



Southeast Fisheries Science Center Reference Document MMTD-2024-10

CRUISE RESULTS

NOAA Ship Gordon Gunter Cruise GU-01-04 (13)

17 July - 22 August 2001

A Study of Sperm Whales in the North-Central Gulf of Mexico

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration National

Marine Fisheries Service

Southeast Fisheries Science Center

Pascagoula, Mississippi

October 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. 779-1339.

This report was created in 2001 and published at NOAA's Institutional Repository in October 2024.

CRUISE RESULTS

NOAA Ship *Gordon Gunter* Cruise GU-01-04 (13)
17 July - 22 August 2001

A Study of Sperm Whales in the North-Central Gulf of Mexico

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Mississippi Laboratories
P.O. Drawer 1207
Pascagoula, Mississippi 39568-1207

INTRODUCTION

The GulfCet I and II studies (Davis and Fargion 1996, Davis et al. 2000) confirmed that about 20 species of cetaceans routinely inhabit the Gulf of Mexico (Gulf). Sperm whales (*Physeter macrocephalus*), an endangered species, and Bryde's whales (*Balaenoptera edeni*) are the only two large whales that commonly inhabit Gulf waters. Bryde's whales are distributed throughout the world in tropical and subtropical waters. Within the Gulf, they are most commonly found in a very small area of the northeastern Gulf near the 200-m isobath. Sperm whales are found throughout the world in oceanic waters (>200 m deep). GulfCet and additional National Marine Fisheries Service (NMFS) surveys funded by the Minerals Management Service (MMS) indicate that sperm whales occur throughout the Gulf in oceanic waters, with concentrations of whales south of the Mississippi River Delta and in the southeastern Gulf off southern Florida.

The NMFS is required to produce stock assessment reports for all marine mammal stocks within the U.S. Exclusive Economic Zone. The MMS needs to evaluate potential environmental impacts of offshore oil and gas activities on marine mammals. During a 1999 Marine Protected Species Workshop, a panel of experts identified the sperm whale as a species of particular concern for proposed deepwater development in Gulf waters (McKay et al. 2001). Both agencies have a need for similar information on sperm whales, and this is the basis for research described in this report.

To meet specific agency mandates and common obligations under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act, sperm whale research is important to both the NMFS and the MMS. The information needs of both agencies relative to sperm whales are by no means mutually exclusive. To ensure that offshore oil and gas exploration and production are conducted in ways to reduce harm to the marine environment, the MMS must understand the effects these operations will have on all marine mammals, including sperm whales. The NMFS is responsible for protecting stocks of cetaceans in U.S. waters. The current designation of a single Gulf sperm whale stock that is separate from the adjacent Atlantic and Caribbean is thought to be conservative but is untested. Stocks should be defined using a variety

of criteria (Dizon et al. 1992), which include: genetics, phenotype (e.g., morphology), distribution (e.g., range and movement patterns), population parameters, and culture (e.g., vocalization patterns).

Protecting a cetacean stock is defined by the MMPA as maintaining a stock above its "optimal sustainable population" (OSP) level, where OSP is somewhere between carrying capacity and 60% of carrying capacity (Gerrodette and DeMaster 1990). The NMFS estimates the abundance of stocks in order to monitor trends in abundance and to estimate potential biological removal (PBR), where PBR is the number of human-caused mortalities that can occur in a stock and still maintain OSP or grow to OSP.

Because sperm whales in the Gulf of Mexico had rarely been studied in detail, during summer 2000, the MMS and the NMFS conducted a 30-day Pilot Study to test methods used to study sperm whales in other parts of the world (Roden and Mullin 2000). The Pilot Study was conducted in an area south of the Mississippi River Delta in waters greater than 200 m deep, where sperm whales appear to occur throughout the year (Figure 1). In late winter/early spring 2001 a similar sperm whale study was conducted in the southeastern U.S. Gulf of Mexico (Mullin et al. 2001). Both studies were carried out from the 68-m NOAA Ship *Gordon Gunter*.

Methods tested included photo-identification to study sperm whale ranging and association patterns, and biopsy sampling to study genetic stock structure and group kinship. Behavioral data from surfaced whales and morphometric data were also collected. A variety of acoustic methods using a state of the art hydrophone array system were also tested. Acoustics can enhance estimates of sperm whale abundance when combined with a standard visual line-transect survey effort. Acoustic data can contribute to an understanding of diving behavior and vocalization patterns. Certain "calls" (codas) can be compared to those of sperm whales in other ocean basins as further evidence of stock structure. Digital acoustic recording tags (DTAGs), developed under Office of Naval Research funding, were deployed by a Woods Hole Oceanographic Institution (WHOI) research team. The DTAGs are designed to help assess whale behavioral reactions to noise related to deepwater oil and gas operations.

OBJECTIVES

The summer 2001 studies focus on the area south of the Mississippi River Delta with the following objectives:

1. genetic sampling focusing on groups for studies of kinship within groups;
2. intensive photo-identification sampling for individual whale association and site fidelity studies;
3. using photo-identification and genetics results from 2000 and 2001, make mark-recapture estimates of the number of sperm whales that use the study area;
4. tests to study acoustic propagation of sperm whale vocalizations to better use the towed array as a line-transect tool (i.e., How far can sperm whale sounds be heard in the Gulf of Mexico?);

5. oceanographic sampling (CTD, XBT, thermosalinograph, remote sensing) to learn about sperm whale habitats;
6. more extensive DTAG deployment to build a baseline of diving, vocalization and behavior patterns for comparison to other areas and for future studies on the effects of anthropogenic noise, including seismic surveying;
7. initial studies of the effects of seismic surveying on sperm whale behavior;
8. a test of a bottom mounted hydrophone to collect data on the ambient noise in the Delta region;
9. passive acoustic dive profiling;
10. studies of surface behavior during daylight hours; and
11. satellite tag deployment in the Delta region for studies of long-term (up to 5 months) ranging patterns.

METHODS

Research Platforms

The Pilot Study was conducted from NOAA Ship *Gordon Gunter* and its size and acoustic characteristics were essential to the success of the study. It was also used for the 2001 southeastern Gulf and the Delta region sperm whale studies. The *Gunter* is a 68-m converted U.S. Navy T-AGOS 13 class vessel built for Navy ocean surveillance missions. The ship is acoustically quiet, and therefore ideal for conducting acoustic surveys. This is also one of the platforms used by the SEFSC to conduct visual line-transect surveys of cetaceans using 25x binoculars in the Atlantic, Caribbean and northern Gulf. It is stable, and the binocular height (15 m above the surface of the water) provides an excellent vantage point for visual surveys and behavioral studies. It will accommodate 15 scientists for multi-objective 24 hours per day operations.

A small 7-m boat, the *Relentless II (R2)*, carried aboard the *Gunter* was also critical in the Pilot Study and was used for DTAG, photo-ID, and biopsy sampling. When sperm whales were sighted, the *R2* moved rapidly into the general area of the whales, and then slowly approached them and made subtle maneuvers around them for data collection. The *R2* was designed so that it can be easily launched and retrieved from the *Gunter*. The *R2* will safely accommodate a driver and three scientists, and is equipped for safety, stability and endurance so that the scientists can routinely spend 4-6 hours up to 5 nm from the *Gunter*.

Study Area & Study Period

During MMS-supported NMFS spring ship surveys, a concentration of sperm whale sightings has occurred in the north-central Gulf south of the Mississippi River Delta in an area bounded by the 200 and 2000-m isobaths from 87.0 to 91.0 ° west longitude (Figure 1). This served as the primary study area for a multi-objective sperm whale research cruise, which was conducted during three parts or "Legs" from 17 July to 22 August 2001. Each leg originated and terminated in Pascagoula, Mississippi. The research emphasized on each leg was different with the primary research occurring as follows: Leg 1, attaching DTAGs and recording behavior; Leg

2, attaching satellite tags; and Leg 3, collecting biopsy and photo-identification samples, and conducting acoustic line transects.

Research Techniques

The goal of both Legs 1 and 2 was to maximize the sperm whale encounter rate to attach tags. Therefore visual and acoustic searching focused along the 1000-m isobath, where sperm whales have commonly been sighted in the past. During the night, an acoustic search for sperm whales occurred along the 1000-m isobath. Once found, sperm whales were tracked acoustically until daylight when they were located visually.

The first working day of Leg 3, 11 August, was to be dedicated to giving members of the news media tours of the *Gunter* and demonstrating sperm whale research techniques. The *Gunter* was to rendezvous with R/V *Tommy Munro* which was to be used to transport the reporters. Because of a mechanical problem with the *Gunter*, it had to return to port on 11 August. Later, during Leg 3, arrangements were made to pick up two reporters from Mississippi ETV and New York Times Television. The last two working days of the leg were dedicated to letting them film sperm whales and research techniques.

During the rest of Leg 3 acoustic line transects were conducted at night. During the day the 1000-m isobath was searched for sperm whales visually and acoustically. When sperm whales were encountered, the *R2* was launched to collect biopsy and photo-identification samples.

Visual Monitoring and Tracking

Cetacean visual operations were conducted using two teams of three observers during daylight hours, weather permitting (i.e., no rain, Beaufort sea state <7). Each team consisted of observers experienced in shipboard cetacean observation and identification techniques. Two observers searched for cetaceans using 25x "bigeye" binoculars mounted on the ship's flying bridge. The third observer recorded data and maintained a search using unaided eye or 7x hand-held binoculars.

Data were recorded on laptop computers using two programs interfaced with a global positioning system (GPS). The programs used were SpermCount, supplied by NOAA's Southwest Fisheries Science Center, and Logger, written by Douglas Gillespie (International Fund for Animal Welfare). SpermCount was used to track sperm whales and to determine the latitude and longitude of whales so that the *R2* could make close approaches for tagging, biopsy, etc. Logger was also interfaced with the ship scientific computing system (SCS) and was used to record environmental data (sea surface temperature, depth, sea state, weather, wind, and glare) and sighting data (species, group size, presence of calves, bearing from the bow, linear distance from the ship, behavioral observations).

Tracking and photo-identification approaches of sperm whales and other cetaceans were conducted under Research Permit No. 779-1339-03 issued to the SEFSC by the National Marine Fisheries Service Office of Protected Resources.

Acoustic Monitoring

The *Gunter* is well suited for both visual and acoustic surveys. The ship is powered by diesel-electric engines, which are acoustically quiet and produce minimal low-frequency background noise during survey operations. Two different towed arrays were used for acoustic monitoring.

The five-element towed array was a 100-m long Kevlar reinforced cable assembly with five high gain hydrophones, spaced at 2-m intervals along the cable. Each element was a piezoelectric ceramic striped cylinder, with the cable assembly and strength member passing through the center. Each sensor, along with its associated signal conditioning, filtering, and line drive electronics, was contained within a hydrodynamically shaped tow body assembly. The frequency response was essentially flat at -127 dB from about 2 kHz to 15 kHz, then climbed to a resonance peak at about 35 kHz with a level of -121 dB, then dropped off at roughly -15 dB per octave after resonance. Below 1.5 kHz, the sensors rolled off at roughly 6 dB per octave to help reduce low frequency tow and impulse noise. The first element was located approximately 17 m behind the forward underwater connector. The aft end of the array was terminated with a similar underwater connector, which allowed for testing of the array wiring and for attachment of an additional array or sensor package. This entire assembly was connected to an 800 m tow cable made from the same type cable as found in the array. This constituted the wet end of the assembly, and it was deployed from and rewound onto a hydraulically powered winch drum with a diameter of 1.2 m. A deck cable running into the acoustics lab completed the assembly and allowed for the transfer of power and signal.

A passive two element array built by Thomas Gordon consisted of 450 m of Kevlar-reinforced cable and 8 m polyurethane tube filled with Isopar M fluid at the end. The tube contained two Benthos AQ4 (medium frequency) elements 3 m apart. Each element was connected to a separate preamplifier. The tube also contained a Druck PTX depth pressure transmitter. The array was connected to a Magrec Limited HP/27ST Stereo Hydrophone Monitor Box. The hydrophone box was powered by a 12-volt battery and provided an overall bandwidth of 10Hz to 100kHz -3db. A high pass filter of -6db could be selected at 0, 40, 80, 400, 1600 and 3200 Hz. An Edirol UA-3 sound card was interfaced with the hydrophone box and laptop computer.

Two software programs were used on the laptop computer. Logger and RainbowClick (RBC), written by Douglas Gillespie, were used for automated click detection of sperm whale vocalizations. In addition to automated detection of clicks, RBC can potentially identify individual sperm whales based on the waveform of their clicks and calculates bearings to whales based on time difference of sound reception between the two elements.

Both arrays were used to track whales, record cetacean vocalizations and ambient noise (e.g., seismic exploration), and collect dive profile, sound propagation and line transect data.

Cetacean Biopsy Sampling

Biopsy sampling of sperm whale skin and blubber was attempted from the *R2*. Sperm whale biopsy sampling was conducted under MMPA Permit No. 909-1465 issued to Dan Engelhaupt. Biopsy samples of skin and blubber were also collected from selected cetaceans when possible

from the bow of the *Gunter* under MMPA Permit No. 779-1339-03 issued to the SEFSC. Samples of all species were collected using a modified crossbow and a .22 caliber dart rifle. Both of these devices were fitted with specially designed biopsy heads that extract a small plug of tissue from the animals. As required by both MMPA permits, data on each sampling attempt were recorded in a log book, including date, time, platform, sampler and recorder names, field number, sampling device, species, location (GPS), number of hits and misses, body location struck, behavioral reaction, and whether a sample was obtained. A complete log can be obtained from the Pascagoula Laboratory.

Sloughed Skin and Fecal Samples

Sperm whales are known to shed skin and this skin can be used for DNA studies. Small nets and skin diving gear were kept in the *R2* to collect skin. Sperm whales often defecate when diving, and fecal samples can yield information about the whales' diet. Nets were kept on the *R2* to scoop fecal samples.

Digital Acoustic Recording Tag (DTAG)

The DTAG, developed by the Woods Hole Oceanographic Institute (WHOI) in collaboration with the Office of Naval Research, can measure the received sound levels a sperm whale "hears" from its surroundings as well as a variety of potential behavioral and physiological responses of the whale that potentially can be correlated to certain sound stimuli. The DTAG was successfully deployed four times during the Pilot Study. The objectives for the 2001 DTAG component of the Gulf of Mexico sperm whale research were as follows:

1. Improve the reliability and longevity of tag attachment.
2. Establish a substantial baseline data set for undisturbed sperm whales (see Mullin et al. 2001).
3. Determine suitable sampling strategies for the tag and for supporting visual observations and ship-based acoustic monitoring.
4. Develop an understanding of natural behavior in the baseline data set.
5. Improve our understanding of the role of sound in socializing and foraging sperm whales.
6. Develop a protocol for controlled airgun sound exposures and perform sound experiments on tagged animals.
7. Test whether the controlled airgun exposures elicit obvious responses that are rare or not present in the baseline data.
8. Develop an integrated approach to response determination and assess its feasibility for a long-term study.

Tagging was done under MMPA Permit No. 369-1440-01, issued to Dr. Bruce Mate with Dr. Keith Mullin acting as co-investigator under the permit, and MMPA Permit No. 981-1578-01 issued to Dr. Peter Tyack with Dr. Mark Johnson acting as co-investigator. The delivery system, consisting of a 40-ft carbon fiber pole, cantilevered and mounted in the bow of the *R2*, was used with great success to deliver tags during the Pilot Study. The long pole allows the *R2* to stay behind the target animal, minimizing the risk of collision.

Satellite Tags

Dr. Bruce Mate of Oregon State University has developed implantable Argos satellite-monitored tags that have been successfully used on humpback, blue and right whales. Leg 2 served as a pilot study for their application to sperm whales in the Gulf of Mexico. Tags were applied with a crossbow at close range from the bow of the *R2*. Twelve tags were prepared for Leg 2. The tags can transmit daily location data for up to 9 months and provide information on ranging and movement patterns. Dr. Mate conducted the tagging under MMPA Permit No. 369-1440-01.

Photo-identification (Photo-ID)

Sperm whale flukes can be used to identify individual whales. A large number of flukes are unique because they vary in smooth and rough edges and occasionally portions of the fluke are missing. Photo-ID has been used numerous times to study aspects of sperm whale biology including: group stability, site fidelity, association patterns between individuals, population size, and group composition. From the summer 2000 and winter 2001 studies, 95 slides of suitable quality for sperm whale photo-ID were analyzed resulting in 55 different sperm whales. A photographer was on the *R2* during all operations (e.g., DTAG) to photograph/video flukes.

Behavioral Observations

Behavioral observations are a crucial element in gaining an understanding of sperm whale biology and habitat utilization. Behavioral data were recorded from the *Gunter* using Logger and digital video cameras (Canon GL1 using 10x setting). Logger, an environmental database program, was run continuously during visual surveys. Navigational and environmental data were downloaded automatically every 10 seconds from the ship's SCS. Additional environmental data were entered by observers every two hours. Visual effort and sightings were also recorded. Protocols for data collection on sperm whale sightings were developed. The program had the benefit of being customized to meet the needs of the project. For each sperm whale group encountered, the following data were recorded: number of whales, status of whales, orientation, bearing and range to whale, and behavior of the group. Additionally, each time fluke ups occurred, an update was recorded in the program. Video cameras were mounted to the top of each 25x binocular for the collection of additional data. These focal video sessions were recorded in the Logger program as well, with the cluster number, number of whales, start and stop time of the session, and reason session ended. The video tape number and cut off time were also recorded.

These sessions provided data on respirations, surface times and fine scale movements of whales. Observers were instructed on operation of the cameras and asked to speak clearly into a microphone describing the heading, number of whales present and behavior of the whales. Each time a whale blew, this was announced in the event that the blow was not detected in the video. Additionally, frequent bearings and reticules were given. During Leg 1 of the cruise, focal sessions before and after the tagging were recorded. While at the surface each tagged whale was video taped. Also during Leg 1, during tagging operations, clusters of whales were updated in the Logger program every five minutes so that fine scale movements could be

determined. As the synchronization of time was essential, each video camera's time was checked every morning and evening and a note made in the Logger program on any discrepancy.

Line-transect Abundance

In post cruise analyses, towed array data can be used to determine perpendicular distances to sperm whale vocalizations. Therefore, when the array is towed in a straight line, line transect methods can be applied to estimate the density of sperm whale groups. Estimating group size is still problematic and probably still requires a visual estimate. During Leg 3, acoustic line transects were conducted at night in the study area in a zig-zag pattern from the 600 m isobath to about 30 nm south (Figure 2). The study area from 87.0 to 90.0° west longitude was covered from east to west surveying every other "tooth" each night in the pattern, and from west to east alternating the pattern.

Environmental Data

Environmental data were collected using a CTD and by launching XBTs. A host of information from shipboard sensors was accessed via the SCS. The SCS continuously displayed and recorded to disk the ship's position, heading and speed, wind speed and direction, barometric pressure, sea surface and air temperatures, and water depth. An acoustic doppler current profiler (ADCP) also recorded data on acoustic backscatter (ABS) 24 hours per day. ABS data can be used as a proxy for zooplankton abundance. Dr. Doug Biggs (Texas A&M University) and Dr. Bob Leben (Colorado Center for Astroynamics Research) supplied satellite imagery of the sea surface temperature prior to and during the cruise.

RESULTS

During each leg, the cruise track was confined to the area near the 1000-m isobath from DeSoto Canyon in the east to Mississippi Canyon in the west (Figures 3-5). Sperm whales were generally encountered throughout this area (Figure 6). Exceptions were the area west of 90° west longitude and a narrow region due south of the Mississippi River delta. Effort and number of samples are summarized in Table 1.

On 15 August 2001 a group of six killer whales were observed "harassing" a group of sperm whales. A rich data set was collected consisting of very clear sound recordings of sperm whale vocalizations, including codas, killer whale vocalizations, digital video with observer narration, tracking data on both the sperm whale "group" and killer whales, and biopsy samples of both killer whales and sperm whales.

Acoustic Monitoring

The objectives were to localize an individual or group of sperm whales as efficiently as possible in conjunction with the visual teams, maintain acoustic contact with the animal(s) through the day and night, and to make high fidelity recordings of all marine mammal species encountered if

time and circumstance allowed. Additional objectives were to collect data on sperm whale dive profiles using clicks and reflected clicks, and acoustic propagation of sperm whale clicks.

A wide array of software was used throughout the leg. Ishmael, written by Dave Mellinger, in conjunction with the towed array, was the chief tool used by the acoustics team to find and track sperm whales. SpectraPlus was used to display data from the array, an active sonobuoy or from hard disk files. SpectraPlus also allowed easy recording to hard disk, though limited in bandwidth. The program Record, written by Jay Barlow of the SWFSC, was used to make high frequency recordings to hard disk. RainbowClick assisted with locating and tracking sperm whales, especially late into the night. WhaleTrak, also by Jay Barlow, was linked with Ishmael and real-time GPS data to provide a graphical display of bearing information and as a means of keeping a log of acoustic activity.

Recordings of sperm whales, other marine mammals, and anthropogenic sounds were made on various media during the cruise. In general, recordings from the towed array were made with a TASCAM 8-track digital tape recorder. Recordings from sonobuoys were made on a Sony 2-track DAT recorder or on open tracks on the 8-track tapes. Additionally, when high frequency (>24 kHz) recordings were needed, 1-track recordings from the towed array were made to the hard disk drive of a PC. These hard disk recordings cover a range from 1kHz to 75kHz. A total of 133 DTRS (8-track) tapes were recorded.

Numerous excellent recordings of seismic (air gun) exploration activity and simultaneous sperm whale vocalizations and air gun activity were made at different times and locations. At least four identified species of marine mammals were recorded.

Click detection distance tests were conducted in an effort to help quantify the maximum range at which a sperm whale click could be heard and reliably used for localization of the animal.

DTAG Sampling

DTAGs were successfully attached 13 times. Two tags stayed on for 9 hours, the maximum time. Three tags fell off within minutes and yielded little data. The average attachment time was about 2.7 hours. Due to a battery problem, one of the 9 hour tags recorded only 11 minutes of data. Therefore, a total of 26 hours of DTAG data were recorded. These included multiple dives of depths of 500 - 800 m.

Satellite Tagging

Satellite tagging was attempted on Leg 2. Leg 2 was heavily impacted by Tropical Storm *Barry*. Of eight scheduled working days for the leg, 4.5 were lost to the storm. Nevertheless, four satellite tags were deployed. One tag was known to be transmitting data at the end of the cruise.

Photo-identification

Eighty-eight fluke photos from 35-mm cameras were obtained that may be useful for photo-ID. These photos were distributed throughout the length of the area surveyed (Figure 7). Fluke images from digital video made during satellite tagging from the *R2* may yield additional photo-ID data.

Cetacean Biopsy Sampling

Fifty genetic (skin) samples were collected from sperm whales throughout the area searched (Tables 1 and 2, Figure 8). Thirty-nine were skin and blubber samples collected with a dart. In addition, 11 sloughed skin samples were collected including five obtained from the suction cups from DTAGs. Skin samples were collected from two of the satellite tagged whales.

Biopsy samples were obtained from three other species, including Clymene dolphin (2), pilot whale (3), and killer whale (2) (Figure 8). The samples from the killer whales are probably the first collected from free ranging animals in the Gulf of Mexico. Squid beaks were recovered on two occasions after a sperm whale dove.

Behavior Data

Focal (DTAG) animal data were collected on forms during daylight hours when a DTAG was attached. Binocular-mounted video tape with observer narration was collected on 146 sperm whale encounters that totaled 16.6 hours (Table 2). About 10 total hours of video and narration of the sperm whale and killer whale sighting on 15 August 2001 were recorded.

Acoustic Line Transect

About 360 nm of acoustic line transects were surveyed during Leg 3 (Figure 5). While the exact number of sperm whale contacts will only be known after analyses of the recordings, very few sperm whales were detected during these transects.

Environmental Data

Eight profiles from the SBE 25 SeaLogger CTD and 50 XBT profiles were collected (Figure 9). A problem with the XBTs that yielded suspect profiles on many drops could not be resolved and may mean the data they provided may be of limited use. These data as well as data from the ship's SCS and ADCP were returned to the NMFS Pascagoula Laboratory for analysis, editing, comparison, and archiving.

CRUISE PARTICIPANTS

Name	Title	Organization
<i>Leg 1 (17-29 July 2001)</i>		
Dr. Keith Mullin	Chief Scientist	NMFS, Pascagoula, MS
Wayne Hoggard	R2	NMFS, Pascagoula, MS
Carol Roden	Visual	NMFS, Pascagoula, MS
Charlotte Cates	Visual	University of Kansas
Dan Engelhaupt	Visual	Univ. of Durham, England
Dr. Jonathan Gordon	Visual	Contractor, England
Thomas Gordon	Visual	Contractor, England
Tony Martinez	Acoustics	NMFS, Miami, FL
Dr. Aaron Thode	Acoustics	MIT, Cambridge, MA
Dr. Dave Mellinger	Acoustics	Oregon State University
Dr. Patrick Miller	Tagging	WHOI, Woods Hole, MA
Nicoletta Biassoni	Tagging	WHOI, Woods Hole, MA
Dr. Mark Johnson	Tagging	WHOI, Woods Hole, MA
Lee Benner	MMS	MMS, Herndon, VA
Dr. Bill Lang	MMS	MMS, New Orleans, LA
<i>Leg 2 (31 July - 9 August 2001)</i>		
Dr. Keith Mullin	Chief Scientist	NMFS, Pascagoula, MS
Wayne Hoggard	R2	NMFS, Pascagoula, MS
Carol Roden	Visual	NMFS, Pascagoula, MS
Charlotte Cates	Visual	University of Kansas
Carolyn Burks	Visual	NMFS, Pascagoula, MS
Kathy Hough	Visual	JCWS, La Jolla, CA
Kathy Foley	Visual	JCWS, Pascagoula, MS
Tony Martinez	Acoustics	NMFS, Miami, FL
Carrie Hubard	Acoustics	NMFS, Pascagoula, MS
Dr. Steven Swartz	Acoustics	NMFS, Miami, FL
Dr. Bruce Mate	Tagging	Oregon State University
Mary Lou Mate	Tagging	Oregon State University
Barbara Lagerquist	Tagging	Oregon State University
Martha Windsor	Tagging	Oregon State University
Sarah Tsoflias	MMS	MMS, New Orleans, LA

Leg 3 (10-22 August 2001)

Dr. Keith Mullin	Chief Scientist	NMFS, Pascagoula, MS
Wayne Hoggard	R2	NMFS, Pascagoula, MS
Carol Roden	Visual	NMFS, Pascagoula, MS
Charlotte Cates	Visual	University of Kansas
Carolyn Burks	Visual	NMFS, Pascagoula, MS
Kathy Foley	Visual	JCWS, Pascagoula, MS
Kathy Hough	Visual	JCWS, La Jolla, CA
Joy Henne	Visual	JCWS, New Mexico
Amy Paine	Visual	JCWS, Miami, FL
Dr. Greg Fulling	Visual	JCWS, Pascagoula, MS
Tony Martinez	Acoustics	NMFS, Miami, FL
Carrie Hubard	Acoustics	NMFS, Pascagoula, MS
Chris Carroll	Acoustics	NAVO, Stennis Space Center, MS
Sarah Tsoflias	MMS	MMS, New Orleans, LA

JCWS - Johnson Control World Services
MIT - Massachusetts Institute of Technology
NAVO - Navy Oceanographic Office
WHOI - Woods Hole Oceanographic Institution

LITERATURE CITED

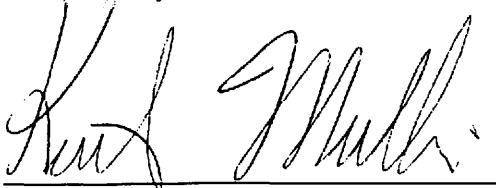
- Davis, R. W. and G.S. Fargion, *eds.* 1996. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico: Final report. Vol II. Technical report. OCS Study MMS 96-0027. Prepared by the Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, L.A. 357 pp.
- Davis, R.W., W.E. Evans, and B. Würsig, *eds.* 2000. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations. Volume II: Technical Report. Prepared by Texas A&M at Galveston and the National Marine Fisheries Service. U.S. Department of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study MMS 2000-003. 346 pp.
- Dizon, A.E., C. Lockyer, W.F. Perrin, D.P. DeMaster, and J. Sission. 1992. Rethinking the stock concept: a phylogeographic approach. *Conservation Biology* 6:24-36.
- Gerrodette, T. and D.P. DeMaster. 1990. Quantitative determination of optimum sustainable population level. *Marine Mammal Science* 6:1-16.

McKay, M., J. Nides, W. Lang, and D. Vigil, *eds.* 2001. Gulf of Mexico marine protected species workshop, June 1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-039. 171 pp.

Mullin, K.D., K.M. Foley, A. Martinez and C. Burks. 2001. A study of sperm whales in the southeastern Gulf of Mexico. Prepared for the MMS Gulf of Mexico OCS Region by the SEFSC, P.O. Drawer 1207, Pascagoula, MS 39568.

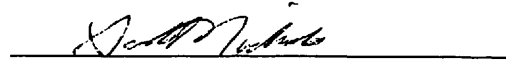
Roden, C.L. and K.D. Mullin. 2000. Application of sperm whale research techniques in the northern Gulf of Mexico - A Pilot Study. Prepared for the MMS Gulf of Mexico OCS Region by the SEFSC, P.O. Drawer 1207, Pascagoula, MS 39568.

Submitted by:

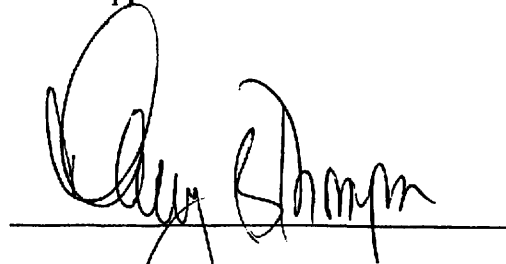


Keith D. Mullin
Field Party Chief

Approved by:



Scott Nichols, Director
Mississippi Laboratories



Nancy Thompson, Director
Southeast Fisheries Science Center

TABLES

Table 1. Summary of research activities conducted during NOAA Ship Gordon Gunter Cruise 01-04 (013) in the north-central Gulf of Mexico.

NOAA Ship Gordon Gunter Cruise 01-04 (013) - Leg 1

Date	Visual Effort hours	Acoustic Effort hours	Sperm Whale Y/N	DTAG no./hours	Biopsy Samples	Photo-ID	CTD	XBT	ADCP hours	Video Encounters	Encounter minutes	Sonobuoy
17 Jul 2001												
18 Jul 2001	11.5	15	Y	1/1.6	0	0	1	0	24	1	1	0
19 Jul 2001	12.5	24	Y	1/9.0	1	2	0	0	24	23	97	0
20 Jul 2001	12.5	24	Y	0	0	3	0	1	24	1	1	1
21 Jul 2001	9.0	24	N	0	1	0	0	2	24	0	0	4
22 Jul 2001	9.5	24	Y	1/1.7	0	1	0	2	24	0	0	0
23 Jul 2001	12.5	24	Y	5.5	1	7	0	1	24	28	183	0
24 Jul 2001	3.0	20	Y	0	0	0	1	1	24	0	0	1
25 Jul 2001	0	18	Y	0	0	0	0	2	24	0	0	3
26 Jul 2001	12.5	24	Y	1/9.0*	1	1	0	1	24	10	77	0
27 Jul 2001	12.5	24	Y	2/5.0	1	4	0	1	24	13	95	0
28 Jul 2001	12.5	20	Y	4/3.5	5	6	0	0	24	28	284	0
29 Jul 2001												

* DTAG stayed on for 9 hours but due to a battery problem, it recorded only 11 minutes of data.

continued

Table 1. continued.

NOAA Ship *Gordon Gunter* Cruise 01-04 (013) - Leg 2

Date	Visual Effort hours	Acoustic Effort hours	Sperm Whale Y/N	Satellite Tags	Biopsy Samples	Photo-ID	CTD	XBT	ADCP hours	Video Encounters	Encounter minutes	Sonobuoy
31 Jul 2001												
01 Aug 2001	11.5	24	Y	1	1	0	1	1	24	0	0	0
02 Aug 2001	5.0	14	Y	0	0	0	0	0	18	0	0	0
03 Aug 2001												
04 Aug 2001												
05 Aug 2001												
06 Aug 2001												
07 Aug 2001	12.5	21	Y	1	1	0	0	0	24	1	28	0
08 Aug 2001	12.5	18	Y	2	6	0	0	0	24	6	14	0
09 Aug 2001												

2 -6 August - Ship in port in Pascagoula for Tropical Storm *Barry*. An aluminum bow pulpit was constructed for the *R2* during this time to improve the chances of attaching a satellite tag.

continued

Table 1. continued.

NOAA Ship *Gordon Gunter* Cruise 01-04 (013) - Leg 3

Date	Visual Effort hours	Acoustic Effort hours	Sperm Whale Y/N	Biopsy Samples	Photo-ID	CTD	XBT	ADCP hours	Video Encounters	Encounter minutes	Sonobuoy
10 Aug 2001											
11 Aug 2001											
12 Aug 2001	12.5	24	Y	0	0	0	2	24	5	15	0
13 Aug 2001	12.5	24	Y	6	6	0	4	24	18	91	0
14 Aug 2001	12.5	24	Y	9	10	0	6	24	6	81	0
15 Aug 2001	12.5	24	Y	8	11	0	5	24	3	671	0
16 Aug 2001	12.5	24	Y	4	8	1	6	24	0	0	0
17 Aug 2001	12.5	24	Y	3	6	1	5	24	1	3	0
18 Aug 2001	12.5	24	Y	8	15	1	4	24	0	0	0
19 Aug 2001	12.5	24	Y	0	0	1	5	24	0	0	0
20 Aug 2001	12.5	24	Y	0	4	1	0	24	3	14	0
21 Aug 2001	12.5	18	Y	0	4	1	1	24			0
22 Aug 2001											

11 August - An unscheduled return to port for mechanical problem.

19-21 August - We worked with photographers from Mississippi ETV and New York Times TV.

Table 2. Biopsy samples collected during NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico. Latitude and longitudes are in degrees, minutes and decimal minutes (e.g., 244905 = 24°49.05'). Sample numbers are numbered sequentially by date (year, month, day).

Species	Latitude	Longitude	Sample Number
<i>Sperm Whale</i>	284905	884165	20010719-01
	285299	883459	20010723-01
	291915	872280	20010726-01
	291636	871830	20010727-01
	285372	881615	20010728-01
	285372	881615	20010728-02
	284944	881807	20010728-03
	285149	881755	20010728-04
	290122	881042	20010728-05
	290387	881599	20010801-01
	290250	880324	20010807-01
	290974	874428	20010808-04
	290946	874812	20010808-05
	291073	874805	20010808-06
	285414	882251	20010813-01
	285638	881991	20010813-02
	285687	881982	20010813-03
	285682	882007	20010813-04
	290025	882082	20010813-05
	285994	882099	20010813-06
	284713	884827	20010814-01
	284772	884795	20010814-02
	284774	884736	20010814-03
	284811	884199	20010814-04
	284811	884199	20010814-05
	284817	884129	20010814-06
	284729	884159	20010814-07
	284626	884227	20010814-08
	284626	884227	20010814-09

continued

Table 2. continued.

Species	Latitude	Longitude	Sample Number
<i>Sperm whale</i>			
	281008	892062	20010815-03
	280992	892059	20010815-04
	280963	892069	20010815-05
	280930	892077	20010815-06
	280920	892075	20010815-07
	280886	892054	20010815-08
	280232	895287	20010816-01
	280472	895114	20010816-02
	280508	894681	20010816-03
	280632	894230	20010816-04
	274634	900399	20010817-01
	274490	900531	20010817-02
	274398	900663	20010817-03
	280959	892798	20010818-01
	280863	892845	20010818-02
	280878	890896	20010818-03
	280684	893291	20010818-04
	280621	893282	20010818-05
	280598	893721	20010818-06
	275765	893868	20010818-07
	275465	894232	20010818-08
<i>Clymene dolphin</i>			
	282332	891254	20010720-01
	273185	904060	20010721-01
<i>Pilot whale</i>			
	291029	875253	20010808-01
	291031	875249	20010808-02
	291064	875217	20010808-03
<i>Killer whale</i>			
	281190	891772	20010815-01
	281246	891762	20010815-02

FIGURES

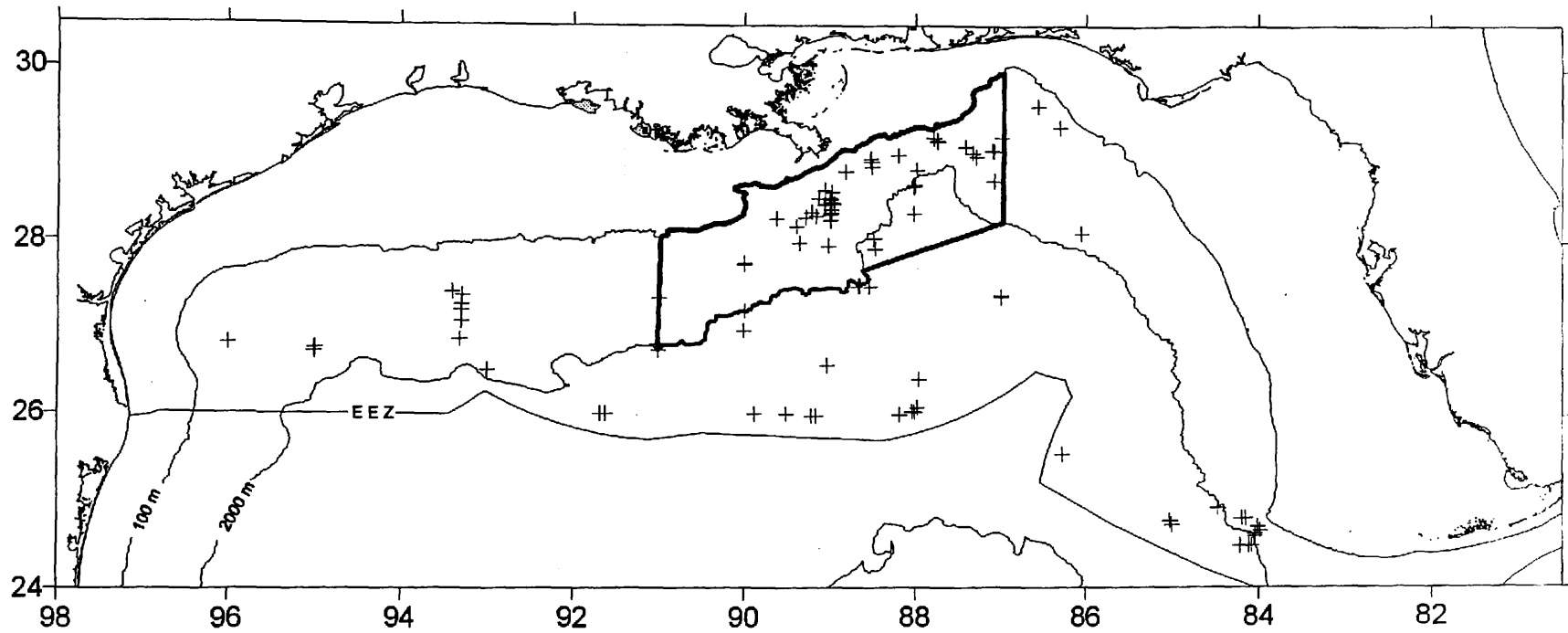


Fig. 1 The locations of sperm whale "group" sightings from NOAA ship Oregon II 1991-1997 (n=97). The July 2000 study area is outlined.

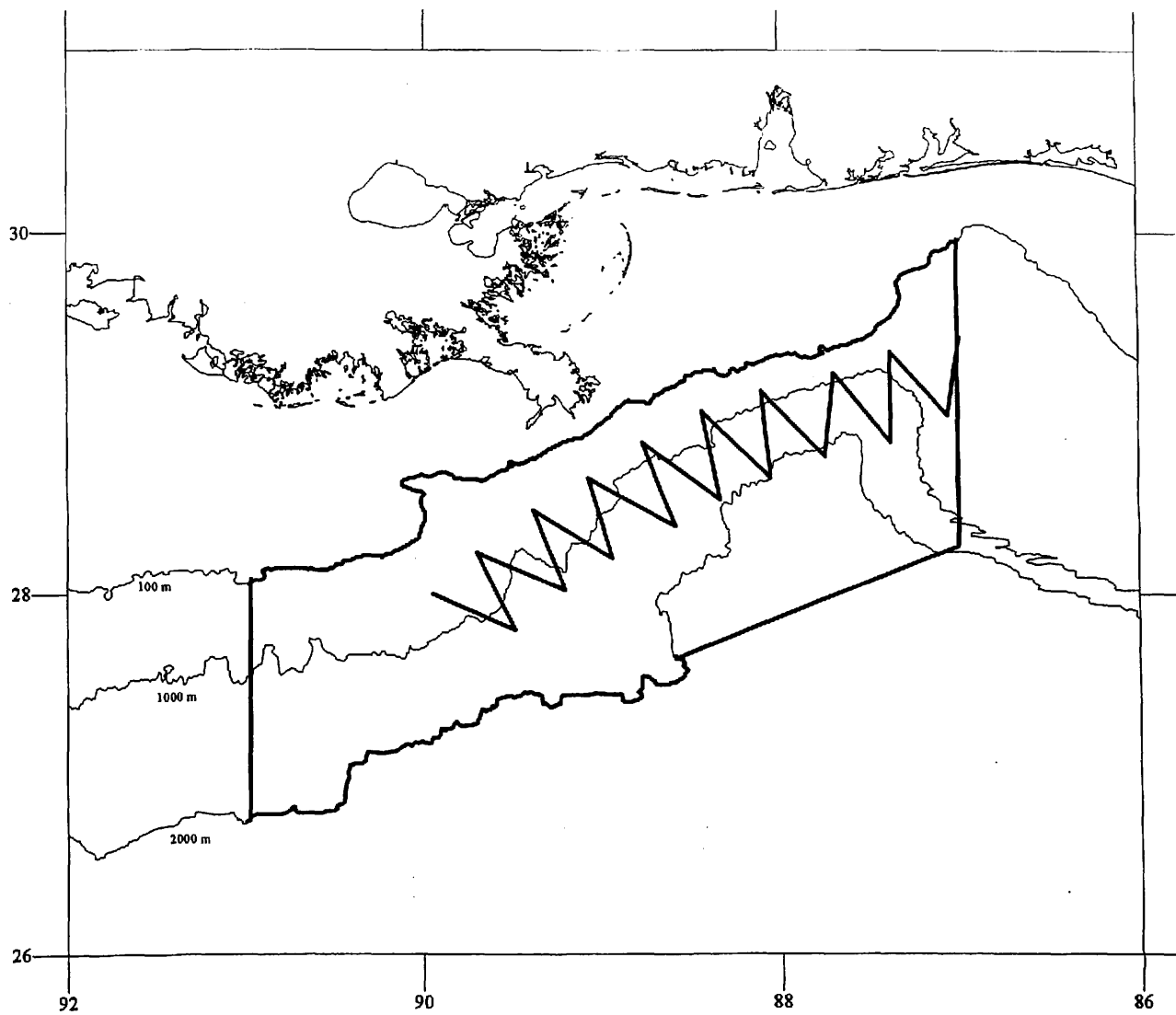


Figure 2. Night acoustic line transects planned for Leg 3 (10-22 August 2001) of NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico.

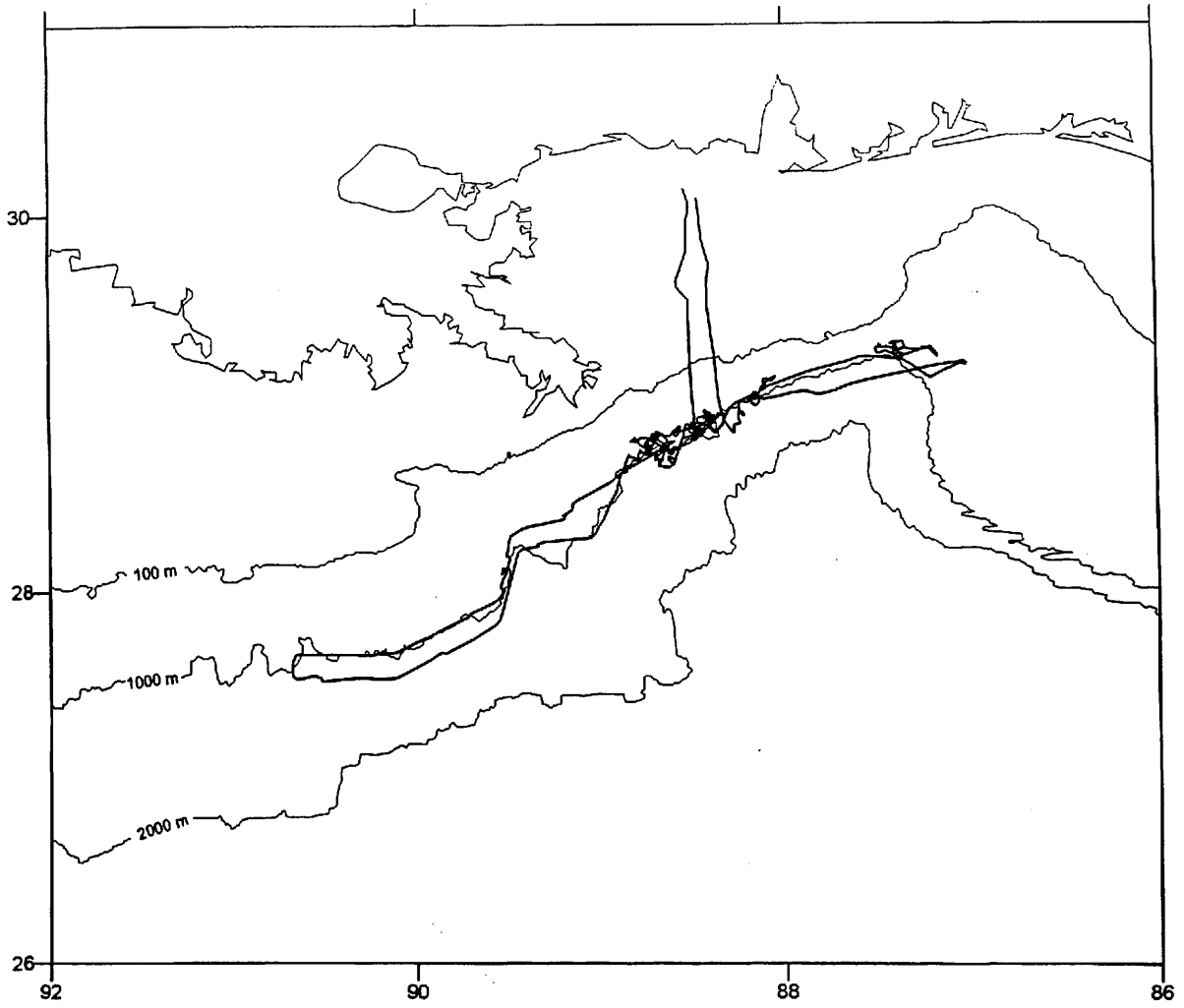


Figure 3. The cruise track of NOAA Ship *Gordon Gunter* Cruise 01-04 (013) during Leg 1 (17-29 July 2001) in the north-central Gulf of Mexico.

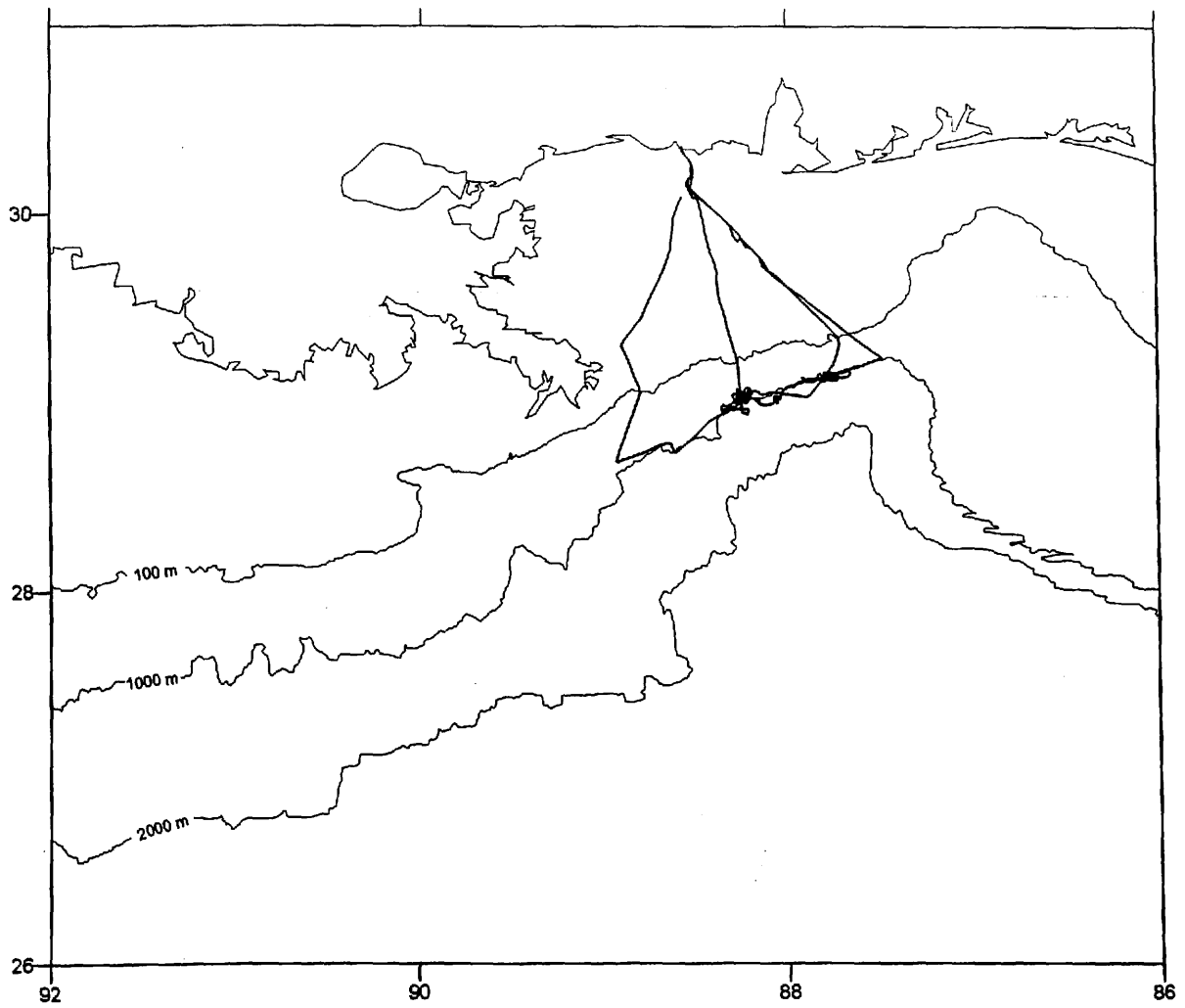


Figure 4. The cruise track of NOAA Ship *Gordon Gunter* Cruise 01-04 (013) during Leg 2 (31 July - 9 August 2001) in the north-central Gulf of Mexico.

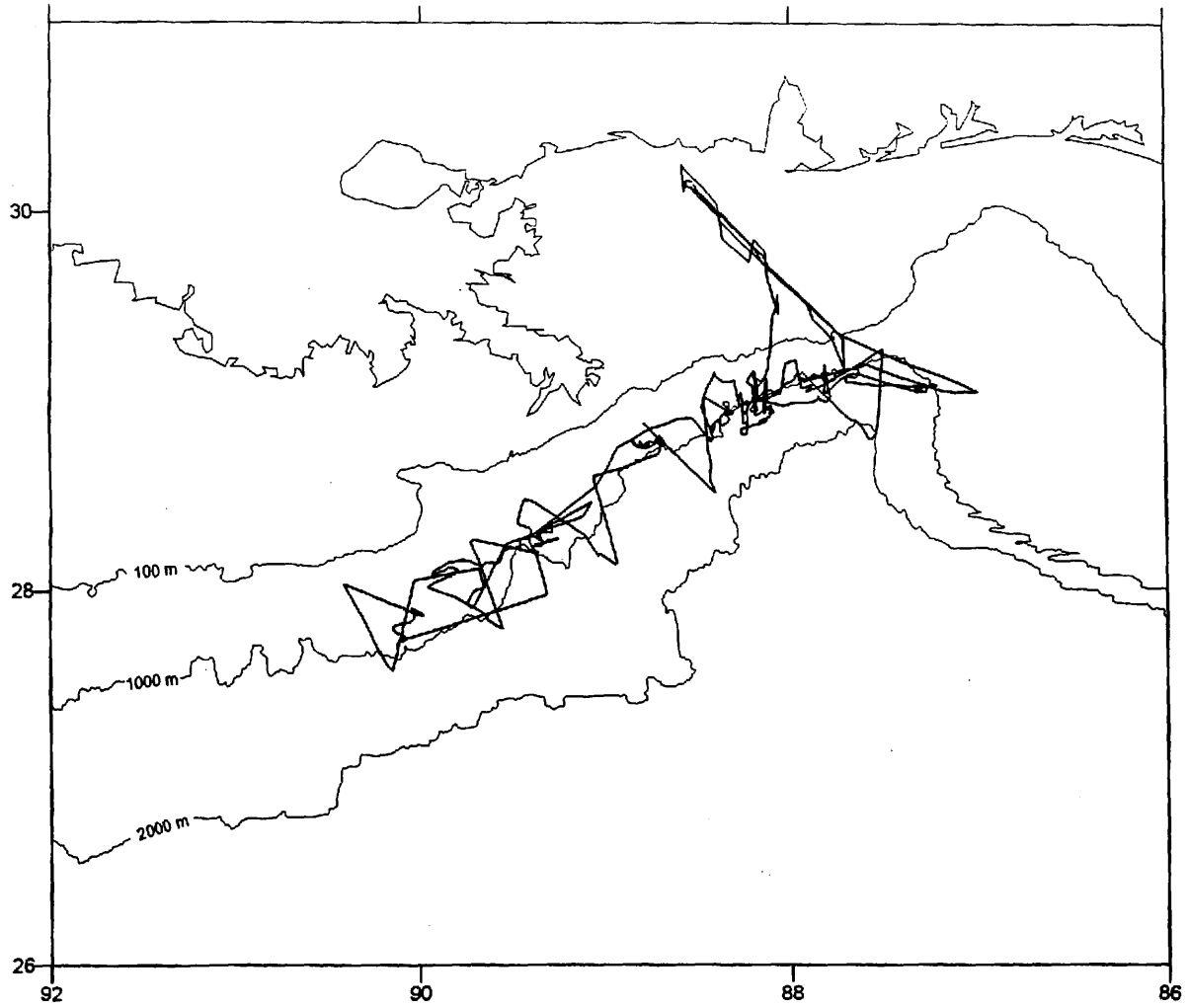


Figure 5. The cruise track of NOAA Ship *Gordon Gunter* Cruise 01-04 (013) during Leg 3 (10-22 August 2001) in the north-central Gulf of Mexico.

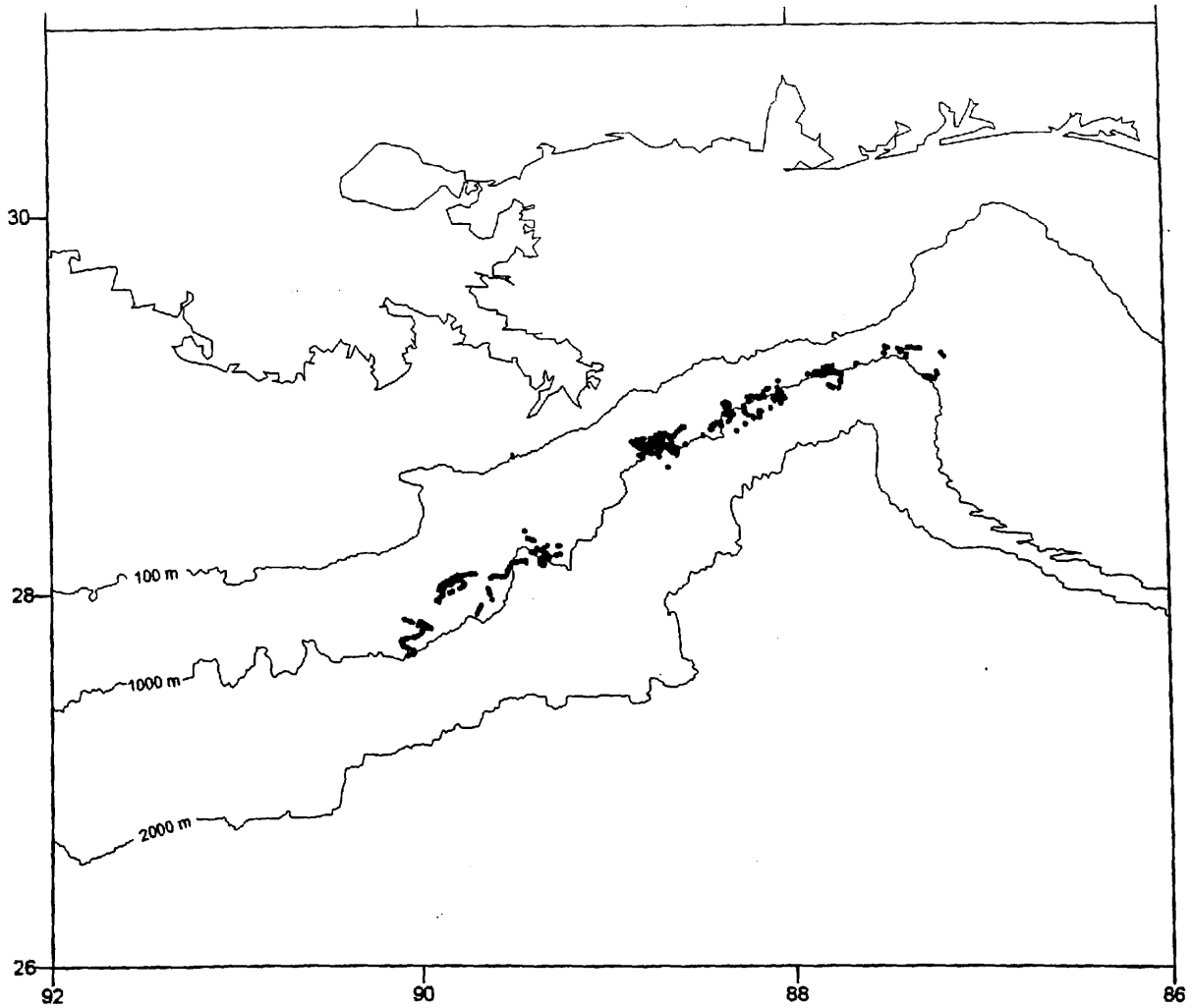


Figure 6. Locations of sperm whales sighted at the surface ($n = 743$) during NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico (17 July - 22 August 2001). Each location does not represent a different whale. Sperm whales were tracked visually for up to 10 hours in some cases and each surfacing was recorded as a separate "cluster."

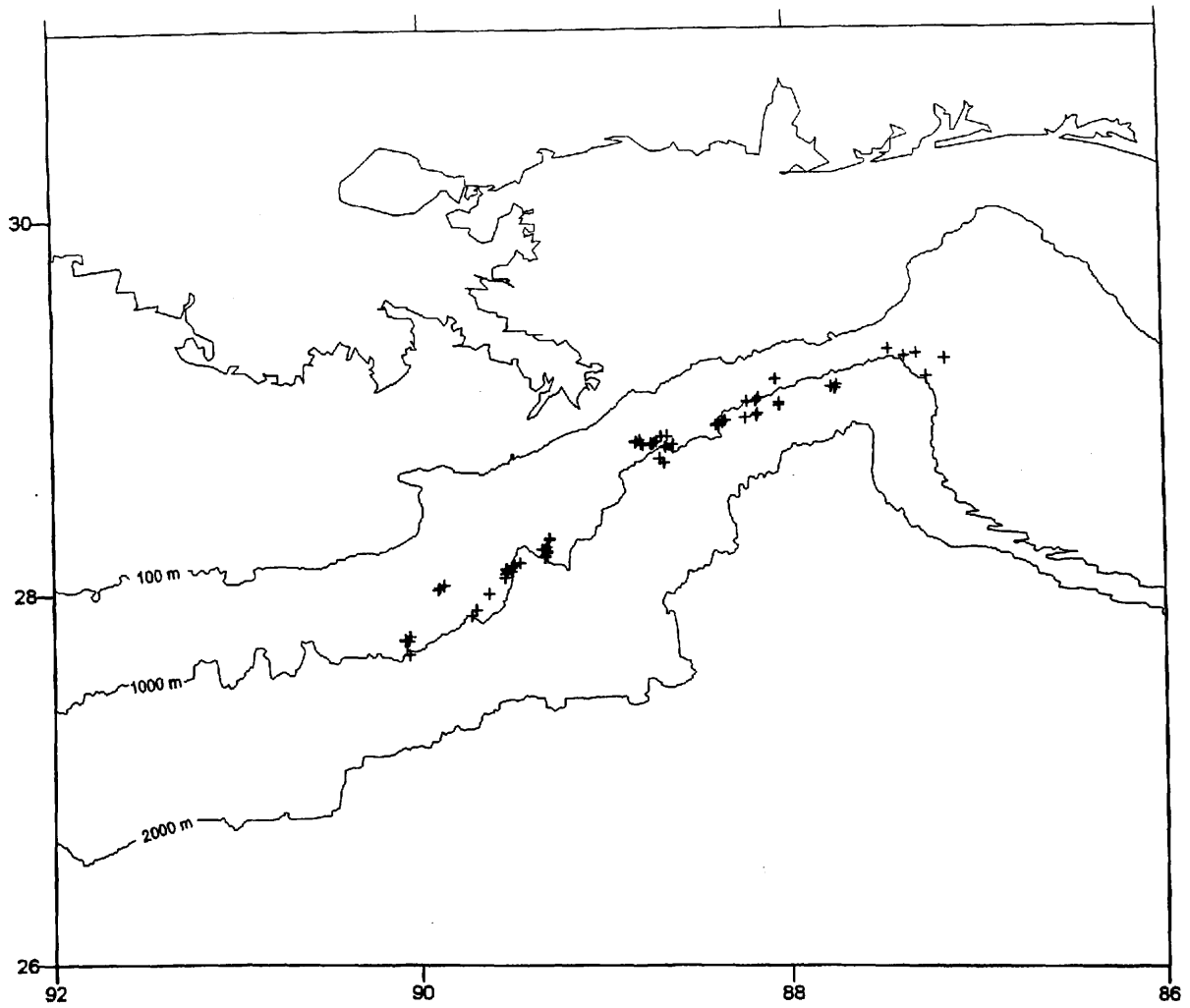


Figure 7. Locations of sperm whale flukes photographed with 35 mm cameras ($n = 89$) during NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico (17 July - 22 August 2001).

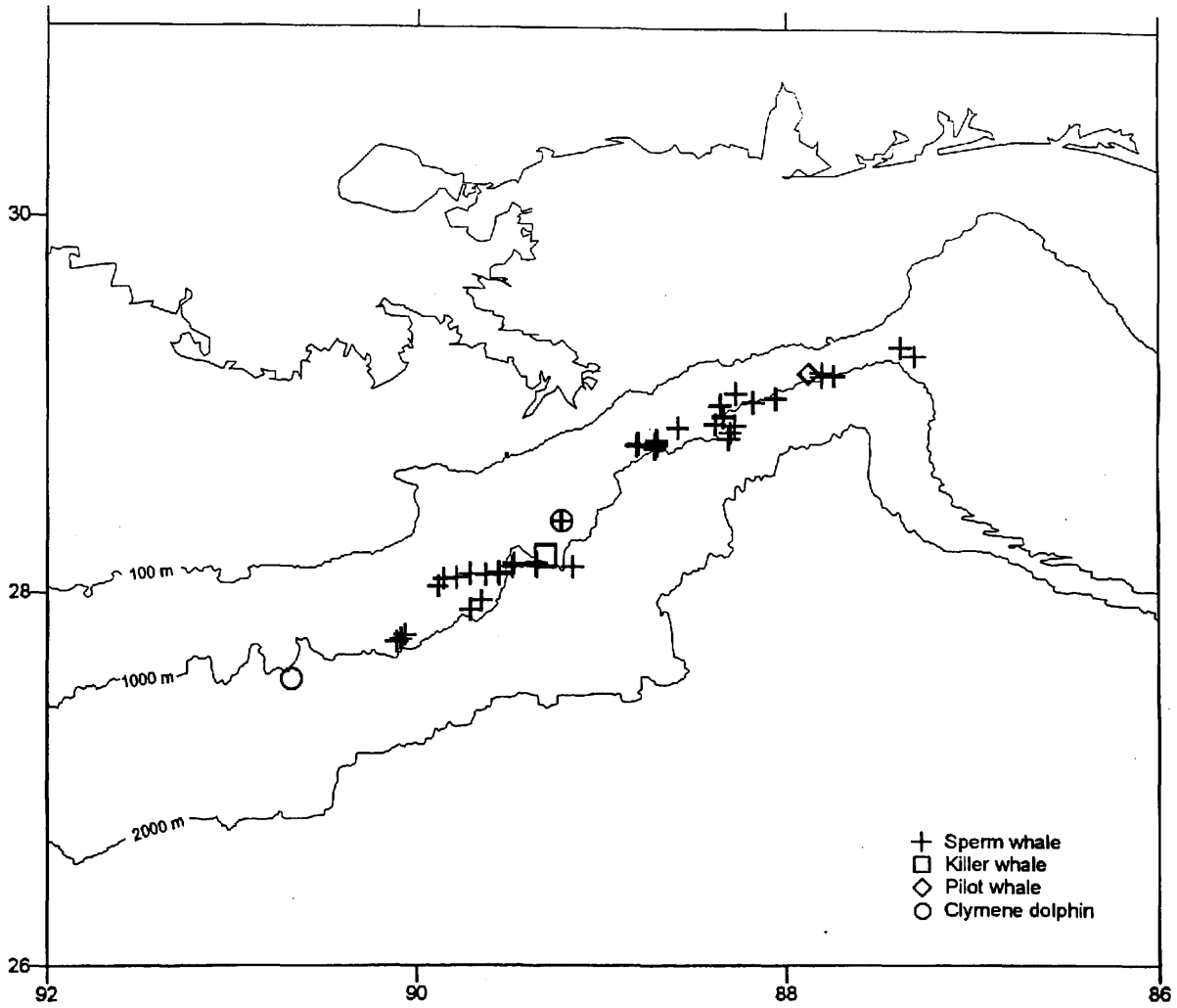


Figure 8. Locations of biopsy samples collected from all cetacean species during NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico (17 July - 22 August 2001); sperm whale ($n = 52$), killer whale ($n = 2$), pilot whale ($n = 3$), and Clymene dolphin ($n = 2$).

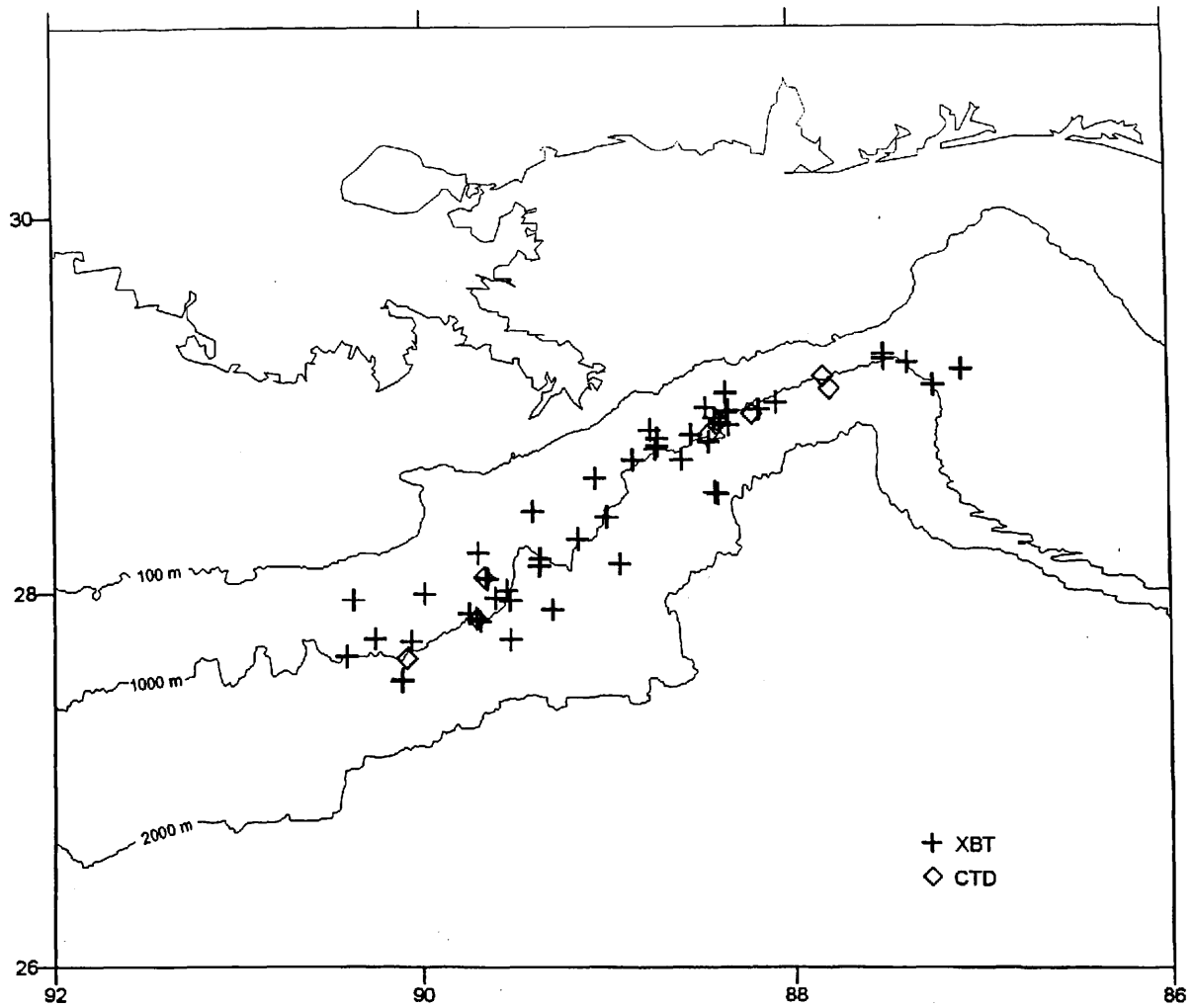


Figure 9. Locations of XBT ($n = 50$) and CTD ($n = 8$) stations during NOAA Ship *Gordon Gunter* Cruise 01-04 (013) in the north-central Gulf of Mexico (17 July - 22 August 2001).