Southeast Fisheries Science Center Reference Document MMTD-2024-06

CRUISE RESULTS

NOAA Ship *Gordon Gunter* Cruise (GU18-06)
November 10 – December 4, 2018

Trophic Interactions and Habitat Requirements of Rice's Whales

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service Southeast Fisheries Science Center
75 Virginia Beach Drive Miami, Florida 33149

February 2024

This cruise report is used for documentation and timely communication of preliminary results immediately following the conclusion of the survey. Data, as presented here, are subject to change as further auditing and analysis occur.

At the time of data collection, Rice's whales (*Balaenoptera ricei*) were recognized as (Gulf of Mexico) Bryde's whales (*B. edeni*); species denomination was changed to *B. ricei* after recognition of the new species status in 2021 (https://doi.org/10.1111/mms.12776). The Southeast Fisheries Science Center was authorized to conduct marine mammal research activities during the cruise under Marine Mammal Protection Act (MMPA) Permit No. 14450-05.

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Funded by the NOAA RESTORE Science Program

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As part of a Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (RESTORE) Science Program project, the Southeast Fisheries Science Center (SEFSC), in collaboration with Scripps Institute of Oceanography (SIO) and Florida International University (FIU), conducted a second research cruise dedicated to Rice's whales (*Balaenoptera ricei*) in the Gulf of Mexico (GoMex). The current known habitat area for the Rice's whale around the De Soto Canyon region (roughly from the Florida Panhandle to Tampa) in the northeast GoMex was designated as the primary study area based on previously documented sightings. (Figure 1). Rice's whales, the only baleen whale resident to the GoMex, are most readily found in a small strip of water from De Soto Canyon southward along the continental slope within the study area, usually between depths of 180 m and 360 m.

The survey (GU18-06) was conducted 10 November – 4 December onboard the NOAA Ship *Gordon Gunter* along prescribed tracklines oriented along the 180–400 m isobaths, with a focus on the 200 m isobath (Figure 1). A list of participating personnel, including affiliation, is provided in Table 1 and daily survey operations are summarized in Table 2. The survey had originally been scheduled to depart on 7 November 2018, but due to delays in foreign national security clearances it was delayed to 10 November. Between 21 – 24 November, the ship had to go into port (Pensacola, FL) for a crew member replacement due to medical reasons. During the mission, a total of 20 days were spent at sea (Table 2).

Cruise Objectives

The primary objectives of this cruise were to conduct visual and passive acoustic surveys to localize Rice's whales and conduct close approaches to deploy telemetry tags, collect biopsy samples, and collect photographic data on select Rice's whales. A mix of tag types was available, with a focus on deploying short-term camera and/or acoustic tags that provide detailed information on animal movement and feeding over short durations. Tags are attached via close approach to free-ranging whales with the scientific small boat, *R3*. Additional survey objectives included acoustic recordings via deployed sonobuoys, scientific echosounder surveys (EK80) and cetacean tissue biopsy sampling.

Summary of objectives:

1. Deploy and recover short duration tags (camera and acoustic tags).
2. Collect tissue samples (biopsies) of Rice's whales for genetic, stable isotope, and persistent organic pollutants (POP) analyses.
3. Photo/video documentation of Rice's whales.
4. Conduct visual surveys to understand Rice's whale spatial distribution.
5. Deploy sonobuoys to collect recordings of the sounds produced by Rice's whales and of anthropogenic sounds.
6. Collect water samples around Rice's whales to test for environmental DNA (eDNA).
7. Collect data on potential prey distribution based on acoustic backscatter using scientific echosounders (EK80).
8. Periodically collect vertical profiles of hydrographic parameters (e.g., temperature,

salinity, oxygen concentration) via CTD and collect continuous underway surface physical oceanographic data.

Visual Survey Operation Methods

Visual surveys were conducted during daylight hours with a goal of maximizing the likelihood of finding Rice's whales for focused data collection. Historic sightings exhibit a near- normal distribution with respect to water depth, with a mean of 225 m. Therefore, four along-bathymetry tracklines spaced 5 km apart were created running approximately along the 180 m, 200 m, 230 m and 260 m isobaths, and were surveyed with a goal of maximizing whale encounters while minimizing repeated encounters with the same individuals over the course of the survey (Figure 1). In addition, cross-bathymetry tracklines (Figure 1) spaced at 10 km apart from north to south throughout the habitat were primarily surveyed at night using scientific echosounders. Marine mammal sightings were defined as systematic records of cetaceans consisting of one or more individuals observed at the same location and time.

Visual survey effort commenced daily at approximately 0630 CST and ended at 1630 CST depending on operational requirements and survey conditions. Survey speed was typically 18 km/hr (10 knots) but varied with ship traffic and sea conditions such as ocean currents. A single team of three observers conducted searches from the vessel's flying bridge with a height above water of 13.9 m. Two marine mammal observers scanned the water using pedestal-mounted 25x150 mm "bigeye" binoculars located on the port and starboard sides. A central data recorder input data using the VisSurvey data acquisition program operating on a laptop computer. The laptop was connected to the ship's network and obtained other survey parameters (e.g., ship's position and heading, wind speed, sea surface temperature, etc.) directly from the Scientific Computing System (SCS). Using the bigeye binoculars, observers relayed the bearing and radial distance of sightings to the data recorder. The location of groups sighted close to the ship without bigeye binoculars were estimated in meters. Observers rotated through the three stations every 30 minutes, with at least a 60 minute break between shifts. Shift durations were extended during sightings that led to focused data collection.

Observers were considered "on effort" whenever the ship was on a prescribed trackline or transit line, at survey speed, and the visual team was actively searching for cetaceans through the bigeyes. Whenever an observer suspected or had in fact seen a marine mammal, a cue (marine mammal, splash, blow, etc.) was immediately entered in the data collection program and the team went "off effort." A cue is a time and location stamp in the database which captures the spatial and temporal data of a sighting. This survey was conducted in "closing mode" with a focus on baleen whale sightings, though sightings of other species were opportunistically recorded. Closing mode entails maneuvering the ship to more closely approach a sighting to improve species identification, obtain accurate group size estimates, and collect photo and video documentation, and potentially to conduct small boat operations for focused data collection. Sightings were identified to the lowest taxonomic level possible while ensuring species identification was recorded conservatively.

A baleen whale sighting was recorded as Rice's whale (*B. ricei*) if the three ridges on the head were seen to confirm the species. A baleen whale sighting was recorded as Sei/Rice's whale (*B. borealis/ricei*) when a dorsal fin and one rostral ridge were observed, but it was not possible to confirm 3 rostral ridges, and as Sei/Rice's/Fin whale (*B. borealis/ricei/physalus*) when a dorsal fin was observed, or as Unidentified baleen whale (*Balaenoptera* sp.) when it was not possible to make detailed observations other than body and head shape distinguishing the sighting from a sperm whale. After sightings were identified to species and group size enumerated, the encounter was closed, and the sighting was entered in the visual data program by the data recorder. For each encounter, time, position, bearing and reticle, species, group size, behavior, and associated animals (e.g., seabirds, fish) were recorded. Group size was counted as the minimum, maximum, and best number of animals for each sighting based upon a consensus among the observers with a complete view of the sighting. Once a baleen whale was sighted, operations were directed by the field party chief (FPC) and included photo and video documentation. Weather dependent, the small boat (*R3*) was deployed to collect photographs, tissue, and water samples and to attempt tagging. In some cases, small-scale scientific echosounder surveys (see below) were conducted in the area following a baleen whale group sighting. In addition, directed surveys were conducted using information from passive acoustic monitoring to guide the ship toward likely locations of whales. During these acoustically directed surveys, the visual team was directed toward potential contacts by the acoustic team. The visual observers were thus considered “off effort” during these surveys.

Basic survey parameters were automatically recorded by the survey program every minute and include the ship’s position, heading, effort status, observer positions, and environmental conditions (e.g., wind speed, sea surface temp, etc.). At the start of the survey day and at 20-minutes time intervals thereafter, the survey program prompted observers for an update of the subjective environmental variables (e.g., glare, sea state, cloud cover, etc.) and sighting conditions.

Visual Survey Results

During this cruise, approximately 1,900 km of trackline were surveyed both on and off effort (Table 2, Figure 2). Sighting conditions were fair to poor during most of the days, with sea states ranging from 3 to 6 on the Beaufort scale (Table 2, Figure 2). For a few days, the weather was too rough to conduct marine mammal operations (Table 2). Eighteen baleen whale sightings were recorded (Table 3, Figures 3 and 4), including four confirmed Rice’s whales (Table 3, Figure 3), five sightings of Sei/Rice’s, two sightings of Sei/Rice’s/Fin whales and seven Unidentified baleen whales (Table 3, Figure 4). The remainder 29 sightings included several species of dolphins (Table 3, Figure 5), for a total of 47 mammal sightings for the cruise.

Marine Mammal Tissue and Water Sampling

No biopsy or water samples were collected during the cruise.

Tag Deployment

Tagging operations during this survey were conducted during focused data collection with Rice’s whales. Three tag types were available for deployment on Rice’s whales to study their

movement patterns and behavior: LIMPET satellite telemetry tags, Acousonde kinematic and acoustic tags, and CATS-Cam kinematic and camera tags, though only Acousonde and CAT-Cam kinematic tag attachments were attempted during this survey. The Model B003B Acousonde (Greenridge Sciences) are 22 cm long, 8 cm wide, 360 g self- contained underwater kinematic and acoustic recorders that are attached to whales via suction-cups. The tag instrumentation includes temperature, light, and pressure sensors, triaxial magnetometers and accelerometers, a compass, and a hydrophone. The Acousonde tag float contained a SPOT 258E satellite transmitter and a VHF transmitter to aid in long- distance and short-distance tag recovery operations, respectively. The CATS Diary Cam WIFI model (Customized Animal Tracking Solutions, Germany) is a 22 cm long, 11 cm wide, 700 g self-contained underwater kinematic, acoustic, and video recorder that is attached to whales via suction-cups. The tag instrumentation includes an accelerator, compass, gyroscope, GPS, temperature, pressure, and light sensors, a HTI-96 min hydrophone and video recorder. The camera uses a CMOS sensor designed for low light conditions with a sensitivity of 3700 mV/lux-sec and a peak dynamic range of 69 dB. The CATS-Cam tag flotation also includes satellite and VHF transmitters to aid in recovery operations. Data recorded on each sampling attempt included GPS location, time, date, sampler and recorder name, species, body location struck, behavioral reaction, and whether or not a sample was obtained.

Weather conditions were marginal for small boat operations throughout the survey. The small boat was only able to be deployed on 18 and 19 November for close approaches to whales for photo-ID data collection and tagging attempts. Weather conditions precluded small boat operations on all remaining survey days. An unsuccessful attempt to deploy a CATS-CAM tag was also made on 19 November. There were no additional opportunities to attempt to deploy additional tags (including LIMPET telemetry tags), attempt biopsies or collect water samples in the footprint of whales for eDNA analyses due to the generally poor weather throughout the cruise.

Passive Acoustic Monitoring Methods

Real-time passive acoustic surveys were conducted using directional sonobuoys (AN-SSQ-53G) to detect, localize, and record low-frequency sounds potentially produced by Rice's whales. Sonobuoys were deployed during daylight hours concurrent with visual surveys. The sonobuoy deployment strategy was to 1) deploy one sonobuoy at the start of each day or occasionally throughout the day along the trackline to monitor the area to determine if calls were present, 2) deploy one sonobuoy opportunistically when the visual team found whales to determine if calls were present, and 3) deploy one or two additional sonobuoys spaced 5–10 km apart (diads and triads) to localize calls when calls were present in scenarios 1 and 2. Acoustic chases were implemented in which sonobuoys were deployed, and when calls were detected, a second or third buoy was deployed and the ship was directed as far as 20 km to the site of calling animals to determine if whales were present where the calls were coming from.

The expendable Directional Frequency Analysis and Ranging (DIFAR) sonobuoys contain a compass in the sensor head and transmit four types of continuous signal back to the ship on a VHF radio carrier in an analog multiplexed format. The four signals are acoustic sound pressure,

east/west particle velocity, north/south particle velocity, and GPS-based location. The acoustic signal frequency range is approximately 10 Hz to 4,000 Hz, which is well suited for large whale vocalizations that have their greatest sound energy concentrated below 1,000 Hz. Prior to deployment, all sonobuoys were programmed for DIFAR mode without Automatic Gain Control, a hydrophone depth of 122 m, and a broadcast duration of 4 hours. The VHF radio signals transmitted by the sonobuoys were received by one of four omni-directional antennas (Diamond X30 144 MHz [primary] and MORAD Custom 168 MHz [backup]) each pair mounted on opposite sides of the ship's mast at 26 m above the waterline. While mounting antennas on this mast at the highest point on the ship achieves the greatest line of sight to deployed sonobuoys, the antennas share space with the large VSAT dome which blocks signal reception to a given antenna during some survey directions; therefore we mounted four antennas to enhance directional coverage during closing-mode approaches (see Appendix). The signal gain from the 144 MHz and 168 MHz antennas was enhanced by Advanced Receiver Research custom 140–144 MHz and P160VDG 160–170 MHz preamplifiers, respectively, powered by a 12V battery located in the lab. The effective radio reception range from the sonobuoys was approximately 15–20 km.

The amplified sonobuoy signals were split in the lab and received on up to three WinRadios (G39WSBe), each tuned to the broadcast frequency programmed for one of the deployed sonobuoys (see Appendix for setup diagram). Analog sonobuoy signals from the three WinRadios were digitized with an RME Fireface UC audio interface sampling 24 bits at 96 kHz and were recorded directly to SATA hard drives as multi-channel wav files using Pamguard (Gillespie et al. 2008) v2.00.14c software. The Pamguard software program was used to record acoustic data, effort, and metadata logs to hard-disk and to process DIFAR signals in real-time. Effort data, detections metadata, and data on the bearing to sounds and the sound types were recorded using Pamguard Logger forms. A custom DIFAR demultiplexing module (Miller et al. 2015) was used for real-time call detection, bearing estimation, and localization when possible. The DIFAR module plots spectrograms and calculates difargrams of selected signals using the Australian Marine Mammal Center demodulation algorithm, allowing estimation of magnetic bearing angles to calling animals, and maps the true bearings alongside the ship GPS trackline and sonobuoy deployment locations. When the same calls were detected on two or more sonobuoys with a sufficient baseline separation, it was possible to locate the source of the sounds by crossing two or more bearings. Two to three acousticians conducted real-time monitoring of sonobuoy data and rotated on 2 to 2.5 hours shifts. Acoustic recordings and metadata databases were recorded to primary and backup SATA hard drives.

See Appendix A for details on PAM hardware set up.

Passive Acoustics Results

Throughout the cruise, 95 sonobuoys were deployed throughout the survey area over 17 survey days (Table 4), yielding 147 hours of multi-channel acoustic recordings (238 sonobuoy-hours). Of the 95 deployed buoys, 90 (95%) successfully broadcast a signal for longer than 15 minutes (Figure 6). All sonobuoys were deployed and monitored in real-time during daylight hours (137 hours monitored), though 5 continued receiving signals after sunset and were only recorded

during this time for later processing. Of the 95 sonobuoys, 64 were deployed for monitoring for calls, and 31 were deployed to be diads or triads for call localization. A total of 50 buoys were part of a localizing diad or triad (i.e., monitoring buoys became part of a diad or triad when loud calls were detected). The passive acoustic technicians monitored the signals continuously and manually detected and classified potential cetacean sounds along with anthropogenic noises. At initial data collection, these sounds were broadly categorized as possible Rice's whale vocalizations (e.g., long-moans, downswept pulses, downswept pulse sequences, and others). Low-frequency tonal sounds were detected on 59 (66%) of the 90 successful sonobuoys for a total of 113 acoustic detections of individuals or groups of whales. Long-moans were detected on all 59 sonobuoys (Figure 6) while 14 (16%) of them had downswept pulse sequences (Figure 6), 5 (6%) had downswept pulse doublets, and 4 (4%) had constant tonal calls detected. To verify the source of the long-moan calls, acoustic chases were conducted on 12 acoustic detections, with 9 chases leading to Rice's whale sightings near the detection localizations. Post cruise analyses of these data that incorporate sonobuoy GPS data will be conducted to verify accuracy of real-time bearings and localizations obtained in the field and to more accurately identify the source of recorded sounds when possible. The data will be used to establish a library of species-specific calls for acoustic identification to aid in the interpretation of recordings made in the absence of visual survey data.

Passive Acoustic Mooring Deployments

As part of a collaborative SEFSC & SIO long-term passive acoustic monitoring project, three High-frequency Acoustic Recording Package (HARP) moorings were opportunistically serviced during this cruise (Table 5). The HARP instruments continuously record sounds up to 100 kHz for up to eighteen months with the objective of collecting calibrated long-term recordings of ambient noise and cetacean vocalizations to evaluate long-term trends in cetacean occurrence. The HARP moorings at the Mississippi Canyon and Main Pass sites were deployed on 11 November 2018, and the mooring at the De Soto Canyon site was refurbished on 13 November 2018.

Scientific Echosounder (EK80) Data Collection

Multi-frequency scientific echosounders (Simrad EK80) continuously sampled the distribution and density of secondary productivity throughout the water column throughout each day of the cruise. The EK80 collected data on frequencies of 18 kHz, 38 kHz, 120 kHz and 200 kHz. During daylight hour surveys for whales, the EK80 collected data continuously, except during close approaches to whales and when the small boat was conducting focused data collection with whales and data collection on the 18 kHz frequency was suspended to avoid disturbances to the whales. Additionally, small-scale surveys were conducted in the vicinity of selected Rice's whale encounters to characterize the prey field in the immediate vicinity of encountered whales and to examine correlations between the diving and feeding behaviors of tagged whales and the local structure of the prey field (Figure 7). During this cruise, the small-scale survey design followed a flower pattern of six tracklines approximately equally spaced around a circle. Cross-shelf tracklines that covered the primary known habitat at 10 km spacing were conducted at night to characterize the overall spatial distribution and structure of the potential Rice's whale prey field (Figure 8). EK80 tracklines were surveyed beginning at sunset and until the

commencement of acoustic survey effort the following day. The backscatter data were stored on hard drives for archiving and further analysis. Environmental data were collected daily using a conductivity, temperature and depth sensor (CTD) unit. CTD casts recorded vertical profiles of salinity, temperature, and oxygen content to a maximum depth of 500 m. Environmental data including water temperature, salinity, and weather conditions (e.g., wind speed, wind direction) were continuously collected via the ship's SCS and recorded in the marine mammal visual sighting database. Nineteen CTD stations were sampled at water depths ranging from 170 m to 333 m. Casts were performed almost daily, typically at the beginning of the mammal survey day (Table 2, Figure 9).

Data and Sample Disposition

All data collected during GU18-06 including visual survey data, passive acoustic data, EK80 data, SCS data, and CTD data are archived and managed at the SEFSC in Miami, FL. Passive acoustic data back-ups are stored at Scripps Institution of Oceanography in La Jolla, CA. Biopsy sub-samples for genetics and eDNA water samples are archived at the SEFSC Marine Mammal Molecular Genetic Laboratory in Lafayette, LA pending analyses. The sub-samples for stable isotopes and contaminants are archived at the SEFSC Miami Laboratory. The data presented here are preliminary and subject to change as further auditing and analyses continue.

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Permit and Funding Source

SEFSC Marine Mammal Program was the primary institution authorized to conduct marine mammal research during this survey under the MMPA research permit #14450-05 issued by the NMFS Office of Protected Resources to the SESFC, in collaboration with researchers from the Scripps Institution of Oceanography and Florida International University.

This survey was funded through a grant from the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act) and the NOAA RESTORE Science Program through the Gulf Coast Restoration Trust Fund (https://restoreactscienceprogram.noaa.gov/projects/rices-whales). DIFAR sonobuoys used for the acoustic surveys were donated by the Navy's Living Marine Resources program and Sonobuoy Liaison Working Group.

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Miller B, Barlow J, Calderan S, Collins K, Leaper R, Olson P, Ensor P, Peel D, Donnelly D, Andrews-Goff V, Olavarria C, Owen K, Rekdahl M, Schmitt N, Wadley V, Gedamke J, Gales N,

Double, M. 2015. Validating the reliability of passive acoustic localisation: a novel method for encountering rare and remote Antarctic blue whales. Endangered Species Research 26:257-269.

Table 1. List of Participants during the GU18-06 survey. Affiliations: SEFSC = NOAA Southeast Fisheries Science Center; CIMAS = University of Miami's Cooperative Institute for Marine and Atmospheric Studies.

Name	Affiliation	Duty
Anthony Martinez	SEFSC, Miami	Field Party Chief (FPC)
Melissa Soldevilla	SEFSC, Miami	Lead acoustician
Katrina Ternus	Riverside Technology, Inc.	Acoustician
Laura Dias	CIMAS	Marine mammal observer
Debra Abercrombie	CIMAS	Marine mammal observer
Kevin Barry	SEFSC, Pascagoula	Marine mammal observer
Melody Baran	CIMAS	Marine mammal observer
Mary Applegate	CIMAS	Marine mammal observer
Jesse Wicker	CIMAS	Marine mammal observer
Heidi Malizia	CIMAS	Marine mammal observer
Nicolas Tucker	Florida International University	EK80 technician
Vincent Quiquempois	Florida International University	Camera tag expert (CATS-CAM)
John Hildebrand	Scripps Institute of Oceanography	Project Co-PI
Rebecca Cohen	Scripps Institute of Oceanography	Acoustician

Table 2. Daily operations during GU18-06 including marine mammal visual survey, survey conditions, number of sightings, and CTD casts performed.

Date	Event	Tracklines (km)	Ave. sea state	Num. delphinid sights	Num. baleen sights	CTD casts
11/8	Delayed departure	0.0	NA	0	0	0
11/9	Delayed departure	0.0	NA	0	0	0
11/10	Departed Pascagoula, MS	0.0	NA	0	0	0
11/11	Marine mammal ops	30.11	3.5	0	0	1
11/12	No Survey (rough weather)	0.00	NA	0	0	2
11/13	Marine mammal ops	122.97	3.8	4	0	2
11/14	Marine mammal ops	133.28	5.0	0	0	1
11/15	Marine mammal ops	98.98	5.2	1	0	1
11/16	No Survey (rough weather)	0.00	NA	0	0	0
11/17	Marine mammal ops	157.52	3.7	1	1	2
11/18	Marine mammal ops	112.52	3.0	0	3	2
11/19	Marine mammal ops	146.64	2.8	7	2	1
11/20	Marine mammal ops	111.10	3.6	1	1	1
11/21	No Survey (Pensacola, FL)	0.00	NA	0	0	0
11/22	No Survey (Pensacola, FL)	0.00	NA	0	0	0
11/23	No Survey (Pensacola, FL)	0.00	NA	0	0	0
11/24	No Survey (Pensacola, FL)	0.00	NA	0	0	0
11/25	Marine mammal ops	69.46	5.1	2	0	1
11/26	Marine mammal ops	91.65	5.3	1	1	1
11/27	Marine mammal ops	155.92	5.8	1	0	0
11/28	Marine mammal ops	151.72	3.2	2	0	1
11/29	Marine mammal ops	118.50	3.0	2	3	1
11/30	Marine mammal ops	144.62	5.0	3	2	1
12/1	No Survey (rough weather)	0.00	NA	0	0	0
12/2	Marine mammal ops	151.51	4.6	2	3	1
12/3	Marine mammal ops	103.37	4.1	2	2	0
12/4	Arrived in Pascagoula, MS	0.00	NA	0	0	0
Totals	**20 days at sea**	**1899.9**	**4.2**	**29**	**18**	**19**

Table 3. Marine mammal sightings during the GU18-06 survey.

Species	Number of Sightings
Atlantic spotted dolphin	4
Bottlenose dolphin	17
Bottlenose/Spotted dolphin	2
Rice's whale	4
Pantropical spotted dolphin	1
Sei/Rice's whale	5
Sei/Rice's/Fin Whale	2
Spinner dolphin	3
Unid. Baleen Whale	7
unid. dolphin	2
Grand Total	**47**

Table 4. Summary of acoustic survey effort during the GU18-06 survey.

Date	Monitoring effort	Recording Effort	Sonobuoys Deployed	Successful Sonobuoys	Groups Detected
11/11/2018	1.4	1.4	1	1	0
11/12/2018	6.5	6.5	4	4	0
11/13/2018	4.2	4.2	3	3	0
11/14/2018	5.5	6.6	4	2	11
11/15/2018	3.8	2.2	4	3	3
11/16/2018	0.0	0.0	0	0	0
11/17/2018	10.3	10.3	5	5	7
11/18/2018	11.8	11.8	6	6	12
11/19/2018	11.6	13.8	7	7	6
11/20/2018	7.8	9.2	7	7	19
11/21/2018	0.0	0.0	0	0	0
11/22/2018	0.0	0.0	0	0	0
11/23/2018	0.0	0.0	0	0	0
11/24/2018	0.0	0.0	0	0	0
11/25/2018	2.3	4.1	3	3	3
11/26/2018	9.9	10.4	7	7	13
11/27/2018	10.5	10.5	7	6	0
11/28/2018	10.3	10.3	7	6	4
11/29/2018	10.2	11.2	8	8	8
11/30/2018	11.0	11.4	7	7	14
12/1/2018	0.0	0.0	0	0	0
12/2/2018	10.4	13.3	9	9	2
12/3/2018	9.9	9.9	6	6	11
Total	**137.4**	**147.0**	**95**	**90**	**113**

Table 5. HARP deployment details.

Site Name	Date & Time Deployed	Latitude	Longitude
Main Pass (MP)	11/11/2018 03:34	29.2545	-88.2985
Mississippi Canyon (MC)	11/11/2018 12:48	28.84708	-88.4647
De Soto Canyon (DC)	11/13/2018 12:29	29.05383	-86.0965

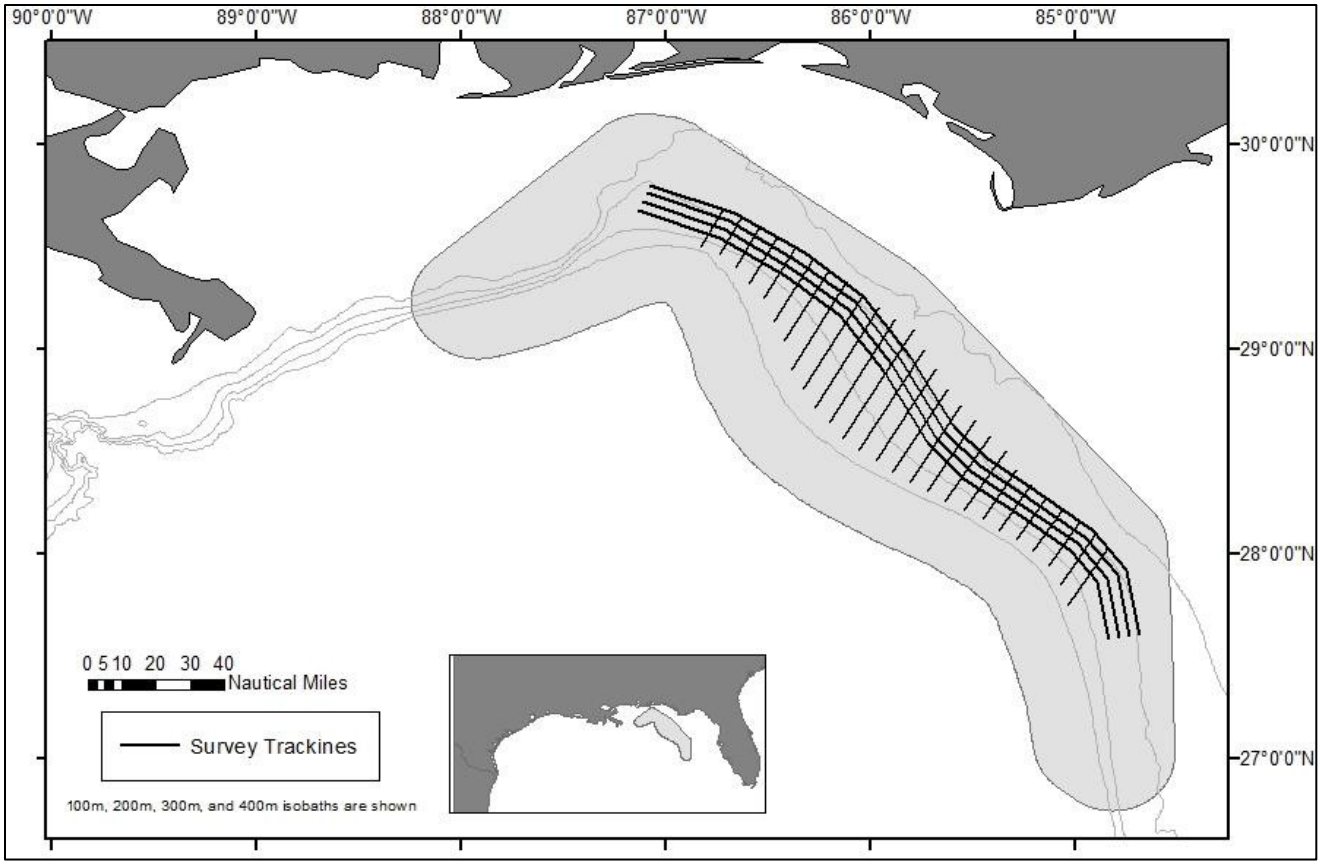

Figure 1. Rice's whale primary habitat and planned along-bathymetry and cross-bathymetry survey tracklines for the GU18-06 survey.

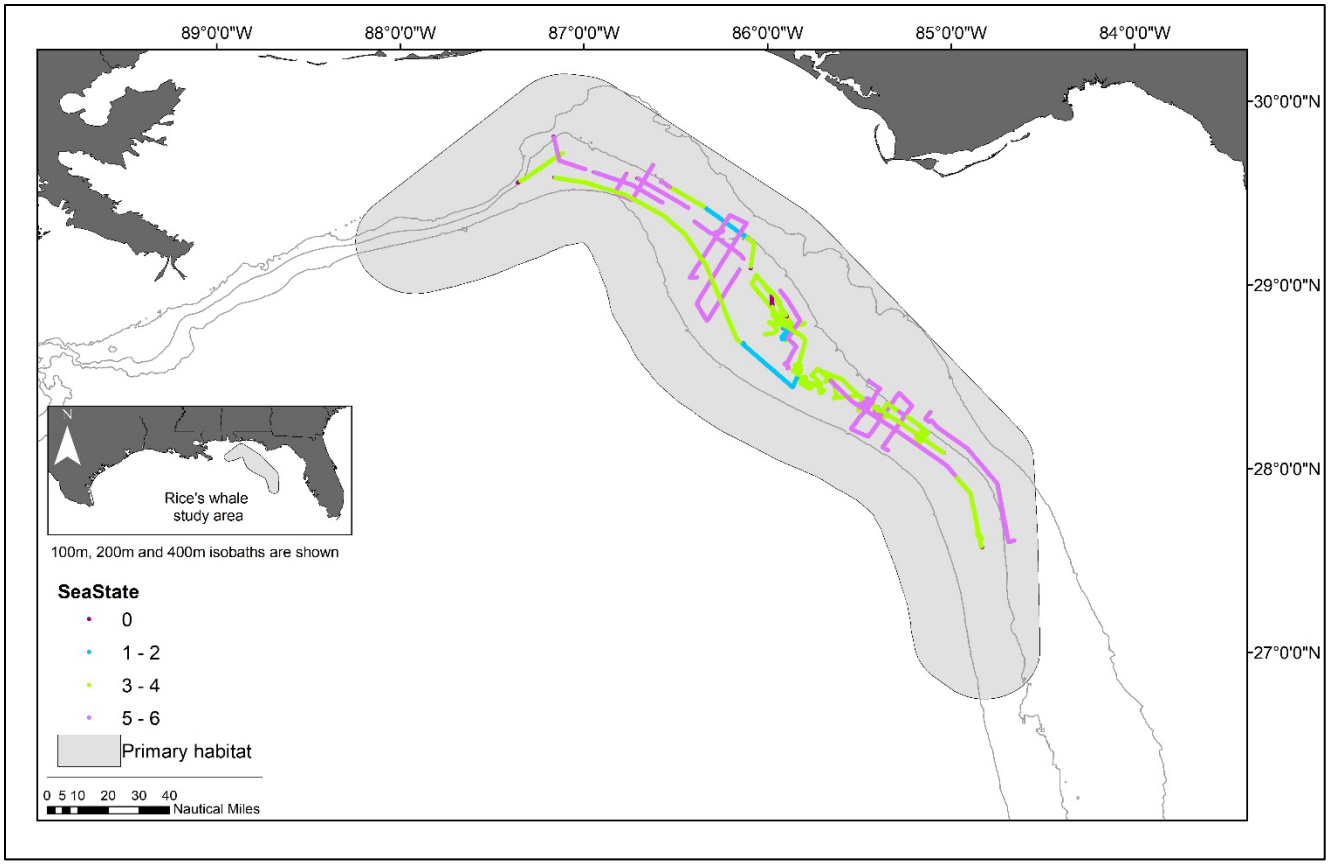

Figure 2. Visual Survey effort and Sea State during the GU18-06 survey.

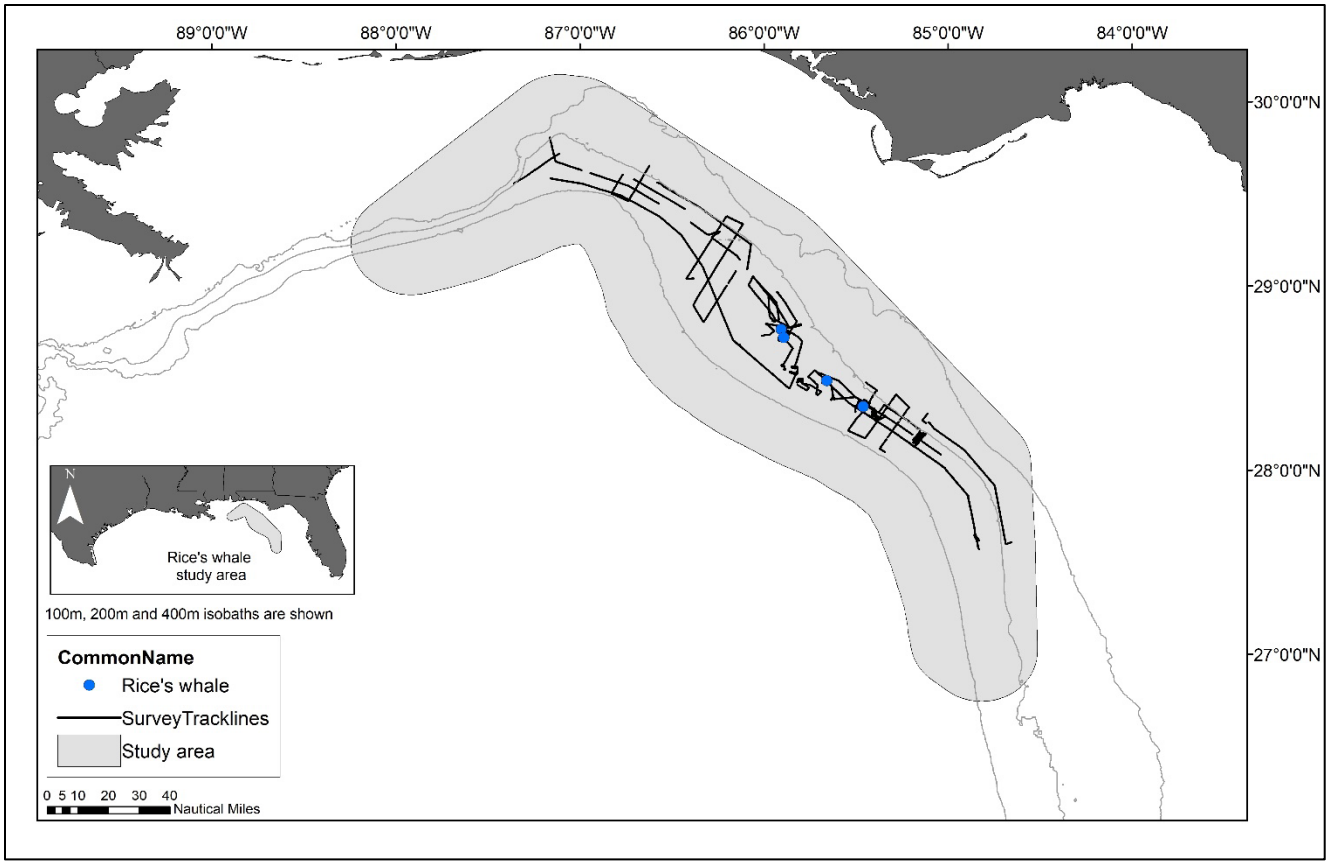

Figure 3. Rice's whale sighting locations during the GU18-06 survey.

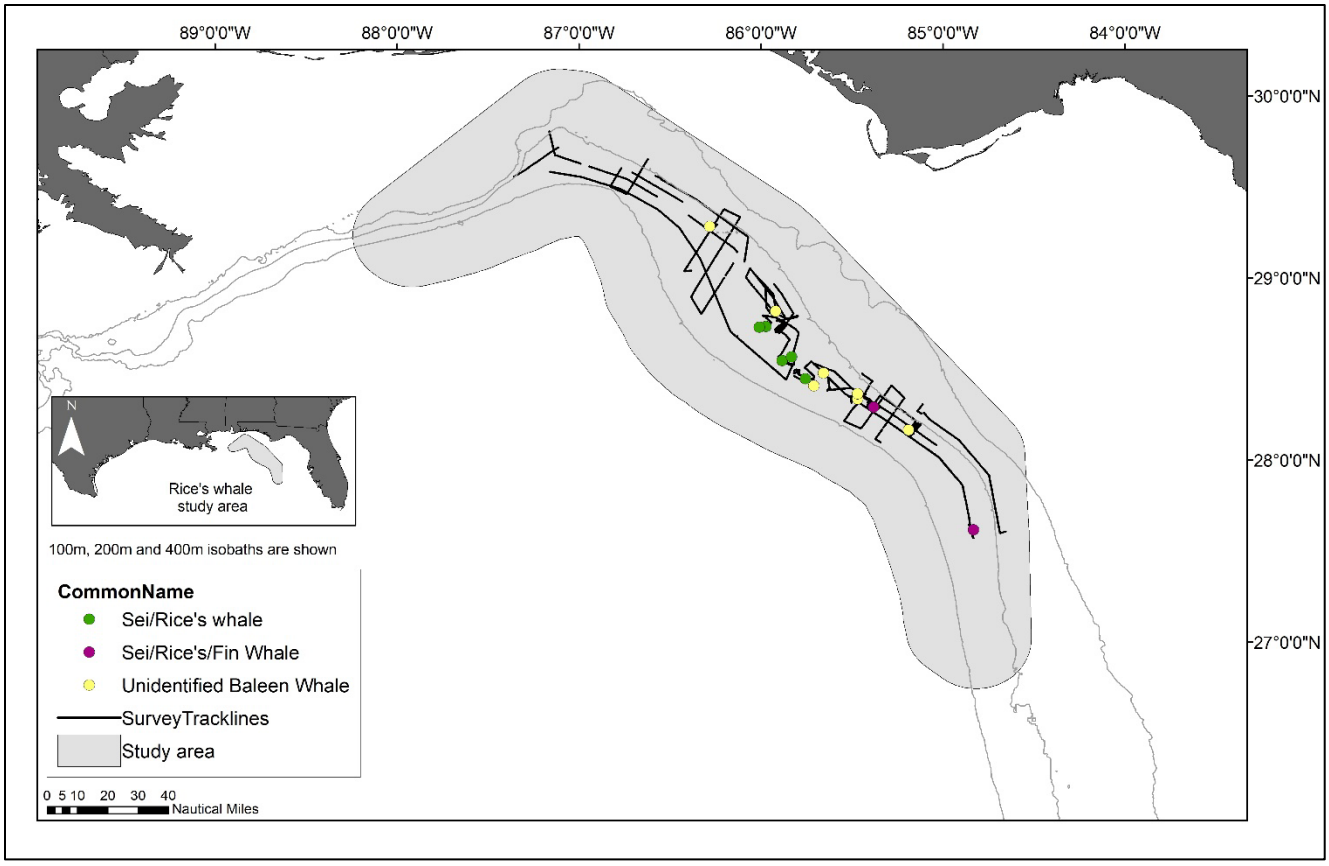

Figure 4. Baleen whale sighting locations during the GU18-06 survey that were not confirmed Rice's whale.

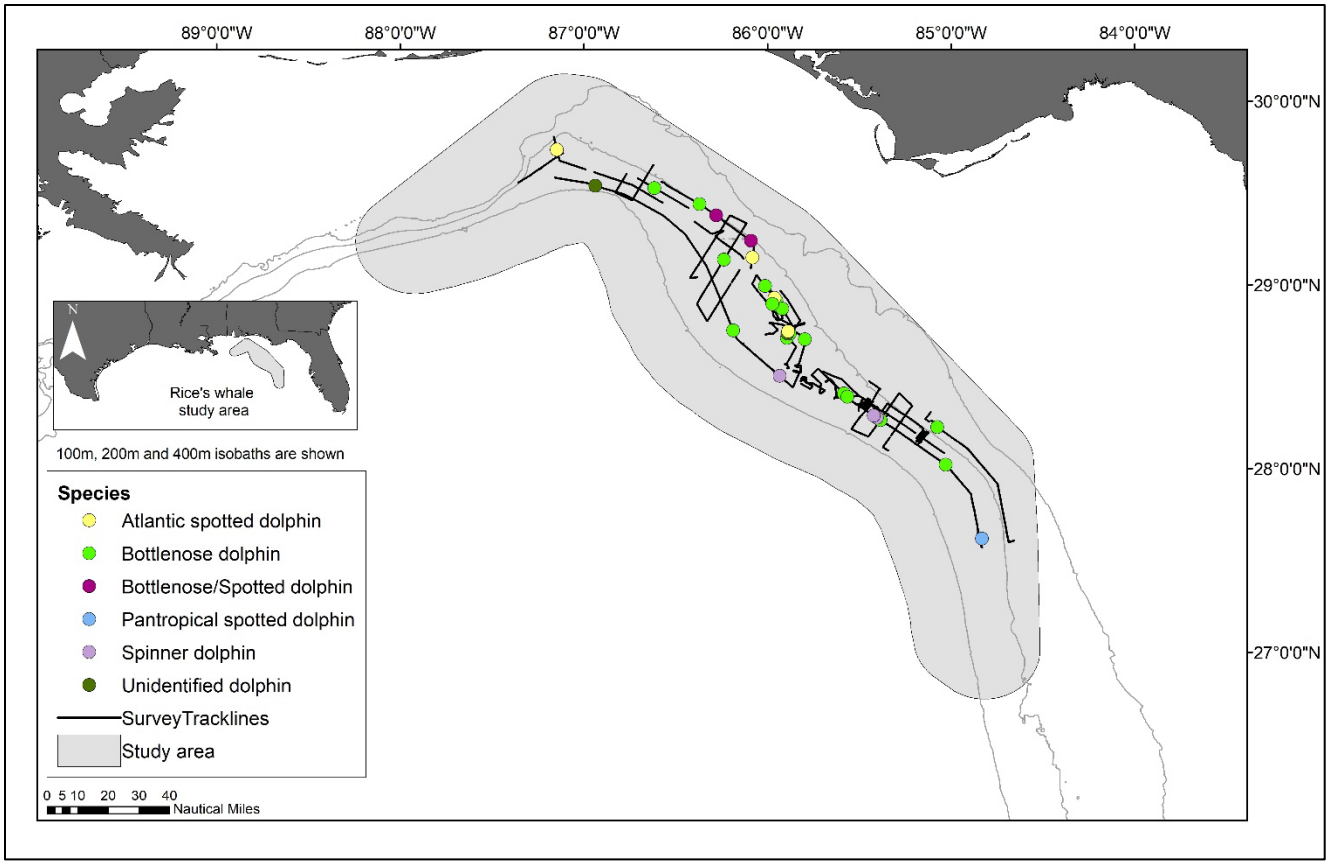

Figure 5. Dolphin sighting locations during the GU18-06 survey.

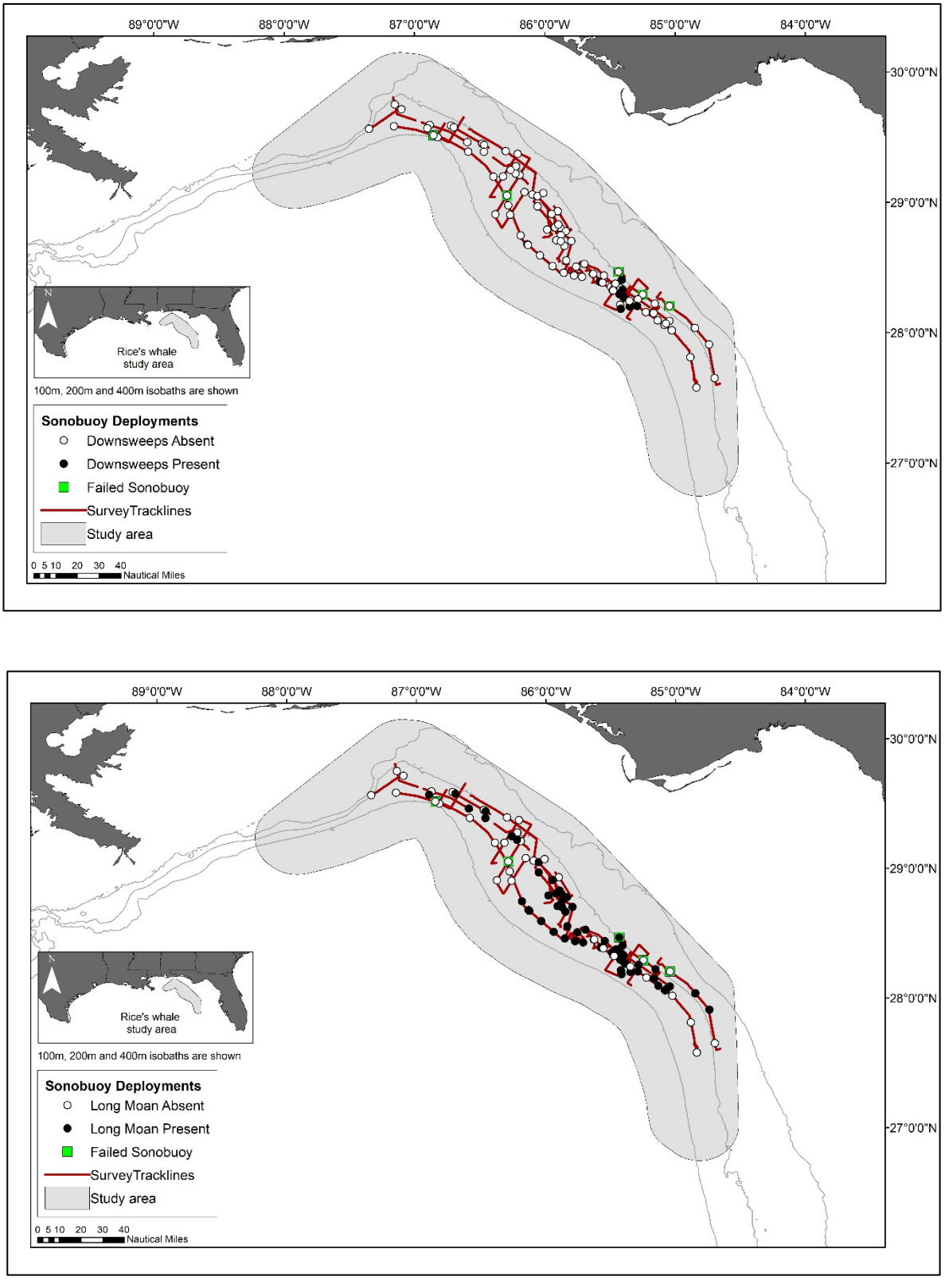

Figure 6. Sonobuoy deployments and Rice's whale acoustic detections during the GU18-06 survey.

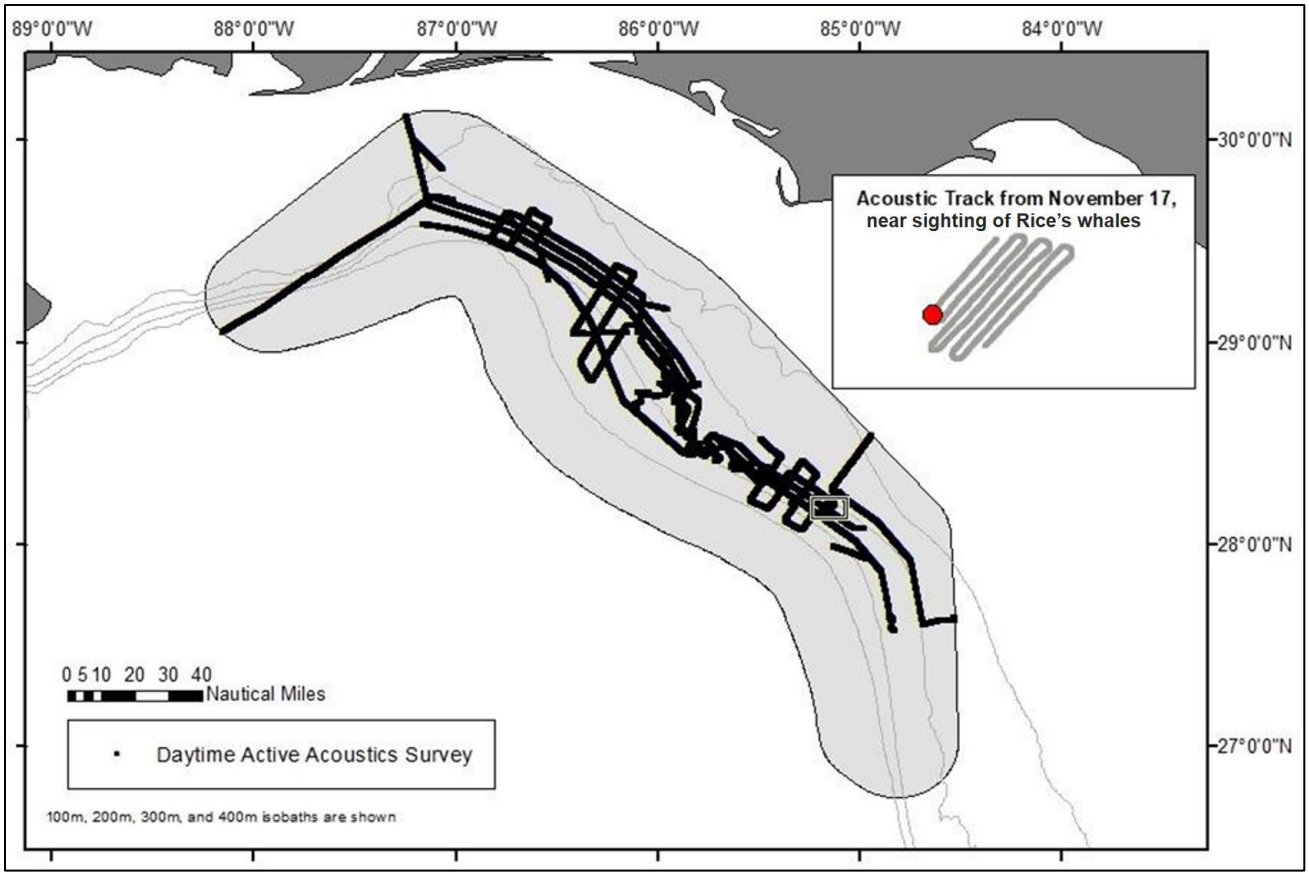

Figure 7. Daytime scientific echosounder surveys with inset showing detailed survey near a Rice's whale sighting on 17 November.

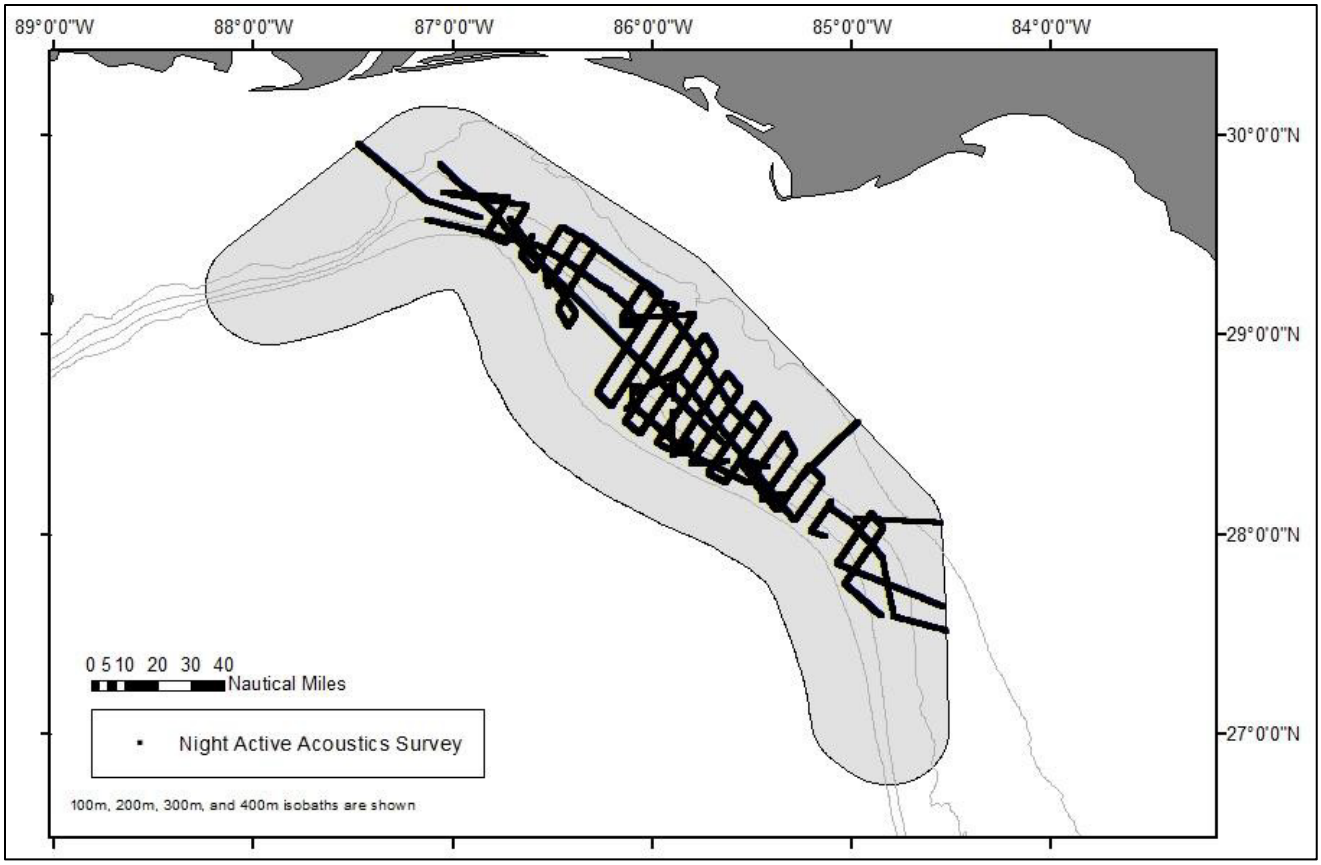

Figure 8. Night-time tracklines surveyed with scientific echosounders during GU18-06.

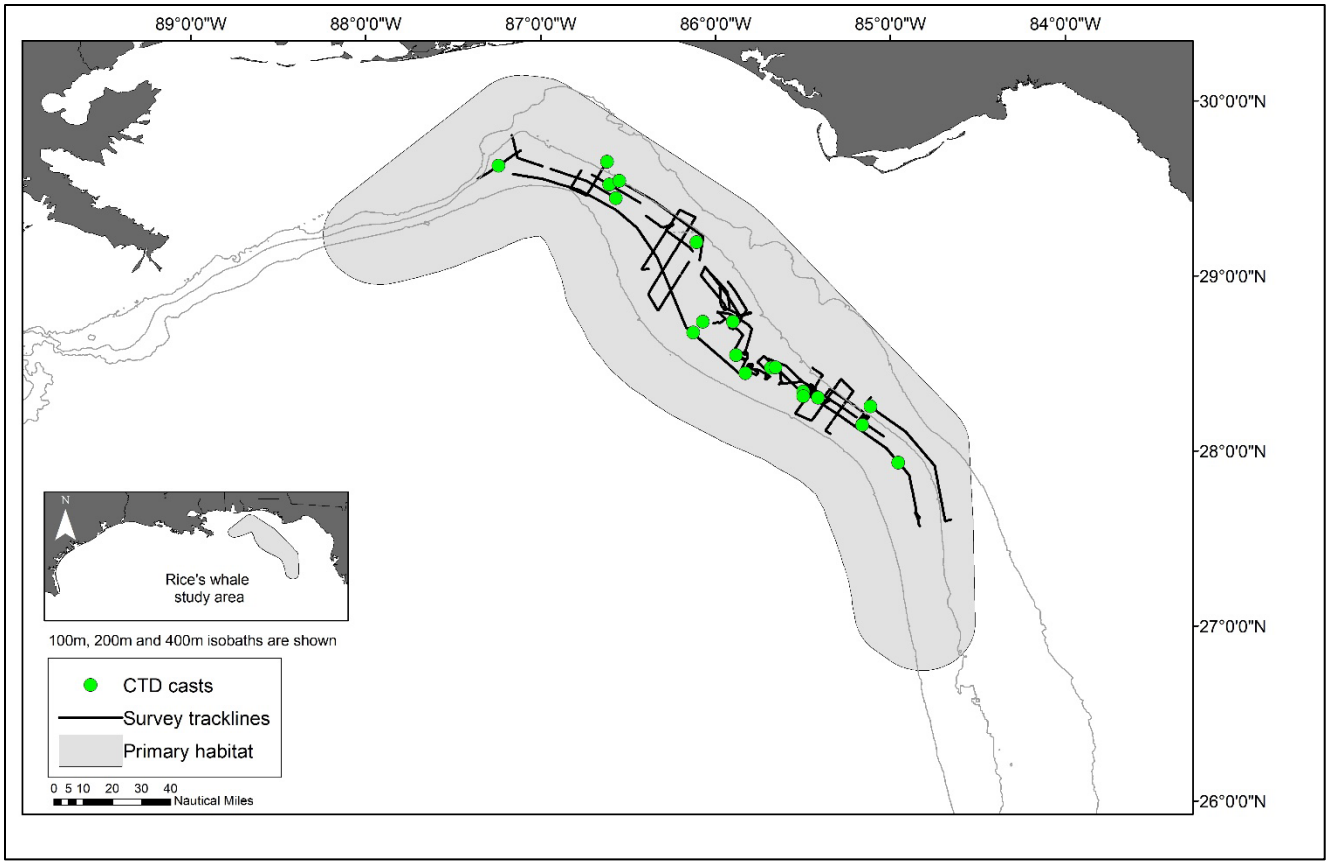

Figure 9. CTD cast locations during the GU18-06 survey.

Appendix A. Sonobuoy system setup and Mounted Antenna Configuration used during the GU18-06 survey.