PROTECTED SPECIES MONITORING IN THE CHERRY POINT OPAREA
ONSLOW BAY, NORTH CAROLINA
JANUARY 2012 - DECEMBER 2012

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Submitted to:
The Department of the Navy
Norfolk, VA

Onslow Bay Vessel Surveys

Methodology

Study Area

The study area within the Cherry Point (CHPT) OPAREA consists of a box approximately 37% larger than the original proposed USWTR; the USWTR area itself is 25 nm (46 km) long and 20 nm (37 km) wide (approximately from NW to SE; Figure 1). Vessel survey effort was conducted both inside and outside the original study area, with a focus on prevailing bathymetric and oceanographic features influencing the study area, such as the 200-m and 1000-m isobaths and Gulf Stream front. These features are known to attract marine mammals and sea turtles in this area, so survey effort was focused on these features to maximize the number of encounters. This resulted in surveys of areas to the north and east of the proposed USWTR site that have not been covered in previous years.

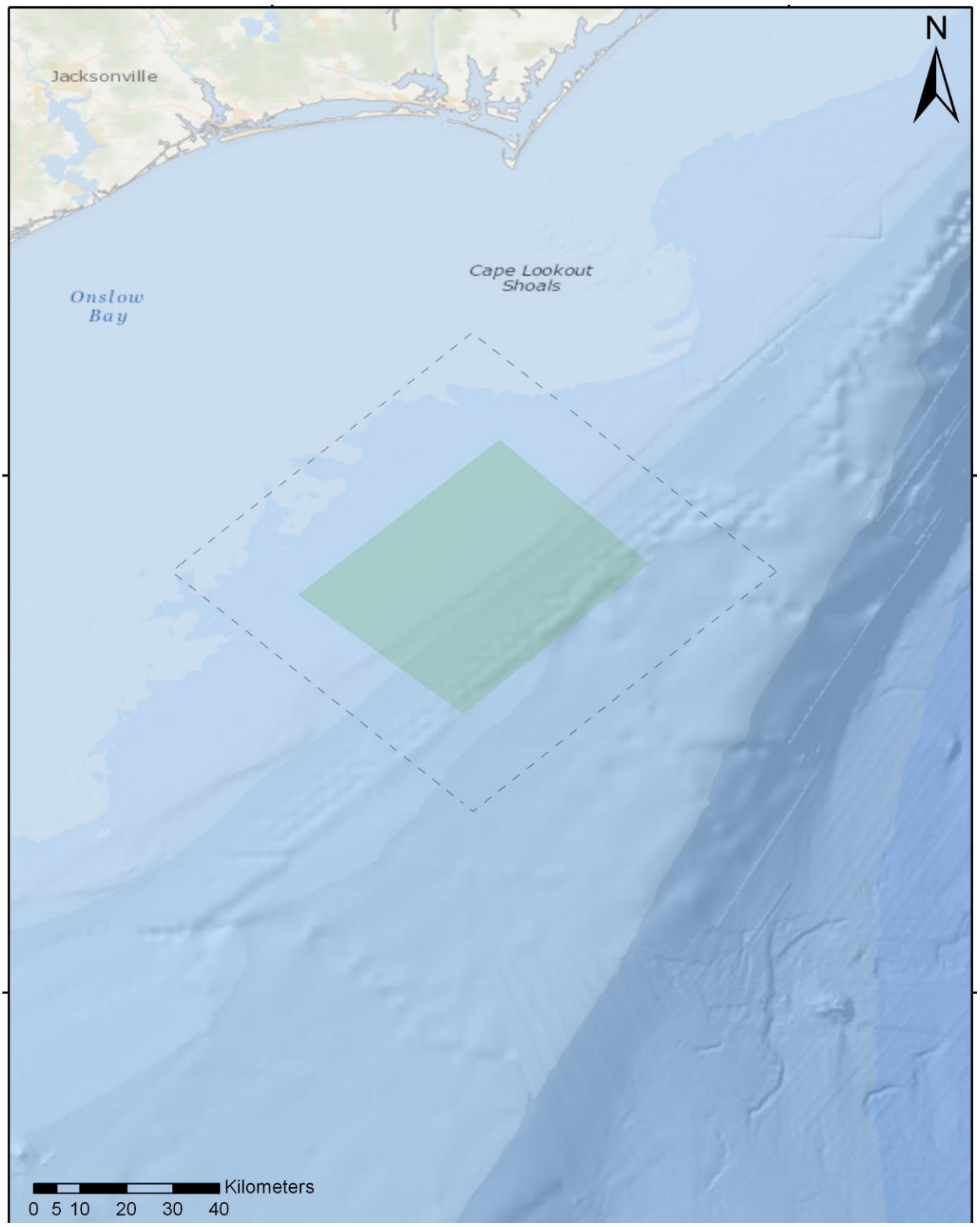

Figure 1. Onslow Bay survey area and original proposed site of the USWTR (shaded box).

Vessel Survey Data Collection

Visual Surveys

During this reporting period vessel survey effort focused on addressing questions of residency and population structure for odontocetes, as previous analysis of photo-identification data from Onslow Bay suggest a considerable level of residency in this area, despite a relatively low level of sampling.

Visual surveys for marine mammals and sea turtles were conducted at a speed of approximately 10 knots, primarily from the F/V *Sensation* (Figure 2), a 16 m offshore fishing vessel. One survey was conducted from the F/V *Diamond Girl*, which is very similar in size and configuration. Observations were made from the flying bridge (5.0 m above waterline) by naked eye and 7x50 binoculars. Two observers (one port and one starboard) scanned constantly from straight ahead to 90° abeam either side of the trackline. The location, species and behavior of each cetacean group were recorded. If turtles were encountered, the location and species were recorded. Environmental conditions (weather, sea state, depth and sea surface temperature) were recorded at each sighting and whenever sighting conditions changed. Sighting and environmental data were recorded using an iPad tablet and GPS unit.

Figure 2. Vessel survey platform, the F/V *Sensation*.

In addition, use of the Onslow Bay survey area by individual cetaceans was examined using photo-identification and biopsy techniques. Photographs were used to confirm species identification and to compare identification features with those used by the aerial survey team. Photographs were taken with Canon or Nikon digital SLR (equipped with 100-400 mm zoom lenses) in 24-bit color at a resolution of 3072 X 2048 pixels and saved in .jpg format. Remote biopsy sampling methods were employed to collect small skin and blubber samples using a variety of 27 kg – 68 kg pull crossbows, depending on the species and sampling distance. Biopsy samples were obtained with a specialized 2.5 cm stainless biopsy tip attached to a modified bolt, typically fired from the stern of the survey vessel.

Passive Acoustic Monitoring

Passive acoustic data were collected in the Onslow Bay survey area using autonomous bottom-mounted recorders.

Bottom-mounted Recorders

To collect time-series of acoustic data in the Onslow Bay survey area, autonomous High-frequency Acoustic Recording Packages (HARPs; Wiggins and Hildebrand 2007) were utilized. The HARP data-logging system includes a 16-bit A/D converter, a hydrophone suspended approximately 12 m above the seafloor, an acoustic release system, ballast weights, and flotation (Figure 3). The data-loggers are capable of sampling up to 200 kHz and can be set to record continuously or on a duty cycle to accommodate variable deployment durations. These

instruments combine high and low frequency hydrophone elements to detect the vocalizations of both odontocete and mysticete whales. The units sample at rates high enough to capture the clicks of many odontocetes.

Since August 2011, three HARPs have been deployed at Onslow Bay Site E (Table 1, Figure 4). The first HARP was deployed in 952 m at 33.77794^{o} N, 75.92641^{o} W on 18 August 2011, and retrieved on 13 July 2012, for a deployment period of 330 days. The second HARP was deployed in 914 m at 33.78666^{o} N, 75.92915^{o} W on 13 July 2012, and retrieved on 24 October 2012, for a deployment period of 103 days. The third HARP was deployed in 853 m at 33.78696^{o} N, 75.92801^{o} W on 24 October 2012. This HARP is still out in the field and expected to be recovered in late spring or early summer 2013. All three HARPs sampled at 200 kHz on a duty cycle of five minutes on/five minutes off. The August 2011 – July 2012 deployment provided data during 73 days (19 August 2011 – 1 December 2011). The July – October 2012 deployment provided data during 80 days (14 July 2012 – 2 October 2012). Both of these deployments yielded less data than expected, likely due to issues with the firmware when collecting duty-cycled data. Future deployments will record continuously to avoid these issues.

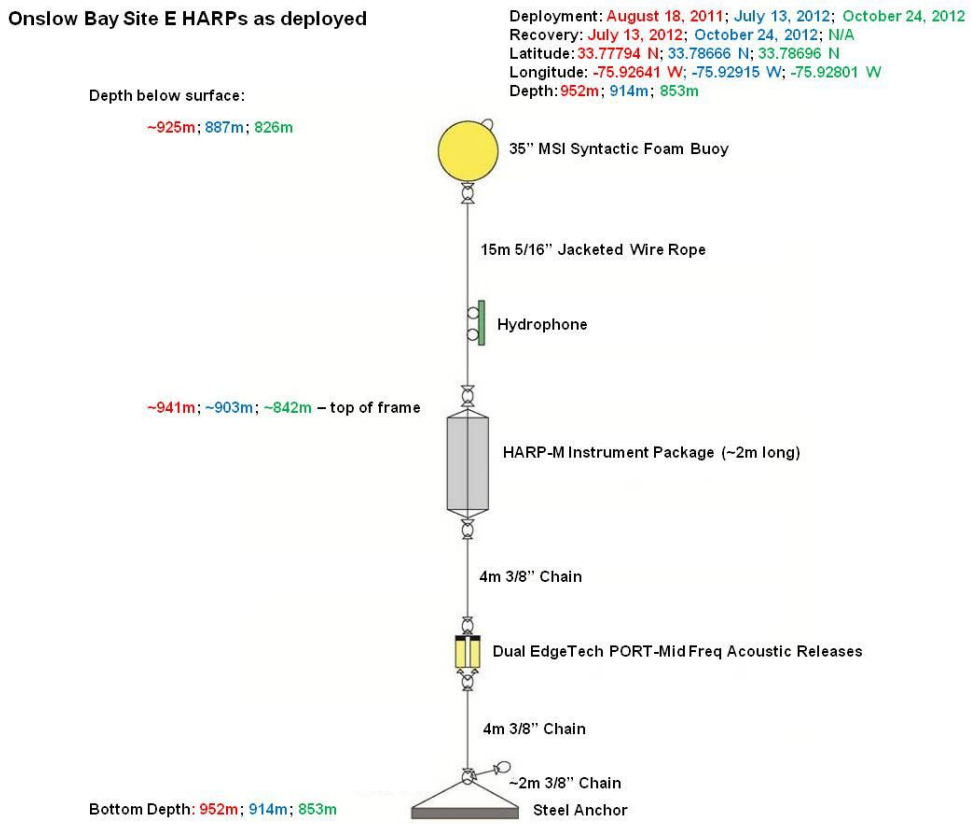

Figure 3. Schematic diagram showing details of Site E Onslow Bay HARP deployments between 2011 – present. Note that diagram is not drawn to scale.

Table 1. Harp deployments in the Onslow Bay survey area.

Site	Deployment Date	Retrieval Date	Latitude	Longitude	Depth (m)	Sampling Rate	Duty Cycle	Amount of data
1A	9-Oct-07	27-May-08	33.7914	-76.5238	162	200 kHz	5-min on/5-min off	2.0 TB
2B	30-May-08	24-Nov-08	33.8111	-76.4283	232	200 kHz	5-min on/5-min off	2.0 TB
3A	24-Apr-09	16-Sep-09	33.7895	-76.5192	174	200 kHz	5-min on/5-min off	2.0 TB
4A	8-Nov-09	19-Jun-10	33.7873	-76.5241	171	200 kHz	5-min on/10-min off	1.2 TB
4C	8-Nov-09	19-Jun-10	33.6778	-76.4769	335	200 kHz	5-min on/10-min off	2.0 TB
5A	29-Jul-10	10-Jun-11	33.7932	-76.5162	171	200 kHz	5-min on/5-min off	3.4 TB
5D	29-Jul-10	10-Jun-11	33.5807	-76.5502	338	200 kHz	5-min on/5-min off	3.3 TB
6E	18-Aug-11	13-Jul-12	33.7779	-75.9264	952	200 kHz	5-min on/5-min off	0.7 TB
7E	13-Jul-12	24-Oct-12	33.7867	-75.9292	914	200kHz	5-min on/5-min off	0.7 TB
8E	24-Oct-12		33.7870	-75.9280	853	200kHz	5-min on/5-min off	

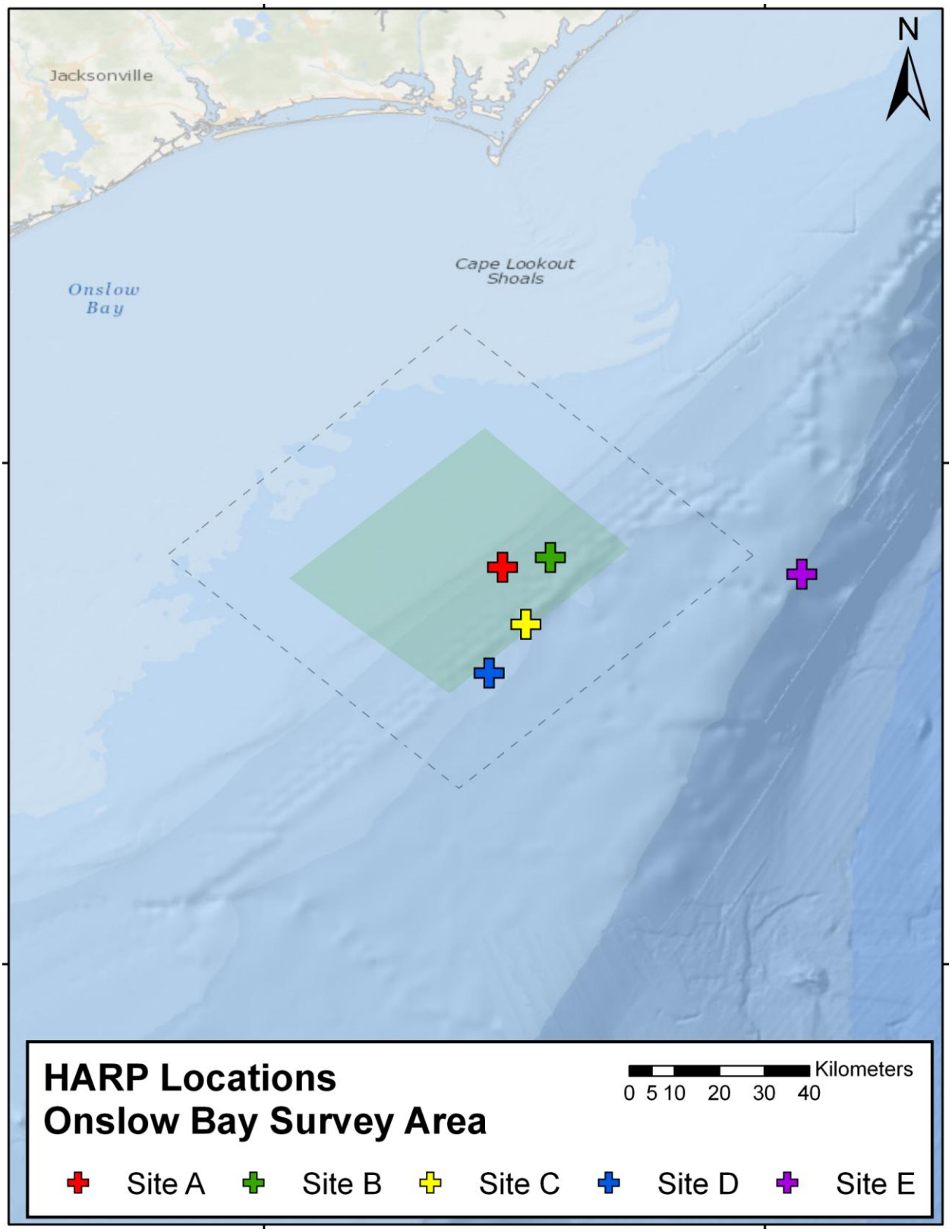

Figure 4. Location of HARP deployment sites in the Onslow Bay survey area.

Data Analysis

Vessel survey effort and sighting data were compiled and mapped using *ArcGIS* 10.1 to illustrate the location of effort and sightings within the study area. All sighting data collected from January 2012 through December 2012 have been posted on the data repository OBIS-SEAMAP (http://seamap.env.duke.edu/).

Acoustic Analysis

HARP Analysis

HARP data require processing prior to analysis, including backing up data in original format, converting data to wav format, decimating wav data by a factor of 100 to aid in baleen whale detection, and creating long-term spectral averages (LTSAs). New compression code was implemented starting in July 2010 which allowed for greater than two TB of data to be collected after the raw data were decompressed. This amount of data is impractical to analyze manually, so these data were compressed for visual overview by using a *MATLAB*-based acoustic program called Triton (Hildebrand Lab at Scripps Institution of Oceanography, CA) to create LTSAs from the wav files, which allowed for rapid review of the data. LTSAs are effectively compressed spectrograms created using the Welch algorithm (Welch 1967) by coherently averaging 500 spectra created from 2000-point, 0%-overlapped, Hann-windowed data and displaying these averaged spectra sequentially over time.

Data from the three 2011-2012 Site E HARP deployments have not yet been analyzed. The data from the 2010-2011 Site A HARP deployment (depth: 171 m; location: 33.79316^{o} N,

76.51620^{o} W; recording period: 30 July 2010 – 3 March 2011; amount of data: 2831.8 hrs during 216 days; Table 1, Figure 4) were manually scanned for marine mammal vocalizations using the "logger" version of *Triton* (v1.81.20121030). The effective frequency range of the HARP (10 Hz – 100 kHz) was divided into two parts for this manual review: 10-1000 Hz and 1-100 kHz. The resulting LTSAs had resolutions of 5 s in time and 1 Hz in frequency (for the data decimated by a factor of 100: 10-1000 Hz band) and 5 s in time and 100 Hz in frequency (for the original data: 1-100 kHz band). LTSAs that were decimated by a factor of 100 were inspected for sounds produced by mysticetes. Non-decimated LTSAs were inspected for odontocete whistles, clicks, and burst-pulses as well as mid-frequency active sonar. The presence of vocalizations and mid-frequency active sonar was determined in one-minute bins, and vocalizations were assigned to species when possible.

Data Storage

All acoustic, visual survey, and photographic data are archived on digital media and backed up on a Duke University network server.

Results

Vessel Survey Effort

Between 01 January 2012 and 31 December 2012, six surveys were conducted, covering 496.8 km and 31.5 hours of photo-identification and biopsy effort (Table 2, Figure 5). Surveys were conducted in Beaufort Sea States (BSS) 1 to 4 (Figure 6). Most survey effort (70.8%) was conducted in good to fair conditions (BSS 2-3); 26.6% of effort was conducted in poor sighting conditions (BSS 4).

Table 2. Dates, kilometers, and hours surveyed during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Date	Distance Surveyed (km)	Survey Time (hrs:mm)
31-Jan-12	42.7	3:22
8-Feb-12	77.8	4:37
1-Jun-12	86.9	5:44
24-Oct-12	83.0	6:18
10-Nov-12	119.0	6:42
3-Dec-12	87.4	4:47

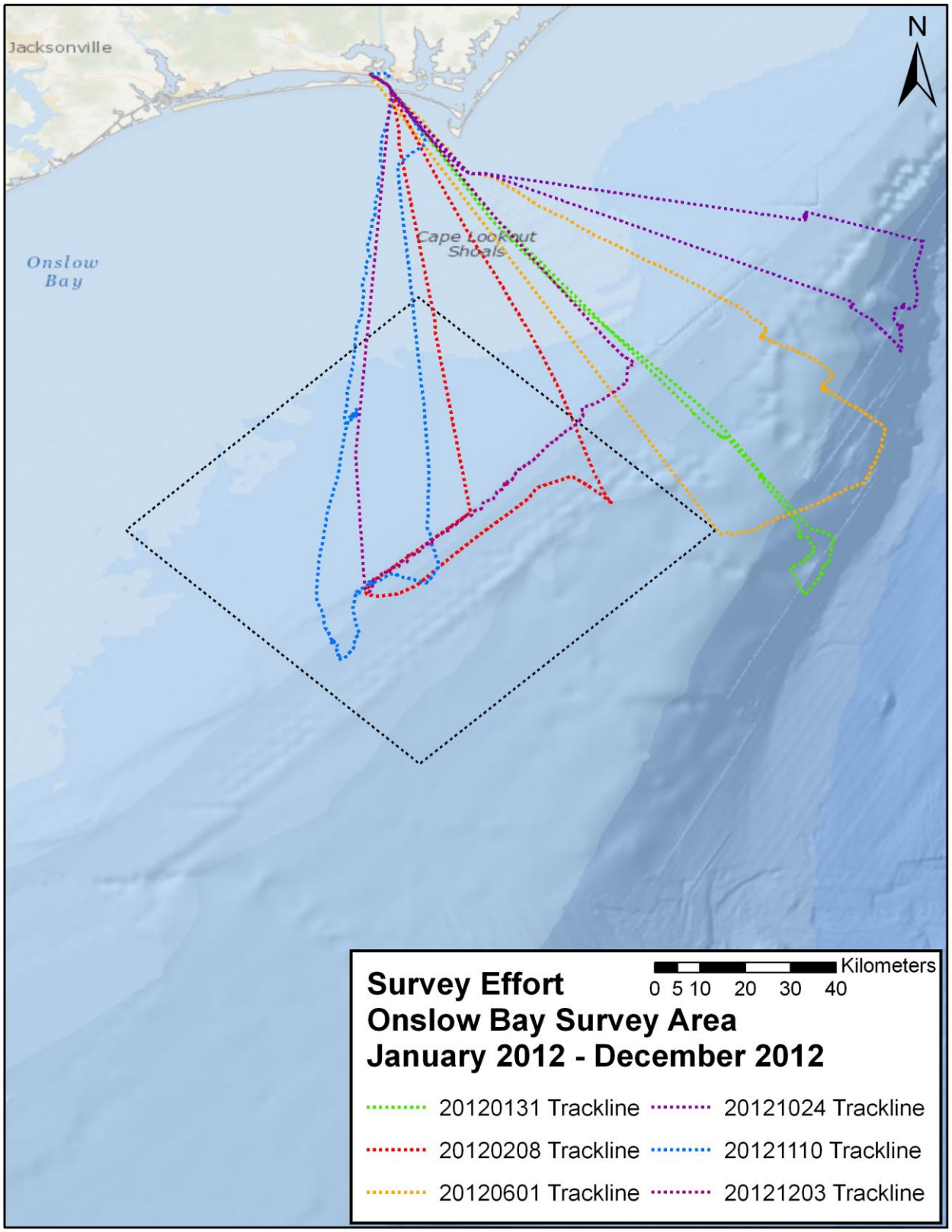

Figure 5. Survey effort in the Onslow Bay survey area, January 2012 – December 2012.

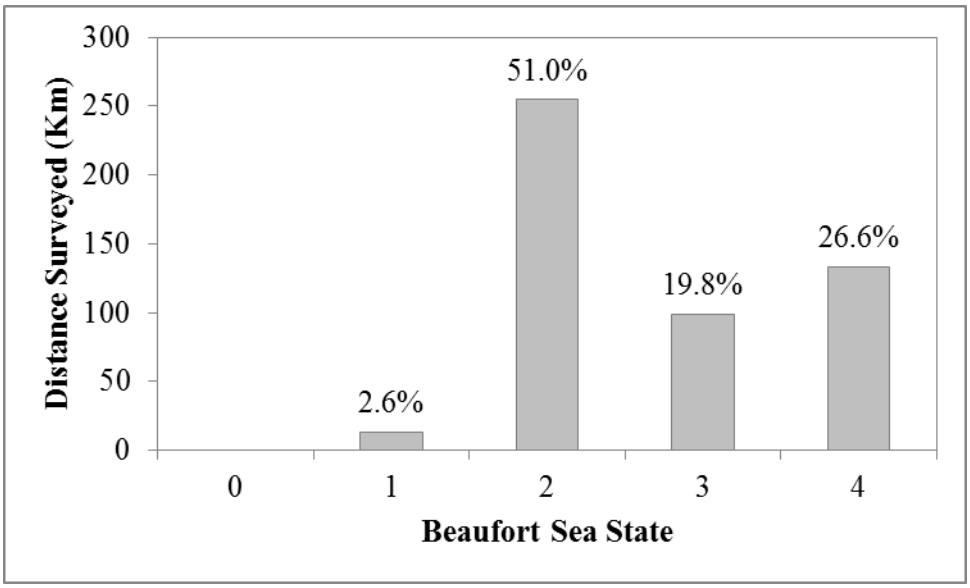

Figure 6. Total distance surveyed by Beaufort Sea State during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Marine Mammals and Sea Turtle Sightings

Twelve cetacean sightings were recorded during vessel surveys in Onslow Bay during 2012, including: Risso's dolphins (*Grampus griseus*; n = 1); *Mesoplodon* spp. (n = 2); Atlantic spotted dolphins (*Stenella frontalis*; n = 1); bottlenose dolphins (*Tursiops truncatus*; n = 7); and one unidentified small whale (Tables 3 and 4). No mixed-species groups were observed. Sightings per unit effort was highest in BSS 2 and 3 and lowest in BSS 4, with no cetaceans observed in BSS 1 (Figure 7).

Two loggerhead sea turtles (*Caretta caretta*) were sighted during vessel surveys in Onslow Bay during 2012 (Tables 5 and 6).

Table 3. Cetacean sightings observed during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Date	Time	Latitude	Longitude	Depth (m)	Temp (C^o)	Species	Group Size	Biopsy Samples	Images
31-Jan-12*	9:06	34.00423	-76.01622	488.3	20.1	*T. truncatus*	20	2	167
31-Jan-12	12:22	33.75776	-75.84635	914.4	24.4	*Unid. small whale*	1	0	0
31-Jan-12	13:17	33.79999	-75.85713	914.4	24.6	*Mesoplodon* spp.	4	0	5
31-Jan-12	14:03	33.92055	-75.93716	658.4	24.7	*T. truncatus*	3	0	8
1-Jun-12	11:50	34.09204	-75.80366	726.0	26.7	*T. truncatus*	13	0	77
1-Jun-12	14:00	34.19700	-75.92630	380.4	26.8	*T. truncatus*	6	1	70
24-Oct-12	8:37	34.43334	-75.84347	143.2	27.2	*G. griseus*	60	5	536
24-Oct-12	13:06	34.21774	-75.65561	1699.3	28.1	*Mesoplodon* spp.	1	0	0
24-Oct-12	14:42	34.25463	-75.75308	685.8	28.1	*T. truncatus*	18	2	28
10-Nov-12	8:17	34.09186	-76.75617	31.1	21.3	*S. frontalis*	150	2	170
10-Nov-12	10:30	33.59810	-76.78538	146.9	25.2	*T. truncatus*	6	1	111
10-Nov-12	11:21	33.57810	-76.77543	180.7	25.3	*T. truncatus*	14	2	277

*off effort

Table 4. Number of cetacean sightings and mean group size for each species observed during Year 1 (June 2007 – June 2008), Year 2 (July 2008 – June 2009), Year 3 (July 2009 – June 2010), Year 4 (July 2010 – December 2011), and Year 5 (January 2012 – December 2012) of vessel surveys in the Onslow Bay survey area.

	Sightings						
Species	Year 1	Year 2	Year 3	Year 4 Line Transect	Year 4 Photo-ID/Biopsy	Year 5 Photo-ID/Biopsy	Mean Group Size
Mesoplodon spp.	0	0	0	0	0	2	2.5±2.1
Globicephala spp.	1	0	2	0	0	0	31.0±20.1
Grampus griseus	3	0	3	0	0	1	34.7±15.7
Stenella frontalis	6	17	17	5	4	1	19.2±34.5
Tursiops truncatus	23	14	29	6	1	7	11.2±13.3
Steno bredanensis	0	0	1	0	0	0	27.0±0.0
Unid. delphinid	3	2	3	0	0	0	1.7±0.5
Unid. small whale	0	0	0	0	0	1	1.0±0.0
Total:	**36**	**33**	**55**	**11**	**5**	**12**	

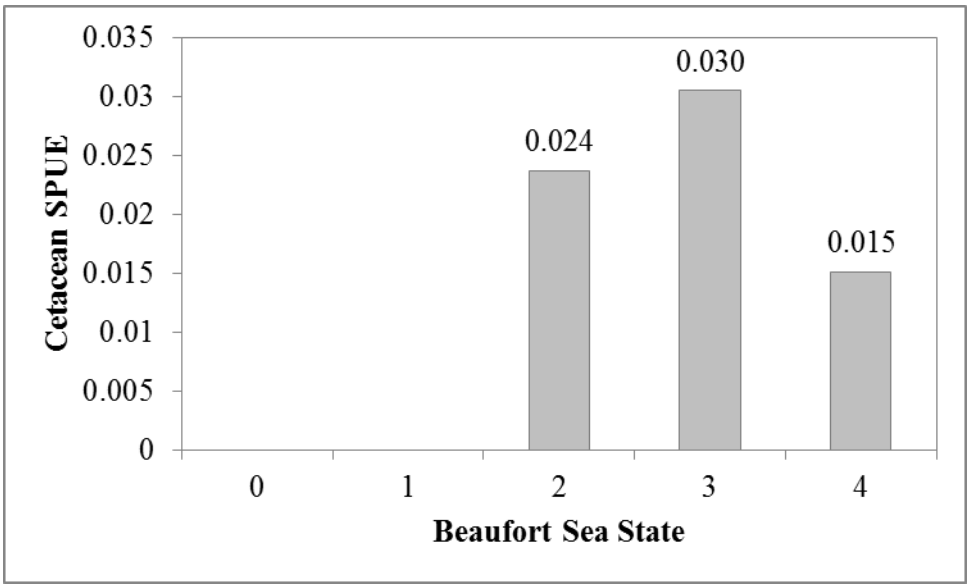

Figure 7. Number of cetacean sightings, corrected for kilometers on effort, observed in each Beaufort Sea State for vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Table 5. Sea turtle sightings made from vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Date	Time	Latitude	Longitude	Depth (m)	Temp (C^o)	Species	Group Size
10-Nov-12	9:47	33.85189	-76.79433	41.3	23.9	*C. caretta*	1
3-Dec-12	14:23	34.16599	-76.21274	56.3	15.1	*C. caretta*	1

Table 6. Number of sea turtle sightings and mean group size for each species observed during Year 1 (June 2007 – June 2008), Year 2 (July 2008 – June 2009), Year 3 (July 2009 – June 2010), Year 4 (July 2010 – December 2011), and Year 5 (January 2012 – December 2012) of vessel surveys in the Onslow Bay survey area..

	Sightings						
Species	Year 1	Year 2	Year 3	Year 4 Line Transect	Year 4 Photo-ID/Biopsy	Year 5 Photo-ID/Biopsy	Mean Group Size
Caretta caretta	19	49	47	2	1	2	1.0±0.1
Dermochelys coriacea	0	0	2	0	0	0	1.0±0.0
Unid. sea turtle	1	0	1	0	0	0	1.0±0.0
Total:	**20**	**49**	**50**	**2**	**1**	**2**	

Distributions and Habitat Associations of Cetaceans and Sea Turtles

The distribution of marine mammals and sea turtles is presented in Figures 8 through 11. As was the case in previous years, spotted dolphins were restricted to relatively shallow shelf waters, whereas bottlenose dolphins ranged over a larger area with several groups observed in deeper waters; this likely reflects the presence of both the coastal and offshore ecotypes of this species in the study area. This inter-specific pattern of distribution has been consistent in all years of the monitoring program. The beaked whales and unidentified small whale were observed in deeper, offshore waters, well to the east (and offshore of) the original survey area (Figure 8). All sea turtles were observed in relatively shallow waters over the continental shelf (Figure 11).

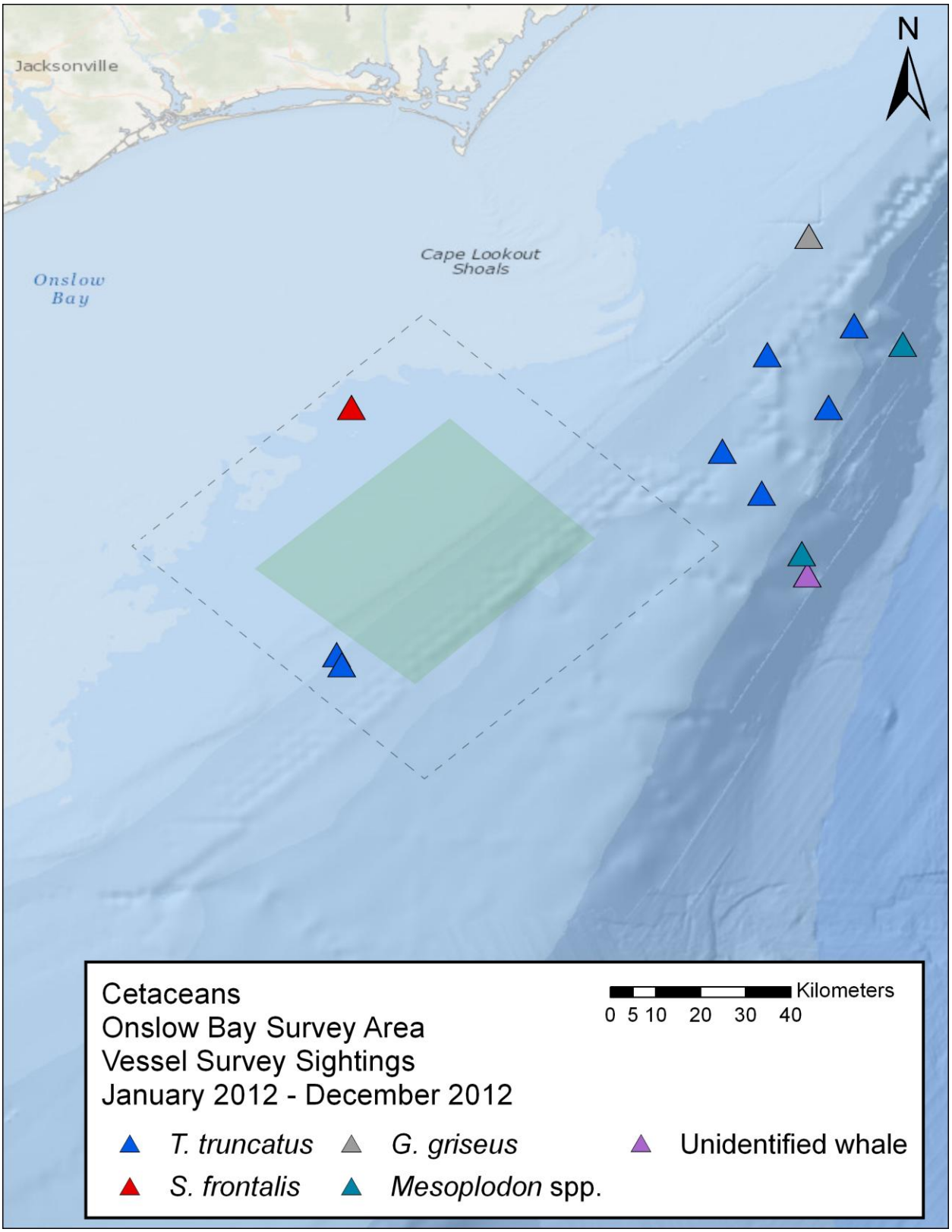

Figure 8. Distribution of all cetacean sightings made during vessel surveys in the Onslow Bay survey area, January 2012 - December 2012.

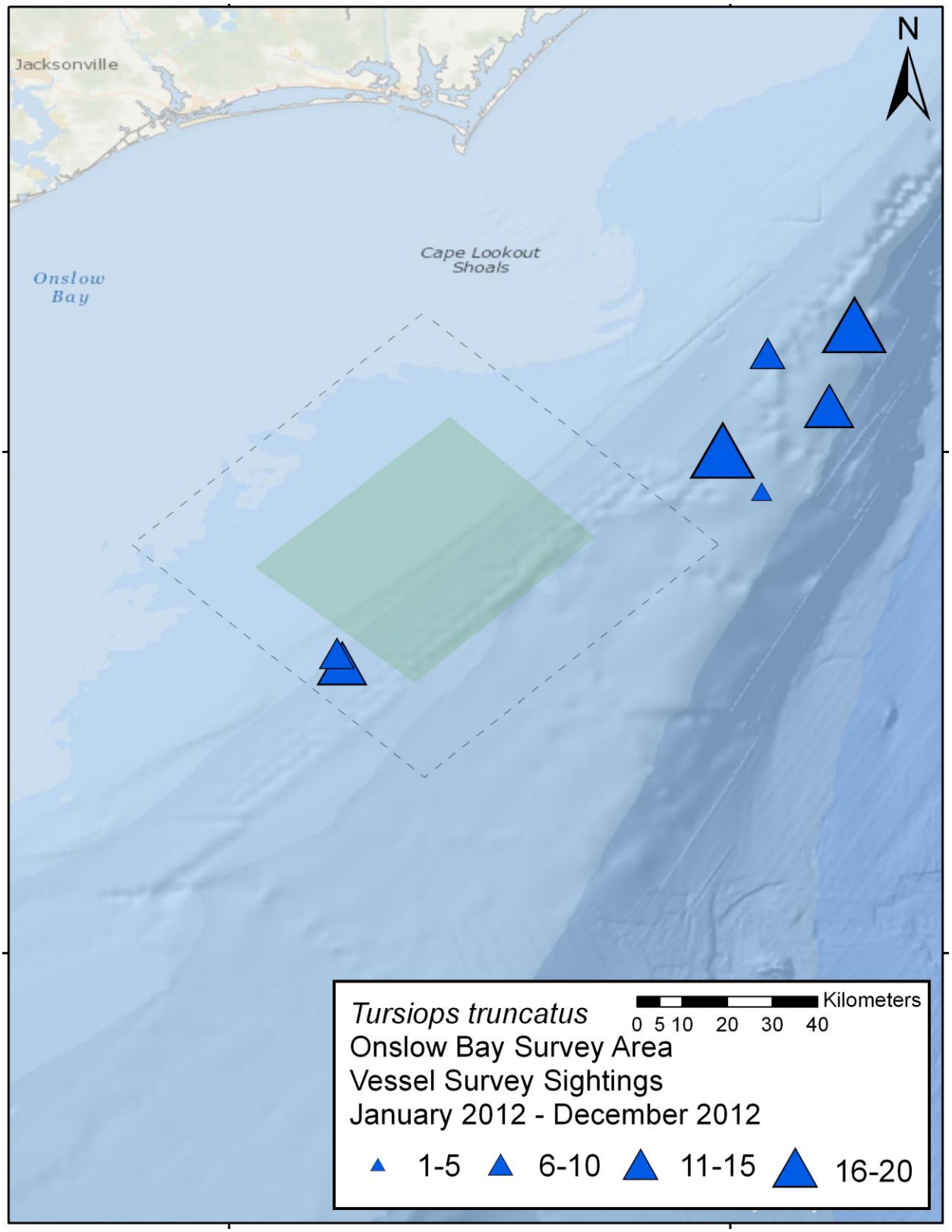

Figure 9. Distribution of bottlenose dolphin sightings indicating group size made during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

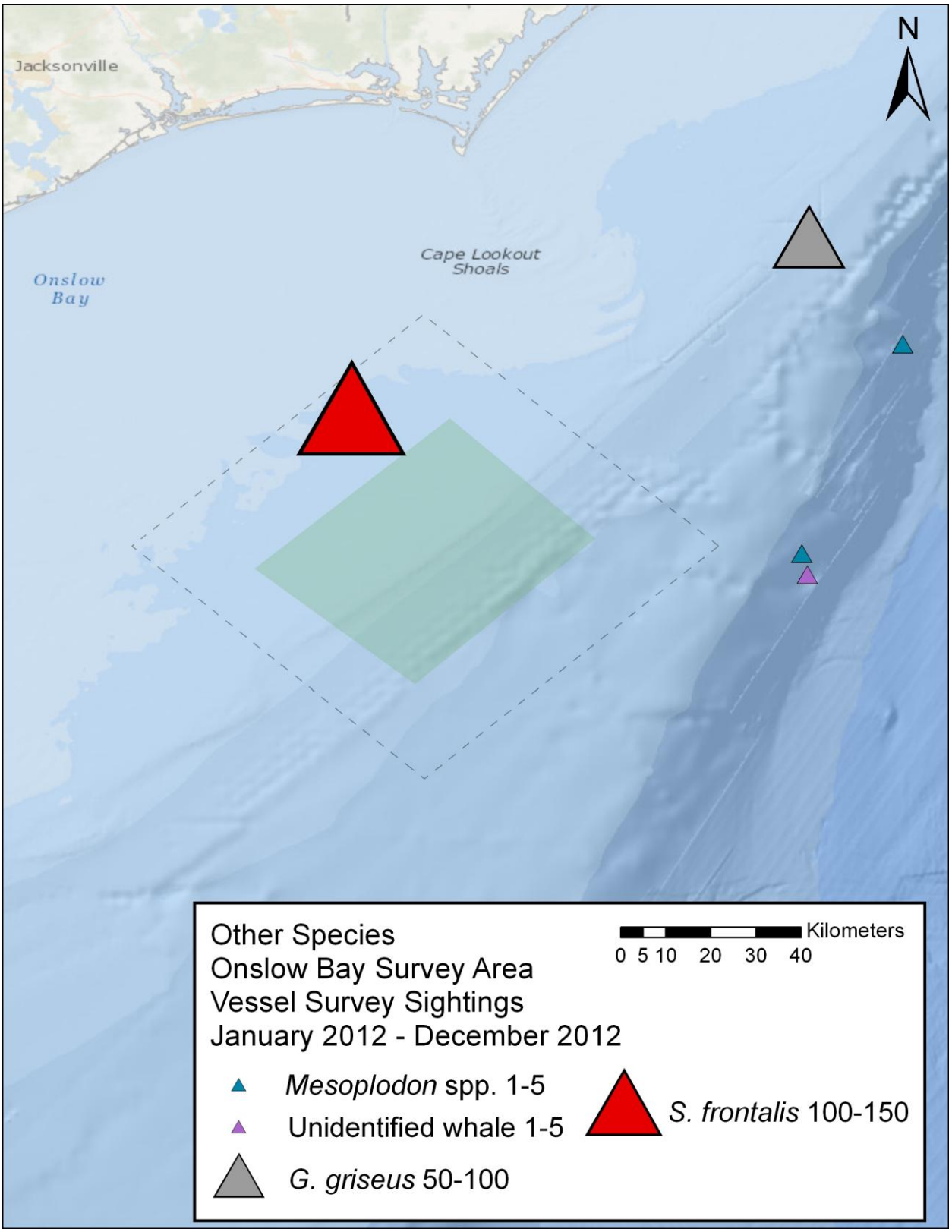

Figure 10. Distribution of all other cetacean sightings indicating group size made during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

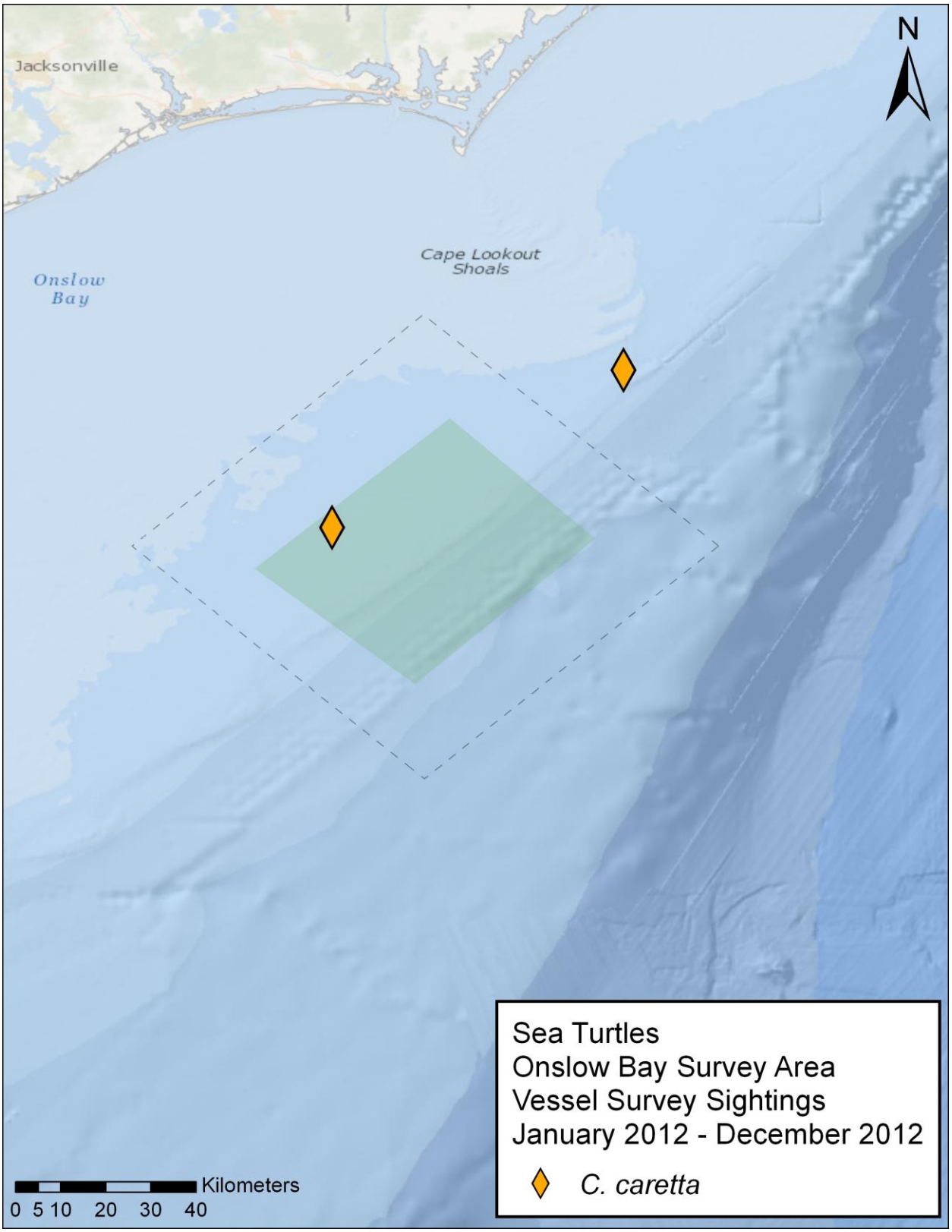

Figure 11. Distribution of sea turtle sightings made during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

Seasonality of Effort and Sightings

Due to unfavorable weather conditions, offshore surveys were not conducted in several months, which resulted in limited effort in 2012. It is, therefore, difficult to identify seasonal trends in cetacean and sea turtle distribution. Bottlenose dolphins were the most commonly encountered cetacean in the survey area. The two sightings of *Mesoplodon* spp. were recorded east of the original survey area in autumn and winter. Loggerheads were the only sea turtle species observed and were only seen during winter surveys. The number of sightings is depicted below by species for both cetaceans and sea turtles during each month of surveys (Figures 12 and 13).

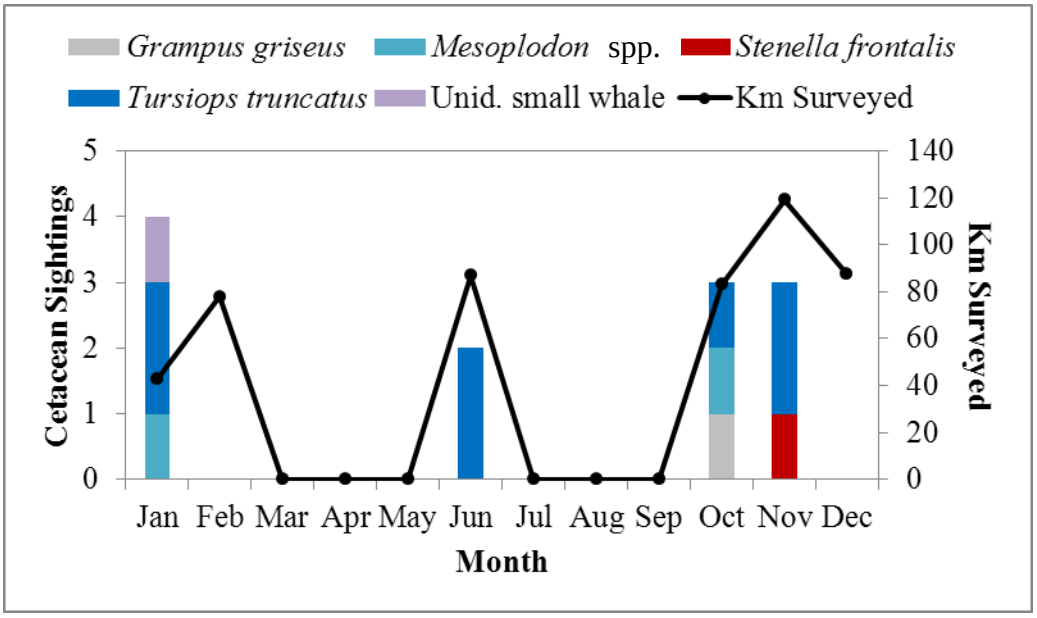

Figure 12. Number of cetacean sightings by month and effort (km surveyed) during vessel surveys in the Onslow Bay survey area, January 2012 – December 2012.

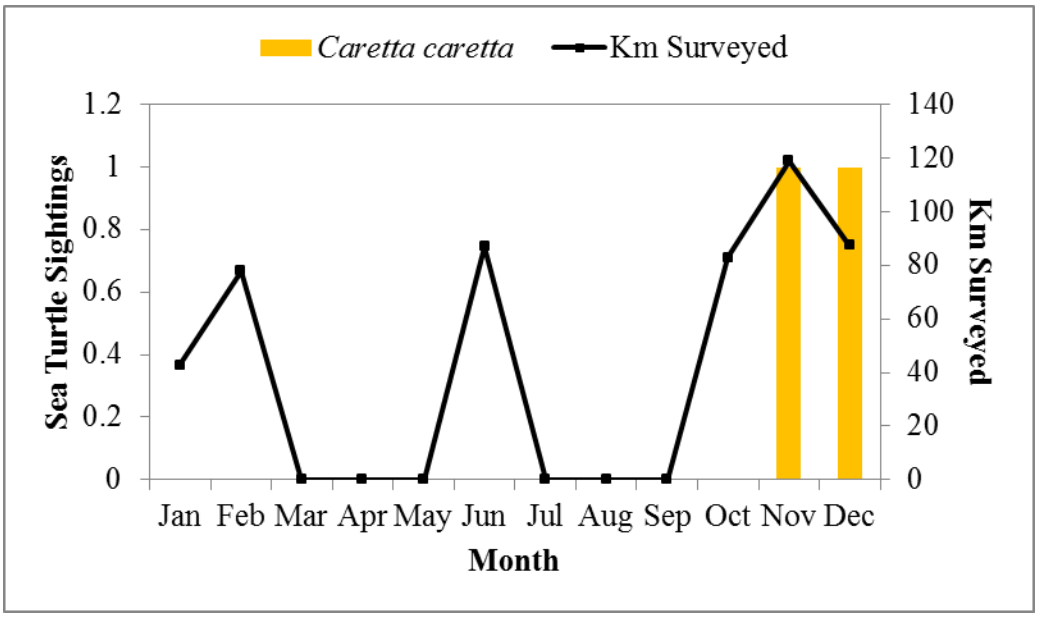

Figure 13. Number of sea turtle sightings by month and effort (km surveyed) during vessel surveys in the Onlsow Bay survey area, January 2012 – December 2012.

Biopsy Sampling

A total of fifteen biopsy samples were collected in 2012 in Onslow Bay from: bottlenose dolphins (n = 8), Risso's dolphins (n = 5) and Atlantic spotted dolphins (n = 2)(Table 7, Figure 14). Skin samples will be analyzed for sex and population identity in the coming months. Voucher specimens of these samples are archived with the Southeast Fisheries Science Center in Lafayette, LA.

Table 7. Biopsy samples (and corresponding photo-identification codes) collected in the Onslow Bay survey area, January 2012 – December 2012.

Date	Time	Latitude	Longitude	Species	Sample #	Photo-ID Code
31-Jan-12	9:24	33.99776	-76.00808	*T. truncatus*	ZTS-12-015	Tt_6-029_OB
31-Jan-12	9:37	33.99996	-76.00591	*T. truncatus*	ZTS-12-016	Tt_7-027_OB
1-Jun-12	14:13	34.20215	-75.93194	*T. truncatus*	ZTS-12-026	Not distinctive
24-Oct-12	8:54	34.43584	-75.84518	*G. griseus*	ZTS-12-053	No ID photos
24-Oct-12	9:07	34.43605	-75.84764	*G. griseus*	ZTS-12-054	Gg_4-002_OB
24-Oct-12	9:13	34.43670	-75.84851	*G. griseus*	ZTS-12-055	No ID photos
24-Oct-12	9:22	34.43703	-75.84884	*G. griseus*	ZTS-12-056	Gg_9-006_OB
24-Oct-12	9:31	34.43692	-75.84788	*G. griseus*	ZTS-12-057	Gg_4-004_OB
24-Oct-12	14:48	34.26005	-75.75545	*T. truncatus*	ZTS-12-058	No ID photos
24-Oct-12	14:53	34.26382	-75.75120	*T. truncatus*	ZTS-12-059	Tt_8-018_OB
10-Nov-12	8:52	34.04532	-76.74152	*S. frontalis*	ZTS-12-060	Sf_9-026_OB
10-Nov-12	9:01	34.04372	-76.73562	*S. frontalis*	ZTS-12-061	Sf_8-019_OB
10-Nov-12	10:41	33.59426	-76.78155	*T. truncatus*	HJF-12-019	No ID photos
10-Nov-12	11:27	33.57456	-76.77519	*T. truncatus*	ZTS-12-062	Tt_9-042_OB
10-Nov-12	11:53	33.55908	-76.76921	*T. truncatus*	ZTS-12-063	Tt_6-031_OB

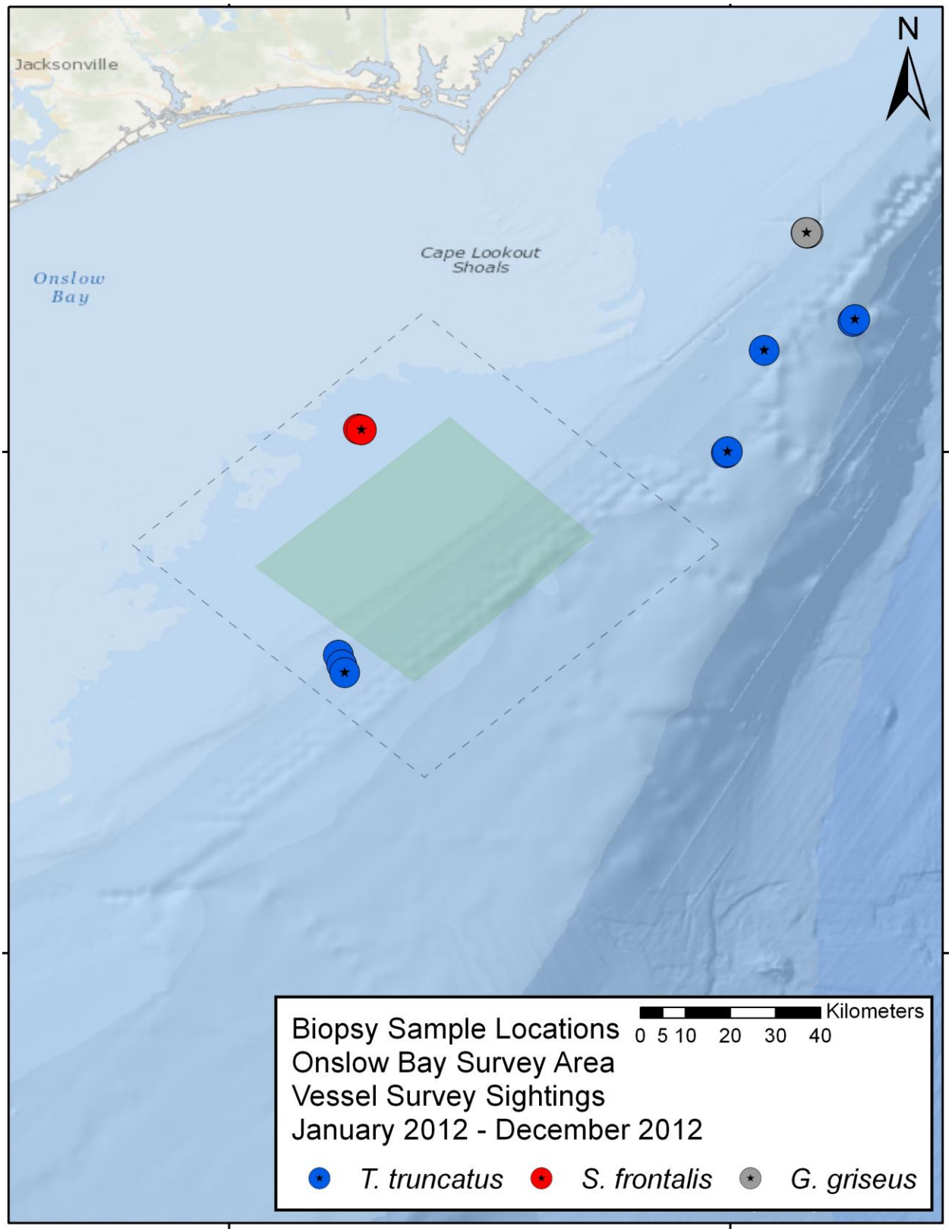

Figure 14. Locations of biopsy samples collected in the Onslow Bay survey area, January 2012 – December 2012.

Photographic Effort

Approximately 1444 digital images were taken during 2012 for species confirmation and individual identification. Every attempt was made to photograph all animals encountered, both to validate species identification and to develop photo-identification catalogs for cetacean species in Onslow Bay. Individuals were identified to species in nine of the twelve encounters. In two sightings, one of an unidentified whale and one of the genus *Mesoplodon*, no images were obtained. Images were obtained in the third sighting, and the animal was identified to the genus *Mesoplodon*.

Images of newly identified dolphins were added to existing photo-identification catalogs in Onslow Bay (Tables 7 and 8). Photo-identification analysis is now complete for all images taken through December 2012. Since the beginning of the monitoring program in 2007, seven bottlenose dolphins and three Atlantic spotted dolphins have been re-sighted (Figure 15). In total, approximately 5% of bottlenose dolphins (7 of 139) and 4% (3 of 78) of Atlantic spotted dolphins identified in Onslow Bay have been resighted, despite limited sampling effort. Interestingly, two bottlenose dolphins (7-015 and 8-009) were seen together in both April 2009 and 2010. One bottlenose dolphin (Ttr 1-004) has now been photographed on three separate occasions. Furthermore, one Atlantic spotted dolphin (Sfr-8004) biopsied and photographed on 12 September 2011 was matched to an animal photographed on 28 June 2001 and on 24 June 2002 during surveys conducted in near-shore coastal waters of Onslow Bay (Figure 15). We also matched an additional Atlantic spotted dolphin from the same 12 September 2011 group to Sf 9-023_MCB, photographed a month earlier on 19 August 2011 during surveys in the coastal waters off of Camp Lejeune, NC (Figure 15). These resightings suggest some degree of

residency for both bottlenose dolphins and Atlantic spotted dolphins within the study area. To date, no other species photographed has been resighted. However the number of sightings and catalog sizes for these species are very small. In addition, the photo-identification catalogs of bottlenose dolphins and Atlantic spotted dolphins from the Jacksonville and Onslow Bay survey areas were compared, but no matches were found between the two sites. Matched genetic and photo-id data will be particularly useful for understanding population structure and site fidelity of odontocetes in Onslow Bay and other Navy OPAREAs. Images of the dorsal fins of stranded cetaceans in North Carolina are compared regularly to our photo-identification catalogs for Onslow Bay, but to date there have been no matches.

Table 8. Summary of photo-identification effort and number of biopsy samples collected during vessel-based surveys in Onslow Bay, January 2012 – December 2012.

Species	Images	Sightings	Catalog Size (2007-2012)	Number of Matches (2007-2012)	Number of Biopsy Samples (2012)
Grampus griseus	536	1	22	0	5
Stenella frontalis	170	1	78	3	2
Tursiops truncatus	738	7	139	7	8

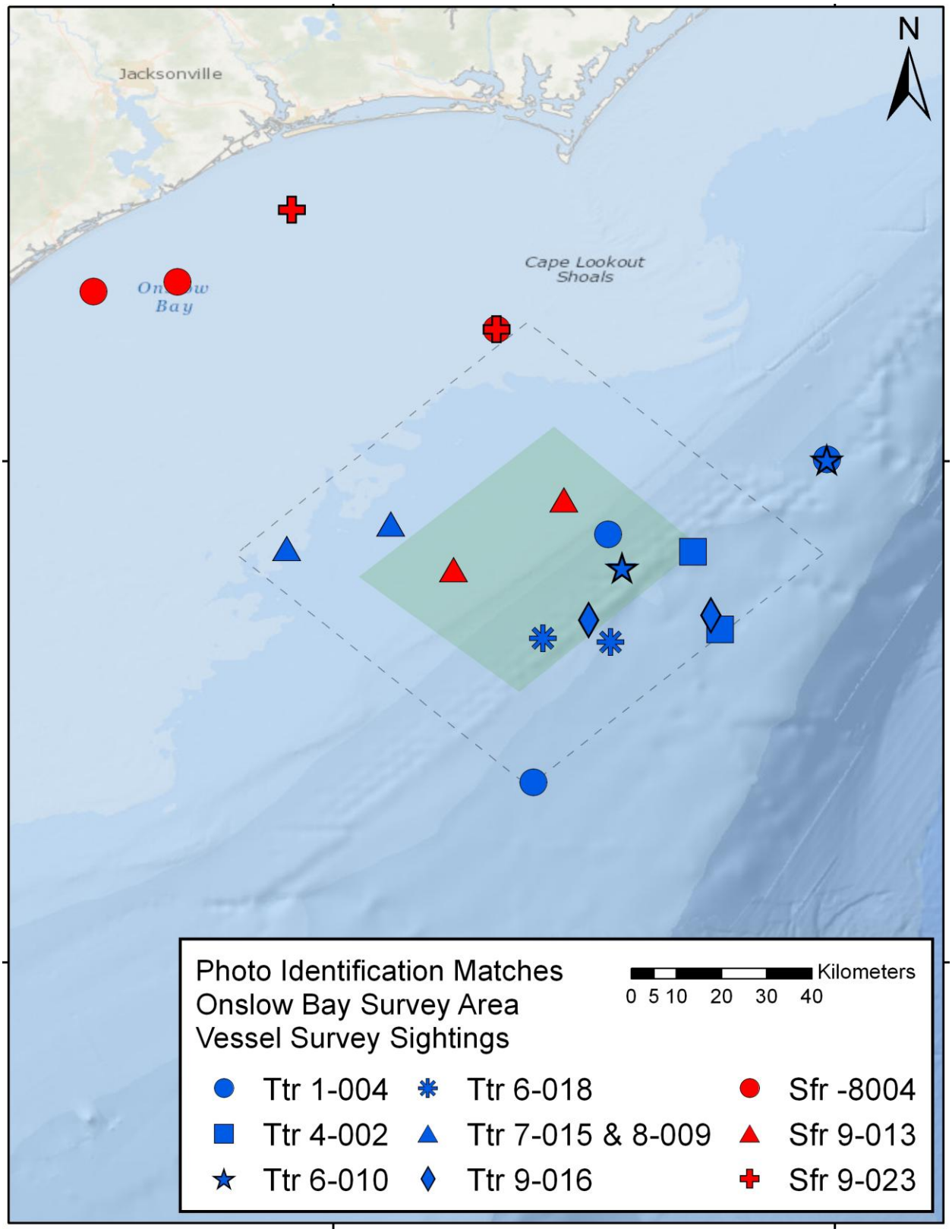

Figure 15. Locations of photo-identification matches of dolphins in the Onslow Bay survey area.

Passive Acoustic Monitoring

HARP Analysis

Underwater ambient noise during this deployment is shown in Figure 16. Table 9 summarizes the detected and identified marine mammal vocalizations for the 2010-2011 Site A HARP deployment. Figures 17-26 show the daily occurrence patterns for the different marine mammal groups (classified to species when possible). Figure 27 shows the occurrence of sonar.

Blue whales were present primarily from September 2010 to the end January 2011 (Figure 17). Type A and B blue whale calls were detected, mainly as song but also occasionally as individual calls. Also, 26 – 27 Hz sounds, which are similar to the calls produced by Antarctic blue whales, were detected between 31 July 2010 and 16 August 2010 (Figure 18).

Fin whale 20-Hz pulses were present starting as early as 19 August 2010, although most detections occurred between December 2010 and February 2011, with a minor peak in October 2010 (Figure 19). In previous deployments, fin whale calls peaked between January and March.

Minke whale pulse trains (mainly slow-down pulse trains) were detected between 12 December 2010 and the last day of the recording period, 3 March 2011 (Figure 20). Peaks in pulse train calls occurred from the end of December through the end of February, similar to the previous findings of peaks between January and March for earlier deployments.

North Atlantic right whale up-calls were detected on two days (18 October 2010 and 29 January 2011) during the 2010-2011 Site A deployment (Figure 21). Moans and variable calls were also

detected on 29 January 2011. These are the first detections of North Atlantic right whales at Site A in Onslow Bay. The timing coincides with the migration of this species to and from the breeding grounds.

Downsweeps similar to those ascribed to sei whales by Baumgartner *et al.* (2008) were detected on 18 October 2010 and between 17 November 2010 and 1 March 2011 (Figure 22). Peaks in these types of calls occurred between 30 November – 1 December 2010 and 18 – 26 January 2011. The general occurrence and peaks in detections are similar to previous findings in Onslow Bay.

Three pulses, unidentified to species, with frequencies sweeping down from approximately 90 – 60 Hz were detected on 26 December 2010. These three pulses followed 10 minutes after the detection of a single variable call (frequency range approximately between 280 – 330 Hz), also unassigned to a species.

Detected odontocete vocalizations included clicks, whistles, and burst-pulses (Figures 23-26). Most of these detections (93%) were assigned to the unidentified odontocete category (Figure 23). As found in previous winter deployments at Site A during 2007-2008 and 2009-2010, a strong pulse of longer-duration and clustered unidentified odontocete vocal events was seen during the 2010-2011 deployment starting in November and ending in January (Figure 23). *Kogia* spp. were present on only four days during the 2010-2011 Site A deployment (Figure 24), which is consistent with the sporadic occurrence found during previous deployments. Risso's dolphins were also detected throughout the deployment with a stronger nocturnal presence, again

agreeing with earlier findings (Figure 25). Sperm whales were detected mainly between November and the end of February, during both day and night (Figure 26).

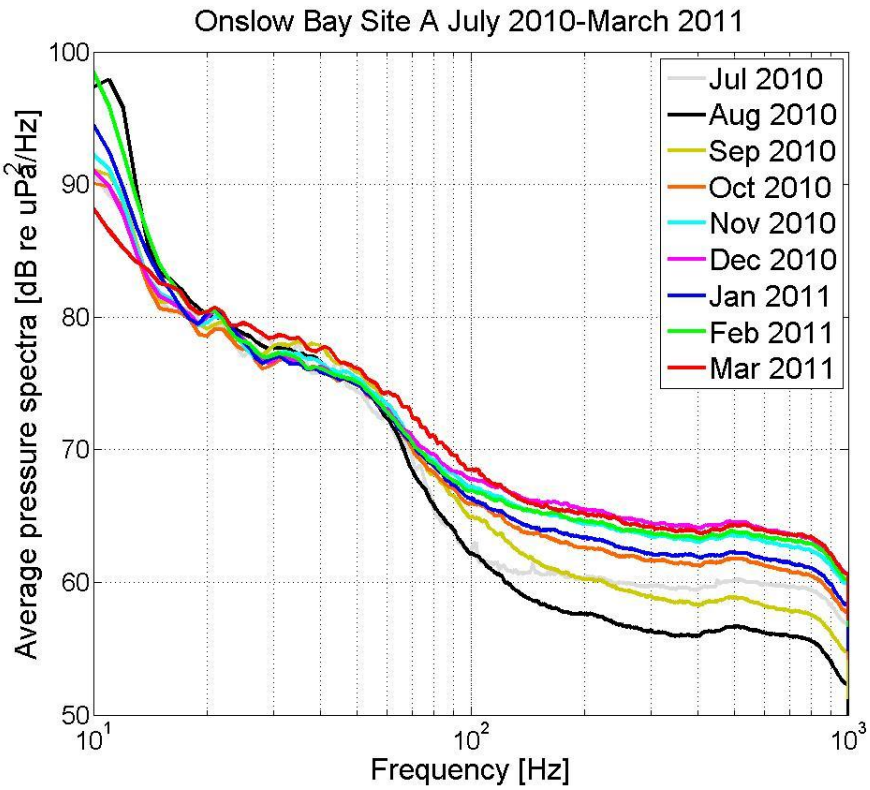

Figure 16. Monthly averages of ambient noise at Site A for July 2010 – March 2011.

Table 9. Summary of detections of marine mammal vocalizations at Site A for July 2010 – March 2011.

Species	**Call type**	**Total duration of vocalizations (hours)**	**Percent of recording duration**	**Days with vocalizations**	**Percent of recording days**
Blue whale	A and B calls (mainly A)	57.35	2.02	72	33.03
Possible blue whale	26 – 27 Hz	8.17	0.29	7	3.21
Fin whale	20 Hz	93.67	3.31	65	29.82
Minke whale	pulse train (slow-down, speed-up, regular)	48.58	1.72	56	25.69
North Atlantic right whale	Up-call, moan, variable call	0.43	0.02	2	0.92
Possible sei whale	downsweep	9.95	0.35	20	9.17
Unidentified odontocete	clicks, whistles, burst-pulses	441.27	15.58	207	94.95
Kogia spp.	clicks	0.27	0.01	4	1.83
Risso's dolphin	clicks	12.63	0.45	19	8.72
Sperm whale	clicks	5.45	0.19	14	6.42

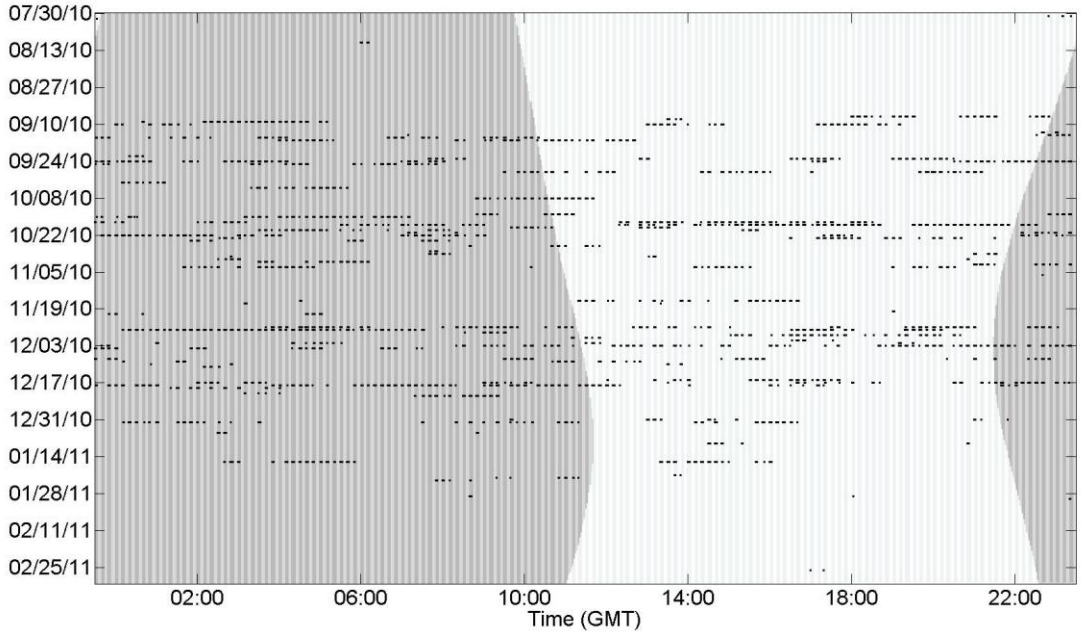

Figure 17. Blue whale Type A and B call detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

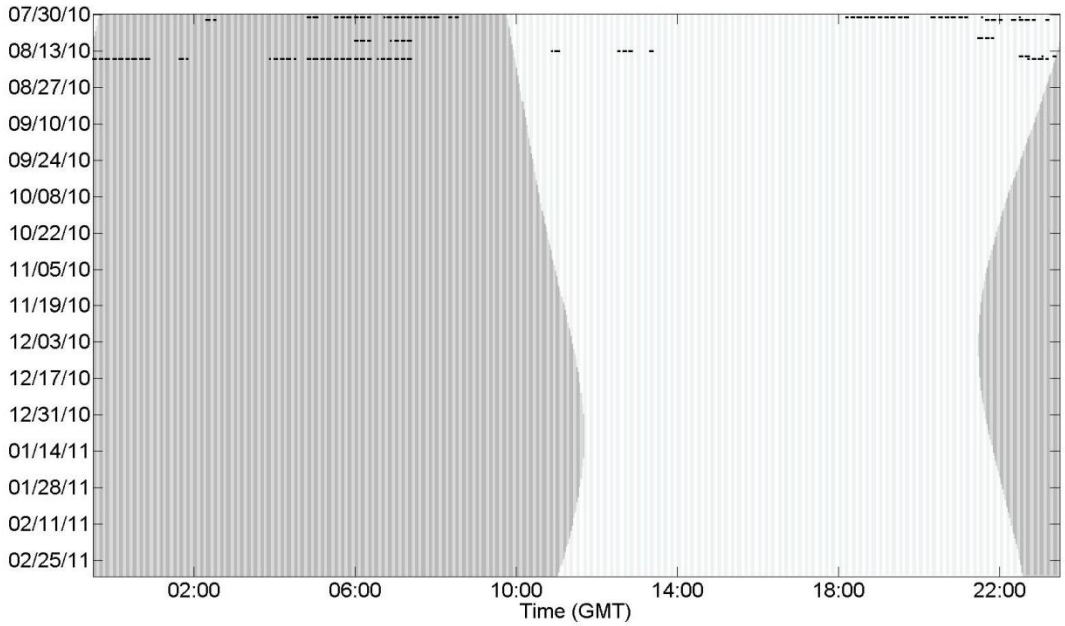

Figure 18. Detections of 26 – 27 Hz sounds (black bars) possibly produced by blue whales for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

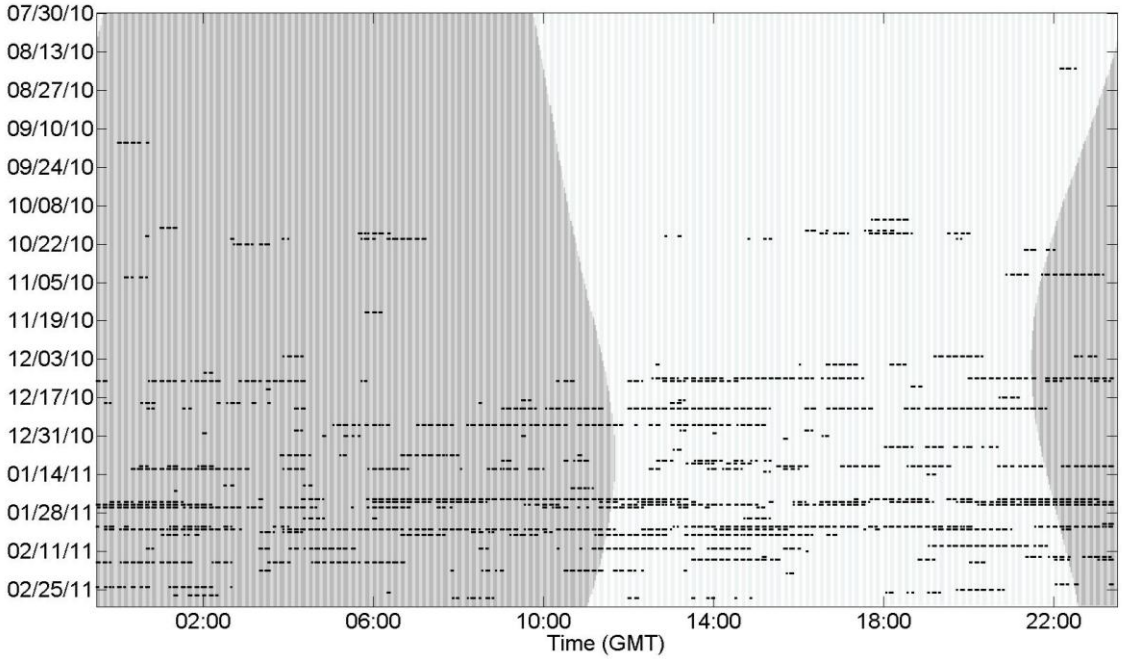

Figure 19. Fin whale 20-Hz pulse detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

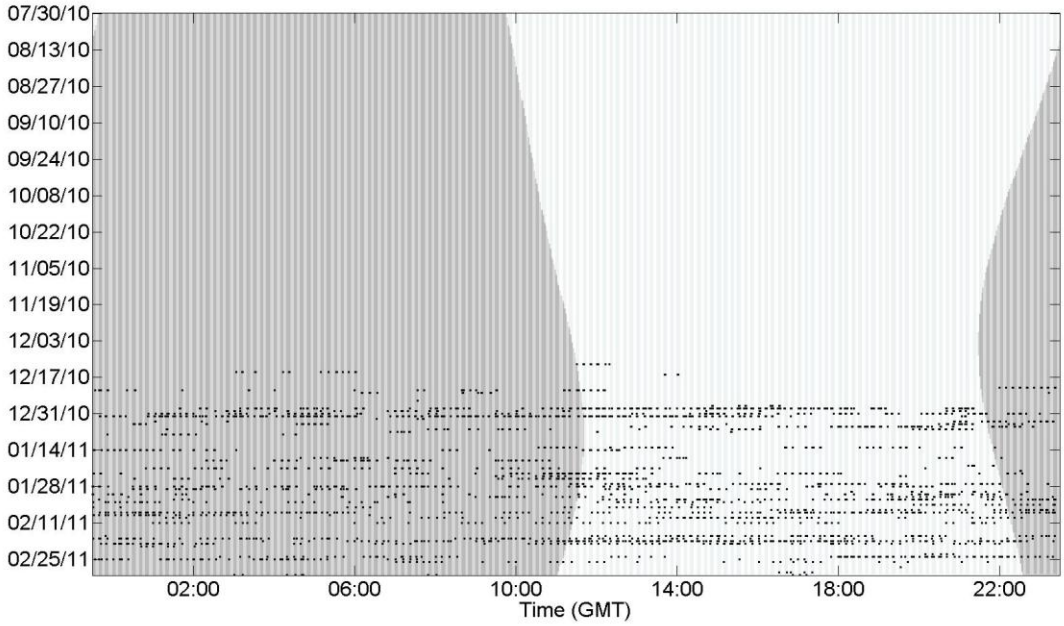

Figure 20. Minke whale detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

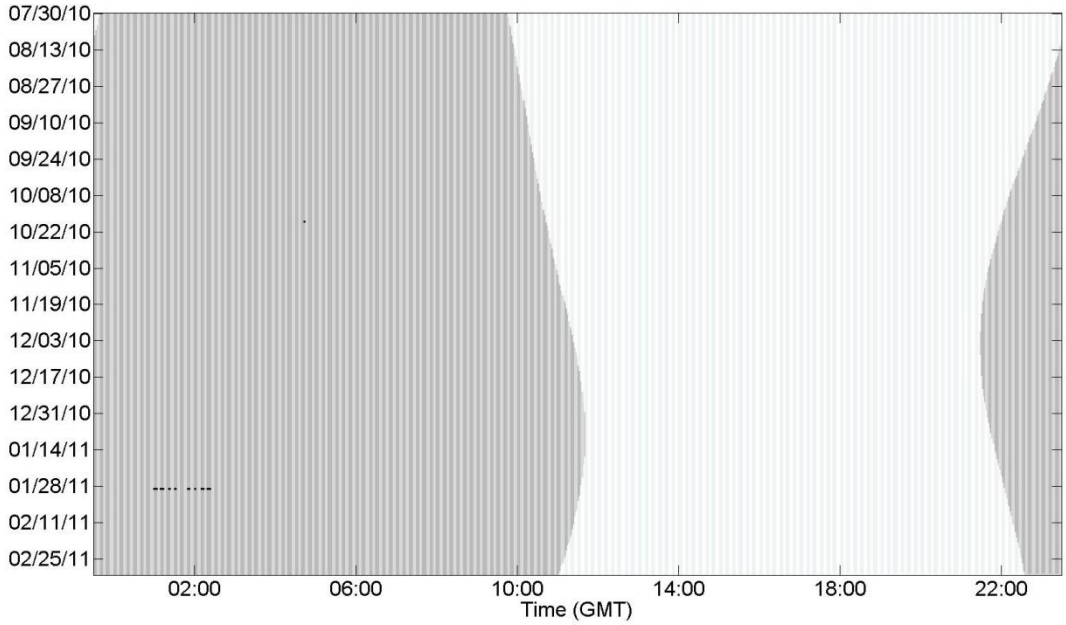

Figure 21. North Atlantic right whale detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

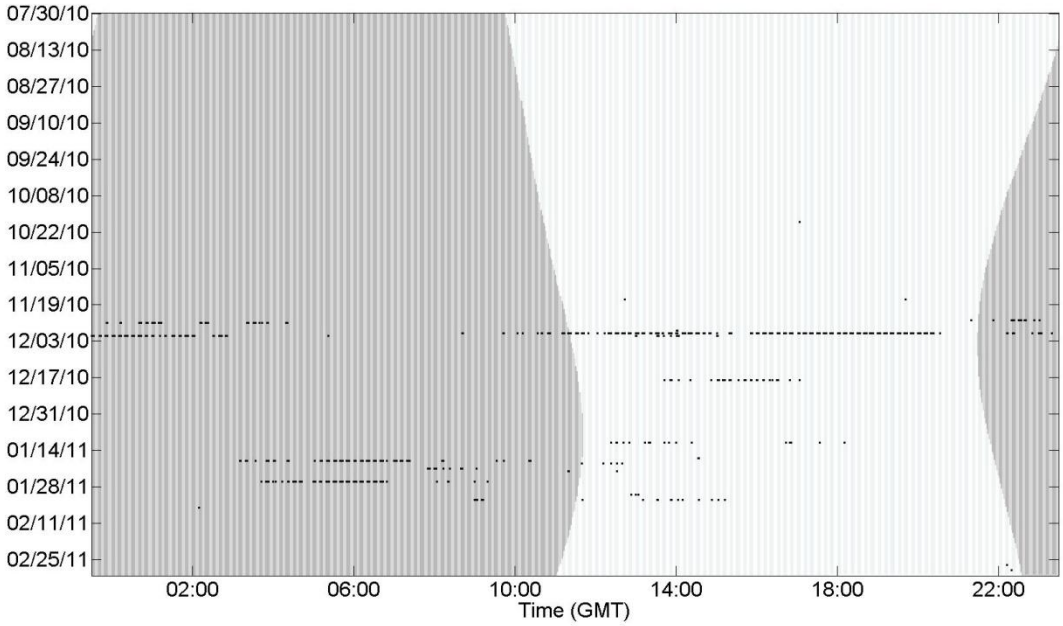

Figure 22. Downsweep detections (black bars) that may be produced by sei whales (Baumgartner *et al.* 2008) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

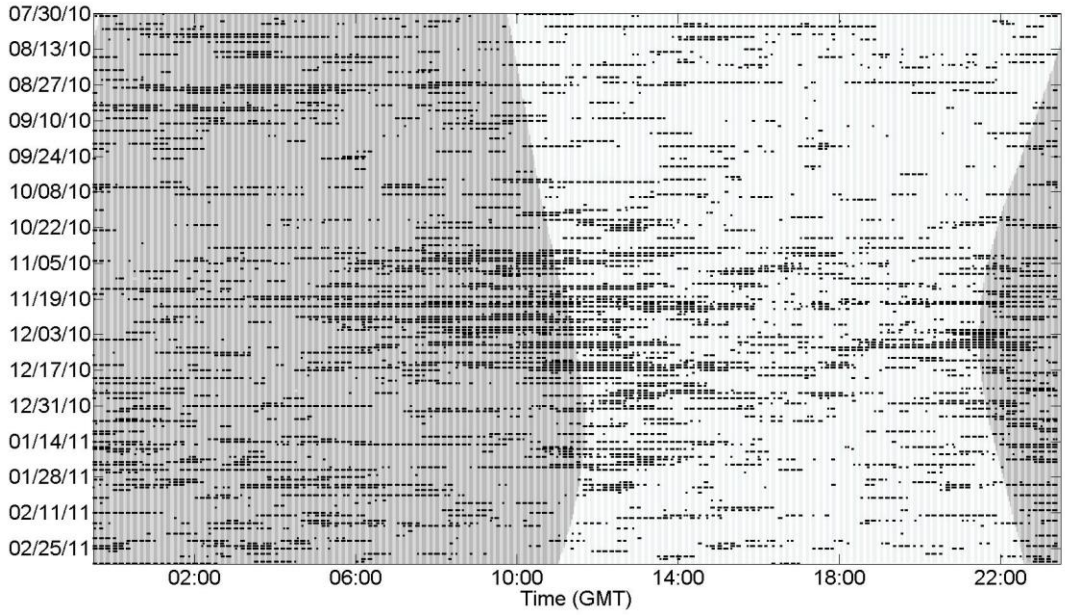

Figure 23. Unidentified odontocete vocalization detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

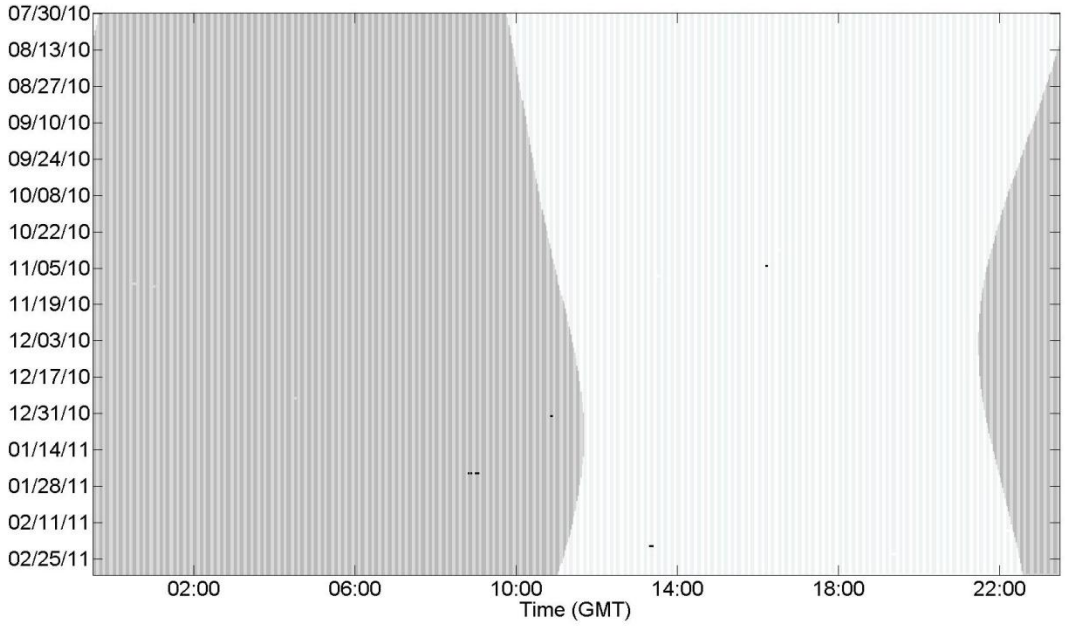

Figure 24. Kogia spp. click detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

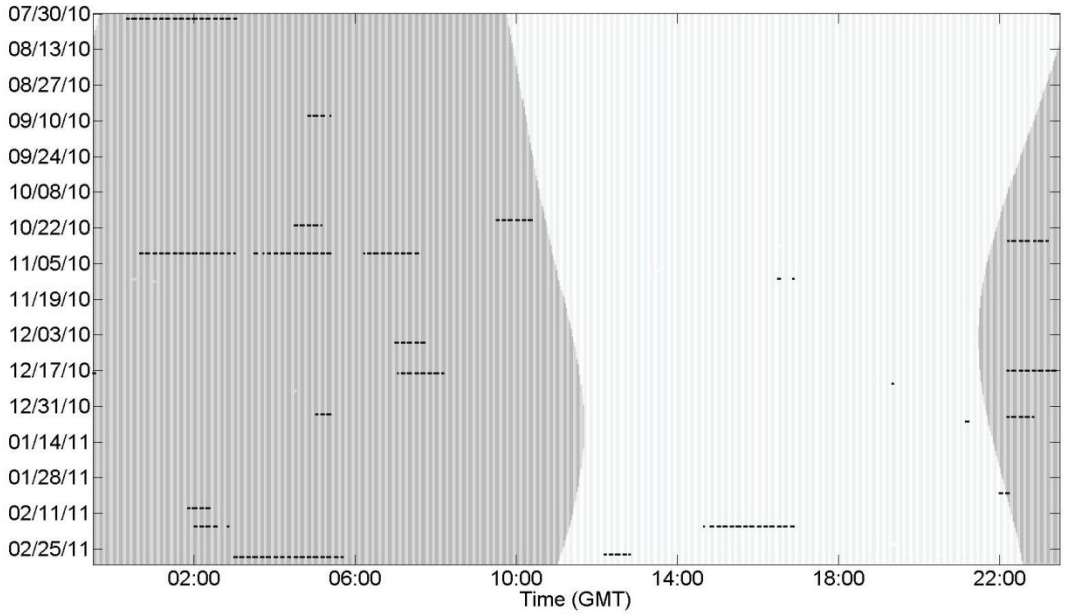

Figure 25. Risso's dolphin click detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

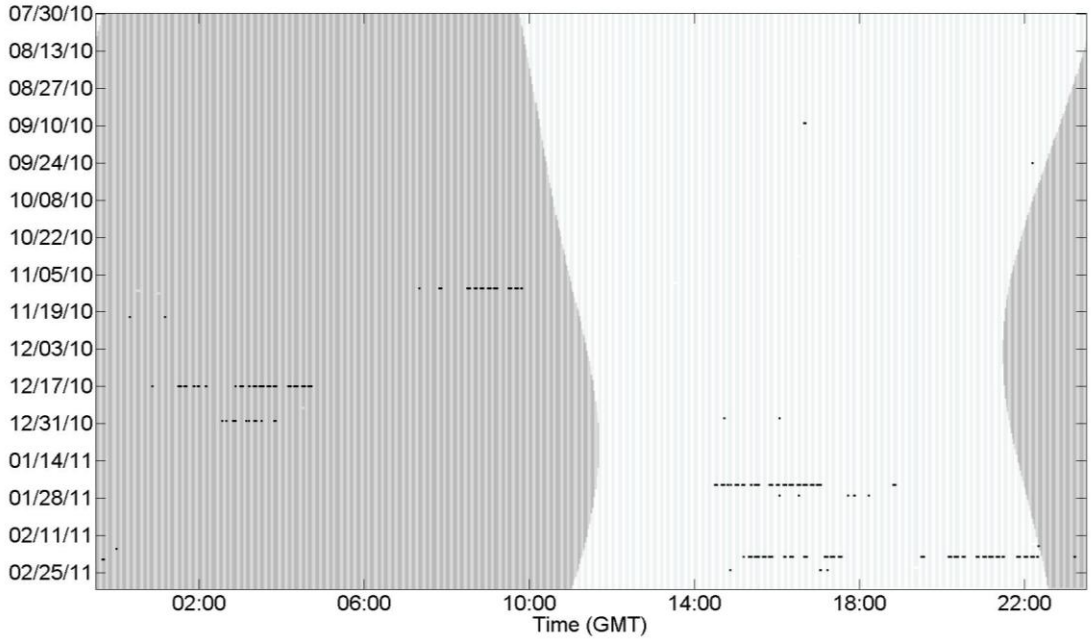

Figure 26. Sperm whale click detections (black bars) for the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

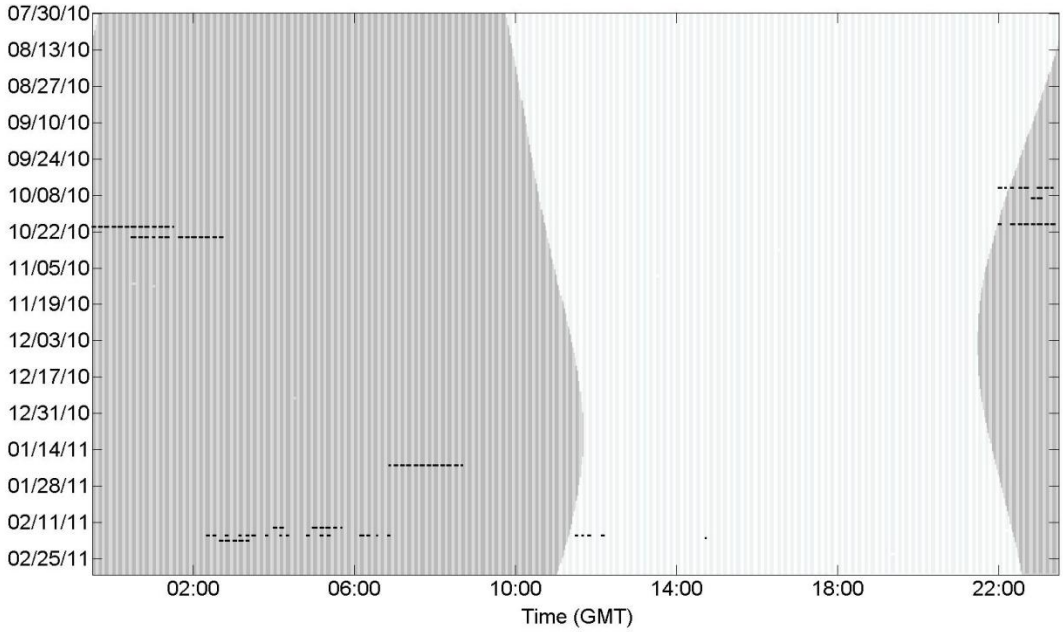

Figure 27. Mid-frequency active sonar (black bars) detected during the 2010-2011 Site A deployment. Shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil).

Acknowledgements

We would like to thank Joel Bell (Naval Facilities Engineering Command Atlantic) for his continued support and guidance. We are indebted to Keith Mullin and Kathy Foley, who allowed us to work under their biopsy permit (779-1633). For assistance with HARPs we thank Dr. John Hildebrand, Ryan Griswold, Sean Wiggins, Tim Boynton, and the Captain and crew of the R/V *Cape Fear*. Additional thanks goes to Ana Širović for sharing knowledge of blue whale calls. For the shipboard surveys, we thank Julia Burrows, Danielle Crain, Jordan Carduner, Erin Cummings, Rachel Kaufmann, Ryan McAlarney, Logan Pallin and Danielle Waples. A special thanks goes to Captain Dale Britt and first mate Alan Scibal for their expertise and good nature on the F/V *Sensation.* Surveys were conducted under NOAA Scientific Permit 948-1692-00 held by the University of North Carolina Wilmington and NOAA General Authorization 808-1798-01, 808-1798-02, and 16185 held by Duke University.

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