CRUISE RESULTS

NOAA Ship *Gordon Gunter* Cruise GU12-02 (67)
7 JUNE – 6 AUGUST 2012

Southeast Gulf of Mexico Sperm Whale Study

U.S Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Mississippi Laboratories
P.O. Drawer 1207
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May 2013

BACKGROUND AND PROJECT OBJECTIVES

Sperm whales (*Physeter macrocephalus*) are endangered marine mammals occurring year-round and widely distributed within the oceanic Gulf of Mexico (Gulf) (waters >200 m deep). While the population is broadly distributed, past surveys have documented the presence of two distinct areas of concentration: 1) near the Mississippi River Delta (northern Gulf), and 2) west of the Dry Tortugas, Florida (southeastern Gulf; Maze-Foley and Mullin 2006). The concentration of animals in the northern Gulf has been intensively studied during the last decade, and is apparently associated with localized increases in secondary production due to either off-shelf transport of high productivity surface water and/or localized upwelling associated with mesoscale circulation (Jochens et al. 2008). Unlike the northern Gulf aggregation, little is known about the southeastern Gulf sperm whales. This concentration of animals has been observed in multiple seasons in a relatively localized area associated with steep bathymetry and a persistent eddy on the southeastern corner of the Loop Current (Mullin et al. 2003, SEFSC unpublished data). Prior field observations suggest that the southeastern Gulf aggregation is composed of females with young calves and juvenile whales, indicating that this area may be an important calving habitat for Gulf sperm whales. The relationship between this southeastern Gulf aggregation and the northern Gulf aggregation is unknown.

The primary objective of this project was to assess the abundance, habitat and spatial distribution of sperm whales of the southeastern Gulf by means of visual and acoustic monitoring, biopsying sampling and deployment of satellite tags. Secondary objectives included collection of data and samples from other cetacean species encountered throughout the study area. This project was conducted jointly by the Bureau of Ocean Energy Management (BOEM) and NOAA Fisheries' Southeast Fisheries Science Center (SEFSC). The data will be used to support environmental assessments associated with potential offshore energy exploration projects in the southeastern Gulf and to improve understanding of potential critical habitat areas for the endangered Northern Gulf sperm whale population.

CRUISE OBJECTIVES

1) Conduct daily visual monitoring of sperm whales and other cetacean species encountered along the visual transect lines;

2) Conduct continuous passive acoustic monitoring of sperm whales and other cetacean species;

3) Collect biopsy tissue samples from sperm whales and other cetacean species;

4) Deploy satellite telemetry tags on sperm whales;

5) Conduct continuous sampling of environmental parameters such as surface water temperature, salinity and depth;

6) Deploy CTD (Conductivity, Temperature, and Depth) and XBT (Expendable Bathythermograph) casts to collect hydrographic profiles;

7) Collect acoustic backscatter data using scientific echosounders (EK60) to characterize secondary production.

SURVEY OPERATIONS AND RESULTS

The study area included the offshore waters along the inner continental slope off the Dry Tortugas (Figure 1). In addition, secondary operational areas were designated in the event that the sperm whale aggregation could not be located during this year's survey. The effort focused on known habitat for the southeastern Gulf sperm whale aggregation.

The survey was conducted onboard the NOAA Ship *Gordon Gunter* from June 7th until August 6th, 2012 totaling 55 sea-days distributed in 3 legs:

Leg 1: June 7th – 25th (19 days)
Leg 2: June 29th – July 16th (18 days)
Leg 3: July 20th – August 6th (18 days)

Due to a combination of mechanical issues and equipment shipping delays, the survey departure was delayed until 10 June with visual effort beginning on 11 June. Daily survey operations are summarized in Table 1.

Visual Survey

Visual survey effort started at approximately 0700 (CST) and ended with day light at 1930 (CST) for leg 1 and 0700 (EST) and 1930 (EST) for legs 2 and 3. Visual surveys were conducted by a team of 3 observers stationed on the vessel's flying bridge (height above water = 13.7 m) and consisted of 2 observers using 25x150mm "bigeye" binoculars and a central observer/data recorder. Survey speed was typically 18 km hr^{-1} (10 kt) but varied with sea conditions. Data were recorded using the VisSurvey data acquisition program operating on a laptop. Whenever an observer suspected or had in fact seen a marine mammal, a cue was entered on the program, and the team went off effort. Typically, if a sighting was within a 3.0 nautical mile (nm) strip on either side of the ship, the ship was diverted from the trackline to approach the group to identify species (to the lowest taxonomic level possible) and estimate group size. For each encounter, time, position, bearing and reticle (a measure of radial distance), 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 bigeye binoculars and close to the ship were estimated in degrees and meters respectively. Photographs were taken from animals that approached the ship as well as biopsy samples were taken from adult bow riding animals. Once a reliable group size estimate and identification were made, the ship returned to course and speed and the observers back on effort. The visual team was considered "on effort" when all 3 observers were standing watch and the vessel was travelling at survey speed, therefore sightings observed on those conditions were considered "on effort." "Off effort" watches were occasionally conducted when the vessel was moving at a slow speed, consequently sightings observed during this period were considered "off effort." "Off effort"

sightings also included sightings performed by non-visual observers casually being at the flying bridge, acoustic detections in which the course and/or speed of the vessel were altered, and new mammal sightings during previous sighting events. Visual survey effort was suspended during high sea states (Beaufort sea state > 5), poor visibility conditions (e.g., fog, haze, rain), or when there was lightning in the area. Survey effort data were automatically recorded every minute and included the ship's position and heading, effort status, observer positions, and environmental conditions which could affect the observers' ability to sight animals (e.g., Beaufort sea state, trackline glare, etc.).

During this project, 4,256 km of visual survey effort was accomplished during the 3 legs (Figure 2). There were 274 marine mammal sightings from 13 confirmed species during the survey (Table 2). During the first 3 days of leg 1, a zig-zag visual survey was conducted along the 300m isobath in the Gulf Bryde's whale habitat as the vessel transited to the primary operational area. Two Bryde's whale sightings (5 animals total) were made during this period in addition to 9 bottlenose dolphin sightings (96 animals) and one group of Atlantic spotted dolphins (20 animals). Within the primary operational area, a diverse suite of oceanic dolphin and small whale species were encountered (Figures 3-5) including pantropical spotted dolphins, Risso's dolphins, beaked whales (Unid. Ziphiids and Mesoplodants), pygmy/dwarf sperm whales, and a variety of other species (Table 2). Notable sightings included a group of Fraser's dolphins which have been seen rarely during past cruises. There were a total of 29 sperm whale group sightings with most of these in the primary operational area (Figure 5). One sperm whale group was sighted and tagged in deeper waters west of the primary area. A total of 81 sperm whales were observed in these sightings, and numerous calves were observed including very small apparent neonates.

Passive Acoustic Survey

Passive acoustic surveys were conducted 24 hours a day when conditions allowed, both simultaneously with visual surveys and during night and other periods when the visual survey was inactive. Passive acoustic monitoring during the survey was conducted using one or both of two towed hydrophone arrays which were deployed behind the vessel and towed at survey speed. Scripps Institution of Oceanography (SIO) provided a six-element array capable of measuring a broad range of frequencies (up to 200 kHz) and NOAA provided a four-element array with maximum sensitivity at mid-frequencies (up to 30 kHz).

The SIO six-element high-frequency oil-filled hydrophone array included paired pre-amplifier and hydrophone elements. The HS150 hydrophones (Sonar Research and Development) have a -204 dB re V/uPa sensitivity with a flat frequency response (+/- 3dB) from 1 to 180 kHz except for a 3 dB peak at 150 kHz (between 140-160 kHz). Custom-built pre-amplifiers provided a bandpass filter with 40 dB gain between 1 kHz and either 100 or 200 kHz for 4 and 2 array elements, respectively. The array was towed off the starboard side at approximately 273 m behind the ship and 18-m depth at standard ship speeds. Data from four of the six elements were recorded through a Mark of the Unicorn (MOTU) HD-896 digital mixer at 24 bit 192 kHz sample rate yielding a recording range of 1-96 kHz, while the remaining two channels were recorded through a National Instruments USB-6251 sound card at 16 bit 500 kHz sample rate yielding a recording range of 1-250 kHz.

The NOAA four-element mid-frequency array oil-filled hydrophone array contained two paired pre-amplifier and hydrophone elements. The four AQ4 mid-frequency hydrophone elements are integrated with matching HP02 29 dB preamplifiers incorporating a high pass filter set at 100 Hz. The elements (AQ4s) have a flat frequency response to 15 kHz and have a near flat working range to 30 kHz. The stereo amplifier (HP27ST Balanced Amplifier) and conditioner unit provide an additional gain of 10-50 dB and high pass filtering between 0 and 3 kHz. The array was towed off the port side at approximately 250 m behind the ship through June 17, 2012 and approximately 350 m behind the ship for the remainder of the cruise. At normal survey speed the array towed at an average depth of 5.5 m at a 250 m tow distance and 7 m depth at a 350 m tow distance. On 22 July, 2012, ~18 lb of lead weight were added to the NOAA array which increased average tow depth to 11.5 m at normal survey speed. Two channels of data each were passed through two Magrec amplifiers, providing variable gain setting and high-pass filtering, to a MOTU MK-3 Traveler digital mixer at 24 bit 96 kHz sample rate yielding a recording range of 1-48 kHz. Backup recordings of elements 1 and 4 were also recorded using an Alesis HD24 digital recorder sampling at 48 kHz.

The International Fund for Animal Welfare (IFAW) software suite, including RainbowClick and Logger, was used to record acoustic data and comments to hard-disk and to obtain bearings to acoustic detections. All acoustic data were recorded as multichannel wav files to 2 TB external SATA hard drives, resulting in 10 TB of data collected. Acoustic field technicians monitored data aurally and visually through spectrographic analysis using Ishmael software and attempted to localize acoustically active cetaceans in real-time using Ishmael's hyperbolic bearing calculator and VisSurvey.

For each towed array, acoustic technicians monitored the signals continuously and recorded and classified cetacean sounds (e.g., echolocation clicks, whistles, etc.) along with anthropogenic noises. Data on the bearing to the sounds and the sound types and intensity were recorded using the Logger data collection software. The array was deployed and monitored for a total of approximately 573.5 h during the survey (Table 1). Acoustic detections of marine mammals were made throughout the survey and were correlated with visual sightings. Direct identification of acoustic detections was made through visual verification of species identifications. At initial data collection, these sounds were typically broadly categorized as unidentified balaenopternids, sperm whales, Risso's dolphins, or unidentified delphinids (Figure 6). However, visual identifications will allow characterization of the acoustic signature of different species and these will be incorporated into classification algorithms.

Satellite Telemetry Tag Deployment on Sperm Whales

Throughout the cruise, and particularly during legs 2 and 3 as weather allowed, the R3 (7-m RHIB) was deployed to conduct close approaches to sperm whales to deploy satellite telemetry tags. These were implantable tags deployed from close distance using a modified compressed air line thrower (Air Rocket Transmitter System - ARTS). The system was used to deploy two types of tag units, both developed by Wildlife Computers: 1) SPOT-5 providing ARGOS satellite based location information and 2) MK-10A units providing ARGOS locations and summaries of dive behaviors. The large number of mother-calf pairs and generally evasive behaviors of the sperm whales encountered during the cruise limited the opportunity to deploy a large number of satellite tags. Eleven tags were deployed during the project consisting of six

SPOT-5 tags and five MK-10A tags; however, one tag did not report back an any information immediately following deployment. The initial reported locations from each tag are shown in Figure 7

Tissue Sample Collection

Biopsy samples were collected from cetaceans throughout the survey. Samples were collected from the *Gunter* using a modified 0.22 caliber rifle on bow riding adult animals. From the R3, only sperm whales were sampled using a crossbow. Both devices were fitted with a custom designed sampling head to extract a small core of skin and blubber. All sampling was conducted by personnel with training and experience to collect biopsy samples from wild cetaceans. Photographs were taken to document biopsy sample collection. Biopsy sampling was attempted after all pertinent group size and biological information was recorded by the visual team. Opportunistic squid samples were collected during sperm whale small boat deployments.

For cetaceans, according to tissue type and size, biopsy samples were divided for up to 6 analyses: genetics, stable isotopes (S.I.), contaminants, hormones, RNA later (CYP1A and microarray) and histopathology (table below). Genetic samples were collected for all biopsies taken.

Analyses	**Tissue type**	**Storage**	**Temperature**
Genetics	Skin	20% dimethyl sulfoxide (DMSO) vial	Room
Stable isotopes	Skin	2 ml cryovial	-20°C
Histopathology	Blubber + skin	pre-filled jar with 10% formalin	Room
RNA later	Blubber + skin	pre-filled vial with RNA later	first 12-24 hours in 2-8°C; following day freeze in -20°C
Contaminants	2/3 blubber	Teflon jar	-80°C
Hormones	1/3 blubber	2 ml cryovial	-80°C

A total of 26 biopsies and 7 additional samples (including 2 sperm whale sloughed skin samples and 1 necropsy and 4 squid samples) were collected during the cruise (Table 4, Figure 8). A neonate sperm whale was found floating during one of the survey days and the carcass was brought on board for necropsy; additional samples were collected. Squid samples included fragments of squid tissue found floating in the vicinity of sperm whales. Biopsy, necropsy and squid tissues were subsampled for the analyses listed above, resulting in a total of 89 samples (Table 5).

Scientific Echosounder (EK60) Data Collection

Calibrations were conducted on the 38 kHz and 18 kHz frequencies of the scientific echosounder (EK60). Calibration is necessary to ensure that the data collected by the gear are comparable between different surveys accounting for deviations in the behavior of the transducers and receivers over time. Calibration followed standard guidelines described in the user manuals for the scientific echosounders and recommendations from the manufacturer. Briefly, a spherical standard target is suspended at a depth of approximately 15 m beneath the transducer by attaching it to three reels stationed in a triangular pattern around the vessel. This allows the position of the sphere within the transducer beam to be controlled. During the calibration, the target is moved throughout the circular beam, and the resulting strength (in dB) of the return signal from the transducer is measured. After a large number of returns are measured, a statistical model is used to correct the returns from acoustic targets for variability in the sensitivity of the receiver throughout the beam. Following the calibration, data was collected continuously throughout the cruise and stored on hard drives for archiving and later data analysis.

Environmental Data

Environmental data were collected at predetermined stations using a CTD unit and XBT. CTD casts recorded vertical profiles of salinity, temperature, and oxygen content to a maximum depth of 1000 m. XBT profiles recorded only temperature up to a depth of 750 m. Constant records of environmental parameters including water temperature, salinity, and weather conditions (e.g., wind speed, wind direction) were collected in situ via the ship's Scientific Computer System (SCS). CTD casts were made on a daily basis (weather dependent), typically at the end of the survey day. Data were collected on a total of 37 CTD stations. XBT casts were made at regular intervals along the trackline throughout the cruise at stations typically spaced 15-20 km apart. A total of 59 XBT stations were sampled (Figure 9). All data from the CTDs and the SCS are maintained at the Pascagoula Laboratory for analysis, editing, and archiving.

Data and Sample Disposition

All data collected during GU12-02 including visual survey data, passive acoustic data, EK60 data, SCS data, XBT and CTD data are archived and managed at the Southeast Fisheries Science Center, Miami, FL. Backup copies of the passive acoustic data and recordings are maintained at SIO (Dr. John Hildebrand). Biopsy samples are being distributed to the analyses laboratories.

Permit and Funding Source

The SEFSC was authorized to conduct marine mammal research activities during the cruise under MMPA Research Permit No. 779-1633, issued to the SEFSC by the NMFS Office of Protected Resources. Tag deployments on sperm whales were made under Permit No. 932-1905 to the NMFS Marine Mammal Health and Stranding Response Program. The project was funded through Interagency Agreement # GM-11-03 between NMFS SEFSC and the BOEM.

Issues

9 May 2012 - From the onset of the cruise and long before we ever set sail, the CO of the *Gunter*, LCDR Jeff Taylor, was very uncomfortable with the mission profile as spelled out in our project instructions. We had performed these same operations safely and effectively for years prior to Mr. Taylor's arrival onboard *Gunter* and our procedures had been proven and vetted by every CO prior to Mr. Taylor's command. Unfortunately, the relationship between the mission and the ship were strained from the beginning.

3 July 2012 - The afternoon provided us with our best/first favorable tagging situation yet; decent weather and a single larger animal that we found around 1615. We launched the R3 at 1700 assuming that we would get three surfacings to try and place a tag. We had agreed on a 1945 recall time. However, this animal was making very long dives, 60 + minutes. At 1930, after only one surfacing/tagging approach, we called the bridge to ask for a 15 minute extension since the animal was just about to surface but it would be very tight to make a tag attempt that if successful, would take a while to process the biopsy and fill out data sheets before heading back to the ship. We were denied those extra 15 minutes. The loss of a tagging opportunity due to a lack of reasonable flexibility is an issue for our missions which are generally not 'station-oriented' and require a smooth operational 'flow' for maximum success.

9 July 2012 - The CO decided to launch their rescue boat to recover some floating garbage. It wound up "costing us" +/- 45 minutes of survey effort in prime weather. He did not consult/inform the FPC ahead of time.

25 July 2012 - During the course of a very complicated sighting that involved several very rare occurrences, including a dead sperm whale calf and the very rare sighting of frasers dolphins, the CO decided to 'cast a few' at some mahi mahi seen in the area. He subsequently hooked up to a mahi and diverted the ship to try to land it. Again, this was without consulting the FPC and without due consideration for the mission at hand.

2 August 2012 - During the course of this cruise and at the CO's behest, the ship did not purchase additional fuel nor allow the small boat fuel tank to be topped off during our second in-port in Key West, FL. The small boat ran out of fuel and the scientific party was forced to suspend tagging operations in order to steam into Port Charlotte, FL (nearest facilities) in order to purchase enough fuel to allow us to finish out the cruise. Unfortunately, this evolution cost the mission approximately 1.5 working days.

List of Participants

Leg 1	Leg 2	Leg 3
Anthony Martinez	Anthony Martinez	Anthony Martinez
Jesse Wicker	Jesse Wicker	Jesse Wicker
Laura Dias	Laura Dias	Laura Dias
Melissa Soldevilla	Melody Baran	Melody Baran
Melody Baran	Carol Roden	Carol Roden
Carol Roden	Emma Jugovich	Emma Jugovich
Emma Jugovich	Desray Rheeb	Desray Rheeb
Desray Rheeb	Suzanne Yin	Suzanne Yin
Suzanne Yin	Tom Ninke	Tom Ninke
Tom Ninke	Shannon Coates	Kerry Dunleavy
Shannon Coates	Kerry Dunleavy	Amanda Debich
Kerry Dunleavy	Amanda Claussen	Katrina Ternus
Kait Fraser	Anne Simonis	Sarah Friedman
Jessica Landis	Deborah Epperson	Keith Mullin
		Kate Mansfield

LITERATURE CITED

Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006. 341 pp.

Maze-Foley, K., Mullin, K.D. 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, groups sizes and interspecific associations. J. Cetacean Res. Manage. 8(2):203-213.

Mullin, K.D., Engelhaupt, D., Cates, C.E., Barros, N.B. 2003. Sperm whale research in the Gulf of Mexico. International Whaling Commission Working Paper SC/55/O15.

Table 1. Daily survey operations and effort during GU-1202

Survey Leg	Date	Visual Effort (km)	Acoustic Effort (hr)
Leg 1	6/11/2012	112.9	6.9
	6/12/2012	180.9	11.6
	6/13/2012	160.2	16.1
	6/14/2012	76.7	17.7
	6/15/2012	97.4	15.4
	6/16/2012	173.0	21.4
	6/17/2012	196.9	22.6
	6/18/2012	124.5	22.5
	6/19/2012	100.7	24.0
	6/20/2012	0.0	22.6
	6/21/2012	0.0	22.8
	6/22/2012	96.4	22.8
	6/23/2012	0.0	17.5
Leg 2	6/30/2012	93.9	11.5
	7/1/2012	51.5	10.6
	7/2/2012	71.4	12.0
	7/3/2012	156.4	13.1
	7/4/2012	84.8	10.4
	7/5/2012	34.4	10.6
	7/6/2012	31.3	10.4
	7/7/2012	82.0	10.4
	7/8/2012	172.5	11.4
	7/9/2012	30.9	12.2
	7/10/2012	113.2	10.1
	7/11/2012	170.1	11.2
	7/12/2012	169.5	11.3
	7/13/2012	0.0	13.0
	7/14/2012	172.0	11.5
	7/15/2012	51.4	9.8
Leg 3	7/22/2012	70.3	10.3
	7/23/2012	121.7	12.3
	7/24/2012	160.2	11.8
	7/25/2012	22.2	4.9
	7/26/2012	116.1	11.3
	7/27/2012	120.4	11.6
	7/28/2012	0.0	10.4
	7/29/2012	136.5	11.3
	7/30/2012	70.8	7.2

	7/31/2012	30.7	12.4
	8/1/2012	119.8	12.2
	8/2/2012	100.2	11.0
	8/3/2012	120.6	0.0
	8/4/2012	137.4	12.4
	8/5/2012	124.6	11.5

Table 2. Marine mammal sightings during each leg of GU12-02

Species	Leg 1	Leg 2	Leg 3
Atlantic spotted dolphin	2	-	1
Bottlenose dolphin	25	1	11
Bottlenose/Spotted dolphin	-	-	9
Bryde's whale	2	-	-
Cuvier's beaked whale	1	1	2
False killer whale	-	1	-
Fraser's dolphin	-	-	1
Pantropical spotted dolphin	7	20	27
Pilot whales	-	-	1
Pygmy/Dwarf sperm whale	1	2	6
Risso's dolphin	2	7	9
Rough-toothed dolphin	1	-	4
Sperm whale	2	14	13
Spinner dolphin	1	1	3
Stenella sp.	1	7	8
Striped dolphin	1	-	-
Unid. Dolphin	7	9	35
Unid. Mesoplondant	1	-	-
Unid. Odontocete	-	6	2
Unid. Ziphiid	7	7	5
Grand Total	**61**	**76**	**137**

Table 3. Biopsy and tissue samples collected during GU12-02

Species	Total samples
Bottlenose dolphins	4
Fraser's dolphins	4
Pantropical spotted dolphins	1
Sperm whales	20
Squid samples	4
Grand Total	**33**

Table 4. Storage methods for samples collected during GU12-02.

Species	Gene.	S.I.	Histo.	RNA	Cont.	Horm.	Other*
Bottlenose dolphins	4	0	0	0	0	0	0
Fraser's dolphins	4	3	1	1	3	0	0
Pantropical spotted dolphins	1	0	0	0	0	0	0
Sperm whales	21	13	5	6	13	6	0
Squid samples	0	0	0	0	0	0	8
Grand Total	**30**	**16**	**6**	**7**	**16**	**6**	**8**

*Other = squid samples included beaks and tissue sampled for genetics and stable isotopes analyses

Figure 1. Primary and secondary planned operational areas for GU12-02

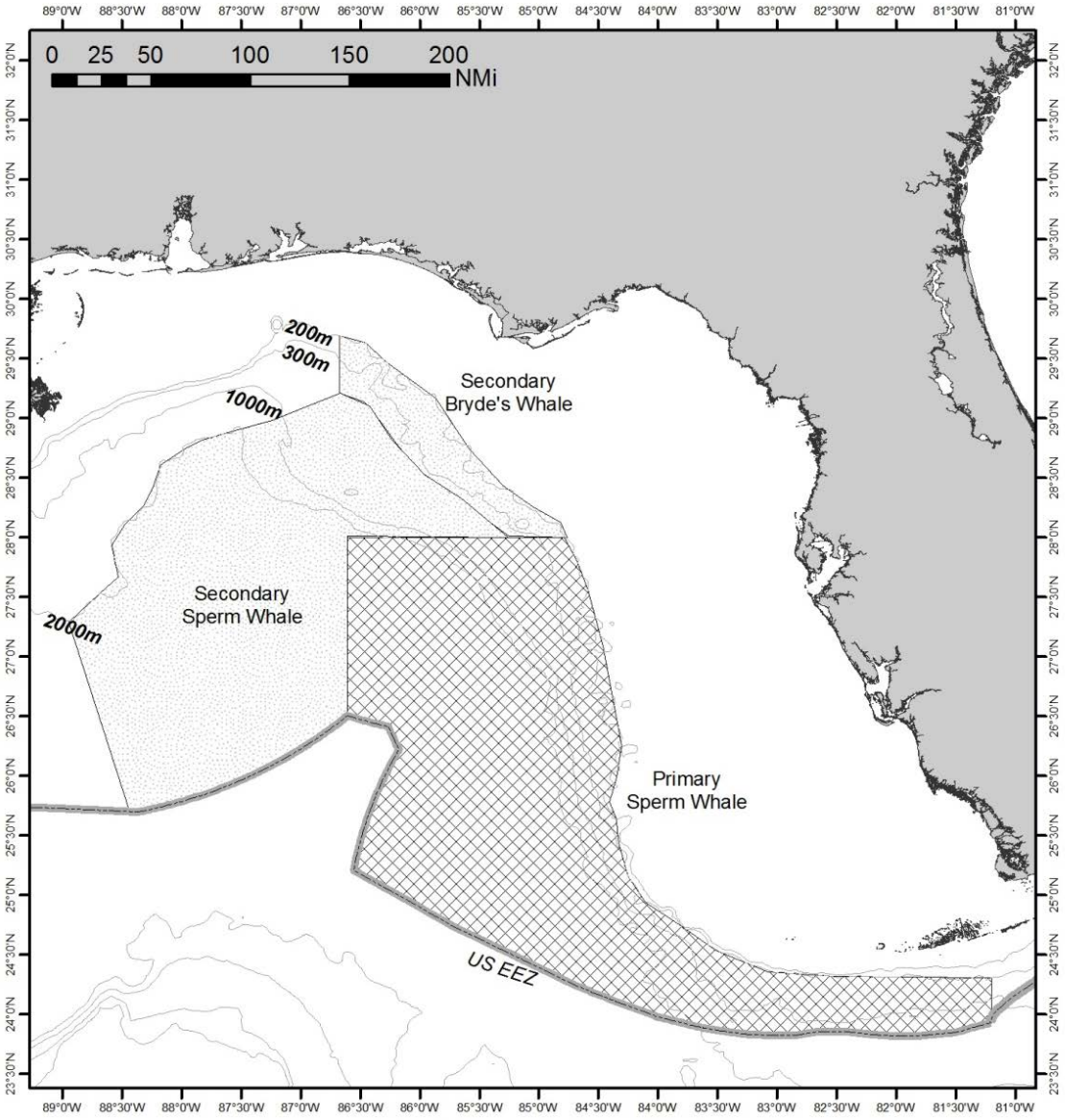


Figure 2. Survey effort accomplished during GU12-02

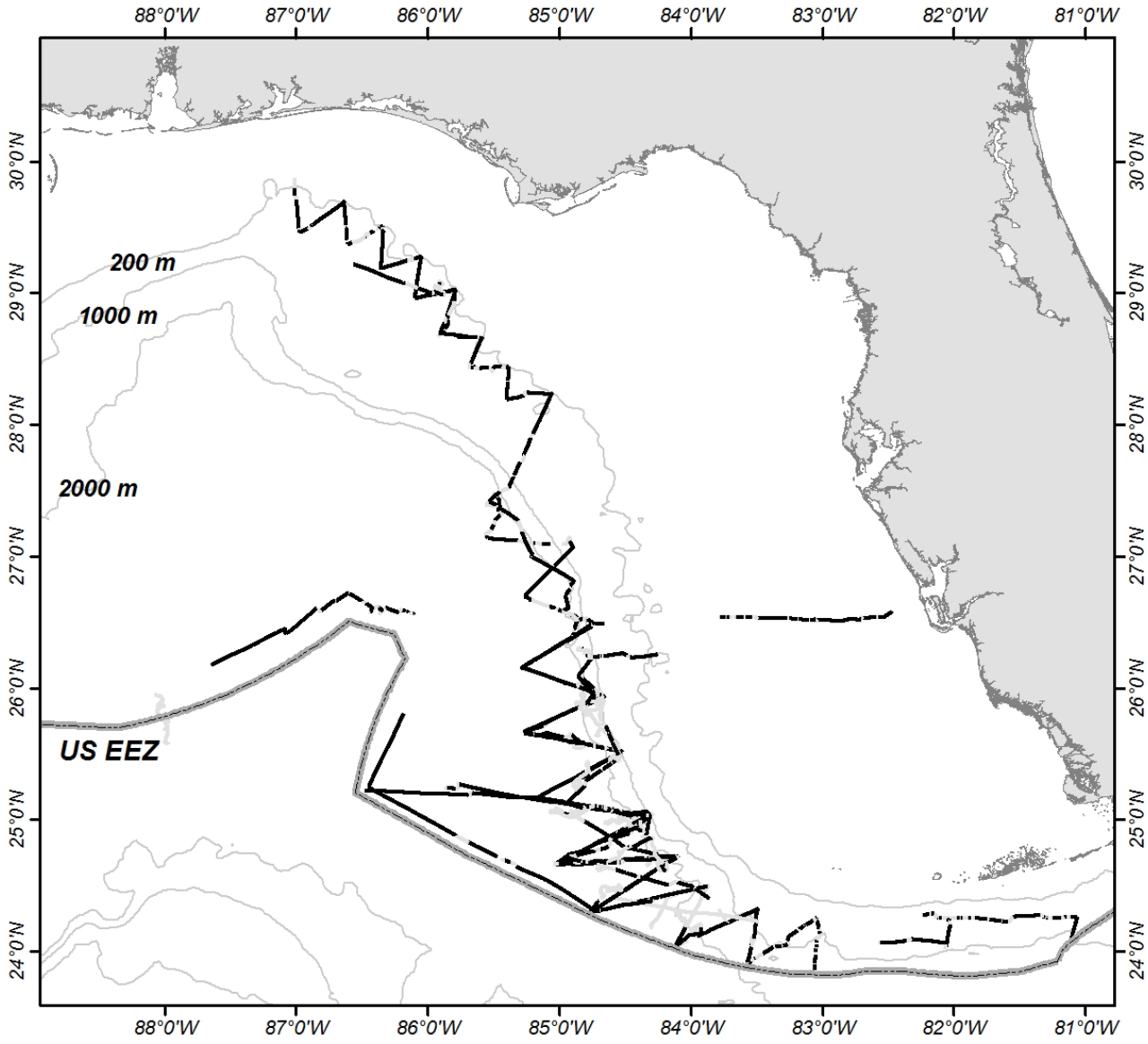


Figure 3. Dolphin sighting locations during GU12-02

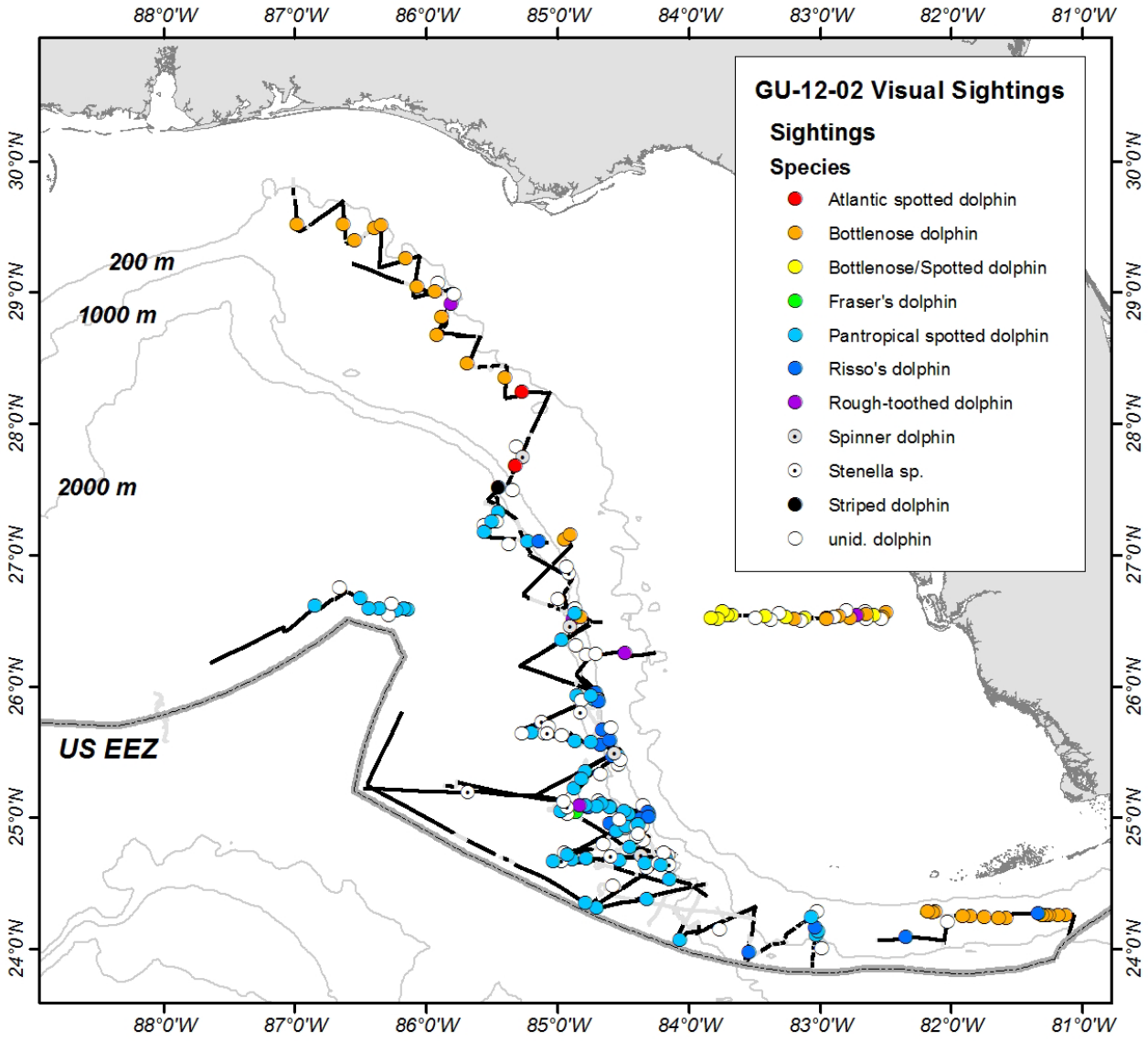


Figure 4. Small whale sightings during GU12-02

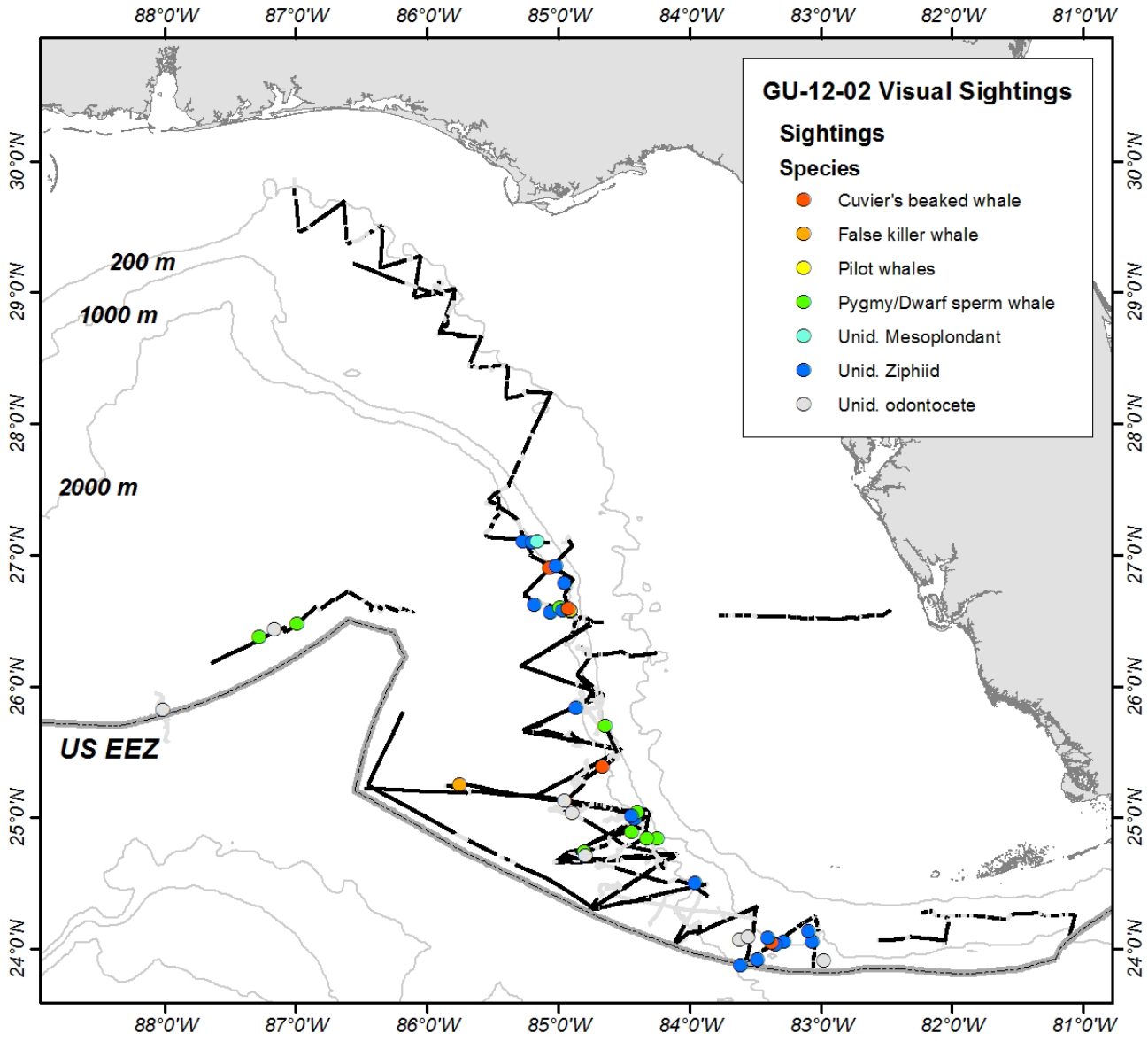


Figure 5. Large whale sightings during GU12-02

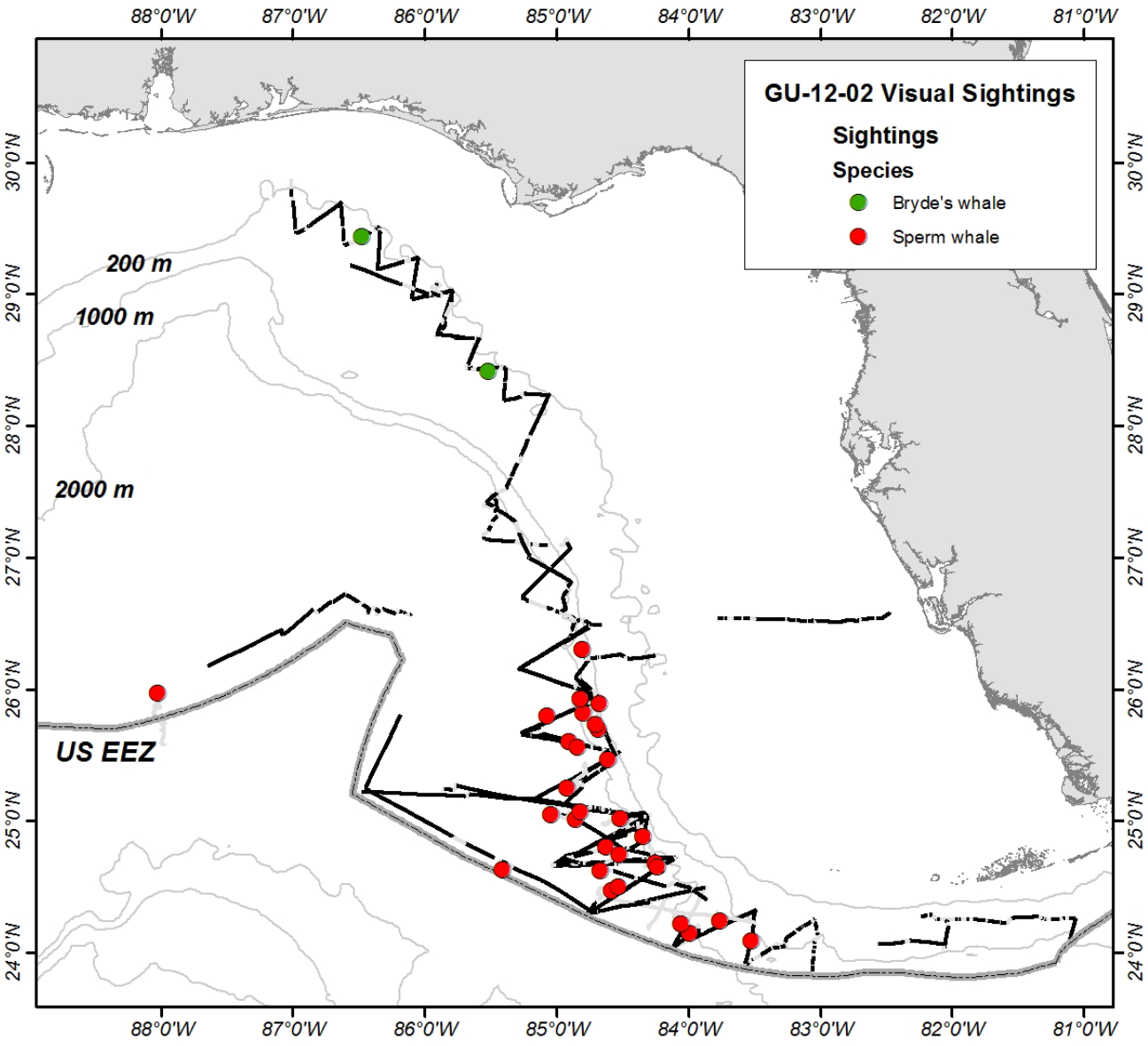


Figure 6. Passive acoustic survey effort and detections during GU12-02

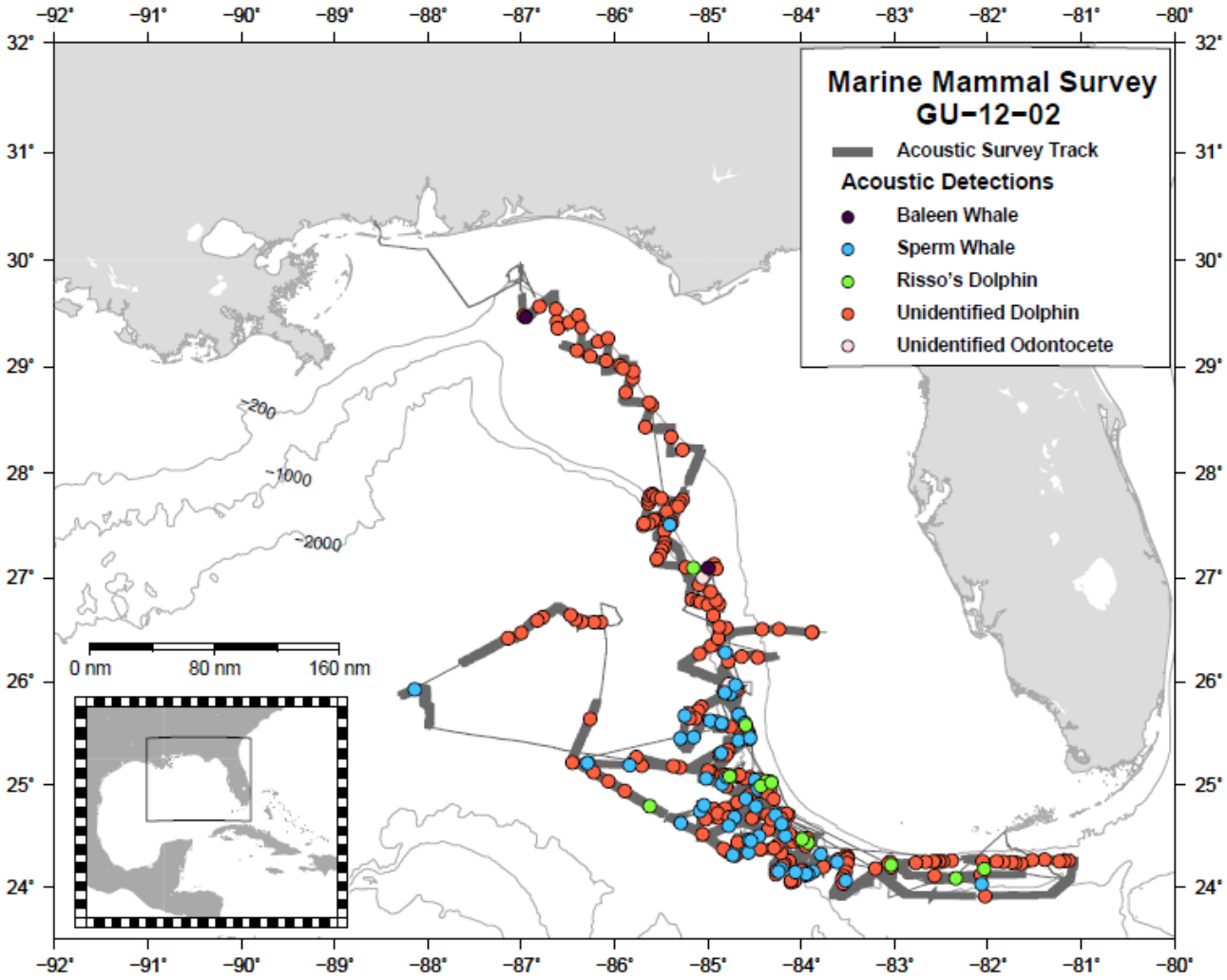


Figure 7. Initial sperm whale tag locations. One tag was deployed in international waters in the western part of the survey area.

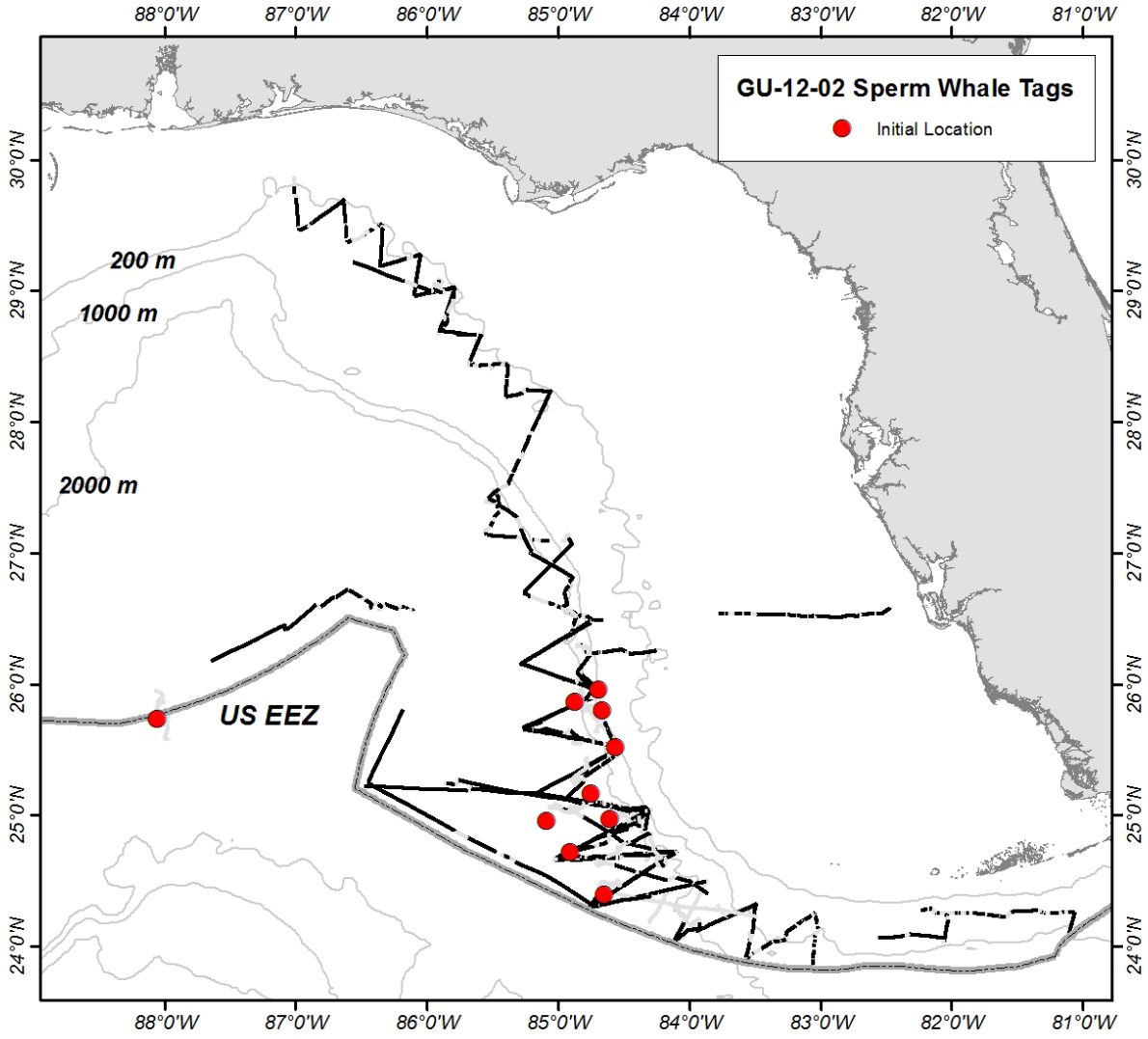


Figure 8. Biopsy sample locations during GU12-02. One biopsy was collected in international waters in the western part of the survey area.

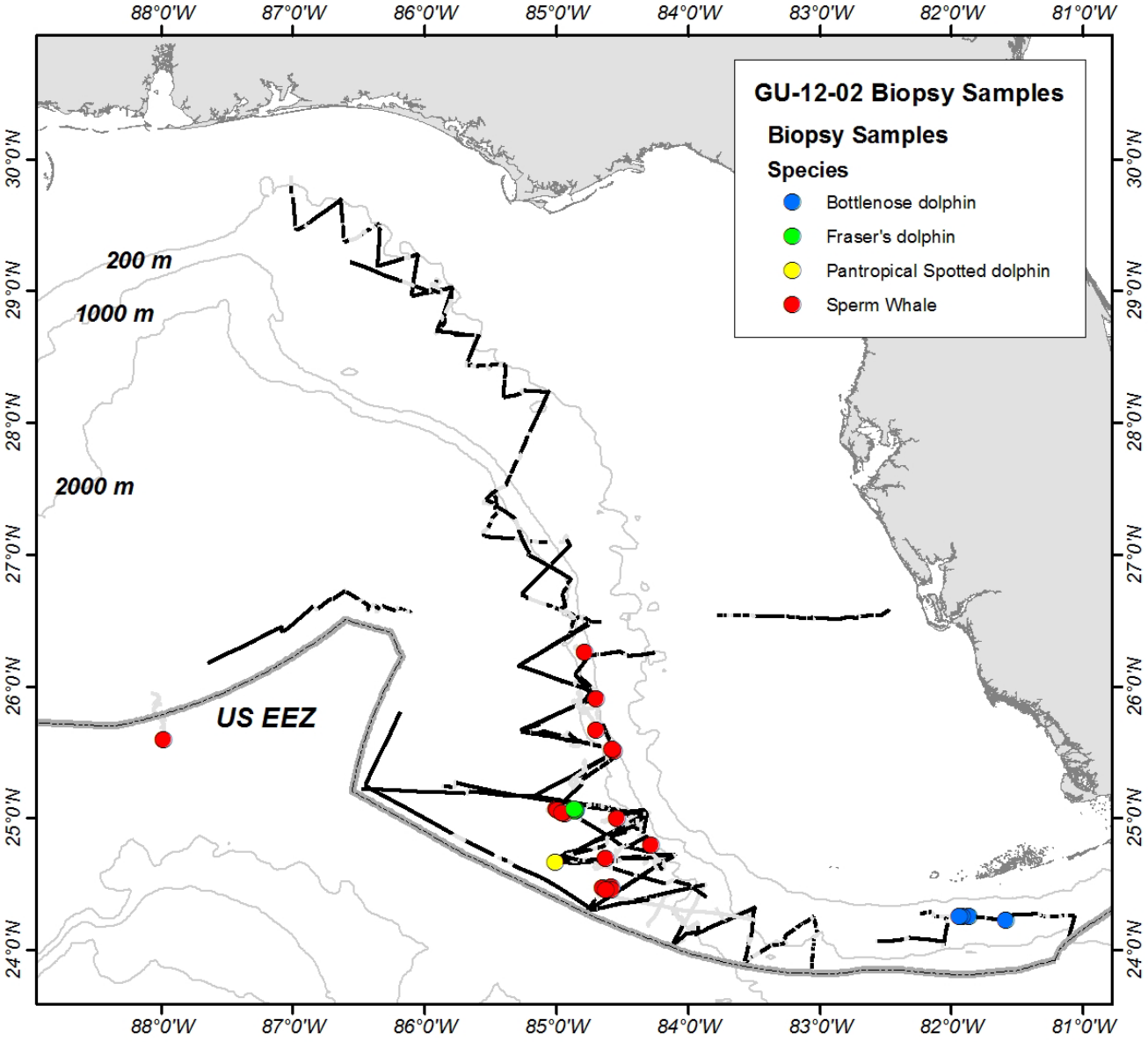
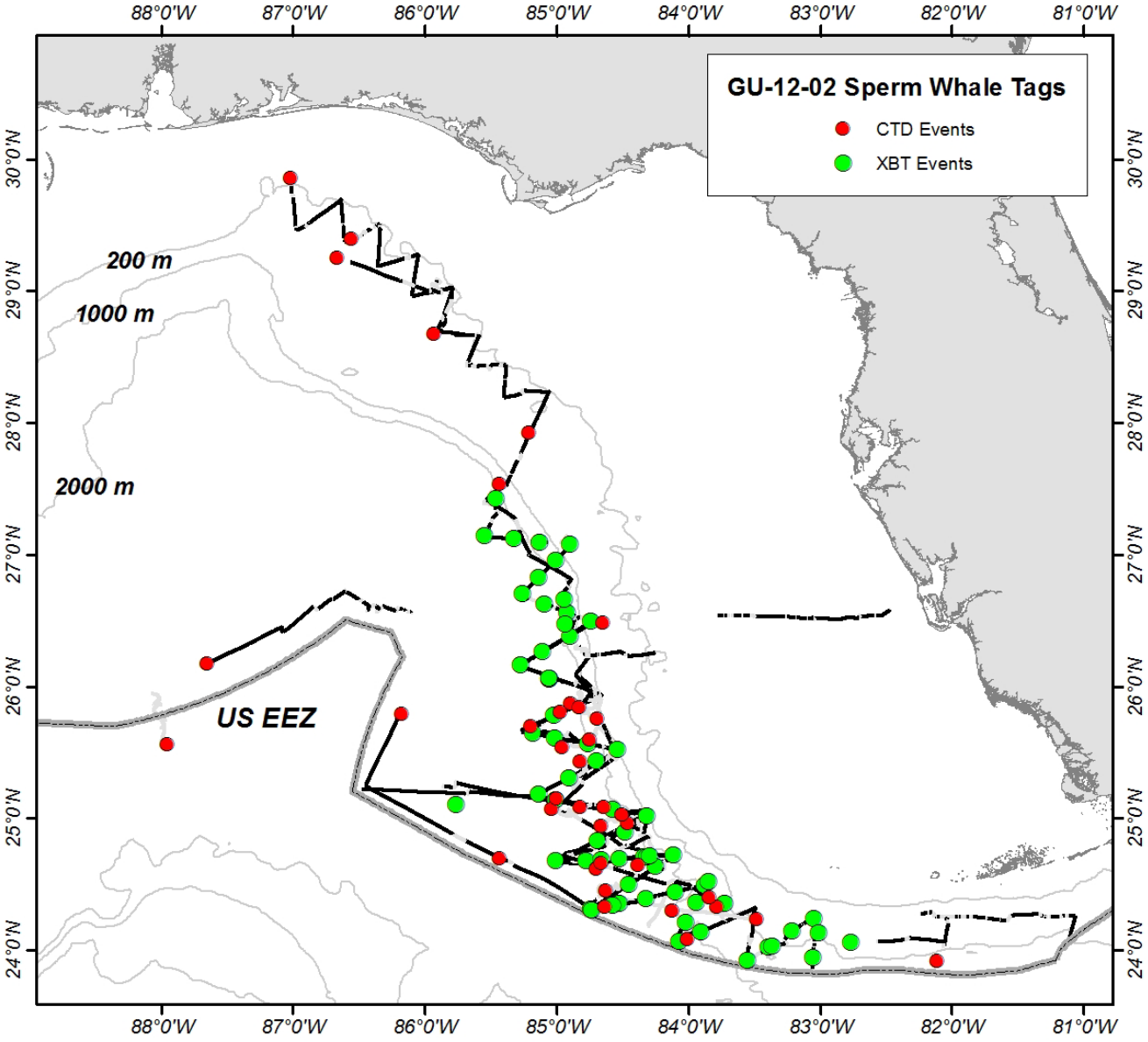


Figure 9. Hydrographic profile sampling stations during GU12-02. One station was sampled in international waters in the western part of the survey area.



U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Cruise Report

Date Submitted: 05/30/2013

Platform: NOAA Ship GORDON GUNTER

Cruise Number:

Project Title: Marine Mammal

Cruise Dates: 06/07/2012 - 08/06/2012

Submitted by: Digitally signed by Anthony Martinez
Date: 2013.09.26 13:38:08 -04'00'
Field Party Chief
SEFSC, Miami, FL

Date: 09/26/2013

Approved by: DESFOSSE.LISA.L.1365834519
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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=DESFOSSE.LISA.L.1365834519
Date: 2013.11.18 13:41:20 -06'00'
Dr. Lisa Desfosse
Director, Mississippi Laboratory
NMFS, Pascagoula, MS

Date: 11/18/2013

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Date: 11/19/2013