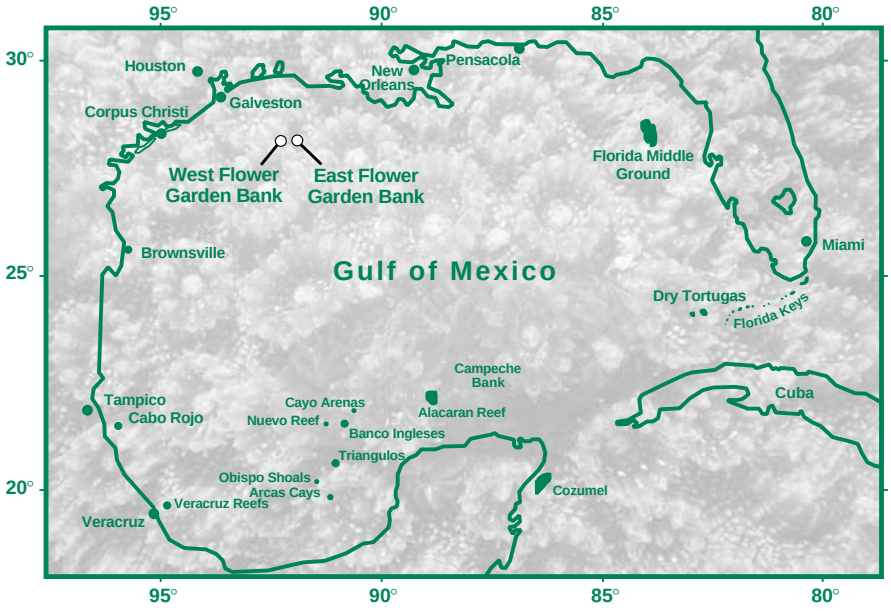
Down under...out yonder

Texas A&M scientists immersed in history, protection, and research at the Flower Gardens

The Flower Garden Banks, two topographic highs in the northwest Gulf of Mexico, host the northernmost coral reefs on the North American continental shelf. To protect their unique biological characteristics and their aesthetic, ecological, commercial, and recreational value, the area (41.7 square nautical miles) was designated a National Marine Sanctuary in 1992 by the National Oceanic & Atmospheric Administration. There are twelve marine sanctuaries in U.S. waters: Stellwagen Bank, the Monitor, *Gray's Reef, the Florida Keys, the Flower Garden Banks, the Olympic Coast, Cordell Bank, the Gulf of the Farallones, Monterey Bay, the Channel Islands, Fagatele Bay, and the Hawaiian Island Humpback Whale National Marine Sanctuaries.*

Stephen R. Gittings



At the turn of the century, only a few long-line fishermen knew the bounties of what they called the Flower Gardens. The name for these oases 100 miles southeast of Galveston came from the colorful corals and sponges visible from the surface, pieces of which the fishermen sometimes landed, fouled on fishing hooks. The reefs appeared on nautical charts in the 1930s, but in 1950 the first detailed contour chart of the area was produced, marking the beginning of the age of exploration for the Flower Gardens. Only one Flower Gardens publication preceded 1950. Three were published in the 1950s, four in the 1960s, nearly three dozen in the 1970s, and over 50 in the 1980s.

The earliest research at the Flower Gardens focused on geology. Henry Stetson first proved the existence of corals on the salt domes that form the banks in 1953. The advent of scuba around this time stimulated diving and collecting expeditions in the 1960s, led by the late Dr. Thomas Pulley, of the Houston Museum of Natural Science. They confirmed that the banks harbored viable, growing coral reefs—the northernmost in North America.

In the 1970s more diving along with the use of submersibles and sophisticated instrumentation by Texas A&M oceanographers Drs. Tom Bright, Dick Rezak, Dave McGrail, and their many graduate students enabled detailed biological, geological, and physical examination of the banks. With increasing development of offshore oil and gas leases, the Bureau of Land Management, and later the Minerals Management Service (MMS), funded these studies through the 1970s and early 1980s.

Monitoring promotes research

The first measurements of coral cover and other important parameters now used to monitor the condition of the Flower Gardens' reefs were made in the 1970s. A formal monitoring program, much of which is still in progress, was developed later by Tom Bright in

conjunction with the MMS, Continental Shelf Associates, Inc., and Mobil Oil, which was planning to drill next to the East Bank.

The results of the monitoring efforts have been gratifying. No substantial changes in coral cover, diversity, growth rates, or other indicators of health, have occurred since the first measurements in the early 1970s. In fact, the reefs of the Flower Gardens appear to be among the healthiest anywhere by all standards.

The monitoring program has enabled regular visits to the banks by scientists and made a variety of supplemental research and pilot studies possible. Coral diseases, which constitute severe threats to some of the world's reefs, are being studied at the Flower Gardens by Rob Zimmerman, of Texas A&M. Strangely, very few of the known coral diseases occur there. One malady, which we call "ridge mortality," may be unique to the Flower Gardens. Others that are prevalent elsewhere have not been observed at the Flower Gardens.

Why study diseases? As Thomas Mann put it, "The actual enemy is the unknown." Presently, the rate of incidence of coral diseases at the Flower Gardens is less than 2%. A concern is that incidence will increase if environmental conditions deteriorate. We know that diseases can kill coral colonies hundreds of years old in a matter of months. Yet because we know so little about coral disease etiology, progression, or control, we remain unprepared to deal with epidemics. It is only with understanding that an effective arsenal of management tools can be developed.

Fish populations are also under study. Less than 150 reef fish species inhabit the Flower Gardens' reefs, a low number compared to reefs farther south. Yet censuses show that a full complement of feeding types exists, including herbivores, carnivores, and omnivores. This is significant because it assures the reef's resilience to most natural environmental catastrophes and some human-induced changes.

In the 1980s, the reefs experienced the mass mortality of a sea urchin species, one that happened to be a dominant grazer. The sea urchins fed on potentially aggressive algae, allowing corals to thrive. Without the sea urchins, the algae spread to cover 14% of the seabed, up from virtually zero percent. During the next several years, however, a species of herbivorous parrotfish became abundant and consumed most of the algae that had grown. This biological control mechanism is not available on many reefs, due to overfishing of grazers and other reef fish. On those reefs, coral cover has been decreasing steadily, from 50% to less than 5% in one case.

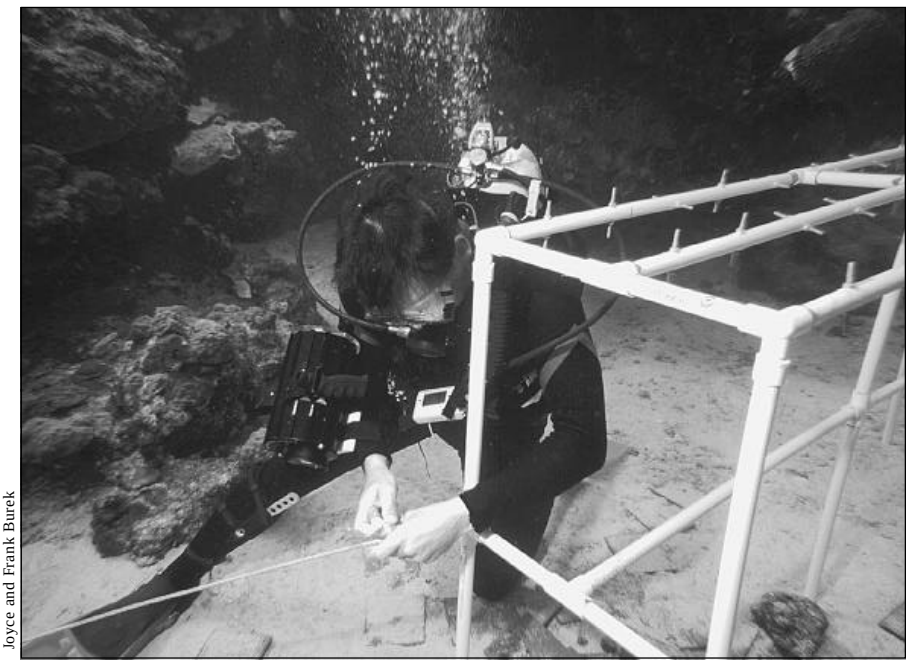
The fish study illustrates a significant issue. We humans have finally tinkered with the oceans and their resources to the point of obvious abuse, particularly in coastal and nearshore environments and on many coral reefs. Aldo Leopold, a naturalist and pioneer in the application of ecological principles to natural resource management, spoke volumes when he stated that the first step in "intelligent tinkering" is keeping all the parts. In many environments of the world, the removal of critical species has contributed to the ecosystem's premature demise. Likewise, on many coral reefs, indiscriminate removal of fish has decimated the populations of herbivores. This has led directly to increases in algae cover at the expense of corals. The outcome is what some call "algal reefs," which have low coral cover, low diversity, and lack reef-building capacity.

The Flower Gardens' corals themselves are also under study, and they are revealing the secrets of the past. Dr. Niall Slowey, of Texas A&M, is using coral cores up to five feet long to study

Top: Researchers board a Mobil Oil gas production platform. The prototype platform, anchored next to the Flower Gardens reefs, was designed to reduce marine pollution caused by gas production. Scientists and volunteers use donated space on the platform as on-site laboratory and living accomodations.

Bottom: A diver secures a rack of PVC pipe to serve as a substrate for transplanted corals. If corals can be successfully raised in the laboratory and transplanted to stressed areas, they may be able to speed recovery of damaged or dying reefs.

Kaile Tsapis



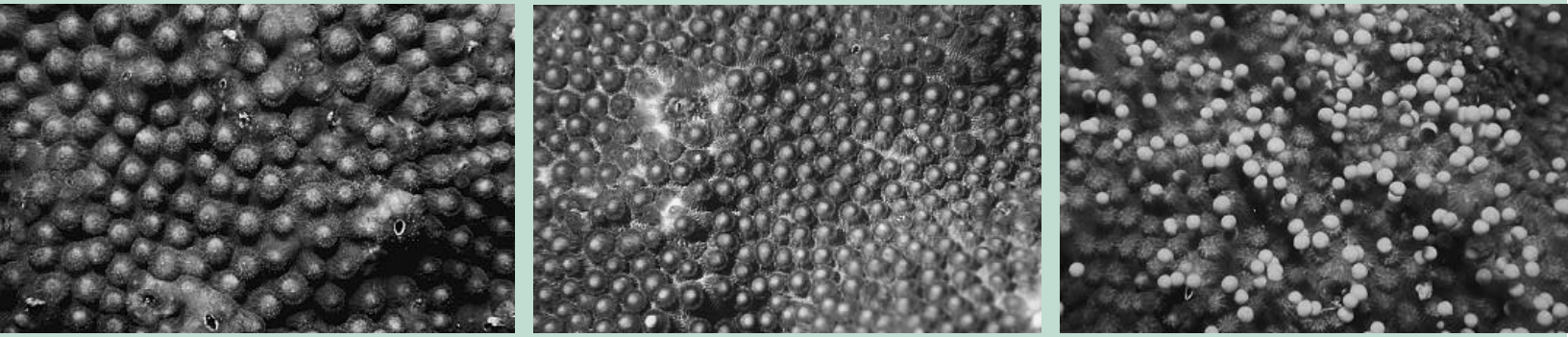
Joyce and Frank Burek

historical atmospheric and oceanographic conditions (See "Coral cores from the Flower Gardens," this issue). Corals secrete seven to eight millimeters of limestone each year, analogous to trees adding annual rings. In each annual layer the corals leave chemical records of water quality. Water chemistry varies with changing temperature, salinity, and elemental composition, all of which reflect changes in climate. Dr. Slowey's cores contain several hundred years of data that should reveal climate conditions in times before humans kept records. These findings may help scientists and others predict future conditions and improve our resource management abilities.

Users care about the Flower Gardens

The remote location of the banks has left them relatively undisturbed by human activities. It also appears that protective regulations imposed by MMS, the National Oceanic & Atmospheric Administration (NOAA), and others, combined with voluntary attempts by the oil industry and the recreational dive community to operate in an environmentally friendly manner have minimized potential impacts on the banks' fragile resources. For example, charter boat operators voluntarily prohibited spearfishing and souvenir collecting prior to the designation of the marine sanctuary, and oil companies operating near the Flower Gardens voluntarily report even minor spills to NOAA.

The reefs see over 2000 recreational divers each year. With this level of visitation, the banks are slowly giving up their secrets—and focusing our attention on important questions. Each winter the reefs witness reunions of enormous hammerhead shark schools. Whale sharks, which grow to sixty feet in length, can be abundant one year but absent the next. Manta rays can be seen year round, an attraction claimed by very few places in the world. We do not know whether the rays are residents, transient wanderers, or repeat visitors. In the summer, divers can see newborn mantas, but seldom the adults, whose whereabouts remain unknown during that season. Adults, some over fifteen feet across, seem to be winter inhabitants. Like rays, the habits and migra-



Montastrea annularis ***corals release packets of egg and sperm during the annual spawning event at the Flower Gardens. The packets break apart on the surface to allow fertilization, and resulting larvae drift for days or weeks before sinking. If the larvae settle on a reef or other suitable substrate they can begin growing into mature corals. (Photos by Joyce and Frank Burek)***

Love on the rocks

In 1990 recreational divers at the Flower Gardens first witnessed "mass spawning," the dramatic, annual, synchronous release of gametes by a variety of coral species. Spawning by any corals was rarely seen before this time, and mass spawning in the Atlantic had never been witnessed under water. The divers reported their experience to scientists and now the two groups mount scientific expeditions every year to study the phenomenon.

The Flower Gardens' reefs exhibit some of the most prolific and highly predictable spawning found anywhere. It happens each year eight evenings after the August full moon, generally between 8:00 and 11:00 p.m. In recent years reports from the Flower Gardens have stimulated "spawning expeditions" and scientific observation there and on reefs in the Caribbean Sea. They have also enabled studies of important controversies in coral-reef science.

For example, the dominant reef-building coral species in the Atlantic Ocean, *Montastrea annularis*, was recently divided into three species based on differences in colony shape, protein content, and other characteristics. Mass spawning by the three "species" at the Flower Gardens allowed researchers to find out if the corals can reproduce with one another—the definitive attribute of a true species.

Preliminary studies at the Flower Gardens and in Panama suggest that interspecific fertilization is rare and in all likelihood, the three do *not* reproduce with each other to any substantial degree. In fact, the three have slightly different spawning times within the already limited "spawning window" of several hours each year.

—Stephen R. Gittings

tions of sea turtles are poorly understood. Studies of these species' life histories have been possible only recently, largely because of the involvement of recreational observers.

Partnerships produce results

Texas A&M oceanographers conducting the monitoring study for MMS from 1988 to 1992 worked with 67 different volunteer divers to collect data. A productive relationship developed between scientists and recreational divers and continues today. At the Flower Gardens, ten to twenty volunteers collect samples each year for Derek Hagman, formerly at A&M and now at the University of Texas, who is studying spawning, larval development, and the utility of laboratory-reared corals for reef restoration efforts. The volunteers also provide samples for toxicology research conducted by Dr. Duane Chapman and Russell Hooten of the National Biological Survey. These important studies will help determine the level of contamination that these and other reefs can tolerate before environmental degradation begins to harm them.

Volunteers also installed mooring buoys to limit damage caused by anchoring, and are involved in censuses of fish, manta, and turtle populations coordinated by Texas A&M graduate students Christy Pattengill, Jeff Childs, and Emma Hickerson, respectively. This summer they also helped A&M scientist Dr. Dave Owens capture, tag, and track a loggerhead turtle on the West Bank, a critical event that should enhance our understanding of the life history of this threatened species.

The partnerships that have developed around the Flower Gardens actually go beyond this. The MMS, which should be credited for the majority of what we know about the Flower Gardens, is no longer the only major federal player. The National Oceanic and Atmospheric Administration (NOAA), with the encouragement and support of the scientific and diving communities, designated the Flower Garden Banks National Marine Sanctuary in 1992. Retired Texas A&M Professor Tom Bright wrote substantial portions of the environmental impact statement and management plan for the sanctuary. NOAA administers research, education, enforcement, and management programs for the site. MMS and NOAA work together on issues such as monitoring, oil spill risk assessment, spill clean-up policies, and development plan reviews. The Coast Guard and the National Marine Fisheries Service cooperate with the sanctuary on enforcement, while the Environmental Protection Agency regulates industrial discharges and supports scientific efforts.

Kaile Tsapis

Greg Boland, a Texas A&M oceanography staff member, teaches an Oceanographic Expeditions volunteer how to filter a sediment-trap sample using a vacuum apparatus. The two are looking for changes in the amount of organic carbon on the seafloor during coral spawning (see sidebar).

Industry has also become an important partner. Exploration and development companies donate funds for research and education projects to the Flower Gardens Fund, a sanctuary support group established by the Gulf of Mexico Foundation, a non-profit 501(c)(3) organization. In addition, Mobil provides free transportation, food, lodging, and logistical support for scientists conducting research from their gas production platform in the sanctuary. Charter boats that normally take recreational divers to the reefs also take graduate students when space is available.

A bright future

Few places in the world can boast the pristine condition of the Flower Gardens. Fortunately for science, in that trait resides enormous potential for investigations of natural processes that should characterize healthy ecosystems. We expect that with increasing awareness of the unique character of the Flower Gardens, their reputation will continue to grow and attract scientific attention.

We are heartened by the fact that, by all accounts, the human race has not had a significant impact on these reefs. These are still wild places where the unpredictable is commonplace. To see and study the Flower Gardens, you do it on the ocean's terms. Currents and waves care not for diver safety. Hammerhead schools do not wait for calm weather. Coral diseases and whale sharks have no respect for political boundaries. Still, the joint efforts of scientists, divers, industry, and resource managers are beginning to lift the veil of Mother Nature's secrecy down under...out yonder.

For more information write to the Flower Gardens National Marine Sanctuary, 1716 Briarcrest Dr., Suite 603, Bryan, Texas, 77802 or call (409) 847-9296.