

Some 30 million people a year make a pilgrimage to northern California to see the towering coastal redwoods. But can the remaining stands of these remarkable trees survive the triple scourge of climate change, drought and wildfires?

Yva Mornathuk & John Eastcott/Minden/NPL

Warning: marvelling at coastal redwoods can lead to neckache. These are among the fastest growing trees in the world – healthy seedlings can grow more than 30cm a year.

# GILN LIVINGTT S

*By* Lynn Houghton



## Canopy colonists

Thanks to the work of intrepid, rope-climbing scientists, a unique ecosystem was discovered in the redwoods' high canopy back in the 1990s. Each year, redwood trees shed needles, cones, bark and other debris, which become caught in their high limbs and notches, and ultimately turn into spongy mats of what is known as canopy soil. Seeds and fungi colonise this soil, while epiphyte plants and even other trees, such as elderberry, huckleberry, Douglas fir and Sitka spruce, take root and grow, more than 100m above the ground. There are 238 additional varieties of plant and many species of bird and insect that reside in this micro-habitat, including the clouded salamander (above) and yellow-cheeked chipmunk.



## Often referred to as the blue whales of the plant world, coastal redwoods are the tallest living things on the planet.

For sheer heart-stopping excitement, nothing quite compares with driving up Northern California's photogenic, cliff-hugging Highway 1, with its dramatic vistas over the Pacific Ocean.

This landscape of wave-soaked beaches and rugged, precipitous promontories rivals the best of the Hawaiian islands.

Yet turn inland and the scenery is just as spectacular. Mist-saturated forests run the entire length of the coast (800km from Big Sur to the Oregon border), and are awash with monumental redwood trees.

Motor north up Highway 1, turn east onto Highway 128 in Mendocino County and follow it along the Navarro River, and you'll find hundreds of these magnificent specimens. Redwoods dominate the landscape for miles, a breathtaking sight that compels drivers to stop and stand among giants.

Often referred to as the blue whales of the plant world, coastal redwoods are the tallest living things on the planet, able to exceed more than 100m in height. Equally impressive



is their longevity, with many trees reaching their 1,000th birthday. The oldest known redwood is thought to be an eye-popping 2,200 years old.

The tallest individual, a roughly 600-year-old specimen known as Hyperion, is located in Redwood National and State Parks, Humboldt County (a UNESCO World Heritage site). Located on a steep, remote slope, it commands the landscape from a height of nearly 116m.

This lofty spectacle draws millions of campers and day-trippers every year, as does the Pacific forest wildlife. Mountain lions leave tantalising clues, though these notoriously shy creatures are seldom encountered. Smaller mammals that live among the trees include ground squirrels,

racoons, woodrats, muskrats and several varieties of vole and chipmunks, to name but a few. Many are nocturnal and difficult to spot, but their existence is given away by the turkey vultures circling overhead.

Birdwatchers are frequently drawn to the coastal cliffs, populated with guillemots, grebes, California brown pelicans, cormorants and Caspian terns. In the campgrounds, Steller's jays squawk noisily at humans invading their space, though flycatchers, warblers, owls and woodpeckers have their feathers less ruffled by human presence. In the heart of the forests, bald eagles, peregrine falcons and rare marbled murrelets nest in tree hollows.

"Coastal redwoods provoke the human spirit," says Candace Tinkler, chief of education and interpretation at Redwood National and State Parks. "People are naturally curious about the superlatives and

Clockwise from above left: highways take visitors straight through the forests; the largest patch of old-growth redwood forest is located in

Humboldt Redwoods State Park; thick, fibrous bark helps to protect coastal redwoods from periodic wildfires; a resident raccoon.

From left: George Ostertrag/Alamy; K Menzel/Getty; Michael Nichols; Juan Carlos Munoz/NPL; Henrik Wallays/Alamy

broader ecological questions, but for many the experience goes beyond science and can be reflective, even restorative."

### Golden oldies

Redwoods are the survivors of the plant kingdom and their ability to withstand drought, floods, fire and pestilence is key to their longevity. They have evolved several unique traits to ensure a long and healthy life. Redwoods are able to absorb moisture from the air, with 40 per cent of their needs supplied by the dense fog that blankets the Pacific Northwest. In addition, these are sprouting trees, with new growth generating from the 'crown' of a single organism. Even if an entire forest burns down, redwood stumps are able to regenerate – and with gusto. Studying a single old-growth tree in Redwood National and State Parks, scientists discovered that no less than 148 trunks had

resprouted from the main bole. Five of these had diameters of over a metre; the largest was more than 40m tall.

Yet another adaptation lies in the redwood's bark. A mature tree's bark often exceeds 30cm in thickness and protects the core of the tree. Tannin in the bark helps to repel insects such as termites, as well as fight fungal pathogens including oak blight.

Despite their armoury of survival tools, coastal redwoods are in peril. Climate change, drought and non-sustainable commercial practices are all impacting the health of these iconic giants. Though only 4 per cent of old-growth forests remain, these trees are still being harvested. Logging is the single most damaging practice responsible for the trees' demise, triggering an unprecedented loss that brings with it a fundamental change in the diversity of

coastal forests. To rub salt in the wound, timber companies don't stop at felling the redwoods – they also plant Douglas firs in their place, a faster growing, popular commercial choice that disrupts these delicate forest ecosystems even further.

Climate change is impacting weather and increasing the trend of drought frequency in California. Another occurrence attributed to global weather changes is a reduction in the amount of fog rolling in off the Pacific Ocean, which is critical for coastal trees' survival. Some studies have already found a reduction of 33 per cent in frequency compared with only a few decades ago.

Ferocious wildfires now plague the state too. The ecology of this region's wilderness has always included natural fires, largely created by lightning strikes, but authorities in land management and fire services agree that these events are more widespread ▶



Clockwise from above: young redwood trees can sprout from the base of a parent's trunk; firefighters struggle to contain a lightning-triggered blaze; a fallen giant.

## For hundreds of years, controlled burning was scrupulously carried out by tribal elders.

and intense than ever before, possibly or primarily due to climate change and ensuing droughts, but also because of the abolishment of controlled burning.

For hundreds of years, controlled burning was scrupulously carried out by tribal elders. Small fires cleared the undergrowth, ensuring that chaparral (tangled shrubs and thorny bushes) never became too dense.

An excess of this sort of vegetation creates a ticking tinderbox, with just one spark capable of causing a catastrophic blaze. The practice is critical as a preventative measure, but was eradicated as early as 1850 as indigenous peoples were exterminated or displaced.

“California has had a fire-adapted environment for millions of years, and we can tell from tree-ring data that there were tremendously destructive fires in the

past, certainly every 10-15 years,” says Sam Hodder, CEO of Save the Redwoods League. “In the wetter climate of the north, fires were less frequent, and the trees were able to withstand these events. With the climate crisis, this has changed.”

In August 2020, flames roared through the forests north of Santa Cruz and San Mateo, devouring large sections of the Big Basin Redwoods State Park. Known as the August Lightning Fires, the blaze was in fact five fires blown together by the wind, destroying some of the oldest redwoods known to exist.

“With the addition of houses and buildings as fuel, combined with drought-stressed conditions, we saw extreme fire behaviour and destruction as never before,” says Scott Sipes, state park supervisor. “This

meant not only a natural but also a cultural loss to the area.”

But there is some good news: fresh ‘sprouts’ were already appearing from the burnt carcasses less than a year later and “the upside is that this tragedy gives us the opportunity to re-imagine management of this park in a more sustainable way,” he says.

### Taking a stand

So, how can these iconic trees be better safeguarded? As ever, mitigating habitat loss is key. “With only a few stands of old-growth forests and original redwoods remaining, our mission is procuring property to protect them,” says Hodder. “Over the past 100 years we have acquired 220,000 acres. We look after this land, nurture the trees and eventually transfer it to the state park system. We also work with owners who have redwoods on their estates.”

Genome sequencing is another exciting new response, with restoration of the redwoods the long-term goal. David Neale and colleagues at the University of California, Davis have cracked the DNA code of coastal redwoods and hope that by pinpointing certain genomes, they can identify those trees more able to withstand climate change in the years to come. ▶

Clockwise from top left: C.A. Gonzalez/The San Francisco Chronicle/Getty; Ethan Daniels/Alamy; Alamy; George Osterlag/Alamy; Illustration by Acute Graphics

Standing among colossal coastal redwoods can be a humbling and spiritual experience.

### PUTTING IT IN PERSPECTIVE: TREES vs BUILDINGS





## The redwood genome is nearly nine times larger than the human genome.

Clockwise from left: Save the Redwood League is mapping the trees; shade-loving plants thrive on the forest floor; a redwood cone.



“We’re basically building a database. A manager or forestry professional will send in their samples and get a risk evaluation of their forest populations, if not individual trees,” explains Neale.

### It’s in the genes

Neale’s team have discovered that the coastal redwood genome is nearly nine times larger than the human genome. In fact, they are ‘hexaploid’, meaning they have six sets of chromosomes (compared to conifers, which have two, for instance), but the development of new sequencing technologies has enabled the team to identify the particular genes best adapted to environmental pressures such as drought and rising temperatures.

Paul Ringgold, chief programme officer of Save the Redwoods League, describes the process in further detail: “Marker trees are selected from among representative healthy redwoods, and then needles, cones and bark are extracted in a non-destructive way and dissolved to study their DNA. Seeds are then preserved for future planting; this allows the growing of trees in the future.”

Redwoods have a remarkable genetic diversity, as Ringgold explains: “The explosion of diversity in redwoods is due to the hexaploid nature of their chromosomes. This creates different colours, variations in bark pattern and even albino specimens. The goal with sequencing is to map the entire genome of the redwoods to find the ins and outs of their adaptability in its entirety.”

The last step on the ladder to safeguarding the redwood is preserving the remaining unspoiled habitat. The shoreline from the community of San Luis Obispo north to the Oregon border is currently protected from development by regulations that came into effect in the 1970s. This law was enacted, in part, to save the beaches and resources of the northern California coast from the unsightly and environmentally damaging sprawl of its southerly neighbours.

If land in the north’s coastal areas can be saved from development with tighter regulations, and larger, protected areas such as the Redwood National and State Parks created, surely it’s a step in the right direction – not only for the redwoods but

for their ecosystem and the species that rely on them. Another recent positive development is the concerted assistance of tribal communities, such as the Yurok, in returning their ancestral homes to a more pristine condition.

With new science and a growing public interest in sustainability, we can only hope that the redwoods have a chance of recovery, and continue to tower over the Pacific Northwest for generations to come. “We are actually fortunate that this landscape and its woodland are so forgiving,” says Hodder. “Otherwise there might be nothing left.”



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**FIND OUT MORE** Read about the conservation work of Save the Redwoods League at [savetheredwoods.org](http://savetheredwoods.org)