

STUDY TITLE: Long-term Monitoring of the East and West Flower Garden Banks National Marine Sanctuary, 2000-2001

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BACKGROUND: The Flower Gardens Banks National Marine Sanctuary (FGBNMS; designated 1992) includes deepwater coral habitats associated with two topographic high points located on the outer continental shelf in the northwestern Gulf of Mexico. The East Flower Garden Bank (EFGB) is located about 193 km southeast of Galveston, Texas (27° 54.5' N, 93° 36.0' W) and the West Flower Garden Bank (WFGB), about 20 km west of EFGB, is located about 172 km southeast of Galveston (27° 52.4' N, 93° 48.8' W; Figure 1.1.1.1). The Flower Garden Banks (FGB) are found in the most active offshore oil/gas exploration and production area in the world. Approximately 4,000 production platforms are located in the northern Gulf of Mexico and are concentrated in the northwestern quadrant where the FGB are located. Two kilometers east of the EFGB, a production platform has been producing natural gas continually since its installation in 1982. Currently, there are no data suggesting that oil and gas production in the vicinity has been detrimental to the coral communities of the FGB (Dokken *et al.* 1999, 2001). The purpose of the long-term monitoring efforts on the coral reefs of the FGB that began in 1989 (Gittings *et al.* 1992) is to provide relevant and timely

environmental data to those charged with managing oil/gas exploration and production in the vicinity of the FGB coral reefs.

OBJECTIVES:

1. To document long-term changes in community composition of reef-building coral and associated communities;
2. To document long-term natural variation in reef growth;
3. To stimulate ancillary research efforts and coordinate monitoring activities by other agencies and institutions; and
4. To evaluate and synthesize monitoring data and other research in order to assess the impact of change and provide recommendations to managers.

DESCRIPTION: Research cruises were conducted aboard the *M/V Fling* during 27 September - 1 October 1998, 12-16 September 1999, 17-22 September 2000, and 16-21 September 2001. Data collection was conducted within previously established 100 x 100 m study sites on both the East and West Flower Garden Banks (Flower Garden study sites). Repetitive and random, non-destructive photographic techniques provided data pertaining to the condition of coral reef organisms. Percent cover of scleractinian corals and major reef biota was determined from digitized images from random and repetitive photography of the coral reef community. Repetitive photography and sclerochronology were utilized to determine lateral growth rates of selected coral species. Growth rates and cover of live corals was compared between this study and previous studies conducted within the same study sites.

Additionally, water quality, insolation, and temperature parameters were monitored at both sites. Two semi-permanent platforms were installed with new water quality monitoring instruments, YSI 6600 Data Sondes, at the EFGB and WFGB. The sensor suite installed in the sondes comprises pressure (depth), temperature, salinity (conductivity), light in the range of photosynthetically active radiation or PAR, dissolved oxygen, pH, and turbidity. Semi-Permeable Membrane Devices (SPMD) were used to monitor the presence of hydrocarbons and other analytes in the water column. Photosynthetically Active Radiation (PAR) and temperature were also monitored in an attempt to relate community changes with major fluctuations of irradiance and temperature.

SIGNIFICANT CONCLUSIONS: Through the 1998 - 2001 sample period the FGB appeared to be healthy and productive. Relative to other coral reef systems of the Gulf of Mexico and Caribbean Sea, the FGB have low diversity of stony corals and high coral cover, generally ~ 50%. Located approximately 180 km from the nearest landmass, the FGB are relatively isolated from terrestrial based impacts when compared to reef systems such as those of the Florida Keys and southern Gulf of Mexico. Although afforded a measure of protection from shore side development and watershed drainage impacts, within the FGB there is potential for habitat damage from industrial and recreational activities occurring in the near vicinity such as marine shipping, oil/gas production, and sport diving. Prior to designation as a National Marine Sanctuary in 1992, substantial anchor damage was observed. Since designation, no damage from

these activities has been documented. No significant impact from oil/gas activity has been documented before or after Sanctuary designation; and recreational activities have not been demonstrated to have a negative impact.

Variability of accretionary growth and encrusting growth was the rule. Annual accretionary growth of *Montastraea faveolata* at the EFGB averaged 7.5 mm/year (range = 5.05 – 11.19). At the WFGB annual encrusting growth ranged from 3.88 to 8.01 mm/year and averaged 5.73 mm/year. No significant upward or downward trends in growth rates were evident, and no correlations of growth to environmental parameters could be ascertained. Rates of coral growth at the Flower Garden Banks were in the mid to upper range of growth rates of corals at various Caribbean Sea reefs. Encrusting growth, measured on colonies of *Diploria strigosa*, was also variable over time, but appeared balanced (i.e. gain versus loss of tissue). No significant long-term trends in encrusting growth were evident.

Habitat characters such as degree of bleaching and percent cover of algae and bare reef rock varied annually from 1998 to 2001. However, as with the growth data, no trends were evident and no change appeared to be long term. Disease was a minor component of the FGB ecosystem dynamics with no apparent significant impact.

Random photographic transects were completed outside the boundaries of the designated 100 m² study area to test whether or not the study area remained representative of the reef habitat. No inconsistencies between the reef character outside the designated study area and the study area were evident. The study area continued to be representative of the reef habitat at each bank.

Based on the results of the random transect data, cover of *Montastrea annularis* complex at the EFGB appeared to be increasing perhaps at the expense of reef rock, *M. cavernosa* and *Diploria strigosa*, but the data is inconclusive. Algal cover increased in 1999, but then declined. Reef rock was also negatively correlated with algal cover. It appeared that *M. annularis* complex and algae are colonized more of the non-living surfaces of the bank. The significant positive correlation between algae and total coral suggested that algae were not expanding at the expense of coral cover.

Unlike EFGB, the WFGB did not exhibit a dramatic increase in cover of *M. annularis* complex. The correlations between *M. annularis* complex, *D. strigosa*, *M. cavernosa* and total coral cover were indicative of the fact that these three species are the predominant corals on the bank. The same negative correlation between reef rock and algae recorded at the EFGB was also seen here. It appeared that like the EFGB, algae primarily colonized non-living surfaces (i.e. reef rock). Unlike the EFGB, *M. annularis* complex did not appear to be expanding into areas of non-living substrate. In addition, there were no significant correlations between *M. annularis* complex and *D. strigosa* or *M. cavernosa* or algae and total cover as seen at the WFGB. It appeared that the coral community at the WFGB remained stable throughout the monitoring period despite the increase in algal cover.

Light intensity in the water column indicated that the water clarity of the Flower Garden National Marine Sanctuary was between that of the clearest coastal waters and clearest oceanic waters. Periodic changes in water clarity reflected changes in cloud cover and concentrations of suspended particles and plankton. It was speculated that flushing events occurred with changing current patterns changing the transmissivity of the water column.

The temperature regime for 2000 and 2001 was unremarkable with temperatures staying within normal parameters. With the peak temperature less than 30°C, bleaching was not a major event with the exception of the *Millepora alcicornis* colonies, which seem to be particularly susceptible.

Considering recommendations of prior reports, the Minerals Management Service and Flower Garden Banks National Marine Sanctuary made substantial progress in implementing many of the recommendations. The *in situ* water quality monitoring instrumentation was upgraded; and the 2002 and 2003 monitoring program, as specified within the published RFP will include:

- 1) Expanded algal studies, nutrient flows, and nutrient concentrations will be conducted.
- 2) More rigorous measurements of potential contaminants will be conducted in the laboratory.
- 3) Continued analysis of population densities of the herbivore, *Diadema antillarum*.
- 4) Deep water stations below the coral cap will be established and monitored.
- 5) Fish census will be conducted.

These actions will not only expand our knowledge and understanding of the Flower Garden Banks ecosystem, but will also improve the foundation from which management decisions are made.