and brominated flame retardants in all five samples.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

There are no data at this time to indicate that these issues are limiting the recovery of the North Atlantic right whale. Currently, there is no commercial harvest of right whales and research activities are not considered to be affecting right whale recovery in the North Atlantic. Whale-watching directed at right whales has been mitigated as the result of the prohibition on approaching or remaining within 500 yards of right whales (see 50 CFR 224.103(c)).

2.3.2.3 Disease or predation:

Disease

Doucette *et al.* (2012) found that 20-30% of the juvenile, lactating, and pregnant females in the study tested positive for domoic acid. Domoic acid is known to cause death of pregnant females, miscarriage, and premature birth in California sea lions (Brodie *et al.* 2006; Goldstein *et al.*

2009). Domoic acid is also known to cause seizures and a chronic neurological syndrome in sea lions (Brodie *et al.* 2006). Domoic acid has been demonstrated to cross the placental barrier, and amniotic fluid may act as a sink for domoic acid, which could lead to reduced appearance of domoic acid in feces, suggesting that the 20-30% figure may be low for pregnant females (Doucette *et al.* 2012). California sea lions exposed to domoic acid show signs of epilepsy, seizures, and atrophy of the hippocampus which could affect a sea lion's ability to navigate (Scholin *et al.* 2000; Goldstein *et al.* 2009). It has been suggested that these types of effects, if they occurred in right whales, could heighten their susceptibility to both ship strikes and entanglements (Doucette *et al.* 2012).

Predation

Low levels of shark predation on right whale calves have been reported in the southeastern U.S. (Taylor *et al.* 2013). However, at this time, there are no data indicating that predation is limiting right whale recovery.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

We have administered conservation regulations to reduce ships strikes and lethal entanglements with right whales since the implementation of the Atlantic Large Whale Take Reduction Plan (the Take Reduction Plan) in 1997 (Borggaard *et al.* 2017). In 2008, we issued regulations seeking to reduce lethal ship strikes (73 FR 60173, October 10, 2008). Unfortunately, the detection of right whale mortalities is haphazard and largely opportunistic. Further complicating this, the country of origin is unknown for many right whale mortality cases (Hayes *et al.* 2017). For the most recent 5-year period of 2010-2014 reported in the right whale stock assessment report (Hayes *et al.* 2017), the minimum rate of human-caused right whale mortality is 5.66 whales per year. This includes commercial fisheries mortality of 4.65 whales per year and vessel strike mortalities of 1.01 whales per year (Table 1). Right whale potential biological removal (PBR) over this period was one whale per year (Hayes *et al.* 2017).

Table 1: Average human-caused mortality estimates for right whales per year, 2010-2014.

Mortality Source	Attributed to US	Attributed to Canada	Unknown, first sighted in US	Unknown, first sighted in Canada	Total
Entanglement	0.40	0	2.50	1.75	**4.65**
Vessel Strike	0.81	0	0.20	0	**1.01**

Vessel Strikes

Right whales continue to face the risk of being struck by vessels throughout their range (Wiley *et al.* 2016). In 2013, the "ship speed rule," requiring vessels 65 feet in length or greater to reduce speed to 10 knots or less inside seasonal management areas (SMA) was extended indefinitely (78 FR 73726, December 9, 2013). Before the rule was made permanent, a series of evaluations

were conducted to determine compliance with and effectiveness of these regulations (see Silber and Bettridge 2012; Conn and Silber 2013; Silber *et al.* 2014). Conn and Silber (2013) concluded that the ship speed rule had reduced the risk of lethal right whale ship strikes by 80-90%, with risk reduction increasing toward 90% throughout the study period. Silber *et al.* (2014) identified an increase in vessel compliance with the ship speed rule throughout a similar study period, notably in response to the publicization of enforcement action against violators. Silber *et al.* (2015) observed a decrease in overall shipping traffic on the U.S. east coast after 2008, likely attributable to the economic recession and changes to global fossil fuel markets, thereby further reducing ship strike risk to right whales.

A dynamic management area (DMA) program – creating 15-day voluntary ship speed reduction zones when three or more right whales are sighted within a specific area – was developed concurrently with the ship speed rule and was described in the preamble of that rule. As of August 2017, we have administered 141 DMAs in the Greater Atlantic region and 15 DMAs in the Southeast region since 2008. DMAs are intended to complement the SMAs to protect right whales sighted outside time and areas in which SMAs are in effect. Asaro (2012) reviewed the temporal and geographic placement of DMA and dynamic area management (predecessor of the DMA program administered through the Atlantic Large Whale Take Reduction Plan) zones to conclude a repeated occurrence of zones in winter months in the central Gulf of Maine from Jeffreys Ledge to Jordan Basin. Silber *et al.* (2012) concluded that compliance with the voluntary speed restrictions within DMAs was poor, with vessels showing a very modest reduction in speed that was unlikely to reduce ship strike risk significantly.

A series of evaluative studies have been produced showing the ship speed rule to be effective at reducing lethal right whale ship strikes. Laist *et al.* (2014) analyzed ship strikes within SMAs and a 45 nautical mile buffer surrounding them to conclude that the years following implementation of the ship speed rule saw a significant reduction in ship strikes when compared to the 18 years prior. Van der Hoop *et al.* (2015) concluded that, since the implementation of the ship speed rule, right whale ship strikes have decreased within SMAs and increased outside of SMA boundaries, and recommended the expansion of SMAs. In Canadian waters, van der Hoop *et al.* (2012) concluded that the Roseway Basin area to be avoided (ATBA) significantly reduced right whale ship strike risk as well. Evaluative studies such as these are a critical component to achieving the recovery plan goal to eliminate lethal right whale ship strikes (Mullen *et al.* 2013).

Entanglement in Commercial Fishing Gear

Commercial fisheries regulations through the Large Whale Take Reduction Plan (Take Reduction Plan) under the MMPA have been ongoing since 1996 (Roman *et al.* 2013; Borggaard *et al.* 2017; Laist 2017). Throughout the same period, right whale entanglement rates have remained high – Knowlton *et al.* (2012) observed that nearly 83% of right whales bore entanglement scars in a photo review. The most recent major amendment to the Take Reduction Plan was published in 2014 and became effective in 2015 (79 FR 36586, June 27, 2014). This "vertical line rule" specified number of traps per trawl requirements for trap/pot gear as a method of reducing the number of vertical lines in the water column, thereby reducing entanglement risk.

This rule resulted in the removal of approximately 2,800 miles of rope from the water column in U.S. waters. This followed the 2007 final rule (72 FR 57104, October 5, 2007) mandating the use of sinking groundline on fixed gear fisheries, which removed approximately 27,000 miles of rope from the water column when it went into effect in 2009 (73 FR 51228, September 2, 2008; Borggaard *et al.* 2017). The vertical line rule also expanded gear marking requirements by enlarging the colored marks required on fixed fishing gear, expanding the colors required for specific fisheries and geographic locations, and expanding the frequency marks are required on verticals lines. A subsequent modification to the vertical line rule expanded the Massachusetts Restricted Area closure to protect approximately 3,000 square miles of right whale habitat (79 FR 73848, December 12, 2014).

Progress in the development of the Take Reduction Plan has been incremental over the past two decades. This is a product of the diverse multi-party decision making of the Atlantic Large Whale Take Reduction Team (the Take Reduction Team)(McDonald and Rigling-Gallagher 2015; Borggaard *et al.* 2017). The implementation of the 2014 vertical line rule concluded a two-part rulemaking strategy – to reduce entanglement risk in groundlines, then vertical lines – first agreed upon by the Take Reduction Team in 2003. Pace *et al.* (2014) analyzed the effectiveness of the Take Reduction Plan in reducing the frequency of right whale mortalities through 2009, before the implementation of the sinking groundline and vertical line rules. They concluded that there had been no change in the frequency of right whale mortalities throughout their range. Van der Hoop *et al.* (2013a) concluded similarly. McDonald *et al.* (2016) analyzed all take reduction teams in the U.S., evaluating performance based on such factors as mortality reduction, team size, and longevity. This study concluded that the Take Reduction Plan was the poorest performer, but cautioned that the wide ranging-scope and complexity of issues discussed by the Take Reduction Team are a major factor (McDonald *et al.* 2016). Brillant *et al*. (2017) emphasized the transboundary nature of right whale distribution, and recommended entanglement mitigation measures be implemented in Canadian waters as well.

A growing body of literature has developed analyzing the effect of chronic entanglement on right whale health and reproduction. Robbins *et al.* (2015) analyzed right whale survivability while experiencing chronic entanglement in fishing gear. It concluded that apparent survival in the first year of entanglement was low, but increased in subsequent years. This study also concluded that the configuration of the entanglement was a strong indicator of its lethality. Lastly, this study highlighted the need for additional research on understanding the nature of long-term chronic entanglements (Robbins *et al.* 2015). Knowlton *et al.* (2015) analyzed the strength of entangling ropes, concluding that fishing rope strength has increased in recent decades, leading to higher entanglement rates. They also encouraged additional research on rope with a 1,700lb breaking strength to allow for right whales to break and shed entangling gear more easily (Knowlton *et al.* 2015). Arthur *et al.* (2015) concluded similarly, stating that large whales are likely unable to break free from modern fishing lines.

As rope severity and sub-lethal entanglement frequency have increased, research efforts have been undertaken to understand the life history impacts of these entanglements. Chronic entanglement exerts stress on right whales as they counteract the force of drag from fishing gear

(Moore and van der Hoop 2012; van der Hoop *et al.* 2016; van der Hoop *et al.* 2017c). Understanding the drag forces exerted on a whale during entanglement can also predict its lethality (van der Hoop *et al.*2013b; van der Hoop *et al.* 2017a). Van der Hoop *et al.* (2017b) concluded that the energy required for a whale to overcome the drag of a chronic entanglement is equivalent to major life history stages, particularly female reproduction.

Right whales are a transboundary natural resource for which recovery efforts require complementary conservation measures in both US and Canadian waters. However, there is currently a disparity between efforts undertaken by the governments of the US and Canada in addressing right whale entanglement risks associated with commercial fishing operations. We are currently engaged in long-term efforts to collaborate with Canadian authorities to work collaboratively in developing transboundary conservation measures. This has included classifying Canadian fisheries as part of the draft 2017 List of Foreign Fisheries under the MMPA (82 FR 39762, August 22, 2017). This classification stems from the 2016 MMPA "import rule" requiring fish and fish product imports into the US to be harvested with conservation measures comparable to those implemented in the US (81 FR 54389, August 15, 2016). Foreign nations have until January 1, 2022 to apply for and receive a comparability finding for each of its export and exempt fisheries on the List of Foreign Fisheries to continue to export fish and fish products from those fisheries to the United States.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Right Whale Health Assessment

Fortune *et al.* (2013) analyzed right whale food requirements and concluded that lactating female right whales may be energetically deficient, raising concerns about nutritional stressors on right whale recovery. Miller *et al.* (2011) analyzed blubber thickness in right whales as an indicator of nutritional health. Blubber was thinnest in lactating females and during periods of low *C. finmarchicus* abundance. Overall, this study observed significant fluctuations in blubber thickness over time, indicating changing energetic stressors throughout the lifetime of a whale (Miller *et al.* 2011). Periods of reduced blubber thickness also reduce buoyancy, which has additional implications on right whale swimming and diving (Nousek-McGregor *et al.* 2014).

Body condition is a good indicator of right whale population health, particularly the observation of changing body condition over time (Schick *et al.* 2013). Recently, the literature has highlighted the changing body condition of right whales and its impact on recovery (Kraus *et al.* 2016). This method includes a photographic assessment of subcutaneous fat, skin condition, rake marks ahead of the blowhole, and cyamids near the blowhole (Pettis *et al.* 2004). Rolland *et al.* (2016) analyzed right whale health from 1980 to 2008 and concluded a steady decrease in body condition across all demographic groups in this nearly 30-year period. Pettis *et al.* (2017) reviewed right whale photographs to assess changes in body condition and health, concluding that entangled whales and lactating females exhibited the poorest body condition overall.

Climate Change

The effects of a changing climate on right whale distribution and life history are difficult to ascertain. Right whales, due to their near constant interaction with human activities along the East Coast of North America, face a number of complex factors limiting their recovery. Climate change represents an additional variable in this complexity. The effects of climate change on global average temperatures and sea surface temperature are clearly apparent (Greene 2016). Rising sea surface temperature is occurring at a faster rate in the Gulf of Maine than nearly all global ocean waters (Mills *et al.* 2013; Pershing *et al.* 2015). Meyer-Gutbrod *et al.* (2015) analyzed climate-driven changes to *C. finmarchicus* to understand how prey availability drives right whale reproduction. This study found that interannual to interdecadal climate processes that affect *C. finmarchicus* distribution subsequently affect right whale reproduction. A range of environmental processes, especially prey availability, may be limiting right whale recovery and warrant more comprehensive inquiry (Meyer-Gutbrod *et al.* 2015; Grieve *et al.* 2017). Pace *et al.* (2017) described the changing distributional patterns of right whale habitat use and its effect in complicating traditional right whale abundance estimates. While this is likely caused by right whale foraging behavior, further investigation is required to determine the effect changing habitat may have on the species' recovery. Particularly, further investigation is needed to understand the northward shift of right whale distribution out of the jurisdiction of conservation measures in the U.S. (regulating both commercial shipping and fishing) into Canadian waters currently lacking equivalent protections.

2.4 Synthesis

2.4.1 Recovery Status

The status of North Atlantic right whale recovery has not improved since the last 5-Year Review was completed in 2012. Therefore, the recommended classification for the North Atlantic right whale is to remain the same: Endangered.

In many ways, progress toward right whale recovery has regressed. The population has been declining since 2010 and has exhibited changes in habitat use (Pace *et al.* 2017). During this period, right whale calving rates have remained below average (Hayes *et al.* 2017) and body condition of the population has worsened (Rolland *et al.* 2016). Important questions have developed in the scientific literature on energetic stressors on right whales, both from prey availability (Meyer-Gutbrod *et al.* 2015) and the energetic costs of chronic, sublethal entanglement (Knowlton *et al.* 2012; van der Hoop *et al.* 2017b). In addition, in the summer of 2017, right whales experienced a significant mortality event of about 3% of the population.

2.4.2 Recovery Efforts in the Next Five Years

We have continued to develop two primary regulatory management strategies: 1) reduction of right whale vessel strikes by the ship speed rule under the ESA and 2) reduction of lethal right whale entanglements by the Take Reduction Plan under the MMPA. The ship speed rule has

largely been effective at reducing vessel strikes to right whales in the U.S., but evidence has shown that expanding the SMAs may be warranted. Additionally, the ship speed rule does not address the risk of strikes from vessels that are less than 65 feet. We intend to continue to evaluate the effectiveness of these regulations and the threat to right whales from vessels less than 65 feet, and employ continued outreach, enforcement, and management efforts to ensure the efficacy of vessel strike mitigation programs.

Over the past two decades, we, with the Take Reduction Team have, made significant progress in implementing regulations to reduce lethal fisheries interactions with right whales through the Take Reduction Plan. Two major regulatory amendments have been implemented, aimed at reducing entanglement risk in groundlines and vertical lines, since the last assessment of the effectiveness of the Take Reduction Plan. More comprehensive evaluative research should be conducted and additional regulatory action should be undertaken, if warranted. In the meantime, scientific research should continue to assess the feasibility of such gear modifications as 1,700lb breaking strength rope and ropeless fishing should these technologies be required in the future.

We will continue to develop our partnership with Canada on right whale conservation. Communication between the two governments will continue to ensure that complementary protections are in place for right whales throughout their entire transboundary range. This is increasingly important as right whale habitat use and distribution has changed in recent years. The next 5-year period will also see the development and execution of comparability findings for foreign fisheries importing seafood products into the US under the MMPA import rule. These conditions will heighten the need for a strong bilateral partnership between the governments of the US and Canada on right whale conservation.

Evidence of environmental stressors on right whales, including ocean noise, prey availability, and the effect of sublethal entanglement on right whale reproduction now warrant a dedicated management strategy under the right whale recovery plan. As listed in Section 4.0, Recommendations for Future Actions, of this review, additional staff personnel should be dedicated to the development of this strategy. Further, a recovery team of experts from the research and management community should be convened to assist in the formulation of such a strategy. Although progress has advanced on some aspects of the recovery plan, it has been without the assistance of a non-governmental advisory body in the Greater Atlantic region since the Northeast Implementation Team (NEIT) disbanded in 2004.[6] The current threats limiting right whale recovery, like changing habitat use, reduced calving, and sublethal entanglement stress are complex, and their translation to conservation policy through the recovery plan is unclear. These issues warrant the assembly of independent research and management experts to assist in the development of an expanded recovery strategy. These actions will be a high priority over the next 5-year period.

[6] "The Northeast Implementation Team (NEIT) for the Recovery of the North Atlantic Right Whale." Retrieved from https://www.greateratlantic.fisheries.noaa.gov/protected/shipstrike/team/index.html on August 14, 2017.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (Indicate reasons for delisting per 50 CFR 424.11)
____ Extinction
____ Recovery
____ Original data for classification in error
__X_ No change is needed

3.2 New Recovery Priority Number: ONE (1)[7]

Brief Rationale:

The North Atlantic right whale faces continued threat of human-caused mortality due to lethal interactions with commercial fisheries and shipping traffic. There is also uncertainty regarding the effect of long-term sublethal entanglements and other environmental stressors that may be limiting right whale calving and recovery. In addition, the right whale population has been in a state of decline since 2010 and has suffered a mortality of nearly about 3% of its population in 2017. Management measures in the U.S. have been in place for an extended period of time, and recent developments in Canada throughout 2017 suggest progress toward implementing conservation regulations.

[7] Under the proposed revisions to the Listing and Recovery Priority Guidelines (82 FR 24944, May 31, 2017), the North Atlantic right whale would also be assigned a recovery priority number of ONE.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Given the current state of North Atlantic right whale recovery, with a low rate of reproduction, longer calving intervals, declining population abundance, continued human-caused mortality, changes in prey availability, increased trans-boundary movement and risk, and uncertainty regarding the effectiveness of conservation regulations, this review concludes with a specific list of recommendations. These recommendations are intended to focus recovery efforts over the next five years on increasing the understanding of the threats facing North Atlantic right whales and gaining insight into the best approaches to mitigate them. These recommendations rely on expanding partnerships between us and the scientific community, fishing and shipping industry members, and Canadian stakeholders for the management and recovery of this shared resource. While recovery of the North Atlantic right whale will need to be assessed in the coming decades, progress toward fulfilling the following recommendations will be critical when conducting the next 5-Year Review in 2022:

2017-1. NMFS Greater Atlantic Regional Fisheries Office should dedicate additional staff personnel to focus on right whale recovery efforts.

2017-2. NMFS should consider how best to utilize recovery teams to enlist expertise in right whale research and management. The recovery team should be convened as soon as possible.

2017-3. NMFS should develop a long-term, cross-regional plan for monitoring right whale population trends and habitat use.

2017-4. NMFS should continue to prioritize and fund a combination of acoustic, aerial, and shipboard surveys for right whale surveillance.

2017-5. NMFS should conduct evaluative research to determine the effectiveness of the Atlantic Large Whale Take Reduction Plan.

2017-6. NMFS should continue to evaluate the effectiveness of the ship speed rule, including determining whether current seasonal management area geographic and temporal boundaries should be modified.

2017-7. NMFS should develop a strategy to understand the energetic stressors on right whales, including environmental variables, prey availability, and the effect of chronic, sublethal entanglement on overall and reproductive health.

2017-8. NMFS should continue to develop a partnership with the government of Canada on the reduction of human-interactions with right whales, including the implementation and assessment of ship speed regulations and cooperation on fishing gear marking and measures to reduce entanglements.

2017-9. NMFS should evaluate the current status of the species and serious injury/mortality triggers in biological opinions for commercial fisheries consultations under Section 7 of the Endangered Species Act to determine if re-initiation is warranted.

2017-10. NMFS should prioritize research on understanding the effects of climate change on right whale foraging, migration, reproduction, habitat use, and distribution.

2017-11. NMFS should prioritize the development of a population viability analysis (PVA) or other assessment to determine the North Atlantic right whale extinction risk.

2017-12. NMFS should conduct research to improve gear modifications and gear marking to inform management for the development of more finely scaled commercial fisheries regulations.

2017-13. NMFS should continue to fund the maintenance and development of a photo ID database for North Atlantic right whales. NMFS should work with curators and data contributors to identify and implement a method for allowing all qualified researchers to enter sightings data into the catalog.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
North Atlantic Right Whale (*Eubalaena glacialis*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

Review Conducted By: Kimberly Damon-Randall
Assistant Regional Administrator for Protected Species

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve: _____ Date: 9/18/17
for John K. Bullard, Regional Administrator

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

__✓__ Concur _____ Do Not Concur

Signature: _____ Date 10/13/17
Chris Oliver, Assistant Administrator for Fisheries