SCIENCE

The Science Behind the Oldest Trees on Earth

How experts have determined that bristlecone pines, sequoias and baobabs have stood for thousands of years

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This cross section of a sequoia in Yosemite National Park in California has markers identifying the dates of tree rings. Jared Farmer

What and where are the oldest known trees on the planet?

If you include plants that can regenerate, the upper age limit could be ten thousand years or more. Such superorganisms, including the famous aspen grove nicknamed “Pando,” are made up of genetically identical trunks connected through a single root system that sends up new shoots over time. These clonal colonies are impossible to date with precision, because the oldest substance long ago decomposed.

Many lists of oldest trees stick to single-trunked plants that produce annual growth rings. These kinds of trees are easier to date. Scientists called dendrochronologists focus on assigning calendar years to tree rings and interpreting data within those rings. By using a

hand-cranked tool called an increment borer, they extract core samples without depriving the tree of strength and vigor.

As a rule, gymnosperms—flowerless plants with naked seeds—grow slower and live longer than angiosperms, flowering plants with fruits. Gymnosperms include ginkgo and every kind of conifer—including yews, pines, firs, spruces, cedars, redwoods, podocarps, araucarias and cypresses. Roughly 25 gymnosperm species can live 1,000 years or longer. The cypress family contains the most millennials, but the longest-lived species is a pine with an effective age limit of five millennia. By contrast, eight centuries is extremely old for an oak, an angiosperm. And only one kind of flowering plant, a baobab, has been positively dated beyond one millennium.

During research for my book *Elderflora: A Modern History of Ancient Trees*, I learned a lot about the world's oldest growers. Here are some of the most exceptional specimens.

The Longest-Lived Gymnosperms

Great Basin bristlecone pine, *Pinus longaeva*, ≥4,900 years

Bristlecone Pine (*Pinus longaeva*) in the White Mountains in California. François Gohier / Gamma-Rapho via Getty Images

The oldest tree ever known was killed in the act of knowing. Until 1964, it grew in a cirque on Wheeler Peak in Nevada's Snake Range in what is now Great Basin National Park. After a graduate student researcher tried and failed to extract a complete core sample, he decided to produce a stump. This scientific desecration haunted him the rest of his career, even though he cut it down with permission of a forest ranger. Originally labeled "WPN-114," this pine was posthumously renamed "Prometheus."

The oldest survivor with a name is "Methuselah," which grows in the Ancient Bristlecone Pine

Forest in the White Mountains of eastern California. This pine was originally cored by tree-ring scientist Edmund Schulman, who made bristlecones famous through his 1958 article in *National Geographic*. The innermost rings on Schulman's core samples are extremely suppressed and partly eroded, making dating difficult. The oldest extracted ring from Methuselah might be from 2490 or 2555 B.C.E. In any case, this tree is well over 4,500 years old today.

Methuselah's location is no longer marked by the U.S. Forest Service, but anyone who hikes the trail will be close to it and many other living beings as old as the pyramids of Giza. In the same population, an unnamed bristlecone even older than Methuselah grows, and it is known only to an inner circle of dendrochronologists. Secrecy provides protection from vandals who would carve names on it, relic hunters who would take cones from it and photographers who would inadvertently damage the fragile soil.

In a deeper sense, the identity of the true oldest living bristlecone is simply unknowable. That's not just because no one has the time—or the funding, or the imperative—to do an exhaustive search throughout the Great Basin. The effort would be futile. On most ancient bristlecones, the oldest wood has long ago been ablated, speck by speck, by desert winds.

Alerce, *Fitzroya cupressoides*, ≥3,613 years

Tourists visit an alerce in the Patagonian region of Argentina. This tree, dubbed “El Alerce Abuelo” (meaning “Grandfather Alerce”) is 187 feet tall and is located within Los Alerces National Park. Cristian Kovadloff / Anadolu Agency via Getty Images

As early as the 1860s, Chilean scientists knew that alerce—a single-species genus within the cypress family—could live 2,500 years or more. That didn’t stop the Chilean state and state-sponsored settlers from clearing the forests of Patagonia and seizing the land from Mapuche, indigenous inhabitants of Chile and Argentina.

Evidence that alerce can live beyond three millennia finally came in 1993. A meticulous survey of stumps revealed that the oldest known alerce had been chain-sawed in 1975, the last year such logging was legal. The species is now categorically protected, though still logged illegally.

In 2022, a Chilean scientist made world news by announcing that the relict old-growth plant known as Alerce Milenario or Gran Abuelo ("Great-Grandfather") in Alerce Costero National Park might be the oldest living tree on the planet. The scientist's estimation—5,484 years, with an 80 percent probability of 5,000-plus years—was derived from a partial core sample and a growth formula based on statistical modeling. By the conventions of dendrochronology, the oldest known must be absolutely known, which is why alerce remains in second place for now.

Whatever its exact age, Gran Abuelo has lately achieved national fame on a par with three other iconic trees of undisputed antiquity but unknown age: El Árbol del Tule in Mexico, Tāne Mahuta in New Zealand and Jomon Sugi in Japan.

Giant sequoia, *Sequoiadendron giganteum*, ≥3,266 years

The giant sequoia named General Grant rises to the sky in Kings Canyon National Park in California. Mark Ralston / AFP via Getty Images

As soon as Anglo-Americans encountered giant sequoia in the midst of the California gold rush, they acted in paradoxical ways: protecting them while also cutting down trophy specimens for traveling exhibits. By counting rings on stumps, people knew definitively in the 1850s that sequoias can live for thousands of years.

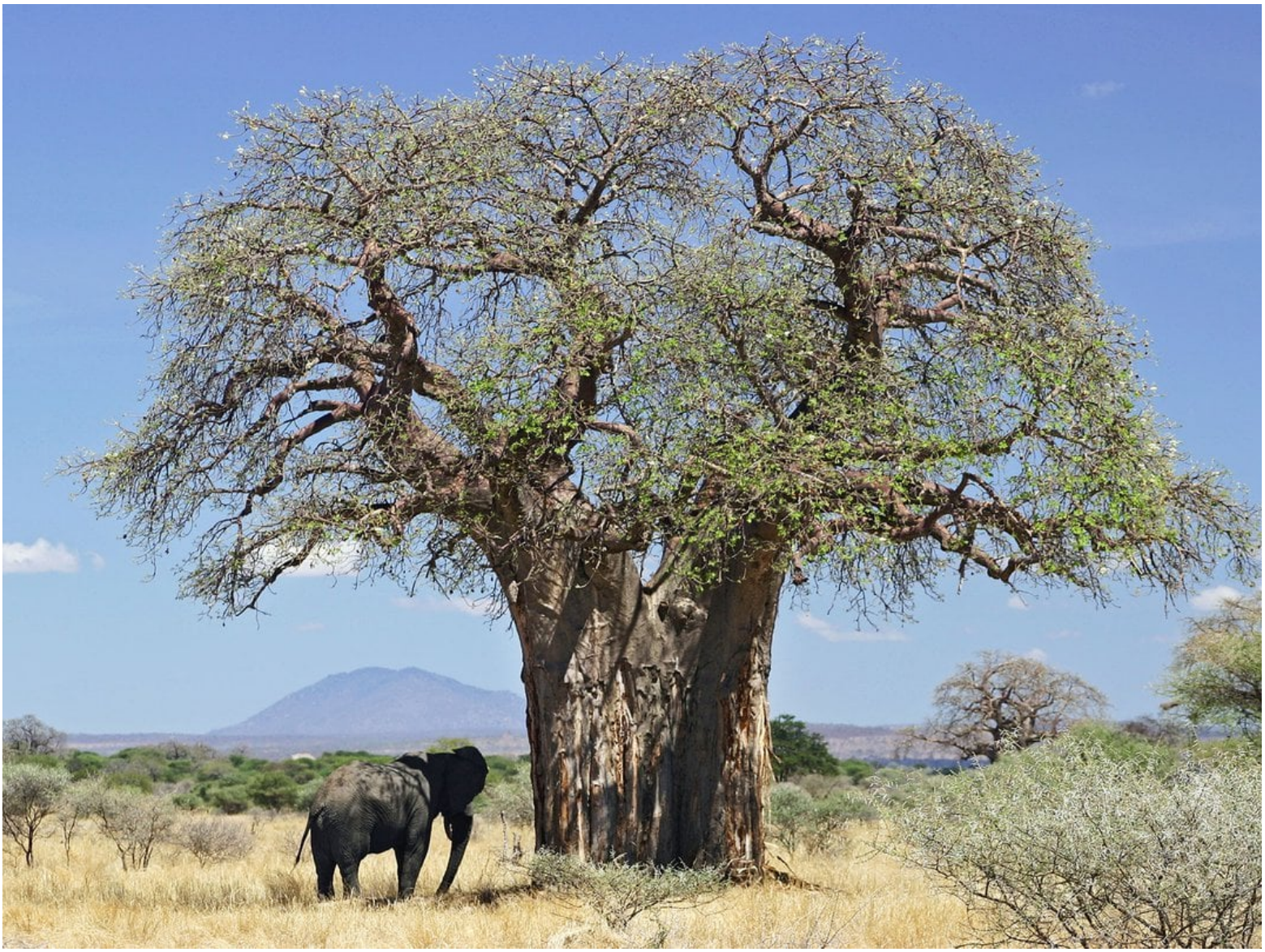
After the Civil War, two of the largest protected sequoias became known as the General Grant and the General Sherman. A rivalry ensued between Fresno County, home of the Grant, and Tulare County, home of the Sherman. In 1931, the California Chamber of Commerce announced an unscientific verdict: Although Sherman was—and still is—the world's largest tree, Grant would count as the world's oldest. Confusingly, tourists routinely referred to another monumental tree, Yosemite National Park's Grizzly Giant, as the age champion based on its incomparably gnarled appearance.

In the 1990s, a forest ecologist created a mathematical formula for estimating a sequoia's age based on the volume of its bole, or the trunk below the crown. He tested his formula on hundreds of stumps in Converse Basin, the one large grove of big trees that had been devastated by industrial logging. Here, many trimillennials, including the oldest ever known at 3,266 years or more, had been leveled to make grape stakes and shingles. The ecologist disproved for good the old assumption that biggest means oldest. By his estimation, the General Sherman was only 2,150 years old, and the Grizzly Giant was a shocking 1,790 years young.

The most senior of these trees probably lacks a name because of its relative smallness. And it may be newly dead. In 2020 and 2021, megafires devastated the southern Sierra, killing up to 20 percent of all mature sequoias. Even for the superflora of elderflora, climate change has become climate crisis.

The Longest-Lived Angiosperm

African baobab, *Adansonia digitata*, **≥**2,500 years



An elephant stands beneath a flowering African baobab in Tanzania. Ferdinand Reus via Wikimedia under CC BY-SA 2.0

In the 18th century, a French naturalist in Senegal speculated that baobabs could live up to 5,150 years—just shy of the age of the Earth according to biblical chronologies. This was nothing more than a guesstimate based on diameter, height and presumed growth rate. French encyclopedias of the post-revolutionary period confidently listed baobab as the "Thousand-Year Tree" (*L'arbre de Mille Ans*). Alexander von Humboldt—the most esteemed naturalist of the 19th century—called the baobab "one of the oldest inhabitants of our globe."

The validation of extreme longevity in African baobab only recently moved beyond musings. Because of their great girth and unusual tissue—an absorbent, elastic material that barely qualifies as wood—baobabs are ill-suited for tree-ring dating. Radiocarbon dating—a technique that measures the amount of carbon-14, an isotope that decays over time—

works better, provided that inner tissue can be obtained. Firm evidence that these succulents can live 1,000 years came in the mid 20th century, when two things coincided: the calibration of the radiocarbon dating method and the construction of Kariba Dam on the Zambezi River, a megaproject that demanded the mass leveling of megaflora. As with bristlecone, alerce and sequoia, scientific knowledge of longevity benefited from arboricide.

More recently, a Romanian chemistry professor secured funding to research the maximum age span of angiosperms. The project got off the ground because one of the most famous baobabs—the Grootboom of Namibia—had just collapsed, allowing access to ancient inner wood. The investigation appeared to be prophetic—or cursed: Wherever the professor went looking in southern Africa for the oldest baobabs, he found fallen giants. In 2018, he reported that of 14 known baobab millennials, ten had buckled or perished in the 21st century, including iconic specimens in South Africa and Botswana. The outlier tree was known as Panke and grew in Mbuma, Zimbabwe. It had, before its sudden death in 2011, reached approximately 2,500 years, an order of magnitude older than the oldest dated olives. The main reason for baobab dieback is drought. Southern Africa is getting hotter and drier.

The oldest known living African baobab, the Dorsland tree of Khaudum National Park, Namibia, still lives despite the senior stems having recently toppled. It is approximately 2,100 years old.

The Oldest Propagated Tree

Peepul, *Ficus religiosa*, ≥1,000 years

The peepul named "Jaya Sri Maha Bodhi" in the temple compound in Anuradhapura, Sri Lanka. Jan Wlodarczyk / Alamy Stock Photo

When Siddhartha Gautama achieved nirvana, becoming the Supreme Buddha, he did it—according to sacred texts—at the foot of a peepul, a kind of fig tree. Because of this connection to the Buddha, the species earned the common name "sacred fig" and the scientific name *Ficus religiosa*.

As organisms, figs don't live especially long, but the same genetic material can be kept alive, one tree at a time, propagated from cuttings, across centuries or millennia. This basic horticultural practice—seen with bananas, citruses and olives—can also be devotional. People don't tend the peepul for its fruit.

Two purported scions of the Buddha's original meditation tree—one in Gaya, India, another in Anuradhapura, Sri Lanka—are alive today. Or, rather, it is the same tree in two places,

both of them now World Heritage Sites. Nineteenth-century writers distinguished between the “bodhi tree” in India and the “bo tree” in Ceylon. Today, the latter conventionally goes by the triple honorific “Jaya Sri Maha Bodhi.”

The island tree has greater claim to antiquity, because Sri Lanka was the cradle of Theravada, the oldest extant branch of Buddhism, which arrived circa 300 B.C.E., presaged by the Buddha’s legendary visits across the Palk Strait. Anuradhapura served as a royal capital for one millennium before being abandoned for a nearly equal period of time. The chronicles of precolonial Sri Lanka are remarkably complete, and they do not record the death of the venerable ficus. This negative evidence can be interpreted as continuous life, or at least continuous caretaking. It seems likely that a core group of Buddhist devotees always held out at Anuradhapura, serving as arborists. Although it cannot be exactly dated, this sacred fig has been enshrined as “oldest historical tree in the world.”

The Triple Oldest Clonal Grower

Huon pine, *Lagarostrobos franklinii*, ≥1,000 years (individual) and ≥10,000 years (clonal) and ~10,000 years (subfossil)

A twisted Huon pine grows on the edge of the Gordon River in Tasmania, Australia. Chris Jones / Alamy Stock Photo

Huon pine, native to the Australian island of Tasmania, is not a pine. Its closest relative, a fellow podocarp—a family of southern conifers—occurs in New Zealand. Despite being an extra-slow grower, adding to its girth one or two millimeters per year, a Huon pine can reach heights well over 100 feet in its typical lowland riparian rainforest habitat.

Almost all the old growth was cut down in the 19th century by industrial loggers, but one anomalous, disjunct population persists below the summit of Mount Read, a volcanic peak on the island's soggy northwest coast. Despite activities of gold and copper miners, these medium-high-elevation Huon pines escaped notice until the 1980s, when the government commissioned a survey of the species.

Scientists went to Mount Read in the 1990s and cored living specimens over 1,000 years old. They also observed that every Huon pine on Mount Read was male. After determining that this hectare-sized population represented a single genet—one clonal superorganism—they tried to measure its age. By radiocarbon dating on-site wood as well as pollen from an adjacent lakebed, they assembled strong evidence that the organism had been growing in place for at least 10,000 years. Australian newspapers hyped this "tree" as the "world's oldest known living organism." The government soon banned logging in the area and established a strict reserve, meaning the general public cannot visit.

Huon pine is one of the very few species known to produce millennial growers at both the individual and the clonal scale. In addition, its resinous wood is so impervious to rot that multi-millennial trunks in pristine condition have been unearthed from riverine sediment. This kind of preserved material is called "subfossil wood." Thus this Tasmanian species is a trifecta of old age.

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ENDANGERED SPECIES NATURE PLANTS TREES