

Sizing Up Sanctuaries

Lesson Time : 60-90 minutes

Grade Level : 9-12

Vocabulary: species abundance, sighting frequency, species diversity

Summary

Compare and contrast fish communities, diversity and habitats in U.S. National Marine Sanctuaries.

Objectives

- Describe the basic habitat and marine fauna differences among three marine sanctuaries.
- Evaluate fish diversity data to compare fish species among sanctuaries.
- Identify physiological and biological factors that contribute to fish diversity differences among sanctuaries.

Introduction

In 1972, the National Oceanic and Atmospheric Administration (NOAA) established the National Marine Sanctuary Program, and boundaries were officially given to some of our planet's most precious natural and cultural underwater resources. As of 2026, there were 18 national marine sanctuaries dotted among the Atlantic Ocean, the Gulf of Mexico, the Pacific Ocean, Great Lakes, and off the coast of American Samoa.

Four marine sanctuaries lay in the waters of the Southern United States: Gray's Reef (off the coast of Georgia), Florida Keys, Monitor (off North Carolina), and Flower Garden Banks (off the Texas/Louisiana border). Although we group them together geographically, they vary in size, habitat types, resources present, and management challenges. After familiarizing you with each sanctuary, we will present you with some exercises using real data to examine how habitat influences the presence or absence of certain species of fish.

Gray's Reef

Located nineteen miles off Sapelo Island, Georgia, the boundaries of Gray's Reef National Marine Sanctuary protect 22 square miles of open ocean and live bottom reef. This unique and beautiful area was named after Milton B. Gray, a biological collector and curator at the University of Georgia Marine Institute, who studied the area during the 1960s. Under the Atlantic Ocean surface, 60-70 feet down, lies one of the largest nearshore sandstone reefs in the southeastern United States. Its

topology supports an unusual combination of temperate and tropical flora and fauna, making this spot an attractive destination for divers and sportfishers.

The sanctuary's hard bottom (limestone/sandstone) and rock outcroppings are interspersed with sand expanses, but the abundance of rocky ledges and other exposed rock surfaces have produced a complex habitat of caves, burrows, troughs, and overhangs which are very inviting to sponges, barnacles, sea fans, hard coral, sea stars, crabs, lobsters, snails, and shrimp. This explains why it is known locally as a "live bottom habitat". Loggerhead sea turtles are also attracted to the ledges and overhangs, which provide protected resting spots. A bountiful resource of food and proximity to nesting sites on barrier island beaches also contribute to making Gray's Reef an ideal habitat for the threatened turtles. A variety of fish species including damselfish, sheepshead, grouper and mackerel make their homes here. Larger fish like barracuda and nurse shark can also be spotted, as can the highly endangered northern right whale, which uses the area as a winter calving ground. With so many residents affected by management decisions, sanctuary managers aim to promote and coordinate research to increase scientific understanding of the area. The monitoring program at the sanctuary focuses on fish populations, benthic invertebrates, oceanographic conditions, sediment transport and visitor use.

Florida Keys

The Florida Keys National Marine Sanctuary extends 220 miles in a northeast to southwest arc between the southern tip of Key Biscayne, south of Miami, to beyond the Dry Tortugas Islands. This archipelago of over 1700 islands is probably best known for its stunning coral reefs; however, this complex ecosystem is made up of a wide variety of habitat types – greater than in other sanctuary regions. Water depths range from 4 feet to 2000 feet, with the depth of the reef tract averaging about 50 feet.

Fringing mangroves, seagrass meadows, hardbottom regions, sandy bottoms, and various reef types all play roles in sustaining the myriad of organisms that call this paradise their home. Mangrove forests and seagrass beds both provide protected spawning and nursery areas for fishes, crustaceans, and shellfish. They also provide food for a multitude of marine species. Many commercially and recreationally important species such as shrimp, crabs, spotted seatrout, and red drum rely on these habitats. Residents of hardbottom habitat include stony and soft corals, sponges, mollusks, crustaceans, echinoderms, and many species of fish. The region's reefs and tropical habitats are highly complex and diverse communities. Current velocity, depth, and proximity to the Gulf or the Atlantic help determine the biological communities in these waters. On the Atlantic side of the sanctuary, the biota is predominantly Caribbean, while the biota on the northern side are characteristic of warm-temperate areas. There is a mixing of biota in nearshore areas, however, as water is exchanged through channels between the islands.

Along with a complex environment come complex management issues. The accessibility of the Florida Keys makes the area more susceptible to human impact than other areas. Freshwater inflow to the sanctuary from the South Florida peninsula has been significantly disrupted by the draining of large tracts of wetlands for agriculture. An increase in coral disease and coral bleaching

is being observed. Overfishing and damage to coral by careless boaters, snorkelers, divers, and occasional large ship groundings are also of concern. Long-term monitoring programs are in place to keep tabs on water quality, coral population dynamics, recreational and commercial fish catch statistics, and seagrass dynamics, among other efforts. A zone monitoring program was initiated in 1997 to determine the effectiveness of no-take (no fishing) zones in protecting biodiversity. Commercial fishing and tourism are vital to South Florida, but it is also critical that we ensure the health and ecological future of the Keys ecosystem.

Flower Garden Banks

Off the border of Texas and Louisiana, about 105 miles from shore and 50-100 feet under the water's surface lies a tropical oasis. This spot in the Gulf of Mexico is the unlikely location of the northernmost coral reefs in the United States – East and West Flower Garden Banks. The Banks themselves are salt domes formed by an interesting process that began 160 to 170 million years ago. The area was then a shallow sea, subject to evaporation. Salt layers were deposited and were gradually covered up by miles of sediments. Eventually, internal pressures became great enough to push isolated pockets of salt up through the sediments. The seafloor bulged upward forming the distinct domes that are now covered by coral reef communities, rising to within 66 feet of the surface.

At Flower Garden Banks you will find shallow water Caribbean reef fishes and invertebrates, even though the nearest tropical coral reefs are 400 miles away off the coast of Mexico. Scientists believe that young corals (planulae), other animal larvae, and plant spores were carried to the area from the Mexican reefs by currents in the western Gulf of Mexico. Luckily, they found an environment very inviting to hard corals, with a solid surface for attachment, clear sunlit water, warm water temperatures, and a steady food supply. This is an isolated area, however, with a small local gene pool, and there is a low coral diversity compared to other Caribbean reefs. Algae are quite abundant, though, with eighty forms providing food for the sanctuary's inhabitants and marine visitors.

Stetson Bank, another part of the sanctuary located seventy nautical miles south of Galveston, Texas, has slightly different environmental conditions. It is home to many species of tropical and subtropical fish and invertebrates, but its temperature fluctuations and water clarity do not support the growth of reef forming corals like those found at the East and West Flower Garden Banks. Stetson Bank is capped by uplifted layers of claystone and sandstone that have eroded to create a strange “moonscape” appearance where sponges are dominant. Frequent visitors to sanctuary waters include manta rays, as well as loggerhead, leatherback, and hawksbill turtles. Occasionally, even whale sharks, the largest fish in the sea reaching lengths of sixty feet, are seen.

Flower Garden Banks faces many resource protection challenges. The principal activities in the vicinity of the sanctuary are oil and gas extraction, commercial fishing and shipping, recreational fishing, diving, and research. An additional management challenge is posed by the remoteness of the Banks – a 7–8-hour boat trip offshore. Now the U.S. Coast Guard takes sanctuary staff once a month on a 45-minute jet ride to observe their waters, flying down as low as 150 feet above the

surface. Coast Guard pilots on other missions keep watchful eyes on the sanctuary, as do oil platform personnel and dive boat operators. Long-term monitoring data demonstrates that all this attention is paying off. Studies have shown that, despite increasing industrial development around the Banks, no statistically significant environmental changes have occurred on the reefs. In fact, while many coral reefs in the world are dying, the reefs at Flower Garden Banks are some of the healthiest anywhere. As a result, scientific research is focusing on comparing the Flower Garden Banks reefs to those in other areas of the Caribbean and around the world.

Data Activity

Who Lives Where: Compare and Contrast

You will be using two databases to access information relevant to this exercise.

The [FishBase](#) database will provide you with species summaries. The [REEF](#) (The Reef Environmental Education Foundation) database contains species abundance survey results for many areas, including the three sanctuaries.

Class Preparation:

- Below is a list of nine species of fish. To download the species information for each, go to [FishBase](#), enter the common name of the fish, then choose the appropriate species – **(Country = USA)** – from the list. Print each species summary.

LIST OF SPECIES: Belted Sandfish, Blue Angelfish, French Grunt, Queen Parrotfish, Yellowtail Snapper, Black Sea Bass (*Centropristis striata*), Spanish Hogfish, Neon Goby, Seaweed Blenny

Exercise:

Compare and contrast the habitats that characterize each sanctuary by examining the species that live there. Use what you have learned about each sanctuary (habitats, water temperature, water clarity, substrate/benthic cover, level of protection for hiding, etc.) and the information from the species summaries to decide which fishes live where. Download and fill in the [Compare & Contrast worksheet](#).

Now, compare your predictions to the species lists for each of the sanctuaries. Follow the directions below to generate the species reports.

- Go to the [REEF](#) website, under the **Database** tab click on **Generate Reports**. Click on **Geographic Area Report**, then select **Tropical Western Atlantic** and click **Go**. Select **Geographic Area Report**. Enter the specified Geographic Zone Code for each sanctuary below. Keep the default Start and End dates and generate the report. Once you have the report, scroll down to the bottom and make a note of the total number of species sighted in that sanctuary, then print out the first two pages of each report.

For more data-based lessons, visit: bridgeoceaneducation.org/data-series.

We will only be looking at the **species with 50% sighting frequency (SF)**. Sighting frequency is a measure of how often the species was observed. It indicates the percentage of times out of all surveys that the species was recorded.

Gray's Reef Geographic Zone Code: 93020001

Florida Keys Geographic Zone Code: 34000000

Flower Garden Banks Geographic Zone Code: 24020000

Monitor Geographic Zone Code: 93030000

Note: Although Stetson Banks is part of Flower Garden Banks National Marine Sanctuary, the two areas are geographically separate and therefore are surveyed separately in the REEF database. Since they have somewhat different characteristics, we will evaluate them separately.

Discussion

1. Who Lives Where?

Looking at the species from the list selected above, who lives in which sanctuary? (Some species will be found at more than one sanctuary, and others will be unique to certain sanctuaries)

2. Who Lives Everywhere?

Among the most sighted fishes ($\geq 50\%$ SF), there is only one species of fish that is found in all four sanctuaries. Analyze the REEF lists to find it. Once you have found it, go to the FishBase database and print out the species summary. Does its biological description explain why it is found in all three sanctuaries?

3. Species Diversity

The definition of species diversity can be rather complex, but in essence, species diversity is greatest when the number of different species is greatest. Diversity in particular environments is influenced by many factors, some of which are water temperature, food availability, the number of habitat types, isolation, and shelter. Which of the sanctuaries would you expect to have the greatest amount of diversity (greatest number of different species)? Which would you expect to have the least? Why? Some clues can be found in the paragraphs above.

4. What are some potential threats to marine fish diversity?

5. What role do the National Marine Sanctuaries play in protecting and maintaining species diversity?

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