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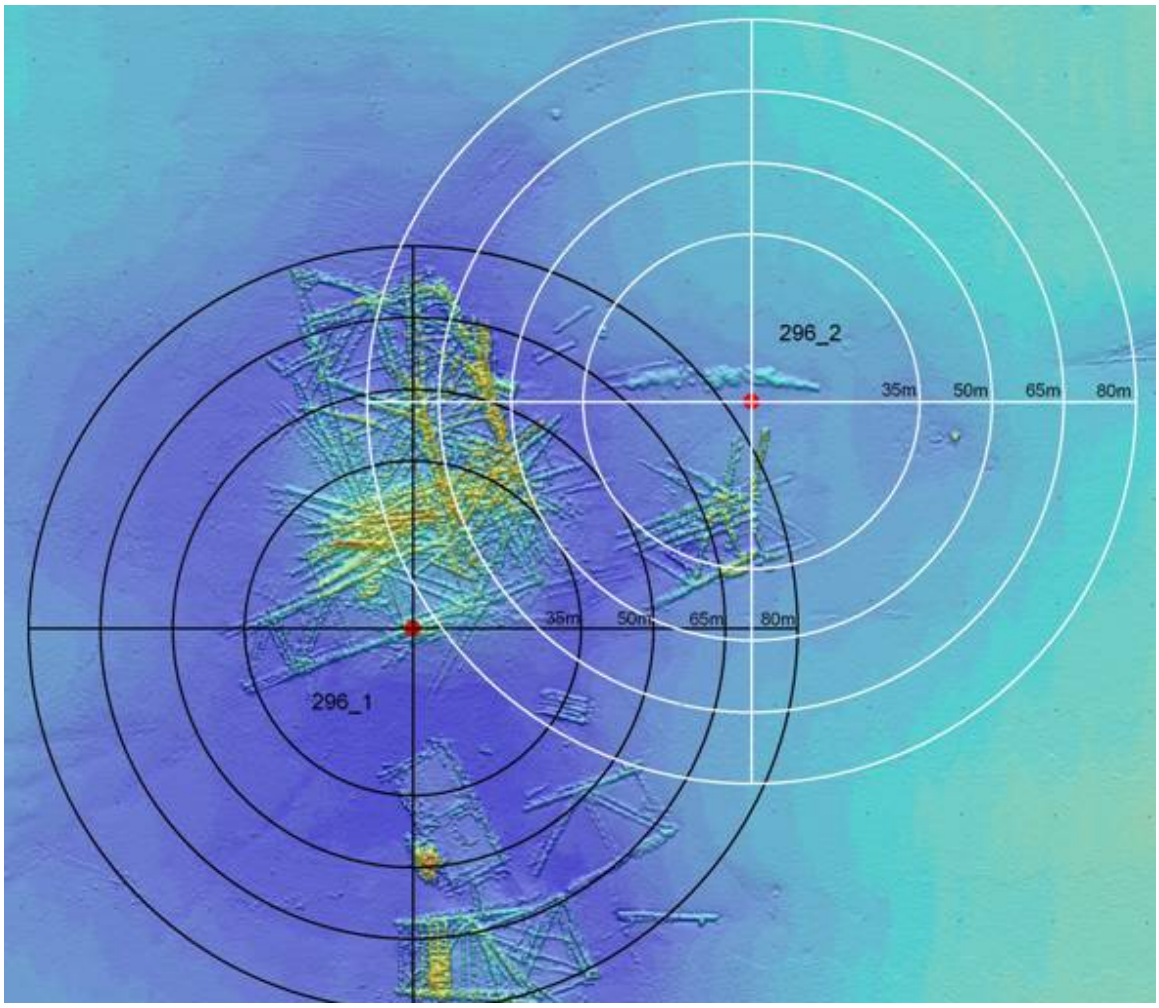
Coastal Marine Institute

# Platform Debris Fields Associated with the Blue Dolphin (Buccaneer) Gas and Oil Field Artificial Reef Sites Offshore Freeport, Texas: Extent, Composition, and Biological Utilization

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Gulf of Mexico OCS Region

LSU Cooperative Agreement
Coastal Marine Institute
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# Platform Debris Fields Associated with the Blue Dolphin (Buccaneer) Gas and Oil Field Artificial Reef Sites Offshore Freeport, Texas: Extent, Composition, and Biological Utilization

Editors

Benny J. Gallaway
John G. Cole
Larry R. Martin

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We especially thank Messrs. John Embesi and Douglas Peters, TPWD, for providing roving diver survey data, videotapes, and other photography from the Buccaneer Gas and Oil Field during and shortly after the partial removal of these structures.

# SUMMARY

The goal of this study was to document the extent, composition, and reef value of debris fields around two sets of production and quarters platforms (GA-288A, AQ; GA-296B, BQ) in the Blue Dolphin Gas and Oil Field (formerly the Buccaneer Gas and Oil Field) that were partially removed and "reefed" in place in August 2003. These sites are now maintained as artificial reefs.

These platforms had been in place since the 1960s, and, because the sites were designated as artificial reefs, the seafloor at these locations was not "cleaned-up" when the platforms were partially removed. These sites, therefore, were believed to offer an unusual opportunity to document the composition, extent, and fish habitat value of the debris fields associated with structures that had been in place for more than four decades.

The site is unusual in that extensive historical investigations had been conducted at these platforms in the late 1970's, thereby providing a qualitative assessment of the debris fields present at that time. Further, additional debris was added in the form of platform sections of various sizes that were cut and dropped in place. Lastly, because the sites have been designated as artificial reef sites by the Texas Parks and Wildlife Department (TPWD), matching funds were available to support studies of these reefs.

We mapped these new artificial reefs and their associated debris fields using side-scan sonar and multibeam echosounder technology, then surveyed them using divers, ROVs (remotely operated vehicle), and hydroacoustic technology to document the biological utilization of these reefs. In these surveys, the focus was placed on documenting the reef and other fish species that were present.

The debris piles around GA-288 and GA-296 each covered about 5,300 m2 and, in 2005, each had a maximum vertical relief of about 6 m. Outside the designated reef areas, the seafloor was relatively clean, and very little, if any, material was located outside a radius of about 150 m. The total fish populations at these two sites in 2004 ranged from about 6,000 to 9,500 individuals. The dominant species included red snapper, Atlantic spadefish, blue runner, and sheepshead. These species were among the dominants when the platforms were standing (Gallaway et al. 1981). The tomtate was initially abundant but largely disappeared after one year.

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| | |
|---|---|
| BGOF | Buccaneer Gas and Oil Field |
| dB | decibel |
| EPA | Environmental Protection Agency |
| ft | feet |
| GIS | Geographic Information System |
| GLM | general linear model |
| GPS | Global Positioning System |
| kHz | kilohertz |
| LGL | LGL Ecological Research Associates, Inc. |
| LSU | Louisiana State University |
| m | meters |
| $m^3$ | cubic meters |
| MBES | Multibeam Echosounder |
| MMS | Minerals Management Service |
| M/V | marine vessel |
| NE | northeast |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| ROV | remotely operated vehicle |
| sec | second |
| Sv | Structure-Survey |
| SW | southwest |
| TPWD | Texas Parks & Wildlife Department |
| Ts | target strength |
| TVG | time varied gain |

# 1. INTRODUCTION

The goal of this study was to document the extent, composition, and reef value of debris fields around two sets of production and quarters platforms (GA-288A, AQ; GA-296B, BQ) in the Blue Dolphin Gas and Oil Field (formerly the Buccaneer Gas and Oil Field) that were partially removed and "reefed" in place in August 2003. These sites are now maintained as artificial reefs. These platforms had been in place since the 1960s, and, because the sites were designated as artificial reefs, the seafloor at these locations was not "cleaned-up" when the platforms were partially removed. These sites, therefore, were believed to offer an unusual opportunity to document the composition, extent, and fish habitat value of the debris fields associated with structures that had been in place for more than four decades. The site is unusual in that extensive historical investigations had been conducted at these platforms in the late 1970's, thereby providing a qualitative assessment of the debris fields present at that time. Further, additional debris was added in the form of platform sections of various sizes that were cut and dropped in place. Lastly, because the sites have been selected as designated artificial reef sites by the Texas Parks and Wildlife Department (TPWD), matching funds were available to support studies of these reefs.

We mapped these new artificial reefs and their associated debris fields using either side-scan sonar or multibeam echosounder technology, then surveyed them using divers, ROVs (remotely operated vehicle), and hydroacoustic technology to document the biological utilization of these reefs. In these surveys, the focus was placed on documenting the reef and other fish species that were present.

The first year of the study provided a quantitative description of the debris fields and associated biological utilization patterns. In a subsequent year of the study, another mapping and biological survey effort was conducted at the artificial reef sites. Comparisons of the distribution and composition of the debris fields between years enabled an assessment of changes in the reefs and reef fish communities. The platform study sites occurred near what we initially believed to be a natural hard-bottom, shell ridge, an important rearing habitat for juvenile red snapper. We examined this habitat on the first cruise and documented that it was not the type of habitat we had expected. It was not surveyed again.

## *1.1 Background*

Before proceeding, we provide a background on the Blue Dolphin Gas and Oil Field. The Blue Dolphin field was historically known as the Buccaneer Gas and Oil Field (BGOF). This field has long been a popular recreational fishing area. In the mid- to late 1970s an average of 1 to 6 fishing boats fished at these platforms on weekdays and from 5 to 16 boats fished in the field on weekend days (Trent et al. 1977). Bob Ditton reported (in Gallaway et al. 1981) that 50% of the offshore marine recreational fishing between Freeport and Beaumont/Port Arthur, Texas, was conducted at oil and gas platforms during this time frame, and that 21% of this total occurred in this field alone.

This artificial reef complex associated with this offshore gas and oil field has historical importance because it served as the study area for a landmark investigation of effects from offshore oil and gas activities (e.g., Middleditch 1981) conducted by the National Marine Fisheries Service (NMFS) under contract to the Environmental Protection Agency (EPA). There

is a wealth of scientific data (and photography) describing the reef and surrounding soft-bottom communities at this site in the mid- to late 1970s. At that time, there was even serious consideration of proposing this field as a marine sanctuary because of its biological richness. The site is also unique in terms of its shallow depth. All or nearly all other decommissioned-platform artificial reefs are located deeper than 85 ft from the surface.

### 1.1.1 Platform Installation/Removal History

The BGOF is located in the northwestern Gulf of Mexico and lies approximately 50 kilometers south of the entrance to Galveston Bay, Texas. The water depth in the field is approximately 21 meters. A total of 24 platform structures have been installed over the life of the field. Gallaway et al. (1976) provided a detailed description of the exploration, drilling, and structures installed by the Shell Oil Company (Shell) in the BGOF. At that time, Shell's lease was comprised of portions of five Federal Galveston Area Lease Blocks (Blocks GA-288, GA-289, GA-295, GA-296, and GA-322). A total of 18 platforms had been constructed in the field prior to 1975: 2 production platforms, each with an associated flare stack and quarters platform, and 14 satellite well jacket platforms (Figure 1). Production platforms GA-288-A and GA-296-B were installed in September 1964 and May 1965, respectively (Gallaway et al. 1976). One of the satellite platforms (GA-296-5) had been removed by the end of 1975, after 11 years of service, leaving 13 satellite jackets through the period of the EPA/NMFS BGOF studies of 1975 through 1980.

All platforms reported by the U.S. Mineral Management Service (MMS) to have been installed over the entire history of the Buccaneer or Blue Dolphin Field are shown in Figure 2 and their periods of service are presented in Table 1. The MMS installation and removal records in Table 1 were compiled from data sources available at the MMS Gulf of Mexico Region web site. The MMS dates for platform installation and removal did not typically reflect the exact date on which a platform was set in the bottom or removed from the site. Twenty-one of the 24 platforms in the BGOF were listed by the MMS as having been installed in the month of January and seven of the 22 which have been removed from the field were listed as having been removed on December 31 of each year (Table 1).

The study platforms were dismantled and dropped to the seafloor in August of 2003. The first step in the process was to remove and salvage the platform decks and other materials of re-useable value (Figure 3). Each structure was then cut to about the 15.2-m (50 ft) depth. The top portions of the structures were cut into smaller pieces and placed on and around the base sections left in place. The standing base left in place was to have a planned profile of about 6.1 m (20 ft). Each reef was then marked with a lighted buoy maintained by the TPWD.

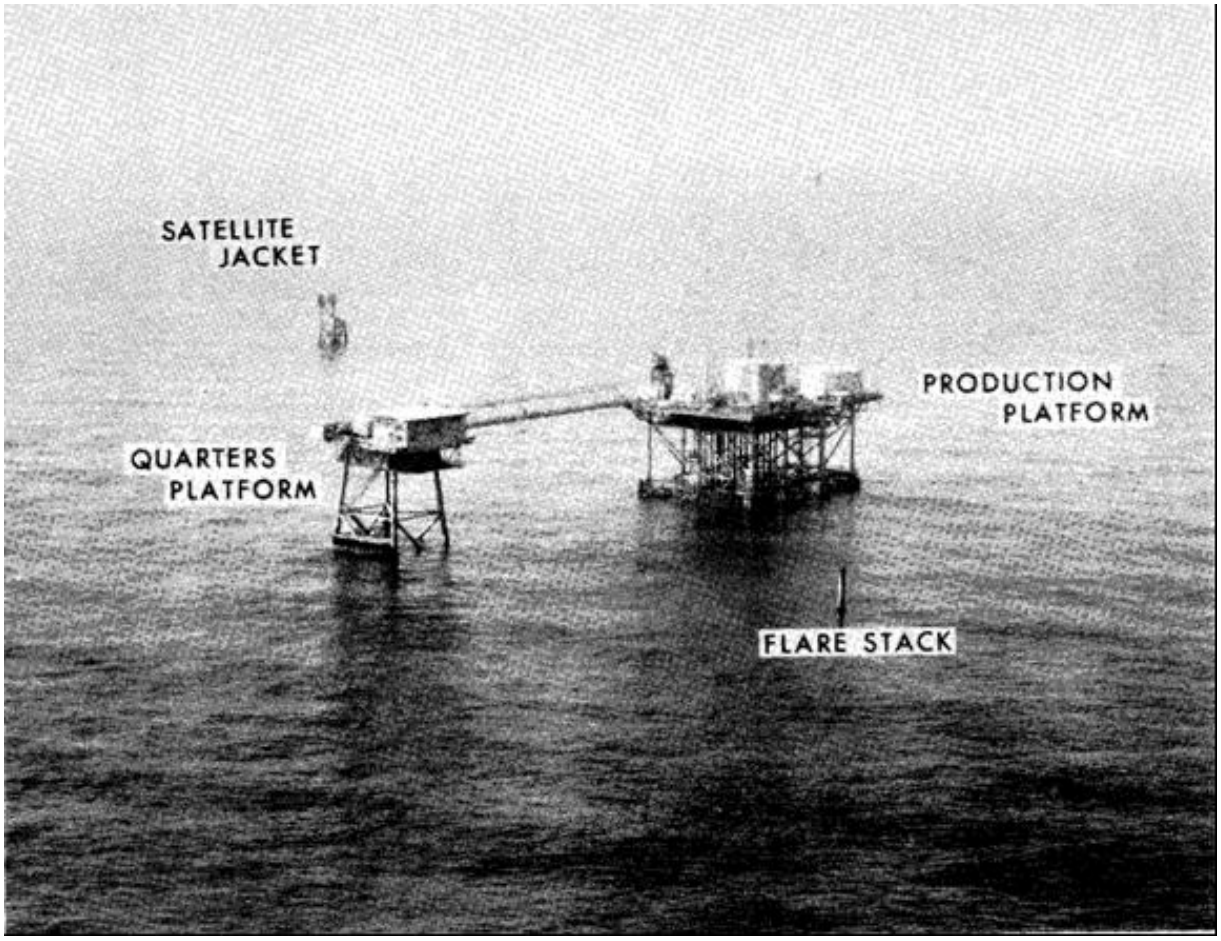


Figure 1. Representative structures in the Shell Oil's Buccaneer Gas and Oil Field. These included two 12-pile production platforms and associated quarters platforms, satellite well jackets, and flare stacks. Photograph courtesy of National Marine Fisheries Service, Galveston Laboratory.

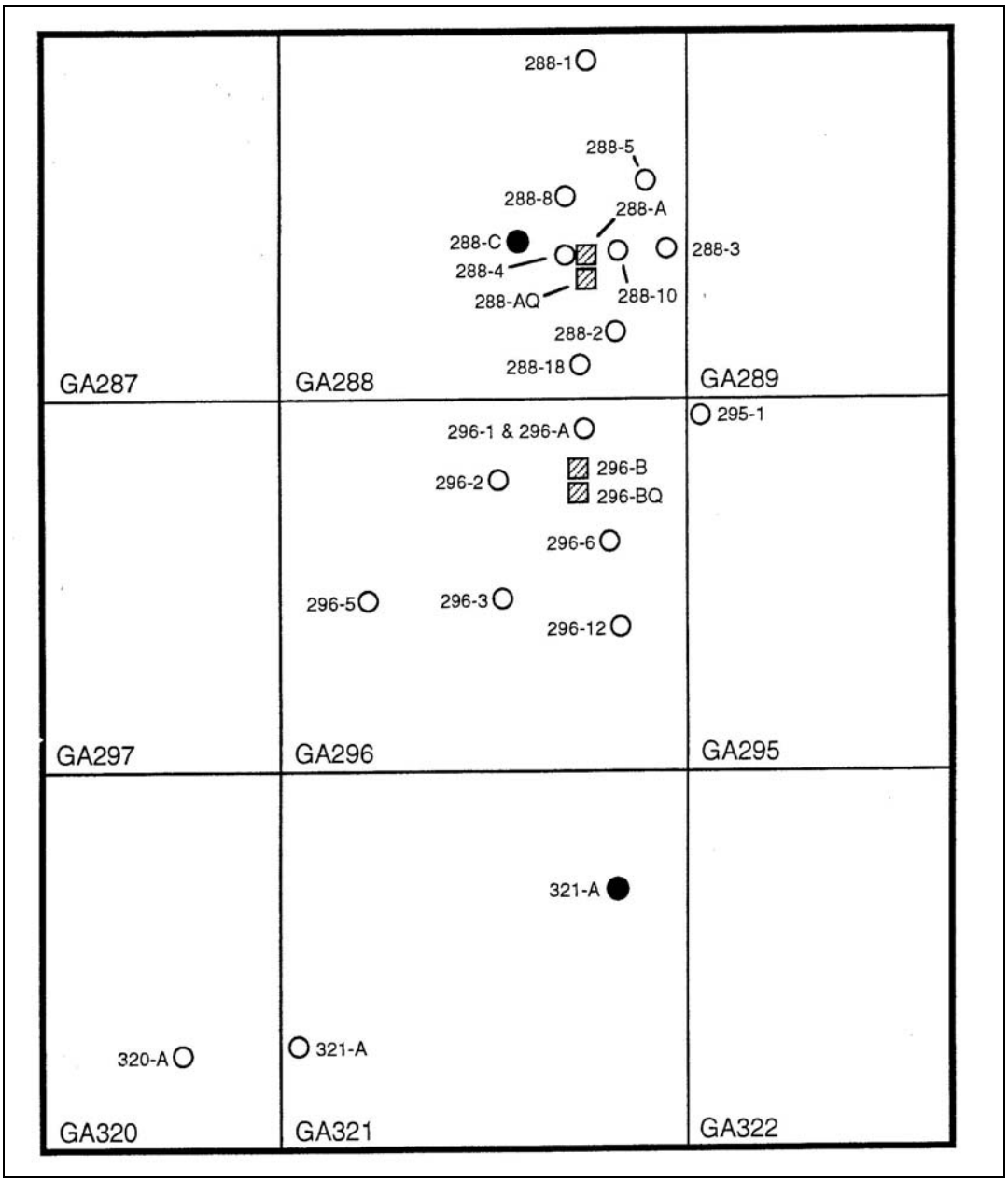


Figure 2. Twenty-three Buccaneer Gas and Oil Field platforms located in Federal Galveston Area Lease Blocks 288, 295, 296, 320, and 321: 2 production platforms with 2 adjoining quarters platforms (squares) and 20 satellite well jacket platforms (circles and solid dots). All platforms have been removed except two satellite well jackets (288-C and 321-A, solid dots) which remain in service and two production (288-A and 296-B) and two quarters (288-AQ and 296-BQ) platforms which were placed on the sea bottom at their respective locations to create two Texas Parks and Wildlife Department artificial reef sites.

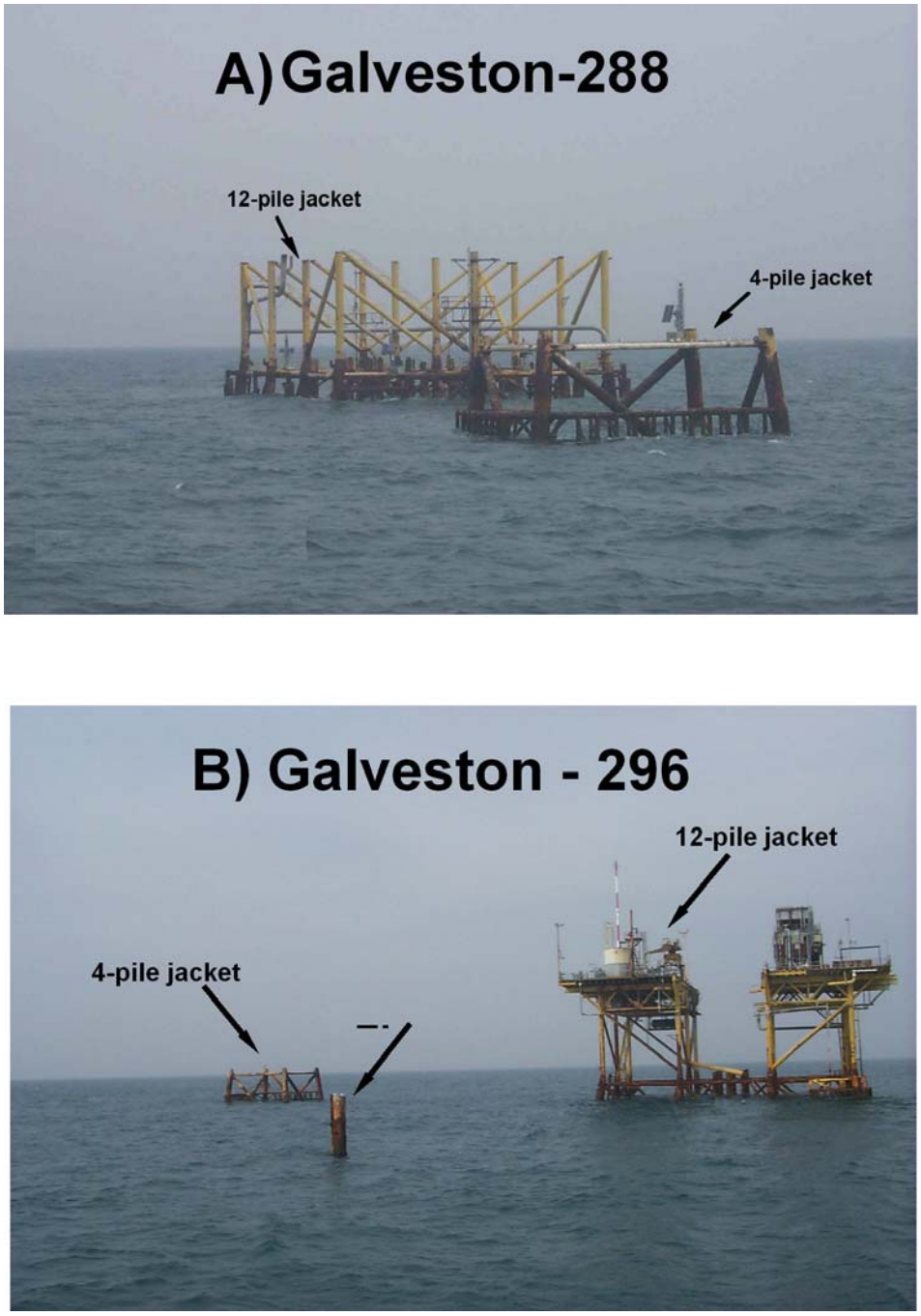


Figure 3. Decomissioning of Shell Oil's 12-pile production and 4-pile quarters platforms GA-288 (A) and GA-296 (B) in progress prior to the in-place reefing at these structures in summer of 2003. Photographs courtesy of John Embesi, Texas Parks and Wildlife Department.

Table 1

Installation and removal dates for the Buccaneer Gas and Oil Field: 2 Production Platforms, 2 Quarters Platforms, and 20 Satellite Well Jacket Platforms. The MMS dates are from data sources available at the MMS website. The NMFS removal dates (Gitschlag, Personal communication, 2003) refer to the date that platform legs were cut with explosive charges and not necessarily the date a structure was removed from the site.

| GA Lease Block Platforms | Install Date | | Removal Date | | Notes |
|---|---|---|---|---|---|
| | MMS | Shell | MMS | NMFS | |
| 288-A | 1/1/1965 | Sep-64 | 8/12/2003 | | non-explosive |
| 288-AQ | 1/1/1965 | | 8/12/2003 | | non-explosive |
| 288-C | 4/28/2001 | | Still in place | | Anchors head of pipeline to beach, no BOF product. |
| 288-1 | 9/3/1992 | | 7/28/1998 | | Walter Oil & Gas |
| 288-2 | 1/1/1963 | | 12/31/1986 | | |
| 288-3 | Jan-63 | | 12/31/1985 | | Appears out of place on the MMS figures. |
| 288-4 | Jan-66 | | 6/9/1994 | 4/22/1994 | Blue Dolphin Energy (Ivory?) |
| 288-5 | Jan-64 | | 6/12/1994 | 5/5/1994 | Blue Dolphin Energy (Ivory?) |
| 288-8 | 1/1/1964 | | 6/12/1994 | 4/19/1994 | Blue Dolphin Energy (Ivory?) |
| 288-10 | Jan-66 | | 6/14/1994 | 5/21/1994 | Blue Dolphin Energy (Ivory?) |
| 288-18 | Jan-67 | | 6/3/1999 | 5/26/1999 | Blue Dolphin Energy |
| 295-1 | Jan-63 | | 12/31/1986 | | |
| 296-A | 8/18/1993 | | 3/19/1998 | 3/19/1998 | Installed at same location as 296-1, Newfield Explo. |
| 296-B | 1/1/1963 | May-65 | 8/22/03? | | MMS clearance listed as 8/24/03, non-explosive. |
| 296-BQ | 1/1/1963 | | 8/22/2003 | | MMS clearance listed as generic explosive. |
| 296-1 | 1/1/1964 | | 6/12/1994 | 4/22/1994 | Blue Dolphin Energy (Ivory?) |
| 296-2 | Jan-63 | | 12/31/1984 | | |
| 296-3 | Jan-67 | | 12/31/1984 | | |
| 296-5 | Jan-64 | | 12/31/1975 | | |
| 296-6 | Jan-64 | | 6/10/1994 | 5/9/1994 | Blue Dolphin Energy (Ivory?) |
| 296-12 | Jan-67 | | 12/31/1984 | | |
| 320-A | Jan-86 | | 5/28/1997 | 5/29/1997 | Kerr-McGee |
| 321-A | Jan-86 | | 9/22/1989 | | Walter Oil & Gas |
| 321-A | 1/23/1992 | | Still in place | | Must have re-used the ID from the previous 321-A. |

Table 2

Species composition and relative abundance of fishes observed at GA-288 in September 2003 by the Texas Parks and Wildlife Department (TPWD) divers and at GA-288 and GA-296 in August 2004 using remotely operated vehicles (ROVs) equipped with a video camera.

| Species | GA-288 | | GA-296 | Rock Ridge GA-296 |
|---|---|---|---|---|
| | September 2003 | August 2004 | August 2004 | August 2004 |
| | TPWD | This Study | This Study | This Study |
| | Percent | Percent | Percent | Percent |
| Tomtate *Haemulon aurolineatum* | 38.1 | 2.9 | 2.7 | 12.0 |
| Sheepshead *Archosargus probatocephalus* | 17.7 | 15.3 | 2.0 | 26.0 |
| Atlantic Spadefish *Chaetodipterus faber* | 13.4 | 12.5 | 29.1 | - |
| Gray Triggerfish *Balistes capriscus* | 13.4 | 4.0 | 2.8 | 2.0 |
| Gray Snapper *Lutjanus griseus* | 10.7 | 0.9 | 3.3 | - |
| Red Snapper *Lutjanus campechanus* | 4.0 | 52.0 | 25.2 | 2.0 |
| Cobia *Rachycentron canadum* | 1.5 | 0.6 | - | - |
| Almaco Jack *Seriola rivoliana* | 0.9 | - | 0.8 | - |
| Blue Runner *Caranx crysos* | 0.3 | - | 28.1 | - |
| Greater Hammerhead *Sphyrna mokarran* | 0.2 | - | - | - |
| Unidentified Fish | - | 8.3 | 2.5 | 26.0 |
| Unidentifed Snapper *Lutjanus* sp. | - | 2.6 | 1.4 | 2.0 |
| Lane snapper *Lutjanus synagris* | - | 0.6 | - | - |
| Lookdown *Selene volmer* | - | 0.4 | 0.9 | 30.0 |
| Bluefish *Pomotomus saltatrix* | - | - | 0.9 | - |
| Remora *Remora remora* | - | - | 0.1 | - |
| Mackerl *Scomberomorus* spp. | - | - | 0.1 | - |
| TOTALS | 100.2 | 100.1 | 99.9 | 100.0 |
| NUMBER OF TAXA | 10 | 11 | 14 | 7 |

Since 1987, the NMFS observers have been required to be present at all platform removals which utilized explosive charges to cut the platform pilings (Gitschlag, Personal communication, 2003). Exact records of the dates on which explosive charges were detonated have been maintained by the NMFS. Dates since 1987 on which explosive charges were used for BGOF platform removals and recorded by the NMFS have been included in Table 1. Discrepancies involving dates or locations for platforms were clarified in several instances by telephone conversations with Messrs. Greg Boland (MMS), Greg Gitschlag (NMFS), and Doug Peter (TPWD). As shown by Figure 2, two satellite structures remain in place.

### 1.1.2 Environmental Setting and Biological Attributes

The results of sediment studies in the area show that the area is predominantly erosional in nature and that relict deposits are actively being exposed, eroded, and redistributed by bottom currents. Most fine, suspended sediments derived from coastal sources are swept seaward and beyond the area of interest. The sediments are mostly sandy to muddy sands with the "mud" or clay coming from the exposed Beaumont Clay fraction (Anderson et al. 1981). Erosion of this cohesive clay sediment is facilitated by bioturbation.

As reported by Gallaway et al. (1981), the structures in the BGOF hosted a diverse and abundant biofouling community (over 17 algae and 101 species of invertebrates). This community consisted of two main components, shelled organisms (namely barnacles), which comprised and shaped the overall habitat, and an encrusting "mat community" (algae, bryozoans, hydroids, sponges, and the like). The dominant was the large Mediterranean barnacle [*Megabalanus tintinnabulum antillensis* (Newman and Ross 1976)] that occupied some 77% of the original platform substrate. This barnacle grew to 6-8 cm in height and had basal diameters of 3-4 cm. The presence and abundance of this species was one of the major biogeographic findings of the study. Historically, it had been known only as an incidental species in Gulf Mexico. For a detailed discussion of this barnacle in the BGOF, see Boland (1980).

The habitat afforded by the barnacle and mat community was alive with cryptic species using this habitat for shelter and food. These included blennies, stone crab, pistol shrimp, polychaetes and brittle stars. Of interest, the now-familiar and common blue-with-orange spots tessellated blenny was first recorded in the Gulf of Mexico from this habitat in 1979. Prior to that, it had been known only from the Lesser Antilles, Venezuela, and Columbia. Of interest, small stone crabs exhibited remarkable abundance until they exceeded a size allowing use of the habitat for cover. They were then eaten by predators or left the area prior to reaching a harvestable size.

These cryptic species were extensively preyed upon by sheepshead, triggerfish, larger blennies and other small reef fishes and even species like Almaco jacks. Of interest, one of the dominant resident species, the Atlantic spadefish, was more dependent on the planktonic community than on the biofouling community for food.

The structure-associated fish fauna in this field were classified as either seasonal transients or resident species. The seasonal-transient, predatory forms included king mackerel, cobia, bluefish, little tunny, dolphin, sharks, blue runner, sharksuckers, and jack crevalle. Seasonal prey species included rough scad, Spanish sardine and scaled sardines. The numerical aggregations of these species in combination with massive schools of lookdowns, Atlantic moonfish, and the ever-present Atlantic spadefish were and likely remain a sight to behold.

Of interest, the bluefish population maxima occurred in winter when some 3,000 to 5,000 fish were estimated around each of the major structures. Most of the specimens were fairly large (30 to 50 cm) and many were tagged. However, we received no tag returns from sports fishermen. Bluefish may represent an underutilized species in these habitats.

Resident species were found to include 1) fishes directly dependent upon the biofouling community for food and/or cover and 2) fishes that utilized the structure as cover but not for food. The trophic-dependent fishes included the species listed above as well as damselfishes, butterfly fishes, angelfishes, sea basses, cubbyu and various wrasses. The latter category (non-trophically dependent) included species such as the Atlantic spadefish, tomtate, red snapper and groupers. The site was documented to be heavily utilized by sub-adult red snapper recruited from the surrounding soft bottom habitat. However, few red snapper recruits escaped the recreational fishery in those days of no-limits.

A major finding was that the BGOF structures served as a major spawning aggregation site for sheepshead in the spring of each year of the study. We understand that these aggregations still occur based upon TPWD observations in spring 2003. It is the only site on the upper Texas coast (or elsewhere) of which we are aware that has been documented to serve as a spawning aggregation area. This area very well may be more important for this species than has been recognized. Whether, the area will still be utilized as a spawning aggregation area now that the platforms have been modified is an open question that should be monitored. Nevertheless, the plan to retain these structures, albeit modified, in this area is likely a very important and good decision.

Debris fields were present around all the platforms investigated in the 1970’s. The debris fields included materials of anthropogenic as well as biogenic origin. The bottom beneath and immediately adjacent to the platforms was littered with metal debris including pieces of catwalk, lengths of wire cable, gears, welding rods, batteries and even a metal stretcher. These large objects were supplemented by a rain of metal flakes that was attributed to corrosion of the metal gratings that comprised the decks of the platforms. Debris of biogenic origin ranged from whole barnacles to clumps of barnacles that broke off during storms, to parts of other colonial organisms to fish scales and fecal pellets. Seasonally, the bottom under the platforms was littered with high densities of intact shells of a planktonic pteropod. These accumulations were attributed to predation by Atlantic spadefish. Recreational fishing debris (plastic can holders, fishing line, hooks and sinkers) was common but no evidence was mentioned regarding discarded or lost commercial fishing gear. The area was a popular recreational fishing area.

## *1.2 Objectives*

The specific objectives of this project were to 1) obtain baseline maps and characterize the Blue Dolphin Gas and Oil Field Artificial Reefs as they existed shortly after being established, and 2) to describe the numbers and types of fish associated with these reefs at that time. Comparison surveys were to be conducted after one year to determine changes from the baseline.

# 2.0 METHODS AND MATERIALS

The original plan was to conduct two sampling cruises, one in summer/fall of 2003 and the other in the same season of 2004. Each survey was to consist of side-scan sonar surveys to map the reef sites and debris distribution, dual beam hydroacoustic surveys to determine fish abundance and biomass at each site and ROV surveys to determine the composition and extent of the debris that was present and to provide identification of the fish species represented at the sites. The second cruise was intended to document changes that had occurred after one year.

The first cruise was conducted as planned in October 2003, except that inclement weather combined with ROV problems prevented completion of the underwater video surveys at the reef sites. However, TPWD divers had conducted a fish survey at the Platform GA-288 debris field in September 2003. We analyzed and used these data to enable estimates of fish composition at that site for the first cruise.

The second cruise was conducted in August 2004 and yielded complete ROV and dual beam hydroacoustic survey data. However, inclement weather prevented us from obtaining side-scan sonar data which requires calm seas. We elected to postpone the attempt to obtain these data until the summer/fall season of 2005. However, these attempts were thwarted by a summer of rough seas and by the two hurricanes (Katrina and Rita) that hit the area in summer/fall 2005. However, multibeam echosounder (MBES) surveys had been conducted at our project sites in June 2005 prior to the hurricanes. We used project funds to obtain and analyze these data to determine changes in the distribution of the debris fields as compared to 2003.

## *2.1 Side-Scan Sonar Survey*

Side-scan sonar has routinely been used for evaluation of surface marine environments since the early 1970s. This source of acoustic data revolutionized the way marine environments are evaluated for engineering, geological, and biological applications. Early side-scan data was, however, collected, displayed and archived only in an analog format. Advances in digital data technology have allowed a transition to a digital format, which has greatly improved the resolution, precision, display and storage of side-scan information. With the continued development of more sophisticated source-receiver technology and improved digital data acquisition and processing software, we were able to generate high-resolution digital side-scan mosaics in a portable, geo-referenced format.

A Klein model 2260NV digital dual frequency (100/500 kHz) tow fish, the Klein T2100 transceiver, and a high-fidelity, low-loss armored, single conductor coaxial tow cable was used to conduct the side scan survey aboard the M/V SPREE. The tow fish contained heading, pitch, and roll sensors as well as a pressure sensor for depth and water temperature. The surveys were conducted at speeds of 5 to 6 knots which were believed to produce the best results. Data from the Klein side-scan system were corrected for slant range and boat speed. The data were acquired simultaneously at two resolution settings, 100 kHz, which produces adequate resolution and has a long range, and 500 kHz, which produces higher resolution images for a shorter range.

The survey transects were laid out along a latitudinal gradient with 100 m spacing and 100 m range setting. Upon completion of the survey, the data were coarsely processed as described below and the resultant mosaics were used to select areas to be surveyed with the ROV.

For our surveys we used a 100 m horizontal scale and the lower frequency data- acquisition option. With these system settings, and with proper system calibration, it was possible to discriminate different sediment types (e.g., shell rubble, sand, silt, mud, or clay) due to differences in acoustic reflectance (Davis et al., 1996; Roberts et al., 1999). The ability to establish accurate geographic positioning of geophysical data sets and features within those data sets is essential to any marine survey. The navigation software used in this survey was ChartView Pro by Nautical Software, Inc. This software is configured to acquire geographic positioning data downloaded to a dedicated PC from a differential GPS (Global Positioning System), such as the dual differential GPS received system that we used (see below). The Chart View software was used to display navigational charts with the survey plan super-imposed on NOAA navigational charts, which enabled us to layout the track lines prior to data collection. During transit or while on station, a status window on the dedicated PC displayed the vessel's course, speed and position. A second monitor in the wheelhouse provided relative course correction information to the helmsman.

Data from the Klein Model 2260 digital side scan fish and transceiver was geo-referenced using a C&C Technologies (system manufacturer) differential GPS receiver that employs two Ashtec (brand) GPS receivers and two differential beacon receivers. The first beacon receiver was a SatLoc (sub-meter accuracy, subscription only) satellite based beacon receiver and the second was a U. S. Coast Guard beacon receiver (3-5 meter accuracy). The corrected GPS fix data were sent to the various data acquisition systems in real time at a rate of one fix per second.

The raw digital data were saved, processed, and displayed along with positioning of the towfish in real time. Side-scan acquisition and processing was performed via ISIS and Hypack hydrographic survey software (Coastal Oceanographics, Inc., Middlefield, CT). The geo-referenced acoustic mosaics of the side scan data was constructed using Isis Sonar and Delph-Map software (Triton Elics International, Inc., Watsonville, CA); the Isis Sonar program used an IBM-compatible PC equipped with a dedicated acquisition and processing board. This software package allows for adjustments of contrast, time varied gain (TVG), and a variety of other image processing utilities that yields an even, corrected side-scan mosaic image. The resultant mosaic was outputted in UTM15, NAD 1927 to be compatible with existing geographic data sets. The Triton Software Package, DELPHMAP, version 2.5 was used to further correct the image for contrast (if required), and export the propriety sonar image as a geo-referenced TIF which can be easily imported into a variety of GIS packages such as ArcView, Geomedia or Imagine. We established a relationship between sonar reflectance patterns and substrate characteristics using information from ROV surveys (see below).

## *2.2 Multibeam Echosounder (MBES) Survey*

The GA-288 and GA-296 artificial reef sites were surveyed on June 1, 2005 using a RESON SeaBat 8125 Multibeam echosounder (MBES) as part of a three-day survey cruise funded by the Flower Garden Banks National Marine Sanctuary-NOAA, with additional support from Gulf Diving LLC, and RESON, Inc. Surveys were conducted aboard the M/V SPREE, operated out of Freeport, Texas, using a pole-mounted, single-head SeaBat 8125 MBES. Vessel position was determined using a Trimble RTK GPS with roll, pitch, and heave determined by an Applanix POS/MV motion sensor. Sound velocity of the water column was recorded with a RESON SVP-15 Sound Velocity Profiler. Survey data were collected and processed using Hypack/Hysweep data acquisition software. Artificial reef sites GA-288 and GA-296 were chosen as areas for

calibration (patch test) of the 8125 MBES during the survey cruise due to their proximity to shore, the presence of discrete structures from the 12-pile and 4-pile debris fields providing abrupt relief from a relatively flat surrounding seafloor, and the availability of prior side-scan sonar, hydroacoustic, and fish survey data to provide a fisheries context.

The SeaBat 8125 MBES is an ideal survey instrument for mapping natural and artificial reef structures because it emits 240 focused beams, each at 0.5 $^{o}$, at a frequency of 455 kHz and rates of up to 40 pulses per second, to ensure a high level of feature detail. At the time of the survey, the 8125 was the world's highest resolution MBES available. The resulting detail of this system results in extremely precise and accurate individual soundings for visualization of the primary reef structures, associated debris, seabed depressions, and general seabed features. Repeated surveys over time can also be used to document degradation of shipwrecks and artificial reef structures, scouring of the seafloor, and movement or burial of artificial reef materials.

Artificial reef site GA-288 was surveyed using a 315º and 135º degree vessel track, with a 45º cross track for swath alignment and depth calibration. It was surveyed by 8 overlapping swaths, at a line spacing of approximately 50 m, for a total area of approximately 320 m (NE/SW) by 380 m (NW/SE) meters. Individual soundings were recorded at approximately 0.15-0.30 m spacing, and gridded at 0.25 m resolution in ArcView 9.1 GIS software. Artificial reef site GA-296 was surveyed along an east to west vessel track of 90 $^{o}$ and 270 $^{o}$ heading, with a single cross track at 180 $^{o}$ for swath alignment and depth calibration. Site GA-296 was surveyed by 7 overlapping swaths, at a line spacing of approximately 50m, for a total area of approximately 360m (east/west) by 320m (north/south). Individual soundings were recorded at approximately 0.10-0.30m spacing, and gridded at 0.25m resolution in ArcView 9.1 GIS software (ESRI; Redlands, CA) for 2D and 3D visualization.

## *2.3 Dual-Beam Hydroacoustic Surveys*

Acoustic surveys were conducted at the Blue Dolphin Artificial Reef sites in October 2003 and August 2004 aboard the M/V SPREE. These surveys used a 120 kHz downward oriented transducer towed from the starboard hip of the research vessel. The towfish was flown 5 m from the side of the hull with a telescoping mast and 3 m below the surface at approximately 4 kts. Navigational data were collected with a Garmin GPS III global positioning system (GPS) with a Garmin GB 21 differential beacon receiver. The antenna for the GPS was mounted directly above the tow body. The navigation data stream, updated once per second, was incorporated into the acoustic data string and then saved onto a laptop computer. The towed transducer provided acoustic coverage from a depth of 5 m to within approximately 1 m of the bottom. On the order of 17 east-west transects, each approximately 8 nm-long, were run with each of these spaced approximately 50-m apart.

Acoustic data were collected with a BioSonics model DT5000 scientific echosounder/multiplexer. All data were collected with 120 kHz transducers which had been factory calibrated to a –42 dB tungsten sphere. Source levels were 223 dB / Pa at 1 m. Sampling rate was 5 pings/sec with a pulse width of 0.4 ms. Received signals were adjusted for spreading loss by applying a 40 log R time varied gain, digitized and recorded on the computer hard drive and later transferred to CD digital media. The data collected threshold was –55 dB, corresponding to a minimum detection of a 2.5 cm fish.

Digitized hydroacoustic data were processed with a BioSonics' Visual Analyzer 4.02. Recent advances in the software allowed simultaneous estimates of sigma (TS, target strength) and mean volume backscatter (Sv, reflected acoustic energy) for each depth strata. These parameters are used to estimate fish density/$m^3$, and fish size as described below. Acoustic data were gathered and processed by LSU personnel and provided to LGL for analysis.

Acoustic data collected by LSU were received in Microsoft Access database tables for each cruise. There were two tables of interest provided for each cruise: 1) the Sv table (named as Structure-Survey-SV, ie., GA288-1-SV); and 2) the Ts table (named Structure-Survey-TS). The Sv table provides location variables and the mean acoustic volume backscattering strength (dB). This is a measure of the scattering over the 2 cubic meters of water sampled. It was used as a proxy for fish biomass (Wilson et al. 2003). Sv is a logarithmic value and is converted to its arithmetic equivalent, which represents "Fish Energy", using the formula $FishEnergy = 10^{Sv/10}$.

The Ts table also provides location data, to allow linking with the Sv table, as well as the target strength variable, which when converted to its arithmetic form is Wilson et al. (2003)'s sigma ($\sigma = 10^{Ts/10}$). When "Fish Energy" is divided by $\sigma$ it can be used to estimate biomass and density of fishes in a sampled volume:

$$Fish/m^3 = 10^{Sv/10}/10^{Ts/10}$$

For each site, we aggregated the data into cells by depth bin (5-10 m, 11-15 m, >15 m) and latitude/longitude blocks that were 0.001 degrees of latitude (~111 m) by 0.0001 degrees of longitude (~9.8 m). For each resulting cell, the mean fish density per 1000 $m^3$ was calculated using the delta lognormal model as described by Gallaway et al. (2007). Results were presented in tabular form, and as 3d scatter plot graphs. The delta mean estimate of the total number of fish (with 95% confidence intervals) was calculated for each depth bin strata, as well as for the overall site. A graphic was created using the all-depth strata values to present the relative density per $m^3$ for each two-dimensional spatial cell, with the platform location and a box depicting the area used for population estimates also shown.

For each cruise, we calculated a logistic regression model to estimate the probability of encountering fish based on distance from nearest structure, without considering depth, and a second model based only on 1 m depth intervals. For the distance model, each two dimensional (latitude/longitude) cell was assigned a distance value as the minimum distance from the center of the cell to the station large and small structures, and a presence/absence value based on whether or not any fish were detected in the water column of the cell. The distance from structure was then modeled against the presence/absence value using a binomial general linear model (GLM) in statistical analysis program R. The R 'predict' function was applied to the model results to calculate fitted probabilities of fish presence based on distance from the nearest structure.

For each ROV drop, we calculated a total fish population estimate (with 95% confidence interval) for the areas in each of the quadrants from the drop location, for the intervals 0-35 m, 35-50 m, 50-65 m, and 65-80 m from the drop location. The video tether restricted the distance from the drop location to 80 m in any direction. These population estimates were calculated independent of the video and were based on the acoustic data previously acquired in the area. The estimates were calculated as the delta lognormal mean estimate of fish per cubic meter multiplied by the estimated volume of the cell.

## 2.4 ROV and Diver Surveys

We did not obtain ROV surveys at the study area artificial reef sites in October 2003, but the small debris pile at the GA-288 site was surveyed by TPWD divers in September 2003 shortly after the structures had been reefed. Five TPWD divers performed roving surveys at site GA-288. They initially dove to the bottom and worked their way to the surface, recording the relative abundance of fishes observed. The abundance categories ranged from sightings of a single individual of a species, to an observation of groups of a species numbering from a few (2 to 10 fish), to many (11 to 100 fish) to abundant (>100 fish).

For analysis we assigned absolute numbers to each abundance category; i.e., single = 1 fish; few = 4 fish; many = 44 fish; and abundant = 100 fish. These were then summed across divers and divided by the number of divers that observed that species to obtain an abundance index. The index values were then summed and used to describe the proportional abundance of each species.

A VideoRay ROV equipped with a color video camera was used to document fish species represented and debris composition on the August 2004 cruise. Times, depths, and headings (magnetic) were displayed on the videotape. Due to difficulties imposed by currents and poor water clarity, the ROV operator was typically unable to conduct systematic transect lines and avoided crossing over or into the main debris piles of the two sites. On some dives, poor-quality boat electrical power created interference that distorted the video image.

The videos obtained were viewed in real time and a log of all significant observations was developed. The species and numbers of fish observed were tabulated and summarized.

# 3.0 RESULTS

Complete data and analysis products based upon the side-scan and MBES surveys are provided in Appendix A; Appendix B provides the dual beam hydroacoustic survey data and analysis products, and Appendix C provides video analysis logs for the August 2004 ROV surveys at both GA-288 and GA-296, and a summary of the diver survey data gathered by the TPWD at GA-288 in September 2003.

## *3.1 Debris Field Descriptions*

### 3.1.1 October 2003

We obtained 100% side-scan coverage of the two sites in October 2003 (Figures A.1 through A.4). Two debris fields were present at each site, one at the location of the 12-pile structure, and one at the location of the 4-pile quarters structure. Riprapp material covered a partially-buried segment of an old pipeline at a location about 20- to 55-m east of the main debris pile at the GA-296 site.

At GA-288, bottom depth was on the order of 23 m and the highest point of the debris field was on the order of 18-m deep. Maximum relief was thus about 5 m. Slightly greater relief was observed at GA-296 (6 m) where the bottom depth was 22 m and the highest point of the debris field was about 16-m deep. At the GA-288 site, the main debris field was mostly encompassed within a circle having a radius of 100 m whereas the 4-pile structure debris field was largely contained within a circle having a radius of 50-m. Similarly, the main debris pile at GA-296 site was contained within a radius of about 83 m and the debris field at the old quarters platform at this site was within a radius of 55-m. Thus, the sites were considered similar in terms of size and relief.

### 3.1.2 June 2005

In June 2005, water depth at site GA-288 was slightly less than 23 m, ranging from 22.4 m at the northern edge of the 12-pile structure to 22.9 m in an area of slight depression on the west side at about the center of the debris pile (Figure A.7). The highest point of the 12-pile structure was 17.7 to 17.8 m in the central and southern region of the main debris pile. Water depth at the 4-pile structure was 16.8 m at the southwest corner of the feature. Total area of debris or reef material is approximately 5,352 $m^2$, including 250 $m^2$ of pipeline-associated material located adjacent to the northeast corner of the 12-pile structure.

Water depth at site GA-296 in June 2005 was approximately 23 m, ranging from 22.9 m at the western edge of the 12-pile structure to 23.4 m in an area of slight depression in the center of the reef structure (Figure A.8). The highest point of the 12-pile structure was 16.6 m, with additional sections at 17.0 and 17.5 m. Water depths at the 4-pile structure were 16.9 m and 18.4 m, respectively, at the crest of two adjacent sections. Total area of reef material at GA-296 is approximately 5,270 $m^2$, including 392 $m^2$ of rip-rapp covered pipeline located just to the east of the 12-pile structure.

Results of the multibeam surveys at both GA-288 and GA-296 in June 2005 suggest little change in the distribution of reef materials described from side-scan sonar and hydroacoustic surveys

conducted in October 2003 (Figures A.13 and A.14). Measurements of minimal depth recorded during hydroacoustic surveys for GA-288 were approximately 18 m deep, compared to 17.7-17.8 m for the multibeam data set in June 2005. Seafloor depth was reported to be 23 m for the hydroacoustic surveys in October 2003, which compares to 22.4-22.9 m depths recorded during the June 2005 multibeam surveys. Minimal and surrounding depths reported for GA-296 were also in agreement, with 16 m reported for the crest of the reef feature from the hydroacoustic survey (16.6-16.9 m in the multibeam data set) and 22-23 m for the surrounding sea bottom (22.9-23.4 m in the multibeam survey). Despite different survey methods, tidal corrections, etc., the agreement in depths suggests little if any change in the structure of reef materials and depth of the surrounding seafloor. The minor differences are most likely due to differences in the areas which were averaged for individual soundings between survey methods.

Comparison of the side-scan sonar mosaic for each reef site with the gridded multibeam dataset also indicates little change in the distribution of reef materials between the 2003 and 2005 surveys (Figures A.13 and A.14). Minor differences in position of features in the side-scan sonar mosaics is most likely due to inaccuracies of location resulting from layback of the side-scan towfish, errors generated during production of the mosaic, or differences in GP and motion sensor capabilities and settings during each survey. Multibeam surveys conducted in 2005 utilized the highest quality positioning equipment available, and were conducted during fairly calm (1-3 ft) seas. Therefore this dataset should set the standard for future comparisons.

Overall, we were struck by how clean the seafloor appeared outside the immediate vicinity of the debris piles (see images in Appendix A, especially Figures A.9 and A.10). There were virtually no materials outside a 100- to 150-m radius of the debris piles of each site. The materials that were represented outside the main debris piles were relatively small and isolated.

## *3.2 Fish Community Descriptions*

The hydroacoustic surveys, like the side-scan and MBES surveys, showed that the debris fields appeared as “islands” of relief extending above a relatively flat plain (Figure 4). “Clouds” of fishes hovered within and above the debris field as compared to the surrounding flat bottoms which were devoid of fish (see Figures B.2 to B.24). Fish were most abundant immediately above the reefs and abundance declined rapidly within a 100-m distance away from the reefs. As shown by Figures 5 and 6, the probability of encountering a fish decreased exponentially with distance from the debris piles and increased with increasing water depth above the debris field, respectively.

### 3.2.1 Population Estimates

On the order of 9,000 fish (95% CI = 7,340 to 10,740) were present at GA-288 in October 2003 as compared to about 6,200 (95% CI = 3,925 to 8,472) which were present at this site in August of 2004 (Figure 7). In contrast, about 7,000 fish (5,178 to 9,046) were present at GA-296 in October 2003 with the total number increasing to 9,573 (7,640 to 11.507) in August of 2004 (Figure 7). The decrease in population size observed at GA-288 between October 2003 and August 2004 was mainly attributed to a decline of fish abundance within the 5- to 10-m depth range (Figure 8).

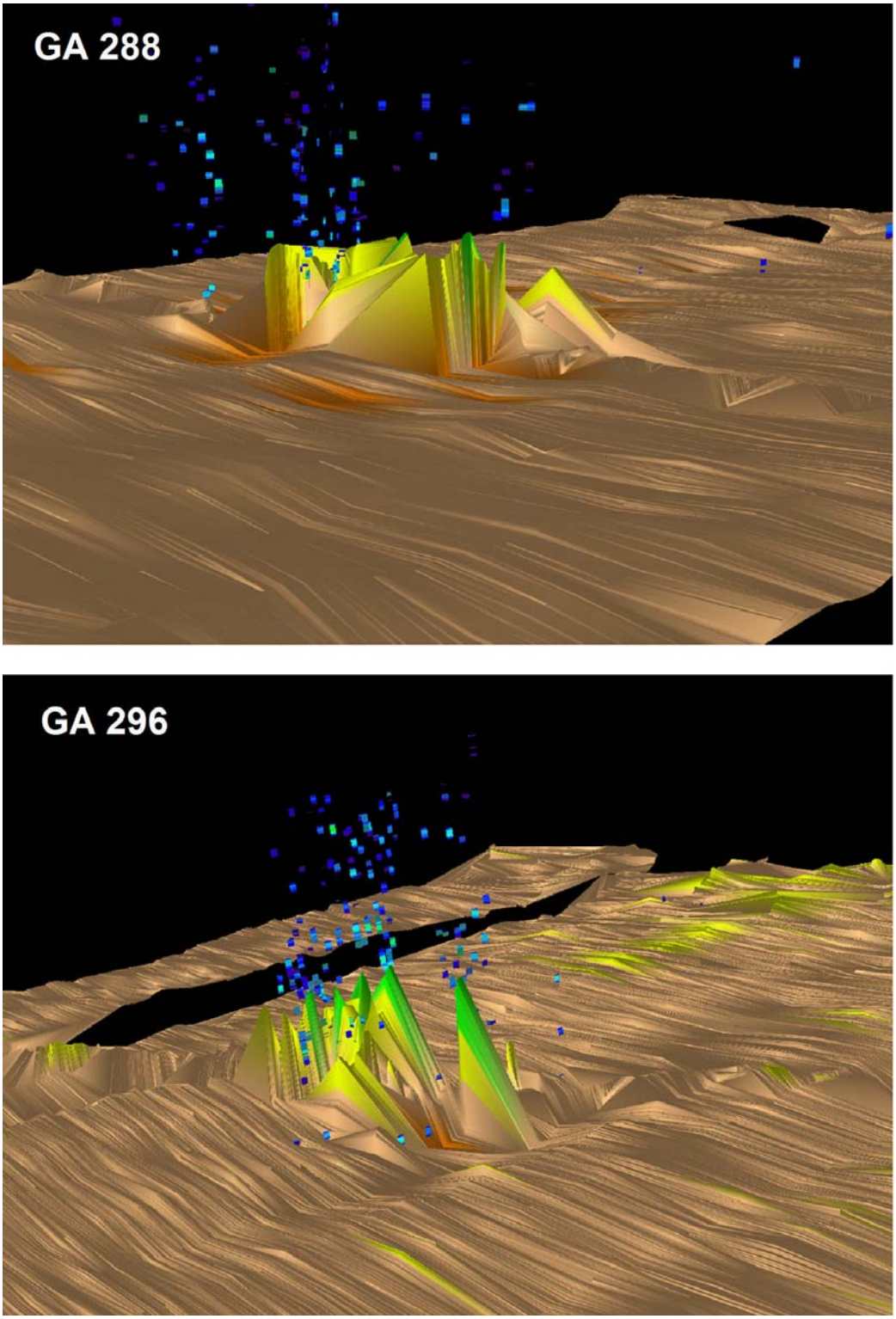


Figure 4. Clouds of fish occur above the Texas Parks and Wildlife Department's Buccaneer Artificial Reefs, which provide vertical reefs rising above a flat plane. The figure is based upon dual-beam hydroacoustic data from October 2003.

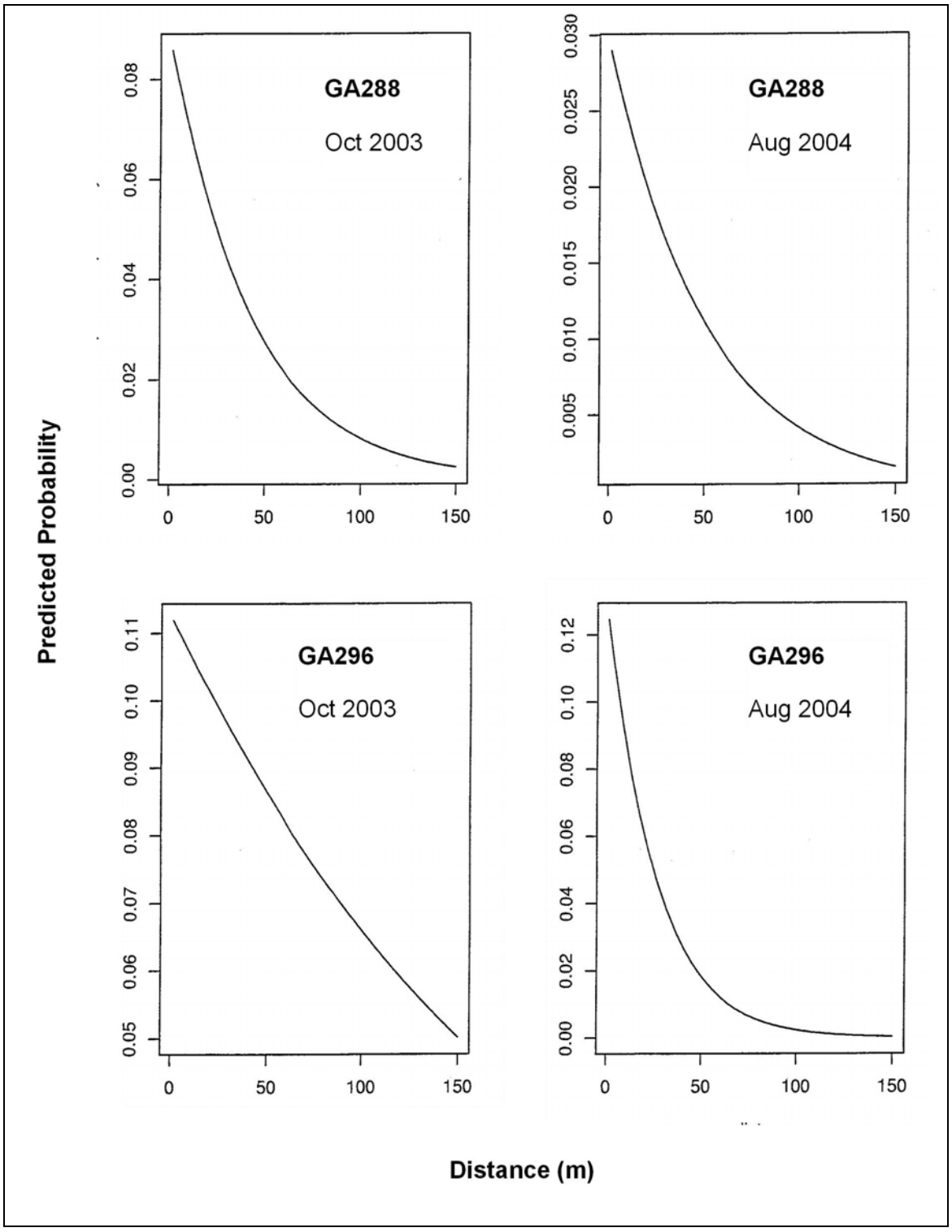


Figure 5. Predicted probability of a fish encounter with distance from the Texas Parks and Wildlife Department's Buccaneer Artificial Reefs GA-288 and GA-296, October 2003 and August 2004.

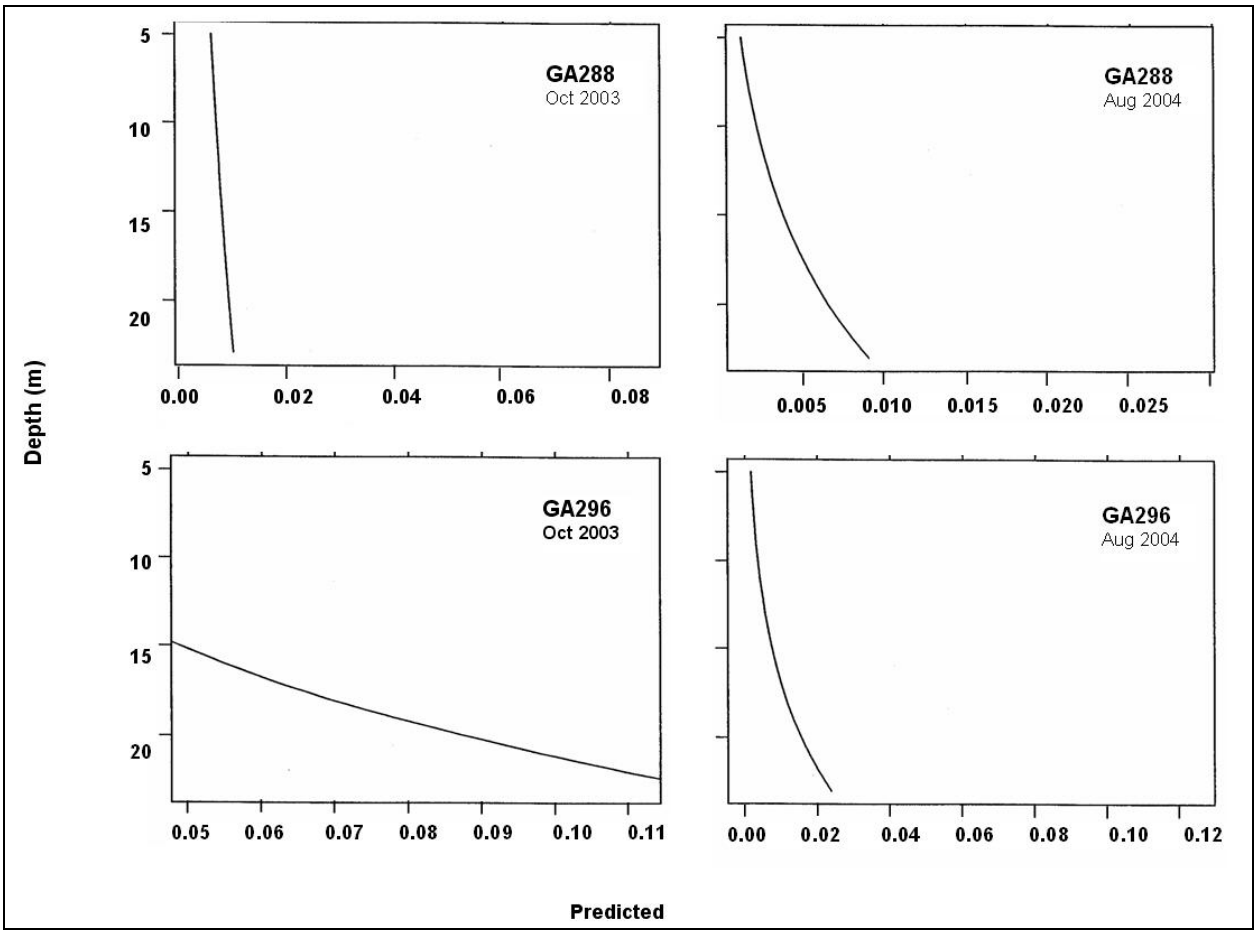


Figure 6. Predicted probability of a fish encounter with depth from the Texas Parks and Wildlife Department's Buccaneer Artificial Reefs GA-288 and GA-296, October 2003 and August 2004.

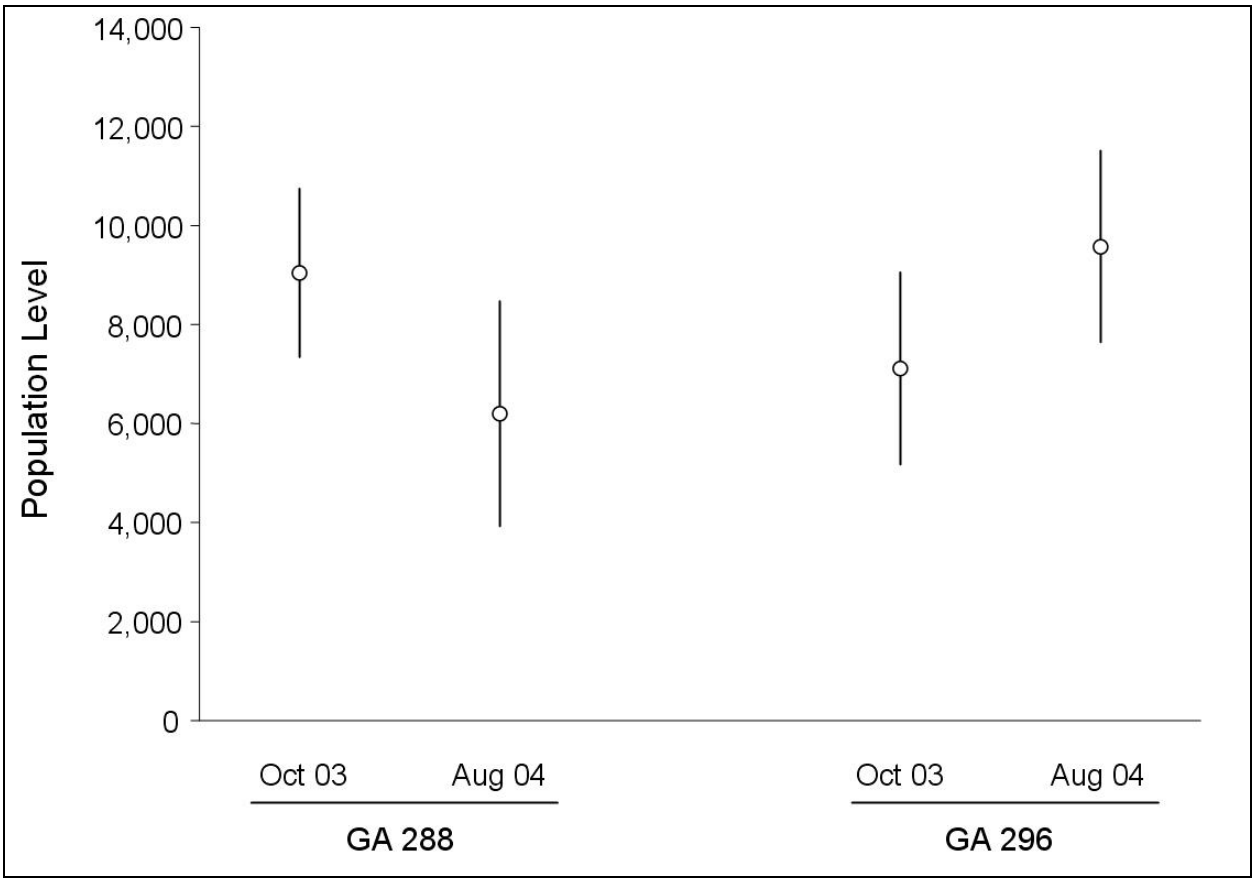


Figure 7. Population estimates (open circles) and 95% CIs (vertical lines) of fish at Texas Parks and Wildlife Department's Buccaneer Artificial Reefs GA-288 and GA-296, October 2003 and August 2004.

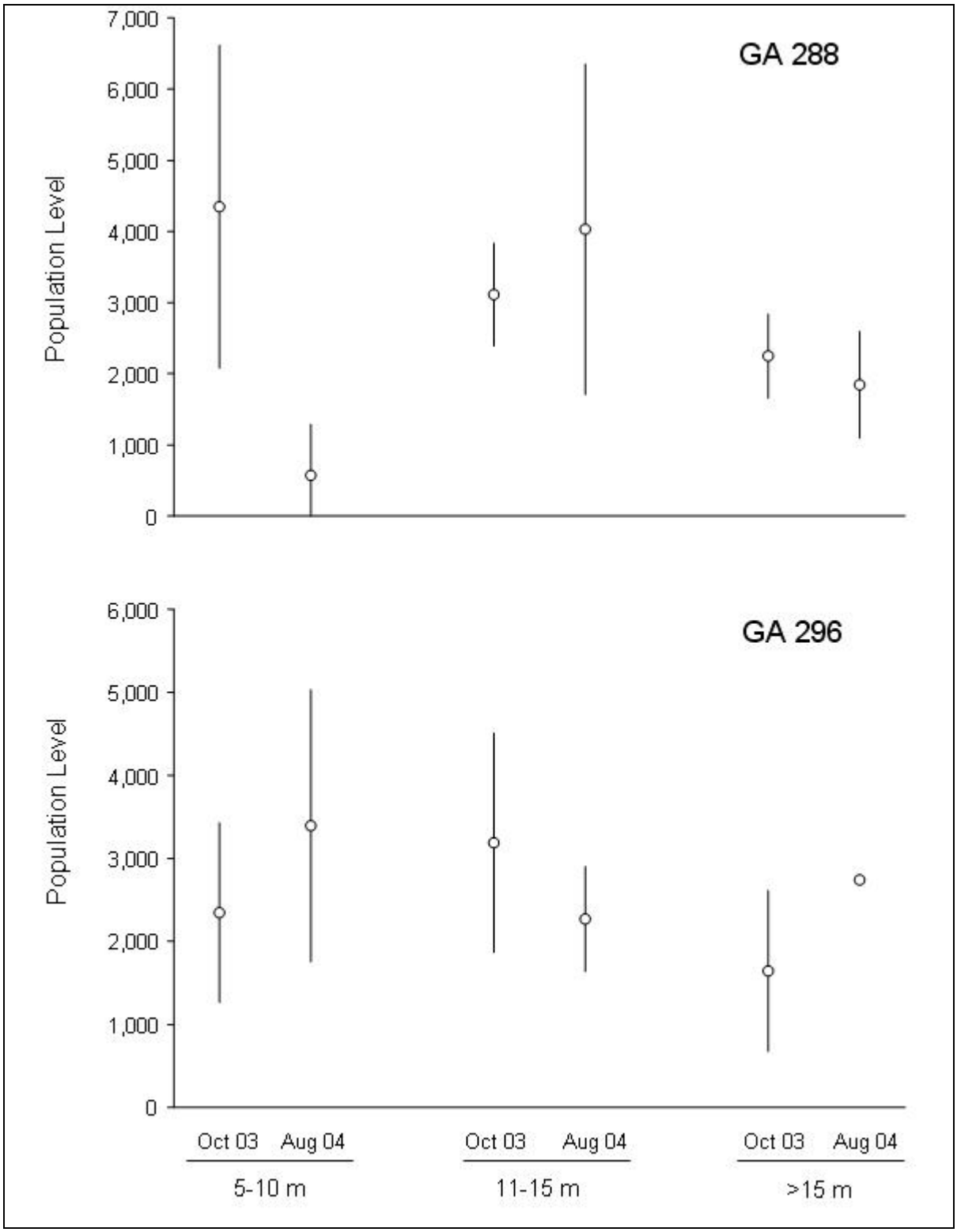


Figure 8. Population estimates (open circles) and 95% CIs (vertical lines) by reef (GA-288 and GA-296), depth and year.

### 3.2.2 Species Composition

The most comprehensive fish survey was that obtained by TPWD divers at GA-288 in September 2003 (Appendix C.2). They observed 21 species of fish and a bottlenose dolphin at the small debris pile at GA-288. The dominant species was the tomtate *Haemulon aurolineatum* (26% of the total observations) followed by the sheepshead *Archosargus probatocephalus* and the seaweed blenny *Parablennius marmoreus*.

In Table 2, we have restricted the species list from the TPWD surveys and our ROV surveys to species that we believed would be registered by the hydroacoustic surveys, and then calculated relative abundance estimates based on these species alone. At site GA-288, tomtate, sheepshead, Atlantic spadefish *Chaetodipterus faber*, grey triggerfish *Balistes capriscus* and gray snapper *Lutjanus griseus* dominated the September 2003 collections. The red snapper *Lutjanus campechanus* comprised about 4% of the total observations included in the analysis. Assuming the total population size in September 2003 was about 9,000 fish (i.e., the same as measured in October 2003), the total number of red snapper was estimated to be on the order of 360 fish.

By the next year (August 2004), the population at this site was on the order of 6,198 fish. The apparent population was dominated red snapper which comprised about 52% of the total ROV observations. Thus, the red snapper population had increased from about 360 fish to on the order of 3,200 snapper even though the overall population had declined. In contrast, tomtate comprised only 2.9% of the total observations in 2004 (as compared to 38.1% in 2003). In a similar fashion, Atlantic spadefish comprised 0.2% of the total observations in 2004 as compared to 13.4% in 2003. The observed decline in total abundance at site GA-288 in 2004 as compared to 2003 corresponded to a decline of species normally residing in the upper part of the water column around standing oil platforms.

In 2004, the dominant fishes at GA-296 included the Atlantic spadefish (29.1%), the blue runner *Caranx crysos* (28.1%), and the red snapper (25.2%) (Table 2). The red snapper population was estimated to be on the order of 2,412 fish. A video drop was also made at the rock ridge or rip-rapp covered pipeline located just northwest of the main debris pile at GA-296. Visibility conditions were very poor at this site and “unidentified” fish comprised 26% of the observations. The lookdown *Selene vomer* was the dominant identified fish comprising 30% of the total observations. The sheepshead was also abundant, comprising 26% of the total observations made along this rock ridge.

### 3.2.3 Comparisons with Other Sites

Stanley and Wilson (1999) surveyed fish populations at a toppled jackup drilling rig in Eugene Island 313 offshore western Louisiana at depths between 60 and 80 m (see also Wilson and Stanley 1998). The fish population at this site was reported to have been on the order of 7,000 fish, similar to our estimates. Wilson et al. (2003) conducted hydroacoustic surveys at a standing platform in 89 m of water (HI 350A) near the West Flower Garden Bank, along with surveys of a toppled (WC617) and a partially-removed platform (HI A355) that were nearby. The respective estimates were 12,000 fish at the standing platform; 2,850 fish at the toppled platform; and 2,700 fish at the partially removed platform. They observed that the reductions in populations at toppled and partially-removed platforms versus standing platforms corresponded to the loss of pelagic planktivores and piscivores in the upper depth strata. The remaining fish population

levels corresponded to the number previously observed at deeper depths when the platforms were still standing.

Wilson et al. (2003) reported total fish populations of between 5,000 and 12,500 for standing platforms offshore western Louisiana at depths between 22 and 24 m; i.e., depths similar to our sites. Our fish population estimates for partially removed platforms all fall within the range observed for the standing platforms surveyed by Wilson et al. (2003). Whereas we did see a population reduction at GA-288 after one year (and that loss was attributable to species residing in the upper part of the water column), we did not see a population reduction at GA-296 after one year. It should be noted, however, that we do not have 2003 population estimates for GA-288 and GA-296 while they were still standing.

# 4.0 CONCLUSIONS

The debris piles around GA-288 and GA-296, two partially removed production platforms being used for artificial reefs, each covered about 5,300 $m^2$ and, in 2005, each had a maximum vertical relief of about 6 m. Outside these piles, the seafloor was relatively clean, and very little, if any, material was located outside a radius of about 150 m.

The total fish populations at these two sites in 2004 ranged from about 6,000 to 9,500 individuals. The dominant species included red snapper, Atlantic spadefish, blue runner, and sheepshead. These species were among the dominants when the platforms were standing (Gallaway et al. 1981). The tomtate was initially abundant, but largely disappeared after one year.

We found no evidence that debris had been dispersed more than 100- to 150-m away from the main platform debris fields. Based upon our observations, the distribution of the debris fields comprising the artificial reefs was stable based upon the lack of change observed between 2003 and 2005.

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# APPENDIX A: Side-Scan Sonar and Multibeam Echosounder (MBES) Survey Images

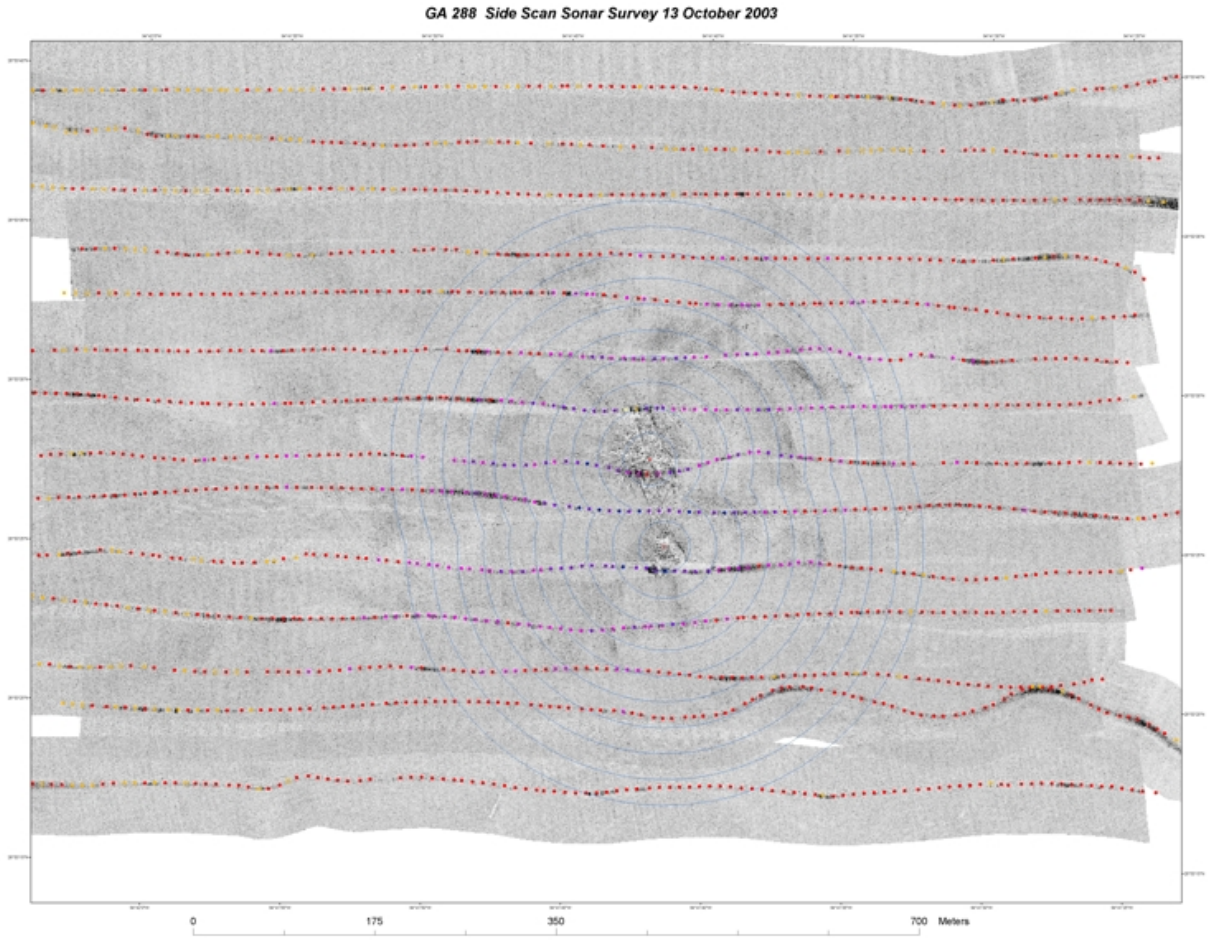



Figure A.1. Side-scan survey mosaic for the GA-288 site, 13 October 2003.

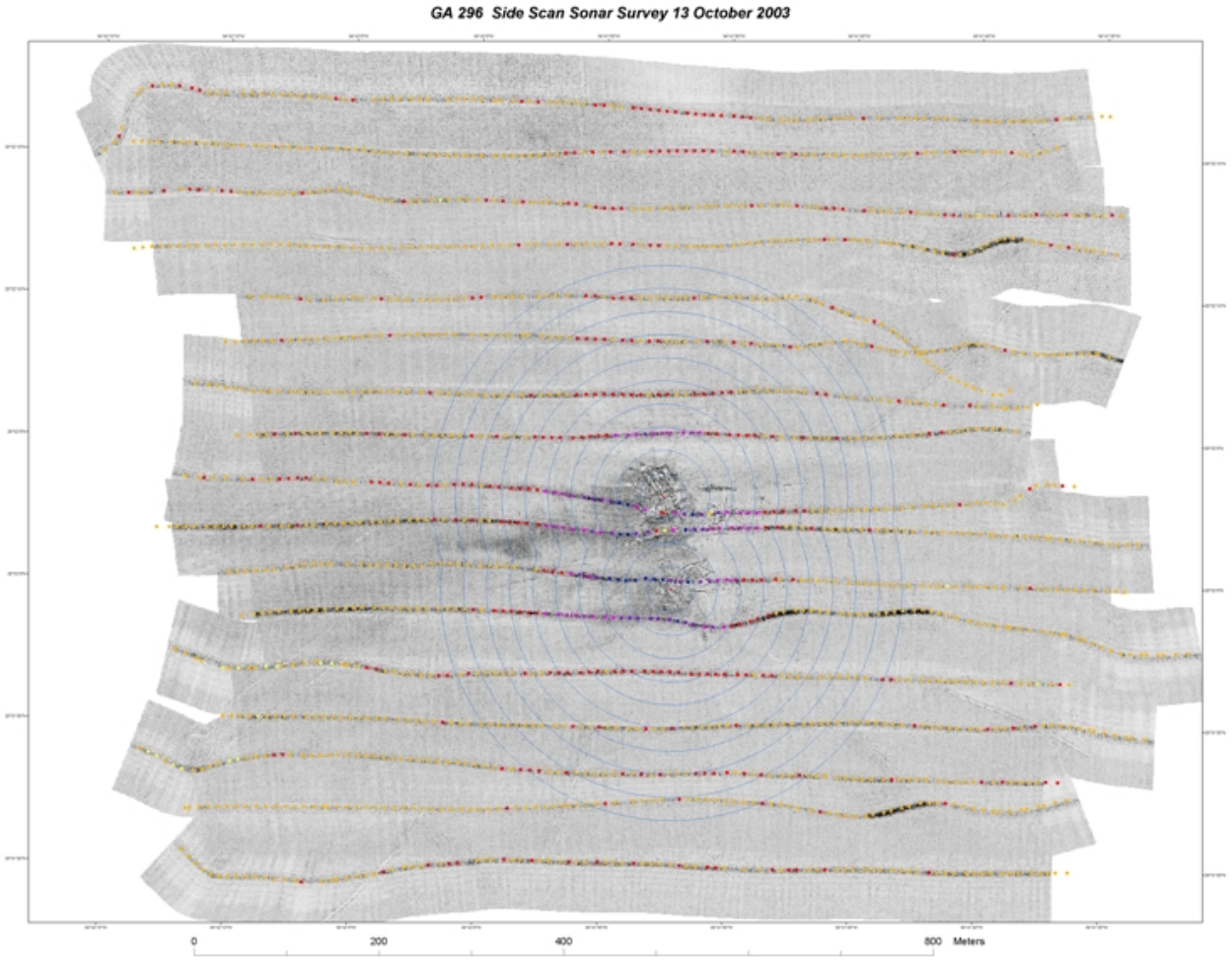



Figure A.2. Side-scan survey mosaic for the GA-296 site, 13 October 2003.

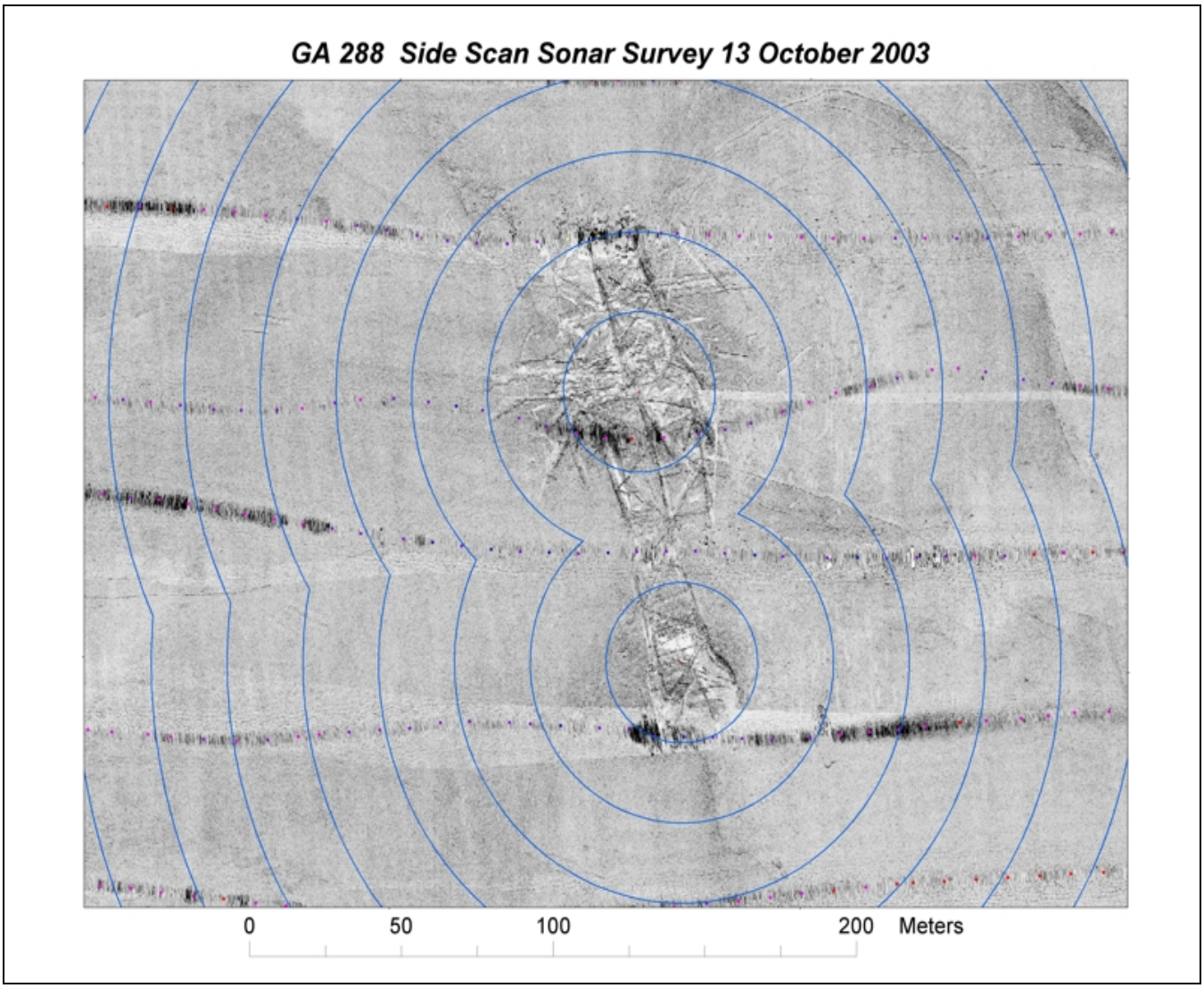



Figure A.3. Side-scan detail for GA-288, 13 October 2003.

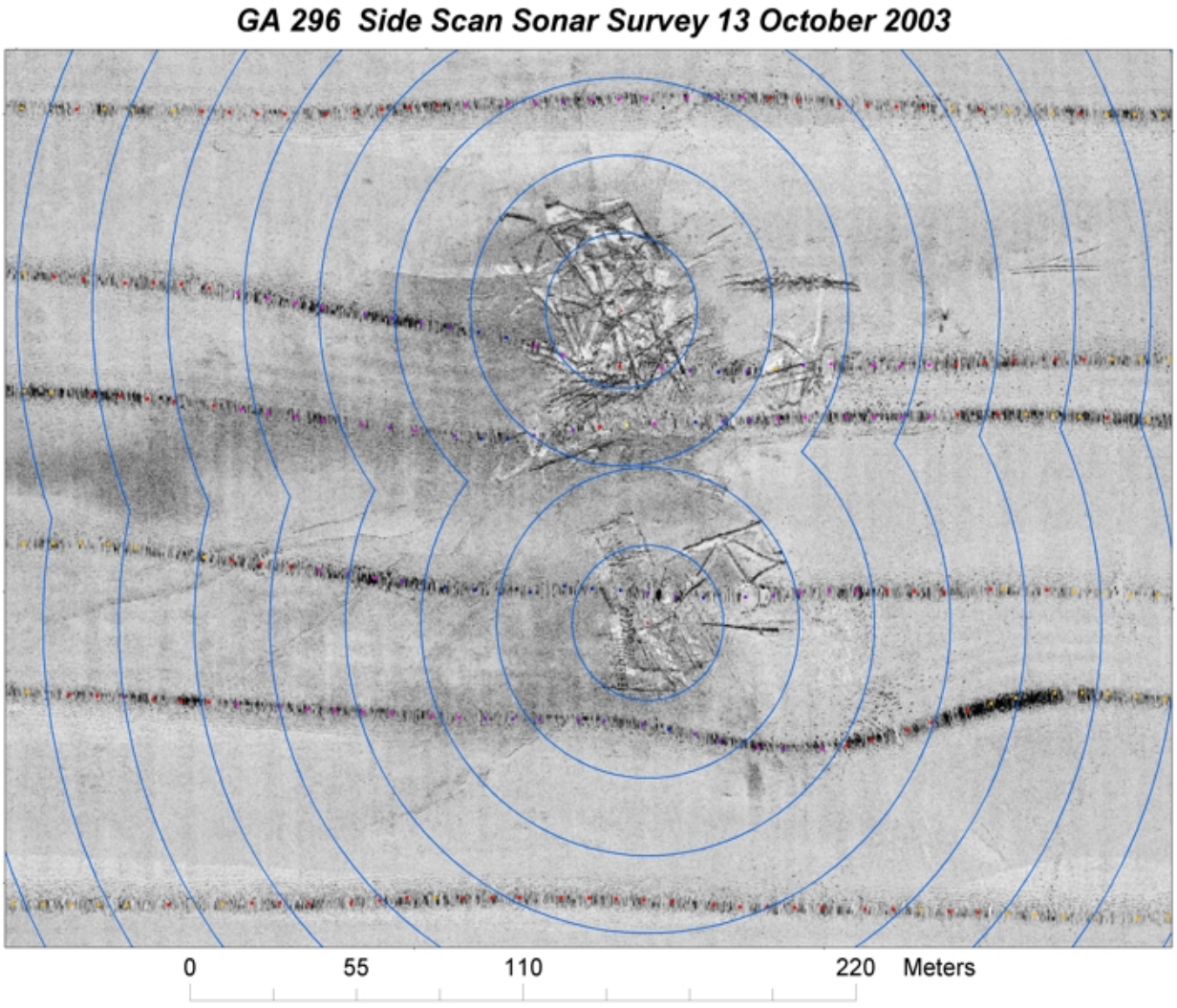



Figure A.4. Side-scan detail for GA-296, 13 October 2003.

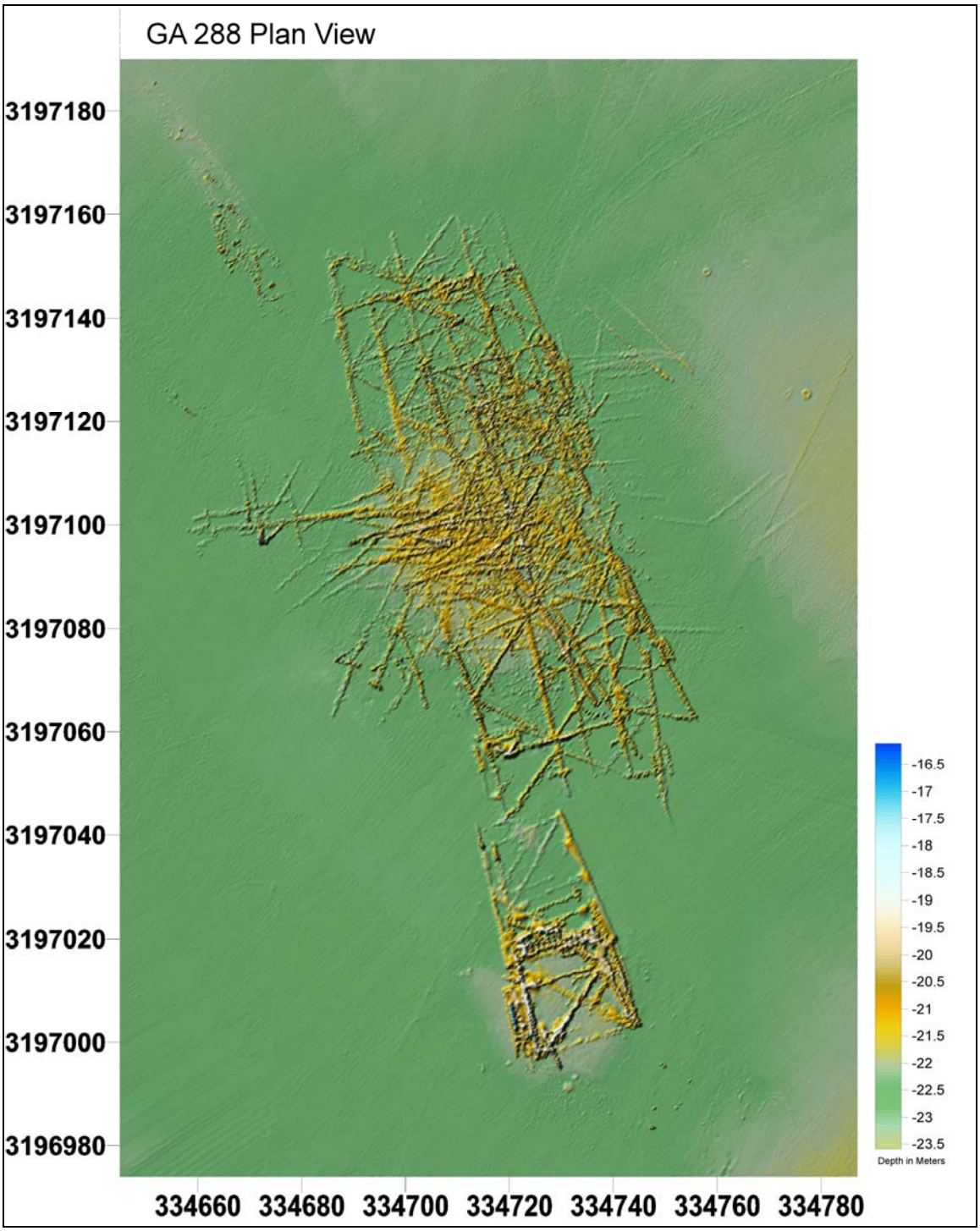



Figure A.5. GA-288 Plan View, MBES survey, June 2005.

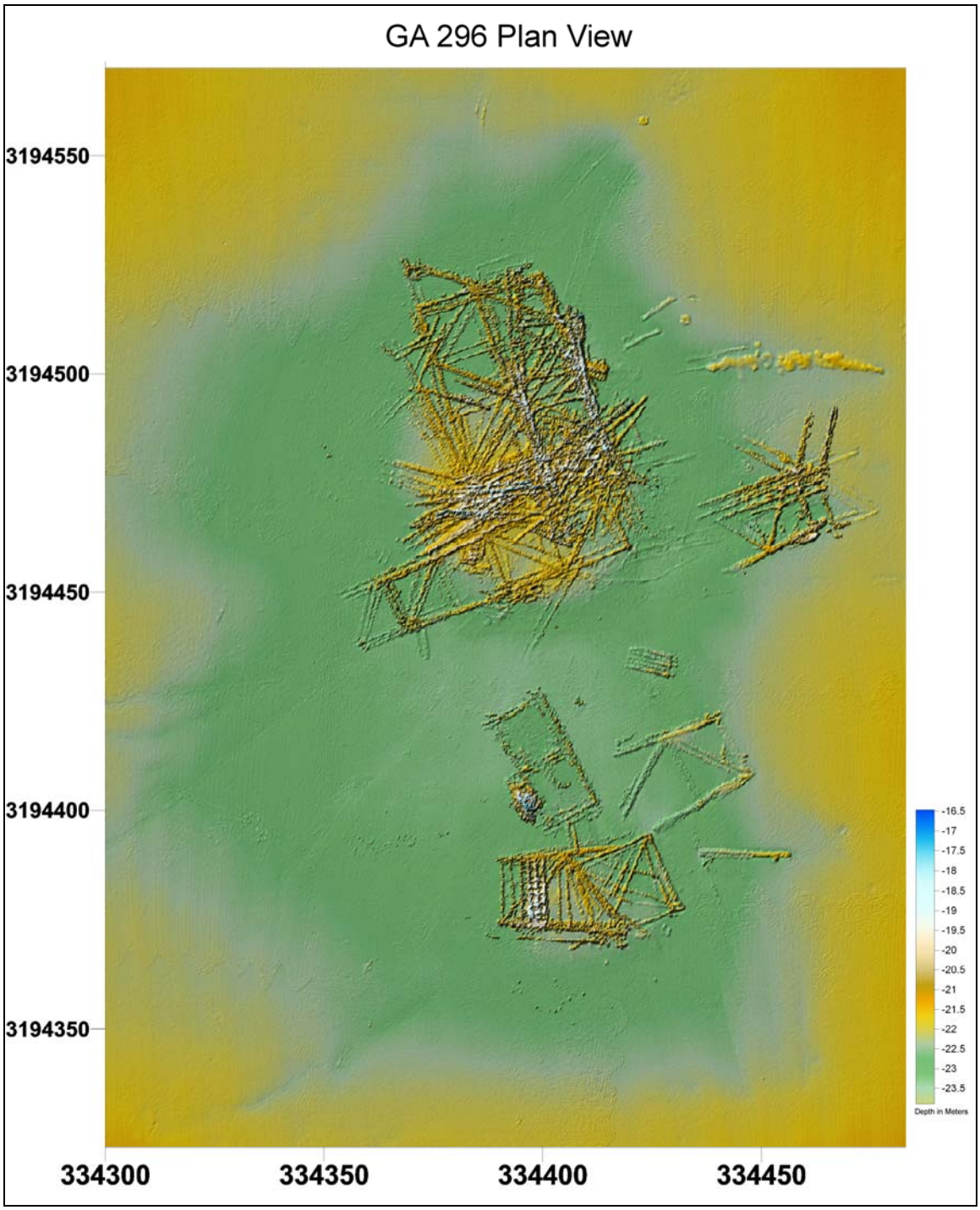



Figure A.6. GA-296 Plan View, MBES survey, June 2005.

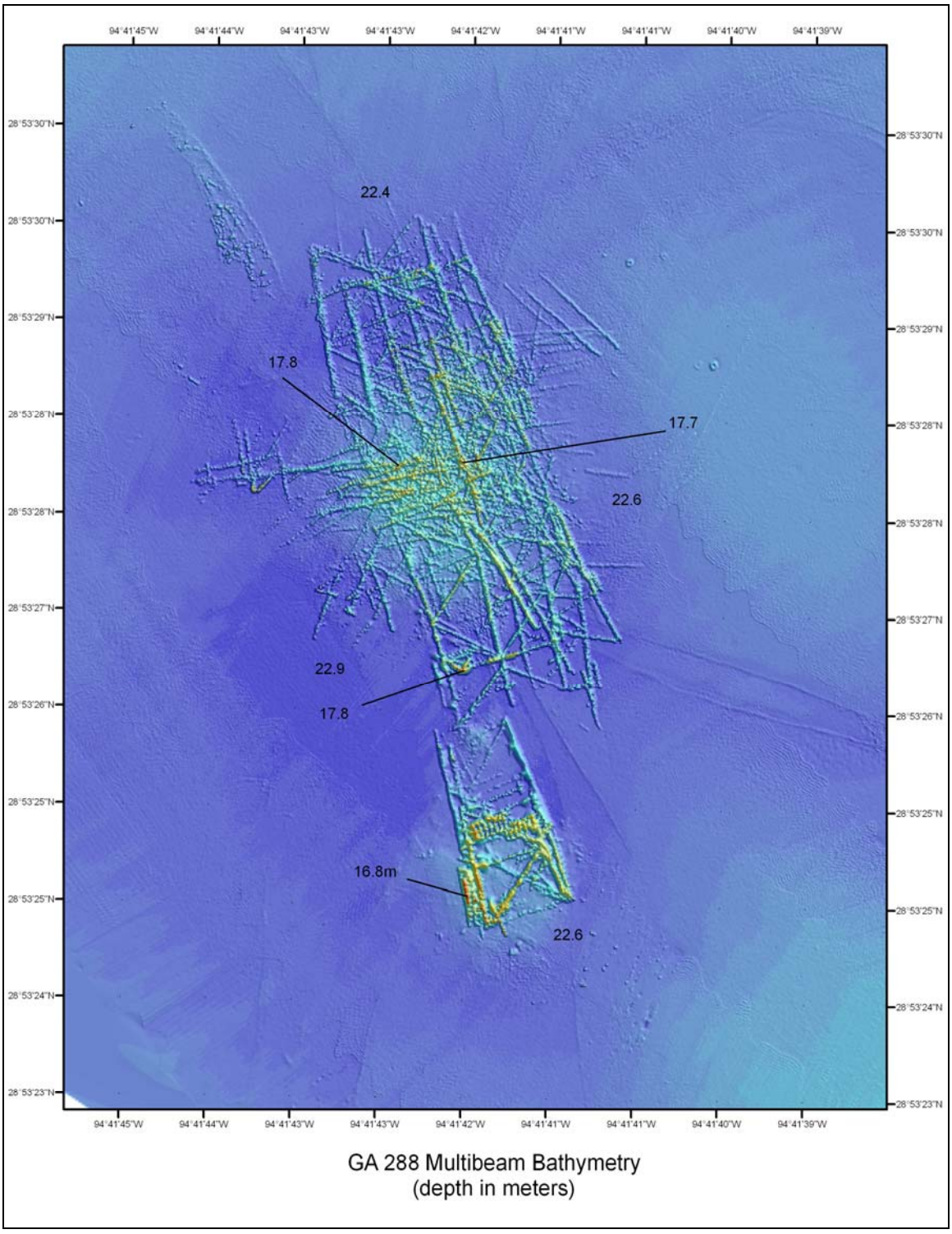



Figure A.7. GA-288, bathymetry, MBES survey, June 2005.

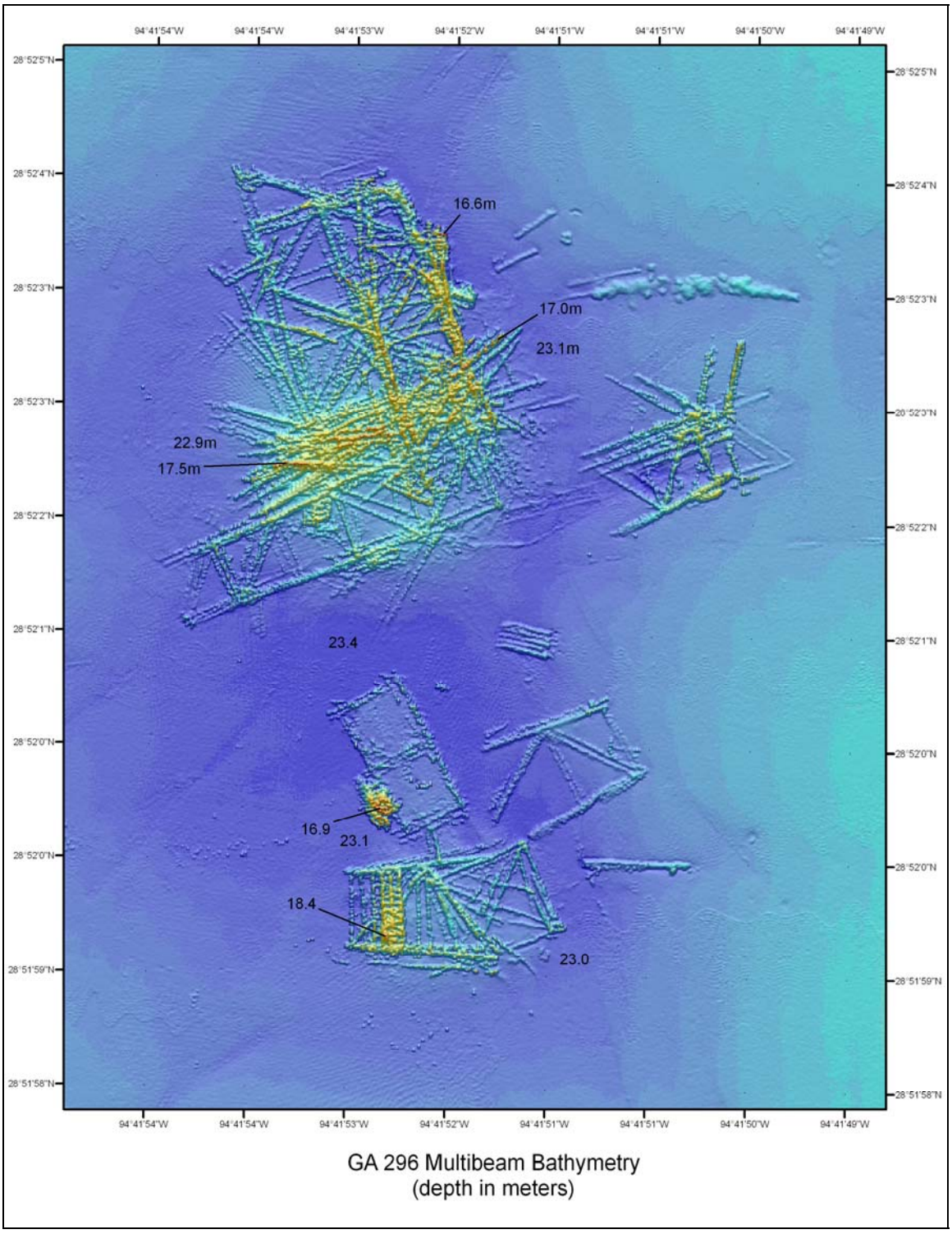



Figure A.8. GA-296 bathymetry, MBES survey, June 2005.

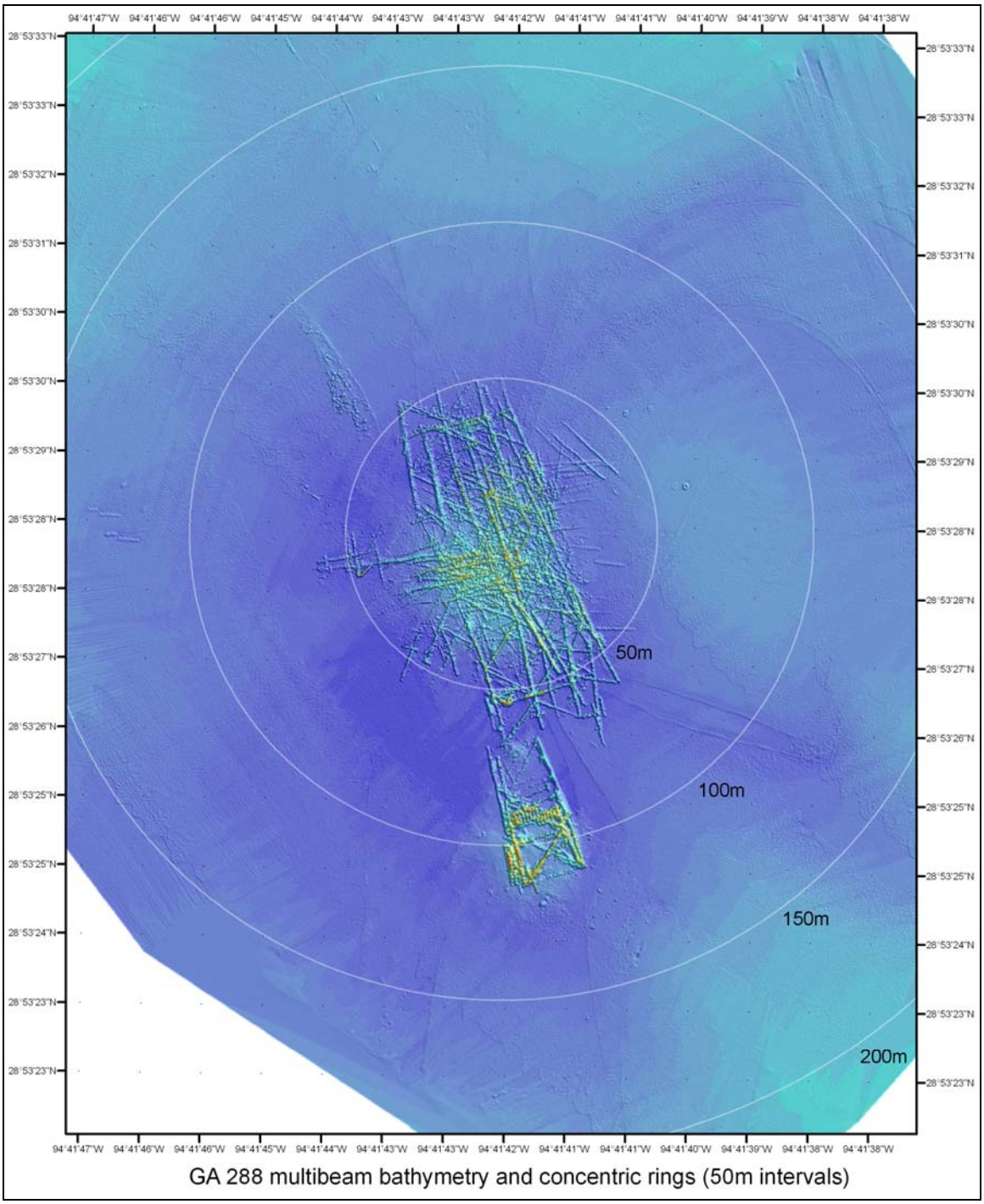



Figure A.9. GA-288 debris-pile distribution, MBES survey, June 2005.

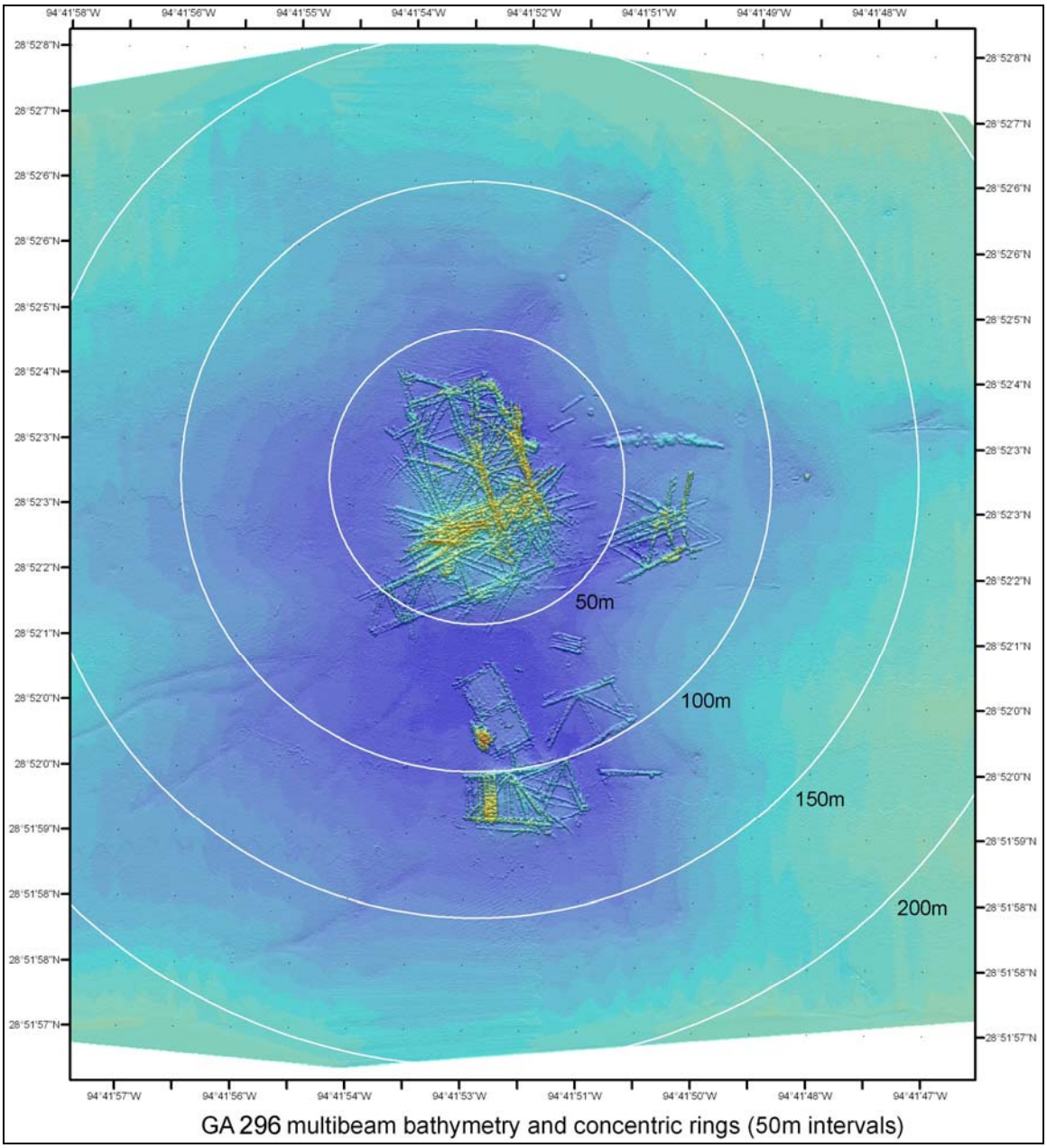



Figure A.10. GA-296 debris-pile distribution, MBES survey, June 2005.

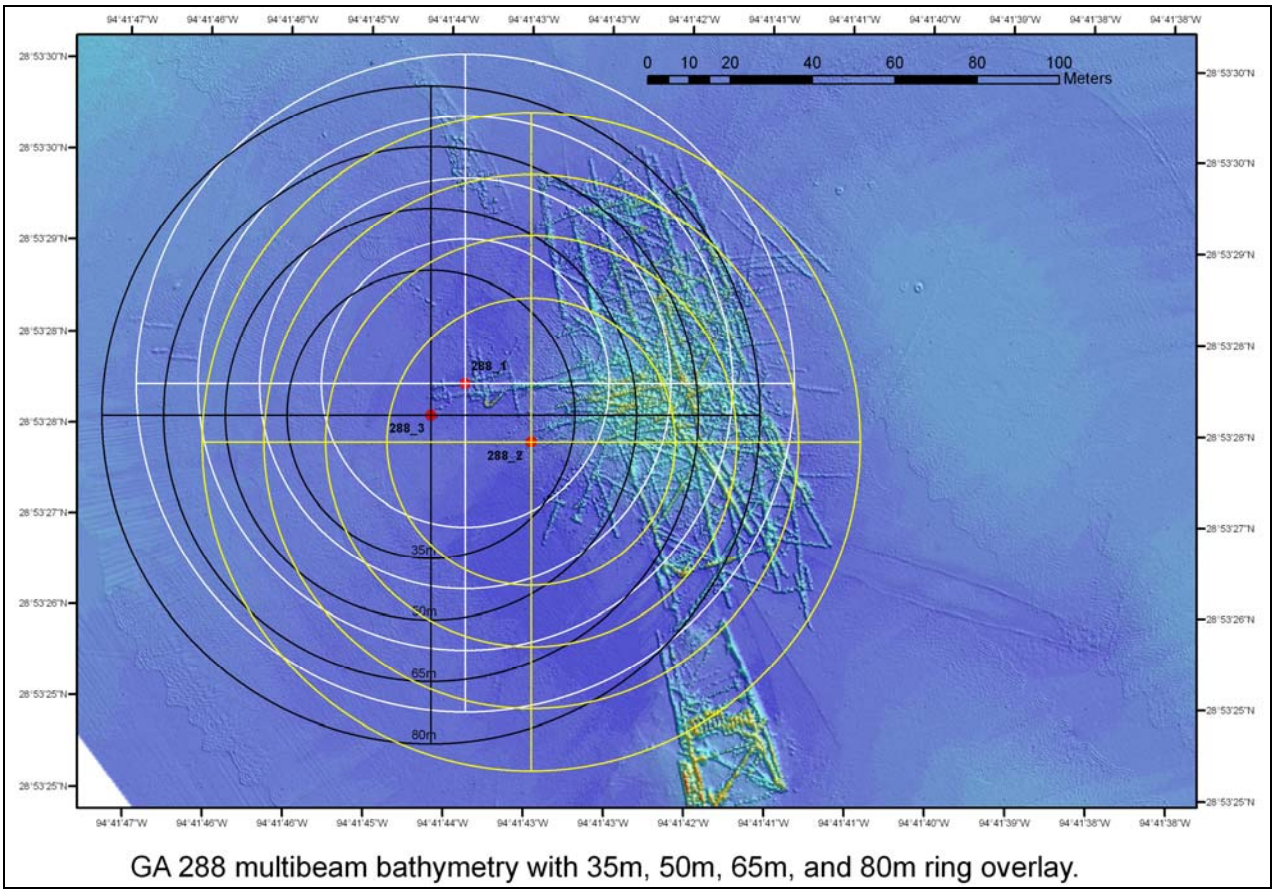


Figure A.11. GA-288 ROV sites relative to debris piles, MBES surveys, June 2005.

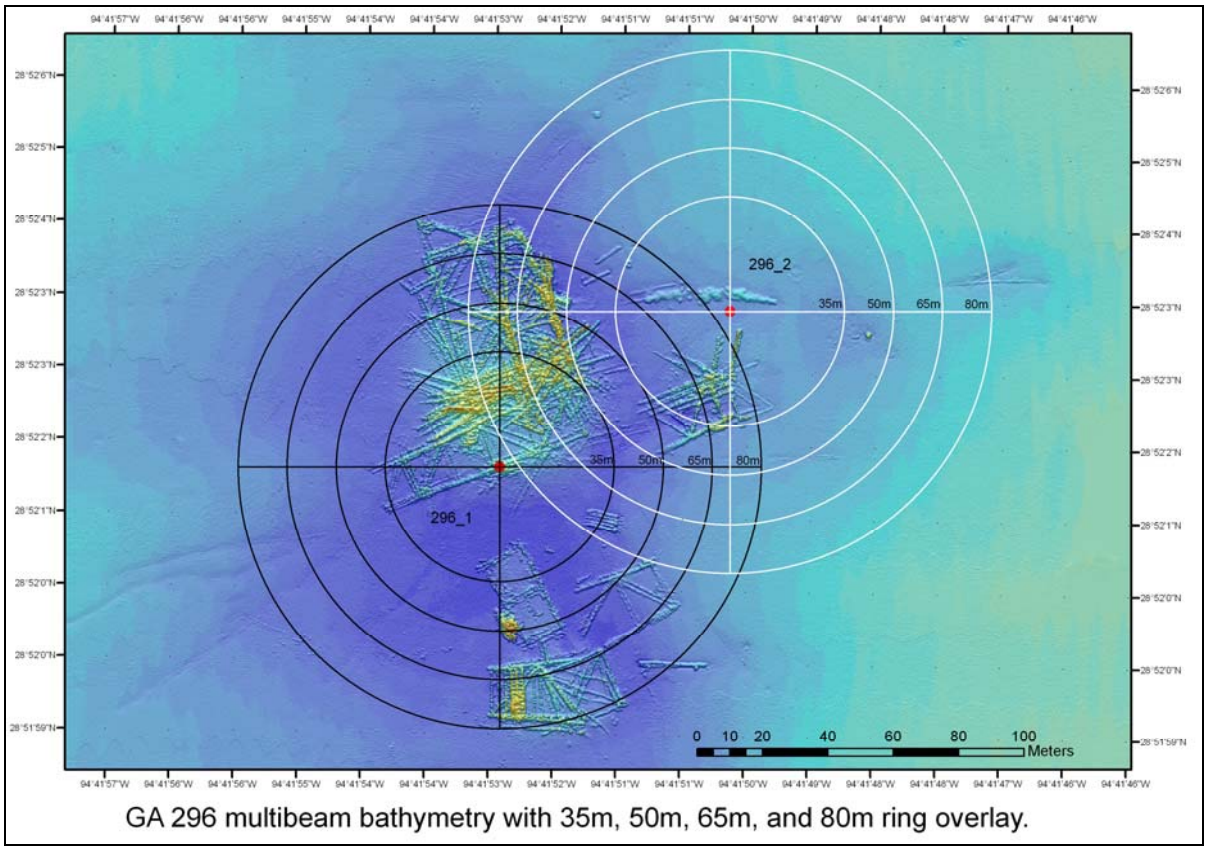



Figure A.12. GA-296 ROV sites relative to debris piles, MBES surveys, June 2005.


Figure A.13. GA-288 side-scan and MBES survey overlay; i.e., 2003 vs. 2005.

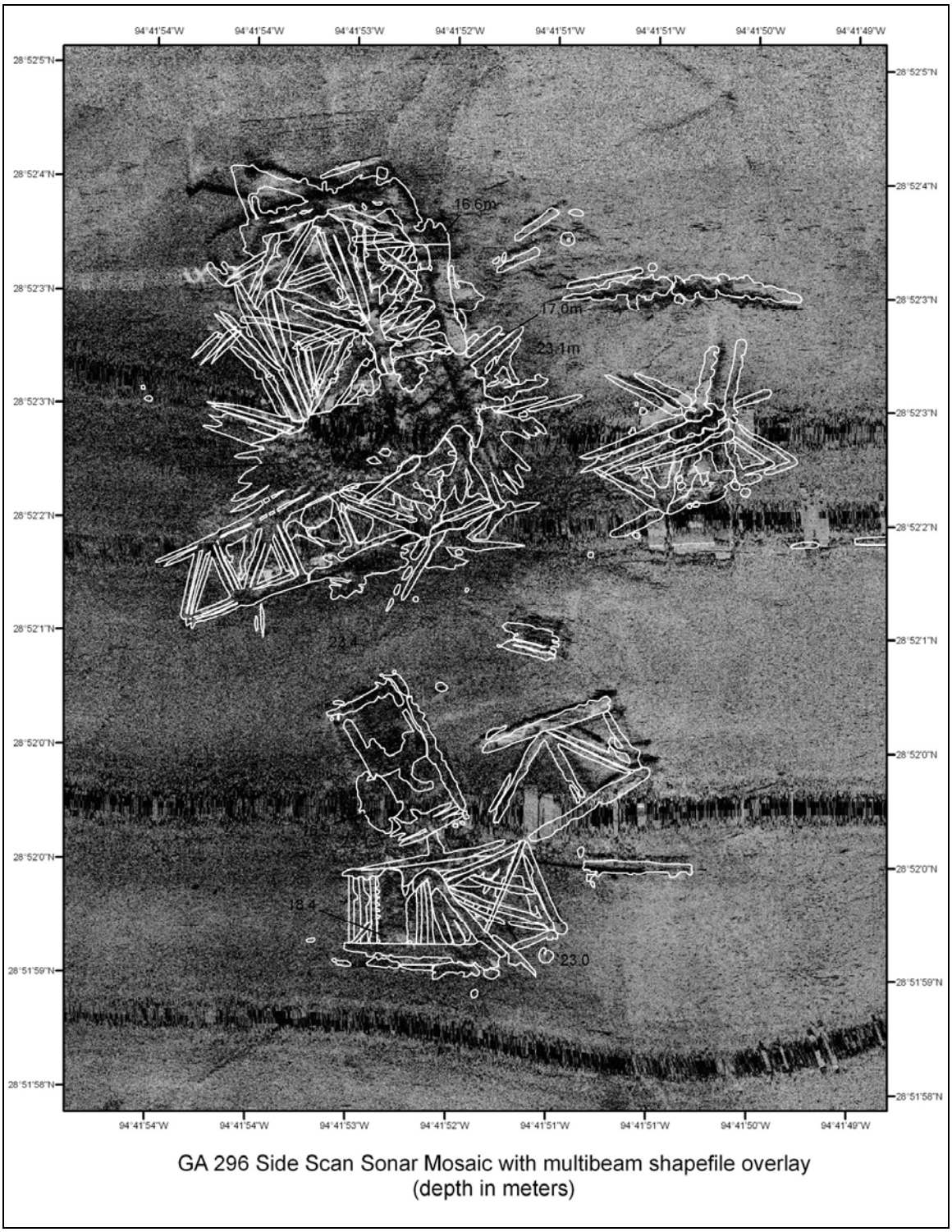



Figure A.14. GA-296 side-scan and MBES overlay; i.e., 2003 vs. 2005.

# APPENDIX B: Dual-Beam Hydroacoustic Survey Data and Analysis

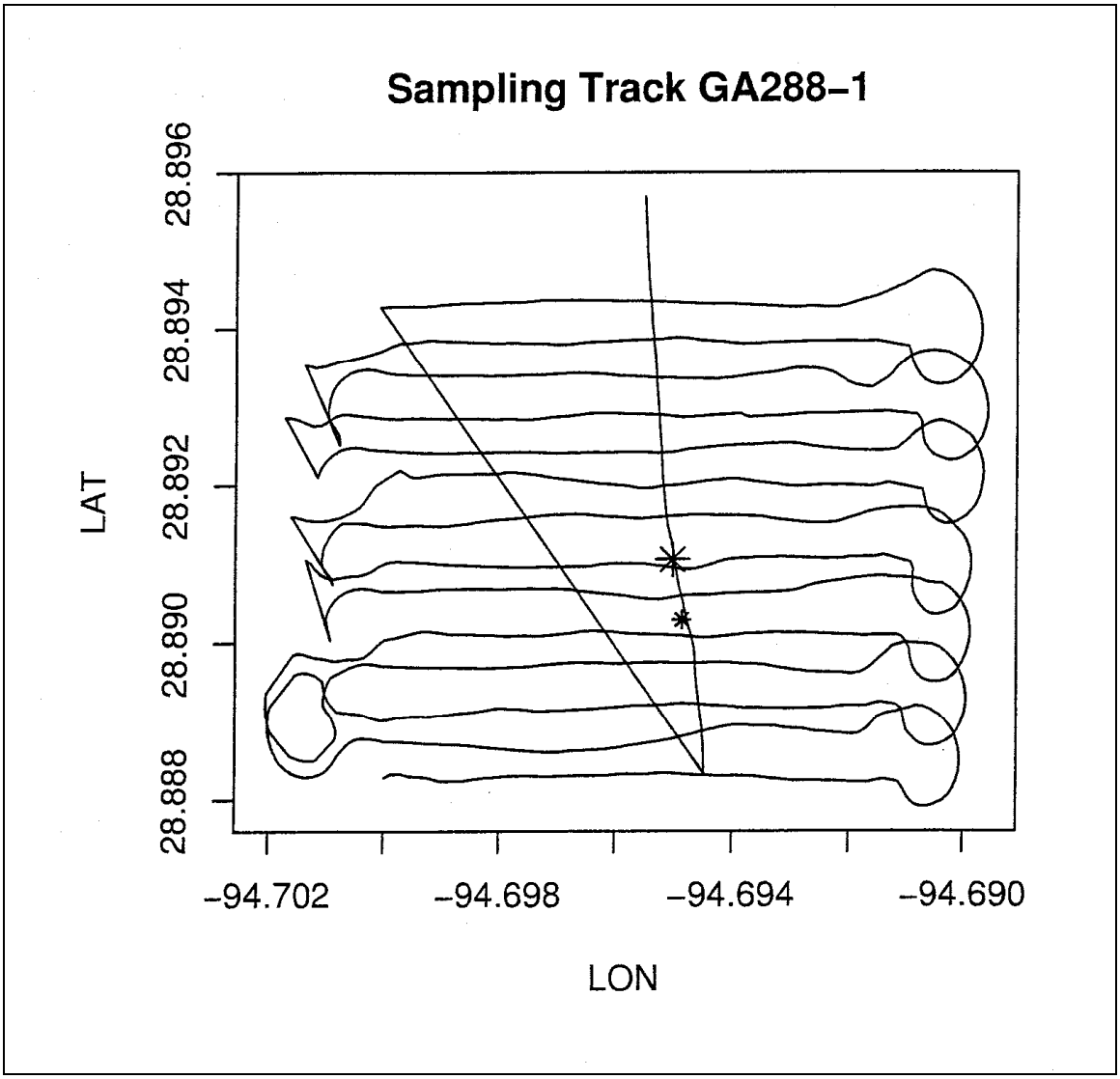



Figure B.1. Dual-beam hydroacoustic survey track, GA-288, October 2003. Large asterisk shows the center of the GA-288 production platform debris pile, small asterisk shows the center of the GA-288 quarters platform debris pile.

| lon | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 | 28.895 | 28.896 |
|---|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6963 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6962 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6961 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6959 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6958 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6957 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6956 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6955 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6953 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6952 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6951 | 0.0 | 48.5 | 0.0 | 14.4 | 11.7 | 0.0 | 0.0 | | |
| −94.6950 | 0.0 | 0.0 | 0.0 | 20.4 | 0.0 | 0.0 | 0.0 | | |
| −94.6949 | 0.0 | 0.0 | 0.0 | 64.5 | 0.0 | 0.0 | 0.0 | | |
| −94.6948 | 0.0 | 0.0 | 32.1 | 16.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6947 | 0.0 | 0.0 | 41.6 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6946 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6945 | 0.0 | 0.0 | 15.8 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6944 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6943 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6942 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6941 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6940 | 0.0 | 0.0 | 16.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6939 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6938 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6937 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6936 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6935 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

Figure B.2. Mean number of fish per 1000 $m^3$ at the GA-288 reef site between depths of 5 to 10 m, October 2003.

| lon | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 | 28.895 | 28.896 |
|---|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6963 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6962 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6961 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6959 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6958 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6957 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6956 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6955 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6953 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6952 | 0.0 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | | |
| −94.6951 | 0.0 | 0.0 | 0.0 | 40.0 | 7.9 | 0.0 | 0.0 | | |
| −94.6950 | 0.0 | 8.3 | 0.0 | 34.8 | 0.0 | 0.0 | 0.0 | | |
| −94.6949 | 0.0 | 23.5 | 0.0 | 34.4 | 0.0 | 0.0 | 0.0 | | |
| −94.6948 | 0.0 | 0.0 | 45.0 | 64.9 | 0.0 | 0.0 | 0.0 | | |
| −94.6947 | 0.0 | 0.0 | 14.2 | 22.4 | 0.0 | 0.0 | 0.0 | | |
| −94.6946 | 0.0 | 0.0 | 18.1 | 0.0 | 0.0 | 0.0 | 3.5 | | |
| −94.6945 | 0.0 | 0.0 | 24.5 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6944 | 0.0 | 0.0 | 24.9 | 11.4 | 0.0 | 0.0 | 34.4 | | |
| −94.6943 | 0.0 | 0.0 | 16.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6942 | 0.0 | 0.0 | 11.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6941 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6940 | 0.0 | 0.0 | 15.9 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6939 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6938 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6937 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6936 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6935 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

Figure B.3. Mean number of fish per 1000 $m^3$ at the GA-288 reef site between depths of 11 to 15 m, October 2003.

| lon | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 | 28.895 | 28.896 |
|---|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 | | |
| −94.6963 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | | |
| −94.6962 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6961 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6959 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | | |
| −94.6958 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6957 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6956 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6955 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6953 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 4.0 | | |
| −94.6952 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | | |
| −94.6951 | 0.0 | 0.0 | 0.0 | 0.0 | 4.9 | 0.0 | 0.0 | | |
| −94.6950 | 0.0 | 5.4 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6949 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 | | |
| −94.6948 | 0.0 | 0.0 | 33.1 | 46.5 | 0.0 | 0.0 | 0.0 | | |
| −94.6947 | 0.0 | 0.0 | 6.8 | 63.5 | 0.0 | 0.0 | 0.0 | | |
| −94.6946 | 0.0 | 0.0 | 11.1 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6945 | 0.0 | 0.0 | 21.4 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6944 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6943 | 0.0 | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6942 | 0.0 | 0.0 | 34.8 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6941 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6940 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6939 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6938 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6937 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6936 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6935 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | | |

Figure B.4. Mean number of fish per 1000 $m^3$ at the GA-288 reef site at depths greater than 15 m, October 2003.

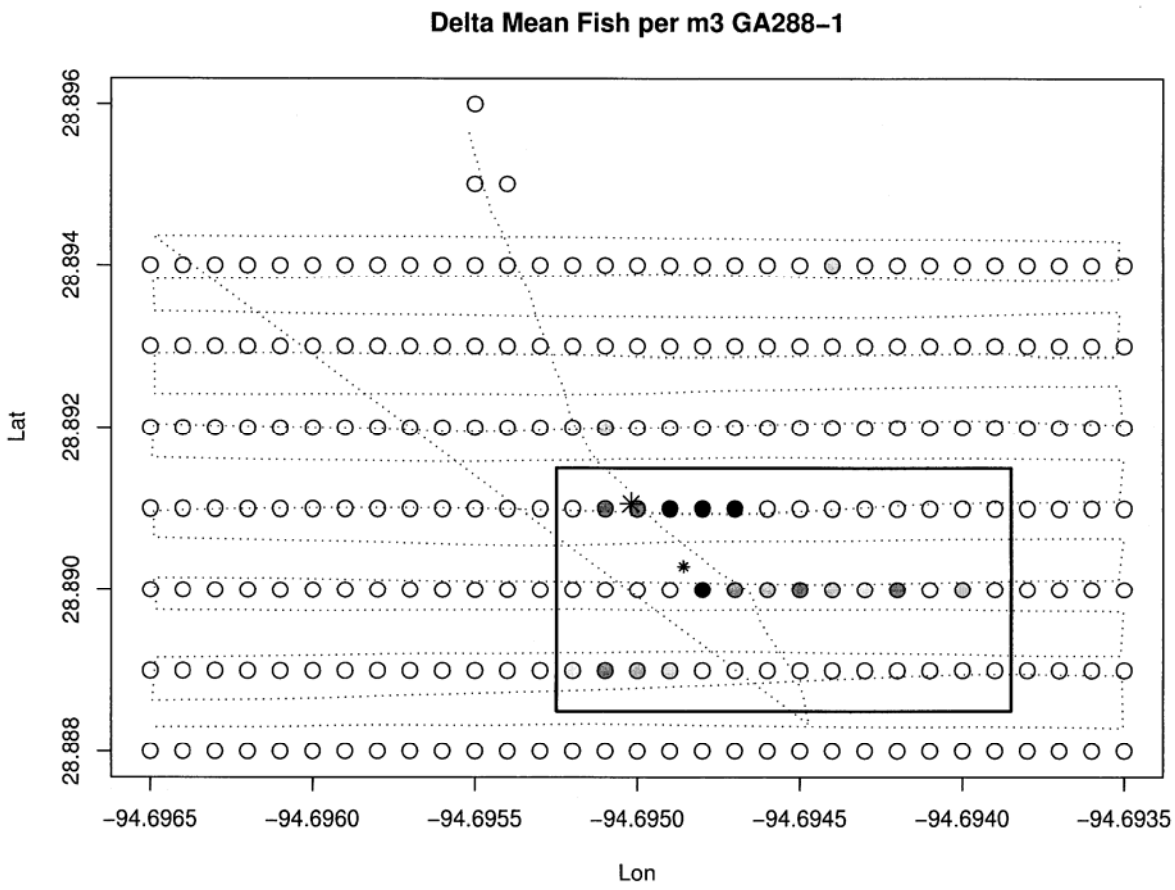



Figure B.5. Relative fish density along dual-beam hydroacoustic survey transect, GA-288, October 2003. Dotted lines show the actual transect track, large and small asterisks show locations of the GA-288 debris piles.

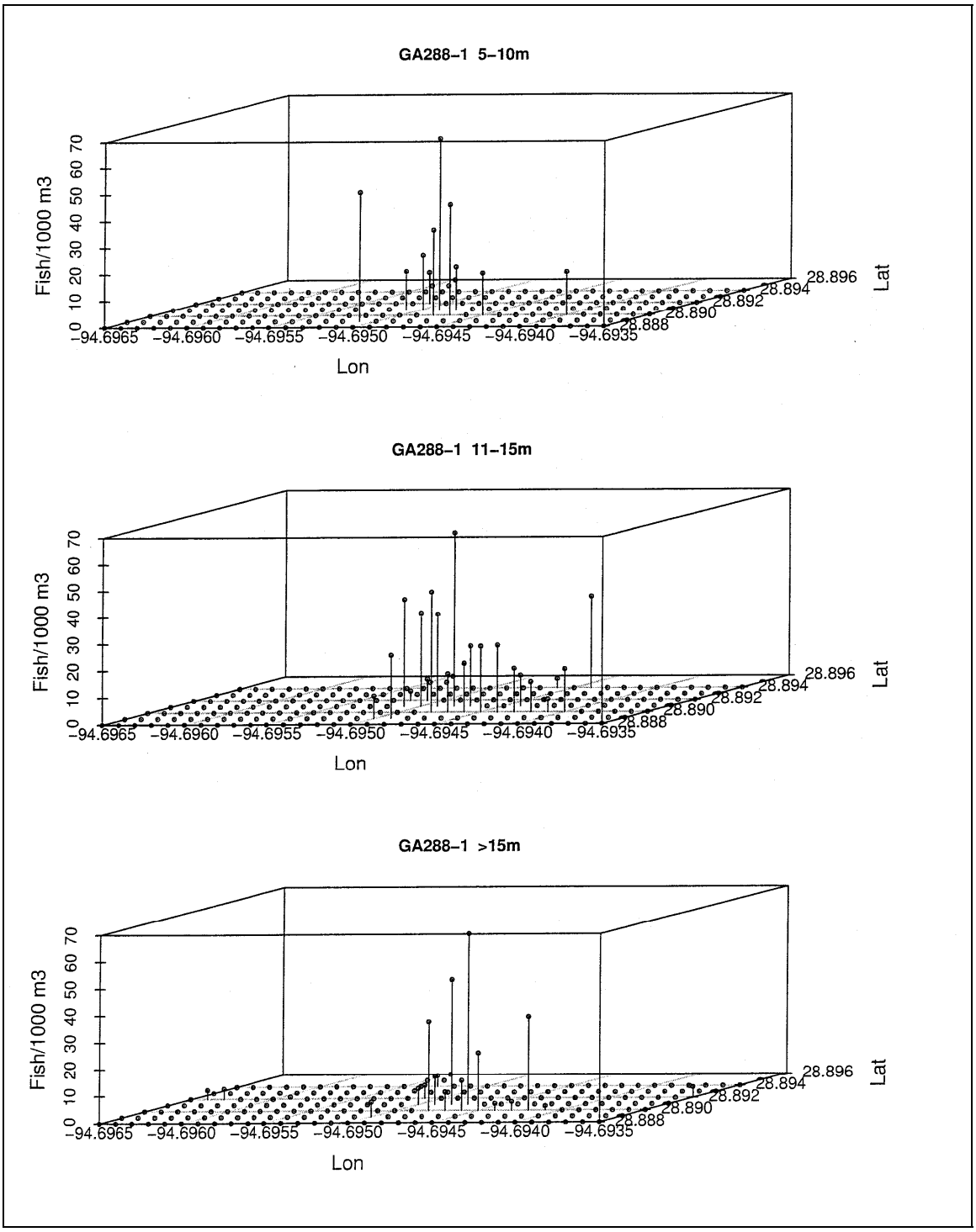



Figure B.6. Fish per 1000 $m^3$ by depth at GA-288, October 2003.

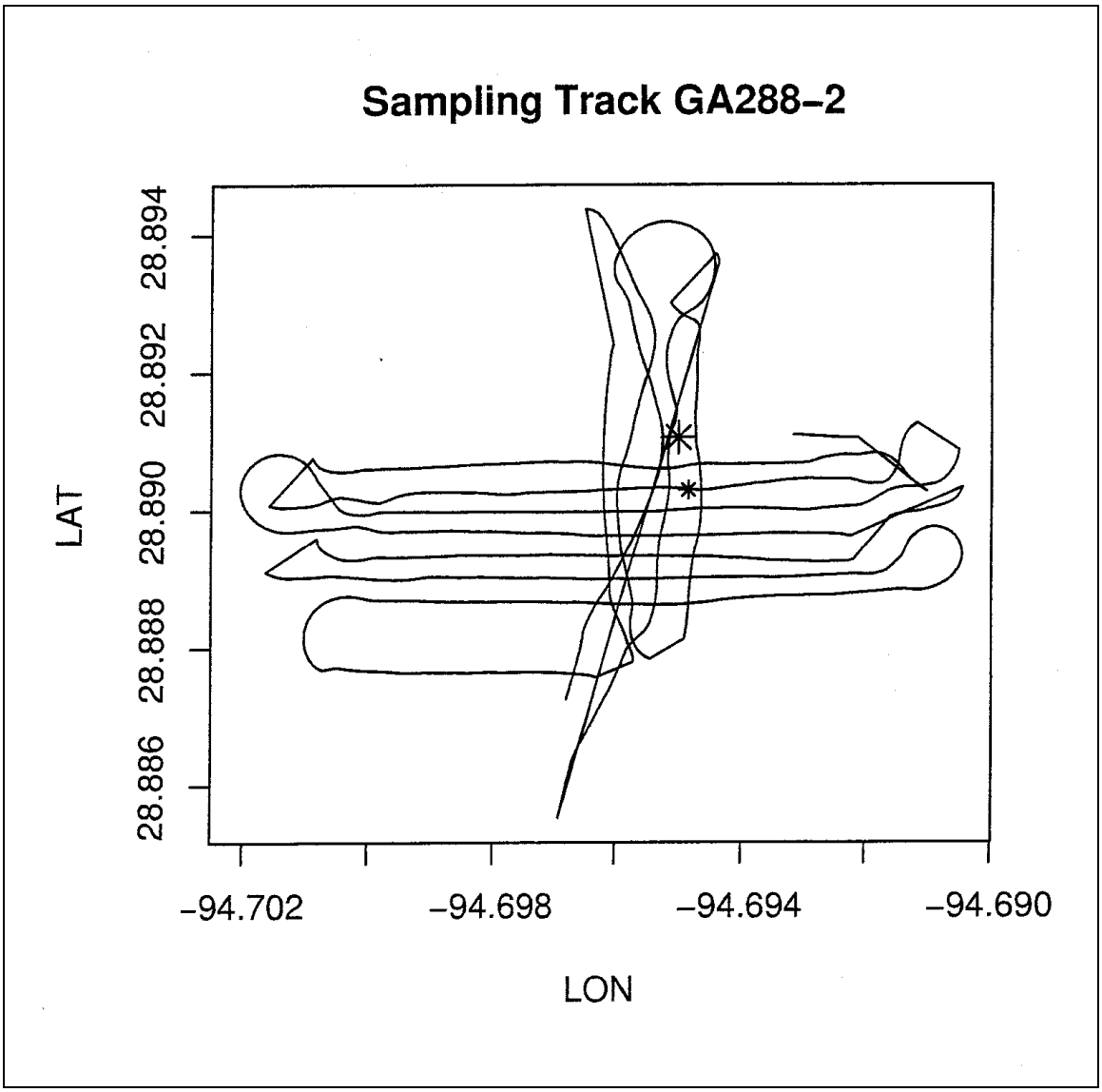
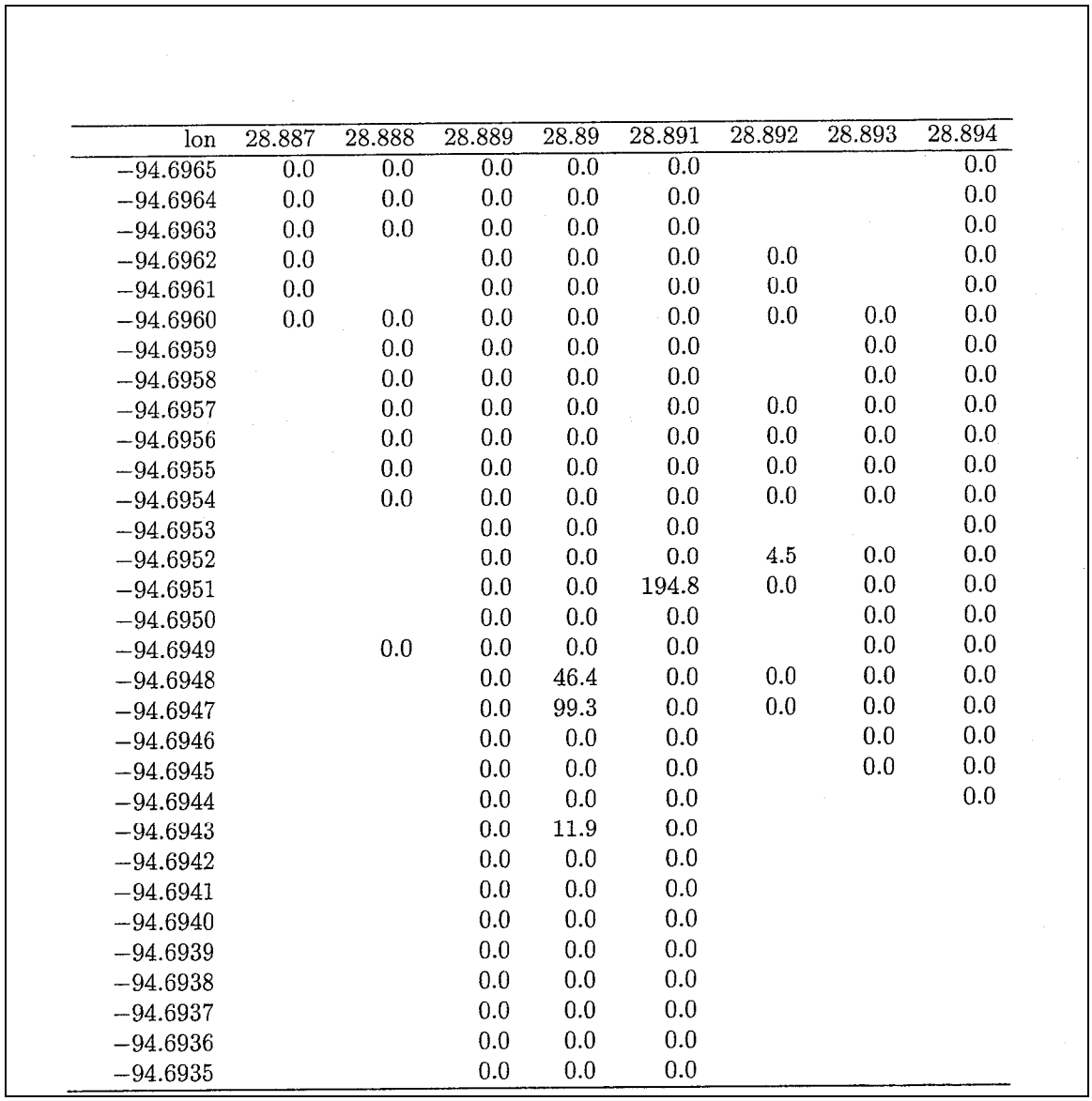



Figure B.7. Dual-beam hydroacoustic survey track, GA-288, August 2004. Large asterisk shows the center of the GA-288 production platform debris pile, small asterisk shows the center of the GA-288 quarters platform debris pile.

| lon | 28.887 | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 |
|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6963 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6962 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 |
| −94.6961 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6959 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6958 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6957 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6956 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6955 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6953 | | | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6952 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6951 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6950 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6949 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6948 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6947 | | | 0.0 | 13.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6946 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6945 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6944 | | | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6943 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6942 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6941 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6940 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6939 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6938 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6937 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6936 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6935 | | | 0.0 | 0.0 | 0.0 | | | |

Figure B.8. Mean number of fish per 1000 $m^3$ at the GA-288 reef site between depths of 5 to 10 m, August 2004.



| lon | 28.887 | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 |
|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6963 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6962 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 |
| −94.6961 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6959 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6958 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6957 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6956 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6955 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6953 | | | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6952 | | | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 |
| −94.6951 | | | 0.0 | 0.0 | 194.8 | 0.0 | 0.0 | 0.0 |
| −94.6950 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6949 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6948 | | | 0.0 | 46.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6947 | | | 0.0 | 99.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6946 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6945 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6944 | | | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6943 | | | 0.0 | 11.9 | 0.0 | | | |
| −94.6942 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6941 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6940 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6939 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6938 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6937 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6936 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6935 | | | 0.0 | 0.0 | 0.0 | | | |

Figure B.9. Mean number of fish per 1000 $m^3$ at the GA-288 reef site between depths of 11 to 15 m, August 2004.

| lon | 28.887 | 28.888 | 28.889 | 28.89 | 28.891 | 28.892 | 28.893 | 28.894 |
|---|---|---|---|---|---|---|---|---|
| −94.6965 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6964 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6963 | 0.0 | 0.0 | 1.9 | 0.0 | 15.4 | | | 0.0 |
| −94.6962 | 0.0 | | 0.0 | 0.7 | 1.9 | 0.0 | | 0.0 |
| −94.6961 | 0.0 | | 2.9 | 0.0 | 0.0 | 0.0 | | 0.0 |
| −94.6960 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6959 | | 0.0 | 0.6 | 3.8 | 1.3 | | 0.0 | 0.0 |
| −94.6958 | | 0.0 | 0.4 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6957 | | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6956 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6955 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6954 | | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6953 | | | 1.0 | 0.0 | 34.2 | | | 0.0 |
| −94.6952 | | | 0.0 | 0.4 | 2.8 | 0.0 | 0.0 | 0.0 |
| −94.6951 | | | 0.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.0 |
| −94.6950 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6949 | | 0.0 | 0.0 | 45.2 | 0.0 | | 0.0 | 0.0 |
| −94.6948 | | | 0.6 | 40.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6947 | | | 0.0 | 16.0 | 5.3 | 0.4 | 0.0 | 0.0 |
| −94.6946 | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 |
| −94.6945 | | | 0.0 | 2.1 | 0.0 | | 0.0 | 0.0 |
| −94.6944 | | | 0.0 | 0.0 | 0.0 | | | 0.0 |
| −94.6943 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6942 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6941 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6940 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6939 | | | 0.0 | 3.2 | 0.0 | | | |
| −94.6938 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6937 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6936 | | | 0.0 | 0.0 | 0.0 | | | |
| −94.6935 | | | 0.0 | 0.0 | 0.0 | | | |

Figure B.10. Mean number of fish per 1000 $m^3$ at the GA-288 reef site at depths greater than 15 m, August 2004.

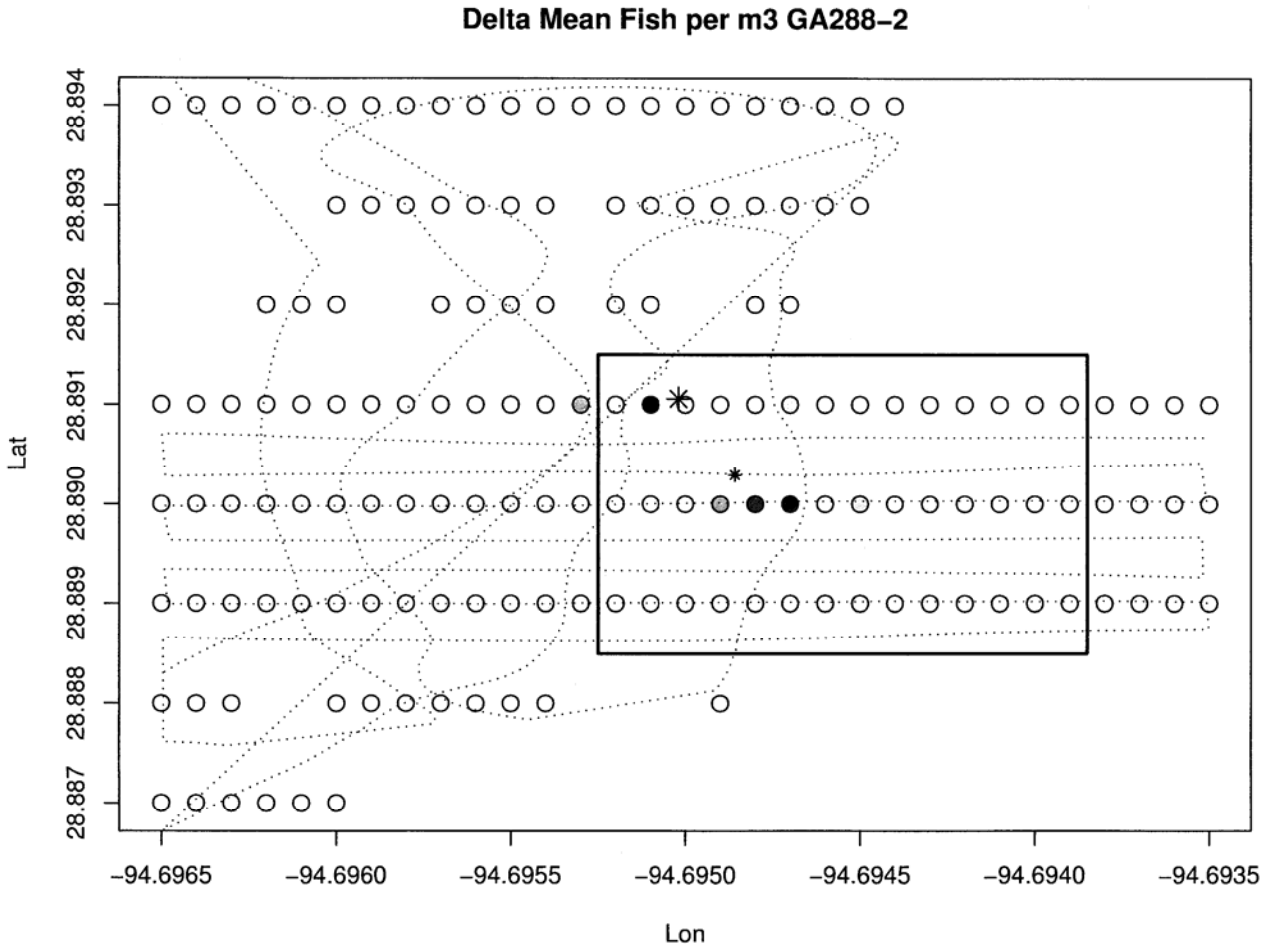



Figure B.11. Relative fish density along dual-beam hydroacoustic survey transect, GA-288, August 2004. Dotted lines show the actual transect track, large and small asterisks show locations of the GA-288 debris piles.

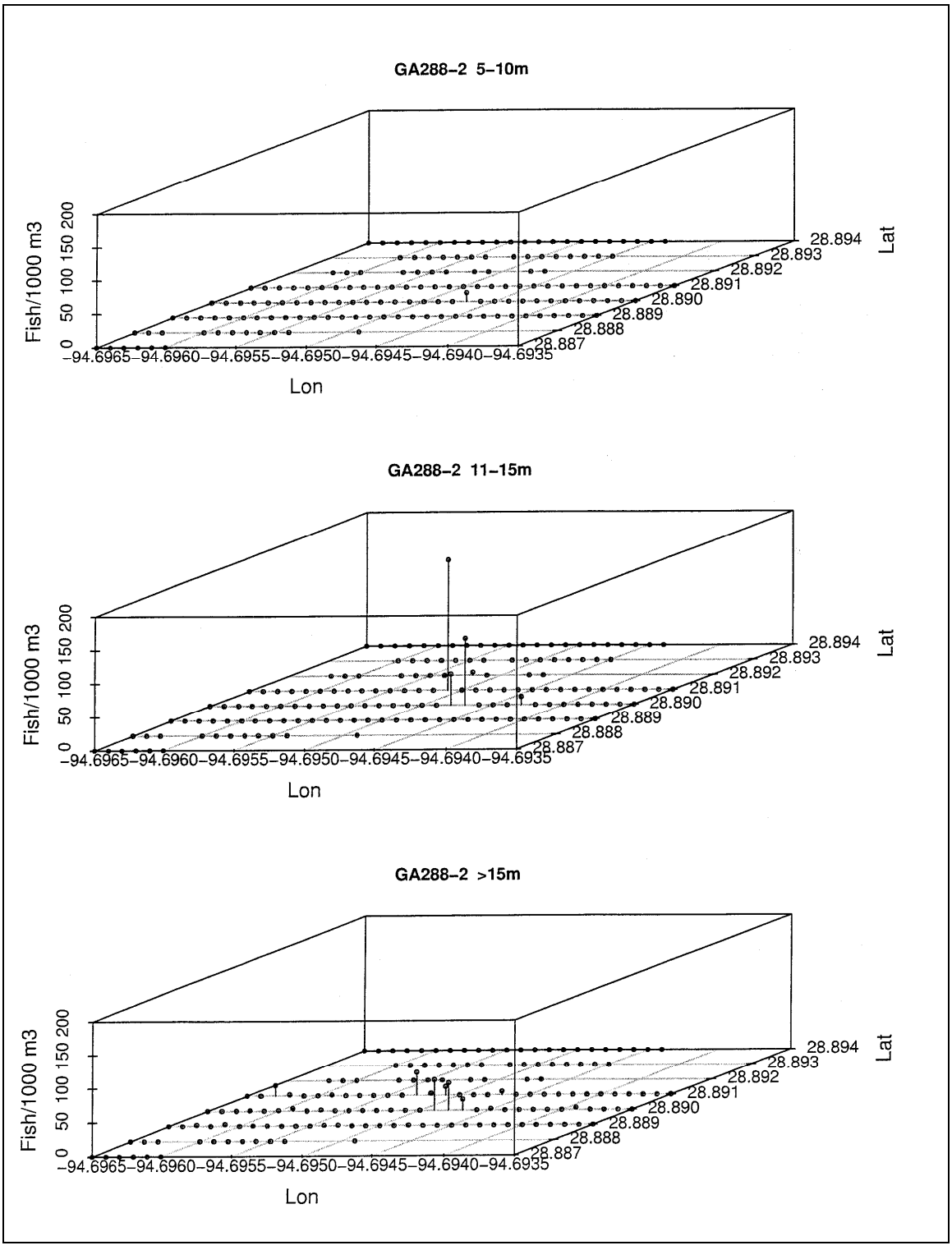



Figure B.12. Fish per 1000 $m^3$ by depth at GA-288, August 2004.

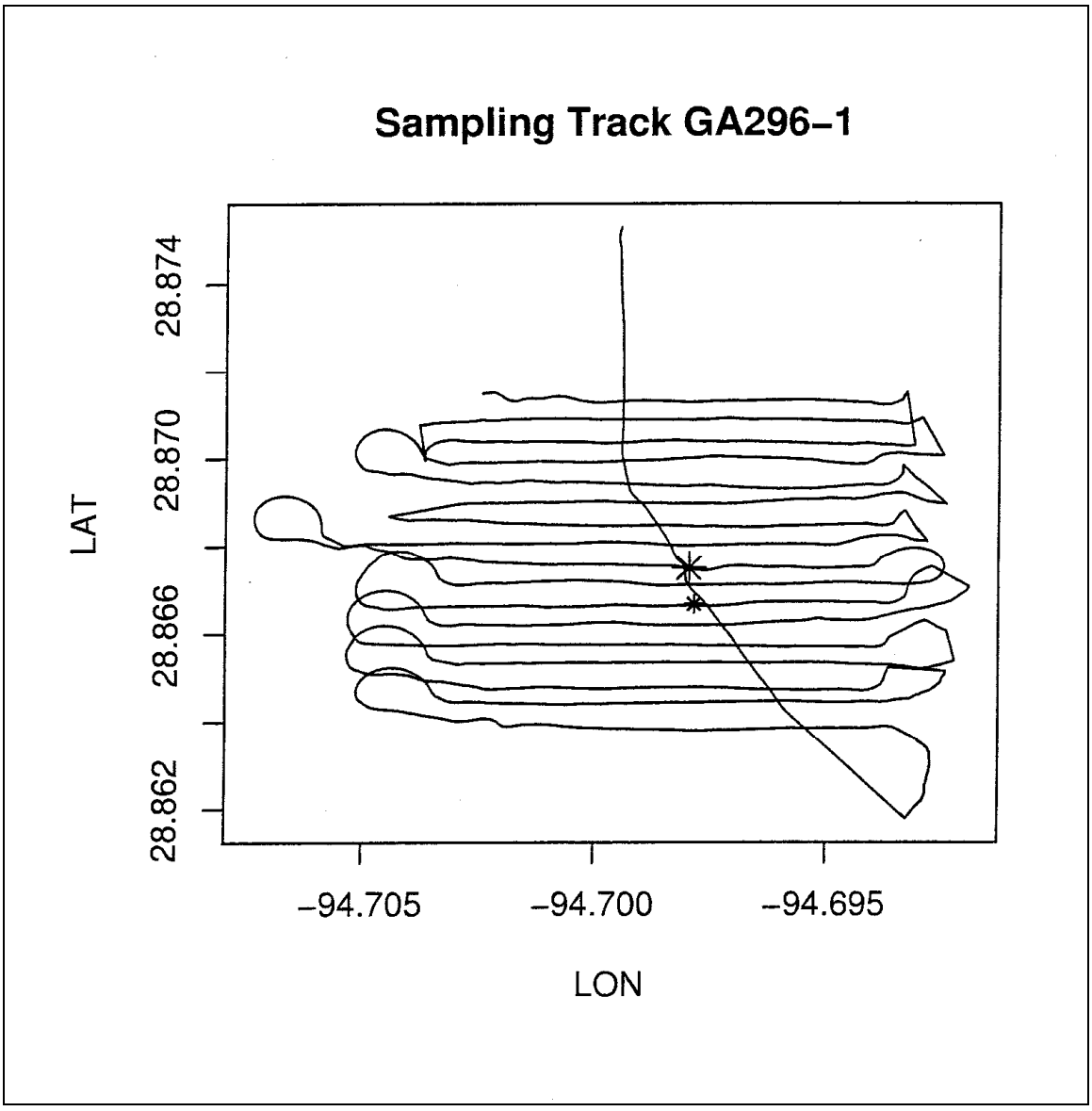



Figure B.13. Dual-beam hydroacoustic survey track, GA-296, October 2003. Large asterisk shows the center of the GA-296 production platform debris pile, small asterisk shows the center of the GA-296 quarters platform debris pile.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6999 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6998 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6997 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6996 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6995 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6994 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6993 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6992 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6991 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6990 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6989 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6988 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6987 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6986 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6985 | 0.0 | 0.0 | 0.0 | 11.4 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6984 | 0.0 | 0.0 | 0.0 | 20.5 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6983 | 0.0 | 0.0 | 0.0 | 14.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6982 | 0.0 | 0.0 | 1.8 | 36.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6981 | 0.0 | 0.0 | 7.9 | 17.2 | 2.4 | 0.0 | 0.0 | 0.0 | |
| −94.6980 | 0.0 | 0.0 | 29.4 | 15.2 | 0.9 | 0.0 | 0.0 | 0.0 | |
| −94.6979 | 0.0 | 0.0 | 30.1 | 50.5 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6978 | 0.0 | 0.0 | 0.0 | 20.8 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6977 | 0.0 | 0.0 | 0.0 | 25.1 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6976 | 0.0 | 0.0 | 0.0 | 54.6 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6975 | 0.0 | 0.0 | 0.0 | 63.9 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.0 | 0.0 | 0.0 | 21.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6973 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6972 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6971 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6970 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

Figure B.14. Mean number of fish per 1000 $m^3$ at the GA-296 reef site between depths of 5 to 10 m, October 2003.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6999 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 3.0 | |
| −94.6998 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | |
| −94.6997 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | |
| −94.6996 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6995 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.3 | 0.7 | 0.0 | |
| −94.6994 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6993 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.5 | 0.3 | |
| −94.6992 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | |
| −94.6991 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | |
| −94.6990 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 | |
| −94.6989 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6988 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | |
| −94.6987 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.5 | |
| −94.6986 | 0.0 | 0.0 | 0.0 | 18.2 | 0.1 | 0.3 | 0.0 | 11.5 | |
| −94.6985 | 0.0 | 0.0 | 0.0 | 58.7 | 0.0 | 0.0 | 0.0 | 0.4 | |
| −94.6984 | 0.0 | 0.0 | 0.0 | 61.7 | 0.1 | 0.0 | 0.0 | 4.4 | |
| −94.6983 | 0.0 | 0.0 | 7.5 | 125.4 | 0.0 | 0.3 | 0.0 | 1.1 | |
| −94.6982 | 0.0 | 0.0 | 3.3 | 90.8 | 1.7 | 0.0 | 0.0 | 0.0 | |
| −94.6981 | 0.0 | 0.0 | 47.8 | 18.2 | 24.3 | 0.0 | 0.0 | 0.0 | |
| −94.6980 | 0.0 | 0.0 | 10.3 | 72.3 | 28.3 | 0.0 | 0.0 | 0.0 | |
| −94.6979 | 0.0 | 0.0 | 31.2 | 97.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6978 | 0.0 | 0.0 | 13.2 | 114.0 | 0.0 | 1.4 | 0.0 | 0.0 | |
| −94.6977 | 0.0 | 0.0 | 0.0 | 190.3 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6976 | 0.0 | 0.0 | 0.0 | 87.1 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6975 | 0.0 | 0.0 | 0.0 | 61.4 | 0.2 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.5 | 0.0 | 0.0 | 14.9 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6973 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6972 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | |
| −94.6971 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6970 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | |

Figure B.15. Mean number of fish per 1000 $m^3$ at the GA-296 reef site between depths of 11 to 15 m, October 2003.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6999 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6998 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6997 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6996 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6995 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | |
| −94.6994 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6993 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6992 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6991 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6990 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6989 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6988 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6987 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6986 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6985 | 0.0 | 0.0 | 0.0 | 74.7 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6984 | 0.0 | 0.0 | 0.0 | 33.6 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6983 | 0.0 | 0.0 | 25.8 | 11.8 | 0.2 | 0.0 | 0.0 | 0.0 | |
| −94.6982 | 0.0 | 0.0 | 0.0 | 23.3 | 31.1 | 0.0 | 0.0 | 0.0 | |
| −94.6981 | 0.0 | 0.0 | 46.9 | 4.0 | 75.6 | 0.0 | 0.0 | 0.0 | |
| −94.6980 | 0.0 | 0.0 | 3.8 | 7.5 | 86.7 | 0.0 | 0.0 | 0.0 | |
| −94.6979 | 0.0 | 0.0 | 161.4 | 15.0 | 0.0 | 0.0 | 0.7 | 0.0 | |
| −94.6978 | 0.0 | 0.0 | 8.2 | 49.3 | 21.1 | 0.0 | 0.0 | 0.0 | |
| −94.6977 | 0.0 | 0.0 | 26.6 | 58.3 | 0.0 | 0.0 | 0.0 | 0.2 | |
| −94.6976 | 0.0 | 0.0 | 8.4 | 33.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6975 | 0.0 | 0.0 | 1.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.0 | 0.0 | 5.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6973 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | |
| −94.6972 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6971 | 0.1 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6970 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

Figure B.16. Mean number of fish per 1000 $m^3$ at the GA-296 reef site at depths greater than 15 m, October 2003.

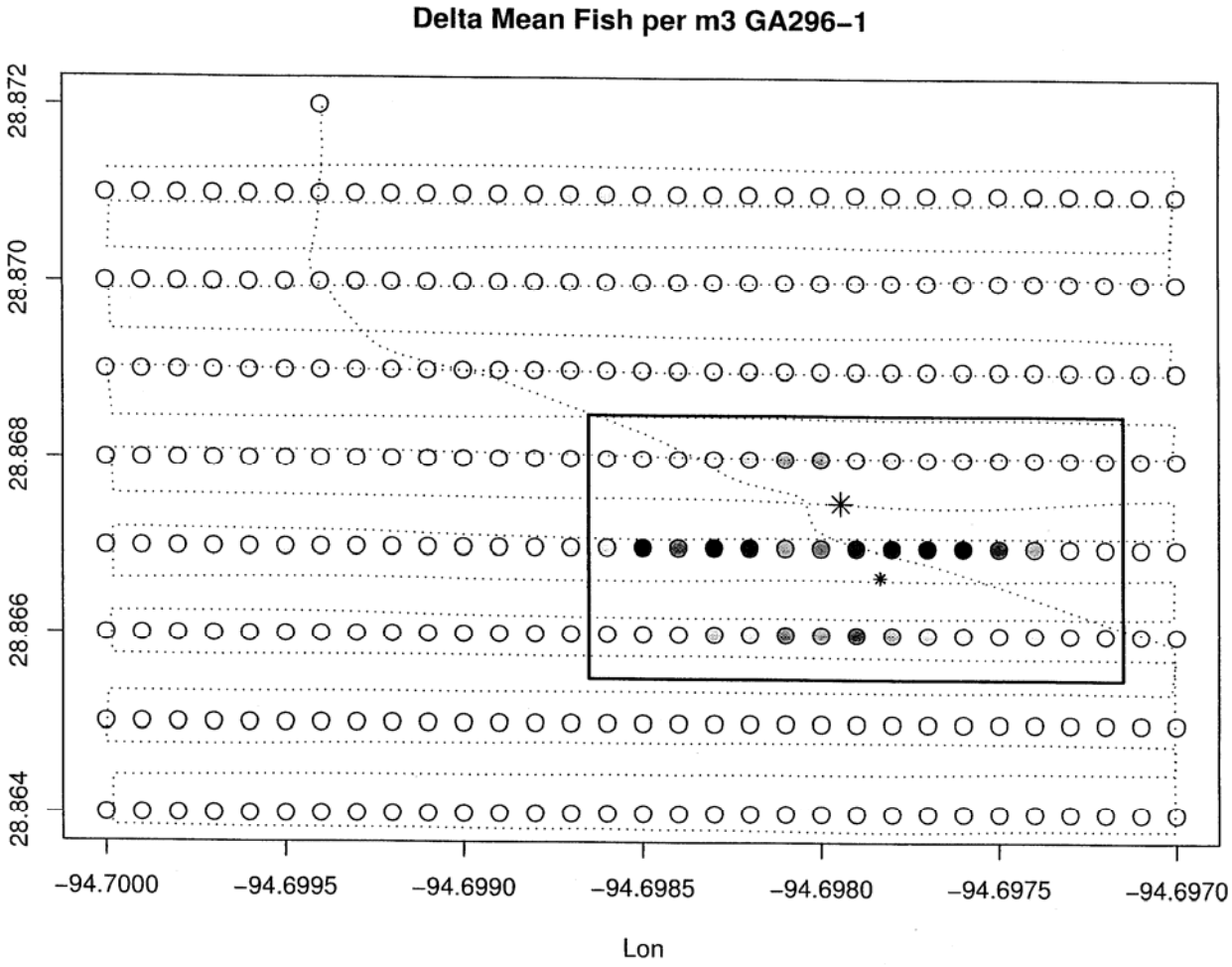



Figure B.17. Relative fish density along dual-beam hydroacoustic survey transect, GA-296, October 2003. Dotted lines show the actual transect track, large and small asterisks show locations of the GA-296 debris piles.

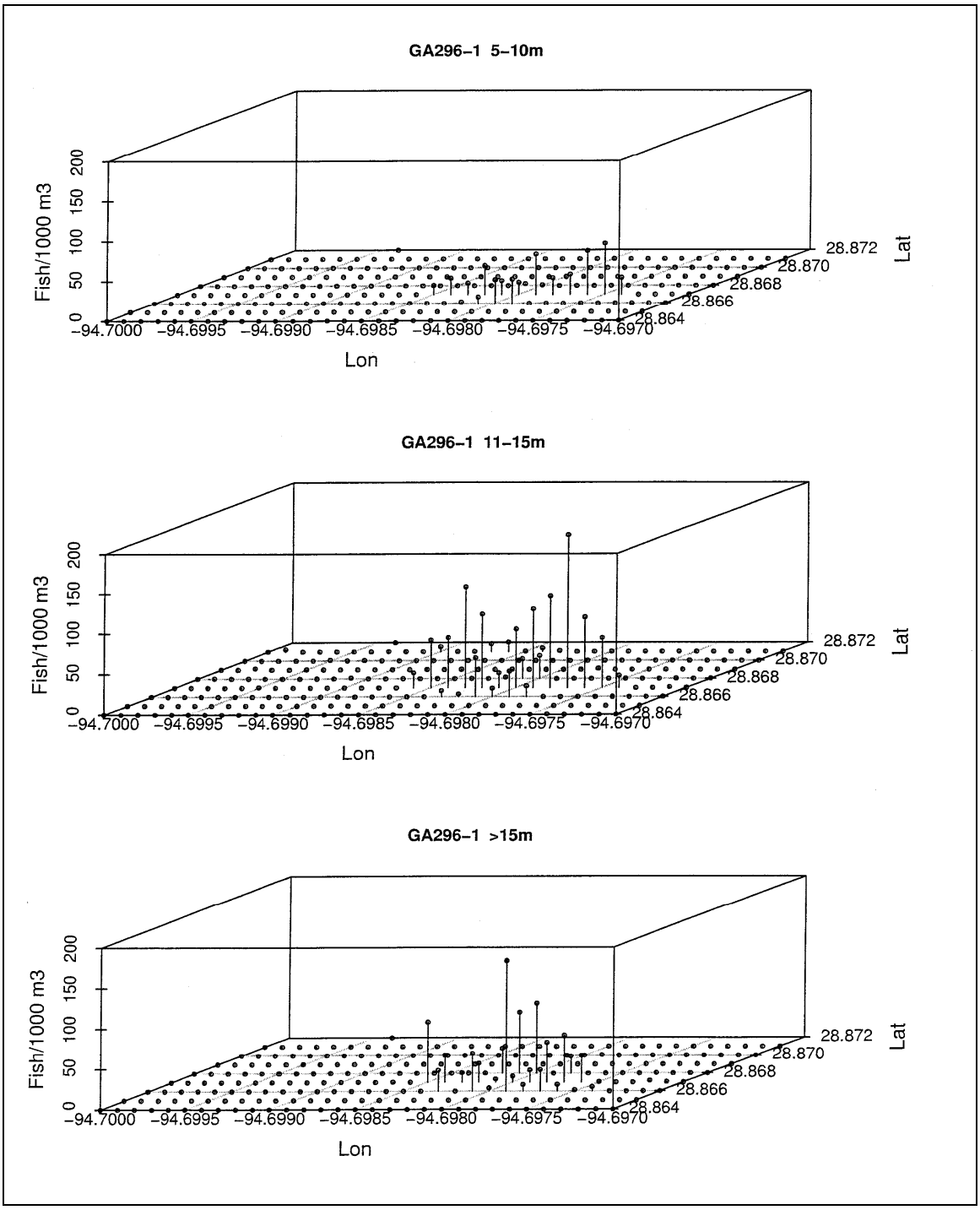



Figure B.18. Fish per 1000 $m^3$ by depth at GA-296, October 2003.

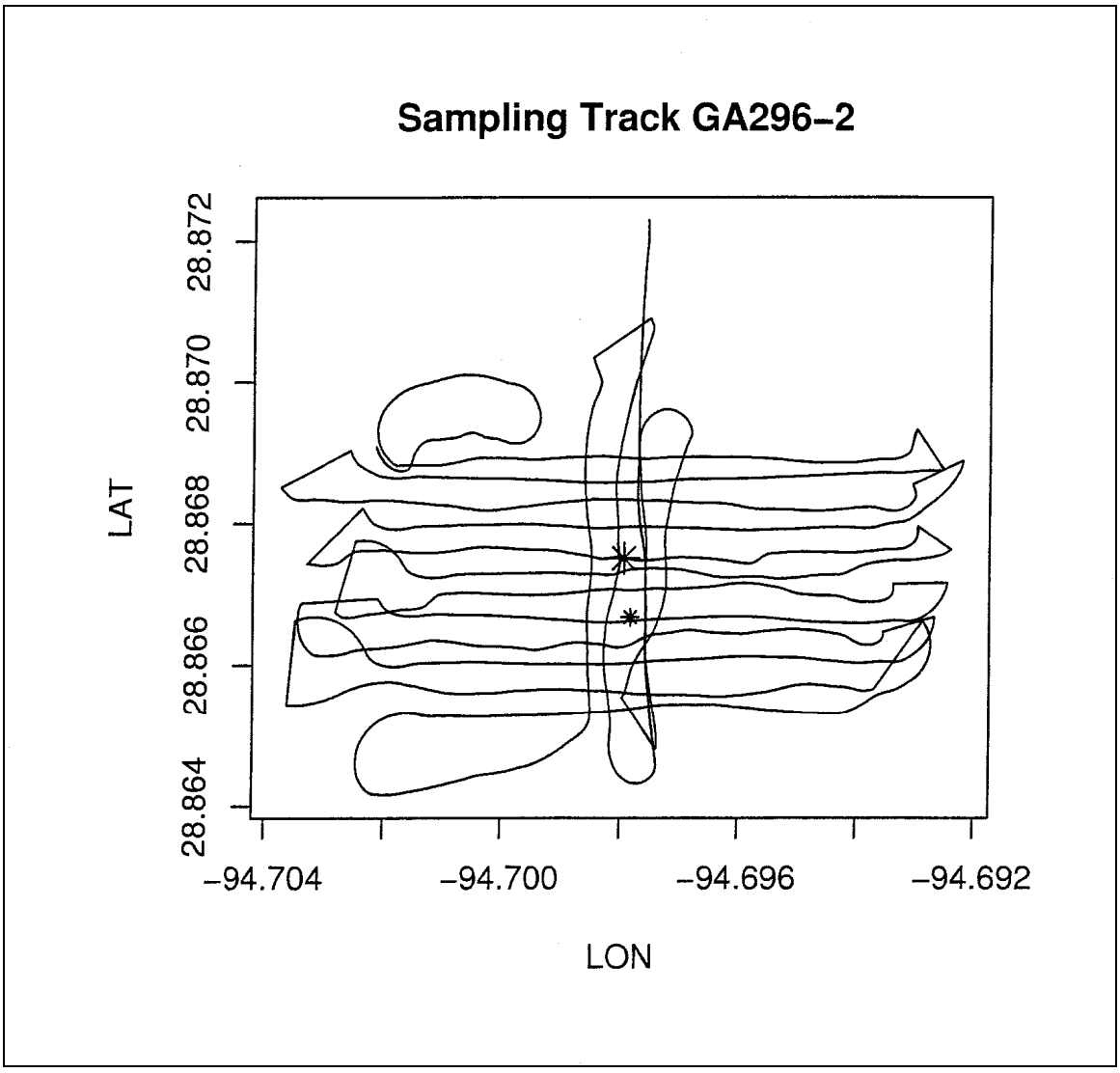



Figure B.19. Dual-beam hydroacoustic survey track, GA-296, August 2004. Large asterisk shows the center of the GA-296 production platform debris pile, small asterisk shows the center of the GA-296 quarters platform debris pile.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6999 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6998 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6997 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6996 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6995 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6994 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6993 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6992 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6991 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6990 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6989 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6988 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6987 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6986 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6985 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 94.7 | | |
| −94.6984 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6983 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6982 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6981 | | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | | | |
| −94.6980 | 0.0 | 0.0 | 0.0 | 335.5 | 8.6 | 0.0 | | | |
| −94.6979 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6978 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6977 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6976 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6975 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6973 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6972 | | 0.0 | 0.0 | 183.4 | 0.0 | 0.0 | 0.0 | | |
| −94.6971 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6970 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

Figure B.20. Mean number of fish per 1000 $m^3$ at the GA-296 reef site between depths of 5 to 10 m, August 2004.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6999 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6998 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6997 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6996 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6995 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6994 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6993 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6992 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6991 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6990 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6989 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6988 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6987 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6986 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6985 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6984 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6983 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6982 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6981 | | 0.0 | 0.0 | 4.5 | 7.0 | 0.0 | | | |
| −94.6980 | 0.0 | 0.0 | 0.0 | 324.5 | 0.0 | 0.0 | | | |
| −94.6979 | 0.0 | 0.0 | 0.0 | 87.9 | 0.0 | 0.0 | 0.0 | | |
| −94.6978 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6977 | 0.0 | 0.0 | 0.0 | 2.2 | 0.0 | 2.8 | 0.0 | 0.0 | |
| −94.6976 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6975 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.0 | 0.0 | 0.0 | 4.7 | 0.0 | 0.0 | 0.0 | | |
| −94.6973 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6972 | | 0.0 | 0.0 | 104.1 | 0.0 | 0.0 | 0.0 | | |
| −94.6971 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6970 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

Figure B.21. Mean number of fish per 1000 $m^3$ at the GA-296 reef site between depths of 11 to 15 m August 2004.

| lon | 28.864 | 28.865 | 28.866 | 28.867 | 28.868 | 28.869 | 28.87 | 28.871 | 28.872 |
|---|---|---|---|---|---|---|---|---|---|
| −94.7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6999 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6998 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6997 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6996 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6995 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6994 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6993 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6992 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6991 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6990 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6989 | | 0.0 | 0.0 | 2.7 | 0.0 | 0.0 | | | |
| −94.6988 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6987 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| −94.6986 | | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | | | |
| −94.6985 | | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6984 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6983 | | 0.0 | 0.0 | 16.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6982 | | 0.0 | 1.3 | 17.4 | 0.0 | 0.0 | | | |
| −94.6981 | | 0.0 | 0.0 | 117.9 | 17.8 | 0.0 | | | |
| −94.6980 | 0.0 | 0.0 | 2.4 | 139.9 | 10.5 | 0.0 | | | |
| −94.6979 | 0.0 | 0.0 | 0.0 | 97.3 | 0.0 | 0.0 | 0.0 | | |
| −94.6978 | 0.0 | 0.0 | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 | | |
| −94.6977 | 0.0 | 0.0 | 0.0 | 18.8 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6976 | 0.0 | 0.0 | 10.9 | 4.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| −94.6975 | 0.0 | 0.0 | 0.0 | 9.8 | 0.0 | 0.0 | 0.0 | 0.0 | |
| −94.6974 | 0.0 | 0.0 | 0.0 | 23.9 | 0.0 | 0.0 | 0.0 | | |
| −94.6973 | | 0.0 | 0.0 | 7.3 | 0.0 | 0.0 | 0.0 | | |
| −94.6972 | | 0.0 | 0.0 | 13.2 | 0.0 | 0.0 | 0.0 | | |
| −94.6971 | | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | | |
| −94.6970 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |

Figure B.22. Mean number of fish per 1000 $m^3$ at the GA-296 reef site at depths greater than 15 m, August 2004.

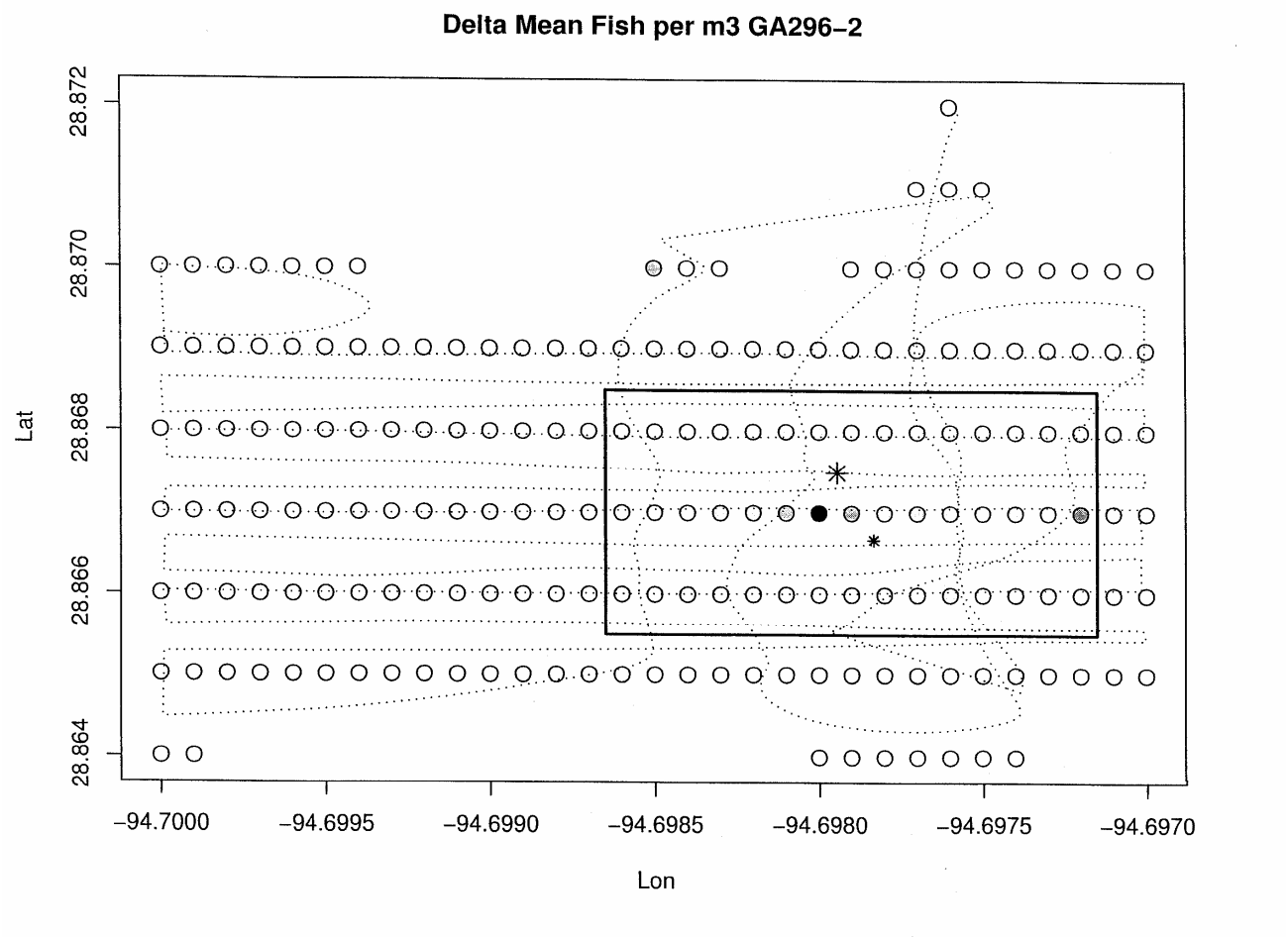



Figure B.23. Relative fish density along dual-beam hydroacoustic survey transect, GA-296, August 2004. Dotted lines show the actual transect track, large and small asterisks show locations of the GA-296 debris piles.

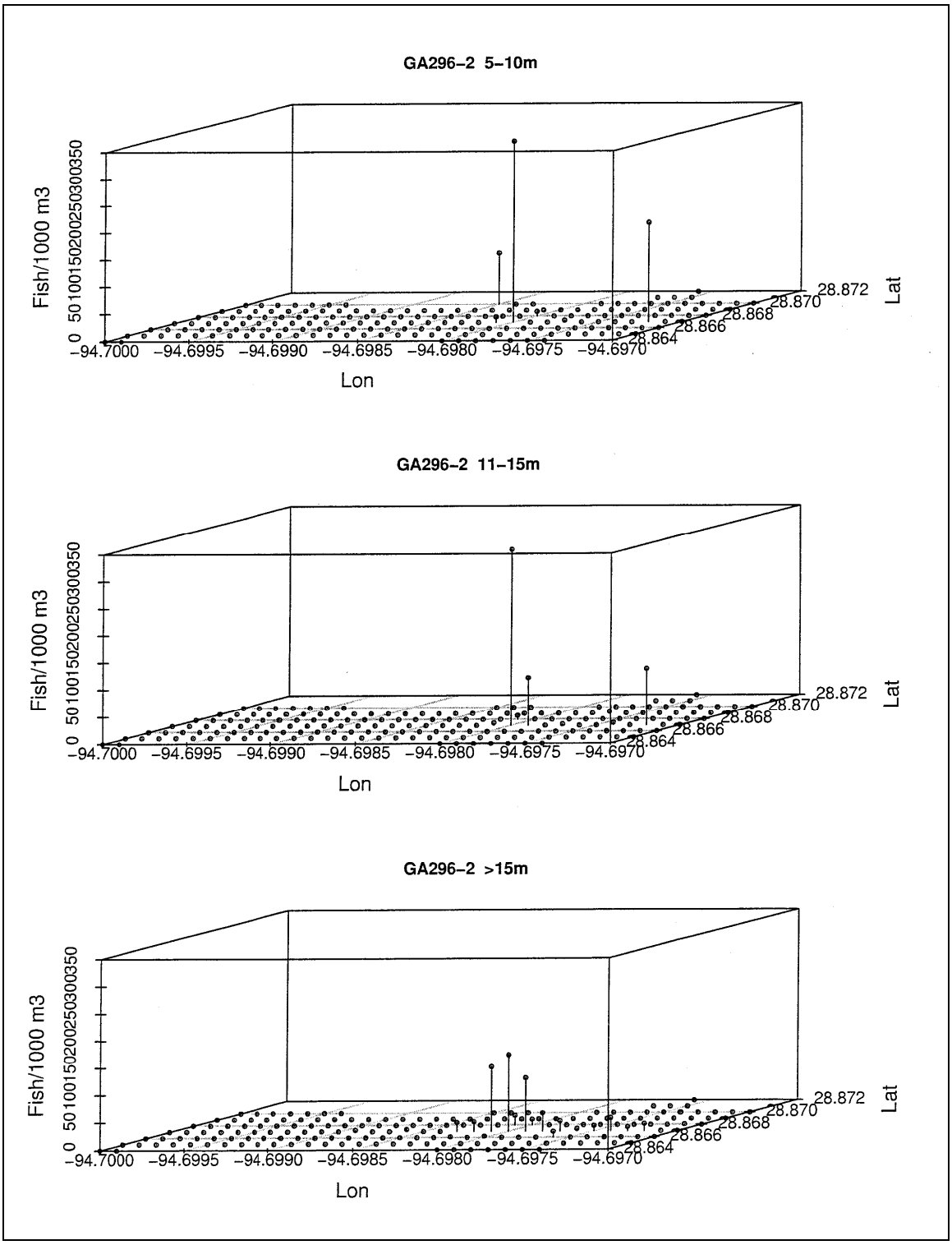



Figure B.24. Fish per 1000 $m^3$ by depth at GA-296, August 2004.

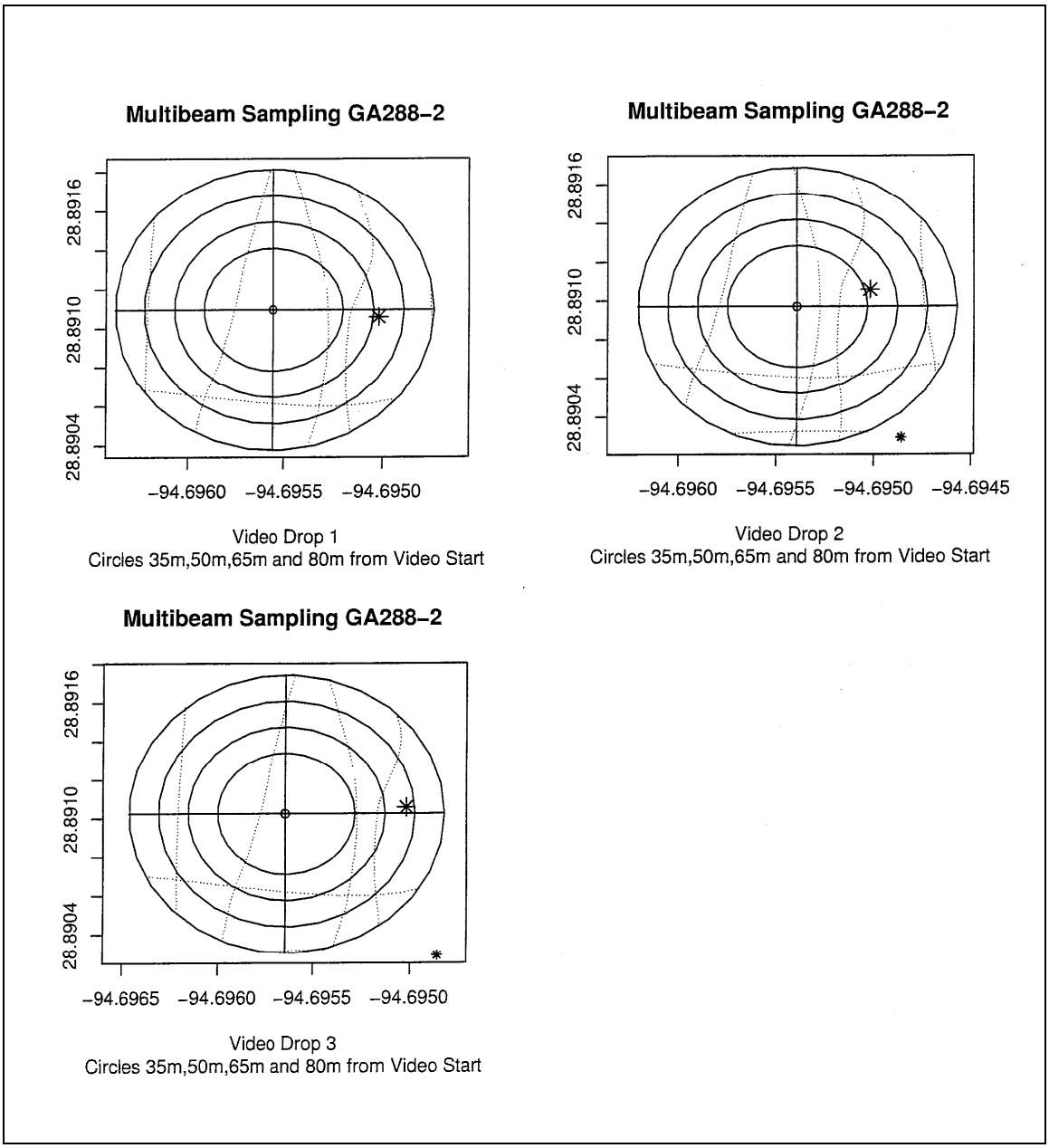



Figure B.25. Location of the ROV video drops (center of circle), at GA-288, August 2004. Large asterisk shows the location of the center of the production platform debris pile; the small asterisk shows the location of the quarters platform pile.

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 55.7 | 464.6 | 15.8 | 0.0 |
| se | 64.1 | 44.8 | 12.9 | 43.8 |
| sw | | 7.8 | | 24.1 |
| nw | 0.0 | 0.0 | 0.0 | 0.0 |

Table 1: GA288-2 mean estimate of fish on bottom - video 1

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 0.0 | 74.9 | 0.0 | 0.0 |
| se | 0.0 | 0.8 | 0.0 | 0.0 |
| sw | | 0.0 | | 1.3 |
| nw | 0.0 | 0.0 | 0.0 | 0.0 |

Table 2: GA288-2 lower confidence level estimate

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 116.0 | 854.3 | 39.5 | 0.0 |
| se | 133.3 | 88.7 | 31.6 | 129.4 |
| sw | | 20.6 | | 46.9 |
| nw | 0.0 | 0.0 | 0.0 | 0.0 |

Table 3: GA288-2 upper confidence level estimate

Figure B.26. Bottom fish population estimates and 95% confidence intervals by quadrant of the GA-288 video drop 1 circle depicted in Appendix B.25, August 2004.

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 82.2 | 401.3 | 422.4 | 0.0 |
| se | 34.4 | 6.3 | 0.0 | 1.3 |
| sw | | | 8.5 | 2.0 |
| nw | | | 0.0 | 0.0 |

Table 1: GA288-2 mean estimate of fish on bottom - video 2

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 13.8 | 0.0 | 0.0 | 0.0 |
| se | 0.6 | 0.0 | 0.0 | 0.0 |
| sw | | | 0.0 | 0.0 |
| nw | | | 0.0 | 0.0 |

Table 2: GA288-2 lower confidence level estimate

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 150.7 | 879.3 | 907.0 | 0.0 |
| se | 68.2 | 16.4 | 0.0 | 3.7 |
| sw | | | 19.8 | 4.7 |
| nw | | | 0.0 | 0.0 |

Table 3: GA288-2 upper confidence level estimate

Figure B.27. Bottom fish population estimates and 95% confidence intervals by quadrant of the GA-288 video drop 2 circle depicted in Appendix B.25, August 2004.

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | | 89.9 | 846.9 | |
| se | | 29.5 | 12.5 | 0.0 |
| sw | 0.0 | 3.4 | 6.4 | 38.6 |
| nw | | 0.0 | 0.0 | 0.0 |

Table 1: GA288-2 mean estimate of fish on bottom - video 3

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | | 13.0 | 117.5 | |
| se | | 1.3 | 0.0 | 0.0 |
| sw | 0.0 | 0.0 | 0.0 | 4.2 |
| nw | | 0.0 | 0.0 | 0.0 |

Table 2: GA288-2 lower confidence level estimate

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | | 166.7 | 1576.2 | |
| se | | 57.7 | 32.6 | 0.0 |
| sw | 0.0 | 7.8 | 13.6 | 73.0 |
| nw | | 0.0 | 0.0 | 0.0 |

Table 3: GA288-2 upper confidence level estimate

Figure B.28. Bottom fish population estimates and 95% confidence intervals by quadrant of the GA-288 video drop 3 circle depicted in Appendix B.25, August 2004.

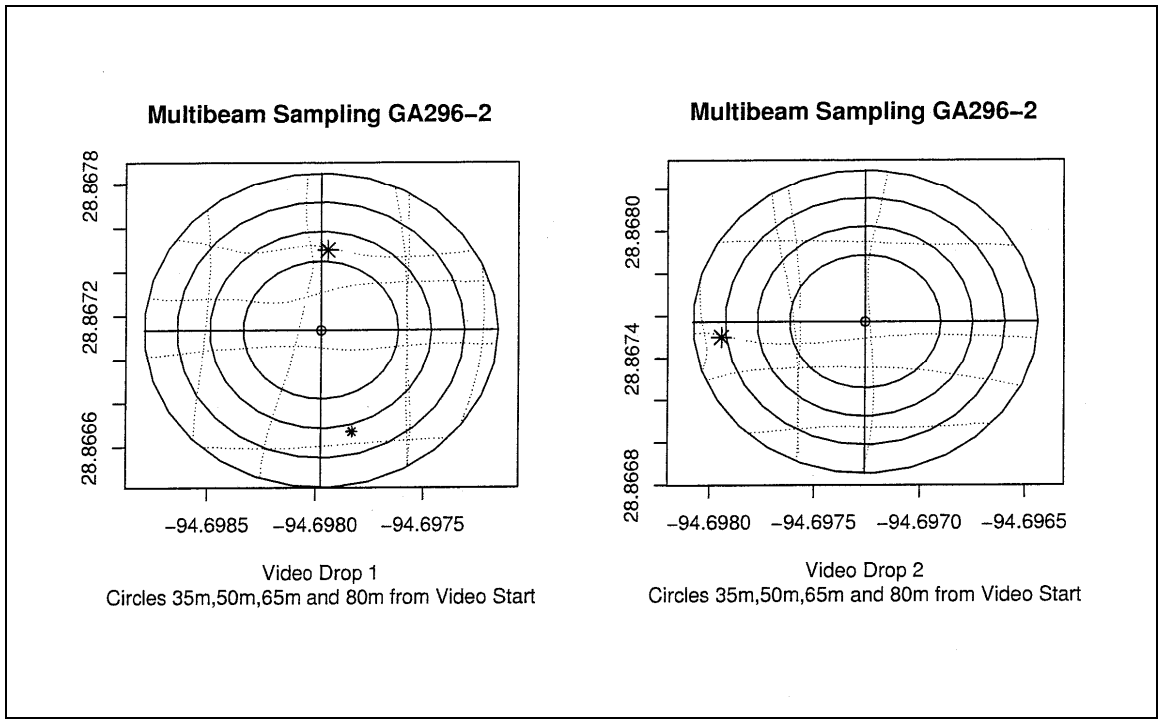



Figure B.29. Location of the ROV video drops (center of circle), at GA-296, August 2004. Large asterisk shows the location of the center of the production platform debris pile; the small asterisk shows the location of the quarters platform pile.

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 658.3 | 34.3 | 88.3 | 640.3 |
| se | 94.2 | 6.5 | 211.3 | 30.7 |
| sw | 264.4 | | 435.2 | 0.0 |
| nw | 362.9 | 139.5 | 19.6 | 0.0 |

Table 1: GA296-2 mean estimate of fish on bottom - video 1

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 110.5 | 11.4 | 0.0 | 406.6 |
| se | 25.4 | 0.0 | 84.7 | 8.6 |
| sw | 180.0 | | 116.7 | 0.0 |
| nw | 144.1 | 54.6 | 0.0 | 0.0 |

Table 2: GA296-2 lower confidence level estimate

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 1206.1 | 57.2 | 181.3 | 873.9 |
| se | 163.0 | 14.3 | 337.8 | 52.9 |
| sw | 348.8 | | 753.8 | 0.0 |
| nw | 581.8 | 224.4 | 46.6 | 0.0 |

Table 3: GA296-2 upper confidence level estimate

Figure B.30. Bottom fish population estimates and 95% confidence intervals by quadrant of the GA-296 video drop 1 circle depicted in Appendix B.29, August 2004.

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 0.0 | | 0.0 | 0.0 |
| se | 219.6 | | 0.0 | 0.0 |
| sw | 67.9 | 25.6 | 31.7 | 1032.4 |
| nw | 0.0 | | 0.0 | 27.3 |

Table 1: GA296-2 mean estimate of fish on bottom - video 2

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 0.0 | | 0.0 | 0.0 |
| se | 120.5 | | 0.0 | 0.0 |
| sw | 17.3 | 6.5 | 0.0 | 485.1 |
| nw | 0.0 | | 0.0 | 0.0 |

Table 2: GA296-2 lower confidence level estimate

| | 35m | 50m | 65m | 80m |
|---|---|---|---|---|
| ne | 0.0 | | 0.0 | 0.0 |
| se | 318.8 | | 0.0 | 0.0 |
| sw | 118.5 | 44.6 | 69.6 | 1579.6 |
| nw | 0.0 | | 0.0 | 69.4 |

Table 3: GA296-2 upper confidence level estimate

Figure B.31. Bottom fish population estimates and 95% confidence intervals by quadrant of the GA-296 video drop 2 circle depicted in Appendix B.29, August 2004.

# APPENDIX C: ROV Video Habitat Surveys Video Analysis Log (16-18 August 2004)

Times, depths, and headings (magnetic) are those displayed on the video tape by the ROV. Due to difficulties imposed by poor or bad water clarity and water currents the ROV operator was not able to conduct systematic survey transect lines and avoided crossing over or through the main debris piles of the two sites (288 Site and 296 Site). Therefore, ROV tracks were conducted in a highly irregular order. Little useful fish count information is contained on most of the video records due to the presence of high water currents, suspended particulate matter, poor visibility, and poor quality boat electrical power which created interference that distorted the video image

Table C. 1

17 August 2004 (296 Site ROV Dive 1).

| Observation | Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|---|
| 1 | 16:44:25 | Video begins during descent | 22 | n/a |
| 2 | 16:45:43 | 1 - Atlantic spadefish | 45 | n/a |
| 3 | | 1 - unidentified fish (gray snapper?) | | |
| 4 | 16:45:47 | 2 - unidentified fish (1 a gray snapper?) | 49 | n/a |
| 5 | 16:45:53 | 2 - red snapper | 53 | n/a |
| 6 | 16:45:59 | 4 - almaco jack | 57 | n/a |
| 7 | | 2 - unidentified fish | | |
| 8 | 16:46:00 | 1 - unidentified snapper (?) | 57 | n/a |
| 9 | 16:46:02 | 1 - unidentified fish | 58 | n/a |
| 10 | 16:46:03 | 1 - unidentified fish | 58 | n/a |
| 11 | 16:46:04 | 3 - unidentified snapper (?) | 59 | n/a |
| 12 | 16:46:10 | 1 - gray triggerfish | 60 | n/a |
| 13 | 16:46:14 | 1 - damselfish (?) | 62 | n/a |
| 14 | 16:46:18 | 1 - unidentified fish | 63 | n/a |
| 15 | 16:46:20 | 17+ - red snapper (poss. more, milling) | 63 | n/a |
| 16 | to 51:05 | 1 - gray triggerfish | | |
| 17 | 16:46:34 | 1 - tomtate | 65 | n/a |
| 18 | | 1 - almaco jack | | |
| 19 | 16:46:36 | 1 to 3 - almaco jack (possibly just 1) | 65 | n/a |
| 20 | 16:46:48 | 1 - gray triggerfish (same 1 as above?) | 65 | n/a |
| 21 | 16:46:51 | 1 - tomtate (same 1 as above?) | 65 | n/a |
| 22 | 16:47:04 | 1 - almaco jack (1 seen above?) | 65 | n/a |
| 23 | 16:47:08 | 1 - almaco jack (1 seen above?) | 65 | n/a |
| 24 | 16:47:09 | 1 - gray triggerfish (1 seen above?) | 65 | n/a |
| 25 | 16:47:14 | 1 - gray triggerfish (1 seen above?) | 65 | n/a |
| 26 | | 1 or 2 - almaco jack (seen above?) | | |
| 27 | | 1 or 2 - bluefish mixed in group | | |
| 28 | 16:47:23 | 1 school - blue runner (50+) | 65 | n/a |
| 29 | 16:47:36 | possibly a separate group (<12) bluefish | 65 | n/a |
| 30 | 16:48:22 | 4 - gray snapper | 65 | n/a |
| 31 | 16:48:31 | 1 - gray triggerfish (seen above?) | 65 | n/a |
| 32 | 16:48:33 | 2 - gray snapper | 65 | n/a |
| 33 | 16:48:38 | 4 - gray snapper (seen above?) | 65 | n/a |
| 34 | 16:48:47 | 1 - gray triggerfish (seen above?) | 65 | n/a |
| 35 | 16:48:55 | 2 - gray snapper | 65 | n/a |

Table C. 1 (continued)

17 August 2004 (296 Site ROV Dive 1).

| Observation | Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|---|
| 36 | 16:49:04 | 6 - gray snapper | 65 | n/a |
| 37 | 16:49:09 | 1 - tomtate | 65 | n/a |
| 38 | 16:49:15 | 3 - gray snapper | 65 | n/a |
| 39 | 16:49:17 | 3 - gray snapper | 65 | n/a |
| 40 | 16:49:25 | ROV starts to move (red snapper still all aroud the ROV) | 62 | n/a |
| 41 | 16:49:37 | 1 - sheepshead | 61 | n/a |
| 42 | | 1 - gray triggerfish | | n/a |
| 43 | 16:49:48 | 1 - large unident. fish @ limits of visibil. | 62 | n/a |
| 44 | 16:49:57 | 2 or more - cocoa damselfish | 64 | n/a |
| 45 | 16:50:02 | 1 - unident. snapper @ limits of visibility | 64 | n/a |
| 46 | 16:50:28 | 2 - gray snapper (rear camera view) | 64 | n/a |
| 47 | | 1 - sheepshead | | n/a |
| 48 | 16:50:36 | 1 - unidentified snapper | 64 | n/a |
| 49 | 16:50:49 | 1 - red snapper | 60 | n/a |
| 50 | | 1 - tomtate | | n/a |
| 51 | 16:50:51 | 1 - unidentified fish | 59 | n/a |
| 52 | 16:50:58 | 1 - unidentified snapper | 55 | n/a |
| 53 | 16:51:13 | 1 - gray triggerfish | 47 | n/a |
| 54 | 16:51:46 | 1 - sheepshead | 48 | n/a |
| 55 | 16:51:55 | 1 - remora | 58 | n/a |
| 56 | 16:52:19 | ROV on bottom (octocoral in view) | 72 | n/a |
| 57 | 16:52:25 | 1 (poss. 2) - unidentified fish | 74 | n/a |
| 58 | 16:53:56 | ROV moving along a piece of pipe | 74 | n/a |
| 59 | 16:54:12 | ROV on bottom | 75 | n/a |
| 60 | 16:54:53 | ROV moves to upper surface of pipe (pipe coated with octocorals) | 74 | n/a |
| 61 | 16:55:17 | ROV parked on pipe | 73 | n/a |
| 62 | 16:56:46 | ROV begins to move along the pipe | 69 | n/a |
| 63 | 16:57:08 | ROV parks on top of pipe | 69 | n/a |
| 64 | 16:58:05 | ROV begins to move over pipe pile | 68 | n/a |
| 65 | 16:58:32 | ROV parked | 69 | n/a |
| 66 | 16:58:56 | ROV begins to move briefly then stops | 69 | n/a |

Table C. 1 (continued)

17 August 2004 (296 Site ROV Dive 1).

| Observation | Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|---|
| 67 | 16:59:15 | ROV moves briefly to a new location on the pipe pile, then parks | 69 | n/a |
| 68 | 17:00:15 | ROV moving slowly over pipe | 69 | n/a |
| 69 | 17:00:50 | 1 - gray triggerfish | 67 | n/a |
| 70 | 17:01:14 | 1 - gray triggerfish (same as above?) | 65 | n/a |
| 71 | 17:01:43 | 1 - dusky damselfish | 67 | n/a |
| 72 | 17:02:08 | 1 - unident. fish @ limits of visibility | 65 | n/a |
| 73 | | ROV parked | | |
| 74 | 17:02:20 | 3 - unidentified fish | 64 | n/a |
| 75 | 17:02:29 | ROV begins to move | 65 | n/a |
| 76 | 17:02:33 | 1 - unidentified fish | 62 | n/a |
| 77 | 17:02:45 | large clump of octocoral | 63 | n/a |
| 78 | | 2 - spotfin butterfly fish | | |
| 79 | | 1 - dusky damselfish | | |
| 80 | 17:03:14 | 1 - red snapper | 61 | n/a |
| 81 | 17:03:19 | 1 - sheepshead | 62 | n/a |
| 82 | 17:03:23 | 1 - unidentified fish | 62 | n/a |
| 83 | 17:03:29 | 1 - mackerel | 58 | n/a |
| 84 | 17:03:31 | 1 school - blue runner (50+) | 58 | n/a |
| 85 | | 2 - gray snapper | | |
| 86 | 17:03:59 | 1 - gray triggerfish (rear camera view) | 58 | n/a |
| 87 | 17:04:02 | 1 - gray snapper | 57 | n/a |
| 88 | 17:04:04 | 3 - unidentified fish | 57 | n/a |
| 89 | | school of blue runner returns | | |
| 90 | | 1 - gray snapper | | |
| 91 | | 1 - gray triggerfish | | |
| 92 | | 1 - unidentified snapper | | |
| 93 | 17:04:22 | 2 - lookdowns | 62 | n/a |
| 94 | 17:04:29 | 1 - gray triggerfish | 61 | n/a |
| 95 | 17:04:31 | 1 - gray snapper | 59 | n/a |
| 96 | 17:04:35 | 1 - gray snapper | 58 | n/a |
| 97 | 17:04:42 | 3 - gray snapper | 57 | n/a |
| 98 | 17:04:47 | 1 - sheepshead | 59 | n/a |
| 99 | 17:04:54 | 1 - red snapper | 61 | n/a |
| 100 | 17:04:59 | 3 - red snapper | 63 | n/a |
| 101 | 17:05:04 | 3 - gray triggerfish | 63 | n/a |

Table C. 1 (continued)

17 August 2004 (296 Site ROV Dive 1).

| Observation | Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|---|
| 102 | 17:05:07 | 2 - red snapper | 57 | n/a |
| 103 | 17:05:23 | 7+ - gray trigger fish attack ROV | 54 | n/a |
| 104 | 17:05:49 | school - red snapper | 60 | n/a |
| 105 | 17:07:01 | 1 - gray snapper among school of red snapper & 7 or more gray triggerfish | | |
| 106 | 17:07:08 | school of blue runner returns (?) | 57 | n/a |
| 107 | 17:07:15 | 1 – sheepshead | 62 | n/a |
| 108 | 17:07:48 | school of blue runner (50+) going in the opposite direction | 63 | n/a |
| 109 | 17:07:56 | 1 - tomtate among red snapper & gray triggerfish | 61 | n/a |
| 110 | 17:08:xx | 3 - lookdowns | 61 | n/a |
| 111 | 17:08:xx | school of blue runner passing again while gray triggerfish continue to attack the ROV with red snapper all around the area | | |
| 112 | 17:xx:xx | 2 - unidentified slender fish(mackerel?) | 63 | n/a |
| 113 | 17:xx:xx | 1 - unidentified slender fish | 63 | n/a |
| 114 | 17:xx:xx | school - gray triggerfish attacking ROV | 59 | n/a |
| 115 | 17:xx:xx | 1 - Atlantic spadefish (at least 1) | 59 | n/a |
| 116 | 17:xx:xx | small school - red snapper | 65 | n/a |
| 117 | 17:xx:xx | gray triggerfish continue to attack the ROV with red snapper abundant | 59 | n/a |
| 118 | 17:xx:xx | 1 - lookdown, red snapper & gray triggerfish present | 60 | n/a |
| 119 | 17:xx:xx | small school (<12) - bluefish with a few blue runner appears | 63 | n/a |
| 120 | 17:xx:xx | small school (<20) - unidentified fish | 61 | n/a |
| 121 | 17:xx:xx | 1 - sheepshead with red snapper and gray triggerfish present | 61 | n/a |
| 122 | 17:xx:xx | 1 - sheepshead & snapper & triggerfish | 61 | n/a |
| 123 | 17:xx:xx | 1 - sheepshead with gray triggerfish | 62 | n/a |
| 124 | 17:xx:xx | snapper & triggerfish remain abundant | 60 | n/a |
| 125 | 17:xx:xx | 1 - sheepshead, snapper & triggerfish | | |
| 126 | 17:xx:xx | 1 - dusky damselfish | 67 | n/a |
| 127 | 17:xx:xx | 4 - lookdown | 64 | n/a |
| 128 | 17:xx:xx | 3 - blue runner | 63 | n/a |
| 129 | 17:xx:xx | snapper & triggerfish remain abundant | 57 | n/a |
| 130 | 17:xx:xx | 1 - almaco jack | 57 | n/a |
| 131 | 17:xx:xx | 1 - sheepshead & snapper & triggerfish | 63 | n/a |

Table C. 1 (continued)

17 August 2004 (296 Site ROV Dive 1).

| Observation | Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|---|
| 132 | 17:xx:xx | 1 - Atlantic spadefish(snapper,triggerfish) | 57 | n/a |
| 133 | 17:xx:xx | 1 - Atlantic spadefish(snapper,triggerfish) | 55 | n/a |
| 134 | 17:xx:xx | 1 - sheepshead & snapper & triggerfish | 61 | n/a |
| 135 | 17:xx:xx | 1 - sheepshead among red snapper | | |
| 136 | 17:xx:xx | 1 - sheepshead among gray triggerfish | 64 | n/a |
| 137 | 17:xx:xx | 1 - unidentified fish (belted sand bass ?) No longer in red snapper, gray triggerfish, or other fish though still in pipe | 67 | n/a |
| 138 | 17:xx:xx | 1 - tomtate | 62 | n/a |
| 139 | 17:xx:xx | several red snapper | | |
| 140 | 17:xx:xx | ~6 - small unidentified fish (1 was a belted sand bass) | 59 | n/a |
| 141 | 17:xx:xx | ROV begins its ascent | | |
| 142 | 17:xx:xx | 1 or 2 - gray triggerfish still attack ROV | 25 | n/a |
| 143 | 17:xx:xx | Video ends abruptly prior to surface | 19 | n/a |

Table C. 2

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 08:25:43 | Video begins during descent below the vessel with 10s to 100s - Atlantic spadefish from 23 feet depth up to the surface numerous - scattered gray triggerfish | 22 | 285 |
| 08:26:22 | small school - gray snapper | 41 | 096 |
| 08:26:50 | school - gray snapper (reappear?) with some red snapper (?) | 53 | 193 |
| 08:26:59 | few - red snapper (?) | 56 | 100 |
| | 2 - shadows at limits of vis. (pipe or fish?) | | |
| 08:27:15 | 1 - shark (?, indistinct shaddow) | 57 | 285 |
| 08:27:16 | 1 - snapper (red?) | 57 | 285 |
| 08:27:17 | 1 - almaco jack | 57 | 264 |
| 08:27:37 | 10s - red snapper (brief encounter) | 55 | 354 |
| 08:28:08 | 1 - gray triggerfish | 49 | 077 |
| 08:28:14 | Glimpse reef pipe | 50 | 012 |
| 08:28:48 | 10s - Atlantic spadefish above ROV seen as video pans upward | 41 | 074 |
| 08:29:33 | soft bottom in sight | 67 | 046 |
| | ROV begins to move across soft bottom | 70 | 055 |
| 08:30:13 | 2 - lookdowns | 72 | 077 |
| 08:30:19 | ROV strikes bottom | 72 | 052 |
| 08:30:32 | 1 - unidentified fish | 72 | 052 |
| 08:30:36 | 1 - red snapper | 72 | 052 |
| 08:31:11 | ROV begins to move | 71 | 192 |
| 08:31:34 | ROV tilted to the right about 45° | 70 | 040 |
| 08:31:48 | ROV parked on bottom | 72 | 077 |
| 08:32:02 | 1 - unidentified fish | 72 | 077 |
| 08:32:05 | ROV begins to move | 72 | 096 |
| 08:32:06 | 1 - sheepshead with object behind that appears to be a rock or concrete | 72 | 222 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 08:32:52 | 2 - unidentified fish on top of rock | 72 | 248 |
| 08:32:59 | 1 - juvenile cubbyu | 72 | 249 |
| 08:33:24 | 1 - cocoa damselfish | 72 | 216 |
| | 1 - belted sandfish | | |
| | ROV going up to top of the hard reef to begin travel along its crest | | |
| 08:33:34 | 1 - unidentified fish | 69 | 242 |
| 08:33:50 | >10 - tomtate, very small juveniles | 70 | 228 |
| 08:33:52 | 1 - unidentified fish (dusky damsel?) | 69 | 230 |
| | 1 - cubbyu, adult | | |
| 08:34:15 | 1 - belted sandfish | 70 | 229 |
| 08:34:19 | 1 - whitespotted soapfish | 70 | 230 |
| 08:34:51 | 1 - dusky damselfish | 69 | 265 |
| 08:35:02 | small school - tomtate, juv., reappear | 70 | 249 |
| 08:35:17 | 1 - tomtate, adult | 70 | 246 |
| 08:36:35 | 1 - whitespotted soapfish | 69 | 247 |
| 08:37:25 | 1 - sheepshead | 67 | 329 |
| 08:37:36 | 2 - unidentified fish (1 small) | 68 | 261 |
| 08:37:39 | 1 - unidentified fish (grouper?) | 68 | 264 |
| 08:37:49 | 1 - sheepshead | 68 | 260 |
| 08:38:04 | 1 - sheepshead | 68 | 264 |
| 08:38:48 | 1 - sheepshead (repeat sighting) | 70 | 254 |
| | 1 - tomtate, adult | | |
| 08:39:01 | 1 - red snapper | 70 | 259 |
| 08:40:08 | 1 - belted sandfish | 69 | 259 |
| 08:40:11 | 1 - dusky damselfish | 69 | 259 |
| 08:40:25 | 1 - belted sandfish (poss. repeat sighting) | 69 | 260 |
| 08:40:48 | 1 - tomtate, juv. | 69 | 260 |
| 08:40:56 | 1 - belted sandfish (prob. same one) | 70 | 260 |
| | ROV starts to move & settles back | | |
| 08:41:46 | 1 - dusky damselfish | 69 | 253 |
| 08:42:03 | 1 - unidentified fish | 69 | 260 |
| | 1 - belted sandfish | | |
| 08:42:15 | 1 - cubbyu | 70 | 267 |
| 08:42:28 | 1 - cocoa damselfish | 68 | 247 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 08:42:33 | 12+ - tomtate, small juvenils | 68 | 236 |
| 08:42:41 | 1 - dusky damselfish | 68 | 264 |
| 08:42:48 | 1 - belted sandfish | 68 | 265 |
| 08:43:32 | ROV moves to a new spot on the rocks | | |
| 08:43:43 | small school - tomtate, juvenils | 68 | 266 |
| 08:43:47 | 1 - tomtate, adult | 68 | 266 |
| 08:43:56 | 1 - dusky damselfish (?) | 68 | 266 |
| 08:43:59 | ROV moves to next elevated pinnacle | 67 | 266 |
| 08:44:25 | 1 - belted sandfish | 68 | 275 |
| 08:44:35 | 1 - dusky damselfish, adult | 68 | 275 |
| 08:44:48 | ROV video pans upward | 68 | 275 |
| 08:44:58 | 2 - unidentified fish (red snapper?) | 68 | 277 |
| 08:45:09 | 10s - tomtate, small juveniles | 68 | 275 |
| 08:45:27 | ROV moves for ~18 seconds | 67 | 248 |
| 08:46:06 | 1 - sea urchin, rear camera view | 67 | 250 |
| 08:46:19 | 8 - lookdowns, adults<br>ROV flying along rock reef | 66 | 090 |
| 08:46:34 | 7 - lookdowns, reappear? | 65 | 096 |
| 08:46:51 | 1 - sheepshead | 65 | 107 |
| 08:47:04 | <10 - tomtate, juveniles | 66 | 094 |
| 08:47:09 | 1 - sheepshead | 67 | 065 |
| 08:48:06 | ROV parked<br>1 - unidentified fish (sheepshead?) | 66 | 068 |
| 08:48:11 | 1 - dusky damselfish (rear camera view) | 66 | 071 |
| 08:48:14 | ROV begins to move along rock reef | 66 | 068 |
| 08:48:19 | 1 - sheepshead | 66 | 160 |
| 08:48:50 | ROV deviates away from reef | 63 | 268 |
| 08:49:37 | ROV lands on sandy bottom while<br>pile of tether is retrieved | 69 | 249 |
| 08:52:45 | Excess tether retrieved, ROV moves<br>across sandy bottom | 69 | 247 |
| 08:53:37 | Steel ring and pipe on bottom | 69 | 256 |
| 08:55:23 | ROV stopped<br>ROV begins moving along pipe | 67 | 181 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 08:55:36 | 1 - belted sandfish | 68 | 206 |
| 08:55:42 | ROV sits on pipe | 69 | 217 |
| 08:55:58 | ROV begins to move along pipe | 70 | 210 |
| 08:56:15 | 1 - belted sandfish | 70 | 237 |
| 08:56:37 | ROV parked, pipe partially burried | 69 | 238 |
| 08:57:39 | ROV continues along pipe | 69 | 238 |
| 08:57:44 | 1 - belted sandfish | 70 | 231 |
| 08:58:14 | Entire pipe above substrate<br>2 - sheepshead<br>6 - tomtate, adults<br>Pipe now off bottom | 69 | 253 |
| 08:58:23 | several - tomtate, adults and<br>1 - sheepshead, mill around ROV while it is parked | 69 | 285 |
| 08:59:18 | ROV begins to move | 69 | 285 |
| 08:59:28 | More pipe appearing | 68 | 253 |
| 08:59:42 | 1 - dusky damselfish, adult | 69 | 200 |
| 09:00:00 | 1 - belted sandfish<br>ROV parked | 69 | 223 |
| 09:00:36 | 1 - lookdown seen as video pans up | 69 | 223 |
| 09:01:46 | ROV begins to move down the pipe | 69 | 202 |
| 09:03:07 | 10+ - unidentified snapper | 70 | 204 |
| 09:03:36 | 2 - tomtate, adults seen via rear camera | 69 | 346 |
| 09:03:39 | ROV parks on pipe briefly | 70 | 344 |
| 09:03:47 | ~6 - tomtate, adults seen via rear camera | 70 | 349 |
| 09:03:58 | ROV begins to move down the pipe | 69 | 349 |
| 09:04:13 | 1 - tomtate, adult | 68 | 055 |
| 09:04:21 | ROV parks on pipe<br>1 - tomtate adult | 69 | 094 |
| 09:04:26 | 4 - tomtate adults seen via rear camera | 70 | 094 |
| 09:05:00 | 3 - tomtate, adults | 69 | 092 |
| 09:05:23 | 6 or 7 - tomtate, adults crossing in dist. | 70 | 094 |
| 09:05:59 | 5 - tomtate, adults drifting, poss. same | 70 | 092 |
| 09:06:13 | ROV begins moving over sandy bottom with scattered pieces of metal debris | 68 | 062 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 09:06:51 | ROV lands on bottom | 70 | 062 |
| 09:07:04 | ROV begins moving across sandy bott. | 70 | 058 |
| 09:07:41 | 1 - possible fish (?) | 68 | 040 |
| 09:08:20 | ROV lands | 69 | 018 |
| 09:09:08 | ROV begins to move | 70 | 049 |
| 09:10:10 | ROV begins work to free tether | 69 | 253 |
| 09:16:35 | ROV resumes to move easterly across sandy bottom | 69 | 052 |
| 09:17:59 | ROV arrives back at rocky reef | 67 | 065 |
| 09:18:10 | 1 - dusky damselfish | 69 | 307 |
| | ROV parked on rock | 68 | |
| 09:18:16 | 1 - belted sandfish | 68 | 288 |
| 09:18:25 | 1 - belted sandfish, this is a 2nd one | 67 | 291 |
| 09:18:44 | 1 - tomtate, juvenil | 67 | 288 |
| 09:19:29 | ROV began to move along rock edge | 67 | 296 |
| 09:20:04 | 1 - dusky damselfish | 68 | 250 |
| 09:20:07 | ROV parked on sandy bottom | 69 | 237 |
| 09:20:25 | ROV began to move | 70 | 231 |
| 09:21:02 | 2 - tomtate, juveniles | 67 | 268 |
| 09:21:14 | 2 - dusky damselfish | 67 | 254 |
| 09:21:50 | 1 - belted sandfish | 67 | 256 |
| | 1 - tomtate, adult | | |
| 09:22:03 | 1 - dusky damselfish | 68 | 266 |
| 09:22:28 | ROV parked on pipe crossing rock | 69 | 280 |
| 09:22:49 | ROV began to move | 70 | 259 |
| 09:22:51 | 1 – sheepshead | 69 | 254 |
| | ROV parked on pipe | | |
| 09:23:17 | ROV began to move back toward rock | | |
| 09:23:26 | 1 - dusky damselfish | 70 | 271 |
| 09:24:15 | 1 - unidentified fish (adult tomtate?) | 67 | 260 |
| 09:24:21 | octocoral colony on top of pipe | 70 | 301 |
| 09:24:39 | ROV stopped on pipe where pipe appears to go into the bottom | 70 | 270 |
| 09:25:15 | ROV reversed course | 69 | 052 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 09:25:28 | ROV arrived back at rock and traveled down the rock reef | 67 | 062 |
| 09:25:58 | 1 – sheepshead | 66 | 024 |
| 09:26:03 | 1 - dusky damselfish | 66 | 043 |
| | ROV parked on rock | | |
| 09:26:18 | 1 - belted sandfish | 68 | 109 |
| 09:26:25 | 1 - unidentified fish | 68 | 109 |
| 09:26:45 | END OF TAPE (GA-296 Day 2.1) | 67 | 109 |
| 09:27:41 | BEGIN TAPE (GA-296 Day 2.2) | 67 | 107 |
| 09:27:51 | 1 - dusky damselfish | 65 | 080 |
| 09:27:59 | 1 - dusky damselfish | 66 | 052 |
| 09:28:01 | ROV tether hung, checking rear camera | 66 | 077 |
| 09:28:18 | ROV reversed course to find hang | 65 | 258 |
| 09:28:45 | ROV back to tether hung on rock | 68 | 254 |
| | octocoral colonies on rock | | |
| | 1 - belted sandfish | | |
| 09:28:47 | 4 - tomtate, juveniles | 68 | 252 |
| 09:28:53 | 1 - unidentified damselfish, adult | 67 | 193 |
| 09:28:54 | ROV unhooked tether | 67 | 193 |
| 09:29:04 | ROV resumed easterly track on rock | 66 | 049 |
| 09:29:35 | 1 - unidentified damselfish, adult | 66 | 077 |
| 09:29:51 | 1 - dusky damselfish, adult | 67 | 120 |
| 09:30:01 | 1 - cocoa (?) damselfish, adult | 65 | 109 |
| 09:30:05 | 1 - unidentified fish | 66 | 132 |
| 09:30:10 | 1 - dusky damselfish, adult | 64 | 065 |
| 09:30:23 | 1 - octocoral colony | 65 | 074 |
| 09:30:32 | 1 - unidentified fish | 65 | 027 |
| 09:30:45 | 1 - unidentified fish | 64 | 096 |
| 09:30:51 | 2 – sheepshead | 64 | 124 |
| 09:31:02 | 3 - unidentified fish | 63 | 092 |
| | 1 – sheepshead | | |
| | 1 - octocoral colony | | |
| 09:31:13 | 2 - dusky damselfish, adult | 64 | 086 |
| 09:32:00 | 1 - unidentified snapper | 65 | 027 |
| 09:32:05 | 1 - unidentified fish | 64 | 181 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 09:32:12 | 13 - tomtate, juveniles | 66 | 092 |
| 09:32:22 | 1 - dusky damselfish, adult | 66 | 098 |
| | 2 - belted sandfish | | |
| 09:32:37 | 1 - tomtate, juvenile | 65 | 100 |
| | 1- threespot damselfish, juvenil | | |
| | 1 - unidentified fish (slippery dick?) | | |
| 09:32:47 | 1 - belted sandfish, rear camera view | 65 | 102 |
| 09:32:49 | 10s - tomtate, juveniles | | |
| 09:33:36 | 1 - dusky damselfish, adult | 66 | 012 |
| 09:34:15 | 1 - unidentified fish | 63 | 024 |
| 09:34:37 | 1 - unidentified fish | 66 | 113 |
| 09:34:43 | 1 – sheepshead | 63 | 207 |
| 09:34:56 | 1 - belted sandfish | 64 | 346 |
| 09:35:02 | 1 - unidentified damselfish, adult | 65 | 034 |
| 09:35:05 | 3 - tomtate, juveniles | 65 | 034 |
| 09:35:07 | 1 - red snapper | 66 | 034 |
| | 1 - unidentified fish | | |
| | 4 to 8 - tomtate, juvenils | | |
| | 1 - dusky damselfish, adult | | |
| 09:36:06 | ROV headed out over soft bottom | 64 | 260 |
| 09:36:50 | ROV crossing over rock | 66 | 000 |
| 09:36:55 | 10s - unidentified small fish, juvenils | 65 | 018 |
| 09:37:00 | ROV back over soft bottom | 65 | 000 |
| 09:37:33 | ROV at end of tether or tether snagged | 67 | 000 |
| 09:39:39 | ROV turned to new heading | 66 | 052 |
| | 1 – sheepshead | | |
| 09:39:53 | ROV following tether | 63 | 244 |
| 09:40:05 | ROV back to rock & crossing over it | 68 | 195 |
| 09:40:17 | ROV over soft bottom | 66 | 253 |
| 09:40:52 | ROV tether snagged | 68 | 228 |
| 09:41:27 | ROV reversed course to free tether | 66 | 18 |
| 09:41:55 | 1 - unidentified fish | 67 | 15 |
| | tether around a rock | | |
| 09:41:59 | ROV freeing tether | 68 | 0 |
| 09:42:09 | 1 - unidentified fish | 66 | 9 |
| 09:42:24 | 1 - gray triggerfish | 66 | 202 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 09:42:37 | 1 - tomtate, adult | 69 | 80 |
| 09:43:13 | 1 - dusky damselfish, same as at 41:55 | 66 | 202 |
| 09:43:18 | 1 - tomtate, adult | 64 | 243 |
| 09:43:34 | ROV tether free, head back up tether | 67 | 235 |
| 09:44:03 | ROV passed by rock again | 68 | 258 |
| 09:44:13 | ROV tether snagged | 67 | 346 |
| 09:45:00 | ROV heads back down tether | 69 | 105 |
| | 1 - pipe in view | | |
| 09:45:10 | 1 - unidentified fish | 68 | 105 |
| 09:45:40 | ROV attempted to move tether weights | 69 | 077 |
| | ROV unable to lift weights | | |
| 09:46:26 | ROV headed down the pipe | 68 | 115 |
| | pipe heavily encrusted by Balanus | | |
| 09:46:59 | 1 - tomtate, adult | 60 | 354 |
| 09:47:07 | platform stairs in view | 57 | 031 |
| 09:47:12 | 1 - red snapper | 57 | 333 |
| 09:47:17 | 1 - unidentified fish (red snapper?) | 57 | 296 |
| 09:47:18 | 1 - red snapper | 57 | 320 |
| 09:47:20 | 1 - unidentified fish (jack?) | 57 | 320 |
| 09:47:26 | 3 - sheepshead | 59 | 341 |
| 09:47:46 | 1 - sheepshead | 56 | 307 |
| 09:47:47 | 1 - gray triggerfish | 56 | 304 |
| | ROV reversed course @ end of stairs | | |
| 09:48:03 | 1 - sheepshead, probably counted prev. | 57 | 154 |
| 09:48:08 | 6 - red snapper | 58 | 128 |
| 09:48:26 | 1 - sheepshead, possibly counted prev. | 61 | 074 |
| 09:48:30 | 2 - sheepshead, possibly counted prev. | 62 | 264 |
| | 2 - red snapper | | |
| 09:48:51 | ROV headed back down pipe | 60 | 259 |
| | 2 - sheepshead | | |
| 09:49:55 | 2 – sheepshead | 66 | 267 |
| 09:50:47 | 1 - belted sandfish @ end of pipe | 71 | 058 |
| 09:50:51 | ROV viewing inside end of pipe | | |
| | ROV enters pipe & backs out | 79 | 046 |
| 09:53:55 | ROV exits pipe | 72 | 058 |
| 09:54:04 | ROV headed across soft bottom | 70 | 171 |

Table C. 2 (continued)

18 August 2004 (296 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 09:54:12 | ROV crossed a smaller pipe | 70 | 165 |
| 09:54:18 | 4 - blue runner | 69 | 152 |
| 09:54:26 | 1 - unidentified fish | 68 | 175 |
| 09:54:46 | 4 or more - gray triggerfish | 65 | 090 |
| 09:55:07 | ROV started ascent | 66 | 150 |
| 09:55:54 | 10s to 100s - Atlantic spadefish under the boat | 21 | 236 |
| 09:56:24 | <5 - blue runner | 2 | 077 |
| 09:56:41 | ~10 - unident. fish (prob. jacks) | 3 | 065 |
| 09:56:58 | ROV at the surface | 0 | 096 |
| 09:59:27 | ROV out of the water | | |
| | END OF TAPE | | |

Table C. 3

16 August 2004 (288 Site ROV Dive 1).

| Time | Activity and sighting(s) | Depth (ft) | Heading (°mag) |
|---|---|---|---|
| 15:14:38 | 1 - gray triggerfish as ROV descends | 45 | 312 |
| 15:14:40 | numerous red snapper (estimated at >20) | 47 | 288 |
| 15:14:53 | 1 - sheepshead | 53 | 296 |
| 15:14:58 | ROV at the bottom | 59 | 296 |
| 15:15:03 | 1 - red snapper | 59 | 253 |
| 15:15:12-14 | 1 - red snapper | 63 | 312 |
| 15:15:28-35 | 2 - unidentified fish | 59 | 288 |
| 15:15:54 | ROV parked on bottom (soft seds & shell hash) | 65 | 285 |
| 15:17:12 | ROV begins to move | 65 | 254 |
| 15:17:13 | 1 - sheepshead | 66 | 206 |
| 15:17:19 | 2 - unidentified fish, off bottom | 66 | 150 |
| 15:17:40 | 2 to 5 - unidentified fish, off bottom, vis. poor | 66 | 177 |
| 15:18:58 | 2 - lookdowns | 67 | 190 |
| 15:20:18 | ROV tether fouled, attempting to clear tether | 68 | 177 |
| 15:21:13 | first pipe to appear on this video (tether tangled) | 68 | 349 |
| 15:21:32 | possibly 6 or more red snapper | 66 | 83 |
| 15:22:01 | 2 - red snapper, possibly from the previous group | 65 | 74 |
| 15:23:29-43 | ~7+ unidentified fish | 70 | 137 |
| | 1 - sheepshead | | |
| 15:24:06 | 1 - large unidentified snapper | 70 | 158 |
| 15:24:33 | 3 - snapper (1 is a red, 1 is possibly the 1 above) | 70 | 158 |
| 15:24:48 | 2 - unidentified snapper | 69 | 139 |
| 15:25:37 | 1 - snapper (?) | 69 | 130 |
| 15:26:01 | ROV parked on bottom | 69 | 86 |
| 15:26:58 | ROV began to move, along some pipe | 68 | 196 |
| 15:28:16 | 1 - sheepshead | 67 | 235 |
| 15:28:17 | start retrieving ROV, no fish seen on ascent | 67 | 240 |
| 15:34:13 | ROV back on bottom, no fish seen on descent | 69 | 49 |
| 15:34:22 | numerous unidentified snapper | 67 | 0 |
| | 2 - sheepshead | | |
| 15:34:36 | ROV started ascent | | |
| 15:37:16 | ROV at the surface, no fish seen during ascent | 0 | |
| 15:37:24 | ROV out of the water | | |

Table C. 4

16 August 2004 (288 Site ROV Dive 2).

| Time | Activity and sighting(s) | Depth (ft) | Heading (°mag) |
|---|---|---|---|
| 17:17:56 | ROV in the water, descending | 51 | 244 |
| 17:18:39 | ROV at the bottom | 71 | 212 |
| 17:18:50 | ROV sitting on the bottom | 73 | 226 |
| 17:19:14 | ROV begins to move high off bottom | 73 | 235 |
| 17:20:19 | 2 sheepshead | 65 | 312 |
| | ROV off bottom 10+ feet | | |
| 17:21:28 | Bottom appears on video briefly | 69 | 267 |
| 17:22:45 | ROV near bottom | 62 | 195 |
| 17:23:20 | ROV back to soft bottom | 68 | 229 |
| 17:23:38 | 1 - sheepshead | 69 | 137 |
| 17:23:47 | 1 - unidentified fish | 70 | 135 |
| 17:24:57 | 1 - piece of pipe briefly in view | 66 | 250 |
| | ROV ascending to ~10 feet off bottom | | |
| 17:26:19 | 1 - piece of pipe seen as ROV heads downward, then upward a few feet, and downward. | | |
| 17:26:59 | Bottom in sight, then ROV ascends up to ~50 feet of water depth and then descends toward bottom | 68 | 160 |
| 17:28:17 | Bottom in sight - briefly, then ROV ascends | 67 | 180 |
| 17:31:25 | ROV at the surface | 0 | 232 |
| 17:33:38 | END OF VIDEO | | |

Table C. 5

17 August 2004 (288 Site ROV Dive 3).

| Time | Activity and sighting(s) | Depth (ft) | Heading (°mag) |
|---|---|---|---|
| 8:09:26 | Start of video – ROV descending | 6 | 322 |
| 8:10:03 | 1 - gray triggerfish | 50 | 43 |
| 8:10:15 | 1 - unidentified snapper | 64 | 330 |
| 8:10:26 | 1 - red snapper | 62 | 31 |
| 8:10:49 | 1 - sheepshead | 65 | 260 |
| 8:11:02 | 1 - red snapper | 68 | 223 |
| 8:11:06 | 1 - red snapper (same one as above ?, swam a circle) | 69 | 187 |
| 8:11:17 | Bottom in sight | 70 | 165 |
| 8:11:20 | 1 - tomtate | 71 | 202 |
| 8:11:36 | ROV lands on bottom and parks | 74 | 94 |
| 8:13:02 | 1 - unidentified fish (snapper ?) as video pans up | 74 | 90 |
| 8:13:35 | ~4 - red snapper | 73 | 98 |
| 8:13:54 | ROV begins to move briefly | 74 | 94 |
| 8:18:26 | 5 or more - red snapper | 65 | 226 |
| 8:18:53 | more than 5 - red snapper (possibly same as above) | 65 | 198 |
| 8:19:17 | 5 - red snapper | 69 | 83 |
| | 1 - gray triggerfish | | |
| 8:19:36 | 15 (possibly more) - red snapper | 74 | 283 |
| 8:19:48 to 22:06 | many (50+) - red snapper (some lane snapper and possibly gray snapper included) | 74 | 283 |
| | 1 to 4 - gray triggerfish | | |
| | 2 or 3 - sheepshead | | |
| 8:23:09 | 1 - unidentified fish (snapper ?) | 73 | 285 |
| 8:23:16 to 24:14 | 1 - gray triggerfish | 72 | 288 |
| | dozens - red snapper | | |
| | 1 - gray snapper (?) | | |
| | 1 - sheepshead | | |
| 8:25:18 | 1 - unidentified fish | 65 | 52 |
| 8:25:35 | ~6 - unidentified fish (probably snapper) | 63 | 254 |
| 8:25:44 to 26:48 | dozens - red snapper | 67 | 253 |
| | 2+ - sheepshead | | |

Table C. 5 (continued)

17 August 2004 (288 Site ROV Dive 3).

| Time | Activity and sighting(s) | Depth (ft) | Heading (°mag) |
|---|---|---|---|
| 8:27:19 | ROV lands on the bottom | 70 | 223 |
| 8:28:30 | 1 - small fusiform unidentified fish above bottom (slippery dick ?) | 70 | 223 |
| 8:29:53 | ROV begins to move | 69 | 223 |
| | 1 - unidentified fish | | |
| 8:30:18 | ROV back on bottom | | |
| 8:30:23 to 31:20 | 1 to 2 dozen - red snapper | 70 | 249 |
| 8:31:44 | 1 - red snapper | 69 | 250 |
| 8:32:40 to 33:22 | 1 - red snapper<br>1 - sheepshead | 69 | 250 |
| 8:33:54 | 2 - sheepshead | 69 | 250 |
| 8:34:00 | dozens - red snapper | 69 | 250 |
| | 2 - sheepshead | | |
| 8:34:58 | ROV begins ascent | 69 | 224 |
| 8:35:29 | 2 - gray triggerfish along a pipe | 50 | 240 |
| 8:35:44 | 2 - gray triggerfish | 45 | 293 |
| | 1 - Atlantic spadefish | | |
| | 1 - unidentified fish (snapper/grunt shape) | | |
| 8:36:23 | 1 - sheepshead | 44 | |
| 8:37:04 | 1 - sheepshead | 57 | 74 |
| | 1 - unidentified fish | | |
| 8:37:10 | 1 - sheepshead | 60 | 167 |
| 8:37:27 | 1 - sheepshead | 56 | 74 |
| 8:37:34 | 1 - unidentified fish | 63 | 253 |
| 8:37:40 | ~1 dozen - red snapper | 63 | 242 |
| | 5 - sheepshead | | |
| 8:38:13 | 1 - sheepshead | 61 | 68 |
| 8:39:10 | 2 - sheepshead | 60 | 260 |
| 8:39:18 | 2 - snapper | 64 | 270 |
| | 2 - sheepshead | | |
| 8:40:31 | ROV on bottom | 69 | 242 |
| 8:42:08 | 1 - sheepshead, seen as video pans upward | 68 | 247 |
| 8:42:24 | 3 - sheepshead | 68 | 246 |
| 8:42:30 | 1 - unidentified fish, at top edge of video frame | 68 | 247 |

Table C. 5 (continued)

17 August 2004 (288 Site ROV Dive 3).

| Time | Activity and sighting(s) | Depth (ft) | Heading (°mag) |
|---|---|---|---|
| 8:43:28 | 1 - red snapper | 68 | 301 |
| 8:44:52 | ROV begins to move | 67 | 247 |
| 8:46:32 | engine block (?) | 65 | 130 |
| 8:46:54 | ROV back on bottom | 68 | 196 |
| 8:48:31 | ROV begins to move along the bottom and appears to be tilted by the water current | 68 | 100 |
| 8:49:01 | ROV stopped and parked on bottom | 68 | 137 |
| 8:50:12 | ROV begins to move | 68 | 90 |
| 8:50:44 | ROV parked on bottom | 69 | 169 |
| 8:50:58 | ROV begins to move | 71 | 193 |
| 8:51:53 | 2 - sheepshead | 64 | 223 |
| | 1 - unidentified fish | | |
| 8:51:59 | few - red snapper | 64 | 196 |
| 8:52:15 | 1 - sheepshead | 61 | 120 |
| 8:52:37 | 1 - sheepshead | 64 | 117 |
| 8:53:35 | 1 - sheepshead | 66 | 322 |
| | 1 - red snapper | | |
| 8:54:05 | several - red snapper | 65 | 268 |
| | 1 - sheepshead | | |
| 8:54:18 | 1 - sheepshead | 61 | 248 |
| 8:56:23 | Bottom in sight after ROV had been 20+ ft. above | 65 | 250 |
| | ROV high off bottom again, ~46 or 47 feet | | |
| | ROV slowly ascending to the surface | | |
| 9:02:36 | 2 - ling, under the boat | 11 | 235 |
| 9:05:18 | END OF VIDEO | 2 | 244 |

Table C.6

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 10:39:01 | ROV descending | 26 | 307 |
| 10:40:10 | Bottom in sight - 1 pipe | 65 | 325 |
| 10:40:27 | ROV turns clockwise to view 2nd pipe | 66 | 006 |
| 10:40:31 | ROV headed down 2nd pipe | 66 | 346 |
| 10:40:40 | 1 - sheepshead | 67 | 338 |
| 10:40:52 | octocoral colonies on pipe | 68 | 328 |
| 10:42:49 | ROV reversed course on pipe | 68 | 235 |
| 10:43:13 | ROV turned right to follow cross pipe | 67 | 315 |
| 10:43:19 | 1 - sheepshead | 65 | 309 |
| 10:44:05 | ROV appeared to have hung tether | 68 | 270 |
| 10:44:30 | 1 - red snapper | 69 | 341 |
| 10:44:36 | 1 - lane snapper | 69 | 338 |
| | ROV stopped | | |
| 10:44:59 | ROV began to move & reversed course | 69 | 299 |
| 10:45:13 | Traveled back down pipe | 68 | 141 |
| 10:45:18 | 1 - lane snapper (same 1 as above?) | 68 | 086 |
| 10:45:35 | 4 - unidentified fish | 69 | 109 |
| 10:45:46 | ROV back to octocoral colonies | 68 | 120 |
| 10:45:58 | 1 - sheepshead | 68 | 107 |
| 10:46:14 | ROV crossed its tether lying across pipe | 69 | 130 |
| 10:46:39 | ROV stopped & landed on pipe | 70 | 169 |
| 10:46:59 | 1 - sheepshead | 69 | 031 |
| 10:47:09 | 1 - gray snapper | 68 | 352 |
| 10:47:24 | 1 - tomtate | 70 | 333 |
| 10:47:31 | 1 - tomtate | 70 | 352 |
| | 1 - sheepshead | | |
| 10:47:55 | 1 - gray snapper (probably the 1 above) | 70 | 090 |
| 10:48:18 | 1 - sheepshead (possibly 1 of 2 above) | 70 | 080 |
| 10:48:36 | ROV began to move | 70 | 080 |
| 10:49:22 | 1 - unidentified fish (gray snapper?) | 70 | 058 |
| 10:49:25 | 1 - tomtate | 70 | 055 |
| 10:49:35 | ROV headed away from pipe | 69 | 248 |
| 10:51:17 | ROV landed on bottom | 70 | 236 |
| 10:51:50 | 1 - unidentified snapper | 71 | 223 |
| 10:51:54 | Rear camera view | 71 | 220 |

Table C.6 (continued)

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 10:52:10 | ROV began to move (turned 180°) | 71 | 214 |
| 10:53:14 | ROV arrived at weight on tether, parked, & continued across bottom | 69 | 015 |
| 10:55:06 | ROV parked on the sediments | 69 | 272 |
| 10:55:50 | ROV began to move | 70 | 266 |
| 10:56:17 | ROV landed by 2 pieces of metal | 69 | 272 |
| 10:57:07 | ROV began to move | 69 | 299 |
| 10:57:26 | ROV headed back down its tether | 68 | 109 |
| 10:58:01 | ROV approached a pipe | 68 | 083 |
| 10:58:07 | ROV landed on the pipe | 68 | 317 |
| 10:58:13 | ROV began to move along the pipe | 69 | 234 |
| 10:58:50 | ROV stopped at debris on the pipe | 69 | 122 |
| 10:59:03 | ROV resumed moving along the pipe | 69 | 128 |
| 10:59:16 | ROV arrived at stairs | 68 | 021 |
| | 1 - sheepshead | | |
| | 1 - tomtate | | |
| 10:59:22 | ROV landed on pipe | 69 | 021 |
| 10:59:30 | ROV began moving along pipe rubble | 68 | 071 |
| 10:59:57 | 2 - belted sandfish | 70 | 080 |
| 11:00:00 | 2 - unidentified fish (above ROV) | 70 | 080 |
| 11:00:17 | 1 - whitespotted soapfish | 70 | 086 |
| 11:00:19 | 1 - tomtate | 70 | 080 |
| 11:00:32 | 1 - tomtate (probably 1 of 2 ID above) | 68 | 077 |
| 11:00:59 | ROV landed on bottom | 71 | 113 |
| 11:01:38 | ROV began to move | 70 | 102 |
| 11:01:41 | 1 - tomtate | 70 | 253 |
| | 1 - red snapper | | |
| 11:02:08 | small group of snapper (1 gray & 4 red) | 68 | 256 |
| 11:02:53 | ROV parked on pipe | 68 | 301 |
| 11:03:10 | 4 - red snapper (probably same above) | 69 | 301 |
| | 1 - gray snapper (probably same above) | | |
| 11:03:31 | 2 - sheepshead | 69 | 266 |
| 11:04:13 | 1 - cobia | 67 | 354 |
| | 1 - large stingray (Dasyatis sp.) | | |
| 11:04:28 | ROV crossed a pipe | 67 | 043 |
| 11:05:50 | ROV parked by a pipe | 69 | 086 |

Table C.6 (continued)

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 11:06:12 | ROV resumed course | 69 | 090 |
| 11:06:20 | ROV appeared to be stopped by tether weights with 2 pipes crossing ahead | 68 | 098 |
| 11:07:03 | ROV turned right along pipes and appeared to struggle dragging weights | 67 | 230 |
| 11:08:17 | ROV turned back down the tether | 69 | 280 |
| 11:08:57 | ROV passed 2 block like objects | 69 | 291 |
| 11:09:19 | ROV parked at tether weights | 68 | 270 |
| 11:09:35 | ROV resumed movement | 69 | 336 |
| 11:10:32 | ROV parked on the bottom | 69 | 352 |
| 11:12:10 | ROV resumed back down tether | 68 | 246 |
| 11:12:32 | ROV arrived back at weights & continued | 66 | 238 |
| 11:13:17 | 1 pipe in view, ROV turned left ~45° | 68 | 241 |
| 11:14:00 | ROV arrived at a walkway gratting | 67 | 086 |
| 11:14:02 | 3 - sheepshead | 66 | 077 |
| 11:14:19 | 1 - red snapper | 69 | 113 |
| 11:14:06 | ROV parked on pipe | | |
| 11:14:44 | 1 - gray snapper | 68 | 113 |
| 11:14:56 | 1 - red snapper | 68 | 152 |
| 11:14:57 | 1 - tomtate | 68 | 150 |
| 11:15:00 | 1 - gray snapper (possibly the same 1) | 68 | 150 |
| 11:15:04 | 1 - unidentified fish<br>(It appeared that 1 gray snapper, 1 tomtate and 3 sheepshead were milling around the ROV.) | 68 | 147 |
| 11:15:38 | 4 - sheepshead (1 in addititon to 3 above) | 69 | 105 |
| 11:15:47 | 1 - gray snapper (probably same 1 above) | 69 | 107 |
| 11:15:48 | 1 - unidentified fish<br>1 - tomtate | 69 | 107 |
| 11:15:50 | 3 - sheepshead flashed by | 69 | 105 |
| 11:15:55 | 1 - lane snapper<br>3 - tomtate<br>1 - sheepshead | 69 | 107 |
| 11:16:01 | 1 - unidentified fish | 69 | 109 |
| 11:16:03 | 1 - sheepshead | 69 | 107 |
| 11:16:13 | 1 - sheepshead | 69 | 107 |

Table C.6 (continued)

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 11:16:50 | 3 - sheepshead (still there cruising) | 69 | 107 |
| 11:17:22 | 1 - red snapper | 69 | 107 |
| 11:17:40 | 1 - red snapper (same one?) | 69 | 107 |
| 11:17:48 | ROV began to move | 70 | 180 |
| 11:18:09 | ROV passed under pipes (within reef) | 69 | 102 |
| 11:18:22 | ROV landed on bottom | 71 | 145 |
| 11:18:41 | 1 - unidentified fish | 70 | 158 |
| 11:18:56 | ROV began to move | 70 | 181 |
| 11:19:00 | 1 - tomtate | 70 | 259 |
| 11:19:14 | 1 - sheepshead | 70 | 000 |
| 11:19:27 | ROV headed back down pipe & tether | 68 | 333 |
| 11:19:52 | ROV landed on bottom | 70 | 338 |
| 11:20:00 | ROV began to move | 71 | 346 |
| 11:20:03 | 1 - sheepshead | 69 | 080 |
| 11:21:33 | ROV approached 1 pipe off bottom and turned toward the right | 67 | 207 |
| 11:21:33 | 1 - sheepshead | 67 | 207 |
| 11:21:39 | ROV parked on pipe | 67 | 195 |
| 11:22:32 | ROV began to move off pipe | 66 | 071 |
| 11:22:45 | ROV dropped down to a lower pipe crossing beneath the 1 where it parked | 68 | 074 |
| 11:22:47 | 1 - sheepshead | 68 | 083 |
| 11:22:50 | 1 - sheepshead<br>ROV arrived back at walkway grating | 68 | 094 |
| 11:23:06 | 1 - sheepshead | 63 | 065 |
| 11:23:08 | 1 - unidentified fish | 62 | 102 |
| 11:23:11 | 1 - gray triggerfish | 61 | 277 |
| 11:23:25 | ROV parked on gratting | 64 | 341 |
| 11:23:31 | 1 - dusky damselfish (adult) | 65 | 346 |
| 11:23:34 | 1 - unidentified snapper<br>~44 Atlantic spadefish passed by ROV | 65 | 346 |
| 11:23:51 | ~19 Atlantic Spadefish passed ROV in opposite direction | 66 | 346 |
| 11:24:06 | 1 - unidentified snapper<br>1 - Atlantic spadefish | 66 | 346 |
| 11:24:12 | 1 - unidentified snapper (gray?) | 66 | 346 |

Table C.6 (continued)

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 11:24:17 | 1 - red snapper | 66 | 346 |
| 11:24:38 | 1 - dusky damselfish (adult) | 66 | 346 |
| 11:24:50 | ROV began to move | 66 | 354 |
| 11:25:00 | 2 - red snapper | 63 | 349 |
| 11:25:11 | 2 - red snapper | 62 | 349 |
| | 1 - sheepshead | | |
| 11:25:48 | 3 - sheepshead | 63 | 135 |
| | ROV amoung several pipes & structures | | |
| 11:26:06 | 1 - sheepshead | 55 | 052 |
| 11:26:06 | 1 - unidentified snapper | 55 | 052 |
| 11:26:17 | ROV began to follow its tether | 59 | 320 |
| 11:26:49 | ROV landed on bottom and panned | 69 | 344 |
| | the camera lens up and down | | |
| 11:27:13 | Rear camera view for 7 seconds | 69 | 344 |
| 11:28:29 | 1 - unidentified small benthic fish | 69 | 344 |
| 11:28:38 | ROV began to move | 69 | 330 |
| 11:28:50 | Several rocks/lumps covered with growth | 68 | 034 |
| 11:28:58 | 1 - sheepshead | 69 | 043 |
| 11:29:06 | 2 - sheepshead with a pipe | 67 | 049 |
| 11:29:27 | ROV viewed ends of 2 large pipes | 68 | 006 |
| 11:29:40 | ROV briefly parked on the bottom | 70 | 009 |
| 11:29:44 | ROV began to move along a pipe | 70 | 027 |
| 11:30:10 | 1 - whitespotted soapfish | 69 | 283 |
| 11:30:15 | ROV parked in front of soapfish | 69 | 299 |
| 11:30:51 | ROV began to move | 69 | 322 |
| 11:30:55 | 1 - tomtate | 68 | 320 |
| 11:31:09 | ROV bagan to follow a smaller pipe | 68 | 074 |
| | which had another pipe crossing under | | |
| 11:31:15 | 1 - tomtate | 68 | 096 |
| 11:31:20 | ROV arrived at stairwell | 66 | 090 |
| 11:31:36 | 1 - unidentified fish | 66 | 027 |
| 11:31:42 | ROV parked | 70 | 071 |
| 11:31:44 | 1 - sheepshead | 71 | 074 |
| 11:32:02 | 1 - sheepshead (the same one?) | 70 | 077 |
| 11:32:19 | 1 - sheepshead | 70 | 074 |
| 11:32:22 | Rear camera view (35 seconds) | 71 | 071 |

Table C.6 (continued)

18 August 2004 (288 Site ROV Dive 4).

| Time | Activity and sighting(s) | Depth (ft) | Heading (° mag) |
|---|---|---|---|
| 11:33:01 | ROV began to move to follow tether | 71 | 077 |
| 11:33:03 | 1 - sheepshead | 71 | 264 |
| 11:33:31 | 1 - tomtate under a pipe | 67 | 315 |
| 11:34:10 | ROV arrived at tether weights and continued to follow its tether | 67 | 322 |
| 11:34:22 | ROV crossed a pipe lying off bottom | 66 | 262 |
| 11:35:15 | ROV began ascending | 63 | 238 |
| 11:36:13 | 3 - Atlantic spadefish<br>1 - unidentified fish | 38 | 180 |
| 11:38:14 | ROV arrived at the surface | 0 | 186 |
| 11:39:54 | ROV on deck | | |
| 11:40:36 | END OF TAPE | | |

# APPENDIX D: Texas Parks and Wildlife Diver Survey Results for GA-288, September 2003.

Table D. 1

Texas Parks and Wildlife Diver Survey Results for GA-288, September, 2003.

| Species | Diver | | | | | Average | Percent |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Belted Sand Bass *Serranus subligarius* | 4 | 4 | 4 | - | 44 | 14.0 | 2.9 |
| Soapfish *Rypticus* sp. | 4 | - | - | - | - | 4.0 | 0.2 |
| Tomtate *Haemulon aurolineatum* | 100 | 100 | 100 | 100 | 100 | 100.0 | 26.2 |
| Ling *Rachycentron canadum* | 4 | 4 | 4 | 4 | 4 | 4.0 | 1.0 |
| Atlantic Spadefish *Chaetodipterus faber* | 44 | 44 | 44 | - | 44 | 44.0 | 9.2 |
| Gray Snapper *Lutjanus griseus* | 4 | 4 | 44 | 44 | 44 | 28.0 | 7.3 |
| Seaweed Blenny *Parablennius marmoreus* | 44 | 44 | 44 | 44 | 44 | 44.0 | 11.5 |
| Almaco Jack *Seriola rivoliana* | 4 | - | 4 | 4 | - | 4.0 | 0.6 |
| Gray Triggerfish *Balistes capriscus* | 44 | 44 | - | 44 | 44 | 44.0 | 9.2 |
| Spotfin Butterflyfish *Chaetodon ocellatus* | 4 | 4 | - | - | 4 | 4.0 | 0.6 |
| Brown Chromis *Chromis multilineata* | 4 | - | - | - | - | 4.0 | 0.2 |
| Cocoa Damselfish *Stegastes variabilis* | 4 | 44 | 44 | - | 44 | 34.0 | 7.1 |
| Seargent Major *Abudefduf saxatilis* | 44 | - | - | - | 44 | 44.0 | 4.6 |
| Sheepshead *Archosargus probatocephalus* | - | 44 | 44 | 44 | 100 | 58.0 | 12.2 |
| Spotted Scorpionfish *Scorpaena plumieri* | - | 1 | 1 | 1 | 4 | 1.8 | 0.4 |
| Greater Hammerhead *Sphyrna mokarran* | - | 1 | - | - | 1 | 1.0 | 0.1 |
| White Spotted Filefish *Cantherhines macrocerus* | - | 4 | 4 | - | 4 | 4.0 | 0.6 |
| Red Snapper *Lutjanus campechanus* | - | - | 4 | 4 | 44 | 17.3 | 2.7 |
| Blue Runner *Caranx crysos* | - | - | 4 | - | - | 4.0 | 0.2 |

Table D. 1 (continued)

Texas Parks and Wildlife Diver Survey Results for GA-288, September, 2003.

| Species | Diver | | | | | | Average | Percent |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | | |
| Bar Jack<br>*Caranx ruber* | - | - | 4 | - | - | | 4.0 | 0.2 |
| Spotted Hogfish<br>*Bodianus pulchellus* | - | - | - | 44 | - | | 44.0 | 2.3 |
| Bottlenosed Dolphin<br>*Tursiops truncatus* | - | - | - | - | 4 | | 4.0 | 0.2 |

## The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

## The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.