RESULTS OF RECONNAISSANCE MAPPING
OF THE GRAY'S REEF NATIONAL MARINE SANCTUARY

Submitted by the

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INTRODUCTION

Reconnaissance mapping of the Gray's Reef National Marine Sanctuary and adjacent areas was carried out by personnel from the Skidaway Institute of Oceanography under contract to the Georgia Department of Natural Resources. Three cruises on board the Skidaway Institute of Oceanography R/V BLUE FIN were made during the period November 1981 - February 1982, using high resolution bathymetric, topographic, and subbottom profiling systems. In addition, closed-circuit underwater television (CCTV) was used to ground-truth remote-sensing data and to aid in establishing sites to monitor any future environmental impact. The geological and biological conditions of Gray's Reef National Marine Sanctuary have been described by Hunt (1974) and NOAA-OCZM (1980). The location of Gray's Reef National Marine Sanctuary is shown in Figure 1.

OBJECTIVES OF THE STUDY

The primary objectives of the proposed survey were:

1) to obtain continuous and simultaneous regional bathymetric, topographic, and shallow subbottom information over an 80 square mile area centered around the Gray's Reef National Marine Sanctuary as shown in Figure 2 and Maps 1 and 2 (in pocket).

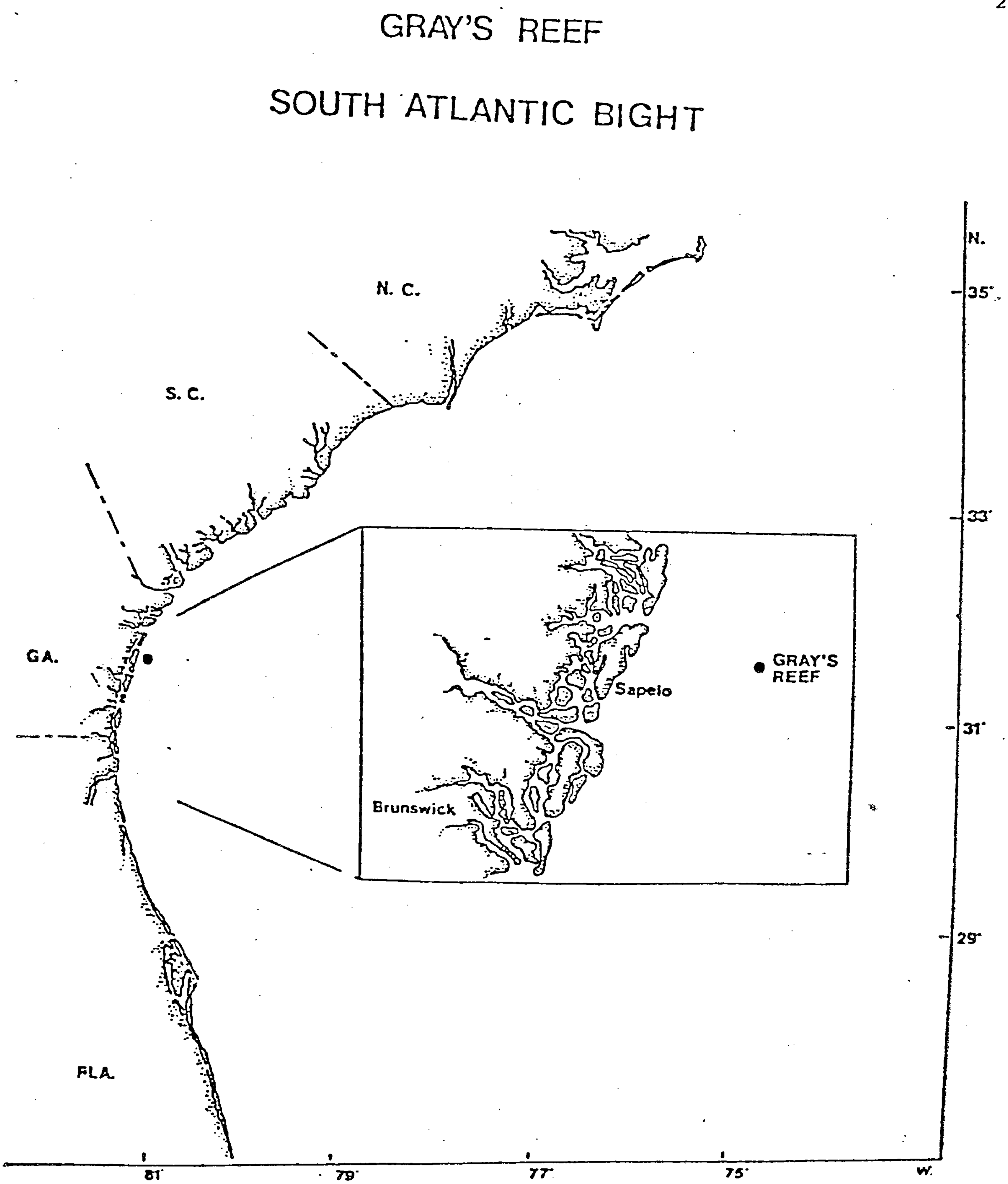

Figure 1. Location of Gray's Reef National Marine Sanctuary.

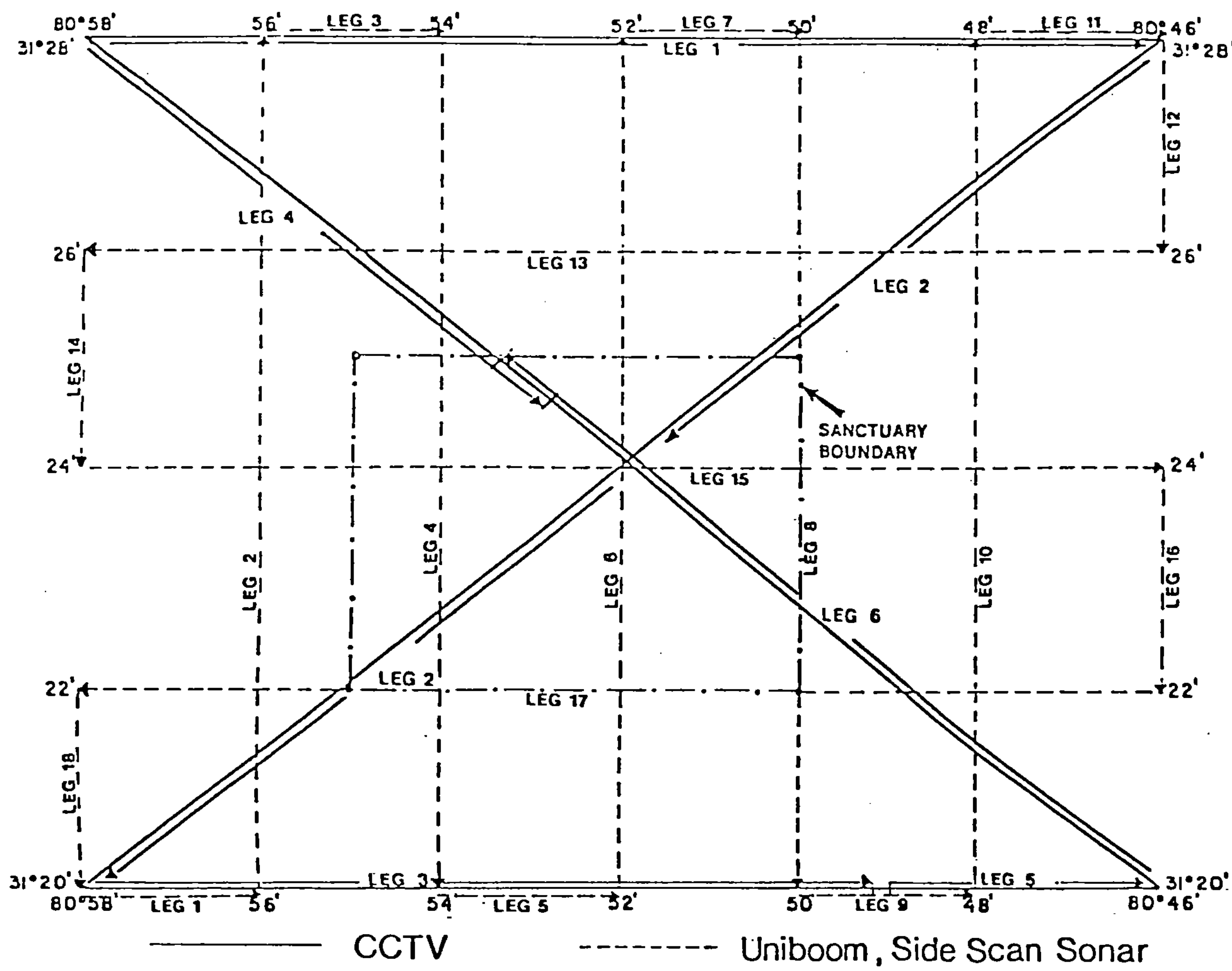

Figure 2. Track line location and identification map, Gray's Reef National Marine Sanctuary survey area.

2) to document the occurrence and distribution of reefs/live bottoms in the survey area as well as any other pertinent biogeological conditions and features as shown on Map 3.

3) to report the results of the survey in such a manner as to facilitate planning/evaluation of any future detailed and accurately located baseline mapping, monitoring, and biogeological studies of the sanctuary.

DATA ACQUISITION

Field Methods

A total of eleven (11) ship days were required to complete the survey. The track lines and data-type are shown in Figure 2 and Maps 1 and 2. The data acquired were as follows:

Navigation

Station keeping and track line course was maintained using a Micrologic Loran C.

Bathymetry

An EdoWestern precision depth recorder was used to obtain continuous depth profiles over the survey track lines.

Topography

An EG&G sidescan sonar was used to map the occurrence and distribution of reefs, hardgrounds, sand waves, and other bottom morphology beneath and 150 meters on each side of the survey track lines.

Shallow Subbottom Profiles

An EG&G Uniboom high-resolution subbottom profiling system was used to obtain shallow (-50 m) stratigraphic information. These data were used to verify outcrops of reef substrate and the presence of shallow-buried strata that could provide live bottom substrate if the sand cover were removed by scour.

Closed-Circuit Television

A JayMar Ocean Eye 1000 sled-mounted closed-circuit underwater television (CCTV) system was towed on the bottom along the track lines shown in Figure 2 and Map 2. The bottom was continuously viewed on the monitor and recorded on video tape.

The television data were used 1) to locate previously unknown and undescribed live bottoms inside and outside the sanctuary boundaries, 2) to characterize the physical and biological habitats of these, and 3) to complement and correlate information obtained from the sidescan sonar and Uniboom system.

On the basis of video tape review and sidescan sonar data, the five localities shown in Figure 3 were selected for subsequent SCUBA observation and habitat monitoring. The locality ISO-2 is a live bottom presently being monitored by the Coastal Resources Division of Georgia Department of Natural Resources as part of the Living Marine Resources Study under contract to the Bureau of Land Management and will provide excellent baseline information.

Laboratory Procedure

Video Tape Analysis

Thirteen one-hour closed-circuit television (CCTV) tapes were recorded during Gray's Reef cruises GR-1 (November 9 and 10, 1981)

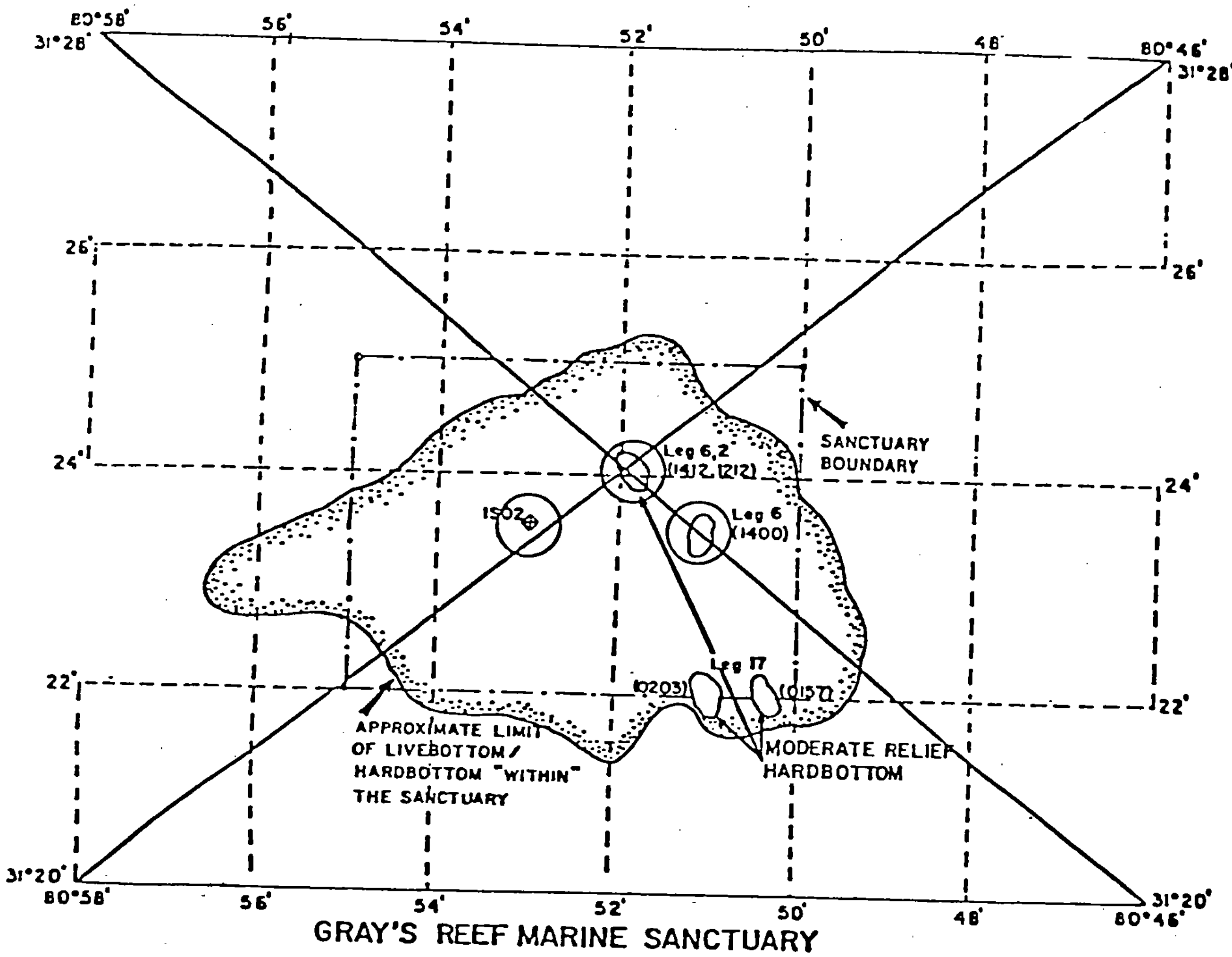

Figure 3. Localities selected for SCUBA observations and habitat monitoring.

and GR-2 (December 3 and 4, 1981). The location of CCTV track lines is shown in Figure 2 and the location of each videotape is shown on Map 4. The one-half inch videotapes were edited using a Sony Model AV-3560 videorecorder (VTR) and a Sony Model CVM-950 video monitor. Each tape was viewed completely while noting the position (latitude and longitude), depth, and elapsed time given on the cruise log.

Bottom types and hardbottoms were characterized according to the Henry and Giles' (1979) classification scheme (Table 1). The extent of a particular physical habitat and the relative density of its associated biota were noted and later were plotted on the track line map (Map 3). The above definition (Table 1) concerning the occurrence of biota on the low-relief hardgrounds has been expanded slightly. The range is now from very sparse to abundant. This will help distinguish between outcrop areas that are covered by a thin layer of sand with very sparse epibenthos and exposed outcrops with denser biota.

An attempt was made to estimate the frequency of occurrence of the larger fauna and flora associated with the bottom types. Precise species identification of many of the larger benthic organisms observed was not possible due to the absence of samples for laboratory verification. Smaller, cryptic and matting forms could not be discerned. Although high turbidity frequently occurred in the water close to the bottom, only extreme conditions prevented the collection of the data as approximately one meter visibility was required as minimum to verify the substrate and biological assemblage types. Usually the more turbid areas were over barren sand and when visibility was reduced, the ship speed was adjusted to aid in observation.

Table 1. Morphological classification of reefs and hard grounds in the Georgia Bight (Henry and Giles, 1979)

Type I - Low-Relief Hard Grounds

<0.5 m relief

Substrate commonly covered by thin veneer of sand

Sparse to moderate occurrence of sessile epibenthos, principally sponges and octocorals

Widely distributed across the shelf

Generally difficult to detect by sonar technique

Type II - Moderate-relief reefs

Up to 2 m relief

Moderate to abundant occurrence of epibenthos, principally sponges, octocorals, and algae

Generally restricted occurrence but most commonly found off north Florida and the Carolinas in inner and middle shelf depths

Moderate to abundant reef fish community

Generally easy to detect using side-scan and fish-finding sonar

Type III - Shelf-edge reef

Up to 15 m relief

Moderate to abundant occurrence of epibenthos, principally sponges, octocorals, and algae

Occur as discontinuous ridge or ridges at or near the initial break in slope - 30 to 100 m water depth

Abundant reef fish community

Easily detected by sonar technique

Seismic Data Analysis

The experience gained in earlier investigations of live bottoms and hardgrounds (Henry and Giles, 1979; Henry, et al., 1980), together with concurrent CCTV data provided a high degree of confidence in the detection of hardgrounds on the sidescan sonar and Uniboom records. Examples of low-relief and moderate-relief hardgrounds depicted by these techniques are given in Figures 4 and 5. As evident in Figure 4a, low-relief hardbottoms with even thin sand covers are difficult to discern on side-scan records. It is important, therefore, to have as much CCTV ground-truth data as possible in order to accurately map the occurrence of this bottom type.

The location of track lines on which only seismic information was obtained and the track lines on which both seismic and CCTV data were acquired is given in Figure 2 and Map 2. The occurrence and distribution of hardbottom/live bottom, based on seismic data interpretation, is shown on Map 3.

DISCUSSION OF RESULTS

Previous Studies of Live Bottom/Hardground

Henry and Giles (1979) demonstrated the importance of using underwater television to ground-truth the geophysically detectable hardbottom areas to ascertain the amount of emergent hardbottom and to identify the type of biological assemblages that were present. Several previous studies have examined biota associated with live bottom habitats on the South Atlantic continental shelf (Pearse and Williams, 1951, Menzies, et al., 1966; MacIntyre and Pilkey, 1969; MacIntyre, 1970; Huntsman and

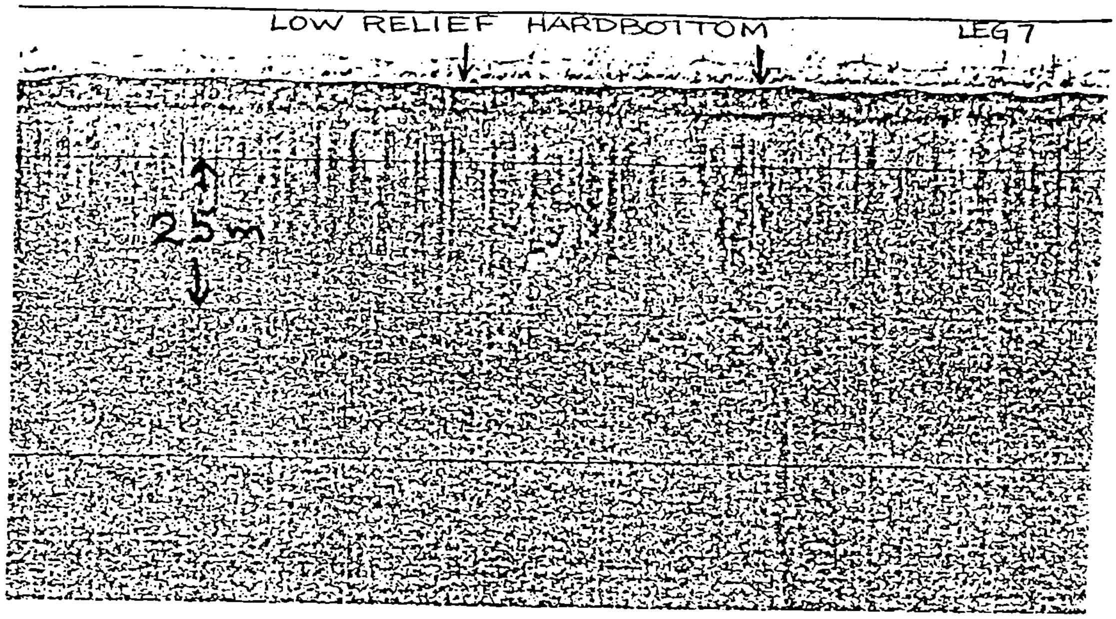

Figure 4a

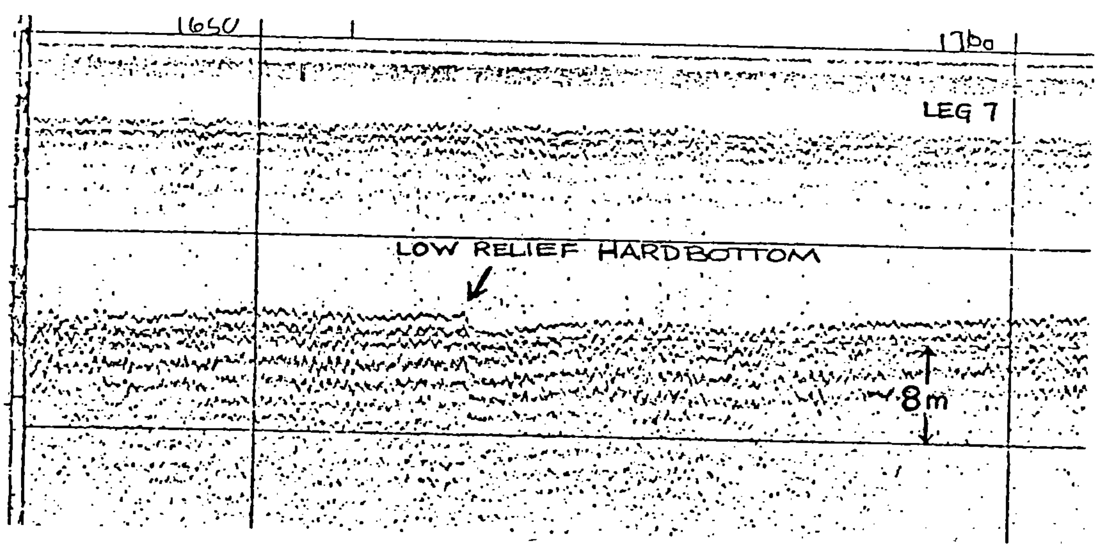

Figure 4b

Figure 4. Seismic signatures of low-relief hardbottom. Figure 4a is plan view of port channel of sidescan record. Figure 4b is Uniboom subbottom profile. Both figures are from the same locality on Leg 7.

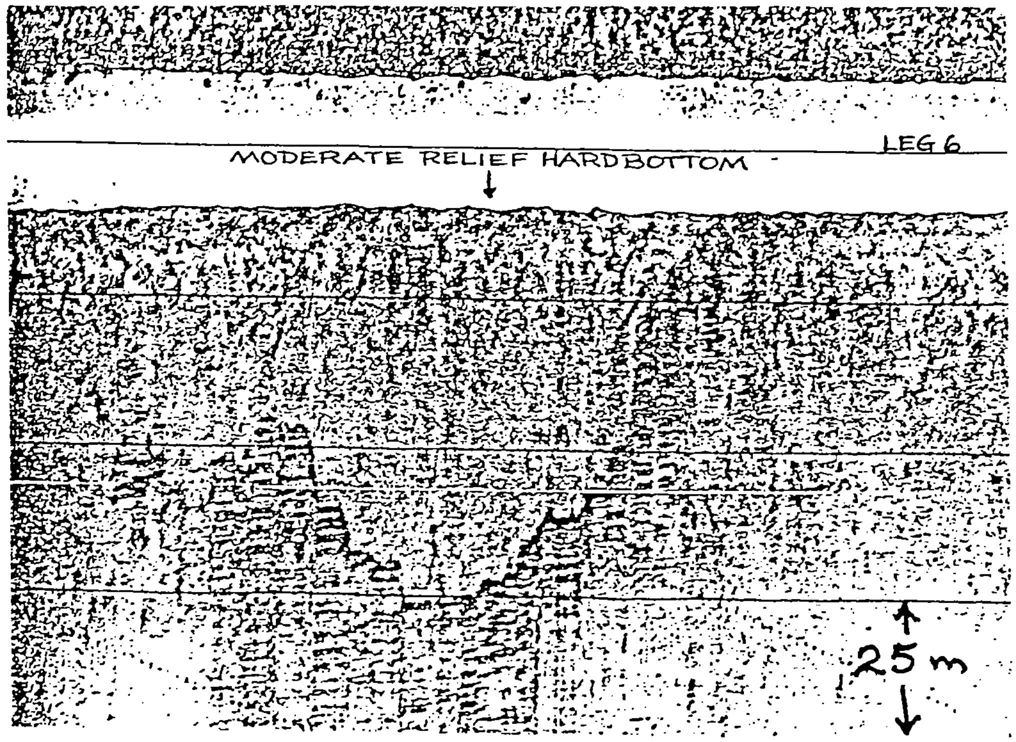

Figure 5a

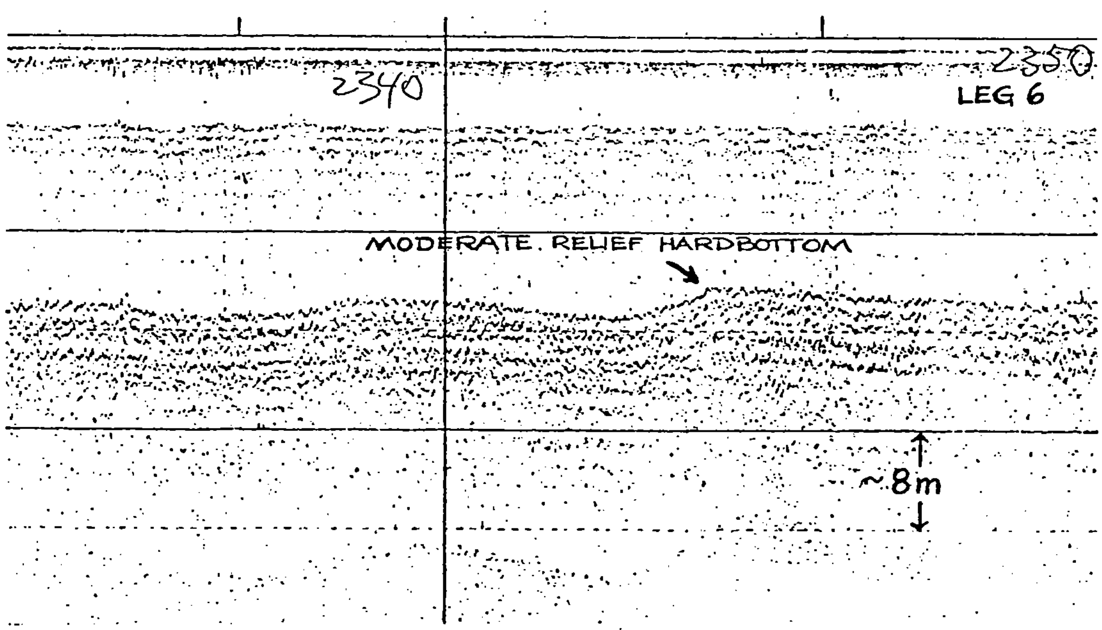

Figure 5b

Figure 5. Seismic signatures of moderate-relief hardbottom. Figure 5a is plan view of port channel of sidescan record. Figure 5b is Uniboom subbottom profile. Both figures are from the same locality on Leg 6.

MacIntyre, 1971; Cain, 1972; George and Staiger, 1978). More recently, studies reported by Continental Shelf Associates (1980), Henry, et al. (1980), Powles and Barans (1980), and Bureau of Land Management (1981) have documented the location and extent of live bottom habitats on the continental shelf and provided generalized characterizations of these sites. In addition, underwater television has been used to estimate the amount of reef habitat on the continental shelf of the South Atlantic and Gulf of Mexico (Barans and Burrel, 1976; Parker, et al., in preparation).

General Description of Gray's Reef National Marine Sanctuary

Gray's Reef, first described by Hunt (1974), is a live bottom located on the South Atlantic continental shelf (Georgia Bight) 23 km (18 n. mi.) due east of Sapelo Island in approximately 20 m (65 ft) of water (Figure 1). Hunt (1974) estimated that the live bottom encompassed approximately 43.8 sq km (12.8 sq mi) between the coordinates 31°22' N and 31°25' N latitude and 80°50' W and 80°55 W longitude (Maps 2 and 3). The sanctuary composes of an area of 57 sq km.

Henry and Giles (1979) described reefs and hardgrounds in the Georgia Bight in terms of three morphotypes (Table 1). Low-relief hardgrounds occur as relatively smooth, rocky outcrops with less than 0.5 m relief and are subject to cyclic covering and uncovering by more or less thin veneers of sand. The associated epibenthos is usually sparse to moderate in occurrence. Moderate-relief hardgrounds exhibit irregular relief to 2 m or more, with moderate to abundant occurrence of fishes and epibenthos. Shelf-edge reefs and ridges range from low relief to over 15 m, usually with abundant occurrence of fishes and epibenthos.

The occurrence and distribution of live bottoms and hardgrounds in the sanctuary and the remaining portions of the survey area are shown on Map 3. It is significant that over 95% of the live bottoms/ hardgrounds observed during the survey occur within the sanctuary. Relative to the surrounding areas, Gray's Reef sanctuary contains extensive, but often patchy and discontinuous, live bottoms of low relief and, to a lesser extent, live bottoms of moderate relief. Recent quantitative studies and preliminary investigations suggest that the live bottoms area composed of a transitional marine biota, with the result that temperate and tropical species overlap in the area (Porter, 1979, pers. comm.; NOAA-OCZM, 1980; BLM, 1981). Much of the biota found on Gray's Reef is different from the more tropical biota encountered on mid-shelf and outer shelf reef formations (George and Staiger, 1978). This temperate assemblage is due to the wide thermal variation and river runoff along the coast, unlike the more stable tropical Gulf Stream waters further offshore (NOAA-OCZM, 1980). Inshore species are usually eurythermal or appear seasonally under favorable conditions. However, there are also offshore influences, such as Gulf Stream eddying, which affect the occurrence of tropical assemblages found on Gray's Reef (NOAA-OCZM, 1980).

Summary of Closed-Circuit Television Observations

General Description

The live bottom areas observed were primarily from video tapes 6 and 13 as shown on Maps 3 and 4. Only small live bottom areas, observed on Tapes 9 and 12, were present outside of the sanctuary boundaries. All of the Tape 6 was within the sanctuary and showed a more or less continuous, mostly very sparse to abundant epibenthic cover. The area with sparse biota on a sand-covered hardbottom is approximately equal to the area with moderate biota on exposed outcrop. The last 5 minutes of Tape 12 showed a live bottom of sparse cover and low relief. This live bottom area is the beginning of the large live bottom area that extends through Tape 13.

The area covered by video tape 13 exhibited patchy and discontinuous low-relief hardbottom. Most of the exposed outcrops were scattered and alternated with flat live bottom areas covered with a thin veneer of sand with sparse biota. Only one very small patch was considered to have an abundant occurrence of epibenthos with a relief of approximately 2 ft.

Tapes 1-4 were recorded on Leg 1 which was a west to east transect located approximately 3 n. mi. north of the sanctuary. This leg was characterized by barren, coarse/shelly sand bottom and Lithothamnion balls. Sea pens (Virgularia presbytes) were very numerous in some areas.

Most of Tape 5 (beginning of Leg 2) also is outside of the sanctuary and shows the bottom to consist of flat sandy areas alternating with ripple areas and composed of coarse, very shelly sand. This area has more bioturbation, Lithothamnion balls, and invertebrates than in Leg 1. Many seastars (Luidia sp.) and whelks (Busycon sp.) were found in this area.

Description of Live Bottom Communities

The live bottom outcrop areas observed were primarily low relief with very sparse to abundant occurrence of biota. Occasionally, some dense patches had relief that bordered between low and moderate. Overall, most of the live bottom encountered was discontinuous and patchy. It is important to note that most of the relatively extensive areas of moderate relief documented from CCTV and SCUBA observations by Hunt (1974) were not surveyed in this study.

The most numerous invertebrate taxa observed were the octocorals Leptogorgia virgulata, Titanideum frauenfeldii, Lophogorgia hebes; sponges Haliclona oculata, Cliona sp. (gamma stage), Ircinia campana, Ircinia spp. (ramose types), Homaxinella spp. of Axinellidae, and many other branching and encrusting sponges. There were also many of the sponges Speciospongia vesparium, Geodia spp., Anthosigmella varians, Aplysina sp., Halicionidae, Microcionidae, Endectyon tenax, and possibly many of the octocorals Leptogorgia setacea and Muricea pendula; the ascidians Aplidium spp. and Styela sp., and unidentified bryozoans and hydroids. A more detailed list of taxa is given in Table 2. These organisms were identified from other sources outside of this study, i.e., still color photography on Gray's Reef, obtained during a survey by the submersible DIAPHUS during August 15-18, 1978 (U.S. Geol. Survey, 1978).

Many other epibenthic organisms were reported for the region by Edwards (pers. comm., 1982) and Plough (1978): algae, bryozoans, hydroids, polychaetes (esp. Filograna implexa), encrusting sponges (esp. Chondrilla nucula, Cliona spp., Schondrosia collectrix, and Spirastrella coccinea), and ascidians (esp. Styela plicata, Molgula arenata, Didemnum candidum, Clavelina sp., and Aplidium sp.)

Very few fishes were identified due to the sled and/or fish moving too fast or to poor visibility. The fishes observed were Centropristis

Table 2. Invertebrate Taxa - identified from still color photography and black and white hand-held and towed CCTV

ANNELIDA
Filograna implexa

ANTHOZOA
Astrangia danae
Cirrhipathes sp.
Cladocora arbuscula
Epizoanthus americanus
Leptogorgia setacea
Leptogorgia virgulata
Lophogorgia sp.
Lophogorgia hebes
Muricea pendula
Oculina varicosa
Telesto spp.
Titanideum frauenfeldii
Virgularia presbytes

ASCIDIACEA
Aplidium constellatum
Aplidium stellatum
Clavelina sp.
Didemnum sp.
Styela plicata

BRYOZOA
Unidentified

ECHINODERMATA
Asterias sp.
Astropecten sp.
Diadema antillarium
Eucidaris tribuloides
Goniaster tesselatus
Holothuridae
Luidia sp.
Luidia alternata
Lytechinus varigatus
Narcissia trigonaria
Ocnus pygmaeus
Tethyaster sp.

HYDROZOA
Unidentified

MOLLUSCA
Busycon sp.
Chama congregata
Fasciolaria sp.
Spondylus americanus

PORIFERA
Anthosigmella varians
Aplysina fistularis
Chondrilla nucula
Chondrosia collectrix
Cliona spp. (alpha, beta, and gamma stages)
Endectyon tenax
Haliclona oculata
Haliclonidae
Homaxinella sp.
Homaxinella rosacea
Homaxinella waltonsmithi
Ircinia spp.
Ircinia campana
~~Ircinia fasculata~~
Ircinia felix
Ircinia strobilina
Microciona spp.
Speciospongia vesparium
Spirastrella coccinea

philadelphica, Halichoeres bivittatus, Centropristic striata, Hemipteronotus novacula, Dasyatis centroura, Myliobatidae, Sparidae, Rypticus sp., Clupeidae sp., and Mustellus canis. A list of fish species identified on Gray's Reef from earlier TV tow tapes and still color photographs has been provided in Table 3.

Barren Sand Areas

The barren sand areas were characterized by coarse, shelly sand (primarily bivalve shell halves heavily encrusted with algae) and usually ripples with some degree of bioturbation. Also observed on this type of bottom were varying amounts of "rock-like" debris, which appear to be a conglomerate of shell, algae (Lithothamnion balls), and other material, perhaps bryozoa (Henry, et al., 1980).

The occurrence of organisms associated with the coarse sand/shell bottom is usually very sparse. The most common organisms seen were sea pens (Virgularia presbytes). Sea pens and sea panseys (Pennatulacea) do not require hard substrate for attachment, thus they are commonly found in soft sand areas (Continental Shelf Associates, 1979). Sea stars (Stelleroidea) were very numerous, especially Luidia sp., and to a lesser extent Asterias sp. Only a few Astropecten sp. were seen. Other echinoderms were rarely seen, such as sea cucumbers (Holothuroidea), sea biscuits, and sea urchins (Echinoidea). Small molluscs were hard to discern; however, many whelks (Busycon sp.) were seen and a few possible tulips (Fasciolaria sp.) In the highly bioturbated areas, many pearly razorfish (Hemipteronotus novacula: Labridae) were seen diving into their burrows. Several large schools of small planktivorous juvenile and adult fishes were seen swimming near the bottom.

Table 3. Fishes and other vertebrates - identified from still color photography and black and white hand-held and towed CCTV

FISH
Apogon sp.
Apogon pseudomaculatus
Archosargus probatocephalus
Balistes capriscus
Bodianus pulchellus
Bothidae
Calamus spp.
Caranx ruber
Centropristis ocyurus
Centropristic philadelphica
Centropristic striata
Chaetodipterus faber
Chaetodon aya
Chaetodon sedentarius
Chromis enchrysurus
Dasyatis centroura
Diplectrum formasum
Diplodus holbrook
Equetus umbrosus
Equetus lanceolatus
Gobiidae
Gymnothorax sp.
Haemcilon aurolineatum
Halichoeres bivittatus
Halichoeres caudalis
Hemipteronotus novacula
Holocanthus bermudensis
Holocentrus sp.
Lutjanus sp.
Monacanthus hispidus
Muraena sp.
Mustelus canis
Mycteropera microlepis
Myliobatidae
Narcine brasiliensis
Opsanus pardus
Priacanthus arenatus
Priacanthus cruentatus
Rhomboplites aurorubens
Rypticus maculatus
Rypticus saponacens
Scorpaena spp.
Seriola dumerili
Serranus phoebe
Serranus subligarius
Sphyraena barracuda
Starksia ocellata
Stenotomus aculeatus
Strongylura sp.

CETACEANS
Stenella plagiodon

TURTLES
Caretta caretta

CONCLUSIONS AND RECOMMENDATIONS

Only a very small percentage of live bottom/hardground, less than 10%, was present outside the sanctuary boundary (see Map 3). The results of this survey and that of Hunt (1974) show that, compared with surrounding areas of the shelf, the sanctuary contains extensive areas of low and moderate-relief live bottom with generally moderate to abundant epifaunal density.

The diversity and density of benthic epifauna varies according to the degree of substrate exposure above the ocean floor. Moderate-relief areas supported abundant epifaunal growth and densities decreased with increasing sediment coverage. However, no other trends or distributional patterns were evident due to the rather wide track line spacing.

It is recommended that a total coverage map of the sanctuary be made using the EG&G Seafloor Mapping System in order to fill in the gaps in survey coverage. Such a map would be extremely useful for sanctuary management decisions, for documenting and evaluating environmental impacts, and as a basic reference or guide for any research program.

ACKNOWLEDGEMENT

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