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STUDY TITLE: Long-term Monitoring of the East and West Flower Garden Banks National Marine Sanctuary, 1998-1999

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BACKGROUND: The Flower Garden Banks coral reef system is a unique low diversity, high cover, 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 East and West Flower Garden Banks (EWFGB) 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 250+ species of fishes and 500+ 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 disasters 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 sensitive ecosystems associated with the Flower Gardens coral reefs,
2. Document long-term changes in reef-building coral and associated communities at the FGB caused by either impacts of petroleum exploration and production or other human impacts,
3. Document long-term natural variation in reef growth and associated communities on the FGB and,
4. Stimulate ancillary research efforts and coordinating monitoring activities with agencies and institutions conducting water quality assessments and other studies in the vicinity of the EWFGB in order to observe, document, and expediently evaluate causes of environmental change.

DESCRIPTION: Research cruises were conducted aboard the M/V Fling during 27 September - 1 October 1998 and 12-16 September 1999. 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. 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.

Several ancillary studies were conducted at both Flower Garden study sites describing algae and micromolluscan populations, primary production of macroalgae, and porewater toxicity tests.

SIGNIFICANT CONCLUSIONS: The dominant coral species at both banks were *Montastraea annularis* and *Diploria strigosa*. The occurrence of algae increased from 3% in 1998 to over 20% in 1999. This increase was due to the presence of large amounts of red turf algae in the Order Ceramiales and mainly at the expense of bare reef rock. The reasons for the initial spike in algal occurrence is not yet known.

Annual growth rates of *Montastraea faveolata* were measured using sclerochronology, a measurement of accretionary growth bandwidths. One core was removed from banks, longitudinally sectioned, and x-rayed to reveal growth bandwidths. Mean accretionary

growth from 1998-1999 averaged 7.3 mm/year at the East Bank and 5.0 mm/year at the West Bank.

Sixty permanent encrusting growth stations of *Diploria strigosa* were photographed at each bank and used to calculate growth and/or retreat rates in cm/year. The East Bank exhibited a net retreat in 1998 and net advance in 1999. Net retreat was reported for both years at the West Bank.

Repetitive quadrats were used to monitor changes in structure of particular coral communities at the EWFGB. Yearly repeated photographs of forty stations at each bank were compared to previous years. Percent cover, number of individual coral colonies, incidents of coral bleaching and disease, and tissue loss were recorded from the photographs. Mean coral cover at the East Bank was greater than 55% in 1998 and 1999, and 52% both years at the West Bank. Several incidents of bleaching occurred, with the highest occurrence recorded at the West Bank in 1999. Only three incidents of coral disease were reported. The majority of tissue loss was due to coral retreat/algal replacement and sediment deposition on living coral colonies.

The ancillary studies provided the following results:

1. Fredericq *et al.* and Lehman and Albert recorded a combined taxonomic list of 72 species of algae collected at the FGB. Fredericq *et al.* noted an abundance of blue-green algae and speculate it was caused from nutrient loading.
2. Dunton and Miller reported blue-green algae as the primary source of nitrogen in the water column and described the FGB as being “autogenous” in meeting nutrient supplies.
3. Barrera and Tunnell reported an increase of 100 species of the known micromolluscan faunal assemblage at the FGB.
4. Porewater toxicity testing conducted in sediments of the FGB by Nipper and Carr revealed no toxicity due to organic or inorganic pollutants.

The East and West Flower Garden Banks’ coral reef habitats remain healthy and productive, particularly in comparison to other reefs of the Mexican Gulf of Mexico, the Florida Keys, and the Caribbean Sea. However, some negative shifts in the monitoring parameters were recorded (i.e. encrusting growth, algal biomass, and possible disease occurrence). It is not known what the impact of these shifts will be or whether they are short-term anomalies or the first steps of a long-term trend. Subsequently, continued close scrutiny is crucial. The 2000-2001 monitoring data will be critical in assessing the true meaning of the 1998 and 1999 results. Of particular interest will be the status of the algal bloom and incidence of disease.

STUDY PRODUCTS: Dokken, Q.R. 2001. Long-term monitoring of the east and west flower garden banks national marine sanctuary, 1998-1999. OCS Study MMS-2001-101. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, La. 138 pp.