Fish and Benthic Communities of the Flower Garden Banks National Marine Sanctuary: Science to Support Sanctuary Management

Peces y Comunidades Bentónicas del Santuario Marino Nacional Flower Garden Banks: Ciencia para Apoyar la Gestión del Santuario

Poissons et les Communautes Benthiques du Sanctuarie Marin National Flower Garden Banques: Science pour Appuyer la Gestion du Sanctuarie

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EXTENDED ABSTRACT

Fish and benthic communities were surveyed for three years in the Flower Garden Banks National Marine Sanctuary (FGBNMS). Data generated provides baseline information on key biological communities, and can be utilized to address resource management priorities in the sanctuary. Benthic and fish community surveys were designed based on previous survey designs (Caldow et al. 2009) and implemented by a team of multidisciplinary scientists using three complementary techniques:

i) Diver surveys, using recreational and technical scuba techniques, quantified benthic and fish communities on the coral reef at depths between 18 - 45 m / 59-150 ft,
ii) Remotely operated vehicles (ROV) conducted video surveys at depths greater than 46 m / 150 ft; and
iii) Fishery acoustics (sonar) surveyed fish in the water column across all habitat types and depths.

FGBNMS is one of the least impacted, thriving coral reef ecosystems in the western Atlantic and Caribbean region. It does, however, face numerous pressures that should be recognized and responded to through informed management actions. In April of 2012, NOAA published an updated management plan for the sanctuary, representing over five years of data analysis and public participation to ensure a sound strategy for conserving and protecting sanctuary resources for the future. During the management plan review process, input on potential resource protection and management issues was collected and summarized. This process identified direct and indirect impacts of fishing activities as a priority issue for management attention. Hook and line fishing (both commercial and recreational) has always been allowed within the Sanctuary. However, to better understand this and other management issues, enhanced biogeographic data are needed to determine the most appropriate management actions needed to fulfill the sanctuary goals and objectives. The Sanctuary Management Plan proposes a research strategy that includes characterizing FGBNMS to obtain comprehensive baseline information on fish and benthic communities prior to any management action. A second component of the strategy includes utilizing a fully-protected research area to compare to areas where fishing and other activities occur. The process of designing the research area will build upon prior successful efforts within other sanctuaries, such as Tortugas Ecological Reserve in Florida Keys National Marine Sanctuary and Gray's Reef National Marine Sanctuary, as well as the information presented in this report.

Habitat Maps

Refined benthic habitat maps of East and West Flower Garden Banks were produced that provide more accurate estimates of the quantity and spatial distribution of benthic habitats throughout the sanctuary. Major benthic habitats were classified as coral reef, algal nodules, crustose coralline algal reef, deep reef, and soft bottom. Benthic habitat maps have been integrated into the Coastal and Marine Ecological Classification Standard (CMECS) and now contribute to a national framework for classifying the environment into biogeographic and aquatic settings.

Benthic Communities of the Coral Reef and Upper Mesophotic Reefs

Benthic communities were surveyed in-situ using standard and technical SCUBA techniques. In the coral reef zone (18-46 m) benthic communities are dominated by coral, with 52% mean cover per site. Three species of *Orbicella* (formerly *Montastraea*) coral, Endangered Species Act candidate species, account for a third of the total coral cover. Benthic communities are stable and healthy (observations of bleaching and disease were rare), and possibly the least impacted coral reef ecosystem in the tropical western Atlantic (Johnston et al. 2013). This study included a comprehensive assessment of benthic communities on the upper mesophotic coral reef from 33 - 45 m. Coral species composition changed slightly with depth. Some species, such as *Montastraea cavernosa* and *Stephanocoenia intersepta,* were more abundant in deeper waters.

Expanding existing shallow reef monitoring activities to include the deeper reef to 50 m is recommended to fully understand the linkages between anthropogenic and natural events and natural resources.

Benthic microalgae of the genus *Gambierdiscus*, the causative organism for ciguatera fish poisoning (CFP), were found in all strata to depths of 45 m. Six species were reported in all, three of which are known to be toxic.

Fish Communities on the Coral Reef and Upper Mesophotic Reefs

Fish communities were surveyed in-situ using standard and technical SCUBA techniques. The most important factors structuring fish communities on the coral reef (18-46 m) are depth and habitat relief. This is the first comprehensive assessment of fish communities on the upper mesophotic reef from 33 - 45 m using *in-situ* diver surveys. The families Pomacentridae (damselfish), Labridae (wrasses) and Serranidae (groupers) comprised 81% of total fish density and were recorded at all depths and habitat types with similar communities found at East and West Banks.

Economically valuable species and apex predators such as groupers, snappers and sharks were larger and more abundant at depths >33 m. Apex predator biomass in the upper mesophotic strata was dominated by groupers, of which, many species are known to exhibit high site fidelity. Apex predators are important in terms of trophic flow in coral reef ecosystems; therefore, the conservation of these species and their habitats should be a management focus.

Non-native lionfish densities were low but increased during the study period. The combination of large apex predators and lionfish provides an opportunity to examine natural predation as a biological control.

Benthic and Fish Communities in the Mid to Lower Mesophotic Zone

Deep-water surveys expand on prior characterizations of the sanctuary by providing a comprehensive survey design using a remotely operated vehicle (ROV) to quantify fish and benthic communities in deep (> 46 m) sanctuary habitats. Deep coral species, such as *Stichopathes* and *Nicella,* were common in the sanctuary, with densities ranging from 0.4 to 1.2 individuals per m^2 (3.3 ft^2) on deep reef habitats. Deep reefs with relief ranging from 20 - 100 + cm yielded high fish density, biomass and species richness. *Mycteroperca phenax* (scamp), *Lutjanus campechanus* (red snapper), and *Seriola dumerili* (greater amberjack) were the dominant apex predators on deep water reefs. Fish communities were vastly different than those observed in the coral reef zone.

Mapping Fish Density Using Fishery Acoustics

Using sonar, fishery acoustics were used to comprehensively assess fish density within the sanctuary. The fishery acoustic survey was designed to sample fish and other marine organisms throughout the water column, over the full depth range (17 - 250 m) and across all habitat types within the sanctuary. Large fish (> 29 cm) density was significantly greater on East Bank in deep water (> 46 m) habitats; in contrast, large fish were more abundant on the coral reefs at depths less than 46 m on West Bank. On the coral reefs (18 - 45 m), hotspots of large fish densities were consistently observed in similar locations on each bank.

Large fish density on the West Bank coral reef was 3-10 times greater than other coral reef ecosystems (St. John, U.S. Virgin Islands; Tortugas Ecological Reserve; Vieques, Puerto Rico). Of these systems, West Bank is situated the farthest from any port, suggesting that its remote location plays a role in its condition.

CONCLUSIONS/RECOMMENDATIONS

These data represent the first holistic quantification of fish and benthic communities in the sanctuary. Structured by depth and habitat complexity, five distinct benthic and fish communities are found in the sanctuary: coral reefs, algal nodules, coralline algal/deep reefs and softbottom. Groupers and snappers are diverse and abundant on both banks. Species composition, biomass, and density changed with depth and habitat complexity.

The FGBNMS Sanctuary Advisory Council should use the fish and benthic data to help develop an approach to evaluate the required size and location of a research area.

It is recommended that existing annual monitoring be expanded to incorporate techniques used in this project. Biannual spatial monitoring of the coral reefs (to 30.5 m) is being implemented by the National Coral Reef Monitoring Plan (NCRMP) to complement existing long-term monitoring.

In order to address impacts from fishing, lionfish, and recreational diving, it is recommended that fishing and diving activities be quantified in the sanctuary.

LITERATURE CITED

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