Discovering Gray Pine (*Pinus sabiniana*) in Oregon

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"*The tree is remarkable for its airy, widespread tropical appearance, which suggest a region of palms rather than cool pine woods. The sunbeams sift through even the leafiest trees with scarcely any interruption, and the weary, heated traveler finds little protection in their shade.*"

–John Muir (1894)

Until fairly recently, gray pine was believed to be restricted to California, where John Muir encountered it. But the first report of it in Oregon dates back to 1831, when David Douglas wrote to the Linnaean Society of his rediscovery of *Pinus sabiniana* in California. In his letter from San Juan Bautista, Douglas claimed to have collected this pine in 1826 in Oregon while looking for sugar pine (*Pinus lambertiana*) between the Columbia and Umpqua rivers (Griffin 1962). Unfortunately, Douglas lost most of his field notes and specimens when his canoe overturned in the Santiam River (Harvey 1947). Lacking notes and specimens, he was reluctant to report his original discovery of the new pine in Oregon until he found it again in California (Griffin 1962). Despite the delay in reporting it, Douglas clearly indicated that he had seen this pine before he found it in California, and the Umpqua region has suitable habitat for gray pine.

John Strong Newberry[1] (1857), naturalist on the 1855 Pacific Railroad Survey, described an Oregon distribution for *Pinus sabiniana*: "It was found by our party in the valleys of the coast ranges as far north as Fort Lane in Oregon." Fort Lane was on the eastern flank of Blackwell Hill (between Central Point and Gold Hill in Jackson County), so his description may also include the Applegate Valley. Built in September 1853 for service in the Rogue River War, Fort Lane was abandoned three years later. Named for General Joseph Lane[2] (1801-1881), the fort was constructed from local trees, principally pines (Tveskor and Cohen 2008). Surviving old pines near the fort site on Gold Ray Road include both ponderosa and gray pine.

The lone gray pine at Tolo, near the old Fort Lane site, displays the characteristic architecture of multiple upright leaders that are necessary to bear heavy clusters of cones. Photo by Robert Korfhage.

1 John Strong Newberry (1822-1892) is recognized by Oregon botanists from species bearing his name in several genera (*Astragalus, Gentiana, Penstemon, Polygonum, Potentilla*), based on collections he sent to Asa Gray. Newberry Crater in central Oregon was named in his honor in 1903. Over all, he generated over 200 scientific papers and amassed a mineral and fossil collection of over 100,000 specimens.

2 Joseph Lane came to Oregon in 1849; became the first territorial governor in 1859; was elected US Senator and in 1860 was a vice presidential candidate (running with Breckenridge). Lane County is named for him (McArthur 1965).

Artist's depiction of bird's eye view of Ft. Lane, circa 1855. Although the trees appear to be fir, they actually would have been ponderosa or gray pine. Reprinted from Tveskor and Cohen (2008).

Documentation of Gray Pine in Oregon

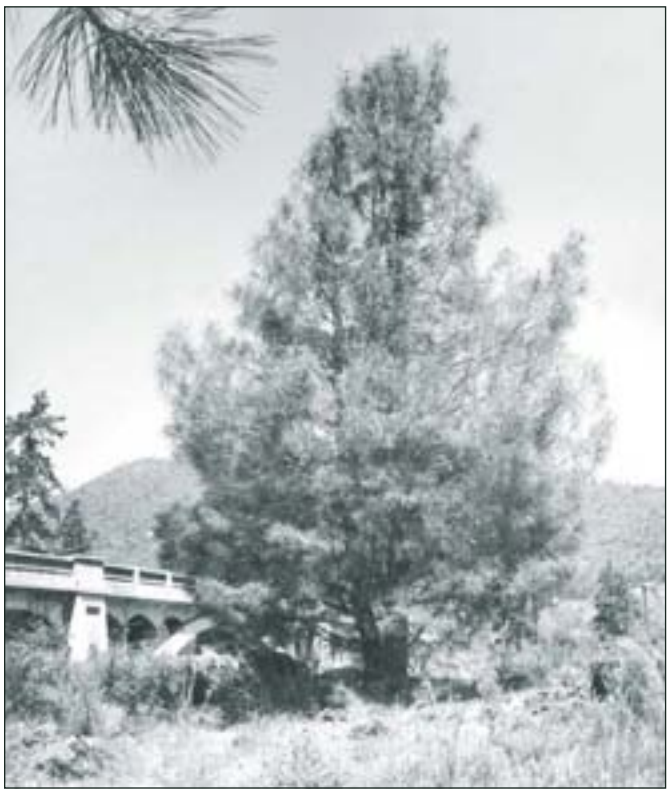
Oliver Matthews (1892-1979), dendrologist and amateur botanist, created the first scientific documentation of *Pinus sabiniana* in Oregon. Matthews first learned of gray pine when civil engineer Earl Marshall told him of an old miner who lived about three miles above Ruch in the Applegate Valley in 1870 and came down to Ruch to gather gray pine seed to eat. Marshall corroborated this story with his own observation around 1917, of finding "eight or ten little trees scattered over say maybe a quarter of an acre, trees maybe 20 ft. tall, in a pasture southwest of Ruch. When he went back in 1925, the trees had been cut down, but the gray pine stumps were still there" (Matthews 1946). In 1940, Lee C. Port, District Ranger on the Rogue River National Forest, told Matthews about a knobcone pine near Gold Hill. Five years later, Matthews found the tree at Rock Point near Gold Hill, and discovered that it was a gray pine. On November 5, 1945, Matthews photographed the pine and collected leaves and cones, which he sent to Oregon herbaria for the first documentation of gray pine in Oregon. This tree was cut down by the Oregon State Highway Department on September 17, 1952, when it was 39 feet tall with a trunk diameter of 17 inches. A ring count showed that it was 33 years old, thus it was a seedling in 1919.

In 1955, Dan Rigel, a logger, found five gray pines west of Boswell Mountain (north of Sams Valley, see Oregon distribution map). Growing in association with stunted Oregon white oak on poor volcanic soils, the trees ranged in size from 45 to 80 feet tall and up to 3.5 feet in diameter.

In 1958 Ivan Skyrman collected seeds from six gray pine trees on east slope of Blackwell Hill near the Ft. Lane site (probably on his brother William's property). Years later, he noted that those trees had been cut for firewood along with most of other pines (Skyrman, pers. comm. 1985). Since then, a tree planted at his residence in Central Point has grown to become Oregon's Champion gray pine: 109 ft. tall and 4.25 ft. in diameter breast height (DBH), a testament to the fertility of soils in that part of the Rogue Valley.

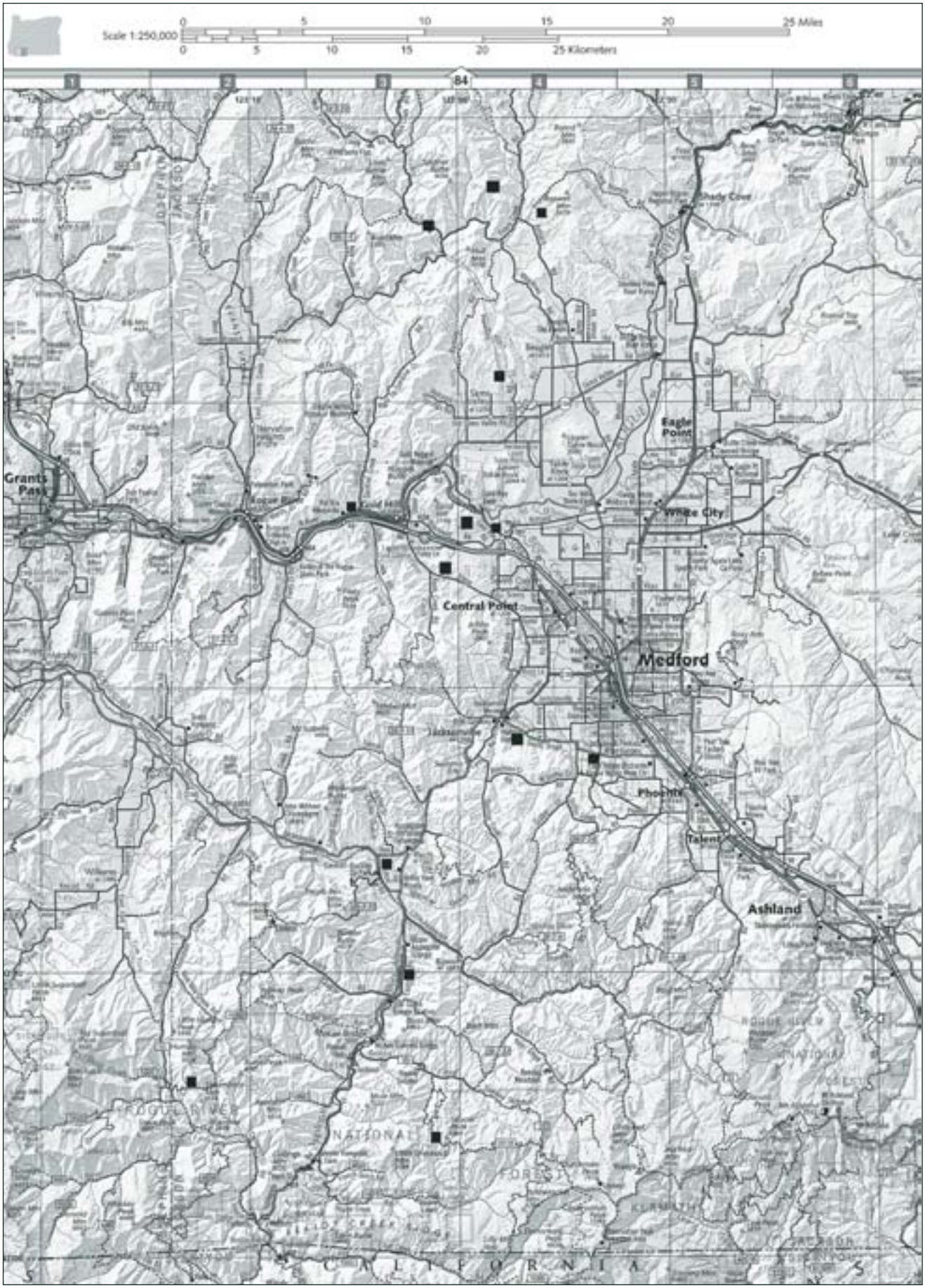
Based on Matthews' herbarium specimens, Morton Peck (1961) included *Pinus* sabiniana in his *Manual of the Higher Plants of Oregon*; unfortunately, Peck got the location wrong ("one locality in eastern Josephine County"). Matthews collected his specimen in western Jackson County.

In 1970 I purchased 20 woodland acres south of Foley Lane and Interstate-5 between Gold Hill and Blackwell Hill in Jackson County. Soon after that I discovered gray pine on my property as well as the adjacent Hidden Valley Ranch (Callahan 2005). Most of the larger specimens were in Harris Gulch; one tree was 39 inches in diameter and 96 ft. tall. The larger trees had clear boles for 30 to 40 ft. I also found several large downed trees, the largest of which measured 55 in. DBH and was 136 ft. long; the ring count near the base was 166 years. Unfortunately, all of the trees over 14 in. DBH in this population were logged in the 1990s, along with the associated ponderosa pine[3]. Ring counts of those stumps ranged from 75 to 149 years. At this site, the gray pines appeared to be out-performing the ponderosa pines! At the time, the Morris brothers (Earl and LaRue, now deceased) requested that I not report these trees because they feared people trespassing on their property (883 acres). I respected their wishes, waiting until the brothers no longer owned the property to donate voucher specimens to the herbarium at Oregon State University. Around the same time, adjacent landowner John Mardon (1906-1994) said that he had cut a dozen or so gray pine for firewood from his south slope into Harris Gulch. Years later, Frank Lang visited the Harris Gulch site with me and we found only seven gray pine



First documented gray pine at Rock Point, west of Gold Hill, photographed and collected by Oliver Matthews. Photo courtesy of Oregon State University Archives.

3 The largest ponderosa pine measured 48 inches DBH and 102 ft. tall, with a ring count of 189 years.



Known locations of gray pine in Jackson Co., Oregon. Map courtesy of Benchmark© maps.

trees on the slopes above the gulch. Since all the mature trees were logged, pine seedling recruitment has been poor. Seven trees currently produce cones with fertile seeds. Plant Oregon Nursery near Talent has added the species to their inventory of native trees for sale and Ogden Kellogg started a population on gabbro soils on his property at Gold Hill.

In 1975, after corresponding with Oliver Matthews for years, I visited him at a Salem rest home. Although in poor health, with failing eyesight and hearing, he was mentally sharp. Matthews began his story about gray pine with Earl Marshall and concluded with the rumors of gray pines up Carberry Creek and in the Applegate Valley. He garnered most of his information from miners and woodcutters, adding that "most...foresters don't know the difference between a knobcone and a gray pine!" My experience with reports from foresters at the Star Ranger District paralleled his; for several years the leads led to nothing but knobcone pine. My luck changed when I applied Oliver's strategy and queried an elderly woodcutter instead. He replied, "Those gray-looking trees with cones the size of coconuts; hell yes, they grow here and also in the Redding area. The wood is hard to split, much like knobcone pine" (both trees have intertwined coarse fibers and rarely split in a straight plane). He indicated on my map where he had cut a stand of gray pine some ten years earlier. The next weekend, after traveling many dead-end spur roads, I found an abandoned road that led to a rocky outcrop with 27 rotting stumps. Heavy cones around the stumps provided evidence that they were gray pine. One stump with high rosin content was in fair condition, and its four-foot diameter yielded an age guesstimate of 120 years. This site was near Burnt Peak-Kinney Mountain, above Carberry Creek, just as Oliver had predicted! (See Oregon distribution map on p. 3).

Oregon dendrologist Oliver Matthews (1892-1979) first documented *Pinus sabiniana* in Oregon. He graduated from Willamette University in 1913 and supported Oregon herbaria (WILLU, OSC, ORE) with numerous collections. His records are archived at the Oregon State University Library. Photo courtesy of Oregon State University Archives.

In 1976, I met with Jim Griffin, the gray pine authority in California, at Hastings Natural History Reservation (inland from Carmel, California) to discuss the distribution of gray pine in Oregon. I briefed him on the new range data, to which he replied, "I just wish I could have had your information when writing my PhD thesis and the "*Distribution of Forest Trees of California*." He regretted that he did not have time to check out the Oregon rumors, even though he suspected that "If gray pine did grow in Oregon, the Medford-Grants Pass portion of the Rogue River Valley would certainly be appropriate habitat" (Griffin and Critchfield 1972). Although unable to personally verify locations reported outside California, Griffin should have acknowledged the presence of gray pine in Oregon because he knew about Oliver Matthew's voucher specimens.

In 1988, Dave Hoffer, a hunter, found a single gray pine on Little Grayback Mountain. Soon afterwards, Wayne Rolle (Forest Service botanist) and I walked the entire Slickear trail from Squaw Peak to Squaw Lakes in search of a second reported gray pine, to no avail. In 2003 I located the stump of a lone gray pine that Calvin Smith, another local hunter, discovered east of Eastside Road in the Applegate Valley the previous year (see Oregon distribution map). The stump, surrounded by numerous gray pine cones, was 32 inches in diameter, and I estimated its age at 76 years.

In 2007, Rick Givens, a local avid outdoorsman, noted several gray pines on an eastern ridge of Spignet Butte (west of Boswell Mtn). I searched the area and found about five trees that had been destroyed earlier by a forest fire. However, several trees remained on private property at the southern base of Spignet Butte, not far west of where Dan Rigel located five trees in the 1950s. In the same year I also found a single gray pine with two intact cones after the Hull Mountain fire near Rock Creek just north of Sams Valley. In 2008 I found two additional populations of gray pine in the foothills east of Jacksonville; one of which was growing with California buckeye (Callahan 2005). In October 2009 I found the first gray pine in Josephine County, along the Galice Road west of Merlin.

Gray Pine Habitat

> *"The form of the tree, as well as its foliage are peculiar, and readily serve to distinguish it from all other pines I have seen…It chooses, in preference, regions unoccupied by other trees, and is generally found scattered sparsely over rough and rocky surfaces, where almost no other plant would take root."* –John Strong Newberry (1857).

> *"These trees* [gray pine]*…are seldom if ever seen in dense groves, but sparsely distributed over extensive areas - well on to one thousand miles of the lighter hilly lands of California and Oregon - they also inhabit some of the most utterly sterile, rough and rocky soils imaginable"* –Albert Kellogg (1882).

In Jackson County, gray pine grows on soils derived from a wide range of parent material including sandstone (Payne Cliff formation), ultramafic, volcanic, metavolcanic or metasedimentary rocks, and limestone. Generally functioning as a pioneer species in the foothills chaparral, gray pine may be a climax species on ultramafic, mafic, and calcareous soils, that are often shallow (low moisture storage capacity) and with mineral imbalances that limit plant growth.

Elevations of gray pine sites in Oregon range from 1,650 ft. (near Gold Hill) to 4,320 ft. (near Squaw Peak). Gray pine survives with as little as 10 inches annual precipitation (in California), giving it a competitive advantage over ponderosa pine and Pacific madrone in dry conditions. During the drought years of 1985 to 1994 (NOAA 2009), bark beetles decimated ponderosa pine populations and madrone suffered extensive dieback, while the gray pine prospered. Of the gray pine sites in Oregon, only the Rock Point site is near a weather station, which recorded 35 inches in 2003.

In Oregon, wedgeleaf ceanothus (*Ceanothus cuneatus*) grows with all fourteen populations of gray pine. Although this shrub also

grows with gray pine in California, it "is not a universal member of the *Pinus sabiniana* communities, ranging beyond the pine to the north and south" (Griffin 1962). Like Oregon white oak (*Quercus garryana*), Brewers oak (*Q. garryana* var. *breweri*) and incense cedar (*Calocedrus decurrens*), gray pine is an incidental component of foothills chaparral. Chaparral comes from Spanish, meaning "a place of scrub oak" which has expanded to include other shrubs, including wedgeleaf ceanothus, whiteleaf manzanita (*Arctostaphylos viscida*), Fremont silktassel (*Garrya fremontii*), Yerba Santa (*Eriodyction californicum*),

Native distribution of gray pine in Oregon and California. Map adapted from Atlas of United States Trees (Little 1971).

Is the Name *sabiniana* or *sabineana*?

The name has been *Pinus sabiniana* since David Douglas named the pine to honor Joseph Sabine, honorary secretary of the Royal Horticultural Society that sent Douglas to collect plants in North America. According to McKelvey (1991), a dedication was added to Douglas' description (Trans. Linn. Soc. London 16:747-750, 1833): "The active and enlightened zeal which Joseph Sabine, Esq. has ever taken ... for the introduction of new choice and useful plants ... induces me to affix his name to one of the most beautiful objects of creation ...," making it clear that Douglas was not honoring Joseph's brother Edward, as Edward apparently maintained after Douglas' death.

Joseph Sabine (1770-1837), patron and friend of David Douglas. Portrait by E. U. Eddis, lithograph printed by Lefevre & Kohler, published by Thomas McLean, 1835. ©The Board of Trustees of the Royal Botanic Gardens, Kew, reproduced with permission.

In 2001, Farjon listed gray pine in *World Checklist and Bibliography of Conifers* as "*Pinus sabineana* Douglas ex D. Don in Lambert," followed by *sabiniana*, indicating that he considered the latter a synonym, with no explanation for the name change. In the second edition of his book on pines, Farjon (2005) wrote, "As this species was named after the former President of the Royal Society Sir Edward Sabine (1788-1883) [Farjon is in error here] the original misspelling "sabiniana" by David Douglas should be corrected under the rules of nomenclature."The change to *sabineana* was quickly adopted by internet sites, including the Integrated Taxonomic Information System's 2009 website (www.catalogueoflife.org), which listed Farjon's Conifer Database as the source of "latest taxonomic scrutiny."

However, Article 60 of the International Code of Botanical Nomenclature (ICBN) that states that the original spelling of a name or epithet is to be retained, with certain exceptions that do not appear to be relevant here. In addition, the idea that the spelling of *sabiniana* was a typographical or orthographical error seems most unlikely. The authors probably followed a frequent custom of the time and simply created a Latin form for Joseph Sabine's surname, *Sabinius*. Because Article 60C.2 of the ICBN allows for an "ana" ending if the person's name ends in a vowel, Farjon's epithet *sabineana* is a properly constructed name, but it isn't needed.

Interestingly, Farjon uses the original spelling, *P. sabiniana,* in his latest book (2008). Farjon's epithet and its citation are not included in the International Plant Names Index (http://www.ipni.org/index.html). Clearly, *Pinus sabiniana* Doug. ex Don in Lambert should be considered the correct scientific name for gray pine. –Frank Lang

mountain mahogany (*Cercocarpus betuloides* var. *macrourus*), poison oak (*Toxicodendron diversilobum*), hollyleaf redberry (*Rhamnus ilicifolia*), and deer brush (*Ceanothus integerrimus*). These shrubs represent a northern extension of the California Floristic Province, and are commonly referred to as foothills chaparral, although both poison oak and wedgeleaf ceanothus also occur on the valley floor (in the basin chaparral type). Antelope bitterbrush (*Purshia tridentata*) grows with gray pine at Rock Point (Gold Hill).

Other trees found with gray pine in Jackson County include Canyon live oak (*Quercus chrysolepis*), California black oak (*Q. kelloggii*), Pacific ponderosa pine (*P. ponderosa* ssp. *benthamiana*), knobcone pine (*P. attenuata*), Douglas fir (*Pseudotsuga menziesii*), sugar pine (*P. lambertiana*), Pacific madrone (*Arbutus menziesii*) and California buckeye (*Aesculus californica*). Because gray pine is shade intolerant, it usually grows on shallow or rocky soils in the ecotone between dense conifer or madrone forests and open grasslands or chaparral. Native grasses common on these sites include Oregon fescue (*Festuca roemeri*), Chinook brome (*Bromus laevipes*) and Lemmon's needlegrass (*Achnatherum lemmonii*).

The *Ceanothus*-chaparral communities are important in Jackson County because they form the climax plant community on xeric slopes, protecting watersheds from soil erosion and providing habitat for numerous animal species (Detling 1961, Keeley 1975). Gray pine is only a minor component of chaparral communities, and is entirely absent in the foothills and basins east of the Rogue Valley, including the extensive populations of wedgeleaf ceanothus on the south slopes of both Table Rocks. It ranges onto the Cascadian volcanic soils only where geologic formations of the Klamath and Cascade mountains merge at the north end of the county (Boswell Mtn.). Ring counts of old wedgeleaf ceanothus indicate a maximum life expectancy of about 50 years. Wedgeleaf ceanothus seeds germinate with or without fire, especially on bare or disturbed mineral soils, although fires may completely replace populations. Even mature gray pine trees cast so little shade that it does not inhibit a dense subcanopy of ceanothus. Both species are deep rooted and the pine may benefit from nitrogen contributed by the shrub. Gray pine and wedgeleaf ceanothus are xeric thermophiles, tolerating drought and high temperatures severe enough to kill associated chaparral and oak species.

Gray pine was probably a component of the basin chaparral that was widespread in the Rogue Valley when Europeans arrived; Medford was once called "Chaparral City" (John Mardon, pers. comm.). The gray pine at Tolo (Gold Ray Road) is at the edge of this basin. Clearing land for agriculture and cutting trees for lumber and firewood during the 1850s eliminated most of the trees in the valley, especially near the railroad.

Likewise, the current distribution of gray pine in California foothills may be a only a portion of its natural range. Historical records indicate that gray pine once grew in the valleys: "on the borders and at the head of the Sacramento Valley, but little above the level of tide water" (Newberry 1857). Small populations of gray pine growing in chaparral stands on the floor of the Sacramento Valley between Dunnigan and Arbuckle may be remnants of a distribution that was more widespread prior to frequent burning (Watts 1959). In the Great Central Valley, "Indians set most of the fires that burned nearly every year. Fire was the brush that painted this landscape. It surged from the valley grasslands below. More fires crept into the foothills from the ponderosa pine forests on the mountains above, and others started in the foothills" (Bonnicksen 2000). Because the chaparral/gray pine type provided little forage for cattle or sheep, stockmen converted vast areas of the Sacramento Valley to annual grasslands; the practice was formally endorsed by University of California range specialist Arthur Sampson: "Controlled burn ignited by the

Gray pine with view of Mount McLoughlin in background and Oregon white oak to the right. This is the last remaining tree from a population on the John Mardon property, which lies on an east-west ridge south of Foley Lane near Gold Hill. Photo by Frank Callahan.

The "Tolo tree" bears a seed tree sign; four seedlings have taken root nearby. Photo by Frank Callahan.

edge method…The tall trees are digger pine, a worthless species on range land" (Sampson and Schultz 1956).

Despite its scarcity, gray pine in valley habitats give an indication of the species' potential maximum size. The record-setting trees listed in the table below were recorded from valley habitats in six California counties.

In 1888, John Gill Lemmon photographed a magnificent specimen in the foothills (ca. 2500 ft. elev.) near Auburn, California, which he estimated to be 180 feet tall. Lemmon may have overestimated the height, but without a diameter figure, it is difficult to scale the height of the tree. The tree in Santa Clara County (nominated by the author in 1991) is ranked as the largest living gray pine.

In Oregon, gray pine's growth on fertile, lowland (agricultural) soils is amazing. It tolerates extremes of heat and drought better than ponderosa pine, which grows better in the foothills (above 2,500 ft.). The Oregon state champion tree, planted in rich bottomland soil 50 years ago, has grown to be almost as large as the tallest gray pine (102 ft.) that Griffin measured in California. In contrast, on poorly developed soil barely three feet deep, it took 166 years for the Harris Gulch tree to grow to 135 feet tall (and 4 ft. 7 in. DBH). The largest individuals are not always the oldest because environmental factors (e.g., soils, climate, fire frequency) play a major role. The oldest reported gray pines range from 175 years (Lieberg 1902, Shin 1911) to 200 years (Biswell and Agee 1999, Powers 1990). Compared to other Western pines, gray pine is not long-lived; mostly due to the frequency of wildfires (Griffin 1962). Fires set by Native Americans in the valleys often raged into the foothills, which may be why John Muir (1894) recorded apparently full-grown specimens of gray pine only 40 to 50 feet tall and two to three feet in diameter, barely half the size of current records.

Tallest ever recorded gray pine tree, published by John Gill Lemmon (1888). Caption reads "Gray-leaf Pine near Auburn, Cal.; 180 feet high; altitude, 2,500 feet." Photo by Britton & Rey, San Francisco.

American Forest National Champion Trees, Gray Pine (www.americanforests.org/resources/bigtrees/)

Year	Circumference (in.)	Diameter (ft. in.)	Height (ft.)	Crown spread (ft.)	Points	California County
1960	190	5'	155	60	375	Fresno
1972	199	5'3"	160	80	379	Fresno
1984	192	5'1"	76	85	289	Tehama
1986	186	4'11"	161	79	367	Shasta
1991	222	5'11"	140	120	382	Santa Clara
2001	176	4'8"	120	77	315	Tulare
2005	200	5'4"	126	86	348	Kern

Friends of Gray Pine

Gray pine owes its wide distribution to birds belonging to the group known as corvids. Its heavy seed with a rudimentary wing is not wind dispersed like smaller-seeded pines; seeds normally fall directly under the canopy of the parent tree. Both Steller's and Scrub Jays are "hoarding granivores," birds that collect and cache seeds to eat later. Even though they are experts in relocating their caches, there are always some caches that are missed or forgotten; those seeds germinate and grow into seedlings. Jays hide their caches about half an inch below the mineral soil surface, assuring the seed some protection from dehydration while it undergoes winter stratification. My informal name for Scrub Jay is "planter of the pine." Scrub Jays live in the chaparral and woodland openings, a range sympatric with gray pine, and do not migrate; obtaining the water they need from their diet.

In contrast, Steller's Jays occupy forests and denser woodlands, ranging from below montane timberline down into the foothills (rarely ranging into the basins) and cover great distances in search of food. In summer, the best places to see Steller's Jays is near water sources, which are rare in chaparral types. Because it is poorly adapted to live in chaparral, Steller's Jay is normally just a transitory visitor, usually during the fall.

The distribution of the gray pine as widely scattered clusters reflects the habits of the two birds: Steller's Jays transport seeds great distances, often out of binocular range, while Scrub Jays usually

Common Names

Despite numerous common names (digger, gray, ghost, foothills, Sabine, grayleaf, bull, squaw, smoky, or pineapple pine), only one published scientific name exists for this species: *Pinus sabiniana*. David Douglas named it for his friend and patron Joseph Sabine (1770-1837), secretary of the Horticultural Society of London, who was an attorney as well as a naturalist (Little 1979). In a letter to Sabine from San Juan [Bautista], Upper California, on 4 February 1831, Douglas extolled his "Great Prickly-Coned Pine" as a "noble new species … one of the most beautiful objects of nature…[that will] flourish when we shall cease to be, when we are gone forever." Douglas wrote a brief Latin description, but did not note the location from which he secured his specimens (Bryant 1929, Griffin 1964a). David Don prepared a full Latin diagnosis and designated a type specimen (Lambert 1832).

This pine was so important to the native people of western North America that each tribal language had a name for it (Hinton 1992).

Tribe	Common Name
Amchumawi	tujhaloé
Chimariko	hatcho
Karuk	axyúsip
Klamath	gapga
Maidu	towáni
Miwok	sakky
Mono	tunah
Patwin	tuwa
Wappo	náyo

Historically, the most widely used common name has been digger pine. "Digger" is a pejorative term used by settlers to collectively describe the native people of central California, who dug roots and bulbs and used the seeds, sap, cones branches, leaves and bark of the pine. The native people resented the European settlers' name for them. In 1924, the Mewuk Indian Tribe at Ione, California, soaked an effigy labeled "Digger" with gasoline and torched it, while they "danced and chanted, indicating joy that the hated name has passed" (Hinton 1992). Lemmon (1888) objected to the name digger pine: "the uncouth name for this interesting tree should be discontinued for one [a name] which must always be characteristic, as it is derived from its most striking character, to wit: its singular, long, grayish leaves." Lanner (1999) agreed with Lemmon: "because the term 'Digger' is comparable in disrespect for Native Americans to the similar sounding term for African Americans, and dendrology is under no obligation to prolong historic insults, gray pine is a better common name."

An isotype of *Pinus sabiniana* Douglas ex D. Don, collected by David Douglas 1833, locality Nova California, accessioned as Herbarium Benthamianum in 1854. Scanned image courtesy of The Board of Trustees of the Royal Botanic Gardens, Kew, reproduced with permission.

cache seed within a mile of where it was produced. Both birds cache seeds in loose, rocky soils of open sites or chaparral. Steller's Jays fly many miles to cache seeds, so probably planted the small, widely scattered gray pine populations in Oregon. Scrub Jays, with their local dispersal, enlarge gray pine populations around the isolated trees planted by Steller's Jays. Because the seed is so large, sometimes the jays place a single seed in a cache; multiple-seed caches that are forgotten can result in clusters of gray pine seedlings.

Enemies of Gray Pine: Fire, Logging, and Squirrels

Like most chaparral species, gray pine is highly combustible; fire usually destroys or severely damages it. Although gray pine does not resprout, under natural conditions it rapidly re-colonizes burned sites, usually with the help of the jays. I watched both jays caching gray pine seed after the Montgomery Creek Fire in northern California; almost all subsequent pine seedlings appeared to be the result of their efforts. Frequent wildfires eliminate gray pine populations by preventing seedling establishment. Since fire regulations ended widespread burning of foothill grasslands, gray pine has been re-colonizing its former habitat in the Sacramento Valley, especially in the Redding area.

When European settlers arrived in the mid-1800s, the Harris Gulch site in Oregon supported large, old growth pine, oak, and madrone, interspersed with openings of bunchgrass and chaparral. Oral history related by descendants of these early settlers indicates that all fires in that area since that time have been human-caused. Bill David, retired forester, and Ansel Rosencrans, a local farmer, witnessed the last fire (in 1945) that started on the Foley Brothers' ranch near Gold Hill. Two boys using a rockpile for target practice created sparks that ignited dry grass. Hot winds rapidly swept the fire into nearby hills. Despite extremely dry conditions, most of the old growth pines (gray and ponderosa) and oaks suffered only basal scarring. Upslope, the fire completely consumed many younger pines and almost all the madrone and manzanita, except those growing in rocky areas with scant vegetation (typical gray pine habitat). Afterwards, madrone and oak resprouted from basal buds, whiteleaf manzanita and wedgeleaf ceanothus germinated from the soil seed bank, and the grasses simply grew back from roots or rhizomes.

Most of the larger gray pine trees survived the 1945 fire with just basal scars. But the 1980s brought a drought, followed by an infestation of bark beetles, which led to logging of all the conifers in Harris Gulch that had survived the fire. Non-merchantable trees were cut and left on the ground. My property was not logged, so these gray pines can furnish seed to restore the surrounding areas. Unfortunately, gray squirrels severely reduce the availability of seed; numerous shredded cones are still lying around the pine stumps.

In addition to shredding mature cones for the seeds, Western gray squirrel (*Sciurus griseus*) destroys both immature cones and entire seed crops by cutting and feeding on the branches (Berry 1914, Griffin 1962). Although Western gray squirrel populations in Oregon and Washington are reported to be in decline (Headley and Sells 2005), gray squirrels in southwestern Oregon have proliferated, benefiting from their association with humans, who set up feeding stations and kill predators. Its main predator, the fisher (*Martes pennanti*), has been nearly extirpated from Oregon due to habitat loss and trapping. Gray squirrels do not cache gray pine seeds or cones; but convert the cones to gnawed "cobs." In addition, they often raid bird caches, which not only deprives the jays, but also hampers seedling recruitment.

Left, gray pine cone from Harris Gulch. Right, a gray pine cone after a gray squirrel chewed off most the scales and ate all of the seeds. A squirrel can strip one of these sturdy cones in about 20 minutes. Photo by Robert Korfhage.

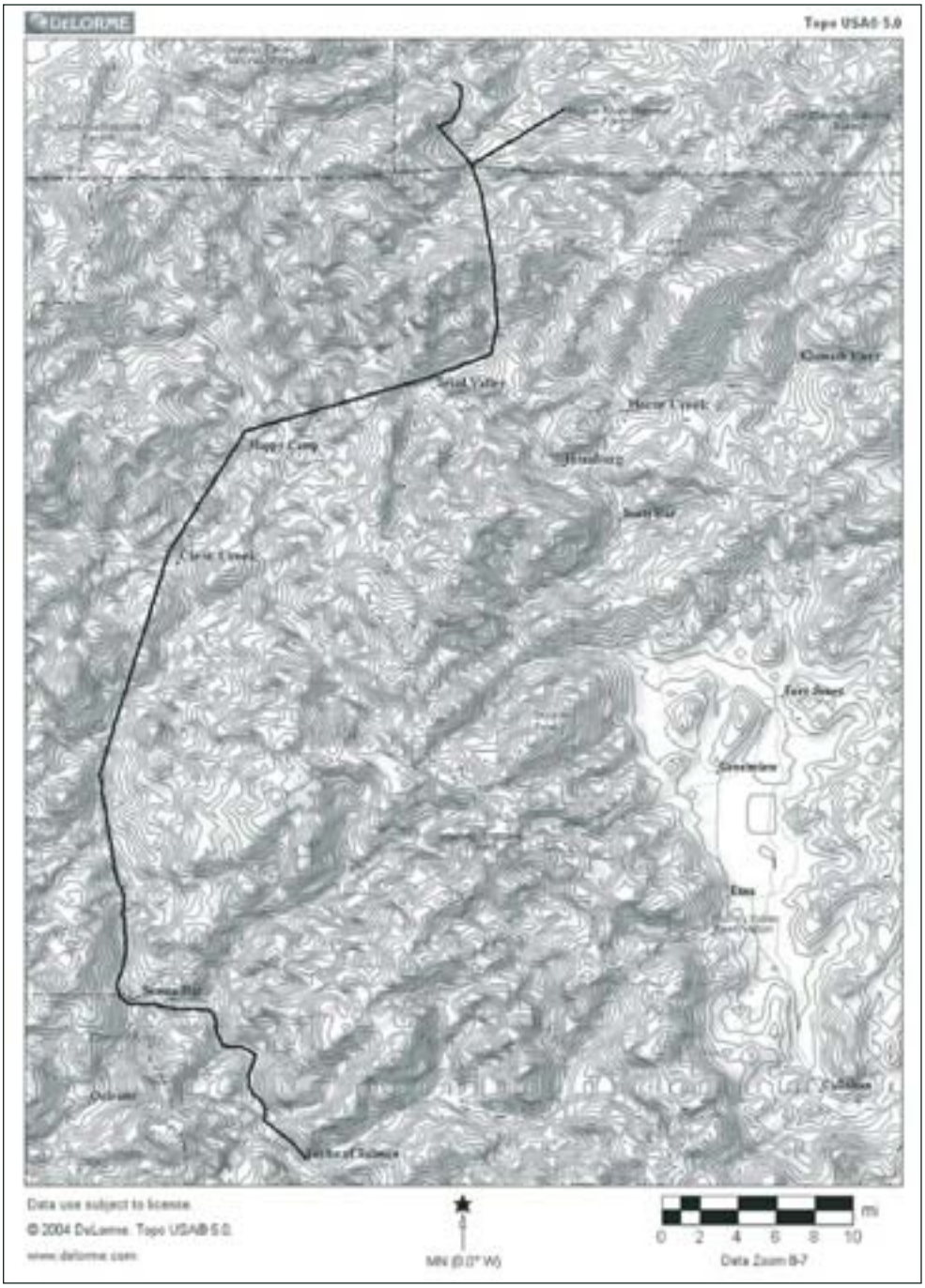
Fossil Origins of Gray Pine and How It Came to Oregon

The fossil pine *Pinus pieperi* Dorf. is either the progenitor or identical to gray pine (Ledig 1999). It dates to early and late Miocene and Pliocene (23.8 to 1.8 million years ago) and occurred south of the present range of gray pine, ranging from the Los Angeles basin north of the San Gabriel Mountains to Palmdale (Griffin 1962). Northward migration apparently occurred after or during the late Pleistocene; gray pine may have been eliminated from southern California either by warmer winter temperatures or by competition with elements of the chaparral formation, which expanded during the Holocene (Ledig 1999). Based on genetic similarity of disjunct populations, Ledig (1999) thought that gray pine formed a continuous population throughout the Great Central Valley 12 to 8 thousand years ago. Then, during the warmer, drier Xerothermic (8,500 to 3,000 years ago), it ascended into the foothills while the chaparral community expanded rapidly in the foothills and basins, fragmenting the gray pine distribution.

During this period, gray pine may have migrated from the Sacramento Valley northward into Oregon, capturing habitat formerly held by Douglas fir and ponderosa pine. In northern California, gray pine currently grows on the south slope of Cottonwood Peak in the Ash Creek drainage west of Interstate 5. The next major population to the south is at the Forks of the Salmon River in Siskiyou County (Plummer Creek). The gap between Squaw Butte and Plummer Creek is 53 miles. Along the

Salmon and Klamath River canyons in the Klamath Mountains in northern California, the simplest path north is over Cook and Green Pass (4,750 ft.) a few miles south of Applegate Reservoir in Oregon. Gray pine at Squaw Peak (northeast of Applegate Reservoir) is only 430 feet lower than that pass. During the hot, dry Holocene and the subsequent gradual cooling period, there was a period of more than 4,000 years in which conditions would have favored range expansion. Pinyon Jays, so well adapted to deserts, may have served to plant the pine increasingly northward. Both the Pinyon and Steller's Jays can fly over 12,000 feet, so none of the mountains passes along this route would present a barrier.

During the same period, the Great Basin species, Western juniper (*Juniperus occidentalis*), moved westward into the rain shadow of the Klamath Mountains. It is still abundant along the southeastern portions of the Rogue Valley (near Emigrant Lake) and to the southwest of the Siskiyou summit. Continuing across the Oregon/California border, it occupies a large area of distribution in the Klamath River canyon all the way south to the town of Callahan. These extensive populations of juniper surrounding the Scott and Shasta valleys are almost all associated with wedgeleaf ceanothus. So why is the gray pine absent from this region? On ultramafic soils, it ranges as far north as Pollard Flat in the Sacramento River canyon. The northern limitation may be competition from other conifers under mesic conditions (*i.e.*, this region is wet enough to support populations of Port Orford cedar (*Chamaecyparis lawsoniana*)). The warmer geologic period ended about 3,800 years ago, and the cooler, wetter climate that followed gave the advantage to other conifers over chaparral species, which gradually diminished to present levels (Daniels *et al.* 2005). In particular, Douglas fir and ponderosa pine reclaimed lost habitat, closing gray pine's former passageway from the Forks of the Salmon River to Cook and Green Pass. Current climate change may reverse the trend and favor chaparral-gray pine communities.

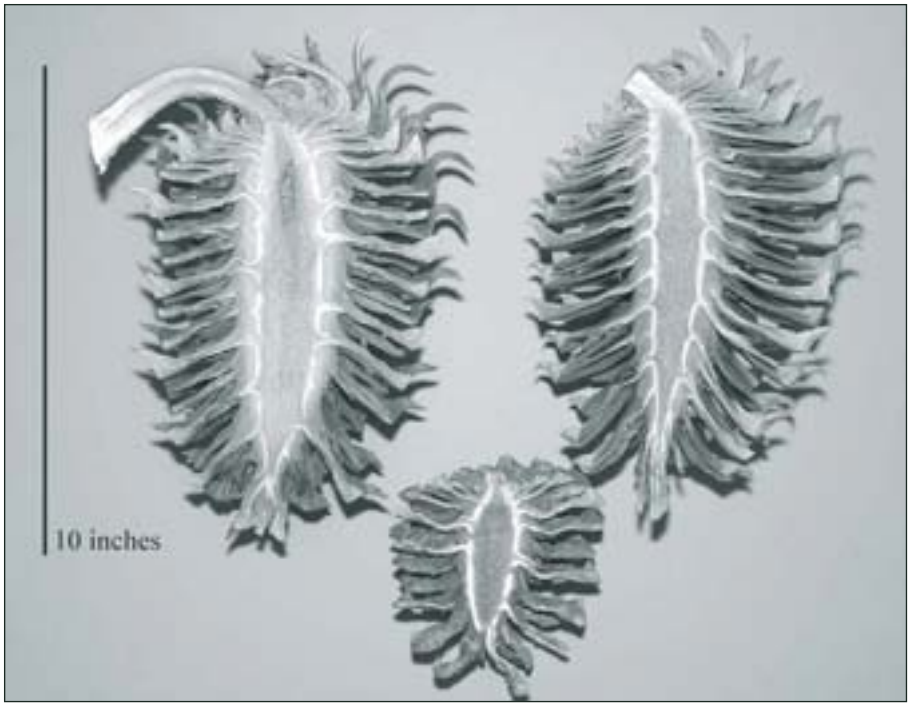


Possible migration route of gray pine from Forks of Salmon north to the Klamath River canyon and over Cook and Green Pass into Oregon. The distance in air miles between the two sites is 53 miles. Birds may have flown a direct route instead of the river canyons. Gray pine seed is ripe in November, but cones open as late as March at Forks of Salmon, providing the jays with food for eating and for caching. Map prepared by Robert Korfhage using mapping program 2004 DeLorme Topo USA®.

Gray Needles, Big Cones, and Gigantic Seeds

"*Scarcely in any sense a beautiful tree, offering no comfort of shade to the inexperienced wayfarer who, dusty and sun-bitten, seeks its protection, scorned too, by the lumbermen, it is nevertheless the most interesting and picturesque tree of the foothills on account of its scattered growth, its thin gray cloud of foliage, its variety of branching and its burden of massive cones*" (Jepson 1910).

Gray pine's "color signature" is so obvious that trees can be identified on GoogleEarth® images, even the "green trees" reported by Steve Edwards from Lamont Meadows,



The three heaviest pine cones in the western US: top left, gray pine (*Pinus sabiniana*) cone, note long peduncle with a 90 degree bend which allows the cone to hang vertically and thick central pith which was used as food by Native Americans; top right, Coulter pine (*Pinus coulteri*), note the narrower pith, short peduncle and asymmetrical cone base; bottom center, the smaller cone of Torrey pine (*Pinus torreyana*) with flat cone base and medium length peduncle. Photo by Robert Korfhage.

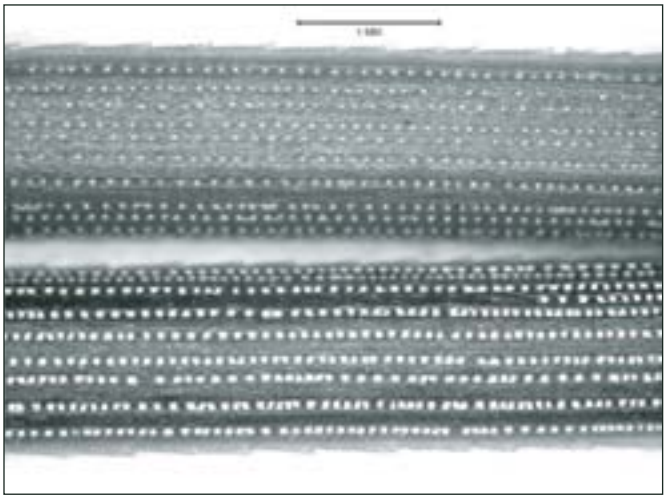
California (Edwards 1997). The secret to gray pine's soft ghostly appearance is its leaf surface. Unlike Colorado blue spruce needles that are coated with wax over the entire surface, gray pine concentrates highly reflective wax around large leaf stomata. Waxy antechambers reduce transpirational water loss from stomata under severe hot-dry conditions by about two thirds, but hinder the rate of photosynthesis by only one third (Jeffree *et al*. 1971).

Gray pine's drooping needles, 6 to 16 inches long, cluster in fascicles of three that may persist for four years. Because gray pine needles are less concentrated on the branch (35 fascicles in 5 inches), compared to Pacific ponderosa pine (85 fascicles in 5 inches), more light penetrates the crown, creating a more open appearance. Sunlight for photosynthesis reaches needles of inner branches of gray pine, compensating for the scanty arrangement of needles.

The main trunk of gray pine divides early into the distinctive upright branches required to support the weight of the cones. A cluster of green cones in a whorl may weigh as much as 20 pounds (4 to 4.5 pounds per cone). Without substantially strengthening the branching system (as in Coulter pine), only a vertical branching system can bear this much weight. Multiple, heavily-weighted leaders make the tree highly vulnerable to wind shearing, which is how most old gray pines meet their demise. As Ron Lanner (1999) observed, "Forked and tilted black trunks and wispy, ghost like foliage immediately signify gray pine. Many lean and tilt this way and that, creating the suspicion of a drunken forest staggering as it ascends the oak studded foothills."

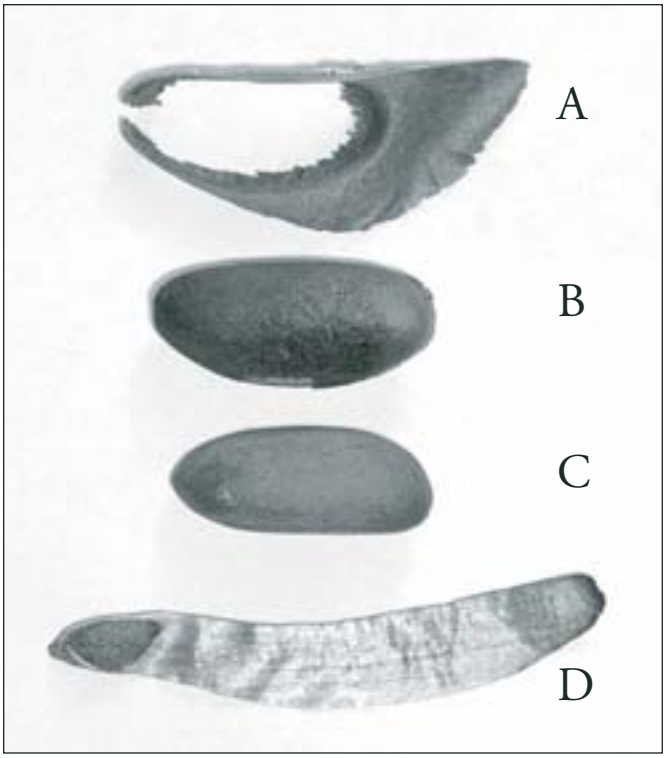
However, among the three big-cone pines, Torrey, Coulter and gray, the latter has by far the widest distribution. Gray pine compensates for a short lifespan by consistently producing seed and tolerating a wider range of soils and climatic conditions than other pines. Perhaps because pollen can be blown for many miles, or because of self pollination, even isolated gray pines produce viable seed. The single tree at Tolo tested at 65% filled seeds, compared to the multiple-tree sites in Harris Gulch with 98% filled seed. Unlike most pines, "isolated single trees of grey pine planted in the Crimea produced full seed of high quality" (Podgorny and Smirnova 1984).

Cones of Oregon gray pine are similar in size to cones of the



Needle surface of Pacific ponderosa pine (top) exhibiting fine stomata bands with low reflectivity compared with gray pine (bottom) with prominent stomata bands of high reflectivity that give this pine its gray color signature. Photo by Cindy Roché.

Peduncles that bore cones persist with a small rosette of cone scales after the cones drop. Because there is no abscission layer, cones weather off after many years. Photo by Robert Korfhage.



A) With only a vestigial wing, the seed of gray pine (*Pinus sabiniana*) is not aerodynamic, having a low area to mass ratio; B) Seed of gray pine from Oregon; C) Seed of bigcone piñon (*Pinus maximartinezii*) from Mexico, formerly the largest known seed in the genus *Pinus*; D) Seed of Guadalupe Island pine (*Pinus radiata* var. *binata*) from Guadalupe Island, Baja California Norte, showing a highly efficient wing. Photo by Robert Korfhage.

North Coast-Klamath Range, which are significantly larger than cones throughout the Sierra Nevada foothills (Griffin 1964b). Oregon's trees produce cones up to 12 inches long and 8 inches wide. Cones are pollinated in early spring, and require two years to reach maturity, in late fall. Even though the number of trees in Jackson County is small, within each population, cones vary greatly in size and shape. This variation and the conservation of alleles (gene variants) during its migration northward (Ledig 1999) supports the idea that our populations may be remnants of a formerly large population, rather than extreme outliers migrating from a distant population.

Seeds produced by Oregon gray pine are about the same size as those at Forks of the Salmon, the possible starting point for northward migration into Oregon. The largest Oregon seed (without wing) was 1 3/8 inch long and 9/16 inch wide, which is the largest seed known in the genus *Pinus*. Like Torrey pine, gray pine delays seed dispersal; seeds collected from five-year-old cones germinated well after stratification (McMaster and Zedler 1981). Farris (1992) found from 61 to 188 seeds per cone, similar to my counts.

In food value, gray pine seeds are comparable to commercial pine nuts, Italian stone pine (*P. pinea*). Gray pine seeds are 30% protein, 60% fat and 9% carbohydrate, compared to stone pine at 34% protein, 48% fat and 7% carbohydrate (Lanner 1981).

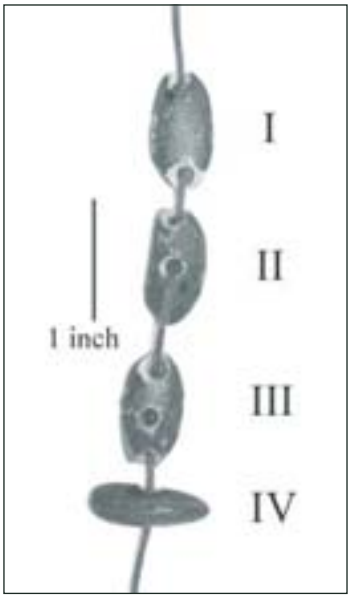
Ethnobotany

Native Americans in California relied heavily on gray pine, utilizing almost every part of the tree. In Oregon, one of the more interesting discoveries were the pine beads excavated in 1932 by Dr. Luther Cressman at a site south of Gold Hill in Jackson County:

> "*The richest burial found was that of a child approximately eight years of age; within this burial were found three types of marine shells: hundreds of* Olivella*, some* Glycymeris *and four pieces of Abalone. Also found were the hulls of Digger Pine seeds, of which some were partially charred. The pinenut hulls were strung together to form ornaments, which were found on the wrists and thorax of the buried child.*" (Ferillini 1989).

Carbon-14 dating of other artifacts showed that the site was 3,000 to 1,000 years old; the Gold Hill people appeared to be ancestors of the historic Takelma (Ferillini 1989). These beads were unusual in that they were drilled laterally (cross-wise through the middle, type IV in the photo), a style that has been found at only two sites: Gold Hill and the Nomlaki site in Tehama County, California. The Nomlaki site contained a mix of longitudinal, oblique and lateral beads (type I, II and IV in the photo) (Farris 1992).

Gray pine seeds were widely traded among tribes, but to what extent were beads manufactured on the site? If laterally-drilled beads were traded, then they should have been found at other excavations, but they have not. The Gold Hill tribe may have developed an endemic style of bead manufacture using the nearby stands of gray pine, but did not trade them because quantities were so limited. Gray pine seeds were widely traded in Coos, Curry, Josephine, and Lake counties. A single gray pine in Josephine Co. is the only gray pine population found outside Jackson County, making it unlikely that tribes in Oregon planted gray pine seeds.



Beads crafted by Native Americans from gray pine seeds differed in how they were drilled for stringing: from top to bottom, longitundinally (I), obliquely (II), longitudinally with a center hole (III), and laterally (IV). Bead styles re-created by Frank Callahan.

Gray Pine Cultivation – Grow Your Own

The few gray pine populations still present in the natural vegetation of Jackson County deserve protection, and could be augmented by planting[4]. Gray pine is a good choice for drought-tolerant home landscaping; examples can be seen in Grants Pass and various locations in Jackson County, including a gray pine planted along Interstate-5 at Mountain Avenue in Ashland. This lacey gray-leafed pine is a handsome accent in the garden and other plants can prosper in its light shade. Take care, though, as falling cones can be dangerous when dislodged by high winds!

4 For seeds, germination requirements, availability of planting stock, contact the author.

In Memoriam
Jim Griffin (1931-2004)

This article is dedicated to Jim Griffin, whose passion for *Pinus sabiniana* laid the groundwork for my story. I met Jim in 1976 and found that we shared an enthusiasm for locating big trees; together, we nominated two trees that became national champions (Coulter pine and bristlecone fir). We also compared notes on the idiosyncrasies of gray pine: a tree with tropical characteristics that can survive temperatures down to minus 30° F and far more successful than its two closest relatives, Coulter and Torrey pine.

James Richard Griffin, always known as Jim, grew up on a family farm in Watsonville, California, a town known for its agriculture. Jim became a botanist either because early years of farm work taught him that there were easier ways to make a living or because his father (Graydon G. Griffin) was a botany student of Willis Jepson. Either way, Jim majored in botany at the University of California, Berkeley (BS, 1952; MS, 1958; and PhD, 1962; "Intraspecific Variation in *Pinus sabiniana* Dougl."). During his college years, Jim met Joan Roberts and the two were married on 5 June 1957. Joan always ribbed him about marrying her for the pines on her property, which was located at Weimar, California, in the gray pine zone. In the summers of 1957 and 1958 Jim worked for the Six Rivers National Forest in Salyer, Trinity County, and in 1959 he worked in the Redwoods, at Weott. In 1960 he was a teaching assistant for Dr. Bob Sweeney at a San Francisco State botany class, held at Sagehen Creek, near Truckee. Between 1962 and 1966 (except for one summer), Jim worked for Doug Roy at the USFS Range and Experiment station, Redding, a gray pine hotspot. During the summer of 1965 Jim and Joan went to Washington, DC, to work for Dr. Elbert L. Little, Jr., Chief Dendrologist for the USDA Forest Service. This was Jim's only employment outside of California, about which Joan commented "that was enough." In the fall of 1966 Jim began teaching and doing research at Hastings Natural History Reservation, Carmel Valley, for the Museum of Vertebrate Zoology, Berkeley, a position he held for 28 years. Joan taught grades K-6 at Hastings, noting that "Hastings was a 200-acre playground for our kids, who grew up without television." Today, son Andrew is an organic farmer on the Griffin family farm and daughter Ruth, like her mother, is a teacher (math tutor). Jim retired in 1994 and returned to Weimar. Sadly, he was diagnosed with Alzheimer's disease, and died in January 2004. We miss him, but are grateful for his botanical contributions.

Jim and Joan Griffin, 7 November 1995. Photo courtesy of Joan Griffin.

Acknowledgements

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