GRAY'S REEF NATIONAL MARINE SANCTUARY

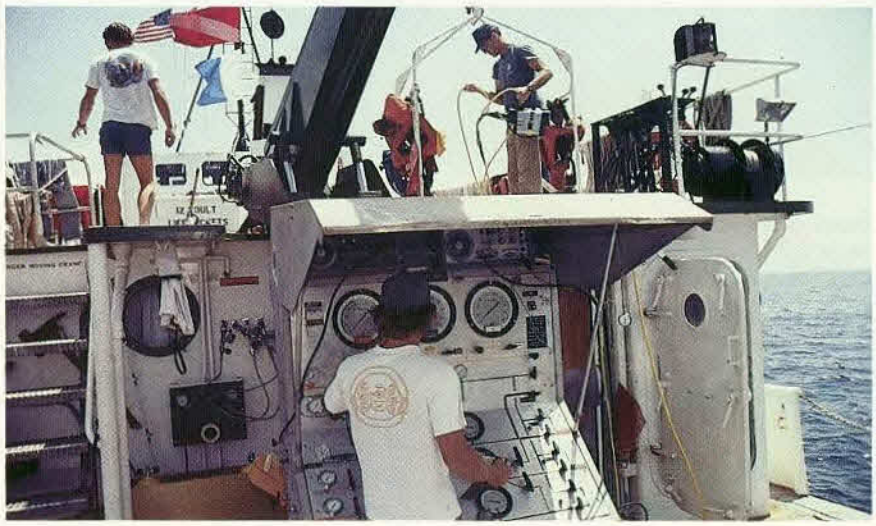
OASIS IN THE SOUTH ATLANTIC BIGHT

TEXT AND PHOTOGRAPHS BY MATTHEW GILLIGAN

There are no signposts, no entrance gates, no welcome stations at this national sanctuary. On the surface, one stretch of restless ocean looks much like any other. But, 18 nautical miles off Georgia's sandy barrier-island shores and 60 feet below the sea surface, a living laboratory of marine life flourishes. Gray's Reef National Marine Sanctuary is host to over 500 species of invertebrates, 100 species of fish, 20 species of seaweeds, and the loggerhead turtle. It is a rocky oasis on an otherwise sandy and desert-like seafloor.

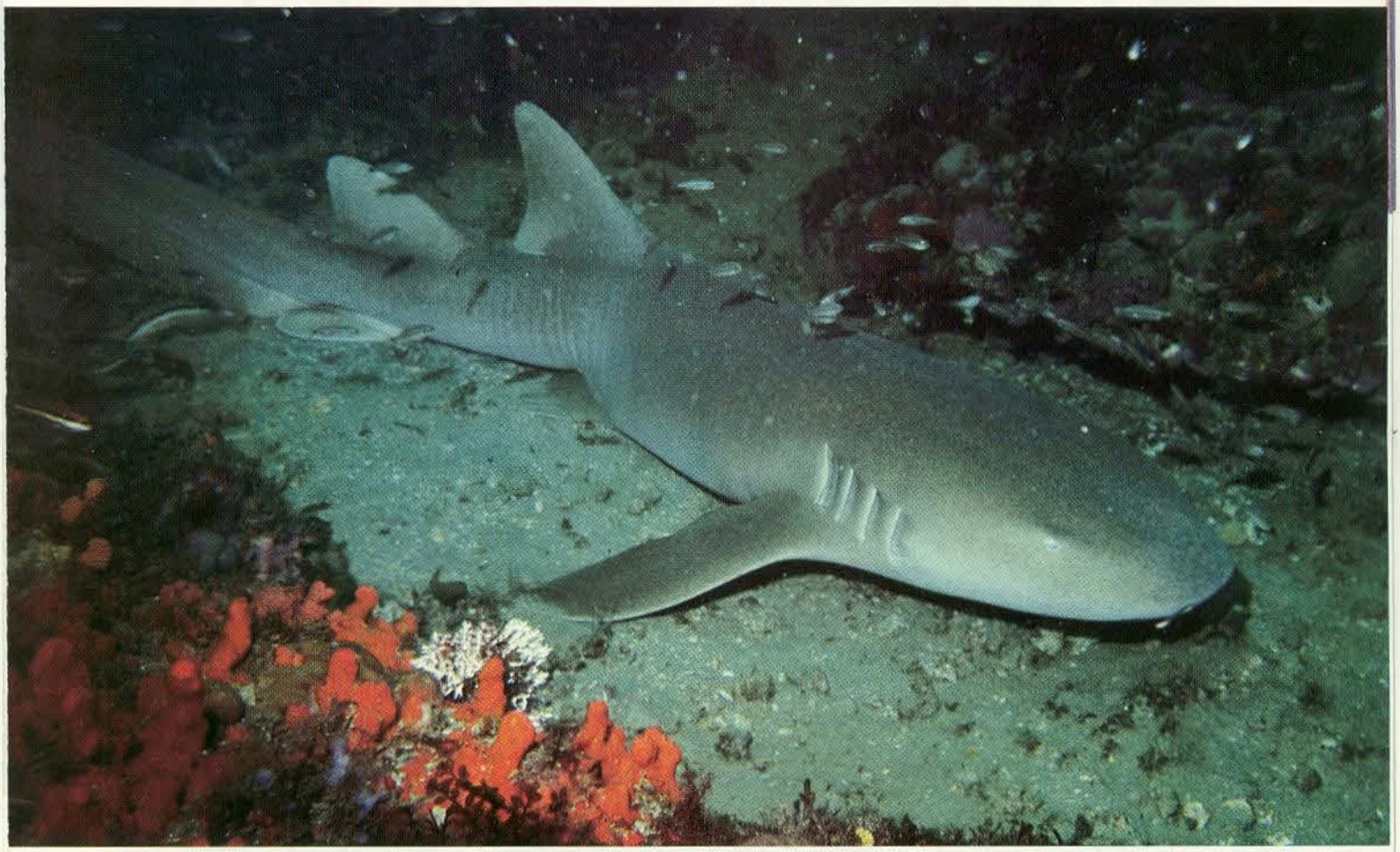
Officially designated in 1981, the

18 nautical miles=33 kilometers
60 feet=18 meters



No surface features mark Gray's Reef, a sanctuary entirely beneath the waves. To study the site, researchers on the RV *Seahawk* use surface-supplied air and scuba to gain the freedom of the reef.

sanctuary was named for Milton "Sam" Gray, a marine biologist and collector who first surveyed its fauna. It covers 20 square miles of seafloor and includes much of the limestone outcrop known locally as Sapelo Live Bottom. It is protected by law from activities that could endanger the rock formations or marine life and hence is a prime site for the scientific study of southeast U.S. coastal reefs. An interpretive center and an aquarium with Gray's Reef exhibits are located on Skidaway Island near Savannah, Georgia.



Nearly motionless on the bottom, this 6-foot nurse shark was found near an outcrop on Gray's Reef. A sluggish bottom feeder, it relies upon sense organs around its mouth to detect small prey buried in the sand.

The sea conditions at Gray's Reef are generally light to calm from late spring through fall, particularly in July and August when winds are typically less than 10 knots and seas are less than 3 feet. From December to May, seas are generally heavy, resulting from more frequent northeasterly winds.

A boat trip from the silty marshes of the Savannah area to the bluish green waters of Gray's Reef 20 to 35 nautical miles away takes from one to three hours. Underwater visibility on the reef averages 25 feet, but it ranges from less than 10 feet to more than 60 feet. Poor visibility is mainly the result of the natural richness of the shelf waters, containing dissolved or suspended organic material from coastal rivers and salt marshes and abundant plankton that thrive on the nutrients.

Look for surface activity

The only way to explore the reef itself is via scuba diving or a trip aboard a submersible. At the surface boaters and fishermen are regularly treated to the sight of leaping dolphins, loggerhead turtles, sea birds, schools of mackerel, great barracuda, cobia, spadefish, and a variety of jellylike ocean drifters. Sapelo Live Bottom became a popular fishing spot decades ago, before the advent of sophisticated navigational aids. It could be located by dead reckoning and the abundance of marine life and activity seen at the surface. Today the reef is still easily located, but it is also a protected refuge and natural laboratory where visitors and scientists explore marine resources and the effect of human activity upon them.

Only 3 to 30 percent of the shallow and sandy continental shelf of the southeast United States is "live bottom," or "hard bottom," habitat. Gray's Reef National Marine Sanctuary offers biologists, geologists, scuba divers, and fishermen a prime and relatively accessible example of this biologically diverse, productive, and seasonal habitat.

Debate is currently raging in the United States over the future of these live bottom habitats in the Exclusive Economic Zone (EEZ—3 to 200 miles offshore). Recently developed roller trawls permit efficient harvest of the snapper/grouper reef-fish complex by allowing the foot rope of the trawl to ride over low to moderate relief live bottom without becoming snagged. Studies have shown that these trawls damage the habitat by scraping off a significant percentage of the sponges, octocorals, and sea squirts that grow attached to the limestone reefs. These encrusting animals are a significant component of the structural complexity of low-relief, live bottom habitats and take many years to grow. Vertical height of a reef is one of the main factors determining fish species diversity on reefs, and studies have shown that after roller trawling, these species are replaced by a less productive sandy-bottom-type fauna.

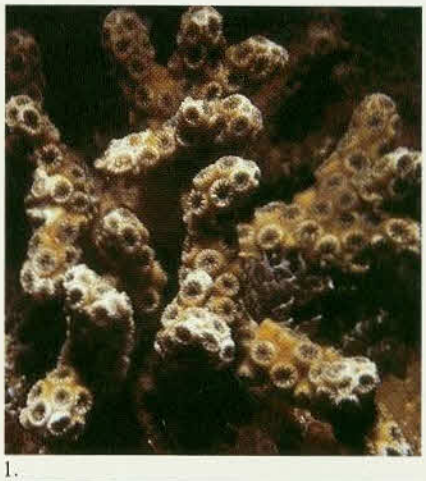
The ecological significance and importance of live bottom habitats are not well understood. Scientific research at Gray's Reef has focused on geological reconnaissance and mapping, physical and chemical studies of the surrounding ocean, and assessment of the productivity and ecology of its living marine resources. However, these studies have only begun to reveal the importance of such reefs to the ecosystem of the continental shelf of the southeast U.S. coast.

Gray's Reef, unlike coral reefs composed of the stony skeletons of colonies of coral polyps, is a fossil-bearing limestone reef formed from marine sediments. Thirteen million years ago, tons of silt, sand, and mollusk shells settled as ocean sediments off the southeast coast of North America. The sediments consolidated into rock 20 to 40 thousand years ago when lower sea levels during glacial periods exposed the area. Today, the rock forms patchy outcrops along the sandy seafloor of the inner and midcontinental shelf of the South Atlantic Bight, the westward curving coastline from North Carolina to Florida. The rock offers attachment surfaces for algae and a myriad of sessile animals, such as sponges, corals, sea whips and fans, and barnacles, and a host of burrowing marine organisms.

A mat of marine life

A living mat of attached and encrusting marine life exists on all the exposed rock surfaces. These animals—filter-feeding sponges, sea fans, sea whips, and sea squirts for the most part—are part of the seascape. This growth is a refuge for small, often mobile, reef dwellers and, like most of the reef community, develops by a constant colonization process.

A common reproductive strategy of marine organisms is to produce a large number of tiny eggs and larvae which



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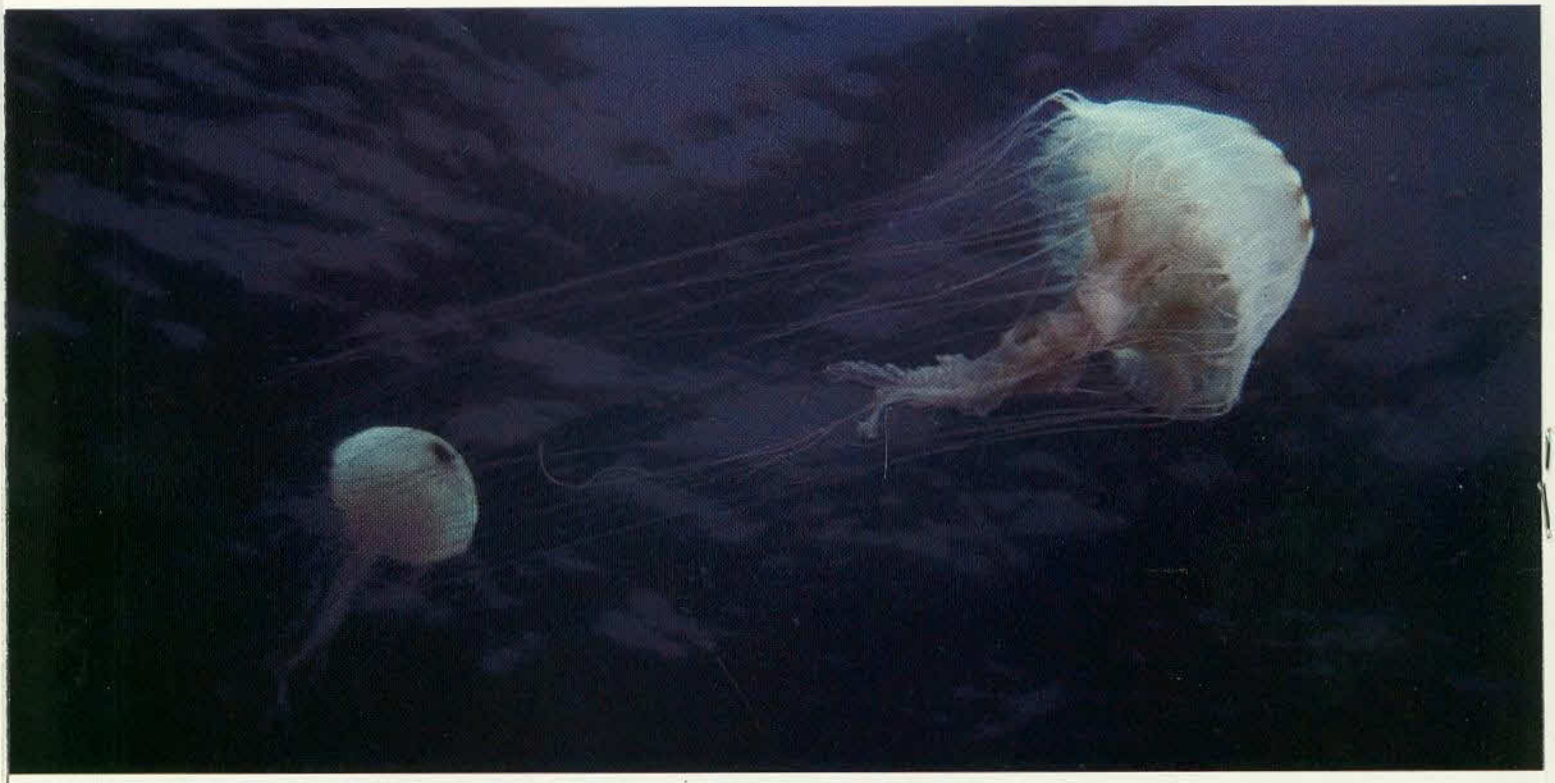
1. A coral, but not a reef-building coral, *Oculina* grows as small colonies attached to the limestone outcrops.
2. Sharing their lives in a kind of symbiosis, these anemones are embedded within an orange sponge.
3. Temporary residents, tropical fishes, like this blue angelfish, do not survive year-round at Gray's Reef.
4. In short supply, space to attach limits the growth of competing filter-feeding sea squirts and anemones.

20 square miles=52 square kilometers
3 feet=0.9 meter
20 to 35 nautical miles=37 to 65 kilometers
25 feet=7.6 meters
10 to 60 feet=3 to 18 meters
3 to 200 miles=4.8 to 322 kilometers

are dispersed by ocean currents. These planktonic larvae rarely end up on the same reef where they were produced. By chance, a few will arrive at a new reef in what has been described as a "lottery" for space. Like terrestrial ecosystems, new habitats (e.g., artificial reefs) undergo a succession of species configurations, changing rapidly at first and, eventually, in a matter of a few years or even months, becoming relatively stable and similar in composition to surrounding communities. As in all habitat patches and islands, local extinctions and colonizations continue, resulting in a turnover of species.

Competition for resources and predation are important factors in determining the success of new arrivals at Gray's Reef. Each new arrival must secure an ecological niche in the community. Often it is a physical niche in the structure of the reef protecting it from predators. Unlike animals in most terrestrial systems, the ecological niche or role of a reef organism may change dramatically during its lifetime. As the organism grows, it may change habits, prey, and activity dramatically. What starts out as a planktonic predator may eventually become an attached filter feeder or a large mobile predator.



Some visitors to Gray's Reef pay no heed to sanctuary boundaries. Drifting jellyfish come and go as they please, and are often abundant in the rich coastal waters above the reef.

Where fresh meets salt water

The oceanographic conditions in the vicinity of Gray's Reef have considerable influence upon the kinds of marine life that exist there. Water temperature, salinity, turbidity, and ocean currents all influence the population dynamics of marine species. Gray's Reef waters are a mixture of sediment and organic nutrient-laden, fresher inshore water from the rivers and marshes of coastal Georgia, and the clearer, saltier water of the Gulf Stream, the inshore edge of which is normally more than 40 nautical miles farther offshore.

The physical environment, especially water temperatures, exerts considerable influence over the lives of reef dwellers, and the strongly seasonal climate at Gray's Reef is an important regulator of community composition. In order to survive and reproduce, individuals must have the genetic wherewithal to handle environmental stresses, as well as use available resources (e.g., find light, nutrients, food, and a mate and avoid predators).

During summer at Gray's Reef, sea temperatures average 82°F at the surface and 77°F on the bottom, warm enough for tropical species to colonize and grow. But, during winter, sea temperatures can fall below 59°F, temperatures that may be lethal to many tropical species. While mobile tropical species can migrate to warmer water in winter, it is hypothesized that the nonmigratory resident tropical species die off each year, after less than a year of life. They are, therefore, essentially annual at Gray's Reef. These species return again the following summer with the ocean currents that bear their eggs and larvae.

The fishes are the most seasonally dynamic component of the reef community. Both the number of species and overall abundance are dramatically

reduced during the colder winter months. Only the black sea bass, leopard toadfish, sheepshead, belted sandfish, wrasses, and groupers may be common in February through March. Seasonal community changes in the invertebrate animals are less evident. Sea anemones, sea urchins, and pycnogonids (small spiderlike creatures that are neither crustacean nor insect) seem to be more common on the reef in winter.

Though the landscape of the reef appears to be dominated by the encrusting animals, more mobile reef dwellers, including sea urchins, sea cucumbers, brittle stars, starfishes, snails, sea slugs, crabs, lobsters, shrimps, worms, octopods, and fishes, share the available space to a surprising extent, exhibiting an almost unbelievable tolerance for one another. Loggerhead turtles, which nest on all of Georgia's sea islands, are frequently seen resting on the bottom in cavelike overhangs of the rocky outcrops at the reef. Adjacent to the reef, sea pens, sea pansies, sea cucumbers, sea biscuits, worms, mollusks, and crustaceans are adapted to life in or on the softer sediments.

In summer, large schools of spadefish, tomtate, scup, spottail pinfish, amberjack, and scad literally cover the reef. Resident reef fishes include Caribbean tropicals, such as the blue angelfish, spotfin butterflyfish, yellowtail reeffish, and cocoa damselfish. The less conspicuous and more sedentary lined seahorse, whitespotted soapfish, and crested blenny, and the night-active bigeye, twospot cardinalfish, and reticulate moray are also found on the reef in summer. The latter are predators and scavengers that seek refuge within the structure of the reef during the day, emerging at night to feed.

Many of the day-active fishes seek the same shelters at night. Large predators like groupers, jacks, mackerels, bluefish, cobia, and great barracuda aggregate near the reef in search of prey providing evidence that reefs, in general, are a focus for marine life and indirect evidence of the reef's biological productivity.

Drifting marine life (plankton) is abundant at Gray's Reef. The larger forms include the comb jellies, the cannonball jellyfish, the sea nettle or summer jellyfish, sea wasp, and the Portuguese man-of-war. The latter two can produce painful stings but are only rarely encountered at Gray's Reef.

The reef community takes full advantage of the nutrient and food-rich shelf waters of the South Atlantic Bight, which are generated in part by Georgia's extensive and biologically productive salt marshes. In summer and fall especially, the productivity of the reef, and the shelf in general, is so great that the ecosystem literally explodes at the surface as shoals of fish, sea turtles, and seabirds. It is no coincidence that marine life is more abundant at the surface above reefs than above sandy bottoms of the inner and midcontinental shelf even though the reefs are 60 feet deep.

Some sea life of Gray's Reef

Reptile
loggerhead turtle
Caretta caretta

Fishes
Atlantic spadefish
Chaetodipterus faber
belted sandfish
Serranus subligarius
bigeye
Priacanthus arenatus
black sea bass
Centropristis striata
blue angelfish
Holacanthus bermudensis
bluefish
Pomatomus saltatrix
cobia
Rachycentron canadum
cocoa damselfish
Pomacentrus variabilis
crested blenny
Hypleurochilus geminatus
great barracuda
Sphyraena barracuda
greater amberjack
Seriola dumerili
leopard toadfish
Opsanus pardus
lined seahorse
Hippocampus erectus
reticulate moray
Muraena retifera
scad
Decapterus spp.
scup
Stenotomus chrysops
sheepshead
Archosargus rhomboidalis
spotfin butterflyfish
Chaetodon ocellatus
spottail pinfish
Diplodus holbrooki
tomtate
Haemulon aurolineatum
twospot cardinalfish
Apogon pseudomaculatus
whitespotted soapfish
Rypticus maculatus
yellowtail reeffish
Chromis enchrysurus

Invertebrates
cannonball jellyfish
Stomolophus meleagris
Portuguese man-of-war
Physalia physalis
sea nettle
Chrysaora quinquecirrha
sea wasp
Tamoya haplonema

Matthew Gilligan is associate professor of biology and coordinator of the marine biology program at Savannah State College (Georgia). He received his Ph.D. in ecology and evolutionary biology at the University of Arizona, where he studied reef-fish ecology of the Sea of Cortez, Mexico. He has been principal investigator and chief scientist for several funded scientific projects on the marine life of Gray's Reef National Marine Sanctuary, and has been scuba diving there since 1980. Author of a number of scientific articles, he recently wrote an illustrated guide to the fishes of Gray's Reef for the Marine and Estuarine Management Division of the National Oceanic and Atmospheric Administration.

Related reading:

Robins, C. Richard, G. Carleton Ray and John Douglass. *A Field Guide to Atlantic Coast Fishes of North America*. Houghton Mifflin, Boston, MA, 1986.

Manooch, C. S. *Fisherman's Guide to the Fishes of the Southeastern United States*. North Carolina State Museum of Natural History, Raleigh, NC, 1984.

A Guide to the Georgia Coast. The Georgia Conservancy, Savannah, GA, 1984.

Harris, C. D. *The fisheries resources on selected artificial and live bottom reefs on Georgia's continental shelf*. Georgia Department of Natural Resources, Coastal Resources Division, May 1978.

40 nautical miles=74 kilometers
82°F=28°c ; 77°F=25°C; 59°F=15°C
60 feet=18 meters