

North Atlantic Right Whale Consortium 2021 Annual Report Card

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NORTH ATLANTIC RIGHT WHALE CONSORTIUM BACKGROUND

The North Atlantic right whale (*Eubalaena glacialis*) remains one of the most endangered large whales in the world. Over the past two decades, there has been increasing interest in addressing the problems hampering the recovery of North Atlantic right whales by using innovative research techniques, new technologies, analyses of existing databases, and enhanced conservation and education strategies. This increased interest demanded better coordination and collaboration among all stakeholders to ensure that there was improved access to data, research efforts were not duplicative, and that findings were shared with all interested parties. The North Atlantic Right Whale Consortium, initially formed in 1986 by five research institutions to share data among themselves, was expanded in 1997 to address these greater needs. Currently, the Consortium membership is comprised of representatives from more than 100 entities including: research, academic, and conservation organizations; shipping and fishing industries; whale watching companies; technical experts; United States (U.S.) and Canadian Government agencies; and state authorities.

The Consortium membership is committed to long-term research and management efforts, and to coordinating and integrating the wide variety of databases and research efforts related to right whales to provide the relevant management, academic, and conservation groups with the best scientific advice and recommendations on right whale conservation. The Consortium is also committed to sharing new and updated methods with its membership, providing up-to-date information on right whale biology and conservation to the public, and maintaining effective communication with U.S. and Canadian Government agencies, state authorities, the Canadian Right Whale Network, the U.S. Southeast and Northeast Right Whale Implementation Teams, the Atlantic Large Whale Take Reduction Team, the Atlantic Scientific Review Group, and members of the U.S. Congress. The Consortium membership supports the maintenance and long-term continuity of the separate research programs under its umbrella, and serves as executor for database archives that include right whale sightings and photo-identification data contributed by private institutions, government scientists and agencies, and individuals. Lastly, the Consortium is interested in maximizing the effectiveness of management measures to protect right whales, including using management models from other fields.

The Consortium is governed by an Executive Committee and Board members who are elected by the general Consortium Membership at the Annual Meeting.

North Atlantic Right Whale Consortium members agreed in 2004 that an annual “report card” on the status of right whales would be useful. This report card includes updates on the status of the cataloged population, mortalities and injury events, and a summary of management and research efforts that have occurred over the previous 12 months. The Board’s goal is to make public a summary of current research and management activities, as well as provide detailed recommendations for future activities. The Board views this report as a valuable asset in assessing the effects of research and management over time.

ESSENTIAL SPECIES MONITORING AND PRIORITIES

In the 2009 Report Card to the International Whaling Commission (IWC), the Consortium Board identified key monitoring efforts that must be continued and maintained in order to identify trends in the species, as well as assess the factors behind any changes in these trends (Pettis, 2009). As right whale distributions change and emerging The key efforts are: (1) Photographic identification and cataloging of right whales in historically and emerging high-use habitats and migratory corridors, which currently includes, but is not limited to, the southeast United States, Cape Cod Bay, Gulf of St. Lawrence, Great South Channel, southern New England, Bay of Fundy, Scotian Shelf, and Jeffreys Ledge, (2) Monitoring of scarring and visual health assessment from photographic data, (3) Examination of all mortalities, and (4) Continue using photo-ID and genetic profiling to monitor species structure and how this changes over time.

The Consortium Board regards the Consortium databases as essential to recovery efforts for the North Atlantic right whale species. In a review of the federal recovery program for North Atlantic right whales, the Marine Mammal Commission agreed with the Board's sentiment, stating that "both databases play critical roles in right whale conservation" and that the Identification Catalog "is the cornerstone of right whale research and monitoring" (Reeves et al. 2007). The review went on to recommend that both databases ("both" here and above refers to the [Identification and Sightings databases](#); there are several other Consortium databases available) be fully funded on a stable basis. Additionally, the Board recognizes the importance that passive acoustic monitoring has played in our understanding of right whale distribution and its potential role in mitigating anthropogenic impacts on the species. The Board strongly supports and encourages efforts to develop a comprehensive Right Whale Acoustic Detection Database that will serve as an additional resource in conservation and management efforts.

Since 2010, right whale distribution and patterns of habitat use have shifted, in some cases dramatically. These shifts have been observed throughout the range of North Atlantic right whales and have direct implications on research and management activities, and on each of the key efforts identified above. As such, the Board believes that identifying potential extralimital and new critical habitats and developing alternative survey effort strategies to respond to the distributional changes should continue to be a priority. These strategies should include efforts to not only locate, both visually and acoustically, and identify individual right whales, but also to ensure that information critical to important monitoring and management efforts (i.e. health assessment, injury and scarring assessments) is effectively and efficiently collected. This will require a commitment to both aerial and shipboard documentation to ensure that information necessary to evaluate individuals and the species as a whole are captured. **The drastic shifts in right whale distribution, both temporally and spatially, and the speed at which they occurred, should be viewed as an indicator of the inadequacy of static mitigation efforts focused solely on past habitat use.**

Discussions about reducing anthropogenic impacts on right whales in both Canadian and U.S. waters are ongoing and encouraging. However, despite the relative reduction in overall mortalities in 2020-2021 and increases in births over 2020 (detailed below), the detected mortalities are still well above the Potential Biological Removal (PBR) of 0.7/year. Additionally, detected mortalities represent a fraction of true annual mortality (Pace et al. 2021).

Anthropogenic injuries and mortalities remain a threat to the existence of North Atlantic right whale and immediate, broad-based mitigation strategies that result in significant risk reduction throughout the right whale's range must be a priority if this species is to survive.

2021 SPECIES STATUS

The ability to monitor North Atlantic right whale vital rates and anthropogenic impacts is entirely dependent on the North Atlantic Right Whale Identification Database (Catalog), curated by the Anderson Cabot Center for Ocean Life at the New England Aquarium. As of September 7, 2021, the database consisted of over a million slides, prints, and digital images collected during the 86,415 sightings of 761 individual right whales photographed since 1935. Each year, 2,000 to 5,000 sightings consisting of 20-30,000 images are added to the identification database.

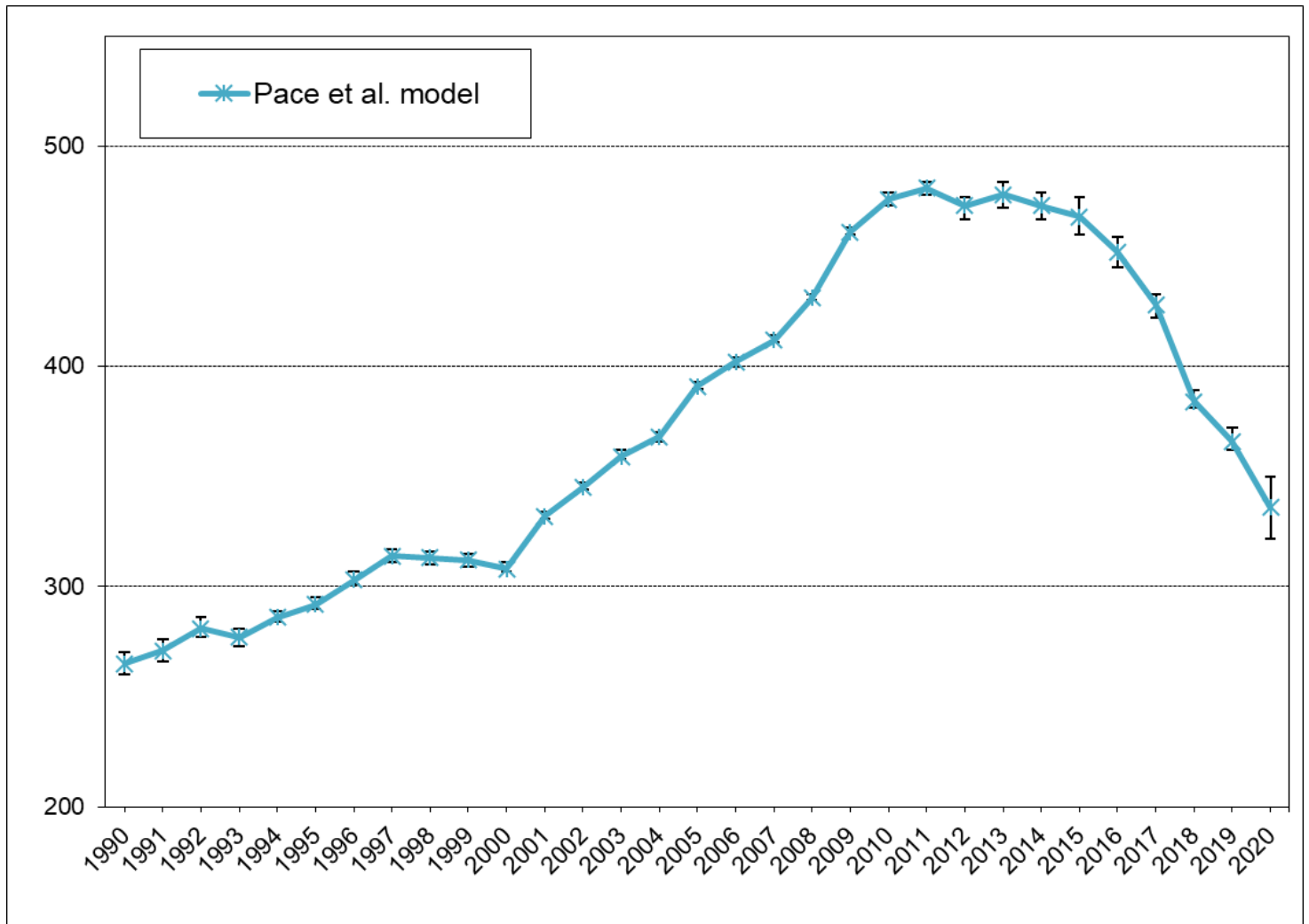
Right Whale Species Estimate 2020

Since 1990, using Catalog data, a number of methods have been employed to estimate the number of North Atlantic right whales alive annually, including the Catalog Method, Presumed Alive Number, Minimum Number Alive, and most recently, the Pace et al. (2017) model. Starting with this year's report card, we only present the single, most accurate assessment method, based on the Pace et al. (2017) model. The move to present a single estimate was based on several considerations. First, previous methods suffered from uncertainties that were difficult to quantify, and frequently led to public misunderstanding about what those numbers represented. Additionally, several of the previous population estimates, such as the Minimum Number Alive, were known to be less accurate towards the end of the time series (i.e. for the previous year or two).

The Pace et al. (2017) model "adapted a state-space formulation with Jolly-Seber assumptions about population entry (birth and immigration) to individual resighting histories and fit it using empirical Bayes methodology." This model estimate accounts for whales that have not been photographed and the full methodology is available in the paper. The model is run annually using updated Catalog data. One indication of how well the Pace model performs is that the estimate for 2019 did not change from last year's model run; the confidence intervals tightened, but the estimate remained the same. It is important to note that the estimates provided by the Pace et al. 2017 methodology represent the estimated abundance at the *start* of the year plus all new entries into the population. If one wanted an estimate at the end of the interval, one could subtract the number of known dead (or estimated number of dead if a detection rate for carcasses was available

The Pace et al. (2017) estimate for 2020 is **336 whales** (95% confidence range +/- 14) using data as of September 7, 2021. This estimate represents an 8% decline over the 2019 estimate. It should be noted that data from 2020 were still coming in when the data were exported for this analysis, so it is possible that the estimate will change once those data are complete. Any changes will be reflected in next year's report.

Figure 1. Assessments of the North Atlantic right whale population 1990-2020. Annual assessments are shown by a point "estimate" along with error bars which represent 95% of the posterior probability. The model estimates the number of whale alive *at the start* of each year plus any new whales estimated to enter during that year. The estimate for 2020 was 336 +/- 14. Data from the North Atlantic Right Whale Catalog as of September 7, 2021.



How Well Are We Monitoring?

Table 1 is an annual count of sightings, unique individuals, estimated population size, kilometers of effort that have been submitted to the sightings database at the University of Rhode Island, and percent of the estimated population that is identified each year from 2000 onward (Table 1). Data as of September 7, 2021.

Table 1. Annual counts of photo-ID sightings, unique individuals, presumed living whales, survey effort (in Beaufort conditions ≤ 4), and the percentage of the population seen. Survey effort from dedicated surveys only; opportunistic sightings do not have associated effort. Additionally, the NARWC does not currently receive effort data for surveys completed by the Department of Fisheries and Oceans Canada or Transport Canada. None of the numbers for 2020 are final as not all of the data for that year have been submitted or analyzed. Data as of September 7, 2021.

| Year | Sightings | Unique IDs | Population Estimate | Survey Effort (1,000 km) | % of Estimated Population Seen* |
|--------|-----------|------------|---------------------|--------------------------|---------------------------------|
| 2000 | 3286 | 246 | 309 | 125 | 80% |
| 2001 | 3983 | 286 | 332 | 127 | 86% |
| 2002 | 2725 | 315 | 345 | 252 | 91% |
| 2003 | 2406 | 315 | 359 | 180 | 88% |
| 2004 | 1839 | 299 | 368 | 287 | 81% |
| 2005 | 3408 | 364 | 391 | 357 | 93% |
| 2006 | 2803 | 348 | 402 | 316 | 87% |
| 2007 | 3768 | 384 | 412 | 267 | 93% |
| 2008 | 4164 | 408 | 430 | 254 | 95% |
| 2009 | 4698 | 427 | 460 | 246 | 93% |
| 2010 | 3236 | 432 | 476 | 271 | 91% |
| 2011 | 3479 | 444 | 481 | 234 | 92% |
| 2012 | 2127 | 383 | 471 | 271 | 81% |
| 2013 | 1905 | 296 | 478 | 215 | 62% |
| 2014 | 2404 | 379 | 473 | 200 | 80% |
| 2015 | 1774 | 268 | 467 | 184 | 57% |
| 2016 | 2210 | 327 | 451 | 155 | 73% |
| 2017 | 3126 | 377 | 425 | 178 | 89% |
| 2018 | 3833 | 358 | 383 | 190 | 93% |
| 2019 | 4402 | 339 | 366 | 141 | 93% |
| 2020** | 1905 | 269 | 336 | 150 | 80% |

*In previous Report Cards, the population estimate and resulting % presumed alive seen were based on the Middle Catalog number (see previous report cards for explanation). Starting with the 2020 report card, we use the Pace et al. (2017) model estimate as the population estimate and as the denominator for the calculation of the % estimated population seen.

** The data for 2020 are not final as not all of the data for that year have been submitted and/or analyzed.

Reproduction

Eighteen mother/calf pairs were sighted in the 2021 calving season, up from 10 in 2020 (Table 2). In addition to these 18 calves associated with a mother, there were two other calves known to be born that could not be linked to a mother. One of these was dead at its initial sighting and the other was seen only once and in the absence of a mother. Because we can only reliably track and account for calves through the identity of their mothers, and because calves observed in the absence of a mother is likely to die, we use the number of identified mothers as the count for the year. Though the increase in calves is certainly encouraging, right whale births remain significantly below what is expected and the average inter-birth interval remains high. The species continues to be in decline and in July 2020, the International Union for Conservation of Nature (IUCN) red listed the North Atlantic right whale changing its status from endangered to critically endangered. This designation is made when a species is considered at high risk for global extinction. The North Atlantic right whale is the only large whale species on the list.

Table 2. Summary of calving events and associated inter-birth interval times for North Atlantic right whales from 2009-2021. The number of available cows, defined as females who have given birth to at least one previous calf, were presumed to be alive, and have not given birth in the last two years, are followed by the percentage of available cows to successfully calve. First time mothers are now included in the available to calve count.

| Year | Calf Count | Available Cows/ % that calved | Average Interval (yrs) | Median Interval (yrs) | Min/Max Interval (yrs) | First time Moms |
|------|------------|----------------------------------|---------------------------|--------------------------|---------------------------|--------------------|
| 2009 | 39 | 66/59.1% | 4.0 | 4 | 2/6 | 8 |
| 2010 | 19 | 49/38.8% | 3.3 | 3 | 2/5 | 4 |
| 2011 | 22 | 51/43.1% | 3.7 | 3 | 2/6 | 3 |
| 2012 | 7 | 66/10.7% | 5.4 | 4 | 4/10 | 2 |
| 2013 | 20 | 90/22.2% | 4.6 | 4 | 2/8 | 7 |
| 2014 | 11 | 86/12.8% | 4.4 | 4.5 | 2/7 | 1 |
| 2015 | 17 | 84/20.2% | 5.5 | 6 | 4/7 | 4 |
| 2016 | 14* | 85/16.5% | 6.6 | 7 | 4/9 | 4 |
| 2017 | 5 | 71/7.0% | 10.2 | 8 | 7/20 | 0 |
| 2018 | 0 | 76/0 | - | - | - | - |
| 2019 | 7 | 87/8.0% | 7 | 7 | 3/10 | 1 |
| 2020 | 10 | 77/13% | 7.6 | 7 | 4/11 | 1 |
| 2021 | 18 | 88/20.5% | 9.2 | 10 | 5/11 | 6 |

*There were 14 mothers seen with calves in the 2015/2016 season, however, due to a three-way calf switch that included the presumed loss of one calf that was never photographed, only 13 calves were photographed.

Mortalities

In 2021, **two** right whale mortalities were detected, matching the number of detected mortalities in 2020. The causes of death, both of which were detected in U.S. waters, were attributed to a vessel strike and a chronic entanglement (Table 3). The one confirmed entanglement related mortality was detected in U.S. waters, however, the origin of the entangling gear remains unclear. The Consortium Board recognizes necropsies, which were performed for both 2021 mortality cases, as significant data collection events that provide valuable information on which management and conservation measures can be (and have been) based. The Board views consistent necropsy response and support (both financial and personnel) as critical to monitor both right whale recovery and the efficacy of management actions.

The 2021 vessel strike mortality was the third in U.S. waters in the last two years. Two of these strikes occurred in Seasonal Management Areas (SMAs), however, in at least one of these cases (the 2021 strike) the vessel responsible was <65ft and therefore not subject to speed restrictions. While details on the size of the vessel involved in the second strike within a SMA are not confirmed, wounds on the whale suggest that it was larger than 40ft and perhaps much larger. The third strike mortality occurred outside of either a Seasonal Management Area or a Dynamic Management Area and was suspected to be caused by a vessel >65ft. The increase in vessel strike mortalities over the last two years in U.S. waters (there were no vessel strike mortalities detected in U.S. waters in 2018 or 2019) and the involvement of vessels and areas not restricted by current mitigation measures underscores the immediacy of necessary changes to measures to include smaller vessels in all areas where right whales are

detected (visually or acoustically) and forecasted to be. For the second consecutive year, there were no detected vessel strike mortalities in Canadian waters in 2021.

Other Vessel Strikes, Entanglements, and Entrapments

Vessel Strikes:

There was **one** vessel strike injury that was not immediately lethal, documented between 01 January 2021 – 31 December 2021 (Table 4). The whale, #3230, was a mom of the year whose calf was fatally wounded by the same vessel (see Table 3). She was seen three days after the strike, but has not been seen since and her survival is uncertain.

Entanglement and Entrapments

There were five active entanglement/entrapment cases reported between 01 January 2021 – 31 December 2021, of which **three** were new (Table 5). Of the three newly entangled whales (with attached gear) detected in 2021, two were in U.S. waters and one in Canadian waters. After multiple disentanglement efforts in Cape Cod Bay and the Gulf of St. Lawrence, one of these whales was resighted, still entangled, in the southeast U.S. in December 2021 with a calf. The other two whales, both of which have entanglements that are considered life threatening, have not yet been resighted.

Whales with attached gear tell only part of the entanglement story. Annual assessments of scarring show that interactions with fishing gear often occur without detection of the actual entangling gear. While still in preliminary analyses, there were at least seven additional entanglement events in Canadian waters and four in U.S. waters in 2021 resulting in scars only, highlighting the ongoing nature of this anthropogenic threat to the species.

Table 3. Documented right whale mortalities 2021. Right whale mortalities detected in 2021 are listed with information on whale, location, and cause of death when determined.

| Whale # | Date | Location | Sex | Age | Field # | Necropsied? | Cause | Comments |
|---------------|------------|--------------------------------|-----|-----|------------|-----------------|----------------------|--|
| 2021Calf03230 | 02/13/2021 | St. Augustine, FL | M | C | EGNEFL2103 | Yes | Vessel Strike | A calf of the year, first sighted with its mom on 01/17/2021, was reported stranded on 02/13/2021 off the coast of Florida. Whale had multiple cuts consistent with propeller wounds from vessel strike. Report received by sport fishing vessel indicated that they “hit a whale” in the area. |
| 3920 | 02/27/2021 | 15 miles E of Myrtle Beach, SC | M | 12 | EGNEFL2104 | Partial, at sea | Chronic Entanglement | Cottontail was initially sighted entangled on 10/19/2020 off of Nantucket, US. The Center for Coastal Studies response team was able to locate the whale, affix a telemetry buoy to the entanglement, and remove ~100 feet of trailing line. The whale was resighted on 02/18/2021 off Indialantic Florida and then sighted dead on 02/27/2021 off Myrtle Beach, SC. |

Table 4. Right whale vessel strikes 2021. Newly reported vessel strikes with whale, location, and injury information. Dead whales first sighted with vessel strikes are not included here.

| Whale # | Date of First Injury Sighting | First location | Sex | Age (current) | Comments |
|---------|-------------------------------|----------------|-----|---------------|--|
| 3230 | 02/16/2021 | Florida | F | 19 | #3230 was a mom of the year and her calf stranded dead on 02/13/2021. Calf had multiple prop cuts on body and head. #3230 was last sighted on 02/16/2021 with at least three prop cuts to her left side. The details (length, depth) of the cuts were not clear in this initial injury sighting. |

Table 5. Right whale entanglements and status updates 2021. Newly reported entanglements (carrying gear) and updates to previously reported entanglements are in **bold**. Dead whales first sighted entangled at death are not included here. However, whales sighted alive as entangled and later dead are included.

| Whale # | Date of First Entanglement Sighting | First location | Sex | Age (in 2020) | Comments |
|---------|-------------------------------------|-----------------------------------|-----|---------------|--|
| 3466 | 12/21/2019 | ~20m south Nantucket USA | M | 15 | At the initial entanglement sighting, the whale had multiple passes of yellow line through its mouth. The line appeared to be buoyant and trails behind the whale to a jumble and at least one bitter end. There is no evidence of tackle or buoys and the flippers do not appear to be involved. No response was mounted due to the time of day and distance from shore. The large amount of line and the jumble indicate that the whale will have difficulty shedding the gear and the configuration may become more complicated. Resighted on 01/18/2020, 01/22/2020, and 1/31/2020 southeast of Nantucket. Reporting group indicates no change in entanglement or condition. Response not possible given time of day and distance to shore. Resighted on 04/07/2021 in Southern New England and has shed the attached gear. |
| 3920 | 10/19/2020 | South of Nantucket | M | 11 | During a search for entangled right whale #4680, the CCS aerial survey team found #3920 entangled south of Nantucket on 10/19/2020. The free-swimming whale had line wrapped tightly around its head with line embedded in the forward part of the upper jaw. There was also trailing line. The CCS response team was able to locate the whale, affix a telemetry buoy to the entanglement, and remove ~100 feet of trailing line. Whale location and weather are being monitored for further intervention. Resighted on 02/18/2021 off Indialantic Florida. Sighted dead on 02/27/2021 off Myrtle Beach, SC. See mortality table #3 above. |
| 1803 | 01/11/2021 | 10 miles east of St. Mary's River | M | 33 | The whale had multiple wraps of blue line around the peduncle and both fluke blades. A trap/pot trailed just aft of the flukes and at least one length of the blue line trailed 50-60 feet aft of the flukes. The overall body condition appears to be quite thin based on shipboards, but not emaciated. Cyamid presence/distribution and pallor on the flukes suggest a chronic entanglement. The flukes are in bad shape. There are multiple wraps on flukes with peduncle involvement and trailing gear. Whale was resighted on 1/12/2021. The Disentanglement team caught the trailing gear to attach buoy but the grapple did not hold. Concern about survival of this whale if gear is not shed. Pre-entanglement sighting was 04/07/2019 in Cape Cod Bay. |
| 3560 | 03/10/2021 | Cape Cod Bay | F | 16 | Entangled with gear. Partially disentangled, removed ~300ft of line. Resighted multiple times between May and August 2021 in the Gulf of St Lawrence and additional rope was removed. Whale was resighted 10/24/2021 in Southern New England and again on 12/02/2021 off the coast of Georgia with a calf. Two short lengths of line (less than a body length) anchored in the mouth remains on the whale with a possibility of an embedded wrap in forward part of rostrum. |
| 4615 | 07/13/2021 | Gulf of St. Lawrence | M | 5 | Whale seen gear free hours prior to initial entanglement sighting. Whale engaged in head raises, tail slashes/flicks, and rolling for much of the sighting. Active bleeding observed at areas where rope was contacting the body was also noted, all suggesting that the entanglement was relatively recent and that the whale was dealing with heavy gear. Telemetry buoy attached. Resighted next day still entangled but not since. |

Monitoring Health of Injured Right Whales

Efforts to better track and monitor the health of anthropogenic injury of North Atlantic right whales were initiated in January 2013. These efforts aim to support annually mandated human-induced serious injury and mortality determinations, to reduce the likelihood of undetected and unreported events, and to better assess both short and long-term impacts of injury on right whale health. Previously and newly injured right whales with evidence of vessel strikes, attached fixed gear, or with moderate to severe entanglement injuries in the absence of attached gear (see Knowlton et al. 2016 for review of injury types) are flagged for monitoring biannually. Each whale's pre- and post-injury health conditions are evaluated using the visual health assessment technique (Pettis et al. 2004) and a determination of the impact of injury on health is made. Based on the available sighting and health information, whales are assigned to one of four categories: 1) Evidence of declining health coinciding with injury; 2) Inconclusive (this determination was assigned to animals when a: evidence of declining health exists but it was unclear whether or not it was linked to injury and/or b: images/information were inadequate to fully assess health condition visually; and/or c: condition has improved but remains compromised); 3) No indication of declining health caused by injury based on available images/information (these are removed from the monitoring list should subsequent sightings also show no impact of injury on health); and 4) Extended Monitor - no indication of declining health or whale's condition has improved but whale will remain on monitoring list because of injury severity and/or is still carrying gear. This last category was created to capture whales without current health impacts related to injury, but with injuries that have the potential to negatively impact future health condition (e.g. some severe vessel strikes, whales carrying gear, etc.).

Between 01 January and 31 December 2021, **seven** new injury-of-interest events were documented for seven whales, including three whales with attached gear, three entanglement injuries but no gear attached, and one vessel strike (Tables 6 and 7). Two whales with new injuries were already on the monitoring list. Of these seven whales with new injuries, one exhibited declining condition coinciding with injury. The impact of injury on the health of the remaining six whales was inconclusive (Table 7). Twenty-four whales previously on the monitoring list were removed, including 17 who became presumed dead (Knowlton et al. 1994) and two that died. The remaining five whales were removed for improved condition and/or length of time since initial injury detections. As of 31 December 2021, the Serious Injury/Human Impact list includes 43 whales with injuries documented from December 2013 through 31 December 2021 (Table 8). The majority of the injuries are entanglement related (37/43 86.0%) followed by vessel strikes (6/43, 14.0%). There is one whale on the list with injuries of unknown origin.

Table 6. Injured Whales on the Monitoring List by Year. Since the inception of the injured right whale monitoring protocol, the number of injured whales and newly reported injuries has varied by year. The number of whales included on the injured whale list is given for each report and is followed parenthetically by how many of those were newly detected injuries.

| Year | June | December |
|-------------|----------------|-----------------|
| 2013 | 33* | 32 (2) |
| 2014 | 45 (16) | 50 (6) |
| 2015 | 51 (4) | 59 (9) |
| 2016 | 60 (4) | 63(8) |
| 2017 | 61 (4) | 70 (10) |
| 2018 | 74 (9) | 70 (8) |
| 2019 | - | 72 (9) |
| 2020 | - | 62 (13) |
| 2021 | - | 43 (7) |

*The first injured whale monitoring report was distributed in June 2013 and therefore does not include a comparative number of newly reported injuries. In 2019, reporting moved from a biannual to an annual basis.

Table 7. Impact of anthropogenic injury on right whale visual health for newly detected injured right whales. New right whale injury cases documented/assessed between 01 January and 31 December 2021 and their injury type and associated impact category.

| | Entanglement | | Vessel Strike | Other | Total |
|--------------------------------|--------------|-----------------|---------------|-------|-------|
| | Gear Present | No Gear Present | | | |
| Decline in Condition | 1 | 0 | 0 | 0 | 1 |
| Inconclusive | 2 | 3 | 1 | 0 | 6 |
| No Decline in Condition | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 3 | 1 | 0 | 7* |

*Two new injuries were detected for whales that were already on the monitoring list.

Table 8. Impact of anthropogenic injury on right whale visual health by injury type This table is based on assessments of photographs pre- and post-injury for all North Atlantic right whales on the Serious Injury/Human Impact list as of 31 December 2021.

| | Entanglement | | Vessel Strike | Other | Total |
|--------------------------------|--------------|-----------------|---------------|-------|-------|
| | Gear Present | No Gear Present | | | |
| Decline in Condition | 9 | 6 | 0 | 0 | 15 |
| Inconclusive | 7 | 8 | 3 | 1 | 19 |
| No Decline in Condition | 2 | 4 | 1 | 0 | 7 |
| Extended Monitor | 0 | 1 | 1 | 0 | 2 |
| Total | 18 | 19 | 5 | 1 | 43 |

*This represents the number of whales on the monitoring list. Many whales have multiple injuries and assessments are tracked under the most recent.

AERIAL AND VESSEL-BASED SIGHTING SUMMARY: 2020

Prior to the 2017 Report Card, sighting information was reported for the time period following the previous NARWC Annual Meeting. However, that reporting included the current year for which not all data has necessarily been received and/or processed. Therefore, beginning with the 2017 Report Card, sighting summaries will be presented for the *previous* calendar year. Cataloged sighting information for the year 2020 (analysed 07 September 2021) is summarized below (Table 9) and includes survey, research, and opportunistic sightings. Months with sightings, survey types, and major contributing organizations (>10% total sightings for region) are listed.

Major Contributing Organizations

AS: Associated Scientists
 BIWSC: Briar Island Whale & Seabird Cruises
 CCS: Center for Coastal Studies
 CMARI: Clearwater Marine Aquarium Research Institute
 CWI: Canadian Whale Institute
 DFO: Fisheries and Oceans Canada
 FWRI: Florida Fish and Wildlife Research Institute
 GDNR: Georgia Department of Natural Resources
 GMWSR: Grand Manan Whale and Seabird Research Station

GUBA*: Gunter Baumgartel
 IQMWWC: Island Quest Marine Whale and Wildlife Cruises
 MIBU*: Miraj Budak
 NEAq: New England Aquarium
 NEFSC: Northeast Fisheries Science Center
 NIHA*: Nick Hawkins
 PEFL*: Peter Flood
 QLM: Quoddy Link Marine

Table 9. Summary of 2020 right whale sightings by habitat region. Analyses for 2020 data are ongoing and therefore the data presented here should not be considered complete.

| Region | # Sightings | Sighting Months | Survey types/activities | Organizations |
|--|-------------|----------------------|--|-------------------------|
| Bay of Fundy | 5 | Jul-Aug | Vessel surveys, biopsy sampling | CWI, BIWSC, IQMWWC, QLM |
| East (East of Mainland US (Azores, Nova Scotian Shelf, Spain, Bermuda, Canary Islands) | 1 | December | Opportunistic | GUBA* |
| Gulf of Maine | 224 | Jan - Mar, Jul - Dec | Aerial and Vessel surveys | NEAq, NEFSC |
| Great South Channel | 9 | Mar - May, Sep, Dec | Aerial surveys | CCS, NEAq, NEFSC |
| Jeffreys Ledge | 3 | Apr | Aerial surveys, opportunistic | CCS, MIBU* |
| Mid-Atlantic (includes south of Cape Cod) | 247 | Jan - Apr, Jun - Dec | Aerial surveys, whale watch | CCS, CMARI, NEAq, NEFSC |
| New England (Massachusetts Bay/Cape Cod Bay) | 499 | Jan - Apr | Aerial and Vessel surveys, biopsy and habitat sampling, drone photogrammetry, whale watch, opportunistic | CCS, PEFL* |
| North (North of latitude 46 degrees including Newfoundland, Gulf of St. Lawrence, Iceland) | 527 | May - Dec | Aerial surveys, drone photography | DFO, NIHA* |
| Roseway Basin | 5 | Sep, Dec | Aerial surveys | DFO |
| Southeast United States | 385 | Jan - Mar, Dec | Aerial and Vessel surveys, biopsy and drone sampling | AS, CMARI, FWRI, GDNR |

MANAGEMENT AND MITIGATION ACTIVITIES

The following management summaries were submitted by the National Marine Fisheries Service, Department of Fisheries and Oceans Canada, and Transport Canada for inclusion in the 2021 NARWC Annual Right Whale Report Card.

NMFS, United States 2021 Management and Mitigation Activities

- *North Atlantic Right Whale Unusual Mortality Event*

An Unusual Mortality Event (UME), which is defined under the U.S. Marine Mammal Protection Act as "a stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response" was declared by the National Marine Fisheries Service for North Atlantic right whales (*Eubalaena glacialis*) starting in 2017, due to elevated numbers of dead or seriously injured whales along the Northwest Atlantic Ocean coast. This is a transboundary event and the investigation includes whales found dead in both Canada and the United States. The UME is ongoing with 50 known cases, including 34 dead and 16 seriously injured individuals to date. Of the 34 confirmed dead whales, 21 were first documented in Canada and 13 were first documented in the United States. The breakdown of known mortalities by year includes: 17 whales in 2017 (12 in Canada; 5 in the U.S.); 3 in 2018 (all in the U.S.); 10 in 2019 (9 in Canada; 1 in the U.S.); 2 in 2020 (both in the U.S.); and 2 in 2021 (both in the U.S., as of 20 August). Of the 24 whales that were necropsied, 20 (83%) were confirmed, probable, or suspect deaths as a direct result of human activities: entanglements (9) or vessel strikes (11). Of the 16 serious injury cases, which involve live free-swimming non-stranded whales, 14 had serious injuries from entanglements and 2 from vessel strikes. Therefore, of the 40 cases examined (both live and dead), 90% (36/40) were impacted by entanglements (23) or vessel strikes (13). Given there are fewer than 400 individual North Atlantic right whales remaining, these 50 individuals in the UME represent at minimum 12.5% of the population, which is an extremely significant impact on such a critically endangered species. More information can be found at NMFS UME website: (<https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2020-north-atlantic-right-whale-unusual-mortality-event>).

- *North Atlantic Right Whale Health Assessment Workshop:*

NOAA Fisheries published a [Technical Memorandum](#) as an outcome of a June 2019 workshop on North Atlantic Right Whale Health Assessment June 24-26, 2019 in Silver Spring, Maryland that was held under the auspices of the Working Group on Marine Mammal Mortality Events in response to the ongoing North Atlantic right whale Unusual Mortality Event and the endangered status of the species. The technical memorandum summarizes the information presented at the meeting and will help inform right whale science and management. A total of 35 participants, including biologists, veterinarians, modelers, managers, and representatives of governmental and nongovernmental agencies, from three different countries (U.S., Canada, and Argentina) attended the workshop. The main goals of the workshop were to: 1) assess current health information data, including associated data gaps, and 2) identify appropriate available and needed tools and techniques for collecting standardized health data that can be used to understand health effects of environmental and human impacts (e.g., entanglement), and inform fecundity and survivorship models to ultimately guide population recovery of North Atlantic right whales. Some of the highest health priorities identified included new or continued support for the following activities:

- 1) Continue to support the photo-identification catalog that provides the ability to track health at the individual level.
- 2) Continue to support the development of the Population Evaluation Tool model and support development of a population-level state-space model with integrated health metrics.
- 3) Continue and expand vessel and aerial photo-identification efforts to acquire population-level seasonal distribution and demographic data.
- 4) Continue and expand collection of health assessment data (e.g., biopsy, photos, photogrammetric length and width measurements, blow, feces) and continue longitudinal studies.
- 5) Necropsy response efforts should be continued and enhanced, including continued support for training of large whale necropsy techniques.

Additionally a [peer-reviewed manuscript](#) by Dr. Michael Moore was also published as a follow-up to this workshop.

- *U.S. North Atlantic Right Whale Implementation Teams*

In 2021, NMFS conducted a number of management activities under the Endangered Species Act (ESA) related to recovery plan implementation specific to Section 4(f). This included continued efforts to work with our Northeast (NEIT) and Southeast (SEIT) U.S. Implementation Teams on activities to assist in the implementation of the recovery plan in the Northeast and Southeast U.S., respectively.

- *Population Evaluation Subgroup*

The U.S. Implementation Team's Population Evaluation Tool Subgroup continued to meet and work towards development of a population viability analysis to characterize North Atlantic right whale extinction risk and to evaluate how management changes would affect the extinction risk. This is a coastwide collaboration including Canada.

- *Species in the Spotlight*

North Atlantic Right Whales became a Species in the Spotlight in 2019. NMFS finalized a Species in the Spotlight 5-year action plan in 2021 which builds upon existing recovery and conservation plans and details the focused efforts needed over the next five years to reduce threats and stabilize the North Atlantic right whale population decline. Considerations included input from the Northeast and Southeast Implementation Teams from their October 2019 joint meeting. It identifies the following urgent actions we can take in the next 5 years to halt the decline of this species:

- Protect North Atlantic Right Whales from Entanglement in Fishing Gear
- Protect North Atlantic Right Whales from Vessel Strikes
- Investigate North Atlantic Right Whale Population Abundance, Status, Distribution, and Health
- Collaborate with Canada on North Atlantic Right Whale Recovery
- Improve our Knowledge of Additional Factors Limiting Right Whale Recovery

- *Atlantic Large Whale Take Reduction Plan*

In 2021, NMFS finalized Phase I modifications to the Plan that addressed entanglement risk from Northeast lobster and Jonah crab trap/pot fisheries. NMFS published a final rule on September 17, 2021 and associated Final Environmental Impact Statement (FEIS) on July 2, 2021. Links to both documents as well as supporting information can be found on the [ALWTRP website](#).

Changes to the Plan include:

- Two new seasonal restricted areas that are closed to buoy lines but allow ropeless fishing
- An expansion of the Massachusetts Restricted Area into Massachusetts State Waters in LMA 1.
- New gear configurations to reduce the number of vertical lines by requiring more traps between buoy lines
- Weak insertions or weak rope into buoy lines with a maximum breaking strength of 1,700 lb.
- Modifications to existing seasonal restricted areas that will allow ropeless fishing
- New state or area specific gear marking colors, new green marks unique to northeast federal waters, and an increase in the number of gear marks required.

NMFS also began Phase II of the Plan modifications to further reduce remaining risk to North Atlantic right whales. A public scoping period ended on October 21, 2021 after two and a half months of public meetings to solicit feedback on what measures should be included in the next round of rulemaking. The ideas provided during the public comment period will be shared with the Atlantic Large Whale Take Reduction Team as they get ready to make recommendations to NMFS in 2022.

Contact Colleen.Coogan@noaa.gov or Marisa.Trego@noaa.gov with questions

- *Offshore Wind Energy:*

Offshore wind energy development along the U.S. East Coast continues to progress rapidly with 17 active leases on the Outer Continental Shelf (OCS) of the U.S. East Coast between southern New England and North Carolina. Lessees are simultaneously conducting site assessment activities, including geotechnical and geophysical surveys, and preparing Construction and Operations Plans (COP) to submit to the Bureau of Ocean Energy Management (BOEM) for approval. New areas to be offered for potential lease sales were announced in 2021 in the Gulf of Maine, New York Bight, Central Atlantic, and the Gulf of Mexico, as well as offshore the Carolinas, California, and Oregon. Additionally, in 2021, the COP for the Vineyard Wind 1 project was approved by BOEM (the lead Federal agency for authorizing the construction, operation, and eventual decommissioning of any offshore wind project). Additionally, the [final Environmental Impact Statement](#) was published for the South Fork Wind project, and nine projects began the environmental review process. The effects of all these activities on protected species and their habitat are assessed through the National Environmental Policy Act (NEPA), as well as under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA).

In 2021, NMFS continued its engagement in the offshore wind development process by fulfilling multiple roles, primarily providing input and review as a cooperating agency to BOEM through the NEPA process and also providing data and analyses on protected species to developers and working on a number of regional coordination projects to advance our scientific understanding of the effects of offshore wind development. Additional activities in 2021 included:

- Completing the [ESA section 7 biological opinion](#) for the South Fork Wind project.
- Completing a [programmatic ESA consultation](#) on offshore wind energy survey activities that includes actions from Maine-Florida.
- Issuing an [MMPA Incidental Take Authorization \(ITA\)](#) related to the construction of the Vineyard Wind 1 project
- Issuing an [MMPA ITA](#) for the South Fork Wind project.
- Coordinating within NMFS to improve our understanding of the effects of offshore wind development on protected species and habitat, including regionally through the [Regional Wildlife Science Entity](#).
- [Publishing a framework for using passive acoustic monitoring](#) to monitor and mitigate the impacts of offshore wind energy development on marine mammals, including specific details for regional monitoring and reducing vessel strike risk.

More information on NOAA's role in offshore wind energy development can be found at:

<https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/offshore-wind-energy-development-new-england-mid-atlantic-waters>

- *Aquaculture Interactions Working Group (AIWG):*

The NOAA Aquaculture Interactions Working Group (AIWG) coalesced in 2019 in partnership between the NMFS Office of Protected Resources and Office of Aquaculture to address the potential risk of protected species interactions with marine aquaculture gear. The objectives of this working group are to: (1) consider ways to assess the risk of adverse impacts to protected species associated with various types of aquaculture gear, (2) evaluate strategies to avoid or minimize risks to protected species and their habitats (e.g., siting, engineering design, monitoring), and (3) develop operational products such as guidance documents and best management practices that will constitute national guidance on assessing and minimizing potential risks to protected species and their habitats from aquaculture operations. Efforts by the AIWG are ongoing, with guidance and information produced by this working group expected throughout 2021.

- *Ropeless Fishing Research:*

During FY21 NMFS NEFSC accelerated the research and development of a ropeless fishing pilot program. To date, we currently have acquired a total of 99 ropeless fishing systems (RFSs) from seven vendors for the NEFSC Gear Library and have plans to acquire gear from two additional vendors soon. Currently, we are contracting with 17 collaborator fishermen (via ASMFC) to conduct both inshore and offshore testing of RFSs. We have completed dedicated training/rigging in ports from Maine, to RI and have accomplished 420 active gear hauls (ie. actively fishing) using RFSs.

We continue to expand our capacity to work on innovative gear solutions. Two FTE's have been reprogrammed to work on ropeless trials and five contractors added to the team. Economics staff are estimating anticipated cost reductions of ropeless technology over time. NEFSC/PSB is working with NASA's Center for Collaborative Excellence and Yet2 to crowdsource market research to identify vendors with the expertise to develop an inexpensive geolocation system for traps and pots to be used by fishermen, managers, and enforcement.

Additionally, we funded NFWF to develop a scoping project to elicit feedback from key stakeholder groups on ropeless fishing conflict issues (matched by \$300K from private corporations). And, NOAA Fisheries staff are actively participating in newly formed ropeless fishing forums including the Ropeless Consortium and Canadian Gear Innovation Summit.

1. Gear Technology Investment

NEFSC Ropeless Gear Library now contains **99** Ropeless fishing units (leveraging investments from WHOI, IFAW, CLF, SeaWorld and others)

Gear Library inventory now consists of **7** brands of acoustic RFS

- i. **53** offshore capable units
- ii. **46** inshore units

2. In-Water Training, Testing, and Data Collection on Ropeless Gear

NEFSC gear trial program with commercial fishermen

- a. Funds ASMFC to Contract **17** Collaborator Fishermen, **8** are "offshore" operations
- b. **7** models of RFS being tested.
- c. **24** days of dedicated training and rigging development with fishermen (Phase 1)
- d. **250+** hauls of data obtained using RFS to catch target species (fishing!) (Phase 2)
- e. **Two** debrief sessions have been held to improve research plan, develop RFS BMP's

- *Vessel Speed Rule Report*

NMFS released the North Atlantic Right Whale (*Eubalaena glacialis*) [Vessel Speed Rule Assessment](#) in January 2021. The assessment included information on biological effectiveness, mariner compliance, outreach and enforcement efforts, navigational safety, and economic impacts. Additionally, the assessment assessed the voluntary Dynamic Management Area (DMA) program and examined small vessel (<65ft) traffic patterns within Seasonal Management Areas.

NMFS continues to move forward with a suite of activities designed to 1) investigate possible modifications to the speed rule regulations, 2) assess the efficacy of non-regulatory vessel strike mitigation efforts, and 3) enhance our outreach and enforcement strategies.

- *DMA and Right Whale Slow Zone info*

NMFS began the voluntary DMA program at the same time as our mandatory speed reduction regulations. Under this program, NMFS established DMAs when visual sightings documented the presence of three or more right whales within a discrete area.

Early in 2020, the North Atlantic right whale Northeast U.S. Implementation Team identified the opportunity for NMFS GARFO to enhance vessel strike reduction efforts by also using acoustic information to alert vessels of right whale presence. Based on their idea, NMFS GARFO launched the Right Whale Slow Zones campaign in August of 2020. Slow Zones are established using information from either NMFS' DMA program (i.e., visual sightings) or the information from acoustic receivers. NMFS GARFO alerts vessel operators of areas where right whales were detected (visually or acoustically) throughout New England and the Mid-Atlantic. Following a right whale detection, a Slow Zone remains in effect for 15 days. Vessels of all sizes are requested to avoid the areas or slow all vessels to 10 knots or less to prevent collisions with right whales.

Over the last six years, NMFS has recorded a noticeable and steady increase in the number of DMAs (i.e., visually-triggered Right Whale Slow Zones) in the Northeast. During 2016, five DMAs occurred in the Northern portion of the range and speed reductions were requested. However, in the last four years (2018-2021), notifications have increased in this area to 20 or more annually. This year, NMFS GARFO called for 18 DMAs and 17 DMA Extensions, totaling 35 visual triggers between 01 January 2021 and 21 December 2021. These DMAs were called for in 7 locations (Martha's Vineyard, MA, Virginia Beach, VA, Atlantic City, NJ, Nantucket, MA, Boston, MA, Chatham, MA, and Cape Cod, MA). Because the mandatory Seasonal Management Areas (SMAs) are longer and cover more area along the southeast coast, the need for establishing a voluntary DMA is rare in the Southeast Region. However, a DMA in Outer Banks, NC was established in January of 2021, and was subsequently extended and expanded, a DMA was established in Nags Head, NC in October 2021, and another DMA was established in Outer Banks, NC in December 2021, totaling to 4 visual triggers outside of the SMAs in 2021.

Right Whale Slow Zones also utilize acoustic receivers and arrays to trigger right whale presence notifications in the Northeast U.S. In 2021, we had 15 acoustically-triggered Slow Zones in six locations (Martha's Vineyard, MA, Boston, MA, Portland, ME, Ocean City, MD, New York Bight, NY, and Atlantic City, NJ). In addition, 13 acoustic detections led to extensions of the original trigger, totaling 28 acoustic triggers.

A full list of DMAs and Slow Zones are available in Appendix 1.

Fisheries and Oceans Canada and Transport Canada, Canadian 2021 Management and Mitigation Activities

Input from Fisheries and Oceans Canada

- Since 2017, Canada has implemented measures with the objective of protecting the North Atlantic right whale (NARW) when it is found in our waters. The NARW is listed as Endangered under Canada's Species At Risk Act. Canada's protection and recovery strategy begins with the premise that fishing gear entanglement prevention should be the primary objective of any strategy to support the recovery of the NARW. This includes changes to the seasonality of fisheries to avoid interactions and a combination of temporary and season-long fishing area closures designed to ensure gear, including lobster and snow crab gear, is removed from the water based on right whale presence. These closures are supported by the most comprehensive whale monitoring and detection regime in the world which includes flights, vessels, and acoustic devices. Closure areas, some of which remain in place for several months, are adaptive and occur in areas where whales are found to aggregate. In addition, the Department has put in place a series of regulatory measures, including the requirement for the reporting of lost gear, accidental contact with marine mammals, and the implementation of a gear marking regime for non-tended fixed gear fisheries.
- In 2021, temporary and season-long closures, triggered by single whale detections, were modified to ensure the ongoing presence of right whales based on feedback from industry, provincial governments, Indigenous communities, academia, and non-governmental organizations. There were a total of 533 closures with a total coverage of approximately 75,312 km² within the Gulf of St. Lawrence, Bay of Fundy and Roseway Basin. The seasonal closure area (adaptive static area) covered approximately 26,764 km².
- Canada's on the water, in the air and acoustic whale surveillance program covers all of Atlantic Canada and Quebec, with targeted monitoring in the Gulf of St. Lawrence, the Bay of Fundy and other areas. For example, at any given time through peak NARW months in Canada (April to November), upwards of 3

planes from DFO and Transport Canada were monitoring different areas for right whales and potential overlap with fishing activity and vessel traffic. As of November 2021, over 2000 hours of flights were designated for NARW.

- Right whales were first sighted in Canadian waters on April 25, 2021. As of mid-November, there have been over 1400 detections in Canadian waters of right whales. Analysis of photos to determine number of individuals in Canadian waters during the 2021 season is ongoing, as of December 10, 2021, 120 individuals have been identified.
- Fisheries and Oceans has been working with the fishing industry and partners to identify gear solutions for preventing and alleviating harm to right whales from entanglements. The Department's objective is to protect right whales while also supporting sustainable fisheries. Over the past several years the Department has supported industry trials of "whale safe" gear modifications such as ropeless fishing gear that can be used in areas closed to traditional fixed gear fishing methods because of right whale presence.
- In addition to ropeless gear, trials of low breaking strength devices have been undertaken in fisheries in several regions. Fixed gear fisheries in Atlantic Canada and Quebec will be required to incorporate 'weak' gear modifications by the 2023 seasons, and to support the adoption of modifications suited to different fishery conditions, a new funding program was announced in August 2021. The Whalesafe Gear Adoption Fund (WSGF) is providing up to \$20 million to fishery groups and other partners to develop, test, and adopt low breaking strength gear modifications. Future gear modifications that are being considered include requirements for maximum rope diameters of 5/8 inches, sinking rope between pots and traps, and reductions in vertical and floating rope.
- Fisheries and Oceans is committed to addressing the threat of abandoned, lost, or otherwise discarded fishing gear through various initiatives, including the Ghost Gear Fund. In 2020-2022 the Ghost Gear Fund provided \$8.3 million for projects that prevent and mitigate abandoned, lost, or discarded fishing gear. In spring 2021, an additional \$8.4 million was made available for projects to address gaps and build on the successes from the first year of the fund. Since its initiation in 2020, the Ghost Gear Fund has contributed to the removal of 739 tonnes of ghost gear from Canadian waters, including 118Km of rope, thereby reducing threats to vulnerable fish stocks, marine mammals and vital ecosystems.
- Fisheries and Oceans has continued annual investment of over \$1 million for marine mammal response organizations and investments in science to better understand threats to right whales, and to inform future management measures. The Department is also delivering \$4.5 million over four years to build additional capacity across Canada for safe and effective marine mammal incident response. The funds for 2021-22 will further support necropsies, Indigenous community response capacity, and in particular increased large whale disentanglement response capacity. Additionally, the Large Whale Disentanglement Advisory Committee has been created to discuss actions underway and planned by Fisheries and Oceans Canada (DFO) and others regarding the disentanglement of large whales, and to allow participants to provide advice on government decision-making, such as disentanglement training and succession planning.
- On November 30 and December 2, 2021, Fisheries and Oceans Canada held the North Atlantic Right Whale Advisory Committee meeting (formerly the Roundtable) with indigenous groups, the fishing industry, provinces, and marine mammal experts. The advisory committee meeting and other discussions with harvesters play an important role in the preparation of Canada's measures to protect right whales and to support sustainable fisheries for 2022 and beyond.

Input from Transport Canada

- In 2021, Transport Canada once again implemented a large mandatory static speed restriction zone covering much of the Gulf of St. Lawrence, and dynamic speed restriction zones in the shipping lanes north and south of Anticosti Island to reduce the risk of vessel collisions with the North Atlantic right whale. These measures, applicable to all vessels longer than 13m, came into force on April 28, 2021 and were in place until November 15, 2021.
- Additionally, Transport Canada instituted Seasonal Management Areas from April 28 to June 29, 2021 to expand the static speed restriction zone for part of the season.

- A mandatory restricted area covering 4,000 km² in and near the Shediac Valley to protect aggregating North Atlantic right whales was in effect from June 14 to August 27, 2021 – the area was closed to all vessels longer than 13m with exceptions for fishing vessels and certain other activities. Vessels permitted to transit in or through the zone were limited to speeds of no more than 8kn over ground.
- Transport Canada also conducted a trial voluntary slowdown for a second year in Cabot Strait from April 28 to June 29, 2021, and September 29 to November 15, 2021.
- Transport Canada once again incorporated a Remotely Piloted Aircraft System (RPAS or drone) and an acoustic underwater glider into its surveillance technologies to detect North Atlantic right whales to inform active management of dynamic vessel speed management measures. These two technologies complimented the surveillance flights flown by Transport Canada's National Aerial Surveillance Program (NASP).
- Transport Canada began evaluating the 2021 measures before the conclusion of the season, and continues to engage with the marine transportation industry, fishers, scientists, and other stakeholders to refine and develop measures for 2022.

2021 NORTH ATLANTIC RIGHT WHALE PUBLICATIONS/REPORTS

Reports and publications that utilized NARWC databases in 2021 and/or those of general interest to the right whale community are listed and hyperlinked (when available) below.

[Cole, A.K., Brilliant, S.W. and Boudreau, S.A., 2021. Effects of time-area closures on the distribution of snow crab fishing effort with respect to entanglement threat to North Atlantic right whales. *ICES Journal of Marine Science*, 78\(6\), pp2109-2119](#)

[Crowe, L.M., Brown, M.W., Corkeron, P.J., Hamilton, P.K., Ramp, C., Ratelle, S., Vanderlaan, A.S. and Cole, T.V., 2021. In plane sight: a mark-recapture analysis of North Atlantic right whales in the Gulf of St. Lawrence. *Endangered Species Research*, 46, pp.227-251.](#)

[Dombroski, J.R., Parks, S.E. and Nowacek, D.P., 2021. Dive behavior of North Atlantic right whales on the calving ground in the Southeast USA: implications for conservation. *Endangered Species Research*, 46, pp.35-48.](#)

[Fortune, S.M., Moore, M.J., Perryman, W.L. and Trites, A.W., 2021. Body growth of North Atlantic right whales \(*Eubalaena glacialis*\) revisited. *Marine Mammal Science*, 37\(2\), pp.433-447.](#)

[Farmer, N.A., Garrison, L.P., Horn, C., Miller, M., Gowan, T., Kenney, R.D., Vukovich, M., Willmott, J.R., Pate, J., Webb, D.H. and Mullican, T.J., 2021. The Distribution of Giant Manta Rays In The Western North Atlantic Ocean Off The Eastern United States.](#)

[Gavrilchuk, K., Lesage, V., Fortune, S.M., Trites, A.W. and Plourde, S., 2021. Foraging habitat of North Atlantic right whales has declined in the Gulf of St. Lawrence, Canada, and may be insufficient for successful reproduction. *Endangered Species Research*, 44, pp.113-136.](#)

[Gowan, T.A., N.J. Crum, and J.J. Roberts. 2021. An open spatial capture-recapture model for estimating density, movement, and population dynamics from line-transect surveys. *Ecology and Evolution* <https://doi.org/10.1002/ece3.7566>](#)

[Graham, K.M., E.A. Burgess, and R.M. Rolland. 2021. Stress and reproductive events detected in North Atlantic right whale blubber using a simplified hormone extraction protocol. *Conservation Physiology* 9\(1\): coaa1 33.](#)

Hamilton, P.K., Frasier, B.A., Conger, L.A., George, R.C., Jackson, K.A., Frasier, T.R. In Press. Genetic identifications challenge our assumptions of physical development and mother-calf associations and separation times: A case study of the North Atlantic right whale (*Eubalaena glacialis*). *Journal of Mammalogy Special Issue* 102-1.

[Hamilton, P.K., Knowlton, A.R., Hagbloom, M.N., Howe, K.R., Marx, M.K., Pettis, H.M., Warren, A.M., and Zani, M.A. 2021. Maintenance of the North Atlantic Right Whale Catalog, Scarring and Visual Health Databases, Anthropogenic Injury Case Studies, and Near Real-Time Matching for Biopsy Efforts, Entangled, Injured, Sick, or Dead Right Whales. NOAA Final Report 1305M2-18-P-NFFM-0108](#)

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2022. North Atlantic Right Whale Consortium 2021 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

www.narwc.org

[Henry AG, Garron M, Morin D, Reid A, Ledwell W, TVN Cole TVN. 2021. Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2014-2018. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 21-07; 62 p.](#)

[Johnson, H., Morrison, D. and Taggart, C., 2021. WhaleMap: a tool to collate and display whale survey results in near real-time. *Journal of Open Source Software*, 6\(62\), p.3094.](#)

[King, K., Joblon, M., McNally, K., Clayton, L., Pettis, H., Corkeron, P. and Nutter, F., 2021. Assessing North Atlantic Right Whale \(*Eubalaena glacialis*\) Welfare. *Journal of Zoological and Botanical Gardens*, 2\(4\), pp.728-739.](#)

Knowlton AR, Clark JS, Hamilton PK, Kraus SD, Pettis HM, Rolland RM, Schick RS. In press. Fishing gear entanglement threatens recovery of critically endangered North Atlantic right whales. *Conservation Science and Practice*.

[Koubrak, O., VanderZwaag, D.L. and Worm, B., 2021. Saving the North Atlantic right whale in a changing ocean: Gauging scientific and law and policy responses. *Ocean & Coastal Management*, 200, p.105109.](#)

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[Pace, R.M. III, R. Williams, S.D. Kraus, A.R. Knowlton, and H.M. Pettis. 2021. Cryptic mortality of North Atlantic right whales. *Conservation Science and Practice* 3\(2\):e346.](#)

[Pershing, A.J. and Pendleton, D.E., 2021. Can Right Whales Out-Swim Climate Change? Can We? *Oceanography*, 34\(3\), pp.19-21.](#)

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[Quintana-Rizzo, E., S. Leiter, T.V.N. Cole, M.N. Hagbloom, A.R. Knowlton, P. Nagelkirk, O. O'Brien, C.B Kahn, A.G. Henry, P.A. Duley, L.M. Crowe, C.A. Mayo, and S.D. Kraus. 2021. Residency, demographics, and movement patterns of North Atlantic right whales *Eubalaena glacialis* in an offshore wind energy development area in southern New England, USA. *Endangered Species Research* 45:251-268. <https://doi.org/10.3354/esr01137>](#)

[Ramp, C., Gaspard, D., Gavrilchuk, K., Unger, M., Schleimer, A., Delarue, J., Landry, S. and Sears, R., 2021. Up in the air: drone images reveal underestimation of entanglement rates in large rorqual whales. *Endangered Species Research*, 44, pp.33-44.](#)

[Record, N.R. and Pershing, A.J., 2021, December. Facing the Forecaster's Dilemma: Reflexivity in Ocean System Forecasting. In *Oceans* \(Vol. 2, No. 4, pp. 738-751\). Multidisciplinary Digital Publishing Institute.](#)

[Ross, C.H., Pendleton, D.E., Tupper, B., Brickman, D., Zani, M.A., Mayo, C.A. and Record, N.R., 2021. Projecting regions of North Atlantic right whale, *Eubalaena glacialis*, habitat suitability in the Gulf of Maine for the year 2050. *Elem Sci Anth*, 9\(1\), p.00058.](#)

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Appendix 1: 2021 DMA and Right Whale Slow Zones

| Trigger Date (date of RW detection) | Number of right whales sighted or A=right whales acoustically detected | Sightings Source | General Location | Boundaries |
|--|---|---|-------------------------------|--|
| 1/6/2021 | 4 | NCWS aerial survey | Outer Banks, NC | 35 38 N 34 57 N 074 48 W 075 38 W |
| 1/8/2021 | 8 | New England Aquarium (NEA) survey team | South of Martha's Vineyard | 41 25 N 40 44 N 069 59 W 070 55 W |
| 1/9/2021 | A | Atlantic City Woods Hole Oceanographic Institution (WHOI) Acoustic Buoy | East of Atlantic City | 39 25 N 38 44 N 073 44 W 074 36 W |
| 1/13/2021 | 8 | NCWS aerial survey | Outer Banks, NC | 35 47 N 34 57 N 074 48 W 75 46 W |
| 1/13/2021 | 3 | HDR Marine Species Monitoring Survey | East of Atlantic City | 37 09 N 36 29 N 075 02 W 075 52 W |
| 1/14/2021 | 3 | Observer aboard Fugro Enterprise | East of Atlantic City | 39 47 N 39 07 N 073 31 W 074 22 W |
| 1/15/2021 | A | WHOI acoustic array (Atlantic City Buoy, Cox Ledge Slocum glider, and New York Bight NW buoy) | Southeast of New York | 40 41 N 40 01 N 73 03 W 73 55 W |
| 1/15/2021 | 15 | NOAA aerial survey | Southeast of Nantucket Island | 41 25 N 40 44 N 069 28 W 070 21 W |
| 1/19/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast of Atlantic City | 39 25 N 38 44 N 073 44 W 074 36 W |
| 1/25/2021 | A | WHOI Stellwagen Slocum glider | East of Boston | 42 47 N 42 07 N 069 51 W 070 46 W |
| 1/31/2021 | 5 | NEA survey team | South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W |
| 2/9/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast of Atlantic City | 39 25 N 38 44 N 073 44 W 074 36 W |
| 2/11/2021 | 3 | NEFSC aerial survey team | South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W |
| 2/17/2021 | A | Stellwagen Slocum Glider | East of Boston | 40 40 N 42 00 N 069 57 W 070 52 W |

Appendix 1: 2021 DMA and Right Whale Slow Zones

| Trigger Date (date of RW detection) | Number of right whales sighted or A=right whales acoustically detected | Sightings Source | General Location | Boundaries |
|--|---|---|---|--|
| 2/18/2021 | A | Rutgers New Jersey Slocum Glider | Southeast of Atlantic City | 39 25 N 38 44 N 073 44 W 074 36 W |
| 2/21/2021 | A | Rutgers New Jersey Slocum Glider | Southeast of Atlantic City | 38 59 N 38 19 N 073 34 W 074 26 W |
| 2/26/2021 | 12 | NEA aerial survey team | South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W |
| 2/27/2021 | A | Stellwagen Slocum Glider | East of Boston | 42 40 N 42 00 N 069 57 W 070 52 W |
| 2/27/2021 | A | Rutgers New Jersey Slocum Glider | Southeast of Atlantic City | 39 25 N 38 44 N 073 44 W 074 36 W |
| 3/3/2021 | 3 | Observed from HDR Naval Research Vessel | East of Virginia Beach | 37 10 N 36 32 N 074 51 W 075 40 W |
| 3/7/2021 | 5 | NEA aerial survey team | South of Martha's Vineyard | 41 21 N 40 41 N 070 15 W 071 06 W |
| 3/7/2021 | 5 | NEA aerial survey team | South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W |
| 3/16/2021 | 33 | NEA aerial survey team | South of Martha's Vineyard | 41 21 N 40 41 N 070 15 W 071 06 W |
| 3/16/2021 | 33 | NEA aerial survey team | South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W |
| 3/26/2021 | A | Stellwagen Slocum Glider | East of Boston | 42 49 N 42 08 N 070 09 W 071 04 W |
| 3/30/2021 | 57 | NEFSC aerial survey team | South of Nantucket Isl (1 and 2) and South of Martha's Vineyard (3) | (1) 41 01 N 40 19 N 069 50 W 070 46 W and (2) 41 23 N 40 40 N 069 39 W 070 35 W and (3) 41 21 N 40 41 N 070 15 W 071 06 W |

Appendix 1: 2021 DMA and Right Whale Slow Zones

| Trigger Date (date of RW detection) | Number of right whales sighted or A=right whales acoustically detected | Sightings Source | General Location | Boundaries |
|--|--|--|--------------------------------|---|
| 4/7/2021 | 8 | NEFSC aerial survey team | South of Martha's Vineyard | 40 42 N 40 02 N 070 45 W 071 34 W |
| 4/8/2021 | 17 | NEFSC aerial survey team | East of Boston, MA | 42 39 N 41 54 N 070 08 W 071 06 W |
| 4/9/2021 | 65 | NEFSC aerial survey team | (2) South of Nantucket Island | 41 23 N 40 40 N 069 39 W 070 35 W and 41 01 N 40 19 N 069 50 W 070 46 W |
| 4/9/2021 | 5 | Center for Coastal Studies aerial team | Southeast of Chatham, MA | 41 56 N 41 15 N 069 23 W 070 16 W |
| 4/18/2021 | 3 | Opportunistic sighting from shore | East of Boston | 42 39 N 41 54 N 070 08 W 071 06 W |
| 4/28/2021 | 46 | Center for Coastal Studies aerial team | East of Boston | 42 39 N 41 54 N 070 08 W 071 06 W |
| 5/2/2021 | A | Stellwagen Slocum glider | North of Cape Cod, MA | 42 40 N 42 00 N 069 40 W 070 34 W |
| 5/3/2021 | 3 | Center for Coastal Studies aerial team | East of Cape Cod Bay | 42 16 N 41 35 N 069 30 W 070 22 W |
| 7/2/2021 | A | Martha's Vineyard Acoustic Buoy | Southwest of Martha's Vineyard | 41 23 N 40 44 N 071 16 W 070 23 W |
| 8/1/2021 | 3 | AMAPPS aerial survey team | Southeast Nantucket Island | 41 01 N 40 21 N 069 00 W 069 52 W |
| 8/16/2021 | 6 | Center for Coastal Studies aerial team | South Nantucket Island | 41 24 N 40 40 N 069 32 W 070 30 W |
| 8/16/2021 | 3 | Center for Coastal Studies aerial team | Southeast Nantucket Island | 41 04 N 40 26 N 069 11 W 070 04 W |
| 8/25/2021 | 5 | NEA aerial survey team | South Nantucket Island | 41 24 N 40 40 N 069 32 W 070 30 W |

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| Trigger Date (date of RW detection) | Number of right whales sighted or A=right whales acoustically detected | Sightings Source | General Location | Boundaries |
|--|--|---|-----------------------------|--|
| 9/11/2021 | 8 | Center for Coastal Studies aerial team | South of Nantucket Island | 41 26 N 40 41 N 069 30 W 070 30 W |
| 9/29/2021 | 8 | NEFSC research vessel | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 9/29/2021 | A | WHOI Ocean City acoustic buoy | South of Atlantic City | 38 38 N 37 58 N 074 13 W 075 04 W |
| 10/7/2021 | 3 | Public sighting | Nags Head, NC | 36 13 N 35 35 N 075 11 W 76 00 W |
| 10/7/2021 | 13 | NEFSC shipboard survey team | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 10/15/2021 | 16 | NEFSC shipboard survey team | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 10/24/2021 | 17 | NEFSC aerial survey team | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 11/4/2021 | A | Gulf of Maine Slocum glider | East of Portland, ME | 43 36 N 42 56 N 068 03 W 068 58 W |
| 11/6/2021 | 15 | Center for Coastal Studies aerial team | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 11/11/2021 | A | Ocean City University of Maryland Center for Environmental Science/WHOI Acoustic Buoy | East of Ocean City, MD | 38 38 N 37 58 N 074 13 W 075 04 W |
| 11/17/2021 | 15 | NEFSC aerial survey team | South of Nantucket Island | 41 20 N 40 35 N 069 32W 070 32 W |
| 11/20/2021 | A | New York Bight WHOI Acoustic Buoy | Southeast of New York City | 40 35 N 39 56 N 072 47 W 073 40 W |
| 11/24/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast Atlantic City, NJ | 39 25 N 38 44 N 073 44 W 074 36 W |
| 11/30/2021 | A | New York Bight WHOI Acoustic Buoy | Southeast of New York City | 40 35 N 39 56 N 072 47 W 073 40 W |

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| Trigger Date (date of RW detection) | Number of right whales sighted or A=right whales acoustically detected | Sightings Source | General Location | Boundaries |
|--|---|--|--------------------------------|--|
| 12/2/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast of Atlantic City, NJ | 39 25 N 38 44 N 073 44 W 074 36 W |
| 12/11/2021 | A | New York Bight WHOI Acoustic Buoy | Southeast of New York City | 40 35 N 39 56 N 072 47 W 073 40 W |
| 12/11/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast of Atlantic City, NJ | 39 25 N 38 44 N 073 44 W 074 36 W |
| 12/11/2021 | A | Ocean City University of Maryland Center for Environmental Science/WHOI Acoustic Buoy | East of Ocean City, MD | 38 38 N 37 58 N 074 13 W 075 04 W |
| 12/20/2021 | A | Atlantic City WHOI Acoustic Buoy | Southeast of Atlantic City, NJ | 39 25 N 38 44 N 073 44 W 074 36 W |
| 12/20/2021 | A | Ocean City University of Maryland Center for Environmental Science/WHOI Acoustic Buoy | East of Ocean City, MD | 38 38 N 37 58 N 074 13 W 075 04 W |
| 12/21/2021 | A | New York Bight WHOI and Wildlife Conservation Society Acoustic Buoy | Southeast of New York City | 40 35 N 39 56 N 072 47 W 073 40 W |
| 12/27/2021 | 3 | Clearwater Marine Aquarium Research Institute's North Carolina Warning System aerial survey team | Outer Banks, NC | 35 47 N 34 57 N 074 48 W 075 46 W |
| 12/29/2021 | A | WHOI Atlantic City buoy | Southeast of Atlantic City, NJ | 39 25 N 38 44 N 073 44 W 074 36 W |
| 12/31/2021 | A | Ocean City University of Maryland Center for Environmental Science/WHOI Acoustic Buoy | East of Ocean City, MD | 38 38 N 37 58 N 074 13 W 075 04 W |