



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
2009 – 2010**

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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 has 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 44 surveys were flown from 15 November 2009 to 15 April 2010 and extended from North Myrtle Beach, South Carolina (33.82°N) to St. Catherine's Island, Georgia (31.58°N). Preliminarily, 33 right whale sightings consisting of 84 right whales were documented (including resights of 17 individuals, four individuals sighted three times and one individual sighted four times). Sightings consisted of five cow/calf pairs, 10 single whales, and 17 groups of two or more adult/juvenile right whales. Preliminary photo-identification has resulted in the confirmed identification of three individual cow/calf pairs and 26 of the individual adult/juvenile whales. The individuals documented include 23 males, 19 females, and 16 individuals of unknown gender (including calves), for a total of 58 individual whales in the study area. Of the 19 females seen, nine gave birth to new calves this season, although only three were seen with their calves within the study area. The remaining six calving females were seen while pregnant prior to giving birth. Preliminary sightings of note include 18 individuals, including a cow/calf pair, that were unique to the study area and not sighted by other survey teams to the south. Also of note was the observation of nine surface active groups (50% of all individuals involved being adult males and only one individual being an adult female) and the observations of a previously entangled individual, a previously ship-struck individual and an individual with a new wound. The number of whales sighted was greatest in February, resulting in 46% of all whales documented during the 2009-2010 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. 2009). 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 in 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 2009 and concluded on 15 April 2010. The SCGA survey area for the 2009-2010 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 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 (formerly known as East Cooper 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 normal 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 2009 through 15 April 2010, 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 17 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 while the right observer 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 that was installed in the plane 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 2009-2010 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

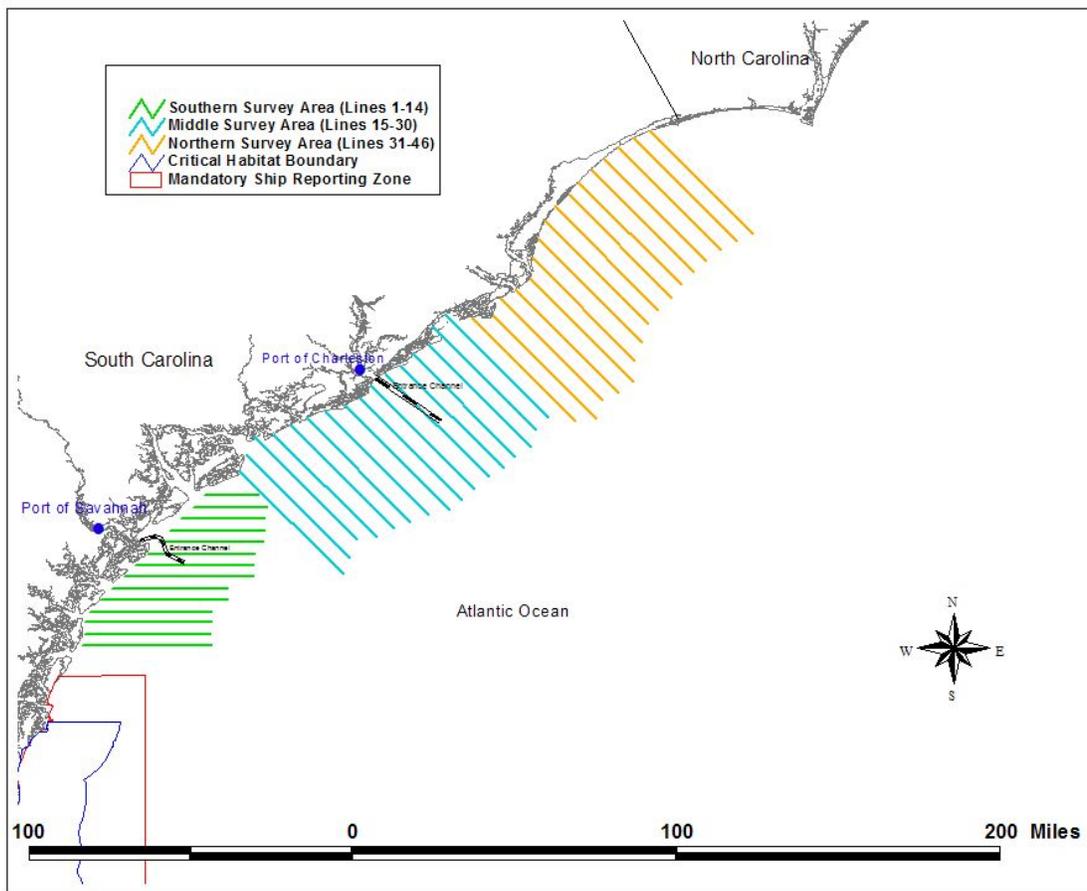


Figure 1. Map of South Carolina-Georgia survey tracklines flown during the 2009-2010 season.

Sighting distance for all large whales was calculated from overhead GPS locations. 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 location. 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:

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

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

$$a = \text{lat } 1, b = \text{lat } 2, c = \text{long } 1, d = \text{long } 2$$

The sighting distance from the trackline of large vessels was determined using angles obtained from a digital inclinometer at the time of the vessel's sighting and the equation:

$$= (a/3.281) * (\text{TAN (RADIANS (b))})$$

a= altitude, b=angle

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 nmi from the closest 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 sliding window or through the right observer's window which could be opened. 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 2009-2010 SCGA survey season. Preliminary photo-identification by the SCGA Wildlife Trust team and initial verification by NEA has been completed and all photographs taken during the 2009-2010 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.

Results

Aerial Surveys

A total of 44 SCGA surveys were flown from 15 November 2009 through 15 April 2010 (Tables 2 and 3). A total of 298.6 hours of Hobbs time was logged, averaging 7.1 hours per survey in the northern section, 7.0 hours in the middle section, and 6.2 hours in the southern section (including complete and partial surveys). A total of 4421.1 nautical miles (nmi) of trackline were flown in the northern section, 11109.6 nmi in the middle, and 4143.4 nmi in the southern, for a total of 19674.1 nmi of trackline flown. Additionally, the total amount of trackline miles flown in a Beaufort sea state ≤ 3 was 19161.0 nmi. The northern survey area was completed on six survey days and partially completed on three survey days. The middle survey area was completed on 13 survey days and partially completed on nine survey days. The southern survey area was completed on 12 survey days and partially completed on one survey day. The 13 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 1.11 (SD = 0.74) nautical miles from the trackline (Figure 3).

Sightings of Large Vessels

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 2009-2010 season. "S" refers to the southern survey zone, "M" to the middle, and "N" to the north.

Date	Complete Surveys	Partial Surveys	Hobbs	Total Trackline NMI Flown	Trackline NMI Flown in Beaufort 3 or Less	Number of Right Whales Seen	Comments
15-Nov-09	M		7.3	565.20	565.20	0	Complete
16-Nov-09	S		5.8	323.50	323.50	0	Complete
20-Nov-09		M	5.3	423.60	423.60	0	Incomplete-fog
26-Nov-09		N	5.3	364.09	364.09	0	Incomplete-fog
28-Nov-09		M	6.1	423.60	423.60	1	Incomplete-wind
30-Nov-09	S		5.8	323.50	323.50	0	Complete
4-Dec-09		M	3.7	282.40	282.40	0	Incomplete-rain
21-Dec-09	M		7.3	565.20	565.20	0	Complete
22-Dec-09	S		5.6	323.50	323.50	0	Complete
23-Dec-09	N		7.6	563.40	563.40	0	Complete
27-Dec-09	S		5.7	323.50	323.50	0	Complete

Date	Complete Surveys	Partial Surveys	Hobbs	Total Trackline NMI Flown	Trackline NMI Flown in Beaufort 3 or Less	Number of Right Whales Seen	Comments
3-Jan-10	S		6.2	323.50	323.50	1	Complete
4-Jan-10		M	6.5	494.60	494.60	1	Incomplete-wind
6-Jan-10		M	4.9	301.20	301.20	1	Incomplete-wind
7-Jan-10	N		7.8	563.40	563.40	0	Complete
11-Jan-10		M	6.1	423.60	353.00	0	Incomplete-wind
12-Jan-10		S	4.8	261.40	261.40	2	Incomplete-wind
13-Jan-10	M		7.5	565.20	493.70	0	Complete
14-Jan-10	N		7.8	563.40	563.40	0	Complete
15-Jan-10	M		7.4	565.20	565.20	0	Complete
19-Jan-10	S		6.4	323.50	323.50	2	Complete
20-Jan-10	M		7.7	565.20	565.20	1	Complete
27-Jan-10		M	6.9	494.60	494.60	4	Incomplete-wind
28-Jan-10	S		6.5	323.50	323.50	1	Complete
8-Feb-10	N		8.0	563.40	563.40	0	Complete
14-Feb-10		M	6.7	494.40	383.43	0	Incomplete-wind
19-Feb-10	M		8.9	565.20	565.20	13	Complete
20-Feb-10	M		8.4	565.20	565.20	10	Complete
21-Feb-10	S		8.6	323.50	323.50	16	Complete
1-Mar-10	N		8.9	563.40	554.36	7	Complete
6-Mar-10		M	6.4	424.00	424.00	3	Incomplete-wind
7-Mar-10	S		6.2	323.50	323.50	1	Complete
9-Mar-10	M		8.1	565.20	565.20	4	Complete
10-Mar-10		N	4.0	282.00	282.00	0	Incomplete-rain
17-Mar-10	M		8.1	565.20	565.20	1	Complete
19-Mar-10	S		6.5	323.50	323.50	6	Complete
20-Mar-10	M		8.4	565.20	565.20	6	Complete
24-Mar-10	N		7.9	563.40	563.40	0	Complete
25-Mar-10	M		7.9	565.20	565.20	3	Complete
31-Mar-10	S		5.9	323.50	323.50	0	Complete
3-Apr-10	M		7.3	565.20	565.20	0	Complete
6-Apr-10		N	6.2	394.60	221.00	0	Incomplete-wind
11-Apr-10	S		6.5	323.50	277.53	0	Complete
12-Apr-10	M		7.7	565.20	533.74	0	Complete

Table 3. Survey effort totals for SCGA surveys conducted during the 2009-2010 season.

Survey Area	Complete Surveys	Partial Surveys	Hobbs Time	Total Trackline Miles Flown	Total Trackline Miles Beaufort ≤ 3	Number of Right Whales Seen
North	6	3	63.5	4421.1	4238.5	7
Middle	13	9	154.6	11109.6	10825.1	48
South	12	1	80.5	4143.4	4097.4	29
Totals	31	13	298.6	19674.1	19161.0	84

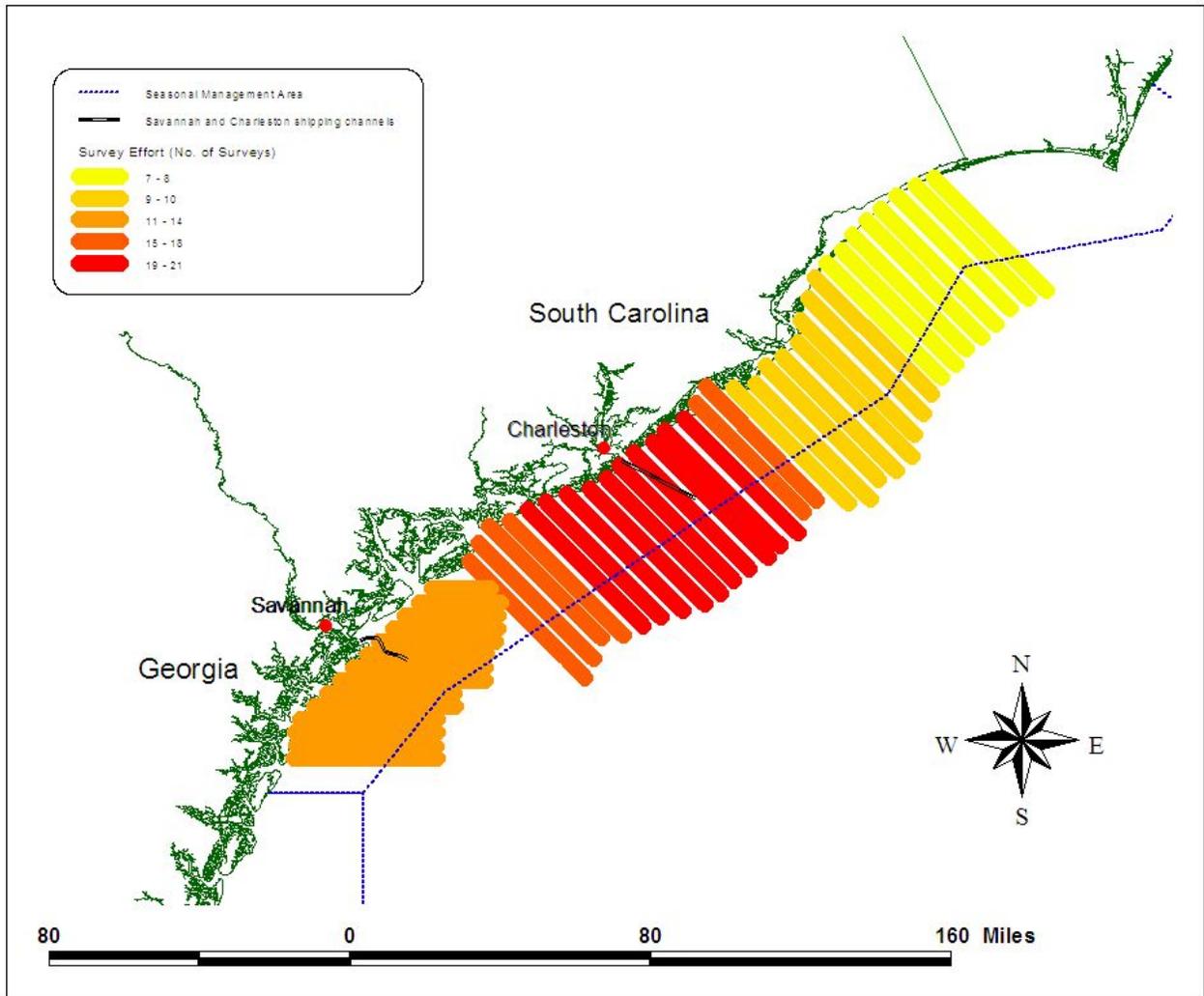


Figure 2. Survey effort for SCGA surveys conducted during the 2009-2010 season. Areas with higher (19-21 surveys) effort are depicted in red; areas with lower (7-8 surveys) effort are depicted in yellow.

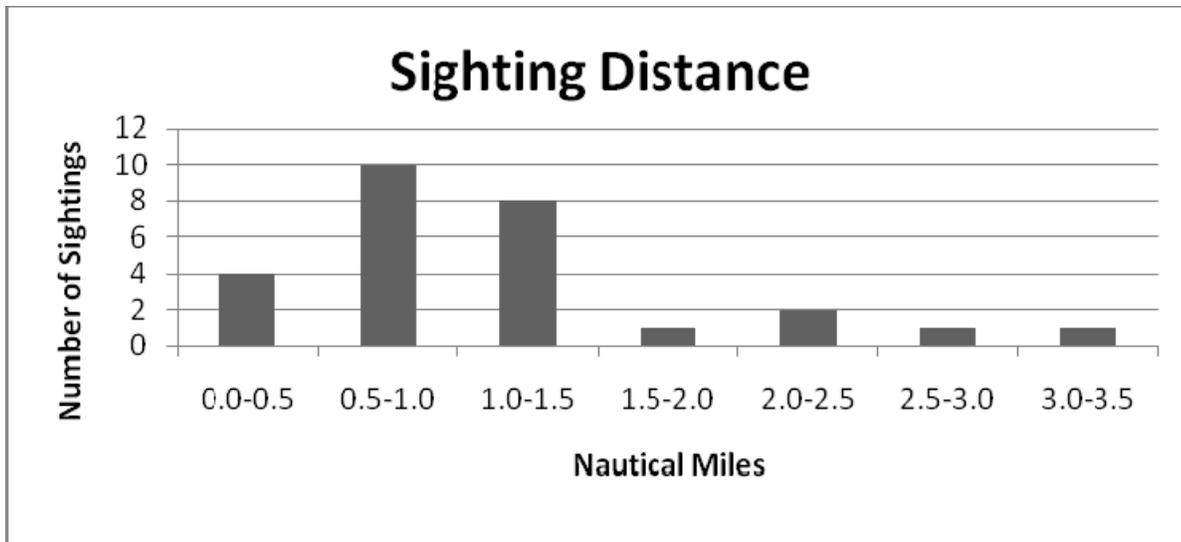


Figure 3. Right whale sighting distances during the 2009-2010 season.

Whale/Ship Interactions

Two co-occurrences of whales and vessels were documented in the SCGA survey area during the 2009-2010 survey season. On 07 March 2010, at 13:48(L), an estimated 30 ft sport fishing vessel was observed approaching a surface active right whale (2009 calf of EGNO 1611) at a high speed. This vessel approached within 10 feet of the whale at 32.25493N/-80.34969W. Radio contact from the survey aircraft was not established with the vessel. After approximately three minutes near the whale, the vessel continued on its original course at 13:51(L). No vessel name or registration number was acquired.

On 20 March 2010 at 09:22 (L) and position 32.40132N/-80.24792W, a sport fishing vessel named *Southern Accent* was observed heading WNW toward shore when it altered course toward a group of six surface active whales. The vessel slowed to idle and repeatedly approached the whales within 20 feet at position 32.39863N/-80.25378W. During one of the approaches, the vessel passed directly over a submerged right whale while idling toward another whale. The submerged whale was not injured. The survey plane repeatedly attempted to hail the vessel but no contact was initiated. After 33 minutes of unsuccessful hailing attempts, US Coast Guard-Charleston was contacted at 9:55 and advised of the situation. At 10:00(L) the final position of both the vessel and the whales was 32.41512N/-80.26366W at which time the survey plane continued on survey while the vessel was still in close proximity to the whales. At 11:30, the survey plane revisited the location of the co-occurrence. The whales were still present but no vessels were seen in the area.

Dead/Entangled Right Whales

No dead or entangled right whales were observed within the SCGA study area during the 2009-2010 season.

Humpback Whales

One humpback whale was observed within the SCGA study area during the 2009-2010 season. On 19 March 2010, a single humpback whale was observed in the middle survey area at

32° 41.162N, 079° 43.263W, just north of the Charleston harbor entrance channel. This whale was traveling slowly to the northeast, away from the channel.

Right Whale Sightings and Identifications

Thirty-three right whale sightings were documented during the SCGA surveys, consisting of 84 right whales. The total number of whales seen includes resights of 17 individuals, four individuals sighted three times, and one individual sighted four times for a total of 58 different individual whales. Five cow/calf pairs, 10 single whales, and 17 groups of two or more adult/juvenile right whales were documented (Figure 4). Preliminary photo-identification by the SCGA Wildlife Trust team and verification by New England Aquarium (NEA) has resulted in the identification of three cow/calf pairs (two of the pairs were observed twice) and 26 of the individual adult/juvenile whales which accounts for 32 of the 58 animals sighted during the season (Tables 4 and 5). Twenty-six individual whales have not been positively identified at the time of this report. All right whale identification information included in this report is preliminary and should not be considered final until NEA completes the confirmation process.

The 58 individual right whales documented include 23 males, 19 females, and 16 individuals of unknown gender, which includes the 3 calves (Table 5). Of the animals with a known age and gender, adult males (nine or more years old) accounted for 40% of the individuals observed. Females that had calved (either before or after being observed in the SCGA study area) accounted for 15% of all observed individuals (Figure 5). Of the 19 females seen, 9 gave birth to new calves during the 2009-2010 season, although only three were seen with their calves within the SCGA study area. The remaining six calving females were seen in the SCGA survey area while pregnant prior to giving birth. Of the nine 2009-2010 mothers seen in the SCGA survey area, two last gave birth in 2005, five last gave birth in 2007, one last gave birth in 2008 (and lost her calf that same year) and one was primiparous.

Table 4. Right whale sightings from SCGA surveys conducted during the 2009-2010 season. "Poss" indicates photo-identification that has not yet been verified by NEA. The numbers and codes listed in the "EGNO" column include EGNO numbers for known whales and intermatch codes (i.e. BK01SEUS09), which were created to assist in the preliminary matching of juvenile whales until they are assigned EGNOs.

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	RIWH Letter	NEA EGNO	NRW Number
1	1	11	28	2009	13:18	SCRW20091128	32.53893	-79.85668	A	3180	SCGA001
2	2	01	03	2010	12:47	SCRW20100103	31.83930	-80.82729	A	2642	SCGA002
3	3	01	04	2010	11:14	SCRW20100104	32.22260	-80.20830	A	1934	SCGA003
4	4	01	06	2010	13:49	SCRW20100106	32.73124	-79.57671	A	3603	SCGA004
5	5	01	12	2010	15:27	SCRW20100112	31.90694	-80.42278	A	1241	SCGA005
5	6	01	12	2010	15:27	SCRW20100112	31.90694	-80.42278	B	1241's calf	SCGA005
6	7	01	19	2010	13:50	SCRW20100119	32.18762	-80.47667	A	3360	SCGA006
6	8	01	19	2010	13:50	SCRW20100119	32.18762	-80.47667	B	2645	SCGA006
7	9	01	20	2010	9:34	SCRW20100120	32.25497	-80.17052	A	2605	SCGA007

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	RIWH Letter	NEA EGNO	NRW Number
8	10	01	27	2010	11:07	SCRW20100127	31.97648	-79.97234	A	BK01SEUS09	SCGA008
8	11	01	27	2010	11:07	SCRW20100127	31.97648	-79.97234	B	3523	SCGA008
8	12	01	27	2010	11:07	SCRW20100127	31.97648	-79.97234	C	3504	SCGA008
8	13	01	27	2010	11:07	SCRW20100127	31.97648	-79.97234	D	3423 poss	SCGA008
9	14	01	28	2010	9:11	SCRW20100128	31.56513	-80.97987	A	2009CalfOf3290	SCGA009
10	15	02	19	2010	11:40	SCRW20100219	32.34862	-79.68452	A	2460	SCGA010
10	16	02	19	2010	11:40	SCRW20100219	32.34862	-79.68452	B	2460's calf	SCGA010
11	17	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	C	1981	SCGA011
11	18	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	D	2304 poss	SCGA011
11	19	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	E	2018 poss	SCGA011
11	20	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	F	3229 poss	SCGA011
11	21	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	G	3110 poss	SCGA011
11	22	02	19	2010	13:38	SCRW20100219	32.42754	-79.64278	H	1402 poss	SCGA011
12	23	02	19	2010	14:18	SCRW20100219	32.47515	-79.61821	I	3420	SCGA012
12	24	02	19	2010	14:18	SCRW20100219	32.47515	-79.61821	J	2770 poss	SCGA012
12	25	02	19	2010	14:18	SCRW20100219	32.47515	-79.61821	K	2681 poss	SCGA012
12	26	02	19	2010	14:18	SCRW20100219	32.47515	-79.61821	L	2009CalfOf1266 poss	SCGA012
13	27	02	19	2010	14:44	SCRW20100219	32.51737	-79.69268	M	3260	SCGA013
14	28	02	20	2010	8:43	SCRW20100220	32.45965	-79.95548	A	1241	SCGA014
14	29	02	20	2010	8:43	SCRW20100220	32.45965	-79.95548	B	1241's calf	SCGA014
15	30	02	20	2010	9:37	SCRW20100220	32.22597	-80.17872	C	2770 poss	SCGA015
15	31	02	20	2010	9:37	SCRW20100220	32.22597	-80.17872	D	3110 poss	SCGA015
15	32	02	20	2010	9:37	SCRW20100220	32.22597	-80.17872	E	2681 poss	SCGA015
16	33	02	20	2010	9:58	SCRW20100220	32.22102	-80.20155	F	1981	SCGA016
16	34	02	20	2010	9:58	SCRW20100220	32.22102	-80.20155	G	3229 poss	SCGA016
16	35	02	20	2010	9:58	SCRW20100220	32.22102	-80.20155	H	2304 poss	SCGA016
16	36	02	20	2010	9:58	SCRW20100220	32.22102	-80.20155	I	1402 poss	SCGA016
16	37	02	20	2010	9:58	SCRW20100220	32.22102	-80.20155	J	2018 poss	SCGA016
17	38	02	21	2010	8:41	SCRW20100221	32.20228	-80.14967	A	2630 poss	SCGA017
17	39	02	21	2010	8:41	SCRW20100221	32.20228	-80.14967	B	1801 poss	SCGA017
17	40	02	21	2010	8:41	SCRW20100221	32.20228	-80.14967	C	2310 poss	SCGA017
17	41	02	21	2010	8:41	SCRW20100221	32.20228	-80.14967	D	2142 poss	SCGA017
17	42	02	21	2010	8:41	SCRW20100221	32.20228	-80.14967	E	2760	SCGA017
18	43	02	21	2010	10:31	SCRW20100221	31.66855	-80.84350	F	2009CalfOf2145	SCGA018
19	44	02	21	2010	11:11	SCRW20100221	31.74533	-80.71745	G	2018 poss	SCGA019
19	45	02	21	2010	11:11	SCRW20100221	31.74533	-80.71745	H	1402 poss	SCGA019

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	RIWH Letter	NEA EGNO	NRW Number
20	46	02	21	2010	11:26	SCRW20100221	31.73841	-80.72169	I	1981	SCGA020
20	47	02	21	2010	11:26	SCRW20100221	31.73841	-80.72169	J	2770 poss	SCGA020
21	48	02	21	2010	12:19	SCRW20100221	31.81000	-80.55725	K	2601 poss	SCGA021
21	49	02	21	2010	12:19	SCRW20100221	31.81000	-80.55725	L	3420	SCGA021
22	50	02	21	2010	14:23	SCRW20100221	31.89877	-80.42574	M	2460	SCGA022
22	51	02	21	2010	14:23	SCRW20100221	31.89877	-80.42574	N	2460's calf	SCGA022
23	52	02	21	2010	15:34	SCRW20100221	32.07417	-80.46380	O	1209 poss	SCGA023
23	53	02	21	2010	15:34	SCRW20100221	32.07417	-80.46380	P	3770	SCGA023
24	54	03	01	2010	10:26	SCRW20100301	32.99197	-79.12896	A	3515	SCGA024
24	55	03	01	2010	10:26	SCRW20100301	32.99197	-79.12896	B	3060	SCGA024
24	56	03	01	2010	10:26	SCRW20100301	32.99197	-79.12896	C	1719	SCGA024
25	57	03	01	2010	17:21	SCRW20100301	32.97460	-79.24630	D	3515	SCGA025
25	58	03	01	2010	17:21	SCRW20100301	32.97460	-79.24630	E	3060	SCGA025
25	59	03	01	2010	17:21	SCRW20100301	32.97460	-79.24630	F	1719	SCGA025
25	60	03	01	2010	17:21	SCRW20100301	32.97460	-79.24630	G	3510	SCGA025
26	61	03	06	2010	15:19	SCRW20100306	32.37522	-79.74348	A	S049	SCGA026
27	62	03	06	2010	15:58	SCRW20100306	32.52112	-79.80942	B	1145	SCGA027
27	63	03	06	2010	15:58	SCRW20100306	32.52112	-79.80942	C	1145's calf	SCGA027
28	64	03	07	2010	13:48	SCRW20100307	32.25493	-80.34969	A	2009CalfOf1611 poss	SCGA028
29	65	03	09	2010	9:34	SCRW20100309	32.51760	-79.35777	A	1402 poss	SCGA029
29	66	03	09	2010	9:34	SCRW20100309	32.51760	-79.35777	B	2608 poss	SCGA029
29	67	03	09	2010	9:34	SCRW20100309	32.51760	-79.35777	C	1056	SCGA029
29	68	03	09	2010	9:34	SCRW20100309	32.51760	-79.35777	D	3295	SCGA029
30	69	03	17	2010	9:32	SCRW20100317	31.88382	-79.97618	A	3260	SCGA030
31	70	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	A	3150 poss	SCGA031
31	71	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	B	1616 poss	SCGA031
31	72	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	C	1803 poss	SCGA031
31	73	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	D	3640	SCGA031
31	74	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	E	3193 poss	SCGA031
31	75	03	19	2010	13:56	SCRW20100319	32.25817	-80.29725	F	1328 poss	SCGA031
32	76	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	A	S047	SCGA032
32	77	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	B	1803 poss	SCGA032
32	78	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	C	3450 poss	SCGA032
32	79	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	D	1328 poss	SCGA032
32	80	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	E	3640	SCGA032
32	81	03	20	2010	9:10	SCRW20100320	32.39863	-80.25378	F	3150 poss	SCGA032

Sighting #	Whale #	Month	Day	Year	Time (L)	Survey Name	Latitude	Longitude	RIWH Letter	NEA EGNO	NRW Number
33	82	03	25	2010	11:10	SCRW20100325	32.33142	-79.60390	A	3590	SCGA033
33	83	03	25	2010	11:10	SCRW20100325	32.33142	-79.60390	B	1176 poss	SCGA033
33	84	03	25	2010	11:10	SCRW20100325	32.33142	-79.60390	C	3391	SCGA033

Table 5. Demographics of individual right whales sighted during the 2009-2010 SCGA season. Asterisk (*) indicates right whales that are unique to the SCGA survey area. "U" is an abbreviation for "unknown". Individuals in bold are 2009-2010 mothers.

	Identification code (EGNO/Intermatch)	Date Sighted	Birth Year	Age	Calf of	Gender	First Seen	Last Seen	# calves produced (inc. 0910)	Last Known Calving
*	1056	3/9/2010	U	>30	U	U	1980	2007	0	n/a
	1145	3/6/2010	U	>29	U	F	1981	2005	7	2005
	1176 poss	3/25/2010	U	>29	U	M	1981	2006	n/a	n/a
	1209 poss	2/21/2010	U	>30	U	F	1980	2009	0	n/a
	1241	1/12/2010	1982	28	1240	F	1982	2006	5	2005
	1241	1/12/2010	1982	28	1240	F	1982	2006	5	2005
*	1328 poss	3/19/2010	U	>27	U	M	1983	2006	n/a	n/a
*	1328 poss	3/20/2010	U	>27	U	M	1983	2006	n/a	n/a
*	1402 poss	2/19/2010	1984	26	1157	M	1984	2006	n/a	n/a
*	1402 poss	2/20/2010	1984	26	1157	M	1984	2006	n/a	n/a
*	1402 poss	2/21/2010	1984	26	1157	M	1984	2006	n/a	n/a
*	1402 poss	3/9/2010	1984	26	1157	M	1984	2006	n/a	n/a
*	1616 poss	3/19/2010	U	>24	U	M	1986	2006	n/a	n/a
	1719	3/1/2010	U	>23	U	F	1987	2007	0	n/a
	1801 poss	2/21/2010	1988	22	1242	M	1988	2008	n/a	n/a
*	1803 poss	3/19/2010	1988	22	1266	M	1988	2008	n/a	n/a
*	1803 poss	3/20/2010	1988	22	1266	M	1988	2008	n/a	n/a
	1934	1/4/2010	1989	21	1034	F	1989	2009	0	n/a
	1981	2/19/2010	1989	21	1281	U	1989	2008	0	n/a
	1981	2/20/2010	1989	21	1281	U	1989	2008	0	n/a
	1981	2/21/2010	1989	21	1281	U	1989	2008	0	n/a
	2018 poss	2/19/2010	1990	20	1118	M	1990	2009	n/a	n/a
	2018 poss	2/20/2010	1990	20	1118	M	1990	2009	n/a	n/a
	2018 poss	2/21/2010	1990	20	1118	M	1990	2009	n/a	n/a
*	2142 poss	2/21/2010	1991	19	1242	M	1991	2006	n/a	n/a
	2304 poss	2/19/2010	1993	17	1604	M	1993	2006	n/a	n/a
	2304 poss	2/20/2010	1993	17	1604	M	1993	2006	n/a	n/a
*	2310 poss	2/21/2010	U	>17	U	M	1993	2006	n/a	n/a
*	2460	2/19/2010	U	>16	U	F	1994	2009	3	2007

	Identification code (EGNO/Intermatch)	Date Sighted	Birth Year	Age	Calf of	Gender	First Seen	Last Seen	# calves produced (inc. 0910)	Last Known Calving
*	2460	2/20/2010	U	>16	U	F	1994	2009	3	2007
*	2601 poss	2/21/2010	1996	14	1701	F	1996	2009	1	2007
	2605	1/20/2010	1996	14	1705	F	1996	2007	2	2007
	2608 poss	3/9/2010	1996	14	1408	M	1996	2008	n/a	n/a
*	2630 poss	2/21/2010	U	>14	U	M	1996	2006	n/a	n/a
	2642	1/3/2010	1996	14	1142	F	1996	2007	2	2007
	2645	1/19/2010	1996	14	1245	F	1996	2008	1	2007
	2681 poss	2/19/2010	1996	14	1281	M	1996	2008	n/a	n/a
	2681 poss	2/20/2010	1996	14	1281	M	1996	2008	n/a	n/a
*	2760	2/21/2010	U	>13	U	M	1997	2006	n/a	n/a
	2770 poss	2/19/2010	U	>14	U	M	1996	2006	n/a	n/a
	2770 poss	2/20/2010	U	>14	U	M	1996	2006	n/a	n/a
	2770 poss	2/21/2010	U	>14	U	M	1996	2006	n/a	n/a
	3060	3/1/2010	U	>10	U	U	2000	2008	n/a	n/a
*	3110 poss	2/19/2010	2001	9	1710	M	2001	2007	n/a	n/a
*	3110 poss	2/20/2010	2001	9	1710	M	2001	2007	n/a	n/a
	3150 poss	3/19/2010	2001	9	2050	M	2001	2008	n/a	n/a
	3150 poss	3/20/2010	2001	9	2050	M	2001	2008	n/a	n/a
	3180	11/28/2009	2001	9	2150	F	2001	2008	2	2008
	3193 poss	3/19/2010	U	>9	U	M	2001	2008	n/a	n/a
	3229 poss	2/19/2010	2002	8	1629	M	2002	2007	n/a	n/a
	3229 poss	2/20/2010	2002	8	1629	M	2002	2007	n/a	n/a
	3260	2/19/2010	U	>8	U	F	2002	2009	1	n/a
	3260	3/17/2010	U	>8	U	F	2002	2009	1	n/a
	3360	1/19/2010	U	>7	U	F	2003	2008	2	2007
	3295	3/9/2010	U	>8	U	U	2002	2008	n/a	n/a
	3360	1/19/2010	U	>7	U	F	2003	2008	0	2007
	3391	3/25/2010	U	>7	U	M	2003	2008	n/a	n/a
*	3420	2/19/2010	2004	6	2460	F	2004	2009	n/a	n/a
*	3420	2/20/2010	2004	6	2460	F	2004	2009	n/a	n/a
	3423 poss	1/27/2010	2004	6	1123	M	2004	2008	n/a	n/a
	3450 poss	3/20/2010	U	>6	U	F	2004	2007	n/a	n/a
	3504	1/27/2010	2005	5	1204	M	2005	2009	n/a	n/a
	3510	3/1/2010	2005	5	3010	M	2005	2008	n/a	n/a
	3515	3/1/2010	2005	5	1315	F	2005	2008	n/a	n/a
	3523	1/27/2010	2005	5	2223	F	2005	2008	0	n/a
*	3590	3/25/2010	2005	5	1013	F	2005	2009	0	0
	3603	1/6/2010	2006	4	1503	F	2006	2008	0	n/a
*	3640	3/19/2010	U	U	U	U	2008	2009	n/a	n/a
*	3640	3/20/2010	U	U	U	U	2008	2009	n/a	n/a
	2009 calf of 1266 poss	2/19/2010	2009	1	1266	U	2009	2009	n/a	n/a
	2009 calf of 1611 poss	3/7/2010	2009	1	1611	U	2009	2009	n/a	n/a
	2009 calf of 2145	2/21/2010	2009	1	2145	U	2009	2009	n/a	n/a

	Identification code (EGNO/Intermatch)	Date Sighted	Birth Year	Age	Calf of	Gender	First Seen	Last Seen	# calves produced (inc. 0910)	Last Known Calving
	2009 calf of 3290	1/28/2010	2009	1	3290	U	2009	2009	n/a	n/a
	2010 calf of 1145	3/6/2010	2010	0	1145	U	2010	2010	n/a	n/a
	2010 calf of 1241	1/12/2010	2010	0	1241	U	2010	2010	n/a	n/a
	2010 calf of 1241	1/12/2010	2010	0	1241	U	2010	2010	n/a	n/a
*	2010 calf of 2460	2/19/2010	2010	0	2460	U	2010	2010	n/a	n/a
*	2010 calf of 2460	2/20/2010	2010	0	2460	U	2010	2010	n/a	n/a
	BK01SEUS09	1/27/2010	U	U	U	U	2009	2009	n/a	n/a
*	S047	3/20/2010	U	U	U	U	2010	2010	n/a	n/a
	S049	3/6/2010	U	U	U	U	2010	2010	n/a	n/a

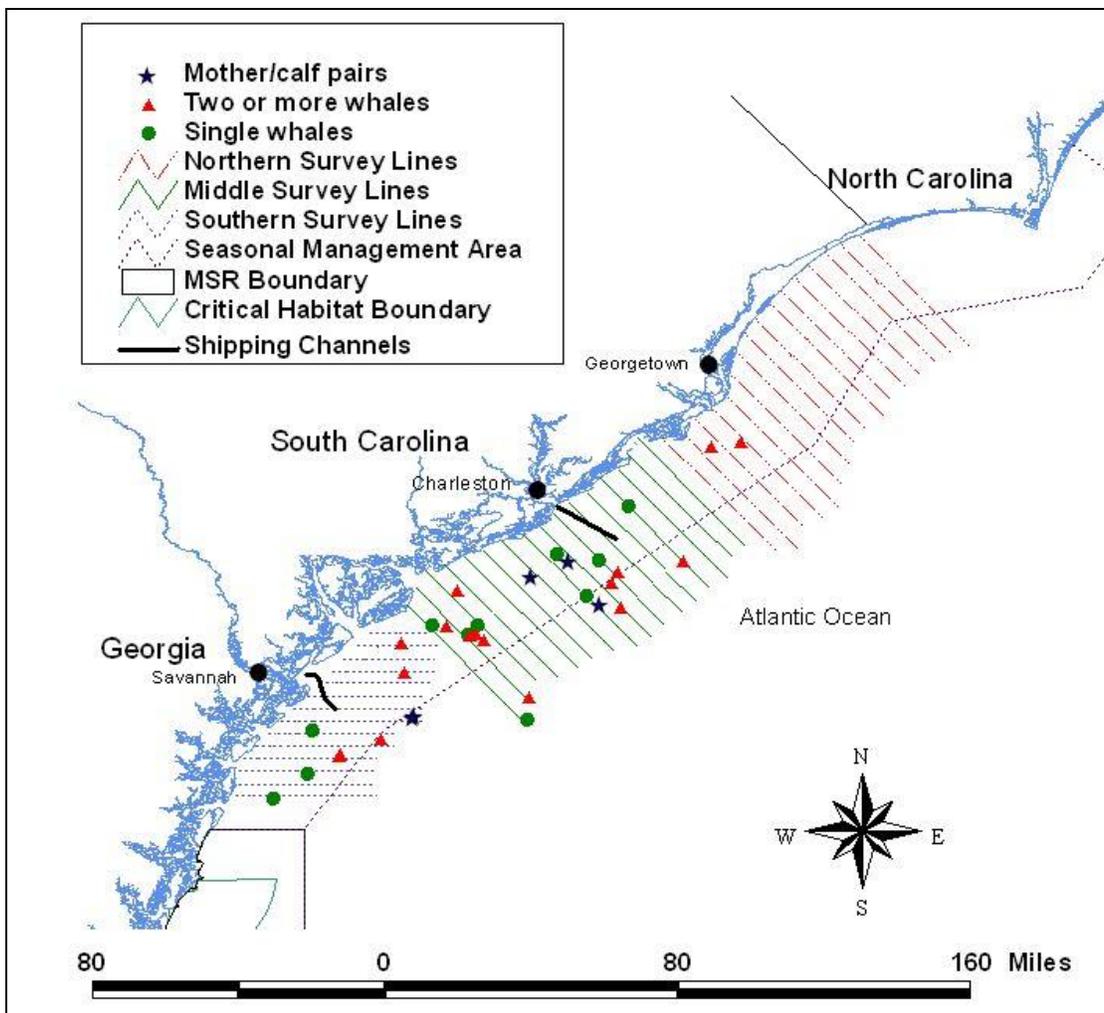


Figure 4. Right whale sightings by group type during the SCGA 2009-2010 season.

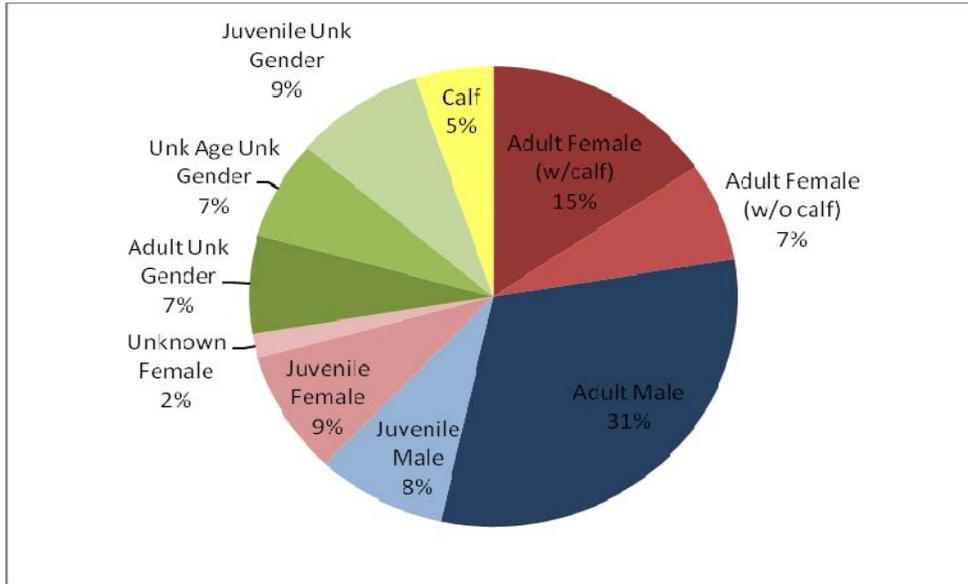


Figure 5. Preliminary demographic distribution of right whales observed during the SCGA 2009-2010 season.

Sightings of note include 18 individuals that were unique to the study area (based on preliminary analysis) and not sighted by EWS survey teams to the south: EGNOs 2460 and calf, 1056, 1328, 1402, 1616, 1803, 2142, 2310, 2601, 2630, 2760, 3110, 3420, 3590, 3640, 3770 and S049. EGNO 2460 (Monarch) and her calf were documented on February 19 and 21, 2010 in our middle and southern sections respectively but were not documented by other survey teams. Also of note was the documentation of nine surface active groups (SAG) this season sighted between January 27 and March 20, 2010. Group size varied from three to six individuals. Of the 34 total individuals involved in these SAGs, 17 (50%) were adult males while only one was an adult female. Nine were juveniles and four were adults of unknown gender. The remaining three were of unknown age and gender. A notable SAG observed on February 21, 2010 consisted of five individuals. Two of the five were brothers (EGNO's 1801 and 2142), and a third sibling (ENGNO 3770) was observed 18 miles away. EGNO's 1801 (age 22) and 2142 (age 19) are both males born to EGNO 1242. EGNO 3770 is her 2007 calf whose gender has yet to be determined. Interestingly, EGNO 1242, the mother, has never been documented in the southeast U.S. Other notable sightings included the observation of EGNO 3420 (Platypus) who was previously entangled but is now free of all gear; EGNO 3590 who was hit by a ship in April 2009 causing damage to her fluke; and the 2009 calf of 3290 who was observed with a new wound on its back.

Geographic locations of the 33 SCGA right whale sightings are depicted by month in Figure 6. During the 2009-2010 season, 27% of the right whale sightings occurred in the months of November-January while 73% of the sightings occurred during February-April (Figures 7 and 8). This temporally uneven distribution of sightings is very similar to the results of the 2005-2006 season where the vast majority of sightings occurred in the second half of the season, but is in contrast to the 2004-2005 season where the majority of sightings occurred in the first half of the season. Additionally, these

seasons with temporally uneven sighting distributions are in contrast to the 2006-2007, 2007-2008 and 2008-2009 seasons during which sightings were distributed more evenly throughout the seasons. The number of right whale sightings per trackline miles flown was calculated for each week of the season (Figure 9). An increase in the sightings per unit effort was noted during the second half of February.

The average number of whales per sighting during the 2009-2010 season was greatest in March with 3.1 whales per sighting (average for entire season was 2.5 whales per sighting) yet 46% of all whales seen were documented during February (compared with 37% in March) (Figure 7).

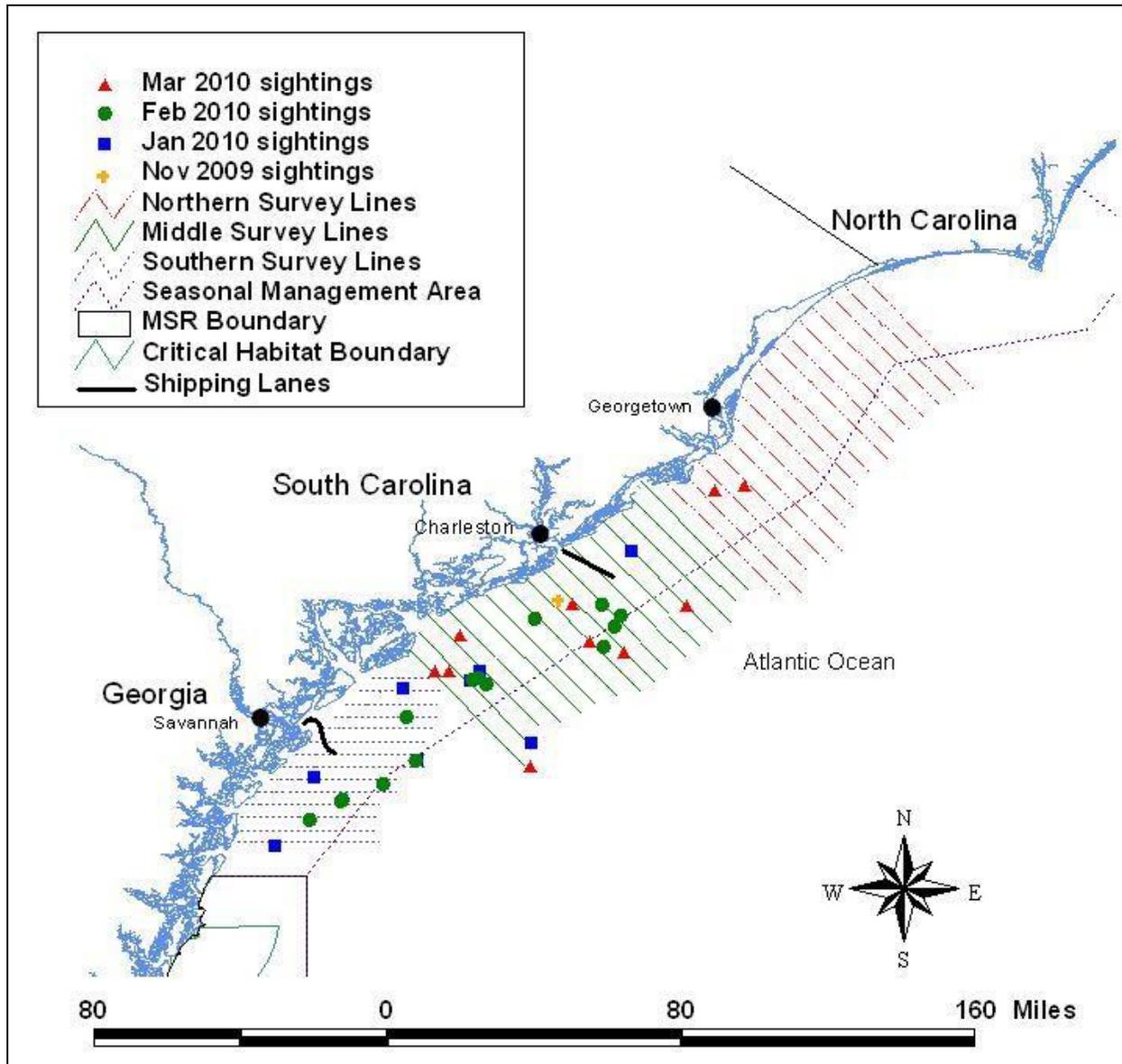


Figure 6. Right whale sightings by month during the SCGA 2009-2010 season.

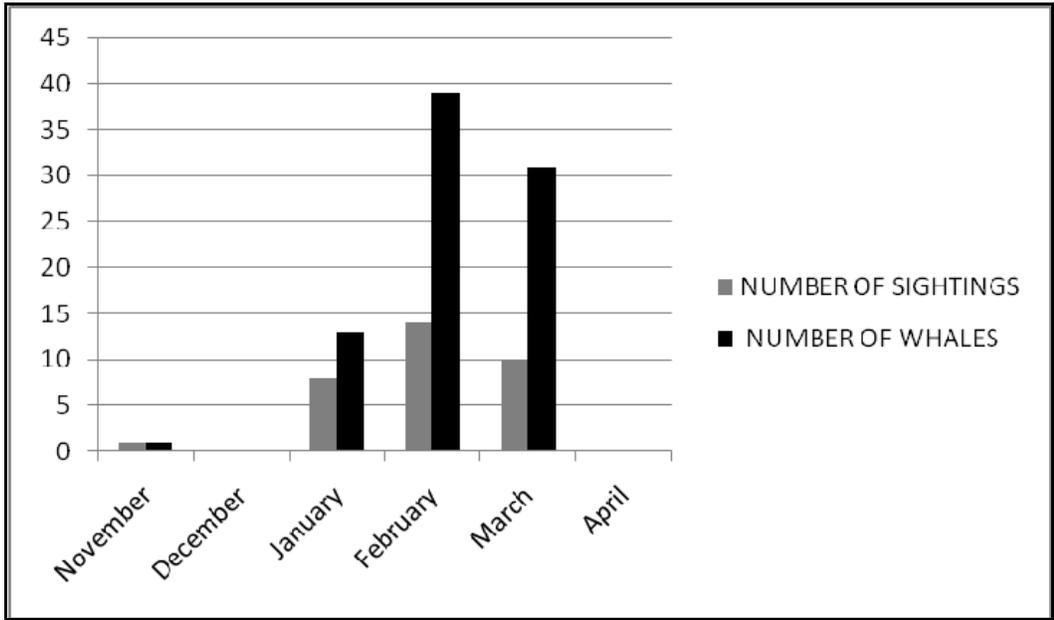


Figure 7. Number of sightings and right whales by month during the SCGA 2009-2010 season.

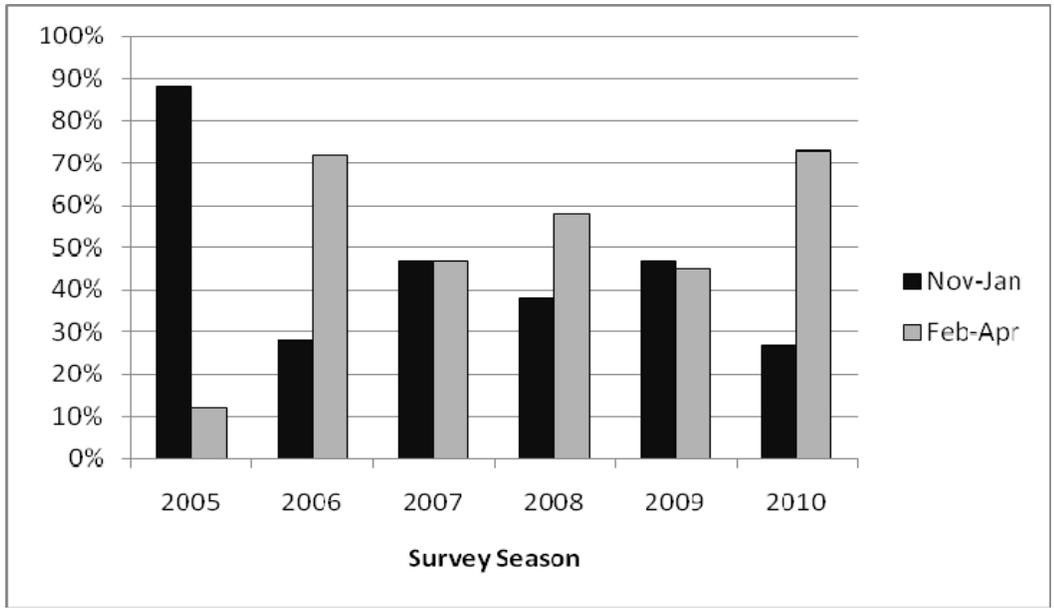


Figure 8. Temporal distribution of SCGA right whale sightings for all survey seasons.

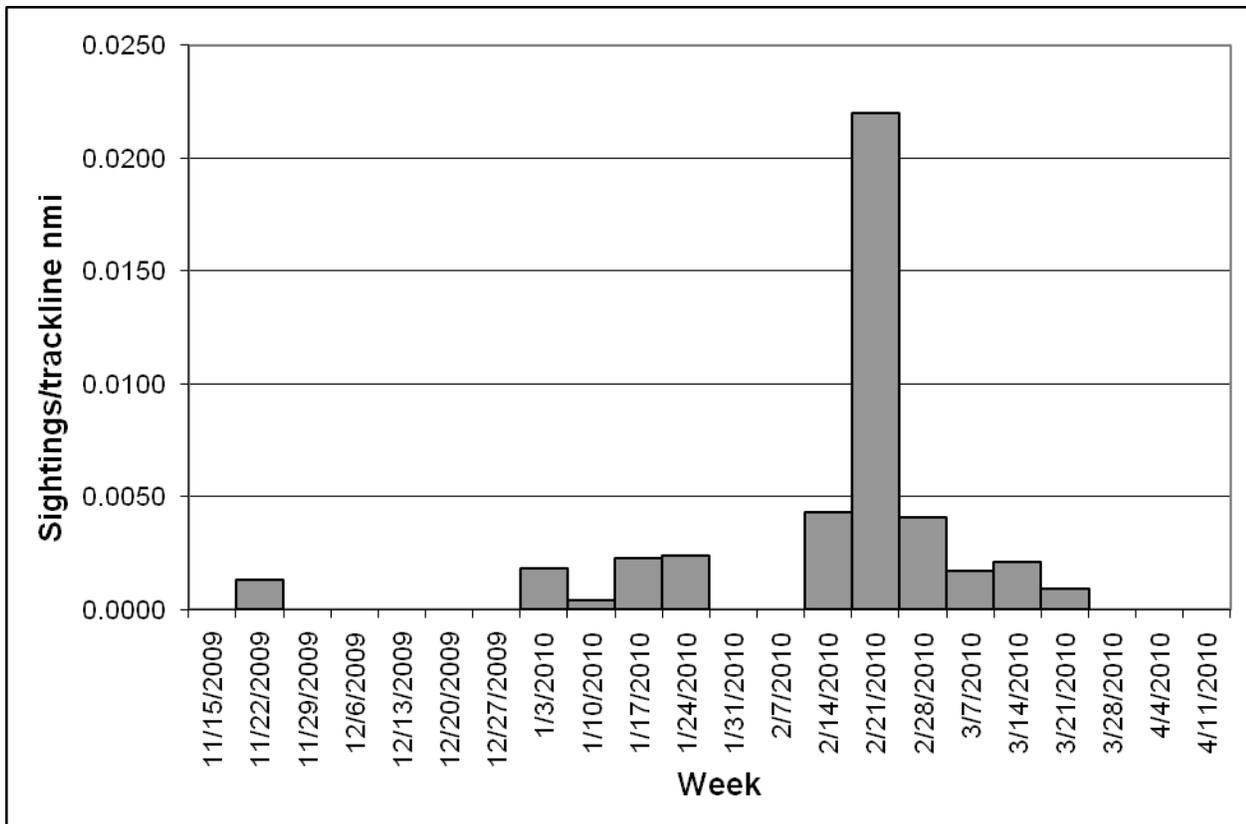


Figure 9. Weekly right whale sightings per trackline nmi flown during the 2009-2010 season.

Discussion and Recommendations

A total of 58 individual right whales were documented in the SCGA survey zone during the 2009-2010 season, similar to the average number of right whales documented seasonally since 2004 ($n = 61$). Of the animals with a known age and gender, 40% were adult males and 26% were juveniles, indicating the importance of the region to demographic groups other than calving females. Nine SAGs were observed during the season involving 3 to 6 individuals. Fifty percent of the participants were adult males and only one was a known adult female (four animals were of unknown gender). SAGs are believed to play a role in mating however often do not lead directly to calving. At least two of the observed SAGs contained all males. Based on preliminary analysis, 18 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 provide a constant 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 the newly implemented ship speed zones, have likely decreased the risk of ship strikes to whales while in the critical habitat. Six 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. The coast of South Carolina had been surveyed sporadically in the past, but for the past six years consistent survey effort throughout the migration and calving season has provided valuable additional sightings and increased warnings to mariners. The number of right whales sighted in the SCGA survey area (84) is lower than the EWS survey areas to south; however survey effort expended in the region was also lower due to funding levels and a large coverage area. A sightings-per-unit-effort analysis would be useful to compare effort-corrected data throughout the region to determine whale densities and important whale habitat in the SEUS and mid-Atlantic.

The boundary of the current critical habitat was designated in 1994 by NMFS based on the best available scientific data at the time. Sixteen 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 zero for North Atlantic right whales, as calculated in Marine Mammal Protection Act stock assessment reports (NMFS 2009).

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