

North Atlantic Right Whale Consortium 2019 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 Right Whale Implementation Team, 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 POPULATION 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 population, as well as assess the factors behind any changes in these trends (Pettis, 2009). The key efforts are: (1) Photographic identification and cataloging of right whales in historically and emerging high-use habitats and migratory corridors, including, but not limited to, the southeast United States, Cape Cod Bay, Gulf of St. Lawrence, Great South Channel, 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 population 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 population. 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 Consortium databases available) be fully funded on a stable basis.

Over the last several years, 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, as well as 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 be a priority. These strategies should include efforts to not only locate 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.

In 2019, **ten** right whale mortalities were detected, bringing the total detected mortalities for the last three years to **30**. Over the same time period, a total of **12** right whale calves were born. Given that detected mortalities likely under-represent actual mortalities by a significant amount (Kraus et al. 2005, unpub. data), the state of this population is dire. Anthropogenic factors, including entanglement in fixed fishing gear and vessel strikes, have been implicated in 13 of the 30 most recent mortalities (the remaining 17 have undetermined cause of death, though two of these are suspected as human impact – one entanglement and one vessel strike). Additionally, for all mortalities detected between 2003 and 2018 for which a cause of death could be determined, all juvenile and adult deaths were due to either entanglement or vessel strike (Sharp et al. 2019). Anthropogenic related deaths, which management measures have clearly not reduced (Pace et al. 2014; Sharp et al. 2019), are increasing the threat to the survival of this species.

In the spring of 2018, Canada announced new measures to mitigate both entanglements and vessel strikes in areas in which right whales frequent, including vessel speed reductions, temporary and fixed fisheries management areas and closures, and increased reporting requirements for fishing activity, lost gear, and interactions with marine mammals. There were no detected right whale mortalities in Canadian waters in 2018, though there were three entangled whales detected that year. In 2019, similar mitigation measures, though reduced in scope compared to 2018, were put into place in Canadian waters. Between 04 and 27 June 2019, seven right whale mortalities were detected in Canadian waters, three of which were attributed to vessel strikes. In response, vessel strike mitigation measures in the Gulf of St. Lawrence were expanded on 08 July 2019. Two additional right whale mortalities were detected in Canadian waters in July 2019 (causes of death undetermined) and a third whale who became severely entangled in the Gulf of St. Lawrence in August 2019, well after the snow crab fishery season was over, was discovered dead in waters off New York, U.S. in September 2019.

While there were no right whale mortalities detected in Canadian waters in 2018, three were detected in U.S. waters, all of which were entanglement related. One of these three entanglements was attributed to snow crab gear. Additionally, live entangled whales were detected in U.S. waters in both 2018 (1) and 2019 (2).

Ongoing discussions about reducing anthropogenic impacts on right whales in both Canadian and U.S. waters are encouraging. However, immediate, broad-based mitigation strategies that result in significant risk reduction throughout the right whale's range in light of changing distributions and habitat use must be a priority if this species is to survive.

POPULATION STATUS

The ability to monitor North Atlantic right whale vital rates 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 4, 2019, the database consisted of over a million slides, prints, and digital images collected during the 78,399 sightings of 746 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. Using Catalog data, a number of methods have been employed to estimate the number of North Atlantic right whales alive annually. Due to lag times in Catalog data submissions and data processing, only data through 2018 were available

for these calculations. Here we describe four different estimate methods and present the Consortium's best estimate for 2018. The first two methods use the calendar year; the last two methods use the "whale" year which runs from December 1 to November 30. This latter definition was created to avoid "double counting" whales seen in the southeast US in December and January

Presumed Alive Method

The presumed alive method (PA) counts whales that have been seen at least once in the last six years (Knowlton et al. 1994). It is a consistently measureable and easily available value, but it assumes that whales remain alive for six years after their last sighting (which is often not the case) and the estimates for recent years may be artificially low due to delays in data processing. The PA number for 2018 is 462.

Catalog Method

The Catalog method (formerly referred to as the "Report Card" method) includes a low, middle and high estimate. A table with all of these estimates as well as a full description of the methodology is provided in Appendix 1 of this report card. The values are based upon the number of photographed whales only; they exclude potential unphotographed whales and therefore should not be considered a "population estimate". This method has the weakness of utilizing the PA methodology with its assumptions, but it does incorporate whales that have been photographed but not yet added to the Catalog. The Catalog estimates for 2018 range from a low of 343 to a high of 727 with a middle estimate of 502.

Minimum Number Alive Method

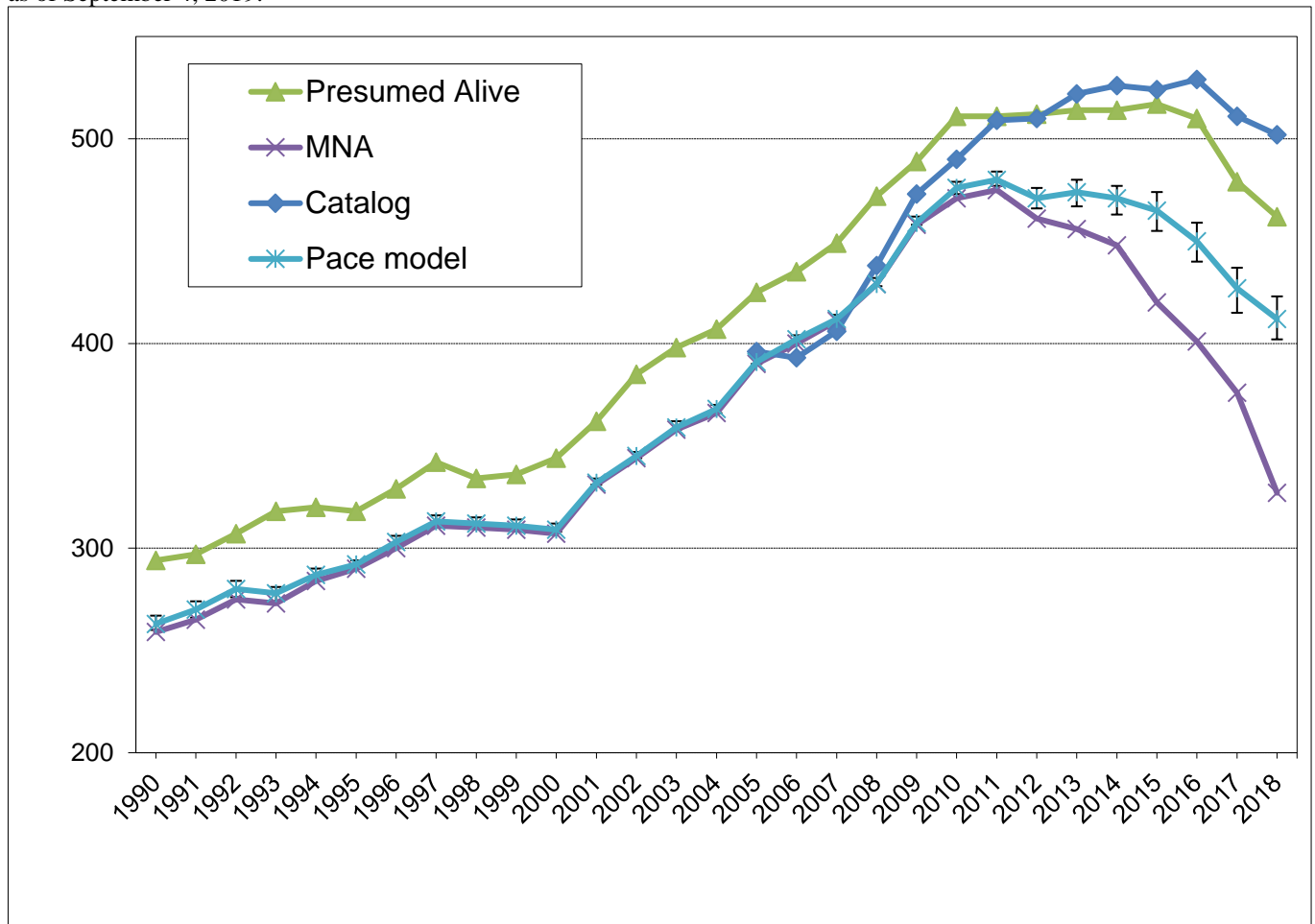
The Minimum Number Alive (MNA) is the number that was historically used in National Marine Fisheries Service stock assessment reports and counts whales seen in a given year, plus any whale not seen that year- but seen both before *and* after (see Hayes et al. 2017). The MNA number is more accurate than PA for older years, but is also not accurate for recent years for the same reason as the PA method, plus the fact that there have been fewer "after" years to detect a whale. The MNA number for 2018 is 327.

Pace Method

The Pace Method was added to the 2016 report card and has been included ever since. This analysis comes from the Pace et al. 2017 model which "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. The full methodology is available in the paper. 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 sample period plus all new entries into the population. That number for 2018 is 412. 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 full results for all four methods are presented in Figure 1. All numbers except the past Catalog method estimates were recalculated using data as of September 4, 2019 and therefore the numbers in this figure will differ from those in past report cards. The PA number is always artificially high as a comparison to the past year's MNA numbers attest. The difference is largely due to whales that have not been seen since before the year in question. For example, the 30+ animals that the PA number included in 1990 and the MNA did not are whales that have not been seen since 1990 and are thus very likely dead. From 1990 to 2010, the average difference between the PA number and the MNA number was 35 animals. If that difference remained consistent into this decade, the adjusted presumed alive number in 2018 would be 427 whales. The Pace method removes assumptions of when a whale is alive and is likely more accurate. The Catalog estimates are always higher than the other two methods for the most recent years. However, the fact that the old Catalog estimates for 2005 to 2009 were close to the eventual MNA numbers suggests that the methodology worked reasonably well through 2009. However, starting in 2010, the two numbers started to diverge. This is partially because fewer whales were seen so the MNA number may be artificially low. But it also appears that the six-year assumption for PA whales is increasingly erroneous; whales die sooner than six years after their last sighting. The Catalog estimate does however capture recent increase in calves that have not yet been cataloged. This delay in cataloging is largely due to the right whale distribution shift which has resulted in fewer calves being seen on the feeding grounds with their mothers, and fewer sightings of them as juveniles anywhere- both of which make cataloging recent calves challenging.

Figure 1. Assessments of the North Atlantic right whale population based on four available assessment methods. The Pace model shows a point "estimate" along with error bars which represent 95% of the posteriori probability. That model estimates the number of whale alive *at the start* of each year plus any new whales estimated to enter during that year. Data through 2018 as of September 4, 2019.



Best Right Whale Population Estimate 2018

We believe the Pace Method provides the best estimate for 2018. To get an estimate of whales alive *at the end* of 2018 using this methodology, we take the estimate at the start of 2018 (412, Figure 1) and subtract the observed deaths during 2018 (2 cataloged whales and one unidentified). Therefore, the best estimate for the end of 2018 is **409** right whales (95% confidence range +/- 11 and 10 respectively) using data as of September 4, 2019.

How Well Are We Monitoring?

Below is an annual count of sightings, unique individuals, whales presumed alive, kilometers of effort that have been submitted to the sightings database at the University of Rhode Island, and percent of the population that is identified each year from 2000 onward (Table 1). The shift in whale distribution has reduced both the number of sightings contributed to the Catalog and the percent of the population seen annually since 2011. Data as of September 4, 2019.

Table 1. Annual counts of sightings, unique individuals, presumed living whales, survey effort, and the percentage of the population seen. Survey effort from dedicated surveys only; opportunistic sightings do not record or report effort. None of the numbers for 2018 are final as not all of the data for that year have been submitted or analyzed. Data as of September 4, 2019.

Year	Sightings	Unique IDs	Presumed Living Population	Survey Effort (1,000 km)	% of population seen
2000	3087	236	344	125	69%
2001	3849	282	362	127	78%
2002	2718	303	385	252	79%
2003	2405	314	398	180	79%
2004	1811	286	407	287	70%
2005	3399	353	425	357	84%
2006	2801	347	436	316	80%
2007	3739	379	450	267	84%
2008	4147	390	473	254	83%
2009	4635	422	491	246	86%
2010	3224	421	512	271	82%
2011	3464	437	513	234	85%
2012	2127	375	512	271	73%
2013	1905	296	514	215	58%
2014	2399	369	513	200	72%
2015	1771	262	510	184	51%
2016	2199	319	499	155	64%
2017	3014	343	465	178	74%
2018	3453	343	462	135	74%

Reproduction

There were 7 documented calves born in 2019 (Table 2).

Table 2. Summary of calving events and associated inter-birth interval times for North Atlantic right whales from 2009-2019. 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/ % to calve	Average Interval	Median Interval	First time Moms
2009	39	66/59.1%	4.0	4	8
2010	19	49/38.8%	3.3	3	4
2011	22	51/43.1%	3.7	3	3
2012	7	66/10.7%	5.4	4	2
2013	20	90/22.2%	4.6	4	7
2014	11	86/12.8%	4.4	4.5	1
2015	17	84/20.2%	5.5	6	4
2016	14*	85/16.5%	6.6	7	4
2017	5	71/7.0%	10.2	8	0
2018	0	76/0	-	-	-
2019	7	87/8.0%	7	7	1

*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

Between 01 January 2019 – 31 December 2019, ten right whale mortalities were documented. Nine were detected in Canadian waters and one in U.S. waters (Table 3). Cause of death was identified in four cases (three vessel strike and one entanglement). The Consortium Board recognizes necropsies 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.

Live Vessel Strikes, Entanglements, and Entrapments

Vessel Strikes:

There were no non-lethal vessel strike injuries documented between 01 January 2019 – 31 December 2019.

Entanglement and Entrapments

There were eight active entanglement/entrapment cases reported between 01 January 2019 – 31 December 2019, of which five were new. Table 4 includes newly reported cases as well as pertinent updates to previously reported cases.

Table 3. Documented right whale mortalities 01 January 2019 – 31 December 2019.

Whale #	Date	Location	Sex	Age	Field #	Necropsied?	Cause	Comments
4023	06/04/2019	GSL	M	9		Yes	undetermined	Last sighted alive 08/21/2018 in the Gulf of St. Lawrence
1281	06/20/2019	GSL	F	38+		Yes	vessel strike	Last sighted alive on 05 and 07 June 2019 in the Gulf of St Lawrence
Unk	06/24/2019	Cabot Straight	Unk	Unk		No	undetermined	Carcass not recovered. Reported with images on 07/18/2019
1514	06/25/2019	GSL	M	34+		Yes	vessel strike	Last sighted alive 05 and 07 June 2019 in the Gulf of St. Lawrence
3815	06/25/2019	GSL	F	11		No	undetermined	Last sighted alive 05 and 07 June 2019 in the Gulf of St. Lawrence. Resighted floating dead in the GSL 07/18/2019
3329	06/26/2019	GSL	F	16		Yes	undetermined	Last sighted alive on 04/25/2019 in Cape Cod Bay
3450	06/27/2019	GSL	F	15+		Yes	vessel strike	Last sighted alive on 05 and 10 June 2019 in the Gulf of St. Lawrence
3421	07/18/2019	GSL	M	15		Yes	undetermined	Last sighted alive on 10 June 2019 in the Gulf of St. Lawrence
Unk	07/21/2019	Cape Breton	Unk	Unk		No	undetermined	Carcass not recovered. No conclusive evidence that this is the same carcass as was first seen on 06/24/2019.
1226	9/16/2019	NY	M	40+		Yes	entanglement	Was seen entangled and possibly anchored in the Gulf of St. Lawrence on 08/06/2019. Was not resighted prior to its death.

Table 4. Right whale entanglements and status updates 01 January 2019 – 31 December 2019. 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 (current)	Comments
4091	05/12/2018	60 miles ESE of Chatham, USA	F	8	The whale has line wrapped around its right flipper, at minimum, with about 50ft green line trailing. What appears to be a red, yellow and green buoy is near the right flipper. Due to weather forecast and distance, the CCS response team could not mount a response. Resighted 12/31/2018 and 01/13/2019 south of Nantucket. Although the view of right flipper was not ideal, neither line nor the buoy were visible.
3960	08/20/2018	Gulf of St. Lawrence	M	9	Whale observed with multiple wraps of the rostrum, damaged baleen, and no line trailing, although the sighting team felt that there was likely weight attached. Throughout the sighting the whale was thrashing at the surface and the configuration of the entanglement changed often. This behavior, the condition of the whale and changing entanglement configuration, led the team to believe that it was likely a new entanglement. As the team on scene was consulting and documenting the whale, its entanglement configuration continued to change and the whale picked up speed swimming at ~8kts. After more observations, the team felt that the whale might have shed the entanglement. No additional sightings of this whale have been reported. While observers noted that no gear was visible at the end of the sighting, they could not see all body areas and the whale was relatively distant and therefore the whale is considered still entangled. Resighted in Cape Cod Bay on 03/20/2019 and confirmed to be gear free.
2310	12/20/2018	Southeast of Nantucket	M	Adult, >24	The whale appears to have a short bitter end at the area of its left pectoral flipper that enters its left mouth. The line passes through the mouth and exits out the right side, trailing roughly 1-2 body lengths, at minimum, aft of the flukes. It appears as though the trailing line sinks into the water column due to the nature of the line, no bitter end was observed. There were no significant injuries associated with the entanglement documented. The whale was slightly thin. A response was not mounted. The whale may shed the line on its own. Resighted on 02/3/2019 south of Nantucket and again on 4/25/2019 in Cape Cod Bay. Disentanglement attempt was unsuccessful and entanglement remains.
4423	04/25/2019	Great South Channel	M	5	Entanglement consists of thick line coming from depth approximately one whale length behind flukes that leads to a mass of rope and possibly submerged buoy. Whale is thin and grey. Resighted in July 2019 in the Gulf of St. Lawrence still entangled. A disentanglement attempt on 07/16/2019 appears to have cut part of the line on the right side of the whale and altered the tautness of the line configuration. Multiple resights in July and August show that the whale remains entangled with a bridle of heavy rope through its mouth and is trailing a ball of gear aft of the flukes. The condition of the whale remains poor. Resighted 10/28/2019 in the Gulf of St Lawrence and confirmed to be gear free. Condition is still poor with large lesions on both sides of the head and behind the blowholes. Whale does present as thin based on aerial images.

Table 4 (cont'd). Right whale entanglements and status updates 01 January 2019 – 31 December 2019. 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 (current)	Comments
4440	06/29/2019	Gulf of St. Lawrence	M	5	The whale was essentially hogtied with line from the mouth to the peduncle. Line exiting the left mouthline trails to peduncle and line exiting from the right mouthline and/or the right flipper leads there as well. At the peduncle there are at least two passes of line forming a tight wrap. Beneath the flukes is a heavily damaged Norwegian float and on top of the flukes there is a light knot and short bitter end. Wounds around the peduncle are extensive. A disentanglement effort on 07/16/2019 was successful in making a cut in the line exiting the left side of the mouth. The whale was resighted on 07/19/2019, at which time a survey team observed that the line in the mouth had been shed. At that time, there remained a line wrap and buoy at the peduncle and trailing line of approximately one length aft of the flukes. On 08/14/2019, the whale was sighted gear free in the Gulf of St. Lawrence.
3125	07/04/2019	Gulf of St. Lawrence	M	18	Last sighted gear free 03/20/2019 in Cape Cod Bay. Extensive entanglement through the mouth with multiple trailing lines. Rope may involve both flippers as well. A research team in the Gulf was able to attach a telemetry buoy to the entangling gear on 07/19/2019. The whale was tracked to the Scotian Shelf and intercepted by a disentanglement team from Newfoundland on 07/23/2019 and 07/25/2019. The team believes they were able to cut one line of rope at the head and may have damaged others. Another disentanglement attempt was made on 08/2/2019 ~60miles east of Cape Cod. Multiple cuts to the entangling lines were made and the whale can now open its mouth. Remaining line on the whale includes embedded mid-rostrum wrap and wrap over the blowholes as well as line that is likely extensively woven in the baleen. The whale's condition is poor.
1226	08/06/2019	Gulf of St. Lawrence	M	Adult, >40	Last sighted gear free in the Gulf of St. Lawrence on 07/16/2016. Whale has at least two wraps around rostrum and a trailing bitter end. There appears to be extensive damage to the peduncle and the whale may be anchored. Whale was found floating dead off the coast of New York on 09/16/2019. See Table 3 above for details.
3466	12/21/2019	~20m south Nantucket	M	15	Last sighted gear free on 04/29/2019 in Cape Cod Bay. 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.

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 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 2019, nine new injury of interest events were documented, all of which were entanglement related (four with attached gear and five with injuries but no gear attached). Of these nine, three exhibited declining condition coinciding with injury. The impact of injury on the health of five whales was inconclusive. There were no visual indicators of injury impact on health condition for the remaining newly injured whale. Seven whales previously on the monitoring list were removed, including one who was discovered dead on 6/4/2019 in the Gulf of St. Lawrence. The remaining seven whales exhibited stable health condition and wound healing. As of 31 December 2019, the Serious Injury/Human Impact list includes 72 whales with 80 injuries documented from March 2004 through 31 December 2019 (Table 5). The majority of the injuries are entanglement related (69/80, 86.3%) followed by vessel strikes (9/80, 11.3%). There are two whales on the list with injuries of unknown origin (Table 6).

Table 5. 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. There are currently eight whales on the injured list with multiple 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)

*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 6. Impact of anthropogenic injury on right whale visual health by injury type 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 2019.

	Entanglement		Vessel Strike	Other	Total
	Gear Present	No Gear Present			
Decline in Condition	9	14	2	1	26
Inconclusive	12	13	1	1	27
No Decline in Condition	5	9	3	0	17
Extended Monitor	1	1		0	2
Total	27	37	6	2	72*

*This represents the number of whales on the monitoring list. Eight of these whales have each had second injuries documented since their initial injury sighting. For purposes of this report, whales are included under the category representing their most recent injury.

Aerial and Vessel-based Sighting Summary: 2018

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 2018 (analysed 04 September 2019) is summarized below (Table 7) 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

BHC: Boston Harbor Cruises	GMWSR: Grand Manan Whale and Seabird Research Station
CCS: Center for Coastal Studies	NEAq: New England Aquarium
CMARI: Clearwater Marine Aquarium Research Institute	NEFSC: Northeast Fisheries Science Center
CWI: Canadian Whale Institute	NWW; Newburyport Whale Watch
CWR: Campobello Whale Rescue	QLM: Quoddy Link Marine
DFO: Fisheries and Oceans Canada	TC: Transport Canada
FWRI: Florida Fish and Wildlife Research Institute	WHOI: Woods Hole Oceanographic Institution
GDNR: Georgia Department of Natural Resources	

Table 7. Summary of 2018 right whale sightings by habitat region. Analyses for 2018 data are ongoing and therefore the data presented here should not be considered complete.

Area	# Sightings	Sighting Months	Survey types/activities	Contributing Organizations
Bay of Fundy	19	Jul-Sep	Vessel surveys, biopsy sampling	CWI, CWR, GMWSR, NEAq, QLM
East (Nova Scotian Shelf)	8	May	Aerial surveys	DFO/TC
Gulf of Maine	164	May, Oct, Dec	Aerial and Vessel surveys	NEAq, NEFSC
Great South Channel	150	Jan, Mar-Apr, May, Aug-Sep	Aerial and Vessel surveys	NEFSC
Jeffreys Ledge	9	Apr-May, Dec	Aerial surveys, whale watch	BHC, CCS, NWW
Mid-Atlantic (includes south of Cape Cod)	283	Jan-Apr, Jun-Sep, Nov-Dec	Aerial surveys	NEAq, NEFSC
New England (Massachusetts Bay/Cape Cod Bay)	1617	Jan-May, Nov-Dec	Aerial and Vessel surveys, biopsy and habitat sampling, drone photogrammetry	CCS, NEFSC, WHOI
North (Gulf of St. Lawrence)	1287	May-Sep	Aerial and Vessel surveys, biopsy sampling	NEAq, NEFSC
Southeast United States	46	Jan-Feb, Dec	Aerial and Vessel surveys, biopsy sampling	CMARI, FWRI, GDNR

Management and Mitigation Activities

United States

- NOAA called for 29 Dynamic Management Area (DMA) voluntary speed reduction zones between 01 January 2019 and 31 December 2019 (Table 8).

Table 8. Dynamic Management Area (DMA) voluntary speed reduction zones posted by NOAA between 01 January 2019 and 31 December 2019.

Event ID	Trigger Date (date of RW sightings)	Number of Right Whales	Sightings Source	General Location	Boundaries
163	1/2/2019	53	Aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
164	1/15/2019	100	Aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
165	1/27/2019	20	NEA aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
166	2/4/2019	11	NEA aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
167	2/17/2019	19	NEA aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
168	3/1/2019	10	NEA/USCG Survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
169	3/13/2019	15	Research Vessel	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
170	3/28/2019	6	Aerial Survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
171	4/7/2019	15	NEA aerial survey	South of Nantucket	41 12 N 070 36 W 40 28 N 069 31 W
172	4/19/2019	11	Boston Harbor Cruises	East of Boston	42 40 N 070 20 W 42 02 N 071 15 W
173	4/23/2019	3	NEFSC aerial	Southwest Martha's Vineyard	40 39 N 070 56 W 39 59 N 071 47 W
174	4/29/2019	3	NEFSC survey	South of Martha's Vineyard	40 47 N 070 29 W 40 07 N 071 22 W
175	5/7/2019	4	NEFSC survey	SW Martha's Vineyard	40 39 N 070 56 W 39 59 N 071 47 W
176	5/14/2019	4	NEFSC aerial survey	South of Martha's Vineyard	40 47 N 070 29 W 40 07 N 071 22 W
177	5/16/2019	5	NEFSC ship survey	SE of Nantucket	40 48 N 068 24 W 40 05 N 069 20 W
178	5/15/2019	4	NEA aerial survey	South of Nantucket	40 44 N 070 01 W 40 04 N 070 51 W
179	5/22/2019	15	NEFSC Ship survey	SW Martha's Vineyard	40 39 N 070 56 W 39 59 N 071 47 W
180	5/22/2019	15	NEFSC Ship survey	South Martha's Vineyard	40 47 N 070 29 W 40 07 N 071 22 W
181	5/25/2019	9	NEA aerial survey	South of Nantucket	40 44 N 070 01 W 40 04 N 070 51 W
182	7/15/2019	3	NEA aerial survey	South of Nantucket	41 34 N 070 32 W 40 54 N 069 39 W
183	7/25/2019	7	NEA aerial survey	South of Nantucket	41 14 N 069 32 W 40 29 N 070 32 W
184	8/3/2019	10	NEFSC aerial survey	South of Nantucket	41 14 N 069 32 W 40 29 N 070 32 W
185	8/12/2019	9	NEFSC aerial survey	South of Nantucket	41 14 N 069 32 W 40 29 N 070 32 W
186	8/30/2019	19	NEFSC aerial survey	SE of Nantucket	41 23 N 068 14 W 40 43 N 070 10 W
187	9/9/2019	7	NEFSC aerial survey	SE of Nantucket	41 23 N 068 14 W 40 43 N 070 10 W
188	11/9/2019	3	NEFSC aerial survey	South of Nantucket	41 01 N 069 10 W 40 25 N 069 56 W
189	11/19/2019	?	NEFSC aerial survey	South of Nantucket	41 01 N 069 10 W 40 25 N 069 56 W
190	12/12/2019	8	NEFSC aerial survey	South of Nantucket	41 10 N 069 42 W 40 28 N 070 43 W
191	12/29/2019	14	CCS aerial survey	SE of Nantucket	41 35 N 069 35 W 40 52 N 070 37 W

- In 2019, 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:
 - Convened U.S. North Atlantic Right Whale Implementation Team (RWIT; composed of the Northeast U.S. Implementation Team (NEIT) and Southeast U.S. Implementation Team (SEIT)) to coordinate on coast wide issues. Regional teams also continued to meet and work independently on regional issues. The RWIT's Population Evaluation Tool Subgroup continued to meet and work towards development of a population viability analysis.
 - Announced the availability of the latest comprehensive report on Recovering Threatened and Endangered Species FY 2017-2018 and added the North Atlantic Right whale to the Species in the Spotlight. As part of the Species in the Spotlight campaign, NMFS will develop a five-year action plan. The 5-year action plan will build upon existing recovery and conservation plans and will detail the focused efforts needed over the next 5 years to reduce threats and stabilize the North Atlantic right whale population decline. NMFS sought input on the plan from the U.S. RWIT. With North Atlantic Right Whales now being added to the list, NMFS hopes that more focused attention will help stabilize the declining population. NMFS recognized the Right Whale Consortium as a *Species in the Spotlight Partner* which recognizes the efforts of over 200 partners dedicated to conserving and recovering the species.
- The Atlantic Large Whale Take Reduction Team continued their efforts to meet the requirements of the Marine Mammal Take Reduction Act, to develop recommendations to modify the Atlantic Large Whale Take Reduction Plan to reduce entanglement related serious injuries and mortalities to below the Potential Biological Removal Level of less than one per year. During a full Team meeting in April 2019, attendees came to near-consensus on recommendations to achieve risk reduction targets by jurisdictional/lobster management area to respect the diversity of the trap/pot fisheries. Two primary risk reduction measures were proposed:
 - Rope breaking at 1700 lbs or less via engineered weak rope or by introducing weaknesses regularly in rope, and
 - Less rope - reduce the number of buoy lines
 And the recommendation included strong support for:
 - Gear marking
 - Safety exemption
 - Monitoring post implementation: including whale numbers and distribution, endline numbers, outcomes on socioeconomics
 - Support for regulating in a way that allows regional gear innovations
 NMFS is working with the states and offshore lobster fishermen to develop take reduction measures for the Gulf of Maine and southern New England waters. Alternatives being developed are consistent with an agreement to achieve risk reduction across lobster and state management areas through a combination of line reductions and weak rope/weak insertions into rope. Scoping was conducted in August, 2019, with eight meetings held from Maine through Rhode Island. Alternatives and analyses that will be included in the Draft Environmental Impact Statement will reflect scoping comments received from over 800 people that attended scoping meetings, and nearly 27,000 pieces of correspondence received during scoping. The Draft Environmental Impact Statement and Proposed Rule are anticipated to be published for public comments in early 2020.
- NMFS convened two workshops related to NARW recovery and conservation:
 - NARW Health Assessment workshop from June 24-26, 2019 in Silver Spring, Maryland, held under the auspices of the Working Group on Marine Mammal Unusual Mortality Events. Workshop participants assessed current health information data, including associated data gaps, and identified 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 NARW recovery.
 - NARW Monitoring and Surveillance workshop from October 22-24, 2019 in La Jolla, CA. NMFS working group members developed recommendations for prioritizing and integrating NARW monitoring and surveillance efforts range-wide across platforms (aerial, vessels, passive acoustic monitoring). NMFS will evaluate the recommendations and develop a comprehensive strategy to inform NARW conservation efforts and maximize NMFS' efficiency and ability to leverage resources to answer outstanding questions related to population and health status, as well as distribution and habitat use.
- In 2019, the NMFS Greater Atlantic Regional Fisheries Office had an increase in activity under the ESA related to the burgeoning offshore wind energy industry. With 15 active leases on the Outer Continental Shelf

(OCS) of the East Coast, much of this work was providing technical assistance about protected species to developers and the Bureau of Ocean Energy Management (BOEM, the lead Federal agency for authorizing the construction, operation, and eventual decommissioning of any offshore wind project). Many of the proposed projects are currently in the site assessment phase; effects of site assessment activities, including geotechnical and geophysical surveys, are assessed under the ESA and permits may also be necessary under the Marine Mammal Protection Act (MMPA). Effects of some survey activities are considered in a 2013 programmatic biological opinion (Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf). This Opinion is in the process of being updated. Additional activities in 2019 included:

- Initiating an ESA section 7 consultation for the construction, operation, and decommissioning of Vineyard Wind 1, the first commercial scale offshore wind energy project in the United States in the northern portion of lease area OCS-501. Consultation is expected to be completed following the issuance of a Supplemental Environmental Impact Statement by BOEM.
- Re-initiating the 2013 programmatic biological opinion on offshore wind energy survey activities to expand the geographic range to include actions south of North Carolina and to update relevant background information and complete updated analyses of effects to ESA listed species including NARWs.
- Following receipt of letters in the fall of 2018 from researchers both for and against invasive tagging of NARW, NMFS agency scientists and managers re-evaluated the risks and benefits of invasive tagging for this species. Following this review, in May 2019, NMFS instituted a temporary suspension of dart tagging of reproductive-age female NARW while tag improvements are being implemented and tagging reports are more closely reviewed. NMFS' current position on invasive tagging of NARW includes:
 - Prohibiting deep-implant tags designed to anchor in the fascia between muscle and blubber layers;
 - Allowing use of dart-style tags designed to anchor into the blubber layer, except on lactating females with neonates, and calves less than approximately 6 months old; and, temporarily suspending dart tagging of reproductive-age females; and
 - Requiring enhanced mitigation specific to dart tagging (including requiring the use sterile tags, prohibiting tagging of compromised individuals, requiring notification of tagging, and follow-up monitoring).
 - As part of an adaptive management plan, NMFS will annually re-evaluate use of dart tags on NARW, or earlier as needed, based on review of the following:
 - Monitoring reports submitted by researchers including information on efficacy of the tags (e.g., tag transmission duration) and effects of the tags (e.g., wound reaction and healing, animal health and behavior) for NARW and other cetacean species;
 - Tagging protocols and best practices developed by the International Whaling Commission, the International Union for the Conservation of Nature, and the Office of Naval Research;
 - The current status of and threats to the NARW population; and
 - Management needs to support conservation and recovery.
- NOAA Fisheries announced the availability of additional \$1.6 million to support recovery actions for North Atlantic right whales
 - New federal funds will be available through the Atlantic States Marine Fisheries Commission for fishermen affected by pending right whale regulations.

Canada

- 2019 is the third year that the Government of Canada has implemented targeted management measures to help protect and recover NARW by addressing primary threats to the population: vessel strikes (Transport Canada lead) and entanglement in fishing gear (Fisheries and Oceans lead).
- The 2019 measures are focused on the prevention of entanglement and vessel strike by managing snow crab and lobster fisheries and all other non-tended fixed-gear fishing in Quebec and Atlantic Canada. Fisheries management measures include:
 - A season-long area closure (static zone) in the Gulf of St. Lawrence, covering 2,400km²;
 - If one or more right whales are detected anywhere in known foraging areas in the Gulf of St. Lawrence or the 2 critical habitats in the Roseway and Grand Manan Basins, 15 day closures (dynamic zone) of up to 2,100 km² are implemented for snow crab and lobster fisheries (and all other non-tended fixed-gear fisheries); and
 - Outside these areas, in Quebec and Atlantic Canada sightings are reviewed on a case-by-case with special consideration given to sightings of 3 or more whales or a mother and calf pair.

- In response to the NARW mortalities in 2019, on July 9, DFO expanded the dynamic zone to the entire Gulf of St. Lawrence covering 227,940 km², stretching from the St. Lawrence Seaway, to the Cabot Strait and Strait of Belle-Isle. As a result, any sighting of a single NARW observed in the entire Gulf of St. Lawrence triggers a dynamic closure to all non-tended fixed gear fisheries. The number of flights by DFO were also doubled, from 5 to 10 per week.
- DFO has also implemented a range of fisheries measures to reduce the amount of rope in the water to lower the risk of NARW entanglement. Since 2017 they have adjusted opening and closing times in key fisheries, including in the Gulf of St. Lawrence. This minimizes the number of vertical lines and limits the number of traps, such as in the Gulf crab fishery.
- DFO also implemented requirements to identify and sequentially mark buoys, and are phasing in mandatory fishery-specific gear marking for all fixed-gear fisheries by 2020. Finally, they require all fishing licence holders to report lost gear and any interactions with marine mammals.
- Extensive surveillance of Quebec and Atlantic Canadian waters for NARW was achieved using multiple aircraft, vessels, and passive acoustic technology including hydrophones and gliders. Fisheries and Oceans, Transport Canada and partners are preparing plans for survey and surveillance efforts in 2020.
- As in 2019, DFO's Conservation and Protection branch continued to conduct extensive air and vessel patrols to verify compliance and enforce management measures related to NARW, including opening/closing of fishing areas and the removal of lost, abandoned, illegal or otherwise discarded fishing gear (i.e. "ghost gear"). Enforcement actions taken by fishery officers can lead to charges for violations under the *Fisheries Act*, *Species at Risk Act*, and other applicable laws and regulations.
- DFO 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. They meet annually with our Marine Mammal Response partners to discuss the operational season and needs moving forward.
- DFO has implemented mandatory lost gear reporting for licence holders in all fixed-gear fisheries, as well as, mandatory reporting of any accidental contact between marine mammal and a vessel or fishing gear.
- From July 18-20, 2019, DFO also participated in a coordinated blitz with Canadian Coast Guard to retrieve ghost gear from five key areas in the Gulf of St. Lawrence. The five areas were identified based on the lost gear reports as well as areas of heaviest fishing in 2019. Over the course of the operation, 101 crab pots were recovered, over 10,000 lbs of crab were returned to the water, and 9.1 km of rope was removed from the water.
- DFO is supporting a number of industry trials of "whale safe" gear technologies that minimize or eliminate the risk of entanglement to whales and evaluating pilot projects using scientific expertise. The Department is hosting a Gear Innovation Summit in February 2020, which will include a stream focused on technological solutions to mitigate ghost gear.
- In 2019, 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 NARW. These measures came into force on April 28, 2019 (see map [HERE](#)).
- On July 8, 2019, following the NARW mortalities, enhanced measures were announced, including expanding the speed restriction zones further east, increasing the number of vessels that speed restrictions apply to (all vessels over 13 m instead of just vessels 20m+), increasing the buffer zones around the dynamic speed zones, and increasing aerial surveillance (see map [HERE](#)).
- Transport Canada tested additional surveillance technologies to evaluate their effectiveness for possible integration into vessel traffic management in the Gulf of St. Lawrence, including a trial for a second year of Remotely Piloted Aircraft Systems (RPAS) and, in collaboration with the University of New Brunswick, a trial of acoustic monitoring to detect NARW in the dynamic speed zones using an underwater glider.
- Transport Canada began evaluating the 2019 measures before the conclusion of the season, and continues to engage with the marine transportation industry, scientists, and other stakeholders to refine and develop measures for 2020.
- Canada's National Marine Mammal Peer Review Committee met in October 2019 to review data and address question related to right whale distribution, habitat use, and risk of interactions with fishing gear and collision with vessels in Canadian waters.
- The Government of Canada consults with fishing and shipping industry representatives, Indigenous groups and other partners, for feedback on measures and to support the development of future measures. The NARW Roundtable meeting held on November 7th, 2019.

2019 North Atlantic Right Whale Publications/Reports

Reports and publications that utilized NARWC databases in 2019 and/or those of general interest to the right whale community are listed and hyperlinked (when available) below.

Publications

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Appendix 1

Catalog Assessment Method

We have developed standardized criteria that can be applied each year to get a low, middle (best estimate) and upper number of whales in the population as determined from Catalog data. One term needs to be explained to understand these numbers. Whales are given temporary intermatch codes if 1) two or more sightings match each other, and 2) neither have been matched to a catalog whale. Some of these whales will eventually be matched to existing cataloged whales and others will be determined to be “new” to the Catalog and assigned a number. Once an intermatch whale is given a Catalog number, or matched to another intermatch code whale, the intermatch code is made inactive. The results for 2018 are provided below in Table 1.

LOWER

To determine the lower bound, we simply count the number of unique cataloged whales identified the year before. Because of delays in processing data, this number is lower than the eventual total number of whales seen alive in that year.

MIDDLE

The middle bound is determined by summing three categories:

- 1) All whales presumed to be alive in that year (i.e. seen in the last six years),
- 2) Intermatch whales that are likely to be added to the Catalog. This is calculated by first finding all intermatch codes that span two or more years (both those that are active and those that were matched and made inactive), removing all calves and any SEUS whales whose sightings span two years only because they are seen in December and January of the same field season. Then, we determine which of those intermatch whales have Catalog numbers and what percent of those were new to the catalog (i.e. had not been matched to an existing cataloged whale). The remaining, unidentified intermatch whales are then multiplied by that fraction to determine how many are likely new to the Catalog (e.g. if only 20% of the matched intermatch whales were new, then 20% of the unmatched intermatch whales are likely new). That number is then added to the count of calves born more than two years earlier that are unmatched with active intermatch codes (indicating there is enough information to potentially match them in the future). Process changed Oct. 2009.
- 3) Calves from the last two years that have not been cataloged. We make an assessment of whether there is enough photographic information to likely be able to match them to future sightings and thus eventually assign them a Catalog number. We then sum those that will likely be cataloged.

UPPER

The upper bound is also the sum of three categories:

- 1) All Cataloged whales minus those whose carcasses were identified. Even whales missing for 30 years included.
- 2) All active intermatch whales minus calves from the last two years.
- 3) All calves from the last two years minus those known to be dead.

Table 1. The Catalog method of estimating the population represents an assessment of the number of photographed whales in the North Atlantic Right Whale Identification Database. Analysis completed 9/4/19.

Low: 343 individuals

343 Cataloged whales seen in 2018

Middle: 502 individuals

462 Cataloged whales presumed alive in 2018

37 Intermatch whales likely to be added to Catalog

3 Calves from 2017 and 2018 likely to be added to Catalog

High: 727 individuals

684 All Cataloged whales in 2018 minus those known dead

39 All active intermatch codes without 2016 & 2017 calves

4 All uncataloged 2017 and 2018 calves minus dead