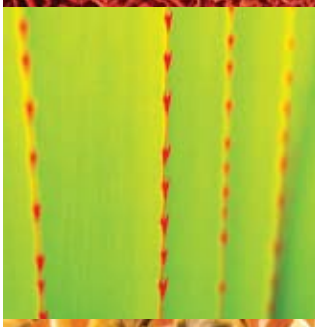
ECOREGION: CARIBBEAN



The warm temperatures, beautiful clear waters, and bountiful sea life of the Caribbean have long drawn humans to these waters. The Caribbean ecoregion is a large area that includes the Caribbean Sea, the Gulf of Mexico, and part of the Atlantic Ocean. Most of the Caribbean experiences hot and humid weather with heavy rain all year round. During certain times of year, the low-pressure zones of the eastern Caribbean Sea help create hurricanes that often damage the coast and low-lying parts of the region's islands.

In these vast open waters, habitats that provide food and shelter are crucial for the animals that call the Caribbean home. Mangrove forests along coastlines have tangled, fast-growing roots that offer protection and food to a variety of animals, including crabs, scallops, and anchovy fish. Large meadows of swaying seagrasses provide habitats in the currents beneath the ocean's surface. Further out to sea, the **coastal shelves** and warm tropical waters of the Caribbean create perfect conditions for coral reefs. Coral reef ecosystems are some of the most biologically diverse in the world, and the Caribbean contains 7% of the world's reefs.[1]

THE IMPACTS OF CLIMATE CHANGE

Climate change may affect many of the resources that make the Caribbean such a popular destination. As sea levels rise due to increasing temperatures, ocean water will slowly spread over and erode many of the Caribbean's famous islands and white beaches. Climate change also will likely increase the intensity of coastal storms, making hurricanes more destructive to habitats and ecosystems.[2] Finally, climate change is forecasted to make ocean waters both warmer and more acidic.

As human activities continue to release large amounts of carbon dioxide into the air, the ocean will absorb more of this gas. Once dissolved in the ocean, carbon dioxide combines with water to form a weak acid called **carbonic acid**. This **acidification** threatens nearly all shelled organisms living in the ocean. The increased acidity lowers the concentration of carbonate ions, a building block of the calcium carbonate that many marine organisms use to grow their skeletons including corals, which create/build reef structures. Some free floating plants and animals at the bottom of the food chain may have a more difficult time producing their shells, which may have consequences for other sea life that depend on the health and availability of these shelled organisms.[3]

Mangrove, seagrass, and coral reef ecosystems, among others, are vulnerable to large changes in climate and sea level. Many mangroves, especially on low-lying coastal

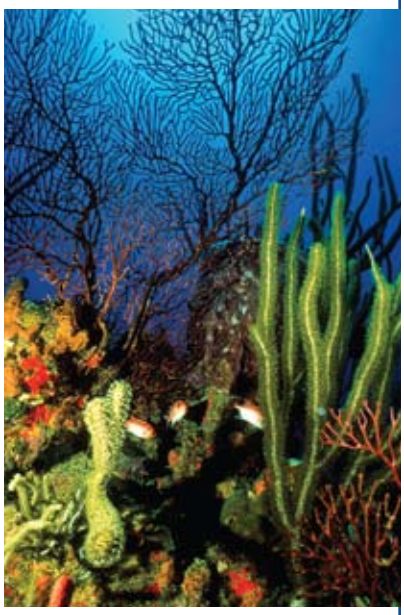
regions, may be overtaken by rising sea levels.[4] Coastal seagrass plant distribution may shift causing habitat changes for the ecosystem. Already stressed by polluted waters, the distribution of these plants may intrude into new locations due to changes in water temperature and flow patterns.[5] In both cases, disturbances of these habitats would greatly affect the many species which depend on these safe havens for survival.

Of these habitats, coral reefs might be the most vulnerable Caribbean marine ecosystem. Coral reefs are fragile ecosystems that are sensitive to changes in their environment.

Coral reefs grow under specific temperature and light conditions and have done so for thousands of years. They become stressed if the temperature changes more than 2–3° F (1.1–1.7° C) outside of their normal range for an extended period of time. Scientists predict that by 2100 air temperatures will rise by about 3–5° F (or about 1.5–3° C).[6] This temperature change will affect ocean temperatures and, combined with changes in ocean chemistry and increases in storm intensity, will likely challenge the survival of these beautiful ecosystems.

Many human activities have caused changes in the environmental conditions of these irreplaceable ecosystems. But the long-term survival of shallow-reef corals may now depend on their ability to adapt to rising temperatures.[7]

SPOTLIGHT ON A SPECIES



Corals are unique animals renowned for their brilliant colors and are responsible for creating the vast reefs that other species use for food and shelter. Each individual coral animal is known as a **polyp** and has a simple tubular body with a ring of stinging tentacles around a central mouth. **Polyp**s live together in colonies and gradually form the hard structures that we associate with coral. Different species of coral form differently shaped skeletons, such as brain or fan coral.

Single-celled organisms known as **zooxanthellae** reside within the coral **polyp**s and provide them with nutrients and energy.[8] The **zooxanthellae** use sunlight to make food for the coral through the process of photosynthesis, which is why clear water and access to sunlight are so important to coral



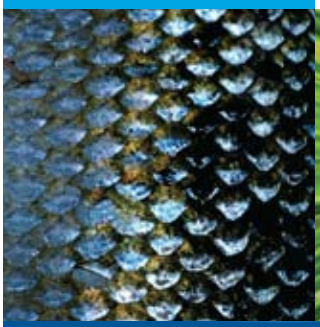

survival and growth. Land-based sources of pollution, such as runoff, sewage, and coastal development, can increase nutrients and decrease water clarity, which affect coral health.[9] Sponges, sea anemones, crustaceans, parrot fish, and eels are some examples of species that make their homes in healthy reef ecosystems.

Many corals respond to stressors such as changes in temperature and ocean chemistry by expelling their **zooxanthellae**. Since the **zooxanthellae** are responsible for most of the corals' color, corals that have expelled their algae appear white, or "bleached." Because **zooxanthellae** provide a large portion of the corals' food and are involved with growth processes, expelling them can significantly reduce coral health. Bleaching in the Caribbean is usually triggered by an increase of at least 1.8° F (1° C) above the normal summertime temperatures for 2–3 days, but can also be caused by other environmental changes.[10] Many scientists believe that climate change has already led to more incidents of coral bleaching. If climate change proceeds as projected, it will further endanger these beautiful animals that provide homes for so many species that call the Caribbean home.

PROFILING A CLIMATE STEWARD

In April and May of each year, Florida Keys National Marine Sanctuary staff and volunteers accompany middle-school students on several snorkeling trips to nearby coral reefs where they engage in observational activities that include fish identification and water quality sampling. The program is called *Coral Reef Classroom*, and since 1991 it has sponsored trips for several thousand local students, many of whom had never been to the reef, to learn about their unique environment.

Coral reef ecosystems are under many stresses, including changes in ocean temperature and chemistry, increased land-based pollution, climate change, and overfishing. During *Coral Reef Classroom*, students are introduced to the Niskin Bottle (sampling at depth), Secchi Disc (**turbidity**), Refractometer (salinity), and a premeasured oxygen indicator kit; they use simple anemometers (wind speed), compasses, and wave and tide charts for weather reporting. A plankton tow is conducted off the reef line and students examine the results using two-way viewers. Observations are noted on a data log that teachers take back to the classroom for follow-up discussion.




A major goal of *Coral Reef Classroom* is to increase awareness and understanding of the many influences on the reefs in the Florida Keys, such as currents in the Gulf of Mexico and runoff from the extended Everglades ecosystem. In this short classroom and field program, the Florida Keys National Marine Sanctuary encourages environmental stewardship and gives students a glimpse into the world of marine science. You can visit *Coral Reef Classroom* online at: http://floridakeys.noaa.gov/edu/crc.html.

In other programs, volunteer scuba divers and snorkelers can be trained to assess the health of coral reef ecosystems while enjoying the natural beauty of the coral. These volunteers count how many animals they see of certain species, and look for warning signs about the health of the ecosystem like coral bleaching. The data they collect is pooled together so that scientists can have an idea of the health of coral reef ecosystems all over the world!

If you don't live near the Caribbean region, there are other things you can do to help protect coral reefs to be a Coral Reef Crusader®! For example, SaveNature.org has a program called *Adopt a Reef*®. In this program, schools can hold fundraisers, such as read-a-thons, in order to protect threatened and endangered areas of the ocean or coral reef ecosystems. The school receives an honorary "deed" to the land they have saved. You can check out the *Adopt a Reef*® website at: www.savenature.org/.

FOR MORE INFORMATION

- The World Wildlife Fund's Ecoregion website contains detailed information about the ecosystems of the Caribbean, including mangroves and reefs. www.worldwildlife.org/wildworld/profiles/terrestrial_nt.html
- The Mangrove Action Project gives a great overview of mangrove forests. www.mangroveactionproject.org/mangroves
- The Smithsonian Marine Station website includes detailed information on seagrasses and the habitat that they provide. www.sms.si.edu/IRLspec/Seagrass_Habitat.htm
- The World Resources Institute's Reefs at Risk website provides information on coral reefs in the Caribbean and around the world. www.wri.org/project/coral-reefs
- The Intergovernmental Panel on Climate Change (IPCC) is the definitive source of unbiased climate change science. Chapter 6 is of particular interest for Caribbean issues. www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter6.pdf

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