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by

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Introduction

Aerial surveys are flown December 1 through March 31 each year in the Southeast United States (U.S.) to detect North Atlantic right whales (*Eubalaena glacialis*) in their primary calving area.

The purpose of the aerial surveys is to contribute to (in prioritized order):

- Population monitoring via detection and identification of individual right whales including cow/calf pairs occurring in the Southeast U.S.
- Monitoring trends in human-related serious injuries and mortality.
- Vessel-strike reduction.

Given these objectives, we focused aerial surveys in areas where we expected the highest number of right whale detections.

Additionally, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), U.S. Navy, U.S. Coast Guard, and U.S. Army Corps of Engineers have agreed to implement the "Early Warning System" (EWS) – a system of aerial surveys and communications designed to provide mariners with information on whale locations. The goal of the EWS is vessel-whale collision mitigation.

This report briefly summarizes results from NOAA Fisheries-administered aerial surveys and the EWS during the 2016/2017 North Atlantic right whale calving season.

Methods

Aerial Surveys

Teams/Platform

Two dedicated teams flew aerial surveys in 2016/2017. The Sea to Shore Alliance (S2S) team, contracted by the Georgia Department of Natural Resources (GDNR), was based out of St. Simons Island, Georgia and flew aboard a NOAA-owned De Havilland Twin Otter. The flight team consisted of two observers and a dedicated data recorder. The Florida Fish and Wildlife Conservation Commission (FWC) team was based out of St. Augustine, Florida and flew aboard a Cessna Skymaster. The FWC flight team consisted of two observers; one of these also served as the data recorder. Two pilots were seated at the controls in each aircraft.

2016/2017 Survey Zone and Frequency

Flight lines were selected from a geographic area ranging from near Savannah, Georgia to just north of Cape Canaveral, Florida. Surveys focused on areas where the highest number of right whale detections were expected based on dynamic combinations of habitat features within the survey zone. Transects oriented east-west and parallel to shore were used (Figure 1). Generally, each team attempted to fly every day that visibility was greater than 2 nautical miles (nmi) and sea state was less than 4 on the Beaufort Wind Scale.

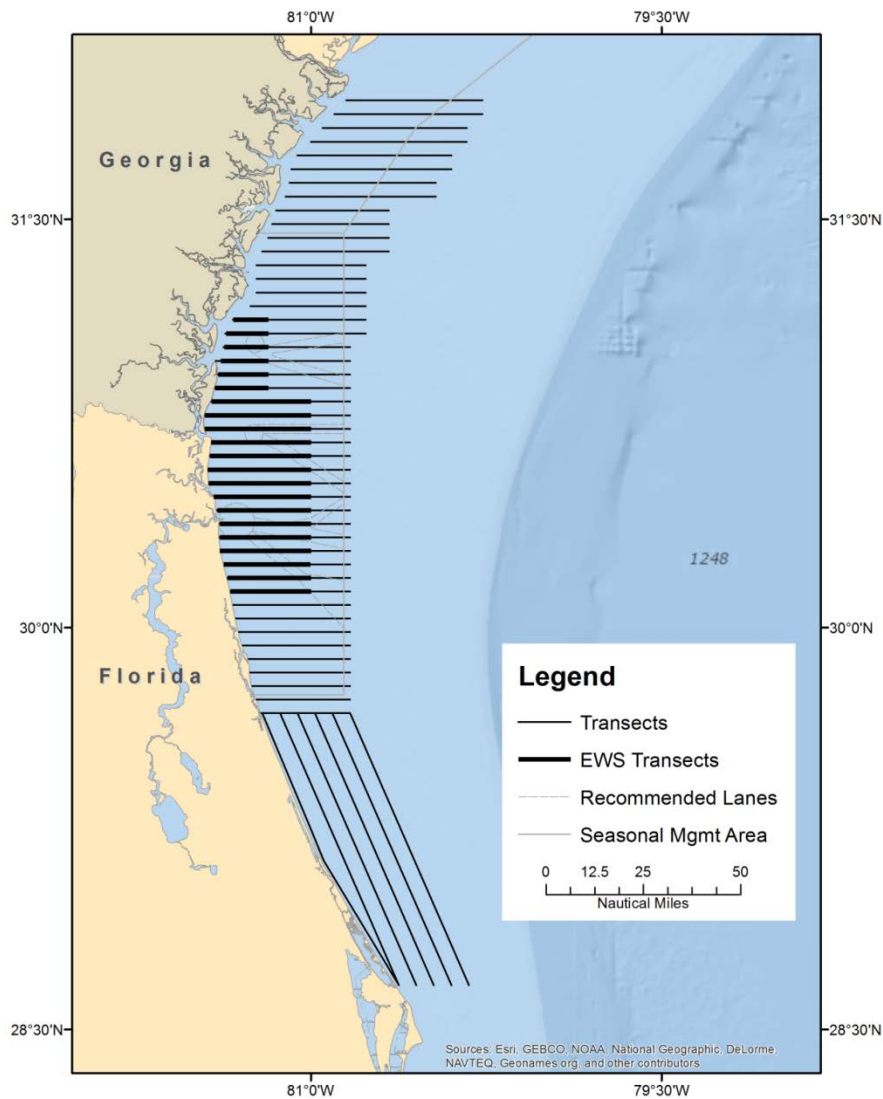


Figure 1. Transects available to be flown by aerial survey teams during the 2016/2017 North Atlantic right whale calving season. Thick black lines represent EWS transects.

Daily Survey Area

The aerial survey zone was too large for two aerial teams to survey in a single day, so a subset of the area was selected and flown each day. In general, the following criteria were used in daily flight planning:

1. EWS transects
2. Avoiding airspace conflicts with military operations
3. Weather

4. Predicted whale locations¹
5. Recent whale sightings
6. Distributing effort throughout the survey area
7. NOAA-affiliated, boat-based biopsy/tagging projects
8. Aircraft availability/hours

Aerial Survey Data

Survey data collection methods followed those described in Keller *et al.* (2012) and Gowan and Ortega-Ortiz (2014).

Whale Alerts

Whale alerts were generated from aerial survey sightings or from public sightings which were verified by or relayed through a reliable source. Teams issued whale alerts to marine users and other users in near-real time using geographically-based email distribution lists² (Figure 2).

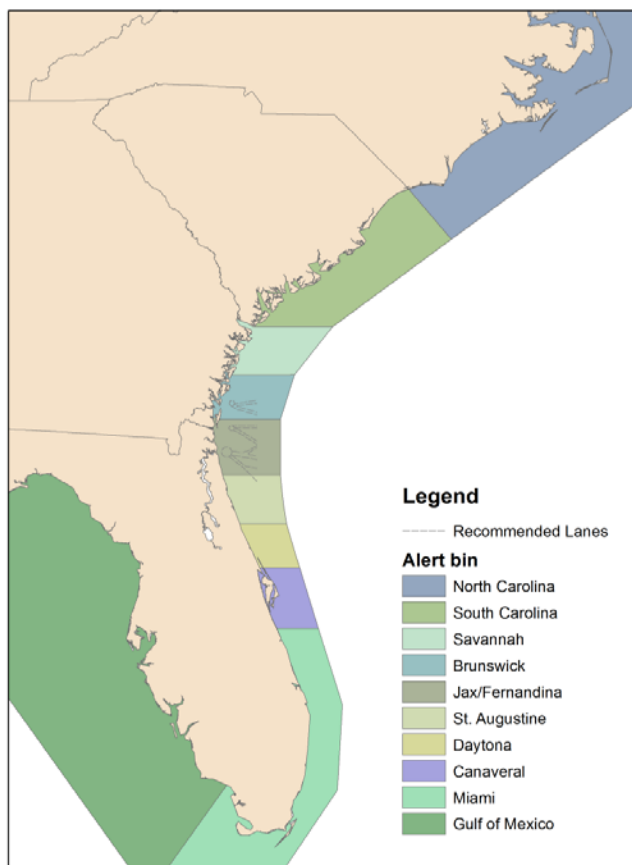


Figure 2. Coverage area of whale alert email distribution lists.

¹ The FWC produced bimonthly predictions of right whale distribution using methods described by Gowan and Ortiz (2014). This paper validated hindcasted predictions, but not forecasted predictions (i.e., before sea surface temperature data for the period are available).

² Users received email or text message alerts; text messages were possible if users provided a short message service (SMS) to email gateway.

Results

Aerial Surveys

The FWC conducted 54 surveys and S2S conducted 36 surveys. Survey effort was influenced by weather, aircraft availability, military activity, etc. Mean daily survey duration was 6.2 hours (6.5 hours for FWC and 5.6 hours for S2S, combined SD 1.4 hours) and on-effort trackline distance was 397 nmi (409 for FWC and 377 for S2S, combined SD = 117). The maximum daily survey length was 9.7 hours and the minimum daily survey length was 2.5 hours. Search effort was unevenly distributed throughout the survey season (Table 1) and area (Figure 3). Three surveys were flown off South Carolina and North Carolina for exploratory purposes.

Table 1. Number of nautical miles (nmi) flown while on effort.³

Month	On-Effort Trackline Distance (nmi)*
December	7338
January	10150
February	10030
March	7030

*Exploratory surveys are not included in total distance

The two survey teams observed and/or verified 18 right whale sightings;⁴ 7 of those sightings were first reported from other sources (collaborating research vessels, volunteer sighting network, public, dredge, U.S. Navy, U.S. Coast Guard, etc.). Most sightings were associated with the areas of highest effort (Figure 4) and were concentrated in January (Table 2).

³ “On effort” is defined as those times when the following conditions are met: Beaufort sea state < 4, visibility at least 2 nmi (3.7 kilometers), altitude < 1200 feet (366 meters), and not circling a sighting, or on verification survey.

⁴ A “sighting” consists of 1 or more right whales.

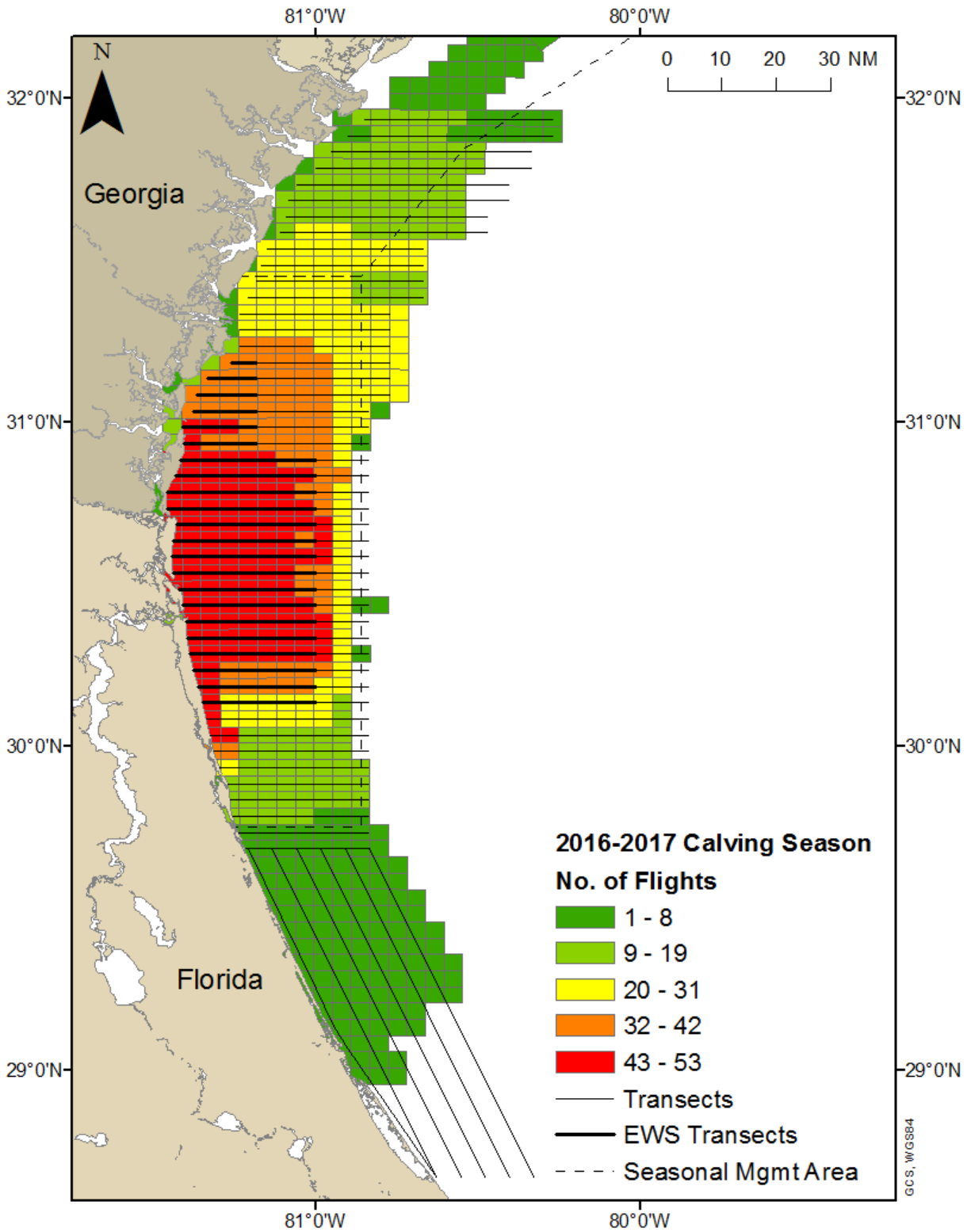


Figure 3. Density distribution of survey effort in the 2016/2017 survey area. Effort is displayed as number of flights in 3- by 3-nmi grid cells (gray lines). Transects are black and EWS transects are thick black. Exploratory surveys off SC and NC are not shown in full.

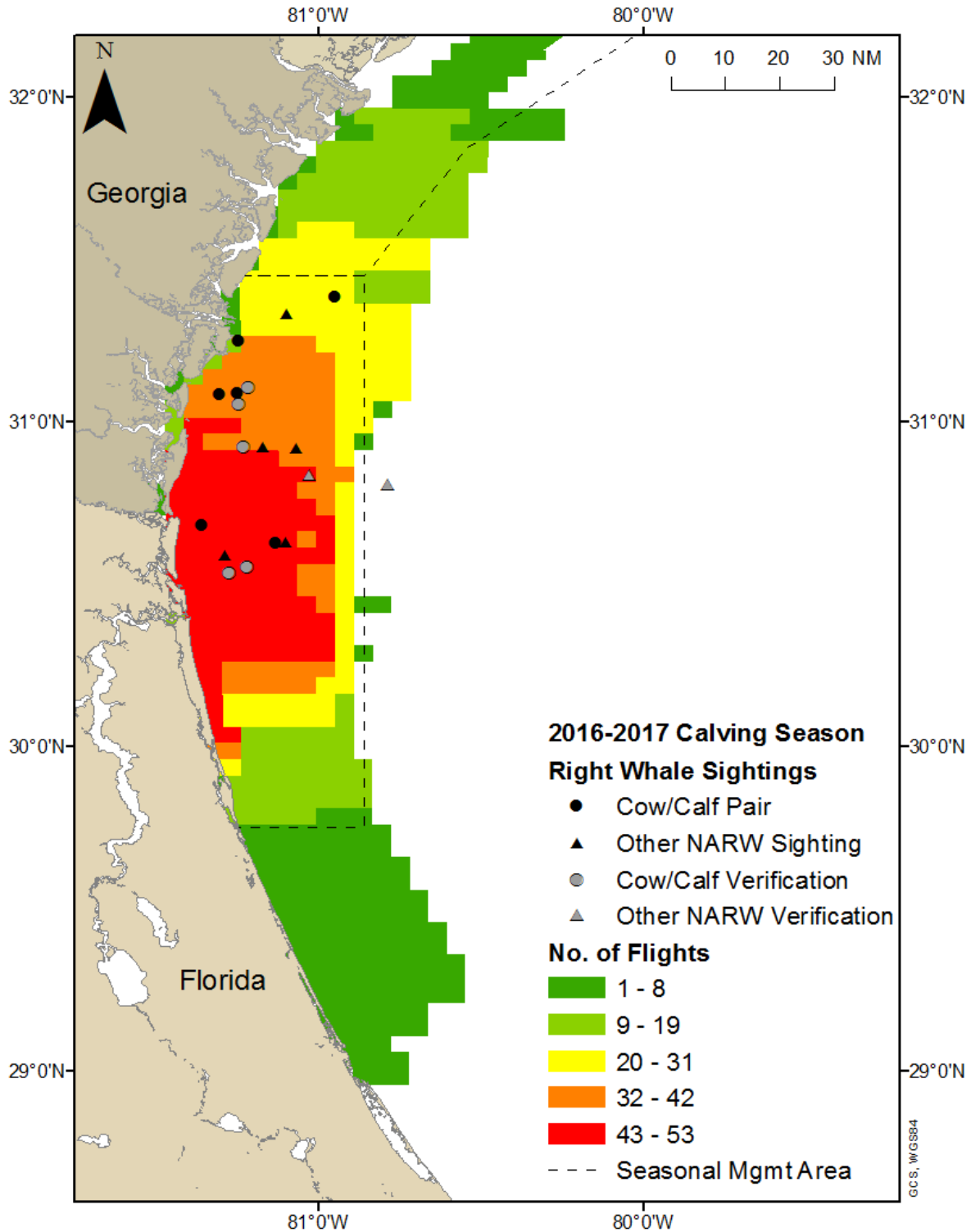


Figure 4. Geographic distribution of right whales sighted while on effort (black symbols) or reported to aerial survey teams and verified (grey symbols) during the 2016/2017 season. Circles represent sightings of cow/calf pairs and triangles represent sightings of other right whales.

Table 2. Monthly number of right whales and right whale sightings (detected per nautical mile of on-effort trackline).

Month	Number of Right Whale Sighting Events*	Number of Right Whales**	Sighting Events/1,000 nmi	Individual Right Whales/1,000 nmi
December	1	1	0.1	0.1
January	15	24	1.5	2.4
February	2	4	0.2	0.4
March	0	0	0	0

* A right whale sighting consists of 1 or more right whales.

** Individuals may have been re-sighted within the same or different months.

Individual right whales were first sighted (i.e., detected for the first time in the season) between late December and mid-January (Figure 5). No new whales were sighted after January 13, 2017

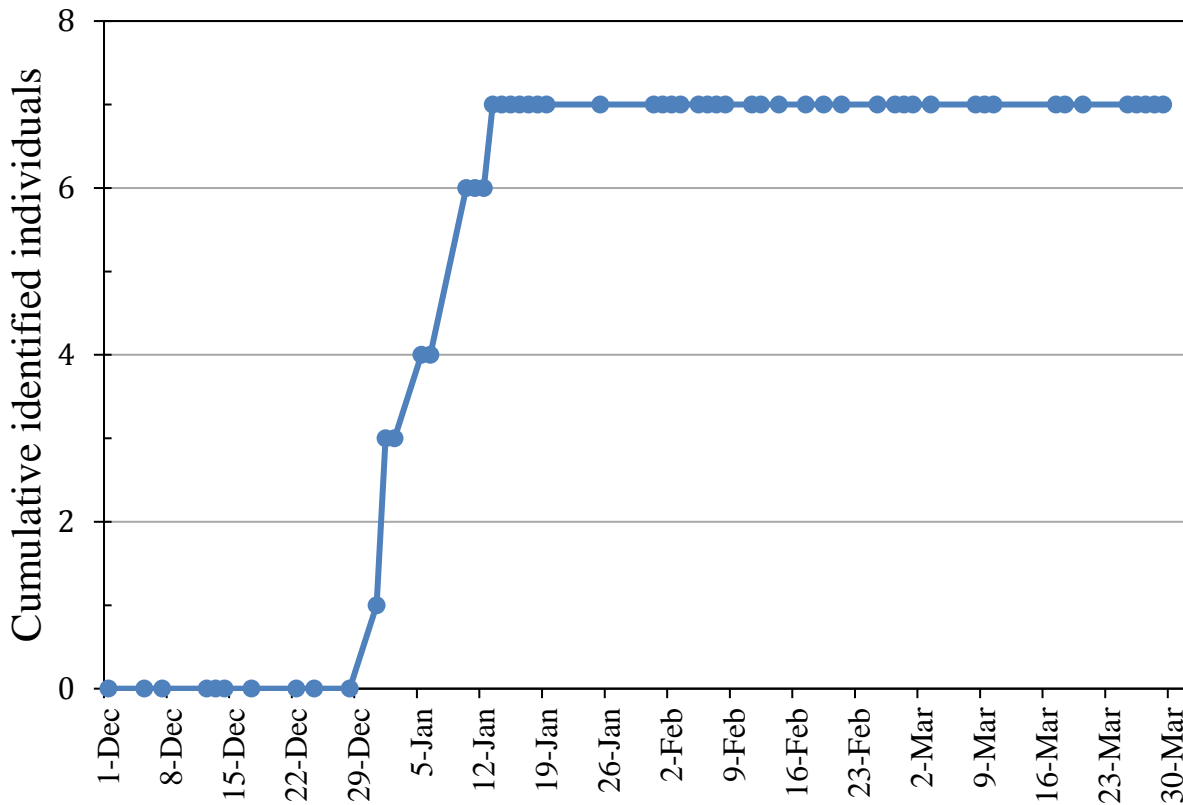


Figure 5. Rate of right whale discovery during the 2016/2017 season by the S2S and FWC aerial survey teams in the calving area (calves included). Points represent all flight days.

Three cow/calf pairs were detected in the Southeast U.S. during the 2016/2017 calving season (Table 3). Of these, one was seen in the Southeast prior to giving birth. The mean calving

interval observed across known calving females was 7.7 years (median = 8 years). The number of known calves produced for 2016/2017 and the previous 10 years is included in Appendix A.

Table 3. Catalog numbers, ages, and other known calving information for calving females observed in the Southeast U.S. during the 2016/2017 calving season.

(Note: Numbers reflect known calving information – some calving events may have gone undetected. Data provided by the North Atlantic Right Whale Consortium, February 2018).

Whale ID	Age	Number of Calves Known to Have Been Produced by a Given Female	Age At First Known Calving	Last Known Calving Year	Presumed Calving Interval
1012	>39	8	>5	2009	8
1711	30	3	16	2009	8
2614	21	4	8	2010	7

One right whale other than cow/calf pairs was observed in the Southeast U.S. calving area: Eg3530, an entangled adult male.

In all, four different right whales (excluding calves) were seen in the Southeast U.S. calving area during the calving season. Aerial survey teams also sighted 12 different humpback whales (*Megaptera novaeangliae*). No other large whale species were observed.

Whale Alerts

A total of 202 subscribers representing various industries, agencies, and organizations received whale alerts as of March 2017 (Table 4). Some entities (e.g., Navy and Coast Guard) subscribed using an email address that automatically distributed whale alerts to multiple internal recipients.

Table 4. Number of representatives from various organization types receiving Whale Alerts at the end of the 2016/2017 right whale calving season.

Recipient Type	Count
Commercial Fishing	1
Commercial Shipping/Harbor Pilots	43
Law Enforcement (Federal, State, Local)	21
Resource Managers (Federal, State, Local)	30
U.S. Army Corps of Engineers/Dredge/Dredge Observers	33
U.S. Coast Guard	11
U.S. Navy	9
Volunteer Sighting Networks	2
Whale Researchers	47
Other	5
Total	202

A total of 28 whale alerts were issued for the 2016/2017 season. Sightings were generated by aerial surveys, other researchers and agencies, and the general public (Figure 7).

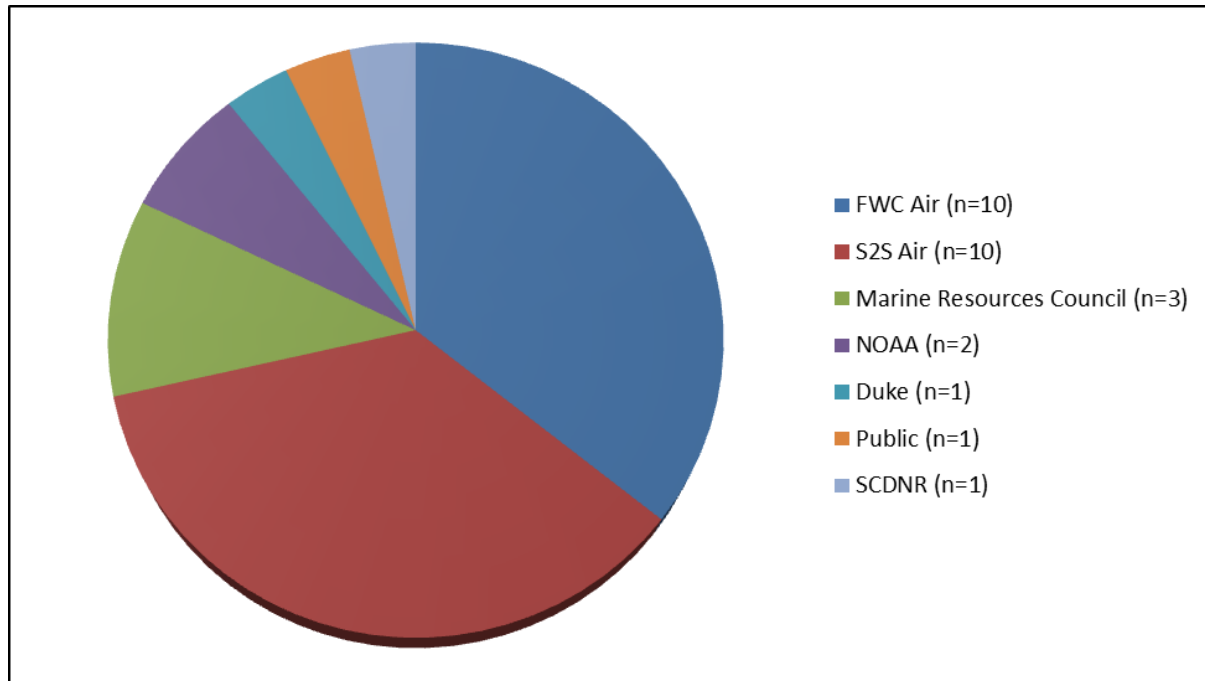


Figure 7. Right whale sighting sources for whale alerts (includes only sightings that were verified).

Miscellaneous

Injured and Entangled Whales

One free-swimming entangled right whale was sighted during the 2016/2017 season. Eg3530, was sighted by the FWC aerial survey team on January 5 approximately 20 nmi east of Little Cumberland Island, GA. The entanglement presented as two segments of rope exiting each side of the mouth, coming together over the head to form a bridle, and trailing behind the whale to an unknown depth. The entanglement was deemed life-threatening so staff from the GDNR attached a satellite tracking buoy on the evening of January 5. GDNR and FWC boat teams relocated the whale on January 6 and removed all of the entangling gear (135 lb trap, 450 ft of rope). A 135 lb Canadian snow crab trap (NOAA Fisheries Greater Atlantic Regional Fisheries Office, unpub. Data) and over 450ft of associated rope was recovered and sent to the Greater Atlantic Region Fisheries Office for analysis. Eg3530 was last sighted in the Southeast by the S2S aerial survey team on January 14 off Fernandina Beach, FL and subsequently by the Center for Coastal Studies in Cape Cod Bay, MA on February 19, 2017.

Mortalities

No dead whales were observed by the survey teams.

Dynamic Management Areas

No Dynamic Management Areas were established within the Southeast U.S. during the 2016/2017 calving season.

Inlet Incursion

A cow/calf pair was sighted by a fisherman inside Sebastian Inlet, FL (west of the highway A1A bridge) the night of January 15. FWC law enforcement confirmed the sighting and later witnessed the whales depart from the inlet at 12:30 AM on January 16. Eg1711 and calf were sighted approximately 1 nmi north of Sebastian Inlet at sunset on January 15 and are likely the pair that swam into the inlet. The pair was not re-sighted in the calving area after that time.

Key Points

- Poor weather and the requirement to fly EWS mitigation lines had substantial impacts on the temporal and spatial distribution of effort, respectively.
- Three cow/calf pairs were documented in the Southeast U.S. during the 2016/2017 season. This is the fewest number of right whale calves seen since the 1999/2000 season.⁵
- The mean and median calving interval for the females known to have calved in the Southeast U.S was 7.7 and 8 years, respectively.
- One cow/calf pair entered Sebastian Inlet, FL for approximately 4 hours. A cow/calf pair also swam into Sebastian Inlet in 2016.
- Only one other right whale was sighted in the Southeast U.S. during the 2016/2017 season (see Injured and Entangled Whales section).

Acknowledgements

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⁵ Two additional cow/calf pairs were sighted in the Northeast U.S. during the spring of 2017.

Appendix A. Known North Atlantic right whale calf births and mortalities counted annually range-wide December 2006 - March 2017 (not exclusive to the Southeast U.S.) (Waring *et al.* 2016, North Atlantic Right Whale Consortium February 2018).

North Atlantic right whale calf production, 2007-2017		
Year ^a	Reported calf production	Reported and assumed calf mortalities ^b
2007	23	2
2008	23	2
2009	39	1
2010	19	0
2011	22	0
2012	7	1
2013	20	1
2014	11	1
2015	17	0
2016	14	1
2017	5	0

^a Includes November and December of the previous year.

^b Includes assumed deaths based on observations of cows seen with a calf and then resighted later that same year without a calf. Assumed mortality may include unreported calves (i.e. not all of the dead calves had been seen with their mothers).