National Park Service
U.S. Department of the Interior

Grand Canyon National Park

A Living Canyon:
Discovering Life at Grand Canyon

Grand Canyon's scale and beauty overwhelm the senses and inspire awe. At first glance the great chasm appears lifeless, but thousands of interconnected plants and animals bring this magnificent stone wilderness to life.

The canyon's extreme elevation changes and dramatic topography produce a range of climates, creating homes for a surprisingly rich diversity of living things. These organisms' interactions with and adaptations to this rugged environment define Grand Canyon's ecology.

This living canyon is only one part of a larger story. Its forests, deserts, and rivers do not begin or end with Grand Canyon, just as threats to this ecosystem do not exist only inside park boundaries. As global climate changes, plants and animals must adapt or they will die.

Whether by foot, bicycle, shuttle bus, or car, Grand Canyon provides you with unique opportunities to explore diverse biological communities and make your own discoveries.

Living Communities

Five distinct biotic communities exist in Grand Canyon's ecosystem. Interdependent plants and animals comprise each unique community. Elevation, light, temperature, slope, aspect, precipitation, and natural disturbances—such as fire and flood—contribute to the complexity and dynamics of these communities. As you travel through the park and beyond, notice how your surroundings gradually change.

Mixed Conifer Forest
Merriam's Canadian life zone
See pages 4–5.

Located only on the North Rim, this community is the highest and coolest in the park. Life here adapts to an extreme winter climate.

Summer temperatures: 75°F (24°C)–44°F (7°C)
Winter temperatures: 39°F (4°C)–17°F (-8°C)
Precipitation: Averages 25 inches (64 cm) per year, including 11 feet (3.5 m) of snow

Ponderosa Pine Forest
Merriam's transition life zone
See pages 6–7.

These forests thrive on the North Rim and South Rim, acting as a transition zone between the mixed conifer forest and pinyon-juniper woodland. Air temperatures are slightly cooler and precipitation is slightly greater than the pinyon-juniper woodland.

Pinyon-Juniper Woodland
Merriam's upper Sonoran life zone
See pages 10–11.

This mixture of trees flourishes inside the canyon and along the warm, sunny areas of canyon rim. The trees are shorter because this community receives less precipitation than higher elevation forests.

Summer temperatures: 82°F (28°C)–50°F (10°C)
Winter temperatures: 44°F (7°C)–20°F (-7°C)
Precipitation: Averages 15 inches (38 cm) per year, including 5 feet (1.5 m) of snow

Desert Scrub
Merriam's lower Sonoran life zone
See pages 12–13.

Found down inside Grand Canyon, this is the hottest and driest community. Life here adapts to extreme heat and a very dry climate.

Summer temperatures: 103°F (39°C)–74°F (23°C)
Winter temperatures: 58°F (14°C)–32°F (-0°C)
Precipitation: Averages 9 inches (23 cm) per year, including 2 inches (5 cm) of snow

Riparian
See pages 14-15.

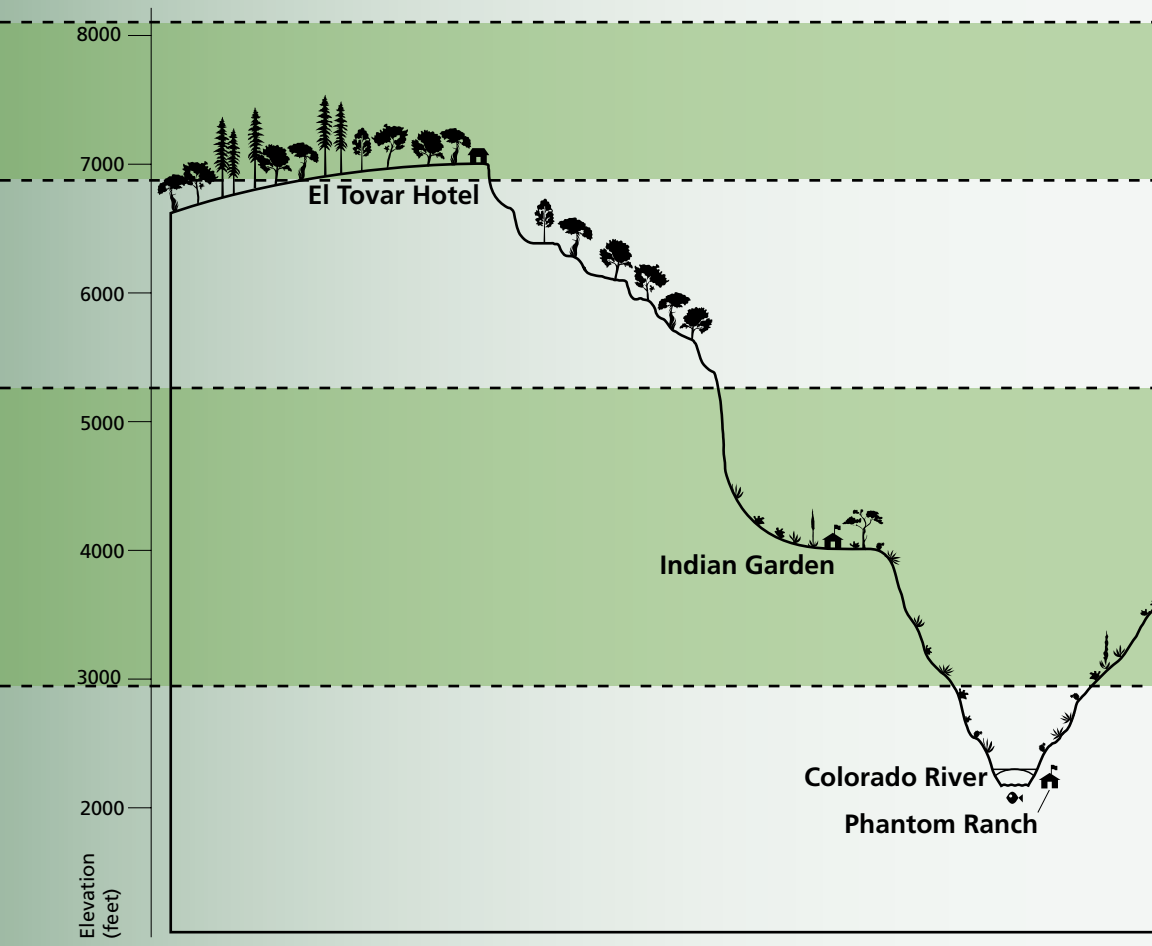
Riparian areas of the inner canyon include springs, seeps, and streams, as well as the Colorado River and its banks. Precious water allows for a rich diversity of life, even though air temperatures and precipitation amounts resemble the desert scrub community.

Life Zones of Grand Canyon

In 1889, C. Hart Merriam, head of the United States Biological Survey, studied Grand Canyon and the San Francisco Peaks, near Flagstaff, Arizona. In 50 short miles (80 km) from the summit of the peaks to the bottom of Grand Canyon, Merriam encountered 10,000 feet (3,048 m) of elevation change and observed the biological equivalent of traveling 1,750 miles (2,816 km) from Canada to Mexico.

Merriam revolutionized the concept of life zones, which forms the basis of modern ecology. He alleged that temperature alone dictated life in each zone. Today, we study communities instead of life zones and understand that many more factors contribute to each biotic community. How does Merriam inspire you to investigate Grand Canyon?

South Rim



What Is the Key to Desert Life?

Water—summer monsoon rain and winter snow play a vital role in shaping Grand Canyon's communities. Monsoons form when warm air from the south rises and cools over northern Arizona, creating quickly moving, violent thunderstorms. Conversely, winter storms originate from the north and west, bringing precipitation as snow.

What Makes Grand Canyon So Special?

The park's diverse biotic communities provide a range of opportunities for many different species of plants and animals to thrive. In fact, Grand Canyon hosts the highest number of plant species of any national park. How many will you find?

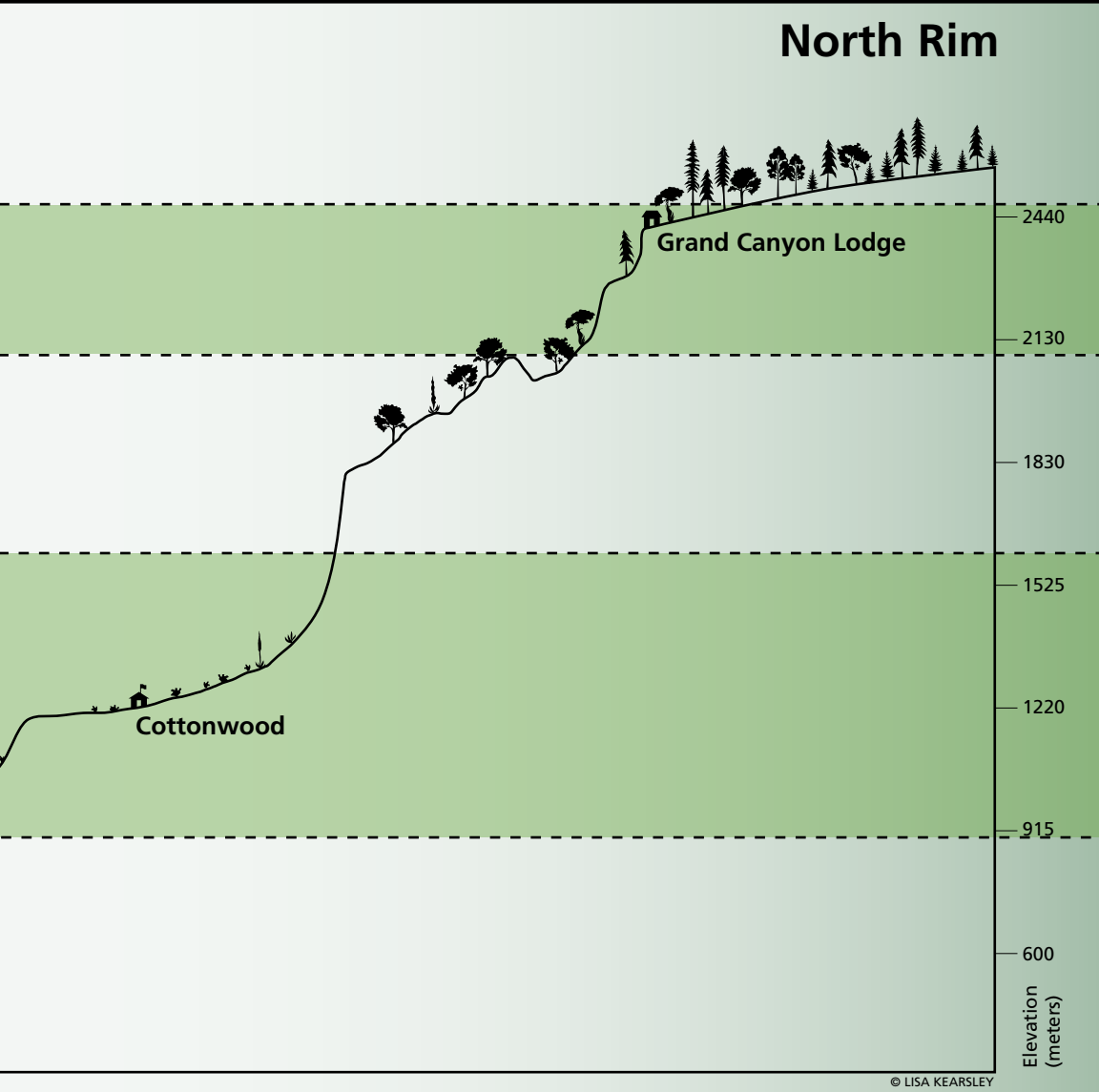
- Vascular Plants: 1,750 species
- Birds: 373 species
- Mammals: 92 species
- Fish: 18 species (5 native)
- Reptiles and Amphibians: 57 species
- Invertebrates: 8,480 known species

Exotic (non-native)
Animals: 23 species
Plants: 198 species

Endemic (found only in the park)
Animals: 20 species
Plants: 9 species

Look for numbers (❶, ❷, ❸, etc.) in this brochure. Each species identified with a number is described on the back page.

Data from *Park Profile 2014*



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Mixed Conifer Forest

More than Meets the Eye
Your trip to the North Rim is not complete unless you see deer graze in the meadows. This fragile and unique ecosystem comprises only 0.003% of the park. Found interspersed with the mixed conifer forest, meadows feature amazing diversity, with 15–30 plant species per 0.1 acre (0.4 ha). Approximately 90% of the grasses, sedges, and other plants are native.

While meadows cover only a tiny area, their rich and healthy habitat indicates good air quality—though visibility may be reduced due to air pollution blowing through from other regions. What can you do to reduce air pollution in your daily life to protect Grand Canyon's meadows?

ABOVE PHOTO NPS / TOM BEAN
TOP BACKGROUND PHOTO NPS / TOM BEAN

An Eventful Life
The high elevations of the North Rim produce a short, frenzied growing season. Dense, dark spruce and fir forests broken by bright, open meadows dominate this landscape. In late spring and summer, these meadows will delight you with colorful wildflowers and a symphony of bird songs. Quaking aspen mix with conifers, often sprouting in areas disturbed by fire.

Aspen trees dropping their festive gold leaves signal winter's approach. The meadows appear stark as plants become dormant. Some animals busily prepare for winter, scurrying to store food. Others simply avoid winter through hibernation or migration, just as many of you hide inside or travel to warmer climates when the snow falls.

In winter, each species must endure or avoid the deep snow and cold temperatures. Evergreen trees survive with the help of tough, narrow needles packed with chemicals that act like antifreeze. This needle adaptation helps them use every warm day for photosynthesis and growth.

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People vs. Predators vs. Prey

As settlers arrived on the North Rim, fears for personal safety, loss of livestock, and the desire to protect deer and other game animals led to the systematic extermination of many predators. Hunters killed all the wolves (*Canis lupus*). Mountain lions and bobcats narrowly escaped the same fate.

Overhunting, missing predators, and open grasslands meant the deer population exploded and overgrazed native plants in the forests and meadows. Thousands of deer ate themselves out of food and starved to death during winter 1924–25.

Predator populations slowly recover, and we now understand the essential role predators play in maintaining a healthy balance with their prey. Though wolves have not returned, park biologists now study a relatively healthy mountain lion population and how these predators interact with their prey, desert bighorn sheep.

An estimated 800 mountain lions, 550 bobcats, 30 wolves, and 5,000 coyotes were killed prior to 1931.

BACKGROUND PHOTO NPS

Ponderosa Pine Forest

Do You See the Difference?
The tassel-eared Abert's squirrel (left) on the South Rim and Kaibab squirrel (right) on the North Rim share a common ancestor. The canyon acts as a barrier between the two squirrels. Genetic changes that occurred because of this isolation brought about a distinct coloration in each species. The North Rim is the only place in the world where the Kaibab squirrel lives.

ABOVE LEFT PHOTO © US FOREST SERVICE; COCONINO NATIONAL FOREST
ABOVE RIGHT PHOTO © J.G. HALL
TOP BACKGROUND PHOTO NPS / TOM BEAN

An Inviting Openness
On a warm day near Grandview Point, you may smell the faint aroma of vanilla or butterscotch and see some of the tallest trees on the South Rim. This sweet scent radiates from the ponderosa pine. These towering pines, with straight trunks, long needles, and orange bark, thrive in the cooler, wetter areas along the canyon's edge. As you approach Cape Royal on the North Rim, look for this plant community between the mixed conifer forest and pinyon–juniper woodland.

Ponderosa pines adapt to the region's dry climate with a widespread root system and long taproot. Competition for moisture, nutrients, and sunlight, coupled with frequent fire, creates open forests. Thickets of Gambel's oak grow scattered through this plant community, providing an important food source and shelter for wildlife. Listen for the Steller's jay scolding from a treetop and perhaps catch a glimpse of wild turkeys (*Meleagris gallopavo*) strutting through the forest.

Hidden Connection
Tassel-eared squirrels thrive almost exclusively in ponderosa pine forests, sharing one of Grand Canyon's closest bonds. The squirrels feed on every part of the ponderosa pine: pollen, cones, seeds, inner bark, and mycorrhizae (a fungus on the roots that helps trees absorb water). Through their scat, the squirrels provide nutrients and spread the helpful fungus which benefits the trees.

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Our Changing Views

During the last 100 years, humans altered the forest around you by suppressing wildfires. Before settlement, old-growth ponderosa pine forests featured open, grass-covered spaces. Now, you see thick underbrush and dense debris in many places. Unfortunately, this generates hotter, faster fires that have the potential to consume all of the large trees in a forest.

Today, fire managers work to safely restore the forest using natural and prescribed fire, hazard fuel reduction, and fire effects monitoring. Their efforts return balance to the ecosystem and prepare the forest to face future climate changes.

A Powerful and Creative Process

Forest fire—what comes to mind? While this word may conjure terrifying images for you, the ponderosa pine forest requires this ingredient to survive. Lightning often accompanies summer monsoon storms, bringing the potential for forest fires. Naturally occurring, low-intensity fires clear the forest and add crucial nutrients to the soil. These fires reduce competition, allowing trees to grow tall and healthy.

With specialized adaptations, ponderosa pine thrives under natural fire conditions. Deeper root systems provide safety from ground fires. The thick, fire-resistant bark of mature trees shelter it from all but the most intense forest fires.

In 1902 (left), the Matthes Survey encountered a naturally open ponderosa pine forest. Decades of wildfire suppression resulted in a much denser forest (right).

ABOVE (LEFT) PHOTO NPS
ABOVE (RIGHT) PHOTO © US FOREST SERVICE, COCONINO NATIONAL FOREST
BACKGROUND PHOTO NPS

Resident Regulars

NPS

NPS / MICHAEL QUINN

Grand Canyon Generalists
While some animals survive in specific communities, others thrive nearly anywhere. No matter which Grand Canyon community you visit, your best chance to see wildlife is to walk quietly and look for one of these resourceful creatures: raven, rock squirrel, deer, coyote, or elk.

Do Not Feed Me
Approaching or feeding wildlife is prohibited and dangerous. Seemingly tame animals are wild and may injure you or a loved one. Many animals carry diseases that can be transmitted to humans. Animals develop a dependency on human food and are more likely to die younger. For your safety—and the animals'—view wildlife from a safe distance of 75 feet (23 m).

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Back from the Brink

The California condor, largest bird in North America, is a scavenger with a wingspan up to 9.5 feet (2.9 m). Shootings, habitat loss, and lead poisoning almost caused their extinction. In 1996, biologists reintroduced condors to Arizona and now, some condors use remote caves in Grand Canyon as nest sites.

Today, the greatest threat to condors remains poisoning. Unbeknownst to them, the birds ingest lead bullet fragments in the animal carcasses they feed on outside the park. Land managers promote using non–lead ammunition, which helps preserve and expand the current endangered condor population.

Pinyon-Juniper Woodland

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Bluebird Feast
In early winter, bluebirds relish the small, succulent pink berries of juniper mistletoe. Mistletoe is a partial parasite, dependent on its host tree for water and minerals, but feeds itself by photosynthesis in its yellowish-green stems.

ABOVE PHOTO NPS
TOP BACKGROUND PHOTO © NPS / TOM BEAN

Life in Dry Woodlands
Hot, dry breezes rise from inside the canyon. Thin soils close to the canyon's edge hold little water, and trees grow short, gnarled, and twisted. Trees conserve precious water with waxy coatings on their needles or scale-like leaves. Though it does not appear lush, the pinyon-juniper woodland houses fascinating relationships.

Animals bring life to this community. Pinyon jays co-evolved with pinyon pines: they eat and spread massive amounts of pine nuts—not a true nut, but a seed—storing them in soil miles away to return to and eat later. Every few years, when the pinyons put out a bumper crop of pine nuts, the jays cache far more than they need for food, giving birth to a new generation of trees.

American robins (*Turdus migratorius*), bluebirds, coyotes, and gray foxes all depend on the berries—or modified cones—of the Utah juniper for a year-round food source. You may see the beginnings of a new juniper with a bit of organic fertilizer attached. Look for these large tan seeds or blue berries in orange-brown coyote scat.

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Invasive Elk

Viewing the large elk herds in the park is exciting. However, park managers consider non-native species, like elk, invasive to Grand Canyon. In the early 1900s, humans introduced Rocky Mountain elk into Arizona. Elk migrated north from the Williams area and eventually made a home at Grand Canyon. They survive here quenching their thirst on unnatural water sources and feasting on non-native grass. What role can you play to manage non-native species where you live?

ABOVE PHOTO NPS / MICHAEL QUINN
TOP RIGHT PHOTO NPS / MICHAEL QUINN
MIDDLE RIGHT PHOTO NPS / MICHAEL QUINN
BOTTOM RIGHT PHOTO NPS

You Can Save a Life

The seemingly bare ground between large plants is rarely unoccupied. Extremely sensitive biological soil crust takes decades to form. These crusts play important roles in reducing soil erosion and increasing water conservation. You can prevent damage to delicate vegetation by walking on established trails.

On the South Rim, off–trail foot traffic nearly trampled one miniature, ground-hugging member of the pea family out of existence. Today, fencing protects the endangered sentry milk-vetch, a plant that only grows along the canyon's edge in narrow bands atop the porous Kaibab Formation.

Park botanists are experts at growing and replanting this fragile plant where careless footsteps almost eliminated it. Your actions to stay on trails can protect this community, including its endangered and endemic species.

Desert Scrub

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Hiking Down into Grand Canyon in Spring?
Keep your eyes out for 12-foot (3.7 m) tall flowering yellow stalks. While some plants bloom annually, the century plant blooms only once after 15–25 years and then dies. Ancestral Puebloan people and the Havasupai Tribe made baskets and hair brushes from this plant's fibers.

ABOVE PHOTO © JO SUOMALA
TOP BACKGROUND PHOTO NPS / TOM BEAN

Adaptations to Desert Life
If you hike down into Grand Canyon, with every step you will quickly discover it gets hotter and dryer. Elevation and temperatures at Phantom Ranch, at the bottom of the canyon, equate to those found in Phoenix, Arizona. Here, limited precipitation comes as cold, gentle winter rain and violent summer monsoon thunderstorms.

The Sonoran, Mohave, and Great Basin deserts meet in Grand Canyon, sustaining a rich diversity of life. Following a wet winter, spring wildflowers will delight and amaze you. The beautiful descending whistle of the canyon wren (*Catherpes mexicanus*) adds a memorable soundtrack to your hike.

Nocturnal animals, such as ringtails, owls (Order Strigiformes), and bats (Order Chiroptera), avoid the scorching heat by resting during the day and emerging from shelters at night. This useful adaptation helps them survive the extreme heat. Take a hint from these animals and avoid hiking in mid–day heat.

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Riparian Oases in the Desert
Springs and seeps make up just 0.01% of Grand Canyon's landscape, but species concentrations may be 500 times that of the surrounding desert. Essential to life, these enchanting places showcase delicate maidenhair fern (*Adiantum* sp.), yellow columbine (*Aquilegia flavescens*), and crimson monkey flower (*Mimulus cardinalis*). Each unique water source provides a home to plants or insects, some of which are found nowhere else on Earth.

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Windows to the Past

What will packrats find at Grand Canyon in the centuries to come? Our own daily actions influence global climate, which in turn affects the plants that grow here and the animals that depend on them. Will future packrat middens contain the same seeds and bones they do today?

ABOVE PHOTO OF MIDDEN © NANCY E. MULEADY-MECHAM

Climate Chroniclers

Ancient hoarders provide a glimpse into Grand Canyon's past. Packrat (*Neotoma* spp.) urine solidifies middens containing evidence of seeds, leaves, and bones collected nearby. Middens can survive more than 30,000 years in this dry climate, providing wonderful snapshots of past environments.

Middens, along with giant ground sloth (Order Pilosa) dung, condor bones, and pollen preserved in caves, illustrate stable, colder temperatures 11,700 years ago. Some plant species, such as the limber pine (*Pinus flexilis*), have since disappeared from Grand Canyon. Other species, like juniper, are now only found at higher elevations.

Although climates always change, human activities currently accelerate this process. Park managers implement sustainable practices that decrease greenhouse gas emissions, conserve water, increase recycling, and use alternative energy and fuels. What daily practices do you use to protect your planet?

Some, such as Roaring Springs below the North Rim, provide drinking water for visitors. Proposed mining claims and new developments near the park threaten springs by drawing water from aquifers extending beyond park boundaries.

Park scientists study the springs, seeps, and streams, as well as the hydrology of the surrounding plateaus, applying the best science to protect this life-giving resource. How can you reduce your water use where you live?

Riparian

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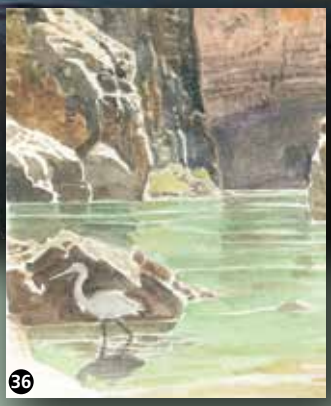

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Why Do Tributaries Matter?
At Grand Canyon, 768 year-round and intermittent streams and rivers flow into the Colorado River. The canyon's intricate system of tributaries survived the construction of Glen Canyon Dam, and today National Park Service biologists use these protected places to manage native fish species.

Using a method called tributary translocation, biologists transport populations of native fish to tributary environments downstream in western Grand Canyon. Warmer water temperatures and fewer nonnative predators provide the ideal conditions the fish need to reproduce.

ABOVE PHOTO NPS
TOP BACKGROUND PHOTO NPS / NIC K. BEREZENKO

Overcoming Obstacles
The Colorado River originates in Colorado's Rocky Mountains and flows over 1,400 miles (2,253 km) to the Gulf of California. As it runs 277 miles (446 km) through Grand Canyon, it loses 2,000 feet (610 m) of elevation, averages 300 feet (91 m) wide, and 40 feet (12 m) deep. The river, together with its tributaries, seeps, and springs, comprises the riparian community of Grand Canyon.

Construction of Glen Canyon Dam in 1963 brought about a series of changes to the river and its ecosystem. However, the powerful waterway still exists as a safe haven for several native species of fish – including the endangered humpback chub (*Gila cypha*), speckled dace (*Rhinichthys osculus*), flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostonus discobolus*), and razorback sucker (*Xyrauchen texanus*). Endangered razorback sucker were even discovered spawning here in 2014 for the first time in decades. Active management of these native fishes by National Park Service biologists enables the Colorado River to continue to be a significant regional refuge for these unique species.

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A Complex Condition
Since the Glen Canyon Dam introduced a steadier flow regime and eliminated spring floods, tamarisk (*Tamarix* spp.)—an invasive shrub—dominates beaches throughout Grand Canyon. However, tamarisk attracts insects, providing food for birds and animals. In fact, Bell's vireo (*Vireo bellii*), a bird in decline across its range, extended its range more than 100 miles (161 km) upriver because of the food provided in these new nesting sites.

Effects of Glen Canyon Dam on the Colorado River		
Characteristic	*Pre-Glen Canyon Dam*	*Post-Glen Canyon Dam*
Water Color	Reddish-brown, sediment-laden.	Cold and clear except when tributaries contribute sediment.
Water Temperature	33–40°F (0.5–4.4°C) winter. 75–85°F (24–29°C) summer.	Near 48°F (9°C) year round. Warms slightly during summer and downstream.
Sandbars/Beaches	Plentiful. Renewed by annual flooding.	Dramatic decrease in size and number.
Vegetation	Scoured from beaches during annual flooding. Little plant life growing in river due to sediment load.	Increased growth to water's edge. Dominated by tamarisk. Single-celled diatoms and algae growing in river.
Human Activity	Limited. Unregulated.	Very popular for rafting. Strictly regulated.
Floods	Seasonal. Scoured debris and rebuilt beaches. Scoured vegetation from river edge.	Controlled or human-made. Much smaller scale and duration.
Glen Canyon	Free-flowing river through natural, wild canyon. Provided wildlife habitat and scenic beauty.	Full of water and sediment. Created Lake Powell and its recreational activities.

Grand Canyon's dynamic ecosystem provides a sanctuary for an incredible diversity of life. While the biological communities inside the canyon may be different from those on the rim, relationships between living things and their adaptations to the environment connect all parts of this remarkable place.

The qualities that make Grand Canyon an important refuge for plants and animals also make it an important retreat for humans in a time when access to nature is increasingly limited. It is truly a place of exploration, wonder, and discovery for you to enjoy and protect.

Tread carefully. Your actions impact every community you visit because everything is connected. Whether at Grand Canyon National Park or in your own neighborhood, you have the power to positively influence your surroundings and help protect natural places for future generations.

National Park Service
U.S. Department of the Interior

Plants and Animals Featured in this Brochure

1. Desert bighorn sheep *(Ovis canadensis nelsoni)*
2. Blue spruce (*Picea pungens*)
3. Quaking aspen (*Populus tremuloides*)
4. Silvery lupine (*Lupinus argenteus*)
5. Wholeleaf Indian paintbrush (*Castilleja integra*)
6. Mule deer *(Odocoileus hemionus)*
7. Hairy woodpecker *(Piciodes villosus)*
8. Abert's squirrel *(Scurius aberti aberti)*
9. Kaibab squirrel *(Scurius aberti kaibabensis)*
10. Ponderosa pine (*Pinus ponderosa)*
11. Harvester ant (*Pogonomyrmex* sp.)
12. Steller's jay (*Cyanocitta stelleri*)
13. Gambel's oak (*Quercus gambelii*)
14. Mountain lion (*Felis concolor*)
15. Common raven *(Corvus corax)*
16. Cliff chipmunk *(Tamias dorsalis)*
17. Coyote *(Canis latrans)*
18. Rock squirrel *(Otospermophilus variegatus)*
19. California condor *(Gymnogyps californianus)*
20. Western bluebird *(Sialia mexicana)*
21. Gray fox *(Urocyon cinereoargenteus)*
22. Claret cup cactus *(Echinocereus mojavensis)*
23. Beetle (Order Coleoptera)
24. Rocky Mountain elk *(Cervus elaphus nelsoni)*
25. Utah juniper (*Juniperus osteosperma*)
26. Pinyon pine *(Pinus edulis)*
27. Sentry milk-vetch *(Astragalus cremnophylax* var. *cremnophylax)*
28. Century plant (*Agave utahensis*)
29. Bobcat *(Lynx rufus)*
30. Sacred datura *(Datura wrightii)*
31. Spider wasp (Family Pompilidae)
32. Grand Canyon rattlesnake *(Crotalus oreganus abyssus)*
33. Ringtail *(Bassariscus astutus)*
34. Canyon tree frog *(Hyla arenicolor)*
35. Costa's hummingbird *(Calypte costae)*
36. Snowy egret *(Egretta thula)*

Further Information

Field Guide to the Grand Canyon by Stephen R. Whitney

Field Guide to the Grand Canyon (Pocket Naturalist Series) by James Kavanagh

nps.gov/grca/learn/nature

WATERCOLOR AND SKETCHES © JOHN D. DAWSON
COVER PHOTO: DESERT BIGHORN SHEEP © MIKE BUCHHEIT

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