EXPLORE

NOAA Office of Ocean Exploration Quick Look Report

Expedition Title: From the Estuary to the Abyss: Exploring Along the Latitude 31-30 Transect

Results (please check all disciplines in which this cruise collected data)	**Details** (please describe any novel discoveries in the discipline, answers such as "possible, awaiting data analysis" and "no apparent discoveries" are acceptable)
Bathymetric Mapping ☑ Yes ☐ No	(please note total area mapped and technology employed, e.g. multibeam, side scan, etc.) Dive sites were mapped using a Knudsen 3.5/12kHz (dual frequency) deep water high-powered precision echosounder.
New Species Discovered ☐ Yes ☐ No	(please note number, type, and significance ,i.e. radically new vs. slight adaptation of known species) It is unknown if new species were discovered; this will take years of detailed study of the samples collected.
Bio-prospecting ☐ Yes ☑ No	(please note number, type, and potential use of new compounds discovered)
Habitat Range Extended ☑ Yes ☐ No	(please note species discovered in new habitats and how far from previous range were they found0 Geographic range extended for at least one species of mollusk and one fish. Additional range extensions will probably be discovered as samples are analyzed.
Chemical Processes ☑ Yes ☐ No	(please note new or unusual chemical properties such as methane seeps, hypersaline pools, vents, etc. observed) Samples of corals and mollusks were collected to analyze chemical properties for determining age of specimens and climate history.
Geologic Processes ☑ Yes ☐ No	(please note new or unusual geologic processes that may impact scientific understanding of the region) Many rock and sediment samples were collected for future study.
Physical Processes ☑ Yes ☐ No	(please note new or unusual oceanographic processes that may impact scientific understanding of the region) Samples and measurements were taken to describe present conditions and to infer climate history.
Sub/ROV/AUV Dives ☑ Yes ☐ No	(please note name, type, and cumulative hours of bottom time for each platform / if available please provide average working time per dive for each platform / please note if new depth records were set) 1834 min of bottom time in JSL-II submersible (mean = 131 min per dive).
New Technology ☐ Yes ☑ No	(please note any new tools developed for or during this cruise, also identify first use of an existing technology in a new application) Chimneymaster was used to collect sponges, a new use for this technology.
Maritime Cultural Heritage ☐ Yes ☑ No	(please note discoveries impacting knowledge of the past, i.e. number and type of shipwrecks)
Outreach ☑ Yes ☐ No	(please describe outreach channels, e.g. web, port call, etc., used in this project) OE and other web sites; media event at end of cruise.
Students Involved ☑ Yes ☐ No	(please note the number and level of students on the expedition) Five graduate students on cruise; corresponded with at least 22 high school and 34 undergraduate students during cruise.
Multidisciplinary ☑ Yes ☐ No	(please identify the formal disciplines represented in the science party) Ichthyology, fisheries biology, geology, invertebrate (coral, crustacean) systematics/ taxonomy, marine geology, engineering, data management/ processing, formal/ informal education, benthic ecology, reef biology, deep-sea biology, geography.
Exploration of New Regions ☑ Yes ☐ No	(please note if the area of operations had been previously studied, if so please check no and approximate as slight, moderate or significant, the level of knowledge before the cruise) Some areas on the Charleston Bump and shelf edge were previously studied; several new sites were explored and comprised greater depths and different habitats than those previously studied.

NOAA OE FY 2004 Quick Look Report

Project title: From The Estuary To The Abyss: Exploring Along The Latitude 31-30 Transect

Principal Investigator and institution: George R. Sedberry, Marine Resources Research Institute, South Carolina Department of Natural Resources

Expedition dates and itinerary:

Date	Site	Lat (N)	Long (W)	Approx. Depth (m)	Activity
20-Aug	Ft. Pierce FL				Depart
21-Aug	Sponge Cliff	31°14.7708'	78º57.1512'	578	Fathometer, Dive, Grab, Plankton, CTD
22-Aug	Sponge Cliff	31°14.7708'	78º57.1512'	578	Dive, Dipnet, Night Light & Trap, Fathometer
	Wreckfish Cave	31° 19.1136'	78º 50.5770'	460	Grab, Plankton, CTD
23-Aug	Wreckfish Cave	31° 19.1136'	78º 50.5770'	460	Grab, CTD, Dipnet, Pipe Dredge, Fathometer, U/W for Charleston for sub parts, Beam Trawl.
24-Aug	Wreckfish Cave	31° 19.093'	78º 50.201'	525	Beam Trawl, Night Light & Trap, Dive, Plankton, Fathometer
	Barrelfish Cliff	31° 23.5812'	78º 35.8836'	591	Fathometer, Dive, Grab, Hook & Line
25-Aug	Popenoe's Coral Mounds 1	31° 25.1214'	77º 51.4170'	736	Night Light & Trap, Fathometer, Dive, Grab
	Popenoe's Coral Mounds 2	31° 24.2280'	77º 49.0158'	760	Pipe Dredge, Dive, Grab
26-Aug	Sandy Tongue	31° 33.1458'	77º 28.5372'	895	CTD, Plankton, Fathometer, Dive, Dipnet
	Deep Flats	31° 48.6'	77º 31.2'	800	Fathometer, Dive, Plankton, CTD, Pipe Dredge

Expedition dates and itinerary (continued):

Date	Site	Lat (N)	Long (W)	Approx. Depth (m)	Activity
27-Aug	Charleston				Offload personnel
	Manheim's Coral Mounds 1	31º 48.6'	77º 34.8'	800	Weather day, operations suspended. Dipnet
28 Aug	St. Augustine N			60	Weather day, operations suspended. Dipnet
29 Aug	St. Augustine N	30º 01.800'	80º 16.20'	60	Fathometer, Dive
	Jacksonville N	30º 25.200'	80º 12.60'	60	Fathometer, Dive
30 Aug	Cutthroat Cliff	30º 17.000'	79º 20.30'	850	Plankton, Fathometer, Dive, Night Light & Trap
	St. Augustine N	30º 01.800'	80º 16.20'	60	Dive
	Red Snapper Sink	29º 44.440'	80º 44.875'	18	Fathometer
31-Aug	St. Augustine S	29º 52.80'	80º 16.80'	60	Plankton, CTD, Fathometer, Dive
	Flagler Scarp	29º 40.0'	80º 12.0'	60	Fathometer, Dive
1-Sep	Ft. Pierce				Media event

Chief Scientist and institution: George R. Sedberry, Marine Resources Research Institute, SCDNR

Co-sponsors / partners / participating organizations:

Participant	Participant's Organization	Participants Supporting Funding Agency
Katrina Bryan	South Carolina Aquarium	South Carolina Aquarium, NOAA OE
Lenny Collazo	NOAA/NCDDC	NOAA
Susan Thornton DeVictor	SCDNR	NOAA OE, NOAA Fisheries
Joshua (J.D.) Dubick	NOAA/NOS/NCCOS	NOAA NOS
Kelly Filer	College of Charleston	NOAA OE, NOAA Fisheries
Cara Fiore	College of Charleston	NOAA OE, NOAA Fisheries
Sarah Griffin	College of Charleston	NOAA OE, NOAA Fisheries
Jeff Jenner	NOAA/NCDDC	NOAA
Rachel King	SCDNR	NOAA OE, NOAA Fisheries
Josh Loefer	SCDNR	NOAA OE, NOAA Fisheries
Scott Meister	SCDNR	NOAA OE, NOAA Fisheries
Paulette Mikell	SCDNR	NOAA OE, NOAA Fisheries
Christina Ralph	College of Charleston	NOAA OE, NOAA Fisheries
Leslie Sautter	College of Charleston	NOAA, College of Charleston Project Oceanica
Zeb Schobernd	College of Charleston	NOAA OE, NOAA Fisheries
George Sedberry	SCDNR	SCDNR, NOAA OE, NOAA Fisheries
Jessica Stephen	SCDNR	NOAA OE, NOAA Fisheries
Byron White	SCDNR	NOAA OE, NOAA Fisheries

Vessel Identification: R/V *Seward Johnson*.

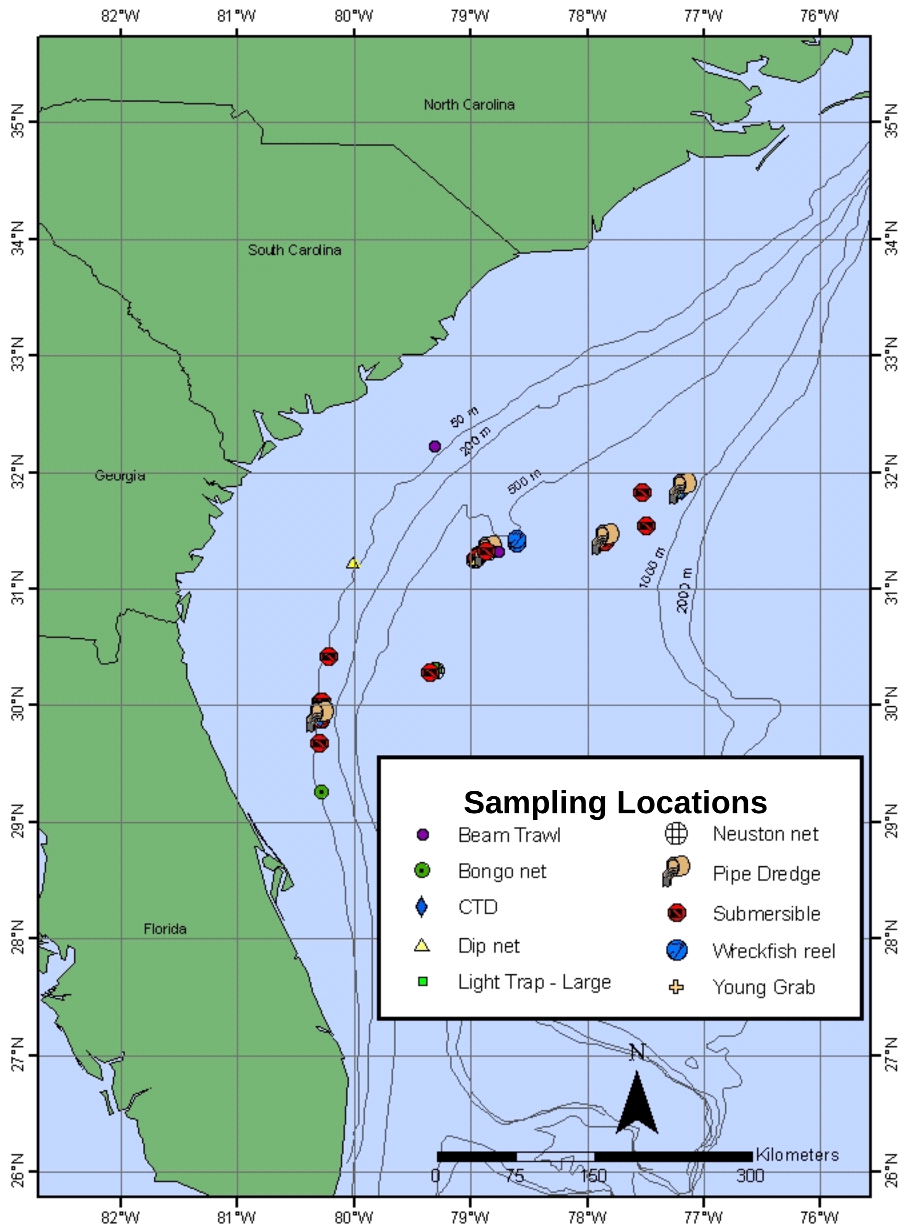
Primary Equipment: Submersible *Johnson Sea-Link II*, 3-m beam trawl, pipe dredge, 60-cm bongo (standard MARMAP) plankton net, 1x3 m neuston net, Young grab, light traps, carrion traps, dipnets, hook-and-line, CTD, shipboard sensors (conductivity, temperature, depth, weather, etc.), precision echosounder.

Geographic area of operations: Blake Plateau; northern Florida outer continental shelf.

Summary of Expedition Objectives: The primary goal of the expedition was to determine the composition, density and diversity of biota as they relate to habitat characteristics and distance from terrestrial influences. To achieve this goal, we planned to map, explore and describe deep habitats, particularly hard bottom habitats, along the deeper (400 - 2000 m) portions of a transect from the estuary to the abyss, including description their use by marine organisms and the adaptations these organisms have for specialized habitats. We focused on examining the effects of gradual change (e.g. depth) vs. abrupt change (sand to rock) in physical features on associated faunas. During the expedition, we accomplished the following objectives, in order to address our goals:

1. Use sonar to map features of the shelf edge, Florida-Hatteras Slope, Blake Plateau and Charleston Bump off South Carolina and Georgia.

2. Explore complex and unique habitats such as caves, overhangs, depressions, coral mounds, pinnacles, and pavements with submersibles and bottom sampling gear deployed from surface ship, and visually document and describe habitats and faunal assemblages in depths from 400 - 1000 m.



3. Obtain samples and videotaped transects to compare faunas associated with different depths, bottom features and hydrography (e.g. current velocity), in terms of community structure, feeding guilds, growth and morphology. Data collected during this effort will be compared to existing shallow-water databases the PIs have compiled.

4. Obtain samples of macroinfaunal assemblages in relation to environmental factors (depth, seafloor landscape, physical properties of sediment, levels of organic matter in sediments, water-column characteristics).

5. Collect new and unusual species for taxonomic study and educational purposes.

6. Obtain corals for determining growth rates that will assist in conservation of deepwater coral banks and in determination of growth rates in the deep sea and factors that influence growth.

7. Collect DNA samples from corals, mollusks, decapods and other organisms to elucidate patterns of recruitment.

8. Collect samples to examine impacts of microbial resistance in the marine realm.
9. Develop educational materials (web, classroom curricula, video productions) from the research.

Milestones achieved (key findings): During the expedition, we obtained specimens of the following unique or rare taxa:
Sladenia schaferi: We collected the third known specimen of this species, resulting in a considerable range extension (from the southern Caribbean) and additional material for a taxonomic revision of this genus that is being conducted by John Caruso (University of New Orleans).
Miscellaneous fishes: We collected and/or observed specimens of several species that are rare in collections, especially from the Blake Plateau. This included frilled shark, synaphobrachid eels, chlorophthalmids and chaunacid anglerfishes.
Sessile epifauna: We collected several corals and sponges, including several sponges collected with the "chimneymaster", which collected them with their associated fauna intact.
Decapod megalopae: We collected larval stages of several decapods, to grow out and describe their development.
Mollusks: Specimens of slitshell that were collected on a deep scarp were identified by Dr. Jerry Harasewych, Curator of Marine Mollusca at the National Museum of Natural History (Smithsonian Institution), as *Bayerotrochus midas*. The location where they were collected is a northern range extension. One of the specimens will be donated to the USNM mollusk collection.
Other: We also explored some spectacular deep scarps. These were similar in form to scarps previously explored on the Charleston Bump (450 - 600 m), but had more relief (200 m) and were deeper (600 - 850 m). Because of the increased depths, associated fish faunas were different, although bottom features appeared very similar. We collected rock and sediment samples also, to compare scarps at different depths, to determine their geological origin.

We explored "coral mounds" mapped by previous investigators who used side scan sonar. Some of these mounds appear to be rubble mounds, containing very little live coral, in spite of their high profile and signature (diffuse or "soft" echo) on echosounder traces.

We also discovered that beam trawls are not an effective way to sample the bottom on the Blake Plateau.

Sample log entry:

ocean explorer/Explorations

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Explorations : Estuary To The Abyss : Logs

My First Submersible Dive
August 22, 2004

Christina Ralph
Graduate Student
College of Charleston

Sea lilies were scattered along the bottom at our dive site. These filter feeding invertebrates are in the class Crinoidea (phylum: Echinodermata), and catch particles from the water with tube feet located on arms that branch outward from the center stalk. From the submersible window, these creatures almost look like flowers blowing in the breeze. *Click image for larger view.*

I am still in shock after yesterday's experience. I cannot believe that I have descended hundreds of meters to the bottom of the ocean in a submersible and seen the critters that inhabit this amazing environment. I am so grateful to be a part of this research cruise, not only because it is a wonderful opportunity, but also because I'm learning more about the field component of my thesis project and how data is collected using a research submersible.

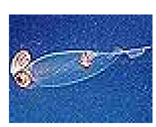
For my research project at the College of Charleston, I am describing fish assemblages that live on deep reefs off the Southeast coast of the United States, trying to determine how these assemblages have changed over time, and trying

August 30 Log

August 29 Log

August 28 Log

August 27 Log



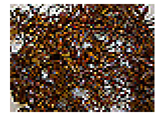
August 26 Log

to find out whether or not there is any relationship between fish assemblages and habitat type. In order to study these fish, I am analyzing video footage recorded during submersible dives. Like a census used for human populations, scientists conduct a visual fish census by identifying names (or species) of fishes seen in particular habitats and estimating the density, or abundance, per unit area for each species.

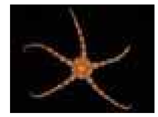
Christina Ralph describes the beardfish she observed during her dive in the Johnson Sea Link II to her colleagues, Kelly Filer, Zeb Schobernd, and Sarah Griffin. The beardfish (Polymixia nobilis – see inset) swim along the bottom with their barbels in constant contact with the sediment. These barbels act as sensory organs. *Click image for larger view.*

The first step in a visual fish census is to correctly identify which species of fish are seen. Identifying fish underwater in submersibles or from video footage can be a little tricky. You are not able to hold the fish in your hand and count or measure discriminating characteristics like fin rays or gill rakers (structures in the gills which are used by some fish to filter food from the water). Also, fish seen underwater can look very different than dead or preserved specimens. Therefore, a variety of characteristics must be used to identify fish underwater, including behavior, swimming styles, colors and patterns on the body, and size.

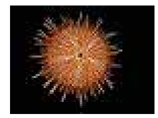
The next step of a visual census is to estimate the number of fish seen for a particular species per unit area (density). To calculate density, scientists set up timed transects along strips of reef. During an ideal transect, the submersible moves along an imaginary line on the reef, usually at a constant speed. These transects are videotaped with a camera that is mounted onto the submersible. After surfacing, the videotapes are analyzed by first counting the number of fish seen during transects. Fish density is then calculated by dividing the total number of fish seen for a particular species by the area or volume of water viewed.



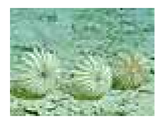
August 25 Log



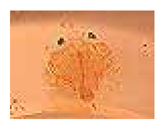
August 24 Log



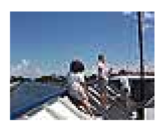
August 23 Log



August 22 Log



August 21 Log



August 20 Log

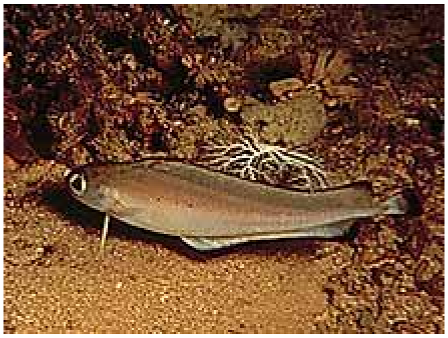
Volume is measured in cubic meters (fish swim in a three-dimensional plane), and is determined by multiplying the transect length by the transect width and height.

Two lasers beams (seen as a red and green dot) from the submersible reflect off of the wreckfish shown here. The dots produced by these lasers are 25 centimeters apart and can be used to estimate fish length and the area viewed by the camera.*Click image for larger view.*

Measurements for transect width and height are estimated from two laser beams mounted on the submersible's camera, which can also be seen on the videotapes. The space between these two beams represents a known distance from which we can calculate the two dimensional area viewed (width and height of camera field). As the camera is zoomed in, the space between the lasers increases on the monitor, while the area viewed decreases. The reverse is true when the camera is zoomed out: the space between the lasers decreases while the area viewed increases. These lasers can also be used to estimate fish length. Finally, transect length is determined from the track of the submersible relative to the ship, combined with position data from the Global Positioning Systems (GPS).

After determining fish density seen within a small area, scientists can extrapolate to estimate total fish abundance in larger areas with similar habitats. Also, comparisons can be made between current density estimates and those from previous years to see how fish assemblages have changed over time.

My first submersible mission began at two o'clock yesterday afternoon. I was a little nervous knowing that we would dive to over 600 meters, but my excitement soon caused these fears to fade. The first sight from the sub porthole was just endless clear, blue water. As we descended, the light slowly filtered out and the blue shades turned darker and darker. We were soon surrounded by nothing but black water. I peered out the porthole, not expecting to see anything in the blackness, but I was wrong. At first, I thought I saw little glints of light from reflections on the bubbles released from the sub, but these flashes of light were not bubbles at all. We were surrounded by a solid snow of jellyfish and other plankton that produced their own light (bioluminescence) as they drifted through the water. What an amazing sight!



Laemonema are a type of morid cod with an elongate body and tapering dorsal and anal fins. *Click image for larger view.*

After twenty-five minutes of steady descent, the sub finally touched bottom. Strong currents caused us to drift over a mile from our intended touchdown site. Instead of rocky scarps, we were surrounded by a flat terrain covered with sand and silt sediments, and dotted with corals, brittle stars, and sea lillies. The light from the sub attracted hundreds of tiny red shrimp. We also could see quite a few species of fish in the immediate area. My favorite sight was the beard fish (*Polymixia nobilis*) that were swimming around. These fish have two barbels that extend from their lower jaw that they use to feel and probe the sediment for food. We also saw two species of shark and a species of the genus *Laemonema*, a type of morid cod with an elongate body and tapered dorsal and anal fins. We hope to collect a *Laemonema* specimen in order to accurately identify the species we are seeing in this area.

Unfortunately, due to technical difficulties, our dive was cut short and we had to leave the bottom early. As we began to ascend back to the surface, I realized that I now have even more questions about this amazing habitat and the organisms that live here. Hopefully I will get another chance in the sub before this cruise is over. I can’t wait to see what new information and sights our next dive reveals!

(top)

Sign up for the Ocean Explorer E-mail Update List.

Summary of digital data collected:

3.88 GB of VIDS data, including continuous measurements of location (GPS); surface water temperature, salinity, fluorescence; weather; acoustic Doppler current profile (ADCP).

97.60 MB of precision echosounder data.

1.11 MB of CTD data.

42.30 MB of submersible navigation data.

39.50 MB of sampling data logs, including field data for locations of all sub and ship collections in MS-ACCESS database.

Approximately 40 hours of digital videotape, including a 106 KB submersible video annotation file.

Several thousand digital still images taken from submersible-mounted and hand-held digital still cameras, or captured from digital videotape.

Summary of outreach and educational activities:

During this expedition, we included two educators-at-sea in all activities. They corresponded with secondary and college marine biology and marine geology classes while at sea. In addition, we composed and contributed daily logs and essays to the OE web site, and composed and have posted detailed photographic and video documentaries on the Project Oceanica web site http://oceanica.cofc.edu/EstuaryToAbyss/home.htm). An open house was not planned for this expedition, but there was a media event. Unfortunately the impending landfall of Hurricane *Frances* at Ft. Pierce FL precluded much press interest in this expedition, but we did have one interview with a local weekly. Photographic and video imagery collected during the expedition was used in a local TV news story on the Charleston Bump, which was broadcast in the Charleston SC area on 12-13 September.

Thoughts for the future:

Observations and collections made during this expedition added to our list of fish and other species known from the Blake Plateau. During previous OE expeditions to the Charleston Bump, we have made a considerable number of collections and observations on shallower parts of the Blake. Extending our sampling from 1800 down to 3000 ft during this expedition resulted in the collection and observation of several rare and poorly known fishes and other organisms. Additional exploration is needed to extend this transect farther out onto the edge of the Blake Plateau and beyond. The Blake Scarp, Blake Ridge and Blake Spur are poorly known, but bathymetry maps indicate that they are areas of complex bottom topography in much greater depths than have been previously sampled. Future explorations should examine these fascinating deepwater habitats, which show promise for harboring rare, unusual and new species.

During this expedition, we discovered that "coral mounds" on existing maps may or may not contain living coral reefs and that some of these features may experience periodic natural die-offs. This needs further investigation, to include coring of living and "dead" coral mounds to examine their oceanographic climate history to understand growth patterns.

Summary of expedition operations:

Expedition operations have been summarized above ("Expedition dates and itinerary"). Thirteen submersible dives were completed, and a variety of sampling gear was deployed from the surface ship, to collect plankton, benthos and fishes.

Sampling Gear	Number of Collections (Deployments)
Beam Trawl	3
Bongo net	12
CTD	5
Dip net	5
Dip Netting - Night Light	2
Grab, Young	9
Light Trap - Large	3
Light Trap - Small	3
Neuston net	5
Pipe Dredge	4
Submersible	13
Wreckfish reel	3

Several types of collections were made during submersible dives. These included organisms, rocks, sediments and water samples.

	Collection Method						Dive	Bottom
Dive No.	Arm Scoop	Chimney Master	Claw Grab	Suction	Water Sample	Total Coll	Time (min)	Time (min)
3460	2	0	0	0	0	2	48	20
3461	2	1	1	4	0	8	203	165
3462	4	1	4	5	1	15	180	152
3463	1	0	1	5	0	7	164	140
3464	4	0	5	3	1	13	179	145
3465	5	0	2	4	1	12	164	126
3466	3	0	1	8	0	12	182	140
3467	3	1	3	6	1	14	132	95
3468	7	0	1	0	0	8	193	174
3469	3	0	0	0	0	3	90	84
3470	10	0	2	6	0	18	153	111
3471	1	0	2	2	0	5	131	126
3472	2	0	6	0	0	8	192	187
3473		0	0	5	0	5	175	169
Totals	**45**	**3**	**22**	**43**	**4**	**117**	**2186**	**1834**

Date	Gear	Latitude (°N)	Longitude (°W)	Depth (m)
21 August 2004	Submersible	31.26692	-78.93145	612
	Young Grab	31.26222	-78.92765	629
	Young Grab	31.26287	-78.92003	626
	CTD	31.25797	-78.93610	555
	Bongo net	31.25333	-78.93508	508
	Bongo net	31.25333	-78.93508	508
	Neuston net	31.24375	-78.96007	357
	CTD	31.28308	-78.92818	556
	Neuston net	31.28938	-78.92300	563
	Bongo net	31.27552	-78.91673	549
	Bongo net	31.27552	-78.91673	549
22 August 2004	Dip Netting - Night	31.27152	-78.92052	576
	Light Trap - Small	31.27152	-78.92052	576
	Light Trap - Large	31.27152	-78.92052	576
	Submersible	31.25878	-78.94383	581
	Dip net	31.25212	-78.94420	510
	Young Grab	31.32003	-78.84083	520
	CTD	31.32003	-78.84083	515
	Dip net	31.32003	-78.84083	530
	Pipe Dredge	31.32003	-78.83640	530
23 August 2004	Neuston net	31.31422	-78.84230	520
	Dip Netting - Night	31.31875	-78.82582	520
	Light Trap - Small	31.31875	-78.82582	520
	Light Trap - Large	31.31875	-78.82582	520
	Beam Trawl	32.21542	-79.31263	40
24 August 2004	Beam Trawl	31.31813	-78.78952	520
	Beam Trawl	31.32235	-78.75917	512
	Submersible	31.31352	-78.85985	542
	Submersible	31.38595	-78.60332	665
	Wreckfish reel	31.38487	-78.59897	505
	Dip net	31.38487	-78.59897	505
	Wreckfish reel	31.38677	-78.59797	613
	Wreckfish reel	31.42015	-78.59793	730
25 August 2004	Submersible	31.39738	-77.85012	745
	Young Grab	31.42080	-77.82773	738
	Young Grab	31.41835	-77.82587	722
	Young Grab	31.41958	-77.82313	720
	Submersible	31.39593	-77.84785	783
	Young Grab	31.42395	-77.86178	761
	Young Grab	31.42120	-77.84992	770
	Young Grab	31.42548	-77.85700	765
	Pipe Dredge	31.42155	-77.83933	765

Date	Gear	Latitude (°N)	Longitude (°W)	Depth (m)
26 August 2004	Dip net	31.55095	-77.48548	866
	Submersible	31.53713	-77.48908	866
	Submersible	31.82412	-77.52495	900
	Bongo net	31.83142	-77.19658	988
	Bongo net	31.83142	-77.19658	988
	CTD	31.83633	-77.18325	1002
	Pipe Dredge	31.84922	-77.17482	976
27 August 2004	Dip net	31.22008	79.99775	
29 August 2004	Submersible	30.02190	80.27778	52
	Submersible	30.40967	80.21448	51
30 August 2004	Bongo net	30.31137	79.29448	828
	Bongo net	30.31137	79.29448	828
	Neuston net	30.30422	79.28738	828
	Light Trap - Small	30.31002	79.34322	770
	Light Trap - Large	30.31002	79.34322	770
	Submersible	30.27593	79.33965	836
	Submersible	30.02508	80.27677	63
31 August 2004	Neuston net	29.87453	80.27105	
	Bongo net	29.26328	80.26738	73
	Bongo net	29.26328	80.26738	73
	Pipe Dredge	29.90807	80.27897	86
	Submersible	29.87063	80.28237	60
	CTD	29.88080	80.28148	
	Pipe Dredge	29.89960	80.28122	

Several dives and bottom time were missed because of technical problems with the sub (leaking hatch; lost tracking) or ship (broken tow winch). In addition, videotapes and digital images were not recorded on a few dives because of electronic malfunctions that did not become obvious until after completion of the dive. We also missed some dives and were not able to dive at some planned locations because of the weather. In spite of these difficulties, the ship, sub and scientific crew maintained a persistent and positive attitude and accomplished most of the objectives.