

This is the cruise report for the SWSS 2005 Mesoscale Population Study (MPS) cruises aboard the motor sailor “Summer Breeze” from 13 June to 3 August to investigate sperm whale biology in the Gulf of Mexico. Fieldwork was conducted as part of the MMS-sponsored Sperm Whale Seismic Study under Cooperative Agreement Number 1435-01-02-CA-85186.

Introduction and Narrative

Our primary goal during this project was to survey for sperm whales along the shelf edge of the northern Gulf of Mexico approximately between longitude 91W and 86W, with a particular emphasis on the survey blocks that included the Mississippi Canyon and Mississippi River Delta outflow regions. These are the areas that had the highest sperm whale encounter rates in previous years. This was particularly the case for mixed groups, which comprise females and immature animals. Because our survey vessel, a 46’ motor-sailor, was based in St. Petersburg, Florida, a passage had to be made along the western Florida coast to and from our main study areas. We aimed to survey between the 500 and 1500m depth contours in this eastern area but with a lower level of effort. Within our main survey area we expected, based on experience from previous years, to encounter mainly large mixed groups in the Canyon and Delta outflow regions and maturing males in small and dispersed groups to the east and in the DeSoto Canyon and Florida coast regions. The primary data to be collected on this project were photo-id images, along with visual and acoustic measures of length, acoustic recordings and where possible, biopsy samples. The photo-id data are useful for revealing a variety of basic biological data for this population, including population size, range of movements, residence patterns, and social organization.

The cruise was conducted in four legs, described below. The science team members for each leg are shown in Table 1. Jonathan Gordon and Christoph Richter were the Field Party Chiefs for legs 1 and 4 and legs 2 and 3, respectively. Figure 1 summarizes the planned survey blocks and the actual tracks over the four legs.

Table 1. Team for the SWSS 2005 MPS cruise aboard the *Summer Breeze*.

Participant	Function	Participation in legs
Jonathan Gordon	Party chief, legs 1+4	1 and 4
Christoph Richter	Party chief, legs 2+3	1- 3
Raul Diaz	Biopsy	2-4
Ricardo Antunes	Acoustics	1-4
Thomas Gordon	Logistics	1-4
Sam DuFresne	Observer	1-4
Sierra Deutsch	Observer	1-4
Pip Bauerlein	Skipper	1-4

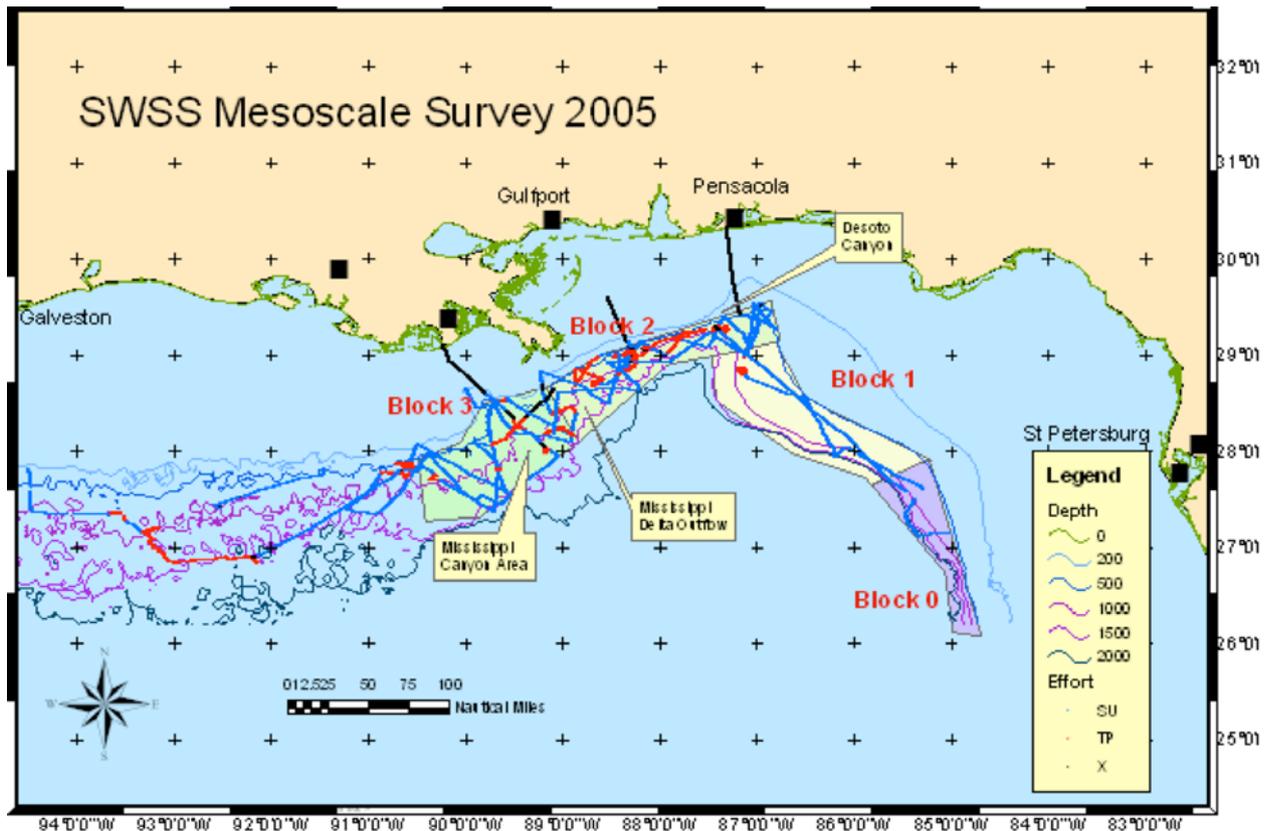


Figure 1. Plot of the 2005 SWSS Mesoscale Population Study cruise aboard the *Summer Breeze* from 13 June – 3 August. The predetermined survey blocks (Blocks 0 to 3) are overlaid by the actual track of the *Summer Breeze* (thick colored lines: blue: survey mode [regular acoustic monitoring] (SU); red: tracking and photo-ID mode (TP); black: off effort or on transit (X)). Depth contours are shown with thin colored lines.

The charter of the vessel began on 4 June but work to assemble and check equipment stored in Galveston, Texas, had been underway for several weeks beforehand. Equipment was driven to St. Petersburg in a rented truck by two of the team. Most of the rest of the team assembled in St. Petersburg on 3 June. Mobilization, which essentially involved adapting a standard inshore charter yacht to be a viable offshore research vessel, was extensive and took nine days of intense work. Preparations were hampered somewhat by the fact that some of the key personnel arrived late because of delays in receiving visas and by a few days of torrential rain and stormy weather from “Arlene”, the first hurricane of the season, which passed offshore. Mobilization work included establishing an acoustic monitoring and science work station, fitting two towed and one directional hydrophones, fitting a through-hull temperature sensor system, fitting a satellite communications system and a navigation computer, fitting a man-overboard alarm system, converting two heads to food storage, adapting the vessel’s accommodation to provide seven reasonable sea berths, and augmenting the vessel’s fuel supplies with 32 jerry cans on deck.

Summer Breeze left St. Petersburg on 13 June and monitoring work began on 14 June, when we reached deep water. The first leg consisted of surveys along the Florida Shelf edge, into the DeSoto Canyon and along the northern edge of the Gulf of Mexico as far as the Mississippi Delta Region. During this leg, whales seemed generally to be less abundant than

in previous years. No large mixed groups were encountered and maturing males seemed to be distributed further to the west than in other years. Many of the whales that we did see appeared not to be feeding during the day, thus were not fluking and could not be photo-identified. The vessel made its first port call in Gulfport, Mississippi, on 20 June, a day earlier than planned, in part because one of the team had developed a worrying ear infection but also to allow time to attend to a number of mechanical problems which had developed on the boat. We also used this time to build a mount for a new directional hydrophone. Figure 2 shows the tracks of leg 1.

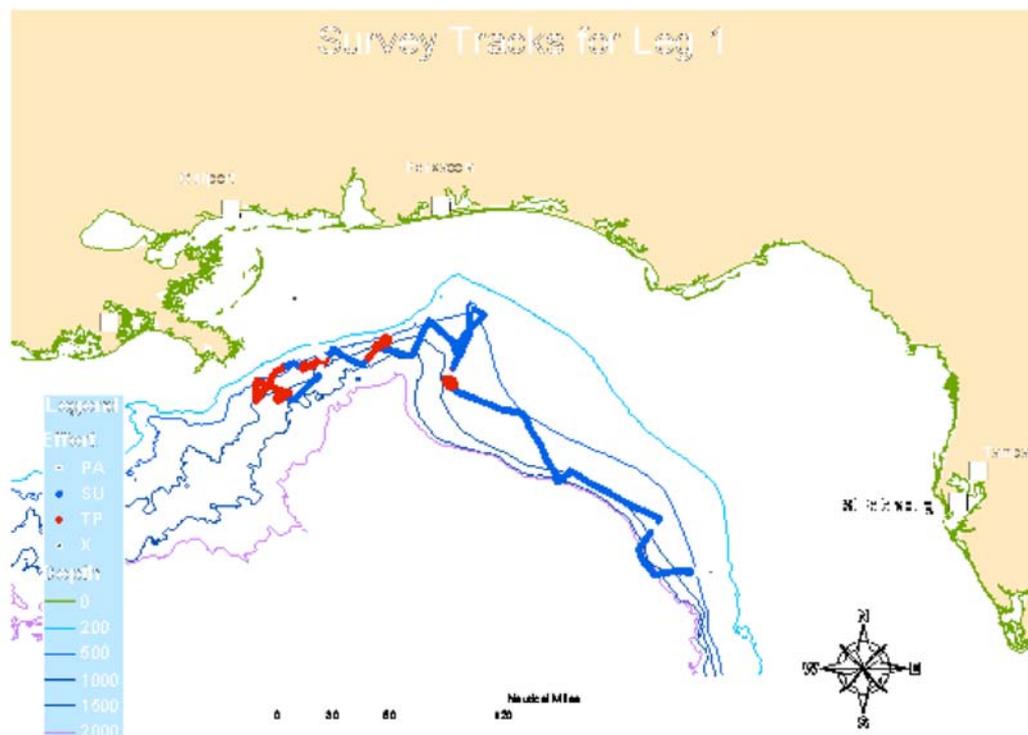


Figure 2. Plot of leg 1 of the 2005 SWSS Mesoscale Population Study cruise aboard the *Summer Breeze* from 13 June – 20 June. Green line: survey mode [regular acoustic monitoring]; red line: tracking and photo-ID mode (TP), black line: off effort or transiting. Depth contours are shown with thin colored lines

The second leg began on 23 June and continued the survey to the west. No whales were encountered in the Mississippi Canyon (previously an area with a high encounter rate) and most encounters were with small groups (≤ 4 animals) towards the western end of our survey blocks. Work was hampered by poor weather due to frequent thunder squalls and persistent high winds. Leg 2 was curtailed on 29 June when one of the team developed a serious eye infection. The boat returned to Gulfport; the ill team member attended hospital and was then required to recover at her family home.

A reduced team left Gulfport after this emergency port call to continue the survey on 2 July. The team soon picked up a loose aggregation of four whales and tracked them over 33 hours

as they moved some 60 miles roughly following the 1000m contour into the DeSoto Canyon region. However, tropical storm Cindy then intervened, forcing a port call to Pensacola, Florida. Immediately after this storm passed, hurricane Dennis began moving up the eastern Gulf, with Pensacola directly on its track. Due to the lack of shelter in Pensacola, the team decided to move the boat to the west as quickly as possible and took shelter at Morgan City, Louisiana, on 9 July. This also provided an opportunity for the team member with the infected eye, now recovered, to rejoin the vessel.

Summer Breeze put to sea again on 12 July, reaching deep water and resuming monitoring on 13 July. Just after midnight, a major electrical fault developed in the vessel's engine resulting in the starter motor, alternator and all of the engine's wiring burning out. With no propulsion, major repairs required and hurricane Emily now threatening, the boat sailed slowly towards Galveston, where TAMUG could provide support. *Summer Breeze* eventually arrived at the TAMUG Small Boat Basin late on 15 July. Figure 3 shows the tracks during legs 2 and 3.

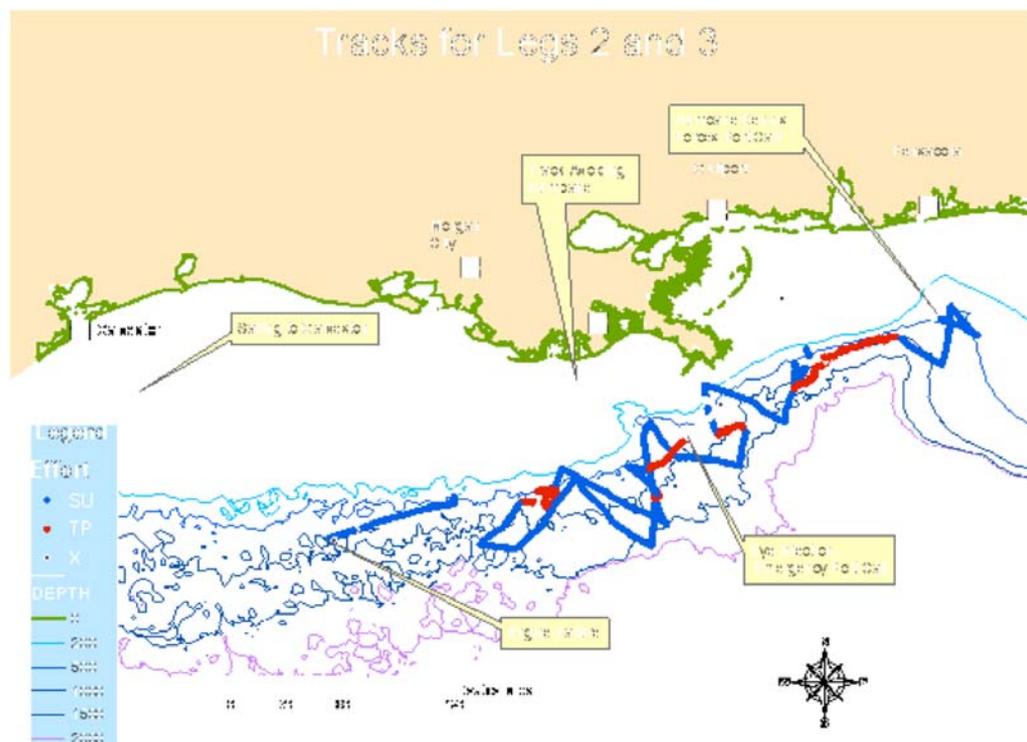


Figure 3. Plot of legs 2 and 3 of the 2005 SWSS Mesoscale Population Study cruise aboard the *Summer Breeze* from 23 June – 15 July. Green line: survey mode [regular acoustic monitoring]; red line: tracking and photo-ID mode; black line: off-effort or transiting. Depth contours are shown with thin colored lines.

Repairs to the engine took over a week to complete but it was possible to rearrange travel to bring the start of the final leg forward by a few days and *Summer Breeze* left Galveston on 23 July. The boat was once again operating with a reduced team as the biopsy collector had an

injured foot which had become infected and required shore rest. Although Galveston was well to the west of the planned survey areas, it was decided to survey from there, in part to cover a gap between the areas surveyed by the S-tag and MPS projects but also to further investigate the apparently anomalous patterns of sperm whale distribution this year. With generally good weather conditions and whales encountered on most days, this final leg was especially productive. One large mixed group was encountered and followed for two days. It was well to the west of our designated survey area. In the main study area, only maturing males were encountered. A brief port stop was made at Port Fourchon, LA, to pick up the team member whose injured foot had recovered and to take on fuel and fresh provisions. On 30 July, a loose grouping of three whales was tracked as they crossed the track of an active seismic survey vessel. This should provide interesting opportunistic observations of such interactions.

No sperm whales were encountered during the passage along the Florida coast during the final return leg though monitoring was also affected by torrential rain and thunder storms. Hydrophones were recovered and surveying ended in the evening of 2 August. The vessel arrived back in St. Petersburg on the evening of 3 August. Three days were spent removing our equipment from the boat, refitting its normal charter inventory, cleaning and tidying up. Research equipment was driven back to Galveston in a rented truck by two of the team members and the rest of the team members dispersed. Figure 4 shows the tracks of leg 4. Information on all legs and port calls is summarized in Table 2.

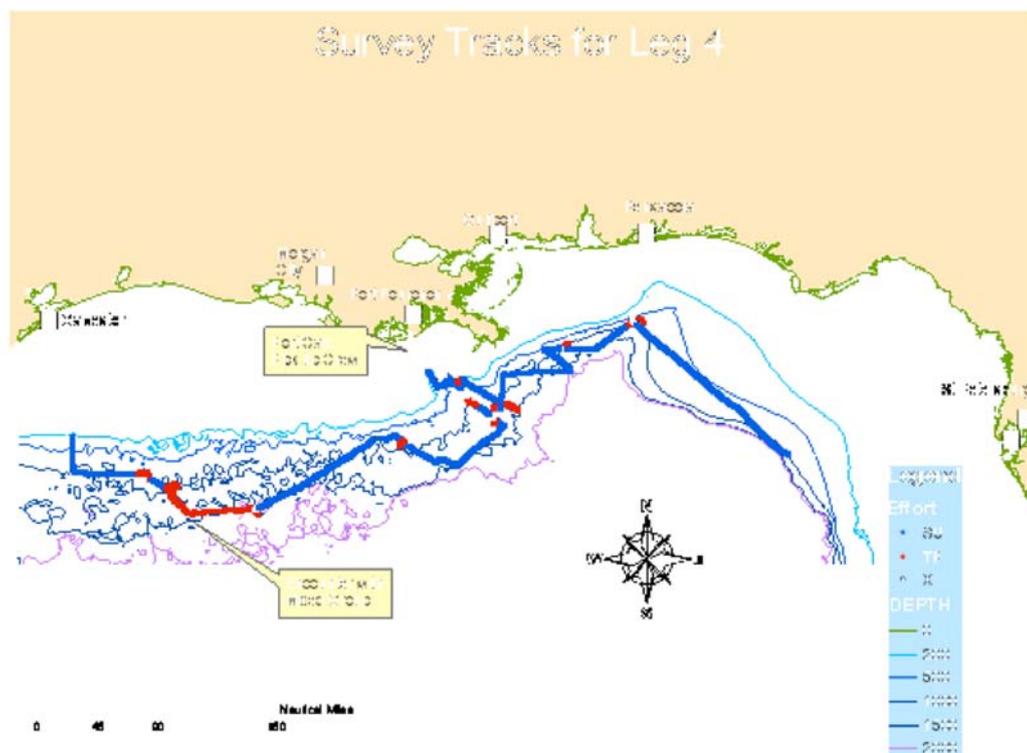


Figure 4. Plot of tracks during leg 4 of the 2005 SWSS Mesoscale Population Study cruise aboard the *Summer Breeze* from 23 July – 3 August. Green line: survey mode [regular acoustic monitoring]; red line: tracking and photo-ID mode, black line: off effort or transiting. Depth contours are shown with thin colored lines.

Table 2. Summary of legs and port calls of the 2005 MPS cruise aboard *Summer Breeze*.

Leg	Start		End		Party Chief	Comments
	Date	Port	Date	Port		
1	1 June	Galveston, TX	12 June	St. Petersburg, FL	Gordon	mobilization
	13 June	St. Petersburg, FL	20 June	Gulfport, MS		
2a	23 June	Gulfport, MS	29 June	Gulfport, MS	Richter	medical
2b	2 July	Gulfport, MS	5 July	Pensacola, FL	Richter	tropical storm Cindy
3a	7 July	Pensacola, FL	9 July	Morgan City, LA	Richter	hurricane Dennis
3b	12 July	Morgan City, LA	15 July	Galveston, TX	Richter	engine breakdown
4a	23 July	Galveston, TX	30 July	Fourchon, LA	Gordon	team member pick-up
4b	30 July	Fourchon, LA	3 August	St. Petersburg, FL	Gordon	
	3 August	St. Petersburg, FL	8 August	Galveston, TX		demobilization

Accomplishments

During the 2005 MPS cruise on the *Summer Breeze*, we completed 333 hours in survey mode during which we covered 1969 nautical miles. This included 1262 regular one-minute acoustic monitoring stations. In addition, 311 hours were spent in tracking and photo-ID mode, covering 680 nautical miles.

June and July 2005 were record-setting months for hurricanes, with seven tropical storms in all. This project was affected by four of them. Nevertheless, because the vessel was able to be on the water over a span of approximately 6 weeks, overall results and success with sperm whale encounters was satisfactory, and new data on sperm whale age and sex distribution, sounds, behavioral patterns, and photo-identifications were gathered. This information is outlined in more detail below. Probably the most significant finding from this season will prove to be the provision of evidence of an apparent shift in the distribution of different components of the population.

Permits

The behavioral/photo-identification part of this project was conducted under National Marine Fisheries Service Scientific Research Permit To Take Marine Mammals, Amendment No. 1, Permit No. 821-1588-01 (Principal Investigator Dr. Randall W. Davis; Co-Investigator Dr. Bernd Würsig), Project II: "Stock Assessment, Movement Patterns, and Habitat Use of Sperm Whales and Opportunistically Conduct Level B Harassment of Delphinidae in the Gulf of Mexico". (Expiration: Sept. 30, 2005). Biopsy sampling was conducted under Permit No. 909-1726-00 (Principal investigator Dan Engelhaupt of the University of Durham. Expiration date 30 June 2010).

Vessel

The research platform used for this leg of the survey was the *Summer Breeze*, which had also been used last year. It was chartered from Sunsail in St. Petersburg Florida. *Summer Breeze* is a 46' sloop with a 76HP engine and 7 berths (Figure 5).



Figure 5. The *Summer Breeze*, a 46' sloop, which served as the research vessel for the 2005 MPS cruise (Photo: Bill Lang). To extend the reach of the vessel, 34 red and yellow jerry cans were lashed to the deck. One of the towed hydrophones can be seen coiled up at the port stern.

Summer Breeze was modified to provide extra storage for food and equipment by adapting the heads and providing lee cloths and additional fans to improve its accommodation. An acoustic work station (see below for details) was set up in the main cabin. Communication and navigation was improved by adding a Global Star satellite telephone system, a dedicated navigation and communication computer, and additional GPS receivers. In addition, a man-overboard alarm system was fitted to enhance team safety. Finally, to provide additional fuel capacity, 34 five-gallon jerry cans were lashed on deck.

The provision of clean electrical power and the elimination of electrical noise is often a problem on a small vessel. A pure sine wave inverter (Prosine 1800) was installed running directly off the vessel's house batteries. This provided clean AC power for computers and for the acoustic work station. A separate DC power supply served preamplifiers and panel meters.

Acoustic

Two stereo "Ecologic" towed hydrophone arrays, one with 100m and the other with 200m of cable, were carried and were towed off each quarter. Having two matched hydrophones provided a spare in the event of loss or damage, and also allowed them to be towed as "tandem" arrays to allow more accurate acoustic tracking using programs such as Rainbow Click¹. Each array contained a depth sensor.

¹ Rainbow Click is a computer program written by Douglas Gillespie with support from the International Fund for Animal Welfare to promote benign and non-invasive research.

The acoustic work station was housed in a waterproof SKB instrument case. It consisted of a laptop computer and two Magrec HP27ST preamplifiers, which were interfaced via a USB sound card (M Audio). Two panel meters measured depth of the hydrophone arrays. As only one computer was available for acoustic analysis, an audio switch was used to select between the arrays when the hydrophones were deployed as tandem arrays to resolve left/right ambiguity. A calibration tone generator was also mounted in the instrument case to allow for calibration of the system.

A feed from the main system in the acoustic work station was available at the helm allowing monitoring of the hydrophones on deck using headphones. In addition, the output from the hydrophones could be fed into the vessel's HiFi system providing general monitoring of underwater acoustic activity.

Two hand held directional hydrophones mounted on long fiberglass poles were used when tracking sperm whales at close range. In addition, a more elaborate directional hydrophone within a streamlined pod was built following designs for directional hydrophones used from motor sailors by Hal Whitehead and colleagues. The advantage of this design is that it can stay mounted to the vessel. A mount for this was attached to the main-sheet arch of *Summer Breeze*.

Operation

The towed hydrophone systems worked well. The 100m hydrophone was used continuously whenever the vessel was in water deeper than 200m. The second hydrophone was occasionally deployed to assist with tracking whales. Hand held directional hydrophones were normally used by stopping the boat and deploying them from the swim platform at the stern of the boat. With such good access to the water this proved feasible in calm conditions. The streamlined directional hydrophone was not completely successful. Sufficient tests were done to demonstrate that it could be monitored underway and provided reliable bearings to whales being tracked. However, it proved impossible to make a sufficiently strong but temporary attachment on a vessel that was only available for a short term charter.

Data collection

Wherever possible data were collected directly to computers to minimize transcription errors and speed up later analysis. The Logger² program ran continuously on the computer at the acoustic work station. It collected the vessel's track from GPS, information on search status and effort, hourly environmental data, non-sperm whale sightings, acoustic data, and information on encounters with sperm whale groups and individuals. All data were stored in a coordinated relational database. All recordings from the towed hydrophones were made at a 96kHz sampling rate using the tape recorder within Logger. On some occasions Logger's automatic recording and buffering capabilities were used. In addition, data on hydrophone depth and surface water temperature were stored within the Logger database using programs written for this project by Ricardo Antunes. A new feature in Logger is the ability to open forms and control some functions using external buttons. We installed a system of wireless remote control buttons to be able to open key forms and initiate tape recordings from deck

² Logger is a computer program written by Douglas Gillespie with support from the International Fund for Animal Welfare to promote benign and non-invasive research.

which made it easier to record data on a computer below decks. Occasionally, for example when working with larger schools of sperm whales, notes were also made on paper forms. This information was transcribed into Logger immediately after these encounters ended.

Photo-ID and Photogrammetry

The primary data collected on this project were photographs and observations to characterize individual animals, in particular images to allow animals to be identified. To collect these, animals were carefully approached from astern to allow sequences of photographs of the fluke up to be taken as close to perpendicular as possible. We used two digital SLR cameras (Canon 1D and 1D-MarkII), equipped with Sigma 100-300 mm lenses. Observers also looked carefully at the whale's dorsal fin using stabilized 12X binoculars (Fujinon) to determine whether or not it carried a callus (calluses are more common on mature females). Ranges to whales were measured using laser range finders. These distances served two purposes. Firstly, relaying this information to the helm helped with maneuvering. A range of between 40-50 meters is ideal for photo-identification. Secondly, the exact range to the whale when it fluked can be used to estimate fluke width, and consequently body length of the whale. Along with the distance to the fluke, we also recorded an estimate of the relative angle between us and the fluke, since this measure influences the quality of the estimates of fluke width.

Some 180 photographic sequences were taken of fluke ups for photo-identification. Of these, 31 were taken on leg 1, 37 on the middle legs and 112 on the final leg. This distribution reflects both the poor weather and other problems encountered in the middle of the season. It also points to the general lack of large mixed groups within our study area and the fact that the whales encountered during the first and middle legs often were not feeding and thus not fluking up. Until matching analysis is completed we won't know how many whales this represents and how many of these match individuals already in the catalogue. However, some individuals bore such obvious marks that we are confident that several animals have already been identified in previous years.

Acoustic Monitoring

Hydrophones were monitored every 15 minutes for one minute when the vessel was offshore and in survey mode. This year we experienced some electrical noise on the system (emanating from the alternator) which we were unable to fully eliminate. We believe that this must relate to changes made to the boat between the two seasons but we were never able to isolate the cause. To facilitate monitoring, the engine would be turned off on every second monitoring station. A total of 1262 standard one minute monitoring stations were completed. Dolphins were detected at 19% of these (compared to 13% in 2004). Seismic airguns could be heard at 28% of these. This compares with detection rates for seismic of 5% and 30% in 2004 and 2003 respectively. Sperm whales were detected at 8% of stations compared to 11% in 2004. However, as the vessel would come off survey mode and start tracking soon after whales are detected, these are much lower than detection rates one would expect for a non-closing survey mode.

Coda Recordings

Codas, stereotyped patterns of clicks believed to be used for communication and most often heard from socializing whales, can be analyzed to reveal the cultural organizational structure

of sperm whale populations. This year we continued to add to our repertoire of recordings from mixed groups and were particularly excited to obtain substantial recordings from groups of maturing males, which have previously been poorly sampled. Table 3 summarizes dedicated coda recordings.

Tissue Collection

Biopsy samples were collected for Dr Dan Engelhaupt. Only one of the team, Raul Diaz, is permitted for this work. Diaz was not available for the first leg and was injured for the first part of the final leg, consequently only two samples were collected from individuals believed to be males (PM05****-01GOM; PM05****-02GOM). The biopsy samples were stored in 20% DMSO solution to preserve the tissues. In addition, three sloughed skin samples were collected.

Other Sightings

The small team on this project had a heavy workload to maintain round the clock monitoring, and while the small research vessel used was quiet and excellent for acoustic monitoring it lacked a good visual observation platform. Thus, an effective visual monitoring watch was not maintained when sperm whales were not being tracked. Nonetheless, a number of sightings of species other than sperm whales were made in offshore waters and these are summarized in Table 4. Two highlights were an encounter with a Bryde's whale on the continental shelf south of Pensacola and an encounter with false killer whales offshore from the Florida coast.

Habitat Characterization

We are mainly dependent for habitat characterization on the expert interpretation of satellite products such as MODIS, SSH, SST by Drs. Biggs and Jochens, with MODIS and SSH images provided by Drs. Hu and Leben, respectively. However, some supplementary data that may assist with ground-truthing and interpreting satellite images were also collected. Surface water temperature was logged every minute at a water depth of ~1m. These data were recorded in Logger through an interface program written by Ricardo Antunes and over 24,000 measurements were recorded. In addition, whenever time allowed, usually at the end of the day, a CTD cast was completed using a hand deployed Seabird SeaCat CTD.

Table 3. Summary of Dedicated Coda Recordings

<i>Date (d/m/y)</i>	<i>Number of Recordings Made</i>	<i>Minutes of Recording</i>
17/06/2005	8	31.6
18/06/2005	3	11.2
19/06/2005	8	66.6
03/07/2005	11	47.8
04/07/2005	5	27.2
25/07/2005	7	46.2

26/07/2005	3	20.5
01/08/2005	7	81.1

Table 4. Summary of sightings of species other than sperm whales during the 2005 MPS cruise.

Date	Time (UTC)	Species	Estimated Group Size	Latitude N	Longitude W
15 June	19:10	Pantropical spotted dolphins	25	28.06	-86.23
	20:37	Unidentified dolphin	10	28.15	-86.29
	22:10	Pantropical spotted dolphins	50	28.28	-86.35
16 June	16:26	Kogia species	1	29.00	-87.11
	18:41	Kogia species	1	29.17	-87.02
17 June	13:25	Pantropical spotted dolphins	2	29.09	-87.55
	13:40	Melon-headed whale	200	29.10	-87.57
19 June	01:14	Pantropical spotted dolphins	20	28.76	-88.62
	13:05	Risso's dolphin	6	28.99	-88.44
	18:54	Pygmy Killer Whale	12	28.99	-88.40
	19:49	Risso's dolphin	6	29.00	-88.36
	22:54	Short-snouted spinner	15	29.06	-88.28
25 June	12:45	Pantropical spotted dolphins	30	28.12	-88.91
27 June	18:07	Short-snouted spinner	8	27.80	-90.55
28 June	19:39	Melon-headed whale	15	27.97	-90.36
03 July	10:50	Unidentified dolphin	50	28.86	-88.42
	18:00	Bryde's whale	1	29.67	-87.22
04 July	15:08	Pilot whale	20	29.24	-87.65
	18:44	Unidentified dolphin	7	29.25	-87.56
13 July	15:52	Bottlenose dolphin	8	27.74	-91.52
25 July	21:51	Melon-headed whale	80	26.84	-92.99
30 July	11:03	Melon-headed whale	30	28.16	-88.89
02 August	16:00	False killer whale	18	28.23	-86.18
	22:27	Pantropical spotted dolphins	20	27.66	-85.58

Rig Recordings

Our intention was to make recordings of noise fields close to oil platforms and drill ships on an opportunistic basis as and when opportunities presented themselves using both the vessel's primary towed hydrophones and a calibrated recording setup. Recordings are summarized in Table 5.

Table 5. Recordings of rig noise completed during 2005 MPS cruise aboard *Summer Breeze*.

Date	Time (UTC)	Rig Name
14 July 2005	02:18	Ocean Victory
27 July 2005	17:00	Ocean Saratoga
27 July 2005	17:40	Brutus
27 July 2005	19:00	Genesis
28 July 2005	02:26	Ocean America
27 July 2005	06:17	TranOcean