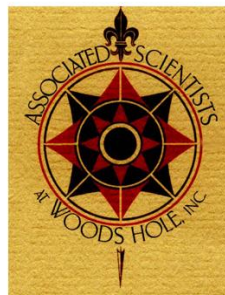


**Monitoring Endangered Right Whales  
in Coastal Waters of Northeast Florida  
by a Volunteer-Based Citizens Network**

**2015-16 SEUS Season**

**A Report to:**  
Volunteers, Collaborators, and Sponsors

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**Monitoring Endangered Right Whales in Coastal Waters of Northeast Florida**  
**By a Volunteer-Based Citizens Network**  
**2015-16 Season**

**Preface**

At the 15<sup>th</sup> annual meeting of the North Atlantic Right Whale Consortium, 2-3 November 2016, New Bedford, Massachusetts, there was a clear message. Beginning around 2011, there has been a change in distribution and abundance; a continuing issue with human impacts; and an increase in uncertainty and concern over the status of the population. Discussion topics included food sources, climate change, calf production, and human impacts. After several decades of monitoring and cautious optimism, there is a downturn in the outlook for the species. There is an increased need for the best efforts of the programs like the Marineland Right Whale Project.

**Summary**

*“For it is in these waters that the history of the endangered right whale will be written”*

The Marineland Right Whale Project completed the 16<sup>th</sup> year of the program in the near shore waters of northeastern Florida, generally between St. Augustine Inlet (29°54') and Canaveral Seashore (28°56').

Environmental factors were monitored closely. The sea-surface-temperature (SST) this year was middling or average—and we had neither a “warm” nor a “cool” season. Based on 16 years of sampling, sea-surface-temperature (SST) in the Marineland area is warming. Is this variability, a cyclical event, or evidence for climate change?

Similar to previous seasons, the number of verified right whale sightings (8) continued at low levels (with the possible exception of 2014). Of these sightings, all were mother-calf pairs—with only 2 different mother-calf pairs sighted. There were no sightings in the singles-pairs category, or, of groups of  $\geq 3$ . Noteworthy were several instances of offshore sightings by aircraft, beyond the sighting range of the shore spotters.

In collaboration with the Marine Resources Council, a number of sightings were recorded south of Cape Canaveral, seemingly in contradiction to what might have been predicted based on the warm SSTs in this area. Likewise, the southern excursion of female #3450 and her first calf adds to our curiosity about habitat use of first-time mothers. These “data outliers” provide valuable information.

In an example of good collaboration, the volunteer network and our coastal survey aircraft contributed to the biopsy sampling of the calf of #3450 just north of Ponce Inlet on 1 February. We also sighted and photographed #4094 on 17 February after she had lost her LIMPET satellite tag.

Possible human impacts were recorded on a single occasion. Mother-calf pair #3450 was approached by a recreational drone off Ormond Beach on 29 January. The approach was judged benign and the operator was advised on appropriate caution and regulations.

Humpback whales were sighted on five occasions—a relatively small number for our area.

The right whale data and photos for the season were submitted to the New England Aquarium's collaborative catalog and database on 1 July 2016. The humpback records and photos were submitted to the Florida Fish and Wildlife Commission's team and ultimately to the Center for Coastal Studies, Provincetown, Massachusetts.

Outreach and education continued—nine presentations to volunteers and 19 presentations for public education and engagement were given, including participation in the Town of Marineland's 75<sup>th</sup> Anniversary Celebration on 15 November 2015. Both within and external to our program, public awareness and citizen science is gaining in visibility and importance.

Right whales are a keystone species—for the ocean habitat, for the health of our natural resources, and ultimately, for human health and well-being. In more than a decade, there has been learning. Yet, the learning is incomplete. Continuing monitoring and diligence are warranted.

*And finally, why do this? Why should we care? It is not a pocketbook issue. It cannot be justified as an economy issue. It is a quality-of-life issue—for this generation and the next. Whales, sunsets, rainbows, mountains, birds, trees, rivers, flowers, and sandy beaches. We are all involved. We are all stewards.*

## **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,” was initiated in 2001, and the 2015-16 season was its 16<sup>th</sup>.

## 1.2 Right Whale Calving and Wintering Grounds

The coastal waters of the southeastern United States—principally Florida and Georgia—are the principal calving and nursing ground for the endangered North Atlantic right whale, *Eubalaena glacialis*. The small population numbers about 524, with a small number of calves born each year (the average in the recent 10 years has been 19).

Florida's coastline includes 175 nautical miles (nmi) of right whale critical habitat. In the 2015-16 season, as in several 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.

This more southerly coverage is important for several reasons, including: a) right whale sightings-per-unit effort (SPUE) values for the area south of St. Augustine are often comparable to those for the more heavily surveyed area to the north, b) characterizing the biology and addressing the mitigation in the more northerly EWS area necessarily includes data from throughout the right whale habitat, c) several channel entrances, with their associated vessel activity, lie in this more southerly area, and d) this area is experiencing rapid coastal development and an increase in population and warrants careful monitoring. Lastly, observations at the edge (the “outliers”) of a population’s distribution can be useful to measuring variability and change (*e.g.*, climate cycles or change) for a population and its environmental correlates (Greene *et al.* 2009).

Recovery and protection of right whales continues to be a priority and sometimes contentious topic. The National Oceanic and Atmospheric Administration (NOAA) has regulations that affect routing and speed of some vessels. (The five-year “sunset clause” expired in December 2013—an important deadline—the rule is now permanent but does allow for a review of efficacy.) The Navy has issued Environmental Impact Statements for bringing additional vessels to Mayport, and for establishing an Undersea Warfare Testing Range (USWTR) east of Jacksonville (construction has begun, and operation is expected for the 2018-

20 timeframe; R. Kalin, 6 October 2015). The commercial and cruise ship operators are proposing increases in vessel size and/or number in several parts of the region. Channel dredging and beach replenishment projects are ongoing. The Bureau of Ocean Management (BOEM) has proposed seismic testing along the U.S. east coast. Development of marinas may bring additional boating traffic. With recent uncertainty about the status of the right whale population, and continuing interactions (some negative) between humans and whales, successful co-existence will continue to be an issue. Continued monitoring and best efforts are required.

### **1.3 Program Scope and Objectives**

Building on the previous 15 seasons of experience, objectives for 2015-16 included:

- a) asking and addressing the important scientific questions, b) maintaining the number and quality of volunteers, c) increasing the sighting effort and geographic coverage, d) continuing to develop collaborations with other investigators and groups, e) continuing to increase data quality and percentage of right whales that are photo-identified, f) continuing to describe both patterns and variability, and g) synthesize and publish results.

## **2.0 Methods**

### **2.1 Overview**

During the course of 16 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 teams
  - \* Mobile
  - \* Community/Condo
- Opportunistic sightings
- Right Whale Hotline
- Response teams
- Aircraft surveys and response
- 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, is posted on the website: [www.aswh.org](http://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 aerial surveys, is in the near-shore waters of northeastern Florida between St. Augustine Inlet (29°54') and Canaveral Seashore (28°56'), within 5 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 (29°04'), while the aerial survey monitoring extends further 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 from the shore, the air, and occasionally from a vessel. Likewise, the response, extended observations, and photographs may include shore, air, vessel, and/or a combination. Throughout, there are standardized search effort and data collection protocols. This includes photo documentation and photo-identification, which is 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 above, 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 observers, 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 min 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 1230 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 (Figure 2) provides effective coverage of our ~ 60 nmi section of coastal habitat.

## 2.5 Aerial Surveys and the AirCam

To complement the shore-based network, aid in obtaining high-quality identification photos, and provide additional search effort (including in the area beyond ~2 nmi from the shore), we utilize a small, quiet, open-cockpit aircraft designed specifically for wildlife surveys and photography (an AirCam). The aircraft is hangered in Hastings, Florida, about 15 nmi west of the Matanzas Inlet. Survey flights are weather-dependent (clear skies, winds  $\leq 12$  kt, and sea states  $\leq$  Beaufort 3). Based on these criteria, we typically fly two to three times a week. The plane functions in two modes—flying a standard survey pattern (Figure 3), and responding to reported sightings. During flights, a Garmin GPS Map 296 automatically records the GPS positions every 30 sec, as well as on demand at waypoints, conditions changes, and sighting locations. As in previous seasons, we monitor the aircraft's flights in real time through the use of a SPOT Gen3 satellite messenger. The SPOT Gen3 transmits the aircraft position every 10 minutes, which can be viewed on a computer, tablet, or smart phone. The SPOT unit is also capable of emergency notification, and sending GPS location-based messages, such as when the aircraft is preparing for takeoff or has landed at the conclusion of a flight. This season, we implemented a new feature offered by Lockheed Martin Flight Services to have the AirCam's SPOT positions relayed to the Lockheed Martin system for automated flight monitoring. This adds an additional layer of aircraft tracking and safety.

## 2.6 Response Teams

A central location (the office in Marineland) is manned during daylight hours (Figure 4). This 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).

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.

## **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 include ship/boat collisions, fishing gear entanglement, and harassment by boaters and paddleboarders/surfers.

Data and photo documentation are submitted to NOAA law enforcement, the Whale-Vessel-Interaction database maintained by the Florida Fish and Wildlife Conservation Commission (FWCC), as well as the database and photo catalog maintained by the New England Aquarium (NEAQ), Boston, Massachusetts.

## **2.8 Phone Notification System**

The phone notification system has proven to be a success and is continuing. To facilitate faster, efficient, and complete notification of survey team members during whale sightings, we contract with One Call Now, an automated telephone messaging service. After importing the team members' names and contact numbers, One Call Now allows us to create a voice message and deliver it to any combination of the sectors we designate 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 during surveys and follows.

## **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 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  $\pm 0.5$  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. After a gap in 2014 and 2015, the SAUF1 station was fully operational in the 2015-16 season.

## **2.10 Quantification of Aerial Survey Effort**

In the 2011-12 season we sought to quantify the aerial survey effort incorporating consideration of survey conditions. In this way, a sightings-per-unit (SPUE) value could be prepared, and compared across seasons. We also sought to evaluate the merits of comparing SPUE with the other aerial survey teams. Working with Dr. Robert Kenney, Graduate School of Oceanography, University of Rhode Island, we established protocols and created datasets aimed at quantifying the aerial effort data for our area. This proved to be more complicated than anticipated. Secondly, in our case, calculation of SPUE is confounded by the interplay of shore-based and aerial sightings. As a result, in the 2015-16 season, we continued to record and tabulate data in a more streamlined fashion.

## **2.11 Unmanned Aerial System (UAS) and Observations**

On 13 October 2015 we purchased a DJI Phantom 3 Pro multi-rotor drone or UAS. On 10 February 2016, we received the Section 333 Exemption from the FAA to authorize our operation for research purposes. On 29 August 2016, the FAA implemented the new Part 107 small UAS rule, which facilitates our operation. A remaining hurdle for our particular operation is obtaining authorizations to operate within state and national park boundaries (when we are beach-launching), and a waiver to operate within 5 nmi of an airport. Applications have been submitted.

## **2.12 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, Boston, Massachusetts. The humpback whale data and photos are submitted to the Florida Fish and Wildlife team, and subsequently to the Center for Coastal Studies, Provincetown, Massachusetts.

## 3.0 Results

### 3.1 Sighting Effort

#### *Shore-Based*

Similar to previous years, 37 lookout points were monitored within the 60 nmi section of coast between the St. Augustine Inlet and the Canaveral Seashore (refer back to [Figure 1](#)). Included in these points were 28 points in the six sectors, 3 condo/community teams, as well as the lookout points provided by the Volusia County Beach Patrol. The 20 points and 3 condo/communities in Sectors 1 through 4, St. Augustine Beach to Ormond Beach, were surveyed seven mornings a week. The eight points in Sectors 5N and 5S, Ormond Beach to Daytona Beach South, were surveyed up to four mornings a week by two teams.

Dedicated surveys began on Monday, 4 January 2016, and ended ten weeks later on Sunday, 13 March 2016. During this ten-week period, the dedicated mobile and community teams logged 1,553 hours of survey time, generally beginning at 0800 hr and ending around 1200 hr. This combined effort was supplemented by opportunistic lookouts along the coast.

#### *Aerial Surveys and Photo-Documentation*

From 21 December 2015 to 29 February 2016, the Associated Scientists/Marineland group made 19 flights in the SEUS with the AirCam on 19 separate days. The 19 flights surveyed parallel track lines at 0.5 nmi and 1.5 nmi from the shoreline (refer back to [Figure 2](#))—a dual-purpose mode that benefits multi-species search objectives, facilitating the detection of manta rays (*Manta* sp.) that may be present in the study area in early winter and those arriving during their spring migration. Fifteen of the nineteen flights completed both parallel track lines within an area defined from 29° 55' N to 28° 56' N, with the track lines about 60 nmi in length. Several flights were incomplete or partial surveys due to weather and other factors ([Table 1](#)). No flights were made in March mostly due to weather conditions that exceeded defined parameters for survey flights.

The exact track line surveyed during each flight varied somewhat due to weather conditions, coordination with the FWC survey aircraft, and reports of sightings by the Volunteer Sighting Network and others. An overall total of 2,318 nmi were flown during 59.2 flight hours. Weather variables and sighting data were recorded according to standard protocols.

### 3.2 Right Whale Sightings 2015-16

#### *Overall Sighting Summary*

In the 2015-16 season, there were 8 sightings in the Marineland area (St. Augustine inlet to Canaveral Seashore) (Table 2, Figure 5). This was about half of the sightings for the 2013-14 season, and similar to the 2012-13 and 2014-15 seasons. (Recall that during the 2011-12 season, there were only two sightings in our area—both of the same individual.) For the recent five years, the average number of total sightings has been 11. For the preceding ten years, the average has been 19.

All eight sightings were of mother-calf pairs, with two different mothers: Catalog #3450 (*Clipper*), and #4094 (*Mayport*). Female #3450 is of unknown age but more than 12 years old. She gave birth to her 1st known calf in 2016. Female #4094, is 6 years of age; and also gave birth to her 1st calf. MC pair #3450 was the most sighted, on 7 of the 8 occasions (more information below). MC pair #4094 was only seen on a single occasion, on 17 February by the AirCam survey plane about 1.7 nmi from shore, just south of Sunglow Pier (more information below). The pair subsequently moved closer to shore. In this season, we did not record any non-mother-calf pairs or singles, or groups ( $\geq 3$  individuals).

Our partners to the south, the Marine Resources Council, reported 7 sightings in the area south of Cape Canaveral, with 6 of MC pairs, and 1 of a single individual (Figure 6). The first report for the season of female #3450 and her 1<sup>st</sup> calf was on 19 January (Figure 7). This was a new calf report by MRC. The sightings of this pair were further highlighted by a Sebastian Inlet river incursion on 8 February. At 08:41, Peggy Bentley, a Sebastian Inlet State Park employee (who had attended a training session for park employees and staff on 21 January) phoned the MRC hotline. Fishermen at the park reported seeing them enter the inlet between 07:30 and 08:00. Julie Albert and other MRC responders were on site by 10:41. FWC (boat and aircraft) and others also responded. The pair remained in the Indian River Lagoon overnight and exited around noon on the following day, 9 February. Videos of the event were taken by Stephanie Schoolfield, Melbourne Beach, Florida, and several news organizations. (Videos are available on YouTube and Vimeo; search on “Sebastian Inlet Whale.”)

Female #3450 and calf were the subjects of another collaborative effort. At 08:43 on 1 February a beachwalker sighted whales north of Ponce Inlet. The call to the MRC hotline was relayed, and the on-duty Marineland Team 5 was deployed, as was the AirCam. We also relayed the information to the FWC team, who deployed a truck and trailered boat to Ponce Inlet. By 13:26, the FWC team had successfully biopsy-darted the calf.

The only non-mother calf pair for our area was #1968, Quattro, sighted by fishermen at 10:00 on 1 February about 20 nmi offshore of Port Canaveral at a popular fishing spot, “Pelican Flats.” The sighting was originally reported to MRC. This individual was injured and unwell.

Four individuals were satellite-tagged this season (see <https://georgiawildlife.wordpress.com/2016/04/06/year-2-of-tagging-right-whales-in-the-southeast/>), One, #4094, was sighted by our group. The 6-year-old female was judged unlikely to be pregnant, and was therefore LIMPET tagged on 16 January, seen on 20 January, and again on 21 January (with a calf). The tag was lost on 22 January, likely dislodged by the calf. The Marineland’s aerial sighting on 17 February provided post-tagging photographs and documented a more nearshore location for this pair.

Based on a compilation by the Florida Fish & Wildlife team, no individual right whales were uniquely sighted in our area this season. That is, all whales recorded by our groups south of St. Augustine were also recorded by one or more of the other survey teams.

Humpback whales were sighted on five occasions in our area (refer back to **Figure 5**)—a relatively small number compared to the previous season.

### *Aircraft Sightings*

From 21 December 2015 to 29 February 2016, the Associated Scientists/Marineland group made 19 flights in the SEUS with the AirCam on 19 separate days.

On four days there were right whale sightings. On three of the days, sightings were relayed from other sources. However, on one day, 17 February, the aircraft team recorded two unique sightings—female #4094 and calf and #3450 and calf. Both sightings were just beyond the practical sighting distance from the shore.

The AirCam team photographed humpback whales on two occasions (other sightings were from shore). Data and photographs were provided to the Florida Fish and Wildlife team.

### *Opportunistic and Contributed Sightings*

Despite 10 weeks of on-watch effort, the dedicated teams reported no right whale sightings this season. All sightings came from other components of the program.

Citizens reported a number of sightings directly, or, through the MRC hotline. Photos and videos were likewise contributed.

On 19 January, a MRC hotline call at 16:14 about 1.3 mi S of Port Canaveral was an important call as it was a report of an additional calf for the season. Julie Albert of the MRC responded and obtained photographs.

On 30 January, Carlos Diaz reported from the Atlantis Condo in Ormond Beach (he has reported previously). Photographs in foggy conditions were sufficient to identify another sighting of MC pair #3450.

In a final example of an opportunistic report, a sighting and photographs on 1 February by fisherman Bill Fazio from Pelican Flats, 20 nmi offshore of Canaveral were relayed to the MRC. This was identified as #1968, Quattro, and injured an unwell 27 year-old female.

### *Human Impacts*

We had no entangled, injured, or dead whales this season in the Marineland area. We did have one event of a close approach and possible harassment. On Friday, 29 January, Female #3450 and calf were swimming slowly south off Ormond Beach. Responders and Team members were on site. At ~ 13:00, a recreational-type drone was flown in the vicinity of the mother-calf pair, documented by photographs. One of our Team Leaders spoke with the operator and advised on cautions and regulations. The event was judged to be benign and no further actions were taken.

### **3.3 Quantification of Aerial Survey Effort**

As described, we developed a streamlined collection and tabulation of effort data in the 2012-13 season. We continued to track basic sightings-per-unit-effort values (Table 1). Analysis and further refinement are underway.

### **3.4 Unmanned Aerial System (UAS) Observations**

Due to delays related to paperwork as well as the sparsity of whales in our area, the UAS was not employed for right whale observations in the 2016 season.

### **3.5 Sea Surface Temperature**

The large-scale sea-surface-temperature (SST) was monitored from the NAVOCEANO daily plots. Relative to at least some other seasons, the cold-water feature progressing southward along the coast was relatively undeveloped (Figure 8). The finer-grain SST as measured at the NOAA SAUF1 station at the St. Augustine pier showed the customary mid-season dip (Figure 9). A comparison to other seasons indicated this was neither a “warm” nor a “cool” season, but rather a “middling” one (Figure 10). Lastly, in a cross-season analysis, using 1 February as a reference point, in 2016 the SST was slightly less than the 16° C temperature we use as a reference point—almost average (Figure 11).

### **3.6 Weather and Survey Conditions**

As described, continued emphasis and training were placed on the dedicated surveyors’ documentation of environmental conditions, providing better quality data to analyze surveys and weather conditions. Of the 70 total survey days, full surveys were conducted in good weather conditions on 19 days (27%)—identical to last season. On 49 days (70%), full or partial surveys took place under moderate or poor weather conditions. On 2 survey days (3%), no surveys took place, or, less than 25% of the survey area was covered due to high winds, fog, or extreme cold. Windy conditions that produced increased Beaufort sea states were the principal causal factor in approximately 2/3<sup>rds</sup> of the survey days having moderate or poor weather conditions. Wind and fog in March precluded some surveys, but 38% of the days had good conditions, and 62% were moderate.

### **3.7 Collaboration with the Florida Fish and Wildlife Conservation Commission Team**

As in past seasons, an active and successful collaboration with other researchers is an essential component of this project. Collaboration on skills and resources increases the options available and the results obtained. In particular, the Marineland Right Whale Project and the Florida Fish and Wildlife Conservation Commission shared resources and exchanged information before, during, and after the season. This was the case for flight planning, relay of sighting reports, cooperation on a biopsy darting on 1 February, and compilation of summary data and reports.

### **3.8 Volunteer Training and Public Outreach**

The participation of local citizens is central to the program. This season, we had about 220+ dedicated participants (most of whom were returnees and had one or more years of prior experience), and many more when the opportunistic spotters are included. The training,

education, and outreach are achieved through numerous meetings, seminars, and community presentations (Table 3). As shown, we were involved with school, church, Elderhostel, environmental, community, and recreational groups. On 15 November 2015, we participated in the 75<sup>th</sup> Anniversary Celebration of the Town of Marineland (Figure 12).

We have learned that feedback and communication is essential to the success of a volunteer network. This includes regular gatherings, periodic newsletters, and e-mail updates. In this season, e-mail updates and reports were sent on a regular basis. The website ([www.aswh.org](http://www.aswh.org)) was updated at the beginning of the season. In addition, sightings and results were posted for both volunteers and the public in a timely manner at [marinelandrightwhale.blogspot.com](http://marinelandrightwhale.blogspot.com).

The “Marineland Right Whale Survey Project” brochure was on hand, and the Team Handbook was updated and reprinted. (The Team Handbook was also posted on the website, [www.aswh.org](http://www.aswh.org).) At the end of the season, as a gift and souvenir for the volunteers, the “Marineland Right Whale Project” re-usable grocery bags were distributed to volunteers, business partners, and collaborators as a symbol of our larger environmental stewardship interests.

Our program information and results were provided to local news outlets, resulting in a number of newspaper articles. In addition, several magazine articles were prepared:

Gromling, F. 2016. Sixteen Years of Whale Research. *Sun and Surf* 58(3): 54-56.

Gromling, F. 2016. The Value of Volunteers. *Sun and Surf* 58(4): 50-52.

### **3.9 Disposition of Data**

As in previous years, images and corresponding data were submitted to the Right Whale Catalog at the New England Aquarium, Boston, Massachusetts. The complete packet was mailed to the New England Aquarium on 1 July 2016. The data and photographs of humpback whales were provided to the Florida Fish and Wildlife team, and subsequently to the Center for Coastal Studies, Provincetown, Massachusetts.



## **4.0 DISCUSSION**

### **4.1 Perspective**

Until about 2011, we believed that we were monitoring and encouraging slow and steady progress for conserving and recovering the small population of endangered North Atlantic right whales. This has changed. We are now working to understand a downturn. This involves asking and answering questions, and addressing the unknowns. This mission goes beyond right whales. It extends to overall environmental awareness and stewardship.

### **4.2 Overview**

Effective conservation and management depends on good information. After 16 years, that information is telling us that right whale distribution and abundance in our area is fluid and dynamic. There is uncertainty with the population size and distribution, variable environmental conditions, variable right whale biology, and changing demographics on the SEUS calving and wintering ground (and elsewhere). While we often search for means, patterns, and predictions; recording, analyzing, and understanding the variability of the many environmental and biological parameters is key to our improved conservation and stewardship of the ocean and its inhabitants.

### **4.3 The Big Picture**

The current best estimate is that there are about 524 individual right whales in the population (NARWC Annual Report Card 2015, at [www.narwc.org](http://www.narwc.org)). Within this population, there may be ~100 reproductive females. (A given female will have a multi-year calving interval.) In 2016, there were 14 calves born—a five-year average of 19—and below expected. In addition, the calving interval has increased from 3.5 to 6.6 years (K. Jackson, 11 May 2016 summary).

Only 20 adult right whales were sighted in the SEUS in the 2016 season (calves not included here). This is a dramatic change from seasons where we had ~ 200. This is attributable in large part to the change in the number of juveniles migrating to the SEUS.

On all counts, large changes are occurring in the SEUS.

### **4.4 Surveys and Sightings**

For the Marineland Right Whale Project, from 2001 through 2011, the total number of sightings per year showed a general upward trend (Figure 13). However, for the recent 5-year period, 2012 through 2016, the number of sightings were at a lower level. This decrease was similarly reflected in the number of mother-calf pairs sighted in our area (Figure 14). There are likely several contributing factors—of which we have a poor understanding (see below).

As we have done previously, we note the unpredictability of weather and whales. Nearly every year presents different puzzles. Note, for example, the gap in right whale sightings from north of Ormond Beach, past Marineland, and to St. Augustine (refer back to [Figure 5](#)). Even though we imagine that whales at some point were in or passed through this area, they did so unsighted.

We also note the two sightings beyond the range of shore observers (detected by aircraft). This tells us something about habitat use and the value of complementary tools.

We expect that our efficacy will be enhanced by the UAS in 2016-17.

#### **4.5 Habitat Use and Movements**

As described previously, there were a number of more offshore sightings this season. This more offshore area south of St. Augustine is perhaps under-sampled. We note that the compilation by Kraus and Kenney (1991) show a number of offshore sightings south of St. Augustine. To some unknown degree, the offshore sightings may be a function of survey effort. While the indications are that the distribution is generally more nearshore in this area, in view of current changes, our curiosity is aroused.

Likewise, we continue to be curious about movements. In reports from past years, we suggested that first-time mothers may share the characteristic of being frequently sighted, having a nearshore occurrence, a repetitive longshore movement, and a southerly occurrence. The extended southerly excursion of mother-calf #3450, 19 January through 17 February (refer back to [Figure 7](#)), contributes to these data.

Lastly, looking beyond numbers and distribution of sightings, we conducted a “first-last analysis” by season. That is, when did the first mother-calf pair arrive in the Marineland area, and when did the last mother-calf pair depart the area? This is an imperfect analyses (there is a sighting effort factor), but does give some impression of habitat use. In the 2015-16 season, MC pairs arrived late and left early ([Figure 15](#)). In the 2011-12 season, no MC pairs were sighted. On the other hand, in both the 2005-06 and 2012-13 seasons, there was an extended MC occurrence in the area. Very likely, a combination of factors is involved.

#### **4.6 Human Impacts**

While the recreational drone approach to a mother-calf pair off Ormond Beach on 29 January was generally benign, the issue of nearshore whales in good weather attracting attention and subsequent approaches remains. Education and outreach efforts continue. We favor an educational and collaborative, rather than a punitive reaction, so as to engage rather than alienate local citizens.

## 4.7 Sea-Surface Temperature

SST continues to be examined as a correlate to right whale distribution and abundance. The 11 March 2015 repair of the NDBC sensor at the end of the St. Augustine pier was welcome, and continues to contribute to continuing analyses of this factor. As seen back in [Figure 9](#), the SST in the Marineland area appears to be warming. Does this constitute a cyclical event or a trend, or, a combination of both?

## 4.8 Observations and Models

There is continuing interest in the predictive capabilities of modeling (*e.g.*, Gowen and Ortega-Ortiz 2014). Models, as do many tools, may provide useful information. We submit, however, that a carefully considered observational program should appropriately be conducted in parallel with a carefully considered modeling effort.

## 4.9 Conservation and Management

The Marineland Right Whale Project has completed its 16<sup>th</sup> year of right whale monitoring in a 60 nmi section of the SEUS right whale critical habitat. The program is a successful combination of public engagement and careful science. The volunteers are an invaluable resource, and we continue to refine the approaches and methods that optimize their contribution.

A major product of the program is the awareness and engagement of a diverse local citizenry. As described, the number of sightings reported from both dedicated and opportunistic sources is a direct result of heightened awareness and interest.

Collaboration with other investigators and programs continues to yield results. Information, sightings, and photographs from multiple sources (shore, boat, plane), multiple investigators (FWCC, MLD, MRC, NEAQ), and multiple seasons are producing an accurate description of the SEUS biology of right whales and their habitat. Information and perspective gained from our program is regularly provided to the SEUS Right Whale Forum and SE US Right Whale Recovery Plan Implementation Team.

Monitoring and conservation of the whales and their ocean habitat continues. Continuing monitoring and diligence is warranted. Our efforts continue to be aimed at the successful co-existence of right whales and humans—for this generation and the next.

And finally, why should we care? Why is this important? In discussing the economics of public issues, Miller *et al.*, 2014, describe whales as a “charismatic” species—that is, people get satisfaction from simply knowing that they are out there swimming in the ocean. Thus, whales are said to have “existence value”—people get satisfaction just from knowing that they exist, satisfaction that would be lost if the co-existence of humans and whales would cease. There is a value that is difficult to quantify. Aside from any scientific and economic studies, healthy whales relate to healthy humans and enhance the quality of life.

The cornerstones of our program continue to be careful science, thoughtful analyses, good people, and contribution to conservation and management—all held over the long term.

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Greene, C.A., B.C. Monger, and L.P. McGarry. 2009. Some like it cold. *Science* 324: 733-734.

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### **Acknowledgments**

First and foremost, we are grateful for the good efforts and strong commitment of our volunteers. Joy Hampp, Terry Clark, and Becki Smith are program coordinators and also the very capable aerial survey team. Program support is or has been provided by the U.S. Army Corps of Engineers, Jacksonville District; the Batchelor Foundation; the Elizabeth Ordway Dunn Foundation; Victoria Principal Foundation; the Deerbrook Trust; the Lastinger Family 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., the 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 authorized by NMFS permit #13927.

Table 1: AirCam Survey Effort Summary 2015-16. Flown as a dual-purpose survey (right whales and manta rays) on parallel 0.5 and 1.5 nmi tracklines. The standard survey area extends from the St. Augustine Inlet south to the Canaveral National Seashore. This pattern is a total of 134 nmi. "Good" trackline is defined as clear visibility of at least 2 nmi and Beaufort sea state  $\leq 3$ .

DATE	DAY	CATEGORY	HOBBS HRS	TRACKLINE (NM)	POOR COND (NM)	TOTAL GOOD TRACKLINE (NM)	EFFORT (KM)	SIGHTINGS	RIGHT WHALES	SPUE (per KM)	NOTES
<b>2015</b>											
<b>21-Dec</b>	Mon	Complete	3.2	134	0	134	247.90	0			
<b>29-Dec</b>	Tue	Complete	3.2	134	0	134	247.90	0			Delayed departure due to fog
<b>2016</b>											
<b>11-Jan</b>	Mon	Partial	2.5	82	64	18	33.30	0			Increasing BSS
<b>12-Jan</b>	Tue	Complete	3.5	134	38	96	177.60	0			BSS @ 4 for Poor Condition
<b>16-Jan</b>	Sat	Partial	2.2	63	0	63	116.55	0			Aborted due to rain
<b>20-Jan</b>	Wed	Complete	3.2	134	33	101	186.85	0			
<b>21-Jan</b>	Thurs	Partial	3.7	134	0	134	247.90	1	2	0.00807	Diverted to S. Ponte Vedra for FWC M/C sighting; Ended S. line in New Smyrna Bch.
<b>25-Jan</b>	Mon	Complete	3.2	134	0	134	247.90	0			
<b>26-Jan</b>	Tue	Complete	3.2	134	0	134	247.90	0			
<b>30-Jan</b>	Sat	Complete	3.2	134	0	134	247.90	1	2	0.00807	
<b>31-Jan</b>	Sun	Complete	3.0	134	0	134	247.90	0			

<b>1-Feb</b>	Mon	Complete	3.4	134	0	134	247.90	1	2	0.00807	
<b>11-Feb</b>	Thurs	Partial	1.3	29	29	0	0.00	0			Shortened survey due to high BSS
<b>17-Feb</b>	Wed	Complete	4.1	134	0	134	247.90	2	4	0.01614	
<b>20-Feb</b>	Sat	Complete	3.3	134	0	134	247.90	0			
<b>21-Feb</b>	Sun	Complete	3.1	134	0	134	247.90	0			
<b>22-Feb</b>	Mon	Complete	3.4	134	0	134	247.90	0			
<b>28-Feb</b>	Sun	Complete	3.3	134	0	134	247.90	0			
<b>29-Feb</b>	Mon	Complete	3.2	134	0	134	247.90	0			
<b>TOTALS</b>			59.2	2318	164	2154	3984.90	5	10	0.00251	

Table 2. Sighting summary 2015-2016. This summary includes sightings by both the Marineland Project and the Marine Resources Council.

Date	Day	Time <sup>1</sup>	Location	Lat <sup>2</sup>	Long <sup>2</sup>	Species/ Class	Hdg	Pager #	Notes (Who sighted, etc.)	Verified?/ Photos?	
11 Dec	Fri	12:26	Flagler Bch	29 29.8	81 07.5	HUWH	S		Tony Caruso	Y	
3 Jan	Sun	10:00	JAX Beach			RIWH	sta		Erin Hindy phcall	N/N	
18 Jan	Mon	10:42	Ormond Beach	29 16.4	81 01.2	HUWH			Toni Anderson, Team	Y/N	“probable” HUWH
19 Jan	Tues	16:45	Cape Canaveral	28 23.6	80 35.0	MC	S	OTHER009	Julie, MRC	Y/Y (at dusk)	#3450, Clipper New, # 7
20 Jan	Wed	15:47	Cocoa Beach	28 17.0	80 35.6	MC	N	MRC001	Julie, MRC	Y	#3450
21 Jan	Thur	09:20	Ponte Vedra	30 00.2	81 18.2	MC		FWS012	FWC, AC later	Y	#3317
29 Jan	Fri	12:49	Ormond	29 21.5	81 03.6	MC	S	MRC002, MLD verify	Becki, Team 4 Sheila respond photos	Y/Y	#3450
30 Jan	Sat	08:29	Ormond, Grenada	29 17.0	81 01.1	MC	S	FWS020	Carlos Diaz, Becki, FWC, AC	Y/Y	#3450
30 Jan	Sat	10:50	Surf Club			?			Joyce Young, Sheila & Team 2 respond	N/N	?
01 Feb	Mon	08:43	South Daytona	29 05.5	80 55.2	MC		MLDA001	Team 5 S, AC FWC dart calf	Y/Y	#3450, Clipper
01 Feb	Mon		Pelican Flats	28 14	80 14	sing			Boater, via Julie, MRC	Y/Y	#1968
02 Feb	Tues	16:13	Canaveral Nat SS	28 55.0	80 48.3	MC	S	MRC003	Via Julie, MRC	Y/Y	#3450, Clipper
02 Feb	Tues	20:37 ?	Ponce Inlet				S		Via Julie, MRC	N/N	??
06 Feb	Sat	14:39	Satellite Beach	28 12.3	80 35.0	MC	sta	MRC004	Julie, MRC	Y/Y	
07 Feb	Sun	16:43	South Daytona			?			Via Julie, MRC; Becki, Jim, John T. respond	N/N	Not verified
8 Feb	Mon	12:45	Sebastian Inlet	27 51.1	80 27.4	MC		FWS030	Julie, MRC, FWS030		#3450, Clipper

9 Feb	Tues	12:57	Off Sebastian I	27 52.1	80 26.2	MC	N	Other036	0.7 off the beach		#3450, Clipper
11 Feb	Thur	10:45	Sea Place			??			Betty P and Team 1, AC responds in p.m.	N/N	Not verified
14Feb	Sun	17:15	Ormond-by-the-Sea	29 18.5	81 01.8	MC	S	MRC005	Becki, Dale, Elaine, Jim respond	Y/N	Visual, no photos
16Feb	Tues	11:32	Ponce I	29 05.4	80 55.3	MC	S	MRC006	Mike Brothers	Y/Y	#3450, Clipper ?
17Feb	Wed	11:31	S. Daytona	29 08.8	80 55.8	MC	W	MLDA002	AirCam, others	Y/Y	#4094
17 Feb	Wed	12:22	New Smyrna B	29 00.4	80 52.1	MC	sta	MLDA003	AirCam, others	Y/Y	#3450, Clipper
22 Feb	Mon	11:08	Beverly Beach	29 33.5	81 06.4	HUWH			AirCam	Y/Y	
28 Feb	Sun	11:08	Surf Club	29 39.5	81 11.0	HUWH			AirCam	Y/Y	
15Mar	Tues		Dayt Bch Sh	29 11.5	80 58.7	HUWH		Estimated loc	MRC, NWSJRNL		Mark vanFleet
29 Mar	Tues		St. Aug			HUWH			T Pitchford, Julie		
30 Mar	Wed		Daytona			HUWH			T Pitchford, Julie		
9 May	Mon		Malacompmpa			HUWH			Fred Pelliman		Maybe ?

Table notes:

>> all positions are whale positions rather than observer positions

<sup>1</sup> Time = time of initial report or species verification

<sup>2</sup> Lat and Long = position when verified and photographed



Table 3. Presentations to groups and organizations

A: Volunteer Recruitment/Training

Date	Presenter	Detail
<b>2015</b>		
4 Dec	Paul Eckstein, Joy Hampp	Introductory talk held at Flagler County Public Library, Palm Coast, FL; 22 attended
5 Dec	Paul Eckstein, Joy Hampp	Introductory talk held at Ormond Beach Public Library; Ormond Beach, FL; 6 attended
5 Dec	Joy Hampp, Diane Hazel	Introductory talk held at Anastasia Branch, St. Johns County Public Library, St. Augustine Bch, FL; 14 attended
15 Dec	Joy Hampp, Becki Smith	Pre-season coordination meeting for Project Team Leaders, Beverly Beach Town Hall, Beverly Bch, FL; 14 attended
17 Dec	Joy Hampp, Becki Smith	Introductory talk held at Ocean Art Gallery, Flagler Beach, FL; 18 attended.
<b>2016</b>		
2 Jan	Joy Hampp, Jim Hain	Training class held for new and returning Project surveyors at Whitney Center for Marine Studies, U. of Florida Whitney Laboratory, Marineland; 154 attended
13 Feb	Jim Hain, Joy Hampp	Mid-Season update for Project survey teams at Whitney Center for Marine Studies, U. of Florida Whitney Laboratory, Marineland; 85 attended
29 Mar	Joy Hampp, Jim Hain	Year-end review for Project survey teams at U. of Florida's Whitney Center for Marine Studies, Marineland, FL; 116 attended

Table 3 (cont'd)

## B: Public Education/Outreach

Date	Presenter	Detail
<b>2015</b>		
2 Nov	Frank Gromling	Right whale presentation for NE Florida Sierra Club, Ponte Vedra Beach, FL; 26 attended
11 Nov	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 30 attended
15 Nov	Joy Hampp, Becki Smith, Assorted Vols	Right whale information table, Town of Marineland 75 <sup>th</sup> Anniversary Celebration, Marineland, FL; Est. 300-400 attended.
9 Dec	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 24 attended
<b>2016</b>		
13 Jan	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 39 attended
15 Jan	Arliss Ryan, Penny Bellas, Robin Pinga	Right whale presentation for Osceola Elementary School, St. Augustine, FL; 115 students & teachers attended.
23 Jan	Frank Gromling	Right whale presentation for Gamble Rogers Memorial State Park, Flagler Beach, FL; 18 attended.
27 Jan	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 39 attended
10 Feb	Paul Eckstein	Right Whale talk for Presbyterian Women's Association, Trinity Presbyterian Church, Palm Coast, FL; 42 attended.
24 Feb	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 34 attended
4 Mar	Paul Eckstein	Right whale presentation for Road Scholar program, Hilton Garden Inn, St. Augustine Beach, FL; 35 attended
17 Apr	Frank Gromling	Right whale presentation for Center for Spiritual Living Daytona Beach, Beville Rd., Daytona Beach, FL; 20 attended.
21 Apr	Frank Gromling	Right whale presentation for Flagler Beach Rotary Club, Father O'Flaherty Hall, Flagler Beach, FL; 28 attended
12 May	Frank Gromling	Right whale presentation for Gamble Rodgers State Park, Ocean Art Gallery, Flagler Beach, FL; 18 attended.

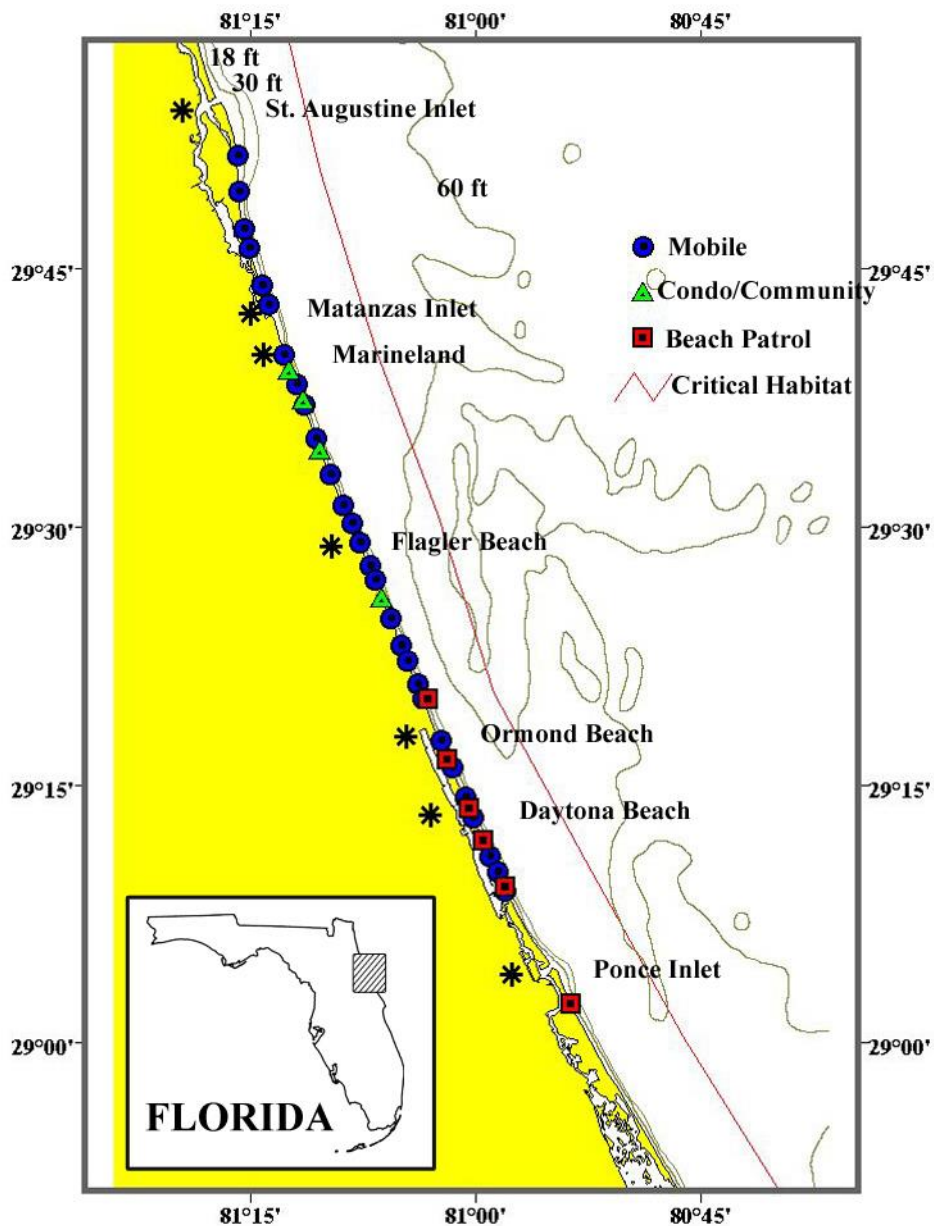


Figure 1. The 37 lookout points used by shore-based spotters in the Marineland Project during the 2015-16 season. Although there may be small adjustments to locations, and points may be added and subtracted, the overall sighting effort has remained fairly constant for the past several years. The 5 nmi boundary of the 1994 SEUS right whale critical habitat (red line) and three near-shore depth contours (labeled) are shown.



Figure 2. A core of 200+ dedicated and capable volunteers provide “eyes on the water.” (Many eyes are the antidote to few and widely scattered whales.) The volunteers include fishermen, beachwalkers, condo dwellers, town and county employees, and the teams that conduct surveys from January through mid-March.



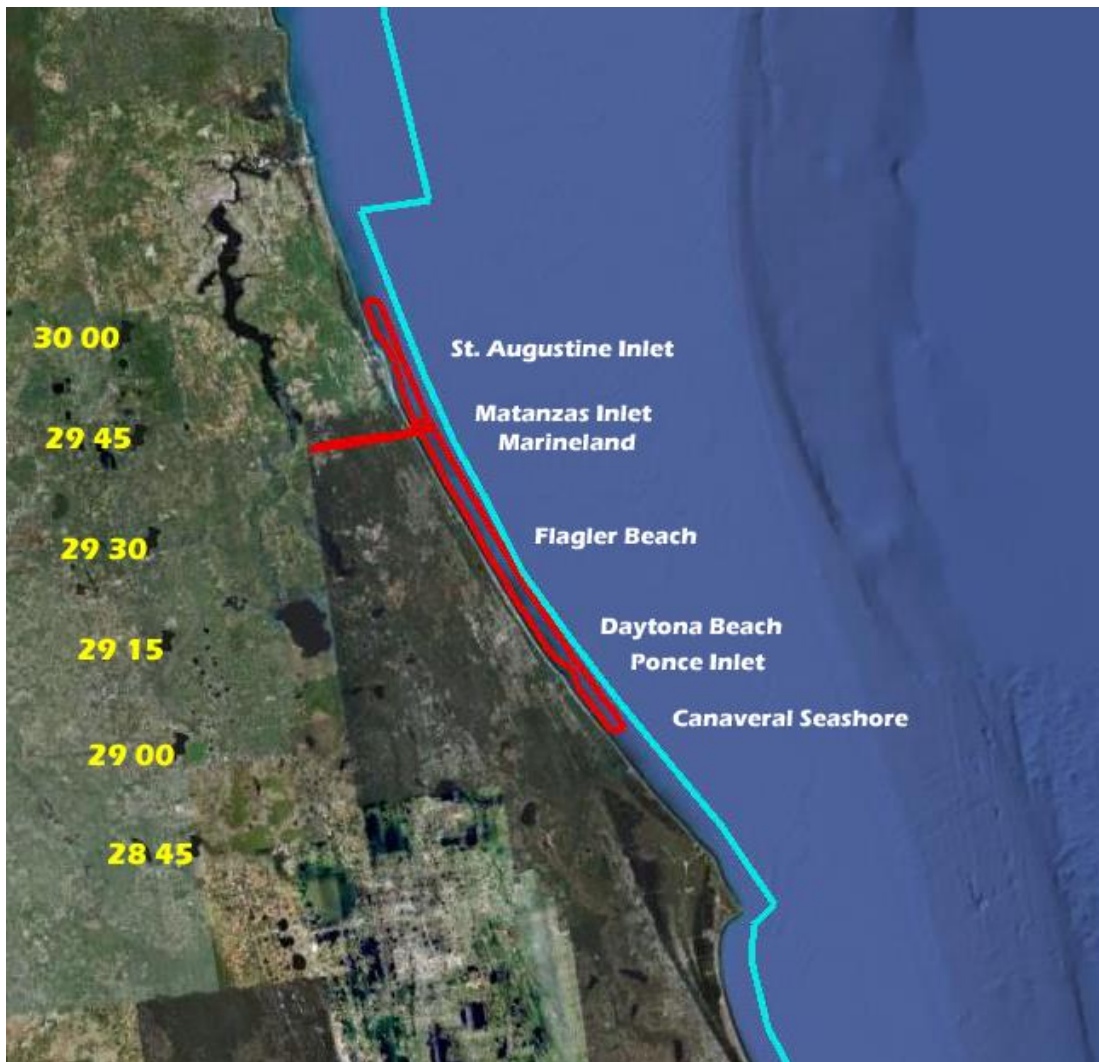


Figure 3. The shore-based sighting network and the aircraft surveys and responses are both complementary and synergistic. Shown are the standard aircraft survey tracks (red line) and the boundary of the 1994 SEUS right whale critical habitat (aqua line). The aircraft also responds to sighting reports originated by shore spotters, and aids in obtaining high-quality photographs essential to photo-identification and documentation.



Figure 4. The central call-in and dispatch office at the Guana-Tolomato-Matanzas National Estuarine Research Reserve facility in Marineland is manned during daylight hours. This is also the repository for equipment, data, and images.

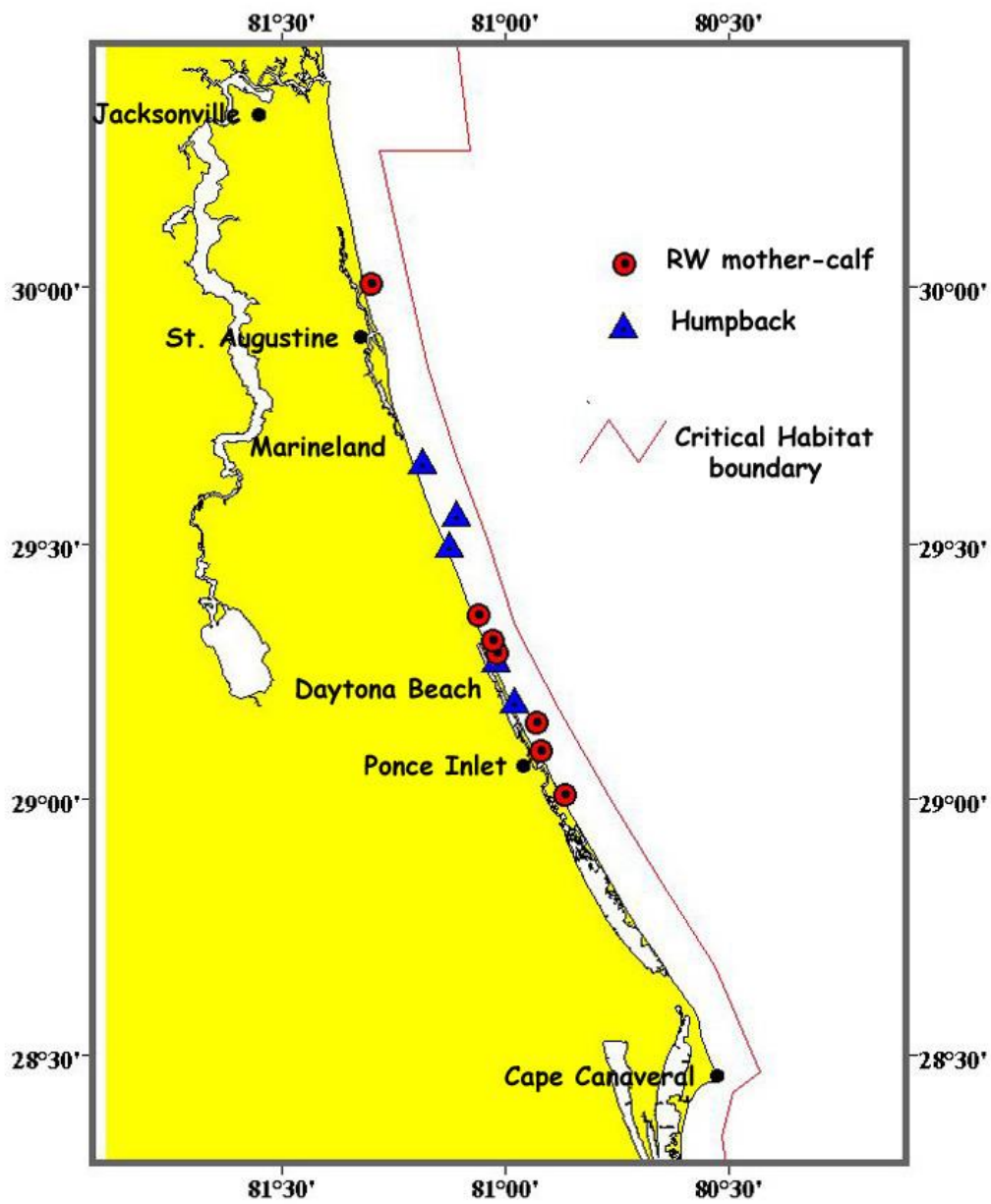


Figure 5. Verified right and humpback whale sightings in the Marineland survey area, St. Augustine to Canaveral National Seashore.

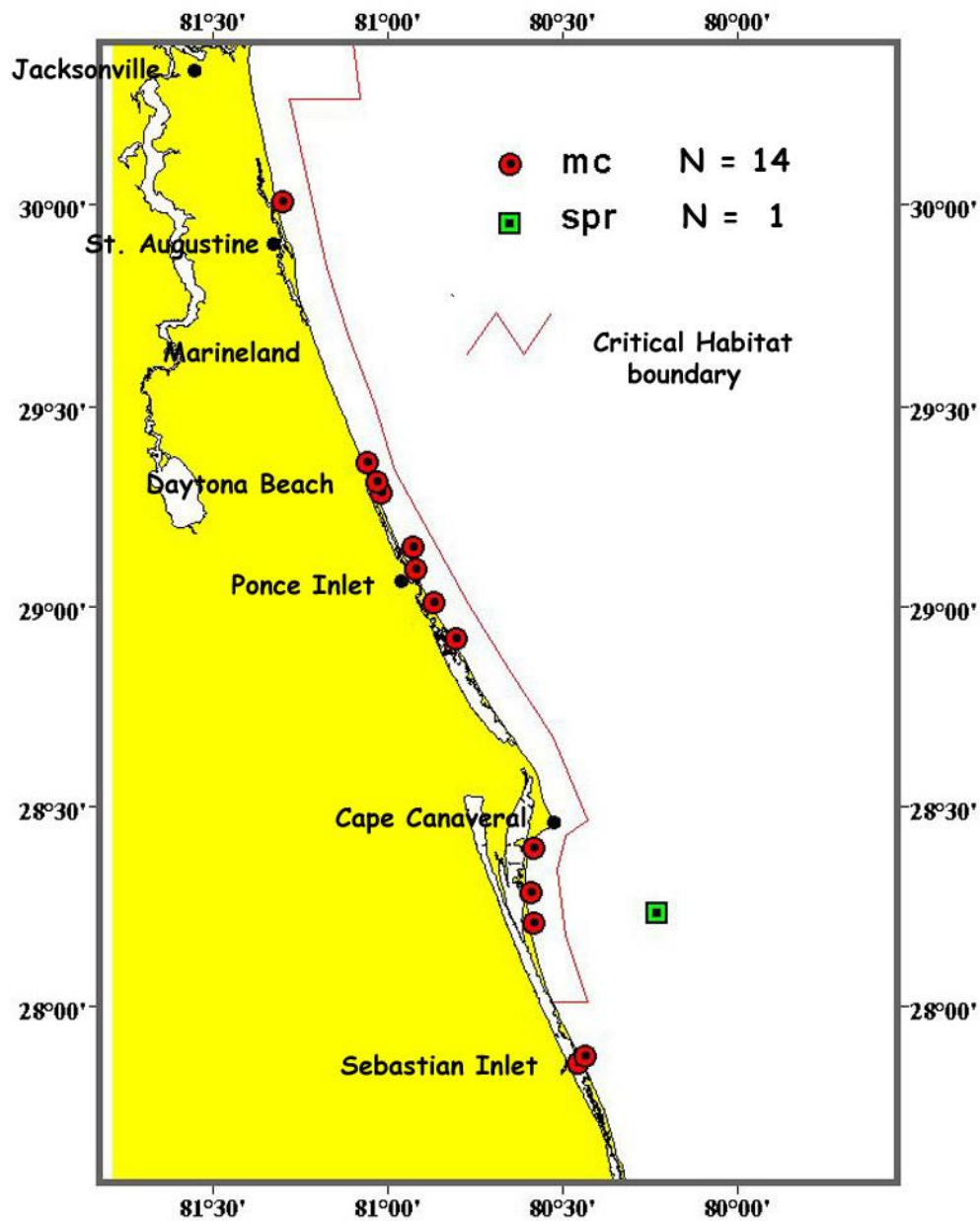


Figure 6. Verified whale sightings by the Marineland Right Whale Project and the Marine Resources Council during the 2015-16 southeastern U.S. (SEUS) season.



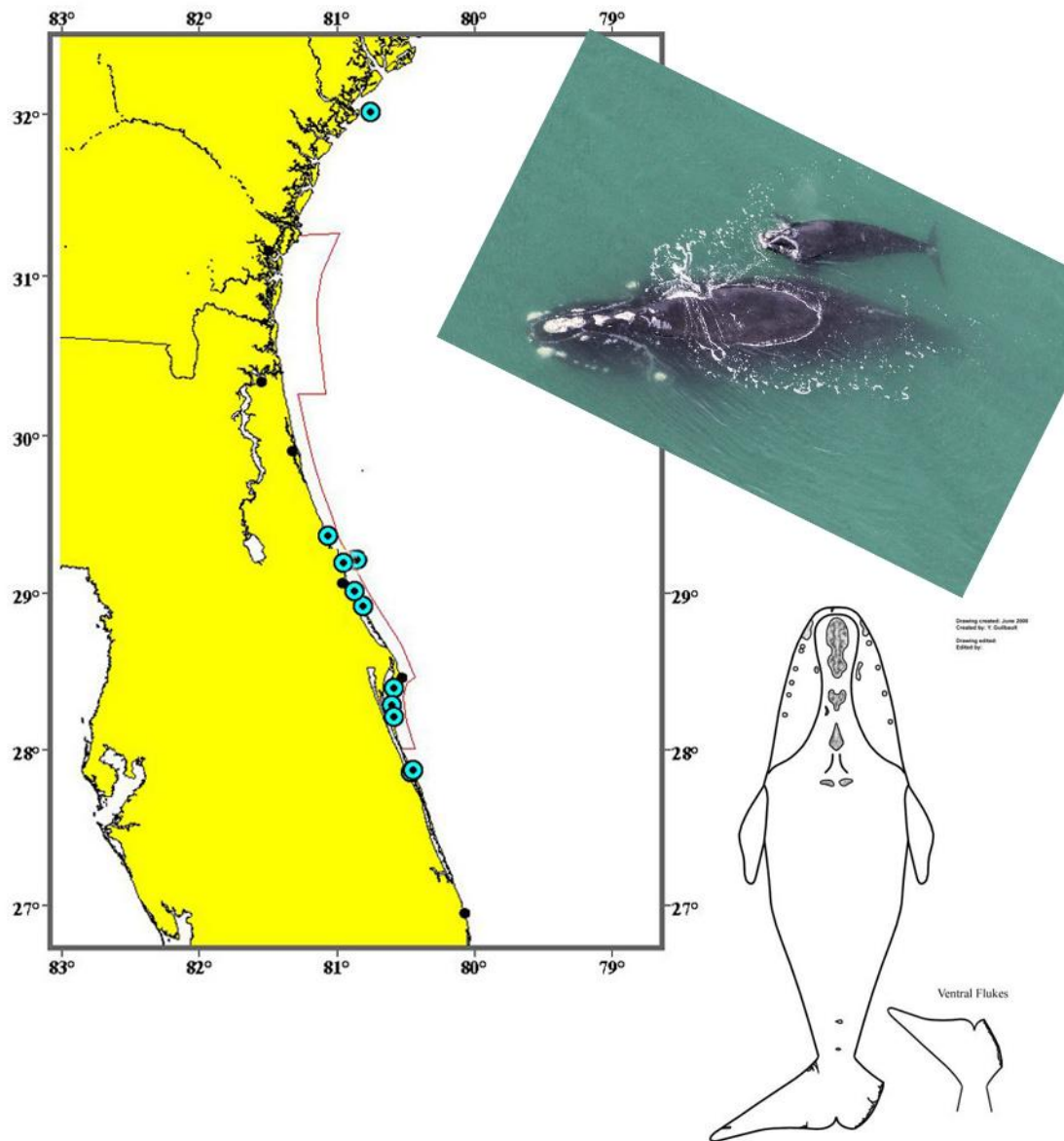


Figure 7. Our most frequently sighted right whale during the 2015-16 season was female #3450, *Clipper*. This individual was first reported in the SEUS on 19 January with a calf off Cape Canaveral. At the time, this female was at least 12 years old, and the calf her first known calf. She is distinguishable by the missing right fluke tip. There were nine verified sightings—all south of Ormond Beach. On 8 February, the pair swam between the jetties at Sebastian Inlet, and remained in the Indian River Lagoon until exiting again around noon on 9 February. Despite the fact that this pair passed through the 165 nmi N-S area between Ormond Beach and Savannah, Georgia, there were no reported sightings. The last sighting was 28 February off Savannah, GA. With gaps of a week or more in time and distances of more than 100 nmi with no sighting reports, we are again reminded of the uncertainty in sighting whales.

**NAVOCEANO K10 SST 01FEB16**  
**20 °C Isotherm in Red**

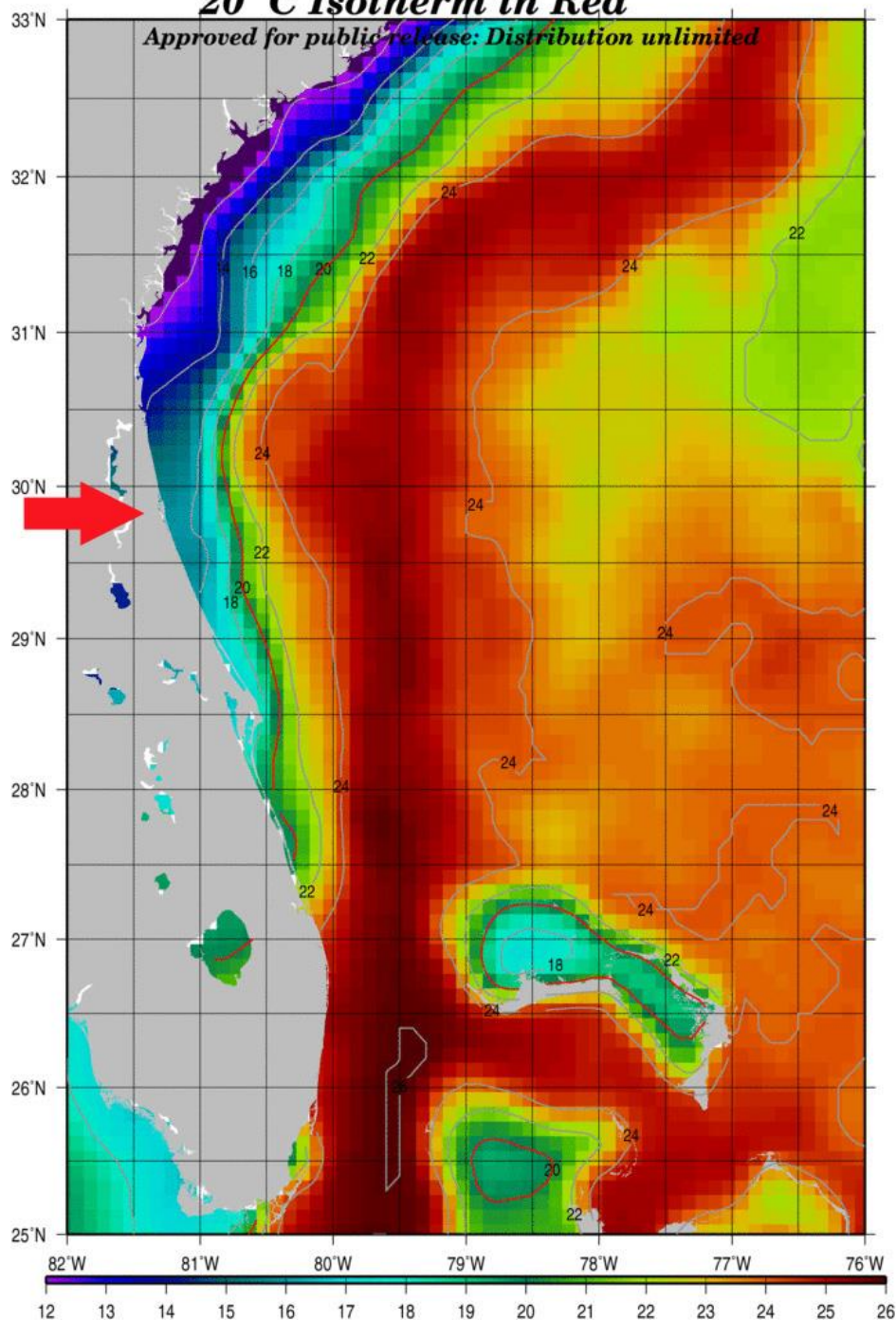


Figure 8. The Sea-Surface-Temperature (SST) as interpolated from satellite-based AVHRR measurements provide the big-picture view of ocean temperature features—the warm Gulf Stream is shown to left of center and the cool-water feature developing southward along the coast is shown in the upper left. The red arrow indicates the location of Marineland as a reference point. At mid-season on 1 February 2016, the cool water feature is relatively undeveloped and the SST in the Marineland area is about 15° C.

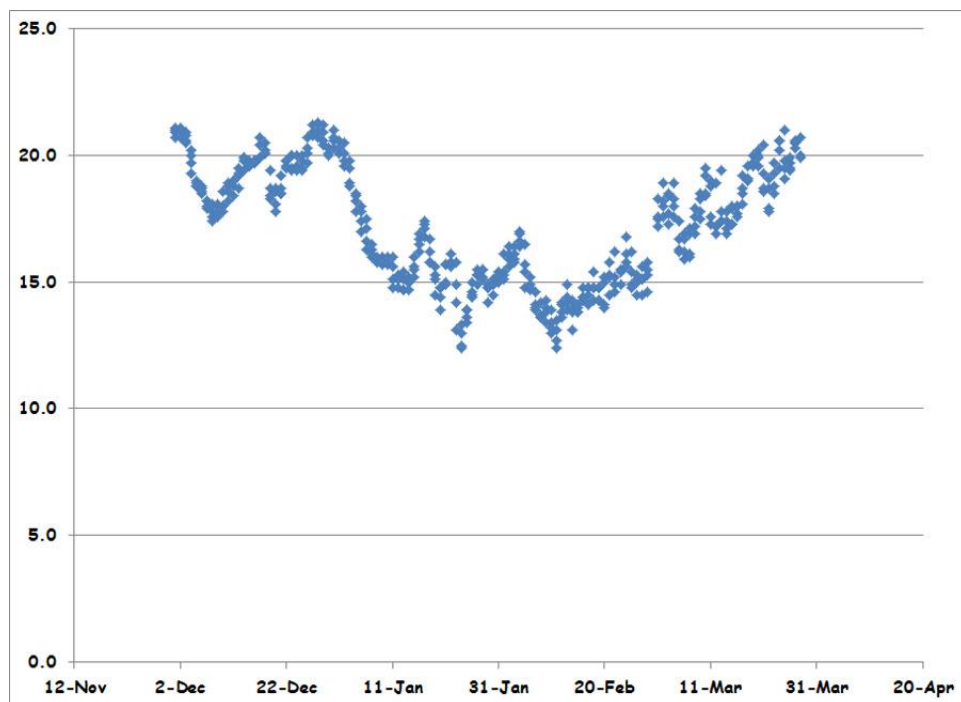


Figure 9. The SST as measured at the NDBC station on the end of the St. Augustine pier.

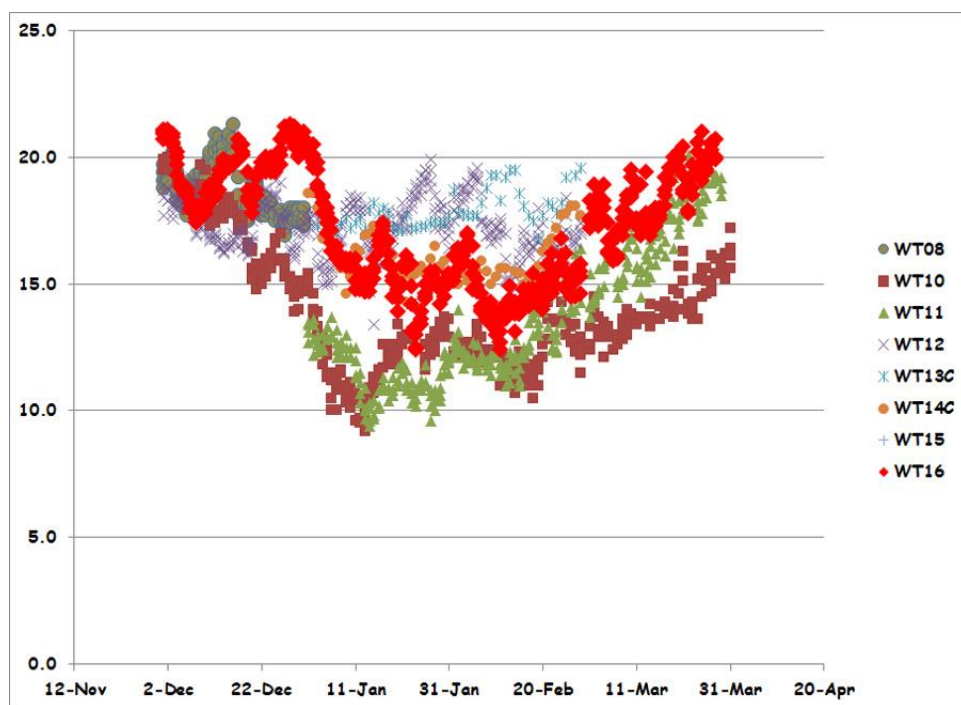


Figure 10. The across-year comparison of SSTs, as measured at the NDBC station on the end of the St. Augustine pier. The 2016 SST suggests neither a “warm” nor a “cold” year.

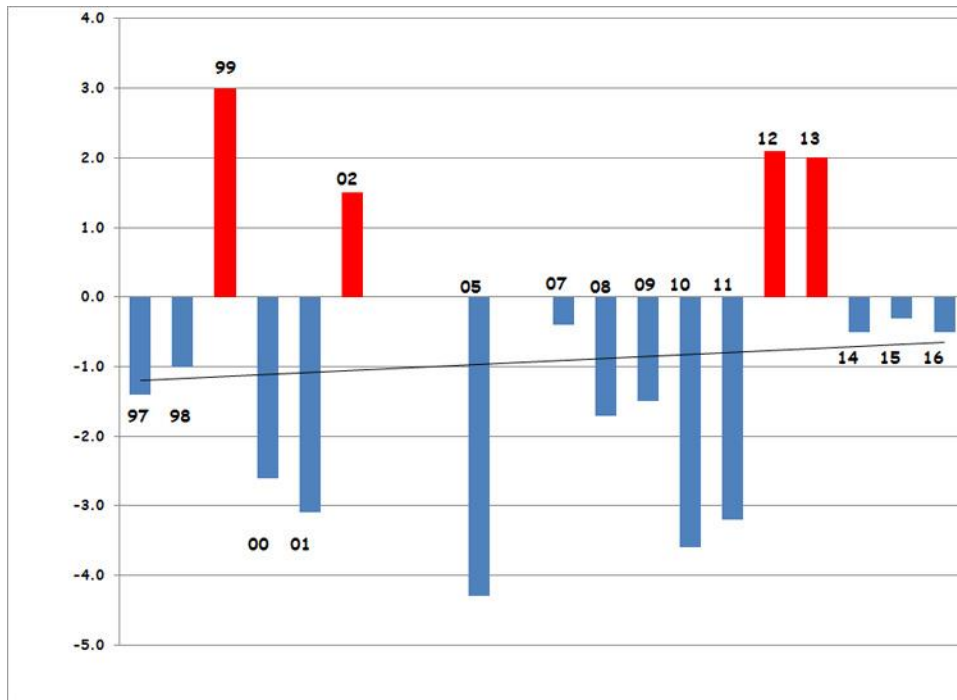


Figure 11. An index of SST in the Marineland area from 2000 through 2016. The values are assigned based on the degree that the average SST on 1 February was above (red) or below (blue) the 16° C reference level (a value based on Garrison (2007) and adapted for the Marineland area). The index is imperfect, as the NOAA data station on the end of the St. Augustine pier was inoperative in 2014 and 2015, and the intake water temperatures from the Marineland facility were used instead. The trendline suggests a slight ( $\sim 0.5^{\circ}\text{C}$ ) warming trend during the 17-year period.





Figure 12. As part of community involvement, outreach, and volunteer recruiting, on 15 November 2015, the Marineland Right Whale Project participated in the 75<sup>th</sup> Anniversary Celebration for the Town of Marineland. (Photos: D. Ogg and D. Hazel)

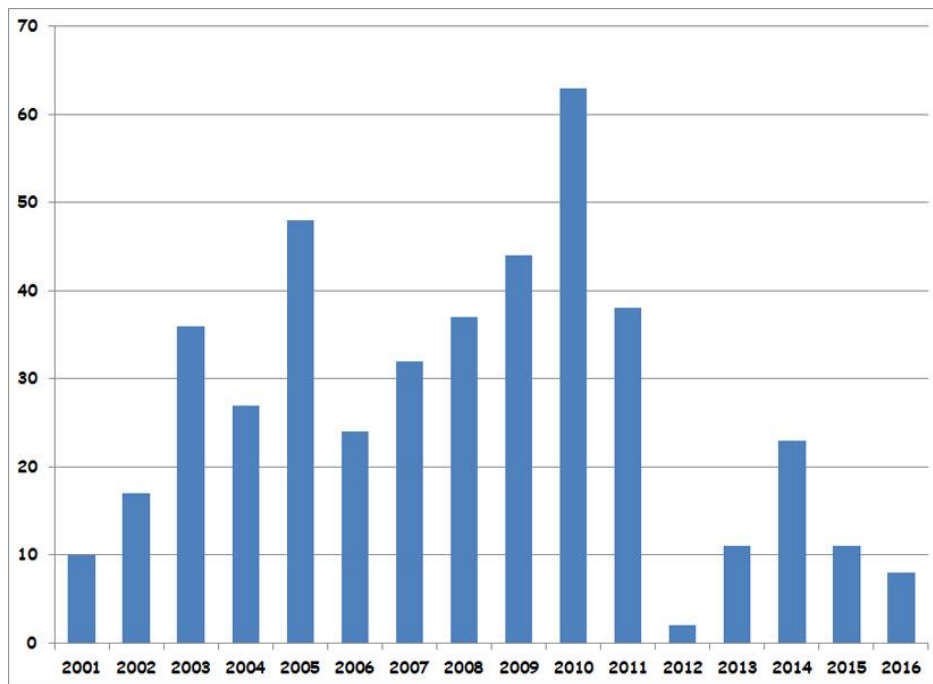


Figure 13. Total number of right whale sightings in the Marineland area, 2001 through 2016.

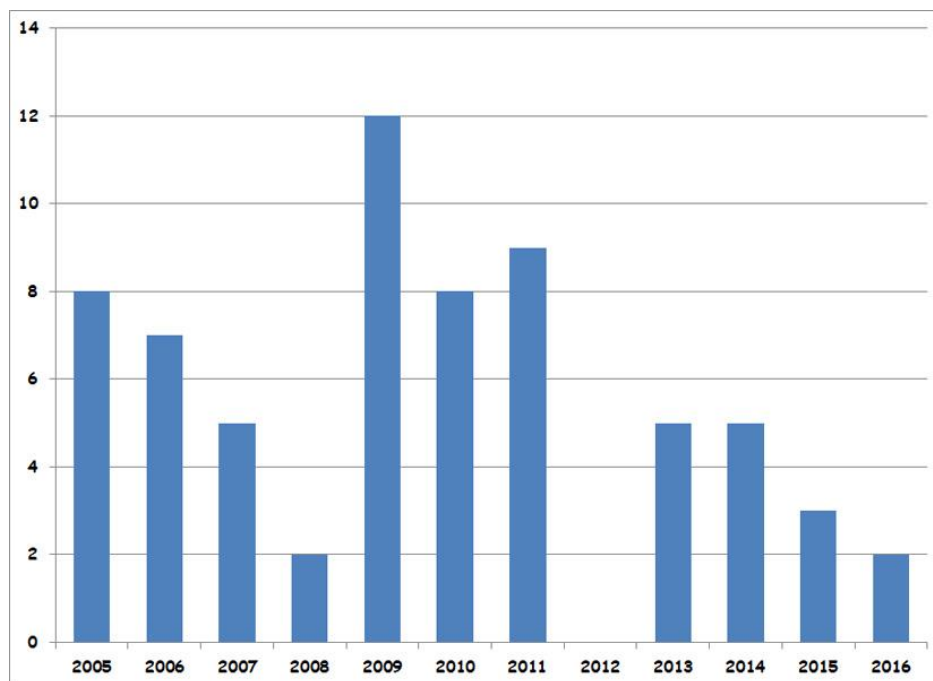


Figure 14. The number of different mother-calf pairs sighted in the Marineland area.

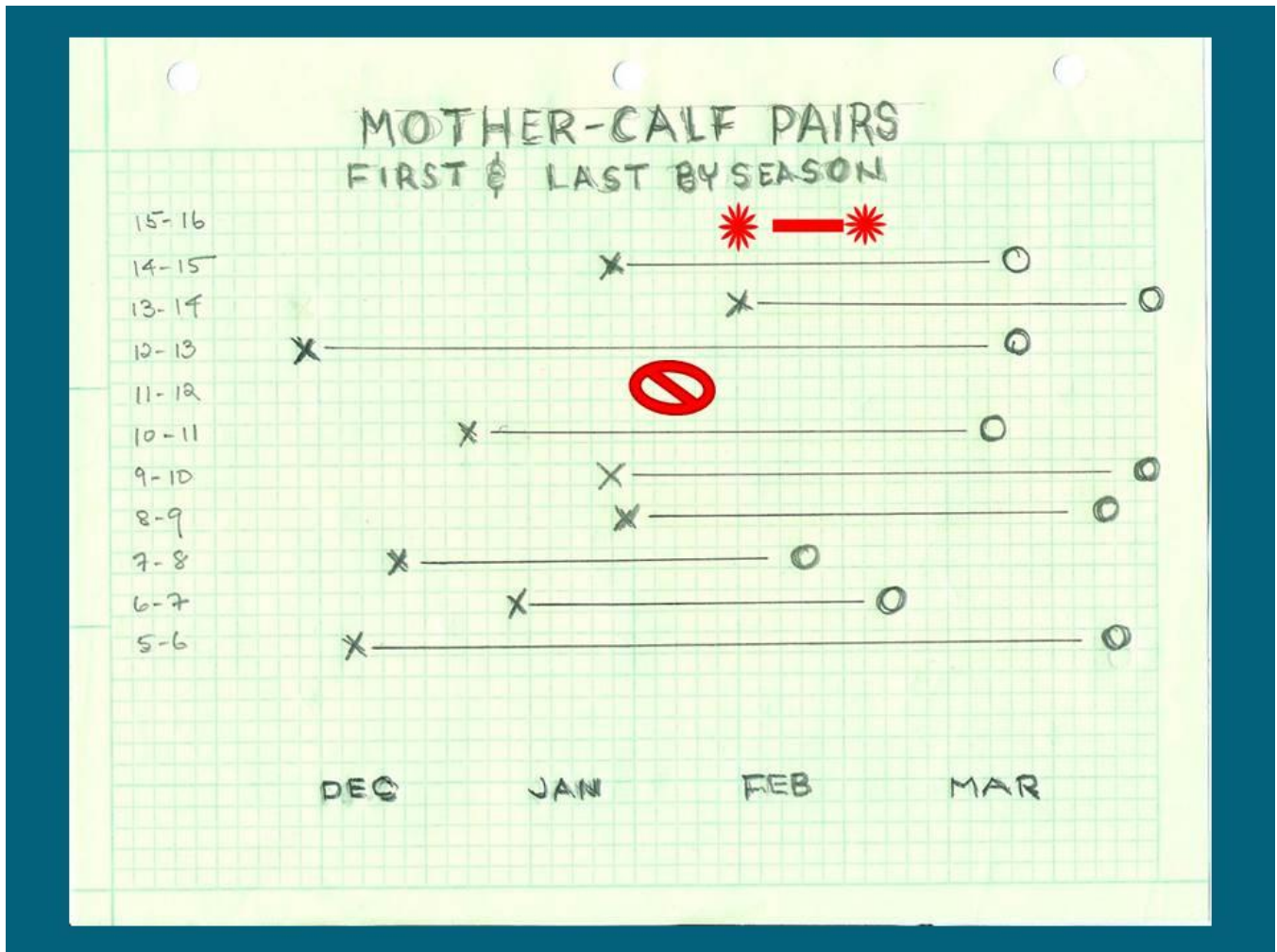


Figure 15. Lastly, looking beyond numbers and distribution of sightings, we conducted a “first-last analysis” by season. That is, when did the first mother-calf pair arrive in the Marineland area, and when did the last mother-calf pair depart the area? This is an imperfect analyses (there is a sighting effort factor), but does give some impression of habitat use. In the 2015-16 season, MC pairs arrived late (29 January) and left early (17 February). Note that in the 2011-12 season, no MC pairs were sighted. On the other hand, in both the 2005-06 and 2012-13 seasons, there was an extended MC occurrence in the area. Very likely, a combination of factors is involved.