Monongahela National Forest

Monongahela National Forest is located in the Allegheny Mountains of West Virginia. This national forest covers over 363,500 hectares (909,000 acres), the fourth largest national forest in the northeast United States. The landscape is rugged with spectacular views of exposed rocks, spring wildflowers, and colorful fall leaves.

In the 1880s the Allegheny Mountains were logged extensively. Clear-cut logging removed all vegetation in many areas. Major forest fires added to the amount of deforested land. Soil erosion was widespread in the region. Streams filled with mud and silt, resulting in poor water quality.

President Theodore Roosevelt created the National Forest Service to protect forests and watersheds from damage. Some of the first land bought was 2900 hectares (7200 acres) near the Monongahela River. This land became Monongahela National Forest on April 28, 1920.

Today, the Monongahela ecosystem is primarily a second-growth forest of more than 75 species of trees, such as black cherry, oak, hemlock, and poplar. It is a popular vacation area, positioned within a day's drive of one-third of the population in the United States.

The Monongahela forest is in demand for many reasons, including recreation, logging and mining jobs, and water supply. Balancing the impact from each use is a challenge for forest managers. In addition, air pollutants from sources outside the forest produce damaging acid rain in the forest.

Monterey Bay National Marine Sanctuary

The central coast of California supports a unique ecosystem known as the kelp forest. Kelp grows from the rocky seabed to the ocean surface. These forests of kelp are home to fish, sea otters, snails, sea urchins, crabs, and many other organisms.

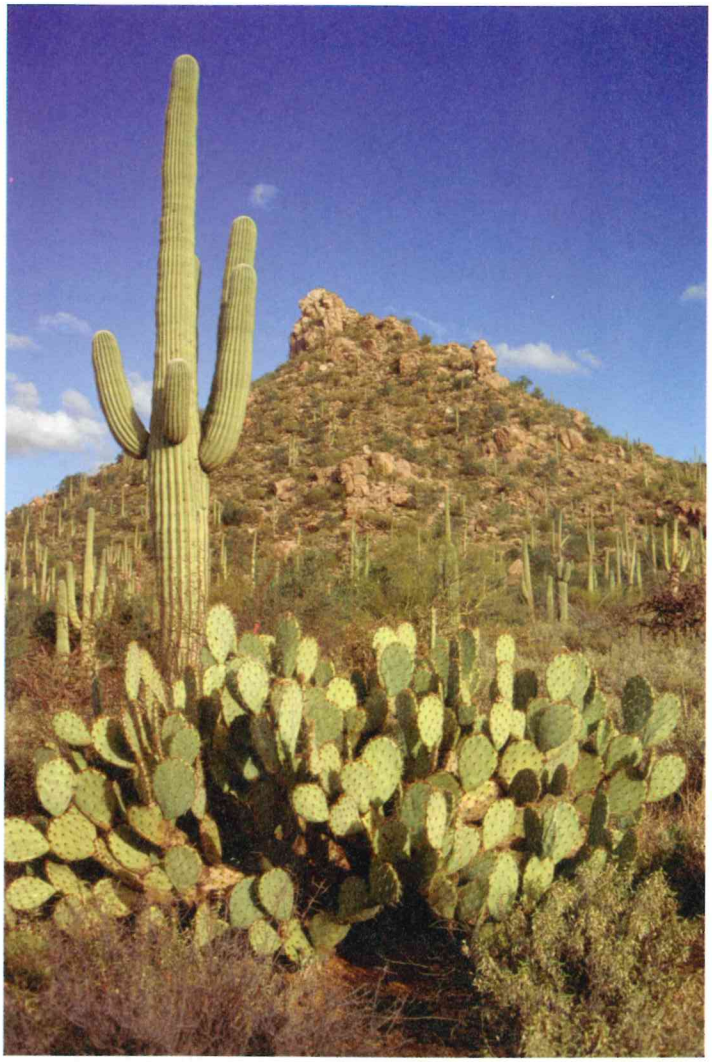
Monterey Bay National Marine Sanctuary is one of 13 national marine sanctuaries. A marine sanctuary is like a national park in the ocean. Every national marine sanctuary protects ocean waters, the habitats found in them, and the local cultural history. Some activities, like dumping waste and drilling for oil, are not allowed in Monterey Bay National Marine Sanctuary. Other activities, like fishing and recreation, are permitted but regulated.

The national marine sanctuary system was founded in 1972. Monterey Bay is the largest of the marine sanctuaries, covering 13,730 square kilometers (km) (5360 square miles). The sanctuary stretches from San Francisco to Santa Barbara, from the shoreline out into the ocean an average of 50 km (31 miles).

In the spring, water from deep underwater canyons flows up to the surface. The water is cold and contains lots of nutrients that phytoplankton need in order to grow. This upward movement of water is called upwelling. Upwelling results in tremendous productivity by phytoplankton, the base of the food pyramid in Monterey Bay National Marine Sanctuary.

A primary concern for the kelp forest is the impact of fishing, kelp harvesting, and mariculture. Other issues include sea-otter abundance, jade collecting, and seabed disturbance.

Saguaro National Park



The southwestern United States includes California, Nevada, Arizona, Utah, New Mexico, and Texas. This region of the United States has many dry habitats, including deserts. The Sonoran Desert is in Arizona, part of California, and a bit of Mexico. This hot, dry desert is the most lush and diverse of the North American deserts. This ecosystem has many unique plants, including saguaro cacti, mesquite trees, ocotillos, and other succulent plants. During the day, the desert seems quiet, except for the occasional bird. A closer look might reveal rabbits and piglike peccaries resting in the shade. Lizards and snakes might surprise you as they move from a place where they had been sunning to a cooler place.

Tucson, Arizona, is surrounded by the Sonoran Desert. In 1933 an extensive forest of saguaro cacti was preserved as a national monument by the federal government. The winter of 1937 was very cold, and some of the saguaros were damaged by frost. People thought that the freeze damage was a disease, and they worried that all saguaros were at risk. This worry led to the preservation of another forest of saguaros to the west of Tucson. In 1994 Saguaro National Monument became Saguaro National Park, preserving the habitat for the forests of the unusual cacti and all the populations that live in the desert ecosystem with them.

The primary issue in Saguaro National Park is damage to plants and animals by off-road vehicles. Expansion of cities into the desert is another concern. In the past an important issue was cattle grazing.

Yellowstone National Park

In 1872 the U.S. Congress established Yellowstone National Park, the first park of its kind in the world. The park is in the Greater Yellowstone ecosystem, which also includes Grand Teton National Park and several national forests in Wyoming and Montana.

Yellowstone National Park includes several distinct ecosystems. There are unusual thermal pond ecosystems, freshwater lakes and streams, grasslands, and forests. The dominant habitat is taiga, or boreal forest. Taiga thrives in cold continental or subarctic climates. The dominant taiga plants are trees like pines and spruce.

Yellowstone National Park supports a diverse community of large wildlife, including elk, moose, deer, coyotes, and bears. Lucky visitors may see a wolf or one of the three species of large cats that inhabit the park.

The most unusual feature of Yellowstone National Park is the geothermal activity. Magma close to the surface of Earth creates geothermal pools and geysers. Old Faithful is a geyser that throws superheated water more than 55 meters (180 feet) into the air every 76 to 100 minutes. Geothermal pools contain water heated by the same underground geothermal activity. The water in these pools is so hot that few organisms can live in them. They harbor several species of colorful cyanobacteria and algae, which turn the geothermal areas bright shades of yellow and orange.

A primary issue in Yellowstone National Park at this time is the reintroduction of wolves. Other issues are fire management and winter snowmobile use.

ADAPTATIONS

Imagine you are taking a vacation at Monterey Bay in California. Just offshore by the mouth of the bay is an extensive kelp forest. The long stemlike stipes of these huge algae reach 50 meters (164 feet) or more from the rocky seabed to the surface. Bobbing at the water's surface and diving down to the bottom are several members of a population of sea otters.

Slip into your one-person submarine and join the subsurface community. Fish swim among the kelp stipes, and jellyfish float on the current. Small kelp crabs, exactly the same color as the kelp, cling to the kelp fronds. As you descend to the bottom, you spot a lingcod resting between a couple of rocks, and spiny sea urchins are everywhere. Stuck tightly to the large rocks are abalones (ab•uh•LONE•ees), shellfish the size of small plates. If you are lucky, you might catch a glimpse of a harbor seal, a shark, or even a gray whale cruising through the area.

This is a typical central California marine nearshore ecosystem. The diversity and concentration of life are awesome.

The fun continues. The next week you visit Rocky Mountain National Park in Colorado. Three thousand meters (almost 10,000 feet) up in the Rockies you are surrounded by a different forest, this time pine, fir, and spruce. The trees are full of flying and climbing animals like jays, thrushes, woodpeckers, warblers, wasps, flies, and squirrels. In the understory are willows, wildflowers, and grasses. These

are visited by chipmunks, lizards, ants, bees, grasshoppers, crickets, and butterflies. If you sit quietly, you might see a deer, mountain sheep, or coyote pass through the area. This is a typical mountain-forest ecosystem, humming with a wide diversity of life.

Reflect for a moment. The organisms in the marine kelp forest and the organisms in the mountain forest are completely different. Not one sea otter lives in the Rocky Mountains, nor does a single chipmunk live in the kelp forest. Why?

The answer is that every organism has **adaptations** that make it possible for it to live in a particular environment. Adaptations are structures, characteristics, and behaviors that increase an organism's chances of surviving and reproducing in a particular environment. Kelp-forest organisms are fine-tuned for life in cold, turbulent seawater; mountain-forest organisms are adapted for life on land in the cool mountain air.

What adaptations do kelp-forest organisms have? The kelp-forest environment is cold, aquatic, salty, and turbulent. Anything that lives there has to be able to withstand chilling temperatures year-round, salt water, and tremendous tidal and storm surge. Let's look at tidal surge. Organisms need to have methods for staying put. Different organisms have different adaptations for staying in the ecosystem. The kelp have strong rootlike structures called holdfasts and limber, flexible stipes. The holdfast grips rocks solidly, and the rest of the alga waves and flows in the tidal surge. The strong holdfast and flexible stipe are two **structural adaptations** the kelp has for staying in the ecosystem.

Sea otters wind themselves up in the floating fronds of the kelp to keep from being swept away. Young otters must learn this trick from the older otters. Anchoring in the kelp is a **behavioral adaptation** that keeps sea otters from being swept out of the ecosystem.

The abalone is a dome-shaped mollusk (related to snails) with a large foot that acts like a suction cup. When the surge is strong, the powerful suction and streamlined shape of the shell allow the abalone to stay attached to the rocks. Are these structural or behavioral adaptations? The shape of the shell is structural, as is the large suction

foot, but the act of clamping down in response to increased surge could be considered a behavioral adaptation.

Other examples of adaptations in the kelp forest include thick fur (sea otter) or layers of insulating fat (seals and whales) to protect against the chilling effects of cold

ocean water. Warmblooded animals without some form of insulation are not adapted for life in the kelp forest. Spines (sea urchin), hard protective coverings (crabs and snails), fins for fast swimming (fish), and protective coloration (kelp crabs) are all structural adaptations that increase the organism's chance of survival. Nocturnal hunting (octopus), egg guarding (lingcod), and kelp anchoring (sea otter) are all behavioral adaptations for survival.

A few adaptations are shared by *all* the organisms in the kelp-forest ecosystem. All are adapted to live in a salt environment. All are adapted to live in cold water. All are adapted to withstand the rigors of tidal surge. They don't have the *same* adaptations for dealing with these important environmental factors, but they all have adaptations. By contrast, none of the organisms in the mountain-forest ecosystem has an adaptation for even one of the major kelp-forest factors.

What are some of the adaptations exhibited by organisms in the mountain forest? What adaptations do the trees have for survival and reproduction? What adaptations do the birds and squirrels have? What about the wildflowers and grass? The woodpecker's beak, the butterfly's brightly colored wings, the buck's antlers, the chipmunk's cheek pouches, the cricket's chirp, the grasshopper's long legs—they all are adaptations that help each organism survive in its ecosystem.

Let's change locations again. In this ecosystem we find the barrel cactus, an unlikely-looking plant if we are still thinking about the forest ecosystem. The cactus doesn't have the structures we are accustomed to seeing. No trunk or stem really, no branches, and no apparent leaves. It does have roots and flowers, and forms seeds, so it is a plant, but a strange one.

Think about the desert where a plant like this lives. What are the usual conditions in the desert? It is frequently windy, intensely sunny, often hot, and almost always dry. An organism would thrive in this environment if it had adaptations for dealing with these extremes of climate. Leaves are necessary for most plants as sites for photosynthesis. But broad, flat leaves are a liability if it is windy, intensely sunny, and hot. A good adaptation for wind and intense light would be fewer and smaller leaves.

The barrel cactus has taken this adaptation to the limit. We can imagine that over millions of years of variation in the cactus population, the individuals with the smallest and fewest leaves were the ones that survived best. The successful descendants of those earlier plants have just

the bare remains of leaves. The spines seen on the barrel cactus today are its tough, highly adapted leaves.

The barrel cactus has adaptations for dealing with the scarcity of water as well. Just about the whole body of the cactus, which is a highly adapted stem, is devoted to storing water. The spongy tissue inside the cactus holds many liters of water, which can be used by the cactus to stay alive during extended dry spells. And all those spines protect all that water from other organisms that would like to have it. The spines are adaptations for protecting the stored water.

Some organisms are able to live in a number of different environments. The coyote is one example. Coyotes live in high mountains, marshes, prairies, forests, deserts, and towns. They have long legs for running, a keen sense of smell, good eyesight, fur to protect them from the elements, and the ability to eat almost anything. In addition, coyotes travel in packs, dig dens to protect their young, and hunt day and night. These structures and behaviors are general adaptations that give coyotes flexibility to survive in many different terrestrial ecosystems. Can you think of other organisms with general adaptations that give them the flexibility to survive in many ecosystems? *Homo sapiens* is one. Think about all the places people live. What is it about humans that makes them so flexible? What adaptations do we have that make it possible for us to live on land, underwater, in space, and all over the planet's surface?

Adaptations are the keys to survival. Every organism alive on Earth has adaptations that allow it to live and reproduce in its environment. Organisms are born with their adaptations. If conditions change, individual organisms can't change their adaptations to cope with the new conditions. Those organisms that were born with adaptations to deal with the new conditions are the ones that will survive, reproduce, and continue the population.

THINK QUESTIONS

1. What are structural adaptations? Give three examples.
2. What are behavioral adaptations? Give three examples.
3. Frogs live in pond environments. List three frog adaptations and describe how they help the frog survive.
4. A trout stream runs through a meadow where the stream bottom is dark and there are lots of shadows. Then the stream flows down through some rapids where the water splashes over and around light-colored rocks. The trout have dark backs in the meadow and light backs in the rapids. How do you explain the color variation in the trout population?