

Suppression of Sugar Pine by Douglas-Fir in a Northern California Plantation

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Competition from naturally invading Douglas-fir severely suppressed a 56-year-old sugar pine plantation in northern California. Only 19 percent of the planted 3-0 stock remained. The average tree was only 38.1 centimeters (15 in) in diameter and 23.8 meters (78 ft) tall. Unless weeded of native conifers, sugar pine is not a suitable plantation species in this area.

Sugar pine (*Pinus lambertiana* Dougl.) is an important species in the mixed conifer forests of California. It occurs on higher mountains of the Coast Ranges and is very common in the central and northern Sierras at elevations between 1200 and 1600 meters (1). It is occasionally found near the Pacific coast of northern California, but does not occur mixed with the dominant coastal redwood (*Sequoia sempervirens* (D. Don) Endl.) or Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco).

Near the turn of the century, when much of the coastal redwood forest was clearcut, it was common practice to burn the brush and slash shortly after logging in order to "open" the country. After several such harvest operations, William H. Gibbs, a forward-looking forester with the Caspar Lumber Company, established several plantations to test the feasibility of introducing

"exotic" species into the central coast redwood region. California nutmeg (*Torreya californica* Torr.), Sitka spruce (*Picea sitchensis* (Bong.) Carr.), and sugar pine were planted during the winter of 1926-27. We believe the results of these trials are best represented by the outcome of the sugar pine planting.

The sugar pine was 3-0 stock apparently from a Sierran seed source. About 0.1 hectare on a 5 percent south-facing slope was originally planted at a 2.4-by-2.4-meter spacing (fig. 1). The area

had been cleared of old growth redwood-Douglas-fir forest and burned with a hot ground fire 6 months before planting.

In 1947 the State of California acquired the timberland holdings of the Caspar Lumber Company (approximately 20,000 hectares), which included the sugar pine plantation. The plantation site is currently managed by the California Department of Forestry as part of Jackson Demonstration State Forest (JDSF).

The plantation is located in west central Mendocino County,



Figure 1—Note stand density and amount of downed material in 56-year-old sugar pine plantation.

California, in the center of the coast redwood region. The site is 18 kilometers from the Pacific Ocean at an elevation of about 230 meters. Annual rainfall averages 130 centimeters, falling almost exclusively as rain from November to April. Additional moisture is provided during much of the summer by coastal fog. Temperatures range from -4° C in winter to 27° C in summer. The deep (>1.2 meters) sandy loam soils are considered excellent for growing conifers.

Sampling

The plantation was sampled in the winter of 1982 when it was 56 years old. Using a numbering system set up in an earlier plantation check (2), all living trees were located and included in the sample. The plantation had been measured in 1927 (Caspar Lumber Company), 1957, 1962, and 1967 (JDSF staff).

Height was measured to the nearest 0.1 meter with a Spiegel-Relaskop. Diameter at breast height was recorded to the nearest centimeter with a steel diameter tape. Our field notes also contain information about regeneration, disease or insect damage, subjective ratings of crown position (dominant, co-dominant, intermediate, suppressed), and general condition of the stand.

Findings

Survival and growth statistics for the stand are shown in table 1 along with available data from previous samplings. In 1962, six Douglas-firs thought to have invaded the plantation shortly after planting were marked so that their growth could also be monitored. The performance of these six trees is also shown in table 1.

First year survival (42 percent) of the pine was quite low considering the use of 3-0 stock. It is possible that blacktailed deer (*Odocoileus heminous columbianus*) browsed the new trees in the burned-over harvest area, thus contributing to tree mortality. Current (1982) survival is 19 percent.

Although sugar pines have shown reasonable growth, they have been overtopped by native Douglas-firs for the past 20 years. The sparseness of sugar pine crowns is illustrated in figure 2. Similar results have been obtained in southwestern Oregon (3). We expect none of the pines to survive to the planned 80-year rotation age of this stand.

No evidence of mortality from insects or disease was found in the plantation. White pine blister rust (*Cronartium ribicola*), common in other parts of the sugar pine range, has not been found here.

Sugar pine cones are quite distinctive and normally easy to find in sugar pine forests. At this site, however, no regeneration

Table 1—Survival and growth of a 56-year-old sugar pine plantation in northern California. Data for six Douglas-fir trees growing with the sugar pine are shown in brackets for comparison

Plantation Characteristics	1927	1957	1962	1967	1982
Survival (%)	42.3	32.7	3.2 [100]	30.3 [100]	19.2 [100]
Total basal area (m ² /ha)	—	7.8	9.8 [2.0]	11.2 [2.4]	12.4 [3.9]
Mean diameter (cm)	—	24.1	25.1 [40.9]	27.7 [45.5]	38.4 [57.9]
Volume (m ³)	—	21.4	35.7 —	— —	36.4 —
Mean height (m)	—	—	— —	— —	25.5 [33.7]
Tallest (m)	—	—	— —	— —	35.1 [39.0]
Dominant or					
codominant (%)	—	—	43.3 —	39.7 —	12.5 —
Intermediate (%)	—	—	22.4 —	30.2 —	32.5 —
Suppressed (%)	—	—	34.3 —	30.2 —	55.0 —
Six Largest Sugar Pines					
Mean diameter (cm)	—	—	35.8 [40.9]	49.5 [49.8]	58.2 [57.9]
Mean height (m)	—	—	22.0 [28.2]	— —	30.9 [33.7]

¹From Malain et al. (1963).



Figure 2—*Sugar pines exhibit sparse crowns as a result of competition with Douglas-fir. Note the 2 trees in the lower left corner.*

occurred and there were no cones found. Other studies have shown that heavy cone crops occur every 4 years on the average and that small diameter trees like those in this plantation produce a very small percentage of a normal cone crop (3). As these characteristics indicate, sugar pine is not well adapted to unmanaged plantations in this area.

Conclusions

As results of this study indicate, introduced sugar pine is unable to compete with naturally seeded Douglas-fir. Therefore, landowners who want to establish sugar pine plantations in this area will have to weed out invading native conifers. Considering the inferior merchantability of sugar pine compared to redwood

in this area, a plantation requiring this sort of intensive management would seem to be unfeasible except for special purposes.

Literature Cited

1. Griffin, J. R.; Critchfield, W. B. The distribution of forest trees in California. PSW-82/1972. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 1976. 114 p.
2. Malain, R. J.; Burns, D. M.; and Sindel, J. E. Sugar pine planting on Jackson State Forest. Calif. State For. Note 17. 4 p.
3. Fowells, H. A.; Schubert, G. H. Seed crops of forest trees in the pine region of California. Agric. Tech. Bull. 1150. Washington, DC: U.S. Department of Agriculture; 1956. 48 p.
4. Fowells, H. A. Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture; 1965. 762 p.