Appendix II
Redwood Species Comparisons

In the literature reviewed for this appendix, examples of albinism (Davis and Holderman, 1980, Peirce, 1901) and fasciation (Becking, 1970; Peirce, 1901; Roy, 1966) were reported for sequoia or dawn redwood.

Comparison of the Giant Sequoia, Coast Redwood, and Dawn Redwood

Characteristic	Giant Sequoia	Coast Redwood	Dawn Redwood
Discovery (leading to botanical description)	by Augustus Dowd in Calaveras North Grove, Calaveras County, 1852	by Archibald Menzies in Santa Cruz County, 1794	by Tsang Wang near No-tao-hsi, Sichuan Province, China, 1944
Early Names	known as "wawona" or big tree to Nokelumne Tribe	known as "palo colorado" or redwood to Spanish-Americans	known as "shul-hsa" or water-fir to Chinese
Distribution	Western Sierra Nevada in California usually found in mixed stands with other conifers; young trees not tolerant of shade drought resistant	Pacific coast ranges of California and southwestern Oregon often found in nearly pure stands, or in mixed stands; young trees moderately tolerant of shade high moisture requirement	Shul-hsa and Wangjiaying valleys, Hubel and adjacent Sichuan mountains, China widely scattered in mixed stands; most abundant in shady ravines(a); young trees tolerant of shade high moisture requirement
Altitudinal Range	2800-8900 feet		2300-4400 feet
Max. Height	310 feet(b) 40.3 feet(e) at base	367.8 feet(c)	164 feet(d)
Max. Diameter	25-30 feet near base	30.5 feet(f) at base; 12-18 feet near base	10.9 feet(d) at base; 5-8 feet near base
Max. Circumference	112 feet(g) at base	95.7 feet(f) at base	
Max. Bole Volume	52,500 cubic feet (h), or 630,000 board feet	30,114 cubic feet(i), or 361,366 board feet	

(After Boe, 1974a, 1974b; Buchholz, 1939; Chu and Cooper, 1950- Davidson, 197;, Elias, 1989; Harlow and Harrar, 1958; Hartesveldt et al., 1975; Harvey, 1978; Johnson, 1974; Li, 1957; Munz and Keck, 1973; Ouden and Boom, 1978; Rehder, 1940; Shirley, 1937; Sterling, 1949; USDA, 1948)

(a) The California Academy-Lingnan Dawn-Redwood Expedition discovered only 1219 trees remaining in Sichuan and Hubei in 1948. Most were found growing in an "apparent state of semi-cultivatlon," planted around farmhouses, or in straight rows along the edges of rice fields bordering streams. "There can hardly be said to be any Metasequola forests or even moderate natu-

ral stands. Most of the trees are in rows following up side streams. There are rarely as many as 50 along a single branch stream (Gressitt, 1953)."

(b) The "California Tree," Grant Grove, Kings Canyon National Park (Shirley, 1937). In nearby Redwood Mountain Grove, Fry and White (1931) measured one prostrate giant sequoia 347 feet long.

(c) The "Tall Tree," Tall Trees Grove, Redwood National Park (Zahl, 1964). Also known as the "Howard A. Libbey Tree for the founding president of the Arcata Redwood Company (Carranco, 1982). In the aftermath of winter floods in 1964, siltation around the base reduced its standing height to 366.6 feet (Becking, 1967).

(d) An isolated tree near Wangjiaying, Hubel Province (Chu and Cooper, 1950). Estimated to stand "about 50 meters (Chu and Cooper, 1950)" in 1948, the tree was reported by Gressitt (1953) to be 115 feet high with a diameter of 8.5 feet at six feet above the ground.

(e) The "General Grant Tree," Grant Grove, Kings Canyon National Park (Harvey et al., 1981). Standing 267.4 feet high, the tree had a ground circumference of 107.6 feet and bole volume of 47,450 cubic feet (569,400 board feet) in 1976. Its bole volume scaled 43,038 cubic feet (516,456 board feet) in 1931 (Jourdan, 1932).

(f) The "Reed Tree," North Fork of the Mad River, Humboldt County (Zinke, 1965). Standing 302 feet high, the tree had a breast height diameter of 26.9 feet in 1966 (Becking, 1968). Although spared by loggers cutting the proximate forest, it has since been toppled by winds (Zinke, 1990, Personal communication). The largest standing circumference would be the "Big Tree," Circle Trail, Prairie Creek Redwoods State Park (Shirley, 1937). In 1937 the tree stood 300 feet high with a ground circumference of 90 feet and breast height diameter of 17.i feet.

(g) The "Boole Tree," Converse Basin Grove, Sequoia National Forest (Shirley, 1937). Standing 268.8 feet high, the tree had a mean diameter of restored base of 33.2 feet and bole volume of 39,974 cubic feet (479,688 board feet) in 1931 (Jourdan, 1932).

(h) The "General Sherman Tree," Giant Forest, Sequoia National Park (Harvey et al., 1981). Standing 274.9 feet high, the tree had a ground circumference of 102.6 feet and base diameter of 36.5 feet in 1976. Its bole volume scaled 49,660 cubic feet (595,920 board feet) in 1931 (Jourdan, 1932).

(i) The "Captain Elam Tree," Maple Creek drainage, Humboldt County (Peattle, 1980; Roy, 1966; Tiemann, 1935). Standing 308 feet high, the tree had a 20-foot diameter at five feet above the ground, and a 12-foot diameter at 230 feet, scaling 14 logs from 12 to 17 feet in length. However, the largest coast redwood was likely felled before 1900. According to Soule (1899), "one of these giant redwood trunks, near Bucksport, yielded, a few years since, 480,000 feet B.M. (board measure) of first-class lumber, and many other trees have yielded 400,000." Bucksport is located near the mouth of the Elk River on Humboldt Bay within Eureka city limits.

Comparison of the Giant Sequoia, Coast Redwood, and Dawn Redwood

Characteristic	Giant Sequoia	Coast Redwood	Dawn Redwood
Maximum Age	3126 years(j)	2200 years(k)	300-600 years(l)
Wood	brittle, light, soft(m); coarse-grained; heart-wood red; tending to fracture transversely when felled	tough, light, soft(m); close-grained; heart-wood red; tending to fracture lengthwise when felled	brittle, light, soft(n)
Bark	fibrous, deeply furrowed into large ridges, 1-2 feet thick at base; rich cinnamon-brown color	fibrous, furrowed into small ridges; 0.5-1.0 feet thick at base; red-brown to dull gray-red color	fibrous, fissured, deeply fluted and tressed at base; thin; red-brown to dark gray color
Burls	few; when cut from tree will not grow leaves	common(p); when cut from tree will grow new leaves	
Roots	to 150 feet from base, 6-8 feet below surface	to 50 feet from base, 4-6 feet below surface	
Buds	naked	naked and scaly(q)	scaly
Leaves	small, awl-shaped ap-pressed around stem; sessile; blue-green color evergreen, falling with branchlets in 2-5 years	two kinds: awl-shaped appressed around stem; and flat needle-like, al-ternate in two rows; ses-sile; dark yellow-green color evergreen, falling with branchlets in 2-5 years (maximum 7 years)	flat needle-like, opposite in two rows; with small stalks; blue-green color deciduous
Long Branchlets	bear short shoots in al-ternate array	bear short shoots in al-ternate array	bear short shoots in op-posite pairs
Short Branchlets	leaves in spirals; decidu-ous	leaves in spirals and in two rows, except at tip; deciduous	leaves opposite in two rows; deciduous
Reproduction	only by seeds	by seeds, and by root collar or crown sprouts(r)	only by seeds
Pollen Cones (stami-nate)	sessile; 0.16-0.31 inches long; scales arranged in spirals	stipitate; 0.06 inches long; scales arranged in spirals	stipitate; 0.16-0.24 inches long; scales op-posite

(j) Measuring 26.5 feet in diameter at six feet above the ground, the tree was felled by loggers in the Millwood Grove near Grant Grove, Kings Canyon National Park (Fry and White, 1931). In 1925, A.E. Douglass traced the ring chronology of a giant sequoia stump near Springville to 1120 B.C.

(Douglass, 1945). The age of the General Sherman Tree is less than 2500 years (Hartesveldt et al., 1975).

(k) Measuring 12 feet in diameter, the tree was felled by loggers in the Avenue of the Giants, Humboldt County, in 1934 (Weaver, 1975).

(l) "According to Chaney (personal communication) increment cores suggest for the largest trees an age of at least 300 years (Chu and Cooper, 1950)." Hu (1948) preferred a maximum age of about 600 years.

(m) The wood of giant sequoia has a dry weight of 18 lb/ft3; and coast redwood, 26 lb/ft3 (Peattle, 1980).

(n) Ouden and Boom (1978) projected that Metasequola may "become one of the most valuable timber trees, since careful investigations have shown that the quality of wood equals that of Ables alba (European silver fir)." Although its pulping characteristics are similar to and its fibers stronger than southern pines (Johnson, 1974), the D.S. Forest Products Laboratory regarded Metasequola as "too light in weight, too weak, limber and soft to have economic value as a solid wood product (Wyman, 1968)." The wood has not been considered valuable in China (Gressitt, 1953).

(p) Exceptional burls include a seven-ton growth that was nine feet in diameter at 150 feet above the ground (Pioneer Western Lumberman, 1917), and another that nearly encircled a trunk for a distance of 60 feet (Fritz, 1928). But the greatest burl on record once extended 1.5 feet into the ground, massed like a giant boulder, 105 feet in circumference and nine feet high at the crown (Anon, 1945). Seven redwoods up to six feet in diameter grew out of this giant burl near Big Lagoon in Humboldt County, which required four men and 30 days to harvest its extraordinary yield of 60 tons of sound veneer stock in 1944.

(q) In contrast to scaly buds found on the lower, two-ranked foliage, Davidson (1971) reported that bud leaves of the many-ranked tip foliage "become, in effect, naked since the so-called bud 'scales' remain alive and green for about five years... indistinguishable from ordinary leaves except that they are usually shorter."

(r) Two conifers associated with coast redwood also sprout from stumps: the California nutmeg or torreya (Torreya californica) and the Pacific yew (Taxus brevifolia) (Jepson, 1910; Roy, 1966). Sprouting is vigorous in the former and weak in the latter. Although neither has been regarded as commercially important, there has been much recent interest in the bark of Pacific yew, provenance of the cancer-fighting drug taxol (Daly, 1992).

Comparison of the Giant Sequoia, Coast Redwood, and Dawn Redwood

Characteristic	Giant Sequoia	Coast Redwood	Dawn Redwood
Seed Cones	ellipsoid, 2-3.5 inches long; mature second season; persistent and may remain growing for over 20 years 25-40 scales arranged in spirals; 3-9 seeds on each scale	ovoid, 0.5-1.125 inches long; mature first season; persistent and shed seeds during 2nd winter season 14-24 scales(t) arranged in spirals; 2-5 seeds per scale	globose or ovoid, 0.80 inches across; mature and shed seeds first season in late December-early January 16-26 scales opposite; 5-8 seeds per scale
Seeds	with broad lateral wings; 0.25 inches long; in two rows on each scale average 230 seeds per cone or 81,000 F r pound(v)	with narrow lateral wings; 0.0625 inches long; in one or two rows(u) on each scale average 60 seeds(w) per cone or 120,000 F r pound(x)	with minute lateral wings; 0.23 inches long; in one row on each scale
Chromosomes	22 per diploid cell	66 per diploid cell (y)	22 per diploid cell

(t) 18-35 scales were reported by Becking (1982).

(u) Cone scales of the coast redwood may bear 1-14 ovules in one or two rows, not solely in one row as previously reported (Davidson, 1971).

(v) Average number obtained from 21 samples (Boe, 1974b). The number of cleaned seeds F r pound ranged between 62,000 and 100,000.

(w) Davidson (1971) found this figure to be about half the average number of ovules that he obtained F r cone, "which calls into question" what might be considered a seed. 90-150 seeds F r cone were reported by Becking (1982).

(x) Average number obtained from 157 samples (Boe, 1974a). The number of cleaned seeds F r pound ranged between 59,000 and 300,000.

(y) All other known wild conifers have between 20 and 24 chromosomes (Libby and McCutchan, 1978).

All three species are remarkably resistant to depredations by insects and fungi, and have been extensively used as an ornamental in temperate and sub-temperate latitudes.