Southeast Fisheries Science Center Reference Document MMTD-2024-02

CRUISE REPORT

NOAA Ship *Gordon Gunter* Cruise GU23-03

June – August 2023

Vessel Survey for Abundance and Distribution Summer Research Cruise

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

January 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.

The Southeast Fisheries Science Center was authorized to conduct marine mammal research activities during the cruise under Marine Mammal Protection Act (MMPA) Permit No. 21938-03.

As part of the Vessel Surveys for Abundance and Distribution of Marine Mammals and Seabirds (VSAD) project, the Southeast Fisheries Science Center (SEFSC) conducted a shipboard survey of the oceanic waters (>100 m deep) of the Gulf of Mexico (GoMx) out to the U.S. Exclusive Economic Zone (EEZ) to collect data to help inform plans to support marine mammal and seabird population restoration efforts. This project is associated with the *Deepwater Horizon* (DWH) Natural Resource Damage Assessment (NRDA) Restoration Plan (DIVER ID 317). These data are intended to support planning and evaluation of restoration activities associated with the DWH NRDA restoration effort along with supporting other management and conservation needs.

The survey was conducted between 21 June and 15 August 2023 onboard the NOAA Ship *Gordon Gunter* along prescribed tracklines in a "double saw-tooth" configuration (Figure 1). A total of 7,480 km of survey effort were planned. Tracklines were spaced at 120 km and oriented perpendicular to bathymetry (Figure 1).

The cruise was segmented into two legs, totaling 38 sea-days:

Leg	Date	Location	Days at Sea
1	DEP: 21 Jun 2023	Pascagoula, MS	11
	ARR: 1 Jul 2023	Pascagoula, MS	
2	DEP: 20 Jul 2023	Pascagoula, MS	27
	ARR: 15 Aug 2023	Pascagoula, MS	

The survey was originally planned for three legs (leg 1: 11 June to 1 July, leg 2: 6 July to 23 July, leg 3: 28 July to 15 August). However, due to mechanical issues with the ship and a shortage of qualified professional mariners, the departure date for leg 1 was delayed and legs 2 and 3 were combined into one 27-day leg. Survey participants are listed in Table 1 and daily survey operations are summarized in Table 2.

The primary goal of this survey was to collect data on the distribution and abundance of marine mammals in the U.S. waters of the GoMx using visual survey teams and passive acoustic monitoring. The project also includes a partnership with the U.S. Fish and Wildlife Service (USFWS), who are responsible for collecting, maintaining, and analyzing the data on seabird distribution and abundance. This report will focus primarily on the NOAA data collected for cetacean abundance and distribution. Seabird data are available through USFWS.

Twenty-one species of cetaceans are known to routinely inhabit continental shelf (20 m to 200 m) and oceanic (>200 m) waters of the U.S. GoMx. In the continental shelf waters, the most common cetacean species are common bottlenose (*Tursiops truncatus*) and Atlantic

spotted dolphins (*Stenella frontalis*). Oceanic waters are inhabited by species including sperm whales (*Physeter macrocephalus*), dwarf and pygmy sperm whales (*Kogia* spp.), beaked whales (Ziphiidae), and other large (e.g., killer whales [*Orcinus orca*], short-finned pilot whales [*Globicephala macrorhynchus*], Risso's dolphins [*Grampus griseus*]) and small (e.g., pantropical spotted dolphins [*Stenella attenuata*]) delphinids. Though other species of baleen whales are occasionally sighted, Rice's whales (*Balaenoptera ricei*) are the only baleen whale resident in the GoMx and are seen frequently in the northeastern GoMx, from De Soto Canyon southward along the continental slope, usually between depths of 180 m and 360 m.

Cruise objectives

The specific objectives of this survey were to:

1. Conduct a two-team visual line transect survey to estimate the abundance and spatial distribution of multiple cetacean species in U.S. Gulf of Mexico waters
2. Conduct passive acoustic surveys simultaneous with visual surveys to provide supplemental information on multiple cetacean species abundance and spatial distribution
3. Collect data on the distribution and abundance of seabirds and other marine life
4. Recover and redeploy autonomous acoustic moorings

Visual Survey Operations

The survey design was similar to that conducted during the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) surveys in the summers of 2017 and 2018 (GU17-03 and PC18-05) and the winter of 2018 (GU18-01), which used the two-independent visual observer teams approach.

The independent teams approach with Distance sampling was implemented to estimate the detection probabilities for marine mammal sightings. This method used two teams of visual marine mammal observers that operate independently of one another. During this approach, one survey team with two observers was stationed on the vessel's flying bridge (height above water = 13.9 m) and the second team, also with two observers, was stationed on the wings of the bridge deck (height above water = 11.2 m). Each visual survey team utilized two pedestal-mounted, 25x150 mm "bigeye" binoculars located on the port and starboard sides of the ship. A centralized data recorder located inside the ship's chemistry laboratory communicated with both teams via discreet VHF channels to maintain independence of the teams. Observers used the bigeye binoculars to determine and relay 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 degrees and meters. Marine mammal sightings were defined as systematic records of cetacean groups consisting of one or more individuals observed at the same location and time.

Visual survey effort started daily at approximately 0630 and ended at 1930 CDT depending on operational requirements and survey conditions. Survey speed was typically 18 km hr^{-1} (10 kt) but varied with ship traffic and sea conditions, such as sea states and wind speeds. Data were recorded by the data recorder using a custom visual data acquisition program (VisSurvey) installed on a networked laptop.

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. Observers scanned the water using the bigeye binoculars from 10° right and left of the ship's bow to the beam (90° left or right depending on the side); i.e., the left observer scanned from 10° right to 90° left and the right observer scanned from 10° left to 90° right. Whenever an observer suspected or had seen a marine mammal, a cue (marine mammal, splash, blow, etc.) was immediately entered in the data program and the team went "off effort." A cue is a time and location stamp in the database that captures the spatial and temporal position of the sighting. After sightings were identified to the lowest taxonomic unit possible and group size enumerated, the sighting was entered in the visual data program by the data recorder. Group size estimates were recorded independently by each observer. Observers were instructed to only enter values for sightings they observed entirely. Group size was counted as the minimum, maximum, and best number of individual animals in each sighting.

Observers were considered to be "off effort" whenever the ship was maneuvering and turning onto a new trackline, if other operations were taking place (e.g., safety drills), during bad weather (rain, sea state >6, poor visibility due to fog, lightning within 4 nm), and whenever not actively searching for cetaceans through the bigeyes. Sightings observed under such conditions were recorded as off effort. Off-effort sightings may also have included naked-eye observations and sightings detected by non-mammal observers, mammal observers off duty, or other crew (including ship's crew).

For each sighting (either on- or off-effort), time, position, bearing and reticle, species, group size, behavior, and associated animals (e.g., seabirds, fish) were recorded. An attempt was made to photograph animals that closely approached the ship.

This survey was primarily conducted in "passing mode," whereby the ship maintains a steady course and speed along the trackline while the visual teams identify the sighting to species level if possible and count the number of individuals in the sighting. This differs from surveys prior to 2017 that were conducted in "closing mode," which entails maneuvering the ship to more closely approach animals sighted, and should be considered when comparing these data to historical datasets. Closing mode was used sparingly during the present survey and was restricted to sightings of special interest determined by the Field Party Chief (FPC).

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 temperature, etc.). At the start of the

survey day and at 20-minute time intervals thereafter, the survey program prompts observers to update the subjective environmental variables (e.g., glare, sea state, cloud cover, etc.) and sighting conditions.

Visual Survey Results

During this cruise, 6,190 km of trackline were visually surveyed on effort (Table 2, Figure 1). Sighting conditions were fair to good throughout most of the survey, with sea states of 2-3 on most survey days (Figure 2). There were 397 marine mammal sightings from 16 confirmed species during the survey, not including unidentified taxa (Table 3). A diverse suite of oceanic dolphin and small whale species were encountered including pantropical spotted dolphins, Risso's dolphins, pygmy/dwarf sperm whales, beaked whales (Ziphiids and Mesoplodonts), and pilot whales (*Globicephala* spp.; Table 3, Figures 3 and 5). Continental shelf species included common bottlenose dolphins and Atlantic spotted dolphins (Figure 3). There were 74 sperm whale sightings (Figure 4). During this cruise, sperm whale sightings were entered as soon as the observer finished counting individuals seen at the location of the cue. This differs from methods used in some SEFSC surveys prior to 2017 where observers spent additional time intervals counting sperm whales that surfaced after the initial detection. Therefore, sperm whale group size estimates and sighting definitions are likely not comparable between this survey and previous studies in the GoMx. These differences will be considered when estimating abundance.

Marine mammal biopsy sampling

Biopsy operations during this survey were limited to sightings of special interest as determined by the FPC. Tissue samples were collected from the small boat with a crossbow fitted with a custom designed sampling dart and 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 and as authorized by the MMPA permit and approved National Marine Fisheries Service (NMFS) Atlantic Institutional Animal Care and Use Committee (IACUC) protocols. Nine biopsy samples were collected from Stenellid dolphins (7 *S. attenuata*, 1 *S. clymene*, 1 *S. coeruleoalba*) during this cruise (Figure 3). They were subsampled for future analyses including genetics (skin stored in DMSO), stable isotopes (skin frozen at -80°C), and contaminants (blubber frozen at -80°C).

Passive Acoustic Survey

Towed Array

Passive acoustic surveys using a towed hydrophone array were conducted concurrent with visual surveys during daylight hours when environmental conditions allowed. Passive acoustic surveys were suspended during portions of the tracklines that occurred in water depths

shallower than 75 m and during nearby lightning storms. Passive acoustic monitoring for odontocetes was conducted using one of two modular towed hydrophone arrays deployed approximately 300 m behind the ship and weighted with 13.6 kg (30 lbs) lead wire. Hydrophone depth was not measured on the first leg of the cruise due to a faulty pressure sensor in the towed array; depth averaged 12 ± 1.3 m on prior cruises at this speed, tow distance, and weighting. On the second leg from July 21 and August 15, when the depth sensor was functional, the hydrophone depth averaged 12 ± 1.3 m at a standard survey speed of 10 kts.

The custom-built modular towed hydrophone array was deployed in one of two configurations: 1) as a five-element mixed-frequency oil-filled end array or 2) a four-element high-frequency oil-filled end array (Rankin et al. 2013). The five-element end array included paired pre-amplifier and hydrophone elements capable of recording a broad range of frequencies. Sensors 1, 3, and 5 were optimized for greater detection ranges for mid-frequency recordings by using APC International 42-1021 hydrophones with custom-built pre-amplifiers. The APC 42-1021 hydrophones have a -212 dB re V/uPa sensitivity with a flat frequency response (+/- 4 dB) from 1 to 45 kHz. The corresponding pre-amplifiers provided a highpass filter with 45 dB gain above 5 kHz. Sensors 2 and 4 were optimized for recording the full bandwidth of high-frequency echolocation signals by using Reson TC4013 hydrophones with custom-built pre-amplifiers. The TC4013 hydrophones have a -212 dB re V/uPa sensitivity with a flat frequency response (+/- 2 dB) from 5 to 160 kHz. The corresponding pre-amplifiers provide a high-pass filter with 50 dB gain above 5 kHz. The four-element broadband end array included four High Tech, Inc. HTI-96-min hydrophones with custom-built pre-amplifiers. The HTI-96-min hydrophones have a -181 dB re V/uPa sensitivity with a flat frequency response (+/- 5 dB) from 14 to 85 kHz. The corresponding pre-amplifiers provided a highpass filter with 37 dB gain above 2 kHz. The four-element array incorporated a Keller 7SE pressure sensor ahead of the hydrophones in the end array to measure depth, and data were digitized using a Measurement Computing USB-1208LS A/D converter and recorded in the software program Pamguard (v.1.15.03; Gillespie et al. 2008).

During Leg 1 from June 23 to June 30, the five-element end array was deployed. Data from sensors 1, 2, 4, and 5 were digitized for recording with a custom 12 channel SailDAQ soundcard (www.sa-instrumentation.com, accessed Jan. 12, 2018) sampling 16 bits at 500 kHz, yielding a recording bandwidth of 1-250 kHz. SailDAQ output from sensors 1 and 5 were then routed through a custom Magrec amplifier and Mark of the Unicorn (MOTU) Traveler mk3 audio interface for real-time aural monitoring (Appendix A). During leg 2 from July 21 to August 14, the four-element end array was deployed. Data from all four sensors were digitized for recording with the SailDAQ soundcard sampling 16 bits at 500 kHz and data from sensors 1 and 4 were routed through the Magrec and MOTU for real-time aural monitoring (Appendix B).

While the array was deployed, acoustic signals were monitored by a team of two acoustic technicians who rotated through a primary and on-call secondary position every 1 to

2.5 hours while the array was deployed. The software Pamguard (v.2.00.20; Gillespie et al. 2008) was used to control the SailDAQ, to record acoustic data and metadata to hard-disk, and for real-time monitoring including logging effort and encounter details and obtaining bearings to acoustic detections. All acoustic data were continuously recorded as four minute, 4-channel wav files to 8 TB external SATA hard drives. Acoustic field technicians continuously monitored data aurally and visually through spectrographic analysis using both Pamguard and Ishmael (Mellinger 2001) software, and detected and localized acoustically-active odontocetes in real-time using Pamguard's automated click detectors, hyperbolic bearing calculator, and manual target motion analyses as well as Ishmael's hyperbolic bearing calculator for manually-selected whistles. Metadata describing acoustic encounters included individual click detections with corresponding time, localization, and localization quality information.

Passive Acoustics Results

During the survey, over 334 hours of acoustic data were recorded with a towed array yielding 4.36 TB of data and 141 cetacean detections. During real-time monitoring, acoustic detections were broadly categorized as Risso's dolphin clicks, sperm whale clicks, dwarf/pygmy sperm whale clicks, unidentified Ziphiid clicks, unidentified delphinid vocalizations (whistles and clicks), or unidentified odontocetes (clicks only; Table 4, Figure 6). Preliminary acoustic detections include 58 sperm whale encounters, four *Kogia* species encounters, and two unidentified beaked whale encounters. Sperm whale encounters may represent either individuals or groups of individuals. Additional unidentified odontocete encounters may be identified as beaked whale encounters in post-processing. Unidentified acoustic detections of odontocetes were made throughout the survey and were correlated with visual sightings when localization was possible. These recordings with visually-verified species identifications will be reanalyzed and verified in post processing to develop acoustic species classification algorithms for acoustic species identification. Acoustic data will also be used to improve estimates of sperm whale and beaked whale abundance.

Passive Acoustic Mooring

As part of NOAA's Ocean Noise Reference Station Network (NRS) project, the GoMx NRS06 buoy was refurbished during this cruise. The NRS buoy was deployed to continuously record sounds up to 2.5 kHz for two years with the objective of collecting calibrated long-term recordings of ambient noise to allow comparisons of noise conditions among sites in US waters and over time. The NRS buoy was recovered, refurbished, and redeployed on July 27, 2023 (Figure 7).

As a part of the NOAA SEFSC's Rice's whale passive acoustic monitoring project to improve understanding of Rice's whale occurrence and habitat use in the western GoMx, eight long-term SoundTrap ST600STD moorings were deployed on August 5, 2023 along the Texas

shelf break. The SoundTraps were deployed to continuously record low frequency sounds between 20 Hz and 12 kHz for up to 6 months (Figure 7).

Environmental Data

Environmental data including water temperature, salinity, and weather conditions (e.g., wind speed) were continuously collected *in situ* via the ship's Scientific Computer System (SCS) and recorded in the visual marine mammal sighting database.

Seabird Survey

Seabird observers conducted counts of all birds detected within a 300-m strip transect whenever the ship was under normal cruising speed along tracklines and while in transit between tracklines. During Leg 1 (22 June – 1 July) and Leg 2 (20 July – 15 August), seabird observers logged ~121 hours and ~319 hours of effort, respectively. During these two legs, observers detected a total of 22 species of pelagic, offshore, and coastal open water seabirds. Relatively rare or infrequently detected seabird species for the GoMx (see Haney et al. 2019, Michael et al. 2023) included red-billed tropicbirds (*Phaethon aethereus*), red-footed boobies (*Sula sula*), and black-capped petrels (*Pterodroma hasitata*) (VSAD unpublished data).

Data and Sample Disposition

All data other than seabird data collected during GU23-03 including visual survey data, passive acoustic data, and SCS data are archived and managed at the SEFSC in Miami, FL with backup copies at the SEFSC Pascagoula Laboratory. Seabird data are maintained by USFWS. The data presented here are preliminary and subject to change as further auditing and analyses continue.

Permit and Funding Source

The Southeast Fisheries Science Center was authorized to conduct marine mammal research activities during the cruise under MMPA Research Permit No. 21938-03, issued to the SEFSC by the NMFS Office of Protected Resources, and IACUC# Atlantic IACUC-2020-002. The data in this accession were funded by the Vessel Surveys for Abundance and Distribution of Marine Mammals and Seabirds Project (DIVER ID 317). This project is one of many selected by the Open Ocean Trustee Implementation Group to restore natural resources injured by the 2010 DWH oil spill in the GoMx.

References

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Table 1. List of Participants

Name	Legs	Affiliation	Duty
Jesse Wicker	1	CIMAS, Miami	Field party chief (FPC) – leg 1
Anthony Martinez	2	SEFSC, Miami	Field party chief (FPC) – leg 2
Carrie Sinclair	1, 2	SEFSC, Pascagoula	Field party chief (FPC) – leg 1; Marine mammal observer
Melissa Soldevilla	1	SEFSC, Miami	Lead acoustician
Mary Applegate	1, 2	CIMAS, Miami	Data manager, marine mammal observer
Felipe Triana	1, 2	CIMAS, Miami	Marine mammal observer
Thomas Ninke	1, 2	CIMAS, Miami	Marine mammal observer
Paula Olson	1	CIMAS, Miami	Marine mammal observer
Heidi Malizia	1	CIMAS, Miami	Marine mammal observer
Rachel Hardee	1, 2	CIMAS, Miami	Marine mammal observer
Ellie Hartman	1, 2	CIMAS, Miami	Marine mammal observer
Lisa Barry	1, 2	CIMAS, Miami	Marine mammal observer
Corey Accardo	2	CIMAS, Miami	Marine mammal observer
Amy Brossard	2	CIMAS, Miami	Marine mammal observer
Matt Maiello	2	SEFSC, Miami	Marine mammal observer
Shannon Merkle	1, 2	CIMAS, Miami	Acoustician
Jonathan Reid	2	Marine Conservation Research, Ltd.	Acoustician
Chris Haney	1	USFWS/Terra Mar	Seabird observer
Jon Andrew	1, 2	USFWS/Terra Mar	Seabird observer
Lisa Hug	2	USFWS/Terra Mar	Seabird observer

Affiliations: SEFSC = NOAA Southeast Fisheries Science Center; CIMAS = Cooperative Institute for Marine and Atmospheric Studies

Table 2. Daily survey operations and effort during GU23-03 including the visual and acoustic effort, the average sea state, number of marine mammal sightings, number of acoustic detections from the towed array, number of sonobuoys deployed, and the number of Acoustic Recording Packages (HARPs) deployed or recovered.

Survey Leg	Date	Visual Effort (km)	Ave. sea state	Num. sights	Num. biopsies	Acoustic Effort (hr)	Num. Ac. Dets.	ARP deploy/ recover
Leg 1	21-Jun	0	NA	0	0	0	0	0
	22-Jun	30.5	2.8	0	0	0	0	0
	23-Jun	202.9	2.5	7	0	12.7	2	0
	24-Jun	186.9	2.0	19	4	12.2	10	0
	25-Jun	195.9	1.8	19	1	12.3	7	0
	26-Jun	211.7	2.1	19	0	12.4	6	0
	27-Jun	174.7	1.7	18	2	12.6	7	0
	28-Jun	222.3	2.3	17	0	12.9	2	0
	29-Jun	208.7	3.1	13	0	12.7	6	0
	30-Jun	167.1	2.1	11	0	10.8	10	0
	1-Jul	0	NA	0	0	0	0	0
Leg 2	20-Jul	0	NA	0	0	0	0	0
	21-Jul	146.8	2.3	15	0	11.3	6	0
	22-Jul	157.2	3.5	9	0	8.6	2	0
	23-Jul	165.6	3.9	3	0	7.5	2	0
	24-Jul	235.4	3.3	4	0	12.4	4	0
	25-Jul	206.9	2.9	6	0	6.0	2	0
	26-Jul	142.9	0.8	38	0	6.4	7	0
	27-Jul	71.8	2.0	13	0	0	0	1
	28-Jul	197.4	2.3	12	0	10.4	6	0
	29-Jul	246.0	2.6	5	0	13.1	6	0
	30-Jul	201.9	2.2	16	0	8.1	0	0
	31-Jul	210.0	2.6	19	0	13.0	6	0
	1-Aug	190.5	1.9	26	0	10.8	3	0
	2-Aug	210.3	1.9	22	0	10.5	5	0
	3-Aug	176.2	2.6	13	0	11.0	3	0
	4-Aug	152.5	2.8	4	0	9.3	1	0
	5-Aug	0	NA	0	0	0	0	8
	6-Aug	232.0	3.3	2	0	11.8	3	0
	7-Aug	175.6	3.7	6	0	9.8	10	0
	8-Aug	232.1	3.3	11	0	11.6	2	0
	9-Aug	226.0	3.4	3	0	8.5	4	0

Survey Leg	Date	Visual Effort (km)	Ave. sea state	Num. sights	Num. biopsies	Acoustic Effort (hr)	Num. Ac. Dets.	ARP deploy/ recover
	10-Aug	186.1	3.3	6	1	12.7	1	0
	11-Aug	254.8	2.6	12	0	10.9	6	0
	12-Aug	217.0	1.9	6	0	12.4	2	0
	13-Aug	192.3	2.2	10	1	12.0	6	0
	14-Aug	161.9	2.5	13	0	7.5	4	0
	15-Aug	0	NA	0	0	0	0	0
Total		**6190.1**	**2.5**	**397**	**9**	**334.2**	**141**	**9**

Table 3. Marine mammal sightings during each leg of GU23-03

Species	Leg 1	Leg 2	Total
Atlantic spotted dolphin (*Stenella frontalis*)	3	0	3
Blainville's beaked whale (*Mesoplodon densirostris*)	1	0	1
Clymene dolphin (*Stenella clymene*)	0	4	4
Common bottlenose dolphin (*Tursiops truncatus*)	3	24	27
Common bottlenose or Atlantic spotted dolphin (*T. truncatus/S. frontalis*)	1	0	1
Cuvier's beaked whale (*Ziphius cavirostris*)	3	7	10
False killer whale (*Pseudorca crassidens*)	2	0	2
Fraser's dolphin (*Lagenodelphis hosei*)	1	0	1
Gervais' beaked whale (*Mesoplodon europeaus*)	1	0	1
Melon-headed or Pygmy killer or False killer whale (*Peponocephala electra/Feresa attenuata/P. crassidens*)	2	1	3
Melon-headed or Pygmy killer whale (*P. electra/F. attenuata*)	1	4	5
Pantropical spotted dolphin (*Stenella attenuata*)	9	13	22
Pilot whales (*Globicephala* sp.)	1	4	5
Pygmy or Dwarf sperm whale (*Kogia* sp.)	9	14	23
Pygmy sperm whale (*Kogia breviceps*)	0	1	1
Rice's whale (*Balaenoptera ricei*)	0	2	2
Risso's dolphin (*Grampus griseus*)	4	3	7
Rough-toothed dolphin (*Steno bredanensis*)	1	6	7
Sei or Fin or Bryde's-like whale (*Balaenoptera borealis/physalus/edeni/ricei*)	0	1	1
Sperm whale (*Physeter macrocephalus*)	15	59	74
Spinner dolphin (*Stenella longirostris*)	2	2	4
Spinner or Clymene dolphin (*S. longirostris/clymene*)	1	1	2
Stenellid dolphin (*Stenella* sp.)	15	24	39
Striped dolphin (*Stenella coeruleoalba*)	0	2	2
Unidentified dolphin (Delphinidae)	35	59	94
Unidentified large whale	0	2	2
Unidentified mesoplodont (*Mesoplodon* sp.)	2	4	6
Unidentified odontocete (Odontoceti)	10	31	41
Unidentified ziphiid (Ziphiidae)	2	6	8
Grand Total*	**123**	**274**	**397**

*Total number of sightings per leg does not equal sum of species sightings as one sighting was mixed species.

Table 4. Towed array marine mammal acoustic detections during each leg of GU23-03

Species	Leg 1	Leg 2	Total
Sperm whale	17	41	58
Kogiidae	1	3	4
Ziphiidae	0	1	1
Risso's dolphin	0	0	0
Odontocete	10	23	33
Delphinid	21	19	40
Total*	**50**	**91**	**141**

*Total number of detections per leg does not equal sum of species detections as some detections were mixed species.

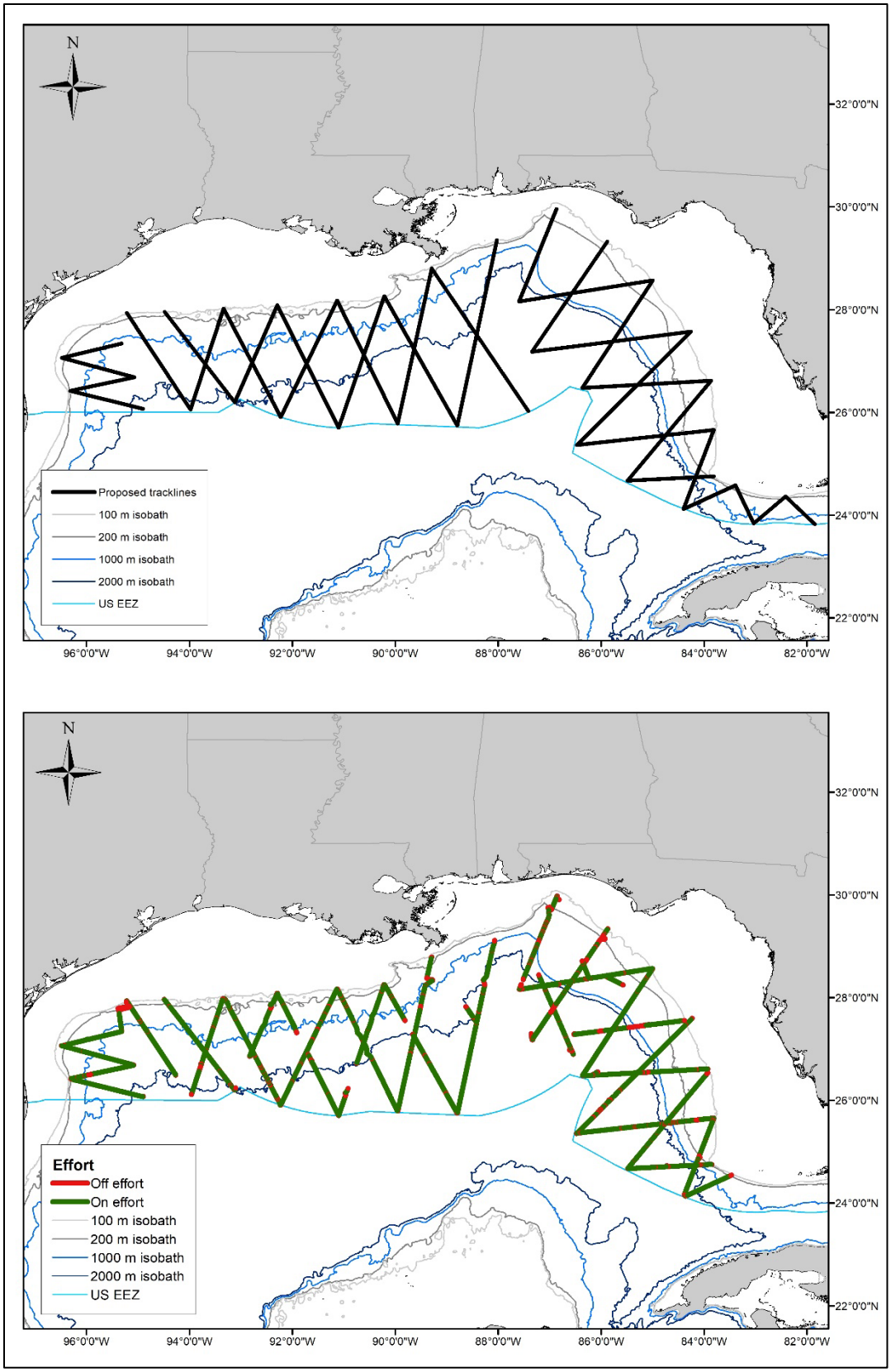


Figure 1. Planned survey tracklines and accomplished survey effort during GU23-03

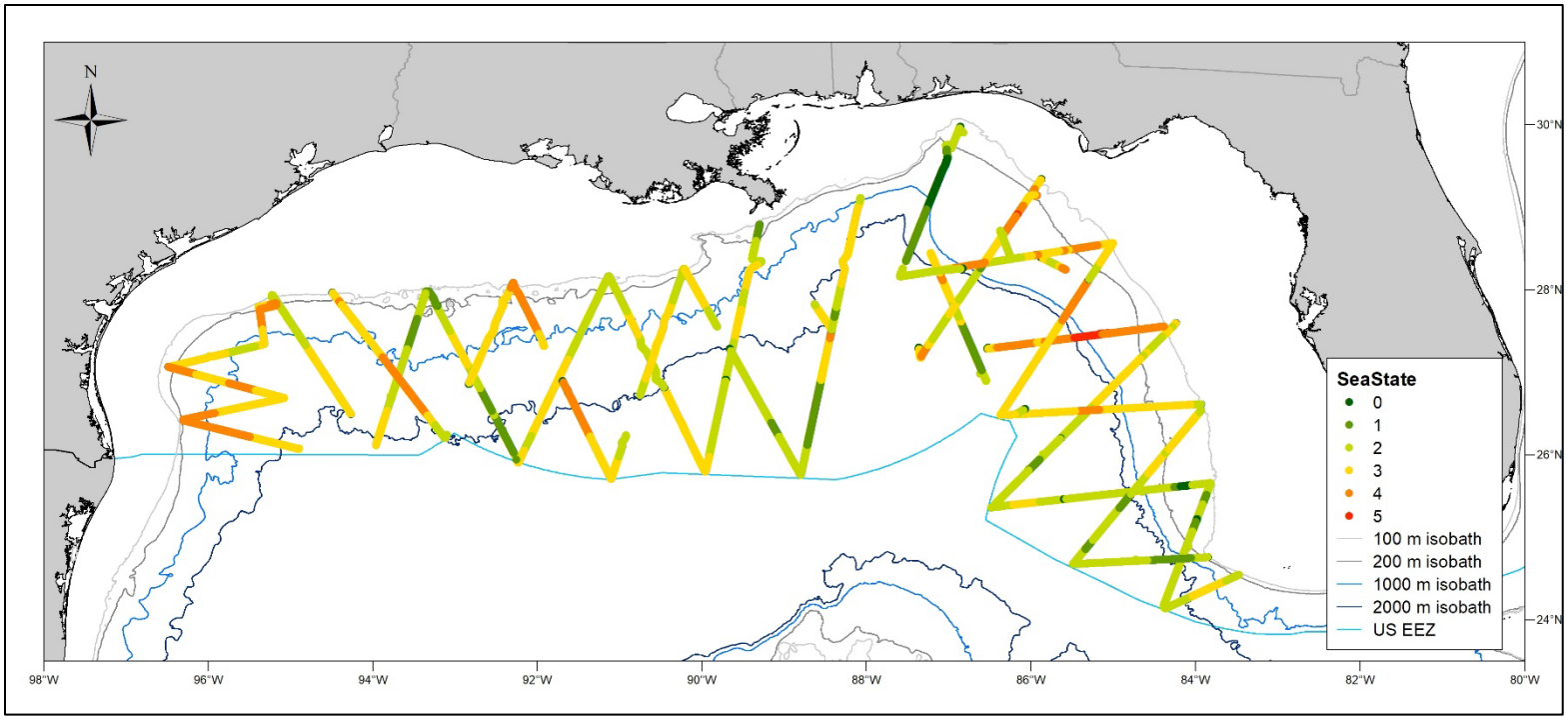


Figure 2. Sea state conditions on the trackline during survey effort for GU23-03

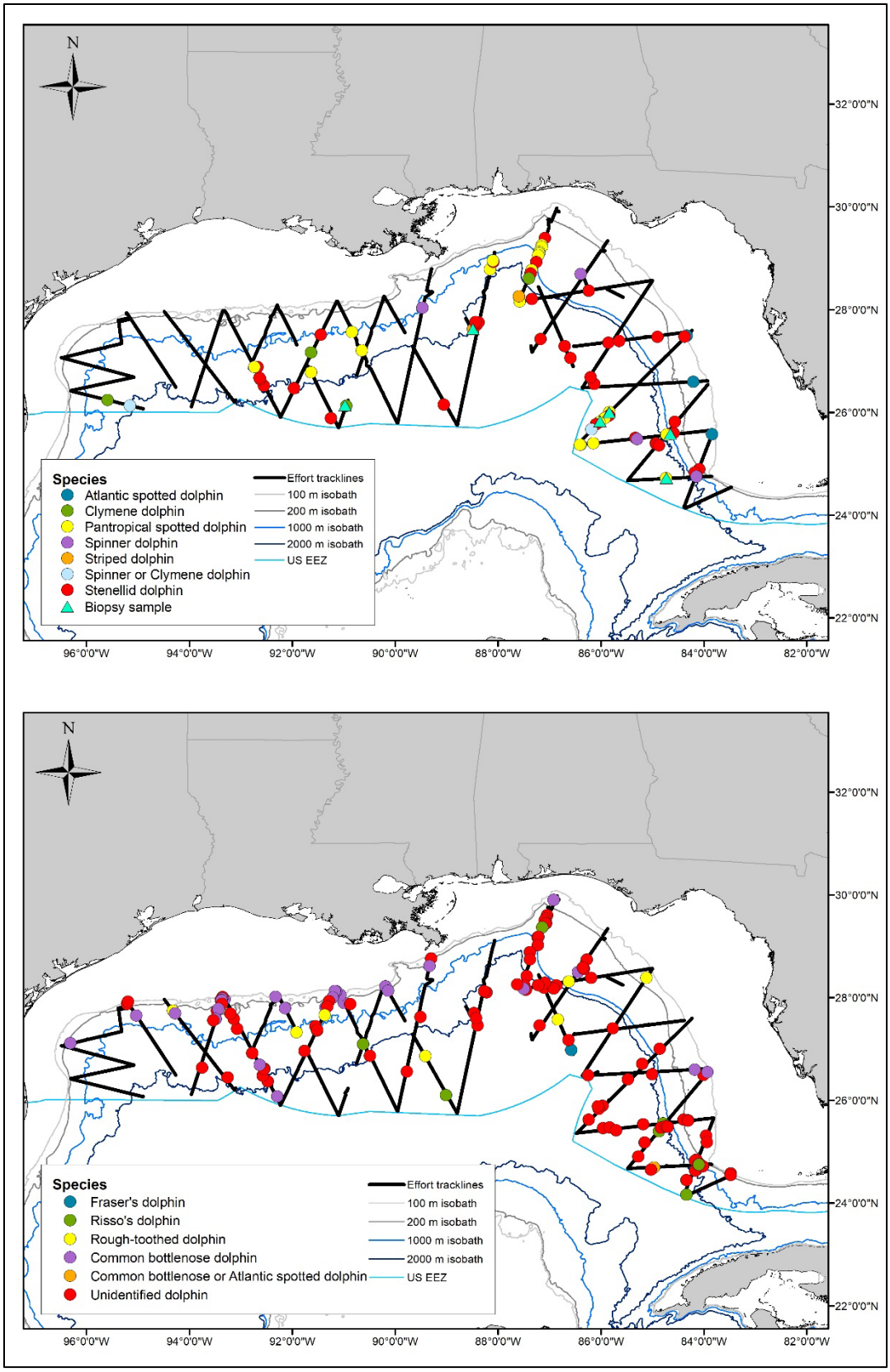


Figure 3. Dolphin sighting locations during GU23-03

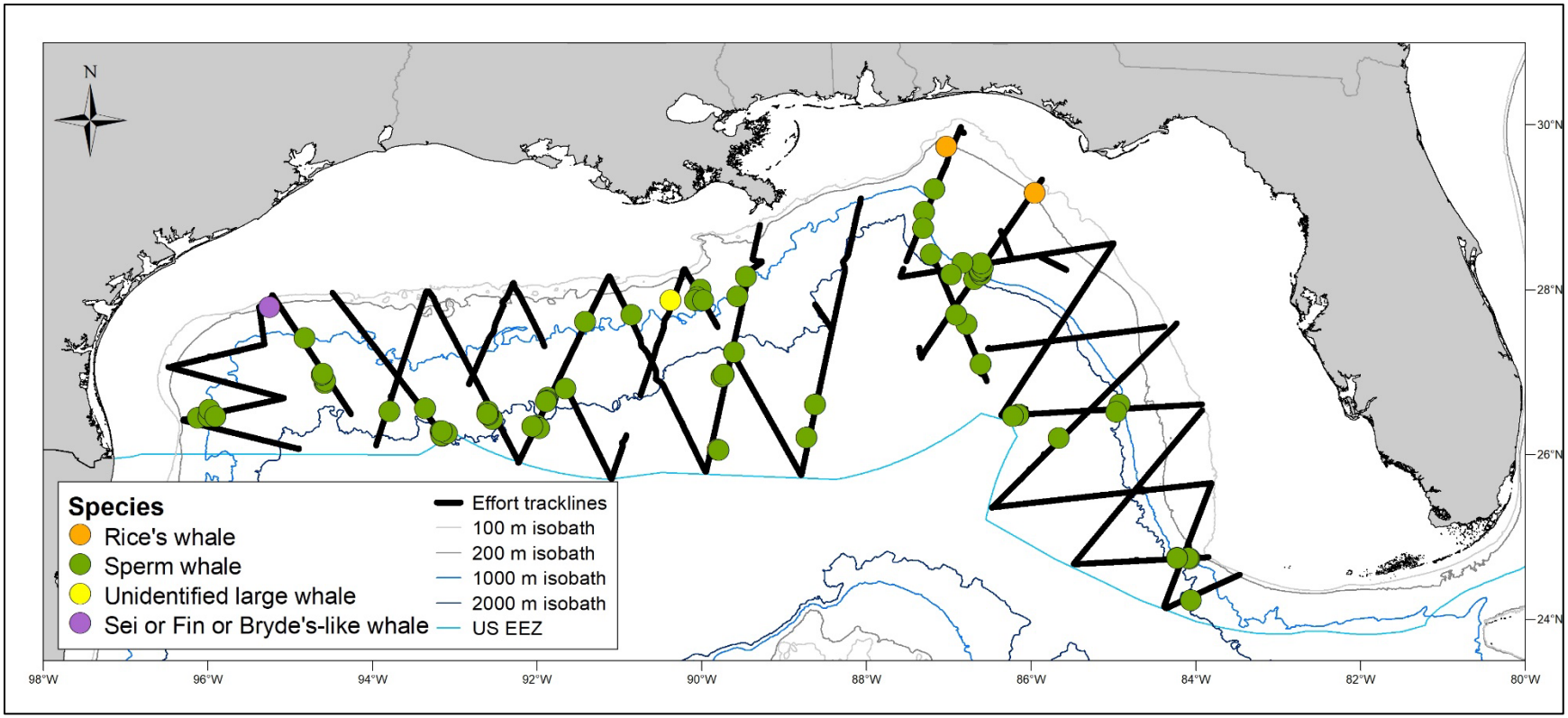


Figure 4. Large whale sightings during GU23-03

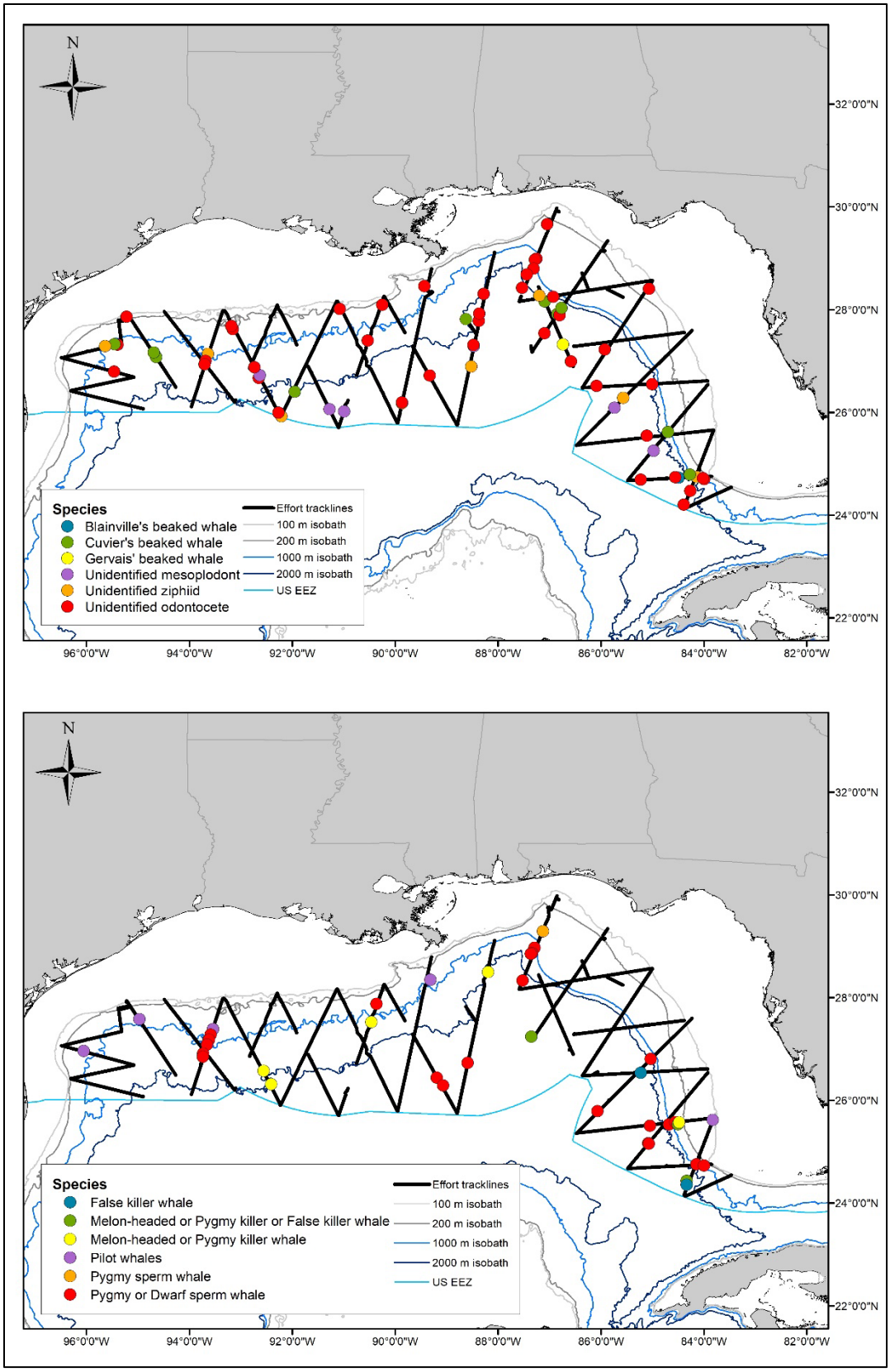


Figure 5. Small whale sightings during GU23-03

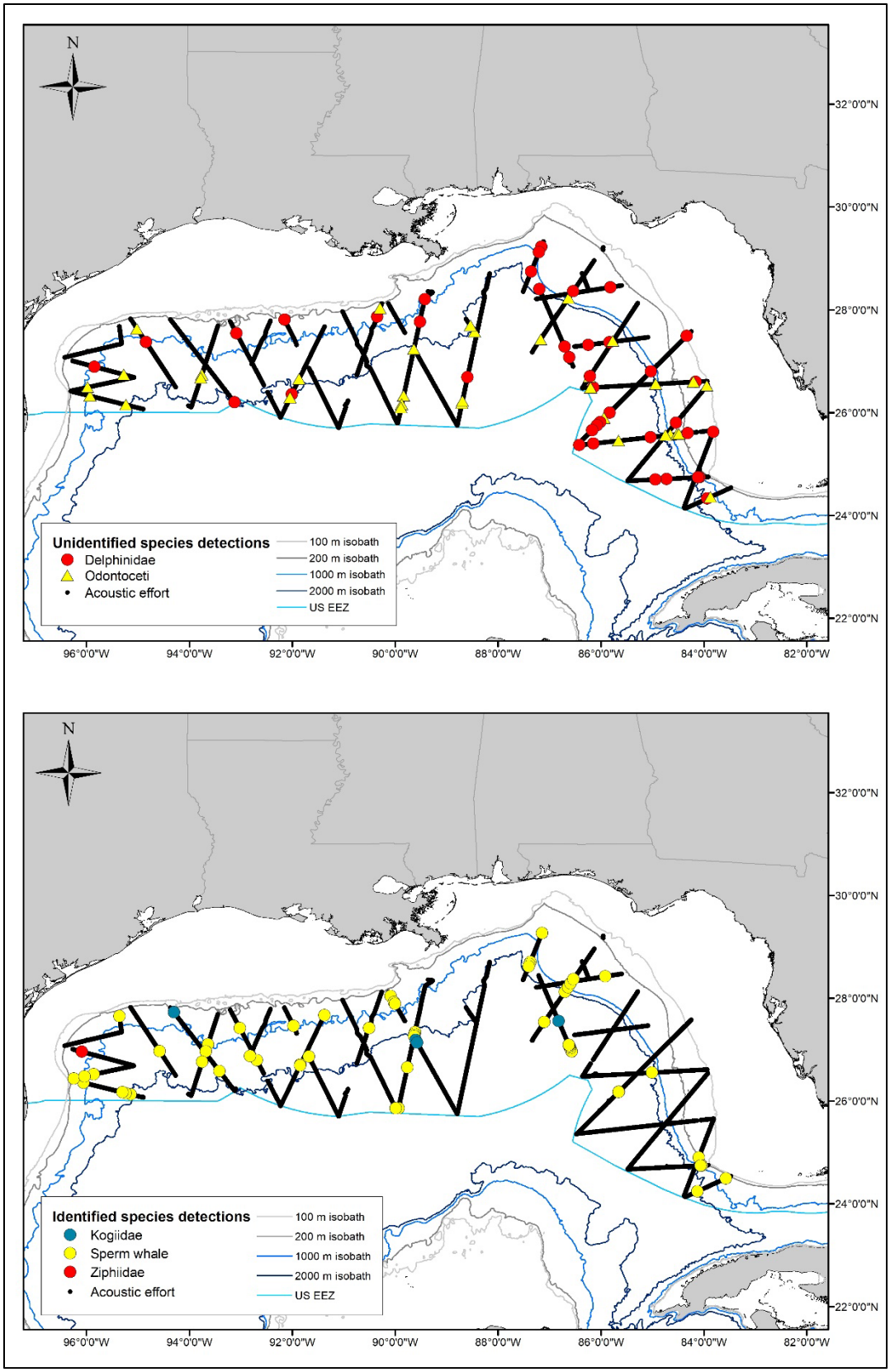


Figure 6. Passive acoustic towed array survey effort and detections during GU23-03

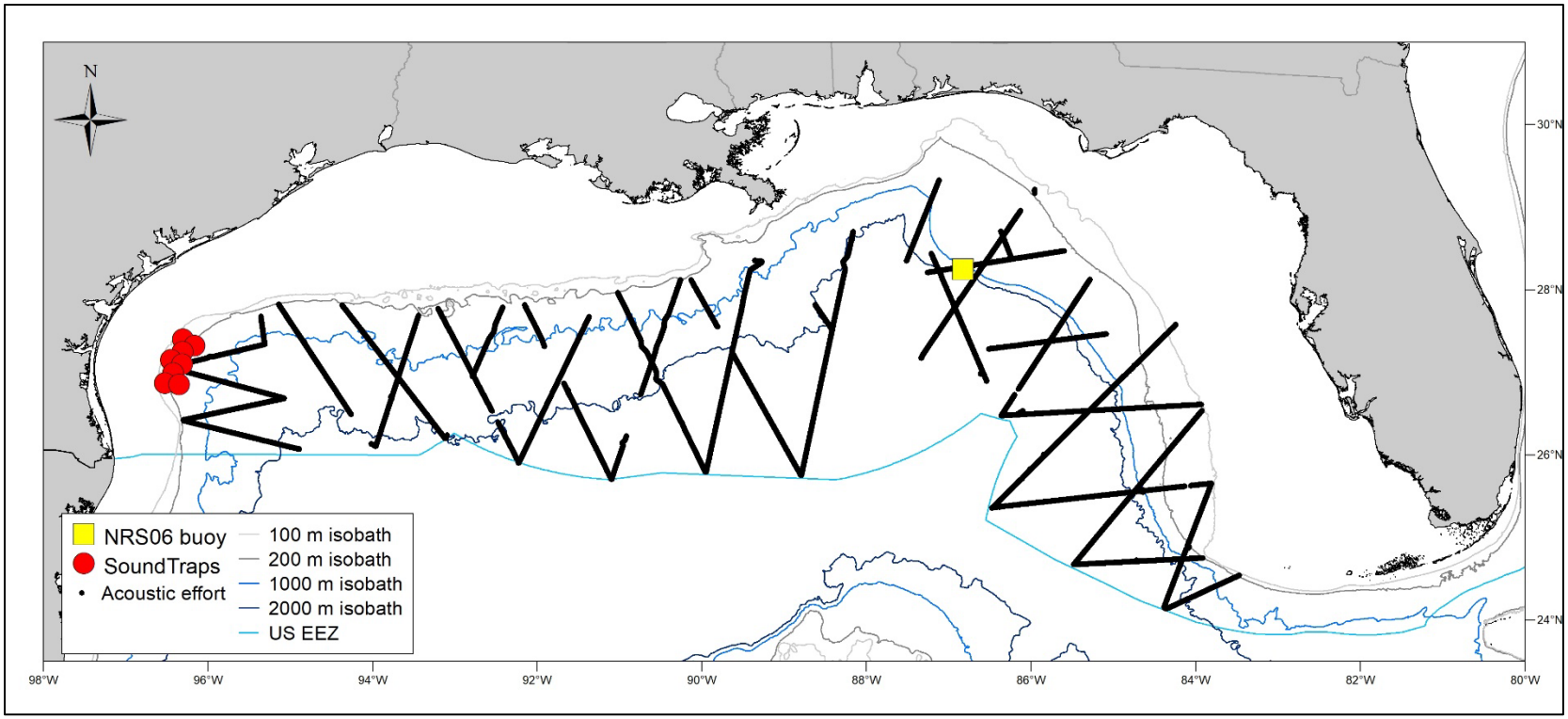
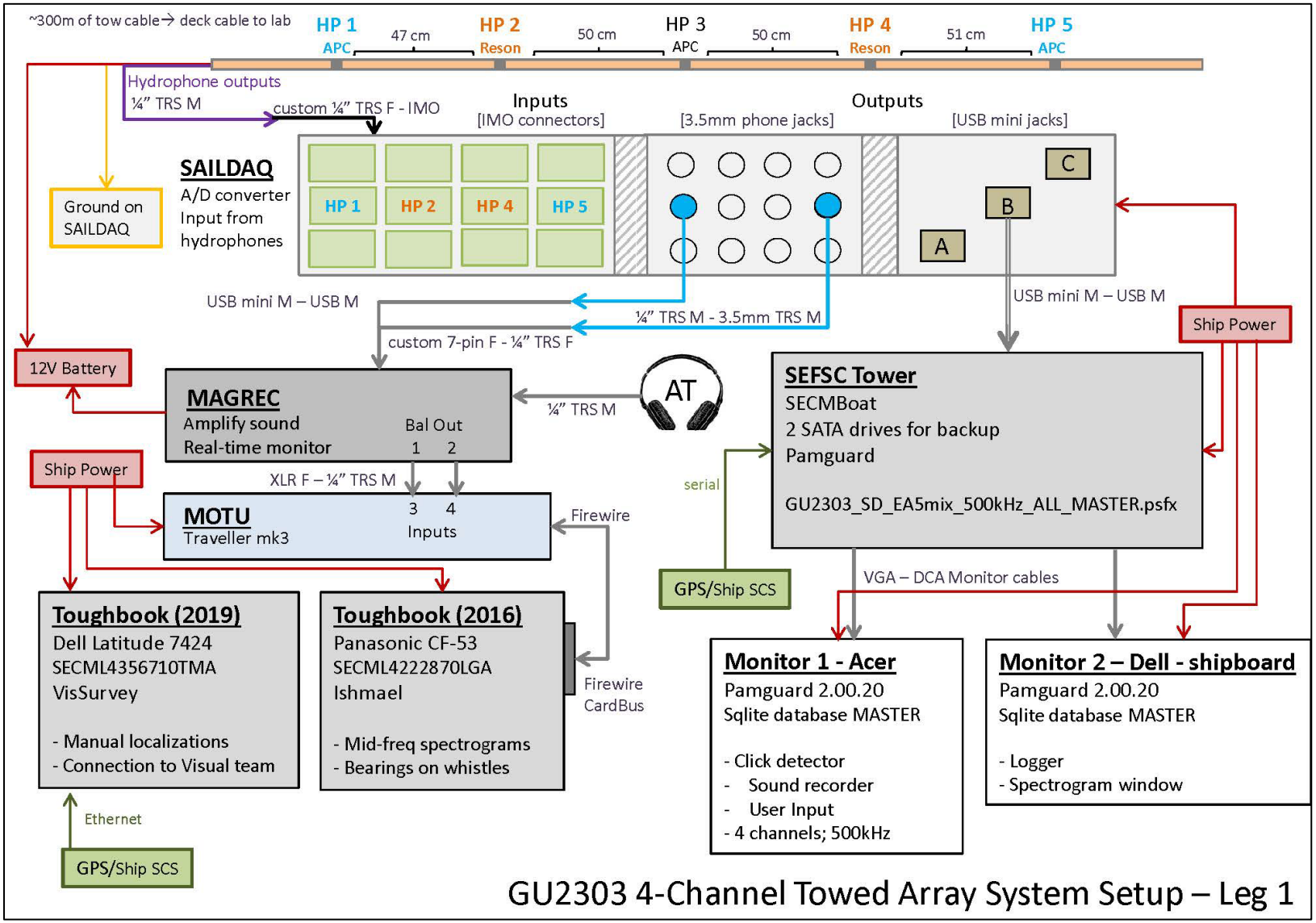


Figure 7. Passive acoustic moorings deployed or recovered during GU23-03

Appendix A. Acoustic setup diagram used during Leg 1, including towed hydrophone array, acoustic recording hardware, data inputs, and software



Appendix B. Acoustic setup diagram used during Leg 2, including towed hydrophone array, acoustic recording hardware, data inputs, and software