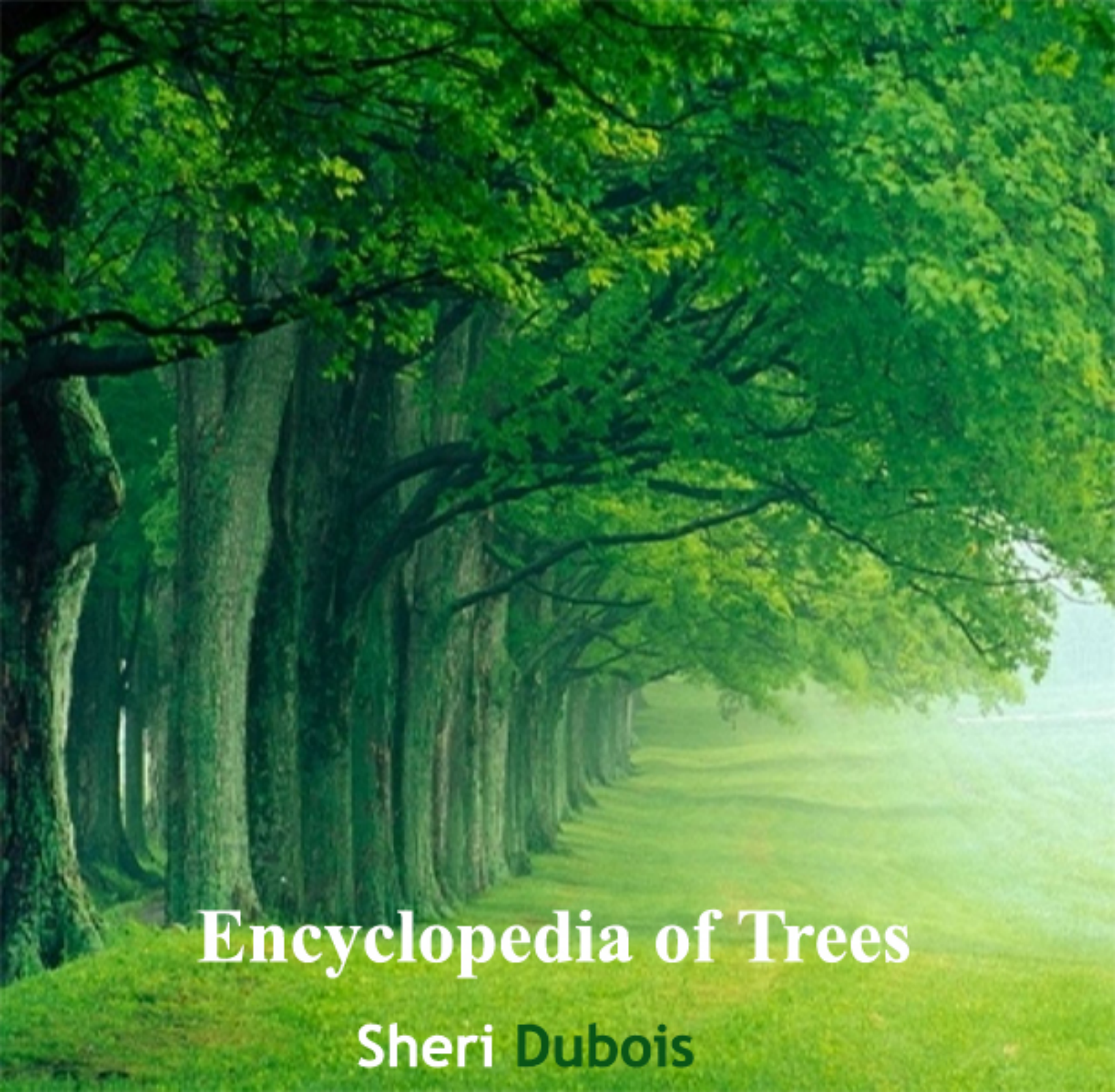
Encyclopedia of Trees
Sheri Dubois

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Chapter-1

Tree

Trees on a mountain in northern Utah during early autumn

Trunk base of a Coast Redwood tree in Jedediah Smith Redwoods State Park: Simpson Reed Discovery Trail, near Crescent City, California

A **tree** is a perennial woody plant. It is most often defined as a woody plant that has many secondary branches supported clear of the ground on a single main stem or trunk with clear apical dominance. A minimum height specification at maturity is cited by some authors, varying from 3 m to 6 m; some authors set a minimum of 10 cm trunk diameter (30 cm girth). Woody plants that do not meet these definitions by having multiple stems and/or small size are called shrubs. Compared with most other plants, trees are long-lived, some reaching several thousand years old and growing to up to 115 m (379 ft) high.

Trees are an important component of the natural landscape because of their prevention of erosion and the provision of a weather-sheltered ecosystem in and under their foliage. They also play an important role in producing oxygen and reducing carbon dioxide in the atmosphere, as well as moderating ground temperatures. They are also elements in landscaping and agriculture, both for their aesthetic appeal and their orchard crops (such as apples). Wood from trees is a building material, as well as a primary energy source in many developing countries. Trees also play a role in many of the world's mythologies.

Classification

A Sweet Chestnut tree in Ticino, Switzerland

A tree is a plant form that occurs in many different orders and families of plants. Trees show a variety of growth forms, leaf type and shape, bark characteristics and reproductive organs.

The tree form has evolved separately in unrelated classes of plants, in response to similar environmental challenges, making it a classic example of parallel evolution. With an estimate of 100,000 tree species, the number of tree species worldwide might total 25 percent of all living plant species. The majority of tree species grow in tropical regions of the world and many of these areas have not been surveyed yet by botanists, making species diversity and ranges poorly understood.

Tropical tree in Campeche, Mexico

The earliest trees were tree ferns, horsetails and lycophytes, which grew in forests in the Carboniferous period; tree ferns still survive, but the only surviving horsetails and lycophytes are not of tree form. Later, in the Triassic period, conifers, ginkgos, cycads and other gymnosperms appeared, and subsequently flowering plants in the Cretaceous period. Most species of trees today are flowering plants (Angiosperms) and conifers.

A small group of trees growing together is called a grove or **copse**, and a landscape covered by a dense growth of trees is called a **forest**. Several biotopes are defined largely by the trees that inhabit them; examples are rainforest and taiga. A landscape of trees scattered or spaced across grassland (usually grazed or burned over periodically) is called a **savanna**. A forest of great age is called **old growth forest** or **ancient woodland** (in the UK). A young tree is called a sapling.

Morphology

Beech leaves

Tree roots anchor the structure and provide water and nutrients. The ground has eroded away around the roots of this young pine tree.

The parts of a tree are the roots, trunk(s), branches, twigs and leaves. Tree stems consist mainly of support and transport tissues (xylem and phloem). Wood consists of *xylem* cells, and bark is made of *phloem* and other tissues external to the vascular cambium. Trees may be grouped into *exogenous* and *endogenous* trees according to the way in which their stem diameter increases. Exogenous trees, which comprise the great majority of trees (all conifers, and almost all broadleaf trees), grow by the addition of new wood outwards, immediately under the bark. Endogenous trees, mainly in the monocotyledons (e.g., palms and dragon trees), but also cacti, grow by addition of new material inwards.

As an exogenous tree grows, it creates growth rings as new wood is laid down concentrically over the old wood. In species growing in areas with seasonal climate changes, wood growth produced at different times of the year may be visible as alternating light and dark, or soft and hard, rings of wood. In temperate climates, and tropical climates with a single wet-dry season alternation, the growth rings are annual, each pair of light and dark rings being one year of growth; these are known as annual rings. In areas with two wet and dry seasons each year, there may be two pairs of light and dark rings each year; and in some (mainly semi-desert regions with irregular rainfall), there may be a new growth ring with each rainfall. In tropical rainforest regions, with

constant year-round climate, growth is continuous and the growth rings are not visible nor is there a change in the wood texture. In species with annual rings, these rings can be counted to determine the age of the tree, and used to date cores or even wood taken from trees in the past, a practice known as the science of dendrochronology. Very few tropical trees can be accurately dated in this manner. Age determination is also impossible in endogenous trees.

The roots of a tree are generally embedded in earth, providing anchorage for the above-ground biomass and absorbing water and nutrients from the soil. However, while ground nutrients are essential to a tree's growth the majority of its biomass comes from carbon dioxide absorbed from the atmosphere. Above ground, the trunk gives height to the leaf-bearing branches, aiding in competition with other plant species for sunlight. In many trees, the arrangement of the branches optimizes exposure of the leaves to sunlight.

Not all trees have all the plant organs or parts mentioned above. For example, most palm trees are not branched, the saguaro cactus of North America has no functional leaves, tree ferns do not produce bark, etc. Based on their general shape and size, all of these are nonetheless generally regarded as trees. A plant form that is similar to a tree, but generally having smaller, multiple trunks and/or branches that arise near the ground, is called a shrub. However, no precise differentiation between shrubs and trees is possible. Given their small size, bonsai plants would not technically be 'trees', but one should not confuse reference to the form of a species with the size or shape of individual specimens. A spruce seedling does not fit the definition of a tree, but all spruces are trees.

Record breaking trees

The world's champion trees can be rated on height, trunk diameter or girth, total size, and age.

Tallest trees

The heights of the tallest trees in the world have been the subject of considerable dispute and much exaggeration. Modern verified measurements with laser rangefinders, other measuring devices, or with tape drop measurements made by tree climbers (such as those carried out by canopy researchers or members of groups like the U.S. Eastern Native Tree Society), have shown that some older measuring methods and measurements are often unreliable, sometimes producing exaggerations of 5% to 15% or more above the real height. Historical claims of trees growing to 130 m (427 ft), and even 150 m (492 ft), are now largely disregarded as unreliable, and attributed to human error. Historical records of fallen trees measured prostrate on the ground are considered to be somewhat more reliable. The following are now accepted as the top ten tallest reliably measured species (taken only currently standing specimens):

1. Coast Redwood (*Sequoia sempervirens*): **115.56 m (379.1 ft)**, Redwood National Park, California, United States

2. Australian Mountain-ash (*Eucalyptus regnans*): **99.6 m (326.8 ft)**, south of Hobart, Tasmania, Australia
3. Coast Douglas-fir (*Pseudotsuga menziesii*): **99.4 m (326.1 ft)**, Brummit Creek, Coos County, Oregon, United States
4. Philippine rosewood (*Petersianthus quadrialatus*): **96.9 m (317.9 ft)**, Agusan del Sur, Mindanao, Philippines (it is possible that it is slightly lower, because the height might include Christmas decorations on the top of the tree)
5. Sitka Spruce (*Picea sitchensis*): **96.7 m (317.3 ft)**, Prairie Creek Redwoods State Park, California, United States
6. Giant Sequoia (*Sequoiadendron giganteum*): **94.9 m (311.4 ft)**, Redwood Mountain Grove, Kings Canyon National Park, California, United States
7. Tasmanian Blue Gum (*Eucalyptus globulus*): **90.7 m (297.6 ft)**, Tasmania, Australia
8. Manna Gum (*Eucalyptus viminalis*): **89 m (292 ft)**, Evercreech Forest Reserve, Tasmania, Australia
9. *Shorea faguetiana*: **88.3 m (289.7 ft)** Tawau Hills National Park, in Sabah on the island of Borneo
10. Alpine Ash (*Eucalyptus delegatensis*): **87.9 m (288.4 ft)**, Tasmania, Australia

A view of a tree from below; this may exaggerate apparent height

Stoutest trees

The girth of a tree is usually much easier to measure than the height, as it is a simple matter of stretching a tape round the trunk, and pulling it taut to find the circumference. Despite this, UK tree author Alan Mitchell made the following comment about measurements of yew trees:

The aberrations of past measurements of yews are beyond belief. For example, the tree at Tisbury has a well-defined, clean, if irregular bole at least 1.5 m long. It has been found to have a girth that dilated and shrunk in the following way: 11.28 m (1834 Loudon),

9.3 m (1892 Lowe), 10.67 m (1903 Elwes and Henry), 9.0 m (1924 E. Swanton), 9.45 m (1959 Mitchell) ... Earlier measurements have therefore been omitted."

As a general standard, tree girth is taken at 'breast height'. This is cited as **dbh** (diameter at breast height) in tree and forestry literature. Breast height is defined differently in different situations, with most forestry measurements taking girth at 1.3 m above ground, while those who measure ornamental trees usually measure at 1.5 m above ground; in most cases this makes little difference to the measured girth. On sloping ground, the "above ground" reference point is usually taken as the highest point on the ground touching the trunk, but some use the average between the highest and lowest points of ground. Some of the inflated old measurements may have been taken at ground level. Some past exaggerated measurements also result from measuring the complete next-to-bark measurement, pushing the tape in and out over every crevice and buttress.

Modern trends are to cite the tree's diameter rather than the circumference. Diameter of the tree is calculated by finding the medium diameter of the trunk, in most cases obtained by dividing the measured circumference by π; this assumes the trunk is mostly circular in cross-section (an oval or irregular cross-section would result in a mean diameter slightly greater than the assumed circle). Accurately measuring circumference or diameter is difficult in species with the large buttresses that are especially characteristic in many species of rainforest trees. Simple measurement of circumference of such trees can be misleading when the circumference includes much empty space between buttresses.

One further problem with measuring baobabs *Adansonia* is that these trees store large amounts of water in the very soft wood in their trunks. This leads to marked variation in their girth over the year (though not more than about 2.5%), swelling to a maximum at the end of the rainy season, minimum at the end of the dry season.

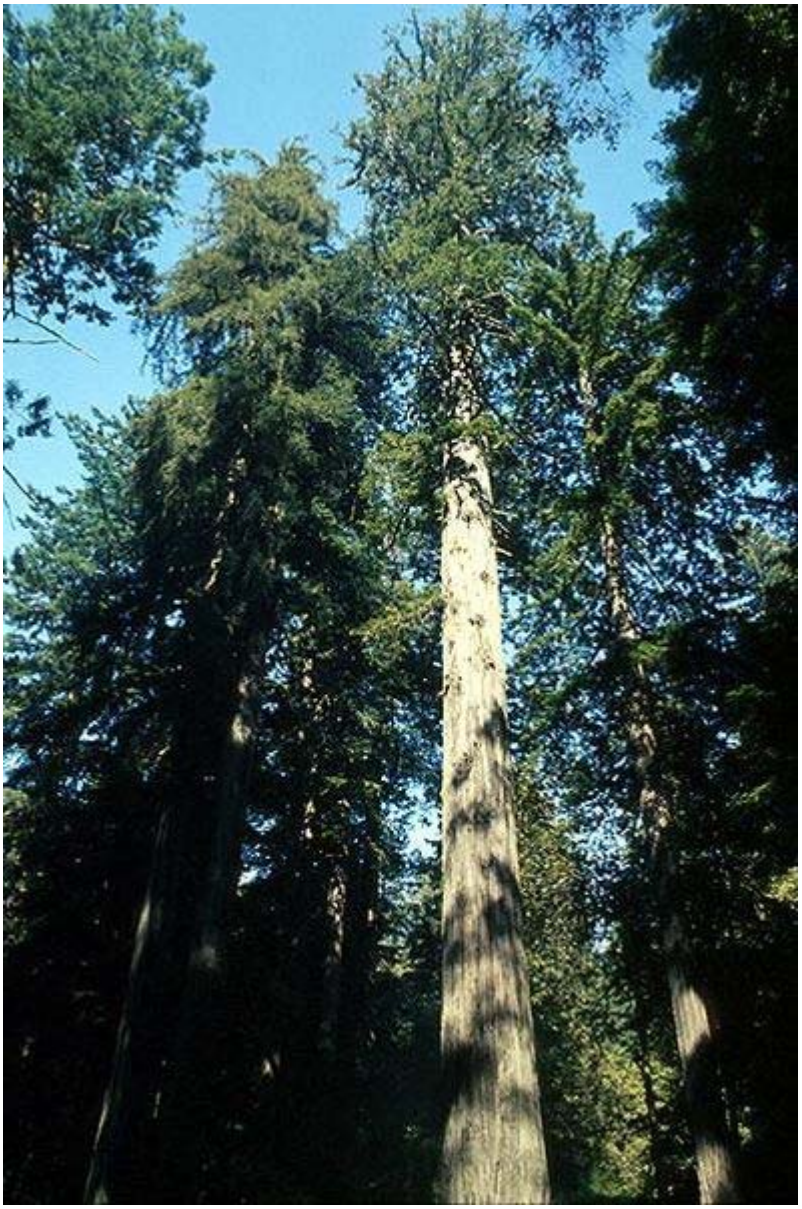
The stoutest living single-trunk species in diameter are:

1. African Baobab *Adansonia digitata*: **15.9 m (52 ft)**, Glencoe Baobab (measured near the ground), Limpopo Province, South Africa. This tree split up in November 2009 and now the stoutest baobab could be Sunland Baobab (South Africa) with idealised diameter 10.64 m and correct circumference - 33.4 m.
2. Montezuma Cypress *Taxodium mucronatum*: **11.62 m (38.1 ft)**, Árbol del Tule, Santa Maria del Tule, Oaxaca, Mexico. Note though that this diameter includes buttressing; the actual idealised diameter of the area of its wood is 9.38 m (30.8 ft).
3. Giant Sequoia *Sequoiadendron giganteum*: **8.85 m (29 ft)**, General Grant tree, General Grant Grove, California, United States
4. Coast Redwood *Sequoia sempervirens*: **7.9 m (25.9 ft)**, Lost Monarch Jedediah Smith Redwoods State Park, California, United States.
5. Australian Oak *Eucalyptus obliqua*: **6.72 m (22 ft)**
6. Australian Mountain-ash *Eucalyptus regnans*: **6.52 m (21.4 ft)**, Big Foot
7. Western Redcedar *Thuja plicata*: **5.99 m (19.7 ft)**, Kalaloch Cedar, Olympic National Park

8. Sitka Spruce *Picea sitchensis*: **5.39 m (17.7 ft)**, Quinalt Lake Spruce, Olympic National Park
9. Alerce *Fitzroya cupressoides*: **5.0 m (16.4 ft)**

An additional problem lies in instances where multiple trunks (whether from an individual tree or multiple trees) grow together. The Sacred Fig is a notable example of this, forming additional 'trunks' by growing adventitious roots down from the branches, which then thicken up when the root reaches the ground to form new trunks; a single Sacred Fig tree can have hundreds of such trunks.

Largest trees



The coniferous Coast Redwood is the tallest tree species on earth.

The largest trees in total volume are both tall and large in diameter and, in particular, hold a large diameter high up the trunk. Measurement is very complex, particularly if branch volume is to be included as well as the trunk volume, so measurements have only been made for a small number of trees, and generally only for the trunk. No attempt has ever been made to include root volume. Measuring standards vary.

The top ten species measured so far are*:

1. Giant Sequoia *Sequoiadendron giganteum*: **1,487 m³** (52,508 cu ft), General Sherman
2. Coast Redwood *Sequoia sempervirens*: **1,203 m³** (42,500 cu ft), Lost Monarch
3. Montezuma Cypress *Taxodium mucronatum*: **750 m³** (25,000 cu ft), Árbol del Tule
4. Western Redcedar *Thuja plicata*: **500 m³** (17,650 cu ft), Quinault Lake Redcedar
5. Tasmanian Blue Gum *Eucalyptus globulus*: **368 m³** (13,000 cu ft), Rullah Longatyle (Strong Girl, also Grieving Giant)
6. Australian Mountain-ash *Eucalyptus regnans*: **360 m³** (12,714 cu ft), Arve Big Tree
7. Coast Douglas-fir *Pseudotsuga menziesii* **349 m³** (12,320 cu ft) Red Creek Tree
8. Sitka Spruce *Picea sitchensis* **337 m³** (11,920 cu ft) Queets Spruce
9. Australian Oak *Eucalyptus obliqua*: **337 m³** (11,920 cu ft) Gothmog
10. Alpine Ash *Eucalyptus delegatensis*: **286 m³** (10,100 cu ft), located in Styx River Valley

(*)This list does not take into account now dead specimens.

Smallest tree

Many fully grown mature trees may be very short due to environmental factors or disease. However healthy and well grown specimens of a few species of tree only reach a height of a few centimetres. Amongst these is Lepidothamnus laxifolius believed to be the shortest conifer in the world.

Oldest trees

The oldest trees are determined by growth rings, which can be seen if the tree is cut down, or in cores taken from the bark to the center of the tree. Accurate determination is only possible for trees that produce growth rings, generally those in seasonal climates. Trees in uniform non-seasonal tropical climates grow continuously and do not have distinct growth rings. It is also only possible for trees that are solid to the center. Many very old trees become hollow as the dead heartwood decays. For some of these species, age estimates have been made on the basis of extrapolating current growth rates, but the results are usually largely speculation. White (1998) proposes a method of estimating the age of large and veteran trees in the United Kingdom through the correlation between a tree's stem diameter, growth character and age.

The verified oldest measured ages are:

1. Great Basin Bristlecone Pine (Methuselah) *Pinus longaeva*: 4,844 years
2. Alerce *Fitzroya cupressoides*: 3,622 years
3. Giant Sequoia *Sequoiadendron giganteum*: 3,266 years
4. Sugi *Cryptomeria japonica*: 3,000 years
5. Huon-pine *Lagarostrobos franklinii*: 2,500 years

Other species suspected of reaching exceptional age include European Yew *Taxus baccata* (probably over 2,000 years) and Western Redcedar *Thuja plicata*. The oldest known European Yew is the Llangernyw Yew in the Churchyard of Llangernyw village in North Wales, which is estimated to be between 4,000 and 5,000 years old.

The oldest reported age for an angiosperm tree is 2293 years for the Sri Maha Bodhi Sacred Fig (*Ficus religiosa*) planted in 288 BC at Anuradhapura, Sri Lanka. This is also the oldest human-planted tree with a known planting date.

Damage

El Grande, about 280 feet high, the most massive (though not the tallest) *Eucalyptus regnans* was accidentally killed by loggers burning-off the remains of legally loggable trees (less than 280 ft) that had been felled all around it.

The two sources of tree damage are either biotic (from living sources) or abiotic (from non-living sources). Biotic sources include insects that bore into the tree, deer that rub bark off, and fungi.

Abiotic sources include lightning, vehicles impacts, and construction activities. Construction activities can involve a number of damage sources, including grade changes that prevent aeration to roots, spills involving toxic chemicals such as cement or petroleum products, or severing of branches or roots.

Both damage sources can result in trees becoming dangerous, and the term "hazard trees" is commonly used by arborists, and industry groups such as power line operators. Hazard trees are trees that, due to disease or other factors, are more susceptible to falling in windstorms, or having parts of the tree fall.

Evaluating the danger a tree presents is based on a process called the Quantified Tree Risk Assessment.

Assessment as to labeling a tree a hazard tree can be based on a field examination. Assessment as a result of construction activities that will damage a tree is based on three factors: severity, extent and duration. Severity relates usually to the degree of intrusion into the TPZ and resultant root loss. Extent is frequently a percentage of a factor such as canopy, roots or bark, and duration is normally based on time. Root severing is considered permanent in time.

Trees are similar to people. Both can withstand massive amounts of some types of damage and survive, but even small amounts of certain types of trauma can result in death. Arborists are very aware that established trees will not tolerate any appreciable disturbance of the root system. However, lay people and construction professionals are seldom cognizant of how easily a tree can be killed.

One reason for confusion about tree damage from construction involves the dormancy of trees during winter. Another factor is that trees may not show symptoms of damage until 24 months or longer after damage has occurred. For that reason, persons uneducated in arboriculture science may not correlate the actual cause and resultant effect.

Various organizations, such as the International Society of Arboriculture, the British Standards Institute and the National Arborist Association (about 2007 renamed the Tree Industry Association), have long recognized the importance of construction activities that impact tree health. The impacts are important because they can result in monetary losses due to tree damage and resultant remediation or replacement costs, as well as violation of government ordinances or community or subdivision restrictions.

As a result, protocols for tree management prior to, during and after construction activities are well established, tested and refined. These basic steps are involved:

- Review of the construction plans

- Development of the related tree inventory
- Application of standard construction tree management protocols
- Assessment of potential for expected tree damages
- Development of a tree protection plan (providing for pre-, concurrent, and post construction damage prevention and remediation steps)
- Development of a tree protection plan
- Development of a remediation plan
- Implementation of tree protection zones (TPZ)
- Assessment of construction tree damage, post-construction
- Implementation of the remediation plan

International standards are uniform in analyzing damage potential and sizing TPZs (tree protection zones) to minimize damage. For mature to fully mature trees, the accepted TPZ comprises a 1.5-foot (0.46 m) set-off for every 1-inch (25 mm) diameter of trunk. That means for a 10-inch (250 mm) tree, the TPZ would extend 15 feet (4.6 m) in all directions from the base of the trunk at ground level.

For young or small trees with minimal crowns (and trunks less than 4 inches (100 mm) in diameter) a TPZ equal to 1-foot (0.30 m) for every inch of trunk diameter may suffice. That means for a 3-inch (76 mm) tree, the TPZ would extend 3 feet (0.91 m) in all directions from the base of the trunk at ground level. Detailed information on TPZs and related topics is available at minimal cost from organizations like the International Society for Arboriculture.

Trees in culture

The tree has always been a cultural symbol. Common icons are the World tree, for instance Yggdrasil, and the tree of life. The tree is often used to represent nature or the environment itself. A common misconception is that trees get most of their mass from the ground. In fact, 99% of a tree's mass comes from the air.

Tree value estimation

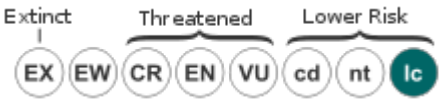
Studies have shown that trees contribute as much as 27% of the appraised land value in certain markets.

Chapter-2

Abies Procera and Adansonia Digitata

Abies procera

Abies procera **Noble Fir**

Conservation status

Least Concern (IUCN 2.3)
Scientific classification

Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Pinaceae

Genus: *Abies*

Species: ***A. procera***

Binomial name

Abies procera
Rehder

Abies procera, the **Noble Fir**, is a western North American fir, native to the Cascade Range and Coast Range mountains of extreme northwest California and western Oregon and Washington in the United States. It is a high altitude tree, typically occurring at 300–1,500 metres (980–4,900 ft) altitude, only rarely reaching tree line.

Cone

Description

Abies procera is a large evergreen tree typically up to 40–70 m (130–230 ft.) tall and 2 m (6.5 ft.) trunk diameter, rarely to 90 m (295 ft.) tall and 2.7 m (8.9 ft.) diameter, with a narrow conic crown. The bark on young trees is smooth, grey, and with resin blisters, becoming red-brown, rough and fissured on old trees. The leaves are needle-like, 1-3.5 cm long, glaucous blue-green above and below with strong stomatal bands, and a blunt to notched tip. They are arranged spirally on the shoot, but twisted slightly s-shaped to be upcurved above the shoot. The cones are erect, 11–22 cm long, with the purple scales almost completely hidden by the long exserted yellow-green bract scales; ripening brown and disintegrating to release the winged seeds in fall.

Foliage

Abies procera is very closely related to Red Fir (*Abies magnifica*), which replaces it further southeast in southernmost Oregon and California, being best distinguished by the leaves having a groove along the midrib on the upper side; Red Fir does not show this. Red Fir also tends to have the leaves less closely packed, with the shoot bark visible between the leaves, whereas the shoot is largely hidden in Noble Fir. Red Fir cones also mostly have shorter bracts, except in *Abies magnifica* var. *shastensis*; this variety is considered by some botanists to be a hybrid between Noble Fir and Red Fir.

Uses

Noble Fir is a popular Christmas tree. The wood is used for general structural purposes and paper manufacture.

Adansonia digitata

Adansonia digitata

Baobab tree in Tanzania

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Malvales
Family:	Malvaceae
Genus:	*Adansonia*
Species:	***A. digitata***

Binomial name
Adansonia digitata L.

Adansonia digitata, the **baobab**, is the most widespread of the *Adansonia* species on the African continent, found in the hot, dry savannahs of sub-Saharan Africa. It also grows, having spread secondary to cultivation, in populated areas. The northern limit of its distribution in Africa is associated with rainfall patterns; only on the Atlantic coast and in the Sudan does its occurrence venture naturally into the Sahel. On the Atlantic coast this may be due to spreading after cultivation. Its occurrence is very limited in Central Africa and it is found only in the very north of Southern Africa. In Eastern Africa the trees grow also in shrublands and on the coast. In Angola and Namibia the baobabs grow in woodlands, and in coastal regions, in addition to savannahs. Also found in Dhofar region of Oman and Yemen in the Arabian Peninsula, Asia. This tree was found recently in India in the states of Andhra Pradesh (although this claim is disputed) and in Karnataka

Growth

Each leaf comprises five leaflets.

Baobab flower

The trees usually grow as solitary individuals, and are large and distinctive trees on the savannah, in the scrub, and near settled areas, with some large individuals living to well over a thousand years of age. The tree bears very large, heavy white flowers. The showy flowers are pendulous with a very large number of stamens. They carry a carrion scent and researchers have shown that they appear to be primarily pollinated by fruit bats of the subfamily Pteropodinae. The fruits are filled with pulp that dries, hardens, and falls to pieces which look like chunks of powdery, dry bread.

The specific epithet *digitata* refers to the fingers of a hand, which the five leaflets (typically) in each cluster bring to mind.

The baobab is a traditional food plant in Africa, but is little-known elsewhere. It has been suggested that the vegetable has the potential to improve nutrition, boost food security, foster rural development, and support sustainable land care.

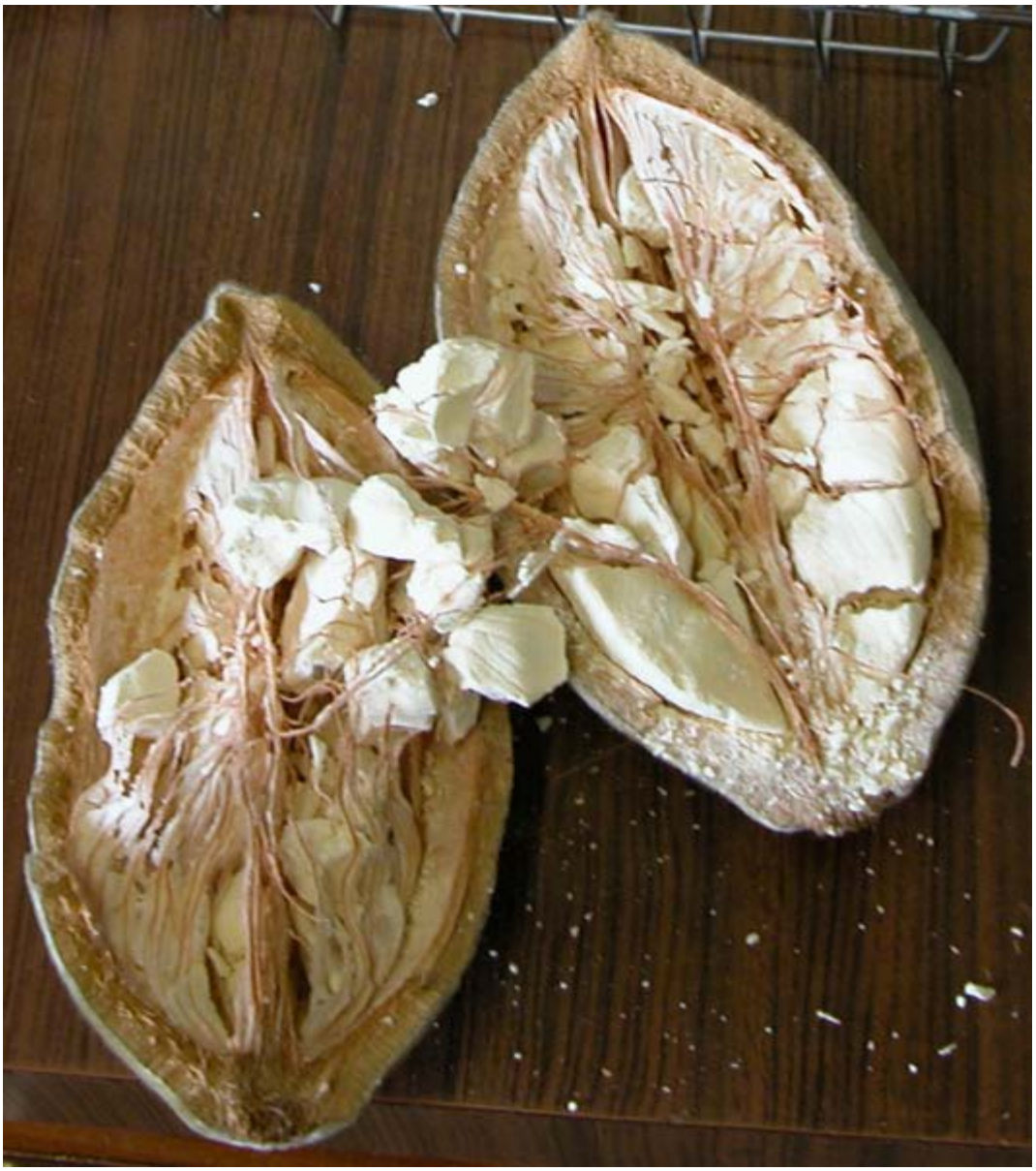
Vernacular names

Adansonia digitata is known by many common names, the most common of which is **baobab**. It is also known as the *dead-rat tree* (from the appearance of the fruits), *monkey-bread tree* (the soft, dry fruit is edible), *upside-down tree* (the sparse branches resemble roots) and *cream of tartar tree*. In French, it is known as *calebassier du Sénégal* and

arbre de mille ans; in Portuguese as *molambeira*, *imbondeiro*, *calabaceira* and *cabacevre*; and in Swahili as *mbuyu*, *mkuu hapingwa*, *mkuu hafungwa* and *muuyu*.

It is called *momret* in the Tigrigna language of Ethiopia, where it favors lowland areas with moist and well-drained soils, such as the valley of the Tekeze River lowlands, and "kuka" by the Hausa speaking people of West Africa. In Nigeria, it is a very popular tree in the savannahs of the north and its leaves are used to prepare local soup called "miyan kuka". In Sudan, the tree is called "tabaldi" and its fruit is called "gongu laze".

Fruit



The fruit can be up to 25 centimetres (10 in) long and is used to make a drink.

The African baobab's fruit is 6 to 8 inches or 15 to 20 centimetres long. It contains 50% more calcium than spinach, is high in anti-oxidants, and has three times the vitamin C of an orange. It is sometimes called a superfruit. The leaves can be eaten as relish, while the fruit dissolved in milk or water can be used as a drink. The seeds also produce edible oil.

In 2008, the European Union approved the use and consumption of baobab fruit as an ingredient in smoothies and cereal bars.

The United States Food and Drug Administration granted generally recognized as safe status to baobab dried fruit pulp as a food ingredient in 2009.

To grow *A. digitata* from a seed, cutting into the thick seed coat greatly speeds up germination, from months or years to seven days.

Chapter-3

Eucalyptus Delegatensis and Eucalyptus Globulus

Eucalyptus delegatensis

Eucalyptus delegatensis, commonly known as **Alpine Ash** or **Gum-topped stringybark** or **White-top,** is a sub-alpine or temperate tree of southeastern Australia. A straight, grey-trunked tree, it reaches heights of over 90 metres in suitable conditions. The tallest currently known specimen is located in Tasmania and is 87.9 m tall.

Among flowering plants, only the *Eucalyptus regnans* (Mountain Ash) grows taller, the Tasmanian Blue Gum, the Manna Gum, the Messmate Stringybark, the *Shorea faguetiana*, the *Koompassia excelsa* and possibly also the *Eucalyptus nitens* and the *Allantospermum borneense* about the same.

The bark is thick and fibrous at the base, smooth on the smaller branches. In the Tasmanian subspecies, the entire trunk and the larger limbs are thick-barked; in the mainland subspecies the rough bark extends only part-way up the trunk.

The nominate subspecies is native to cool, deep soiled, mountainous areas between 850m and 1500 m in Victoria and New South Wales; *E. d. tasmaniensis* is found in most higher-altitude parts of Tasmania apart from the south-west.

Alpine Ash requires very high rainfall by Australian standards — over 1200mm (47 inches) per year and snow or frosts during the winter months. It is an important tree for the timber industry, often grouped with Mountain Ash, Messmate Stringybark and sold as Vic(torian) Ash or Tas(manian) Oak.

Alpine Ash regenerates only from seed. While occasional fires do not severely impact Alpine Ash forest, repeated fires in the same area can wipe stands out because it takes roughly twenty years for seedlings to reach sexual maturity.

Eucalyptus globulus

Eucalyptus globulus

E. globulus in Hawaii.

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Myrtaceae
Genus:	*Eucalyptus*
Species:	***E. globulus***

Binomial name

Eucalyptus globulus
Labill.

The **Tasmanian Blue Gum**, **Southern Blue Gum** or **Blue Gum**, (*Eucalyptus globulus*) is an evergreen tree, one of the most widely cultivated trees native to Australia. They typically grow from 30 to 55 m (98 to 180 ft) tall. The tallest currently known specimen in Tasmania is 90.7 m tall. There are historical claims of even taller trees, the tallest being 101 m (330 ft). The natural distribution of the species includes Tasmania and southern Victoria (particularly the Otway Ranges and southern Gippsland). There are also isolated occurrences on King Island and Flinders Island in Bass Strait and on the summit of the You Yangs near Geelong. There are naturalized non-native occurrences in southern Europe (Galicia and Portugal), southern Africa, New Zealand, western United States (California), Hawaii and Macaronesia.

The d'Entrecasteaux expedition made immediate use of the species when they discovered it, the timber was used to improve their oared boats. The Tasmanian Blue Gum was proclaimed as the floral emblem of Tasmania on 27 November 1962. The species name is from the Latin *globulus*, a little button, referring to the shape of the operculum.

Description

The bark sheds often, peeling in large strips. The broad juvenile leaves are borne in opposite pairs on square stems. They are about 6 to 15 cm long and covered with a blue-grey, waxy bloom, which is the origin of the common name "blue gum". The mature leaves are narrow, sickle-shaped and dark shining green. They are arranged alternately on rounded stems and range from 15 to 35 cm in length. The buds are top-shaped, ribbed and warty and have a flattened operculum (cap on the flower bud) bearing a central knob. The cream-colored flowers are borne singly in the leaf axils and produce copious nectar that yields a strongly flavored honey. The fruits are woody and range from 1.5 to 2.5 cm in diameter. Numerous small seeds are shed through valves (numbering between 3 and 6 per fruit) which open on the top of the fruit. It produces roots throughout the soil profile, rooting several feet deep in some soils. They do not form taproots.

The plant was first described by the French botanist Jacques Labillardière in his publications *Relation du Voyage à la Recherche de la Pérouse* (1800) and *Novae Hollandiae Plantarum Specimen* (1804). The author collected specimens at Recherche Bay during the d'Entrecasteaux expedition in 1792.

Plantations

E. Globulus in Hermosillo, Sonora

Blue gum is one of the most extensively planted eucalypts. Its rapid growth and adaptability to a range of conditions is responsible for its popularity. It is especially well-suited to countries with a Mediterranean-type climate, but also grows well in high altitudes in the tropics.

It comprises 65% of all plantation hardwood in Australia with approximately 4,500 km² planted. The tree is widely cultivated elsewhere in the world. It is primarily planted as a pulpwood, and also as an important fuelwood in many countries.

Blue gums have historically been used as street trees but are now regarded as unsuitable by many municipalities due to their rapid growth and mature size.

Uses

Timber

Blue gum timber is yellow-brown, fairly heavy, with an interlocked grain, and is difficult to season. It has poor lumber qualities due to growth stress problems, but can be used in construction, fence posts and poles.

Essential oil

The leaves are steam distilled to extract eucalyptus oil. *E.globulus* is the primary source of global eucalyptus oil production, with China being the largest commercial producer. The oil has therapeutic, perfumery, flavoring, antimicrobial and biopesticide properties. Oil yield ranges from 1.0-2.4% (fresh weight), with cineole being the major isolate. *E.globulus* oil has established itself internationally because it is virtually phellandrene free, a necessary characteristic for internal pharmaceutical use. In 1870, Cloez, identified and ascribed the name "eucalyptol" — now more often called cineole — to the dominant portion of *E. globulus* oil.

Herb tea

Tasmanian blue gum leaves are used as a therapeutic herbal tea.

Honey

Blue gum flowers are considered a good source of nectar and pollen for bees.

Environmental weed

It was introduced to California in the mid-19th century, partly in response to the Southern Pacific Railroad's need for timber to make railroad ties, and is prominent in many parks in San Francisco and throughout the state. Naturalists, ecologists, and the United States National Park Service consider it an invasive species due to its ability to quickly spread and displace native plant communities, while local authorities, especially many fire departments across California consider them to be a major fire hazard, although the United States Department of Agriculture does not list it among its Invasive and Noxious plants list in California. Due to such reasons, programs across the state of California have been taken to remove all eucalyptus growth and restore native biomes in some park areas, such as on Angel Island in San Francisco Bay, and in the Hills of Oakland California, where Eucalyptus Trees helped fuel the 1991 Oakland Hills Firestorm.

Related species

Many botanists treat the Tasmanian Blue Gum as a subspecies of a broader species concept. This broader *E. globulus* includes the following subspecies:

- *E. globulus* subsp. *bicostata* = *E. bicostata* - Southern Blue Gum, Eurabbie, Victorian Blue Gum
- *E. globulus* subsp. *globulus* = *E. globulus* - Tasmanian Blue Gum
- *E. globulus* subsp. *maidenii*= *E. maidenii* - Maiden's Gum
- *E. globulus* subsp. *pseudoglobulus* = *E. pseudoglobulus* - Gippsland Blue Gum, Victorian Eurabbie

The broader *E. globulus* concept is supported by Royal Botanic Gardens, Melbourne and the Tasmanian Herbarium, but not by Royal Botanic Gardens, Sydney where the four taxa are considered distinct species.

Chapter-4

Eucalyptus Oblique and Eucalyptus Regnans

Eucalyptus obliqua

Messmate Stringybark

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Myrtaceae
Genus:	*Eucalyptus*
Species:	***E. obliqua***

Binomial name

Eucalyptus obliqua

L'Hér.

Eucalyptus obliqua, commonly known as **Australian Oak**, **Brown Top**, **Brown Top Stringbark**, **Messmate**, **Messmate Stringybark**, **Stringybark** and **Tasmanian Oak**, is a hardwood tree native to south-eastern Australia.

Description

It grows as a tree up to 90 metres tall, with a trunk up to three metres in diameter. It has a lignotuber, so burnt or coppiced trees sometimes recover in mallee form. It has thick, rough, stringy bark, and glossy green leaves from six to 22 centimetres long, and 1½ to 7 centimetres wide. Inflorescences consist of seven to 15 white flowers. The fruits are barrel-shaped. Currently, the tallest known specimen is 86 m tall and located in Tasmania. Historically, qualified surveyors have documented trees up to 98.8 m (324 ft).

Taxonomy

E. obliqua has the taxonomic distinction of being the first *Eucalyptus* species discovered and published. It was first collected in 1777 during Cook's third expedition; the botanist David Nelson collected the specimen from Bruny Island, an island which is part of Tasmania. This specimen was sent to the British Museum in London, where it was examined by the French botanist Charles Louis L'Héritier de Brutelle. L'Héritier used it as the type species for a new genus, which he published in 1788. He named the genus *Eucalyptus* from the Greek *eu* ("good, well") and *calyptos* ("covered") in reference to the flower bud cap. He gave this species the name *obliqua* from the Latin *obliquus* ("oblique"), in reference to the leaf bases of unequal length. Thus the full name of the species is ***Eucalyptus obliqua* L.Her.**

The species has a great many synonyms:

- *Eucalyptus nervosa* Miq. nom. illeg.
- *Eucalyptus fabrorum* Schltdl.
- *Eucalyptus falcifolia* Miq.
- *Eucalyptus pallens* DC.
- *Eucalyptus heterophylla* Miq.
- *Eucalyptus procera* Dehnh.
- *Eucalyptus obliqua* var. *degressa* Blakely
- *Eucalyptus obliqua* var. *megacarpa* Blakely
- *Eucalyptus obliqua* L.Her. var. *obliqua*

Distribution and habitat

E. obliqua is widespread in cooler areas of south eastern Australia. It occurs from Kangaroo Island, through southeast South Australia, throughout Victoria and Tasmania, mainly east of the tablelands in New South Wales, with a few populations extending into southern Queensland. Thus the overall range of latitude is 28–43½°S. It occurs from sea

level up to elevations of 1200 metres in the Northern Tablelands of New South Wales. The climate is humid or subhumid, with temperatures ranging from cool to warm, and annual rainfall ranging from 500 to 2400 millimetres. Severe winter frosts are common, severe drought extremely uncommon.

It occurs on a wide range of soils in hilly or mountainous areas. In cool mountainous areas it forms tall open-forest with other *Eucalyptus* species such as *E. fastigata* (Brown Barrel), *E. nitens* (Shining Gum), *E. cypellocarpa* (Mountain Grey Gum), *E. viminalis* (Manna Gum) and *E. delegatensis* (Alpine Ash).

Uses

One of the most important Australian hardwoods, *E. obliqua* is often sold with *E. regnans* (Mountain Ash) as "Vic Ash" or "Tasmanian Oak". It is slightly denser that *E. regnans* - estimates of density range from 720 kg/m³ to 830 kg/m³ - and harder too. The sapwood is pale brown, the heartwood light brown. It has an even texture, with straight grains sometimes interlocked, and well-defined rings. Gum veins are common.

The timber has moderate hardness and strength, but low durability. It splits easily, and is easily worked, glued and stained; it is also suitable for steam bending. It is mostly used for pulp production and for construction and manufacture, especially in house building, joinery, flooring, and furniture.

Eucalyptus regnans

Eucalyptus regnans

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Myrtaceae
Genus:	*Eucalyptus*
Species:	***E. regnans***

Binomial name

Eucalyptus regnans
F.Muell.

E. regnans, field distribution

Eucalyptus regnans, known variously by the common names **Mountain Ash**, **Victorian Ash**, **Swamp Gum**, **Tasmanian Oak** or **Stringy Gum**, is a species of *Eucalyptus* native to southeastern Australia, in Tasmania and Victoria. Historically, it has been known to attain heights over 100 metres (330 ft) and is one of the tallest tree species in the world.

Description

It is an evergreen tree, and it is the tallest of the eucalypts, growing to 70–100 m (230–330 feet), with a straight, grey trunk, smooth-barked except for the rough basal 5–15 metres (16–49 ft). The leaves are falcate (sickle-shaped) to lanceolate, 9–14 centimetres (3.5–5.5 in) long and 1.5–2.5 centimetres (0.6–1.0 in) broad, with a long acuminate apex and smooth margin, green to grey-green with a reddish petiole. The flowers are produced in clusters of 9–15 together, each flower about 1 cm diameter with a ring of numerous white stamens. The fruit is a capsule 5–9 millimetres (0.20–0.35 in) long and 4–7 millimetres (0.16–0.28 in) broad.

Habitat

It occurs in cool, deep soiled, mostly mountainous areas to 1,000 metres (3,300 ft) altitude with high rainfall of over 1,200 millimetres (47 in) per year. They grow very quickly, at more than a metre a year, and can reach 65 metres (213 ft) in 50 years, with an average life-span of 400 years. The fallen logs continue supporting a rich variety of life for centuries more on the forest floor.

Unusually for a eucalyptus, it tends not to recover by re-shooting after fire, and regenerates only from seed. The seeds are released from their woody capsules (gumnuts) by heat and for successful germination the seedlings require a high level of light, much more than reaches the forest floor when there is a mature tree canopy. Severe fires can kill all the trees in a forest, prompting a massive release of seed to take advantage of the nutrients in the ash bed. Seedling densities of up to 2.5 million per hectare have been recorded after a major fire. Competition and natural thinning eventually reduces the mature tree density to about 30 to 40 individuals per hectare. Because it takes roughly 20 years for seedlings to reach sexual maturity, repeated fires in the same area can cause

local extinctions. If, however, no fires regenerate an area, the trees die off after about 400 years and are replaced by other species.

Giant mountain ash trees, Blackspur Range, Victoria. Photo: Bob Beale

Tallest specimens

Eucalyptus regnans is the tallest of all flowering plants, and possibly the tallest of all plants, although no living specimens can make that claim. The tallest measured living specimen, named Centurion, stands 99.6 metres tall in Tasmania. Before the discovery of the Centurion, the tallest known specimen was Icarus Dream, which was rediscovered in Tasmania in January, 2005 and is 97 metres (318 ft) high. It was first measured by

surveyors at 98.8 metres (324 ft) in 1962 but the documentation had been lost. 16 living trees in Tasmania have been reliably measured in excess of 90 metres (300 ft).

Historically, the tallest individual is claimed to be the Ferguson Tree, at 132.6 metres (435 ft), found in the Watts River region of Victoria in 1871 or 1872. This record is often disputed as unreliable, despite first-hand documentary evidence of it being measured on the ground with surveyor's tape by a senior forestry official. Widespread agreement exists, however, that an exceptionally tall individual was reliably measured at 112.8 metres (370 ft) by theodolite in 1880 by a surveyor, George Cornthwaite, at Thorpdale, Victoria (the tree is known both as the Cornthwaite or Thorpdale Tree). When it was felled in 1881, Cornthwaite remeasured it on the ground by chain at 114.3 metres (375 ft). The stump was commemorated with a plaque that exists today. That tree was about 1 metre shorter than the world's current tallest living tree, a Coast Redwood, 115.55 metres (379.1 ft).

The tallest specimens of this and many other species encountered by early European settlers are now dead as a result of bushfires, logging and advanced age. Few living specimens exceed 90 metres (300 ft); old records of logged trees make varied claims of extreme heights, but these are difficult to verify today.

Most of those claims come from Victoria. Al Carder, notes that in 1888 a cash reward of 100 pounds was offered there for the discovery of any tree measuring more than 122 metres (400 ft). The fact that such a considerable reward was never claimed is taken as evidence that such large trees did not exist. Carder's historical research, however, revealed that the reward was offered under conditions that made it highly unlikely to be collected. First, it was made in the depths of winter and applied only for a very short time. Next, the tree had to be measured by an accredited surveyor. Since loggers had already taken the largest trees from the most accessible Victorian forests, finding very tall trees then would have demanded an arduous trek into remote wilderness and at considerable altitude. In turn, that meant that searchers also needed the services of experienced bushmen to be able to guide them and conduct an effective search. Only one expedition actually penetrated one of the strongholds of *E. regnans* at Mount Baw Baw but its search was rendered ineffectual by cold and snow and managed to measure only a single living tree — the New Turkey Tree: 99.4 metres (326 ft) — before appalling conditions forced a retreat, Carder notes.

In 1911, a previously unknown report was discovered: it was written by a licensed surveyor, G.W. Robinson, who had kept his personal forestry records from six decades earlier during the 1850s in the Dandenong Ranges, near Melbourne. Robinson had arranged with loggers to notify him when they found a very tall tree, and noted that every one he measured exceeded 91 metres (299 ft), the tallest being 104 metres (341 ft). Robinson noted that the tallest trees were felled first and had no doubt that "some of the trees felled earlier would have measured quite some 400 ft".

Victoria's early State botanist, Ferdinand von Mueller, claimed to have personally measured one tree near the headwaters of the Yarra River at 122 metres (400 ft). A

government surveyor, David Boyle, claimed in 1862 to have measured a fallen tree in a deep gully in the Dandenongs at 119.5 metres (392 ft), and with a diameter at its broken tip that indicated it might have lost another eight metres of trunk when it broke, for 128 metres (420 ft).

The tops of the tallest trees are often snapped by wind: allowing for that in estimating an original height, however, presupposes that the break occurred in a hitherto undamaged tree. An alternate, and possibly more realistic scenario, is of a tree with several episodes of breakage and regrowth building up a stout stem without ever attaining the potential maximum height.

Von Mueller's early records also mention two trees on the nearby Black Spur Range, one alive and measuring 128 metres (420 ft) and another fallen tree said to measure 146 metres (479 ft), but these were either based on hearsay or uncertain reliability. David Boyle also reported that a tree at Cape Otway measured 160 metres (520 ft), but this too was based on hearsay.

Many prominent botanists and tree enthusiasts have long been sceptical of such claims because they lacked first-hand evidence from a credible source. But Carder notes that nor can all the claims be considered imaginary: "The frequency, the persistence, and the wide occurrence of the reports leads to the belief that there was some basis of fact for the statements made."

None, however, had been verified by direct documentation until 1982 when Ken Simpendorfer, a Special Projects Officer for the Forests Commission, Victoria, directed a search of official Victorian archives. It unearthed a forgotten report from more than a century earlier, one that had not been referred to in other accounts of the species up to that time. It was written on 21 February 1872, by the Inspector of State Forests, William Ferguson, and was addressed to the Assistant Commissioner of Lands and Surveys, Clement Hodgkinson. Ferguson had been instructed to explore and inspect the watershed of the Watts River and reported trees in great number and exceptional size in areas where loggers had not yet reached. He wrote: "In one instance I measured with a tape line one huge specimen that lay prostrate across a tributary of the Watts, and found it to be 435 ft [133 metres] from its root to the top of its trunk. At 5 feet from the ground it measures 18 feet in diameter, and at the extreme end where it has broken in its fall, it is 3 feet in diameter. This tree has been much burnt by fire, and I fully believe that before it fell it must have been more than 500 ft [150 metres] high. As it now lies, it forms a complete bridge across a deep ravine."

Carder concludes that the height limit for *E. regnans* is "not greatly over 300 feet now, but there is sound evidence that trees very much taller did indeed at one time stand,".

It is also possible that individual trees will again attain such heights. Author Bob Beale has recorded that the tallest trees in the Black Spur Range now measure about 85 metres (279 ft) but — due to major bushfires in the 1920s and 30s — are less than 80 years old and have been growing consistently at the rate of about one metre a year.

In New Zealand

A *Eucalyptus regnans* stand in the Orokonui Ecosanctuary near Dunedin, New Zealand (where *E. regnans* is an introduced species) contains that country's tallest measured tree.

Uses

At 92 metres (302 ft) "The Big Tree" at the centre was until recently thought to be the tallest remaining Mountain Ash.

Eucalyptus regnans is valued for its timber, and has been harvested in very large quantities. Primary uses are sawlogging and woodchipping. It was a major source of newsprint in the 20th century. Much of the present woodchip harvest is exported to Japan. While the area of natural stands with large old trees is rapidly decreasing, substantial areas of regrowth exist and it is increasingly grown in plantations, the long, straight, fast growing trunks being much more commercially valuable than the old growth timber.

It is a medium weight timber (about 680 kg/m³) and rather coarse (stringy) in texture. Gum veins are common. The wood is easy to work and the grain is straight with long, clear sections without knots. The wood works reasonably well for steam-bending. Primary uses for sawn wood are furniture, flooring (where its very pale blonde colour is

highly prized), panelling, veneer, plywood, window frames, general construction. The wood has sometimes been used for wood wool and cooperage. However, the wood needs steam reconditioning for high value applications, due to a tendency to collapse on drying. This wood is highly regarded by builders, furniture makers and architects.

Conservation

Great controversy surrounds the logging of old-growth *Eucalyptus regnans* in its natural range in both Victoria and Tasmania. Aside from its symbolic significance as the largest eucalypt of all, *Eucalyptus regnans* has value to conservationists in provides essential habitat to important birds and mammals (notably the Wedge tailed eagle, the Lyrebird and the endangered Victorian state animal emblem Leadbeater's Possum). In a land of vast, arid plains and desert, the contrasting lush fertility of mountain-ash forest is particularly dear to nature lovers.

Although its status as a species is secure, old-growth forests of *Eucalyptus regnans* are particularly susceptible to destruction by forestry. For this reason stands of very old and very tall trees exist only in pockets. Very few such stands of trees fall within those areas that have been listed as National Park or World Heritage environments. Most lie within areas controlled by state forestry management authorities and their heritage value is balanced against the commercial value of harvesting and then planting fast-growing and more productive monoculture timber crops on these comparatively well-watered and fertile areas.

In Tasmania, over 85% of old growth *E. regnans* forests have been logged. The trees continue to be clearfell logged by Gunns, a major forestry enterprise.

Political opposition to the logging of old-growth forests by the process known as clearfelling has grown very strong in recent years (particularly in the case of woodchipping), and the extent of future harvesting remains uncertain.

It has long been believed that while many species of eucalyptus successfully survived severe bushfires, forests of *Eucalyptus regnans* are highly susceptible to destruction by fire. While the process of recovery of most eucalyptus forests is rapid, so that trees that are devoid of leaves may be fully foliaged within two years, in the case of *Eucalyptus regnans*, the recovery of a forest after a severe fire might require the total regrowth from seed of the devastated area, taking perhaps 200 years or more.

It has been suggested that fire is necessary for the germination of *Eucalyptus regnans*, and that young *Eucalyptus regnans* trees flourish best where there is open space, allowing sunlight to penetrate. Prior to European intervention, indigenous land management practices involved controlled burning in order to maintain grassland. This resulted in cleared areas in forests, around the peripheries of which young trees could germinate and grow. It is probable that these indigenous practices were used within forests of *Eucalyptus regnans*. Cleared spaces also occur naturally in tall forests when an old tree

falls, or dies and loses its foliage. These very tall trees do not survive independently of each other, as single trees are more subject to lightning strikes and wind damage.

The natural habitat of the *Eucalyptus regnans* is in general the areas of Australia with the highest and most reliable precipitation. These areas are less prone to catastrophic fires than other forested areas. Research has indicated that a stand of Mountain Ash in Victoria is actually a multi-age stand due to fire, having experienced seven fires since the 15th century, whereas, since European settlement, many of Australia's Eucalyptus forests have suffered severe fires as often as every 20 years.

Studies conducted in the 20th by T. M. Cunningham and David H. Ashton suggest that the re-growth habit of *Eucalyptus regnans* requires open space, and an ash layer. For this reason clearfelling (as opposed to selective logging methods) can be justified for the successful germination and growth of seedlings, and, by hypothesis, the survival of the forest. The clearfell process can lead to spectacular and uniform regrowth of commercially viable timber, if managed properly. Those who support clearfelling see it as an ideal method of land management. Such arguments however completely overlook the impact of such activities on stream health, water yield of catchments, impacts on threatened forest fauna, and long term soil healthy and viability.

In addition to this, opponents of clearfelling point out that the forests survived for centuries without clearfelling and that it takes perhaps 300 years to replace a giant tree, commercially valuable only as woodchip, and therefore designated as "waste" by the harvesters. Opponents of clearfelling point out that the clearfell process was unavailable until the arrival of European settlers (indigenous people practised a mosaic burn system that kept the forest open but didn't remove large amounts of timber).

Half of Victoria's forested water catchment areas, which provides water requiring little treatment, are composed of *E. regnans* forest. Yields from these catchments fall significantly 20–40 years after disturbance, these areas have an increased risk of bushfire due to climate change.

Impact on the environment

ABC News reported on 17 June 2009 that a study has been carried out by environmental scientist Professor Brendan Mackey of the Australian National University which identified that mountain ash forests in Victoria’s Central Highlands as the best in the world at locking up carbon.

Mackey and colleagues found the highest amount of carbon was contained in a forest located in Victoria’s Central Highlands, which held 1900 tonnes of carbon per hectare. This most “carbon-dense” forest was a stand of unlogged mountain ash over 100 years old. Mountain ash live for at least 350 years, according to Mackey.

Chapter-5

Eucalyptus Viminalis, Fitzroya and Taxodium Mucronatum

Eucalyptus viminalis

Manna Gum

Eucalyptus viminalis

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Myrtaceae

Genus: *Eucalyptus*

Species: ***E. viminalis***

Binomial name
Eucalyptus viminalis

E. viminalis, field distribution

Eucalyptus viminalis, **Manna Gum**, also known as **White Gum**, **Ribbon Gum** or **Viminalis** is an Australian eucalypt.

It is a straight erect tree, often around 40 metres tall, with rough bark on the trunk and base of larger branches, its upper bark peels away in long "ribbons" which can collect on the branches and surrounding ground . Occasionally it can attain very large sizes. The tallest currently know specimen is located in northeast Tasmania and is 89 m tall .

E. viminalis is widely distributed in the cooler areas of Australia where the leaves are the favoured food of Koalas . Sap has a 5–15% sugar content which makes it an essential part of the energy budget for arboreal or tree dwelling marsupial mammals like Yellow-bellied, Sugar and other gliders. Koala reintroduced to Kangaroo Island impact on native *E. viminalis* and is part of a A$4,000,000 management project from 2005-9.

There are three subspecies:

- *E. viminalis* subsp. *viminalis* - NSW, Victoria, Tasmania, Mount Lofty Range of South Australia
- *E. viminalis* subsp. *cygnetensis* - western Victoria, southeastern South Australia
- *E. viminalis* subsp. *pryoriana* - southern Victoria

Timber is generally pale pink to pinkish brown in colour, often with distinctive light grey streaks. The attractive light pink tones of this species and its easy workability make it desirable in furniture applications. Structurally, uses are limited due to its low strength and durability, however some is used in seasoned and unseasoned house framing. Sapwood is distinct.

From its geographical distribution, it is unsurprising that it is hardy down to −15 degrees Celsius (+5 °F) or more making it suitable for planting in Europe.

Fitzroya

Fitzroya

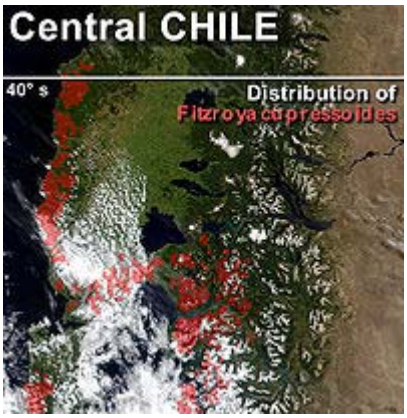
Conservation status

Endangered (IUCN 2.3)

Scientific classification	
Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Cupressaceae
Genus:	***Fitzroya***
Species:	***F. cupressoides***

Binomial name

Fitzroya cupressoides
I.M.Johnst.



Distribution of *F. cupressoides* in Central Chile (red)

Fitzroya is a monotypic genus in the cypress family Cupressaceae with a single species, ***Fitzroya cupressoides*** native to the Andes mountains of southern Chile and Argentina, where it is an important member of the Valdivian temperate rain forests. The scientific name of the genus honours Robert FitzRoy; common names include **Lahuan** (the Mapuche Native American name), **Alerce** (South American Spanish), and **Patagonian Cypress**.

It is a very large evergreen tree, the largest tree species in South America, normally growing to 40–60 m (131–196 ft; but occasionally more than 70 m in Argentina) tall and up to 5 m trunk diameter. The leaves are in decussate whorls of three, 3–6 mm long (to 8 mm long on seedlings) and 2 mm broad, marked with two white stomatal lines. The cones are globose, 6–8 mm diameter, opening flat to 12 mm across, with nine scales in three whorls of three. Only the central whorl of scales is fertile, bearing 2-3 seeds on each scale; the lower and upper whorls are small and sterile. The seeds are 2–3 mm long, flat, with a wing along each side. The seeds are mature 6–8 months after pollination.

In 1993 a specimen from Chile was dated as 3622 years old. This gives it the second-greatest fully verified (by counting growth rings) age for any living tree, after the Great Basin Bristlecone Pine. Much larger specimens existed in the past before the species was heavily logged in the 19th and 20th centuries; Charles Darwin reported finding a specimen 12.6 m (41' 6") in diameter.

A team of researchers from the University of Tasmania found fossilized foliage of *Fitzroya* on the Lea River of northwest Tasmania. The 35 million year-old fossil has been given the species name *Fitzroya tasmanensis*. The finding demonstrates the ancient floristic affinities between Australasia and southern South America, which botanists identify as the Antarctic flora.

Fitzroya cupressoides seedlings - first year of its very slow growth to a potential of an eventual 3,600 years

In the colonial Chiloé the *Fitzroya* wood was very valued and roof shingles of *Fitzroya* were used as money and were called "real de alerce".

Taxodium mucronatum

Montezuma Cypress

"El Árbol del Tule", in Santa María del Tule, Oaxaca, Mexico

Conservation status

Least Concern (IUCN 3.1)

Scientific classification

Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Cupressaceae
Genus:	*Taxodium*
Species:	***T. mucronatum***

Binomial name

Taxodium mucronatum
Ten., 1853

Synonyms

Taxodium distichum var. *mucronatum* (Ten.) A.Henry, 1906
Taxodium mexicanum Carrière, 1855
Taxodium distichum var. *mexicanum* (Carrière) Gordon, 1858
Cuprespinnata mexicana (Carrière) J.Nelson, 1866

Taxodium mucronatum, also known as **Montezuma Cypress**, **Sabino**, or **Ahuehuete** is a species of *Taxodium* native to much of Mexico (south to the highlands of southern Mexico), and also the Rio Grande Valley in southernmost Texas, USA as well as Huehuetenango Department in Guatemala. Ahuehuete is derived from the Nahuatl name for the tree, ***āhuēhuētl***, which means "upright drum in water" or "old man of the water."

Description

It occurs from 300 to 2,500 m (980 to 8,200 ft), in Mexico mainly in highlands at 1,600 m (5,200 ft) and 2,300 m (7,500 ft) altitude. It is a large evergreen or semi-evergreen tree growing to 40 m (130 ft) tall and with a trunk of 1–3 m (3.3–9.8 ft) diameter. The leaves are spirally arranged but twisted at the base to lie in two horizontal ranks, 1–2 cm (0.39–0.79 in) long and 1–2 mm (0.039–0.079 in) broad. The cones are ovoid, 1.5–2.5 cm (0.59–0.98 in) long and 1–2 cm (0.39–0.79 in) broad.

Montezuma Cypress is primarily a riparian tree, growing along upland riversides, but can also be found next to springs and marshes. Unlike Bald Cypress and Pond Cypress, Montezuma Cypress rarely produces cypress knees from the roots. Trees from the Mexican highlands achieve a notable stoutness. They are very drought-tolerant and fast-growing and favor climates that are rainy throughout the year or at least with high summer rainfall.

One specimen, the Árbol del Tule in Santa María del Tule, Oaxaca, Mexico, is the second stoutest tree in the world with a diameter of 11.42 m (37.5 ft). Several other specimens from 3–6 m (9.8–20 ft) diameter are known. The stoutest tree in the world is the Big Baobab, an African Baobab.

Uses

Montezuma Cypresses have been used as ornamental trees since Pre-Columbian times. The Aztecs planted *āhuēhuētl* along processional paths in the gardens of Chapultepec because of its association with government. Artificial islands called *chinampas* were formed in the shallow lakes of the Valley of Mexico by adding soil to rectangular areas enclosed by trees such as *āhuēhuētl*; they also lined the region's canals prior to Spanish conquest.

Ahuehuetes are frequently cultivated in Mexican parks and gardens. The wood is used to make house beams and furniture. The Aztecs used its resin to treat gout, ulcers, skin diseases, wounds, and toothaches. A decoction made from the bark was used as a diuretic and an emmenagogue. Pitch derived from the wood was used as a cure for bronchitis The leaves acted as a relaxant and could help reduce itching.

A linear grove is located in the main courtyard of the Getty Center Art Museum, thriving since 1995.

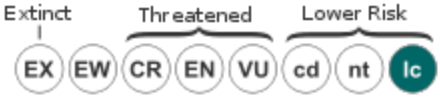
Chapter-6

Picea Sitchensis

Picea sitchensis
Sitka Spruce

Quinault Lake Spruce, Largest according to American Forest by points

Conservation status



Least Concern (IUCN 2.3)

Scientific classification

Kingdom:	Plantae
Division:	Pinophyta

Class:	Pinopsida
Order:	Pinales
Family:	Pinaceae
Genus:	*Picea*
Species:	***P. sitchensis***

Binomial name

Picea sitchensis
(Bong.) Carr.

Picea sitchensis, the **Sitka Spruce**, is a large coniferous evergreen tree growing to 50–70 m tall, exceptionally to 100 m tall, and with a trunk diameter of up to 5 m, exceptionally to 6–7 m diameter. It is by far the largest species of spruce; the fourth largest conifer in the world (behind Giant Sequoia, Coast Redwood and Western Red Cedar); and the third tallest conifer species (after Coast Redwood and Coast Douglas-fir). It acquires its name from the community of Sitka, Alaska.

Description

Foliage, mature seed cone and (center) old pollen cone

The bark is thin and scaly, flaking off in small circular plates 5–20 cm across. The crown is broad conic in young trees, becoming cylindric in older trees; old trees may have no branches in the lowest 30–40 m. The shoots are very pale buff-brown, almost white, and glabrous (hairless) but with prominent pulvini. The leaves are stiff, sharp and needle-like, 15–25 mm long, flattened in cross-section, dark glaucous blue-green above with two or three thin lines of stomata, and blue-white below with two dense bands of stomata.

The cones are pendulous, slender cylindrical, 6–10 cm long and 2 cm broad when closed, opening to 3 cm broad. They have thin, flexible scales 15-20 mm long; the bracts just

above the scales are the longest of any spruce, occasionally just exserted and visible on the closed cones. They are green or reddish, maturing pale brown 5–7 months after pollination. The seeds are black, 3 mm long, with a slender, 7–9 mm long pale brown wing.

Size

More than a century of logging has left only a remnant of the spruce forest. The largest trees were cut long before careful measurements could be made. Trees over 90 m tall may still be seen in the Pacific Rim National Park and Carmanah Walbran Provincial Park on Vancouver Island, British Columbia (the *Carmanah Giant*, at 96 meters (315 ft) tall the tallest tree in Canada), and in the Olympic National Park, Washington and Prairie Creek Redwoods State Park, California (USA); two at the last site are just over 96 meters (315 ft) tall. The *Queets Spruce* is the largest in the world with a trunk volume of 337 m^3 (11,901 cubic feet) it's 75.6 meters (248 ft) tall and 455 cm (15 ft) in dbh. It is located near the Queets River in Olympic National Park, about 16 miles (26 km) from the Pacific Ocean.

Age

Sitka Spruce is a long-lived tree, with individuals over 700 years old known. Because it grows rapidly under favorable conditions, large size may not indicate exceptional age. The *Queets Spruce* has been estimated to be only 350 to 450 years old, but adds more than a cubic meter of wood each year (Van Pelt, 2001).

Taxonomy

DNA analyses has shown that only *Picea breweriana* has a more basal position than Sitka Spruce to the rest of the Spruce. The other thirty-three species of Spruce are more derived which suggests that *Picea* originated in North America.

Distribution and habitat

Sitka Spruce forest in the Olympic Mountains, Washington

Sitka Spruce is native to the west coast of North America, with its northwestern limit on Kodiak Island, Alaska, and its southeastern limit near Fort Bragg in northern California (Griffin & Critchfield 1972). It is closely associated with the temperate rain forests and is found within a few kilometers of the coast in the southern portion of its range. North of Oregon, its range extends inland along river floodplains, but nowhere does its range extend more than 80 km from the Pacific Ocean and its inlets.

Uses

Felled sitka spruce, Oregon Coast Range, 1918

Sitka Spruce is of major importance in forestry for timber and paper production. Outside of its native range, it is particularly valued for its fast growth on poor soils and exposed

sites where few other trees can be grown successfully; in ideal conditions young trees may grow 1.5 m per year. It is naturalized in some parts of Ireland and Great Britain where it was introduced in 1831 (Mitchell, 1978) and New Zealand, though not so extensively as to be considered invasive. Sitka Spruce is also planted extensively in Denmark, Norway and Iceland. In Norway, Sitka spruce was introduced in the early 1900s. An estimated 50,000 hectares have been planted in Norway, mainly along the coast from Vest-Agder in the south to Troms in the north. It is more tolerant to wind and saline ocean air, and grows faster than the native Norway Spruce.

Sitka Spruce is used widely in piano, harp, violin, and guitar manufacture, as its high strength-to-weight ratio and regular, knot-free rings make it an excellent conductor of sound. For these reasons, the wood is also an important material for sailing boat spars, aircraft wing spars, and the nosecones of Trident missiles. The Wright brothers' Flyer was built using Sitka Spruce, as were many or most aircraft before World War II; during that war, aircraft such as the British Mosquito used it as a substitute for strategically important aluminium.

Newly grown tips of Sitka Spruce branches are used to flavour spruce beer and are boiled to make syrup.

The root bark of Sitka Spruce trees is used in Native Alaskan basket-weaving designs.

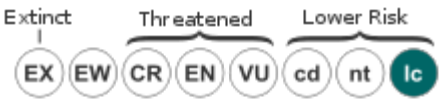
Chapter-7

Pseudotsuga Menziesii

Pseudotsuga menziesii

Coast Douglas-fir in Warsaw

Conservation status



Least Concern (IUCN 2.3)

Scientific classification

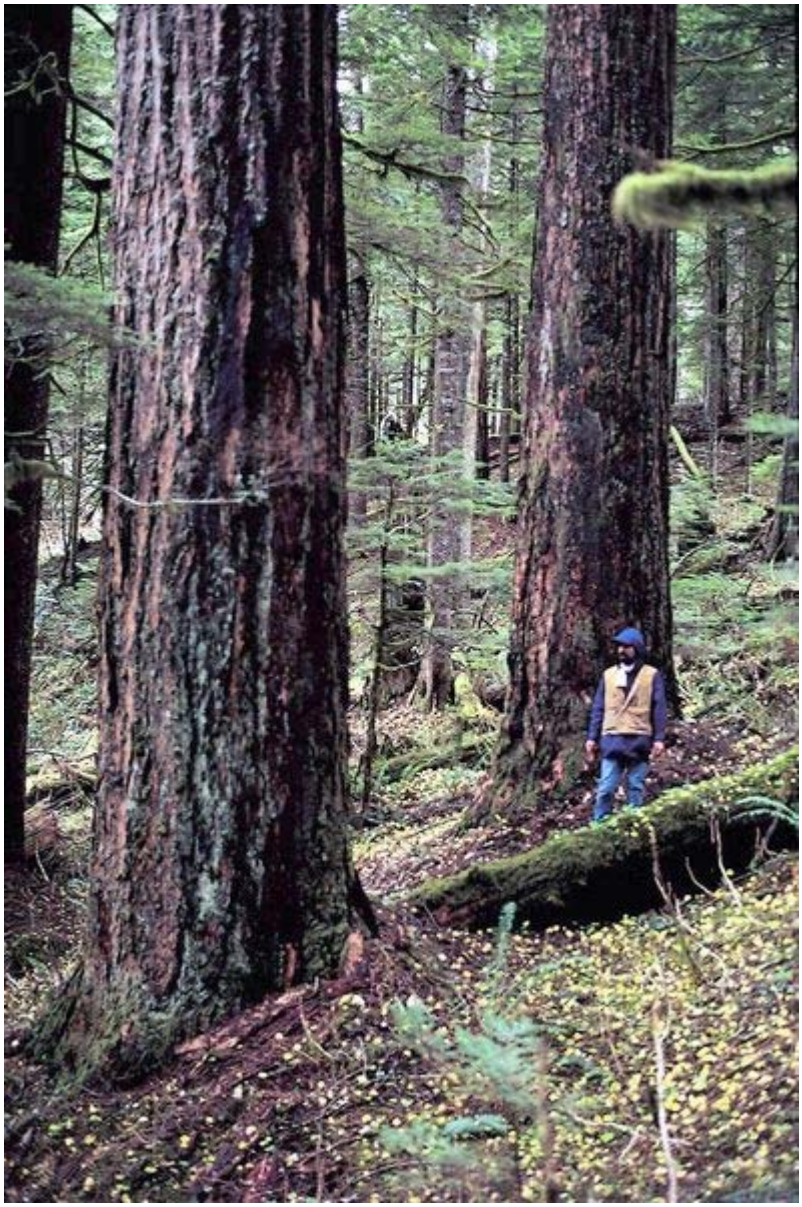
Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Pinaceae
Genus:	*Pseudotsuga*
Species:	***P. menziesii***

Binomial name

Pseudotsuga menziesii
(Mirb.) Franco

Pseudotsuga menziesii, known as **Douglas-fir**, **Oregon Pine**, or **Douglas spruce**, is an evergreen conifer species native to western North America. Its variety ***Pseudotsuga menziesii* var. *menziesii***, also known as **coast Douglas-fir** grows in the coastal regions, from west-central British Columbia, Canada southward to central California, United States. In Oregon and Washington its range is continuous from the Cascades crest west to the Pacific Coast Ranges and Pacific Ocean. In California, it is found in the Klamath and California Coast Ranges as far south as the Santa Lucia Mountains with a small stand as far south as the Purisima Hills, Santa Barbara County. In the Sierra Nevada it ranges as far south as the Yosemite region. It occurs from near sea level along the coast to 1,800 metres (5,900 ft) in the California Mountains. Further inland, coast Douglas-fir is replaced by the other variety, Rocky Mountain or interior Douglas-fir (*P. menziesii* var. *glauca*). Interior Douglas-fir intergrades with coast Douglas-fir in the Cascades of northern Washington and southern British Columbia, and from there ranges northward to central British Columbia and southeastward to central Mexico, becoming increasingly disjunct as latitude decreases and its altitudinal limits increase.

The specific name, *menziesii*, is after Archibald Menzies, a Scottish physician and rival naturalist to David Douglas. Menzies first documented the tree on Vancouver Island in 1791. Colloquially, the species is also known (incorrectly) as "**Douglas Pine**" or simply as "**doug-fir**".



Mature forest; Mount Hood National Forest

Young forest; Anacortes Community Forest Lands

Description

Coast Douglas-fir is currently the second-tallest conifer in the world (after Coast Redwood). Currently, Coast Douglas-fir trees 60–75 metres (200–246 ft) or more in height and 1.5–2 metres (4.9–6.6 ft) in diameter are common in old growth stands, and maximum heights of 100–120 metres (330–390 ft) and diameters up to 4.5–6 metres (15–20 ft) have been documented.> The tallest living specimen is the "Doerner Fir", (previously known as the Brummit fir), 99.4 m (326 ft) tall, at East Fork Brummit Creek in Coos County, Oregon, the stoutest is the "Queets Fir", 4.85 m (15.9 ft) diameter, in the Queets River valley, Olympic National Park, Washington. It commonly lives more than 500 years and occasionally more than 1,000 years.

Coast Douglas-fir cone, from a tree grown from seed collected by David Douglas

The bark on young trees is thin, smooth, gray, and contains numerous resin blisters. On mature trees, it is 10–30 cm (3.9–12 in) thick and corky. The shoots are brown to olive-green, turning gray-brown with age, smooth, though not as smooth as fir shoots, and finely pubescent with short dark hairs. The buds are a very distinctive narrow conic shape, 4–8 mm (0.16–0.31 in) long, with red-brown bud scales. The leaves are spirally arranged but slightly twisted at the base to lie in flattish either side of the shoot, needle-like, 2–3.5 cm (0.79–1.4 in) long, green above with no stomata, and with two whitish stomatal bands below. Unlike the Rocky Mountain Douglas-fir, Coast Douglas-fir foliage has a noticeable sweet fruity-resinous scent, particularly if crushed.

The mature female seed cones are pendent, 5–11 centimetres (2.0–4.3 in) long, 2–3 cm (0.79–1.2 in) broad when closed, opening to 4 cm (1.6 in) broad. They are produced in spring, green at first, maturing orange-brown in the autumn 6–7 months later. The seeds are 5–6 mm (0.20–0.24 in) long and 3–4 mm (0.12–0.16 in) broad, with a 12–15 mm (0.47–0.59 in) wing. The male (pollen) cones are 2–3 cm (0.79–1.2 in) long, dispersing yellow pollen in spring.

In forest conditions, old individuals typically have a narrow, cylindric crown beginning 20–40 metres (66–130 ft) above a branch-free trunk. Self-pruning is generally slow and trees retain their lower limbs for a long period. Young, open-grown trees typically have branches down to near ground level. It often takes 70–80 years for the trunk to be clear to a height of 5 metres (16 ft) and 100 years to be clear to a height of 10 metres (33 ft).

Appreciable seed production begins at 20–30 years in open-grown Coast Douglas-fir. Seed production is irregular; over a 5-7 year period, stands usually produce one heavy crop, a few light or medium crops, and one crop failure. Even during heavy seed crop years, only about 25 percent of trees in closed stands produce an appreciable number of cones. Each cone contains around 25 to 50 seeds. Seed size varies; average number of cleaned seeds varies from 70-88/g (32,000-40,000 per pound). Seeds from the northern portion of Coast Douglas-fir's range tend to be larger than seed from the south.

Ecology

A snag provides nest cavities for birds

The rooting habit of coast Douglas-fir is not particularly deep, with the roots tending to be shallower than those of same-aged Ponderosa Pine, Sugar Pine, or California Incense-cedar, though deeper than Sitka Spruce. Some roots are commonly found in organic soil layers or near the mineral soil surface. However, Douglas-fir exhibits considerable morphological plasticity, and on drier sites coast Douglas-fir will generate deeper taproots. Interior Douglas-fir exhibits even greater plasticity, occurring in stands of interior temperate rainforest in British Columbia, as well as at the edge of semi-arid sagebrush steppe throughout much of its range, where it generates even deeper taproots than coast Douglas-fir is capable.

Douglas-fir snags are abundant in forests older than 100–150 years and provide cavity-nesting habitat for numerous forest birds. Mature or "old-growth" Douglas-fir forest is the primary habitat of the Red Tree Vole (*Arborimus longicaudus*) and the Spotted Owl (*Strix occidentalis*). Home range requirements for breeding pairs of spotted owls are at least 400 ha (4 square kilometres (990 acres) of old-growth. Red tree voles may also be found in immature forests if Douglas-fir is a significant component. This animal nests almost exclusively in the foliage of Douglas-fir trees. Nests are located 2–50 metres (6.6–160 ft) above the ground. The red vole's diet consists chiefly of Common Douglas-fir needles. A parasitic plant sometimes utilizing *P. menziesii* is Douglas-fir Dwarf Mistletoe (*Arceuthobium douglasii*).

Its seedlings are not a preferred browse of Black-tailed Deer (*Odocoileus hemionus columbianus*) and elk (*Cervus canadensis*), but can be an important food source for these animals during the winter when other preferred forages are lacking. In many areas, coast Douglas-fir needles are a staple in the spring diet of blue grouse (*Dendragapus*). In the winter, New World porcupines primarily eat the inner bark of young conifers, among which they prefer Douglas-fir.

The leaves are also used by the woolly conifer aphid *Adelges cooleyi*; this 0.5 mm long sap-sucking insect is conspicuous on the undersides of the leaves by the small white "fluff spots" of protective wax that it produces. It is often present in large numbers, and can cause the foliage to turn yellowish from the damage in causes. Exceptionally, trees may be partially defoliated by it, but the damage is rarely this severe. Among Lepidoptera, apart from some that feed on *Pseudotsuga* in general the gelechiid moths *Chionodes abella* and *C. periculella* as well as the cone scale-eating tortrix moth *Cydia illutana* have been recorded specifically on *P. menziesii*.

Mature individual in the Wenatchee Mountains

Douglas-fir seeds are an extremely important food for small mammals. Mice, voles, shrews, and chipmunks consumed an estimated 65 percent of a Douglas-fir seed crop following dispersal in western Oregon. The Douglas Squirrel (*Tamiasciurus douglasii*) harvests and caches great quantities of Douglas-fir cones for later use. They also eat mature pollen cones, developing inner bark, terminal shoots, and tender young needles. The seeds are also important in the diets of several seed-eating birds. These include most importantly American sparrows (Emberizidae) – Dark-eyed Junco (*Junco hyemalis*), Song Sparrow (*Melospiza melodia*), Golden-crowned Sparrow (*Zonotrichia atricapilla*) and White-crowned Sparrow (*Z. leucophrys*) – and true finches (Fringillidae) – Pine Siskin (*Carduelis pinus*), Purple Finch (*"Carpodacus" purpureus*), and the Douglas-fir

Red Crossbill (*Loxia curvirostra neogaea*) which is uniquely adapted to foraging for *P. menziesii* seeds.

The coast Douglas-fir variety is the dominant tree west of the Cascade Mountains in the Pacific Northwest, occurring in nearly all forest types, competes well on most parent materials, aspects, and slopes. Adapted to a moist, mild climate, it grows larger and faster than Rocky Mountain Douglas-fir. Associated trees include Western Hemlock, Sitka Spruce, Sugar Pine, Western White Pine, Ponderosa Pine, Grand Fir, Coast Redwood, Western Redcedar, California Incense-cedar, Lawson's Cypress, Tanoak, Bigleaf Maple and several others. Pure stands are also common, particularly north of the Umpqua River in Oregon.

Shrub associates in the central and northern part of Coast Douglas-fir's range include Vine Maple (*Acer circinatum*), Salal (*Gaultheria shallon*), Pacific Rhododendron (*Rhododendron macrophyllum*), Oregon-grape (*Mahonia aquifolium*), Red huckleberry (*Vaccinium parvifolium*), and Salmonberry (*Rubus spectabilis*). In the drier, southern portion of its range shrub associates include California Hazel (*Corylus cornuta* var. *californica*), Oceanspray (*Holodiscus discolor*), Creeping Snowberry (*Symphoricarpos mollis*), Western Poison-oak (*Toxicodendron diversilobum*), Ceanothus (*Ceanothus* spp.), and Manzanita (*Arctospaphylos* spp.). In wet coastal forests, nearly every surface of old-growth Coast Douglas-fir is covered by epiphytic mosses and lichens.

Planted at Bicentennial Trails in Michigan.

Phytochemicals

Poriol is a flavanone, a type of flavonoid, produced by *P. menziesii* in reaction to infection by *Poria weirii*.

Forest succession

Bark from an old specimen in the Dawyck Botanic Gardens, Scotland.

The Red Creek Fir, ca.15 km from Port Renfrew, BC, measures 43.7ft around its base and stretches 242 ft high

The shade-intolerance of Douglas-fir plays a large role in the forest succession of lowland old growth rainforest communities of the Pacific Northwest. While mature stands of lowland old-growth rainforest contain many Western Hemlock (*Tsuga heterophylla*) seedlings, and some Western Redcedar (*Thuja plicata*) seedlings, Douglas-fir dominated stands contain almost no Douglas-fir seedlings. This seeming contradiction occurs because Douglas-firs are intolerant of deep shade and rarely survive for long within the shaded understory. When a tree dies in a mature forest the canopy opens up and sunlight becomes available as a source of energy for new growth. The shade-tolerant Western Hemlock seedlings that sprout beneath the canopy have a head-start on other seedlings. This competitive advantage allows the Western Hemlock to grow rapidly into the sunlight, while other seedlings still struggle to emerge from the soil. The boughs of the growing Western Hemlock limit the sunlight for smaller trees and severely limit the chances of shade-intolerant trees, such as the Douglas-fir. Over the course of centuries, Western Hemlock typically come to dominate the canopy of an old-growth lowland rainforest.

Douglas-firs are seral trees in temperate rainforest, and possess thicker bark and a somewhat faster growth rate than most other climax trees of the area, such as the Western Hemlock and Western Redcedar. This quality often gives Douglas-firs a competitive advantage when the forest experiences a major disturbance such as fire. Periodically, portions of a Pacific Northwest lowland forest may be burned by wildfire, may be logged, or may be blown down by a wind-storm. These types of disturbances allow Douglas-fir to regenerate in openings, and low-intensity fires often leave Douglas-fir trees standing on drier sites, while less drought- and fire-tolerant species are unable to get established.

Conifers dominate the climax forests of the coast Douglas-fir. All of the climax conifers that grow alongside Douglas-fir can live for centuries, with a few species capable of living for over a millennium. Forests that exist on this time scale experience the type of sporadic disturbances that allow mature stands of Douglas-fir to establish themselves as a persistent element within a mature old-growth forest. When old growth forests survive in a natural state, they often look like a patchwork quilt of different forest communities. Western Hemlock typically dominate oldgrowth rainforests, but contain sections of Douglas-firs, Redcedar, Alder, and even Redwood forests on their southern extent, near the Oregon and California border, while Sitka spruce increases in frequency with latitude.

The logging practices of the last 200 years created artificial disturbances that caused Douglas-firs to thrive. The Douglas-fir's useful wood and its quick growth make it the crop of choice for many timber companies, which typically replant a clear-cut area with Douglas-fir seedlings. The high-light conditions that exist within a clear-cut also naturally favor the regeneration of Douglas-fir. Because of clear-cut logging, almost all the Pacific Northwest forests not strictly set aside for protection are today dominated by Douglas-fir, while the normally dominant climax species, such as Western Hemlock and Western Redcedar are less common. On drier sites in California, where Douglas-fir behaves as a climax species in the absence of fire, the Douglas-fir has become somewhat invasive following fire suppression practices of the twentieth and twenty-first centuries; it is becoming a dominant species in many oak woodlands, in which it was previously a minor component.

Fall cone and foliage; Anacortes Community Forest Lands

Buds and pollen cones; William O. Douglas Wilderness

Uses

Coast Douglas-fir is one of the worlds best timber producers and yields more timber than any other tree in North America. The wood is used for dimensional lumber, timbers, pilings, and plywood. Creosote treated pilings and decking are used in marine structures. The wood is also made into railroad ties, mine timbers, house logs, posts and poles, flooring, pulp, and furniture. Coast Douglas-fir is used extensively in landscaping. It is planted as a specimen tree or in mass screenings. It is also a popular Christmas tree.

Away from its native area, it is also extensively used in forestry as a plantation tree for timber in Europe, New Zealand, southern South America and elsewhere. It is also naturalised throughout Europe (Austria with Liechtenstein, Belgium, Britain, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Switzerland, Italy, Yugoslavia, Portugal, Poland, Romania, Spain and Sweden), Argentina and Chile (called *Pino Oregón*), and in New Zealand sometimes to the extent of becoming an invasive species (termed a wilding conifer) subject to control measures.

The buds are used to produce eau de vie, a clear, colorless fruit brandy.

Native Hawaiians built *waʻkaulua* (double-hulled canoes) from Coast Douglas-fir logs that had drifted ashore.

Largest trees

Coast Douglas-fir in Vancouver, British Columbia, 1887)

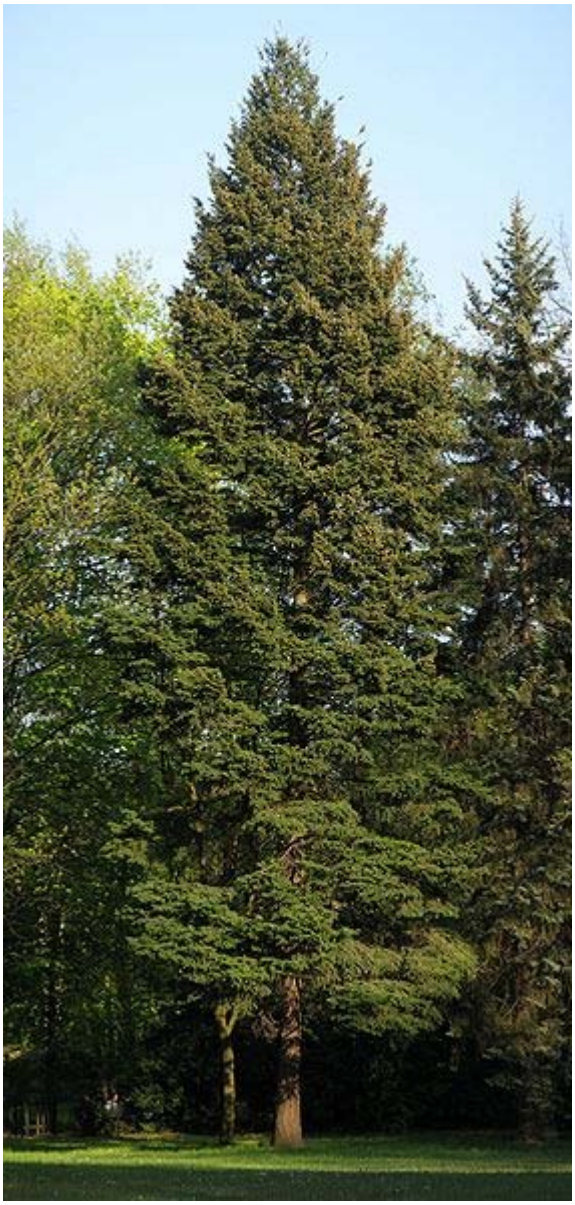
- The tallest tree in the United Kingdom is a Coast Douglas-fir. The tree, growing in Reelig Glen by Inverness is called Dughall Mor and stands at 64 m. It was measured in 2005 by Tony Kirkham and Jon Hammerton from the Royal Botanic Gardens, Kew, the late Jim Paterson from The Tree Register and David Jardine of the Forestry Commission.

- A tree cut down in 1902 at Lynn Valley on the north shore of the city of Vancouver, British Columbia was reported to have measured 415 feet (126 m) in height, and 14 feet 3 in. (4.3 m) in diameter.

- A Douglas-fir felled in 1897 at Loop's Ranch in Whatcom County, Washington reportedly measured 465 feet (142 m) in height, 34 feet (10 m) in circumference at the butt, and 220 feet (67 m) to the first branch. With a volume of 96,345 board feet (227 m^3), this tree was estimated to be 480 years old.

- New research suggests Douglas-fir could grow to a maximum height of between 430 feet (130 m) and 476 feet (145 m) at which point water supply would fail.

Two-weeks-old cotyledons in Getafe (Spain).



Royal Baths Park in Warsaw

Young tree

Chapter-8

Sequoia Sempervirens

Sequoia sempervirens

Del Norte Titan, the fourth largest coast redwood

Conservation status

Vulnerable (IUCN 3.1)

Scientific classification

Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Cupressaceae
Subfamily:	Sequoioideae
Genus:	*Sequoia*
Species:	***S. sempervirens***

Binomial name

Sequoia sempervirens
(D. Don) Endl.

Sequoia sempervirens is the sole living species of the genus ***Sequoia*** in the cypress family Cupressaceae (formerly treated in Taxodiaceae). Common names include **coast redwood**, **California redwood**, and **giant redwood**. It is an evergreen, long-lived, monoecious tree living 1200–1800 years or more. This species includes the tallest trees on Earth, reaching up to 379 feet (115.52 m) in height and up to 26 feet (7.9 m) diameter at breast height. Before commercial logging and clearing began by the 1850s, this massive tree occurred naturally in an estimated 2.1 million acres along much of coastal California (excluding southern California where rainfall is not abundant enough) and the southwestern corner of coastal Oregon within the United States.

The name **sequoia** sometimes refers to the subfamily Sequoioideae, which includes the coast redwood along with *Sequoiadendron* (giant sequoia) and *Metasequoia* (dawn redwood).

Description

Bark detail

Coast redwoods have a conical crown, with horizontal to slightly drooping branches. The bark is very thick, up to 30 cm (12 in), and quite soft, fibrous with a bright red-brown when freshly exposed (hence the name *redwood*), weathering darker. The root system is composed of shallow, wide-spreading lateral roots.

The leaves are variable, being 15–25 millimetres (0.59–0.98 in) long and flat on young trees and shaded shoots in the lower crown of old trees, and scale-like, 5–10 millimetres (0.20–0.39 in) long on shoots in full sun in the upper crown of older trees; there is a full range of transition between the two extremes. They are dark green above, and with two blue-white stomatal bands below. Leaf arrangement is spiral, but the larger shade leaves are twisted at the base to lie in a flat plane for maximum light capture.

The species is monoecious, with pollen and seed cones on the same plant.

The seed cones are ovoid, 15–32 millimetres (0.59–1.3 in) long, with 15–25 spirally arranged scales; pollination is in late winter with maturation about 8–9 months after. Each cone scale bears 3–7 seeds, each seed 3–4 millimetres (0.12–0.16 in) long and 0.5 millimetres (0.020 in) broad, with two wings 1 millimetre (0.039 in) wide. The seeds are released when the cone scales dry out and open at maturity.

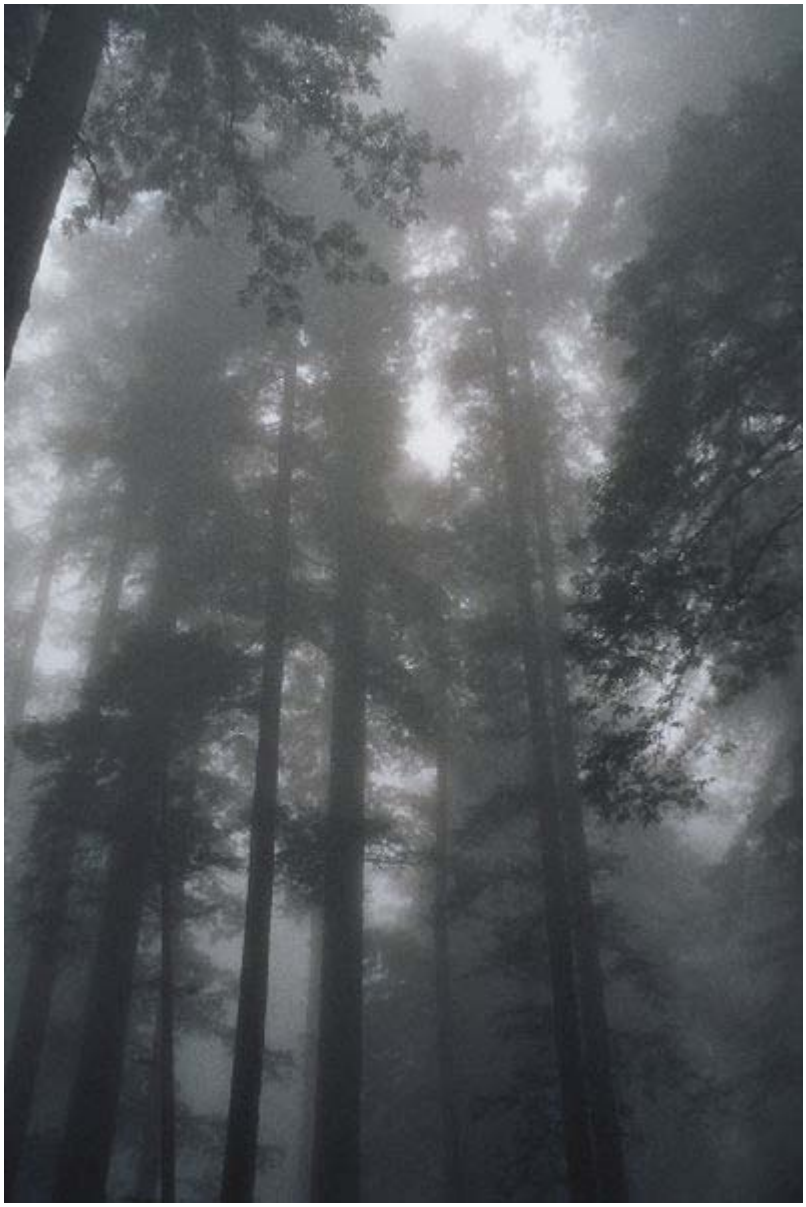
The pollen cones are oval, 4–6 millimetres (0.16–0.24 in) long.

Its genetic makeup is unusual among conifers, being a hexaploid (6n) and possibly allopolyploid (AAAABB). The mitochondrial genome of the redwood is paternally inherited (unlike that of other conifers).

Range and ecology

Sunlight shining through redwoods in Muir Woods

Coast redwoods occupy a narrow strip of land approximately 750 km (470 miles) in length and 8–75 km (5–47 miles) in width along the Pacific coast of North America; from the most southerly grove in Monterey County, California to groves that exist in extreme southwestern Oregon. The elevation range is mostly from 30–750 metres (98–2,460 ft), occasionally down to sea level and up to 920 m (about 3,000 feet) (Farjon 2005). They usually grow in the mountains where there is more precipitation from the incoming moisture off the ocean. The tallest and oldest trees are found in deep valleys and gullies, where year-round streams can flow, and fog drip is regular. The trees above the fog layer, above about 700 metres (2,300 ft), are shorter and smaller due to the drier, windier, and colder conditions. In addition, tanoak, pine and Douglas-fir often crowd out redwoods at these elevations. Few redwoods grow close to the ocean, due to intense salt spray, sand and wind. Condensation from coastal fog accounts for a considerable part of the trees' water needs.



Fog is of major importance in coast redwood ecology. Redwood National Park.

The northern boundary of its range is marked by two groves on the Chetco River on the western fringe of the Klamath Mountains, 25 km (15 miles) north of the California-Oregon border. The largest (and tallest) populations are in Redwood National and State Parks (Del Norte and Humboldt Counties) and Humboldt Redwoods State Park (Humboldt County, California), with the majority located in the much larger Humboldt County. The southern boundary of its range is the Los Padres National Forest's Silver Peak Wilderness in the Santa Lucia Mountains of the Big Sur area of Monterey County, California. The southernmost grove is in the Southern Redwood Botanical Area, just north of the national forest's Salmon Creek trailhead.

This native area provides a unique environment with heavy seasonal rains (of up to 2,500 mm or 100 inches and more annually). Cool coastal air and fog drip keep this forest consistently damp year round. Several factors, including the heavy rainfall, create a soil with fewer nutrients than the trees need, causing the trees to depend heavily on the entire biotic community of the forest, and complete recycling of the trees when dead. This forest community includes Coast Douglas-fir, Western Hemlock, Tanoak, Pacific Madrone, and other trees along with a wide variety of ferns, Redwood sorrel, mosses and mushrooms. Redwood forests provide habitat for a variety of mammals, birds, reptiles, and amphibians. Old growth redwood stands provide habitat for the federally threatened Spotted Owl and the California-endangered Marbled Murrelet.

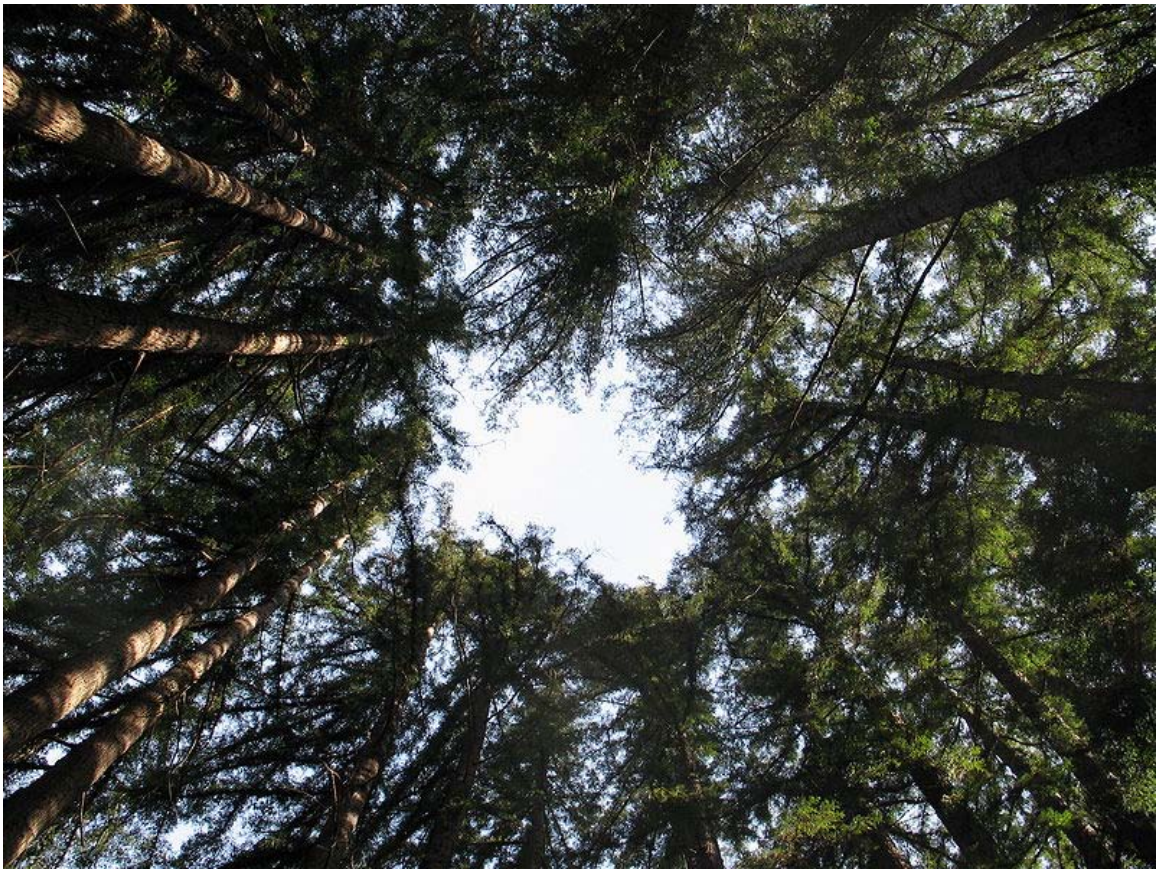
The thick, tannin-rich bark, combined with foliage that starts high above the ground provides good protection from both fire and insect damage, contributing to the coast redwood's longevity. The oldest known coast redwood is about 2,200 years old; many others in the wild exceed 600 years. The numerous claims of older trees are incorrect. Because of their seemingly timeless lifespan, coast redwoods were deemed the "everlasting redwood" at the turn of the century; in Latin, "sempervirens" means "ever green" or "everlasting".

The prehistoric fossil range of the genus is considerably greater, with a subcosmopolitan distribution including Europe and Asia until about 5 million years ago.

Reproduction

Coast redwood reproduces both sexually by seed and asexually by sprouting of buds, layering, or lignotubers.

Seed production begins at 10–15 years of age, and large seed crops occur frequently, but viability of the seed is low, typically well below 15%. The low viability may discourage seed predators, which do not want to waste time sorting chaff (empty seeds) from edible seeds. The winged seeds are small and light, weighing 3.3–5 mg (200-300 seeds/g; 5,600-8,500/ounce). The wings are not effective for wide dispersal, and seeds are dispersed by wind an average of only 60–120 m (200–400 feet) from the parent tree. Growth of seedlings is very fast, with young trees known to reach 20 m (65 feet) tall in 20 years.



A ring of Sequoia trees as seen from below.

Coast redwoods can also reproduce asexually by layering or sprouting from the root crown, stump, or even fallen branches; if a tree falls over, it will regenerate a row of new trees along the trunk. This is the reason for many trees naturally growing in a straight line. Sprouts originate from dormant or adventitious buds at or under the surface of the bark. The dormant sprouts are stimulated when the main adult stem gets damaged or starts to die. Many sprouts spontaneously erupt and develop around the circumference of the tree trunk. Within a short period after sprouting, each sprout will develop its own root system, with the dominant sprouts forming a ring of trees around the parent root crown or stump. This ring of trees is called a "fairy ring". Sprouts can achieve heights of 2.3 m (8 feet) in a single growing season.

Redwoods may also reproduce using burls. A burl is a woody lignotuber that commonly appears on a redwood tree below the soil line, though when above, usually within 3 metres (9.8 ft) of the soil. Burls are capable of sprouting into new trees when detached from the parent tree, though exactly how this happens is yet to be studied. Shoot clones commonly sprout from burls and are often turned into decorative hedges when found in suburbia.

The species is very tolerant of flooding and flood deposits, the roots rapidly growing into thick silt deposits after floods.

Cultivation and uses

Coast redwood is one of the most valuable timber species in California, with 899,000 acres (364,000 ha) of redwood forest, all second growth, managed for timber production. Coast redwood lumber is highly valued for its beauty, light weight, and resistance to decay. Its lack of resin makes it resistant to fire.

P. H. Shaughnessy, Chief Engineer of the San Francisco Fire Department wrote:

In the recent great fire of San Francisco, that began April 18th, 1906, we succeeded in finally stopping it in nearly all directions where the unburned buildings were almost entirely of frame construction and if the exterior finish of these buildings had not been of redwood lumber, I am satisfied that the area of the burned district would have been greatly extended.

Because of its impressive resistance to decay, redwood was extensively used for railroad ties and trestles throughout California. Many of the old ties have been recycled for use in gardens as borders, steps, etc. Redwood burls are used in the production of table tops, veneers, and turned goods.

The coast redwood is locally naturalized in New Zealand, notably at Rotorua. Other areas of successful cultivation outside of the native range include Great Britain, Italy, Portugal, the Queen Charlotte Islands, middle elevations of Hawaii, a small area in central Mexico (Jilotepec) and the southeastern United States from eastern Texas to Maryland. Coast redwood trees were used in a display at Rockefeller Center and then given to Longhouse Reserve in East Hampton, Long Island, New York and these have now been living there for over 17 years (2010) and survived 2°F (-17°C).

Statistics

Dried resin of a redwood tree

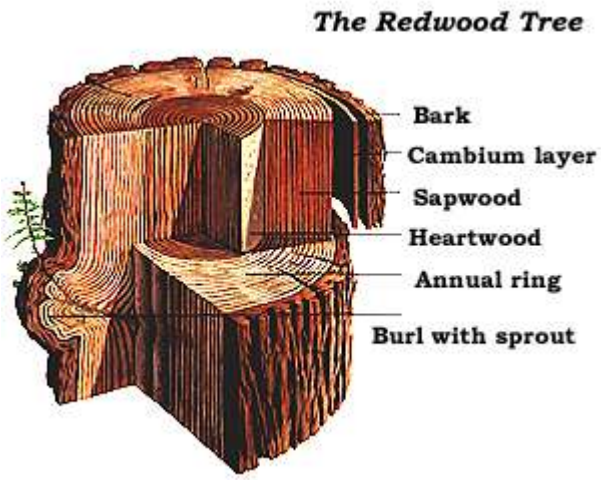
An example of a bonsai redwood, from the Brooklyn Botanic Garden.

Trees over 60 m (200 feet) are common, and many are over 90 m (300 feet).

- The current tallest tree is Hyperion, measuring at 115.61 m (379.3 feet). The tree was discovered in Redwood National Park during Summer 2006 by Chris Atkins and Michael Taylor and has been measured as the world's tallest living organism. The previous record holder was the Stratosphere Giant in the Humboldt Redwoods State Park, at 112.83 m, last measured in 2004 (was 112.34 m in Aug 2000 and 112.56 m in 2002). Until it fell in March 1991, the "Dyerville Giant" was the record holder. It too stood in Humboldt Redwoods State Park; it was 113.4 metres high and estimated to be 1,600 years old.
- There are 41 measured living trees more than 110 m (361 feet) tall.
- There are 178 measured trees that are more than 106.7 m (350 feet) tall. Preliminary analysis of LiDAR data indicates there are hundreds of additional trees in excess of 106 m (348 ft) previously unknown.
- A tree claimed to be 115.8 m (380 feet) was cut down in 1914.
- A tree claimed to be 129 m (424 feet) was felled in November 1886 by the Elk River Mill and Lumber Co. at the south fork of Elk river in Humboldt County, yielding 79,736 marketable board feet from 21 cuts.

- Although coast redwoods are currently the world's tallest trees, it is possible that Australian mountain ash and Douglas-fir trees were taller—exceeding 400 feet (120 m)—before the commercial logging of the 19th and 20th centuries. However, there is fairly solid evidence that before logging coast redwoods were the world's largest trees, with specimens measured at over 55,000 cubic feet (1,600 m^3).

The foliage of an "albino" *Sequoia sempervirens* exhibiting lack of chlorophyll



Trunk in sectional view

The theoretical maximum potential height of coast redwoods is limited to between 122 and 130 m (between 410 and 425 feet), due to gravity and the friction between water and the vessels through which it flows.

The **largest coast redwood** in volume is the "Lost Monarch", with an estimated volume of 42,500 cubic feet (1,200 m^3); it is 320 feet (98 m) tall with a diameter of 26 feet (7.9 m) at breast high (DBH). It is located in the Grove of Titans. Among current living trees there are only 6 known Giant Sequoias that are larger; these are shorter, but have thicker trunks overall, giving the largest Giant Sequoia, General Sherman, a volume of 1,487 cubic metres (52,510 cubic feet), making it the world's largest known tree. A redwood cut down in 1926 had a claimed volume of 1,794 m^3 (63,350 cubic feet), but this is not verified.

About fifty albino redwoods (mutant individuals that cannot manufacture chlorophyll) are known to exist, reaching heights of up to 20 metres (66 ft). These trees survive as parasites, obtaining food by grafting their root systems with those of normal trees. While similar mutations occur sporadically in other conifers, no cases are known of such individuals surviving to maturity in any other conifer species.

Largest trees

The nine largest known coast redwoods by total wood volume in the main trunk and stems combined as of 2009.

Rank	Tree Name	Location	Volume		Height		Diameter (b.h)	
			(m^3)	(cu ft)	(m)	(ft)	(m)	(ft)
1	Lost Monarch	JSRSP	1206	42,500	97.8	321	7.92	26.0
2	Melkor	RNP	1109	39,100	106.3	349	6.82	22.4

3	Iluvatar	PCRSP	1064	37,500	91.4	300	6.25	20.5
4	Del Norte Titan	JSRSP	1055	37,200	93.6	307	7.22	23.7
5	El Viejo Del Norte	JSRSP	1002	35,400	98.7	324	7.01	23.0
6	Howland Hill Giant	JSRSP	953	33,580	100.6	330	6.02	19.8
7	Sir Isaac Newton	PCRSP	942	33,192	91.1	299	6.85	22.5
8	Terex Titan	PCRSP	919	32,384	82.3	270	6.49	21.3
9	Adventure Tree	PCRSP	912	32,140	101.8	334	4.95	16.5

The order of largest and tallest can change at any time due to new discoveries, loss of stem and foliage, growth, and new measurements. One of the better known Internet databases for large conifers is The Gymnosperm Database, but its data can be different from other resources due to differences in standards.

Tallest trees

Trees over 112 m (367.5 ft) as of 2010.

Tree Name	Height (m)	Height (ft)	Location
Hyperion	115.61	379.3	RNSP
Helios	114.58	375.9	RNSP
Icarus	113.14	371.2	RNSP
Stratosphere Giant	113.11	371.1	HRSP
National Geographic	112.71	369.9	RNSP
Orion	112.63	369.5	RNSP
Lauralyn	112.62	369.5	HRSP
Paradox	112.56	369.3	HRSP
Mendocino	112.20	368.1	MWSR
Apex	112.00	367.4	HRSP

There is fairly solid evidence that before logging coast redwoods were the world's largest trees, with specimens measured at over 55,000 cubic feet (1,600 m^3).

Chapter-9

Sequoiadendron

Sequoiadendron giganteum

The "Grizzly Giant" tree in Mariposa Grove, Yosemite National Park

Conservation status

Vulnerable (IUCN 2.3)

Scientific classification

Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida
Order:	Pinales
Family:	Cupressaceae
Subfamily:	Sequoioideae

Genus: ***Sequoiadendron***

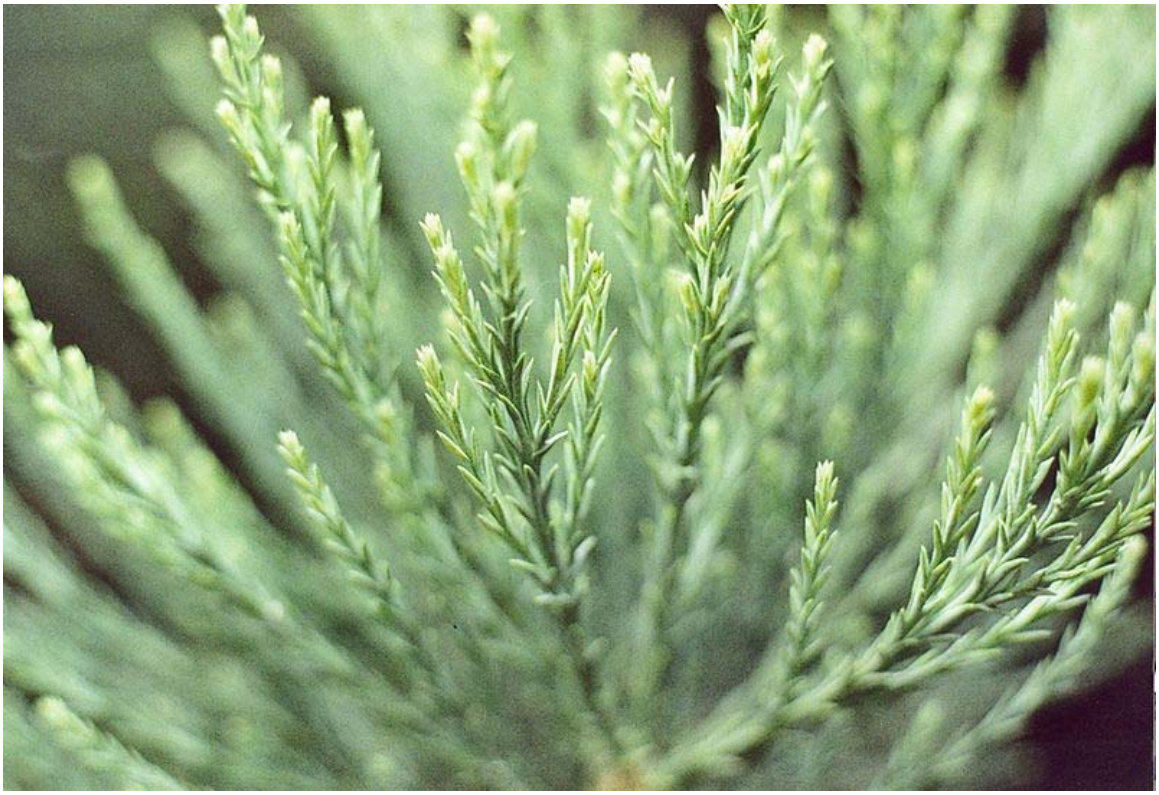
Species: ***S. giganteum***

Binomial name

Sequoiadendron giganteum
(Lindl.) J.Buchh.

Sequoiadendron giganteum (**giant sequoia**, **Sierra redwood**, **Sierran redwood**, or **Wellingtonia**) is the sole living species in the genus ***Sequoiadendron***, and one of three species of coniferous trees known as redwoods, classified in the family Cupressaceae in the subfamily Sequoioideae, together with *Sequoia sempervirens* (Coast Redwood) and *Metasequoia glyptostroboides* (Dawn Redwood). The common use of the name "sequoia" generally refers to *Sequoiadendron,* which occurs naturally only in groves on the western slopes of the Sierra Nevada Mountains of California.

Description



Leaves of *Sequoiadendron giganteum*

Giant Sequoias are the world's largest trees in terms of total volume (technically, only 7 living Giant Sequoia exceed the 42,500 cubic feet (1,200 m^3) of the Lost Monarch Coast Redwood tree). They grow to an average height of 50–85 metres (160–279 ft) and 6–8 metres (20–26 ft) in diameter. Record trees have been measured to be 94.8 metres (311 ft) in height and 17 metres (56 ft) in diameter. The oldest known Giant Sequoia based on ring count is 3,500 years old. Sequoia bark is fibrous, furrowed, and may be

90 centimetres (3.0 ft) thick at the base of the columnar trunk. It provides significant fire protection for the trees. The leaves are evergreen, awl-shaped, 3–6 mm long, and arranged spirally on the shoots. The seed cones are 4–7 cm long and mature in 18–20 months, though they typically remain green and closed for up to 20 years; each cone has 30-50 spirally arranged scales, with several seeds on each scale giving an average of 230 seeds per cone. The seed is dark brown, 4–5 mm long and 1 mm broad, with a 1 mm wide yellow-brown wing along each side. Some seed is shed when the cone scales shrink during hot weather in late summer, but most seeds are liberated when the cone dries from fire heat or is damaged by insects.

Giant sequoia cones.

Giant sequoia regenerates by seed. Trees up to about 20 years old may produce stump sprouts subsequent to injury. Giant sequoia of all ages may sprout from the bole when old branches are lost to fire or breakage, but (unlike coast redwood) mature trees do not sprout from cut stumps. Young trees start to bear cones at the age of 12 years.

At any given time, a large tree may be expected to have approximately 11,000 cones. The upper part of the crown of any mature Giant Sequoia invariably produces a greater abundance of cones than its lower portions. A mature giant sequoia has been estimated to disperse from 300,000-400,000 seeds per year. The winged seeds may be carried up to 180 m (600 ft) from the parent tree.

Lower branches die fairly readily from shading, but trees less than 100 years old retain most of their dead branches. Trunks of mature trees in groves are generally free of branches to a height of 20–50 m, but solitary trees will retain low branches.

Distribution

The natural distribution of giant sequoia is restricted to a limited area of the western Sierra Nevada, California. It occurs in scattered groves, with a total of 68 groves, comprising a total area of only 144.16 square kilometres (35,620 acres). Nowhere does it grow in pure stands, although in a few small areas stands do approach a pure condition. The northern two-thirds of its range, from the American River in Placer County southward to the Kings River, has only eight disjunct groves. The remaining southern groves are concentrated between the Kings River and the Deer Creek Grove in southern Tulare County. Groves range in size from 12.4 square kilometres (3,100 acres) with 20,000 mature trees, to small groves with only six living trees. Many are protected in Sequoia and Kings Canyon National Parks and Giant Sequoia National Monument.

Giant sequoia is usually found in a humid climate characterized by dry summers and snowy winters. Most giant sequoia groves are on granitic-based residual and alluvial soils. The elevation of the giant sequoia groves generally ranges from 1,400–2,000 metres (4,600–6,600 ft) in the north, and 1,700–2,150 metres (5,600–7,050 ft) to the south. Giant sequoia generally occurs on the south facing side of northern mountains, and on the northern face of more southern slopes.

High levels of reproduction are not necessary to maintain the present population levels. Few groves, however, have sufficient young trees to maintain the present density of mature giant sequoias for the future. The majority of giant sequoias are currently undergoing a gradual decline in density since the European settlement days.

Ecology

Two giant sequoias, Sequoia National Park. Note the large fire scar at the base of the right-hand tree; fires do not kill the trees but do remove competing thin-barked species, and aid giant sequoia regeneration.

The giant sequoias are having difficulty reproducing in their original habitat (and very rarely reproduce in cultivation) due to the seeds only being able to grow successfully in mineral soils in full sunlight, free from competing vegetation. Although the seeds can germinate in moist needle humus in the spring, these seedlings will die as the duff dries in the summer. They therefore require periodic wildfire to clear competing vegetation and soil humus before successful regeneration can occur. Without fire, shade-loving species will crowd out young sequoia seedlings, and sequoia seeds will not germinate. When fully grown, these trees typically require large amounts of water and are therefore often concentrated near streams.

Fires also bring hot air high into the canopy via convection, which in turn dries and opens the cones. The subsequent release of large quantities of seeds coincides with the optimal post-fire seedbed conditions. Loose ground ash may also act as a cover to protect the fallen seeds from ultraviolet radiation damage.

Due to fire suppression efforts and livestock grazing during the early and mid 20th century, low-intensity fires no longer occurred naturally in many groves, and still do not

occur in some groves today. The suppression of fires also led to ground fuel build-up and the dense growth of fire-sensitive White Fir. This increased the risk of more intense fires that can use the firs as ladders to threaten mature Giant Sequoia crowns. Natural fires may also be important in keeping carpenter ants in check.

In 1970 the National Park Service began controlled burns of its groves to correct these problems. Current policies also allow natural fires to burn. One of these untamed burns severely damaged the second-largest tree in the world, the Washington tree, in September 2003, 45 days after the fire started. This damage made it unable to withstand the snowstorm of January 2005, leading to the collapse of over half the trunk.

In addition to fire, there are also two animal agents for giant sequoia seed release. The more significant of the two is a longhorn beetle (*Phymatodes nitidus*) that lays eggs on the cones, into which the larvae then bore holes. This cuts the vascular water supply to the cone scales, allowing the cones to dry and open for the seeds to fall. Cones damaged by the beetles during the summer will slowly open over the next several months. Some research indicates that many cones, particularly higher in the crowns, may need to be partially dried by beetle damage before fire can fully open them. The other agent is the Douglas Squirrel (*Tamiasciurus douglasi*) that gnaws on the fleshy green scales of younger cones. The squirrels are active year round, and some seeds are dislodged and dropped as the cone is eaten.

Discovery and naming

Shortly after their discovery, giant sequoias were subject to much exhibition.

The giant sequoia was well known to Native American tribes living in its area. Native American names for the species include **Wawona**, **Toos-pung-ish** and **Hea-mi-withic**, the latter two in the language of the Tule River Tribe.

The first reference to the giant sequoia by Europeans is in 1833, in the diary of the explorer J. K. Leonard; the reference does not mention any locality, but his route would have taken him through the Calaveras Grove. This discovery was not publicized. The next European to see the species was John M. Wooster, who carved his initials in the bark of the 'Hercules' tree in the Calaveras Grove in 1850; again, this received no publicity.

Much more publicity was given to the "discovery" by Augustus T. Dowd of the Calaveras Grove in 1852, and this is commonly cited as the species' discovery. The tree found by Dowd, christened the 'Discovery Tree', was felled in 1853.

The first scientific naming of the species was by John Lindley in December 1853, who named it *Wellingtonia gigantea*, without realizing this was an invalid name under the botanical code as the name *Wellingtonia* had already been used earlier for another unrelated plant (*Wellingtonia arnottiana* in the family Sabiaceae). The name "Wellingtonia" has persisted in England as a common name, though is deprecated as cultural imperialism (R. Ornduff in Aune 1994). The following year, Joseph Decaisne transferred it to the same genus as the Coast Redwood, naming it *Sequoia gigantea*, but again this name was invalid, having been applied earlier (in 1847, by Endlicher) to the Coast Redwood. The name *Washingtonia californica* was also applied to it by Winslow in 1854, though this too is invalid, belonging to the palm genus *Washingtonia*.

In 1907 it was placed by Carl Ernst Otto Kuntze in the otherwise fossil genus *Steinhauera*, but doubt as to whether the giant sequoia is related to the fossil originally so named makes this name invalid.

The nomenclatural oversights were finally corrected in 1939 by J. Buchholz, who also pointed out that the giant sequoia is distinct from the coast redwood at the genus level and coined the name *Sequoiadendron giganteum* for it.

John Muir wrote of the species in about 1870:

Do behold the King Sequoia! Behold! Behold! seems all I can say. Some time ago I left all for Sequoia and have been and am at his feet, fasting and praying for light, for is he not the greatest light in the woods, in the world? Where are such columns of sunshine, tangible, accessible, terrestrialized?

Uses

Clothespin tree in the Mariposa Grove, Yosemite National Park

Wood from mature giant sequoias is highly resistant to decay, but due to being fibrous and brittle, it is generally unsuitable for construction. From the 1880s through the 1920s logging took place in many groves in spite of marginal commercial returns. Due to their weight and brittleness trees would often shatter when they hit the ground, wasting much of the wood. Loggers attempted to cushion the impact by digging trenches and filling them with branches. Still, it is estimated that as little as 50 percent of the timber made it from groves to the mill. The wood was used mainly for shingles and fence posts, or even for matchsticks.

Pictures of the once majestic trees broken and abandoned in formerly pristine groves, and the thought of the giants put to such modest use, spurred the public outcry that caused most of the groves to be preserved as protected land. The public can visit an example of 1880s clear-cutting at Big Stump Grove near General Grant Grove. As late as the 1980s some immature trees were logged in Sequoia National Forest, publicity of which helped lead to the creation of Giant Sequoia National Monument.

The wood from immature trees is less brittle, with recent tests on young plantation-grown trees showing it similar to Coast Redwood wood in quality. This is resulting in some interest in cultivating Giant Sequoia as a very high-yielding timber crop tree, both in California and also in parts of western Europe, where it may grow more efficiently than Coast Redwoods. In the northwest United States some entrepreneurs have also begun growing Giant Sequoias for Christmas trees. Besides these attempts at tree farming, the principal economic uses for Giant Sequoia today are tourism and horticulture.

Cultivation

Sequoiadendron giganteum at New Forest, Hampshire, England, one of the tallest in the UK at 52.73 m

Giant Sequoia is a very popular ornamental tree in many areas. Areas where it is successfully grown include most of western and southern Europe, the Pacific Northwest of North America north to southwest British Columbia, the southern United States, southeast Australia, New Zealand and central-southern Chile. It is also grown, though less successfully, in parts of eastern North America.

Sequoiadendron giganteum at Pötzleinsdorf Park in Vienna

Trees can withstand temperatures of −31 °C (−25 °F) or colder for short periods of time, provided that the ground around the roots is insulated with either heavy snow or mulch. Outside its natural range, the foliage can suffer from damaging windburn.

Since its discovery a wide range of horticultural varieties have been selected, especially in Europe. There are, amongst others, weeping, variegated, pygmy, blue, grass green, and compact forms.

Europe

The famous Giant Sequoia avenue at Benmore Botanic Garden, planted in 1863. These giants are all over 50 m tall.

Sequoiadendron giganteum in the Sequoiafarm Kaldenkirchen (Germany)

The Giant Sequoia was first brought into cultivation in 1853 by Scotsman John D. Matthew, who collected a small quantity of seed in the Calaveras Grove, arriving with it in Scotland in August 1853. A much larger shipment of seed collected (also in the Calaveras Grove) by William Lobb, acting for the Veitch Nursery at Budlake near Exeter, arrived in England in December 1853; seed from this batch was widely distributed throughout Europe.

Growth in Britain is very fast, with the tallest tree, at Benmore in southwest Scotland, reaching 54 metres (177 ft) at age 150 years, and several others from 50–53 m tall; the stoutest is around 12 m in girth and 4 m in diameter, in Perthshire. The Royal Botanic Gardens at Kew in London also contains a large specimen. The General Sherman of

California has a volume of 1489 cubic meters; by way of comparison, the largest giant sequoias in Great Britain have volumes no larger than 90-100 cubic meters, one example being the 90 cubic meter giant in the New Forest.

Growth rates in some areas are remarkable; one young tree in Italy reached 22 metres (72 ft) tall and 88 centimetres (2.89 ft) trunk diameter in 17 years (Mitchell, 1972).

The re-introduction of the Giant Sequoia into the German forestry was realized in 1952 by two members of the German Dendrology Society E. J. Martin and Illa Martin in the Sequoiafarm Kaldenkirchen.

Growth further northeast in Europe is limited by winter cold. In Denmark, where extreme winters can reach −32 °C, the largest tree was 35 metres (115 ft) tall and 1.7 metres (5.6 ft) diameter in 1976 and is bigger today. One in Poland has purportedly survived temperatures down to −37 °C with heavy snow cover.

United States and Canada

Unopened pollen (male) cones of cultivated tree in Portland, Oregon, USA (fall)

Giant sequoias are grown successfully in the Pacific Northwest and southern US, and less successfully in eastern North America.

Immature seed (female) cones of cultivated tree in Portland, Oregon, USA (fall)

Giant Sequoia cultivation is very successful in the Pacific Northwest from western Oregon north to southwest British Columbia, with fast growth rates. In Washington and Oregon, it is common to find giant sequoias that have been successfully planted in both urban and rural areas. In the Seattle area, large specimens (over 90 feet) are fairly common and exist in several city parks and many private yards (especially east Seattle including Capitol Hill, Washington Park, & Leschi/Madrona).

In the northeastern US there has been some limited success in growing the species, but growth is much slower there, and it is prone to *Cercospora* and *Kabatina* fungal diseases due to the hot, humid summer climate there. A tree at Blithewold Gardens, in Bristol, Rhode Island is reported to be 27 metres (89 ft) tall, reportedly the tallest in the New England states. The tree at the Tyler Arboretum in Delaware County, Pennsylvania at 29.1 metres (95 ft) may be the tallest in the northeast. Specimens also grow in the Arnold Arboretum in Boston, Massachusetts (planted 1972, 18 m tall in 1998), at Longwood Gardens near Wilmington, Delaware, and in the Finger Lakes region of New York. Private plantings of Giant Sequoias around the Middle Atlantic States are not uncommon. Since 2000, a small amateur experimental planting has been underway in the Lake Champlain valley of Vermont at the Vermont Experimental Cold-Hardy Cactus Garden where winter temperatures can reach −37 °C with variable snowcover.

A cold-tolerant cultivar 'Hazel Smith' selected in about 1960 is proving more successful in the northeastern U.S.A. This clone was the sole survivor of several hundred seedlings grown at a nursery in New Jersey.

Australia

The Ballarat Botanical Gardens contain a significant collection, many of them about 150 years old. Jubilee Park and the Hepburn Mineral Springs Reserve in Daylesford, Cook Park in Orange, New South Wales and Carisbrook's Deep Creek park in Victoria both have specimens. In Tasmania specimens are to be seen in private and public gardens, as they were popular in the mid Victorian era. The Westbury Village Green has mature specimens with more in Deloraine. The Tasmanian Arboretum contains young wild collected material. The National Arboretum Canberra has begun a grove.

New Zealand

Several impressive specimens of Sequoiadendron giganteum exist throughout the South Island of New Zealand. Notable examples include a set of trees in a public park of Picton, as well as robust specimens in the public and botanical parks of Queenstown.

Largest trees

General Sherman, the largest tree in the world

As of 2009, the largest Giant Sequoias (all located within California) by volume are:

Rank	Tree Name	Grove	Height		Girth at ground		Volume	
			(ft)	(m)	(ft)	(m)	(ft^3)	(m^3)
1	General Sherman	Giant Forest	274.9	83.8	102.6	31.3	52,508	1,486.9
2	General Grant	General Grant Grove	268.1	81.7	107.5	32.8	46,608	1,319.8

3	President	Giant Forest	240.9	73.4	93.0	28.3	45,148	1,278.4
4	Lincoln	Giant Forest	255.8	78.0	98.3	30.0	44,471	1,259.3
5	Stagg	Alder Creek	243.0	74.1	109.0	33.2	42,557	1,205.1
6	Boole	Converse Basin	268.8	81.9	113.0	34.4	42,472	1,202.7
7	Genesis	Mountain Home Grove	253.0	77.1	85.3	26.0	41,897	1,186.4
8	Franklin	Giant Forest	223.8	68.2	94.8	28.9	41,280	1,168.9
9	King Arthur	Garfield Grove	270.3	82.4	104.2	31.8	40,656	1,151.2
10	Monroe	Giant Forest	247.8	75.5	91.3	27.8	40,104	1,135.6
11	Robert E. Lee	General Grant Grove	254.7	77.6	88.3	26.9	40,102	1,135.6
12	J. Adams	Giant Forest	250.6	76.4	83.3	25.4	38,956	1,103.1
13	Ishi Giant	Kennedy Grove	248.1	75.6	105.1	32.0	38,156	1,080.5
14	Column Tree	Giant Forest	243.8	74.3	93.0	28.3	37,295	1,056.1
15	Summit Road Tree	Mountain Home Grove	244.0	74.4	82.2	25.1	36,600	1,036.4
16	Euclid	Mountain Home Grove	272.7	83.1	83.4	25.4	36,122	1,022.9
17	Washington	Mariposa Grove	236.0	71.9	95.7	29.2	35,901	1,016.6
18	General Pershing	Giant Forest	246.0	75.0	91.2	27.8	35,855	1,015.3
19	Diamond Tree	Atwell Mill Grove	286.0	87.2	95.3	29.0	35,292	999.4
20	Adam	Mountain Home Grove	247.4	75.4	94.2	28.7	35,017	991.6

- The General Sherman tree is estimated to weigh about 2100 tonnes.
- The Washington Tree was previously the second largest tree with a volume of 47,850 cubic feet (1,355 m^3), but after losing over half its trunk in January 2005 it is no longer of great size.
- The trees named "Franklin", "Column", "Monroe", "Hamilton" and "Adams" were named by Wendell Flint and others, these five are now included on the official map of giant forest, where they are all situated.
- The Hazelwood Tree (not listed above) had a volume of 36,228 cubic feet (1,025.9 m^3) before losing half its trunk in a lightning storm in 2002, if it were still at full size it would currently be the 16th largest giant sequoia on earth.

Giant Sequoia superlatives

The Muir Snag thought to be over 3500 years old

Largest

- General Sherman - Giant Forest - 52,508 cubic feet (1,486.9 m^3)

Tallest

- Unnamed Tree - Redwood Mountain Grove - 311 feet (95 m)

Oldest

- Examples in Converse basin, Mountain home grove and Giant forest - 3500 years or more.

Largest Girth

- Waterfall Tree - Alder Creek Grove - 155 feet (47 m) - tree with enormous basal buttress on very steep ground.

Greatest Base Diameter

- Waterfall Tree - Alder Creek Grove - 57 feet (17 m) - tree with enormous basal buttress on very steep ground.
- Tunnel Tree - Atwell Mill Grove - 57 feet (17 m) - tree with a huge flared base, that has burned all the way through.

Greatest Mean Diameter at Breast Height

- General Grant - General Grant Grove - 29.0 feet (8.8 m)

Largest Limb

- Arm Tree - Atwell Mill, East Fork Grove - 12.8 feet (3.9 m) in diameter

Thickest Bark

- 3 feet (0.91 m) or more

Source:

Extinct species

- *Sequoiadendron chaneyi*

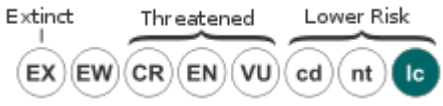
Chapter-10

Thuja Plicata

Thuja plicata

An old tree in Vancouver

Conservation status



Least Concern (IUCN 2.3)

Scientific classification

Kingdom:	Plantae
Division:	Pinophyta
Class:	Pinopsida

Order:	Pinales
Family:	Cupressaceae
Genus:	*Thuja*
Species:	***T. plicata***

Binomial name

Thuja plicata
Donn ex D.Don

Range

Thuja plicata (**Western Redcedar**) is a species of *Thuja*, an evergreen coniferous tree in the cypress family Cupressaceae native to western North America. It is the Provincial tree of British Columbia, and has extensive applications for the indigenous First Nations of the Pacific Northwest.

Description

A shoot with mature cones. Mount Baker-Snoqualmie National Forest.

It is a large to very large tree, ranging up to 65–70 m tall and 3– 4 m in trunk diameter, exceptionally even larger. Trees growing in the open may have a crown that reaches the ground, whereas trees densely spaced together will only exhibit a crown at the top, where light can reach the leaves. It is long-lived; some individuals can live well over a thousand years, with the oldest verified being 1,460 years.

The foliage forms flat sprays with scale-like leaves in opposite pairs, with successive pairs at 90° to each other. The foliage sprays are green above, and green marked with whitish stomatal bands below; they are strongly aromatic, with a scent reminiscent of pineapple when crushed. The individual leaves are 1–4 mm long and 1–2 mm broad on most foliage sprays, but up to 12 mm long on strong-growing lead shoots.

The cones are slender, 10–18 mm long and 4–5 mm broad, with 8–12 (rarely 14) thin, overlapping scales; they are green to yellow-green, ripening brown in fall about six months after pollination, and open at maturity to shed the seeds. The seeds are 4–5 mm long and 1 mm broad, with a narrow papery wing down each side. The pollen cones are 3–4 mm long, red or purple at first, shedding yellow pollen in spring.

Distribution and habitat

Western Redcedar is native to the northwestern United States and southwestern Canada, from southeastern Alaska and British Columbia south through Washington and Oregon to the far northwest of California, primarily in coastal forests but with a disjunct inland population in the southeast of British Columbia, the extreme southwest of Alberta, northern Idaho and westernmost Montana. Pollen analysis and carbon-14 dating indicates postglacial colonization around the lower Fraser Valley around 6600 years ago. There it prospers and accounted for nearly half the vegetation in the area 500 years ago. Currently, Western Redcedar comprises about twenty percent of the region's forests.

Western Redcedar is among the most widespread trees in the Pacific Northwest, and is associated with Douglas-fir and western hemlock in most places where it grows. It is found at the elevation range of sea level to a maximum of 2290 m above sea level at Crater Lake in Oregon. In addition to growing in lush forests and mountainsides, Western Redcedar is also a riparian tree, and grows in many forested swamps and streambanks in its range. The tree is shade-tolerant, and able to reproduce under dense shade.

It has been introduced to other temperate zones, including western Europe, Australia (at least as far north as Sydney), New Zealand, the eastern United States (at least as far north as Central New York), and higher elevations of Hawaii.

The species is naturalized in Britain.

Taxonomy and name

Thuja plicata is one of two *Thuja* species native to North America, the other being *Thuja occidentalis*. The species name *plicata* derives from a Greek word meaning "folded in plaits", a references to the pattern of its small leaves.

Most authorities, both in Canada and the United States cite the English name in two words as western redcedar, or occasionally hyphenated as western red-cedar, to indicate is not a cedar *(Cedrus)*, but it is also confusingly cited as western red cedar in some popular works. In the American horticultural trade, it is also known as the giant arborvitae, by comparison with arborvitae for its close relative *Thuja occidentalis*. Other names include giant redcedar, Pacific redcedar, shinglewood, British Columbia cedar, canoe cedar, and red cedar. *Arborvitae* comes from the Latin for "tree of life"; coincidentally, native Americans of the West coast also address the species as "long life maker".

Notable specimens

The "Quinault Lake Redcedar" is the largest Western Redcedar in the world

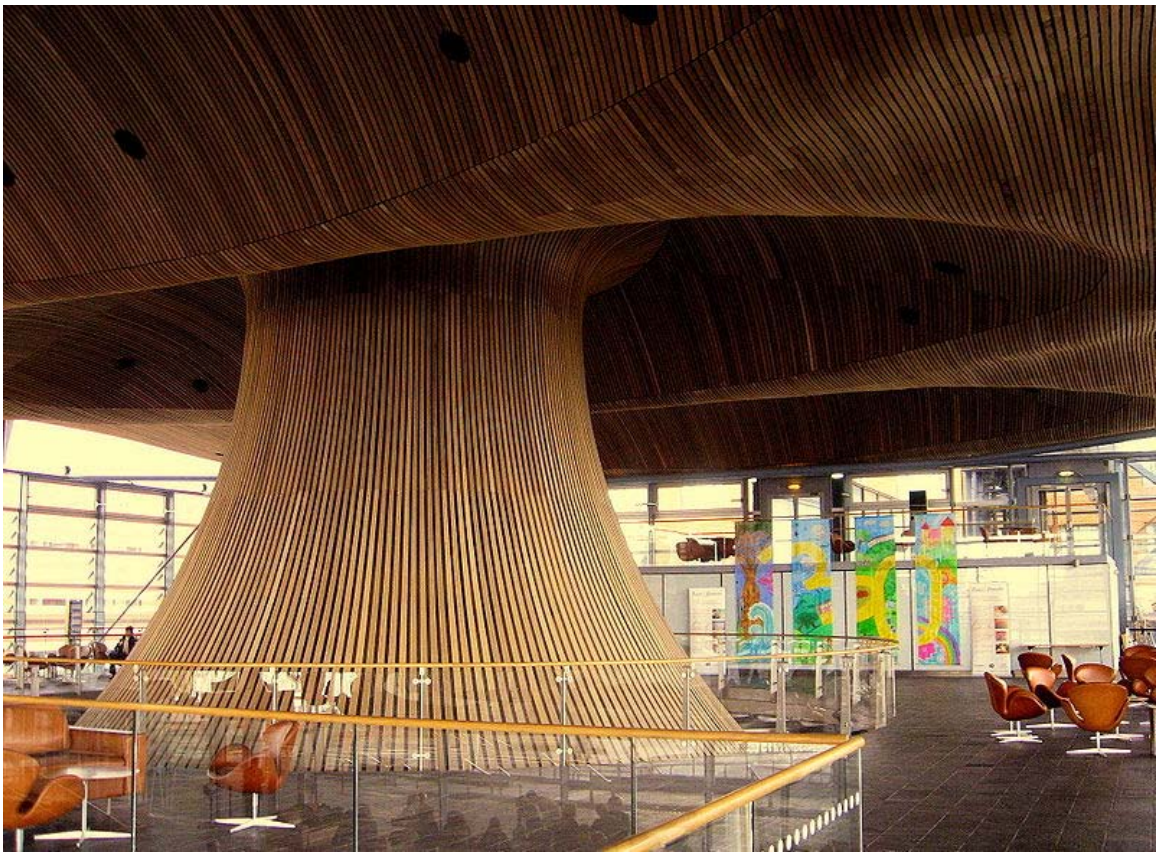
The "Quinault Lake Redcedar" is the largest known specimen in the world with a wood volume of 500 cubic metres (17,700 cu ft). It is located near the northwest shore of Lake Quinault north of Aberdeen, Washington, about 34 km from the Pacific Ocean, it is 55 m tall with a diameter of 6.04 m By way of comparison, the largest known tree, a Giant Sequoia named "General Sherman", has a volume of 1,480 cubic metres (52,300 cu ft).

The second largest is the Cheewhat Lake Cedar, in the West Coast Vancouver Island-Pacific Rim National Park, at 449 cubic meters, and then the Kalaloch Cedar in the Olympic National Park, at 350 cubic meters.

A redcedar over 71m tall, 4.5m in diameter and over 700 years old stood in Cathedral Grove on Vancouver Island, British Columbia, before it was set on fire and destroyed by vandals in 1972. That tree now lies in "Giant's Grave", a self dug grave created by the force of its own impact.

A giant stump of a Western Redcedar tree is on display outside of the Tree House exhibit at the Jardin botanique de Montréal in Quebec, Canada. Visitors are welcome to pose next to it for dramatic photographs showing the tree's giant scale.

Uses



Canadian Western Redcedar cowl in the National Assembly for Wales.

The soft red-brown timber has a tight, straight grain and few knots. It is valued for its distinct appearance, aroma, and its high natural resistance to decay, being extensively used for outdoor construction in the form of posts, decking, shingles and siding. It is cultivated as an ornamental tree, to a limited extent in forestry plantations and for screens and hedges. It is also used to line closets and chests, for its pungent aromatic oils are believed to discourage moth and carpet beetle larvae, which can damage cloth by eating wool and similar fibres. This is more effective in a properly constructed *redcedar chest* (sometimes made entirely of redcedar), since the oils are confined by shellac and leather seals. A well-sealed redcedar chest will retain its pungent odour for many decades,

sometimes for over a century. Its light weight, strength and dark warm sound make it a popular choice for guitar soundboards.

Thujaplicin, a chemical substance, is found in mature trees and serves as a natural fungicide, thereby preventing the wood from rotting. This effect lasts around a century even after the tree is felled. However, thujaplicin is only found in older trees, and saplings that do not produce the chemical often rot at an early stage, causing some trees to grow with a somewhat hollow, rotten trunk.

Role in indigenous societies

Klallam people and canoe, ca. 1914

Western Redcedar has an extensive history of use by the indigenous peoples of the Pacific Northwest Coast, from Oregon to southeast Alaska. Some northwest coast tribes refer to themselves as "people of the redcedar" because of their extensive dependence on the tree for basic materials. The wood has been used for constructing housing, totem poles, and crafted into many objects, including masks, utensils, boxes, boards, instruments, canoes, vessels, and ceremonial objects. Roots and bark were used for baskets, ropes, clothing, blankets and rings.

History

A huge number of archeological finds point to the continuous use of redcedar wood in native societies. Woodworking tools dating between 5000–8000 years ago, such as carved antlers, were discovered in shell middens at the Glenrose site, near Vancouver. In Yuquot, on the west coast of Vancouver, tools dating 3000–4000 years old have been

found. The Musqueam site, also near Vancouver, yielded bark baskets woven in five different styles, along with ropes and ships dated to 3000 years ago. At Pitt River, adzes and baskets were dated around 2900 years ago. 1000 year old wooden artifacts were unearthed on the east coast of Vancouver Island.

A legend amongst the Coast Salish peoples describes the origins of the Western Redcedar. In this legend, there was a generous man who gave the people whatever they needed. When the Great Spirit saw this, he declared that when the generous man died, a great redcedar tree will grow where he is buried, and that the cedar will be useful to all the people; providing its roots for baskets, bark for clothing, and wood for shelter.

Tools

The wood was worked primarily with the adze, which was preferred over all other tools, even ones introduced by European settlers. Alexander Walker, an ensign on the fur trade ship *Captain Cook* reported that the indigenous peoples used an elbow adze, which they valued over new tools brought by the Europeans, such as the saw or the axe, going so far as to modify traded tools back into an adze. Tools were generally made from stone, bone, obsidian, or a harder wood such as hemlock. A variety of hand mauls, wedges, chisels and knives were used. Excavations done at Ozette in Washington state turned up iron tools nearly 800 years old, far before European contact. When James Cook passed the area, he observed that almost all tools were made of iron. There has been speculation on the origin of these iron tools, some theories include shipwrecks from East Asia, or possible contact with iron-using cultures from Siberia, as hinted in the more advanced woodworking found in northern tribes such as the Tlingit.

Wood

Harvesting redcedars required some ceremony, and included propitiation of the tree's spirits as well as those of the surrounding trees. In particular, many people specifically requested the tree and its brethren not to fall or drop heavy branches on the harvester, a situation which is mentioned in a number of different stories of people who were not sufficiently careful. Some professional loggers of Native American descent have mentioned that they offer quiet or silent propitiations to trees which they fell, following in this tradition.

Felling of large trees such as redcedar before the introduction of steel tools was a complex and time-consuming art. Typically the bark was removed around the base of the tree above the buttresses, and then some amount of cutting and splitting with stone adzes and mauls would be done, creating a wide triangular cut. The area above and below the cut would be covered with a mixture of wet moss and clay as a firebreak, and then the cut would be packed with tinder and small kindling and slowly burned. The process of cutting and burning would alternate until the tree was mostly penetrated through, and then careful tending of the fire would fell the tree in the best direction for handling. This process could take many days, and constant rotation of workers was involved to keep the fires burning through night and day, often in a remote and forbidding location.

A pole outside a six-post house at the University of British Columbia.

Once the tree was felled the work had only just begun, as it then had to be stripped and dragged down to shore. If the tree was to become canoes then it would often be divided into sections and worked into rough canoe shapes before transport, but if it were to be used for a totem pole or building materials it would be towed in the round to the village. Many trees are still felled in this traditional manner for use as totem poles and canoes, particularly by artists who feel that using modern tools is detrimental to the traditional spirit of the art. Non-traditionalists simply buy redcedar logs or lumber at mills or lumber yards, a practice that is commonly followed by most working in smaller sizes such as for masks and staves.

Because felling required such an extraordinary amount of work, if only planks for housing were needed, these would be split from the living tree. The bark was stripped and saved, and two cuts were made at the ends of the planking. Then wedges would be pounded in along the sides and the planks slowly split off the side of the tree. Trees which have been so harvested are still visible in some places in the rainforest, with obvious chunks taken off of their sides. Such trees usually continue to grow perfectly well, since redcedar wood is resistant to decay. Planks are straightened by a variety of methods, including weighing them down with stones, lashing them together with rope, or forcing them between a line of stakes.

Redcedar wood is used to make huge monoxyla canoes in which the men went out to high sea to harpoon whales and conduct trade. One of those canoes (a 38 feet craft dug out about a century ago), was bought in 1901 by Captain John Voss, an adventurer. He gave her the name of Tilikum ("Friend" in Chinook jargon), rigged her, and led her in a three years hectic voyage from British Columbia to London.

Redcedar branches are very flexible and have good tensile strength. They were stripped and used as strong cords for fishing line, rope cores, twine, and other purposes where bark cord was not strong enough or might fray. Both the branches and bark rope have been replaced by modern fiber and nylon cordage among the aboriginal northwest coast peoples, though the bark is still in use for the other purposes mentioned above.

Bark

Illustration of women pulling bark from a tree, from *Indian Legends of Vancouver Island* by Alfred Carmichael

The bark is easily removed from live trees in long strips, and is harvested for use in making mats, rope and cordage, basketry, rain hats, clothing, and other soft goods. The harvesting of bark must be done with care because if the tree is completely stripped it will die. To prevent this, the harvester usually only harvests from trees which have not been stripped before. After harvesting the tree is not used for bark again, although it may later be felled for wood. Stripping bark is usually started with a series of cuts at the base of the tree above any buttresses, and the bark is peeled upwards. To remove bark high up, a pair of platforms strung on rope around the tree are used, and the harvester climbs by alternating between them for support. Since redcedars lose their lower branches as all tall trees do in the rainforest, the harvester may climb 10 m or more into the tree by this method. The harvested bark is folded and carried in backpacks. It can be stored for quite some time as mold does not grow on it, and is moistened before unfolding and working. It is then split lengthwise into the required width and woven or twisted into shape. Bark harvesting was mostly done by women, despite the danger of climbing 10 m in the air, because they were the primary makers of bark goods. Today bark rope making is a lost art in many communities, although it is still practiced for decoration or art in a few places. Other uses of bark are still common for artistic or practical purposes.