



FINAL REPORT TO
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

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**Documenting Spatial and Temporal Distribution
of North Atlantic Right Whales off South Carolina and Northern Georgia
2011 – 2012**

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Abstract

The North Atlantic right whale, *Eubalaena glacialis*, is listed as a federally-protected endangered species under the Endangered Species Act, in addition to being protected by the Marine Mammal Protection Act. The winter calving grounds off the coasts of Georgia and Florida have been designated as critical habitat. The region just north of the critical habitat, including northern Georgia and South Carolina (SCGA), has long been considered an important migratory route. However, survey effort and photo-identification data since 2004 have suggested that some individuals utilize this area not only as a migratory route, but as a residency area as well. The purpose of this aerial survey effort is to collect data on the distribution and use patterns of right whales off the coasts of northern Georgia and South Carolina to assist in determining appropriate management actions in the region. A total of 50 surveys were flown from 15 November 2011 to 15 April 2012 and extended from North Myrtle Beach, South Carolina (33.82°N) to St. Catherine's Island, Georgia (31.58°N). Preliminarily, 27 right whale sightings consisting of 70 right whales were documented (including re-sightings of 14 individuals, two individuals sighted three times, two individuals sighted four times and one individual sighted five times). Sightings consisted of five cow/calf pairs, seven single whales, and 15 groups of two or more adult/juvenile right whales. Preliminary photo-identification has resulted in the confirmed identification of four individual cow/calf pairs and 34 individual adult/juvenile whales. The individuals documented include 12 females, 11 males and 19 individuals of unknown gender (including four calves), for a total of 42 individual photographed whales in the study area. Of the 12 females sighted, five gave birth to new calves this season, although only four were seen with their calves within the study area. The remaining calving female was seen while pregnant prior to giving birth. Preliminary sightings of note include 16 individuals that were unique to the study area and not sighted by other survey teams to the south. Also of note were the observations of an entangled whale, and eleven surface active groups. The number of whales sighted was greatest in January, resulting in 47% of all whales documented during the 2011-2012 season.

Introduction

The North Atlantic right whale, *Eubalaena glacialis*, is listed as a federally-protected endangered species under the Endangered Species Act, in addition to being protected by the Marine Mammal Protection Act. Recent increases in calving may have been accompanied by increases in mortality (Kraus et al. 2005); however, examination of the minimum number alive population index suggests a positive trend in numbers (Waring et al. 2011). A slow reproductive rate is further hindered by human-related mortality, the largest known threat to the species, including vessel collisions and entanglement in fishing gear (NMFS, 2005). It is essential that mitigation measures are enacted quickly and efficiently to minimize human-related mortality, particularly in the calving grounds of the Southeast United States (SEUS).

Right whales are slow moving, especially when accompanied by a calf, and are often not easily seen while at the water's surface due to the lack of a dorsal fin. These factors make them vulnerable to collisions with vessels, especially in areas of increased vessel traffic. The winter calving grounds off Georgia and northern Florida have been designated as critical habitat for right whales. An Early Warning System (EWS) was created to provide right whale location information to military and commercial vessels transiting the critical habitat area. The region just north of the critical habitat, including northern Georgia and South Carolina, has long been considered an important migratory route. However, survey effort and photo-identification data since 2004 suggests that some individuals utilize this area not only as a migratory route, but as a residency area as well. Resource managers are interested in learning more about right whale use of this southern mid-Atlantic region. In addition, continuing mortality from vessel collisions and gear entanglement in the mid-Atlantic region is of concern to researchers and managers.

Aerial survey coverage along the entire coasts of Georgia and South Carolina is enabling a better understanding of distribution and use of these habitats by calving females and other demographic segments of the population. Conservationists, researchers, and managers have speculated that the current boundaries of the SEUS critical habitat, established in 1994, and other existing management boundaries may not accurately delineate the areas in need of management measures to facilitate recovery of the species and reduce anthropogenic mortality. Through this continuing multi-year study we hope to provide managers with a more thorough understanding of right whale use of the study area to assist with management decisions and recovery challenges.

Methods

Study Area

The South Carolina/northern Georgia (SCGA) survey season began on 15 November 2011 and concluded on 15 April 2012. The SCGA survey area for the 2011-2012 season extended from North Myrtle Beach, South Carolina to the southern end of St. Catherine's Island, Georgia. The survey area was divided into three sections: northern, middle and southern. The northern area extended from North Myrtle Beach, SC (33.82°N) to Cape Romain, SC (33.01°N) and consisted of 16 southeast/northwest transect lines of varied lengths (35.1 - 35.3 nautical miles, nmi) which were flown at approximately 4 nmi intervals. The middle area extended from Cape Romain, SC to Fripp Island, SC (32.34°N) and consisted of 16 southeast/northwest transect lines of varied lengths (35.3 - 35.4 nmi) which were also flown at approximately 4 nmi intervals. The southern section extended from Hilton Head Island, SC

(32.23°N) to St. Catherine's Island, GA (31.58°N) and consisted of 14 east/west transect lines of varied lengths (11.7 – 29.0 nmi) which were flown at 3 nmi intervals (Figure 1). The northern and middle transect lines were flown in a southeast/northwest direction as opposed to the east/west orientation of the southern section in order to cover a larger bathymetric range. A complete northern survey consisted of 563.4 nmi of trackline, a complete middle survey consisted of 565.2 nmi of trackline, and a complete southern survey consisted of 323.5 nmi of trackline (Table 1). These totals do not include miles flown in transit to, from, and between transect lines. The survey aircraft departed from Mt. Pleasant Regional Airport in Mt. Pleasant, SC. After completing half of the survey lines for the day, the plane would land to refuel and to provide a rest period to avoid observer fatigue. When flying in the northern section, the plane would refuel at Georgetown Airport in Georgetown, SC. In the middle section the plane would refuel at Mt. Pleasant Regional Airport in Mt. Pleasant, SC or at Charleston Executive Airport in Johns Island, SC. In the southern section, the plane would refuel at Hilton Head Airport in Hilton Head, SC. The plane returned to Mt. Pleasant Regional Airport at the end of each survey day. Without whale sightings, a complete northern survey took approximately 8.1 Hobbs hours to finish, a complete middle section took approximately 7.7 Hobbs hours, and a complete southern section took approximately 6.3 Hobbs hours, including transit times to and from the airports.

Aerial Surveys

Surveys were scheduled to be flown from 15 November 2011 through 15 April 2012, weather permitting, under VFR (visual flight rules) conditions. Conditions necessary for survey flight included a minimum ceiling of 455m, visibility greater than 2nmi, wind speed less than 12 knots, and Beaufort sea state of 3 or less. Surveys were conducted in a Cessna 337 Skymaster aircraft owned and operated by Orion Aviation. The aircraft was equipped with Global Positioning System (GPS), Automatic Identification System (AIS), navigation aids, radar, aviation VHF radio, marine VHF radio, life raft, GPIRB-equipped PFDs, flares, EPIRB, and satellite telephone. Flight protocols included mandatory usage of PFDs and Nomex flight suits. All observers were also required to complete emergency egress training prior to the start of the survey season.

Surveys were flown at an altitude of 1000 ft (303 m) and at a ground speed of 100 knots. The surveys were typically flown south to north with the western waypoint of the southernmost trackline as the start point. However, the section flown, the start point and direction of flight was determined daily, based on weather conditions throughout the survey area and other survey factors. Spreading survey effort equally amongst the survey areas was also a factor. The survey crew consisted of a pilot, co-pilot and two observers. The observers were positioned on either side of the aircraft behind the pilot and co-pilot seats. All events, sightings, and changes in environmental conditions were recorded on a laptop computer using Logger 2000, a software program designed for marine data entry. To minimize time spent looking away from the window, when an event occurred the left observer recorded the time and position of the event on the computer and then recorded the time and event information into a handheld digital voice recorder. Time, location, number and species of all large whales were recorded. In addition, the AIS receiver recorded large vessel (over 33m in length) information including name, position, speed, length, and course.

Table 1. South Carolina-Georgia survey trackline waypoints for the 2011-2012 season.

Track Line	Latitude West	Longitude West	Latitude East	Longitude East
1	31.58	-81.13	31.58	-80.57
2	31.63	-81.12	31.63	-80.57
3	31.68	-81.12	31.68	-80.57
4	31.73	-81.10	31.73	-80.57
5	31.78	-81.05	31.78	-80.50
6	31.83	-81.00	31.83	-80.50
7	31.88	-80.95	31.88	-80.43
8	31.93	-80.90	31.93	-80.43
9	31.98	-80.85	31.98	-80.43
10	32.03	-80.80	32.03	-80.43
11	32.08	-80.75	32.08	-80.37
12	32.13	-80.70	32.13	-80.37
13	32.18	-80.65	32.18	-80.37
14	32.23	-80.60	32.23	-80.37
15	32.34	-80.45	31.89	-80.00
16	32.41	-80.42	31.96	-79.97
17	32.49	-80.39	32.04	-79.94
18	32.50	-80.30	32.05	-79.85
19	32.54	-80.23	32.09	-79.78
20	32.57	-80.16	32.12	-79.71
21	32.60	-80.08	32.15	-79.63
22	32.62	-79.99	32.17	-79.54
23	32.66	-79.93	32.21	-79.48
24	32.71	-79.88	32.26	-79.43
25	32.76	-79.82	32.31	-79.37
26	32.80	-79.75	32.35	-79.30
27	32.85	-79.70	32.40	-79.25
28	32.89	-79.63	32.44	-79.18
29	32.97	-79.61	32.52	-79.16
30	33.02	-79.56	32.57	-79.11
31	33.01	-79.44	32.56	-78.99
32	33.02	-79.35	32.57	-78.90
33	33.10	-79.32	32.65	-78.87
34	33.13	-79.25	32.68	-78.80
35	33.18	-79.19	32.73	-78.74
36	33.27	-79.18	32.82	-78.73
37	33.35	-79.15	32.90	-78.70
38	33.43	-79.12	32.98	-78.67
39	33.49	-79.08	33.04	-78.63
40	33.54	-79.02	33.09	-78.57
41	33.60	-78.98	33.15	-78.53
42	33.65	-78.92	33.20	-78.47
43	33.70	-78.87	33.25	-78.42
44	33.75	-78.81	33.30	-78.36
45	33.79	-78.74	33.34	-78.29
46	33.82	-78.67	33.37	-78.22

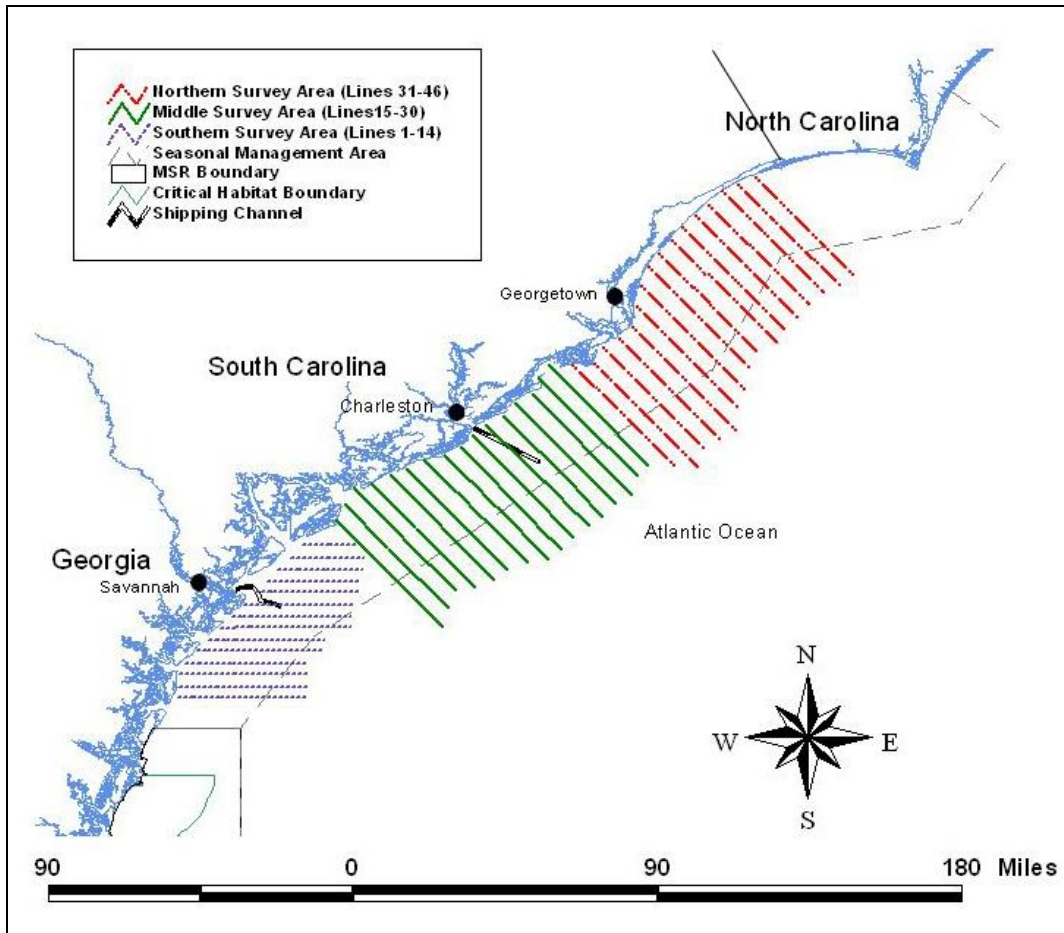


Figure 1. Map of South Carolina-Georgia survey tracklines flown during the 2011-2012 season.

Sighting distance for all large whales was calculated from overhead GPS positions. When a right whale was observed, a GPS position was recorded along the trackline at the point of observation. The survey aircraft then broke track and flew directly over the right whale to obtain a GPS position. The aircraft also circled at 1000 ft over each right whale encountered to obtain photographs. Circling for photographic documentation was generally limited to 15 minutes for each sighting, with a maximum of 30 minutes during special circumstances. After right whales were documented, the aircraft returned to the trackline at the point of departure to continue the survey.

Determination of Sighting Distance from the Trackline

Sighting distance from the trackline for observed right whales was calculated whenever possible, using the latitude and longitude position (lat/long) on the trackline perpendicular to the position of the whale sighting (lat1,long1), and the lat/long of the exact overhead position of the right whale (lat2,long2). The whale's distance in nautical miles from the trackline was determined by the equation¹:

$$= \text{ACOS}(\text{COS}(\text{RAD}(90-a)) * \text{COS}(\text{RAD}(90-b)) + \text{SIN}(\text{RAD}(90-a)) * \text{SIN}(\text{RAD}(90-b)) * \text{COS}(\text{RAD}(c-d))) * 3440.065$$

a = lat 1, b = lat 2, c = long 1, d = long 2

Notification of Right Whale Sighting Information

Upon completing data collection for each right whale sighting, the aircraft would immediately use the aircraft satellite phone to call a designated ground contact. The ground contact would then relay the right whale sighting information via email to distribution lists which included harbor pilots, USCG, Navy, and other stakeholders and interested parties. The information sent included date, time, latitude, longitude, number of adults and calves, direction of movement, and distance in nautical miles from the nearest sea buoy. The communication system supported real-time notification of right whale presence to ships in order to minimize the probability of right whale death or injury due to ship strike. It also facilitated verification of sighting reports by aerial survey teams from other sources such as military ships and aircraft.

Photographic Identification

Right whales are identified by the patterns of cornified skin primarily located on the top of the head between the tip of the rostrum and the blowhole (Payne et al. 1983; Kraus et al. 1986). Photographs of right whale callosity patterns and other features, including scars, are used for identification and the cataloging of individual right whales. Right whales observed during the SCGA aerial surveys were photographed in order to identify individual animals. During a right whale sighting, the left observer recorded all sighting information into the voice recorder and entered the sighting positions into the computer. If possible, the observer also sketched the right whale(s) being photographed, including callosity patterns and body scarring, and recorded observed behaviors. The aircraft would circle at an altitude of 1000 ft (303m) over the whale(s) while the right observer photographed the animals through the co-pilot's large crank-out style window. Photographs were taken using a Canon 20D digital camera with a fixed 300 mm image stabilizing lens. All photographs obtained during the season were compared against each other and the New England Aquarium's (NEA) catalog of North Atlantic right whales in order to determine the probable identity of individual right whales encountered during the 2011-2012 SCGA survey season. Preliminary photo-identification by the SCGA Sea to Shore Alliance team and initial verification by NEA has been completed and all photographs taken during the 2011-2012 season have been forwarded to NEA for final confirmation. All right whale identification information included in this report is preliminary and should not be considered final until NEA completes the confirmation process.

¹ equation source: http://bluemm.blogspot.com/2007_01_01_archive.html

Results

Aerial Surveys

A total of 50 SCGA surveys were flown from 15 November 2011 through 15 April 2012 (Tables 2 and 3). A total of 318.6 hours of Hobbs time were logged, averaging 7.4 hours per survey in the northern section, 6.3 hours in the middle section, and 5.9 hours in the southern section (including complete and partial surveys). A total of 5331.0 nm of trackline were flown in the northern section, 10342.4 nmi in the middle, and 5711.1 nmi in the southern, for a total of 21384.5 nmi of trackline flown. The northern survey area was completed on seven survey days and partially completed on three survey days. The middle survey area was completed on 10 survey days and partially completed on 12 survey days. The southern survey area was completed on 17 survey days and partially completed on one survey day. The 16 partially completed SCGA flights were largely due to factors such as weather and sea state conditions. See Figure 2 for a graphical representation of survey effort. Days with no survey effort in the SCGA survey area were primarily due to unacceptable weather conditions.

Sighting Distances for Right Whales

Sighting distances were calculated whenever possible, and the average sighting distance for all right whale sightings was 1.31 (SD = 1.03) nmi from the trackline (Figure 3).

Sightings of Large Vessels

Automatic Identification System (AIS) data for large vessels were collected continuously during the surveys and saved into a text file using the software Coastal Explorer to be analyzed at a later date.

Table 2. Survey effort for SCGA surveys conducted during the 2011-2012 season. "S" refers to the southern survey area, "M" to the middle, and "N" to the north.

Date	Complete Surveys	Partial Surveys	Hobbs	Total Trackline NM Flown	Trackline NM Flown in Beaufort 3 or Less	Number of Right Whales Seen	Comments
20-Nov-11	M		7.3	565.20	565.20	0	Complete
21-Nov-11	N		7.6	563.40	563.40	0	Complete
22-Nov-11	S		6.3	323.50	323.50	1*	Complete
25-Nov-11		M	5.5	423.60	423.60	0	Incomplete-sunset
26-Nov-11	N		7.8	563.40	563.40	0	Complete
30-Nov-11		M	3.8	282.80	282.80	0	Incomplete-sunset
5-Dec-11	S		5.2	323.50	323.50	0	Complete
6-Dec-11		M	7.4	558.83	558.83	0	Incomplete-rain
14-Dec-11	M		7.0	565.20	521.01	0	Complete
15-Dec-11	N		8.1	563.40	563.40	2	Complete
16-Dec-11	S		6.0	323.50	323.50	1	Complete
19-Dec-11	M		7.3	565.20	565.20	0	Complete
22-Dec-11	S		6.0	323.50	323.50	1	Complete
29-Dec-11		N	6.8	430.60	394.32	1	Incomplete-wind
1-Jan-12		M	6.5	463.23	463.23	2	Incomplete-wind
4-Jan-12	S		6.5	323.50	323.50	6*	Complete
6-Jan-12	M		7.8	565.20	565.20	7	Complete
8-Jan-12	S		7.1	323.50	323.50	12	Complete
10-Jan-12		M	6.4	485.88	485.88	0	Incomplete-fog
19-Jan-12		M	6.3	458.60	458.60	0	Incomplete-sunset
20-Jan-12	S		6.9	323.50	323.50	6**	Complete
24-Jan-12		M	6.5	423.60	423.60	0	Incomplete-wind
25-Jan-12	S		5.8	323.50	323.50	0	Complete
28-Jan-12		N	6.8	484.95	484.95	0	Incomplete-wind
30-Jan-12		M	1.8	70.80	0.00	0	Incomplete-wind
31-Jan-12	N		7.7	563.40	563.40	0	Complete
1-Feb-12	M		8.2	565.20	565.20	18	Complete
4-Feb-12	S		6.0	323.50	323.50	4	Complete
8-Feb-12		M	6.8	452.28	452.28	2	Incomplete-wind
13-Feb-12	S		6.1	323.50	323.50	1	Complete
15-Feb-12		M	5.7	446.70	446.70	0	Incomplete-sunset
17-Feb-12		S	4.4	211.59	211.59	2	Incomplete-fog
22-Feb-12	S		5.8	323.50	323.50	0	Complete

Date	Complete Surveys	Partial Surveys	Hobbs	Total Trackline NM Flown	Trackline NM Flown in Beaufort 3 or Less	Number of Right Whales Seen	Comments
8-Mar-12	S		5.9	323.50	323.50	2*	Complete
12-Mar-12	M		7.3	565.20	565.20	0	Complete
13-Mar-12	N		8.0	563.40	563.40	2	Complete
14-Mar-12	M		7.2	565.20	565.20	0	Complete
15-Mar-12	N		7.6	563.40	563.40	0	Complete
16-Mar-12	M		7.2	565.20	565.20	0	Complete
19-Mar-12	S		5.7	323.50	323.50	0	Complete
20-Mar-12		M	7.2	553.50	553.50	0	Incomplete-rain
23-Mar-12	N		7.9	563.40	563.40	0	Complete
28-Mar-12	S		5.8	323.50	323.50	0	Complete
30-Mar-12	M		7.1	565.20	537.11	0	Complete
1-Apr-12	S		5.6	323.50	323.50	0	Complete
4-Apr-12	S		5.5	323.50	323.50	0	Complete
8-Apr-12		M	1.2	70.60	20.16	0	Incomplete-wind
10-Apr-12	S		5.6	323.50	323.50	0	Complete
13-Apr-12	M		7.2	565.20	565.20	0	Complete
14-Apr-12		N	5.4	471.63	471.63	0	Incomplete-wind

*These right whales were sighted in the Middle area after completion of the Southern area survey while the aircraft was off survey and in transit back to the airport.

**Five of these right whales were sighted in the Middle area after completion of the Southern area survey while the aircraft was off survey and in transit back to the airport.

Table 3. Survey effort totals for SCGA surveys conducted during the 2011-2012 season.

Survey Area	Complete Surveys	Partial Surveys	Hobbs Time	Total Trackline Miles Flown	Total Trackline Miles Beaufort ≤ 3	Number of Right Whales Seen
North	7	3	73.7	5331.0	5294.7	5
Middle	10	12	138.7	10342.4	10148.9	29*
South	17	1	106.2	5711.1	5711.1	36**
Totals	34	16	318.6	21384.5	21154.7	70

*14 additional right whales were sighted in the Middle area after completion of the Southern area survey while the aircraft was off survey and in transit back to the airport.

**14 of these right whales were sighted in the Middle section after completion of the Southern area survey while the aircraft was off survey and in transit back to the airport.

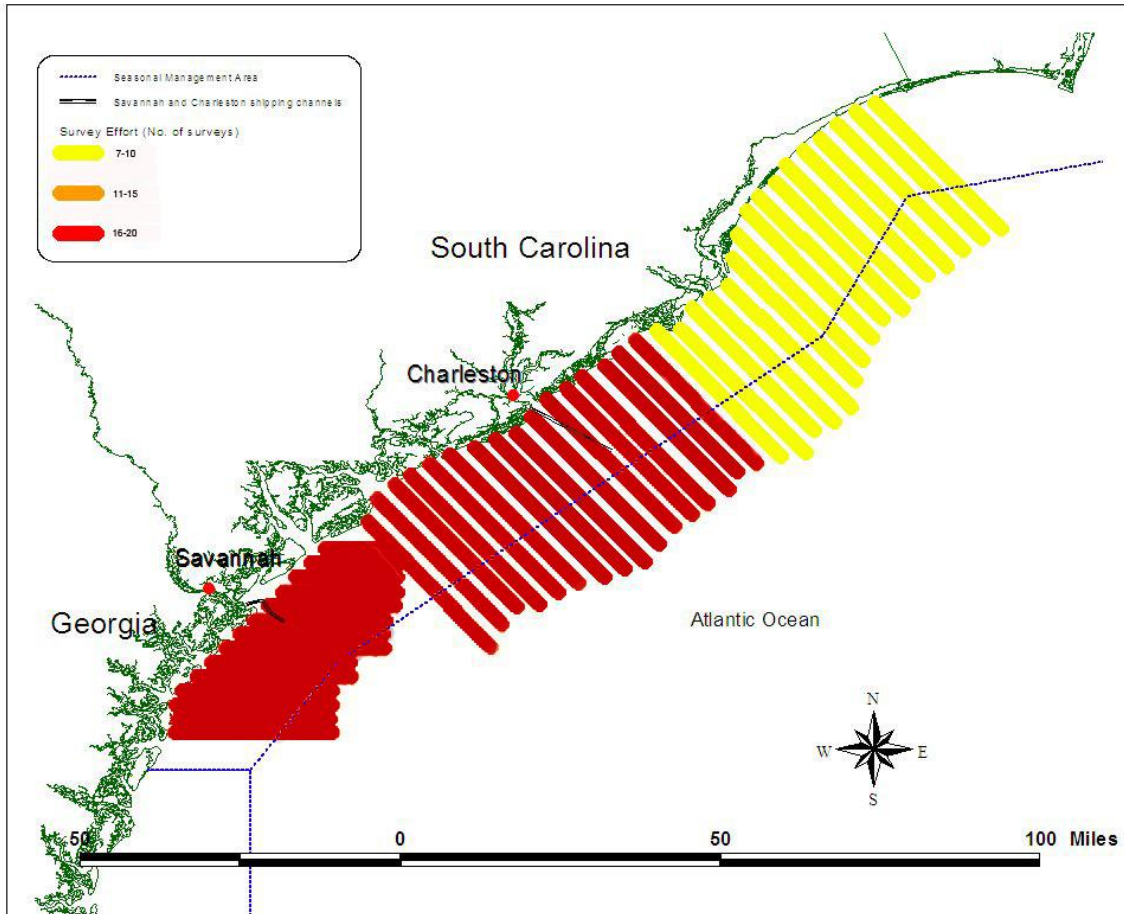


Figure 2. Survey effort for SCGA surveys conducted during the 2011-2012 season. Areas with higher (16-20 surveys) effort are depicted in red; areas with lower (7-10 surveys) effort are depicted in yellow.

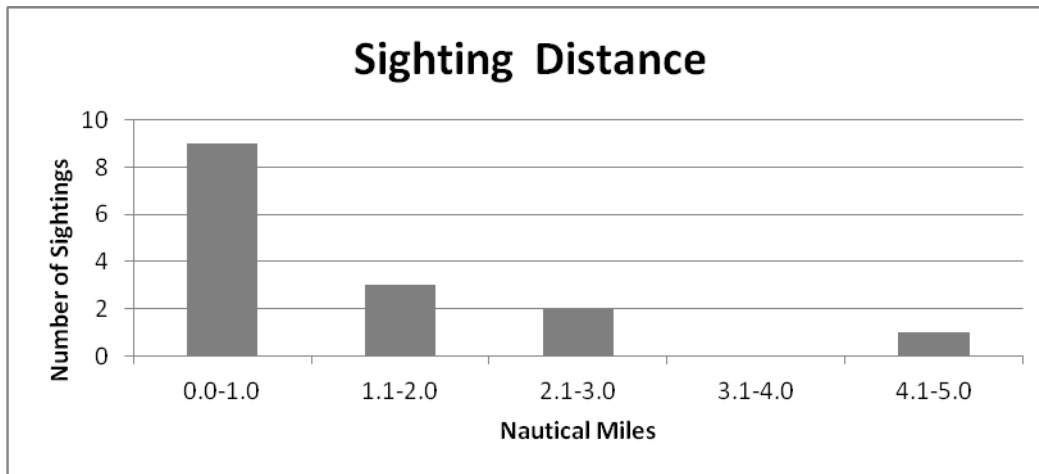


Figure 3. Right whale sighting distances during the 2011-2012 season.

Whale/Ship Interactions

No co-occurrence of whales and vessels were documented in the SCGA survey area during the 2011-2012 survey season.

Dead/Injured/Entangled Right Whales

One entangled right whale was observed within the SCGA study area during the 2011-2012 season. On 20 January 2012, EGNO 1719, an adult female, was documented in the southern section at position 32° 14.4N, -080° 21.1W at 13:57(L). This whale was first documented as entangled on 19 January 2012 by the Northern EWS survey team. EGNO 1719 was observed with a white line exiting the left mouth and ending approximately 3/4 of the way down the left side of the body, as well as a white line exiting the right mouth and ending approximately five feet aft of the flukes. NOAA Fisheries determined, in part based on 19 January 2012 photo documentation by Georgia Department of Natural Resources and the NEWS survey team, that this was a non-life threatening entanglement, there was little gear to work with, and the gear appeared non-descript and, if retrieved, likely could not be identified to fishery. Therefore, no intervention was necessary. The SCGA survey team acquired photo documentation showing the nature of the entanglement had not changed significantly from the day before. The team left the whale at 14:23(L) at position 32° 15.7N, -080° 20.7W. The whale was traveling steadily to the northeast during the event.

Humpback Whales

One humpback whale was observed within the SCGA study area during the 2011-2012 season. On 28 March 2012, a humpback whale was documented in the southern section at position 32° 7.80N, -080° 31.97W. The whale appeared to be logging (resting) at the surface during the first pass and quickly changed its behavior to 2-3 minute dives and began heading south.

Right Whale Sightings and Identifications

Twenty-seven right whale sightings were documented during the SCGA surveys, consisting of 70 right whales (includes resights). The total number of whales seen includes resights of 14 individuals, two individuals sighted three times, two individuals sighted four times and one individual sighted five times for a total of 42 different individual whales (including four calves). Five cow/calf pairs, seven single whales, and 15 groups of two or more adult/juvenile right whales were documented (Figure 4). Preliminary photo-identification by the SCGA Sea to Shore Alliance team and verification by New England Aquarium (NEA) has resulted in the identification of four cow/calf pairs (one of the pairs was observed twice) and all 34 of the individual adult/juvenile whales which accounts for the 42 animals photographed during the season (Tables 4 and 5). All right whale identification information included in this report is preliminary.

The 42 individual right whales documented include 12 females, 11 males and 19 individuals of unknown gender, which includes the four calves (Table 5). Adult males (nine or more years old) accounted for 14% of the individuals observed. Females that had calved (either before or after being observed in the SCGA study area) accounted for 12% of all observed individuals (Figure 5). Of the 12 females seen, five gave birth to new calves during the 2011-2012 season, although only four were seen with their calves within the SCGA study area. The remaining one calving female was seen in the SCGA survey area while pregnant prior to giving birth. Of the five 2011-2012 mothers seen in the SCGA survey area, three last gave birth in 2008, one last gave birth in 2007 and one last gave birth 10 years ago in 2002.

Table 4. Right whale sightings from SCGA surveys conducted during the 2011-2012 season. The numbers and codes listed in the “EGNO” column include EGNO numbers for known whales and temporary codes for young whales that have yet to be assigned an EGNO (i.e. 2010CalfOf1701).

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	RiWHLetter	NEAq EGNO	NRWNumber
1	1	11	22	2011	13:47	SCRW20111122	32.48864	-80.18020	A	1301	SCGA001
2	2	12	15	2011	13:32	SCRW20111215	33.42096	-78.84919	A	3820	SCGA002
2	3	12	15	2011	13:32	SCRW20111215	33.42096	-78.84919	B	2010CalfOf1701	SCGA002
3	4	12	16	2011	8:43	SCRW20111216	32.04529	-80.60354	A	1301	SCGA003
4	5	12	22	2011	13:21	SCRW20111222	31.76465	-80.87206	A	3904	SCGA004
5	6	12	29	2011	10:32	SCRW20111229	33.45466	-78.73908	A	3890	SCGA005
6	7	01	01	2012	11:50	SCRW20120101	32.56527	-79.93768	A	3810	SCGA006
6	8	01	01	2012	11:50	SCRW20120101	32.56527	-79.93768	B	3917	SCGA006
7	9	01	04	2012	15:34	SCRW20120104	32.37696	-80.30267	A	2010CalfOf1241	SCGA007
7	10	01	04	2012	15:34	SCRW20120104	32.37696	-80.30267	B	3740	SCGA007
7	11	01	04	2012	15:34	SCRW20120104	32.37696	-80.30267	C	3791	SCGA007
8	12	01	04	2012	15:43	SCRW20120104	32.37719	-80.30437	D	3917	SCGA007
8	13	01	04	2012	15:43	SCRW20120104	32.37719	-80.30437	E	3810	SCGA007
8	14	01	04	2012	15:43	SCRW20120104	32.37719	-80.30437	F	2470	SCGA007
9	15	01	06	2012	14:30	SCRW20120106	32.32375	-80.32420	A	3740	SCGA008
9	16	01	06	2012	14:30	SCRW20120106	32.32375	-80.32420	B	3794	SCGA008
9	17	01	06	2012	14:30	SCRW20120106	32.32375	-80.32420	C	2010CalfOf2430	SCGA008
9	18	01	06	2012	14:30	SCRW20120106	32.32375	-80.32420	D	3791	SCGA008
9	19	01	06	2012	14:30	SCRW20120106	32.32375	-80.32420	E	3810	SCGA008
10	20	01	06	2012	14:56	SCRW20120106	32.32359	-80.32852	F	3701	SCGA008
10	21	01	06	2012	14:56	SCRW20120106	32.32359	-80.32852	G	2010CalfOf2430	SCGA008
11	22	01	08	2012	10:17	SCRW20120108	31.87030	-80.78242	A	3760	SCGA009
11	23	01	08	2012	10:17	SCRW20120108	31.87030	-80.78242	B	3950	SCGA009
11	24	01	08	2012	10:17	SCRW20120108	31.87030	-80.78242	C	3701	SCGA009
12	25	01	08	2012	12:03	SCRW20120108	31.70431	-80.93517	D	1208	SCGA010
13	26	01	08	2012	12:50	SCRW20120108	31.82828	-80.76567	E	3701	SCGA011
13	27	01	08	2012	12:50	SCRW20120108	31.82828	-80.76567	F	3950	SCGA011
13	28	01	08	2012	12:50	SCRW20120108	31.82828	-80.76567	G	3760	SCGA011
14	29	01	08	2012	15:11	SCRW20120108	32.07567	-80.60878	H	2011CalfOf2790	SCGA012
14	30	01	08	2012	15:11	SCRW20120108	32.07567	-80.60878	I	3810	SCGA012
14	31	01	08	2012	15:11	SCRW20120108	32.07567	-80.60878	J	3791	SCGA012
14	32	01	08	2012	15:11	SCRW20120108	32.07567	-80.60878	K	3740	SCGA012
14	33	01	08	2012	15:11	SCRW20120108	32.07567	-80.60878	L	3794	SCGA012

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	R/WHLetter	NEAq EGNO	NRWNumber
15	34	01	20	2012	13:57	SCRW20120120	32.24324	-80.35628	A	1719	SCGA013
16	35	01	20	2012	14:53	SCRW20120120	32.53753	-80.03960	B	3504	SCGA014
16	36	01	20	2012	14:53	SCRW20120120	32.53753	-80.03960	C	3730	SCGA014
16	37	01	20	2012	14:53	SCRW20120120	32.53753	-80.03960	D	2011CalfOf1123	SCGA014
17	38	01	20	2012	15:03	SCRW20120120	32.53321	-80.04170	E	3903	SCGA014
17	39	01	20	2012	15:03	SCRW20120120	32.53321	-80.04170	F	3740	SCGA014
18	40	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	A	3915	SCGA015
18	41	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	B	3301	SCGA015
18	42	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	C	3150	SCGA015
18	43	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	D	3530	SCGA015
18	44	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	E	3333	SCGA015
18	45	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	F	3760	SCGA015
18	46	02	01	2012	8:13	SCRW20120201	32.58567	-79.82260	G	2440	SCGA015
19	47	02	01	2012	11:17	SCRW20120201	32.51009	-79.88912	H	3705	SCGA016
19	48	02	01	2012	11:17	SCRW20120201	32.51009	-79.88912	I	3510	SCGA016
19	49	02	01	2012	11:17	SCRW20120201	32.51009	-79.88912	J	1307	SCGA016
20	50	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	K	3915	SCGA017
20	51	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	L	3301	SCGA017
20	52	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	M	3150	SCGA017
20	53	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	N	3530	SCGA017
20	54	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	O	3333	SCGA017
20	55	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	P	3760	SCGA017
20	56	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	Q	2440	SCGA017
20	57	02	01	2012	13:02	SCRW20120201	32.55404	-79.84162	R	3823	SCGA017
21	58	02	04	2012	13:06	SCRW20120204	31.89187	-80.73546	A	1208	SCGA018
21	59	02	04	2012	13:06	SCRW20120204	31.89187	-80.73546	B	2012CalfOf1208	SCGA018
22	60	02	04	2012	13:27	SCRW20120204	31.89569	-80.64976	C	3920	SCGA019
22	61	02	04	2012	13:27	SCRW20120204	31.89569	-80.64976	D	3810	SCGA019
23	62	02	08	2012	13:44	SCRW20120208	32.16586	-79.62502	A	3220	SCGA020
23	63	02	08	2012	13:44	SCRW20120208	32.16586	-79.62502	B	2012CalfOf3220	SCGA020
24	64	02	13	2012	13:49	SCRW20120213	32.06966	-80.62720	A	2011CalfOf2420	SCGA021
25	65	02	17	2012	12:53	SCRW20120217	32.14114	-80.55038	A	1812	SCGA022
25	66	02	17	2012	12:53	SCRW20120217	32.14114	-80.55038	B	2012CalfOf1812	SCGA022
26	67	03	08	2012	14:00	SCRW20120308	32.32403	-80.35389	A	1705	SCGA023
26	68	03	08	2012	14:00	SCRW20120308	32.32403	-80.35389	B	2012CalfOf1705	SCGA023
27	69	03	13	2012	9:45	SCRW20120313	33.45412	-78.48771	A	1705	SCGA024
27	70	03	13	2012	9:45	SCRW20120313	33.45412	-78.48771	B	2012CalfOf1705	SCGA024

Table 5. Demographics of individual right whales sighted during the 2011-2012 SCGA season. Asterisk (*) indicates right whales that are unique to the SCGA survey area. "U" is an abbreviation for "unknown". Individuals in bold type are 2011-2012 mothers.

Unique to SCGA	Identification code (EGNO)	Date Sighted	Birth Year	Age	Mother	Gender	First Seen	Last Seen	# calves produced (inc. 1112)	Last Known Calving
	1208	1/8/2012	N/A	>31	N/A	F	1981	2009	6	2008
	1301	11/22/2011	1983	28	1001	F	1983	2011	5	2008
*	1307	2/1/2012	N/A	>38	N/A	M	1974	2010	0	N/A
	1705	3/8/2012	1987	25	1004	F	1987	2010	4	2007
	1719	1/20/2012	N/A	>25	N/A	F	1987	2011	0	N/A
	1812	2/17/2012	N/A	>24	N/A	F	1988	2009	5	2008
*	2440	2/1/2012	1994	18	1140	M	1994	2011	0	N/A
	2470	1/4/2012	N/A	>18	N/A	M	1994	2011	0	N/A
*	3150	2/1/2012	2001	11	2050	M	2001	2011	0	N/A
	3220	2/8/2012	N/A	>12	N/A	F	2002	2002	2	2002
*	3301	2/1/2012	2003	9	1301	M	2003	2011	0	N/A
*	3333	2/1/2012	2003	9	1233	M	2003	2011	0	N/A
*	3504	1/20/2012	2005	7	1204	M	2005	2010	0	N/A
*	3510	2/1/2012	2005	7	3010	M	2005	2011	0	N/A
*	3530	2/1/2012	N/A	>7	N/A	M	2005	2011	0	N/A
	3701	1/6/2012	2007	5	1701	U	2007	2010	0	N/A
*	3705	2/1/2012	2007	5	2605	F	2007	2011	0	N/A
	3730	1/20/2012	2007	5	2430	F	2007	2011	0	N/A
	3740	1/4/2012	2007	5	2601	M	2007	2011	0	N/A
*	3760	1/8/2012	2007	5	2360	U	2007	2011	0	N/A
	3791	1/4/2012	2007	5	3360	U	2007	2010	0	N/A
	3794	1/6/2012	N/A	>5	N/A	F	2007	2011	0	N/A
	3810	1/1/2012	2008	4	3130	U	2008	2011	0	N/A
	3820	12/15/2011	2008	4	3020	U	2008	2010	0	N/A
*	3823	2/1/2012	2008	4	1123	U	2008	2011	0	N/A
	3890	12/29/2011	2008	4	2790	F	2008	2011	0	N/A
*	3903	1/20/2012	2009	3	1503	F	2009	2009	0	N/A
*	3904	12/22/2011	2009	3	1204	F	2009	2010	0	N/A
*	3915	2/1/2012	2009	3	1515	U	2009	2011	0	N/A
	3917	1/1/2012	2009	3	3317	U	2009	2011	0	N/A
	3920	2/4/2012	2009	3	3108	U	2009	2011	0	N/A
	3950	1/8/2012	2009	3	1611	M	2009	2011	0	N/A
	4001	12/15/2011	2010	2	1701	U	2010	2011	0	N/A
*	2010CalfOf1241	1/4/2012	2010	2	1241	U	2010	2011	0	N/A

Unique to SCGA	Identification code (EGNO)	Date Sighted	Birth Year	Age	Mother	Gender	First Seen	Last Seen	# calves produced (inc. 1112)	Last Known Calving
	2010CalfOf2430	1/6/2012	2010	2	2430	U	2010	2011	0	N/A
*	2011CalfOf1123	1/20/2012	2011	1	1123	U	2011	2011	0	N/A
	2011CalfOf2420	2/13/2012	2011	1	2420	U	2011	2011	0	N/A
	2011CalfOf2790	1/8/2012	2011	1	2790	U	2007	2011	0	N/A
	2012CalfOf1208	2/4/2012	2012	0	1208	U	2012	2012	0	N/A
	2012CalfOf1705	3/8/2012	2012	0	1705	U	2012	2012	0	N/A
	2012CalfOf1812	2/17/2012	2012	0	1812	U	2012	2012	0	N/A
	2012CalfOf3220	2/8/2012	2012	0	3220	U	2012	2012	0	N/A

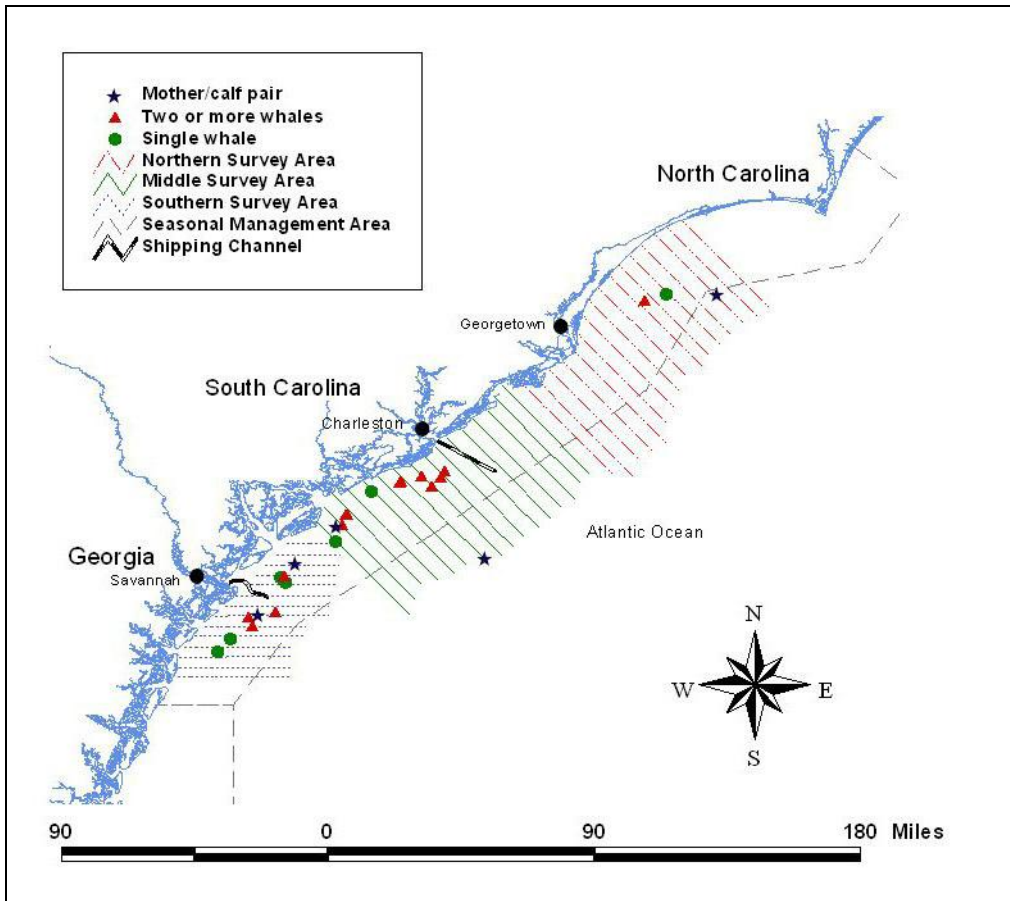


Figure 4. Right whale sightings by group type during the SCGA 2011-2012 season.

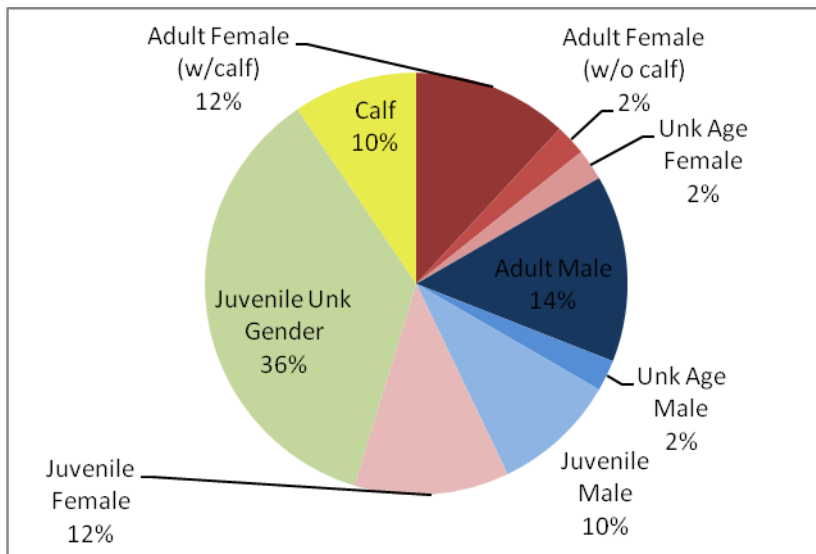


Figure 5. Preliminary demographic distribution of right whales observed during the SCGA 2011-2012 season.

Sightings of note include 16 individuals that were unique to the study area (based on preliminary analysis) and not sighted by EWS survey teams to the south: EGNOs 1307, 2440, 3150, 3301, 3333, 3504, 3510, 3530, 3705, 3760, 3823, 3903, 3904, 3915, the 2010 calf of EGNO 1241 and the 2011 calf of EGNO 1123. Additionally, 13 of the 16 unique whales were observed in surface active groups (SAG). A total of 11 SAGs were documented. These 11 groups involved a total of 25 participants (60% of all individual whales observed), six of which were adult males, one was a female of unknown age, and 18 were juveniles. None of the SAG participants were known to be adult females. Other notable sightings included the observation of an entangled whale, EGNO1719, on 20 January 2012.

Geographic locations of the 27 SCGA right whale sightings are depicted by month in Figure 6. During the 2011-2012 season, 56% of the right whale sightings occurred in the months of November-January while 44% of the sightings occurred during February-April (Figures 7 and 8). This relatively even distribution of sightings is very similar to the results of the 2006-2007, 2007-2008, 2008-2009 and 2010-2011 seasons where the sightings were relatively evenly distributed between both halves of the season, but is in contrast to the other seasons where the vast majority of sightings occurred in one half of the season. The number of right whale sightings per trackline nautical miles flown was calculated for each week of the season (Figure 9). A peak in the number of sightings per trackline nautical miles flown was noted in January.

The average number of whales per sighting during the 2011-2012 season was greatest in February with 3.4 whales per sighting (average for entire season was 2.6 whales per sighting) yet 47% of all whales seen were documented during January compared with 39% in February (Figure 7).

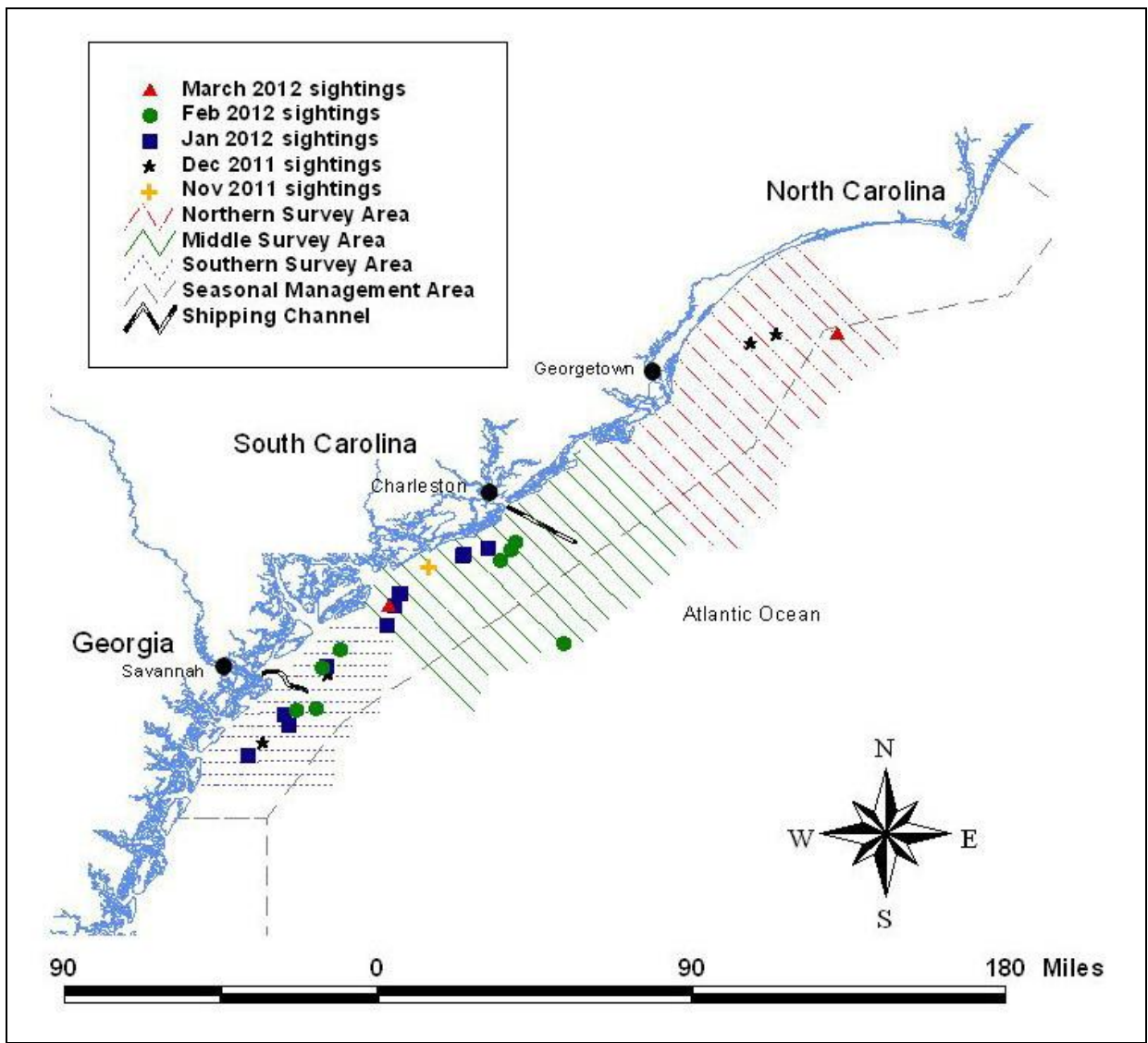


Figure 6. Right whale sightings by month during the SCGA 2011-2012 season.

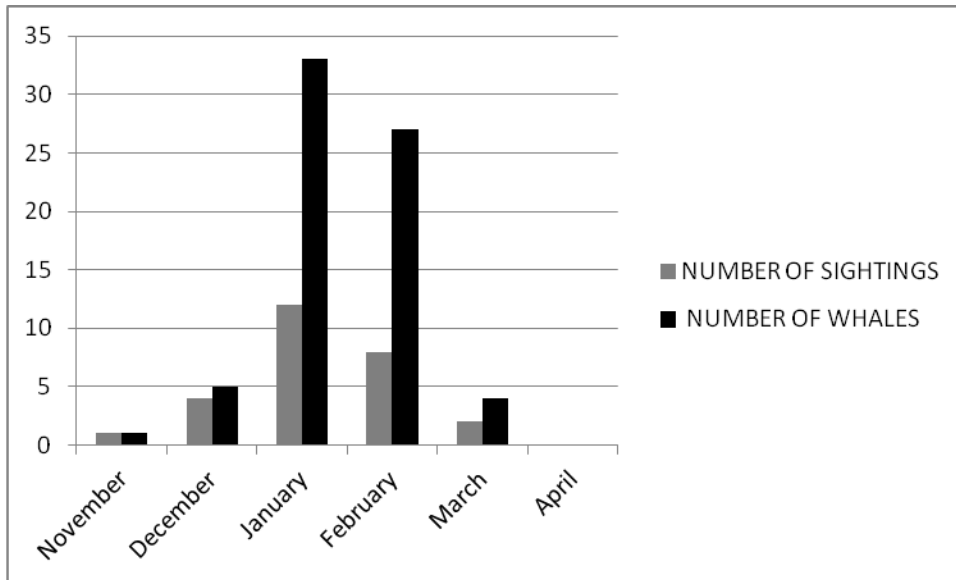


Figure 7. Number of sightings and right whales by month during the SCGA 2011-2012 season.

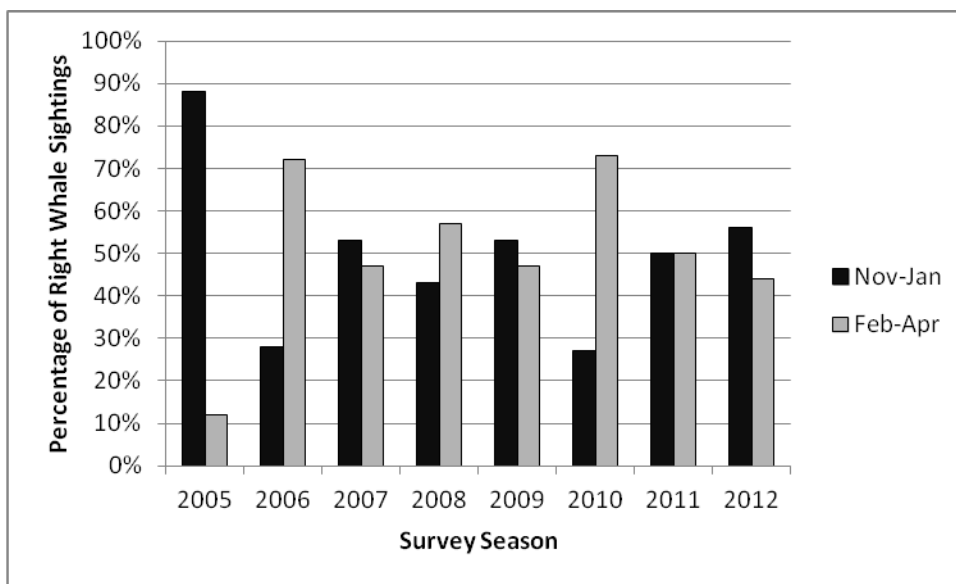


Figure 8. Temporal distribution of SCGA right whale sightings for all survey seasons.

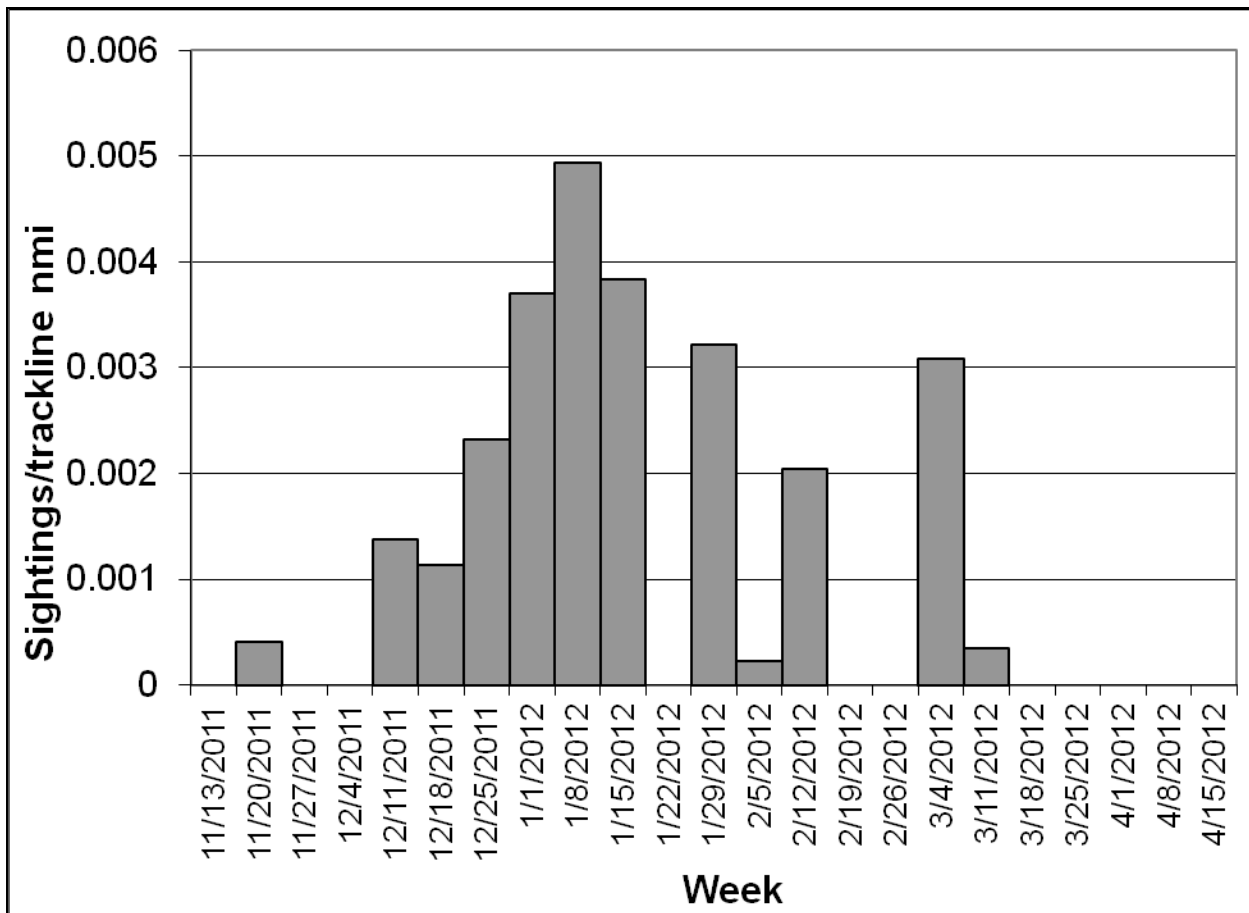


Figure 9. Weekly right whale sightings per trackline nmi flown during the 2011-2012 season.

Discussion and Recommendations

A total of 42 individual right whales (including four calves) were documented in the SCGA survey zone during the 2011-2012 season which is lower than the average number of right whales documented seasonally since 2004 ($n = 57$). Of all the whales documented, 14% were adult males and 58% were juveniles, indicating the importance of the region to demographic groups other than calving females. Eleven surface active groups (SAGs) were observed during the season involving a total of 25 individuals. Six of these participants were adult males, one was a female of unknown age, and 18 were juveniles. No known adult females were involved. SAGs are believed to play a role in mating however often do not lead directly to calving. Based on preliminary analysis, 16 whales sighted in the SCGA survey zone were not sighted further south by other aerial survey teams, indicating that a portion of the population may migrate to the mid-Atlantic region rather than the Florida/Georgia critical habitat.

The calving ground off the SEUS is an extremely important area for reproduction in the North Atlantic right whale. In addition, this area is vital to military and commercial interests. Three major shipping routes pass through the designated critical habitat and present a threat to the slow-moving right whale, particularly females with calves. Three additional shipping routes are located in the vicinity, to the north and south of the critical habitat boundary. The Early Warning System and associated aerial surveys and communication systems, as well as federal ship speed zones (implemented in December 2008), have likely decreased the risk of ship strikes to whales while in the critical habitat. Eight years of expanded aerial survey coverage has provided more reliable information on right whale distribution and habitat use and additional protection outside the traditional SEUS survey areas.

For the past eight years consistent survey effort throughout the migration and calving season has provided valuable additional sightings and increased warnings to mariners along the coast of South Carolina. The number of right whales sighted in the SCGA survey area ($n = 70$) is lower than the Northern and Central EWS survey areas ($n = 156$ and 104 right whales, respectively) but is higher than the number of right whales sighted by the Southern EWS survey team ($n = 9$), despite much lower survey effort in the SCGA area. This indicates a shift in distribution to the north from previous seasons, possibly due to variations in necessary resources such as preferred water temperature as described by Keller *et al.* 2006. The average water temperature at the Edisto buoy (NDBC Station 41004, 41 nmi southeast of Charleston, SC) during the 2011-2012 season was 20.3°C , which is 1.7°C warmer than the previous season and 0.6°C warmer than the average over the past seven seasons (19.7°C). With the increase in water temperature, an increase in the number of individual whales was documented between the 2010-2011 and 2011-2012 seasons (36 and 42 respectively). These numbers are lower than the average number of individual whales documented seasonally ($n = 55$) throughout the eight years of this study. These distribution shifts indicate the importance of understanding the variables that affect right whale movements and identifying the best methods for documenting whales throughout the region as variables change over time.

The boundary of the current critical habitat was designated in 1994 by NMFS based on the best available scientific data at the time. Eighteen additional years of spatial and temporal distribution data now exist, which provide a more accurate picture of right whale distribution in the southeast and mid-Atlantic. The data from these surveys provide valuable information regarding the most appropriate boundaries for critical management designations that will protect features essential to the conservation of the species. Additionally, distribution data in this region will assist with other management actions

that may be implemented in the future, such as ship reporting systems, speed zones, or routing. Data collected during these surveys will assist in determining the effectiveness of the seasonal management area implemented in 2008 along the eastern seaboard (50 CFR Part 224).

Portions of the east coast of the United States are without consistent survey effort, limiting spatial and temporal distribution data and ultimately protection available for the right whale. However, limitations of these aerial survey efforts must also be addressed, including high costs, the inability to fly in inclement weather and darkness, safety issues, observer bias, observer fatigue, etc. If the goal is to provide maximum protection for right whales, we must investigate new technologies and management techniques that may provide a more reliable means for detecting and protecting right whales throughout their range. Without moving forward on these fronts it is unlikely that we will ever reach a potential biological removal level of 0.7 for North Atlantic right whales, as calculated in NMFS Marine Mammal stock assessment reports (NMFS 2011).

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