

Cruise Report

**NOAA Ship NANCY FOSTER Cruise NF-03-01-NC
(May 8 -16, 2003)**

Benthic and Fish Surveys at Gray's Reef National Marine Sanctuary, Spring 2003

June 2003

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



National Ocean Service

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Preface

This cruise report is a summary of field work conducted in and around the Gray's Reef National Marine Sanctuary (GRNMS), May 8-16, 2003, on NOAA Ship Nancy Foster Cruise NF-03-01-NC. The present research, which is part of an ongoing ecological characterization of GRNMS and nearby shelf waters, is aimed at developing a better understanding of the dynamics of benthic and fish resources in relation to environmental factors, and of the functional (trophic) relationships between these key components of the sanctuary ecosystem. This research addresses priority topics for the GRNMS identified at a recent workshop (2001) on strategies for future research and monitoring at the sanctuary. A total of four 75-m sediment transects were sampled by divers, and three stations located immediately adjacent to GRNMS were sampled with otter trawl, beam trawl and young grab. The primary focus of the cruise was on the collection of bottom sediment samples for the analysis of benthic macroinfaunal community structure; sampling of fishes for gut-content analysis of benthic prey; and sampling of primary producers, invertebrate prey, and fish consumers for stable-isotope analysis of energy flow among various trophic levels. Hook-n-line collection of fishes for gut-content and stable-isotope analysis also was conducted opportunistically at some stations.

The field work described herein was conducted by scientists and staff from the following NOAA organizations:

- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), Charleston, SC.
- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Fisheries and Habitat Research (CCFHR), Beaufort, NC.
- NOAA, National Ocean Service (NOS), National Marine Sanctuary Program, Gray's Reef National Marine Sanctuary (GRNMS), Savannah, GA.
- NOAA, Office of Marine and Aviation Operations (OMAO), NOAA Ship Nancy Foster.

The work, sponsored by the National Marine Sanctuary Program, is a component of a broader coordinated site characterization of the sanctuary by the GRNMS office, CCEHBR, and one other NCCOS center: the Center for Coastal Fisheries Habitat Research (CCFHR).

Additional copies of this cruise report can be obtained by contacting:

1. NOAA, NOS, National Centers for Coastal Ocean Science, Center for Coastal Environmental Health and Biomolecular Research, 219 Fort Johnson Road, Charleston, South Carolina, 29412, Telephone: 843/762-8511.

1.0 Introduction

A partnership between NOAA's National Centers for Coastal Ocean Science (NCCOS) and National Marine Sanctuary Program (NMSP) was initiated in 1999 to provide a stronger and more effective science base for managing NOAA's National Marine Sanctuaries. Under this partnership, NCCOS's role is to work with NMSP to conduct research aimed at addressing sanctuary management needs and to help apply this and related information in the development and implementation of effective management plans. Priority topics for the Gray's Reef National Marine Sanctuary (GRNMS) include studies to improve our understanding of the ecological characteristics and dynamics of benthic and fish communities, and of the trophic relationships between these key components of the sanctuary ecosystem. Such needs were identified at a recent workshop (2001) on strategies for future research and monitoring at the sanctuary.

Two projects were funded in FY03 under the NCCOS-NMSP partnership to help address the needs of GRNMS: (1) a study of benthic fauna and their importance as prey to bottom-feeding fishes (led by Dr. Hyland, NCCOS/CCEHBR) and (2) a study of the dynamics of juvenile fish recruitment (led by Dr. Hare, NCCOS/CCFHR). In an effort to promote the coordination of results from these two related projects and to maximize efficient use of ship-time, the present cruise was structured to support the field-sampling requirements of both projects combined. Study objectives include: (1) evaluate potential variations in benthic fauna in relation to reef proximity and associated predation effects (i.e., "halo effect") and compare data on benthic species composition from these sites to stomach contents of fishes caught in the same area as a basis for computing measures of the dependence of each fish species on various benthic prey organisms; (2) using a combination of unbaited hook-and-line and diver-assisted (spear-fishing and netting) techniques, collect samples of juvenile/adult bottom-feeding fishes at each of the three live-bottom transect sites for gut analysis of benthic prey; (3) conduct otter trawl tows just outside sanctuary boundaries to supplement the collection of juvenile/adult bottom-feeding fishes for gut analysis of benthic prey; (4) using 0.04m² Young grab sampler, collect three replicate bottom grabs of sediment for benthic infaunal analysis at each of the otter-trawl sites (to use in conjunction with gut contents for computing measures of the dependence of each fish species on various benthic prey organisms); (7) conduct CTD casts at each of the trawl sites and at each of the three live-bottom transect sites; (8) collect samples of primary producers (water-column microalgae, benthic micro- and macro-algae), invertebrate prey (zooplankton and benthic macroinvertebrates), and fish consumers to use in stable-isotope analysis of energy flow among various trophic levels.

Samples were collected along four 75-m transect lines within the sanctuary and at three trawl stations located directly outside the GRNMS boundaries during the week of May 8 – May 16, 2003, using the NOAA Ship Nancy Foster. Along each of the four 75-m transect lines, six sediment cores (0.0071-m² x 10-cm each) were collected at 1-m, 10-m, 25-m and 75-m for analysis of benthic community structure (5 replicates) and sediment physical characteristics (1 replicate). At each transect, samples were obtained for stable-isotope analysis of energy flow among trophic levels. At each of the three trawl stations located outside of the sanctuary, multiple beam and otter trawls were conducted plus three replicate Young Grab samples were collected. A CTD cast was completed at all three trawl stations and at each sediment transect.

Fish collections were also made opportunistically within the sanctuary boundaries using hook-n-line, diver netting, and diver spearing.

2.0 Scientific Approach

The primary objectives of this study are to characterize spatial patterns of benthic macroinfauna in relation to live-bottom habitat, and to determine the trophic importance of these fauna to fishes feeding in the area. It is hypothesized that benthic fauna serve vital roles in the transfer of energy to higher trophic levels, including a variety of commercially and ecologically important fishes that congregate around live-bottom habitat present in the area and use the surrounding open sandy areas as foraging grounds.

The seafloor within the GRNMS and surrounding shelf waters of the South Atlantic Bight is characterized by open stretches of sandy bottom interspersed with rocky formations that are heavily encrusted with sessile invertebrates. These “live bottom” rocky reefs are known to attract a variety of commercially and ecologically important species of fishes. Some of these species are believed to forage in the adjacent sandy areas. One objective of this study is to examine variations in the structure of benthic macroinfaunal communities inhabiting these sandy substrates in relation to reef proximity and the associated predation effects from foraging by fishes congregating around the reefs. Depressed abundances and diversity of benthic infauna immediately surrounding the reefs (referred to as a “halo zone” effect) would provide evidence of the trophic linkages between these reef-associated predators and benthic fauna in the surrounding sandy substrates. Samples for analysis of benthic macroinfauna (> 0.5 mm) were collected by divers, with hand-held coring devices, at each of four locations (Figure 1; Table 1) positioned at known distances (1m, 10m, 25m, and 75m) along each of four transects extending out from prominent live-bottom relief. Five replicate cores (0.0071-m² x 10-cm each) were collected at each location (a total of 80 infaunal cores). One additional sediment core was collected at each location along each transect for the analysis of grain size and TOC (a total of 16). A CTD cast was taken at each of the four live-bottom transect sites to obtain measurements of water depth, salinity, conductivity, irradiance, and temperature.

Another objective of the this study is to provide additional direct evidence of the importance of benthic infauna as prey to fishes foraging on the sandy seafloor, by performing gut analysis of fishes caught in the GRNMS area and comparing the data on gut contents to data on benthic community composition in sediment samples from the same area. Fish were collected using three methods: bottom trawling, diver-assisted techniques (spear-fishing and netting), and hook-n-line. A total of 257 fish were collected from 19 different target taxa (Table 2) through this combination of methods. A target fish species is defined here as a predator that forages on benthic invertebrates in soft-bottom (sandy) substrates within the sanctuary (e.g., tom-tate, cubbyu, goatfish, flatfish). Final selection of which taxa to analyze for prey contents will be made at a later time.

Bottom trawling was conducted with a 15-ft otter trawl (with 1-inch stretched mesh) towed for 10 minutes at approximately two knots and a 2-m beam trawl. Replicate trawls (minimum of three) were taken primarily during night at a minimum of three stations just outside the sanctuary boundaries (see Table 1 and Fig. 1 for site locations). A CTD was taken at each trawl site to

obtain measurements of water depth, salinity, conductivity, irradiance, and temperature. Three replicate Young Grab samples were collected at each of the three trawling locations to use in conjunction with gut contents for computing measures of the dependence of each fish species on various benthic prey organisms. Non-trawling techniques were used to acquire fish samples from hard-bottom habitats in the vicinity of the four dive transects. These include diver-assisted techniques (micro-barbing and diver netting), and hook-n-line fishing using a sabiki rig.

All fish samples were preserved onboard the ship by freezing. Stomach contents from these samples will be identified to species and compared to data on benthic community composition in sediment samples collected during this same study, or in recent years (spring 2000-2002) on related benthic surveys within GRNMS. Data from these comparisons will be used to compute measures of the dependence of each fish species on various benthic prey organisms (e.g., Ivlev's index of electivity; and simple calculations of the relative contribution, by % abundance and % volume, of individual prey species found both in stomachs and in the ambient benthic community to each fish's total diet).

Total primary production on the southeast U.S. continental shelf is supported by three sources: phytoplankton (water column), benthic microalgae, and benthic macroalgae. Benthic fauna, supported by energy sources originating in both the water column and sediments, represent a major source of secondary production on the seafloor. Traditionally, fisheries production on the shelf has been linked with phytoplankton production. However, two lines of evidence suggest a much greater role of primary and secondary production by benthic organisms on the seafloor. First, benthic primary production may be substantial; for example, concentrations of chlorophyll in surface sediments often exceed depth-integrated chlorophyll concentrations in the water column. Second, recent studies have shown very high abundances and diversity of benthic macroinfauna in the GRNMS and surrounding shelf waters. This study uses stable-isotope techniques to evaluate the relative importance of the benthos versus other trophic sources in the transfer of energy to selected fishes at the GRNMS.

Stable isotopes of N and C provide a method to determine the source of food supporting a particular organism and thus a way to evaluate the transfer of energy among various trophic levels. As part of ongoing research to support management at GRNMS, we will use this cruise as an opportunity to collect samples for subsequent stable-isotope analysis (analyses will be covered by future FY04 funding). Isotope ratios will be measured and compared in a number of different organisms from various trophic levels including primary producers (water-column microalgae, benthic micro- and macro-algae), invertebrate prey (zooplankton and benthic macroinvertebrates), and fish consumers. Samples were obtained by a variety of methods, for example: (1) by divers taking sediment scrapes for benthic macroalgae and microalgae at each of the three live-bottom dive transects; (2) by taking water samples and plankton-net samples from the ship for the analysis of phytoplankton and zooplankton; and (3) by using a combination of grabs and hand-held cores to collect sediment samples for the analysis of benthic invertebrate prey. Samples were frozen onboard the ship, and then transported back to the CCFHR lab in Beaufort, NC and stored until time of analysis. For more information about the stable isotope sampling please contact Jon Hare (jon.hare@noaa.gov).

3.0 Sampling Logistics and Scientific Parties

The four 75-m sediment transects and three trawling stations were sampled on May 8 – May 16, 2003 from the NOAA ship Nancy Foster, Cruise NF-03-01-NC. Samples were collected from the deck of the Nancy Foster as well as using her launches to deploy divers. The scientific crew consisted of six staff from NOAA, NOS, NCCOS, Center for Coastal Environmental Health and Biomolecular Research, three staff from NOAA, NOS, NCCOS, Center for Coastal Fisheries Habitat Research, one staff member from NOAA, NOS, National Marine Sanctuary Program, Gray's Reef National Marine Sanctuary, and one volunteer. A summary of field logistics and scientific parties is given in Table 3 and 4, respectively.

4.0 Preliminary Results

All in-situ measurements and records of sampling were recorded on standard field sheets. A daily activity log was also maintained to track sampling activities (Appendix A). See Table 5 for a record of water quality measurements taken by CTD cast at each station.

The sediments collected along the 75-m transects exhibited a wide range of types from coarse sand with shell hash to fine sand. In a prior characterization of bottom habitats using remote sensing techniques (M. Kendall, NOAA), two types of soft-bottom surface relief could be distinguished within the sanctuary in addition to live-bottom outcrop: rippled sands, which comprise the majority of the sanctuary's seafloor, and flat sands present predominantly in the western side of the sanctuary (see Fig. 1). Transects A, B, and C were established next to live-bottom ledges surrounded by rippled sand and Transect D was established next to live-bottom in an area of flat sands. All live-bottom ledges from which these transects extended were of moderately high relief (approximately 0.8-1.0 m in height) and were inhabited by typical live-bottom invertebrates (corals, anemones, bryozoans, sponges). All four transect sites also had numerous fish species associated with them. A wide variety of animals were visible to the naked eye in the sediment samples collected to characterize the macroinfaunal assemblages. Common infaunal members that were seen included molluscs, crustacea, polychaetes, sponges, and echinoderms.

For more information concerning preliminary results related to the stable isotope sampling please contact Jon Hare (jon.hare@noaa.gov).

5.0 Acknowledgements

Funding for this field work is provided by the NOAA National Marine Sanctuary Program.

All members of the field crew (see Table 3 for lists) are commended for their high level of technical expertise, teamwork and dedication to getting the required sampling completed. Special appreciation also is extended to the officers and crew of the NOAA ship Nancy Foster for the superb job performed on NF-03-01-NC in the Gray's Reef National Marine Sanctuary.

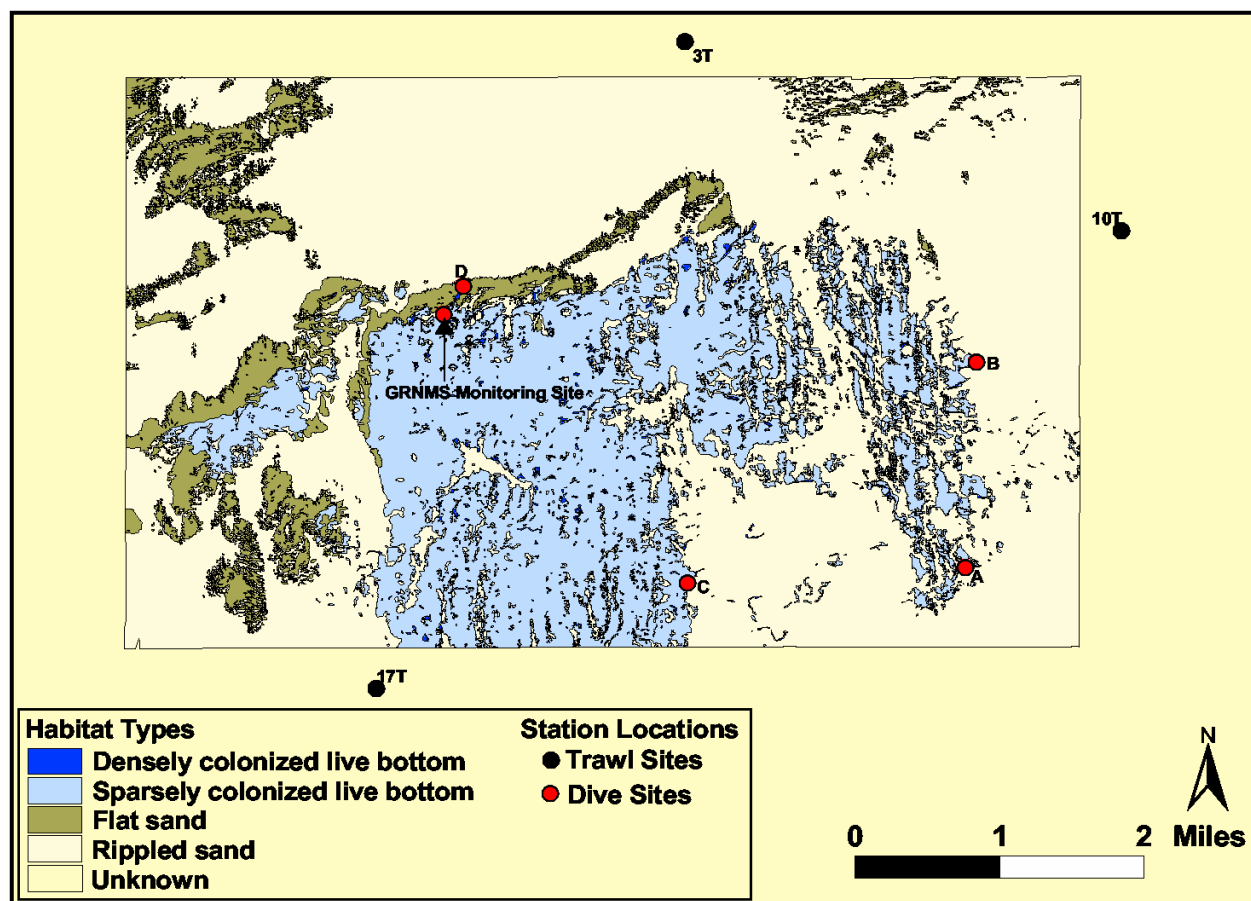


Figure 1. Study area and sampling sites for the spring 2003 benthic survey and fish surveys at GRNMS (NOAA Ship Nancy Foster Cruise NF-03-01-NC). Bottom habitat map of GRNMS courtesy of NOAA/NOS/NCCOS/Center for Coastal Monitoring and Assessment.

Table 1. Locations of sampling sites for spring 2003 benthic and fish survey at GRNMS.

Station	Sample Type	Latitude	Longitude
A	75-m transect (dive site)	31° 22.2306	-80° 50.3274
B	75-m transect (dive site)	31° 23.5146	-80° 50.2560
C	75-m transect (dive site)	31° 22.1322	-80° 51.9954
D	75-m transect (dive site)	31° 23.9898	-80° 53.3383
3T	Trawl and Young Grab	31° 25.518	-80° 52.008
10T	Trawl and Young Grab	31° 24.336	-80° 49.386
17T	Trawl and Young Grab	31° 21.474	-80° 53.862
GRNMS Monitoring Site	Fish collections only	31° 23.8146	-80° 53.4612

Table 2. Summary of fish taxa collected for gut content analysis during spring 2003 benthic and fish survey at GRNMS.

Family	Taxa Name	Comman Name	Total
Bothidae	<i>Bothidae</i> spp.	Flounder	2
Bothidae	<i>Citharichthys macrops</i>	Spotted Whiff	5
Bothidae	<i>Etropus microstomus</i>	Smallmouth Flounder	24
Bothidae	<i>Paralichthys lethostigma</i>	Southern Flounder	1
Bothidae	<i>Syacium papillosum</i>	Dusky Flounder	16
Congridae	<i>Ariosoma balearicum</i>	Conger Eel	5
Cynoglossidae	<i>Symphurus</i> spp.	Tonguefish	16
Dactyloscopidae	<i>Dactyloscopus tridigitatus</i>	Sand Stargazer	23
Gadidae	<i>Urophycis regia</i>	Spotted Hake	8
Haemulidae	<i>Haemulon aurolineatum</i>	Tomtate	9
Haemulidae	<i>Orthopristis chrysoptera</i>	Pigfish	4
Labridae	<i>Hemipteronotus novacula</i>	Pearly Razorfish	22
Mullidae	<i>Upeneus parvus</i>	Dwarf Goatfish	1
Ophidiidae	<i>Otophidium omostigma</i>	Spotted Cusk Eel	2
Ophidiidae*	<i>Ophidion</i> spp.	Cusk Eel	22
Sciaenidae	<i>Equetus umbrosus</i>	Cubbyu	28
Serranidae	<i>Diplectrum formosum</i>	Sand Perch	20
Sparidae	<i>Stenotomus chrysops</i>	Scup	28

* - 2 species: Moon-eye Cusk Eel (*O. selenops*) and Striped Cusk Eel (*O. marginatum*)

Table 3. Scientific crew for spring 2003 benthic and fish survey at GRNMS.

Name	Affiliation
Jeff Hyland	NOS/NOAA/NCCOS/CCEHBR
Len Balthis	NOS/NOAA/NCCOS/CCEHBR
Jon Brewer	NOS/NOAA/NCCOS/CCFHR
Cindy Cooksey	NOS/NOAA/NCCOS/CCEHBR
JD Dubick	NOS/NOAA/NCCOS/CCEHBR
Mike Green	NOS/NOAA/NCCOS/CCFHR
Margaret Holbrook	NOS/NOAA/NCCOS/CCEHBR
Greg McFall	NOS/NOAA/NMS/GRNMS
Debbie Moroney	Volunteer with GRNMS
Stephanie Rexing	NOS/NOAA/NCCOS/CCEHBR
Harvey Walsh	NOS/NOAA/NCCOS/CCFHR

Table 4. Field logistics summary of spring 2003 benthic and fish survey at GRNMS.

Date	NOAA Vessel	Launch Site, Staging Area	Field Activities
5/8/03	Nancy Foster	Depart Charleston, SC for GRNMS	Arrive GRNMS. Sample Station 3T.
5/9/03	Nancy Foster	GRNMS	Sample transect A, and stations 3T, 10T.
5/10/03	Nancy Foster	GRNMS	Sample transects A, B, and stations 10T, 17T.
5/11/03	Nancy Foster	GRNMS	Sample transects B, C, and stations 10T, 17T.
5/12/03	Nancy Foster	GRNMS	Sample transect C, and stations 3T, 17T.
5/13/03	Nancy Foster	GRNMS	Sample transects C and D.
5/14/03	Nancy Foster	GRNMS	Sample transect D and GRNMS Monitoring Site.
5/15/03	Nancy Foster	GRNMS	Sample GRNMS Monitoring Site. Depart for Charleston, SC.
5/16/03	Nancy Foster	Return to Charleston, SC	Demobilization.

Table 5. Water quality measurements as measured with a SeaBird 19 CTD during the spring 2003 benthic and fish survey at GRNMS.

Station	Depth (m)	Temp. (deg C)	Cond. (S/m)	Pressure (psi)	PAR/ Irradiance	Salinity (PSU)	Density (sigma-t, KG/m ³)
3T	0.5	24.78	4.28	0.73	5.10E-03	27.63	17.85
3T	10.0	19.58	4.53	14.61	2.67E-01	33.16	23.47
3T	20.5	19.37	4.53	29.95	2.33E-01	33.36	23.68
10T	0.5	25.62	4.74	0.73	1.28E-01	30.43	19.71
10T	10.5	19.87	4.68	15.34	2.71E-01	34.17	24.16
10T	21.0	19.86	4.68	30.68	2.86E-01	34.20	24.19
17T	0.5	25.52	4.80	0.73	5.10E-03	30.94	20.12
17T	9.0	19.44	4.62	13.15	2.28E-01	34.08	24.20
17T	17.5	19.39	4.63	25.56	2.03E-01	34.12	24.25
A	0.5	24.69	4.69	0.73	5.10E-03	30.68	20.17
A	9.0	19.58	4.67	13.15	6.71E+01	34.31	24.35
A	18.5	19.57	4.67	27.02	1.29E+01	34.35	24.38
B	0.5	25.52	4.73	0.73	6.24E+00	30.40	19.71
B	9.5	19.61	4.66	13.88	2.17E+00	34.23	24.28
B	19.0	19.53	4.66	27.75	8.33E-01	34.28	24.33
C	0.5	25.57	4.80	0.73	5.10E-03	30.85	20.04
C	9.0	20.53	4.74	13.06	4.32E+00	34.16	23.98
C	18.0	19.88	4.71	26.29	8.45E-01	34.41	24.34
D	0.5	24.27	4.88	0.73	5.10E-03	32.38	21.58
D	9.0	22.67	4.84	13.15	5.17E+00	33.29	22.73
D	18.0	20.77	4.83	26.29	9.36E-01	34.68	24.31
GRNMS Monitoring Site	0.5	24.22	4.92	0.73	5.10E-03	32.70	21.84
GRNMS Monitoring Site	10.0	21.89	4.85	14.61	1.46E+01	33.95	23.45
GRNMS Monitoring Site	20.0	21.26	4.88	29.22	2.27E+00	34.66	24.17

Appendix A

Activity Log

NF-03-01-NC Activity Log

Date	Time	Activity
5/8/03	0945	Depart Pier Papa, Charleston
	2135	Arrive station 03T
	2135-2400	3 beam trawls, 1 CTD
5/9/03	0845	Arrive station R1
	1030-1645	Diving operation @ R1 (lay transect + complete coring at A01, A10). Dive 1 ^(5 divers) @ 1029, Dive 2 ⁽³⁾ @ 1507, Dive 3 ⁽³⁾ @ 1600. All dives today completed 1645. Underway for station 03T @ 1700
	1750	Arrive station 03T
	1750-2034	3 infaunal grabs, 3 otter trawls. Depart 2045
	2130	Arrive station 10T (franchise lost)
5/10/03	2130 - 0205 5/10/03	3 otter trawls, 3 beam trawls, 1 CTD
	0940	Resume dive operations @ R1
	1230	[Dive 1 (4 divers), video + coring @ A25 + A75, in water @ 1002 - up 1037
		[Dive 2 (2 divers), isotope sampling + remove transect - up 1133 ; CTD @ 1228
	1310	Arrive station R4 Completed all work at R1.
	1325 - 1811	Diving operations @ R4 [Dive 1 (4 divers) in @ 1359, lay transect. Dive 2 (3 divers) in @ 1457, scout transect 75-m end. Dive 3 (2 divers) in @ 1540, take cores at B01, B02, B25, B75] - up @ 1617
	1811	CTD @ R4; Head for station T17 @ 1820

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Date	Time	Activity
5/10/03	1915	Arrive station # 117T (Grablot)
	1915 (5/10)	Off-rawl 1 @ 1915, Off-rawl
	to 0146 (5/11)	2 @ 1954, Off-rawl 3 @ 2019,
		CTD @ 2104, Beam Trawl 1 @ 2332, Beam Trawl 2 @ 0007, Beam Trawl 3 @ 0042
5/11/03	0915	Rescue Boat departs for R4 DIVE 1 (Mortney, Brewer) to R4 to collect isotope samples + remove transect In: 1020, Up: 1100
	1030	Arrive Station R9
	1200 - 1852	Diving operations @ R9 [Dive 1 (4 divers) in @ 1202; to key transect; Up @ 1236] (Holtbrock + Battis @ 1229, McFall + Rogers @ 1236) Dive 2 (3 divers: Rogers, Holtbrock, Battis) in @ 1305, up @ 1327; scouted for end Dive 3 (2 divers: Brewer + Holtbrock Maroney) in @ 1439, up @ 1570; collected cores @ C01 + C10 Dive 4 (Brewer + Maroney), in @ 1540, up @ 1610; coring @ C25 + C75 Dive 5 (McFall, Holtbrock, Battis): In @ 1713; up @ 1740; fishing by diver techniques + video; CTD @ 1852; depart for station T17
	1939	Arrive station T17
	1948-2050	4 benthic grabs, @ T17
	2158	Arrive station T10

BT4 @ 0109,
BTS @ 0146

NF-03-01-NC Activity Log

Date	Time	Activity
	2210-2334 2210-2334	4 benthic, 2 beamtrawls @ T10
5/12/03	0130	Arrive Station 3T
	0140-0235	3 beam trawls
	0930	Monarch underway for diving at station R9
	1100-1142	to ^{dive 1} collect the isotope sampler + Remove transect; also video footage taken (McFall, Brewer, Moroney, Middleton, etc.)
	1100-1142 1155-1224	Dive 2 (on rescue boat) - Collect fish (Holbrook, Balthis)
	1438-1509	Dive 3 (collect fish) - Balthis, Holbrook, Moroney, McFall
	1538-1606	Dive 4 (collect fish) - McFall, Balthis, Holbrook, Moroney
	1745-1809	Bottom grabs (10) for lancelet hunting @ 17T
	1827-2015	Offet trawling (4) @ 17T
	2015-2200	Beam trawling @ 17T
5/13/07	0915-1205	Diving operations to collect fish @ R9:
		Dive 1 (Holbrook + Balthis, In @ 0948, McFall, Rogers) Up @ 1026
		Dive 2 (McFall, Rogers, Brewer, Moroney) In @ 1123, Up @ 1205

NF-03-01-NC Activity Log

Date	Time	Activity
	1228	CTD at (with Nustik) @ R9
	1305	Underway to F3
	1437-1511	Dive 1 - Lay Transect GR03D (McFall, Balthis, Marone, Holbrook)
	1539-1603	Dive 2 (same) - confirm transect
	1643-1706	Dive 3 (Middlemiss, Brewer) - Coring @ D1 + D10, <small>BUT samples lost</small>
	1757-1826	Dive 4 (same) - coring @ D25 + D75
	1933-1958	1 CTD with nusten + extra nusten
	2006-2021	4 grabs taken to search for infauna for isotope analysis
5/14/03	-	Anchor for night on west side of sanctuary
	0934	Arrive Station F3
	0953-1021	Dive 1 - search for lost cores from yesterday, <small>cores found</small> Coring @ D1 and D10 (Balthis, Holbrook, Middlemiss, McFall, Rogers).
	1050-1127	Dive 2 - Coring + D1 and D10; Fishing
	1144-1220	Dive 3 - collect isotope samples & remove transect (Brewer, Marone). All dive transects completed.
	1330-1630	Arrive GRNMS monitoring site
		DIVE 1 (McFall, Balthis, Holbrook, Middlemiss), In @ 1441. Up @ 1523 1523; Collect Fish
		DIVE 2 (Middlemiss, Marone), In @ 1630 1630 Up @ 1630 1630. Collect Fish } DIVE scrapped due to currents @ 1630
	1736	CTD @ 1776

NF-03-01-NC Activity Log

Date	Time	Activity
	1740-1950	Continue Fishing by hook-n-line @ GRNMS monitoring site
	1950	depart for Station 19T to anchor for night. Arrive 10T @ 2045
5/15/03	0915-1148	Dive operations to recover lost grab: Dive 1 (Batthuis, Holbrook, Brewer, Maroney) on Monard. In @ 1021. Up @ 1046. 1053 (Maroney, Brewer)
		Dive 2 (same): In @ 1119. Up @ 1132. 1148 (Holbrook, Batthuis, Maroney, Brewer)
		Grab coordinates: 31°21.686' N, 80°54.312' W
		Grab NOT Found - Search aborted.
	1230	Underway for GRNMS monitoring site
	1424-1506	Dive operations to catch fish: Dive 1 (McFall, Rogers, Batthuis, Holbrook) - Monard. In @ 1424, Up @ 1454 (Batthuis, Holbrook) 1506 (Rogers, McFall)
		Dive 2 (same) In @ 1528 Up @ 1554 (Batthuis, Holbrook), 1610 (Rogers, McFall)
		Dive 3 (Brewer, Maroney) - Rescue boat. In @ 1626. Up @ 1703
		Dive 4 (same). In @ , Up @
	1753	CTD @ Monitoring site - Fish until ~ 2000
	2010	Underway for Charleston

5/16/03 ~ 0900 Arrive port Charleston