Monitoring Endangered Right Whales in Coastal Waters of Northeast Florida by a Volunteer-Based Citizens Network

2021–22 Season

Annual Report by the Marineland Right Whale Project to:
Volunteers, Colleagues, Collaborators, and Sponsors

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Preface

The Marineland Right Whale Project was initiated in 2001 and completed its 22nd field season in March 2022. It is one of about a dozen programs and organizations extending from Canada to Florida dedicated to the science and conservation of the North Atlantic right whale, *Eubalaena glacialis*. After wide concern about a decreasing population, our 20 October 2021 report to the Army Corps of Engineers described a slowly increasing trend in the 1) number of sightings by the Marineland group, and 2) annual calf production. While neither the number of MRWP sightings nor the overall calf production were as high as in the 2021 season, the gradual upward trend continued.

1.0 Background and Overview

1.1 The Marineland Right Whale Project

A collaboration of two organizations, Associated Scientists at Woods Hole and the Marine Resources Council, have joined in providing monitoring and stewardship of the endangered North Atlantic right whale, *Eubalaena glacialis*, and its nearshore habitat in coastal waters of northeastern Florida. At the core of this effort is a volunteer network—citizen scientists who are provided training and resources and work alongside experienced staff. The Marineland component, "The Marineland Right Whale Project," (MRWP) was initiated in 2001, and the 2021–22 season was its 22nd.

1.2 Right Whale Calving and Wintering Grounds

The coastal waters of the southeastern United States (SEUS)—principally Florida and Georgia—are the principal calving and nursing ground for the endangered North Atlantic right whale, *Eubalaena glacialis*. The small population currently numbers about 340, with a small number of calves born each year (the average for the past 10 years has been 12).

Florida's coastline includes 175 nautical miles (nmi) of right whale critical habitat. (Note that a revised and enlarged right whale critical habitat was designated on 27 January 2016.) In the 2021–22 season, as in most preceding seasons, the great majority of aerial survey effort by the states of Georgia and Florida took place in the northern section—the Mandatory Ship Reporting/Early Warning Survey area. South of St. Augustine (about 125 nmi or 70% of the Florida critical habitat), most sighting effort was provided by the Volunteer Sighting Network—a collaboration between Associated Scientists at Woods Hole and the Marine Resources Council.

1.3 Monitoring Priorities

Monitoring priorities include documenting calf production, health of mother-calf pairs, and human impacts (vessel strikes, fishing gear entanglements, boater harassment, and habitat issues). All are aimed at conservation and recovery of this endangered species.

1.4 Collaborations

Throughout the survey season, we are in near-daily contact with the group to our south, the Marine Resources Council, and the group to our north, the Florida Fish and Wildlife Commission (FWC). More broadly, we collaborate/communicate with the Georgia DNR/Clearwater Aquarium Team, the New England Aquarium right whale group, the Navy, and the National Oceanic and Atmospheric Administration/National Marine Fisheries Service.

2.0 Methods

2.1 Overview

During the course of 22 seasons, the volunteer sighting network has evolved, and refinements and innovation have been incorporated. In its present form, a number of interrelated components have proven essential to success:

- Dedicated survey teams
  - * Mobile
  - * Stationary (Community/Condo)
- Opportunistic sightings
- Right Whale Hotline
- Response teams
- Drone photos and videos
- Timely and effective communication with volunteers and collaborators
- Education and outreach
- Collaboration
- Data processing, analyses, synthesis, and presentation

The volunteer handbook, which provides essential information on right whale biology and survey protocols, is posted on the website: www.aswh.org.

2.2 Study Area and Sectors

The study area, monitored with a combination of a shore-based sighting network and the complementary drone flights, is in the near-shore waters of northeastern Florida between St. Augustine Inlet (latitude 29º54′N) and Canaveral Seashore (28º56’), within 5 nautical miles (nmi) of the coast (Figure 1). This ~60nmi section is subdivided into six sectors, each ~10 nmi in latitudinal extent). The shore-based monitoring extends south to Ponce Inlet (29º04’), while some opportunistic monitoring extends farther south to Canaveral Seashore.

2.3 Sighting Protocols

Sightings, photo documentation, and data collection are based on interrelated sources and responses. The initial sightings are made almost exclusively from the shore. The response, extended observations, and photographs may be from the shore, or air (drone), or a combination. Throughout, there are standardized search effort and data collection protocols. This includes photo documentation and photo-identification, which are essential to monitoring and data collection. The results are optimized through communication, collaboration, and by utilizing multiple platforms.

2.4 Shore-Based Lookouts

As described, the study area is divided into six sectors. A shore-based volunteer sighting network works with experienced scientists. The volunteer sighting network includes two components: 1) scheduled, and 2) opportunistic observers. The scheduled observers, typically teams of two to four volunteers, are of two types: a) mobile and b) stationary. The mobile teams meet at 0800 hr at a designated point and travel by vehicle to a series of lookout stations where a 15 minute search is conducted at each. At the end of the series (typically five stations per team), they reverse the search and end back at the starting point.

The stationary teams (typically based in shore-front condos or housing communities) maintain lookouts from dune walkovers, or the balconies of shorefront buildings. In both cases, most watches are concluded by 1200 hr.

The opportunistic observers are residents and/or workers who have been provided information and the sighting-report hotline number; and report sightings made during the course of normal recreation or work. Opportunistic observers include, for example, the Volusia County Beach Patrol.

The 200+ member volunteer sighting network and its several components provides effective coverage of our ~ 60 nmi section of coastal habitat.

2.5 Response Teams

A central location (the office in Marineland) is manned during daylight hours and is linked to the central call-in hotline maintained by the Marine Resources Council. When a sighting is reported, a response team that includes experienced scientists and volunteers is deployed. The response team carries portable GPS units (Garmin 12XL or similar) and digital cameras with long lenses (*e.g.*, Canon EOS 60D with a Canon EF 600-mm image-stabilized f 4.0 telephoto lens fitted with either a 1.5 or 2.0 Canon telextender). On many occasions, the response includes a drone and drone operator.

Standardized protocols are followed for data collection. Bearings are measured using binoculars with built-in compasses *(e.g.*, Nikon OceanPro 7X50 Model #7441). Ranges are estimated visually by experienced observers based on calibration and training trials. Data and sighting sheets are standardized and reviewed for quality control. Whenever possible, whale locations are recorded by the GPS function of the drone; otherwise they are estimated from shore.

2.6 Unmanned Aerial Systems (UASs)

Since the 2016 season, drones (unmanned aerial systems or UASs) replaced the airplane that we flew from 2007 through 2017. The MRWP currently has three drones, two DJI Phantom 3 Pros, and a DJI Phantom Pro 4 v.2. In addition, four volunteers operate a DJI Phantom Pro 4 v.2, a DJI Phantom 3, and a DJI Mavic 2 Pro. With a total of five drones and five operators, the plan is that for any given sighting event, at least two will be available. All drones are registered with the Federal Aviation Administration (FAA). As we are considered to be a commercial operation (*e.g.*, includes scientific research) under CFR 14, Part 107, three of our operators have an FAA Remote Pilot Certificate. Four of our operators are listed in our NOAA/NMFS research permit, #20626.

Because of the proximity of several coastal airports to our study area, we have applied for, and received, FAA airspace waivers for Northeast Florida Regional (SGJ), Flagler (FIN), and Ormond (OMN) airports. (This waiver provides for operations within five nautical miles of the airport). In addition, we have the AirMap app on our mobile phones to utilize the Low Altitude Authorization Capability (LAANC) and provide for operation within five nmi of Daytona Beach International (DAB). In the future, we will apply for authorization for New

Smyrna Beach (EVB). The Canaveral Seashore National Park is closed to drone operations, making this section of the coast unavailable.

The protocol for drone use in the course of our work is as follows: When a sighting is reported, a response team is deployed. This will typically include one or more drone operators. An assessment will be made as to weather and sea state conditions, as well as the distance from shore to the whale(s)—*i.e.*, is it reasonably within range? A drone will be deployed to first obtain high-quality identification photos and second, to record video that will contribute to behavioral studies. As detailed in our NOAA/NMFS permit, operators and assistants wear vests identifying them to the public as researchers In many cases, images will be sent to members of the FWC Team for assessment in decisions about darting and boat/aircraft deployment. Likewise, if conditions or distance preclude a drone launch, this information will be relayed so that FWC has the option of deploying their aircraft for photo-ID.

2.7 Monitoring for Human-impacted Individuals

In the field and during photo archiving and analysis, particular attention is paid to noting and documenting human-impacted individuals. Impacts or potential impacts include ship/boat collisions, fishing gear entanglement, and harassment by boaters, paddle boarders/surfers, and jet skiers

Data and photo documentation are submitted to NOAA law enforcement, the Whale-Vessel-Interaction database maintained by FWC , as well as the database and photo catalog maintained by the New England Aquarium, Boston, Massachusetts.

2.8 Phone Notification System

The phone notification system, which was implemented several years ago, has proven to be a success. The system was temporarily discontinued in 2020–21 due to the pandemic to avoid groups gathering at a sighting location. The volunteers were advised and were understanding. When the system is operating, we contract with One Call Now, an automated telephone messaging service, to facilitate fast, efficient, and complete notification of survey team members during whale sightings,. After importing the team members' names and contact numbers, One Call Now allows us to create a voice message and deliver it to certain sectors, or, to the entire list, within 20 minutes. Volunteers either answer the call live and hear the message, or, the service leaves a voice mail. Having the opportunity to see right whales is a high-priority goal, both as a reward for the volunteers' assistance, and, to help new volunteers establish their right-whale sight image for better detection/species identification during surveys and follows. An

additional function of the phone network is to advise volunteers on weather conditions and changes to the survey schedule.

2.9 Sea-Surface-Temperature (SST)

Sea-surface temperature (SST) satellite images are received daily from the Naval Oceanographic Office, Stennis Space Center, Mississippi. The images are based on Advanced Very High Resolution Radiometer (AVHRR) reflective measurements interpolated, averaged, and analyzed within a 10 km (~5 nmi) grid. The SST value is ground-truthed with drifting buoys. The error estimate for the images with reference to the buoys is described as ± 0.5 degrees. In parallel, for a nearshore fine-grain measurement, we use the SAUF1 National Data Buoy Station at the end of the St. Augustine Pier. Data are posted on the National Data Buoy Center website (Station SAUF1-St. Augustine, Florida), and are available for download.

2.10 Outreach and Education

Engaging citizens and community is an important part of our core mission. Training and orientation sessions are given to volunteers and potential volunteers prior to and at the beginning of the season. As the season progresses, updates with information and results are scheduled. We also give public talks, and respond to media requests, both print and television. We also partner with other organizations, *e.g*., the Blue Ocean Society, Portsmouth, New Hampshire.

2.11 Data and Photo Analysis, and Submission

As is the custom, the right whale data and photos are submitted to the database and photo catalog maintained by the New England Aquarium. The humpback whale data and photos are submitted to FWC, and subsequently to the Center for Coastal Studies, Provincetown, Massachusetts.

3.0 Results

3.1 Sighting Effort

Cautions resulting from the COVID-19 pandemic affected us throughout the season. Adjustments were made and the survey effort continued. The shore-based dedicated lookouts were active from 4 January through 13 March 2022. The network included ~ 200 volunteers

monitoring a 60-nautical mile section of coastline from St. Augustine to New Smyrna Beach. Conservatively estimated, 3,000 hours of volunteer sighting effort took place.

In advance of the formal lookouts, experienced volunteers responded successfully to a number of reported sightings in the month preceding our dedicated surveys, December 2021.

3.2 Right Whale Sightings 2021-22

3.2.1 Overall Sighting Summary

In the 2021-22 SEUS season, the Marineland Right Whale Project and our partner organization, Marine Resources Council, received and responded to 30 right whale sightings (Table 1, Figure 2).

The Marineland Right Whale Project recorded 23 verified sightings during the 2021–22 season. The first sighting was mother-calf (MC) *Derecha*, #2360 on 26 December 2021. The last sighting was MC *Derecha*, #2360, on 22 February 2022. *Derecha* and calf were the most frequently sighted, with 10 sightings.

#3560, *Snow Cone*, and calf #2 were sighted on three occasions, noteworthy due to the mother's entanglement. Drone photos of the entanglement were obtained on 13 January and 17 February. Close up land-based images of the entanglement were obtained on 13 January and contributed by local photographer Paul Chokota. Selected land images from 13 January and all drone photos and videos from 17 February were submitted to the Atlantic Large Whale Disentanglement Network, Center for Coastal Studies.

A third MC pair, #2040, *Naevus*, was sighted twice. A pair of adult females, *Babushka*, #3890, and *Curlew*, #4190, were sighted on three occasions. And lastly, the 2021 calf of #3904, *Champagne*, was sighted once. We had no sightings of groups ≥3 this season. We had four sightings of what we believed to be MC pairs that were not photographed to the photo-ID level.

Noteworthy this season was the reappearance of #3560, *Snow Cone*, and #2360, *Derecha*; both lost their calves in the 2020 season, but, after an unusually short interval, gave birth this season. Very resilient.

3.2.2 UAS Assisted Sightings

The use of shore-launched drones considerably enhanced the efficacy of the shore-based sighting network. The Marineland Right Whale Project had 13 days with successful drone flights, 26

December through 22 February (Figures 3 & 4). Total # of flights = 35. Belly-up calves were sexed on two occasions

Drones also aided in documenting human interactions on several occasions (see below), including the wounded and entangled #3560, *Snow Cone*.

Similarly, our partners, the Marine Resources Council team, had three days with 10 successful drone flights.

3.2.3 Human Impacts

As described, the entangled and wounded female, #3560, *Snow Cone*, was sighted on three occasions. Experienced responders judged that due to young age of calf and general appearance of #3560, an intervention and disentanglement response was not warranted. On 25 April, the Center for Coastal Studies reported the pair near Cape Cod, Massachusetts. At that time, the rostrum wound with embedded line was judged to be probably lethal.

Some human interactions appear benign. Sunday, 13 February, was a clear, sunny, day off Daytona Beach Shores. On two occasions, recreational boaters approached the yearling calf of female #3904. On both occasions, the boaters were cautious and maintained their distance. We judged the approaches to be non-intrusive and benign. As we have previously noted, such events are more likely to occur on weekends with good weather.

3.3 Sea Surface Temperature

As has been our practice for more than a decade, daily sea-surface temperature plots were obtained from NAVOCEANO, Stennis Space Center, Mississippi. Water temperature data were also downloaded from the NOAA National Data Buoy Center monitoring site on the St. Augustine pier (Figure 5). Analyses are underway.

3.4 Collaboration with the Florida Fish and Wildlife Conservation Commission Team

We collaborate and communicate with other groups on a near-daily basis. This includes the Florida Fish and Wildlife Conservation Commission team. This collaboration includes several components, among them the genetic sampling of calves.

The collaboration took place on six occasions (refer back to Table 1). As an example, on 13 January and 1 February, as the sighting was too distant for our capabilities; the information was

relayed, and the whales were successfully photographed by the FWC aircraft, and by their vessel on 1 February. On 11 February, the information on female #2040, *Naevus*, and calf were relayed to FWC, who deployed their boat and obtained photos.

3.5 Professional meetings and participation

The MRWP provided summary information for a presentation at the Southeast U.S. right whale implementation team (SEIT) virtual meeting on 17 May 2022 (refer back to Figure 3).

3.6 Training and Public Outreach

Due to constraints surrounding the COVID-19 pandemic, the usual large gathering volunteer training sessions were reduced again in 2022. Engagement of new volunteers was limited, and emphasis placed on returning experienced volunteers. We did hold a season-end summary and review on 19 March (Table 2); this was our first gathering since 8 February 2020.

As with gatherings, our public presentations were reduced this year, compared with pre-pandemic years. With appropriate precautions, we gave a number of talks (Table 2). We also continued to support the right whale display at the Flagler Beach Museum.

On 23 February, we supported the Florida premiere of the documentary *Last of the Right Whales*. We set up a display and informational table at the SunRay Cinema in Jacksonville. Two of our staff, Sara Ellis and Julie Albert, served on the invited post-film Q&A panel, which was moderated by Dinah Pulver of *USA Today* (Figure 6).

Sharing images, videos, and results with our volunteers is central to the program. To this end, we prepared a summary video for the 2022 season, *Volunteers 2022* (runtime 5 minutes). This is on the YouTube channel of the Marineland Right Whale Project. In addition, the production team of *Last of the Right Whales* created two featurettes that included our volunteers and drone footage: *Meet the NARW Citizen Scientists* and *Meet Snow Cone, North Atlantic Right Whale 3560.* Both are on the YouTube channel of HitPlay Productions.

On 1 June 2022, we entered into an agreement with sophomore Kyriaki Gavrill and her faculty advisor, Megan Salomone, Byram Hills H.S., Armonk, NY, for mentoring in the Authentic Science Research Program. Email and phone call exchanges followed. The preliminary project focus is: *Behavior and sociality in whales and their conservation implications*. Monthly correspondence takes place. Kyriaki will visit us and participate in the program in February 2023.

3.7 Disposition of Data

The submission of data and photographs to the Right Whale Catalog at the New England Aquarium, Boston, Massachusetts, took place on 13 April 2022. Archiving of data, images, videos, and reports is continuing. Our intentionally redundant backup system consists of two multi-Terrabyte external hard drives.

4.0 Discussion

4.1. Two Decades of Contribution

During 22 years, the Marineland Right Whale Project has submitted photos and data on about 510 sightings to the collective database at the New England Aquarium. This included 79 mother-calf pairs (52 unique females), 33 non-reproductive females, and 60 males.

This season, as with many, there were surprises and highlights. The two whales in two days of the second month were interesting. Further, it provides an example of sightings, responses, and collaborations. The description follows:

At 10:30 on Tuesday the 1st, Team One called. Whales up to the northeast. We responded. From Butler Beach, we briefly saw distant blows and backs. As it was too far and too elusive for us to launch the drone, we relayed the sighting information to FWC and their aerial crew. Shortly thereafter, two whales were photographed from the plane. They were two adult females, #3890, *Babushka*, and #4190, *Curlew*. The last two digits of their catalog numbers aroused our curiosity. They were both offspring of female #2790, but different fathers—they were half-sisters. There's more. They are both listed as potential mothers.

The next day, Wednesday the 2nd, the FWC called. Whales in Ormond-by-the Sea. We alerted responders in the area and got on the road. After several stops with no sightings, a call with the Beach Patrol got us connected. We got in a single drone flight in increasing winds and sea state (Figure 7). It was the two sisters. Their behavior was similar to the previous day but different from what we generally observe from mother-calf pairs . . . they were surfacing briefly and doing extended submergences. And, they were moving quickly. Afterwards, we wondered . . . do they know that they are sisters? Is there a communication or bonding? Are they both pregnant? Will they both have calves this season? We are reminded that there is a lot we don't know, but our curiosity is piqued.

4.2. Population Overview

In December of 2022, it is difficult to be optimistic. At the October 2022 meeting of the North Atlantic Right Whale Consortium, the continuing decline of the population was reported. The

current estimate is 340 ± 7 (Figure 8). Recall that back in 2011, the estimate stood at 509 individuals. Human impacts continue. It is estimated that there are 55-60 entanglements per year, with six serious. With respect to human efforts, keynote speaker Scott Kraus described that, "the Take Reduction Team/Plan has had no detectable influence on right whale conservation."

One whale, with a connection to the Marineland Right Whale Project, provides an example. On 8 February 2020, female #3560, *Snow Cone*, was sighted by one of our teams off St. Augustine. She was 15 years old and had given birth to her first calf. This pair subsequently was prominent in the *Last of the Right Whales* documentary. There was a dark cloud. In June 2020 the carcass of the calf was reported off New Jersey, the victim of not one but two vessel strikes. With evidence if stamina and resilience, *Snow Cone* appeared back on the SEUS calving grounds in December 2022, with her second calf. However, *Snow Cone* was now entangled in fishing gear. Sightings were made throughout the season, followed by a sightings in April and May off Cape Cod, and in July in the Gulf of St. Lawrence. The dark clouds continued. On 22 September 2022, *Snow Cone*, now without her calf (had it been successfully weaned?), was sighted south of Nantucket. The entanglement persisted and her health had declined. The prognosis was poor. She has not been seen since. Her experience and life history is not atypical. What are we, as scientists, conservationists, and citizens, to conclude?

4.3. Outlook and Approach

An often-expressed view is that unless something changes, extinction is imminent. With uncomplicated arithmetic, low calving rates and high mortality (much of it human-caused) leads to an irrefutable decline. Another view, a less common one, is that fluctuations and variability (Figure 9) are characteristic of biological systems, that currently undiscovered habitats may hold individuals to at least partially contradict the population decline, and that resilience of the whales will contribute to a recovery and increase in numbers. The answer surely includes an increase in calving rates and a decrease in human-caused mortality. These, combined with resilience and variability provides cautious hope (Figure 10).

Acknowledgments

First and foremost, we are grateful for the good efforts and strong commitment of our research associates, Sara Ellis and Joy Hampp. Ralph Bundy, Terry Clark, and Sara Ellis are our capable drone operators. Bill Gough and Martha Garito are successful photographers. Program support is provided by the U.S. Army Corps of Engineers, Jacksonville District; the Batchelor Foundation; the Brookby Foundation, and private donors. In-kind services are provided by the

University of Florida's Whitney Laboratory, the Guana-Tolomato-Matanzas National Estuarine Research Reserve, the Volusia County Beach Patrol, Jacoby Development, Inc., Marineland Dolphin Adventure, and many others. Collaboration and assistance with research and analysis was provided by the Marine Resources Council, the Florida Fish and Wildlife Conservation Commission, and the New England Aquarium. Research was authorized by NMFS permit #20626.

Table 1. Sighting summary 2021-2022 season for the Volunteer Sighting Network, collaborative reports of the Marineland Right Whale Project and the Marine Resources Council.

Date	Day	Time[1]	Location	Lat[2]	Long[2]	Species/ Class	Hdg	Pager #	Notes (Who sighted, etc.)	Verified?/ Photos?
6 Dec	Mon	9:00	Folly Beach, SC	32 34.2	79 55.5	MC	STA	VSN001	MRC, boaters	1245, Slalom
22 Dec	Wed	13:15	St. Augustine Bch	29 50.5	81 15.6	MC	STA	VSN002	MRC, FWC response	??
22 Dec	Wed	15:40	New Smyrna Beach	29 03.3	80 54.0		N	VSN003	Julie, MRC, Joel drone	2360, Derecha
26 Dec	Sun	12:03	Flagler Beach Pier	29 30.2	81 07.7	MC	N	FLWS023	Terry, Ralph drone, FWC later	2360, Derecha
7 Jan	Fri	17:25	Marineland	29 38.2	81 11.7	MC	S	VSN004	Sara & Jeanne; J. Jakush gets photo from Washington Oaks	2360, Derecha
8 Jan	Sat	9:22	Flagler Beach	29 27.3	81 06.7	MC	S	VSN005	Team 3, T Clark drone	2360, Derecha
9 Jan	Sun	13:28	Highbridge	29 25.7	81 05.9	MC	N	VSN006	Team 4, T. Clark drone	2360, Derecha
10 Jan	Mon	8:45	Marineland	29 40.1	81 12.4	MC	N	VSN007	Sara drone; Team 2,	2360, Derecha
10 Jan	Mon	10:20	Beach Haven, Matanzas	29 42.2	81 12.2	MC	S	VSN008	Sara & Terry, Team 2 but no drone flights or photos	ID=UNK
12 Jan	Wed	16:00	Serenata Club, Ponte Vedra Bch	29 58.2	81 18.3	MC	N	VSN009	Serenata staff	Video, ID UNK
13 Jan	Thur	13:04	Flagler Beach	29 27.9	81 06.7	MC	S	FLWS040	Team 3, Terry relay to FWC plane	3560, Snow Cone
13 Jan	Thur	14:53	S Flagler, Gamble Rogers	29 26.3	81 06.2	MC	S	VSN010	Sara drone	3560, Snow Cone
14 Jan	Fri	11:00	Ponte Vedra	30 12.8	81 22.0	MC	S	VSN011	Ponte Vedra: Julie received video from second caller	ID=UNK
20 Jan	Thur	15:57	S Ponte Vedra	30 01.3	81 19.1	MC	S	VSN012	S Ponte Vedra	3430
23 Jan	Sun	13:00	Flagler, S. Flagler, Gamble Rogers	29 27.3	81 06.3	MC	S	VSN013	Flagler Beach, Terry & Sara drone, Jim land; FWC plane	2360, Derecha
23 Jan	Sun	17:55	Ormond Beach	29 24.6	081 05.6	M/C	S	VSN014	MRC	2360, Derecha
24 Jan	Mon	9:31	Grenada,	29 17.4	81 02.0	MC	S	VSN015	Sara drone	2360, Derecha

			Ormond							
24 Jan	Mon		Washington Oaks, Sea Colony	29 38.2	81 11.8	MC	S	FLWS064	Washington Oaks, Sea Colony	3560 , Snow Cone
26 Jan	Wed	15:43	New Smyrna Beach	28 58.4	80 51.2	MC	S	VSN016	Julie & Joel, Tradewinds condo	2360, Derecha
28 Jan	Fri	14:00	St. Augustine pier, Anastasia State.Park	29 52.0	81 15.8	MC	N	VSN017	MRC, Team 1, Tessa & Jim Cole, Katie Jackson	2040, Naevus
30 Jan	Sun	11:50	Vero Beach			MC	SE	OTHER151	Public, Semkow	2360, Derecha
1 Feb	Tues		Crescent Beach	29 46.3	81 12.8	2 AD	STA	FLWS069	Team 1, relay to FWC's plane and vessel, 2.25 nmi offshore	3890, Babushka, 4190, Curlew
1 Feb	Tues	08:36	Melbourne Beach	27 59.3	80 31.0	MC	STA	VSN018	MRC, Land & drone images	2360, Derecha
1 Feb	Tues	16:53	Melbourne Beach	28 02.1	080 32.4	MC	N	VSN019	MRC	2360, Derecha
2 Feb	Wed	11:12	Cocoa Beach	28 17.6	080 36.4	MC	STA	VSN020	MRC, Joel drone	2360, Derecha
2 Feb	Wed	13:34	Ormond	29 15.4	81 00.7	2 AD	S	VSN021	Via whale alert app, Sara drone flight	3890, Babushka 4190, Curlew
2 Feb	Wed	15:52	New Smyrna Beach	29 00.1	80 52.2	MC	N	VSN022	Julie & Joel	3430
4 Feb	Fri		Gamble Rogers	29 25.6	81 05.6	2 AD ?	S	VSN023	Team 4	ID=UNK
7 Feb	Mon	13:23	Ormond	29 20.0	81 02.8	MC	STA	VSN024	Whale Alert app, Team 4, Sara drone	2360, Derecha
8 Feb	Tues	14:21	Daytona Bch Shores	29 10.2	80 58.6	MC	N	VSN025	MRC	2040 Naevus
11 Feb	Fri	17:08	Crescent Beach	29 46.5	81 14.8	MC	STA	FWC075	MRC hotline, calf # 6, FWC plane & boat, Sara drone	2040, Naevus
13 Feb	Sun	12:56	Daytona Beach Shores-Ponce Inlet	29 07.9	80 57.2	SING	S	VSN026	MRC, Sara drone, Jim land, boaters	2021 calf of 3904
16 Feb	Wed		Marineland to Varn Park	29 39.9	81 12.0	MC	S	VSN027	Team 2, Sara drone: no photos	ID=UNK
17 Feb	Thur	11:12	Ormond	29 15.2	81 00.6	MC	S	VSN028	T Pitchford, msg Sara drone	3560, Snow Cone
21 Feb	Mon	14:50	Jungle Hut to	29 29.0	81 06.5	2 AD	S	VSN029	Jim land photos Beverly	3890, Babushka

			Volusia County Line						Bch, Sara drone: no photos	4190, Curlew
21 Feb	Mon		Ocean Hammock Park	29 49.4	81 15.6	MC	S	OTHER213	FWC, Team 1	2360, Derecha
22 Feb	Tues	13:09	Beverly Beach to N Flagler	29 31.6	81 08.5	MC	S	VSN030	Sara and Jack Dewhurst drone	2360, Derecha

[1] time typically assigned when verified and photographed

Table 2. Presentations to groups and organizations, 2022 season

A: Volunteer Recruitment/Training

Date	Presenter	Detail
19 Mar	Jim Hain, Sara Ellis	Season-end event, Whitney lab, Marineland, FL, 80 attendees.

B: Public Education/Outreach

Date	Presenter	Detail
19 Jan	Terran McGinnis	Child-focused right whale talk at the St. Johns County Public Library (main branch), St. Augustine, FL- 11 attendees
27 Jan	Terran McGinnis	Adult-focused right whale talk at Ocean Art Gallery – Ormond Beach, FL - 21 attendees
1 Feb	Terran McGinnis	Adult-focused right whale talk (virtual) for Florida Master Naturalist Program, St. Augustine, FL - 15 attendees
5 Feb	Sara Ellis	"North Atlantic Right Whales, How you can help." Gamble Rogers State Park, Flagler Beach, FL – 12 attendees.
12 Feb	Terran McGinnis	Adult-focused right whale talk at the St. Johns County Public Library (main branch), St. Augustine, FL - 8 attendees
23 Feb	Sara Ellis	On post-film Q&A panel, *Last of the Right Whales* screening, Jacksonville, FL – 150 attendees
27 Apr	Sara Ellis	*Last of the Right Whales* screening, Portland, ME – 120 attendees
16 May	Sara Ellis	On post-film Q&A panel, *Last of the Right Whales*, Waterville, ME – 20 attendees

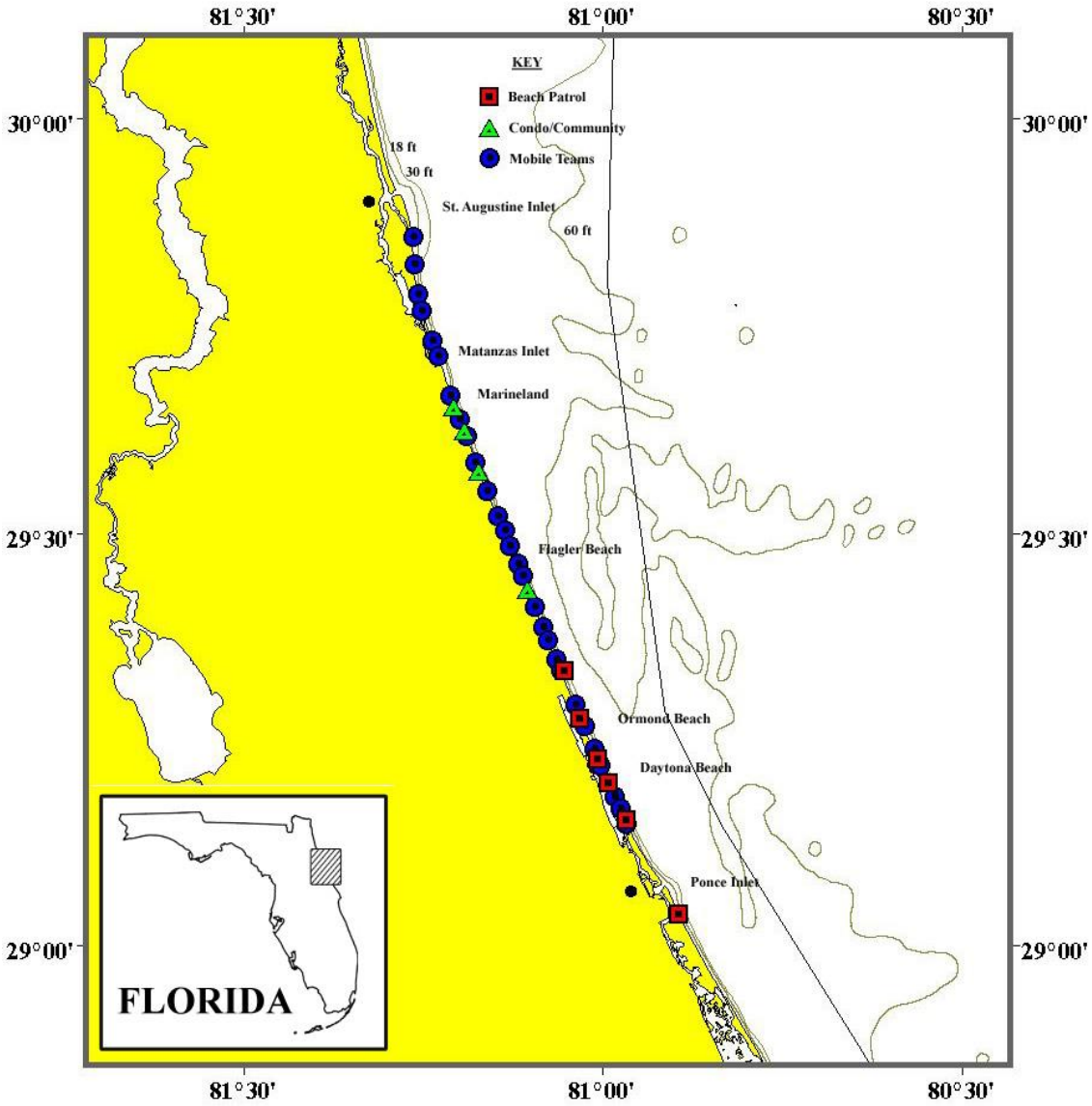

Figure 1. The 37 lookout points used by shore-based spotters in the Marineland Right Whale Project during the 2021–22 season. Although there may be small adjustments to locations, and points may be added and subtracted, the overall sighting effort has remained fairly constant for the past several years. The boundary of the 2016 SEUS right whale critical habitat (blue line) and three near-shore depth contours (labeled) are shown.

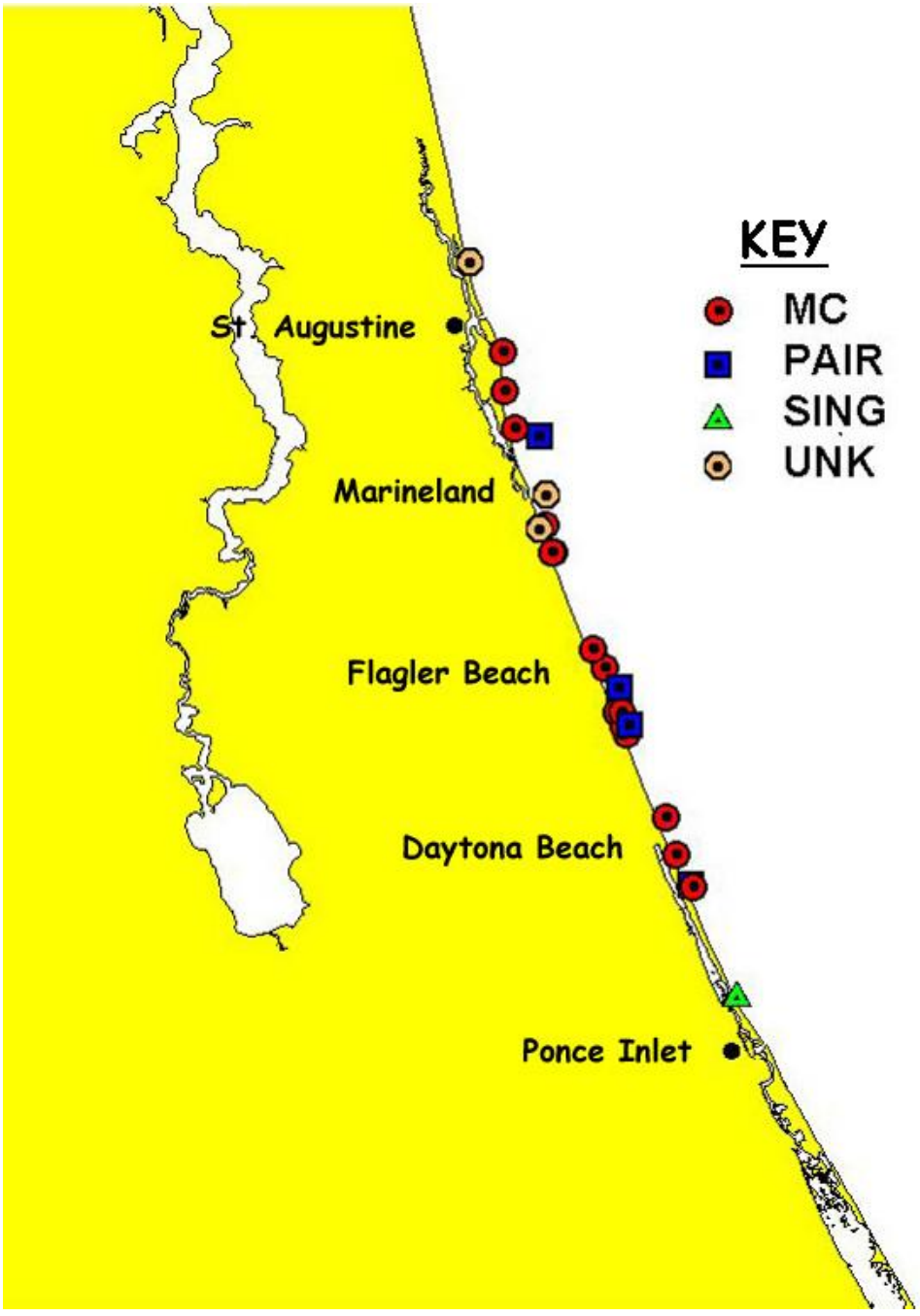

Figure 2. Verified right whale sightings by the MRWP during the 2021-22 southeastern U.S. season. The first sighting was on 26 December 2021 and the last on 22 February 2022. The 60 ft depth contour is shown. The solid vertical line is the boundary of the right whale critical habitat, as defined in January 2016.

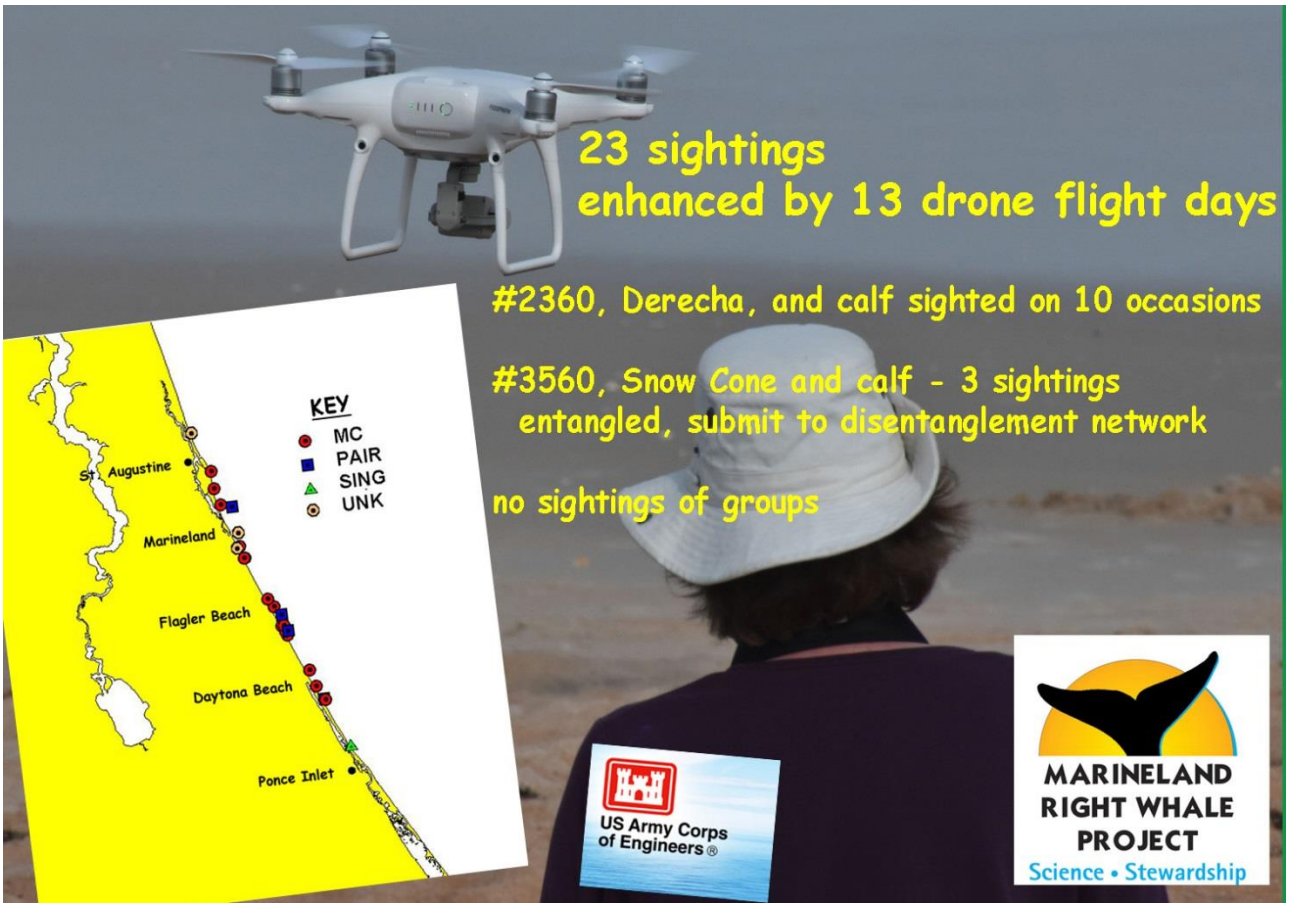

Figure 3. A 2021-22 season summary for the Marineland Right Whale Project. The use of an unmanned aerial system (UAS), or drone, enhanced photo identification and behavioral video documentation. Flying conducted with Federal Aviation Administration remote pilot certificates and NOAA/NMFS research permit #20626.

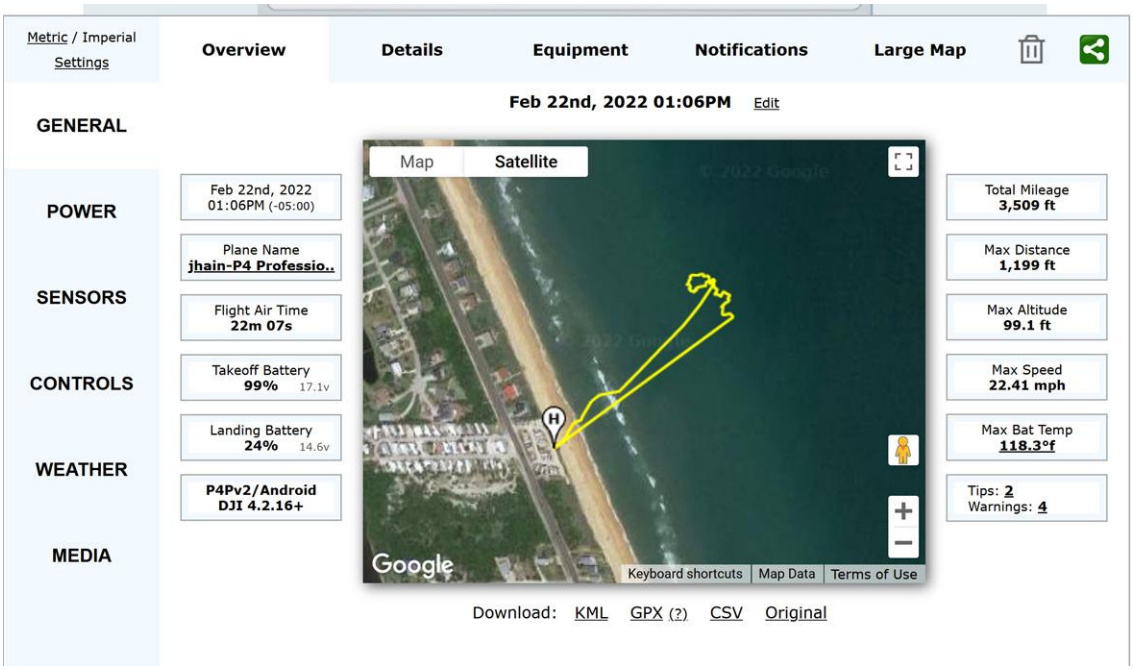

Figure 4. The use of unmanned aerial systems/multi-rotor drones has enhanced the information gathering of the program. In addition to photos and video, the system collects system and flight data, including GPS locations and a flight track. It is downloadable using the Airdata app. This example is from 22 February 2022, Female #2360, *Derecha*, and calf, off Beverly Beach.

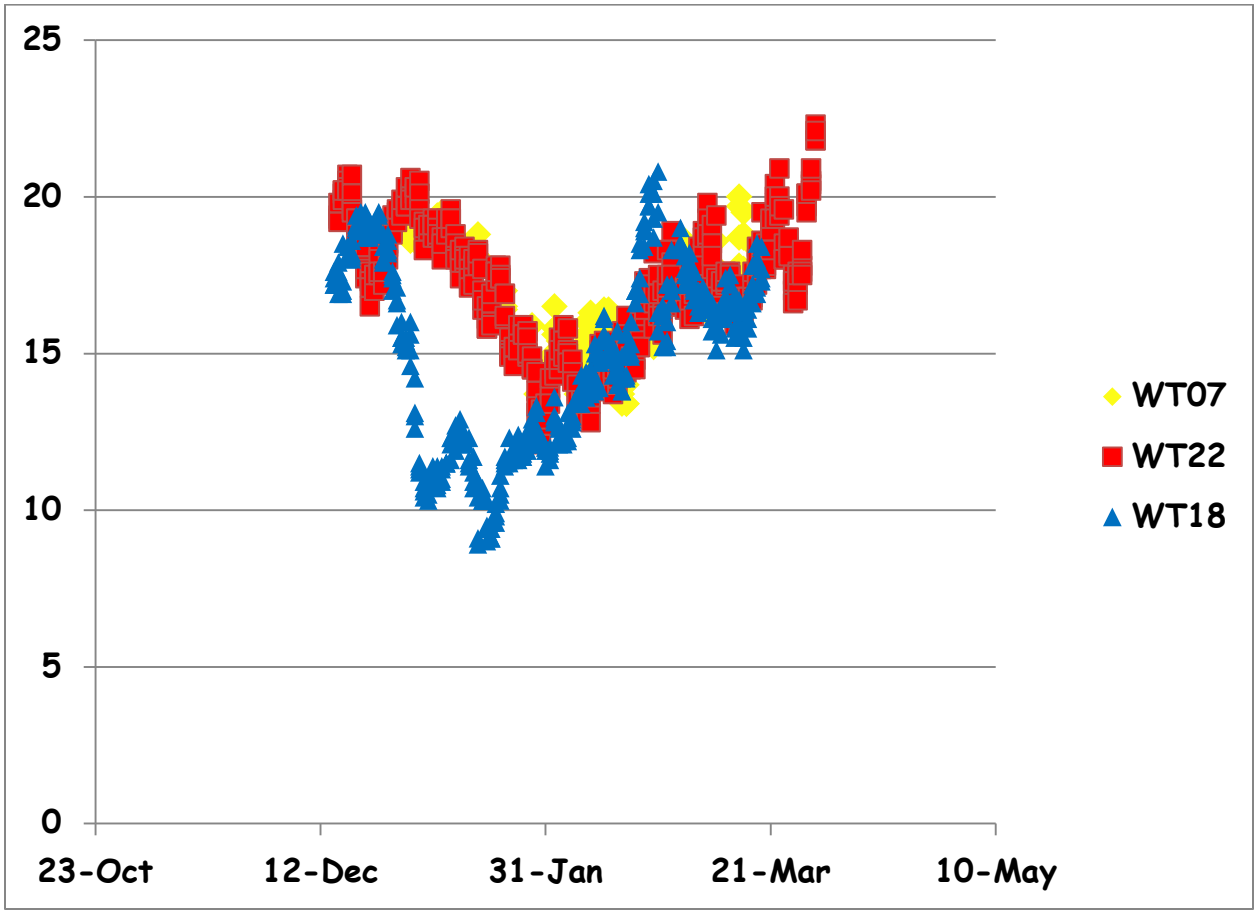

Figure 5. The 2022 sea surface temperature as measured at the National Data Buoy Center's SAUF1 station on the St. Augustine Pier. Two other seasons are shown for comparison: the 2007 season was similar; the 2018 season had a precipitous cold drop in late December/early January before returning to a more "normal" pattern.

Figure 6. The right whale documentary, *Last of the Right Whales*, shot over the 2020 and 2021 seasons, premiered in Jacksonville, Florida, on 23 February 2022. Sara Ellis, Marineland Right Whale Project, and Julie Albert, Marine Resources Council, were on the Q&A panel following the screening.

Figure 7. On February 1st and 2nd, a pair of young right whales was sighted off Crescent Beach and Ormond Beach respectively. They were females: #3890, *Babushka*, and #4190, *Curlew*. They were half-sisters, with the same mother, 2790, but different fathers—1818 and 1616. Even though they were of reproductive age, neither calved in the 2022 season.

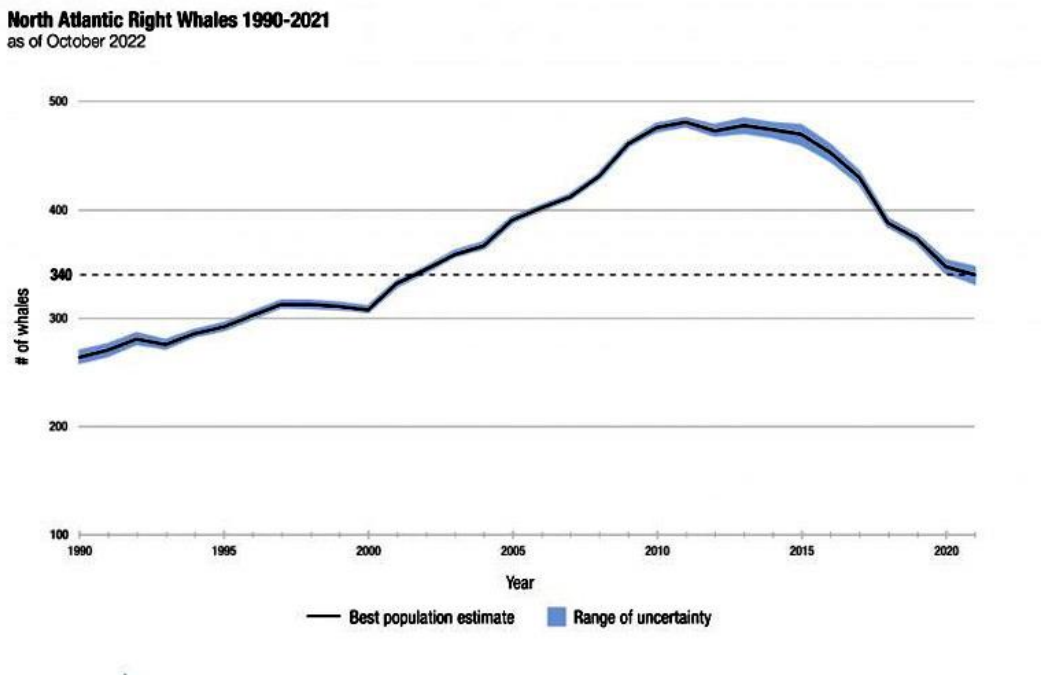

Figure 8. Assessments of the North Atlantic right whale population 1990-2021. Annual assessments are shown by a point estimate along with associated error that represents 95% of the posterior probability. The model estimates the number of whales alive at the start of each year plus any new whales entered during that year (see Pace *et al.*, 2017, *Ecology and Evolution* 7: 8730-8741) for model methodology). The estimate for 2021 was 340 +/- 7. Data from the North Atlantic Right Whale Identification Catalog as of August 30, 2022. The report card in its entirety will be posted in January at www.narwc.org.

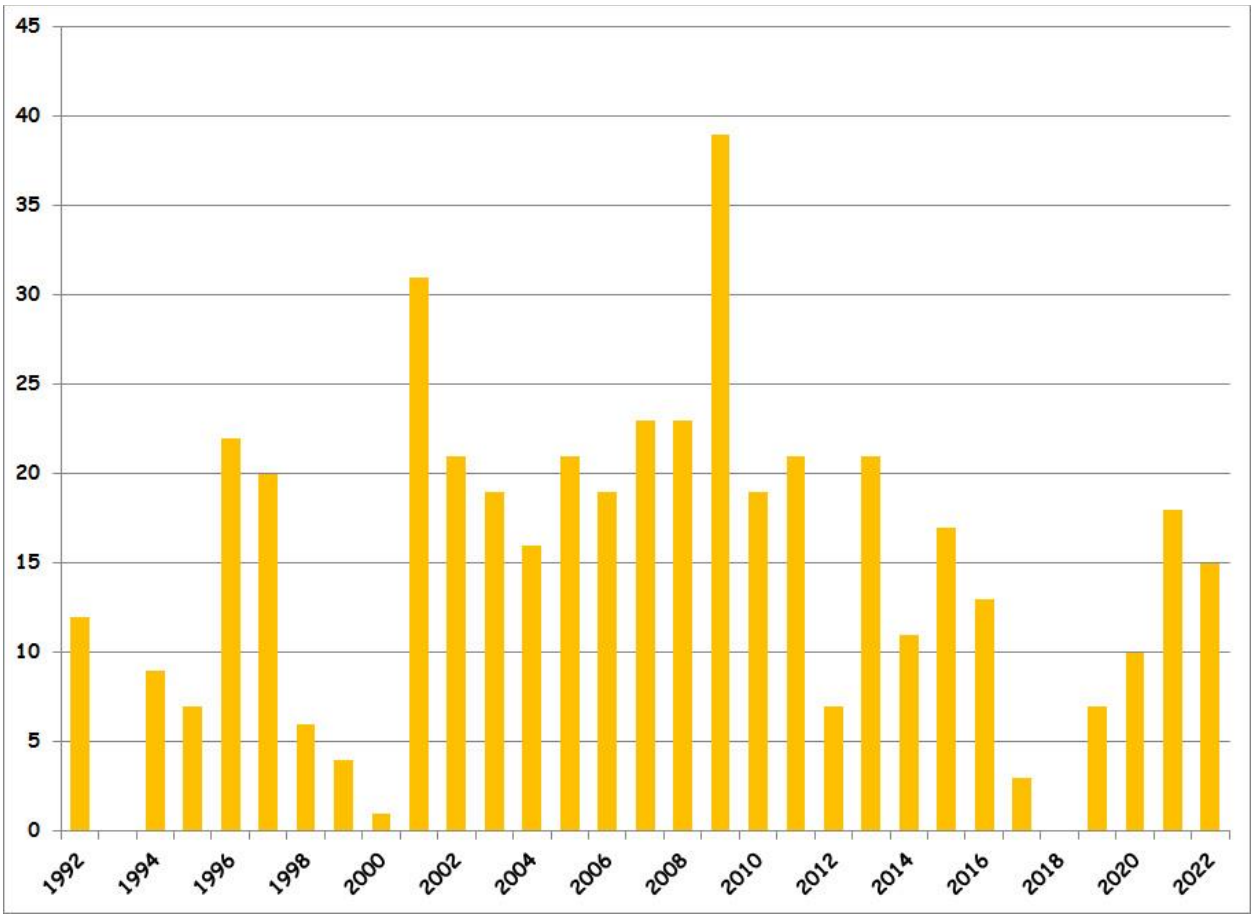

Figure 9. Calves born into the right whale population, 1992 through 2022. Large variability is present. In 2009, the calf count was 39, in 2018 it was 0. Data source: New England Aquarium.

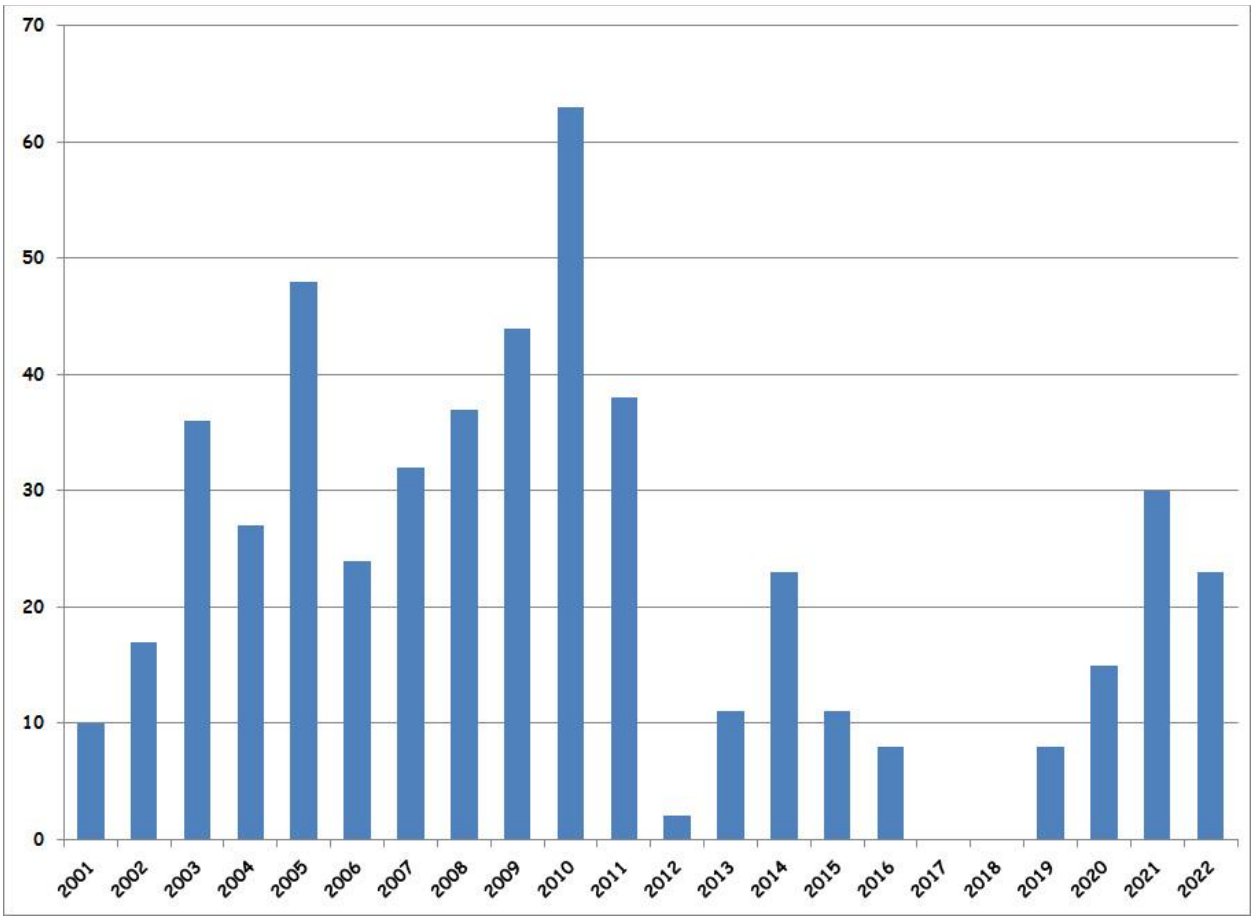

Figure 10. Sightings by the Marineland Right Whale Project 2021 through 2022. Similar to the above annual calf production, there is large variability, with a low year in 2012 (two sightings of the same individual), and the absence of sightings in 2017 and 2018. The most recent four-year period hints at an upturn.