

STUDY TITLE: Long-term Monitoring of the Flower Garden Banks, 2002-2003

REPORT TITLE: Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2002-2003

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BACKGROUND: The Flower Garden Banks (FGB) are located in the northwestern Gulf of Mexico and form part of a discontinuous arc of reef environments along the outer continental shelf. These coral reef banks are the largest charted calcareous banks in the northwestern Gulf of Mexico and are the northernmost coral reefs on the continental shelf of North America. Although coral and non-coral communities exist on neighboring banks (e.g. Sonnier Bank, Stetson Bank), the reefs at Cabo Rojo, Mexico and Middle Grounds, Florida, are the closest developed coral reefs in the Gulf of Mexico.

The topographic features of the FGB were created by salt diapirs of Jurassic Louann origin and the consequent uplifting of sedimentary rocks. The caps of these salt domes extend into the photic zone in clear oceanic water where conditions are ideal for colonization by coralline algae, hermatypic corals, invertebrates and fish species typical of Caribbean basin coral reefs. Though coral species richness is more depauperate at the FGB than that of Caribbean reefs, 21 species of scleractinian corals and 177 species of tropical Atlantic fish are present at the banks. Oceanic salinity conditions prevail at FGB and range from 34 to 36 PSU, with water temperatures ranging from

18°C (mid-February) to ~ 32°C (August). Water clarity at the Banks is excellent, commonly 30 m or more, providing light to photosynthesizing organisms.

Since 1973, MMS has conducted a program of protective activities at the FGB coral reefs. The topographic features stipulation (since 1973) was designed to protect sensitive biological resources from the adverse effects of routine oil and gas activities. The stipulation specifically protects the biota of the FGB from physical damage associated with oil and gas activities including anchoring, rig emplacement and potential toxic and smothering effects from drilling muds and cuttings discharges. The stipulation defines a No Activity Zone (NAZ) around each of the banks and no oil or gas structures, drilling rigs, pipelines, or anchoring are allowed within the NAZ. From 1988 to 1992, the MMS monitored the FGB coral reefs on an annual basis to detect any changes that may be caused by oil and gas activities, as well as any other incipient changes. In addition to the protective measures provided by MMS, the FGB were designated as a United States National Marine Sanctuary in 1992. Starting in 1996 the National Oceanic and Atmospheric Administration, Flower Garden Banks National Marine Sanctuary (FGBNMS) and the MMS partnered to continue the long-term monitoring at the FGB.

OBJECTIVE: To monitor the East and West Flower Garden Banks in accordance with the long-term monitoring protocol, ensuring that the protective measures established by MMS continue to be effective.

DESCRIPTION: Monitoring cruises were conducted aboard the *M.V. Fling* in October 2002, and April and August 2003. The general locations of the study sites are marked by permanent mooring buoys: FGBNMS permanent mooring number 2 at the East Bank and mooring number 5 at the West Bank. Subsurface buoys were installed at the corners of the 100m x 100m study sites at each bank to facilitate underwater relocation. Establishment of the perimeter and crosshairs subdivided each study site into four quadrants. To estimate the areal coverage of benthic components, fourteen, 10-m long transect tapes were randomly positioned at each study site. Coverage was estimated from these transects in three ways: still photography, videography, and visual assessment in the field. The linear-point intercept (LPI) method was used as well, to ascertain whether data recorded directly on the reef was different than data derived from either of the photographic methods. Four coral cores were extracted from *Montastraea faveolata* colonies at each bank in order to determine annual growth rates and any possible indicators of past coral bleaching events or other stressors. *Diploria strigosa* is the second largest contributor to coral cover at the FGB. For this reason *D. strigosa* lateral growth margins were monitored and photographed to detect changes, either as retreat or growth of margins, from year to year. Repetitive 8m² quadrats were photographed and analyzed using random dot analysis (percent cover of species and coral condition) and planimetry (measure growth or loss of tissue over time) in order to monitor changes in coral reef community structure. Perimeter lines were videotaped each year to document change at known locations along the perimeter and within the study site. A general sense of coral condition and fish populations were obtained and compared from year to year. Physical and chemical characteristics of the seawater overlying the reef caps at the FGB were assessed by monitoring temperature, salinity,

dissolved oxygen, pH, turbidity, and content in chlorophyll a, dissolved inorganic nitrogen, dissolved organic nitrogen, inorganic phosphorous, and trace metals. These water quality parameters were selected to characterize the environmental background in which the FGB coral reef resources exist. Surveys of fish assemblages were conducted at each bank in order to determine relative abundance and diversity of species. Surveys of sea urchins and lobsters were performed at night to determine abundance and distribution of populations.

As repetitive quadrat and lateral growth (*Diploria strigosa*) stations were missing markers, displaced, or otherwise degraded in 2002, a site rehabilitation cruise was completed in April 2003. The goal of this cruise was to reestablish the initial sample size of forty repetitive quadrat stations and sixty lateral growth stations on the East and West Banks. A new numbering system was established and old stations were refurbished with new pins and tags, while a small number of new stations were established at each bank. Since the majority of stations were refurbished, the long-term dataset should not be affected for either the repetitive quadrat or lateral growth stations.

SIGNIFICANT CONCLUSIONS: The East and West FGB coral reefs continue to thrive and remain the highest coral cover dominated reefs in the Caribbean and Gulf of Mexico. The reef communities have remained stable for the monitoring period 1988-2003, while other reefs in the region have declined. Continued monitoring of these reefs will document their long-term condition and be useful for studies focused on the dynamics of the robust benthic communities and the fish populations they support.

STUDY RESULTS: Monitoring results for 2002-2003 highlighted the continued stability of FGB reefs, expressed as consistently high coral cover, with a mean of 54.05% for both banks and both years, as well as the continuing trend of coral growth seen in repetitive quadrats and lateral growth of individual colonies of *Diploria strigosa*. Robust fish populations and oligotrophic water conditions persisted while occurrences of disease and bleaching were low, 0.004% and 0.002%, respectively - averaged for both banks in both years. Sea urchins continued to occur at low densities, averaging 0.01/m² (both banks, both years); however, herbivorous fishes appear to keep algal cover under control as they represented the largest fish guild on both banks for both years.

The *Montastraea annularis* complex was the predominant component of coral cover at both banks in both years, with 33.59 ± 3.86% and 28.47 ± 2.98% cover at East Bank in 2002 and 2003 and 31.73 ± 3.57% and 33.80 ± 4.31% at the West Bank in 2002 and 2003. *Diploria strigosa* was the next most abundant species, ranging from 3.20 ± 0.91% at the West Bank in 2002 to 9.04 ± 2.68% in 2003. The East Bank estimates were 6.96 ± 1.69% and 6.19 ± 1.55% in 2002 and 2003. Repetitive quadrats showed changes in coral species cover and coral condition (disease, paling, bleaching, and fish biting) from 2002 to 2003. The incidence of disease, paling and bleaching were low at both banks in both years; none of these metrics was above 0.61%, and there was no evidence of disease in any of the repetitive quadrats analyzed. Nine deep repetitive quadrats (32-40 m depth) were established on the East Bank in April 2003 and

photographed in August 2003. Coral cover was high, at 75.14% overall. The *Montastraea annularis* complex (42.37%) and *M. cavernosa* (14.74%) were the dominant species at these sites. Lateral growth stations were monitored to measure changes in *Diploria strigosa* colonies. Overall there was a 3-5% increase in *Diploria strigosa* margins from 2001-2002, but the sample size for the 2002-2003 comparison was not sufficient to draw conclusions. Sclerochronology was used to measure the accretionary growth rates of *Montastraea faveolata*. Yearly growth rates ranged from 7.3 to 10.7 mm and differed significantly ($P=0.02$) between banks. Interestingly, a disruption in accretion was seen in one quarter of the samples from both banks within the 1997-1998 (the year of widespread bleaching throughout western Atlantic coral reefs) growth band. A mean of 51 fish species were observed per bank per year in 2002 and 2003. Herbivores were the dominant fish guild, with Scaridae (parrotfish) and Acanthuridae (surgeonfish) representing the largest portion of these. Urchin surveys documented low densities of *Diadema antillarum* at both banks in both years and only one *Panulirus argus* (lobster) was documented along transects at the East Bank in 2002.

STUDY PRODUCT: Precht, W.F., R.B. Aronson, K.J.P. Deslarzes, M.L. Robbart, T.J.T. Murdoch, A. Gelber, D.J. Evans, B. Gearheart, and B. Zimmer. 2006. Long-term monitoring at the East and West Flower Garden Banks, National Marine Sanctuary, 2002-2003. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study MMS 2006-035.

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