

ACCESS NUMBER: 30822

STUDY TITLE: Long-term Monitoring of the East and West Flower Garden Banks

REPORT TITLE: Long-term Monitoring of the East and West Flower Garden Banks, 1996-1997

CONTRACT NUMBER(S): 14-35-01-96-CT-30822

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA: Gulf of Mexico

FISCAL YEARS OF PROJECT FUNDING: FY 1996; FY 1997

COMPLETION DATE OF REPORT: May 1998

COSTS: FY 1996: \$46,309; FY 1997: \$48,443; **CUMULATIVE PROJECT COST:** \$94,752.

PROJECT MANAGER: Quenton R. Dokken, Ph.D.

AFFILIATION: Center for Coastal Studies, Texas A&M University Corpus Christi

ADDRESS: NRC Suite 3200, 6300 Ocean Dr. Corpus Christi, TX 78412

PRINCIPAL INVESTIGATORS*: Q.R. Dokken, I. MacDonald, J.W. Tunnell

KEY WORDS: coral reef, monitoring, marine sanctuary, biology, habitat, scleractinian, hermatypic corals, sclerochronology

BACKGROUND: The Flower Garden Banks coral reef system is a unique high diversity coral reef environment located approximately 200 km (110 nmi) southeast of Galveston, Texas on the outer continental shelf of the Gulf of Mexico. Designated as a National Marine Sanctuary in 1992, the Flower Garden Banks represents the northernmost coral reef on the continental shelf of North America. The banks are topographic highs of bedrock displaced upward by the intrusion of two salt diapirs. The bedrock is capped with the calcium carbonate deposition of hermatypic reef-building corals and calcareous algae. The living coral reef is comprised of 20 species of corals, and supports 120 species of fishes and 253 species of invertebrates. Potential threats to the long-term health of the reef include human impacts from oil and gas exploration and production, commercial shipping, destruction of organisms by recreational divers and non-point source pollution as well as natural occurrences such as hurricanes. This effort is the continuation of monitoring efforts begun in 1989 and first reported in 1992.

OBJECTIVES: (1) To provide relevant and timely environmental data to those charged

with developing policies concerning oil and gas exploration and production in the vicinity of the Flower Garden Banks National Marine Sanctuary; (2) to document long-term changes in reef-building coral and associated communities at the Flower Garden Banks caused by either impacts of petroleum exploration and production or other human impacts; (3) to document long-term natural variation in reef growth and associated communities on the Flower Garden Banks and; (4) to stimulate ancillary research efforts and coordinate monitoring activities with agencies and institutions conducting water quality assessments and other studies in the vicinity of the Flower Gardens in order to better evaluate causes of environmental change.

DESCRIPTION: Sampling cruises were conducted aboard the *M.V. Fling* during 14 - 18 October 1996 and 9 - 12 September 1997. Sampling was conducted within previously established 100 x 100 m study sites on both East and West Banks. Permanent markers deployed within each site and established by previous monitoring projects served as site boundary markers and aided in relocation of the sites. Repetitive and random non-destructive photographic techniques provided data pertaining to the condition of benthic reef organisms. Percent cover of scleractinian corals and major reef biota was determined from digitized images obtained from random and repetitive photography of the benthic reef community. Repetitive photography, growth spikes, and sclerochronology were utilized to determine accretionary and 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.

SIGNIFICANT CONCLUSIONS: By all growth measures applied, the East and West Flower Garden Banks coral communities appear to be healthy and growing. There were three areas of occurrences inconsistent with historical records: 1) the increase of coral bleaching during the 1997 cruise; 2) the depressed population of sea urchins, a primary herbivore in most coralline ecosystems; and 3) the introduced contaminants in the water column.

The unusually high water temperatures during the summer at the East and West Banks are consistent with the increased occurrence of bleaching. Casual observations following the 1997 cruise do not suggest permanent damage from the bleaching event of 1997.

The Semi Permeable Membrane Devices (SPMD) analyses highlighted several potentially toxic contaminants in the water column in low concentrations. Poly-aromatic hydrocarbons (PAH), DDE, DDT, and other contaminants were present. The impact of these contaminants is not known.

Calculation and analysis of attenuation coefficients, k , provided additional information on the water column characteristics. Water clarity ranges between that of "clear coastal water" and the "clearest of oceanic waters."

Monitoring efforts to date have not taken into account the possible relationship/

dependency of the coral reef cap to the deeper portions of bank. During the 1997 cruise the first attempts were made to establish methods to begin exploration of the banks slope between 30 and 57 meters.

Relative to historically utilized methods of assessing growth, it was judged that sclerochronology would be a more effective method to measure accretionary growth than growth pins. The growth pins have a tendency to encourage abnormal growth at the coral surface. The coral polyps readily attach to the pins and grow in a manner to follow the contour of the pin until completely engulfed.

STUDY RESULTS: As in past studies, random transects indicate *Montastraea annularis* was the dominant coral providing 29.19% and 28.30% cover on the East and West Bank, respectively. Total coral cover did not vary significantly between the East (54.38%) and West (49.78%) bank. Analysis of species diversity and evenness showed no significant difference between studies, banks, or 1996 -97.

Mean accretionary growth at the East Bank was 5.7 mm/year and 7.3 mm/year at the West Bank. Net growth rates were positive for 1996-97. Encrusting growth averaged 0.06 cm/yr at the East Bank and 0.14 cm/yr at the West Bank. There were no significant differences in advance rates (East Bank = 0.37 cm/yr; West Bank = 0.40 cm/yr) between banks or between previous studies. For both banks, 52% of *D. strigosa* margins were found to be advancing. Retreat to advance ratios (East Bank = 0.60; West Bank = 0.317) indicate a net tissue gain.

Repetitive quadrats indicate mean coral cover was estimated at 58.2% and 57.0% for 1996 and 1997, respectively, on the East Bank. Growth exceeded tissue loss. No bleaching was observed in the 1996 quadrats, but in 1997 approximately 1.9% of the coral tissue exhibited bleaching. At the West Bank, mean coral cover was estimated to be 56.6% and 56.5% for 1996 and 1997, respectively. Growth exceeded tissue loss. No bleaching was recorded in 1996, but in 1997 bleached tissue was estimated at 1.2%. Six incidences of disease were recorded in 1,700 colonies observed with an estimated tissue loss of 0.12% resulting. Coral disease was low, occurring in 0.006% of the coral colonies examined. *Diploria strigosa* and *Montastraea* spp. were the most commonly afflicted corals. The overall loss of coral cover due to disease was less than 0.03%.

There were virtually no detectable changes in coral coverage or coral mortality observed in the 1400-m² video transect images. Bleaching was observed to increase relative to past studies covering 1.2% of the transect area.

Semi-Permeable Membrane Devices (SPMD) indicated the presence of Poly-Aromatic Hydrocarbons (PAH) at the West (273 ng) and East Banks (290 ng) from February to September 1997. From September 1996 to February 1997, 1,023 ng of PAH was accumulated at the East Bank. Indications are that the source is either condensate, oil seepage or ship fuels. Pesticides and PCBs were also recorded in the SPMDs. The

amount of 4,4'-DDE (West Bank = 49.5 ng; East Bank = 43.5 ng) and 4,4'-DDT (West Bank = 23.6 ng; East Bank = 21.6 ng) were similar from the two sites collected from February to September. The 4,4'-DDE (93.2 ng) and 4,4'-DDT (39.4 ng) were almost twice as high September to February. The predominance of DDT rather than its metabolite DDE suggests recently used DDT.

Analysis of light attenuation coefficients (k) indicate that the water column at the Flower Garden Banks falls between the published values for the clearest coastal water ($k=0.15$) and the clearest oceanic waters ($k=0.033$). Analysis of trends in k values indicate at least two attenuation regimes most likely related to plankton blooms which reduce the transmissivity of the water column.

Water temperatures ranged from 20.1 to 30.1 °C at the East Bank and 20.2 to 30.0 °C at the West Bank. Temperatures at the East Bank were lower than the 7 year average for the period from mid-April through mid-June, 1977. Another apparent deviation from the 7 year average occurred from late July until mid-August, 1997 at the East Bank when daily temperatures were higher than average. Daily water temperatures at the West Bank were higher than average from early March through the first week of April and again from mid-June through early September, 1997.

Surveys and habitat characterizations of deep (30 to 50 m) reef zones were attempted with moderate success. Due to weather conditions, no deep reef surveys were attempted in 1996. In 1997, deep reef surveys were conducted at each bank. The primary objective was to test the feasibility of surveying the deeper portions of the banks using SCUBA technology. Some general habitat characterization was achieved through analysis of the video transect images.

Sea Urchin surveys were conducted at each bank during both sampling periods. Data indicates that the sea urchin population is depressed and did not vary significantly between sampling years or banks. During the 1996 transect surveys 1 sea urchin was counted (0.003 urchins/m²), and during the 1997 survey 3 sea urchins were counted (0.0375 urchins/m²).

Micromolluscs from sand samples are in the process of identification. To date, 64 species representing 34 families have been identified including species of the families Omalogyridae and Vitrinellidae, which have not been previously reported from the Flower Garden Banks.

STUDY PRODUCTS: Dokken, Q.R., I.R. MacDonald, J.W. Tunnell, Jr., C.R. Beaver, G.S. Boland, and D.K. Hagman. 1999. Long-term Monitoring of the East and West Flower Garden Banks, 1996-1997. OCS Study MMS Pub. No. MMS 99-0005. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana, 122 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).