Dinosaur

Dinosaur National Monument
Colorado/Utah

National Park Service
U.S. Department of the Interior



This is the only national park area set up to protect a historic dinosaur quarry. The tremendous diversity of plant and animal fossils here allows us to describe its ancient environment. *NPS*



Diversity of life in Dinosaur National Monument's dry landscapes gets a boost from the rivers and streams protected as Congress enlarged the park over the years. *NPS*



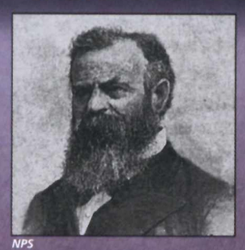
American Indian rock art reflects the long history of human occupation in Dinosaur's rugged terrain. The petroglyphs scattered around the park are about 1,000 years old. *NPS*



Bighorn sheep are so adept at negotiating steep rock and narrow ledges that mountains protect them simply by being inaccessible to most predators. *© Larry Angier*

Many Meanings and Even More To See and Do

Earl Douglass discovered the dinosaur quarry as he hunted fossils for the Carnegie Museum in 1909. The quarry opened the world's best window on Late-Jurassic dinosaurs. And saving it from looters ended up preserving far more. The 80-acre Dinosaur National Monument created in 1915 now includes 210,844 acres of scenic river canyons, mountains, basins, and archeological sites. Twenty-three exposed geological strata, the National Park System's most complete such record, combine with elevation and topography to create the many habitats that support the startling diversity of plant and animal life.



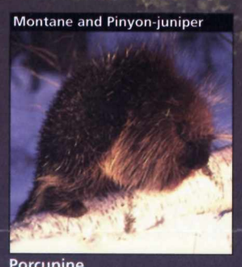
John Wesley Powell *(left)* ran the Green and Colorado rivers and the Grand Canyon in 1869 and in 1871. He helped map the Colorado Plateau, directed the U.S. Geological Survey, and set up the Bureau of American Ethnology in the Smithsonian Institution. Powell had lost an arm at the Battle of Shiloh in the Civil War.

NPS

Much More than Dinosaurs The dinosaur quarry lies in the rock layer geologists call the Morrison Formation. Sites in this formation offer fossils deposited in many environmental habitats, so scientists can reconstruct the look of this area 150 million years ago. Rivers carved today's deep canyons, providing many habitats, including shaded ones, for life to exploit. Canyons also shelter archeological sites, and the record here of human occupation and cultural development is one of North America's most complete. From earliest times people valued the diversity of life so closely linked to geology here.

Montane

Montane and Pinyon-juniper



Porcupine
©Gerald and Buff Corsi
California Academy of Sciences

Cliff and Ledge



Canyon wren
NPS

Pinyon-juniper

Cliff and Ledge

Riparian



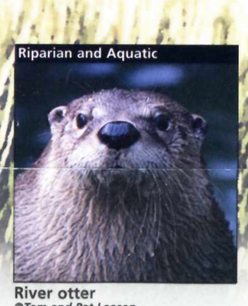
Yuma myotis bat
©Merlin D. Tuttle
Bat Conservation International

Riparian



Bighorn sheep
©Carolyn Fox

Riparian and Aquatic



River otter
©Tom and Pat Leeson

Riparian

Background Photo NPS

Mountain shrub

Desert shrub



Pronghorn antelope
©Gerald and Buff Corsi
California Academy of Sciences

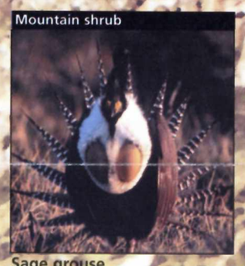
Desert shrub



Badger
©George Wuerthner

Desert shrub

Mountain shrub



Sage grouse
©Louis Swift

Montane



Hermit thrush
©Bill Horn

Aquatic



Razorback sucker
USGS



Bonytail chub
J.N. Rinne, US Forest Service

Aquatic

LIFE COMMUNITIES

Montane

Elevation makes this moister than all communities but the aquatic and riparian. Chickadees and warblers feed on insects and nest in summer here. Cold and snow drive most animals lower down.

Mountain shrub

Fall fruits and berries are important fuel for migratory birds and elk preparing for winter's snow. Small mammals abound, and mule deer summer here. Sage grouse and lazuli buntings breed in this community.

Pinyon-juniper

Pine nut and juniper berry attract Clarks nutcrackers and pinyon jays. As snow gets deep higher up, this is crucial large-mammal habitat for daytime shelter from wind and predators.

Desert shrub

Hot summers, cold winters, alkaline soils, and low precipitation: plants minimize water loss here. Mule deer, coyotes, prairie dogs, and badgers live amid sagebrush and greasewood.

Cliff and Ledge

Shaded, north-facing canyon walls harbor bighorn sheep and birds that do not usually tolerate dry country. Flight lets birds exploit several communities from cliffs. Bighorns lamb on ledges predators cannot reach.

Riparian (stream-side)

Green ribbons of vegetation along waterways, riparian communities are highly productive. Their plants and animals must have continual access to water—but cope with changing water levels.

Aquatic

Streams and rivers and the riparian zones they create are Utah's most biologically productive areas. Birds eat aquatic insects. Mammals come from benches and canyon walls to drink from streams daily.

Beyond the Dinosaur Quarry

Dinosaur fossils can be seen only at the Dinosaur Quarry Visitor Center *(left side of map)*. There is so much to see here besides the dinosaur quarry and dinosaur fossils. Why not change your travel plans so you can take the auto tours and go see some stupendous canyon country? You'll be glad you did.

Dinosaur National Monument is one of over 380 parks in the National Park System. The National Park Service cares for these special places saved by the American people so that all may experience our heritage. For more information on parks and National Park Service programs in America's communities, visit www.nps.gov.

More Information
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Safety and Regulations Summers are hot with cool nights and thundershowers in July and August. Carry and drink plenty of water to prevent dehydration and heat injuries. Help us protect this park by following these regulations: • Do not collect or disturb any rock, fossil, plant, or artifact. • Do not feed, hunt, trap, or injure wildlife. • Pets must be physically restrained at all times and are not allowed in public buildings, on trails or rivers, or in the backcountry. • Firearms and weapons must be unloaded and stored in a vehicle in a way that will prevent their ready use. • Off-road driving is illegal. • Please camp or picnic only at designated sites. • Backcountry permits are required for all backcountry overnight trips.

Canyon Country The Harpers Corner Auto Tour, four hours round-trip, shows you canyons from the overlooks. Walk the trail to stunning canyon views at Harpers Corner. Other scenic areas reached by paved or well-graded roads are Gates of Lodore, Deerlodge Park, and Jones Hole.

Rougher roads, including those to Echo Park and Island Park, may be impassable when wet and may require high-clearance vehicles. Ask for current information at a visitor center. No gas, food, lodging, or supplies are available in the park. Find them in nearby towns.

Dinosaur Quarry Visitor Center The Dinosaur Quarry Visitor Center, seven miles north of Jensen, Utah, is the only place in the park to see dinosaur fossils. It is open daily except Thanksgiving, December 25, and January 1. A shuttle bus runs between the main parking lot and the quarry in summer.

Canyon Area Visitor Center Two miles east of Dinosaur, Colo., this visitor center is the canyon country gateway. It is open daily in summer. Dinosaur fossils are not on display. Exhibits and an orientation program introduce the park. Check at a visitor center for a schedule of summer programs and for information about hiking, fishing, river running, and campgrounds.

All unpaved roads are impassable when wet.

Self-guiding auto tour
Unpaved road
Unpaved road (High-clearance vehicles only)
Distance indicator
Trail
Rapids
Ranger station
Picnic area
Nature trail
Wheelchair-accessible
Campground
Primitive campground

North

0 5 Kilometers
0 5 Miles

Snapshots in Stone

The 23 rock formations exposed in Dinosaur National Monument *(below)* represent extinct ecosystems and are windows into the area's past life.



Future Earth
in 50 million years



Earth Today
present

People of Dinosaur

Ute Indian territory covered two-thirds of present-day eastern Utah and western Colorado just into Wyoming and New Mexico. Utes *(below)* hunted an even larger area. The early ranchers in today's park area were the Chew, Ruple, and Mantle families. Josie Morris *(below right)* homesteaded here into her 80s. Go see her historic cabin and small, scenic spread on the Cub Creek Road *(see park map on side one)*.



©Larry Angier

Today's park environment is mostly semi-arid. Plant communities range from the cold desert shrub to several forests at various mountain elevations. Riparian communities along streams are more lush and biologically diverse.



Petroglyphs *(right)*, rock art of the Fremont Culture

A basket *(left)* and pottery *(right)* of the Fremont Culture



Courtesy of Flossie MacKnight

Josie Bassett Morris chops wood near her cabin at age 80.

CENOZOIC
Quaternary *present time*
12,000 Years and Counting . . .

The Thinnest of Human Veneers

If Earth's age as geologists count it were a football-field long, human time would be grass-blade thin at the goal line. Archeological data goes back 12,000 years here—for one of North America's most complete records of cultural development: from Paleoindian to Archaic, Fremont, and modern Ute. The area's water sources and diverse plants, animals, and rocks provided food, fuel, fiber, and tools. People could garner the resources for living within a two-day walk. The horse, reintroduced from Spain by 1776, greatly changed Ute culture.

Tertiary *66.4-2 mya*

Browns Park Formation

Rise of Rocky Mountains and dinosaur extinction

Bishop Conglomerate

MESOZOIC
Cretaceous *144-66.4 mya*

Mancos Shale

Frontier Formation

Mowry Shale

Dakota Sandstone

Cedar Mountain Formation

Jurassic *208-144 mya*

Morrison Formation

Age of dinosaurs

Stump Formation

Entrada Formation

Carmel Formation

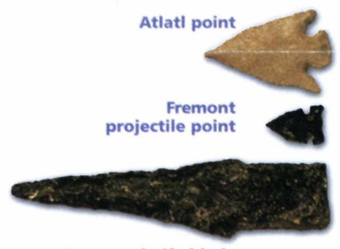
Glen Canyon Sandstone

Triassic *245-208 mya*

Chinle Formation

First dinosaurs and mammals

Moenkopi Formation



Atlatl point

Fremont projectile point

Fremont knife blade of chert

Weapon Evolution

Paleoindians used stone spear points. Archaic peoples used atlatl throwing sticks. Fremont peoples adopted bows and arrows. They and Utes after them made corner- and side-notched points from chert, quartzite, and obsidian. In historic time, Utes traded for metal arrow points.

All images NPS unless credited otherwise

Earth itself shows the great change through time that characterizes other forms of life. Our planet's crust, even below oceans, is a series of great plates moving by fits and starts. The globe today merely shows their position. Experts in crustal structure, or plate tectonics, can predict a future globe—see the top one—and reconstruct earlier ones *(below)*.

A Landscape of Extinct Ecosystems

Since 1990 the thrust of science at Dinosaur National Monument has shifted from just quarrying dinosaur fossils to reconstructing what the ecosystem was like 150 million years ago (mya). We can do this because the Morrison Formation produces so many fossils—besides dinosaur bones—that were deposited in diverse environmental settings. In fact, all 23 of the geologic formations exposed here represent extinct ecosystems. And ecosystems—arid land today but fern-filled once or covered by an ocean or freshwater lakes—change through time. Such story-rich geology both records the diversity of past life and enhances diversity today. Geologic formations weather to become soils to whose chemistry plants may adapt. Big wild buckwheat, for example, grows *only* in the soil from Mowry Shale, and park rockcress lives *only* in the soil from Weber Sandstone. Even the extinct ecosystems contribute to the park's biodiversity. Who are we to disrupt life's complex links by making some of them extinct?

Ecosystem = the sum of all communities here and the physical environment.

Biological diversity* or *Biodiversity = the variety of life forms, the ecological roles they play, and the genetic diversity they contain.

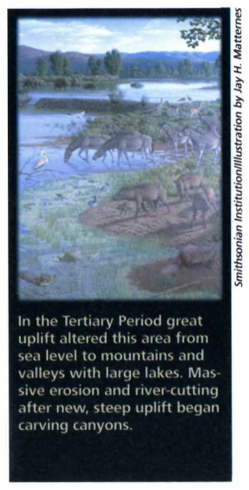
Evidence of Things Unseen: Oceans Give Way to Land

Rivers Mold the Landscape

Ecosystems change through time. Dinosaurs went extinct 65 million years ago. By five million years ago grasslands spread in a climate cooler and drier than in dinosaur days. Horses and rhinos prospered. In recent geologic time rivers preceding the Green and Yampa cut into the mountains. Today's rivers still shape the land. At scenic Harpers Corner Overlook *(see map on other side)* you stand on fossils of ocean life that now rest 2,700 feet *above* the Green River. The river may one day cut through Steamboat Rock *(see photo, far right)*.

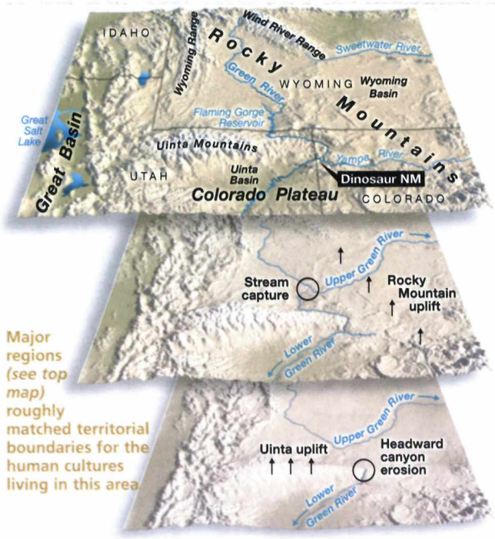


Tertiary Earth
at 10 mya



Smithsonian Institution/Illustration by Jay H. Matternes

In the Tertiary Period great uplift altered this area from sea level to mountains and valleys with large lakes. Massive erosion and river-cutting after new, steep uplift began carving canyons.



Major regions *(see top map)* roughly matched territorial boundaries for the human cultures living in this area.

During the Tertiary Period—66.4 million years ago to two million years ago—the continents moved close to their present positions. What is now the park lay roughly at today's latitude and longitude. The Rocky Mountains had begun their rise here as the Tertiary Period began.

Wandering Rivers, Converging Regions

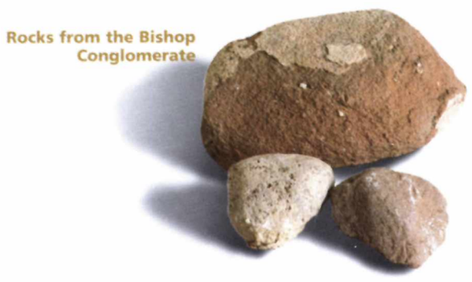
The ancestral Upper Green River once flowed east to the North Platte River *(see bottom map)*. Eventually headward erosion of the ancestral Lower Green River and the uplift of the Rocky Mountains *(see middle map)* caused the drainage to flow southward, as it does today.

At Dinosaur National Monument three major regions converge *(see top map, the landscape today)*. The Colorado Plateau, middle Rocky Mountains, and Wyoming Basin meet here and, with Great Basin influences to the west, enrich the biological diversity of the park's ecosystem.



Path of Least Resistance

Will the Yampa and Green rivers cut through the long fin of Steamboat Rock *(see photo)* like they did the knob to its left? A great conservation struggle defeated a dam proposal here at Echo Park in the 1950s and saved the Yampa—now the only naturally flowing river in the entire Colorado River system.



Rocks from the Bishop Conglomerate

Triassic *245-208 mya*

First dinosaurs and mammals

Moenkopi Formation

Chinle Formation

The Mesozoic Era: The Age of Dinosaurs

A Glimpse of Late-Jurassic Dinosaurs

A gold rush-like quest for dinosaur bones swept America's West in the late 19th and early 20th centuries. Rock of the Morrison Formation has yielded a wealth of dinosaur fossils. Laid down from 147 to 155 million years ago, outcroppings of this rock occur in eight western states. The Dinosaur Quarry is in the Morrison Formation and has produced fossils from all four major Late-Jurassic dinosaur groups: plant-eating sauropods, stegosaurs, and ornithopods and flesh-eating theropods. Fossil pollen and spores now identify 250 species of plants from the Morrison ecosystem. The 34-ton *Apatosaurus* ate ferns, the dominant plants then. Fossils show that dinosaurs lived at the same time as clams, snails, algae, ostracods, crayfish, insects, salamanders, frogs, lizards, turtles, crocodiles, and small mammals. Their fossils tell us more about the Morrison ecosystem than do dinosaur fossils. New fossil finds continue to help us reconstruct the ecosystem that was here 150 million years ago.



Jurassic Earth
at 200 mya



NPS/Illustration by Mark Hallet

Ferns dominated the landscape 150 million years ago. This area lay 400 miles farther south then and was mostly semi-arid to arid, perhaps with seasonally abundant water.

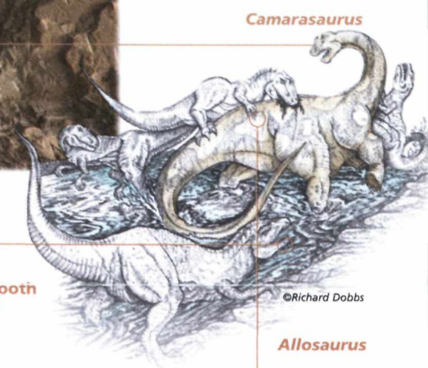
Pangea, the single supercontinent, started to break up during the Triassic and continued throughout the Jurassic. The rift developed first between Europe and North America and then between South America and Africa—and began the opening of the North Atlantic.



©Frank Pennington/Unicorn Stock Photos

Camarasaurus

Look for this neck and skull *(left)* of a *Camarasaurus* (its name means "chambered lizard") in the bone wall in the Quarry Visitor Center. Below, a *Camarasaurus* is attacked by *Allosaurus*, the most common predator in the Jurassic Period of North America.



Mudstone of the Morrison Formation



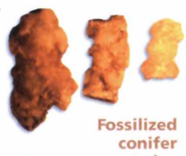
Tooth *(right, actual size)* from a *Torvosaurus*, which may have been similar to the meat-eating *Allosaurus*



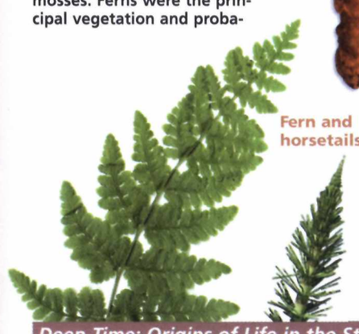
Allosaurus tooth *(actual size)*

Plants of the Morrison Ecosystem

The Morrison ecosystem climate was warm. *Araucaria*, pine-like trees growing up to 150 feet tall, were the dominant trees, with ginkos, tree ferns, horsetails, cycads, and mosses. Ferns were the principal vegetation and probably the major food for plant-eating dinosaurs. Horsetails are one of the Jurassic plants that are still found here today.



Fossilized conifer twigs



Fern and horsetails

Belemnites

Belemnites were invertebrates ("no backbone") with an interior skeleton. Their fossils show that there was an ocean here before the terrestrial Morrison ecosystem developed. Belemnites are relatives of the modern squid *(see drawing below)*.



Belemnite fossil

How *Stegosaurus* Has Been Reconstructed Over Time

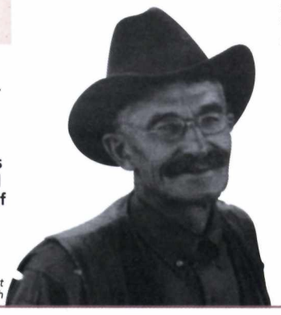






What did *Stegosaurus* look like? These three drawings show, chronologically from left to right, how paleontologists have answered this question. Compare how the drawings show the plates on this dinosaur's back. Fossil evidence for these plates was not good until several recent finds produced fairly intact plates in two, alternating rows. Maybe the plates were protective armor or were used in mating or territorial displays or to inspire fear in predators. Maybe the plates helped regulate body temperature—by radiating excess body heat or collecting needed heat from the environment as jackrabbit ears do. The plates likely served several functions. Its spiked tail no doubt helped this vegetarian defend itself from potential predators.

Paleontologist = one who studies fossil remains. **Earl Douglass** *(below)* discovered the dinosaur quarry while working as a paleontologist for the Carnegie Museum, Pittsburgh, Pa.



Special Collections Department
J. Willard Marriott Library, University of Utah

Allosaurus

Allosaurus was a formidable meat eater, probably both a predator and scavenger. Its enormous mouth held sharp, recurved teeth serrated on both edges. If sauropods herded and migrated, *Allosaurus* may have followed the herds, hunting alone or in packs.

PALEOZOIC
Permian *286-245 mya*

Park City Formation

Weber Sandstone

Ancient sand dunes

Pennsylvanian *320-286 mya*

Morgan Formation

Marine fossils

Round Valley Limestone

Mississippian *360-320 mya*

Doughnut Formation

Humbug Formation

Madison Limestone

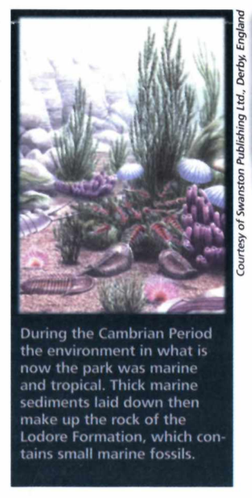
Deep Time: Origins of Life in the Story of Modern Science

Fossil Journeys Through Deep Time

Earth's age—4.6 *billion* years—boggles the mind. Permanent rocks did not form until 3.9 billion years ago. Single-celled life forms appeared 3.5 billion years ago. Multi-celled forms did not proliferate and diversify until 570 *million* years ago (mya), in the Cambrian explosion *(see bottom black band)*. By 500 mya marine animals developed shells and skeletons that readily fossilized. Life moved onto land 400 mya, with early vascular plants, followed by insects and amphibians. Reptiles developed from amphibians, and dinosaurs appeared about 233 mya. The first mammals developed from reptile forms 200 mya and then flourished after the extinction of dinosaurs 65 mya.



Cambrian Earth
at 570 mya



Courtesy of Swanston Publishing Ltd., Derby, England

During the Cambrian Period the environment in what is now the park was marine and tropical. Thick marine sediments laid down then make up the rock of the Lodore Formation, which contains small marine fossils.

Narrow strips of crust exposed above the ocean surface had begun to expand as continents 3.5 billion years ago. Most continents were in tropical latitudes during the Cambrian Period, when large pieces of present continents can first be plotted.



Brachiopod

Worm tunnels in the Lodore Formation record the journeys made by these ancient animals.

Rock from the Lodore Formation



Trilobites *(drawing and fossil)* were marine organisms with lobes in three (tri-) parts down their backs.

Precambrian *2500-570 mya*

Uinta Mountain Group

Lodore Formation

Trilobites & brachiopods

Cambrian Life

Forms of life diversified so quickly in the early Cambrian that this time is known as the "Explosion of Life." Life had not moved onto land, but many complex organisms had evolved and were well adapted to the environment. Many later went extinct, for reasons not well understood. By Cambrian times some animals had developed hard shells or external skeletons that fossilized readily. Primitive members of the group *Chordata* were forerunners of vertebrates and, eventually, mammals.

From Earth's Formation . . . to You

To understand the graph shown along the black band below, you need to think of the history of the Earth as though it were the width of this sheet of paper. At such a scale, humans have inhabited the planet for less time than the *thickness* of this paper. See how long it took, after the Earth formed, for life to arise . . . and then for multicellular life to arise. This park introduces you to many very complex ideas. Be sure to ask questions of park rangers and attend the programs they offer. We hope you find enough ideas here to engage you for life.

▼ *Cambrian to Present*