

STUDY TITLE: Long-Term Monitoring at the East and West Flower Garden Banks

REPORT TITLE: Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2009-2010, Volume 1: Technical Report and Volume 2: Appendices

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SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA: Western

FISCAL YEARS OF PROJECT FUNDING: 2009; 2010; 2011

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COSTS: FY 2009: \$275,000; FY 2010: \$275,000; FY 2011: \$275,000

CUMULATIVE PROJECT COST: \$825,000

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KEY WORDS: Bleaching, Gulf of Mexico, Flower Garden Banks, marine sanctuary, monitoring, coral reef, observations, water quality.

BACKGROUND: Since 1995, the National Oceanic and Atmospheric Administration's (NOAA) Flower Garden Banks National Marine Sanctuary (FGBNMS) has partnered with the Bureau of Ocean Energy Management (BOEM) to monitor the health of the coral reefs of the East and West Flower Garden Banks (FGB). Located 193 and 172 km (East and West Flower Garden Banks, respectively) offshore from Galveston, Texas, the banks are remotely located topographic features on the outer continental shelf in the Gulf of Mexico that are capped with reef-building corals. The monitoring program was developed over a period beginning in the late 1970's, when the BOEM recognized the need for a baseline assessment of the status of the coral reefs in anticipation of increased exploration and development of offshore oil and gas resources in the area.

OBJECTIVES: To assess the health of the East FGB and West FGB coral reefs, through the evaluation of changes in living coral and other benthic community cover,

coral growth rates, reef fish population dynamics, water quality, and other indices of reef vitality.

DESCRIPTION: The benthos (with an emphasis on coral cover and algae) was examined along stationary repetitive photoquadrats to monitor changes in specific coral reef locations over time, and random transect lines were photographed to get estimates of coral cover. Sclerochronology was used to document the accretionary growth rate of *Montastraea faveolata* colonies, and photography was used at permanent stations to monitor the lateral growth of corals. General aspects of coral condition were documented along perimeter lines at the EFGB and WFGB. During each annual monitoring cruise, observations of general coral reef health, as well as notable biological and oceanographic events were qualitatively assessed and documented. Water quality parameters (including seawater temperature and salinity) were recorded using Sea-Bird 37-SMP MicroCAT datasondes to characterize the reef caps and water column environment of the FGBNMS. Fish surveys using the Bohnsack and Bannerot method were conducted at randomly located stations and sea urchin and lobster surveys were conducted along the study site perimeter lines.

SIGNIFICANT CONCLUSIONS: In more than 20 years of continuous monitoring, the coral reefs of the FGBNMS have maintained high levels of coral cover, suffered minimally from hurricanes, coral bleaching, and disease outbreaks, and supported relatively diverse and abundant fish populations as well as other vertebrate and invertebrate species. No significant long-term changes have been detected in coral cover or diversity at the FGB during monitoring efforts that have taken place since 1988 and likely not since the first measurements were made in the early 1970s. Based on the 2009 and 2010 data, the average coral cover on the FGB coral caps is nearly 57 percent. The incidence and prevalence of disease and bleaching in comparison to other western Atlantic coral sites was low.

STUDY RESULTS: The results of the 2009 to 2010 monitoring efforts, conducted in August 2009, and August through November 2010, illustrate the continued stability of the coral reef community and associated fish populations. Random transect results revealed high coral cover within study sites at both banks from 2009 to 2010, with coral cover estimated at $53.35\% \pm 4.17$ and $54.49\% \pm 3.69$, respectively at the EFGB, and $53.84\% \pm 3.73$ in 2009 and to $65.95\% \pm 2.85$ in 2010 at the WFGB. The *Montastraea annularis* species complex (*M. annularis*, *M. faveolata*, and *M. franksi*) was the dominant component of coral cover at both banks, with *M. franksi* identified as the dominant species within the complex.

In 2009 and 2010, macroalgae were more abundant than crustose coralline algae, fine turf algae, and bare rock (CTB), ranging from approximately 22-33% over both banks. The most dominant macroalgal cover was by fleshy algae, thick turf algae, and *Dictyota* spp. An ANOVA revealed significant effects of location (bank), and overall, macroalgal cover was higher at the EFGB than the WFGB. The data for the EFGB was significantly different from that of the WFGB ($p < 0.02$), suggesting variations between banks. Tukey–

Kramer *a posteriori* comparisons also showed that macroalgal cover was significantly higher at the EFGB than the WFGB.

Annual growth of *M. faveolata* at the EFGB averaged 0.55 mm/year (sample range = 0.30-0.76). At the WFGB annual growth averaged 0.69 mm/year (range = 0.33-0.97). When compared to the past three coring events (2003, 2005, and 2007), the 2010 growth rate data were not substantially different.

Random photographic transects were completed within the boundaries of the designated 100 m² monitoring study areas on each bank. These areas were originally selected in 1988 because they appeared to be representative of the reef caps on each bank. Even now, over 20 years later, no inconsistencies between the reef character outside the designated study areas and the study areas themselves are apparent, suggesting that little long-term change is a critical component of ecosystem quality. Lateral growth stations were photographed in 2009 and 2010 to measure changes in *Diploria strigosa* colonies. *Diploria strigosa* is important at the FGB because it is the second largest contributor to coral cover. Net growth was positive over the 2009 to 2010 monitoring period.

Repetitive quadrat data showed that coral cover was consistently high during the 2009 to 2010 monitoring period, averaging around 72% for both banks in all years (note that these stations were not selected as locations that were necessarily representative of the larger reef caps, so percent cover is likely not representative either). Macroalgae and CTB cover showed reverse patterns between banks and the incidences of bleaching, paling, and fish biting were low (ranging from 0.00-2.77% of area assessed). There was no evidence of coral disease in any of the repetitive quadrats analyzed in 2009 or 2010. The coral assemblages remained stable at both banks, with the dominant corals being the *Montastraea annularis* species complex, *Diploria strigosa*, *Porites astreoides*, and *M. cavernosa*. In the 32-40 m deep repetitive quadrats (105-131 ft) at the EFGB, coral cover was high, averaging approximately 81.96% between 2009 and 2010. The *Montastraea annularis* species complex and *M. cavernosa* were the dominant species in this depth range.

The review of the 2009 and 2010 perimeter videos suggests that, in general, the coral communities displayed low levels of stress and high coral cover. The most distressed corals were affected by incidences of paling and bleaching at the WFGB in 2010, followed by fish biting. No evidence of coral disease was observed in the perimeter videos.

Water quality monitoring resulted in seawater temperatures during the late summer months of 2010 to exceed the 30°C coral bleaching threshold. No significant levels of contaminants were found in quarterly water samples.

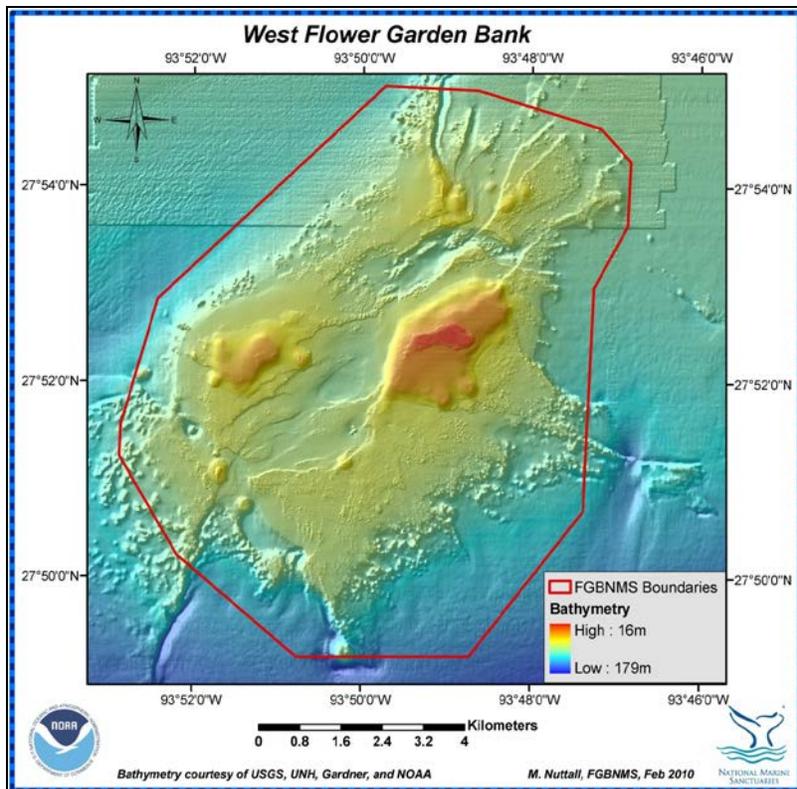
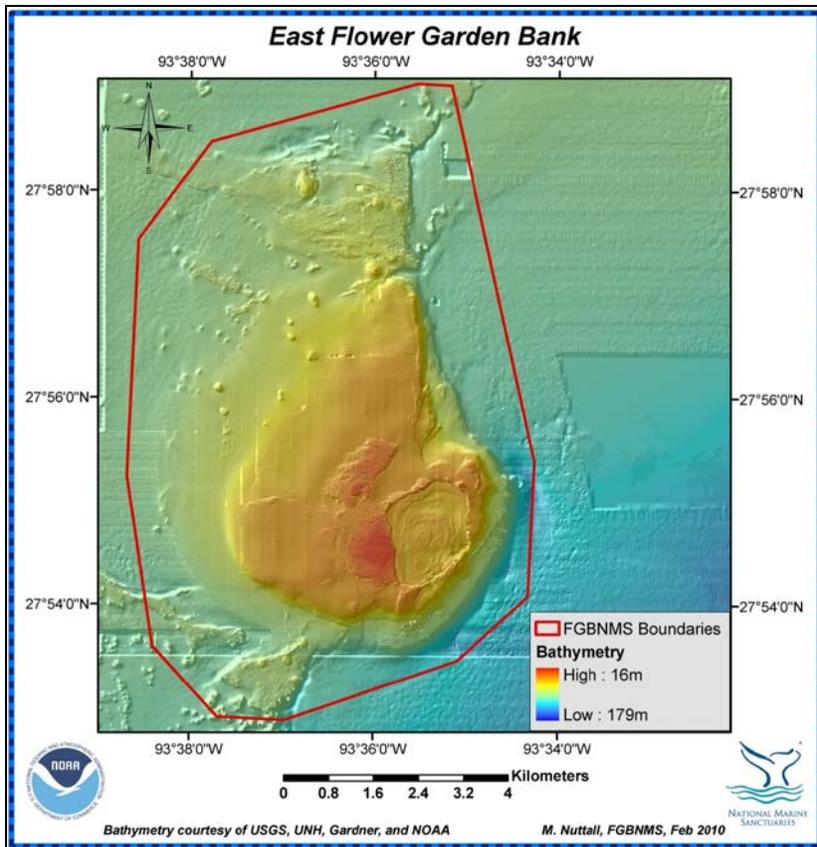
Fish surveys showed robust fish assemblages that were dominated by invertivorous fish, with healthy populations of herbivores, piscivores, and planktivores. An average of 57 fish species were observed per bank per year; Pomacentridae, Labridae, and

Serranidae were the dominant fish families at both banks. Invertivores were the dominant fish guild, with Pomacentridae (damselfish) and Labridae (parrotfish and wrasses) representing the largest density. Following the pattern of coral species present at the FGB (low diversity compared to Caribbean reefs, but high coral cover), the fish assemblages reflect a similar trend of low diversity and high abundance. Sea urchin surveys documented very low densities of *Diadema antillarum* at the EFGB in 2009 (0.25 per 100 m²) and 2010 (0.5 per 100 m²). Higher densities were documented at the WFGB in 2009 (13.75 per 100 m²) and 2010 (11.0 per 100 m²). No *Panulirus argus* (Caribbean spiny lobster) or *Panulirus guttatus* (spotted spiny lobster) were recorded.

STUDY PRODUCTS: Johnston, Michelle A., M.F. Nuttall, R.J. Eckert, J.A. Embesi, N.C. Slowey, E.L. Hickerson, and G.P. Schmahl. **2013.** Long-term monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2009-2010: Volume I: Technical report. U.S. Dept. of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2013-0214. 188 pp.

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Map showing areas of study.