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GROWTH OF YOUNG GIANT SEQUOIA STANDS ON MOUNTAIN HOME DEMONSTRATION STATE FOREST

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In the early 1950's, ten permanent sample plots measuring 132 feet by 330 feet were established to collect tree growth data and determine tree mortality by insect and disease on the Mountain Home Demonstration State Forest. All plots, except for plot two, were located in mixed-conifer stands that were recently cutover. Plot two was in a 70 year old even-aged stand of giant sequoia (*Sequoiadendron giganteum*).

Yields from the five year measurement for all ten plots were published in the State Forest Note #1 (Beechel, 1960). Dunning's tables for old-growth timber were used to determine volume in the nine mixed-conifer plots. Coast redwood volume tables were used to determine volume on the giant sequoia plot. The results of Forest Note #1 are not discussed in this paper.

Eight of these plots were abandoned in 1976. After 1976, only plots one and two continued to be measured because of the high percentage of second-growth giant sequoia found in those plots. The focus at that time was to determine the effects that the presence of giant sequoia has on growth, yield, and cutting cycles of westside conifer stands.

Yields for plots one and two were published in State Forest Note #72 (Cook and Dulitz, 1978). It was the initial effort to develop long-term growth and yield information for second growth giant sequoia stands. State Forest Note #72 and this current note are some of the only information currently available on giant sequoia stands between the ages of 10 and 110 years.

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Description of the Plots

Growth plot one was established in 1952 at the 6,160 foot elevation on a south facing slope that had been heavily logged in 1945, prior to State acquisition of the property. The plot contained three residual trees of merchantable size when it was designated a growth plot. The site was surrounded with veteran old-growth giant sequoia and other species of cone bearing age. As a result of the soil disturbance that took place, the site became crowded with reproduction. There were 5,420 seedlings per acre on the plot when it was established. When the last measurement was taken, the stand was 52 years old (1997). Analysis of stand composition indicated that 65 percent was giant sequoia (68 trees), 12 percent sugar pine (12 trees), 21 percent white fir (22 trees), and 2 percent incense cedar (2 trees). These figures only represent trees greater than 11 inches at diameter breast height (DBH). For the purposes of evaluating yield from this plot, the residual trees left over from the 1945 logging were excluded from the volume information.

Growth plot two was established in 1953 at the 6,250-foot elevation on a south-facing slope in an area adjacent to the long abandoned Frasier lumber mill. Logging in that area of Mountain Home ceased in 1890 and the present stand resulted from the logging disturbance. The stand age was 107 years in 1997. The plot was considered to be even-aged when the initial measurement was performed in 1953 and continues today. The species composition was 86 percent giant sequoia (125 trees), 13 percent white fir (19 trees), and less than one percent incense cedar (one tree), when only trees over 11 inches DBH were tallied. The residual sugar pines on this plot died in the early 1990s from drought conditions and bark beetle attacks.

Both plots occur on areas that have been designated as Site I (Dunning, 1942) on the soil-vegetation map produced by the Cooperative Soil-Vegetation Survey. The soil series in both plots is Dome. The mixture of giant sequoia with the Sierra mixed conifer type found on these plots represents typical cut over conditions on the Mountain Home Demonstration State Forest.

Methods

Growth plots one and two were measured from 1952 to 1997, usually every 3-4 years but some measurements were over five year intervals. Refer to Tables 1 and 2 for stand ages at the time of remeasurement. Tree number tags were placed at breast height (4.5 feet) for trees greater than or equal to 11 inches DBH at the time of plot establishment. Ingrowth trees were added to the plot when they reached a DBH of 11 inches or greater at the time the re-measurement was taken. Numbered tags were also placed on the ingrowth trees at breast height. Diameters were determined at the tag location each time a re-measurement was performed. Double trees had tags located above breast height where it was

possible to take a measurement. Trees that eventually grew together were combined into a single diameter measurement at the tag location.

Yields from an earlier analysis (Cook and Dulitz, 1978) used local giant sequoia volume equations that significantly underestimated the scaled volume. Current volumes for young-growth giant sequoia are from local Mountain Home Demonstration State Forest volume equations (Pillsbury, DeLasaux, and Dulitz, 1991). Volumes for whitewoods are also from local volume equations and tables for young-growth softwood species at Mountain Home Demonstration State Forest (Pillsbury and Joseph, 1990).

Results

The data yield information for a wide range of stand age classes. All trees in growth plot one became established after the 1945 logging; and stand information exists for ages 7 through 52 years (1952-1997) for trees on that plot. Similarly, for growth plot two, stand information has been recorded in detail for ages 63 through 107 (1953-1997). No attempt was made to normalize the growth information by adjusting for stocking. Stand information is provided in Table 3.

Comparative yield for board foot volume is for a fully stocked stand, with all measurable trees 11.6 inches DBH and larger to a top diameter of eight inches inside bark (Kirchner, 1967). Comparative yield for cubic foot volumes are from stands of average stocking and composition inside bark, including stump and top, of all trees two inches and larger in diameter (Dunning and Reineke, 1933). The Mountain Home Demonstration State Forest yield curves depicts trees 11 inches DBH or greater. Results of 52 and 107 years of growth on typical cut over giant sequoia stands on the Mountain Home Demonstration State Forest are shown in Tables 1-3 and Figures 1 and 2.

Table 1. Combined board foot volume growth per acre (Scribner) data for Mountain Home giant sequoia plots 1 and 2.

Plot Number	Stand Age (Years)	Total Volume	Ingrowth	Mortality	Periodic Annual Increment	Mean Annual Increment
1	7	0	0	0		0
					49	
1	18	538	538	0		30
					343	
1	22	1,909	147	0		87
					983	
1	31	10,757	777	0		347
					978	
1	36	15,647	1,424	82		435
					1,002	
1	42	21,657	2,038	1,970		516
					965	
1	46	25,516	942	1,407		555
					891	
1	49	28,189	486	523		575
					1,217	
1	52	31,840	263	177		612
2	63	45,161	0	0		717
					2,053	
2	73	65,691	1,464	0		900
					2,081	
2	77	74,014	285	160		961
					2,300	
2	82	85,516	0	0		1,043
					3,012	
2	83	88,528	550	64		1,067
					2,709	
2	86	96,654	123	123		1,124
					2,073	
2	91	107,018	0	198		1,176
					2,717	
2	97	123,318	255	0		1,271
					2,407	
2	101	132,945	493	2,477		1,316
					2,415	
2	104	140,191	244	4,093		1,348
					2,270	
2	107	147,002	182	62		1,374

Table 2. Combined cubic foot volume growth per acre (Smalians) data for Mountain Home giant sequoia plots 1 and 2.

Plot Number	Stand Age (Years)	Total Volume	Ingrowth	Mortality	Periodic Annual Increment	Mean Annual Increment
1	7	0	0	0		0.0
					12	
1	18	131	131	0		7.3
					78	
1	22	442	248	0		20.1
					219	
1	31	2,410	1,476	0		77.7
					218	
1	36	3,502	360	26		97.3
					153	
1	42	4,417	417	850		105.2
					128	
1	46	4,930	194	249		107.2
					148	
1	49	5,373	104	120		109.7
					224	
1	52	6,045	63	30		116.3
2	63	8,494	0	0		134.8
					342	
2	73	11,921	295	0		163.3
					328	
2	77	13,232	58	27		171.8
					361	
2	82	15,037	0	0		183.4
					487	
2	83	15,524	98	15		187.0
					541	
2	86	17,149	479	28		199.4
					425	
2	91	19,273	534	42		211.8
					451	
2	97	21,980	53	0		226.6
					463	
2	101	23,833	89	465		236.0
					361	
2	104	24,916	33	634		239.6
					388	
2	107	26,080	22	15		243.7

Table 3. Stand data for giant sequoia plots 1 and 2.

Plot 1 (Age 52)

Species	Basal Area per Acre	Trees per Acre
Giant Sequoia	132	68
White fir	40	22
Sugar pine	25	12
Incense cedar	2	2
Totals	199	104

Average DBH = 18.3

Plot 2 (Age 107)

Species	Basal Area per Acre	Trees per Acre
Giant Sequoia	667	125
White fir	33	19
Sugar pine	0	0
Incense cedar	1	1
Totals	701	145

Average DBH = 27.3

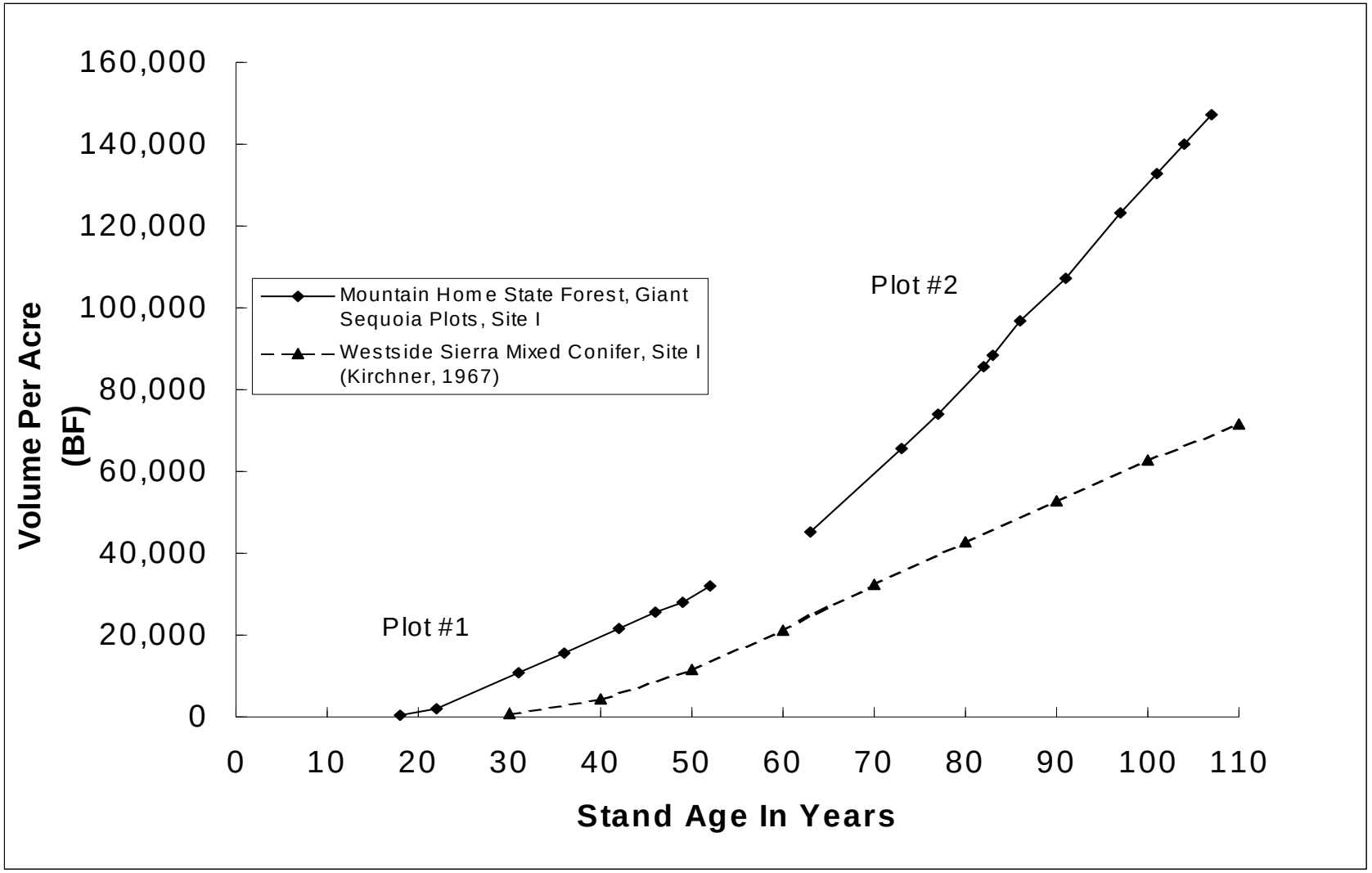

Figure 1. Comparative board foot volume yield (Scribner log rule).

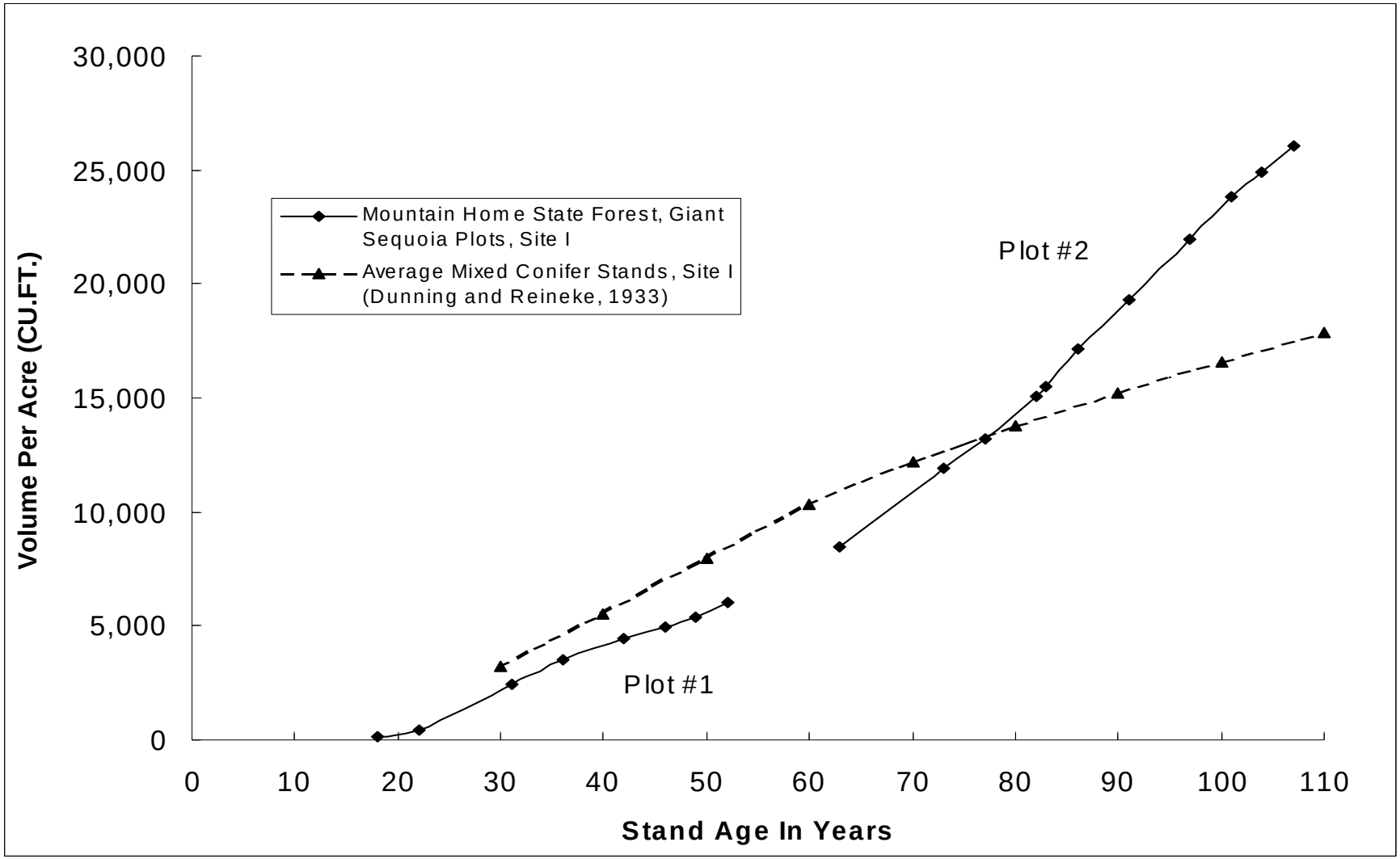

Figure 2. Comparative cubic volume yield.

Conclusions

Growth rates on these giant sequoia plots are shown to diverge significantly higher from the yield that can be expected from second-growth mixed conifer stands in the Westside Sierra Region (Kirchner, 1967; Dunning and Reineke, 1933). Furthermore, there is no sign that mean annual increment has culminated for cubic and board foot volumes. Basal area in growth plot 2 at age 107 is 701 square feet per acre compared to 342 square feet per acre at age 110, as predicted in yield tables for average well stocked mixed conifer stands (Dunning and Reineke, 1933).

This growth information has implications on management strategies for second-growth giant sequoia stands. The tremendous growth potential of these young stands along with demonstrated mechanical properties (Cockrell, 1971), make young-growth giant sequoia a valuable timber resource. Larger young-growth giant sequoia trees tend to have more value because of the higher percentage of decay resistant heartwood and the lower, per unit, harvesting costs. This growth information suggests that rotation ages for this species could be set at long intervals, growing older and larger diameter trees, without a sacrifice in mean annual increment.

In much of the giant sequoia ownership, the primary management goal for young-growth giant sequoia is to replace the old-growth trees that were harvested in the historical logging or lost through natural mortality. The growth information from these plots indicates that, without a disturbance, stand density will remain very high. Even though total stand growth is high, individual tree growth will be low because of the large number of trees per acre. Thinning these young stands would have the effect of concentrating a portion of the total stand growth onto the selected leave trees. These leave trees would then have the potential to grow into the larger size classes at a much more rapid rate.

This data also demonstrates the ability of young giant sequoia to grow at very high densities at the possible expense of the other species in the mixed conifer stand. Where the desired condition is for giant sequoia to be a component in a multi-species stand, these dense stands of young-growth giant sequoia would have to be thinned in order to encourage reproduction of the other mixed conifer species. If no disturbance occurs in these pure young stands, it appears that these stands will remain predominately giant sequoia for a long period of time.

These two plots will continue to be measured over time to determine the long-term trends in growth of young giant sequoia.

Literature Cited

Beechel, Kenneth. 1960. Growth plots on Mountain Home State Forest, State Forest Note No. 1.

Cockrell, R. A. 1971. Mechanical properties of southern Sierra old and second-growth giant Sequoia. California Agricultural Experiment Station, Bul. 854.

Cook, Norman and Dave Dulitz. 1978. Growth of young growth sierra redwood stands on Mountain Home State Forest. State Forest Note No. 72.

Dunning, Duncan and L. H. Reineke. 1933. Preliminary yield tables for second-growth stands in the California Pine Region. U.S.D.A. Forest Service, Tech. Bul. No. 354.

Dunning, Duncan. 1942. A site classification for mixed-conifer selection forests of the Sierra Nevada. U.S.D.A. Forest Service, California Forest and Range Experiment Station, Research Note No. 28.

Hartesveldt, Richard. 1975. The giant sequoia of the sierra nevada. U.S.D.A. National Park Service.

Kirchner, Walter. 1967. A comprehensive analysis of Westside Sierra thinning considerations. U. S. Forest Service, Region V, Sequoia National Forest. Unpublished.

Pillsbury, Norman H. and John P. Joseph. 1990. Volume equations for young growth softwood species at Mountain Home Demonstration State Forest. California Polytechnic State University, San Luis Obispo, CA.

Pillsbury, Norman H., Michael J. DeLasaux and David Dulitz. 1991. Young-growth Sierra redwood volume equations for Mountain Home Demonstration State Forest. California Forestry Note No. 103.

Wensel, L. C. and Richard L. Schoenheide. 1971. Young-growth gross volume tables for Sierra redwood. Hilgardia, Vol. 41, No. 4.

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