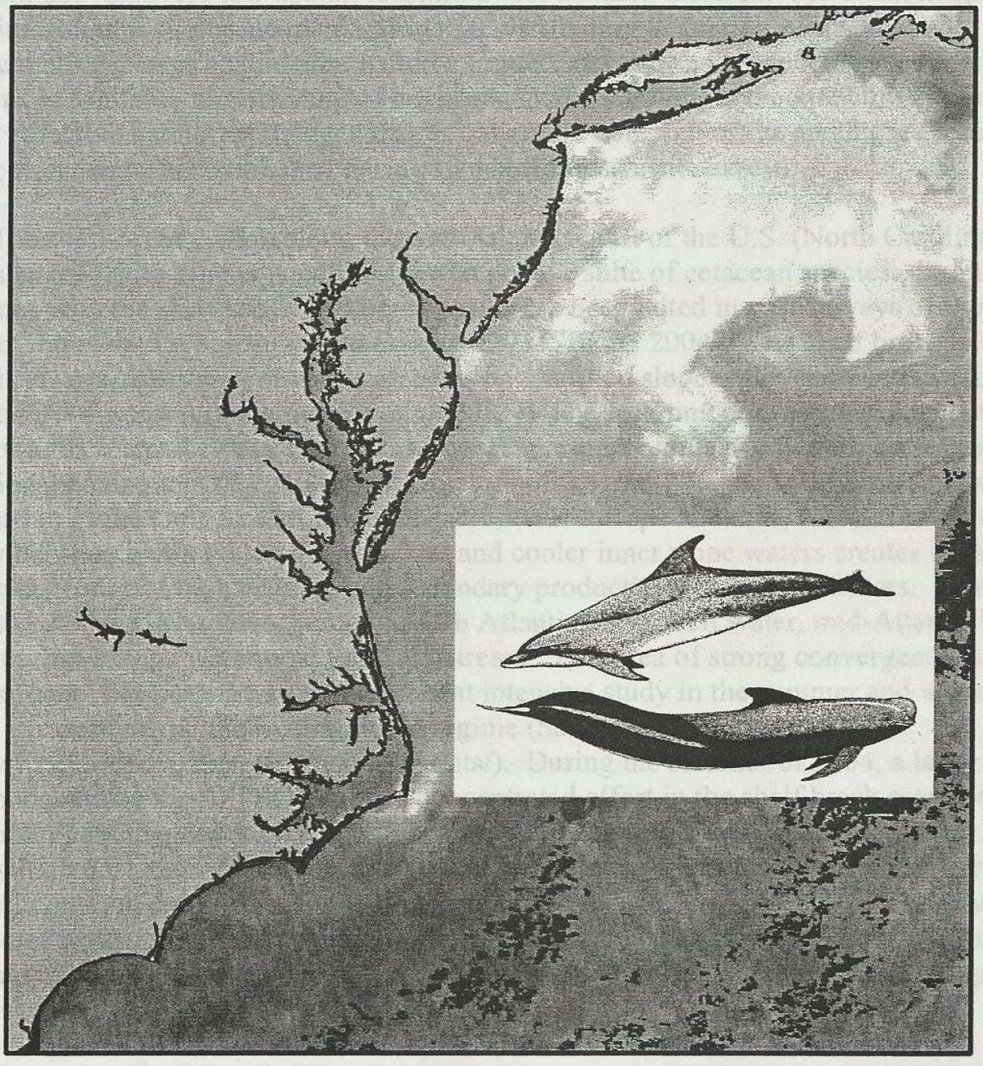
CRUISE RESULTS

NOAA Ship *Gordon Gunter* Cruise GU-06-03 (038)
19 June - 17 August, 2006

Mid-Atlantic Cetacean Habitat Survey



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INTRODUCTION

Habitat modeling is a major focus of current research in the ecology and management of marine mammals. In the past, surveys conducted by NMFS within the framework of marine mammal stock assessments have focused primarily on the large scale distribution of marine mammals and abundance within the U.S. EEZ. By necessity, surveys covered very large spatial extents, but had relatively low spatial resolution. As a result, these surveys could not provide detailed information on marine mammal spatial distribution to support efficient habitat modeling. Further, covering a large spatial area within a limited survey window generally reduces the time and resources available for sampling of environmental conditions and conducting hydrographic profiles. Effective habitat modeling requires both more comprehensive and higher resolution sampling than can be accomplished during standard assessment surveys.

The shelf-break region along the mid-Atlantic coast of the U.S. (North Carolina to New Jersey) is an area with high concentrations of a diverse suite of cetacean species. Strong associations with the shelf break for some species has been noted in past surveys of this region (e.g., Garrison *et al.* 2003, Mullin and Fulling 2003, SEFSC 2004). The shelf break in the mid-Atlantic is an area of strong convergence between stratified slope water and unstratified continental shelf water (Gawarkiewicz *et al.* 2001). The resulting convergence concentrates zooplankton, their small fish predators, and hence marine mammals and other large predators. An additional component of the physical structure of the mid-Atlantic shelf-break and slope is the separation of the Gulf Stream from the shelf break at Cape Hatteras, North Carolina. The boundary between warm Gulf Stream waters and cooler inner slope waters creates an additional convergence front and high primary and secondary productivity in surface waters. Finally, near Cape Hatteras, there is a convergence of south Atlantic bight shelf water, mid-Atlantic bight shelf water, inner slope water, and the Gulf Stream. This area of strong convergence and the "Hatteras Front" has been the subject of recent intensive study in the summer and winter, and this is an extremely dynamic hydrographic regime (Savidge *et al.* 2005, http://www.whoi.edu/science/PO/hatterasfronts/). During the summer of 2004, a large vessel survey conducted by the SEFSC included concentrated effort in the shelf break region of the mid-Atlantic bight ranging from south of Cape Hatteras, North Carolina to New Jersey. There were very high densities of pilot whales (*Globicephala* spp.), bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), sperm whales (*Physeter macrocephalus*) and other species in the region just north of Cape Hatteras and along the shelf break. The high density and diversity of marine mammals observed is likely associated with the hydrographic complexity in these areas.

The region along the shelf-break is also an important area for commercial fishing activity and U.S. Navy activities. The U.S. Atlantic pelagic longline fishery operates year-round in waters just off of Cape Hatteras, and effort is generally concentrated along the mid-Atlantic shelf break during the summer and fall. The longline fishery has a history of relatively high interaction rates with both pilot whales and Risso's dolphins (*Grampus griseus*) in this area. Since the longline fishery is concentrating on swordfish, tunas, and other pelagic predators, it is likely that the physical and habitat features that concentrate these animals along the shelf break and other convergence zones are similar to those that concentrate marine mammals. The spatial

and environmental processes that may result in increased interaction rates between fisheries and marine mammals is an area of current study associated with a Pelagic Longline Take Reduction Team that has recently been convened.

The area offshore of the mid-Atlantic bight is within the Navy VACAPES operational area and is used by the Navy on a regular basis for exercises and other operations. This region, along with the Cherry Point operational area along the North Carolina coast south of Cape Hatteras, has been the focus of intensive efforts to document the known information about marine mammal spatial distribution and occurrence as part of the Navy's Marine Resource Assessments. More recently, a draft Environmental Impact Statement was developed to examine the potential impacts of establishing an underwater test range in the shelf break region near Onslow Bay. The relatively high intensity of expected Navy activities throughout this region necessitates improved information on marine mammal habitat use and improved ability to predict spatial distribution at relatively small spatial and temporal scales.

The need for more detailed information on marine mammal spatial distribution and habitats in the shelf-break region of the mid-Atlantic and south Atlantic was the impetus for the Mid-Atlantic Cetacean Habitat Survey during the summer of 2006 aboard the NOAA Ship *Gordon Gunter*. The survey was designed to explicitly assess both broad scale and mesoscale spatial distribution and abundance of cetaceans and their relationship to physical and biotic environmental conditions.

CRUISE OBJECTIVES

1. Conduct visual line transect surveys of the shelf break region and inner continental slope of the mid-Atlantic to quantify marine mammal abundance and spatial distribution.
2. Collect hydrographic profiles using XBT and CTD casts at spatial scales appropriate for mesoscale physical features including the Gulf Stream front and shelf-break front.
3. Collect zooplankton samples, active acoustics (ER60) and Acoustic Doppler Current Profiler (ADCP) data to quantify the distribution of prey resources associated with marine mammal concentrations.
4. Conduct small boat operations to collect biopsy tissue samples from targeted marine mammal species for genetic, stable isotope, and contaminant analysis.
5. Conduct passive acoustic surveys simultaneous with visual surveys to augment detections of marine mammals.
6. Record occurrences of commercial shipping, fishing vessels, and Navy vessels during the survey.
7. Collect additional sighting information on sea birds, turtles, and other biota as an indicator of habitat productivity.

METHODS

Visual Survey

Visual surveys were conducted by three observers stationed on the flying bridge of the *Gordon Gunter*. Standard ship-based, line-transect survey methods for cetaceans, similar to those used in the Pacific Ocean, Atlantic Ocean and Gulf of Mexico were used (*e.g.*, Barlow 1995, Mullin and Fulling 2003, Fulling *et al.* 2003). Two observers were stationed at the port and starboard 25x "bigeye" binoculars, and the third observer observed the trackline with naked eye and small binoculars and entered data into a laptop computer.

For each marine mammal sighting, time, position, bearing and reticle (a measure of radial distance) of the sighting, species, group-size, behavior, bottom depth, sea surface temperature, and associated animals (*e.g.*, seabirds, fish) were recorded. The bearing and radial distance for groups sighted without 25x binoculars and close to the ship were estimated. Survey effort data were automatically recorded every 1 min and included the ship's position and heading, effort status, observer positions, and environmental conditions which could effect the observers' ability to sight animals (*e.g.*, Beaufort sea state, trackline glare, etc.). Typically, if a sighting was within a 1.5 nm strip on either side of the ship, the ship was diverted from the trackline to approach the group to identify species and estimate group-size. Marine mammals were identified to the lowest taxonomic level possible. In addition, visual observers recorded sightings of sea birds, sea turtles, flyingfish, and other observable species. Position information on sighted commercial and naval vessels was also recorded along with available information on vessel size and speed from AIS data.

Survey speed was usually 18 km hr^{-1} (~10 knots) but varied with sea conditions. However due to budget limitations imposed on the vessel's operations during the second leg, vessel speeds were generally less than 7 knots during the first hour of each survey day. The effectiveness of visual line transect survey effort is severely limited during high sea state and poor visibility conditions (*e.g.*, fog, haze, rain). Survey effort was therefore suspended during heavy seas (sea state > 6) and rain.

Acoustic Survey

Acoustic surveys were most often conducted simultaneously with visual surveys and when the small boat could not be deployed. A two-element hand-deployed array was set 250m astern of the vessel and towed at the survey speed. This towed array is constructed using two hydrophones with a spread of 3 meters. The hydrophones and pre-amps are housed in a flexible, oil filled polyurethane tube which is attached to 400 meters of a high strength, multi-conductor, shielded tow cable. The hydrophones have a frequency response of +/- 1 dB from 1 Hz to 15 kHz and +/- 2 dB from 15 to 25 kHz. Aboard the survey vessel, the signal was high-pass filtered at 1.6 kHz (6 dB roll off) to help eliminate flow noise.

The data from the array was fed into the acoustics lab for amplification, filtering, recording and monitoring. Digital audio tape recordings of signals of interest were made using multi-channel digital tape recorders. These tape recordings were limited to 10 Hz – 24 kHz in

bandwidth. The array signals were constantly monitored by two acoustics operators operating on a four-hour rotational watch during survey effort. Signals were then passed from the recording equipment to a desktop computer for monitoring. The software package "Ishmael" was used to monitor signals. The bearings to signals of interest generated by "Ishmael" were then passed to a second PC for display. This PC was connected to a GPS receiver and loaded with a data recording program that displayed the ship's current position and track in a graphics display window, overlaying lines of bearing recorded by the operators. This provided the acoustics team with a clear picture of how acoustic detections related to visual sightings of cetaceans and other possible sources of sound, such as ship traffic. During acoustic effort, the recorders made a notation every five-minutes indicating whether any sounds were heard during that period and the frequency and intensity of those sounds.

Small Boat Operations

The primary platform for collection of biopsy samples was the small boat, "*R3*", carried aboard the *Gordon Gunter*. The *R*3 was deployed by crane from the deck, and the scientific party included a boat driver, biopsy sampler and photographer/data recorder. Due to engine failure shortly after departing Pascagoula, the *R3* was not available for use during the first leg of the survey. During the 2nd and 3rd legs, the *R3* was deployed during each day the weather and sea conditions allowed safe and effective operations. The *R3* generally surveyed along the same track as the *Gordon Gunter*, identifying and sampling marine mammal groups along the way. When the *R3* was deployed, the positions of marine mammals sighted by the flying bridge team were relayed, and those groups were sampled if they were in the vicinity. *R3* deployment and operations were conducted in accordance with the current small boat guidelines implemented by NOAA Fisheries, NOAA Corps, and the CO of the *Gordon Gunter*.

Biopsy Sampling

Biopsy tissue samples were collected either from the bow of the *Gordon Gunter* or the *R3*. Samples were collected using a modified .22 caliber dart rifle or crossbow fitted with custom designed biopsy heads that extract a small plug of tissue from the animals. Data on each sampling attempt were recorded and included GPS location, time, date, sampler and recorder name, species, body location struck, behavioral reaction, and whether or not a sample was obtained. A complete log of the biopsy data is maintained at the Pascagoula and Miami laboratories. Both photographic and video records of biopsy attempts were taken during these operations. Biopsy samples were retained for genetic analyses, stable isotope analyses, and contaminant analyses. Two-thirds of the skin from each sample was stored in DMSO and frozen at -20 degrees C to preserve genetic material for later analysis. The remainder of the skin was frozen at -20 degrees C in glass vials for stable isotope analysis. The blubber from full samples collected on the small boat was saved for contaminant analysis. These samples were handled using clean techniques and stored in liquid nitrogen inside Teflon vials.

Photo-documentation and Photo-identification

Digital photographs were taken of the majority of the sighted cetacean groups. Photographs were taken primarily to record biopsy attempts and to provide documentation of species-identifications. In addition, attempts were made to photograph dorsal fin profiles and body markings.

Environmental Data

Environmental data was collected continuously throughout the cruise from surface water using the vessel's SSCS system. SSCS data including wind speed, wind direction, water depth, temperature, salinity, and fluorescence were fed into the survey computer operating on the flying bridge and thus are recorded directly in the visual survey database including survey effort and marine mammal sightings. Additional environmental conditions including weather, sea state, and other conditions that may influence marine mammal sighting rates were recorded by the visual team throughout the survey.

Hydrographic profiles were collected at designated stations along the survey trackline. Sampling stations were identified based upon the relevant spatial scales of major oceanographic features. During the first leg, satellite imagery showing sea surface temperature and chlorophyll concentrations were downloaded at 2 to 3 day intervals to identify the location of the Gulf Stream front on the continental slope. Sampling stations were placed to ensure sampling across this frontal zone. During the 2nd and 3rd legs, the focus was on the shelf-break front in the mid-Atlantic region. Generally, hydrographic profile stations were spaced 5 km apart near the shelf break and 10 km apart on the inner slope. Profiles of water temperature to depths of 750 m were collected using XBTs at the majority of stations. At less frequent intervals, but still encompassing the major frontal zones, CTD profiles were made to 500 m. The CTD profile included measures of water temperature, salinity, fluorescence, and dissolved oxygen.

Zooplankton samples were collected using a paired bongo net sampler with a mesh size of 333μ. The bongo net was deployed to a maximum depth of 200 m following procedures standard to the SEFSC SEAMAP cruises conducted aboard the *Gordon Gunter*. The CTD attached to the bongo net performed poorly throughout the cruise. Therefore, a complete CTD profile was also obtained at each plankton station during legs 2 and 3. Samples were preserved in 10% Formalin and will be transferred to 90% Ethanol for later sorting and determination of plankton biovolume.

As an additional measure of secondary production and zooplankton biomass, the ER60 active acoustics system was used during the survey effort each day. The ER60 is a scientific echosounder with two transducers operating at 38 kHz and 120 kHz. These frequencies are appropriate for measuring acoustic backscatter due to larger zooplankton, small fish, and pelagic fish and squids. ER60 data were recorded to hard drive from dawn to dusk on every survey day. While the uncalibrated data are appropriate for measuring relative backscatter, and therefore plankton/fish biomass, it is necessary to calibrate this instrument so as to compare results across cruises. The ER60 aboard the *Gordon Gunter* had never been successfully calibrated. Two calibration attempts were made during this cruise, with one successful calibration of the 38 kHz transducer.

Finally, ADCP data were collected and recorded throughout the survey. This active acoustic tool provides vertical profiles of water velocities and can also be used to measure total zooplankton backscatter. The diesel-electric engines of the *Gordon Gunter* create interference with the ADCP signal at speeds greater than approximately 6 knots. Therefore, ADCP data collected during visual survey effort are likely compromised and of only limited utility. During night hours, the *Gordon Gunter* steamed along tracklines at speeds less than 6 knots to provide clean recordings of ADCP data. These data were collected on most nights throughout the survey.

Permit

The Southeast Fisheries Science Center was authorized to conduct marine mammal research activities during the cruise under Permit No. 779-1633-00 issued to the SEFSC by the NMFS Office of Protected Resources.

RESULTS

Visual Survey

During the 60 day survey, 4,432 km of trackline were surveyed with the visual team "on effort" (Leg 1 - 1,222 km; Leg2 - 1,230 km; and Leg 3 - 1,980 km; Figure 1, Table 1). Survey effort was conducted during transits to and from the primary survey area north of Cape Hatteras and included effort in the Gulf of Mexico on the return transit (Figure 2). In general, weather conditions were poor throughout the survey with an average sea state of 3.3. Eight survey days were either lost or included only partial survey effort due to weather conditions including Tropical Storm Beryl during the 2nd leg. In addition, four full survey days were lost to vessel maintenance issues that delayed sailing from port. During the 2nd and 3rd legs, the *Gunter's* commanding officer limited the amount of time the engines could operate at full capacity due to budgetary limitations. Thus survey speeds could only be maintained between 7 am and 7 pm, and CTD casts could not be conducted after 8 pm to reduce crew overtime. This typically resulted in the loss of 1 to 2 survey hours per day during the 2nd and 3rd legs.

The number of marine mammal sightings per day ranged between 2 and 27 during full survey days (Table 1). Overall, there were 415 cetacean groups sighted (Leg 1, 79; Leg 2, 195; and Leg 3, 131). We observed at least 13 cetacean genera/species (Table 2). Bottlenose dolphins (*Tursiops truncatus*) were sighted with greatest frequency (n = 80), followed by sperm whales (*Physeter macrocephalus*, n = 68), and pilot whales (*Globicephala spp.*, n = 60). Marine mammals were encountered throughout the primary survey area (Figure 3). However, animal densities were extremely high in waters just north of Cape Hatteras and along the mid-Atlantic shelf break. In the Gulf of Mexico, bottlenose dolphins were observed primarily in the Florida Straits, and a group of Bryde's whales (*Balaenoptera edeni*) was observed in the northeastern Gulf (Figure 4). There are several apparent habitat distinctions among delphinids in the mid-Atlantic region. For example, striped dolphins (*Stenella coeruleoalba*) were observed in the offshore waters of the continental slope. Bottlenose dolphins and Atlantic spotted dolphins (*Stenella frontalis*) were observed along the shelf break and clustered near Cape Hatteras; however, there was also a concentration of Atlantic spotted dolphins in offshore waters of the

Gulf Stream. Common dolphins (*Delphinus delphi*) were observed exclusively inshore of the 200 m isobath (Figure 5). Similarly, pilot whales were concentrated seaward of the 200 m isobath along the shelf break and were also observed in Gulf Stream waters offshore (Figure 6). Sperm whales had a similar distribution to pilot whales; however, they primarily occupy waters near the 1000 m isobath (Figure 7). No fin whales or other baleen whales were observed during the survey, which is unusual for this survey area. However, one minke whale (*Balaenoptera acutorostrata*) group was positively identified from the small boat.

Acoustic Survey

Partial or complete acoustic surveys were conducted simultaneously with visual effort on 24 days throughout the survey. Digital Audio Tape recordings of acoustic contacts were made throughout the survey and are stored for later analysis of sound characteristics and bearings to acoustic detections. The "on effort" acoustic survey tracks are shown in Figure 8 indicating locations where acoustic detections of either dolphin whistles or sperm whale clicks were made during five minute survey intervals. These detections can be directly compared to visual detections to augment estimates of sighting probabilities and enhance group size estimates for sperm whales.

Biopsy Samples

A total of 81 biopsy samples were collected during the survey with the majority of these coming from bottlenose dolphins (n = 50) and Atlantic spotted dolphins (n = 20, Table 3, Figure 9). Notable collections include samples from Atlantic spotted dolphins both near the shelf break and in Gulf Stream waters of the mid-Atlantic, which may be a separation of two distinct population units. In addition, many samples from bottlenose dolphins were collected in the Florida Straits, which is a transition zone between Atlantic and Gulf of Mexico stocks that had not been sampled during past cruises. Of the collected samples, 17 included collection of blubber for contaminant analyses, and these were primarily from pilot whales and Atlantic spotted dolphins. All genetic samples have been sent to the SEFSC Marine Mammal Molecular Genetics Laboratory, and other samples will be distributed to external partners for analysis.

Photo-documentation and Photo-identification

Digital photographs were taken of the majority of dolphin sightings from both the large vessel and the small boat. These photographs are generally used to verify species identifications and to document biopsy attempts. The digital photographs and the sighting reference information are stored at the SEFSC Miami laboratory for later reference.

Environmental Data

A total of 455 hydrographic and/or zooplankton stations were sampled during the survey (Figure 10). This includes 57 zooplankton/CTD stations (114 zooplankton samples), 78 CTD stations, and 320 XBT stations. The profile data collected during CTD and zooplankton stations is recorded in the *Gunter's* SSCS event log and processed data is stored in archive databases

saved at the Pascagoula Laboratory. The XBT data is stored in both native and text formats and operational databases maintained at the Miami laboratory. Zooplankton samples are also stored at the Miami Laboratory, where they will be analyzed for both plankton biovolume and composition.

The continuous surface data collected by the SSCS system and the ADCP data is recorded in archive databases maintained by the Pascagoula Lab. Those data integrated directly into the visual survey database are maintained separately in Miami. The ER60 data resides on hard disks that were used to record the data during the survey and are archived on DVD.

The extensive environmental data collected during this survey will be analyzed and incorporated into habitat models and analyses of the mesoscale physical processes that aggregate marine mammals in the mid-Atlantic.

SUMMARY AND CONCLUSION

The summer 2006 Mid-Atlantic Cetacean Habitat Survey is the first cruise conducted by SEFSC with an explicit focus on measuring the underlying habitat features that drive mesoscale spatial aggregation of marine mammals. This type of data and analysis is increasingly important for assessing and mitigating the risks imposed on marine mammal populations through commercial fishing activities, naval activities, and other anthropogenic impacts. The survey intensively covered regions with a high degree of physical complexity, particularly the area north of Cape Hatteras where there is a confluence of the shelf-break front and the Gulf Stream front. Overall, the survey collected a robust data set of marine mammal sightings and environmental data that will allow a holistic characterization of the physical and biological conditions in these regions, improve habitat models, and contribute to the effective management of marine mammal stocks in the mid-Atlantic.

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GU-06-03 (038) Cruise Participants

Name	Title	Sex	Organization	Citizenship
Leg 1 (19 June – 7 July)				
Tony Martinez	Field Party Chief	M	NMFS, Miami, FL	US
Lance Garrison	Visual Observer	M	NMFS, Miami, FL	US
Carrie Barry	Visual Observer	F	IAP, Pascagoula, MS	US
Kevin Barry	Visual Observer	M	IAP, Pascagoula, MS	US
Melody Baran	Visual Observer	F	Concord Inc., Miami, FL	US
Grisel Rodriguez-Ferrer	Visual Observer	F	Concord Inc., Miami, FL	US
Stephen Claussen	Visual Observer	M	Concord Inc., Miami, FL	US
Jesse Wicker	Visual Observer	M	CIMAS, Miami, FL	US
Jenny Litz	Visual Observer	F	CIMAS, Miami, FL	US
Leg 2 (10 July - 29 July)				
Tony Martinez	Field Party Chief	M	NMFS, Miami, FL	US
Lance Garrison	Visual Observer	M	NMFS, Miami, FL	US
Carrie Barry	Visual Observer	F	IAP, Pascagoula, MS	US
Kevin Barry	Visual Observer	M	IAP, Pascagoula, MS	US
Melody Baran	Visual Observer	F	Concord Inc., Miami, FL	US
Grisel Rodriguez-Ferrer	Visual Observer	F	Concord Inc., Miami, FL	US
Stephen Claussen	Visual Observer	M	Concord Inc., Miami, FL	US
Jesse Wicker	Visual Observer	M	CIMAS, Miami, FL	US
Carol Fairfield	Visual Observer	F	NMFS, Miami, FL	US
Leg 3 (31 July - 17 August)				
Tony Martinez	Field Party Chief	M	NMFS, Miami, FL	US
Keith Mullin	Visual Observer	M	NMFS, Pascagoula, MS	US
Carrie Barry	Visual Observer	F	IAP, Pascagoula, MS	US
Kevin Barry	Visual Observer	M	IAP, Pascagoula, MS	US
Melody Baran	Visual Observer	F	Concord Inc., Miami, FL	US
Grisel Rodriguez-Ferrer	Visual Observer	F	Concord Inc., Miami, FL	US
Stephen Claussen	Visual Observer	M	Concord Inc., Miami, FL	US
Jesse Wicker	Visual Observer	M	CIMAS, Miami, FL	US
Elizabeth Tuohy-Sheen	Visual Observer	F	Concord Inc., Miami, FL	US

Submitted by:

Anthony Martinez
Field Party Chief

Dr. Lance Garrison
Principal Investigator

Approved by:

Dr. Scott Nichols, Director
Mississippi Laboratories

FOR Dr. Nancy Thompson, Director
Southeast Fisheries Science Center

Table 1. Summary of survey effort during the Cetacean Habitat Survey – Leg 1.

Date	Survey Event	Survey Effort (km)	Survey Hours	Number of Sightings	Avg. Sea State	Small Boat (hours)
19-June	Depart Pascagoula, MS	0	0	-	-	-
20-June	Transit to Atlantic	0	0	-	-	-
21-June	Transit to Atlantic	0	0	-	-	-
22-June	Transit to Atlantic	0	0	-	-	-
23-June	Transit to Atlantic	0	0	-	-	-
24-June	Survey	255	12.2	5	3.8	-
25-June	Survey	155	12.0	7	4.4	-
26-June	No Survey-Weather	0	0	-	-	-
27-June	Transit to anchor Cape Henry, VA – Weather	0	0	-	-	-
28-June	Transit to Survey Area	0	0	-	-	-
29-June	Partial Survey - Weather	31	2.5	2	4.0	-
30-June	Survey	100	13.3	21	2.4	-
1-July	Survey	88	12.7	14	2.3	-
2-July	Survey	133	12.6	10	2.6	-
3-July	Survey	127	12.6	2	3.9	-
4-July	Survey	124	12.3	3	4.0	-
5-July	Survey	147	13.0	4	4.6	-
6-July	Partial Survey – Transit to Port	63	6.7	11	3.7	-
7-July	In Port- Norfolk, VA	0	0	-	-	-
	Totals	1,222	110	79	3.7	-

Table 1 (cont.) Summary of survey effort during the Cetacean Habitat Survey – Leg 2.

Date	Survey Event	Survey Effort (km)	Survey Hours	Number of Sightings	Avg. Sea State	Small Boat (hours)
10-July	In Port – Norfolk, VA Delayed Sail – Vessel Maintenance	0	0	-	-	-
11-July	In Port – Norfolk, VA Delayed Sail – Vessel Maintenance	0	0	-	-	-
12-July	Survey	72	11.6	16	2.9	-
13-July	Survey	102	12.3	15	5.3	-
14-July	Survey	67	11.9	19	4.6	-
15-July	Partial Survey – Weather	49	4.1	7	3.4	-
16-July	Survey	124	12.8	8	2.8	8
17-July	Survey	100	12.9	23	3.1	6.2
18-July	Survey	82	12.7	27	2.1	7.4
19-July	Transit to Norfolk, VA – Tropical Strom Beryl	0	0	-	-	-
20-July	In Port – Tropical Storm Beryl	0	0	-	-	-
21-July	In Port – Vessel Maintenance	0	0	-	-	-
22-July	In Port – Vessel Maintenance	0	0	-	-	-
23-July	Partial Survey – Transit to Survey Area	67	3.9	3	3.3	-
24-July	Survey	109	12.5	15	2.1	7.2
25-July	Survey	102	13.0	21	3.3	8.5
26-July	Survey	109	12.8	27	2.2	8.1
27-July	Survey	120	12.5	10	3.6	5.5
28-July	Partial Survey – Transit to Port	128	9.0	4	5.0	-
29-July	Return to Port – Norfolk, VA	0	0	-	-	-
	Totals	1,230	142	195	3.4	51

Table 1 (cont.) Summary of survey effort during the Cetacean Habitat Survey – Leg 3.

Date	Survey Event	Survey Effort (km)	Survey Hours	Number of Sightings	Avg. Sea State	Small Boat (hours)
1-August	Survey	105	12.1	24	2.0	-
2-August	Survey	132	13.1	16	3.7	2.7
3-August	Survey	108	13.0	15	4.0	-
4-August	Survey	124	12.8	7	3.8	-
5-August	Survey	85	13.1	7	2.7	5.5
6-August	Survey	124	12.5	5	3.7	-
7-August	Survey	118	12.1	13	2.2	4.6
8-August	Partial Survey - Weather	79	7.1	3	4.3	-
9-August	Survey	142	13.1	5	2.0	-
10-August	Survey	150	13.1	2	3.6	-
11-August	Survey – Transit to Gulf	168	12.9	5	4.0	-
12-August	Survey – Transit to Gulf	180	12.9	13	3.0	-
13-August	Survey – Transit to Gulf	155	12.8	2	2.3	-
14-August	Survey – Transit to Gulf	117	11.4	20	1.6	-
15-August	Survey – Gulf of Mexico	116	13.3	0	2.2	-
16-August	Partial Survey – Gulf of Mexico	78	6.1	4	2.9	-
17-August	Return to Port – Pascagoula, MS	0	0	-	-	-
Totals		1,980	205	141	3.0	12.8
Survey Totals		4,432	457	415	3.3	64

Table 2. Number of cetacean group sightings for each leg during the Cetacean Habitat Survey.

Common Name	Species	Leg 1	Leg 2	Leg 3	Total
Atlantic spotted dolphin	*Stenella frontalis*	15	29	15	59
Bottlenose dolphin	*Tursiops truncatus*	8	27	45	80
Bottlenose/ Atlantic Spotted dolphin	*T. truncatus/S.frontalis*	1	1	-	2
Bryde's whale	*Balaenoptera edeni*	-	-	1	1
Clymene dolphin	*Stenella clymene*	-	3	1	4
Common dolphin	*Delphinus delphis*	-	8	1	9
Cuvier's beaked whale	*Ziphius cavirostris*	-	1	1	2
False killer whale	*Pseudorca crassidens*	-	-	2	2
Pilot whales	*Globicephala spp.*	8	42	11	60
Pygmy/Dwarf sperm whale	*Kogia spp.*	-	-	2	2
Risso's dolphin	*Grampus griseus*	8	4	5	17
Sperm whale	*Physeter macrocephalus*	8	37	23	68
Stenella sp.	*Stenella sp.*	2	-	-	2
Striped dolphin	*Stenella coeruleoalba*	17	6	3	26
Unid. beaked whale	*Mesoplodon spp./Ziphius sp.*	1	3	2	5
Unid. dolphin		3	26	17	46
Unid. large whale		-	-	2	2
Unid. Odontocete		6	2	-	8
Unid. small whale		2	5	9	16
Totals		**79**	**195**	**141**	**415**

Table 3. Tissue biopsy samples collected during each survey leg of the Cetacean Habitat Survey.

Species	Leg 1	Leg 2	Leg 3	Total
Atlantic Spotted Dolphin	4	12	4	20
Bottlenose Dolphin	2	9	39	50
Clymene dolphin	-	1	-	1
Pilot Whale	-	4	3	7
Sperm Whale	-	2	-	2
Spinner Dolphin	-	1	-	1
Survey Total	**6**	**29**	**46**	**81**

Figure 1. Visual survey effort conducted in the U.S. Atlantic ocean during *Gordon Gunter* cruise GU-06-03 during June – August, 2006 including survey effort in the primary survey area north of Cape Hatteras and during transits.

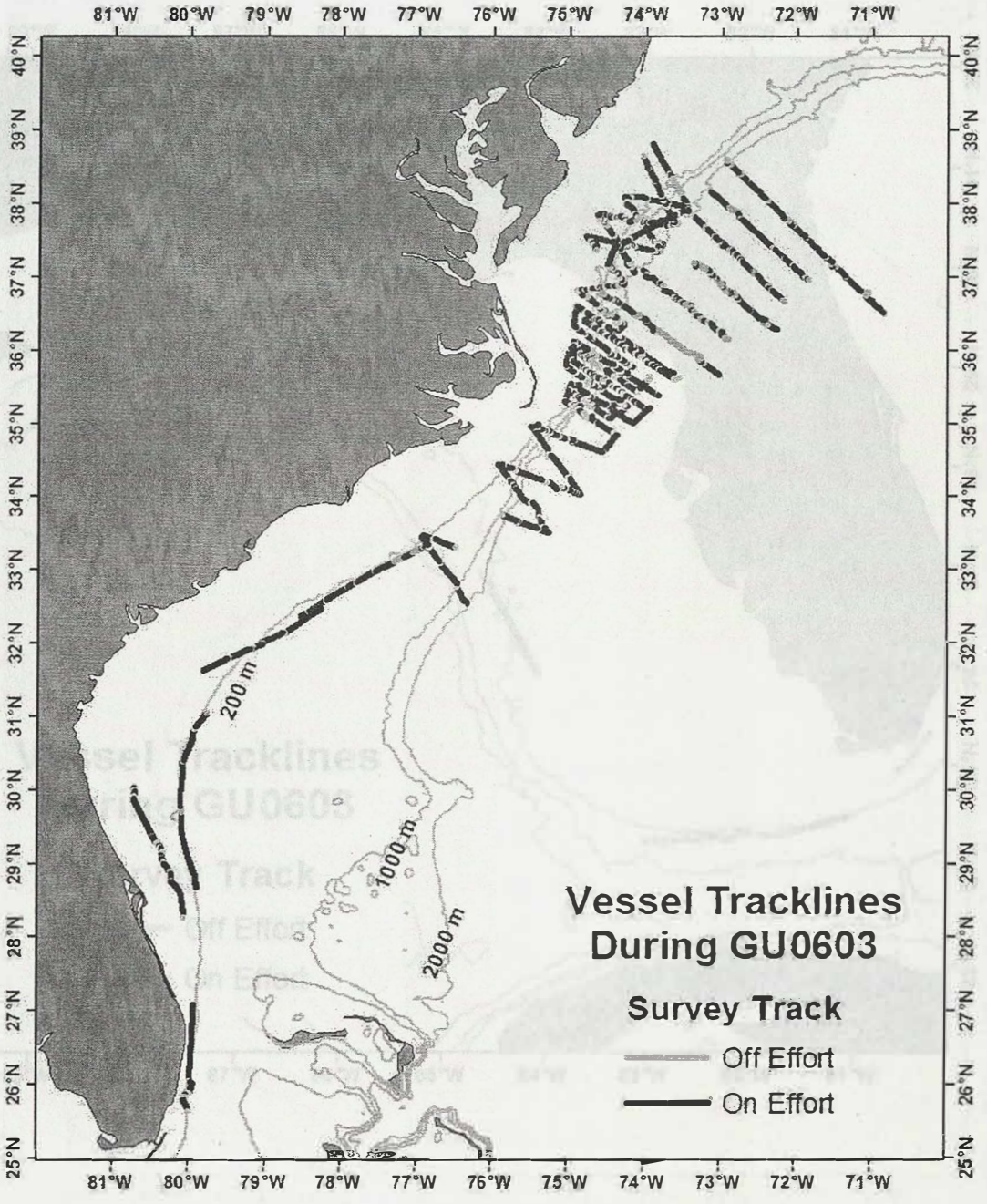

Figure 2. Visual survey effort conducted in the Florida Straits and eastern Gulf of Mexico during *Gordon Gunter* cruise GU-06-03 during the return transit.

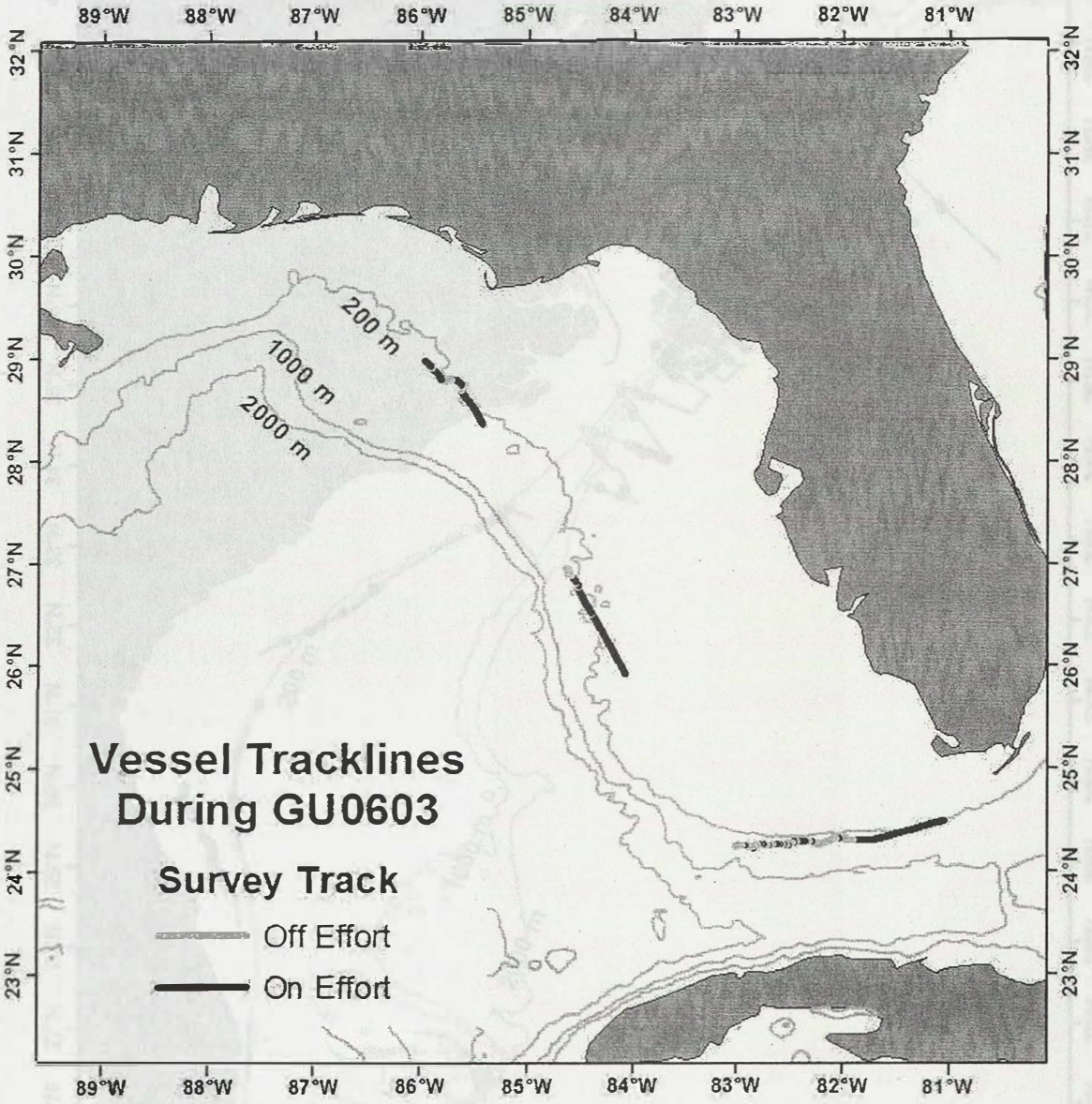

Figure 3. Locations of all cetacean sightings in the U.S. Atlantic during GU-06-03. On effort vessel tracklines are shown.

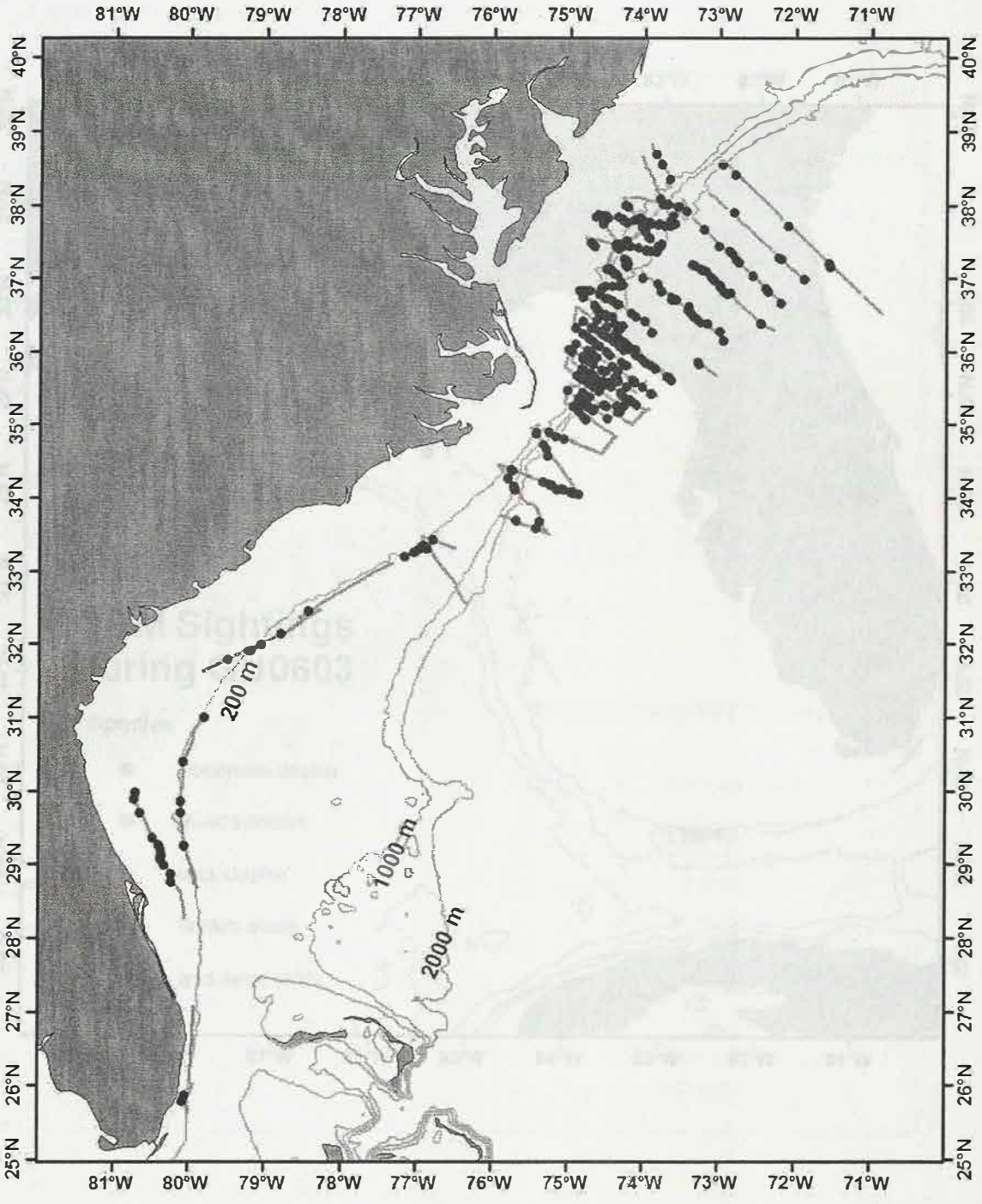

Figure 4. Locations of all cetacean sightings in the Gulf of Mexico during the return transit. On effort vessel tracklines are shown.

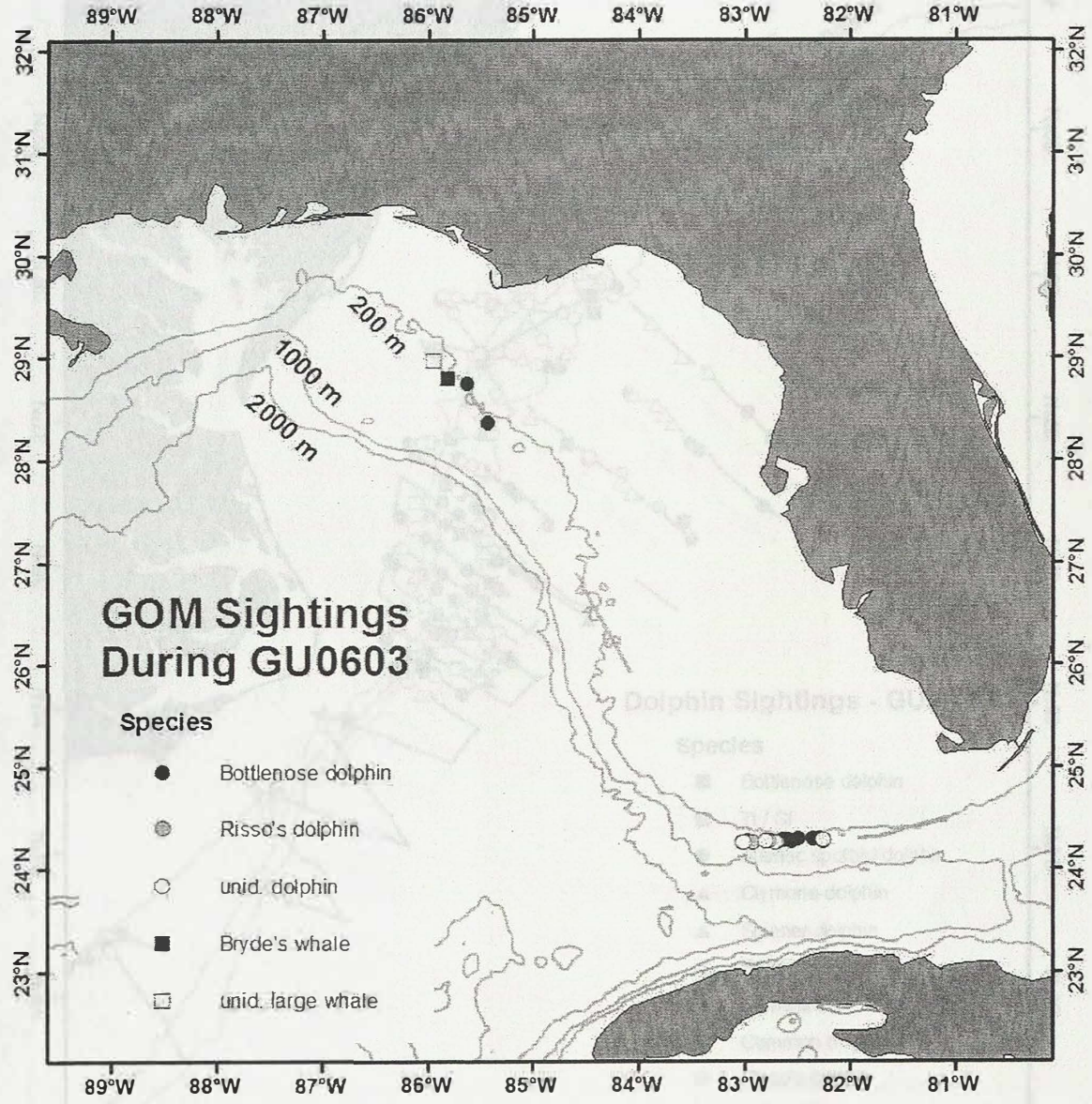

Figure 5. Dolphin sightings in the primary survey area during GU-06-03.

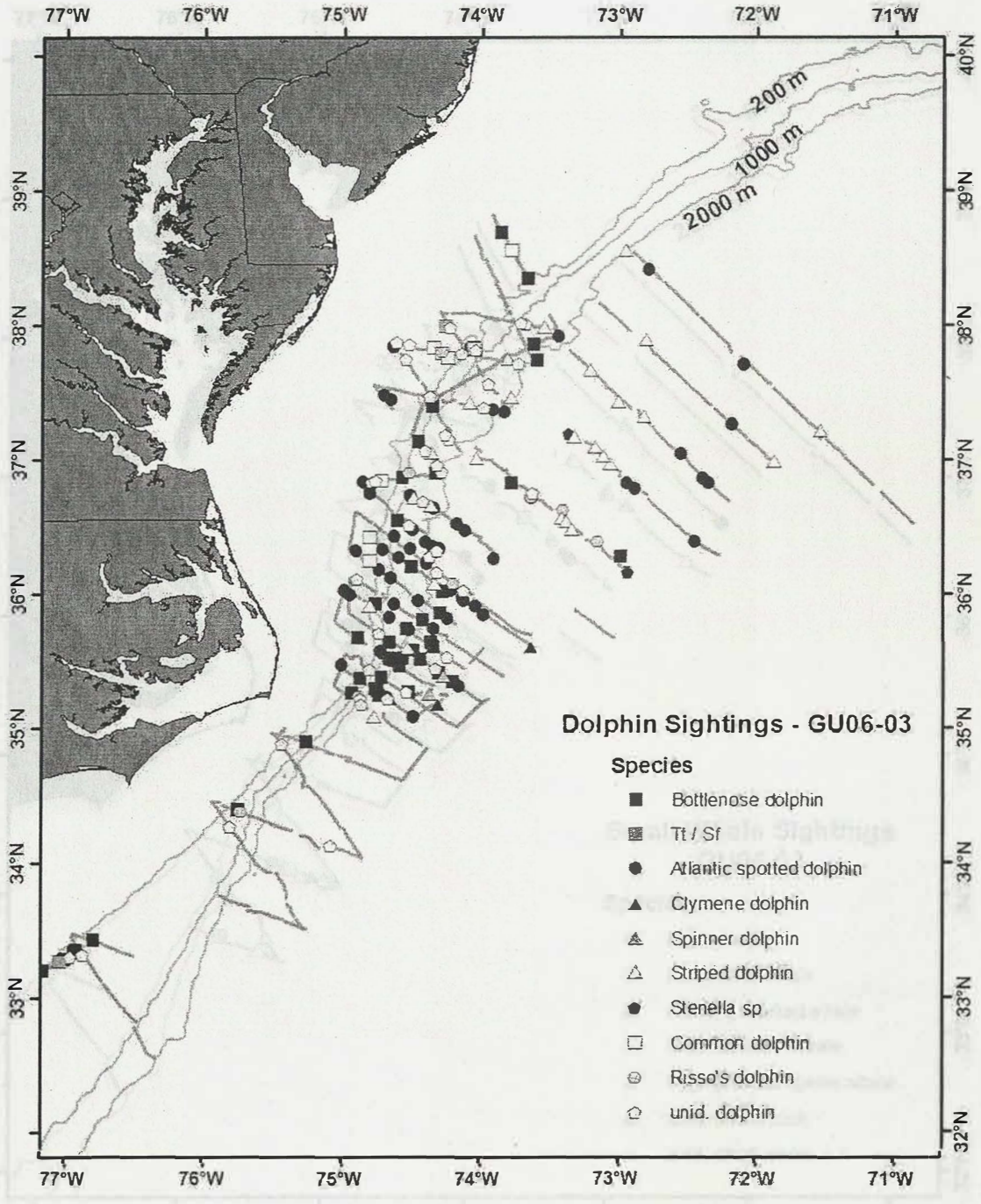

Figure 6. Small whale sightings in the primary survey area during GU-06-03.

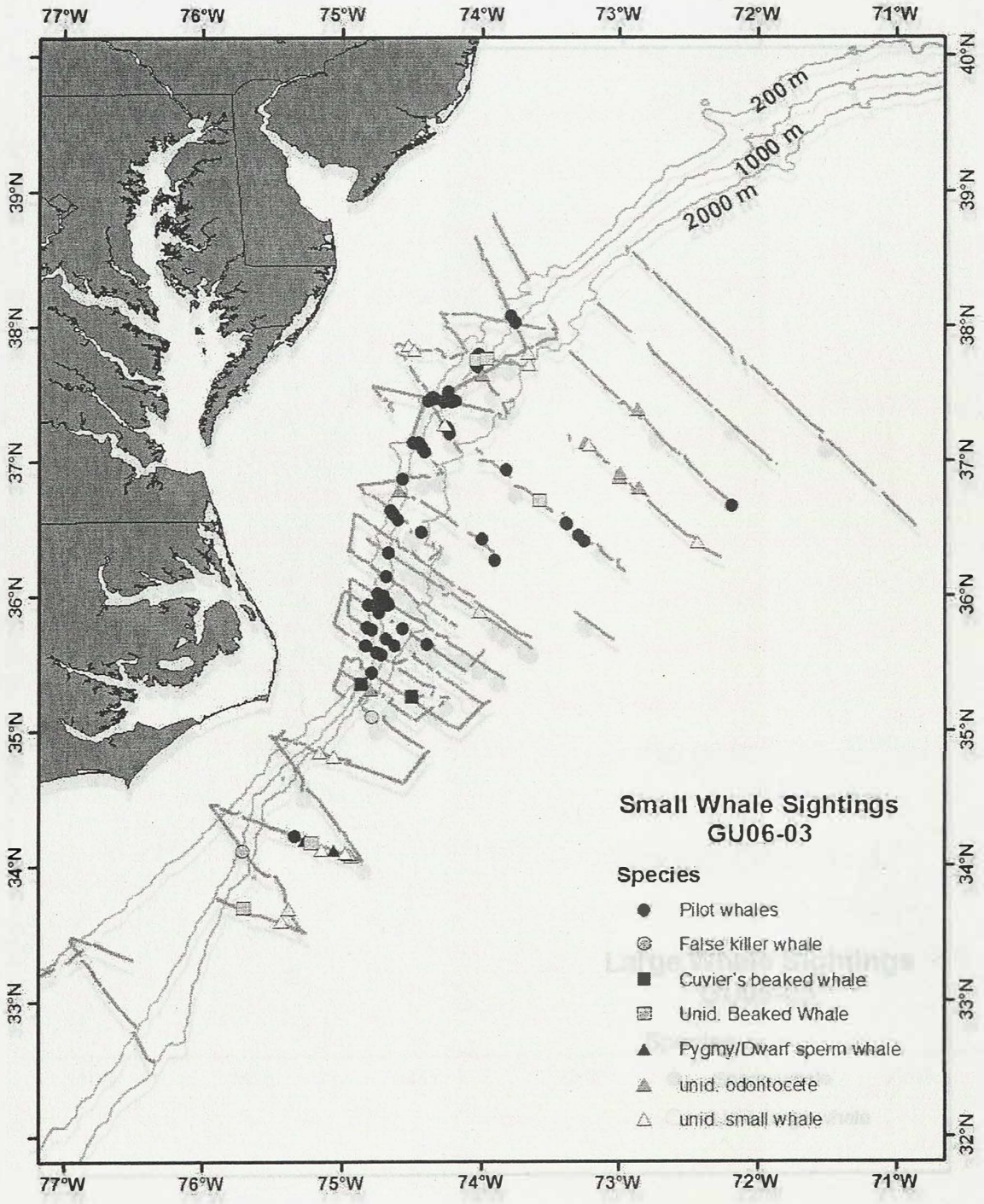

Figure 7. Large whale sightings in the primary survey area during GU-06-03.

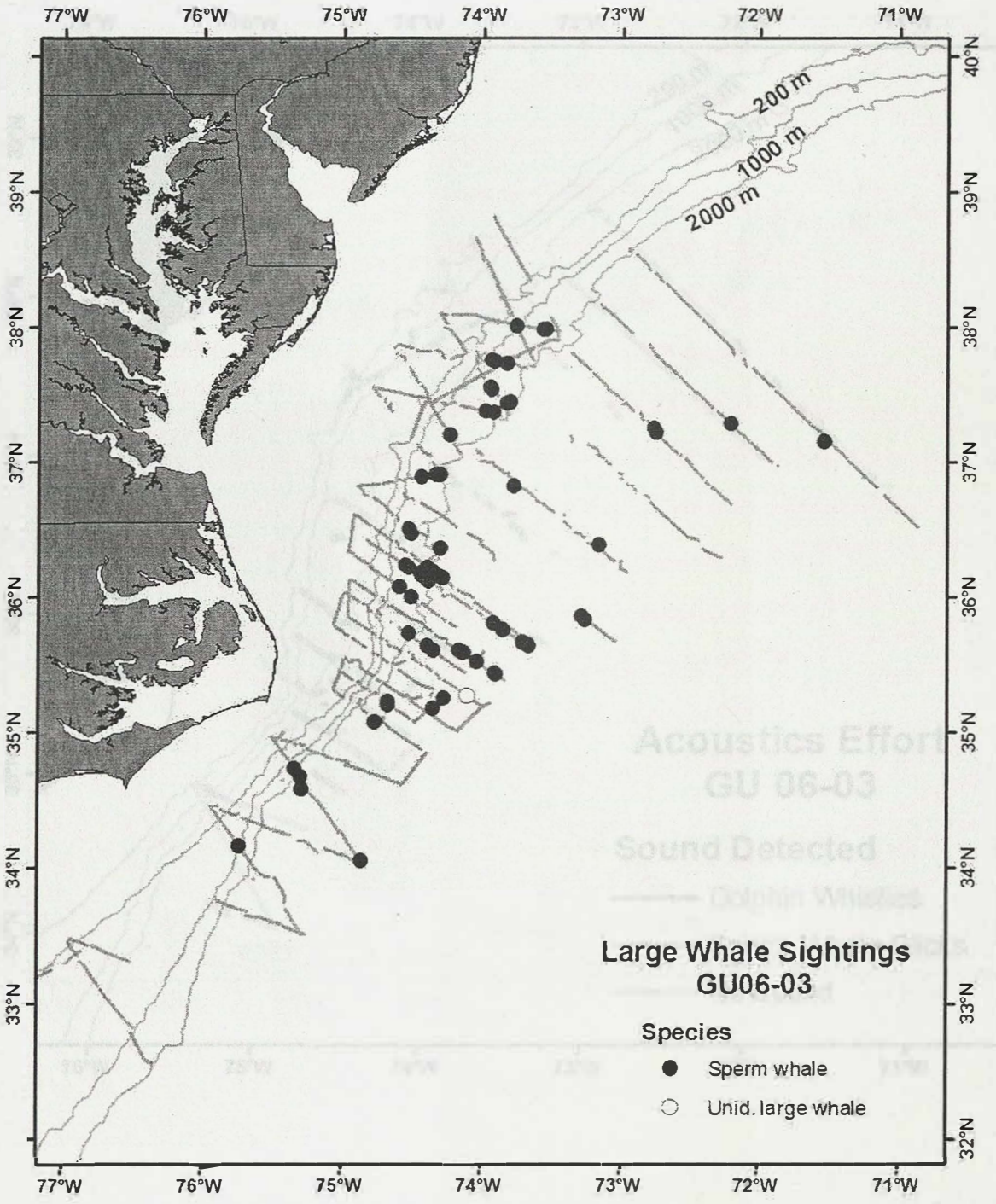

Figure 8. Acoustic survey effort during GU-06-03 indicating on effort segments where dolphin whistles and sperm whale clicks were heard.