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Does Size Matter?

by Debbie Savage

A forest made up of the world's tallest trees can invite a lot of questions. Why do coast redwood trees, *Sequoia sempervirens*, grow only in northern California? Why do they grow so tall? Is there something more significant about this forest than the size of the trees?

The redwood forest attracts visitors from around the world for many reasons; one is its age. Indeed this forest contains descendants of some of the oldest plants on Earth. You can almost imagine a dinosaur crashing through the understory and thundering down the trail. Ferns and horsetails have evolved over 300 million years and once formed forests 50 feet tall.

More than 100 million years ago, ancestors of modern coast redwood trees extended across the northern hemisphere. By the time dinosaurs became extinct 65 million years ago, these redwoods grew as part of a complex forest that included ancestors of modern-day Sequoias, dawn redwood, cedar, fir, hemlock, and a variety of broad-leaved deciduous trees.

Redwoods appeared on the West Coast of North America about 20 million years ago. The Mediterranean climate provides a safe haven for trees that need abundant water, little fluctuation in temperature year round, and summer fog.

Walking in the ancient redwood forest, amongst the world's tallest trees, you can almost imagine a dinosaur crashing through the understory and thundering down the trail.

Gradually climates changed from warm and humid to cooler and drier around the globe. By three million years ago, coast redwood trees had disappeared from Europe, Asia, Greenland, and Japan. Today the redwood forest only exists on this narrow strip of California coastline, which extends 450 miles from the California/Oregon border south to Monterey Bay.

Coast redwood trees can soar to more than 370 feet tall, but they are not the only tree that grows tall in a redwood forest. Douglas-fir trees have grown even taller; one record-breaker in British Columbia measured 400 feet. Western hemlock trees can reach 250 feet tall. Sitka spruce height rivals the hemlock and its bulk can match a medium-sized redwood.

If size is measured in years, then perhaps it does matter. Resistance to fire, insects, disease, and fungi allow the coast redwood to live more than 20 human lifetimes. Redwood trees seldom fall over. Their shallow roots form an extensive system of intertwining threads that connect with the roots of neighboring trees, providing reinforcement against the powerful winds of winter storms.

Just as impressive as the trees is the multi-layered understory that grows beneath. Ten-foot high rhododendron, azalea, huckleberry, and salmonberry bushes flourish, sword ferns grow as tall as a person, skunk cabbage leaves extend as long as your arm, fungus bigger than

dinner plates emerge with the first winter rains, and 80-foot big-leaf maples turn streambanks into a burst of fall colors.

No wonder the smaller things are easily overlooked. Look below your knees along any forest trail and you will find a carpet of redwood sorrel, plants that resemble three-leaved clover, covering the forest floor. Mixed among them you might find wild ginger, Pacific starflower, or yellow redwood violets. Any time of year you can find something blooming.

Then consider what might be living in the trees themselves. Suspended 300 feet above, soil mats trapped in elbows of limbs form a miniature forest floor that provides habitat for a world of plants and animals, some that never touch the ground. This complex biomass rivals the tropical rainforests and qualifies Redwood National and State Parks as a World Biosphere Reserve.

Does size matter? It depends upon how you measure it. Redwood National and State Parks may be home to the world's tallest trees, but the challenge is to see the forest, despite the trees.

LOOK for
redwood forest
indicator species scattered
throughout this guide.
Indicator species
definition: page 5



This Land Is Your Land

This land is your land.
This land is my land.
From California to the New York Island,
From the redwood forest
to the Gulf Stream waters,
This land was made for you and me.

by Jeff Denny

Upon the arrival of settlers to California in the 1850s, the redwood forests soared to an exalted place in the American consciousness. Rising high at the western edge of a once-boundless continent, the redwoods became a towering exclamation point on a national narrative of sweeping landscapes and natural wonders. Is it any wonder Woody Guthrie so easily recalled these magnificent forests in his timeless anthem?

If you create a postcard collage of places uniquely American, a few images quickly come to mind. The Grand Canyon. Yosemite's Half-Dome. The ancient villages of Mesa Verde. The Statue of Liberty. The Lincoln Memorial. The Rockies' purple mountain majesty. The redwoods.

It's no coincidence that these icons are gathered together within our national parks. A truly American invention, our national parks safeguard these treasures alongside nearly 400 equally significant places. From California to the Gulf Stream waters, past ribbons of highways and golden valleys, each park, monument, battlefield, and seashore contains a verse in the shared song of America.

Yet, our national parks and our national stories are not frozen in time. Each one adds new verses and different interpretations to our common story every day. Last year, researchers discovered redwoods taller than any previously imagined. Tiny microbes from the deepest pools of Carlsbad's caverns have been found to attack breast cancer cells without harming their healthy neighbors. Wolves, reintroduced for the first time in nearly a century, spawned a rebirth

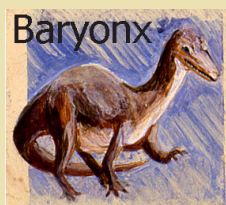


Illustration by Larry Eifert

COAST REDWOOD

Baryonx trod amidst the redwoods 140 million years ago. The tallest trees in the world preceded bats, whales, and the woolly mammoth. As you walk among the ancient ones today, think about their 2,000-year-old timeline: The first form of compass appears in 271 A.D., scrolls replace books starting in 360, Copernicus

Life Among the Limbs

By Laura M. Sturtz

Visitors walking through the redwood forest often feel like children in a room full of adults: all we can see are legs. Lift your gaze from the base of the trees and crane your head back. Observe the massive, high branches of the tallest living things on the planet. There, catch a glimpse of an unseen world flourishing over 300 feet above the forest floor.

Until recently, the secrets of the redwood forest canopy could only be viewed from below. We could look at fallen giants — their mighty limbs shattered — and see evidence of life in the treetops. Acting like archeologists, we tried to piece together an ancient civilization from the ruins. Yet, no one really knew what occurred high in those mighty boughs.



Salamanders have plenty of water, food, and protection to live in this bouquet of leather ferns for their entire lives.

Photo by Thomas Dunklin

Today researchers have gained access to the heights by shooting rubber-tipped arrows, dragging ropes into the crown, and anchoring the ropes over strong limbs. Climbing up the trees, they observe the creatures that dwell in the canopy. In fact, researchers have discovered an entire forest ecosystem growing in the sky. At 200 to 350 feet up, soil forms on limbs as big as six-feet in diameter. In the crooks of massive trees, leather fern grows

in thick mats that can weigh up to a thousand pounds. Huckleberry bushes, Sitka spruce, even other redwoods take advantage and thrive in the moist treetops.

Many birds, mammals, and amphibians flourish in the treetop vegetation. Wandering salamanders, rarely found on the ground, occur by the thousands high above. Other canopy residents like red squirrels and Townsends chipmunks can be found on the ground but find everything they need in the redwood high-rises.

While we cannot hike through the giant limbs of the tallest trees on Earth, we can imagine this hidden world that scrapes the sky. During your visit to Redwood National and State Parks, pull out along the Howland Hill Road or Newton B. Drury Scenic Parkway, or hike through Stout Grove or Lady Bird Johnson Grove. Lift your eyes from the towering trunks, look up into the loftiest limbs, and wonder what treetop creatures might be gazing down from their world.

The Ties That Binds

By Debbie Savage

The first thing I noticed when I moved to coastal California is the rain — up to 100 inches a year. I soon learned that the rain transforms every level of the forest into a colorful array of fungi in all sizes, shapes, and textures, revealing a hidden world with names like *fly agaric*, *witch's butter*, and *turkey tail*. Intrigued, I observed a trail of fungus from the forest floor to the canopy, searching for a connection.

By maintaining a cool, moist environment, the canopy provides ideal habitat for over 300 species of fungus. Fungus is a collection of filaments or threads that may extend for several miles beneath the surface. These threads (hyphae) produce two types of fruiting bodies, mushrooms aboveground and truffles underground. Most fungi obtain nutrients by breaking down leaves, cones, and other forest litter constantly shed from the canopy.

Some fungi infect young tree roots to form a beneficial structure called mycorrhizae (from the Latin mycor for fungus, rhiza for root). By growing into the roots and extending out into the soil, mycorrhizae increase the tree's ability to absorb water and elements such as phosphorus, zinc, manganese, and copper. These filaments also produce antibiotics to protect the roots from disease. In exchange, the fungi receive sugars from the tree's root system.

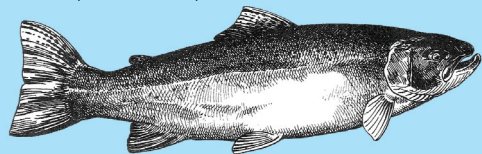
Many forest animals rely on fungi in their diet. Chipmunks on the ground and flying squirrels in the canopy dig for truffles. Roosevelt elk, black bears, banana slugs, and millipedes graze on mushrooms. In turn, these animals disperse fungus spores in their fecal pellets, and new fungi grow from the spores. The more I learned, the more I realized that fungi threads bind the old-growth forest community together. It is the thread that connects the canopy to the soil and forms a vast underground transportation system for water and nutrients. Follow that thread the next time you visit and see where it takes you.



turkey tails (*Polyporus versicolor*)

states that the Earth turns around the Sun in 1512, and Neil Armstrong walks on the moon in 1969. In human terms, redwoods are timeless.

Within a quilt of habitats, these redwood parks house several animals known as indicator species. As critters found in specific living spaces, they indicate a healthy environment. When they disappear, there's trouble in paradise. Read about them throughout the guide.



CHINOOK SALMON

(*Oncorhynchus tshawytscha*)

"Spawn 'til you die" means just once for the fish more commonly known as king, largest of the Pacific salmon. "Hatch, grow, and go" dictates its first six months in freshwater, then it's off to sea for up to five years, returning with one single-minded purpose: to mate and produce offspring. It's good to be the king.

THE LIVING CANOE

"The redwood tree (keehl) is sacred to us. They say redwood tree has a heart."

Yurok elder and master canoe carver Glenn Moore Sr.

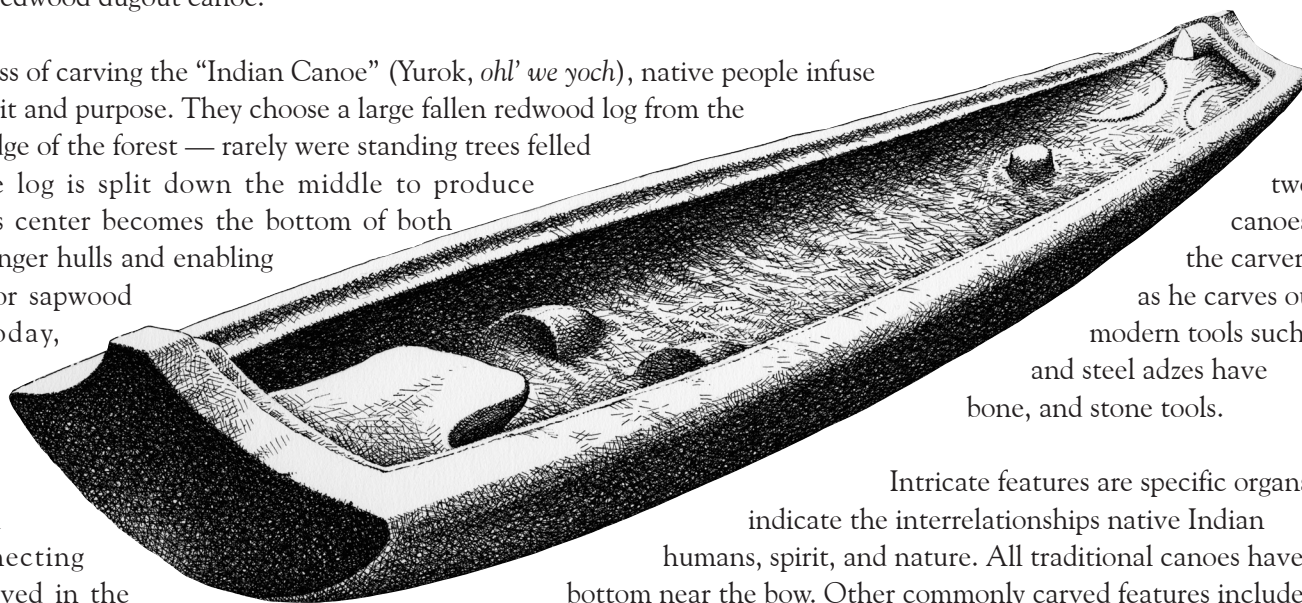
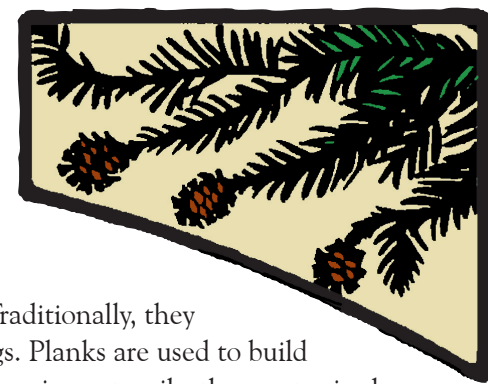
by Jim Wheeler

For native Indian people, redwood trees are sacred providers for all aspects of life. Traditionally, they used elk antler wedges and stone mauls to split thick, board-like planks from redwood logs. Planks are used to build family homes, purifying sweathouses, and Brush Dance grounds. While redwood supplies various utensils, the most prized tool remains the redwood dugout canoe.

In the process of carving the "Indian Canoe" (Yurok, *ohl' we yoch*), native people infuse the craft with spirit and purpose. They choose a large fallen redwood log from the beach or at the edge of the forest — rarely were standing trees felled in the past. The log is split down the middle to produce canoes. The log's center becomes the bottom of both providing for stronger hulls and enabling to remove inferior sapwood each canoe. Today, as chainsaws replaced antler,

of the body and people see connecting a heart knob carved in the eyes, nose, lungs, lifeline, kidneys,

These sturdy, beautiful boats provided the main means of travel up and down the Klamath and Smith Rivers, and the ability to haul freight on both the rivers and the coast. The art of carving redwood canoes is still taught. You can see canoes used annually during the Boat Dances on the Klamath and Trinity Rivers. For both Yurok and Tolowa, redwood is a living entity whose life and spirit are embodied in the hearth of home and sweathouse, and the heart of the canoe.



two canoes, the carver as he carves out modern tools such as bone, and steel adzes have

Intricate features are specific organs indicate the interrelationships native Indian humans, spirit, and nature. All traditional canoes have bottom near the bow. Other commonly carved features include and a seat at the stern.

Looking Forward to the Past

by Jim Wheeler

Walk into an ancient redwood forest and the variety of plant life you encounter at many different levels may look like "chaos of nature." This visual chaos belies an underlying order and stability that is hard for us to perceive in our short lifetimes.

The advent of logging in the 1850s and the suppression of fire after 1900 devastated the redwood forest. Today, with only four percent of the ancient forest remaining, these parks contain close to one-half of all protected primeval redwood forest. Yet more than half of the park acres — over 75,000 — are comprised of logged or second-growth forest. Now, where a naturally chaotic stability once reigned, young, even-aged trees compete for a piece of the sky in conditions so crowded that they choke out nearly all other plants below their canopy. Can we restore the natural chaos?

Visitors who venture into the second-growth forest along Redwood Creek or Mill Creek will discover stands that have more than a thousand

small, unhealthy conifer trees per acre. The forest floor is barren, shaded by the dark, closed canopy.

Like a gardener, park managers must consider thinning the forest to encourage forest health and biodiversity.

Thinning second-growth stands will take many decades off the centuries needed to redevelop ancient forest qualities. In order to grow big trees, many young firs (planted for timber production prior to park establishment) will be cut, and a natural mix of redwood, Douglas-fir, Sitka spruce, grand fir, and western hemlock trees will return. By reducing tree density, the remaining trees grow vigorously. With more space and sunlight reaching the forest floor, essential understory plants and trees will grow and animals can return. With different sizes and ages of trees, we can look forward to the park forests supporting diverse wildlife species, as they did in the recent past.

Humans created unnatural order in the forest. Now we must manage the forest to restore the chaos, to restore stability, to restore the ancient redwood forest.



Second Growth: The uniform leaf canopy blocks sunlight, creating a dark, tedious landscape with little variation or diversity of plant and animal life.

of beaver ponds and aspen groves along Yellowstone's rivers. Our historic places reveal the quiet lives of people like you and me, tucked away in fading memories and dusty archives.

In 2016, we will commemorate the 100th anniversary of the National Park Service. Between today and then, our national parks (and our state parks) face many challenges: increasing budget pressures; human development around park sites; a rapidly growing and mobile population; and a high-speed electronic culture with less time to experience the glory of America's landscape.

What places will stand as icons for the next generation of Americans? What stories will speak to the common American experience of our children and grandchildren? What will we be able to say about the value of parks to those who will protect them into the future? Our national parks can retain that communal vision of America, in its landscapes and in its stories, if we continue to remember that collectively, "This land was made for you and me."

(Song lyrics by Woodie Guthrie. Used with permission by publisher: Ludlow Music, Inc. NY, NY.)