Introduction: Near-Shore Ecosystems—Wetlands and Coral Reefs

Two habitats that thrive along the ocean's coasts are **wetlands** and **coral reefs**. These two near-shore habitats have become familiar topics and issues in Florida news. More scientists are becoming aware of just how important wetlands and coral reefs are to maintaining the balance of life both in the sea and on land.

The term *wetlands* describes any area that is a combination of land and water. A *wetland* at different times may be totally covered with water, partially submerged, or, on occasion, dry and exposed to the sun and wind. Its state often depends on tides, the season, the weather, and many other factors. Because wetlands are near shorelines, some wetlands have been destroyed by developers who have filled them in and built ocean-front residences and recreational areas in their place.

Coral reefs offer us one of the more colorful environments in nature.

Coral reefs offer us one of the more colorful environments in nature. The panorama of lively tropical colors in coral reefs comes from the living coral animals that compose the reef, the many animals that attach themselves to the layers of limestone, and the large number of diverse swimming animals competing for food in this community. The commercial value of coral has prompted some people to destroy these living monuments in an attempt to turn a profit.

Wetlands: A Zone Between Land and Sea

Purifying Water

Wetlands serve as a transitional zone for water as it makes its way to the sea. Water runoff from land contains wastes, or pollutants, as it flows into wetlands. Bacteria on the roots of plants and trees in wetlands break down pollutants into compounds that are less harmful to the chemical balance of the water in rivers, lakes, and the ocean. However, polluted stormwater runoff is becoming a greater problem in Florida as wetlands are destroyed.

A Nursery for Aquatic Animals

Wetlands provide an ideal breeding ground for many aquatic animals. Most wetlands have a muddy substrate—or a floor—that provides food and shelter for organisms. On this floor, protected by water, animals breed and lay their eggs. When the eggs hatch, the young thrive on the plankton and tiny pieces of decaying plants and animals in the waters of the wetlands. Shallow water protects them from ocean predators, or larger animals that would feed on them. Some animals, such as the snapper, only spend the first part of their life in the wetlands and then return to the open ocean as adults. Other animals, such as the oyster and mullet, spend most of their lives in wetland areas.

Nutrient-Rich Wetlands Feed Plants and Animals

Wetlands provide rich sources of nutrients for both plant and animal growth. They may be so rich in organic material that their waters may be murky. **Detritus**, or decaying plant and animal material, is the first link in the wetland food chain. Bacteria and wave action help to break down organic materials into usable forms for zooplankton and many juvenile, or young, organisms. Many of these particles are trapped in the wetlands, providing food, cover, and protection for many animals.

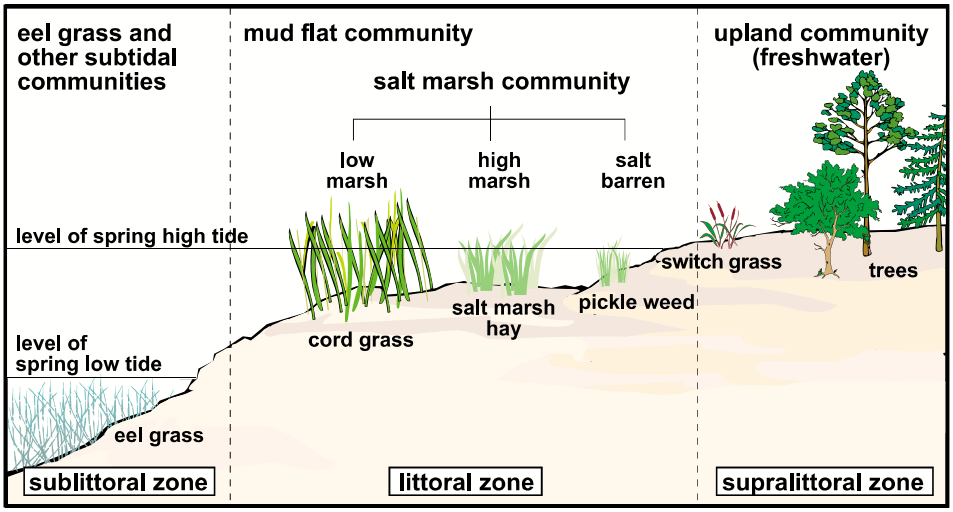
Wetlands provide an ideal breeding ground for many aquatic animals.

The abundance of food and shelter in wetlands provide a perfect near-shore habitat for many organisms throughout their adult life. Animals such as the blue crab, shrimp, and some fish feed on juvenile organisms and only leave wetlands to release their eggs into the open ocean. After hatching, their young drift in the ocean currents before returning to the wetlands to mature and live out their adult life.

Estuaries: Where Saltwater and Freshwater Meet

One type of wetland is an **estuary**—an area where freshwater from the land and saltwater from the sea flow together. Estuaries are generally located where a river empties into the ocean or where freshwater from land drains into the ocean. The resulting water is brackish, or salty to some degree. Because saltwater is denser than freshwater, the deeper depths in an estuary's water column will be saltier; whereas the shallow depths will be less salty. Salinity of the water increases near the open sea and decreases closer to land.

The water level and salinity of estuaries change according to the tides and seasons. At high tide, saltwater flows farther up into the estuary than it does at low tide. At low tides, many areas are exposed to heat and air. An estuary's salinity will be highest during the summer when evaporation is the greatest. During winter and spring, increased storm runoff and decreased evaporation rates lower salinity.



zonation of an estuarine community

The mixing of freshwater and saltwater creates a unique environment for organisms. Many marine animals cannot tolerate the changing salinity in estuaries. Consequently, the number of species inhabiting estuaries is smaller than those living in nearby marine and freshwater habitats. Among the animals that have adapted to the extremes of estuaries are oysters. At high tide they open up their shells to take in water and filter through the rich supply of nutrients. At low tide they trap water inside their shells and close up to prevent the air from overheating them and drying them out. Other permanent residents in estuaries include blue crabs, worms, mussels, and barnacles.

Because the changeable conditions in an estuary keep out many would-be predators, organisms that can live there thrive. But even these organisms are restricted to certain zones according to the level of salinity they can withstand. This separation of marine life in a habitat into definite zones or bands is called *zonation*. Freshwater organisms are restricted to the upper end of the estuary, and saltwater organisms are usually found only near the ocean. The snapper, for example, only moves in and out with the tides, and only along areas of constant salinity, to feed or reproduce. Some organisms, however, have adapted and regulate their salt content and move freely about the entire estuary. The mussel and the marsh periwinkle, a type of snail, are well suited to survive this constantly

The Zonation of Marsh Life

Zone	Dominant Organisms	Environmental Characteristics
low marsh zone (inundated for many hours each day)	*Spartina alterniflora* cord grass ribbed mussel annelid worms marsh periwinkle	slowly traps sediments, increasing the height of the marsh anaerobic mud (mud without oxygen)
high marsh zone (flooded a few hours each day)	*Spartina patens* salt marsh hay salt-resistant herbaceous plants and succulents pickle weed seaside lavender seablight seaside golden rod fiddler crabs	accumulation of detritus gradual formation of thin layer of top soil continued increase of elevation
salt barren zone (flooded only at extreme high tide, usually once each month)	stunted forms *Spartina patens* reed grass pickle weed mounds of partially decayed plant or animal material remaining from last high tide mice and rats amphipods insects	decay of stranded vegetation begins the process of humus (partially decomposed organic material) formation elevation continues to increase
transition zone (above the level of the highest tide)	bayberry *Myrica pensylvanica* groundsel tree poison ivy wildflowers sweet everlasting soapwort British soldier lichens (resistant to salt spray) permanent populations of small mammals	humus forms fresh water accumulates in the soil temperature of soil increases from direct rays of sun reaching the surface

seagrass beds

changing environment. These organisms spend their entire life in this habitat.

Seagrass beds are common in sublittoral estuarine environments. They provide food and protection for many smaller animals. Common seagrasses in Florida include widgeon grass, shoal grass, turtle grass, and manatee grass.

Estuaries are small in area compared to the oceans of the world, but they produce much life. The rivers that flow into them carry minerals and nutrients from the land. The waves and tides help to mix these waters, ensuring a rich food supply. Because so many juvenile organisms depend on this environment for their survival, estuaries are often called the *nurseries of the sea*.

Salt Marshes: Part of the Ocean Nursery

Salt marshes are low, flat coastal wetlands bordering estuaries and well-protected bays in **temperate** areas. Salt marshes develop in littoral zones: When the tide is high, the water completely covers the flat land; during low tide, the muddy land is exposed to air. Any organism or species living in these *littoral zones*, also called the *intertidal zones*, must be able to adapt to the extremes created by tides.

Salt marshes are dominated by salt-tolerant grasses such as *Spartina* and *Juncus*. These grasses survive being partially covered with saltwater by excreting excess salt through special pores. The roots of these grasses trap particles of dirt and detritus thus preventing erosion and building up salt marshes.

Many animals use salt marshes as resting places during migration. Ducks, geese, and shorebirds are very common in marshes, feeding on the wide variety of organisms present. Other animals such as raccoons and turtles enter the marsh at low tide to feed. Common permanent residents of the salt marsh include the periwinkle snail, the fiddler crab, and the killifish. These animals adapt to the changing conditions by shifting their positions with the flow of the tides. The periwinkle snail crawls up and down the grass to stay above the water line. Armies of fiddler crabs emerge at low tide to feed on the nutrient-rich detritus. At high tide, the crabs quickly retreat into their burrows.

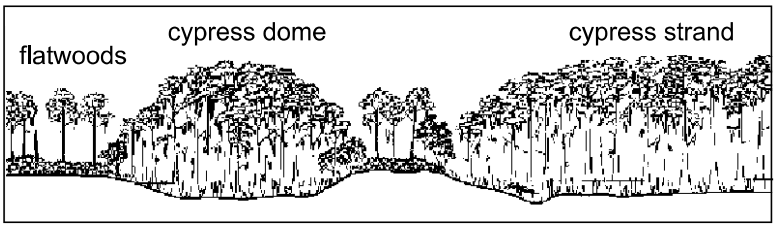
Mudflats: Provide an Environment for Bacteria

Mudflats are environments that have slightly sloping beaches and are characterized by dark, muddy sand. The mudflat area is unvegetated. It lacks seagrasses and marsh grass. Mudflats have very little wave action. The lack of wave action causes sediments to contain little or no oxygen. However, the lack of wave action does allow organic debris, such as *detritus* (decaying plants and animals), to accumulate on the mudflats. Mudflats are jokingly referred to as the "graveyards" of the wetlands because wastes decompose in the mud. Bacteria live in the mud and decompose wastes from marine organisms.

Mudflats usually have a characteristic odor similar to rotting eggs. This smell is a result of the production of a gas called *hydrogen sulfide* from decay. Hydrogen sulfide accumulates in the oxygen-deficient mud. Too many people consider the mudflats an environment devoid of life and importance, but marine scientists have found that mudflats are very important in the structure of the food web. Mudflats provide an environment for bacteria, which play an important role in converting wastes into useful nutrients. Nutrients produced in mudflats are transported by tidal flow to other parts of the estuary and to the open ocean. These nutrients are a major food source for oceanic plankton. Mudflats also provide homes and shelter for mud snails, clams, and worms.

Swamps: Marked by Their Trees

Swamps usually develop further inland from the ocean than do estuaries and salt marshes. Because of their location, swamps are not influenced much by tides. Like all wetlands, however, swamps are cleansing areas for the water that flows through them. The ground of a swamp is covered with detritus-rich mud filled with bacteria that help to break down water pollutants. One by-product of the bacterial action is the gas hydrogen sulfide, which smells like rotten eggs (see *mudflats*, above). This gas production can sometimes be seen as bubbles rise from the mud.



freshwater swamp

The most visible feature of a swamp is its trees. In Florida, the most common tree in a swamp is the

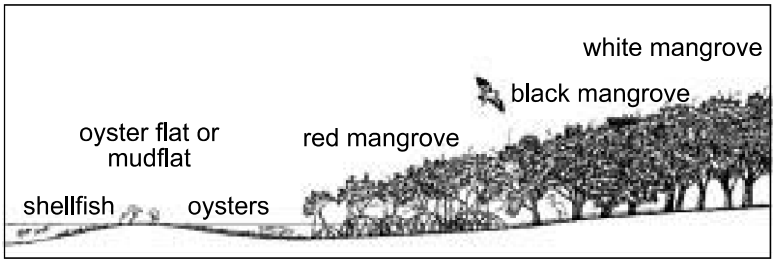
cypress. The cypress tree has large roots or *knees* that stick up out of the water. Tannic acid given off by cypress tree bark makes the water in a swamp slightly acidic. This acid makes the water appear dark. It also leaves rings or stains, showing the water level on trees or other objects in the swamp. Some swamps have scattered mounds of land. These wooded areas or swamp islands are known as **hammocks**. Common organisms found in a swamp include alligators, bass, trout, frogs, birds, and numerous insects.

Mangrove Swamps: Habitats for a Unique Tree

Mangrove swamps are wetlands that cover a large part of the coast in tropical and semi-tropical areas. In Florida, mangrove trees are found in southern Florida and the Keys. The **mangrove** tree is particularly adapted to tolerate the salty mud that covers coastal areas. Like *Spartina* and *Juncus* grasses, the mangrove can excrete excess salt to regulate its biochemistry.

Many small animals find shelter and protection in the mangrove roots. Muddy detritus, which is produced from tides bringing in organic debris and dead leaves from the mangrove trees, provides the basis for most of the mangrove food chains. Like the mudflats, the products of decay from the mangroves enrich the mangrove environment with nutrients. These nutrients are carried out to sea by the tides and are consumed by plankton in the open ocean. Mangrove swamps provide shelter for organisms that live in the water as well as for organisms that are land and air dwellers. Raccoons, osprey, and brown pelicans are just a few of the animals that make their home among the leaves and branches of the mangroves.

Mangroves also protect the shore from erosion. Mangrove tree roots hold sand in place. The entire mangrove community protects the shoreline from storms by absorbing rising storm waters and the impact of the storm waves.



Florida mangrove swamp

There are four types of mangrove trees: the red mangrove, the black mangrove, the white mangrove, and the buttonwood. Red mangrove trees are most noticeable for their many *prop roots*. Prop roots are above-ground roots that give extra support to the red mangroves. The roots grow from the trunk and

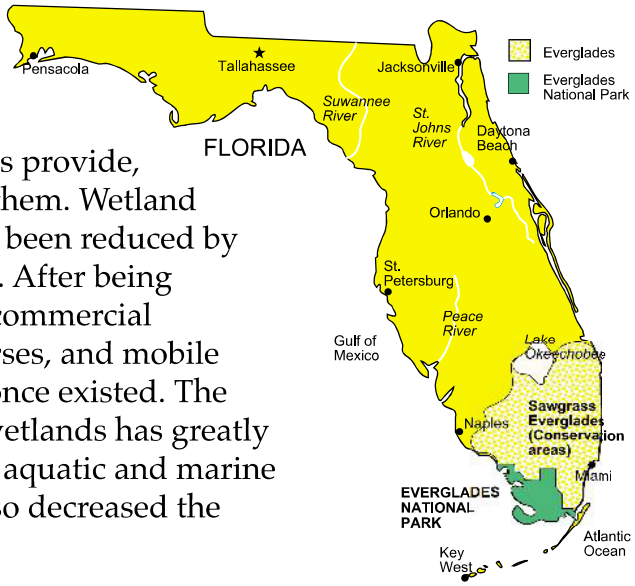
branches and arch above the water before submerging. Many small animals find shelter and protection in these roots. Muddy detritus, which is produced from falling leaves, provides the basis for most of the mangrove food chains. Crabs, oysters, clams, worms, and sponges take refuge on and in the roots of mangroves.

Everglades: Grassy Water

The Florida Everglades provide habitat and food for many birds.

The Florida **Everglades** is a very large wetland area in southern Florida. It is a mixed wetland dominated by grasses. Native Americans knew the Everglades as Pa-Hay-Okee, or *Grassy Water*. Spanish explorers called it *El Laguno del Espiritu Sanctu*, or Lake of the Holy Spirit.

The main source of water in the Everglades is rainwater and overflow from Lake Okeechobee and nearby rivers. In the past, this overflow moved through the Everglades as a huge river of water that began north of Lake Okeechobee. Since the early 1900s, however, the area draining through the Everglades has been ditched and cultivated, and many south Florida rivers have been deepened and straightened. Despite the drastic changes affecting the Everglades, this huge wetland still provides habitat and food for both marine and land animals. This unique habitat has been changed due to pollution and the diverting of the water flow.



Destruction of Wetlands

In spite of the benefits wetlands provide, we have continued to destroy them. Wetland areas in the United States have been reduced by over 40 percent since the 1950s. After being **dredged**, they are filled in for commercial development. Hotels, golf courses, and mobile home lots sit where wetlands once existed. The clearing and development of wetlands has greatly decreased the area available to aquatic and marine animals. This shrinkage has also decreased the

wetlands' ability to filter and clean stormwater runoff before it reaches our lakes, rivers, and oceans. The destruction of wetlands is disturbing the balance of life both in the sea and on land.

Millions of acres of the Florida Everglades have already been destroyed, and the water flow that fed this wetland has been completely changed. The space available for plants and animals that depend on wetlands is constantly being decreased. Almost two-thirds of the total fish catch in the United States is dependent on the survival of healthy wetlands. Yet the water necessary to replenish the wetlands is increasingly being used for agricultural and human uses, causing wetland areas to dry up. Wetlands also serve as natural buffers against storms. As we build on and destroy these buffer zones, we leave ourselves more vulnerable to the destructive forces in nature.

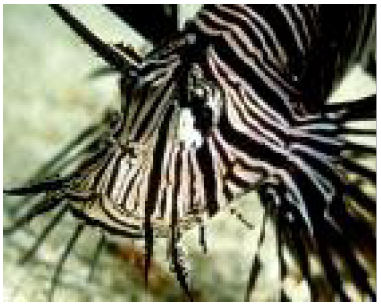
Coral Reefs: The Exotic Community

Coral reefs are named for the main organism that creates them. Reefs are made of *corals*—tiny sea animals that have a hard skeleton made of calcium carbonate. Certain types of algae that also produce calcium carbonate contribute to the formation of coral reefs. Corals build layer upon layer up toward the ocean's surface. Algae help cement the coral shells, other types of shells, and sand together to help produce the reef formation. The base of the reef is formed from the skeletons of *dead* coral; only the top of the reef is *living* coral and algae.

Coral reefs provide habitats for many of the more unusual and colorful marine animals.

Coral and algae have a two-way, or symbiotic, relationship called *mutualism*—each depends on the other to survive (see Unit 9). Microscopic algae called *zooxanthellae* are captured by the *coral polyps*, which are the basic structure of a coral animal. The algae then grow within the coral animal. The algae benefit by living safely within the coral polyp's cells and use the waste products of the coral. In return, the algae supply oxygen and nutrients for the coral animals. Corals are *sessile* filter feeders. Therefore, in addition to the algae, corals must depend on water currents to bring them

food and help remove wastes because they are attached to a surface and cannot move around (see Unit 10).



lionfish

Reef-building corals require warm, tropical waters where the temperature does not drop below 20°C (68°F). The water also must be clear and shallow—less than 100 feet deep—because some species of coral have algae that live in their tissues, and need lots of sunlight so the algae can produce their food. Therefore, reefs are most common in the Pacific, but a few are found in Florida. One of the most well known in our state is in John Pennecamp Coral Reef State Park in the Florida Keys.

clownfish

Coral reefs provide habitats for many of the more unusual and colorful marine animals. Can you guess why? Coral reefs are composed of many types of coral growing together. The different coral types have varying shapes, sizes, and patterns which provide holes and crevices for marine organisms to seek shelter. Corals are classified into two types, hard corals and soft or flexible corals. Examples of hard corals are brain coral and staghorn coral. Soft corals include the gently waving sea fans and the sea pens. Both the soft coral and hard coral provide environments for over 3,000 animal species. Among the colorful marine species are the parrot fish, lionfish, moray eel, sea urchin, cleaner fish, and more.

Coral reefs are productive but fragile environments. Pieces of coral can be broken easily by extreme wave action or from someone touching the coral. Coral is covered by a protective membrane. If the membrane is damaged, then the coral is at risk for infection or disease. Corals around the world are in danger from coastal development, decline in water quality, and too much fishing and diving.

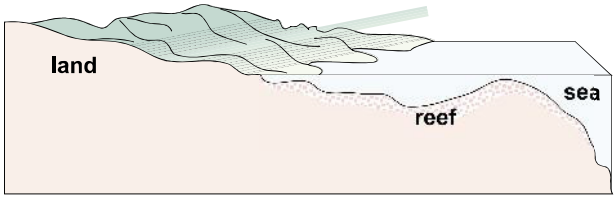
Scientists distinguish among three different types of coral reefs: the **fringing reef**, the **barrier reef**, and the **atoll**.

Fringing Reef

Fringing reefs develop in shallow water along the edge of a volcanic island or land mass. These reefs create a fringe of living coral on the border of a land form. The coral on the side farthest from land has more oxygen and food than the land-side coral and so grows more rapidly. Fringe reefs are commonly found in the Hawaiian Islands in the South Pacific and parts of the Caribbean.

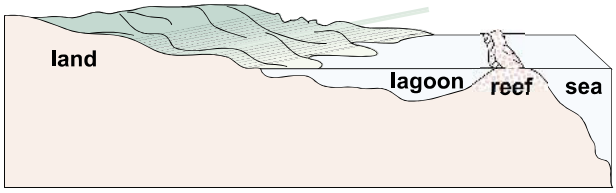
Barrier Reef

Unlike the fringing reef, the *barrier reef* is separated from the land by a body of water called a **lagoon**. The lagoon may be a few miles wide or very narrow.



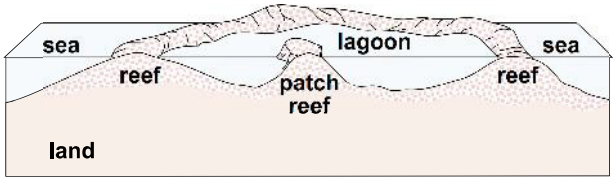
fringing reef - connected directly to shore

The Great Barrier Reef of northern Australia in the Coral Sea is an example of this type. This reef stretches 1,250 miles along Australia's coast and varies in width from 12 to 100 miles. The Great Barrier Reef is the largest barrier reef in the world.



barrier reef - separated from the shore by a lagoon

Atoll Reef

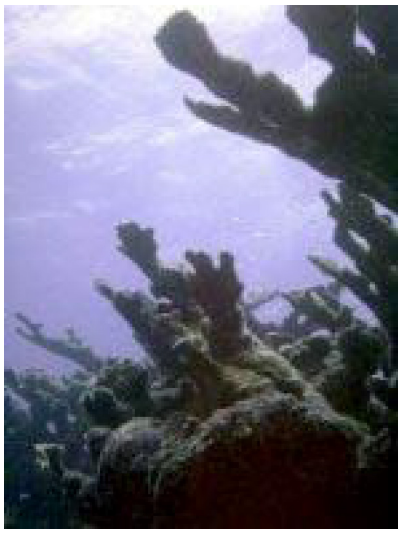


atoll - surrounded a central lagoon

Atolls are ring-shaped reefs that develop from fringing reefs. As the volcanic island or land mass begins to sink, the coral continue to build new layers on top of the old layers. Eventually, the volcanic mountain is completely submerged beneath the water, leaving behind an atoll with a large lagoon in the center.

Atolls are common in the Pacific and Indian oceans and can exist in deep water. The largest atoll, named Kwajalein, surrounds a lagoon over 60 miles long. Kwajalein is in the Marshall Islands, southwest of Hawaii and east of Guam.

Coral Reef Formation



Reef-building corals require warm, tropical waters.

For a long time scientists did not understand how atolls could have been formed in deep water when they knew that living coral required shallow, sunlit waters. Charles Darwin, the famous biologist, studied atolls and developed a theory of reef formation in 1831. He suggested that volcanic islands provided the shallow-water base that coral needed to grow on. As the islands slowly sank or the sea level rose, the coral grew upward, creating lagoons between the coral and the land, forming a barrier reef. By maintaining growth upward, the coral remained in shallow waters, and the top portions of the coral stayed alive. As the islands continued to sink or as sea level rose, eventually only the coral portion remained near the surface, forming an atoll surrounding a shallow lagoon.

Summary

Two coastal habitats important to maintaining the balance of life both in the sea and on land are *wetlands* and *coral reefs*. Wetlands contain bacteria that help to break down pollutants in water before they reach the sea. Wetlands also provide a nutrient-rich, protected breeding ground for many aquatic animals. Different types of wetlands include *estuaries*, *salt marshes*, *swamps*, *mudflats*, *mangrove swamps*, and the *Everglades*. Commercial development has destroyed many wetlands and endangered these essential buffer zones.

Seagrasses provide food and protection for many smaller animals.

Coral reefs are made of layer upon layer of calcium carbonate. They develop only in sunlit, tropical waters and provide habitat for many of the oceans' more colorful and unusual animals. Different types of coral reefs include the *fringing reefs*, the *barrier reef*, and the *atoll*. Like wetlands, coral reefs are threatened by commercial interests.