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SUGAR PINE MANAGEMENT
...an annotated bibliography

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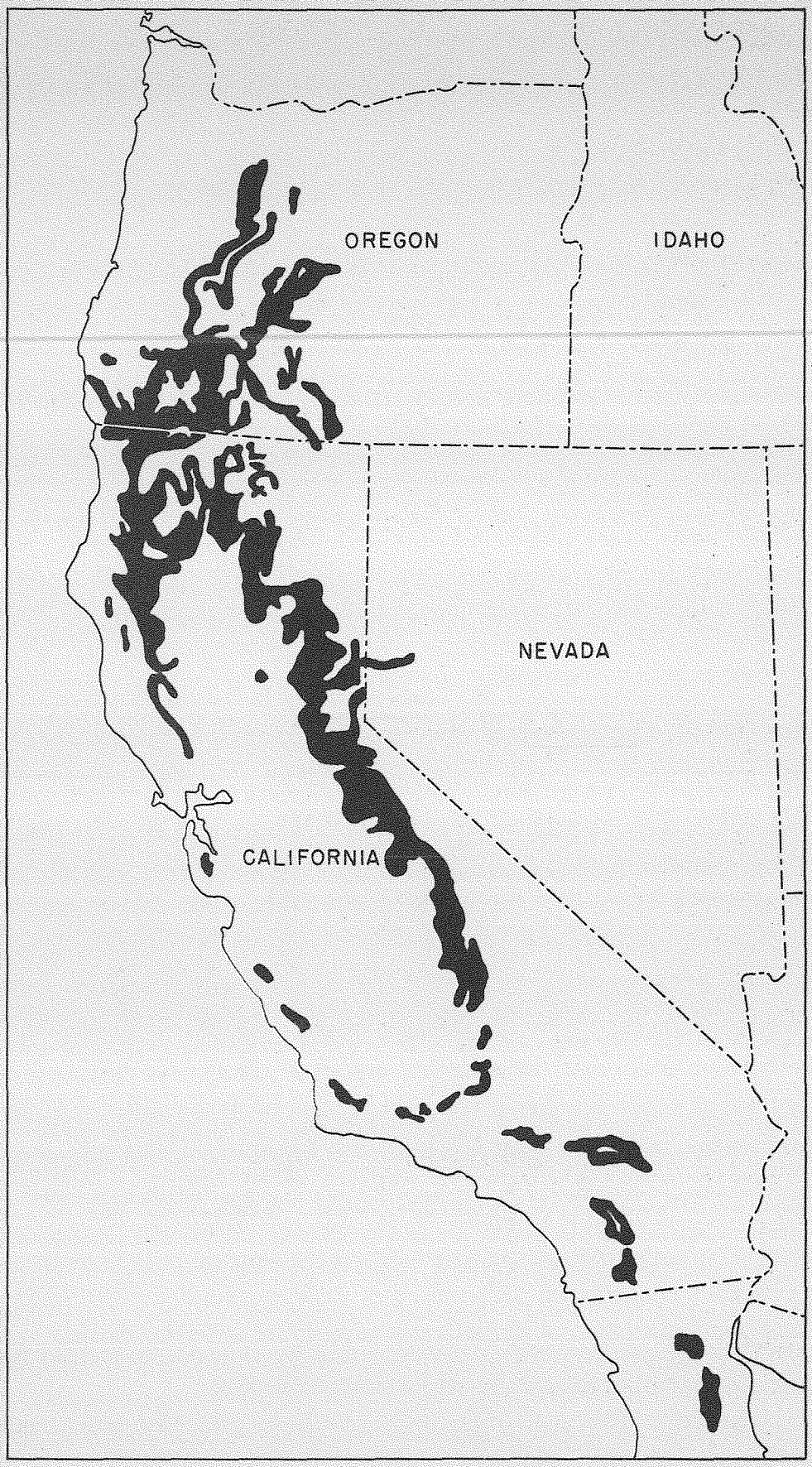

THE NATURAL RANGE OF SUGAR PINE
(From MUNNS, E. N. 1938. The distribution of important forest trees of the United States. U. S. Dept. of Agri. Misc. Pub. 287, 176pp)

SUGAR PINE MANAGEMENT--AN ANNOTATED BIBLIOGRAPHY

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CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
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FOREWORD

The purposes of this bibliography are to enumerate and describe publications that have a bearing on the growing of sugar pine for timber production. It is intended primarily for the information of forest managers, and it includes mainly those articles which appeared to pertain rather directly to management. Although a careful search was made for titles, no claim is made that all possible informative sources of information have been included.

Titles are listed alphabetically by authors. Pages 2 and 3 contain a brief subject index. Numbers in the index refer to serial numbers that appear to the left of the author names. Articles which contain considerable information on two or more subjects have been listed in more than one place in the index. However, indexing is not complete for reports that discuss numerous subjects or contain only minor references to other than the main topic.

SUBJECT INDEX

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1. ANONYMOUS.
1928. First discovery of sugar pine. Jour. Forestry 26:1054.

Quotes from the American Masonic Record and Albany Saturday Magazine, Vol. 1 No. 41, of November 10, 1827, a letter from Douglas written to Dr. Hooker, describing the discovery of sugar pine as "the most princely of the genus and probably the finest specimen of the American vegetation." The sugar pine trees that he saw were "two degrees south of St. Columbia, in the country inhabited by the Umftgun tribe of Indians."

2. ———
1949. A sugar pine regeneration cutting experiment. West Coast Lumberman 76(3):62, 64, illus.

Quotes Duncan Dunning's description of a cutting experiment in a virgin tract of sugar pine in the Stanislaus Experimental Forest, California. The discussion includes the position of sugar pine in virgin old growth, the deterioration of that position in cutover, and the regulated stand structure aimed for in old-growth conversion.

3. ———
1953. Recovery study made on sugar pine snags at mill. Timberman 54(8):151.

A mill study showed that sugar pine snag logs could be cut at a profit providing stumpage rates were kept low and fixed separately from green timber. Cull amounted to 34 percent for snags as compared with an average cull and breakage factor of 4 to 7 percent for normal timber. Net volume sawn at the mill dropped from a normal of 75,000 feet to 67,000 feet per day. Hidden defects were numerous and resulted in considerable degrading. Much of the defect was not apparent until after seasoning and surfacing.

4. ———
1954. Why grow sugar pine? Timberman 56(2):37

An editorial that speaks approvingly of reasons why efforts to manage and continue to grow sugar pine should be sustained.

5. AMERICAN FORESTRY ASSOCIATION.
1951. American tree monarchs. Separate 6 pp., illus.

The largest sugar pine tree recorded was 121 inches d.b.h. and 200 feet in height. It was reported from Girl Scout Camp at Dorrington, Stanislaus National Forest, California by J. R. Hall, Sonora, California. It exceeds the largest reported ponderosa pine (d.b.h. 103 inches, height 162 feet). It is exceeded in diameter but not matched in height by a bristlecone pine on the Inyo National Forest (144 inches d.b.h. but only 40 feet tall).

6. AUSTIN, LLOYD.
1929. Eddy Tree Breeding Station. Madrono 1:203-212.

Ovulate flowers of western yellow pine were hand-pollinated with pollen from 28 different species of pines, including sugar pine, in an attempt to produce species crosses. Also, some ovulate flowers of sugar pine were involved in attempted crosses.

7. AVERELL, J. L.
1953. Diamond Spring sugar pine management area, Plumas National Forest, Demonstration Plots Nos. 1 and 2. U. S. Forest Service, S-CONTROL-Disease-Blister Rust. 2 pp. (Processed)

Presents data to illustrate how a sugar pine area is analyzed by the Forest Service for purposes of management and protection from blister rust.

8. BAKER, FREDERICK S.
1944. Mountain climates of the western United States. Ecol. Monog. 14:223-254, illus.

Describes 28 western climatic areas and presents information for each on precipitation, temperature, and length of growing season. The climatic areas include several which embrace the principal natural range of sugar pine.

9. ———
1949. A revised tolerance table. Jour. Forestry 47:179-181.

Based on 55 returned questionnaires sent out to foresters and on published statements. Changes in tolerance of species with age, criteria for judging tolerance, and various opinions on tolerance are discussed. The degrees of tolerance considered were: (1) very tolerant, (2) tolerant, (3) intermediate, (4) intolerant, and (5) very intolerant. Sugar pine was rated by most foresters as intermediate. Several species commonly associated with sugar pine were

rated as: incense-cedar and white fir, tolerant; Douglas-fir, intermediate; and ponderosa and Jeffrey pine, intolerant.

10. BAKER, F. S.
1951. Reproduction of pine on old railroad grades in California. Jour. Forestry 49:577-8.

Relationship was shown between type of abandoned logging railroad grades and natural reproduction. The pines, including sugar pine, were more abundant on mineral seedbeds where the brush competition was absent or light; they were scarce where the brush competition was more severe.

11. BALDWIN, HENRY IVES.
1942. Forest tree seed of the North Temperate Regions with special reference to North America. 240 pp., illus. Waltham, Mass.

A useful reference book on forest tree seed, including sugar pine. Chapter titles are: Structure and development of tree seeds, seed production of forest trees, seed origin or provenance, seed collection, extraction and cleaning of seed, storage and longevity, biotic enemies of tree seeds, germination, internal factors affecting germination, environmental factors influencing germination, chemistry of seeds and germination, seed stimulation, seed testing, purity analysis, determination of origin, the determination of seed viability without germination, the testing of germination, seed testing stations and seed certification, and tree seed research.

12. BARRETT, S. A., and GIFFORD, E. W.
1933. Sugar pine (Pinus lambertiana Dougl.) seed used by Indians as food. City of Milwaukee Public Museum Bul. 2:150-1.

Large quantities of sugar pine cones were reported collected by the women of the Miwok Indian Tribe for food. Some of the shelled nuts were eaten whole, while others were ground in a mortar to form a paste called lopa. Lopa was prepared especially for feasts.

Sugar pine sugar was also collected for food and, when dissolved in water, used as an eye wash.

13. BENEDICT, W. V. and HARRIS, T. H.
1945. White pine blister rust control in California and Oregon. U. S. Dept. Agr. Bur. Ent. and Plant Quar. 18 pp., illus. (Processed)

Location of blister rust infections and control units are shown for California and Oregon. Blister rust on sugar pine was shown to be moving south. It had spread to Yreka, California, in 1936, to Eureka

and Downieville, California, by 1940, and to Point Reyes and the Calaveras Big Tree grove in 1945.

14. BERRY, SWIFT.
1917. Lumbering in the sugar pine and yellow pine region of California. U. S. Dept. Agr. Bul. 440, 99 pp., illus.

Largely of historic interest. Text and photographs describe a variety of logging processes such as big-wheel yarding, horse-chute yarding, horse-truck yarding, and traction-engine yarding that are no longer used.

15. BETTS, H. S.
1945. Sugar pine. U. S. Forest Service. American Woods. 6 pp., illus. (Processed)

Leaflet containing information on distribution, elevation, age, size, growth, reproduction, cones, supply, production, properties, and uses of sugar pine.

16. BOYCE, JOHN SHAW.
1948. Forest pathology. Ed. 2, 550 pp., illus. New York, Toronto, London.

Describes the comparatively few known diseases of sugar pine.

17. BRUNDAGE, M. R., KRUEGER, M. E. and DUNNING, DUNCAN.
1933. The economic significance of tree size in western Sierra lumbering. Univ. Calif. Agr. Expt. Sta. Bul. 549. 61 pp., illus.

The authors state, "This report, limited to a condensed account of current operating economics as related to log and tree sizes, is based on the first completely coordinated logging and milling study to be undertaken by public forest-research agencies in the California region. Entire trees were traced from the stump to the sawmill lumber-sorting table.... Beyond the green chain, part of the lumber was later reinspected for seasoning degrade and remanufacturing changes by grade, thickness, and width."

Zero-margin diameters for trees from a typical virgin stand of Site I on the west slope California pine region were: Sugar pine--23 inches, ponderosa pine--22 inches, white fir--34 inches, and incense-cedar--28 inches.

Margins per M b.m. for sugar pine were:

Tree diameter, inches	Margin (Dollars)
14	-17.85
16	-10.33
18	- 6.19
20	- 3.25
24	1.05
30	5.29
40	12.14
50	18.97
60	24.15
70	27.41
80	27.34

18. BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE.
1950. Control of white pine blister rust. U. S. Dept. Agr. Leaflet 265, 8 pp., illus. (Processed)

An information leaflet in popular form designed to tell of the menace of blister rust to sugar pine and the other white pines. The nature of the rust, its history in the U. S., and methods of control are stated. Brief, nontechnical, and suitable for general distribution.

19. BURK, CHARLES.
1953. Summary of sugar pine management field data for calendar year 1952 and 3-year averages for calendar years 1950, 1951 and 1952. U. S. Forest Service, Region 5. (Filed under S-PLANS-Timber Surveys--(Sugar pine management) 14 pp. (Processed)

Summary of cruise data on 151,000 acres of federally owned timber land delineated and approved for sugar pine management.

20. BURKS, GEORGE F.
1949. Estimated lumber production in California. 1948. Calif. Forest and Range Expt. Sta. Res. Note 65, 6 pp., illus. (Processed)

Estimated lumber production in California in 1948 was approximately 3,963 million board-feet. Two-thirds was in the Pine Region, and the remaining third in the Redwood Region. Sugar pine made up 9 percent of the lumber production in the Pine Region, but only 0.1 percent in the Redwood Region.

21. CALIFORNIA DIVISION OF FORESTRY.
1952. Blister rust--scourge of sugar pines. 13 pp., illus. (Processed)

Pictorial leaflet dealing with the menace of blister rust to the sugar pines in California and Oregon. Designed for general distribution.

22. CALIFORNIA FOREST AND RANGE EXPERIMENT STATION.
1950. Annual Report (1949). 68 pp. (Processed)

Results of the pilot test of Unit Area Control cutting on the Stanislaus Experimental Forest in 1948:

1. Viable sugar pine seed which fell at the rate of 29,000 seeds per acre produced an average of 707 seedlings per acre.

2. At the end of the 1949 season the number of sugar pines were reduced to 440 per acre, and 25 percent of the mil-acre quadrats were stocked.

3. White fir seed fell at the rate of 161,000 good seeds per acre, and 53 percent of the mil-acres were stocked with one or more fir seedlings.

4. Small rodents were the principal cause of reduced germination. Forty-one percent of the screened sugar pine seed spots had seedlings, whereas only 18 percent of the unscreened spots produced seedlings.

5. Sugar pine seeds germinated at the rate of 2,975 per acre on raked spots, as against 1,550 on unraked areas.

23. _____
1952. Annual Report (1951). 53 pp. (Processed)

Tests indicate that sugar pine crop trees can be increased in number by removing competing white fir. Two decades after thinning the white fir, sugar pine crop trees had increased from 18 per acre to 36 per acre.

24. _____
1954. Annual Report (1953). 64 pp., illus. (Processed)

References to sugar pine:

1. Seed production and seedling establishment records for two periods totalling 16 years on the Stanislaus Experimental Forest showed that over 14 million viable sugar pine and ponderosa pine seed were produced on 46.8 acres. These resulted in only slightly more than 3,000 established seedlings.

2. The relationship between seed-tree size and seed crops was established for sugar pine, ponderosa pine, and white fir. Size for size, sugar pine trees are relatively less reliable cone producers than the other two species until they reach about 28 to 30 inches in diameter. For example, the average number of cones produced by 14-inch tree was: Sugar pine, 8 per tree; ponderosa, 36 per tree; and white fir, 50.

3. The total volume of sawtimber on the western Sierra slopes in California was estimated to be 125 billion board-feet (International 1/4-inch rule). One-tenth of this volume was reported to be sugar pine.

25. CALIFORNIA FOREST AND RANGE EXPERIMENT STATION.
1954. Forest statistics for California. Forest Survey Release 25. 66 pp., illus. (Processed)

Presents detailed statistics on forest area, ownership, stand-size classes, timber types, stocking, site quality, timber volume, growth, and annual cut. Most of the data are shown by species and subregions.

The volume, average annual net growth, and annual cut of sugar pine growing stock (trees 5.0 inches d.b.h. and larger) on commercial forest land in California by subregions were:

Subregion:	Timber volume - 1953	Average annual net growth - 1952	Annual cut - 1952
	(Million cubic feet)		
Eastside Sierra	216	(1/)	4.4
Westside Sierra	2,379	24	36.7
Coast range pine	1,023	3	8.7
Redwood--Douglas-fir	807	2	1.1
Southern California	7	(1/)	(2/)
Totals	4,432	29	50.9

1/ Less than 0.5 million cubic-feet.
2/ Less than 50 thousand cubic-feet.

26. _____
1955. Forest research in California. Annual Report (1954). 70 pp., illus. (Processed)

Items pertaining to sugar pine:

1. The volume of standing live sugar pine sawtimber in California was estimated to be 27 billion board-feet with an average annual cut of 330 million board-feet.

2. Sugar pine trees in Dunning vigor classes 1, 3, and 5 were found to be the best cone producers. On the Stanislaus National Forest during two periods totalling 16 years the average number of cones produced per tree was:

Dunning tree class	Average number of cones per tree
1	45
2	3
3	555
4	31
5	712
6	0
7	2

3. Sugar pine seedlings were reported to have suffered considerable damage as a result of a late spring frost. An estimated minimum temperature of 20° F. on the 5th, 6th, and 10th of June killed 74 percent of the new seedlings and 66 percent of the new growth on 3-year old transplants; however, none of the transplants were killed.

27. CHILDS, T. W. AND BEDWELL, J. L.
1948. Susceptibility of some white pine species to Cronartium ribicola in the Pacific Northwest. Jour. Forestry 46: 595-599.

Studies on planted trees in Oregon and British Columbia indicated that sugar pine, of the 10 white pine species tested, was the most susceptible to Cronartium ribicola. Pinus albicaulis, which was not included in the test, was reported to be the most susceptible member of the genus.

28. CLEMENTS, V. A.
1953. Possible means of reducing mountain pine beetle attacks in young sugar pine. Calif. Forest and Range Expt. Sta. Res. Note 89, 5 pp. (Processed)

The study of stand conditions under which young sugar pines on the Sierra National Forest were attacked by mountain pine beetles showed: (1) the greatest losses occurred where the stand density index was high and (2) the greatest kill in the early stages of the epidemic was in the understory (intermediate and suppressed trees). Methods recommended to increase the resistance to attack were: (a) Reduce the stand density by removing the larger trees of sawtimber size to increase the vigor of the remaining trees, (b) remove the smaller more-susceptible trees which would also tend to reduce the stand density, and (c) a combination of the two methods.

29. CLEMENTS, V. A., STEVENS, C. W., and ROY, D. F.
1949. Form-class volume tables for sugar pine and red fir in California. Calif. Forest and Range Expt. Sta. Res. Note 61. 137 pp., illus. (Processed)

Contains form-class volume tables for form classes 65 through 90. The form class was defined as "the percentage ratio between the d.i.b. (diameter inside bark) at the top of the first log and d.b.h. o.b. (diameter breast high outside bark)." Volumes are given in board feet, Scribner Rule, by d.b.h. and log-height classes for each 16.3-foot log from a 1.5-foot stump to a 10-inch d.i.b. top, and to an average utilized top.

30. CORSON, C. W., and FOWELLS, H. A.
1952. Here's How--a guide to tree planting in the California pine region. Calif. Forest and Range Expt. Sta., Misc. Paper 8, 26 pp., illus. (Processed)

This booklet is designed primarily for use by the men in the field to do a better job of planting. The authors state that, although seeding and planting is a difficult job in California, it is not impossible. To be successful, the planting should be done--

"in the right place
at the right time
with the right stock
in the right way."

The recommendations and suggestions for doing a good job are based on practical experience and research findings.

31. COSENS, RICHARD D.
1952. Reducing logging damage. Calif. Forest and Range Expt. Sta. Res. Note 82, 10 pp., illus. (Processed)

Discusses methods used on the Stanislaus Experimental Forest in 1948 and 1949 in a sugar pine-fir type, to reduce logging damage resulting from: (1) unnecessary and improperly located roads, landings, and yarding trails; (2) improper falling; (3) use of tractor-arch unit in young stands; and (4) lax supervision of logging crews. Logging damage may be reduced by:

"1. Preparing and carrying out a detailed logging plan aimed at reduction of damage;

"2. Properly training and supervising logging crews; and

"3. Focusing engineering and logging ingenuity on designing equipment that will lessen damage to the advance growth as well as increase efficiency of yarding logs."

32. COSENS, RICHARD D., and TACKLE, DAVID.
1950. Costs of rodent control in pine regeneration in California. Calif. Forest and Range Expt. Sta. Res. Note 73, 5 pp. (Processed)

During 1948, a good seed year for sugar pine, 665 acres on the Stanislaus Experimental Forest were treated before seedfall with lethal bait to suppress white-footed mice, chipmunks, and ground squirrels. The bulk of the poison bait used was oat groats treated with "1080" (sodium fluoroacetate) at the rate of 3 ounces "1080" per 100 pounds of groats. Some bait treated with 1 pound of thallium sulfate per 100 pounds of groats was also used. The poison bait was distributed at the rate of 1/2 to 2/3 pounds per acre in pinches of 15 to 30 grains every 15 feet along lines approximately 50 feet apart. Treatment cost 46 cents per acre. Establishment of new seedlings was found to be moderately successful (707 sugar pine seedlings per acre). Timing of the treatment was considered to be an important element in the success of the project.

33. COX, WILLIAM T.
1911. Reforestation on the national forests. U. S. Dept. Agr. Forest Service Bul. 98, 57 pp., illus.

Sugar pine seed information was: Trees per acre bearing seed in appreciable quantities, 8; bushels of cones per tree, 7; pounds of seed per bushel of cones, 1.60; and pounds of seed per acre, 89.60. The average cost of sugar pine seed collected by the Forest Service in 1909 and 1910 was 85 cents per pound, compared to a cost of $1.25 to $2.25 from seed dealers during the same period.

34. CUMMING, W. C. and RIGHTER, F. I.
1948. Methods used to control pollination of pines in the Sierra Nevada of California. U. S. Dept. Agr. Cir. 792, 18 pp., illus.

Describes techniques used for controlling pollination of pines, which have proved effective and practical at the Institute of Forest Genetics. Methods of isolating the ovulate flowers, handling pollen, pollinating the flowers, and protecting the cones and seeds are described.

35. DOWNING, G. L.
1954. Ethylene dibromide sprays for controlling bark beetles in California. Calif. Forest and Range Expt. Sta. Misc. Paper 17, 2 pp. (Processed)

Ethylene dibromide was reported effective for controlling several bark beetles including the mountain pine beetle which attacks sugar pine. Infested trees are felled and bucked and then sprayed with a mixture of 1 pint (85 percent) ethylene dibromide in 5 gallons of diesel oil. The ethylene dibromide solution was applied with a garden sprinkling can when trees occurred in small isolated groups

and with a power sprayer when the infested trees occurred in large groups.

36. DUFFIELD, J. W.
1953. Pine pollen collection dates--annual and geographic variation. Calif. Forest and Range Expt. Sta. Res. Note 85, 9 pp., illus. (Processed)

Pollen collection dates for sugar pine varied from May 21 to May 31 during 3 years at the Eddy Arboretum, Placerville, California, located at 2700 feet elevation. At 5,000 feet elevation, the collection dates were June 8 and July 8 for the 2 years in which pollen was collected. At 6,000 feet elevation, the collection dates for 4 years ranged from July 1 to July 9. The mean interval per 1,000 feet difference in elevation is 8 days.

37. _____ and RIGHTER, F. I.
1953. Annotated list of pine hybrids made at the Institute of Forest Genetics. Calif. Forest and Range Expt. Sta. Res. Note 86, 9 pp. (Processed)

Two sugar pine hybrids are reported. Sugar x Armand's (P. lambertiana x armandi Franch.) and sugar x Korean (P. lambertiana x Koraiensis Sieb. and Zucc.). Both crosses are difficult to make and the seed yield has been low. Since both the Armand's and Korean pines are highly resistant to blister rust, it is hoped that the crosses will inherit this characteristic. The sugar x Korean hybrid may be more cold resistant than the other hybrid.

38. DUNNING, DUNCAN.
1923. Some results of cutting in the Sierra forests of California. U. S. Dept. Agr. Bul. 1176, 26 pp., illus.

Site was the most important factor in the growth of stands left after cutting. A reserve volume of 6,000 to 10,000 board feet on Sites I and II was found to be justified for increased growth and to improve the quality of the second cut. On poorer sites, marking should be aimed to secure reproduction.

Sugar pine was found to rank second to white fir in rate of growth; however, sugar pine maintained a high growth rate to a greater age and diameter than the other associated species. Diameters for best growth on Site II or better were 30 inches for sugar pine, 26 inches for ponderosa pine, and 24 inches for white fir and incense-cedar.

Reserve trees should be immature, free from defect, and have pointed tops, dense dark green foliage, and 60 percent or more of their total height in live crown. These trees should not be left in groups because dense grouping reduces thinning effects and lessens the chances for pine reproduction within the group.

No appreciable increase in pine reproduction, except on Sites I and II, was noted on old cuttings which were relatively lightly thinned by the group selection or shelterwood methods. Leaving more sugar pine and ponderosa pine seed trees and cutting merchantable white fir and incense-cedar heavily was reported as resulting in no change in composition because enough unmerchantable firs and cedars are always present to supply abundant seed.

The primary considerations in marking should be to save the advance pine reproduction and to cut heavily enough to release it. The best advance reproduction was found to have occurred under conditions resembling a shelterwood system. Where reproduction is absent and the stand is even-aged, a heavy shelterwood or seed tree cutting with numerous well distributed seed trees larger than 18 inches in diameter was recommended as the most favorable condition for improved growth and reproduction. Every acre must be studied and marked individually because of the varying forest conditions.

39. DUNNING, DUNCAN.
1928. A tree classification for the selection forests of the Sierra Nevada. Jour. Agr. Res. 36:755-71, illus.

The Dunning tree classification is based on detailed crown and bole characteristics of ponderosa pine; however, it is also used for sugar pine. The four major factors considered were: age--young (less than 50 years), thrifty mature (50 to 150 years), mature (150 to 300 years), and overmature (over 300 years); crown classes--isolated, dominant, codominate, intermediate, and suppressed; crown development--length, width, form of top; and vigor--good, moderate, and poor. The tree classes as summarized by Dunning:

"Class 1: Age class, young or thrifty mature; position, isolated or dominant (rarely codominant); crown length, 65 percent or more of the total height; crown width, average or wider; form of top, pointed; vigor, good.

"Class 2: Age class, young or thrifty mature; position, usually codominant (rarely isolated or dominant); crown length, less than 65 percent of the total height; crown width, average or narrower; form of top, pointed; vigor, good or moderate.

"Class 3: Age class, mature; position, isolated or dominant (rarely codominant); crown length, 65 percent or more of total height; crown width, average or wider; form of top, round; vigor, moderate.

"Class 4: Age class, mature; position, usually codominant (rarely isolated or dominant); crown length, less than 65 percent of the total height; crown width, average or narrower; form of top, round; vigor, moderate or poor.

"Class 5: Age class, overmature; position, isolated or dominant (rarely codominant); crown, of any size; form of top, flat; vigor, poor.

"Class 6: Age class, young or thrifty mature; position, intermediate or suppressed; crown, of any size, usually small; form of top, round or pointed; vigor, moderate or poor.

"Class 7: Age class, mature or overmature; position, intermediate or suppressed; crown, of any size, usually small; form of top, flat; vigor, poor."

40. DUNNING, DUNCAN.
1942. A site classification for the mixed conifer selection forests of the Sierra Nevada. Calif. Forest and Range Expt. Sta. Res. Note 28, 21 pp., illus. (Processed)

Site-class curves, based on the height-age relationship for dominant trees, are presented. The site range was divided into 6 classes (25-foot intervals) of average total height of dominants at the age of 300 years. The site classes were designated A-200, I-175, II-150, III-125, IV-100, and V-75, with A-200 as the best and V-75 as the poorest. The curves defined as the mid-lines of the site-class zones are applicable for forest types which include varying combinations of ponderosa pine, Jeffrey pine, sugar pine, white fir, Douglas-fir, and incense-cedar.

41. ———
1945. Diameter-class volume tables for California old-growth timber. Calif. Forest and Range Expt. Sta. Res. Note 42. 4 pp. (Processed)

Contains volume tables for old-growth ponderosa and sugar pines and white fir. Volumes for sugar pine are for Sites I and II for trees from 12 to 100 inches d.b.h.

42. ——— and REINEKE, L. H.
1933. Preliminary yield tables for second-growth stands in the California Pine Region. U. S. Dept. Agr. Tech. Bul. 354. 23 pp.

Information given includes: Range and occurrence, conditions of establishment of second growth, relative importance of virgin and second-growth forest, age, site index, density of stocking and stand-density index, total basal area, number of trees per acre, average diameter of the stand, volume per acre in cubic feet, ratio of board-feet to cubic feet, volume per acre in board-feet, and mean annual increment. Composition of the types to which the data apply are:

Species type	Percent of total basal area in--					
	Ponderosa pine	Sugar pine	Douglas-fir	White fir	Incense cedar	Red fir
Ponderosa pine-fir	40	3	30	20	7	-
Ponderosa pine-sugar pine	40	37	3	10	10	-
Ponderosa pine-sugar pine-fir	40	25	10	20	5	-
Sugar pine-fir	5	33	20	35	7	-
White fir--Douglas-fir	5	3	45	45	2	-
White fir-red fir	-	3	-	68	-	29

43. ENGSTROM, W. H.
1954. Oregon cone crop, 1954. Oregon State Board of Forestry Res. Note 16. 7 pp. (Processed)

Sugar pine cone crop rating for Oregon in 1954 was reported as "6". This refers to a light crop having many cones on some trees and few cones on 75 percent of the trees. The 1954 cone crop was indicated to be the best since 1950. Some areas had a very good cone crop, while others had few to no cones. The best crops occurred on the east slope of the Cascades and in the Rogue River drainage.

44. FOWELLS, H. A.
1940. Cutworm damage to seedlings in California pine stands. Jour. Forestry 38:590-1.

Cutworm (Noctuidae larvae) damage on sugar pine was significantly higher in cutover stands than in virgin timber. Most serious damage occurred on young seedlings 1 to 2 months old. Cutworms were reported to have destroyed 7.9 percent of 1,536 sugar pine seedlings.

45. ———
1941. The period of seasonal growth of ponderosa pine and associated species. Jour. Forestry 39:601-8, illus.

Differences in seasonal height and radial growth are presented for several coniferous species including sugar pine on the Stanislaus National Forest. Radial growth on sugar pine was found to start about the middle of April; height growth did not begin until about the end of May.

46. ———
1944. Site preparation as an aid to sugar pine regeneration. Calif. Forest and Range Expt. Sta. Res. Note 41. 4 pp. (Processed)

The brush cover of bearmat (Chamaebatia foliolosa) and mountain whitethorn (Ceanothus cordulatus) was removed mechanically from 37 unstocked cutover areas on the Stanislaus National Forest. Plots were established to determine whether natural seedlings would result from the heavy cone crop on sugar pine trees within 150 feet of the plots, and to compare natural reproduction with seed spotting under screens and planting.

Natural reproduction failed in spite of the large numbers of sugar pine seed which fell on the plots (approximately 10,600 seed per acre). Rodent depredation was believed to be the cause of failure.

At the end of the third year seed spotting was less effective than planting on the plots cleared of bearmat (15 percent stocking from seed spotting compared with 34 percent for planting). But seed-spotting was more effective than planting on the areas cleared of whitethorn (67 percent as compared with 41 percent).

The results showed that successful establishment of sugar pine seedlings was possible before brush regained control of the ground.

Growth measurements of seedlings and transplants showed that the plants grew faster on the areas cleared of whitethorn than on those which had bearmat.

47. FOWELLS, H. A.
1946. Forest tree seed collection zones in California. Calif. Forest and Range Expt. Sta. Res. Note 51. 5 pp., illus. (Processed)

The forests of California were divided into 13 zones to insure that stock grown from seed of a particular habitat will be planted on reasonably similar habitats, and to simplify keeping records of seed origin. The zones were delineated on the basis of vegetational types, sites, and arbitrary latitudinal divisions.

48. ———
1948. The temperature profile in a forest. Jour. Forestry 46:897-9, illus.

Air and soil temperatures, recorded at several distances above and below the ground surface, are reported for a mature, mixed-conifer stand composed of ponderosa, Jeffrey, and sugar pines, white fir, and incense-cedar. Three-year average maximum and minimum monthly temperatures are shown for the months of May through October. The highest and lowest temperatures occurred at or near the ground surface. Maximum temperatures decreased and minimum temperatures increased both above and below the ground level. Average differences between temperatures 4.5 feet and 120 feet above ground surface were:

	May	June	July	Aug.	Sept.	Oct.
Minimum	+1.3	+2.4	+3.4	+4.2	+3.5	+2.6
Maximum	-2.0	-1.7	-2.6	-3.2	-2.8	-2.8

49. FOWELLS, H. A.
1949. An index of ripeness for sugar pine seed. Calif. Forest and Range Expt. Sta. Res. Note 64, 5 pp., illus. (Processed)

Seed germination was highly correlated with the specific gravity of the cones. A specific gravity of 0.80 was recommended as the indicator that sugar pine cones are ripe enough for gathering. Owing to the variation in ripening dates for individual trees, cones from each tree should be sampled. If 3 or more cones from a sample of 5 freshly picked cones float in kerosene (Sp. Gr. 0.80 at 60° to 80° F.), the cones on that tree are suitable for seed harvesting. Seeds from cones in the study area were found to be mature during the last week in September in 1941 and the first week in October in 1948.

50. ———
1950. Some observations on the seedfall of sugar pine. Calif. Forest and Range Expt. Sta. Res. Note 70. 3 pp. (Processed)

The rate of fall of sugar pine seeds and their horizontal movement in wind currents are discussed. Studies were conducted with 3 isolated trees in 1941, a year of heavy seed production. The trees were from 150 to 175 feet in height and bore about 150 cones each. Four concentric zones were established around each tree, and the seeds were counted in each zone at 10-day intervals during October. Results indicated that the amount of seeds necessary to produce a few hundred natural seedlings per acre occurred only within a radius of about 100 feet from the seed trees.

51. ———
1953. Regeneration problems and research in California. Calif. Forest and Range Expt. Sta. Misc. Paper 10, 4 pp. (Processed)

Obstacles to successful artificial regeneration in California were described as adverse climate, competing brush, and rodent activity. To overcome these obstacles, several lines of research were suggested: Determine how to condition planting stock to produce a better functioning root system; lower the rate of transpiration of planted trees; find trees of hybrid or selected stock, better able to withstand adverse conditions; improve techniques of storing stock; work out minimum dosages and economical spray techniques to reduce brush competition; find more effective means of temporarily eliminating

rodents from the areas; develop a repellent which will make seeds unattractive to rodents.

52. FOWELLS, H. A., and SCHUBERT, G. H.
1951. Natural reproduction in certain cutover pine-fir stands of California. Jour. Forestry 49:192-6, illus.

Reports natural reproduction on cutover pine-fir stands between 1923 and 1947. Plots were cut in 1923, 1928, and 1929 on the Stanislaus National Forest. Although numerous seed trees of sugar and ponderosa pine were left on the area, no wave of pine reproduction followed the logging disturbance. During a period of nearly 20 years, pines became established at the rate of only 70 per acre. White fir and incense-cedar seeded in to such an extent that pines comprised only 5 percent of the reproduction in 1947. Probably no more pines will become established to form a dominant part of the stand. These observations indicate that silvicultural methods for the mixed-conifer types must be changed in order to provide for adequate natural reproduction of the pines.

53. _____ and SCHUBERT, G. H.
1951. Recent direct seeding trials in the pine region of California. Calif. Forest and Range Expt. Sta. Res. Note 78, 9 pp. (Processed)

Describes several direct seeding trials in California with the following species: Ponderosa pine, Jeffrey pine, sugar pine, white fir, and incense-cedar. Forest rodents were the chief obstacle to successful direct seeding. Covering the seed spots with a wire screen was the only consistently effective means of protecting the seed from rodents. With adequate rodent protection, direct seeding was found to be a satisfactory method of regeneration.

54. _____ and SCHUBERT, G. H.
1953. Planting-stock storage in the California pine region. Calif. Forest and Range Expt. Sta. Tech. Paper 3, 12 pp. (Processed)

A series of experiments dealing with storage of pine nursery stock demonstrated that storage under refrigeration is feasible. Optimum storage temperature appeared to be within a narrow range from 32° to 36° F. All planting stock stored at below-freezing temperatures died when outplanted. Most stock stored at 41° became moldy. Over-winter storage of ponderosa and Jeffrey pines proved practicable, but results with sugar pine were not conclusive.

55. _____ and SCHUBERT, G. H.
1955. Seed crops of forest trees in the pine region of California. Calif. Forest and Range Expt. Sta., 90 pp., illus. (Manuscript report in preparation for publication as U. S. Dept. Agr. Tech. Bul.)

Summarizes 28 years of seed production of sugar pine, ponderosa pine, and white fir, chiefly on the Stanislaus National Forest. This information has been interpreted for application to cutting practices and seed collection. Sugar pine findings:

1. Almost all sugar pine cones were produced on dominant trees.

2. Dunning tree classes 3 and 5 were the best cone producers.

3. Only 6 sugar pine cone crops during the 28-year period were rated as heavy.

4. None of the trees bore cones every year and relatively few bore cones half the time.

5. In good seed years, seedfall per acre was as much as 180,000 seeds.

6. The proportion of sound seeds was usually higher in good seed years.

7. Two class 3 or 5 sugar pines per acre, about 50 inches in diameter, should produce enough seed for adequate regeneration.

8. Cone crops in some years were almost entirely destroyed by tree squirrels, birds, and cone insects.

56. FRITZ, EMANUEL.
1947. Seed production of a sugar pine tree. Jour. Forestry 45:201-3, illus.

The cone production of a sugar pine tree (52 inches d.b.h. in 1933) near Quincy, California during the period 1924-1946. In the 23-year period, the tree produced few to no cones 5 times and 9 crops of 200 or more cones. No records were available for 3 years. Heavy successive crops were produced in the 4 years 1936 to 1939 in the 3 years 1943-1945.

57. GORDON, DONALD T., and COSENS, RICHARD D.
1952. Slash disposal and site preparation in converting old-growth sugar pine-fir forests to regulated stands. Calif. Forest and Range Expt.Sta. Res.Note 81, 7 pp. (Processed)

Describes slash-disposal and site-preparation measures employed to establish sugar pine regeneration on chosen unit areas. The three objectives of slash disposal and site preparation discussed were: (1) To facilitate seeding and planting by clearing logging debris, brush, and unwanted trees from regeneration areas; (2) to provide a seedbed for sugar pine by disturbing the ground and exposing mineral soil; (3) to reduce the fire hazard.

Costs of slash disposal and site preparation are presented in three ways: (1) Per acre of regeneration area ($58.55 in 1948 and $37.38 in 1949); (2) per acre of gross area logged ($20.82 in 1948 and $8.83 in 1949); (3) per thousand board feet of all timber cut ($0.53 in 1948 and $0.22 in 1949). The lower cost in 1949 resulted from increased experience.

58. HADDOCK, PHILIP G.
1954. Sapling sugar pines grown from excised mature embryos. Jour. Forestry 52:434-7, illus.

Young sugar pine trees were grown from excised embryos cultured on nutrient agar media. These trees averaged 7.7 feet in height at the end of 10 years.

59. HALL, RALPH C.
1955. Insect damage to the 1954 crop of Douglas-fir and sugar pine cones and seeds in northern California. Calif. Forest and Range Expt. Sta. Misc. Paper 18, 4 pp. (Processed)

Damage caused by the sugar pine cone beetle in 1954 was reported as spotty in occurrence. Destruction of cones ranged from light to very heavy. A potential crop of 71 cones per tree was reduced to 18--a loss of 75 percent of the cones.

60. HALLIN, WILLIAM E.
1951. Unit area control in California forests. Calif. Forest and Range Expt. Sta. Res. Note 77, 8 pp., illus. (Processed)

Unit area control is described as a silvicultural concept based on 30 years of research aimed at converting unmanaged sugar pine and ponderosa pine stands to regulated stands in which each age class through rotation is uniformly represented and adequately stocked. Experience has shown that previously used silvicultural methods have not provided adequate restocking of pine. The essential characteristic of unit area control is the detailed control of stocking on small areas.

The silvical characteristics of the major species, condition of the stand, treatments, and application of unit area control are discussed.

61. _____
1954. Unit area control--its development and application. Calif. Forest and Range Expt. Sta. Misc. Paper 16. 10 pp.

Unit area control focuses attention upon the group-wise even-aged structure of sugar pine and ponderosa pine forests and the necessity for providing for harvesting and regeneration at appropriate times

and places in order to create proper distribution of age-classes. When ready for final harvest, homogeneous groups in the stand are clear-cut. Stresses the importance of a regular planned program for regeneration cutting to secure prompt regeneration by natural means during seed years and by artificial means in other years.

62. HANSEN, HENRY P.
1943. Paleoecology of two sand dune bogs on the southern Oregon coast. Amer. Jour. Bot. 30:335-340.

An analysis of the pollen profiles of 2 peat bogs, developed in sand dune lakes, reveal forest succession for a period of 4,000 to 7,000 years. Except for two brief intervals in which Tsuga heterophylla predominated, Pinus contorta apparently was the most abundant species. Sugar pine pollen was present.

63. HAYES, G. LLOYD.
1952. Blister rust in sugar pine reproduction and the effectiveness of canker removal and weeding for promoting more sugar pine in the ultimate stand. Pacific Northwest Forest and Range Expt. Sta. (RS-NW-Special. Biological Factors. Diseases. Blister Rust Control) 21 pp. (Typewritten)

This study was undertaken on the South Umpqua Experimental Forest in southern Oregon to determine: (a) the degree of blister rust infection in selected stands of reproduction; (b) what the composition of the ultimate stand is likely to be if no effort is made to save infected trees but further infection is prevented; and (c) to find out how much the sugar pine component might be increased by canker removal and by weeding. Five plots (106 quadrats of 1/250 acre each) were examined in detail. Twenty-nine percent of the 685 juvenile pines examined were infected with rust.

The composition of the ultimate stand by species, based on the assumption of 250 crop trees per acre at rotation age, under the three conditions mentioned above, was calculated as follows:

Species:	Complete absence of BR	If BR infected sugar pines are not counted	If BR cankers are removed and some weeding*
	(Percent)		
Sugar pine	69	45	81
Douglas-fir	18	35	12
Grand fir	8	12	4
Hemlock	5	6	3
Ponderosa pine	1	2	0
Total	100	100	100

*Potential crop trees have been released through weeding.

64. HODGKINS, EARL J.
1952. Effect of different heat treatments upon the viability and vigor of pine pollen. Jour. Forestry 50:450-2, illus.

Sugar pine pollen was completely killed when subjected to heat ranging from 80-82° C. for 15 to 18 hours. Other treatments had variable effects on germinative capacity and pollen vigor.

65. HUGHES, B. O., and DUNNING, DUNCAN.
1949. Pine forests of California. U. S. Dept. Agr. Yearbook 1949:352-388, illus.

An excellent general description of forest types, including sugar pine, and discussion of management problems. Presents Dunning's sketch, "Profile of central Sierra Nevada showing altitudinal limits of the principal forest types."

66. JACOBS, ALLEN W.
1924. Polyembryonism in sugar pine. Jour. Forestry 22:573-4, illus.

Reports the discovery of 12 twin seedlings from 1,200 sugar pine seeds while conducting a germination test.

67. ———
1925. Hastening the germination of sugar pine seed. Jour. Forestry 23:919-931.

Treatments which failed to increase germination were: Mechanical wounding, electrical stimulation, hot water, and too long exposure to acid. Beneficial treatments were: Soaking for 4 days in tap water and exposure to freezing for 48 hours.

68. JAMESON, E. W., JR.
1952. Food of deer mice, Peromyscus maniculatus and P. boylei, in the Northern Sierra Nevada, California. Jour. Mammalogy 33:50-60, illus.

Stomach contents of deer mice were examined in 1949 and 1950 from a mixed-conifer forest and nearby brushfields. The bulk of their diet consisted of seeds (both brush and tree species) and arthropods. Seasonal dietary changes were attributed to availability rather than preference. None of the coniferous seeds were positively identified as sugar pine; however, it was believed that many had been eaten. Although large quantities of coniferous seeds were consumed, the author warns against complete elimination of deer mice because of their beneficial effect by feeding on large numbers of destructive insects.

69. JEPSON, WILLIS L.
1923. The trees of California. Ed. 2, 240 pp., illus. Berkeley.

Excerpts from pages 155-158:

"For unnumbered centuries the mountain and valley country of California has been subjected to the influence of grass, brush, and forest fires."

"The Sierra Nevada forest, as the white man found it, was clearly the result of periodic or irregular firing continued over many thousands of years. Over large and small areas of this region wild fires have run in irregular succession..... the individual trees are extremely well-spaced and commonly form a very open forest, the degree of openness often being in direct ratio to the age of the stand....."

"The forest is not only a thin one over very extensive areas, but it is remarkably free from undergrowth or shrubs.....Indeed, the main silvical features; that is, density, reproductive power, and dominance of types, are in great part expressions of the periodic fire status."

70. JOSEPHSON, H. R.
1941. Factors affecting income from second-growth forests in the western Sierra Nevada. Univ. Calif. Bul. 658. 72 pp., illus.

Data and estimates of forest incomes are presented which indicate the potential earning capacity of well-stocked stands of second-growth pine, including sugar pine. Measures needed to protect and build up the value of second-growth forest resources are also presented.

71. JOTTER, E. V.
1914. Squirrels and sugar pine reproductions. Soc. Amer. Foresters Proc. 9:98-101.

Examples are cited of the destruction of sugar pine cones by squirrels. Sometimes all cones, even immature ones less than 6 inches in length, have been cut from some trees. Many of the smaller cones, with undeveloped seed, were left intact on the ground after being cut. An estimated 50 percent of the sugar pines had no cones left on the tree at the time of maturity, and half of the remaining trees had very little of the original crop.

72. KEEN, F. P.
1929. Insect enemies of California pines and their control. Calif. Dept. Natural Resources, Div. Forestry Bul. 7, 113 pp., illus.

Annual loss due to insects in the California pine region was estimated at 500,000,000 board feet. Insects attacking pine trees from the seedlings to mature stand are discussed. A break-down of the insects attacking sugar pine indicated that 14 are found under the bark of the trunk or branches, 8 in the wood on the trunk or branches, 5 in smaller limbs and twigs, 2 in the cones, and 4 on the needles. Recommended control measures are listed and a key for field identification of the more destructive insects is included.

73. KEEN, F. P.
1952. Insect enemies of western forests. U. S. Dept. Agr. Misc. Publ. 273, 280 pp., illus.

A comprehensive treatise on the insects attacking western forest trees from seeds to the final product. Numerous insect pests of sugar pine are included.

74. KIMMEY, JAMES W.
1946. Notes on visual differentiation of white pine blister rust from pinyon rust in the telial stage. Plant Disease Reporter 30:59-61.

Five visually recognizable differences that may occur between the two rusts, Cronartium ribicola and C. occidentale, are described.

75. ———
1950. Cull factors for forest tree species in northwest California. Calif. Forest and Range Expt. Sta. Forest Survey Release 7. 30 pp., illus. (Processed)

Two types of cull factors are reported. One type, called an indicator factor, is applied to individual tree volumes. The other type, called a flat factor or general factor, is applied to stand volumes. The flat factor was found to be more suitable for sugar pine because of the relatively small cull percentage and because of "hidden" cull which reduced the reliability of the indicator factor. The percent cull in sugar pine in the Coast Range Pine Subregion of California by Dunning's tree classes was reported as:

Tree classes:	Cull as percent of gross board-foot (Scribner Decimal C) merchantable volume
1, 2, 6 and 7	5.6
3 and 4	6.1
5	11.4

76. KIMMEY, JAMES W.
1954. Cull and breakage factors for pines and incense-cedar in the Sierra Nevada. Calif. Forest and Range Expt. Sta. Res. Note 90, 4 pp. (Processed)

Cull and breakage factors for sugar pine growing in the eastside and westside Sierra subregions in California were reported as showing no significant difference. Factors for sugar pine were:

Dunning tree class:	Percent of gross board-foot (Scribner Decimal C) merchantable volume	
	Cull	Breakage
1, 2 and 6	1.2	0.3
3 and 4	3.7	3.7
5 and 5A	6.3	3.8
7	6.7	0.0

77. ———
1954. Determining the age of blister rust infection on sugar pine. Calif. Forest and Range Expt. Sta. Res. Note 91, 3 pp. (Processed)

A study of infections occurring in a single season on 4 sugar pine plots in Oregon and 2 in California showed that: (1) The year of blister rust infection could be accurately determined for sugar pine; (2) Lachmund's method of determining the age of rust infection on western white pine could be safely applied to sugar pine.

78. KITTREDGE, JOSEPH.
1953. Influences of forest on snow in the ponderosa-sugar pine-fir zone of the central Sierra Nevada. Hilgardia 22:1-96, illus.

Describes the kinds, sizes, and densities of forests which are most effective in promoting accumulation of snow, in minimizing losses by evaporation, and in retarding and prolonging the period of melting. Results showed that rates of snow melt were less under forests than in the open and tended to decrease as the density of the forest increased. Recommends that cuttings should be light--either by the selection system or by clear cutting in narrow strips or small groups which do not exceed once or twice the heights of the trees.

79. LACHMUND, H. G.
1933. Method of determining age of blister rust infection on western white pine. Jour. Agr. Res. 46:675-693, illus.

A method was devised for postdating blister rust infections by tallying the cankers on interwhorls of recent growth wood. More than half of the cankers originating in a given year were found on wood grown in the year before the time of infection.

80. LANDQUIST, KARL B.
1946. Tests of seven principal forest tree seeds in northern California. Jour. Forestry 44:1063-6.

Presents data on number of seeds per pound, purity, and germinative energy and capacity for several coniferous species including sugar pine. The effect of stratification on germinative energy and capacity is also shown.

81. LARSEN, L. T., and WOODBURY, T. D.
1916. Sugar pine. U. S. Dept. Agr. Bul. 426. 40 pp., illus.

Comprehensive report on sugar pine. The bulletin covers such items as: Importance of sugar pine; geographical and commercial range; habit and root systems; bark, leaves, flowers, and seed; size and longevity; susceptibility to injury and disease; silvical requirements; reproduction; forest types; the wood; logging; milling; values and grades of lumber; markets; uses, stumpage prices; growth and yield; management; and management of private timberlands.

82. LITTLE, ELBERT L., JR.
1953. Check list of native and naturalized trees of the United States (including Alaska). U. S. Dept. Agr. Agr. Handb. 41. 472 pp. (Supersedes Misc. Cir. 92.)

For sugar pine gives correct botanical name--Pinaceae, Pinus lambertiana Dougl.; approved common name--sugar pine, with an alternate common name, California sugar pine; and range--"Mountains from western Oregon south to southern California and in Sierra Nevada to western Nevada. Also in northern lower California, Mexico."

83. McCLAY, THOMAS A.
1955. A preliminary statement on the economics of growing either sugar pine, ponderosa pine, or Douglas-fir on a specific area. Pacific Northwest Forest and Range Expt. Sta. (RE-NW-ECONOMICS OF MANAGEMENT. General) 5 pp. (Manuscript report)

The high stumpage value, fast growth rate, and freedom from defect of many sugar pines, compel foresters in southwest Oregon to consider it the most favorable species to grow as a future crop. An unknown factor is the silvicultural and pathological behavior of planted stands of pure sugar pine over a rotation. If no unusual complications arise in these fields, an economic comparison with ponderosa pine or Douglas-fir rests largely on the additional costs of blister rust control and the proper selection of site.

A comparative cost analysis between species involves only those initial costs to prepare the site and establish the stand; blister rust control costs are included if the crop is to be sugar pine.

Pruning costs, annual charges for administration, protection, and maintenance of improvements, and costs associated with noncommercial thinnings or release work, if any, are assumed to be about the same regardless of species and do not enter the comparison.

The initial cost ratio of sugar pine to ponderosa pine for a range of sites is shown in a table. The ratios indicate a justifiable expenditure for sugar pine for each dollar to be spent for ponderosa pine. If site index and establishment costs are the same for each species, a 30-percent additional cost might be incurred for blister rust control.

84. MacGREGOR, NEIL J.
1954. Project report on the sugar pine delineation of Mountain Home State Forest. U. S. Forest Service Region 5 Blister Rust Control Unit. 17 pp. (Processed)

This report presents an economic appraisal of proposed sugar pine management units and the formulation of blister rust control plans for areas qualifying for management on the Mountain Home State Forest located in the southern Sierra Nevada of California. The area consists of a 1,604-acre tract in the Bear Creek Unit, which was found to qualify economically for intensive sugar pine management. The report illustrates the economic approach to the selection of pine stands for management by applying directly the assumptions and methods of Vaux's analysis. Thus, the increased value expected to result from sugar pine management has been estimated and is compared with the estimated additional cost of the intensive management program. The conclusion drawn is that intensive management of the unit is justified economically.

85. McKENZIE, HOWARD L.
1941. Injury by sugar pine Matsucoccus scale resembles that of blister rust. Jour. Forestry 39:488-9.

A scale insect (Matsucoccus paucicicatrices) was reported as being injurious to the twigs and branches of young sugar pines from sapling to pole size. In the early stages, the injury is so similar to that caused by white pine blister rust that a microscopic examination is required for positive identification. Faded branchlets and twigs form conspicuous "flags," especially on the smaller branches.

86. MAGUIRE, W. P.
1952. Some observations on the use of the transpiration inhibitor "Plantcote" on lifted tree seedlings. U. S. Forest Service. Tree Planters' Notes 12:15-17.

During a 3-year period small quantities of seedlings of white fir, red fir, Douglas-fir, sugar pine, and redwood were treated by dipping the tops and roots in a solution of 1 part plantcote and 2 parts

water. The seedlings were stored at 38° F. for 2 months before outplanting. None of the sugar pine seedlings showed damage from drying out after 2 months in the field.

87. MASON, HERBERT L.
1936. Principles of geographic distribution as applied to floral analysis. Madrono 3:181-190.

In a discussion relating to perpetuation and evolution of floras (pp. 187-188), Mason states as follows: "The Sierran flora as we know it does not occur in the fossil record. In every case, species belonging to it are found in close association with the redwood. In the Santa Clara lake beds of the Pliocene, for example, the (sugar) pine and Libocedrus are in association with Sequoia and Pseudotsuga. In the older tertiary beds to the north there are five-needled fascicles similar to those of Pinus lambertiana, although otherwise there exists no proof of the close relationship of this pine to the modern species."

88. ———
1946. Edaphic factor in narrow endemism. Madrono 8:241-257.

In a consideration of some taxonomic aspects of certain endemic tree species (pp. 253-256), the author reports that sugar pine is known to grow over several types of rock but does not tolerate serpentine.

89. MARTIN, J. F. and GRAVATT, G. FLIPPO.
1954. Saving white pines by removing blister rust cankers. U. S. Dept. Agr. Cir. 948. 22 pp., illus.

Discusses canker removal generally and the technique of removing them under different conditions of occurrence on the tree. Applicable to western species of white pines although more widely practiced in eastern states where the aesthetic values frequently exceed the timber values, depending upon the purpose of growing the trees.

This booklet tells how to recognize cankers, justification of removal, and explains how to best remove them. Care of wounds is discussed. Recommendations are made regarding pruning and thinning white pine stands. Reinspection of pruned trees is recommended the first and fourth years after treatment and every third year thereafter until no cankers can be found.

90. MARTINEZ, MAXIMINO.
1945. Las pinacean Mexicanas. Section Ayacahuites. (Mex.) Univ. Nac., Inst. de Biol. An. 15:98-129

Concerns taxonomic characteristics and occurrences in Mexico of the following species and varieties of five-needled pines: (1) Pinus flexilis James, (2) P. reflexa Engelmann, (3) P. avacahuite brachyptera Shaw, (4) P. ayacahuite veitchii Shaw, (5) P. ayacahuite Ehrl., (6) P. lambertiana Douglas, and (7) P. strobus chiapensis Martinez. Sugar

pine occurs in Mexico only in Lower California, principally in the San Pedro Martir Mountains.

91. MAY, RICHARD H.
1951. Production of logs and bolts for plywood, pulp, container veneer, shingles, cooperage, poles, and piling in California. 1950. Calif. Forest and Range Expt. Sta. Res. Note 79. 6 pp. (Processed)

The estimated production of sugar pine bolts for shingles and shakes in 1950 was 430,000 board-feet from the Pine Region in California. No sugar pine production was indicated for the other products listed in the title of the report or for the Redwood Region in California.

92. ———
1953. A century of lumber production in California-Nevada. Calif. Forest and Range Expt. Sta. Forest Survey Release No. 20. 33 pp., illus. (Processed)

Lumber production for California-Nevada is given for the period 1869-1951. Sugar pine lumber production was estimated to have been about 35 million board feet in 1869, and 327 million in 1951. For the period 1920-51 (except for 1949 and 1950), the lumber production is subdivided into the portions produced in the Pine Region and Redwood Region. In 1920 more than 141 million board-feet of sugar pine lumber came from the Pine Region in contrast to only 75,000 board-feet from the Redwood Region. In 1951 the production figures show approximately 320 million from the Pine Region and about 7 million from the Redwood Region.

93. ———
1954. Output of forest products in California. Calif. Forest and Range Expt. Sta. Forest Survey Release 23. 10 pp. (Processed)

The sugar pine lumber production and estimated production of logs and bolts for plywood, shingles, and shakes in California for 1952 were reported as:

Location:	Lumber (Million bd.-ft.)	Plywood (Thousand bd.-ft.)	Shingles and shakes (Thousand bd.-ft.)
Redwood Region	7.0	20	--
Pine Region	311.1	5,615	70

94. MIELKE, J. L.
1938. Spread of blister rust to sugar pine in Oregon and California. Jour. Forestry 36:695-701, illus.

Blister rust was first detected on sugar pine in 1936 at several places in Oregon and two in California near the Oregon boundary. The

following year the rust was found on ribes over a wide area extending south about 125 miles in the coastal mountains and in the Sierra Nevada. The distribution of blister rust and its behavior on sugar pine in the two states are described.

95. MIELKE, JAMES L.
1943. White pine blister rust in western North America. Yale Univ. School For. Bul. 52, 155 pp., illus.

A detailed review of the introduction of white pine blister rust into western North America and its spread from 1910 to 1942. The report discusses the epidemiology of the rust (Cronartium ribicola Fischer) and the rust infection on the white pines.

96. MILLER, JOHN M.
1914. Insect damage to the cones and seeds of Pacific Coast conifers. U. S. Dept. Agr. Bul. 95. 7 pp., illus.

Describes the character and cause of blighted cones, wormy and aborted cones, wormy seed, and maggoty cones. Practically all serious damage to cones and seeds is caused by four classes of insects: cone beetles, cone worms, seed chalcids, and fir-cone maggots. Cone beetles were noted in some seasons to destroy from 25 to 75 percent of the sugar pine cone crops over large areas.

97. MILLETT, M. A.
1952. Chemical brown stain in sugar pine. Jour. For. Prod. Res. Soc. 2:232-236.

Results showed that sugars and other materials present in the fraction of high water solubility are the substances primarily responsible for staining in sugar pine. These soluble substances are present in the sap and are concentrated at the surface of the lumber during drying. Stain retardant chemicals showed little promise of correcting this defect when used as dip treatments. It was suggested that the best means of controlling brown stain at the present time was to secure better coordination between cutting and processing operations, and to use moderate kiln-drying schedules.

98. MIROV, N. T.
1936. A note on germination methods for coniferous species. Jour. Forestry 34:719-723.

Recommends cold stratification as a pre-germination treatment for all California conifers. Untreated sugar pine seed had a germinative percent of only 28, compared to 89 percent for seed stratified for 3 months at 40° F.

99. MIROV, N. T.
1940. Tested methods of grafting pines. Jour. Forestry 38:768-777, illus.

Five methods of grafting pines are reported. Sugar pine seedlings were successfully grafted on Monterey pine seedlings and on ponderosa pine transplants. The author states, "....at least for experimental purposes, the scions of any pine species can be grafted on any other pine species."

100. ———
1944. Experiments in rooting pines in California. Jour. Forestry 42:199-204.

Rooting experiments were conducted chiefly on ponderosa pine. Cuttings from sugar pine developed excellent callus and remained alive for more than 18 months, but only 2 percent rooted.

101. ———
1944. Possible relation of linolenic acid to the longevity and germination of pine. Nature (London) 154:218-9.

The ability of seeds of certain pine species to retain viability after prolonged storage may be related to the amount and activity of the unsaturated linolenic acid.

102. ———
1946. Pinus: A contribution of turpentine chemistry to dendrology and forest genetics. Jour. Forestry 44:13-16.

Discusses the present knowledge of turpentine composition, subjects needing investigation, and identification of species from turpentine. The author states that it appears "each pine species as a whole has a specific turpentine by which the pine can be easily identified." Sugar pine turpentine was found to contain a sesquiterpene, aromadendrene.

103. ———
1946. Viability of pine seed after prolonged cold storage. Jour. Forestry 44:193-5.

Report on germination of 21 species of pine after storage at 41° F. in airtight containers for periods ranging from 5 to 15 years. Sugar pine seed stored for 8 to 14 years showed considerable loss in viability.

104. ———
1948. The terpenes in relation to the biology of genus Pinus. Ann. Rev. of Biochem. 17:521-540.

This paper consists of a detailed summarization and discussion

of available information on the terpene chemicals found in the genus Pinus L. A number of white pines, including sugar pine, briefly enter the summary tables and the discussion.

105. MIROV, N. T.
1953. Taxonomy and chemistry of the white pines. Madrono 12:81-89.

No definite chemical relationship was established between sugar pine and the other white pines.

106. ———
1954. Composition of turpentines of Mexican pines. Unasylva 8:167-73.

Sugar pine is found in Baja California in admixture with Jeffrey pine on high plateau range. Gives physical characteristics and chemical composition of turpentines of Mexican pines including sugar pine. Refers to book by Maximino Martinez, Los Pinos Mexicanos. Ediciones Botas, 1948, Mexico, page 361.

107. ——— , HAAGEN-SMIT, A. J., and THURLOW, JAMES.
1949. Composition of gum turpentine of Pinus lambertiana. Jour. Amer. Pharmaceutical Assoc. 38:407-8.

Describes the procedure used in analyzing the composition of turpentine from sugar pine and lists the components. Results differ from an earlier study conducted by A. W. Schorger.

108. NEWLIN, J. A. and WILSON, THOMAS R. C.
1917. Mechanical properties of woods grown in the United States. U. S. Dept. Agr. Bul. 556, 47 pp.

Lists the mechanical properties of 126 species, including sugar pine, based on tests performed on small clear pieces in a green and air-dry condition.

109. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION.
1954. Annual Report (1953). 68 pp. (Processed)

Studies and problems dealing with sugar pine:

Sugar pine was direct seeded successfully by the use of Keyes screens preloaded with soil or vermiculite treated with Semesan and fertilizer. Sugar pine apparently can be seeded successfully at any time from August through May. Sugar pine and ponderosa pine seed coated with tetramine and dextrin also were successful in direct seeding tests.

A pilot-plant test was started to explore costs, methods, and results of pruning sapling and pole sugar pine crop trees to save them from blister rust. Some 4,000 sugar pines on a 35-acre portion

of the South Umpqua Experimental Forest were marked by station personnel and pruned by a contractor. Problems concerning establishment of good natural regeneration of sugar pine and ponderosa pine were surveyed on 60 clearcut burns in the South Umpqua drainage, Umpqua National Forest.

110. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION.
1955. Annual Report (1954). 68 pp. (Processed)

Progress report on activities pertaining to sugar pine:

The increasing use of rodenticides and rodent repellents took a set-back late in 1954 when tetramine became unavailable. Sugar pine and ponderosa pine seed, surface coated with tetramine in dextrin, fall planted in 1953, gave excellent 1-year stands of seedlings. Restocking conditions on older cutovers, largely in the South Umpqua drainage, were studied on 2,440 4-milacre plots on 61 sample cutovers. Douglas-fir was the dominant species on 62 percent of stocked plots; sugar pine and ponderosa together were dominant on 10 percent. The remaining 28 percent stocking was in less desirable species. Control of rodents by "1080" and thallium holds great promise for improving regeneration from natural seed fall. Some 4,600 sugar pine potential crop trees in the 30- to 40-year age class on the South Umpqua Experimental Forest were pruned by contract to rid them of, and to protect them from, blister rust infection. A check late in 1954 showed blister rust infection in only 6 percent of the pruned crop trees; prior to pruning 63 percent were infected.

111. POLI, ADON and BAKER, HAROLD L.
1953. Ownership and use of forest land in the Coast Range Pine Subregion of California. Calif. Forest and Range Expt. Sta. Tech. Paper 2. 64 pp., illus. (Processed)

The net volume of live sugar pine sawtimber on commercial forest land was reported as (million board-feet):

Old growth sawtimber stands	4,521
Young growth sawtimber stands	1,730
Pole timber stands	87
Non-stocked	16
Total:	6,354

112. POLI, ADON and BAKER, HAROLD L.
1954. Ownership and use of forest land in the Redwood--Douglas-fir Subregion of California. Calif. Forest and Range Expt. Sta. Tech. Paper 7. 76 pp., illus. (Processed)

Net volume of live sugar pine saw-timber on commercial forest land was reported as 4,694 million board-feet, which amounts to 3.4 percent of the net volume of live saw-timber in the subregion. The distribution by stand-size classes was: 3,490 million board-feet in old growth saw-timber, 829 million in young growth saw-timber stands, 372 million in pole timber stands, and the remaining 3 million in non-stocked stands.

113. QUICK, CLARENCE R.
1939. Precipitation in the Sierra Nevada, growth rate of conifer saplings, and the distribution of Ribes. Blister Rust Control, Methods Development Unit. Serial Report 103. 13 pp., illus. (Typewritten)

Precipitation records for the period 1918-1938 from four groups of weather stations in the Sierra Nevada were compiled and reduced to percentage average seasonal (July 1-June 30) precipitation. Height growth of a number of selected saplings, sugar pine and white fir, was measured at four locations in the mountains (Chowchilla Mtn., Sierra National Forest; Cow Creek, Stanislaus National Forest; Big Silver Creek, Eldorado National Forest; and Humbug Road, Lassen National Forest). Growth data were reduced to percentage average annual height growth, and compared with precipitation data. Annual height growth of saplings conformed roughly to amount of seasonal precipitation. Cumulative effects on height growth of consecutive dry years and of consecutive wet years were considerable. Differences between the two sets of averages (growth and precipitation) were sometimes marked, and unexplainable from the compiled data. A graph summarizing the increase in amount of precipitation with increase of altitude in the Sierra Nevada is appended.

114. _____
1945. Growth of Ribes, Ceanothus, and sugar pine seedlings (in the greenhouse). Blister Rust Control, Methods Development Unit. Serial Report 128. 8 pp. (Typewritten)

Report of growth tests in forest loam in large tin cans in the greenhouse (1) of gooseberry and ceanothus seedlings in mixed-species cultures and subsequent growth of sugar pine seedlings in the same soil, (2) of sugar pine and ceanothus seedlings in mixed-species culture, (3) of various densities of planting of sugar pine seedlings, and (4) of ceanothus seedlings in soil inoculated with nitrogen-fixing nodule bacteria from three sources.

Sugar pine seedlings made much better growth in general following ceanothus cropping, or mixed ceanothus and gooseberry cropping, than following gooseberry cropping alone. In first-crop cultures, sugar pine did better alone than when mixed with ceanothus. Sugar pine varied relatively little in weight per plant whether 2, 4, 5, 7, or 8 seedlings were grown for 2 years in forest loam in a #10 can (capacity 0.825 gal.). Ceanothus cordulatus seedlings grew better in soil inoculated with macerated tubercles from other plants of the same species than in uninoculated soil. Inoculation with macerated root tubercles from lupine and burclover appeared to reduce vigor of snowbrush seedling growth.

115. QUICK, CLARENCE R.
1945. Growth of sugar pine saplings on Crocker Ridge in an area of stagnated reproduction. Blister Rust Control, Methods Development Unit. Serial Report 130. 9 pp., illus. (Typewritten)

Size and growth of 15 sugar pine saplings studied in an area of dense and somewhat stagnated sugar pine reproduction along the Coulterville-Crane Flat road on a southwesterly shoulder of Crocker Ridge, Stanislaus National Forest. In 1944 the 15 sugar pine saplings averaged 5.3 feet in height, an estimated 37 years of age, and a diameter of 1.35 inches. The 15 saplings averaged 4.1 inches of mean annual height growth for the 5 years 1940-1944, and 3.2 inches mean annual height growth for the 10 years 1935-1944. Height growth was closely related to seasonal precipitation (July to June 30). Since about 1938, the 5 fastest growing saplings are rapidly pulling away from two other groups of 5.

116. _____
1947. Germination tests on sugar pine seed. Blister Rust Control, Methods Development Unit. Serial Report 136. 11 pp., illus. (Typewritten)

A group of 11 papers concerned with sugar pine germination is reviewed. Methods for germination tests in sand culture are described. Sixty to 90 days of stratification at 0° C. (32° F.) resulted in immediate 100 percent germination in the greenhouse. Stratification at 2.2° C. (36° F.) and at 5° C. (41° F.) produced similar results. Sugar pine seed planted and stratified at depths up to 1.5 inches in forest loam emerged 100 percent. Seeds at depths of more than 2.0 inches did not emerge. The more shallowly buried seeds germinated more rapidly. Of 150 seedlings on which cotyledons were counted, about 83 percent had 13 to 16 cotyledons, and about 50 percent had 14 or 15 cotyledons; the total range was from 11 to 19 cotyledons. Sugar pine seed samples varied in number of seeds per pound from 1,050 (25 "colossal" seeds picked out of a collection of large seeds) to 4,650 (100 fully-formed, presumably viable seeds extracted from other samples by shaking on a 4-mesh sieve). Seventeen seed samples averaged 2,140 seeds per pound.

117. QUICK, CLARENCE R.
1949. Some ecologic aspects of the pine inventory method for control area analysis on old cutover. Blister Rust Control, Methods Development Unit. 11 pp., illus. (Typewritten)

Reports an analysis and ecologic interpretation of experimental sugar pine inventory data collected in October and November 1948, by Roy Blomstrom, et al. Data from 7 quarter sections on the Stanislaus National Forest--2 from Bumble Bee area (northwest of Pinecrest), 3 from Cleveland Hollow (southwest of Pinecrest), and 2 from Thompson Meadow (south of Longbarn). Several tables present detailed summaries of trees by species (sugar pine, ponderosa pine, white fir), by size class, and by crown class. Tables and graphs emphasize the marked unevenness of distribution of sugar pine regeneration on old cutovers. The report points up the difficult problem of selecting sugar pine areas and boundaries of areas for Blister Rust Control units in old cutovers.

118. ———
1949. A comparison of sugar pine inventory data from one forty: Stocked quadrat versus continuous strip. Blister Rust Control, Methods Development Unit. 6 pp., illus. (Typewritten)

A single "40" of Blister Rust Control area near Bumble Bee Camp (northwest of Pinecrest), Stanislaus National Forest, was systematically sampled three times by hand compass and pacing to determine amount and distribution of sugar pine regeneration. Sampling methods were: (1) Stocked quadrat sample--quadrats of 4 milacres, spaced 1 chain apart on survey lines 2 chains apart and (2) Continuous strip survey--strips 1/4 chain wide and 2.5 chains apart, run east-west; transects 1 chain long, a 10 percent sample. (3) Continuous strip survey--strips 1/2 chain wide and 2.5 chains apart, run southwest-northeast; transects 1 chain in length, a 20 percent sample.

Seven out of 200 quadrats (4 milacres each) were found stocked with one or more dominant sugar pines, or with 2 or more codominant sugar pines, 18 inches d.b.h. or less. Similarly, 26 out of 160 1/4- x 1-chain transects, and 44 out of 160 1/2- x 1-chain transects, were found stocked with dominant sugar pine regeneration. The continuous strip samples gave a much better distribution pattern of sugar pine regeneration than did the stocked quadrat samples. The stocked-quadrat sample was considered grossly inadequate on small areas.

119. ———
1950. Compound interest and sugar pine investments. Blister Rust Control, Methods Development Unit. 2 pp., illus. (Typewritten)

Cites Rietz, H. L., et al -- Mathematics of Finance, as a general mathematical treatment of compound interest. A general

formula for the amount of $1 at compound interest is: $s = (1 + i)^n$, where s = the eventual sum, i = the interest rate, and n = the number of periods of compound interest. The sum of $1 increased by interest compounded annually, at various percentages of interest up to 7 percent, and for lengths of time up to 100 years, is presented in table and graph. The amount of $1 at 2.5 percent interest climbs to $2 at 30 years, $3 at 45 years, $5 at 65 years, $11.81 at 100 years, and $52 at 160 years.

120. QUICK, CLARENCE R.
1950. Trees per acre in the Sierran mixed-conifer forest. Blister Rust Control, Methods Development Unit. 6 pp. (Typewritten)

Considers the mathematical approach to figure 2 of Dunning and Reineke (42, page 9). This figure, a log-log graph published in 1933, defines the relationship between number of trees per acre and average diameter in inches for various stand-density indices. The stand-density index of 800 was taken "as a fair index for full stocking in these mixed-conifer stands." Figure 2 is compared with a similar graph, "Number of dominants and all trees in relation to average dominant," prepared by Dunning in 1949 for the Region 5 training school in timber management. The 1949 curve declines much less rapidly than the 1933 curve in number of trees with increase in tree size. The "Dominants" line of Dunning's 1949 graph is approximated by a formula. Values for number of dominants per acre for diameters from 4 inches to 30 inches are computed from this formula and presented in a table.

121. ———
1950. Ribes regeneration on the Fanianni (Collins Pine) 1-acre timber plot. Blister Rust Control, Methods Development Unit. Serial Report 146. 14 pp., illus. (Typewritten)

Analyses data collected from a 1-acre plot established in the fall of 1940 on the Lassen National Forest. Development of gooseberry populations after ribes eradication in 1940 and 1947, and after road building and light logging in 1942-43, is described in relation to abundance of mature timber, advance coniferous regeneration, and other vegetation. There were 54 sugar pines on the acre at time of plot initiation, and 37 in 1945 after light logging in 1942-43. Five big overmature and 12 smaller sugar pines were removed.

122. ———
1951. Ribes persistence and regeneration on the Pilot Peak 1-acre plot. Blister Rust Control, Methods Development Unit. Serial Report 147. 17 pp., illus. (Typewritten)

Describes persistence of old gooseberry plants, the occurrence of seedlings, and the establishment of young gooseberry plants in well-developed vegetation on old cutover at an altitude of about 4800

feet on the Sierra National Forest. The plot was established in July 1937. Ribes were eradicated in 1937, 1940, and 1948. In 1945, 100 of the 152 sugar pines on the 1-acre plot were between 2 feet and 11 feet in height. There were no sugar pines under 6 inches in height, and no merchantable sugar pine trees on the plot.

123. QUICK, CLARENCE R.
1951. Natural regeneration of sugar pine following a burn in mature timber. Blister Rust Control, Methods Development Unit. 6 pp. (Typewritten)

Reports natural regeneration of sugar pine and of other tree species on a burn in overmature timber just southwest of Cow Creek Guard Station, Stanislaus National Forest. The burn, of about 1.5 acres, occurred in August 1936, near the west end of plot MC-12 of the California Forest and Range Experiment Station. Intensity of the burn varied greatly--from a slow ground fire at the west edge to an intense fire which killed merchantable trees toward the east margin of the burn. Dense sugar and ponderosa pine regeneration--approximately 6,500 seedlings per acre--started in the spring of 1937 following a very heavy seed crop the preceding fall. Pine regeneration dominated the burn in 1951, and vigorous young pine trees were growing in some places where fire destroyed dense thickets of white fir regeneration.

124. ———
1953. Search for plant-indicator species on blister rust infection areas. Blister Rust Control, Methods Development Unit. 14 pp. (Typewritten)

Reports an attempt to discover plant species or combinations of species which would identify or which would help to define local areas in the Sierra Nevada where sugar pine would be seriously attacked by blister rust. All areas studied were in good sugar pine habitats. More than 125 species of plants were observed and recorded on 17 areas on the Lassen (5), Plumas (6), and Stanislaus (6) National Forests. No clear-cut plant indicators of areas particularly hazardous to sugar pine were found.

125. ———
1954. Ecology of the Sierra Nevada gooseberry in relation to blister rust control. U. S. Dept. Agr. Cir. 937. 30 pp., illus.

A comprehensive treatise on the ecology of Sierra Nevada gooseberry (Ribes roezli Regel), an alternate host of white pine blister rust which threatens to destroy sugar pine on several million acres in California and southern Oregon. Approximately 175 million ribes plants were destroyed during the period 1926-1948 for

the protection of sugar pine. About 90 percent of the time and money expended on the removal and suppression of ribes was on the Sierra Nevada gooseberry.

Mature gooseberry plants are intolerant and may be completely crowded out of well-stocked timber stands. They grow most abundantly on denuded areas and can endure long summer drought. Mortality in the seedling stage is very high. Summer drought and competition with other larger plants prevent the establishment of large numbers of seedlings. Seeds are produced on plants 3 years or older. Although the seeds are small, they remain viable for many years in the duff and germinate vigorously following fire or logging. The best time to start eradication is immediately after a major disturbance such as logging or fire. The second best time is just prior to logging. All seed producing plants should be destroyed before the fruit matures.

126. RIGHTER, F. I.
1939. Early flower production among the pines. Jour. Forestry 37:935-8.

The average minimum age of ovulate flower production for 55 species and varieties of pine was reported as 5.2 years at the Institute of Forest Genetics at Placerville, California. The average minimum age for pollen production was 4.4 years. Sugar pine produced pollen at the age of 7 years; however, no minimum age was given for ovulate flower production.

127. ROY, D. F.
1955. The Clements growth prediction charts for residual stands of mixed conifer in California. Calif. Forest and Range Expt. Sta. Tech. Paper 9. 12 pp. (Processed)

Describes alinement charts for predicting growth of residual trees, ingrowth, and mortality during the first 20 years after partial or selective cutting.

128. _____ and SCHUBERT, G. H.
1953. K-screen seed spots. Calif. Forest and Range Expt. Sta. Res. Note 88. 2 pp. (Processed)

Describes a small tube-shaped protective screen used in seed spotting with sugar pine, ponderosa pine, Jeffrey pine, and Douglas-fir seed. (In Oregon the device is sometimes called a Keyes screen.) Results of direct seeding trials using the K-screen have been erratic. Under certain conditions, seed germination in the screen has been disappointing. The screens have been frost heaved, and they sometimes were knocked out of the ground by livestock, deer, and some of the larger rodents.

129. SACHER, J. A.
1954. Structure and seasonal activity of the shoot apices of Pinus lambertiana and Pinus ponderosa. Amer. Jour. Bot. 41:749-59, illus.

Seasonal changes in the shoot apices of sugar and ponderosa pines were studied near Berkeley, California. New bud formation began about the middle of May and was completed by the first of October; terminal bud scales were produced at the end of the season's growth; buds were dormant from October through March; bud expansion and shoot elongation began the first of April through the first week of May.

130. SAMPSON, ARTHUR W., and DAYTON, WILLIAM A.
1913. Relation of grazing to timber reproduction. Rev. Forest Service Invest. 2:18-24.

Describes grazing damage by cattle, sheep, and goats on a series of plots located on the Shasta National Forest. Coniferous species found on the 43 sample plots, 12 of which were fenced, were: Sugar pine, ponderosa pine, Douglas-fir, white fir, and incense-cedar. Of the 215 sugar pines under 5.5 feet high, none were killed by grazing, 4 were trampled (1 by cattle, 2 by sheep, and 1 by goats), and 65 were grazed (10 by cattle, 14 by sheep, and 41 by goats). A large part of the grazing injury was very minor--removal of a few needles or lateral buds--and was not considered serious except that the lesions might serve as entrance places for parasites.

131. SARGENT, CHARLES SPRAGUE.
1933. Manual of the trees of North America (exclusive of Mexico). Ed. 2, 910 pp., illus. Boston and New York.

Detailed description of taxonomic characteristics and natural ranges of trees including sugar pine. Class Gymnospermae, Family Pinaceae, Genus Pinus, Species lambertiana Dougl.

132. SCHUBERT, G. H.
1950. Quintuplet seedlings in a sugar pine seed. Jour. Forestry 48:128-9, illus.

A case is cited in which 1 sugar pine seed had 5 developed embryos. In the group of 1,600 sugar pine seeds, there were also 14 with twins and 3 with triplets.

133. SCHUBERT, GILBERT H.
1950. Viability losses of sugar pine (Pinus lambertiana, Dougl.) seed infected with certain fungi. Thesis, M.S., Univ. of Calif., Berkeley, Calif. 57 pp., illus. (Typewritten)

Viability losses of sugar pine seed infected with several fungi were investigated. Losses due to Cylindrocarpon, Mucor, and Rhizopus

were found to be low--generally no greater than would be expected through normal sampling errors. Poor stratification technique and improper collecting and handling of seed were believed to be the main causes for the low viability of some of the seed tested.

134. SCHUBERT, G. H.
1952. Germination of various coniferous seeds after cold storage. Calif. Forest and Range Expt. Sta. Res. Note 83. 7 pp. (Processed)

Results of germination tests show that seed of most conifers, including sugar pine, can be collected in large quantities during good seed years with assurance that they will retain high viability for intervals sufficiently long to tide over poor seed years--providing the seed is properly handled and stored. Several conditions pertaining to proper handling and storing of seeds are listed and explained.

135. ———
1953. A trial of three chemicals as rodent repellents in direct seeding. Calif. Forest and Range Expt. Sta. Res. Note 84. 2 pp. (Processed)

Three chemicals--sodium fluoroacetate (compound "1080"), red lead, and zinc phosphide--were tested as rodent repellents. The chemicals were applied as a thin coat over the seed. Dowax and asphalt were used as carriers. A total of 464 sugar pine seed spots were sown with 5 seeds per spot. None of the three chemicals proved effective as rodent repellents.

136. ———
1953. Ponderosa pine cone cutting by squirrels. Jour. Forestry 51:202, illus.

Cites an instance in which 863 out of 926 ponderosa pine cones from a single tree were destroyed by squirrels. Little cone cutting was evident on several nearby large sugar pines bearing 50 or more cones each.

137. ———
1954. Viability of various coniferous seeds after cold storage. Jour. Forestry 52:446-7.

Report on the results of germination tests on 42 coniferous species which had been stored in 5-gallon cans with tight lids at 41° F. from 2 to 24 years. The length of time sugar pine seed remained viable varied considerably and depended on the condition of the seed when collected and on how it was handled. One seed lot, stored for 15 years, had 50 percent viability. However, another lot with an original viability of 90 percent dropped to 10 percent in 3 years.

138. SCHUBERT, GILBERT H.
1955. Freezing injury to sugar pine cones. Calif. Forest and Range Expt. Sta. Res. Note 96, 2 pp., illus. (Processed)

Immature sugar pine cones were reported to have been killed by a severe late spring freeze on the Stanislaus Experimental Forest in 1954. Although no other instances of freezing injury to young sugar pine cones have been reported, it is believed that some frozen cones may have been erroneously classified in the past as "next year's cones."

139. ———
1955. Freezing injury to young sugar pine. Jour. Forestry 53:732.

Young sugar pine seedlings and transplants were reported to be susceptible to late spring and early fall freezing temperatures of about 18° F. An early fall freeze severely damaged all of the 1-0 seedlings in two 4- by 12-foot seedbeds. A late spring freeze killed 74 percent of the seedlings in unscreened seed spots sown earlier that spring and damaged all or most of the new growth on 66 percent of the 3-year old transplants. Seedlings which were under wire screens sustained less freezing injury than the seedlings in unscreened seedspots--31 percent as compared to 74.

140. ———
1955. Effect of ripeness on the viability of sugar, Jeffrey, and ponderosa pine seed. (Paper presented at annual meeting, Soc. Amer. Foresters, Portland, Oregon, Oct. 17-20, 1955, and submitted for publication in Proceedings.) Illus.

Immature sugar pine and Jeffrey pine seed were observed to produce a large number of abnormal seedlings--nearly half of the sugar pine and a third of the Jeffrey pine. No abnormal seedlings were observed among the ponderosa pines or the seedlings derived from mature sugar and Jeffrey pine seed. Therefore, it was believed that abnormal seedling development was associated with immature seed. The viability of immature ponderosa pine seed was about half that of mature seed for both fresh and stored seed. Less than 1 percent of the immature sugar pine seed was viable after 3 years' storage compared to 72 percent for mature seed.

141. SHOW, S. B.
1926. Timber growing and logging practice in the California pine region. U. S. Dept. Agr. Dept. Bul. 1402. 75 pp., illus.

The measures considered necessary to keep forest lands productive and to produce full timber crops are discussed. One of the most

stressed points is to protect the advance reproduction from fires and logging. Others are to leave sufficient trees for seed production to insure restocking and to maintain the pines in the new stands; to combine in the reserve trees the highest possible qualities of growth and seed production; and to remove all the mature and poor risk trees. These measures have to be attained while making the operation profitable.

Under conditions affecting the private timber operator, current expenses incurred to protect and carry the operation as a whole should not be carried at compound interest but should be wiped off the books annually as the necessary current costs for doing business. That is, they should be handled in the same way that a storekeeper charges his rent and taxes to determine his yearly net operating profit.

142. SHOW, S. B.
1930. Forest nursery and planting practice in the California Pine Region. U. S. Dept. Agr. Cir. 92, 75 pp., illus.

One of the most complete reports on forest nursery and planting practice in California. This circular is out of print; however, reference copies are available in most libraries. Many of the practices recommended are still applicable today. The report covers such items as: germination and viability of seed; season, density, and depth to sow seed; shading, watering, and cultivation of seed beds; class of stock and season for planting; and problems encountered with nursery and planting stock.

143. ——— and KOTOK, E. I.
1929. Cover type and fire control in the national forests of northern California. U. S. Dept. Agr. Dept. Bul. 1945. 35 pp., illus.

Describes 9 major cover types of the California pine region with distinct and characteristic differences which bear directly on fire danger, fire risk, rate of spread, and ease of control. Sugar pine occurred in two of the major types: mixed-conifer and sugar pine-fir. These two types are generally subject to surface and ground fires; most of the fires were caused by lightning. The average length of fire seasons was 5-1/3 months in the mixed conifer and 4 months in the sugar pine-fir types; most fires occurred in August.

144. ——— and KOTOK, E. I.
1930. The determination of hour control for adequate fire protection in the major cover types of the California pine region. U. S. Dept. Agr. Tech. Bul. 209. 46 pp., illus.

"Hour control" is the speed-of-attack factor. It includes the total time elapsing from the start of the fire until the first suppression crew begins work onthe fire. Based on the analyses of fire

records for the period 1923-28, the average hour control necessary to give adequate protection were: For the mixed conifer type, 3/4-hour; for the Douglas-fir type, 2-hour; and for the sugar pine-fir type, 4-hour.

145. SIGGINS, HOWARD W.
1933. Distribution and rate of fall of conifer seeds. Jour. Agr. Res. 47:119-128, illus.

The rate at which seeds fell was found to vary greatly with size, weight, and shape, with area and conformation of wing, and with combinations of these seed and wing characteristics. Sugar pine seed with its single, large terminal wing had an average rate of fall of 8.7 feet per second in still air. Average rates for several common associates were: Jeffrey pine, 7.25 feet per second; ponderosa pine, 5.0; white fir, 5.7; red fir, 5.3; and incense-cedar, 5.9.

The distribution of seeds from the cones varies with the height from which released, the rate of release, and the direction and velocity of the wind. A steady wind from one direction deposited the seed in the form of a "V" with the apex at the base of the tree. No data are presented for the number of seeds deposited per square foot; however, the statement is made that the concentration of seed decreases gradually with increasing distances from the base of the tree.

146. SKINNER, EDGEL C.
1955. Log position volume tables for western conifers based on the Girard and Bruce form class volume tables for 16-foot logs. Pacific Northwest Forest and Range Expt. Sta. 54 pp. (Processed)

Contains board-foot volumes by the Scribner rule for individual logs of coniferous trees with form classes from 65 to 90, for diameters at breast height from 10 or 12 to 90 inches, and for merchantable heights from 1 to 11 logs.

147. SMITH, CLARENCE F. and ALDOUS, SHALER E.
1947. The influence of mammals and birds in retarding artificial and natural reseeding of coniferous forests in the United States. Jour. Forestry 45:361-9.

A review of past efforts at artificial and natural reseeding of coniferous forest beginning with the first attempt at direct seeding in 1901 on the San Bernardino National Forest, California. Based on 65 literature references and the authors' own studies, 44 mammals and 37 birds were listed which were found to eat coniferous seeds. The tree squirrels, chipmunks, white-footed mice, and a few species of seed-eating fringillid birds were reported as responsible for the greater part of all seed depredation.

Several protective measures discussed were: reductional control--removal of all or almost all seed eating animals; repellents or mechanical barriers--lethal baits applied to the seed or ground and use of mulches or screens; cultural measures--ground preparation, time of planting, and methods of seeding.

Although occasional successes were noted, no consistently good results were reported for any of the techniques with the exception of wire cone screens which were considered too expensive except on experimental areas.

148. SOCIETY OF AMERICAN FORESTERS, COMMITTEE ON FOREST TYPES.
1954. Forest cover types of North America (exclusive of Mexico). 67 pp., illus. Washington, D. C.

Sugar pine occurs in nine cover types of western North America. It is one of the major components in the ponderosa pine-sugar pine-fir type and a minor component in the following cover types: red fir, white fir, Pacific Douglas-fir, Port-orford-cedar--Douglas-fir, Pacific ponderosa pine--Douglas-fir, Pacific ponderosa pine, California black oak, and Jeffrey pine.

149. SOVULEWSKI, ROBERT and HARRIS, THOMAS H.
1948. A method for the classification of sugar pine lands. Jour. Forestry 46:432-7.

A method is presented to aid in selecting stands of sugar pine for protection against blister rust. Based on productivity judged by forecasting yield on various sites with different stocking of sugar pine.

This method is now superseded by the delineation method based on Vaux's rating tables of 1954. (See Vaux, 1954.)

150. SPENCER, D. A. and KVERNO, N. B.
1953. Research in rodent control to promote reforestation by direct seeding. U. S. Fish and Wildlife Service Prog. Report 3, 66 pp., illus. (Processed)

Deals mainly with application of tetramine to coniferous tree seed to prevent their consumption by rodents. The results with tetramine-treated sugar pine seed were reported as erratic with present techniques of seed treatment. The tests have shown that the injury to the seed was due to the acetone carrier and not due to the tetramine. Seedlings grown from tetramine treated seeds were also protected from rodents during the first few weeks after germination.

151. STEIN, WILLIAM I.
1955. Some lessons in artificial regeneration from southwestern Oregon. Northwest Science 29:10-22, illus.

Several methods of artificial regeneration were tested: Planting nursery stock, sowing seed in unprotected seedspots, and planting seedspots protected with conical screens and K-screens. Trials with several insecticides (aldrin, dieldrin, chlordane, and benzene hexachloride) and fertilizers (bonemeal, superphosphate, muriate of potash, and ammonium phosphate) were also included in the studies.

In several studies conical screens failed to give good protection, whereas properly installed K-screens consistently protected both seeds and seedlings. Results of several planting and direct seeding tests showed:

	Planting		Direct seeding protected with K-screens		
	Trees planted (Number)	First-year survival (Percent)	Seedspots (Number)	Initial stocking (Percent)	First-year stocking (Percent)
Douglas-fir	50	16	160	52	16
Ponderosa pine	550	76	160	74	49
Sugar pine	400	60	820	96	59

The four insecticides had no harmful effect on the germination of sugar pine, ponderosa pine, or Douglas-fir; however, benzene hexachloride killed all the seedlings within a few weeks after germination.

No consistent effects on survival, beneficial or detrimental, were noted for the addition of fertilizers to the soil used in the K-screens.

152. ———
1955. Preliminary recommendations for seedspotting sugar pine in southwest Oregon. Pacific Northwest Forest and Range Expt. Sta. Res. Note 118. 6 pp., illus. (Processed)

Recommendations are presented for seedbed preparation, rodent control, seeding method, time to seed, and choice of seedspot locations. Recommendations include: Sow seedspots in mineral soil free of vegetative competition; prevent rodent damage with repellents or poison baits; sow 2 seeds per spot; space seedspots 4 x 8 feet; plant seed in the fall. Based on past experiments, 20 guides as to choice of seedspot locations are presented.

153. STOCKWELL, PALMER
1942. Pinus embryo size compared with growth rate. Amer. Nat. 76:431-2.

Tests made with sugar pine seed failed to show a significant correlation between size of embryo and size of resultant seedlings.

154. STONE, E. C. and DUFFIELD, J. W.
1950. Hybrids of sugar pine by embryo culture. Jour. Forestry 48:200-1, illus.

Describes a modified embryo culture technique successfully used to germinate sugar pine.

155. STRUBLE, G. R.
1947. Twig damage in sugar pine caused by cone beetle. Jour. Forestry 45:48-50, illus.

The sugar pine cone beetle (Conophthorus lambertianae Hopk.) was reported as a twig miner in the adult stage. Twig killing appeared to be associated with cone production. Trees in areas where cones were infested and killed by the cone beetles were most heavily flagged.

156. SUDWORTH, GEORGE B.
1908. Forest trees of the Pacific slope. U. S. Dept. Agr., Forest Service. 441 pp., illus.

Detailed description of identifying characters, range, and occurrence.

157. TEVIS, LLOYD JR.
1953. Effect of vertebrate animals on seed crop of sugar pine. Jour. Wildlife Management 17:128-31, illus.

In 1951, 20 mature cone-bearing sugar pine trees were tagged near Lake Almanor in Plumas County, California. The cones were counted on 5 dates between August 14 and September 23. Of the original 1,656 cones counted, 896 (54 percent) were reported as cut by pine squirrels (Tamiasciurus douglasii), 559 (34 percent) were destroyed by white-headed woodpeckers (Dendrocopus albolarvatus), and only 201 (12 percent) were undamaged. Squirrels cut some cones from all 20 trees, whereas woodpecker damage was noted only on half of the trees. Woodpeckers destroyed 85 percent of the original 358 cones on one tree and 7 pines lost all cones to squirrels and woodpeckers.

Stellar jays (Cyanocitta stelleri) were noted picking seed from the few cones left undamaged on the trees after the cones began to open.

White-breasted nuthatches (Sitta carolinensis), red-breasted nuthatches (Sitta canadensis), and mountain chickadees (Parus gambeli) were observed removing seeds from cones cut by squirrels which opened on the ground.

Seeds which were shed from open cones on tree or accidentally dropped by birds were consumed by chipmunks (Eutamias amoenus, E. speciosus, and E. townsendi), by white-footed mice (Peromyscus maniculatus), and by mantled squirrels (Citellus lateralis).

As a result of seed depredation by all the birds and mammals noted, it was stated that probably none of the seeds from the 1,656 cones remained to develop into seedlings.

158. TEVIS, LLOYD, JR.
1953. Stomach contents of chipmunks and mantled squirrels in northeastern California. Jour. Mammalogy 34:316-24, illus.

The feeding habits of four species of chipmunks (Eutamias amoenus, E. speciosus, E. townsendi, and E. quadrimaculatus) and one species of mantled squirrels (Citellus lateralis) were studied in a mixed-conifer forest composed of ponderosa, Jeffrey, and sugar pines, Douglas-fir, white fir, and incense-cedar.

Although the sugar pine seed crop was very light in the study area in 1951, no significant quantities were found in stomachs of animals trapped under a few productive sugar pines. The reasons presented were that chipmunks generally cached the seeds and mantled squirrels consumed relatively few coniferous seeds because hypogeous fungi were common. Chipmunks were observed to prefer pine seed over cedar and white fir seed.

159. TILLOTSON, C. R.
1917. Reforestation on the national forests. U. S. Dept. Agr. Bul. 475. 63 pp., illus.

Early seed collecting and processing, direct seeding, and planting practices are described. The primary value of this bulletin is for comparisons with present-day practices. The cost of sugar pine seed ranged from 50 to 65 cents per pound; direct seeding was not recommended because of rodent depredation; and spring planting was recommended for northern California, Oregon, and Washington and fall planting for southern California. In order of preference, recommended classes of sugar pine stock for field planting were 2-1 and 1-2.

160. U. S. FOREST SERVICE, California Region.
1940. Timber management handbook. (Pages revised as needed.) (Processed)

This handbook gives procedure and differs from the Forest Service Manual which states and explains timber regulations and policies. The Handbook includes prescribed standards and information about Dunning's tree classes, slash disposal, sale inspection, annual reports on sales, intensity of cruises, general facts on blister rust control, insect reports, and permanent plots for growth and mortality. Many additional procedures are covered in separate handbooks and special memoranda concerning planting, delineation of sugar pine management areas, ribes control, timber appraisal, intensive timber surveys, and related subjects.

Mimeographed copy in each Supervisor's office and Ranger Station in the California Region. Not available for distribution.

161. U. S. FOREST SERVICE, California Region.
1948. Volume tables. Form 191, R-5 1948, Division of Timber Management, Regional Office San Francisco. (Processed)

Sugar pine volume tables based on Site I and II, prepared by Dunning in 1925. (Scribner Decimal C. Stump height 18 inches, 16-foot logs, 0.3-foot trim allowance, top utilization 8 inches inside bark.) Use Site II tables for poorer sites.

162. ———
1948. Wood plant seed manual. U. S. Dept. Agr. Misc. Pub. 654, 416 pp., illus.

Comprehensive treatise on seed development, production and dispersal, source, collection, extraction, storage, treatments such as stratification, and testing. Section on Pinus includes information about sugar pine: Flowering, May-June; ripening, August-September; seed dispersal, August-October; commercial seed bearing age, minimum, 40-50 years; optimum, 125-175 years; frequency of good crops, 3-5 years; time of collection, August-September; closed cones per bushel, 20; extraction practice, sun dry or convection; cleaned seed per bushel of cones, 25-32 ounces; seed per 100 pounds of cones, 3.0 pounds; clean seed per pound, low--1,500, average--2,100, high--3,200; purity 99 percent; soundness 83 percent; cost per pound, $1.25 to $2.00; viability in sealed storage, 10 + years; dormancy, probably embryo; occurrence of dormancy, variable; stratification, moist sand or peat at 35-50° F. for 90 days; test germination 60° F. at night and 70° F. in day for 120 days with untreated seed and for 40 days with pretreated seed; average germination capacity 56 percent.

163. U. S. FOREST SERVICE.
1953. Sugar pine (Pinus lambertiana). Useful trees of the United States No. 4. 4 pp., illus.

An illustrated leaflet on sugar pine containing general information on distribution and identifying characteristics.

164. ——— California Region.
1953. Proposed Region 5 work specification for sale-area betterment. Prune crop trees to make clear lumber or veneer. 3 pp. (Processed)

Describes proposed pruning guidelines within and outside sugar pine management areas on national forests in California. If within, recommends: Prune crop trees and release and prune potential crop trees. If outside, recommends: Where rust hazard is low, prune crop trees; where hazard is medium, prune only sugar pine 11 inches d.b.h. and larger (only Site II and better will qualify for pruning under the proposed guidelines); where hazard is high, prune no sugar pine.

165. ——— California Region.
1954. Forest facts about your national forests in California Region of U. S. Forest Service. 64 pp. (Processed)

Appraised and bid price per M b.m. for sugar pine and ponderosa pine (includes K-V payment of about 90¢ per M b.m.):

Year	Sugar pine		Ponderosa pine	
	Appr. price	Bid price	Appr. price	Bid price
1951	$37.05	$40.43	$27.48	$33.64
1952	33.45	38.00	26.70	28.43
1953	30.35	31.55	26.18	28.39

Sales made of green timber (excludes salvage), national forests in California, 1953 (includes K-V payment of about 90¢ per M b.m. for each species):

Species	Vol.	Appr. per M b.m.	Bid per M b.m.	Pct. bid exceeded appraisal
	M b.m.			
Ponderosa	143,038	$26.18	$28.39	8.4
White fir	122,892	3.87	4.83	24.8
Douglas-fir	112,770	5.42	6.10	12.5
Sugar pine	58,920	30.35	31.55	4.0
Incense-cedar	13,258	3.47	3.68	6.1
Others	4,000	-	-	-
Total or ave.	454,878	$14.74	$16.04	8.8

166. U. S. FOREST SERVICE.
1954. The answer to the menace of white pine blister rust. U. S. Dept. Agr. 14 pp., illus. (Processed)

Prepared for public distribution. Discusses the spread of white pine blister rust in California and the threat to sugar pine. Explains methods of control and objectives of control. Much of the leaflet is in the form of questions and answers about technical points of control work, pathological features of the disease, economic factors in control work and progress in control work to date. A brief but thorough coverage of the blister rust control problem.

167. ——— and OFFICE OF BLISTER RUST CONTROL.
1952. Sugar pine delineation manual. Forest Service, California Region and Bur. Ent. and Plant Quarantine, Off. Blister Rust Control. 52 pp. (Processed) (Supersedes instructions issued separately in 1951.)

Gives instructions for sampling sugar pine areas on private and national-forest land to evaluate them for sugar pine management, based upon rating tables developed by Vaux (170).

168. VAUX, HENRY J.
1948. Some economic aspects of growing sugar pine in California. Calif. Forest and Range Expt. Sta. Res. Note 58. 33 pp., illus. (Processed)

Forms the initial groundwork for Vaux's bulletin of 1954 on "Economics of the young-growth sugar pine resource," Univ. Calif. Agr. Exp. Sta. Bul. 738.

Discusses the need for research, sugar pine types, areas, and volumes. Investigates sugar pine markets, consumption, principal uses, competitive positions, and long-run market outlook; also, trends in sugar pine values of stumpage and lumber, and the cost elements in growing sugar pine.

169. VAUX, HENRY J.
1954. An economic viewpoint on Pacific Coast forest planting. 1954. Univ. of British Columbia, Lecture Series 23. 17 pp.

Economic problems of planting must be answered in reference to future markets in which the planted timber will be sold rather than to present markets.

Expansion of demand for Pacific Coast timber crops is possible. The present cut of all species in British Columbia, Washington, Oregon, and California is 25 billion board-feet per year. At this rate, the mature stand will last 40 years more. Immature stands, which are the growing stock, would last another 35 years if cut at the same rate. During the past 10 years, the demand has increased one-half of 1 percent per year. If this increase continues, the Pacific Coast deficit will be one-half of its growing stock within 70 years.

Costs of planting always appear as a cash outlay, whereas most costs of natural regeneration do not. For example, natural regeneration of sugar pine in California requires 3 to 5 seed trees per acre. Good sugar pine seed producers usually must be at least 30 inches in diameter and often contain high quality lumber. Reserving them from cutting means leaving as much as $300.00 worth of stumpage on each acre. Because effective sugar pine seed crops occur infrequently, this seed-tree investment has to be maintained for at least 5 years before it can be liquidated by cutting. At 3 percent per year, the interest costs thus incurred have a value of more than $40 per acre, a little more than the current cost of sugar pine planting. Additional real costs of natural regeneration include such items as slower establishment and consequent lengthening of the production period, risk to the large seed-tree investment, and damage to the young stand when seed trees are removed. Thus, planting of sugar pine shows up clearly as a less costly alternative than natural regeneration.

This view of planting problems on the Pacific Coast indicates that the economic advantage of the area would be best served by rehabilitating through planting at least the more productive part (Site III and better) of the existing idle forest land.

170. ———
1954. Economics of the young-growth sugar pine resource. Calif. Agr. Sta. Bul. 738. 56 pp., illus.

Sugar pine occurs on more than 2 million acres of commercially available land outside of national parks. Three-fourths of this is in California and one-fourth in Oregon. In California, half is privately owned and half federally. Blister rust control is the key to

production, but pruning and release of potential crop trees and other management measures also are essential. The objective of management must be to extend efforts to grow sugar pine just to the point where additional returns from sugar pine production are offset by the additional costs which are incurred.

Average annual production of sugar pine from 1949 to 1951, inclusive, was 400 million board-feet. Even in old-growth timber, less than 40 percent of the sugar pine cut is premium quality. The rest is common grades which could be replaced by ponderosa pine commons. The old-growth supply will last about 60 years more (until 2014).

Cost per acre of growing sugar pine, for 1950 dollars, 2-1/2 percent rate of interest, and a risk allowance of 25 percent of other costs, is estimated as follows:

Rust control	$27.00
Two releases of potential crop trees	5.40
Pruning	4.80
Additional roads and other capital development	8.80
Replacement factor	3.50
Total extra cost of management:	$49.50

Size of sugar pine at maturity:

Site class:	d.b.h.	Volume, board-feet
A-200	38	2,780
I-175	34	1,750
II-150	30	1,050
III-125	26	700

An average annual yield of 155 million board-feet of sugar pine can be produced at a marginal cost of $50 per M or less. Also, the anticipated price of sugar pine is $50 per M b.m. This annual production of sugar pine will require intensive management on 650,000 acres of the most productive sugar pine land. Careful selection of these areas for sugar pine management is essential. A system for rating cut-over land for sugar pine management is offered.

171. WAGENER, WILLIS W., and MIELKE, JAMES L.
1936. First blister rust found in California. Plant Disease Reporter 20:220-21.

The first blister rust reported from California was found on June 29, 1936, near Monumental, Del Norte County, about 1.5 miles south of the California-Oregon line. A single branch canker on a young sugar pine was found and removed. Infection probably occurred in 1931, since 1929 blister rust infection had been known on ribes near the coast in Curry County, Oregon, about 50 miles north of the California-Oregon line.

172. WESTERN PINE ASSOCIATION.
1951. Sugar pine: the king of pines. 54 pp., illus.

Discovery of sugar pine by Douglass (1 p.); character and properties of the tree and products (8 pp.); manufacture of products (2 pp.); building uses and industrial uses of lumber (10 pp.); grading and grades of lumber (described and illustrated); select grades (6 pp.); common grades (4 pp.); factory grades (13 pp.); recommended grades (3 pp.); standard manufacture sizes of lumber (1 p.). From Douglass' account of his discovery of sugar pine in 1826 is mentioned a wind-thrown tree with a circumference of 37 feet 9 inches at 3 feet above roots, 17 feet 5 inches at 134 feet, and a total length of 215 feet.

173. WRIGHT, ERNEST.
1931. The effect of high temperatures on seed germination. Jour. Forestry 29:679-87.

Describes a study conducted to determine the effect of various temperatures on seed germination. Results on the effect of high temperatures on sugar pine seed were inconclusive. The seeds were not stratified prior to germination. Only 2 percent of the controls germinated.

174. ZACH, LAWRENCE W., BAUER, DON, and GOODYEAR, HAL.
1943. Practical application of plant hormones in forest-tree propagation. Jour. Forestry 41:214.

Preliminary experiments to determine the effectiveness of indolebutyric acid in forest-tree propagation seemed to show positive results for treated sugar pine seeds.