Natural Setting
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The Flower Garden Banks National Marine Sanctuary encompasses a variety of habitat types, including the northernmost coral reefs in the continental United States. Located about 115 miles directly south of the Texas/Louisiana border, the East and West Flower Garden Banks are perched atop two salt domes rising above the sea floor. Salt formation began 160 to 170 million years ago when salt layers were deposited in what was then a shallow sea, subject to evaporation. Sediments were continually deposited over the salt layers.

Eventually, internal pressures became great enough to push isolated pockets of the salt layers up through the sediments, forcing the seafloor to bulge upward in distinct domes. The Flower Gardens coral reef community probably began developing on top of the domes 10,000 to 15,000 years ago. The community has thrived sufficiently to obscure all trace of the deformed bedrock on which it developed, forming dense coral reefs.

The nearest tropical reefs to the Flower Gardens are 400 miles away off the coast of Tampico, Mexico. Scientists believe that corals at the Flower Gardens probably originated from Mexican reefs when currents in the western Gulf of Mexico carried the young corals (planulae), other animal larvae, and plant spores northward. A few of these planulae were lucky enough to settle on the hard substrate of the Flower Gardens.

Amazingly, this location in the northwestern Gulf provided all the comforts of home for hard corals: a hard surface for attachment, clear sunlit water, warm water temperatures (between 68 and 85 degrees Fahrenheit), and a steady food supply. The corals now form the basis for a complex, yet balanced ecosystem, providing a regional oasis for shallow-water Caribbean reef species.

It was this wonderful biological diversity and breathtaking beauty that prompted researchers and recreational divers to seek protection for the Flower Gardens. They launched what would become a 20 year effort, culminating in 1992, to designate the Flower Garden Banks National Marine Sanctuary.

In 1996, a third bank was added to the Sanctuary. Stetson Bank is located about 30 miles northwest of the West Flower Garden Bank. That small difference in location produces an amazing difference in the habitat. Because of their more northerly position, the winter water temperatures are four degrees cooler, on average, than the Flower Garden Banks. That small temperature difference is enough to prevent corals from growing fast enough to pile up into a coral reef, as they have at the Flower Garden Banks. Instead, you find individual coral colonies interspersed with a much denser population of sponges. You can even see the siltstone bedrock showing through in many places.

While the predominant coral species at the Flower Gardens are large boulder shaped corals such as brain coral and mountainous star coral, the prevalent species at Stetson

are smaller encrusting corals, such as fire coral and green cactus coral. Divers describe the effect as an underwater moonscape.

As you begin your descent through the water column into this unspoiled wilderness, you are passing through the pelagic zone. Here, you find those species that survive by cruising from place to place in search of a meal or a mate. You may encounter such charismatic characters as manta and spotted eagle rays, hammerhead and silky sharks, the ubiquitous chub, loggerhead sea turtles, jack crevalle, amberjack, and if you are really lucky, a whale shark.

Just below 50 feet on the Flower Garden Banks, you encounter the reef cap, which continues to depths around 120-140 feet. As you explore over 300 acres of marvelous high relief reefs, you discover that they include the majority of the species found at the Flower Gardens: about 23 species of corals, over 250 reef invertebrate species, 175+ fish, and 80+ marine algae. Until recently, it was thought that the Flower Garden Banks had no large branching coral species, such as elkhorn or staghorn coral. Nor were the banks thought to be home to more than a sprinkling of "soft corals" such as sea whips or sea fans. Explorations in recent years, however, have revealed at least two colonies of elkhorn coral. Improved underwater camera and video technology, combined with access to high-resolution sonar data and remotely operated vehicles have been key to documenting many additional species of "soft corals" such as gorgonians.

The most obvious organisms found on the reef cap are the massive boulder-shaped coral colonies. Many have been sculpted into mushroom shapes by a process called bioerosion, in which other organisms gradually wear away the colony around its base. Available space created by bioerosion and breakage is quickly colonized by algae, sponges, and other attaching organisms. The dominant coral species are the mountainous star coral (*Montastraea sp.*) and the brain coral (*Diploria strigosa*).

Below 90 feet on the reef cap, you will also see, nestled among the larger corals, ridges or knolls with high concentrations of the small branching finger coral *Madracis mirabilis*. These unusual thickets also feature finger sponges, encrusting sponges and algae. The Madracis ridges are also found scattered around the deeper reef habitat.

To examine these habitats, you must venture below 120 feet into water as deep as 170 feet, not advisable for the average recreational diver. At these depths, corals grow in a flattened manner to maximize their exposure to light, a critical element of life to the symbiotic algae living in the corals' tissues. Habitat relief is much lower than on the shallow reefs. Fewer hard corals live in this zone, primarily because most species need more light. The dominant species are a star coral (*Stephanocoenia michilini*) and fire coral (*Millepora alcicornis*).

At about 150 feet, you will begin seeing the algalsponge habitat, which extends to around 270 to 290 feet deep. Dominated by coralline algae, this habitat covers several square miles, a much larger area than is inhabited by corals. Algal nodules, up to fist size, cover 50 to 80 percent of the bottom in places. Because of the area covered and the

amount of carbonate deposits produced, the algae may be more important to reef formation, overall, than corals are on the banks. Although less is known of the biota in this habitat, some believe that the species diversity may be comparable to that on the reef cap.

If you were exploring the southeast flank of the East Bank, at about 220 feet deep you would discover an unusual underwater salt lake almost 200 feet wide and only ten inches deep. Fed by a brine seep from the underlying salt dome, the lake is highly saline, has high levels of hydrogen sulfide and dissolved hydrocarbon gases, and no oxygen &emdash; not exactly what we think of as ideal living conditions for most organisms! The lake flows into a canyon that allows mixing to occur. This dilutes the brine, adds oxygen and reduces the toxic hydrogen sulfide. So much salt has dissolved from beneath the bank that a large depression, known as a graben, has formed. The graben is more than a mile across and 15 feet deep.

A unique assemblage of biota has developed in and around the lake and in the canyon. Dominant organisms are sulfide-oxidizing bacteria, living at the very thin interface between the dense brine lake and the normal sea water above. A white mat of bacteria and algae covers the floor of the canyon. A specialized community of organisms, called thiobios, inhabit the sulfide-rich canyon stream and feed directly on the plants and bacteria growing there. Most fish cannot tolerate the sulfide of the canyon brine stream, but some are able to take advantage of the food source there by diving into it for quick meals.

The lower two-thirds of the algal-sponge habitat begin a transition zone between organisms that exhibit distinct shallow-water traits and those adapted to deep water. A distinctive transition species is the white, bedspring-shaped, antipatharian sea whip.

Scattered throughout the deeper portions of the Banks, where coralline algae do not thrive and reef-building corals are totally absent, are remnants of ancient reefs. These drowned reefs are the remains of reefs that probably thrived during periods of lower sea levels when they were closer to the surface. Now, the depths and comparatively turbid conditions limit the species diversity.

Until recently, it was believed that the areas surrounding the base of the banks was quite flat and mostly unvegetated sand or mud bottom. Improved mapping technology has revealed that these areas are much more complex than previously thought. They may actually form a sort of “fish highway” between banks, providing protection from predators and sources of food for animals moving between the banks. Even the sandy areas are more diverse than many people imagine. They support healthy communities of organisms living on and within the sediments. Micro algae, a variety of worm species, crabs and sea stars are examples of the organisms inhabiting these areas.