Student Edition

California Education and the Environment Initiative

B

Biology Standard B.6.a.

Biodiversity: The Keystone to Life on Earth

California Education and the Environment Initiative

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Lesson 5 The Implications of Losing Species

None required for this lesson.

Lesson 6 Making a Difference

None required for this lesson.

Biological Riches and Rarities

After dropping supplies at the space station, the shuttle circles Earth once, then twice. Soon the crew will fire the thrusters and return home to California. On the planet below, the Sun rises and sets every 16 minutes. Where it is day, the crew notices areas of brilliant green. The oceans are the deepest blue imaginable. Rivers appear as lines, like veins on the back of a grandmother's hand. From here, Earth seems so fragile, a colorful, spinning globe.

California's Biodiversity

Members of the crew cannot help but think about how rich Earth is. It is home to so many different forms of life. Every living thing depends on another, playing an integral part in its own natural community. Many biological communities exist on Earth. California, for example, has 5,879 species of plants and animals (more than any other state in the United States) and 2,214 endemic species—plants and animals found nowhere naturally beyond its borders.

Biodiversity (biological diversity) is a term used to describe the richness in numbers and variety of species of plants and animals in an area or region.

Climate and Geography

California's Mediterranean climate, with hot, dry summers and mild, wet winters, makes it an ideal place for many species to thrive. Because of its rich biological diversity and the threats to many of its species, biologists have designated California a biodiversity "hotspot."

Earth viewed from space

Mount Whitney, California

Biodiversity hotspots are home to a rich diversity of Earth's plant and animal species. A combination of factors makes them like "magnets" for life. The nation's largest breeding ground for birds, for example, is in California. The state is also home to 20 species of freshwater fish, 17 reptiles, and 17 mammals that are found in no other place on the planet.

California's biodiversity can also be explained by its unique geography. The state has both the highest point in the continental United States at the summit of Mount Whitney

Joshua trees, Mojave Desert, California

(14,494 feet) and the lowest point at Badwater, Death Valley (282 feet below sea level). These distinct elevations are only 80 miles apart, and both are less than 200 miles from the Pacific Ocean. The differences in elevation, combined with California's moderate climate and its 100 million acres, create a mosaic of habitats where life has expanded to take advantage of a multitude of opportunities.

Home to Deserts, Forests, Wetlands, and More

As the shuttle nears Earth, the crew can see the wedge shape of the Mojave Desert boldly outlined by the mountains and fault lines that define it. It is considered "high" desert, with an average elevation of 3,500 feet, though it also extends into the lowest corners of Death Valley. The high desert climate is dry. There is a summer thunderstorm season between July and September, but most rain falls in the winter, and snow is common at higher elevations. The range of temperatures makes it one of the state's greatest centers for biodiversity. Approximately 1,500 plant species live in the Mojave Desert, with 210 of them identified as endemic.

The scientists in the crew especially love the woody Joshua trees (*Yucca brevifolia)*, with "hairy" limbs that seem to stretch for something just beyond their reach. They are endemic in this area. Joshua trees extend roots to take advantage of both surface and deeper sources of water. They are well adapted to frost in the winter and high desert temperatures in the summer.

A number of organisms depend on the Joshua tree for survival, just as the Joshua tree depends on them. One of these is the Tegeticula moth. This small, white moth lays her eggs inside the white blossoms of the Joshua tree, pollinating the flowers, so the embryonic seeds inside will grow. When the larvae of the moth hatch, they feed on a few small seeds. The symbiotic

Carrizo Plain grasslands, California

relationship between the moth and the Joshua tree allows both organisms to produce new life.

As the shuttle drops further, the crew can see beyond the desert to the grasslands of the Carrizo Plain. With the shuttle still far above Earth, the homesick crew talks about how the constant wind plays with sunlight on the natural grasses, tossing them back and forth. Though much of the original grassland of the Great Central Valley has been replaced by agriculture, the protected Carrizo Plain remains largely untouched. It is home to some of California's endangered animals, including the San Joaquin Valley kit fox and the blunt-nosed leopard lizard.

Coral Hollow, in the northwestern San Joaquin Valley, provides another example of original grassland habitat. A variety of reptiles and amphibians, including the California red-legged frog and the western pond turtle, live there. Composed of 70% grassland and 30% riparian woodland, Coral Hollow also displays unique vegetation, including the desert olive, iodine bush, and honey mesquite.

Kit fox cubs

As they survey the land, crewmembers imagine the wildflowers that must be blooming wherever there is enough water to germinate their seeds. They talk about the vernal pools, seasonal wetlands that occur in the Central Valley and other regions. These pools support numerous plants and animals, some threatened with extinction. Formed in the winter months when rain fills clay and hardpan (dense layers of soil that do not easily absorb water) hollows with rainwater, vernal pools provide a temporary home to fairy shrimp, frogs,

Wildflowers by vernal pool

and many aquatic plants. In the spring when the water begins to evaporate, colorful wildflowers spring up, lining the pools with chains of goldfields, creamy Johnny tuck, and lacy meadowfoam.

One crewmember recalls traveling through California to the "land of the giants," the deep old-growth forest that adds so much to biodiversity. Although old-growth redwood forests are wonderful ecosystems, they are known for their remarkable lack of California's biodiversity compared with other forests. Except for a 14-mile extension into Oregon, the coast redwood forest belongs only to California. Redwoods, Earth's tallest trees, sometimes stand 300 feet tall and have trunks that reach 25 feet in diameter at their bases. The average redwood is 600 years old, though many are much older. When they fall, redwoods act as their own "nursery logs," nurturing rows of new seedlings that eventually grow into mature trees. Because of their incredibly thick bark, old-growth redwoods are very fire resistant.

Under the shade of the giant redwood canopy, several trees provide a tall secondary layer of growth. Tanoak, California bay, Douglas fir, hemlock, and sometimes big leaf maple grow with filtered sunlight. Wild rhododendron, poison oak, salal, and huckleberries fill in the next colorful layer. The ground level is rich with redwood sorrel and wood ferns. They provide a safe hiding place for many animals, including the banana slug, Pacific giant salamander, and the red-legged frog.

It is almost time to land, and the crew directs its attention to the desert below. Their high altitude tour of California's biodiversity is nearing an end, and so many places remain to visit! Rogers Dry Lake is now directly in front of the shuttle, its drawn runways clearly marked on hard clay.

As the shuttle touches down, the crew looks to the north, where sunlight illuminates the Sierra Nevada Mountain Range. They take deep breaths, glad to be home. Earth from a distance, though stunning, is nothing compared to the rich beauty and diversity that surround the astronauts when their feet finally touch the ground.

Coast redwood, California

Sierra Nevada range

Bay Area/Delta Bioregion

This bioregion takes its name from the San Francisco Bay and Delta watersheds. It contains freshwater marshes and salt marshes. Hilly coastal areas support coastal prairie scrub, mixed hardwood, and valley oak communities. Sonoma, Marin, and San Mateo Counties have redwood forests. Temperatures are moderate, and winters are rainy.

Human Social Systems

More than 6.6 million people live here. Only the South Coast bioregion has more people. Cities include: San Francisco, Santa Rosa, Oakland, Berkeley, Vallejo, Concord, and San Jose. Businesses include: tourism, high-tech industries, wine making, and banking. Fishing, shipping, and oil refining occur along the coast. Dairy farming, orchards, and vineyards are common. Water from the Sierras flows through reservoirs and canals. This water supplies two-thirds of California's drinking water. Other uses of the water are irrigating crops and maintaining aquatic habitats.

Natural Systems

Hilly areas along the coast support oak woodlands and grasslands. Coastal salt marshes around San Francisco Bay and freshwater marshes in the Delta provide food and shelter to many birds.

Saltwater marsh, San Francisco Bay

- **Habitats:** Prairie scrub, mixed hardwoods, valley oaks, eucalyptus, manzanita, northern coastal scrub, coastal prairie scrub in the Bay Area; mixed hardwoods, valley oaks, redwoods, salt marshes, freshwater marshes in the Delta.
- **Wetland plants:** Pickleweed, great bulrush, saltbush, cattail.
- **Common birds:** Canvasback, western grebe, black-crowned night heron, great egret, snowy egret, California brown pelican, white pelican, seagull, acorn woodpecker, golden eagle, western bluebird, Caspian tern, American avocet, cedar waxwing.
- **Common mammals:** Grey fox, mule deer, bobcat, raccoon.
- **Other animals:** Pacific tree frog, swallowtail butterfly, painted lady butterfly.
- **Marine life:** Chinook salmon, harbor seal, sea lion, leopard shark, bat ray.
- **Endangered species:** California least tern, California black rail and clapper rail, Smith's blue butterfly, salt marsh harvest mouse, San Francisco garter snake, California freshwater shrimp, northwestern pond turtle, tidewater goby (fish). Rare plants include Marin western flax, Baker's manzanita, Point Reyes checkerbloom, Sonoma sunshine.

Factors Affecting Wildlife Diversity

- habitat loss due to urban, residential, and agricultural development
- water management issues including reduced water for wildlife
- water pollution
- invasive species

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Muir Woods, Marin County, California

Clapper rail

Bobcat

San Francisco area traffic

Central Coast Bioregion

This coastal region features beaches, dunes, and mountains. Plant communities include chaparral, mixed hardwood and redwood forests, and oak woodlands. The climate is mild and sometimes foggy. Winters are moist.

Human Social Systems

Artichokes, garlic, and a wide range of fruit and vegetable crops grow in this region. Dairy and cattle ranches are common. Other industries include tourism, wine making, fishing, and oil production. Development pressure is intense, but large blocks of natural land offer many opportunities for conservation.

Natural Systems

Coastal communities bring together marine, freshwater, and terrestrial systems.

- **Mixed coniferous forests in the coastal ranges:** Ponderosa pine, Douglas fir, red alder, and redwoods in the north.
- **Oak woodlands:** Coast live oak, valley oak.
- **Rare tree species:** Monterey pine, Santa Lucia fir.
- **Common birds:** Western snowy plover, willet, whimbrel, long-billed curlew, marbled godwit, American avocet, peregrine falcon, golden eagle, and California spotted owl.
- **Common mammals:** Mountain lion, bobcat, American badger.

Central coast, California

Inland mountain ranges have drier climates and support oak woodlands, grasslands, interior chaparral, and desert-like interior scrub. Oak woodland communities support more than 200 species of plants, 300 vertebrates, and 5,000 invertebrates.

- **Common mammals:** Western gray squirrel, dusky-footed woodrat, Monterey dusky-footed woodrat, pallid bat, Townsend's big-eared bat.

Grasslands now contain mostly nonnative grasses.

- **Rare birds:** Burrowing owl.
- **Common mammals:** California ground squirrel, black-tailed jackrabbit. Tule elk and pronghorn have been reintroduced in the southern part of the region.
- **Rare mammals:** Giant kangaroo rat, San Joaquin kit fox, American badger.

Interior chaparral has a hot, dry climate. It supports drought-resistant shrubs, such as manzanita, California lilac, and chamise.

- **Endangered species:** Morro Bay kangaroo rat, Pacific pocket mouse, California brown pelican, California condor, Santa Cruz long-toed salamander, unarmored threespine stickleback (fish), San Francisco garter snake, southern sea otter, leatherback turtle.

Factors Affecting Wildlife Diversity

- water management conflicts and water transfer
- inappropriate off-road vehicle use
- loss and degradation of dune habitats
- disruption of sand transport processes
- invasive plant and animal species
- growth and development of communities

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Coastal Redwoods, California

Southern sea otter

Pelicans, willets, and godwits

Artichoke farmer

Colorado Desert Bioregion

This bioregion forms part of the larger Sonoran Desert, which reaches across several southwestern states. The Colorado Desert is lower and flatter than the Mojave Desert to the north. It has higher summer daytime temperatures. In winter, frost is rare. Southern sections have rainy seasons in the winter and late summer.

Human Social Systems

Compared with most other bioregions, few people live in the Colorado Desert. Cities include: Palm Springs, Rancho Mirage, El Centro, Blythe, Coachella, and Calexico. This bioregion has four Indian reservations and several military bases. Imperial County is one of California's top agricultural counties. Cotton is a major crop.

Natural Systems

Salt marshes, freshwater ponds, and desert scrub are found in the Salton Sea National Wildlife Refuge.

- **Birds:** Great roadrunner, Gambel's quail, Albert's towhee, endangered Yuma clapper rail, egret, plover, northern pintail, Canada goose, snow goose, rough-legged hawk, peregrine falcon, tern, yellow-headed blackbird, hooded oriole, white-faced ibis.

Palm Canyon, Agua Caliente Cahuilla Indian Reservation

Restored wetlands in the Dos Palmas Preserve provide a desert oasis.

- **Birds:** Hooded oriole, warblers, snowy egret, osprey, American avocet.
- **Other animals**: Endangered desert pupfish, horned lizard.

Colorado River and surrounding land support many types of birds and wildlife.

- **Migratory birds:** Cormorant, merganser, white pelican, bald eagle.

Backcountry desert is home to many desert organisms.

- **Birds and mammals:** Desert bighorn sheep, feral burro, golden eagle, nesting prairie falcon, cactus wren, Gila woodpecker.
- **Endangered species:** Desert slender salamander, Yuma clapper rail, desert pupfish, razorback sucker (fish), unarmored threespine stickleback (fish), Coachella Valley fringe-toed lizard.

Factors Affecting Wildlife Diversity

- water management conflicts and water transfer
- inappropriate off-road vehicle use
- loss and degradation of dune habitats
- disruption of sand transport processes
- invasive plant and animal species
- growth and development of communities

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Roadrunner with prey

Ocotillo and cholla cacti

Desert pupfish

Off-road driving

Klamath/North Coast Bioregion

This bioregion features ancient redwood and Douglas fir forests. The rocky coastline has the state's wettest climate. Rainfall can be over 80 inches (203 cm) per year. The coastal climate is cool, moist, and often foggy. Inland areas have hot, dry summers and low winter rainfall.

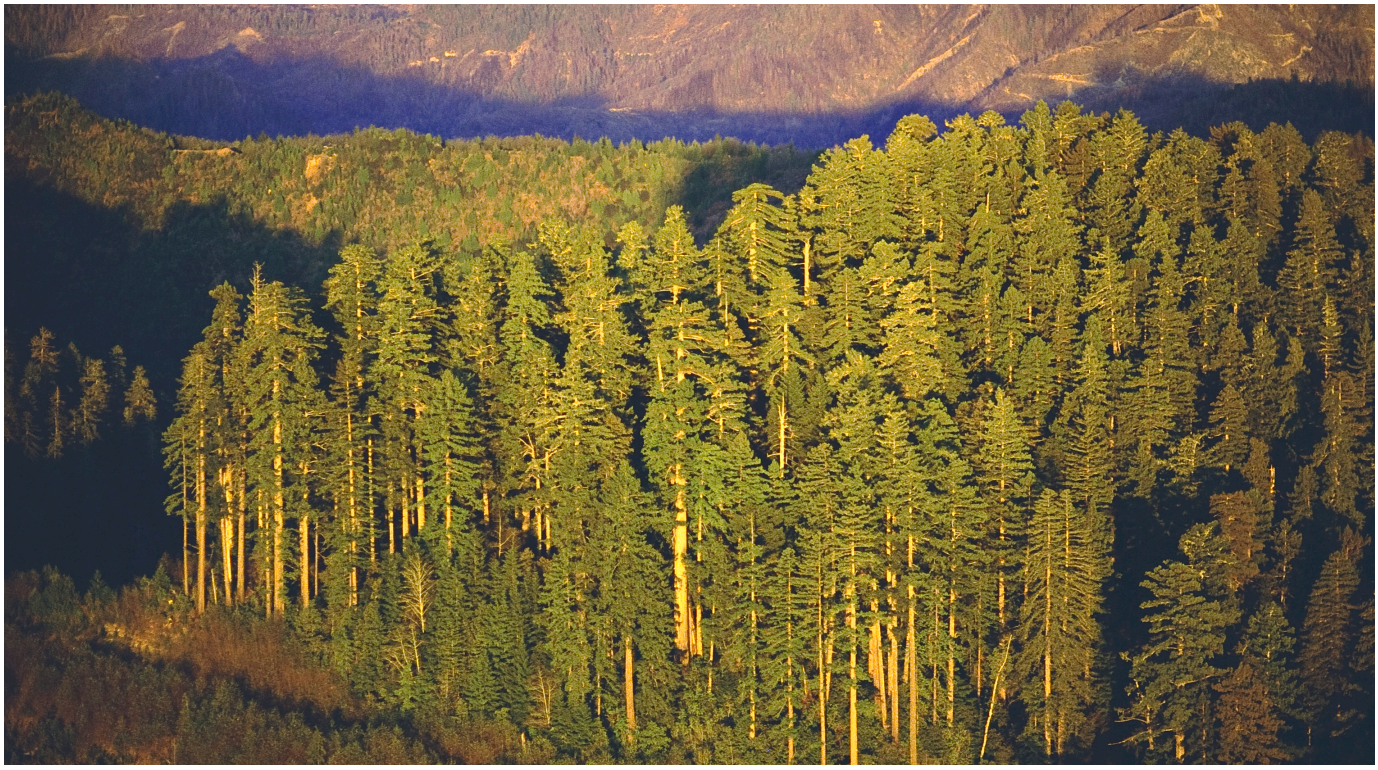
Human Social Systems

The largest cities are Redding and Eureka. Smaller cities include Clearlake, Ukiah, Arcata, Fort Bragg, Yreka, Mendocino, and Crescent City. The economy depends on cattle ranching, dairy farming, timber harvesting, and tourism. Fishing for Coho and king salmon is popular. The timber industry declined after unsustainable timber harvesting led to the listing of the northern spotted owl as an endangered species, and the trend toward sustainable forest management grew.

Natural Systems

Wetlands along the coast provide food and shelter for many types of birds. Some live in California all year, and others stop to eat and rest during spring and fall migrations. Ancient redwood forests and other mature forests provide habitat to the northern spotted owl, an endangered species. The marbled murrelet is another endangered species found in these woods. A seabird, it nests in the tops of tall, old trees along the coast.

- **Mixed conifer forests**: White fir, Douglas fir, ponderosa pine, Sierra lodgepole pine, incense cedar, sugar pine, red pine, Jeffrey pine, mountain hemlock, knobcone pine, western redcedar, red alder, coast redwood, tanoak, Pacific madrone.



Del Norte Coast Redwoods State Park, California

- **Rare plants:** Burke's goldfield, Humboldt Bay owl's clover, coast lily, swamp harebell, Snow Mountain willowherb, marsh checkerbloom, pale yellow stonecrop, Scott Mountain phacelia, McDonald's rock cress, Klamath Mountain buckwheat, Oregon fireweed, Adobe lily.
- **Birds:** Bald eagle, California clapper rail, Aleutian Canada goose, osprey, Swainson's hawk, willow flycatcher, western sandpiper.
- **Other animals:** Deer, fox, black bear, mountain lion, Roosevelt elk, Pacific fisher (mammal), Point Arena mountain beaver, Oregon silverspot butterfly.
- **Rare animals:** Northern spotted owl, marbled murrelet, American peregrine falcon, Lotis blue butterfly, Trinity bristle snail, red-legged frog, Siskiyou Mountains salamander, Pacific fisher, Del Norte salamander, Karok Indian snail, wolverine, goshawk, Chinook salmon.
- **Endangered species:** Marbled murrelet, northern spotted owl, Humboldt Bay wallflower, western lily, Lost River sucker (fish), California clapper rail.

Factors Affecting Wildlife Diversity

- water management conflicts
- in-stream gravel mining
- forest management can have either positive or negative influences. For example, thinning dense forests can enhance biodiversity.
- altered fire regimes
- habitat loss due to agriculture and community development
- livestock grazing
- invasive species

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Old growth redwood forest, California

Roosevelt elk

Northern spotted owl

Logging

Modoc Bioregion

This area has the lowest human population of any of California's bioregions. The rural region features a variety of parks and wildlife refuges. Stretching across the Modoc Plateau, it includes: forests, mountains, high desert, valleys, pine forests, and uplands created by volcanoes. Summers are hot and dry. Winters are cold and moist, with snow at higher elevations.

Human Social Systems

Modoc and Lassen counties are included in the Modoc Bioregion. The largest cities are Alturas, Susanville, Burney, and Magalia.

Two California Indian tribes—the Northern Paiute and the Paiute-Shoshone—live here. The economy depends on ranching and timber operations.

Natural Systems

The western side of the region features land created by volcanoes. Lassen Volcanic National Park is here, along with Lava Beds National Monument and several wildlife refuges. Mount Lassen last erupted in 1915. The eastern part of the bioregion is drier and features high desert ecosystems.

- **High desert vegetation:** Juniper and sagebrush communities.
- **Mountain forests:** Yellow pine, Jeffrey pine, white fir, mixed conifer, cedar, aspen.
- **Rare plants:** Yellow arrowleaf, balsam root, long-haired star tulip, spiny milkwort, Ash Creek ivesia, Raven's lomatium, woolly stenotus.
- **Birds:** Bald eagle, greater sandhill crane, osprey, Canada goose, black-crowned night heron, cinnamon teal, northern pintail, Swainson's hawk, sage grouse,

Mount Lassen, Lassen Volcanic National Park, California

hummingbird, great horned owl, goshawk, bank swallow.

- **Fish and other aquatic life:** Rainbow trout, Modoc sucker, Lost River sucker, Shasta crayfish.
- **Mammals:** Antelope, mule deer, pronghorn, marmot, black bear, coyote, porcupine, muskrat.
- **Endangered species:** Shasta crayfish, Modoc sucker, Lost River sucker, shortnose sucker.

Factors Affecting Wildlife Diversity

- livestock grazing
- feral horse grazing
- altered fire regimes
- western juniper expansion
- invasive plants
- forest management can have either positive or negative influences. For example, thinning dense forests can enhance biodiversity.
- water management conflicts and degradation of aquatic ecosystems

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Aspen and pine trees

Pronghorn antelope

Herding cattle

Mojave Bioregion

One of California's largest bioregions, the Mojave Bioregion's desert may look barren but actually is teeming with life. Streams and springs provide water that support many forms of wildlife. This bioregion has the lowest elevation in North America, 282 feet (86 meters) below sea level in Death Valley National Park.

Human Social Systems

In the past, not many people lived in this desert region. Now the region supports rapidly growing cities. Palmdale is one such city. Others include: Victorville, Hesperia, Ridgecrest, and Barstow. The region also is home to three national parks, several Indian reservations, and a variety of military operations. Mining for gold and other minerals is a major industry, along with ranching and livestock grazing.

Natural Systems

- **Habitats**: Desert wash, Mojave creosote bush, scattered desert saltbush, Joshua tree scrub, alkali scrub, palm oasis, juniper-piñon woodland, hardwood and conifer forests at higher elevations, cottonwood willow riparian forest, alkali marsh, open sandy dunes.
- **Rare plants**: White bear poppy, Barstow woolly sunflower, alkali mariposa lily, Red Rock poppy, Mojave monkeyflower, Stephen's beardtongue.

Mojave Desert, California

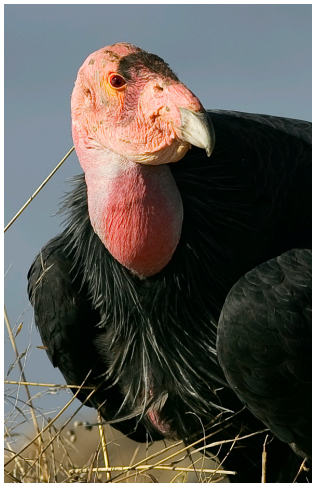
- **Birds:** Snowy plover, least sandpiper, killdeer, white pelican, teal, eagle, harrier, falcon, owls, migratory shorebirds, great blue heron, least Bell's vireo, red-tailed hawk, Canada goose.
- **Mammals:** Coyote, badger, kit fox, longtail pocket mouse, desert kangaroo rat, Merriam's kangaroo rat, black-tailed jackrabbit, bobcat.
- **Rare animals:** Mojave ground squirrel, prairie falcon, Le Conte's thrasher, Nelson's bighorn sheep, gray vireo (bird), desert tortoise, pale big-eared bat, Mojave tui chub (fish), cottontail marsh pupfish (found only in Death Valley National Park).
- **Endangered species:** California condor, Armargosa vole, Owens tui chub (fish), least Bell's vireo (bird).

Factors Affecting Wildlife Diversity

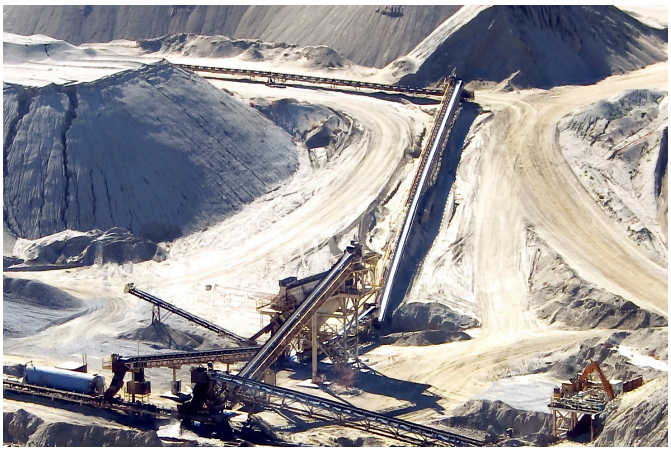
- multiple uses conflicting with wildlife on public lands
- habitat loss due to development
- groundwater overdrafting and loss of riparian habitat
- inappropriate off-road vehicle use
- excessive livestock, burro, and horse grazing
- invasive plants
- land management conflicts
- mining operations

Prickly pear cactus

Coyote



California condor



Gravel mining

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Sacramento Valley Bioregion

The Sacramento Valley Bioregion is a broad, flat valley. The Sacramento River drains from the Sierra Nevada Mountains and is the state's largest river. Most of the land is privately owned. Private landowners play an important conservation role in this bioregion. Over 75% of the known locations of 32 animal "species of concern" in California are on private land. (*"Species of concern" is an informal designation for species for which there are some concerns regarding status and threats.*)

Human Social Systems

More than 1.5 million people live in this region. Sacramento is the state capital. Other cities include: Redding, Chico, Davis, West Sacramento, and Roseville. Many people work for the state government. Others work in lobbying or public relations firms. Tomatoes, rice, olives, and other crops grow in Sutter, Yolo, and Colusa Counties. Food canneries, high-tech industries, and biotechnology contribute to the economy.

Natural Systems

The Sacramento Valley has hot summers, mild autumns, and foggy winters. Except during droughts, rainfall is frequent in winter. The weather usually is too warm for snow. The Sacramento

Sacramento National Wildlife Refuge, California

Valley is an important site for water birds in winter. More than 1.5 million ducks and 750,000 geese visit marshes along the Pacific Flyway in winter months.

- **Habitats:** Oak woodlands, riparian forests, vernal pools, freshwater marshes, grasslands.
- **Birds:** Northern pintail, snow goose, tundra swan, sandhill crane, mallard, grebe, peregrine falcon, heron, egret, hawk.
- **Other animals:** Black-tailed deer, coyote, river otter, muskrat, beaver, osprey, bald eagle, salmon, steelhead (fish), swallowtail butterfly.
- **Species of concern:** Swainson's hawk, burrowing owl, San Pablo vole, Buena Vista Lake shrew.
- **Endangered species:** Winter-run Chinook salmon, delta smelt (fish), giant garter snake, western yellow-billed cuckoo.

Factors Affecting Wildlife Diversity

- habitat loss due to urban, residential, and agricultural development
- water management conflicts and reduced water for wildlife
- water pollution
- invasive species

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Riparian habitat

Swainson's hawk

Housing development

Black-tailed deer

San Joaquin Valley Bioregion

Fertile soils and hot summers make this California's top agricultural region. As agriculture has grown, people have converted many of the region's native grasslands, woodlands, and wetlands to farmland. Diversion of water for irrigation has dried up 95% of the streams. Public parks, reserves, and wildlife areas provide refuges for fish and wildlife. Summers are hot and dry with long, sunny days. Winters tend to be moist and foggy.

Human Social Systems

With more than 2 million people, the San Joaquin Valley ranks third among California's bioregions in terms of human population. The largest cities are Fresno, Bakersfield, Modesto, and Stockton. Agriculture provides the basis for the economy. Oil and gas production also are important. The region includes several Indian reservations and one military operation.

Natural Systems

This region contains important oak woodlands and grasslands. The South Fork Wildlife Area supports 20% of California's remaining stream-bank cottonwood and willow forests. Natural grasslands, ponds, and marshes in the Tule Elk State Reserve support Tule elk. Four endangered species also live there. The Kern National Wildlife Refuge attracts peregrine falcons, ducks, shorebirds, and songbirds. Great blue herons, beavers, coyotes,

Oak trees, San Joaquin Valley, California

black bears, mountain lions, red-shouldered hawks, and mule deer make use of these habitats. These and other parks and wildlife refuges attract up to 1 million birds each winter, including bald eagles and a wide range of ducks.

- **Habitats:** Vernal pools, valley sink scrub, saltbush, freshwater marsh, grasslands, arid plains, orchards, and oak savannah.
- **Rare plants:** Hoover's woolystar, Mason's lilaeopsis, San Joaquin woollythread, California hibiscus, valley elderberry.
- **Rare animals:** Western pond turtle, tricolored blackbird, northern harrier, western yellow-billed cuckoo, longhorn beetle.
- **Endangered species:** California tiger salamander, Swainson's hawk, giant kangaroo rat, Fresno kangaroo rat, San Joaquin kit fox, blunt-nosed leopard lizard, San Joaquin antelope squirrel, Tipton kangaroo rat.

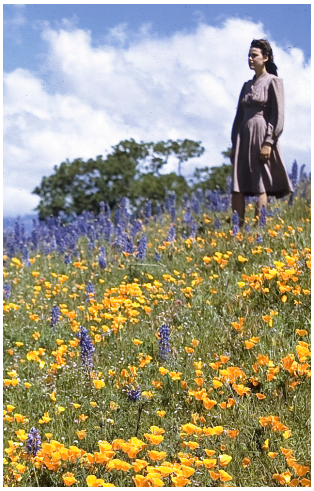
Factors Affecting Wildlife Diversity

- habitat loss due to urban, residential, and agricultural development
- water management conflicts and reduced water for wildlife
- water pollution
- invasive species

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Mountain lion and cub

Kit foxes



Grassland with poppies and lupines

Cattle in feed lot

Sierra Bioregion

The Sierra Bioregion is named for the Sierra Nevada mountain range. Much of the state's water supply comes from these mountains. Mount Whitney is the country's highest peak (outside of Alaska). The region contains three national parks, eight national forests, and many other parks and recreation areas. These areas can host diverse forest types and provide habitat to a wide range of plant and animal species. Winters are snowy, and summers are dry and mild.

Human Social Systems

More than 650,000 people live in this region. Rural towns and small cities include: Truckee, Placerville, Quincy, Auburn, South Lake Tahoe, and Bishop. Software and high-tech industries provide many jobs. Hydropower, tourism, recreation, logging, and cattle ranching also are important. Apple orchards and wineries are found in the foothills. Melting snow fills reservoirs. This provides about two-thirds of the water used in California for drinking, irrigation, and industry.

Natural Systems

Over half of California's plant species live in this region. The diverse habitats support two-thirds of the state's bird and mammal species. Half of the species of reptiles and amphibians in the state live in this region.

High meadow, Sierra Nevada, California

- **Habitats:** Alpine meadow, grassland, sagebrush, chaparral, forested riverbank.
- **Trees and shrubs:** Mixed conifer, blue oak, black oak, red fir, Jeffrey pine, ponderosa pine, bitter brush.
- **Birds:** Bald eagle, great grey owl, California spotted owl, northern goshawk, mountain chickadee, pine grosbeak, mountain quail, willow flycatcher.
- **Other animals:** California mountain king snake, California big horn sheep, mule deer, mountain lion, black bear, wolverine, mountain beaver, Pacific fisher, lodgepole chipmunk. Cold mountain streams are home to California Golden Trout, the state fish.
- **Endangered species:** Owens pupfish, Stebbins's morning-glory, Bakersfield cactus, blunt-nosed leopard lizard, California jewel-flower, California condor, Hartweg's golden sunburst (plant).

Factors Affecting Wildlife Diversity

- dams, water diversions, and hydropower operations
- habitat loss due to community growth and land development
- altered fire patterns
- forest management can have either positive or negative influences. For example, it can thin dense forests and enhance biodiversity.
- livestock grazing
- invasive plants and introduced nonnative fish
- watershed fragmentation and fish barriers
- recreational pressures

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Bakersfield cactus, Bakersfield, California

Wolverine

Giant sequoias, California

Shasta Dam, California

South Coast Bioregion

Landscapes in this bioregion range from flatlands to mountains. Ecosystems range from ocean to desert. The region contains two of California's largest cities: Los Angeles and San Diego. More than in any other bioregion, urbanization has caused intense effects on natural resources. Urbanization in the South Coast Bioregion has resulted in loss of habitat, spread of nonnative species, and loss of native species.

Human Social Systems

More people live in this region than in any other part of California. The natural beauty and year-round mild climate make this a popular location. Recreation and tourism provide many jobs. Tourists visit Disneyland, Hollywood, Sea World, and the San Diego Zoo. Tourism is important to Southern California communities. The miles of beaches and coastal mountain ranges are popular recreation spots. Many people work in the movie and television industries. Other important industries include: oil, shipping, banking, computers, and military. Agriculture and fishing also provide jobs.

Natural Systems

Many conservation projects are underway in this region. The Sespe Condor Sanctuary is home to the endangered California condor. Many coastal wetlands have been lost to development. However, some salt marshes and lagoons are being preserved or restored. Sage scrub communities also need protection. These communities support diverse kinds of wildlife. These include the California gnatcatcher, a threatened bird species.

Malibu Lagoon State Beach, Malibu, California

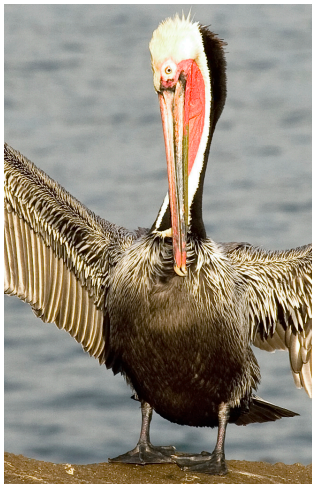
- **Lower elevation habitats:** Chaparral, juniper-pinyon woodland, grassland.
- **Mountain habitats:** Hardwood forest, southern oak, southern Jeffrey pine, southern yellow pine forest.
- **Rare plants:** San Diego barrel cactus, Conejo buckwheat, Plummer's mariposa lily, mountain springs bush lupine, Otay tarplant, Laguna Mountains jewelflower, San Jacinto prickly phlox, Mount Gleason Indian paintbrush.
- **Birds:** Hawks, heron, golden eagle, osprey, peregrine falcon, endangered brown pelican.
- **Other animals:** Mountain lion, coyote, black-tailed jackrabbit, grey fox, raccoon, mule deer.
- **Marine mammals:** Dolphins, whales, and California sea lion.
- **Rare animals:** Stephen's kangaroo rat, monarch butterfly, San Diego horned lizard, Peninsula desert bighorn sheep, orange-throated whiptail (lizard), California least tern, Belding's savannah sparrow, least Bell's vireo, Santa Ana sucker (fish), arroyo southwestern toad, Tehachapi pocket mouse.
- **Endangered species:** California least tern, Channel Islands foxes, California brown pelican, Santa Ana River woolly star, San Diego mesa mint, Nevin's barberry, bird-foot checkerbloom, California orcutt grass.

Factors Affecting Wildlife Diversity

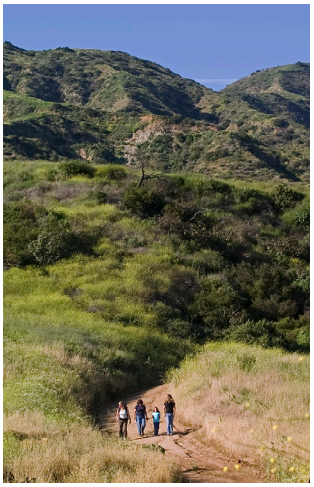
- habitat loss due to urban growth and development
- water management conflicts and degradation of aquatic ecosystems
- invasive species
- altered fire regimes
- recreational pressures

Adapted from California Natural Resources Agency and California Department of Fish and Game, http://ceres.ca.gov/geo_area/bioregions/mapindex.html and http://www.dfg.ca.gov/habitats/WDP/report.html

Long-beaked dolphins



California brown pelican



La Verne hillside, California

Watering lawns

Harvesting fish

Have you ever wondered where the food you eat, the water you drink, and the air you breathe come from? The simple answer may be that your food comes from a store or restaurant, your water from the tap or a bottle, and your air from the atmosphere surrounding you whether you are indoors or out. Digging deeper, you will discover that humans depend on Earth's ecosystems for all of these necessities of life.

Whether they live in a city or suburb, on a ranch or a houseboat, all humans depend on natural ecosystems to provide the goods and services that support their daily lives. What are these ecosystem goods and ecosystem services? Goods are products, and services are processes. If you eat dinner in a restaurant, for example, the meal itself is a collection of goods. The services are the processes performed by waiters, cooks, dishwashers, and other workers who keep the restaurant functioning.

Ecosystem Goods

On an ecosystem level, goods are products, such as food, timber, fuels, and medicines that come from natural products. People take some goods directly from ecosystems. For example, people harvest fish from oceans and fresh waters. Gazing across an orchard, ranch, or farm, the connection with natural ecosystems may be less apparent. However, all modern crops descend

from wild varieties. Through crossbreeding with wild plants or animals, scientists develop new varieties better suited to human needs and environmental conditions.

Ecosystem Services

Ecosystem services are processes essential to human life and to the functioning of natural systems. For example, water is purified as it flows downstream or trickles through a wetland. Green plants restore oxygen to the air. This replaces oxygen used for respiration by humans and most other forms of life. Using energy from the Sun, green plants also produce food and support diverse forms of life. Decomposition of dead organisms and other organic wastes is another ecosystem service. This decay maintains fertile soils. It also continues the cycling of carbon, nitrogen, and other nutrients between biotic and abiotic forms. Ecosystems regulate Earth's climate and water cycle.

Logger cutting coast redwood

Oxygen production

Turkey vulture feeding

Protection

Each year, humans all over the world face losses from natural disasters. Think about disasters you have heard about in the news. Hurricanes, droughts, tsunamis, and wildfires regularly make headlines. In 2005, rebuilding after such disasters cost more than $200 billion. If people had preserved their natural ecosystems before the hurricanes hit, the losses might have been much less severe.

Hurricane Katrina is an example. Housing and other human development have replaced many acres of wetlands along Louisiana's coast.

Hurricane Katrina damage, Louisiana

Clear-cut forest, Haiti, and forested mountains, Dominican Republic

If more of these coastal wetlands had been in place in 2005, they would have reduced the damage caused by the storm. Wetlands function to slow down or "buffer" tidal waves, and that means the waves would have hit the city with lower intensity.

The 2004 tsunami in Asia is another example of human communities made more vulnerable by loss of coastal vegetation. The heaviest damage occurred along coastlines where development had replaced mangrove forests and other native vegetation. The tsunami caused extensive damage to developments, such as shrimp farms and tourist resorts in the coastal areas.

Ecosystem disruption also can make inland communities vulnerable to storms. In 2004, tropical storm Jeanne killed 3,000 people in Haiti. Only 18 people died just across the border in the Dominican Republic. Why? Flooding in Haiti was extreme because intensive logging has left the ground bare. Few trees or other plants remained to slow the runoff of rainfall to the sea.

Louisiana wetlands

Pollination

Did you know that almost all of the fruit and vegetable crops grown in the United States are the result of pollination by insects and other animals? From apples to alfalfa, over 150 food crops in the United States rely on honeybees and other insects to spread their pollen. Through pollination, a male pollen grain fertilizes the female parts of a flower. Of course, there are some exceptions: some types of plants have flowers that can fertilize themselves, while others rely on wind to carry pollen grains from one flower to another.

But, over 90% of the world's 250,000 species of flowering plants depend on insects and other living things. Honeybees, moths, and over 100,000 species of invertebrates pollinate flowers. Hummingbirds and over 1000 species of birds, mammals, and even reptiles also are pollinators. As these organisms move from one flower to the next, they pick up grains of pollen. They also drop pollen grains picked up from other flowers visited along the way. Seeds develop after these grains of pollen fertilize the flowers.

Beekeeper with hive

How valuable are nature's pollinators? Their services to U.S. crops are valued at between $4 billion and $7 billion per year. For agriculture, the most important pollinator is the honeybee. Growers commonly hire beekeepers to bring hives of bees into orchards or fields when crops are ready for pollination. These bees, along with wild insects and other pollinators, help produce good crop yields.

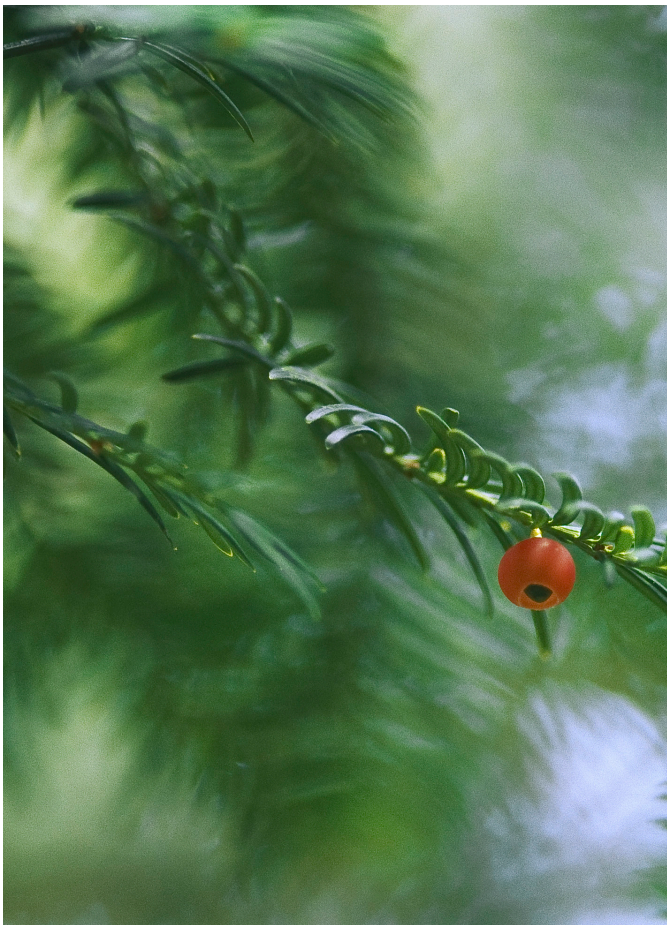
Pollinators perform a service by transferring pollen from one flower to another. The pollinators also benefit from this interaction. From flowers, they receive food. From plant communities, they receive shelter and sites for mating, nesting, and other functions of life. Diverse plant communities support healthy, diverse collections of pollinator organisms. By helping flowering plants to reproduce, the pollinators, in turn, help plant communities to thrive.

Almond trees with blossoms

Hummingbird feeding

Medicines from Nature

When you think of painkillers, antibiotics, and other medicines, you probably think of bottles of potions or pills from a drugstore. You may not realize that many of these medicines come from nature. Of the top 150 drugs prescribed in the United States, 108 come from natural sources; almost 75% are from plants, and 18% are from fungi. Another 5% come from bacteria, while 3% come from a snake species. For example, aspirin is a chemical found in the bark and leaves of willow trees. And the Pacific yew, a small tree native to California, was the original source of an important tumor-fighting drug called taxol.



Pacific yew tree

What other useful compounds remain to be discovered? Scientists have no doubt that other natural sources could produce numerous new medicines. Rainforests, coral reefs, and even deserts provide potential sources of new drugs. Marine organisms seem to be a promising source of new cancer treatments. Among other possibilities, scientists are working to develop new painkillers from snake venom and from poisons found in the skin of frogs.

Lab testing

Boy getting oral medicine

Ocean Food Webs

Seafood provides the leading source of animal protein eaten by humans worldwide. The world fish catch is worth up to $100 billion each year. However, the future of these fisheries may be at risk because of overfishing, pollution, and habitat destruction.

Marine ecosystems are made up of complex food webs. In some cases, the health of the ecosystem depends on a single species or group of species. Consider the case of the sea otter, a marine mammal living along California's rocky coastline. Fur traders overhunted sea otters, and they became nearly extinct in the early 1900s.

When sea otters died out, the kelp forest ecosystems also fell into decline. Sea otters eat huge numbers of shellfish, including sea urchins. The loss of otters as predators disturbed kelp forest food webs. Populations of sea urchins grew rapidly. The urchins ate the kelp and broke its attachments to the rocky ocean floor. Loss of kelp forests left hundreds of species of fish and other aquatic organisms without food and shelter. Diversity of marine life fell when the kelp beds died out, and commercial and recreational fishing declined.

In 1977, officials placed sea otters on the federal Endangered Species list, and with the Marine Mammal Protection Act, made otter hunting illegal. With this new protection, sea otter populations began to recover. As their numbers grew, otters once again were able to keep sea urchin populations in check. Kelp forests began to rebound, and gradually other species reappeared. The sea otter is not yet out of danger of extinction. Scientists and conservationists are working to determine ways to continue protecting this species that has proven vital in maintaining healthy kelp forest ecosystems.

Sea urchins in kelp bed

Sea otters

Genetic Diversity

With all the food choices available today, are you surprised to learn that 90% of human food comes from only 15 species of plants? Wheat, rice, corn, and potatoes are the top crops in terms of tons harvested worldwide. Earth's ecosystems support roughly 80,000 species of plants that might be edible. However, humans currently use only about 15 species of plants for food.

Why might preserving a diverse range of potentially edible wild plants be important? Each species that becomes extinct is lost forever. Each of these organisms might have become an important source of food, medicine, fiber, or fuel, but we will never know. With extinction, such possibilities are lost. When a species becomes extinct, we also lose the genetic information contained in its DNA.

Corn, potatoes, rice, and other crops have descended from wild varieties. Scientists continue to develop new varieties through crossbreeding of domestic and wild strains. Scientists breed such varieties with specific features in mind. For example, a plant scientist might cross a wild variety of corn with natural disease resistance with a domestic corn strain to produce a new variety displaying the best features of both. Using these techniques, scientists develop crops with features, such as greater tolerance to drought. Another aim is to breed crops with higher yields or greater nutritional value to meet the needs of Earth's expanding human population.

Plant scientist

Potato harvest, Idaho Falls, Idaho

Mount St. Helens, Washington

Mount St. Helens is a volcanic peak in the Cascade Mountain Range. It was inactive for most of the 20th century but erupted in 1980. The top 1,300 feet of the mountain suddenly disappeared, sending ash in all directions and forming a deep crater. The blast leveled 249 square miles of forest. Ash and debris filled a valley 15 miles long.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=84.**

Bolivian Farms and Communities

After road construction linked this rural region of Bolivia to urban areas, large numbers of people moved to the area. Large areas of forests were clear-cut and coverted to pastures and cropland. In the upper left corner of the 2003 photograph, each dark square with a star-shaped pattern inside it is a small community.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=31.**

Brazilian Rainforest

Approximately 30% of the world's tropical forests are in Brazil. The fishbone pattern in the second photograph shows a network of logging roads and areas in which the forests have been clear-cut.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=29.**

Agriculture in Louisiana

The watershed of the Tensas River in eastern Louisiana forms part of the larger Mississippi River watershed. Historically, forest covered 90% of this land. During the 1960s and 1970s, 85% of the forests were cleared to make room for soybean farms. This resulted in increased soil erosion and flooding. In these photographs, croplands are tan and forests are green.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=69.**

Australian Outback

These photographs show the site of one of the world's largest open-cut bauxite mines. (Bauxite is a mineral used to make aluminum). Under current mining practices, vegetation is cleared and the topsoil removed. After mining of the bauxite ore, the lowered landscape is covered with topsoil. If the topsoil is stored only a short time before use, it may still contain seeds that will sprout and restore the original plant community. To protect soils on slopes, native plant species are planted so that the area gradually reverts to bushland.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=93.**

Wyperfeld National Park, Australia

Wyperfeld National Park in Australia shows up as a large dark green patch in the 1973 photograph. Much of the park's vegetation is dry, native scrubland. Several varieties of eucalyptus are common, along with over 450 other species of plants, 200 species of birds, and a variety of mammals and reptiles. The light green areas in the 2004 photograph show huge fire scars on the landscape. Fire, to a limited extent, helps to maintain the native vegetation and the habitat it creates for native wildlife. Some fires occur naturally. Some are set by humans either accidentally or to maintain habitat and reduce the amount of fuel available for larger blazes.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*

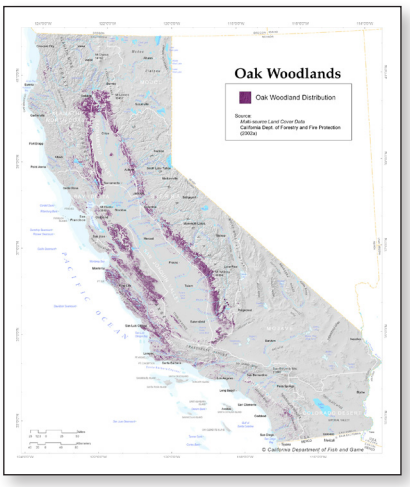
Additional information available at **http://na.unep.net/digital_atlas2/webatlas.php?id=86.**

Rwanda

Over half of the world's 700 surviving mountain gorillas live in bamboo and montane forests in a national park established for their protection. The park boundaries are clearly indicated by vegetation in these photographs. The surrounding landscape has among the highest human population densities in Africa. During the 1990s and early 2000s, large numbers of people moved into the surrounding area as refugees from armed conflict in their countries. Intensive farming and logging occurred outside the boundaries of the park.

Source: United Nations Environment Programme, *Atlas of Our Changing Environment.*

Additional information available at **http://na.unep.net/atlas/webatlas.php?id=272**.



California oak woodlands

Oak woodlands support many species of wildlife. For birds, oak woodlands are one of the top three habitat types in North America. Over 330 species of birds, mammals, reptiles, and amphibians depend on oak woodlands for survival. Acorn woodpeckers, northern pygmy owls, and western bluebirds are a few examples of birds that eat the acorns and use oak trees for shelter.

Like all forests, oak woodlands provide a variety of ecosystem services. For example, they moderate the local climate by providing shade from the Sun and shelter from the wind. They help to prevent soil erosion, and they protect water quality. Their fertile soils support over 200 species of plants.

More than one-third of California's original oak woodlands are now gone. People cut some for firewood. Other woodlands were removed to make room for vineyards, farms, and ranches. Most were cut to make room for new houses, roads, and other types of development. Development pressures continue to build as the state's population grows. A disease called Sudden Oak Death is also damaging oak woodlands. Caused by a type of fungus, this disease has killed many thousands of oak trees in California.

The California Department of Forestry and Fire Protection helps manage oak woodlands in parks and other publicly owned lands. However, individuals or companies own 80% of California's existing oak woodlands. To help protect these areas, in 2001 the California Legislature passed the California Oak Woodland Conservation Act. This act created the Oak Woodland Conservation Program to provide funding for government and landowners to work together to conserve and restore California's oak woodlands. First, each city or county writes an Oak Woodland Management Plan. Conservation easements are an example of the type of protection provided in these plans. When the government buys an easement, the person who owns the land receives money to protect healthy oak woodlands. The owner could be an individual homeowner, a farmer, or a rancher. In each case, the easement provides payment to support efforts designed to protect or restore oak woodland habitats.

Blue oak woodlands

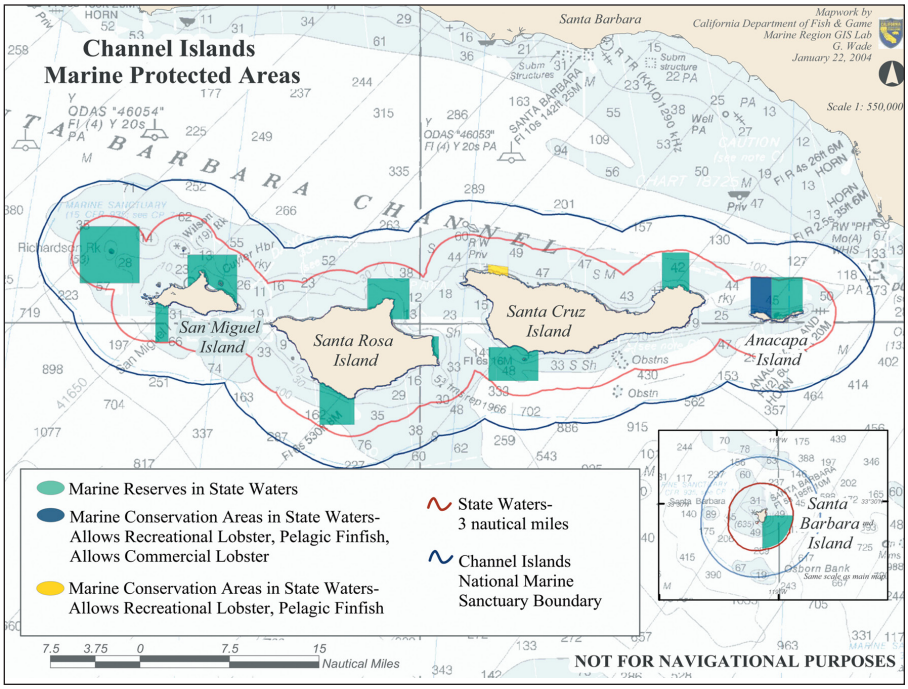
Sardines swimming among Channel Islands, California

Channel Islands National Marine Sanctuary is one of 13 marine sanctuaries in the United States. The federal government created this sanctuary in 1980 to protect ocean resources off the coast of California. It surrounds San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara islands. Stretching from their shorelines to six miles offshore, it covers more than 1,200 square miles.

The Channel Islands National Marine Sanctuary protects a wide range of marine life. Whales, dolphins, seals, and sea otters are a few of the marine mammals found in the sanctuary. Tide pools and reefs along the rocky coastlines support algae, invertebrates, and fish.

Offshore are large beds of kelp, a type of seaweed. Mixing of warm and cold currents in the Channel Islands creates conditions that promote growth of kelp forests that, in turn, support a wide range of marine life. Over 1,000 species of marine organisms find shelter or food in kelp beds. Abalone and sea urchins eat kelp. Fish swim among its strands as they hide from predators and search for prey.

Oceans throughout the world face pressure from overfishing. The population sizes of many species of fish and shellfish are dropping. In the Channel Islands, the California Department of Fish and Game set up a series of marine reserves. These zones around the islands are areas in which no harvesting is allowed. Banning harvesting protects sensitive species by providing sanctuaries where dwindling populations have a chance to recover. This approach seems to be working. Within the Channel Island reserves, scientists have measured higher population densities than outside their boundaries. The diversity of species also is higher within the marine reserves.



Channel Islands National Marine Sanctuary, California

Arcata Marsh, California

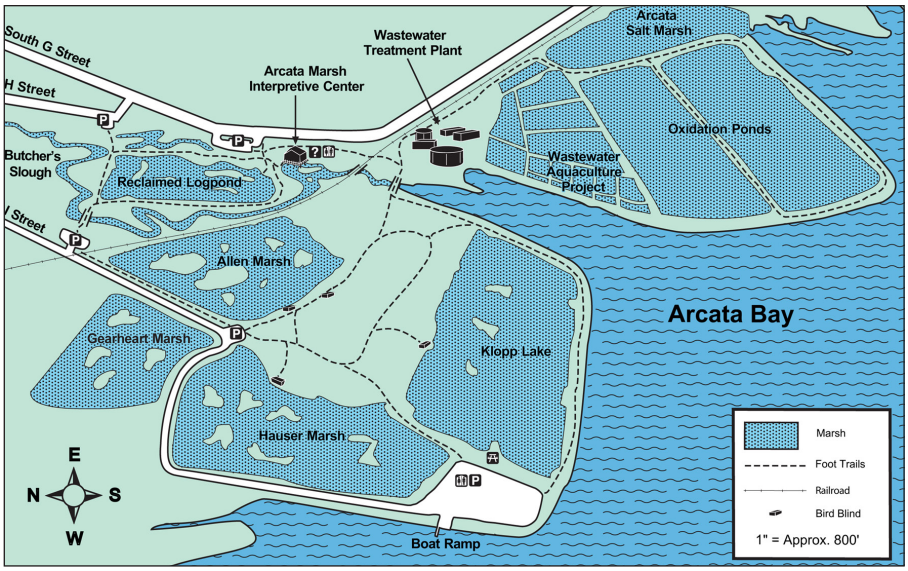
Arcata is a small California city that came up with a creative way to treat its wastewater. Wastewater from Arcata flows into the Pacific Ocean at Humboldt Bay. In 1972, U.S. law required action to improve the bay's water quality. Arcata needed to improve its sewage treatment. One idea was to build a new plant to treat sewage from Arcata and other towns around the bay. Arcata came up with a different idea that has saved money and enhanced the value of the area for fish, wildlife, and recreation. The Task Force on Wastewater Treatment began an investigation of the local wetland areas and their ability to help provide wastewater treatment.

Untreated sewage causes water pollution. Decay of organic matter in the sewage uses up oxygen. This process creates dead zones in which few species of fish or other aquatic organisms can survive. Engineers design wastewater treatment to avoid this ecological problem. Treatment plants clean up sewage before it drains into a river, lake, or ocean. As sewage flows through tanks and filters, bacteria break down much of its organic matter.

In Arcata, sewage starts with this sort of treatment. However, much of the purification takes place in a series of marshes and ponds. Water flows through these wetlands for further treatment before emptying into Humboldt Bay.

Arcata's system uses water purification processes that occur naturally in wetlands. In nature, wetlands are biological filters that purify water. Bacteria and other microbes in wetlands break down organic matter as water trickles through. Compounds, such as greases, solvents, and fuels, also break down. Wetland plants and sediments remove nutrients, such as nitrate and phosphate. Heavy metals, such as cadmium and lead, may stick in the sediments or be taken up by plants.

Arcata created a series of freshwater and saltwater marshes and ponds on land that had once been an industrial site. As wastewater trickles through these wetlands, natural biological processes purify it. The wetlands also provide prime wildlife habitat. These marshes support over 100 species of plants. The roots and stems form dense filters that remove solids and some chemicals from water. Nutrients feed algae, fungi, bacteria, and microorganisms. The nutrient-rich wetlands attract birds, fish, and mammals, such as otters. As a stopover on the Pacific Flyway, the Arcata marshes provide shelter and food to over 200 species of birds.



Arcata Marsh, California

Location of Yolo County, California

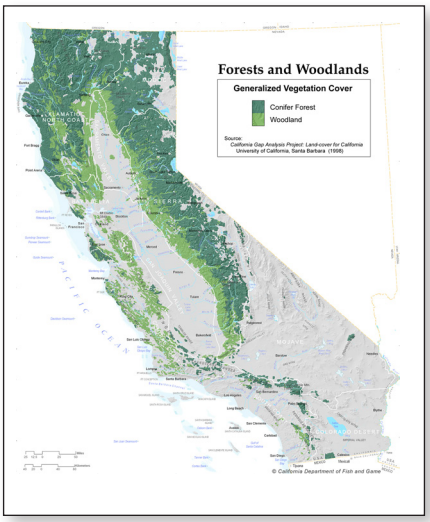
In California's Central Valley, large farms grow vegetables, fruit, and other food products. The fertile farms feed people throughout the world. As farming has become more intensive, the diversity of plant and animal communities has dropped. Audubon California is working to reverse this trend. Through their Landowner Stewardship Program, started in 2000, Audubon works with landowners. Together they design projects to conserve wildlife habitat on farms, ranches, and other rural properties.

In Yolo County, private individuals or companies own 90% of the land. Parks and other public lands cannot adequately protect the county's rare plant and animal species. Instead, farmers and ranchers are learning to protect diverse species on their own land. These landowners carry out a variety of projects to protect species and their habitats. These actions also protect the ecosystem services provided by diverse natural communities.

Landowners are finding many ways to enhance wildlife habitat. Some restore oak woodlands or native grasslands. Others create ponds for wildlife. Still others plant cottonwoods and willow trees along rivers and streams. Farmers create habitats by providing room for native plants to grow between fields of crops. The nectar and pollen in these native plant communities attract insects that help to pollinate the crops and keep pests under control.

Ducks, geese, and other birds need resting places and food as they migrate thousands of miles along the Pacific Flyway each winter. Rice farmers in the Central Valley are working with the state to provide these needed habitats. Conservation easements on farms surrounding wildlife refuges encourage rice farmers to flood their fields after harvest. The resulting wetlands provide rich habitats for migrating birds.

Sandhill cranes, California



California forests and woodlands

California's forests are primarily owned by the federal and state government (57%), industry (11%), and by non-industrial private owners (31%). Eighty-five percent of timber harvested in California comes from private forestlands, and most comes from lands that are certified as "sustainably managed" by third-party verifiers. Although in the 1980s California was self-sufficient in supplying timber for the state's needs, harvesting on public lands has declined to the point that California now imports 80% of the wood it needs. Currently, both nationwide and in California, the amount of wood grown greatly exceeds harvest. The greatest threats to forests in California are wildfire and habitat conversion due to development.

Harvesting timber is done by even-aged methods (clear-cutting and thinning) and uneven-aged management (single tree selection and group selection). Clear-cutting removes most trees, except for designated nesting sites and other special habitats, whereas selective cutting retains most trees on the site. Both methods are required to leave "buffer strips" along streams to protect against sedimentation and to maintain water temperatures favorable for fish. Prompt regeneration is required by law.

Wood is a renewable resource that requires less energy for manufacture and produces a smaller "carbon footprint" than using alternative materials. However, timber harvesting always has potential effects on wildlife habitat and soil erosion. Because of these concerns, in 1973, California passed the Forest Practice Act, which requires all private forest landowners to have approved Timber Harvest Plans (THPs) prior to harvesting. The California Department of Forestry and Fire Protection (CAL FIRE) reviews 550 to 1,400 THPs each year. Landowners must comply with all state and federal laws protecting forest ecosystems in order to have their THP approved. California timber harvest regulations are regarded as the strictest in the nation.

Protecting the health of forests, wildlife, fish, and water is one reason the California Department of Forestry and Fire Protection reviews each THP. Risk of wildfire is another concern. The build-up of dead vegetative material on any piece of land, public or private, could result in larger fires in the future. The goal of the Forest Practice Act and state review of Timber Harvesting Plans is to maintain the stability and diversity of California forests while also protecting human life and property in surrounding communities.

Land cleared for development

California Education and the Environment Initiative

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