Written Testimony of

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Thanks to Chairman Huffman and Ranking Member McClintock for inviting me to testify on the critically important topic of the plight of the North Atlantic right whale, among the most endangered baleen whales in the world. I am Vice President and Senior Science Advisor in the Anderson Cabot Center for Ocean Life at the New England Aquarium. The New England Aquarium is a catalyst for global change through public engagement, commitment to marine animal conservation, leadership in education, innovative scientific research, and effective advocacy for vital and vibrant oceans. The Center's mission is to conduct research on topics related to ocean health and conservation and to develop science-based solutions to marine conservation problems. Before assuming my present role, I served for 22 years as the Aquarium's Vice President and Director of Research. I am Research Faculty at the University of Massachusetts, Boston and am a member of the Marine Technology Society, the Marine Mammal Society, and the American Association for the Advancement of Science. I have spent almost 40 years studying the North Atlantic right whale (*Eubalaena glacialis*), publishing more than 80 scientific papers on its distribution, ecology, and conservation. My research team curates the North Atlantic Right Whale Catalog, a photographic index of nearly every individual right whale in the population that is the cornerstone of work in the field. I am a Board Member and vice-Chair of the North Atlantic Right Whale Consortium, a multi-sector collaborative research and conservation effort with partners from government, industry, research institutions, and conservation organizations. I am also a member of the Atlantic Large Whale Take Reduction Team that the National Marine Fisheries Service (NMFS) has convened since 1996 to reduce entanglements of right whales and other large whales in fishing gear.

I am here to testify in support of federal and state efforts to reduce the threats to the North Atlantic right whale. This is among the most endangered whales on the planet, with only about 400 individuals surviving. Despite almost 50 years of federal management efforts, the stock is now declining rapidly. Why should we care? Protecting right whales protects entire ocean ecosystems, including other whales, sea turtles, commercial fish species, even plankton. Generally, whales are the basis of a large tourist economy on both coasts worth 100's of millions of dollars annually. Whales act as incidental farmers of the sea, capturing food at depth and releasing nutrients at the surface, thereby fertilizing and supporting the entire marine food chain (Roman et al. 2014). This fertilizing function moderates climate change (Pershing et al. 2010) and supports the marine productivity that robust and economically valuable fisheries depend upon (Lavery et al. 2014; Roman et al. 2016). Because whales are mammals like us, they serve as an early warning for drastic ecosystem changes in the oceans that will damage fisheries and coastal human communities. Finally, whales are more like us than most people realize—they have culture, dialects, individual voices, family trees, and long-term social structures (Whitehead and Rendell 2014). For all of these characteristics, we owe them more than treating them as collateral damage in the industrialization of the oceans.

The North Atlantic right whale's life cycle takes it through some of the most industrialized, commercially active regions of the North Atlantic (Kraus and Rolland 2007). These iconic whales forage largely in waters off New England and the Canadian Maritime provinces during the spring, summer, and fall, and pregnant females then migrate to calving grounds off the southeast U.S. coast during the winter. That distribution has exposed them to a suite of anthropogenic stressors, including entanglements in fishing gear, collisions with ships, disturbance and masking from underwater noise, and pollutants. As described further below, these stressors have affected the whales' birth and death rates and have impeded their recovery from whaling. Without concerted efforts to reduce the effects of human activities, this species is likely to go functionally extinct in about 20 years.

The North Atlantic right whale is a large baleen whale that can reach 50 feet in length and weigh as much as 100,000 pounds. They spend the warmer months feeding on tiny zooplankton called copepods in the coastal and offshore waters of eastern North America. In the late fall, pregnant females head south to waters off the Carolinas, Georgia, and northern Florida to give birth in the winter, returning north with their calves in the spring. Like all large whales, the right whale was once hunted for its oil. The species obtained its name from early Yankee whalers as the "right" whale to kill, because of its high yields of oil and baleen, its comparatively slow speed, and its tendency to float for some time after death, enabling easy retrieval. By the early 1700s, the North Atlantic population had been hunted nearly to extinction. However, whalers seeking other species in the Atlantic still hunted and killed any right whales encountered, right through the early 1900's. The League of Nations barred further killing in 1935, a protection that was extended after World War II by the International Whaling Commission. It is listed as endangered under the U.S. Endangered Species Act and is protected under the Marine Mammal Protection Act. According to the most reliable population estimate, an estimated 411 were alive at the end of 2017 (Pace et al. 2017; Pettis et al. 2018). Based upon the known 2018 right whale deaths, the estimated actual deaths, and the lack of calving, it is likely that the population at the end of 2018 was just under 400 animals. A total of seven calves have been born to date in 2019.

Right whales experienced some population growth during the 2000s. During that decade, they produced an average of about 24 calves each year and experienced around three known deaths each year from entanglements with fishing gear and ship kills (Waring et al. 2006, 2011), resulting in an annual increase of about 2.8% in population abundance. This growth rate was significantly smaller than the annual growth observed in many baleen whale populations that have recovered from whaling, including that of the Southern right whale, a related species that lives in the waters of the Southern Hemisphere (Corkeron et al. 2018). This period of slow but positive growth for the North Atlantic right whale lasted until 2010, when the species entered a state of decline. Right whales have now been declining every year for the past eight years (Pace et al. 2017). The decline is marked by increasing numbers of deaths, reduced calving rates, and poor health condition. All scientific evidence indicates that this decline can be attributed entirely to human activities. This type of rapid decline in the population has not been seen since the period of active right whaling prior to 1750 (Reeves et al. 2007).

Increases in Deaths

During the five-year period from 2010-2014, human activities killed or seriously injured right whales at more than twice the rate observed during the previous decade, with known mortalities rising from an average of 2.6 to 5.7 incidents per year. The legal threshold required to trigger management action for this species under the Marine Mammal Protection Act, called the "potential biological removal level", is less than one serious injury or mortality per year (Waring et al. 2006, 2011, 2016). The term "potential

biological removal level," or "PBR," means "the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." For the last 20 years, the annual PBR established by the NMFS for right whales has been between 0 and 1, and that number has been exceeded every year.

In 2017 and 2018, researchers documented the deaths of 20 right whales, nearly 5% of the population. Twelve were subjected to complete or partial necropsies, and the deaths of all the examined whales were due to human causes.

The ***actual*** number of right whale mortalities is likely far greater than the unprecedented amount of documented deaths. Since 1980, the right whale research team at the New England Aquarium has curated a photographic catalog of individuals in the North Atlantic right whale population (Hamilton et al. 2007; http://rwcatalog.neaq.org). From nearly 40 years of photographic records, it is known that only one third of right whales are detected when they die; the rest simply disappear from the photographic sightings record. Based on our limited ability to detect mortalities, the 20 right whale deaths reported during the last two years represent fewer than half of the actual losses during that time period.

As a consequence of human-caused mortality, right whale longevity, which can exceed 70 years (Hamilton et al. 1998), has dropped to a mere 30 to 40 years. It is unlikely that right whales die of old age anymore.

Calving Declines

As mortalities in the population have increased, calving rates have fallen. During the 1980's and 1990's, North Atlantic right whale females had calves every three to five years. In the 2000's, however, most females began producing calves at longer intervals, which are now approaching ten years (Pettis et al. 2018). As a consequence, calf numbers over the 2010-2018 period decreased by 43% as compared to the previous decade. No calves were born in 2018, and seven were born in 2019 to date.

It is unlikely that the research community has failed to detect significant calving activity in undiscovered locations beyond the southeastern US continental shelf. As curators of the North Atlantic Right Whale Catalog, my research team at the New England Aquarium collects photographic data on right whales from hundreds of sources, including several other major research institutions along the east coast of the United States, Canada, and Iceland, fishermen, recreational boaters, the U.S. Coast Guard, and many others. Aerial surveys for this species are regularly flown off Massachusetts, Rhode Island, New York, Maryland, Virginia, North Carolina, South Carolina, and in the whales' calving grounds off Georgia and Northern Florida.

Breeding females make up an unusually small percentage of the right whale population, and as of 2015, only an estimated 105 were alive (Pace et al. 2017). Female right whales may be especially vulnerable to human impacts because their migration to the calving ground (which males rarely make) takes them through the heavily used coastal waters of the eastern United States (Caswell et al. 1999; Fujiwara and Caswell 2001). Females attain sexual maturity around ten years of age, and human activities are now killing them before the age of 40, leaving relatively few years for reproduction. Further, female body condition is dependent upon high-quality habitat that includes a combination of adequate food, quiet conditions for communication, and low levels of extrinsic interactions with human activities. Good body condition is defined as good health and blubber (fat) reserves, which female whales require for ovulation, pregnancy, and especially lactation. Chronic stressors can reduce physiological resilience and

lower body condition over time to the point where it falls below the necessary threshold for pregnancy. Health assessments show that many female right whales are in poor body condition, falling below the health indicators consistent with successful calving (Rolland et al. 2016; Pettis et al. 2017).

Cumulative Impacts and Chronic Stressors

The right whale is subject to a cumulative impacts problem as its survival is threatened by multiple anthropogenic stressors including fishing gear entanglements, ship strikes, underwater industrial noise, habitat use and climate change, and now also the threat of seismic exploration.

Fishing Gear Entanglements: Right whales are increasingly subject to entanglement in fishing gear, particularly in the ropes used by lobster and crab fishermen to deploy, mark, and retrieve their traps at sea. From 2010-2014, entanglements caused more than four times as many right whale deaths and injuries likely to result in death, than during the previous five years (Kenney 2018; Waring et al. 2011, 2016). Additionally, the health consequences of an entanglement can last long after the whale is freed. Right whales can have poor body condition and are significantly less likely to reproduce for at least one year following serious entanglement (van der Hoop et al. 2017). This problem is widespread. At least 83% of all North Atlantic right whales have scars from being entangled at least once in their lives, and 59% have been entangled more than once (Knowlton et al. 2012).

Ship Strikes: Right whales are also killed by collisions with ships, as their habitat coincides with a number of major shipping routes. Overall, mortalities from ship strikes have decreased over the past 15 years (van der Hoop et al. 2015), likely due to several successful conservation efforts that included routing changes in the Bay of Fundy, Roseway Basin, and Boston shipping lanes that were permanently established between 2003 and 2009, and the U.S. adoption, in 2008, of a speed regulation for commercial ships along the U.S. east coast. Nonetheless, vessel collisions continue to account for right whale deaths including, in 2017, one lethal strike reported off Massachusetts and four in the Gulf of St. Lawrence.

Habitat Use and Climate Change: Recent changes in right whale health and habitat changes have been associated with climate change, through changes in oceanographic conditions and in the distribution and abundance of their prey species (Record et al. in press). Since 2010, right whales have been distributed less predictably, including year-round occurrences in southeastern U.S. and mid-Atlantic coastal waters, aggregations in the winter and spring south of Cape Cod (Leiter et al, 2018), and sightings and recordings of right whales on the continental shelf edge during the summer months (June and July) and as far south as Georgia (Hodge et al. 2015; Salisbury et al. 2015). Acoustic detections off the southeastern United States have documented small numbers of right whales in the area from August through October (Davis et al. 2017). Right whale sightings have occurred in Bermuda, the Azores, and the Canaries, indicating that the species occasionally travels into deep, warm waters well beyond the continental shelf. Further, pregnant right whales may give birth south of Cape Hatteras while on southward migration, or go offshore to give birth before returning to coastal habitat in the southeast (Zani et al. in prep). The historical thinking about seasonal movements of right whales no longer applies, as new aggregation areas are being identified and “traditional” ones are being used differently.

Underwater Industrial Noise: Underwater noise constitutes another serious, demonstrated stressor on the population (see section on Seismic Exploration below). Due to shipping noise, right whales have lost much of their ability to communicate over long distances (Hatch et al. 2012). Additionally, the

broadband noise produced by shipping traffic has been shown to induce chronic physiological stress in right whales (Rolland et al. 2012). That result is consistent with data on the effects of noise on numerous other species (Romero and Butler 2007). Chronic stress increases vulnerability to disease and causes increased mortality and compromised reproduction across a wide variety of mammals. Right whales are exposed to widespread shipping, dredging, pile-driving and other industrial noises, which are impairing communication, food finding, and reproduction (Hatch et al., 2012).

Seismic Exploration: In November 2018, NMFS issued five separate incidental harassment authorizations (IHAs) to incidentally harass marine mammals during geophysical survey activities in the Atlantic Ocean. The authorized seismic surveys will involve multiple vessels operating simultaneously, each for periods of months, producing chronic noise that will propagate 100's of kilometers and raise ambient noise levels throughout right whale habitat. Since shipping noise demonstrably increases the stress response in right whales (Rolland et al. 2012), it is likely that constant exposure to seismic airgun noise, which is much louder than ship noise, will increase chronic stress in this species. Chronic stress in all mammals (including humans) reduces immune and endocrine function, negatively affecting reproduction and disease resistance (Romero and Butler 2007). This is an impact that this critically endangered species cannot tolerate. Many adult female right whales now have health scores that are just above the threshold of reproductive success (Rolland et al. 2016), suggesting that any additional stressors that reduce body condition will push them below any ability to reproduce. Low health scores are also associated with lower probabilities of survival. The authorized seismic surveys would reduce fitness in these already health-compromised animals, reducing survival and reproduction and pushing the population increasingly toward extinction.

NMFS Biological Opinion on Seismic Impacts to Right Whales was Flawed:

Before issuing the IHA's, NMFS developed both a Biological Opinion and an IHA notice that included an impact analysis. This analysis was inadequate and contained significant flaws in both fact and interpretation as follows.

One, NMFS bases its impact analysis on a cetacean abundance model by Roberts et al. (2017). This model maps the distribution and density of whale, dolphin, and porpoise populations along the U.S. east coast and in the northern Gulf of Mexico. While the model represents an advance over earlier efforts for many species, it does not incorporate much of the recent data on right whale occurrence that demonstrates their extended use of habitats in the mid-Atlantic and southeast. Because of the distance sampling constraints of the data selection, the model does not take account of numerous opportunistic sightings and systematic acoustic detections in the mid-Atlantic and southeast regions. Moreover, very little systematic distance sampling survey effort has occurred beyond the whales' designated critical habitat, an area covering only a small portion of the continental shelf. As a result, the model is likely to underestimate right whale distribution beyond surveyed areas within 40 miles from shore.

Two, any credible environmental analysis must consider the cumulative acoustic impacts of the five authorized seismic surveys in the context of the right whale's current conservation status and all factors impacting the population. The addition of seismic exploration as another significant stressor on the most vulnerable segment of the population, reproductive females and their calves, was considered in isolation from all other stressors listed above.

Three, seismic exploration is likely to increase ambient noise levels across the entire continental shelf, which may interfere with mother and calf communication, increasing risk for calf survival. In calving

grounds off the southeastern United States and in the migratory corridor, seismic noise would increase the probability that right whale mothers and calves could get separated by disrupting their ability to hear one another. Recent studies show that mother-calf pairs communicate with very low-amplitude calls (Parks et al. 2018; Cusano, et al. 2018), which will be vulnerable to interference or masking from small increases in ambient noise (Clark et al. 2009). Even short-term separation is a risk for calves, primarily from shark predation (Taylor et al. 2012).

Four, seismic noise could displace right whale mothers from their primary calving grounds, leading them to give birth in sub-optimal habitat where newborn survival is compromised. It is likely that the combination of bathymetry and temperature in the coastal waters of the southeastern United States are critical to right whale calving. While NMFS asserts, in its notice supporting the present authorizations, that marine mammals displaced by seismic exploration may "seek temporary viable habitat elsewhere," habitat suitable for right whale calving is limited. Given the 100's of kilometer range of seismic noise propagation, it is certain that the authorized surveys, which combined represent about 850 ship days of active airgun use in a single year, would compromise large areas of right whale habitat for calving and other purposes.

Five, NMFS' assertion that the behavioral effects of the authorized surveys will be "transient" is not biologically defensible. There is strong evidence that seismic airgun noise directly alters the behavior of baleen whales, including vocalization behavior associated with migration, feeding, and other functions, at low received sound pressure levels and at distances of tens to hundreds of kilometers from the airgun source (*e.g.*, Blackwell et al. 2015; Castellote et al. 2012). Additionally, seismic airguns can mask baleen whale vocalizations, reducing the whales' communication space and compromising their behavior, at scales of hundreds to thousands of kilometers (*e.g.*, Estabrook et al. 2016; Nieukirk et al. 2012). Given the amount of seismic airgun activity that NMFS has authorized and its range of influence, important right whale behavioral patterns will be disrupted frequently and repeatedly.

Six, NMFS has prescribed a seasonal closure of coastal waters out to 90 kilometers. This ignores recent changes in distribution as right whales are now occurring further offshore, beyond NMFS' closure area and outside the putative migratory season during times of year when the closure does not apply (Davis et al. 2017) (see Habitat Use and Climate Change section above). This also ignores the way airgun noise spreads for hundreds of kilometers, making the 90 kilometer exclusion zone biologically meaningless.

Right Whale Status and Management Options for Recovery

In conclusion, the North Atlantic right whale is among the most endangered whales on the planet, with about 400 individuals remaining, including about 100 breeding females. Despite almost 50 years of federal management efforts, the stock is now declining rapidly. This decline is linked largely to mortality from entanglements in fishing gear and from vessel collisions. It is exacerbated by low calving rates, which are probably due to the sublethal effects of by entanglements, underwater noise, and food availability. These combined effects are likely to reduce body condition and health in all exposed right whales and will have negative effects on reproduction and survival. The efforts currently underway to reduce accidental killing of right whales by ships and fishing gear must be matched with appropriate protections for reproductive females and their calves off the mid-Atlantic and southeastern United States.

The recent decline in calving rates does not mean that the right whale population is doomed to extinction. Mammalian females of all species slow or stop reproduction when environmental conditions

are poor and wait to have offspring when conditions improve. This species can adapt to changing conditions, will find food sources in new places, and start having calves again at rates that can maintain and grow the population. However, North Atlantic right whales do not have the capacity to sustain high death rates for long. For this species to recover, it is critical for managers to prevent human-caused mortality and eliminate those stressors in their ocean habitats that reduce individual whale health. For all of these reasons, the New England Aquarium is opposed to NOAA's issuance of the five IHAs for seismic exploration. However, we support NOAA's existing ship speed rule, and recommend that NOAA urgently enhance its efforts to reduce the entanglements of right whales in fixed fishing gear. We also support NOAA's work on reducing shipping noise and other noise in the ocean, as well as the many federal and state efforts to reduce pollution of all kinds in the sea. Reducing the human causes of right whale deaths, and reducing sub-lethal stressors that reduce whale health, will allow this species time to adapt to its new environmental conditions and begin the road to population recovery.

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