

A Preliminary Study of the Marine Biota at Navassa Island, Caribbean Sea

MARK GRACE, MELISSA BAHNICK and LISA JONES

Introduction

During the 1998 U.S., Mexico, and Cuba shark assessment cruise (Grace¹), Navassa Island was included as a study site. Primary objectives there were to determine what reef fish and shark populations were present and to collect associated environmental data at

¹Grace, M. 1998. Cruise results for *Oregon II 98-02 (231)*, coastal shark assessment, U.S., Mexico, and Cuba. Cruise report, 26 p., on file at NMFS Mississippi Laboratories, P.O. Drawer 1207, Pascagoula, MS 39568-1207.

The authors are with Mississippi Laboratories of the Southeast Fisheries Science Center, NMFS, NOAA, P.O. Drawer 1207, Pascagoula, MS, 39568-1207 [email: Mark.A.Grace@noaa.gov Melissa.Bahnick@noaa.gov Lisa.M.Jones@noaa.gov].

ABSTRACT—A preliminary study of reef fish and sharks was conducted at Navassa Island in the Caribbean Sea during a 24-h period beginning 9 September 1998. Conducting a study at Navassa Island was of particular interest because exploitation of Navassa Island's fishery resources has been considered minimal due to its remote location (southwest of the Windward Passage, Caribbean Sea) and lack of human habitation. Reef fish (and associated habitats) were assessed with stationary underwater video cameras at 3 survey sites; sharks were assessed by bottom longlining at 5 survey sites. Fifty-seven reef fish identifications to lowest possible taxon were made from video footage. Longline catches produced 3 shark species and 3 incidental catch species. When results from the 1998 National Marine Fisheries Service (NMFS) project are combined with a previous 1977 NMFS survey of Navassa Island, 27 fish families, 79 fish identifications to lowest possible taxon, 4 invertebrate orders or families, 3 coraline families, and 2 macroalgal phyla are reported.

survey sites. Survey activities included use of underwater video cameras to record reef fish assemblages and sea bottom characteristics at selected video sites; bottom longlining was also conducted to assess shark relative abundance (Table 1).

The opportunity to assess fish populations at Navassa Island was important for several reasons, including its status as one of the last unexploited islands in the Greater Antilles. Many Caribbean nations have experienced over-exploitation of fishery resources during recent decades, and conditions for improvement of fishery stocks do not seem likely considering demand for fish products as a protein source (Munro, 1996). Oceanic conditions are another factor that can influence the status of Caribbean reef fish populations since overexploitation potentially affects fish populations downstream of recruitment sources (Roberts, 1998). Therefore, the importance of Navassa Island as a likely source of recruits to neighboring Caribbean areas and as an important habitat for viable fish stocks should be established.

Navassa Island, an uninhabited U.S. possession in the Caribbean Sea located between Haiti and Jamaica (Fig. 1), was claimed by the United States as a part of the 1857 Guano Act. In 1997 the U.S. Coast Guard transferred stewardship of the island to the U.S. Department of Interior which issued a general research permit to NMFS to conduct the 1998 survey.

Navassa Island is a flat-topped prominence (maximum elevation 77 m) of about 5.2 km² in size. A shallow reef is present at the northwestern tip of the island, but most bottom depths adjacent to shore begin at 20 m with a gradual

depth increase to 40 m (Fig. 1); bottom depth increases are more pronounced beyond 40 m, with depths up to 500 m within 0.8 n.mi. of the north shore. The bottom type is coarse sand with broad areas of live bottom (corals, sponges, and algae), limestone rock, and rubble. The shore of Navassa Island is principally limestone cliffs with a small area along the north coast consisting of a steep rocky beach with some sand. The island is covered with dense tropical foliage, primarily palm trees with brush undergrowth and cactus. An abandoned lighthouse and relic building ruins are located midway along the western shore (Fig. 2). Numerous seamounts within its territory (Exclusive Economic Zone) are unique features for the northeast region of the Caribbean Sea.

Materials and Methods

To collect underwater video footage, four Hi-8 video cameras² with wide-angle (120°) lenses were fixed in underwater camera housings (rated to 109 m depth). Cameras were attached orthogonally to a metal camera-support frame (weighted), and deployed with buoys. The 4-camera array was baited with 0.5 kg Atlantic mackerel, *Scomber scomber*, suspended in a mesh basket at the center of the array.

Prior to deployment of video 4-camera arrays, the survey sites' bottom type was assessed with the ship's echosounder to determine presence of bottom features (reef structure) or above-bottom return signals (fish). Due to ship safety concerns, survey operations were not conducted within 0.3 n.mi. of shore. Camera

²Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

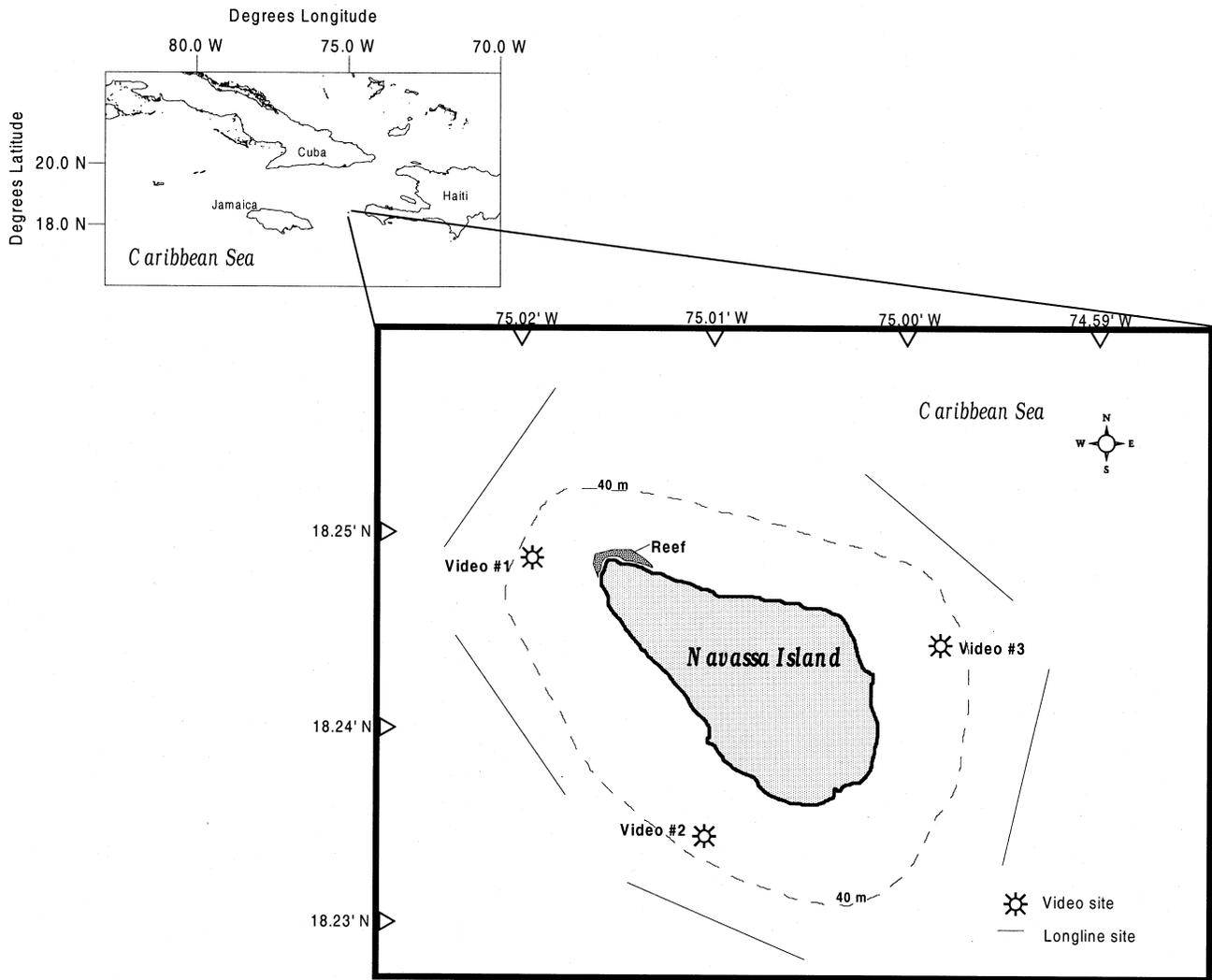


Figure 1.— Survey sites at Navassa Island, *Oregon II* survey 98-02 (231).

Table 1.—Survey site locations and associated environmental data (maximum gear depth) from Navassa Island (1998).

Location (lat./long.)	Gear	Depth (m)	Time (h)	Temperature (°C)	Salinity (ppt)	Dissolved oxygen (mg/l)	Turbidity (% transmittance)	Chlorophyll (mg/m ³)	Effort
18°25.85'N/75°01.84'W	Longline	342.0	0627	16.48	36.26	4.9	0.02	0.0732	2 h
18°24.90'N/75°01.99'W	Video #1	29.9	1000	29.40	36.10	4.7	0.10	0.0178	5 h 50 min
18°23.32'N/75°01.02'W	Video #2	28.0	1409	29.55	36.09	4.8	0.02	0.1368	4 h 26 min
18°24.37'N/74°59.85'W	Video #3	38.3	1757	29.45	36.07	4.8	0.02	0.176	3 h 28 min
18°23.52'N/74°59.37'W	Longline	272.1	2043	16.20	36.22	4.8	0.05	0.081	2 h
18°24.84'N/74°59.63'W	Longline	240.0	0107	16.70	36.27	4.9	0.02	0.076	2 h
18°23.67'N/75°01.89'W	Longline	224.0	0548	18.76	36.60	4.6	0.05	0.085	2 h
18°22.82'N/75°00.75'W	Longline	272.0	0956	18.82	36.62	5.0	0.05	0.081	2 h

drops were made in areas that were determined to be reef habitats; camera drops were not conducted in areas that appeared to be nonreef or devoid of above-bottom return signals. Camera drops were located in approximate triangulation around Navassa Island to provide a measure of coverage.

Five bottom longline survey sites were selected around the island's perimeter and parallel to depth contours when possible. Since the length of the longline (1 n.mi.) was almost equal to the length of Navassa Island, longline sets were relatively close together. The start point for longline sets was estab-

lished by dividing the perimeter of Navassa Island into 5 relatively uniform (by size) sampling zones then selecting a random point within each zone. Direction of longline sets was often dependent on sea and weather conditions and sets were configured so they would not overlap with adjacent longline sites.



Figure 2.—Navassa Island lighthouse and western shore.

The survey platform NOAA Ship *Oregon II* (Fig. 3), was outfitted with commercial-type longline gear for conducting longline operations. Monofilament mainline (426 kg test, 1 n.mi. length) was directed to the stern with longline components attached to the mainline during longline sets (3.7 m gangions of 332 kg monofilament with #3/0 shark hooks, radar reflector buoys, 5 kg weights). Hooks (50) were baited with Atlantic mackerel that was either whole or cut in half, and gear soak time was about 2 h for each set.

Environmental data were collected with a CTD deployed at each survey site. The CTD provides a surface to bottom profile of temperature, salinity, dissolved oxygen, turbidity, and chlorophyll.

Results

Reef fish were identified from video footage (13 h 44 min total) collected at 3 video sites (Fig. 1 and Table 1). Video

footage recorded with each camera of the 4-camera array was reviewed. Species identifications from video footage were made by family, genus or species (lowest possible taxon; some fish identifications were possible only to family or genus due to far-field resolution). Fifty-seven reef fish identifications to lowest possible taxon representing 20 families were made from video footage collected at the 3 video sites (Table 2). It was not uncommon to record several reef fish species in the same video frame. If reef fish were numerous, video segments had to be reviewed a number of times to determine species identifications.

While recording video footage at video sites #2 and #3, the camera-support frame repositioned to its side (due to currents or bottom irregularities) and the camera view changed which affected video documentation of reef fish at those sites. Every effort was made to utilize as much footage as possible for

identifying reef fish. In addition, video footage collected at video site #3 was affected by end-of-the-day decreasing ambient light. Enumerating reef fish from video footage was not attempted since only video site #1 provided footage adequate for enumerations; however, members of reef fish families Pomacentridae, Labridae, and Scaridae were abundant at all 3 video sites.

From video footage reviews it was possible to discern bottom characteristics and associated encrusting organisms at video sites (Table 3). At the northwest video site (#1) the bottom was of relatively even relief with thick patches of soft corals, sponges, and algae; the southernmost video site (#2) had irregular low clumps of rock and encrusting organisms surrounded by sand and thick patches of sea feathers (*Pseudopterogorgia*); the northeastern video site (#3) had numerous clumps or mounds (estimated at 1 m height, 2–4 m diameter, possibly limestone)



Figure 3.—NOAA Ship *Oregon II*.

capped with soft corals, sponges, and algae. Porifera (sponges), Octocorallia (soft corals), and Chlorophyta (green alga) were found in common at the 3 video sites.

Bottom longline effort produced 10 shark captures (Table 4), and the predominant shark captured was the scalloped hammerhead, *Sphyrna lewini*. The highest shark catch rate occurred at the west-southwest longline site with 6 captures (5 scalloped hammerheads and 1 smooth dogfish, *Mustelus canis*). Incidental captures from longline sites included 1 misty grouper, *Epinephelus mystacinus*; 1 silk snapper, *Lutjanus vivanus*; and 1 great barracuda, *Sphyraena barracuda*.

Bird observations were opportunistic (made both unaided and with binoculars), with identifications to genus and species. Species included Cory's shearwater, *Calonectris diomedo*; magnificent frigatebird, *Fregata magnificens*; cliff swallow, *Hirundo pyrrhona*; Bonaparte's gull, *Larus philadelphia*; Pomarine jaeger, *Stercorarius*

pomarinus; masked booby, *Sula dactylatra*; brown booby, *Sula leucogaster*; and red-footed booby, *Sula sula*. Extensive booby nesting areas (identification to species not possible) were noted in treetops along the south side of the island with at least 40 nests observed with young birds roosting.

Discussion

Since 1900 there have been few scientific expeditions to Navassa Island (conducted principally to assess terrestrial fauna: Ekman, 1929; Clench, 1930; Burns et al., 1959), and there are no published records from those expeditions describing marine fauna beyond the splash zone. Recent marine fauna studies of Navassa Island include a project conducted by NMFS in 1977 (Miller³) and 1998, 1999, and 2000 projects (detailed survey results

are not yet available) sponsored by the Center for Marine Conservation (CMC) (Smith⁴). The 1977 NMFS survey deployed hook and line gear, wire and wood crustacean traps, a tumbler dredge, trolling rigs, neuston and ichthyoplankton nets, dipnets, and snorkel diver operations. When results from the 1977 and 1998 NMFS projects are combined, 27 fish families, 79 fish identifications to lowest possible taxon, 4 invertebrate orders or families, 3 coralline families, and 2 macroalgae phyla are reported (Tables 2, 3). Macroalgae was recorded on video footage from all 1998 NMFS camera drop sites (Table 3), and the 1977 NMFS Navassa Island report (Miller³) also confirmed the presence of macroalgal reefs.

The concept of Navassa Island as a pristine and entirely unexploited marine habitat must be viewed with caution. Miller³ mentions Haitian fishermen in-

³Miller, G. 1977. Cruise results for *Oregon II* 77-08 (80), Navassa Island resource assessment survey. Cruise report, 12 p., on file at NMFS Southeast Fisheries Science Center Miami Laboratory, 75 Virginia Beach Dr., Miami, FL 33149.

⁴Smith, M. 1998. Center for Marine Conservation, 1725 DeSales St. N.W., Wash., DC 20036. Personal commun.

Table 2.—Fish identified at Navassa Island during 1998 and 1977. Gear types: trolling = Tr, trap = T, pole and line = P, dredge = D, snorkel diver = Sn, longline = L, video camera = V.

Family and scientific names	Common name	Gear types		Family and scientific names	Common name	Gear types	
		1998	1977			1998	1977
Carcharhinidae				Chaetodontidae (continued)			
<i>Carcharhinus leucas</i>	Bull shark	L		<i>Chaetodon sedentarius</i>	Reef butterflyfish	V	
Triakidae				Pomacanthidae			
<i>Mustelus canis</i>	Smooth dogfish	L		<i>Holacanthus tricolor</i>	Rock beauty	V	
Sphyrnidae				<i>Pomacanthus arcuatus</i>	Gray angelfish	V	
<i>Sphyrna lewini</i>	Scalloped hammerhead	L		Pomacentridae			
Urolophidae				Pomacentridae	Damselfishes	V	
<i>Urolophus jamaicensis</i>	Yellow stingray	V		<i>Chromis</i> sp.	Damselfish	V	
Muraenidae				<i>Chromis cyanea</i>	Blue chromis	V	
<i>Gymnothorax moringa</i>	Spotted moray		T	<i>Chromis multilineata</i>	Brown chromis	V	
Antennariidae				<i>Microspathodon chrysurus</i>	Yellowtail damselfish	V	
<i>Antennarius multiocellatus</i>	Longlure frogfish		D	<i>Pomacentrus</i> sp.	Damselfish	V	
Holocentridae				<i>Pomacentrus partitus</i>	Bicolor damselfish	V	
<i>Holocentrus</i> sp.	Squirrelfish	V		<i>Pomacentrus planifrons</i>	Threespot damselfish	T	
<i>Holocentrus adscensionis</i>	Squirrelfish	V	T	Sphyraenidae			
<i>Holocentrus marianus</i>	Longjaw squirrelfish		T	<i>Sphyraena barracuda</i>	Great barracuda	V, L	Tr, Sn
<i>Holocentrus rufus</i>	Longspine squirrelfish		T	Labridae			
Aulostomidae				Labridae	Wrasses	V	
<i>Aulostomas maculatus</i>	Trumpetfish	V		<i>Bodianus rufus</i>	Spanish hogfish	V	
Serranidae				<i>Clepticus parrae</i>	Creole wrasse	V	
<i>Hypoplectrus</i> sp.	Hamlets	V		<i>Halichoeres garnoti</i>	Yellowhead wrasse	V	
<i>Hypoplectrus puella</i>	Barred hamlet	V		<i>Thalassoma bifasciatum</i>	Bluehead wrasse	V	
<i>Serranus tigrinus</i>	Harlequin bass	V		Scaridae			
<i>Cephalopholis cruentatus</i>	Graysby	V		Scaridae	Parrotfishes	V	
<i>Cephalopholis fulvus</i>	Coney	V	P	<i>Scarus</i> sp.	Parrotfish	V	
<i>Epinephelus guttatus</i>	Red hind	V	P	<i>Scarus taeniopterus</i>	Princess parrotfish	V	
<i>Epinephelus mystacinus</i>	Misty grouper	L		<i>Sparisoma atomarium</i>	Greenblotch parrotfish	V	
<i>Mycteroperca rubra</i>	Comb grouper		D	<i>Sparisoma aurofrenatum</i>	Redband parrotfish	V	T
<i>Mycteroperca tigris</i>	Tiger grouper		Sn	<i>Sparisoma viride</i>	Spotlight parrotfish	V	
<i>Paranthias furcifer</i>	Creolefish	V	P	Gobiidae			
<i>Rypticus saponaceus</i>	Greater soapfish	V		<i>Coryphopterus personatus/hyalinus</i>	Masked/Glass goby	V	
Malacanthidae				Acanthuridae			
<i>Malacanthus plumieri</i>	Sand tilefish	V	P	<i>Acanthurus</i> sp.	Tangs	V	
Carangidae				<i>Acanthurus bahianus</i>	Ocean surgeon	V	T
<i>Elagatis bipinnulata</i>	Rainbow runner		P	<i>Acanthurus coeruleus</i>	Blue tang	V	
<i>Seriola</i> sp.	Jacks		Sn	Scombridae			
<i>Caranx</i> sp.	Jacks	V		<i>Thunnus atlanticus</i>	Blackfin tuna	Tr	
<i>Carnax bartholomaei</i>	Yellow jack	V		Balistidae			
<i>Caranx latus</i>	Horse-eye jack		P	Balistidae	Triggerfish	V	
<i>Caranx lugubris</i>	Black jack		P	<i>Balistes vetula</i>	Queen triggerfish	V	P, T
<i>Caranx ruber</i>	Bar jack	V	P	<i>Canthidermis sufflamen</i>	Ocean triggerfish	V	P, Sn
Lutjanidae				<i>Melichthys niger</i>	Black durgon	V	P, Sn
<i>Lutjanus</i> sp.	Snappers	V		<i>Xanthichthys ringens</i>	Sargassum triggerfish	V	
<i>Lutjanus apodus</i>	Schoolmaster snapper		Sn	<i>Cantherhines macrocerus</i>	Whitespotted filefish	V	
<i>Lutjanus jocu</i>	Dog snapper	V	Sn	Ostraciidae			
<i>Lutjanus vivanus</i>	Silk snapper	L		<i>Lactophrys</i> sp.	Boxfish	V	
<i>Ocyurus chrysurus</i>	Yellowtail snapper	V	Sn	<i>Lactophrys bicaudalis</i>	Spotted trunkfish		T
Haemulidae				<i>Lactophrys polygonia</i>	Honeycomb cowfish	V	
<i>Haemulon album</i>	White margate		P	<i>Lactophrys trigonus</i>	Trunkfish	V	
Mullidae				Tetraodontidae			
<i>Pseudupeneus maculatus</i>	Spotted goatfish	V	T	<i>Canthigaster rostrata</i>	Sharpnose puffer	V	
Kyphosidae				<i>Diodon</i> sp.	Burrfishes		Sn
<i>Kyphosus</i> sp.	Chubs	V	Sn				
Chaetodontidae				Totals (to lowest taxon)		63	33
<i>Chaetodon aculeatus</i>	Longsnout butterflyfish	V	D				

habiting the island, and during the 1998 NMFS project fishing activities from a small sailboat (about 3–4 m length) were observed. This boat sailed to Navassa Island from the east and fishermen checked fishing gear along the south side of the island.

Conclusion

The value of Navassa Island as a unique marine habitat can be estab-

lished through continued studies of its marine ecosystem. Since Navassa Island is uninhabited and remote, it could provide an important platform for researchers to examine a Greater Antilles habitat that may remain in a relatively unexploited state.

During April 1999, Navassa Island was declared a National Wildlife Refuge. This refuge designation encompasses the island and surrounding 12-

mile territorial sea. The U.S. Department of the Interior's, U.S. Fish and Wildlife Service administers Navassa Island through their Caribbean Islands Refuges Office in Boqueron, Puerto Rico.

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Table 3.—Benthic invertebrates and marine plants of Navassa Island (1998 and 1977). Gear types: D = tumbler dredge, Sn = snorkel diver, V = video.

Family and scientific names	Common name	Gear types		Family and scientific names	Common name	Gear types	
		1998	1977			1998	1977
Porifera				Mollusca (continued)			
<i>Agelas schmidtii</i>	Pipes of Pan sponge	V		<i>Lima lima</i>	Spiny fileclam		D
<i>Xestospongia muta</i>	Basket or tub sponge	V		<i>Lima scabra</i>	Rough fileclam		D
Demospongia	Unidentified	V	D	<i>Malleus candeanus</i>	Caribbean hammer oyster		D
Hydrozoa				<i>Murex cabritii</i>	Murex		D
Fire coral unidentified			D	<i>Perotrochus pyramus</i>	Slitsnail		D
Octocorallia				<i>Purpura patula</i>	Widemouth rocksnail		D
<i>Plexaura</i> sp.	Sea rods	V		<i>Spondylus ictericus</i>	Digitate thorny oyster		D
<i>Pseudoplexaura</i> sp.	Porous sea rods	V		<i>Strombus gallus</i>	Roostertail conch		D
<i>Pseudopterogorgia</i> sp.	Sea plumes	V		<i>Trachycardium magnum</i>	Magnum pricklycockle		D
Gorgonacea	Unidentified soft corals	V		<i>Turritella exoleta</i>	Eastern turretnail		D
Hexacorallia				<i>Verticordia fischeriana</i>	Fischer verticord		D
<i>Acropora palmata</i>	Elkhorn coral		Sn	Crustacea			
<i>Diploria</i> sp.	Brain coral		Sn	Anomurans	Hermit crabs		D
Scleractinia	Stony coral		S	Echinodermata			
Mollusca				Astroidea	Sea stars		D
<i>Americardia media</i>	Atlantic strawberry cockle		D	Crinoidea	Crinoids		D
<i>Argopecten gibbus</i>	Atlantic calico scallop		D	Chlorophyta			
<i>Bathytoma viabrunnea</i>	Turrid shell		D	<i>Halimeda</i> sp.	Green algae	V	
<i>Calliostoma aurora</i>	Topsnail		D	<i>Pericillus</i> sp.	Shaving brushes	V	
<i>Cittarium pica</i>	West Indian top snail		D	Phaeophyta			
<i>Conus viliepinii fosteri</i>	Cone shell		D	<i>Dictyota</i> sp.	Strap algae	V	
<i>Coralliophila caribaea</i>	Caribbean coralsnail		D	<i>Lobophora</i> sp.	Fan leaf algae	V	
<i>Cypraea cinerea</i>	Atlantic gray cowrie		D	Unspecified Algae			D
<i>Laevicardium sybariticum</i>	Delicate eggcockle		D				
<i>Leucozonia nassa</i>	Chestnut latirus		D	Totals to lowest taxon		11	29

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Table 4.—Summary of bottom longline captures from 1998 NMFS Navassa Island project (50 hooks set for 2 h at each of 5 bottom longline stations).

Scientific name	Common name	No. captured	Total length (cm)
<i>Carcharhinus leucas</i>	Bull shark	1	170
<i>Mustelus canis</i>	Smooth dogfish	2	96, 101
<i>Sphyrna lewini</i>	Scalloped hammerhead	7	224, 225, 230, 250, 250, 275, 300
<i>Epinephelus mystacinus</i>	Misty grouper	1	78
<i>Lutjanus vivanus</i>	Silk snapper	1	72
<i>Sphyrna barracuda</i>	Great barracuda	1	185

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