WILDLAND PLANTINGS & URBAN FORESTRY

Native & Exotic 1911-1977

County of Los Angeles Department of Forester and Fire Warden • Forestry Division

In Cooperation With

U.S.D.A. • Forest Service • Forestry Research • Chaparral R & D Program

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BY

KLAUS RADTKE
RESEARCH FORESTER

COUNTY OF LOS ANGELES
DEPARTMENT OF FORESTER AND FIRE WARDEN

Photo 1: Group portrait of Forestry personnel 11-1-74

Front row:	Art Arndt, Chief Houts, Chief Barlow, Grant Brown
Second row:	Klaus Radtke, Ross D. Johnson, Paul A. Downing, Harold J. Johnson, Lawrence M. Rankin, Joseph Ferrara, Paul J. Okstad, Paul H. Rippens, Clyde H. Sims
Third row:	James R. Ross, Anthony R. Baal, George Veverka, Norman W. Cook, Ronald S. Mayer, Raymond C. Uterback, William F. Draper, Eldon C. Anderson, James M. Anderson
Back row:	Robert A. Dibala, John Haggenmiller, Herbert A. Spitzer, David K. Boyd, Carl P. Fisher, Robert E. Johnson, John R. Griffen, Larry Blackman, David L. Drennan, James R. Stallings

PREFACE

Since 1973, the Los Angeles County Forestry Division has been cooperating with the Forest Service Riverside Fire Laboratory on fire retardant plant research through yearly agreements. In 1976, the County and the PSW Experimental Station in Berkeley entered into the "Chaparral Ecology and Related Ecosystems Studies" program under which the scope of the initial agreement of fire retardant plant research was greatly expanded.

In a joint meeting between personnel of the Experimental Station and the County in the summer of 1976, Project Leader Gene Conrad of the chaparral program requested that the County, as the oldest afforestation agency in Southern California, write a history of its endeavors. This report was to cover the Division's involvement with the management of the watershed of Los Angeles County.

After 18 months of poring through more than 60 years of accumulated files, meetings with former Division personnel, and field evaluations of outplantings accomplished over the last 25 years, the report is completed. Virtually every member of the Division participated in providing information and helped with field evaluations of outplantings. Without such help, this report could not have been completed.

Emphasis of this report was directed to outplantings of trees both for soil erosion projects and plantation establishment through chaparral conversion. Work of the Parks Section (a section of the Forestry Division until 1945) was omitted as it does not relate directly to chaparral management. The Parks Section was responsible for the establishment of County parks and for the planting and maintenance of roadside trees throughout the County. Many of the older trees still lining streets in the foothill communities and other parts of the County can be attributed to their efforts.

LOS ANGELES, CALIFORNIA
JANUARY 1978

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Photo 2: Little Gleason Reforestation Project - This demonstration of contours for reforestation; a practice widely used in the Mediterranean regions of the world, was the most successful reforestation attempt of its kind in southern California.

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I. INTRODUCTION

The Forestry Division has as its main objective the improvement of vegetative cover in Los Angeles County. This is accomplished by reforestation and afforestation, emergency seeding of burned areas, and erosion control planting of road fills and other denuded areas. The first reforestation efforts in Southern California were made in Los Angeles County at the turn of the century.

In 1928, the County acquired a forest nursery site at Henninger Flats located above Altadena on the Mt. Wilson Toll Road. This nursery has been in continuous production since that time. The nursery operation, the planting program, and all other technical forestry matters are handled by a staff of professional Foresters.

In 1955, after disastrous fires in the Angeles National Forest, the Board of Supervisors expanded the forestry program by establishing branch nurseries at each of three juvenile probation camps. Additional Foresters were added and assigned to the new camp nurseries. Four more branch nurseries have been added since then, and there are now a total of eight forestry nurseries in operation.

Since the inception of the forestry program, the Division has developed effective tree planting techniques for Southern California's severe weather and soil conditions. Trees are grown in tar paper containers 3" square by 12" deep for use in field planting.

The Forestry Division nurseries produce approximately 100,000 trees and shrubs annually. Most of these are potted stock, but a portion for high altitude plantings are bare root trees. Ninety-five percent of the species grown are conifers, and the majority of these are pines. Of the pines, the most frequently grown are: Pinus coulteri, Pinus halepensis, Pinus radiata, and Pinus canariensis. Other commonly grown species include: Cedrus deodara, Cupressus arizonica, Cupressus forbesii, and Libocedrus decurrens.

Forestry Division personnel are also involved in other forestry activities throughout the County. These include plantation maintenance, timberstand improvement, tree disease and insect control, forest tree seed collection, and forest consultation work for other agencies. Foresters are involved in fire fighting on major watershed fires.

The Forestry Division cooperates with other agencies in research and development projects, such as fire-resistant plant experiments and fuelbreak programs. The Division conducts considerable erosion control work on road fills, debris basins, flood control channels, and others. This is accomplished by establishing a suitable plant cover.

A considerable portion of time spent by the Forestry Division staff is with public relations activities. Foresters present conservation and forestry education programs to youth groups, civic groups, and schools, and participate in vocational guidance programs in Los Angeles area schools. Exhibits are set up each year at the County Fair and other public shows. Public service calls are made for a variety of reasons, such as soil erosion and fuel modification advice, and tree inspections.

Photo 3: Students on a field trip to Unit 4 Nursery (Saugus) listen attentively to Forester Ralph Alworth.

Photo 4: The Forestry booth at the yearly Los Angeles County Fair gives everyone an opportunity to pot a tree and care for it.

II. HISTORY OF THE DEPARTMENT OF COUNTY FORESTER & FIRE WARDEN

On February 27, 1899, the first Fish and Game Warden was appointed by the Board of Supervisors under authority of State statutes, although regulatory ordinances for the protection of the fish and game resources of the County had previously been adopted. This office was created at the insistence of sportsmen of the County who demanded proper enforcement of the fish and game ordinances. Later, on June 2, 1913, the Charter of the County of Los Angeles became effective, and the Fish and Game Warden was set up as an appointive County office.

Prior to 1906, fire prevention and suppression was performed by order of the Board of Supervisors, with temporary appointment of Fire Wardens. On May 28, 1906, the Board of Supervisors appointed the Fish and Game Warden as the Chief Fire Warden of the County, authority being vested by appointment as a State District Fire Warden by the State Forester. The creation of the County Fire Warden's office was primarily based upon the demand of many concerned citizens who recognized the necessity of preserving the watersheds of the County. Only by a permanent organization could efficient fire prevention and control services be assured.

During the years 1909-10, public sentiment developed as to the desirability of a proper roadside tree plan in conjunction with the County highway system. This resulted in the appointment, under Chapter 729 of the Statutes of 1909, of a County Board of Forestry on May 8, 1911. This Board of Forestry in turn appointed a Forester whose functional duties were to plant and maintain and have full jurisdictional authority over all trees upon the public roads of the unincorporated portions of the County. The powers of the Board of Forestry were broadened in 1916 to include reforestation or watershed improvement in the mountainous areas, and, in 1917, the improvement and maintenance of County parks and County building grounds.

The Board of Supervisors on December 8, 1919, adopted Ordinance 584 N.S. abolishing the Board of Forestry and creating the office of County Forester. During 1920, the Forester was appointed Fish and Game Warden and Ex-officio Fire Warden. This consolidation of conservation subjects was in the interest of economy, and welded the whole into a unit of greater strength and flexibility to efficiently carry out routine duties as well as to meet those of an emergency nature.

By the year 1923, the functional duties with which the Department was charged were many and extremely diversified. The principal objectives were fire prevention and suppression in unincorporated territory exclusive of national forest areas, the formation and supervision of County Fire Protection Districts, reforestation of denuded mountainous areas, the development and maintenance of County parks, parkways, and roadside plantings, and the protection of fish and game resources of the entire County. These duties were frequently amplified by enactment of amendments

to the Rules Ordinance. Also the assumption of duties laid down in laws, orders, and rules adopted by state and federal governments broadened the scope of the work of the Department and extended its service as a co-operative agency. To adequately cover its cooperative responsibilities, the Department entered into agreements with the national forests lying within the County boundaries, adjacent counties, various cities within the County, and several protective associations.

From the date of consolidation (1920) the Department functioned, with the exception of the Fish and Game Warden, without the authority of County Charter provisions. On September 24, 1934, the Board of Supervisors gave notice to the qualified electors of the County of proposed amendments to the County Charter. These proposed amendments included County Charter Amendment No. 6 which established a department of the County to be known and designated as the Department of County Forester & Fire Warden under the management and control of the County Forester and Fire Warden. This amendment carried by a majority of 115,000 at the election of November 6, 1934. The action of the electorate was ratified on January 24, 1935, by the State Legislature. Thus, Charter Amendment No. 6 became effective and the Department was placed on a firmer and more permanent legal foundation.

On July 1, 1938, Ordinance No. 3144 N.S. became effective. In lieu of the Department of Recreation Camps and Playgrounds, it set up the Department of Parks and Recreation. This new department had jurisdiction over the installation, construction, operation, management, and maintenance of all parks, playgrounds, recreation camps, beaches, and all recreation facilities owned, maintained, or operated by the County of Los Angeles. It furthermore had supervision over the recreational activities of all persons using any such park, playground, recreation camp, beach, or facility. The Department of Parks and Recreation was placed under the supervision of an officer known as the Director. It was further stipulated that no provision in the ordinance should be deemed or construed as authorizing the Department of Parks and Recreation or its Director, or any employee of the department, to plant or care for any trees, hedges, shrubs, lawns or flowers located in or on any property hereinabove referred to; nor to do or perform any act required by charter or general law to be performed by any other County department or officer. This latter provision was necessary to clearly define the gardening duties of the Department of County Forester & Fire Warden as provided by the County Charter.

Coincident with the passage of said Ordinance 3144 N.S., the Board of Supervisors appointed as the Director of the Department of Parks and Recreation an individual occupying the position of County Forester and Fire Warden. Thus, the direction of these two departments was vested in the same individual. To effect economy and flexibility of administration, certain positions of the Department of County Forester & Fire Warden were split as to working time and compensation and part thereof placed in the budget and salary ordinance section applicable to the Department of Parks and Recreation. While faithfully carrying out all legal and fiscal requirements in the functioning of the two departments, the Forester-Fire Warden

and Director, for purposes of administration, combined the gardening duties of the Department of Forester & Fire Warden with those of the Department of Parks and Recreation in a unit known as the Parks and Recreation Division. The administrative duties of this division were divided into Maintenance of Grounds and Structures and Recreational Direction, including operation of golf courses, swimming pools, and all other recreational activities.

The voters of the County of Los Angeles ratified County Charter Amendment No. 3 appearing on the general election ballot November 7, 1944. This Amendment repealed sub-section (b) of Section 24 1/3 of Article 6 of the County Charter and thus relieved the Forester and Fire Warden of the duty of supervising roadside tree planting and the planting and care of all trees, hedges, shrubs, lawns, and flowers on the grounds and property of the County, and the enforcement of ordinances relating thereto. The Amendment was approved by the State Legislature through the adoption of Senate Concurrent Resolution No. 12 on January 16, 1945. Subsequently on January 30, 1945, the Board of Supervisors vested this former responsibility in the Director of Parks and Recreation by Ordinance No. 4446 N.S. which amended the administrative code. These various actions made possible the legal transfer of the gardening functions and appropriations pertaining thereto. The Forestry Division of the County Forester & Fire Warden was left with two sections, namely: field plantings and nursery operations at Henninger Flats.

The next section of this report gives an in-depth history of primarily reforestation activities in the County of Los Angeles from 1905 to the present. Reforestation activities were directly tied to the history of the Department of Forester & Fire Warden as discussed above and to the development of the Department's Forestry Division.

After the 1903 direct seeding attempts failed to establish pine forests in the chaparral areas of southern California - Seeding either on small cleared terraces as shown in Photo 5 (top) or in seed spots prepared on the north side of native shrub and other protected places as shown in Photo 6 (bottom) - Theodore P. Lukens (with beard in center of Photo 6) established the first reforestation nursery in southern California at Henninger Flats in 1904.

Photo courtesy of Huntington Library

III. REFORESTATION HISTORY

A. REFORESTATION - HENNINGER FLATS PLANTINGS 1905-1907

From 1904-1907, the Forest Service operated a reforestation nursery at Henninger Flats. The 12 tree species listed below were planted from 1905-1907 in the vicinity of the nursery. These outplantings served as watershed protection and for species adaptation trials. The report given below is based on a 1925 survival evaluation of the plantings by U. S. Forest Ranger W. Grogan and shows the thinking of the time.

Table I — Species Planted at Henninger Flats 1905-07

Species	Survival % (1925)
1. Cedrus deodara	1
2. Libocedrus decurrens	trace
3. Pinus attenuata	12
4. P. coulteri	4
5. P. flexilis	0
6. P. halepensis	1
7. P. jeffreyi	0
8. P. maritima	0
9. P. radiata	trace
10. P. sabiniana	0
11. P. torreyana	0
12. Pseudotsuga macrocarpa	trace

Table II — Number of Trees Planted 1905-07

Year	No. Planted	Survival No.	Survival %
1905	14,094	1,471	10.4
1906	29,033	2,254	7.8
1907	19,475	432	2.2
	62,602	4,157	6.6

Pinus attenuata with 12 percent survival was the species best adapted for Henninger Flats followed by Pinus coulteri with only 4 percent survival. The vigor of Pinus attenuata did not differ greatly from site to site, indicating that it was adaptable to a variety of sites and could persist on even the harshest ones.

The only planting site that was called a success at this time was the "Hillside Arboretum." Here, the survival of Pinus attenuata was 56 percent and survival of all species planted was 43 percent. This was much higher than expected considering the 3' x 5' spacing. The site, located along a ridge top, had been brushed prior to planting. It was believed that this brush clearing through the elimination of rodent and rabbit habitats and not the lack of brush competition itself accounted for this high survival.

Precipitation for the planting years ranged from 32 to 44 inches and averaged 38 inches. This is substantially higher than the long-term average of 26-27 inches. However, the excellent survival on the "Hilltop Arboretum" was not attributed to this above-normal rainfall because the other planting sites had a very low survival. Trees growing in brush covered areas were generally larger and more vigorous than those on cleared ridge tops. This indicated that trees not destroyed by browsing (primarily rabbit browsing) managed to thrive quite well despite brush competition. It was, therefore, assumed that rabbits would prefer brush covered sites to cleared sites such as the exposed "Hilltop Arboretum."

D. Peavy, who was in charge of the "Hilltop Arboretum" planting, stated that the trees were hand cultivated only the first year after planting. This, perhaps, reduced moisture losses and helped the trees overcome the drought until they were established.

The fact that the stand on the firebreak retained such a high survival up to 1925 was thought to be due to the great tolerance of the Pinus attenuata. Spacing was so close that the condition under which the trees had to grow after the first few years became the same as in the brush. However, the number surviving despite the competition caused by the close spacing was very unusual. In 1925, there were marked signs of natural thinning and many suppresssed trees were dying.

In a 1905 report, Forester Searle stated that he expected Pinus attenuata to act as a nurse tree for Pinus coulteri. This was not the case because Pinus attenuata suppressed Pinus coulteri wherever they were planted close together. In the open or in brush covered land, Pinus coulteri was about as large as Pinus attenuata and was very vigorous and healthy. W. Grogan concluded the report by stating that the result of the plantings indicated that brush was not as competitive a factor as it had previously been considered. This was shown by the comparative health and size of trees planted in brush and on cleared areas.

Additional outplantings were done by the Forest Service in the San Gabriel Mountains prior to 1911 when the County Board of Forestry was founded. Most outplantings were species trials and little attention was paid to site preparation. W. Grogan's conclusions that rabbit, rodent, and deer depredation were far more important factors than site preparation in tree survival showed the thinking of the time. Little emphasis was therefore placed on intensive site preparation until the 1950s.

B. FORESTRY DEPARTMENT COUNTY-WIDE REFORESTATION PLANTINGS 1915-1924

Reforestation and afforestation are the oldest activities engaged in by the Forestry Division. Since their inception in 1915, they have continued without interruption to the present day. However, one has to remember that in Los Angeles County trees were planted primarily as part of the Division's watershed program; that is, for wind and soil erosion control. A natural by-product of this planting was the increased aesthetic value as trees grew in size. The earlier plantings, whether planted along roadsides or on burns, had this primary watershed objective in mind and not much, if any, site preparation was done. The perhaps predictable result was high tree mortality. Despite drought, heavy competition from resprouting chaparral, rodent depredation, and browsing, enough trees always somehow survived to nourish the dream of converting the chaparral to forest as a by-product of watershed erosion control plantings.

Since planting records of the early history of the Division are incomplete, it was necessary to summarize the period from 1915-24 in Table III taken from an earlier report.

Table III HISTORY OF PLANTINGS 1915-1924 INCLUSIVE

1915-16	Nursery established at Altadena in February, 1916. First seed planted on March 30 was incense cedar.
1918-19	Spring: several thousand trees (coulter pine and eucalyptus) planted at Sylmar.
1919-20	Several thousand trees planted in San Dimas and Big Dalton Canyons. In Big Dalton most of the trees were lost through grazing. During this season, some coulter pine replacements were made in the Sylmar plantation. Brush seed was also sown (quantity unknown) in San Dimas and Big Dalton Canyons.
1920-21	30,000 trees were planted in the San Dimas area.
1921-22	68,500 bare root coulter and knobcone pine were planted near Gold Creek.
1922-23	25,000 trees and several tons of brush seed were planted in the San Dimas area; 1,500 trees were planted by the Glendora District of the Forest Service; 1,800 trees planted by Occidental College on their grounds; 60,025 eucalyptus were planted at Gold Creek and Mt. Lukens; 18,000 trees planted at Big Pines which were mostly killed by squirrels and roaming cattle.
1923-24	13,000 trees (pine and eucalyptus) sent to Sylmar; 20,000 trees sent to Big Pines (change in weather conditions killed most of them); 600 black locust were given to the U.S. Forest Service. Most of the stock remained in the nursery because the season was too dry to plant.

During this nine-year period, it is estimated that approximately 500,000 trees were planted and many tons of seed sown on the watersheds of Los Angeles County.

C. REFORESTATION - WATERSHED REHABILITATION 1925-30

Records for the second phase of Forestry Division planting and direct seeding activities are more complete and Table IV is a summary of these activities. It will be noted that Pinus coulteri was by far the most common species planted. Its sturdy appearance, attractive foliage and cones, and medium height with a spreading, shade producing crown made it an immediate favorite with Foresters. The tree is also very versatile in that potted stock can be planted at sea level and bare root, potted stock, and seed spots will grow into vigorous trees even above the 6,000' level. It is also interesting to note that of the five most commonly planted species (Libocedrus decurrens, Pinus attenuata, Pinus coulteri, Pinus sabiniana, and Pseudotsuga macrocarpa), only Pinus attenuata is not native to Los Angeles County.

Rehabilitation of burned watersheds and erosion-control measures on fill and cut slopes were still of highest priority in any planting or seeding effort. Table IV indicates that on the average 8,333 pounds of tree and shrub seeds were seed spotted and direct seeded for this purpose each year.

Table V gives a breakdown of the total number of trees planted by plantations. Map 1 on page 18 shows the locations of these plantations. The large number of trees planted at most of the sites gives an indication of the intensive planting efforts done during this period. It also indicates that little or no site preparation was done prior to planting. Tree mortality was, therefore, high with the result that the old ways of reforestation were being questioned. Foresters began to realize that there was no easy way of converting chaparral watersheds into forests.

Table IV Watershed Rehabilitation 1925-1930

Species	Potted	Bare Root	Direct Seeding in Pounds	Total Stock
Adenostema fasciculatum			9,376	
Aesculus californica			790	
Cascara sagrada			3,679	
Casuarina stricta	680			680
Cedrus deodara	1,505			1,505
Ceratonia siliqua	759			759
Eucalyptus sp.	15,688			15,688
Fraxinus velutina	184	150		334
Juglans californica			2,914	
Libocedrus decurrens	6,485	1,638		8,123
Miscellaneous	3,145	7,083	5	10,228
Native transplants		2,100		2,100
Pinus attenuata	8,280	12,712	58	20,992
" canariensis	1,224	174		1,398
" coulteri	122,152	264,072	998	386,224
" halepensis	2,604	143	½	2,747
" jeffreyi	3,784	5,042	16	8,826
" lambertiana	725		214	725
" monophylla	2,287	265	48	2,552
" ponderosa	40			40
" radiata	677			677
" sabiniana	6,139	4,410	256	10,549
" sylvestris	363			363
" thunbergii	144			144
" torreyana	155			155
Prunus ilicifolia			19,786	
Pseudotsuga macrocarpa	20,596	9,968	9	30,564
Quercus sp.	1,610		1,125	1,610
Rhus sp.			10,472	
Robinia pseudoacacia	1,575	3,075		4,650
Salvia sp.			300	
Sequoia gigantea	508			508
" sempervirens	80			80
Ulmus parvifolia	109			109
Umbellularia californica			15	
Totals	201,498	310,832	50,061½	512,330

TABLE V TOTAL TREES PLANTED AT PLANTATIONS FOR SIX-YEAR PERIOD 1925-1930 INCLUSIVE

PLANTATION	1925			1926			1927			1928			1929			1930		TOTALS		
	Pot	B.R.	Seed	Pot	B.R.	Seed	Pot	B.R.	Seed	Pot	B.R.	Seed	Pot	B.R.	Seed	Pot	B.R.	Pot	B.R.	Seed
1 Dalton		93000														262	100	262	93100	
2 Dexter Canyon													273			5097	400	5370	400	
3 Grizzly, Big Tujunga, Clear Creek	2000		18863	2913	27350	265	4793	22808	8068	15909	5775	1478	7241					32856	55933	28674
4 Little Gleason							3800			3245	2100	8	6378	1680	25	1990		15413	3780	33
5 Monrovia, Fish Canyons		15000	14454		4000														19000	14454
6 Mt. Wilson Rd., Henninger Flats													2212			2501	900	4713	900	
7 Pine Canyon										300	3950	856	2755	5474	714	3004	4352	6059	13776	1570
8 Pine Flats, Chilao									150			14	15837	4205	77	3950		19787	4205	241
9 Quarry 80							971	1200	84	3823	591	2	3082			3650	916	11526	2707	86
10 Ridge Route													175	100	208			175	100	208
11 San Gabriel	5000		3261	1250	43100	135		6000	150	7618	3598	26	405	4984	23			14273	57682	3595
12 San Dimas, Tanbark Flats				300	1000		27032		700	28079	11888	40	16048	13616	346	13270	14347	84729	40851	1086
13 Swartout Valley, Big Pines								7780	50										7780	50
14 Sylmar																1700	200	1700	200	
15 Trail Canyon										785	1712							785	1712	
16 Verdugo Hills											106	11							106	11
17 Wickiup Burn															53					53
18 Roberts Camp		2000																	2000	
19 Miscellaneous		6500		3800	100											50		3850	6600	
TOTALS	7000	116500	36578	8263	75550	400	36596	37788	9202	59759	29720	2435	54406	30059	1446	35474	21215	201498	310832	50061

NOTE: Seed is recorded in pounds.

D. REFORESTATION ACTIVITIES 1931-1940

Figure 1 is a summary of reforestation activities from 1925-40. The graph shows that reforestation was greatly reduced from more than 90,000 trees planted on the average every year up to 1929 to less than 20,000 trees planted each year between 1931-40. This came about because a new policy slowly emerged after the death in 1925 of County Forester and Fire Warden Stewart Flintham who believed strongly in reforestation. The new County Forester and Fire Warden Spencer Turner was a strong advocate of orderly progress and was disillusioned with the high tree mortality encountered up until then. In 1930, he issued the order to "plant less, plant better, and research everything that is being done." Mr. Turner became quite involved with the forestry research aspect of his Forestry Division and would personally inspect all planting sites. He would praise his Foresters for a job well done, but could also severely criticize someone for mistakes.

Mr. Turner's policy change was also affected by his awareness of the value of chaparral as a precious watershed cover that perhaps is fire dependent and best adapted to the site. On all tree planting sites, resprouting chaparral strongly competed for moisture, light, and nutrients, and therefore caused great mortality among the trees that were not browsed or destroyed by rodents. However, the real futility of large-scale brush to forest conversions in Southern California's Mediterranean climate was painfully emphasized by the many brush fires which would normally kill the trees that had managed to outcompete the chaparral.

So, instead of large-scale plantings, the 1930s was the era of Forestry Division research. Trees were not just scattered on burns and roadsides throughout the County, but were concentrated on selected sites such as lookout towers, campgrounds, and plantations. The Little Gleason plantation which was started in the late 1920s was one of the first forest-size plantation attempts. It was established to test tree planting methods and to demonstrate that trees, through regular hazard reduction maintenance, could be protected from fire. To establish the Little Gleason plantation, a spike camp with temporary nursery beds was set up above Aliso Canyon at 5,300' elevation and all materials and supplies were packed in by mule. Planting was done, weather permitting, from late fall to early spring in order to take advantage of the precious soil moisture. Around the clock labor on the planting site permitted much better site preparation and follow-up maintenance than was previously feasible. It also allowed more intensified rodent, deer, and rabbit control.

Map 1 on page 18 shows present-day Los Angeles County. The numbers on the map refer to Tables V and VI which lists all the planting sites from 1925-40 as they appeared in a 1940 report prepared by Forester C. Gerhardy for County Forester and Fire Warden Turner. Superimposed in blue are isohyetal lines giving the 90-year rainfall average (1872-1962) for Los Angeles County. Map 2 on page 19 shows all fires over 100 acres that occurred in Los Angeles County between 1919 and 1945 superimposed on map 1. The constant fire threat to all the plantations undoubtedly reinforced Mr. Turner's policy to concentrate tree plantings where they could be studied and protected.

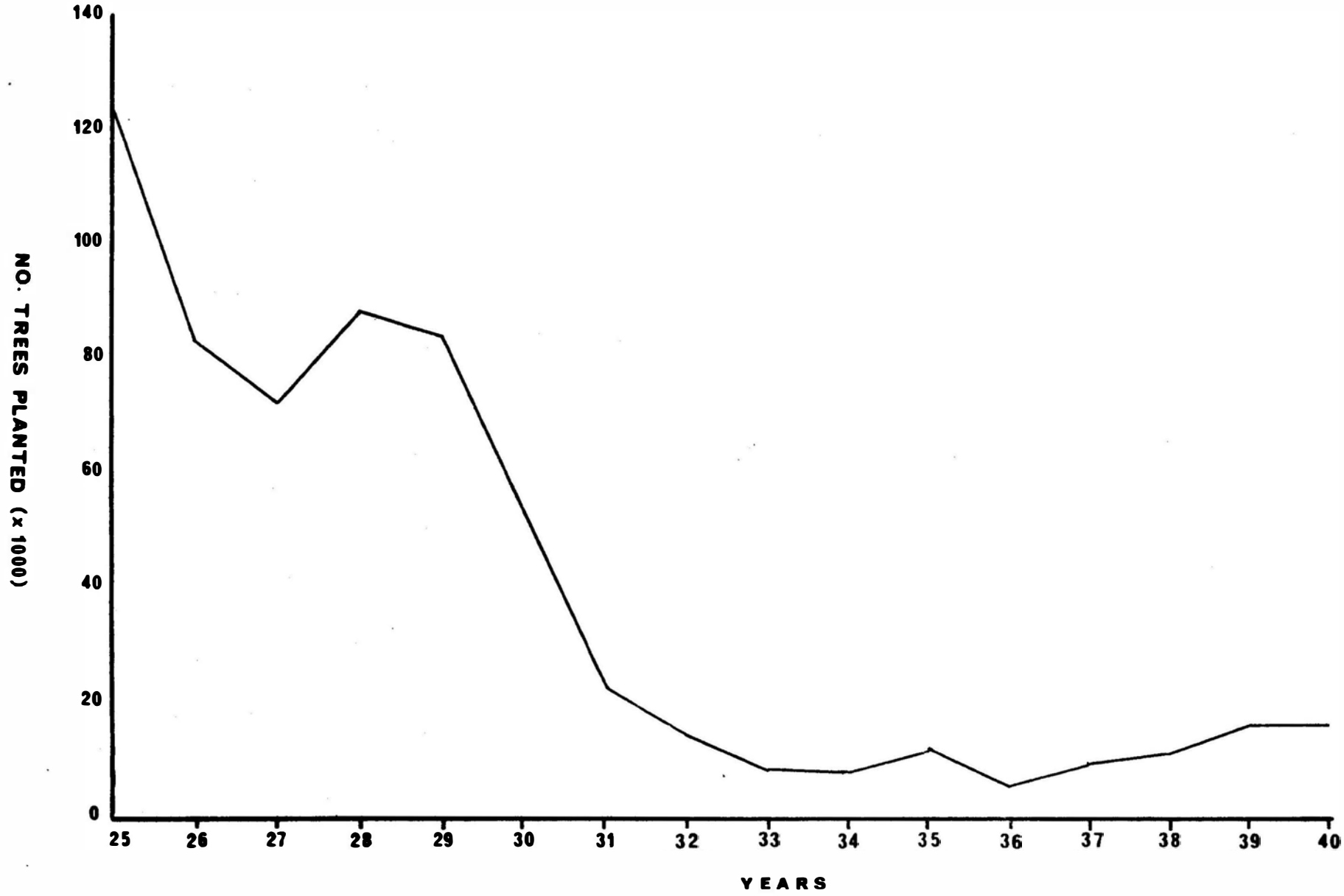
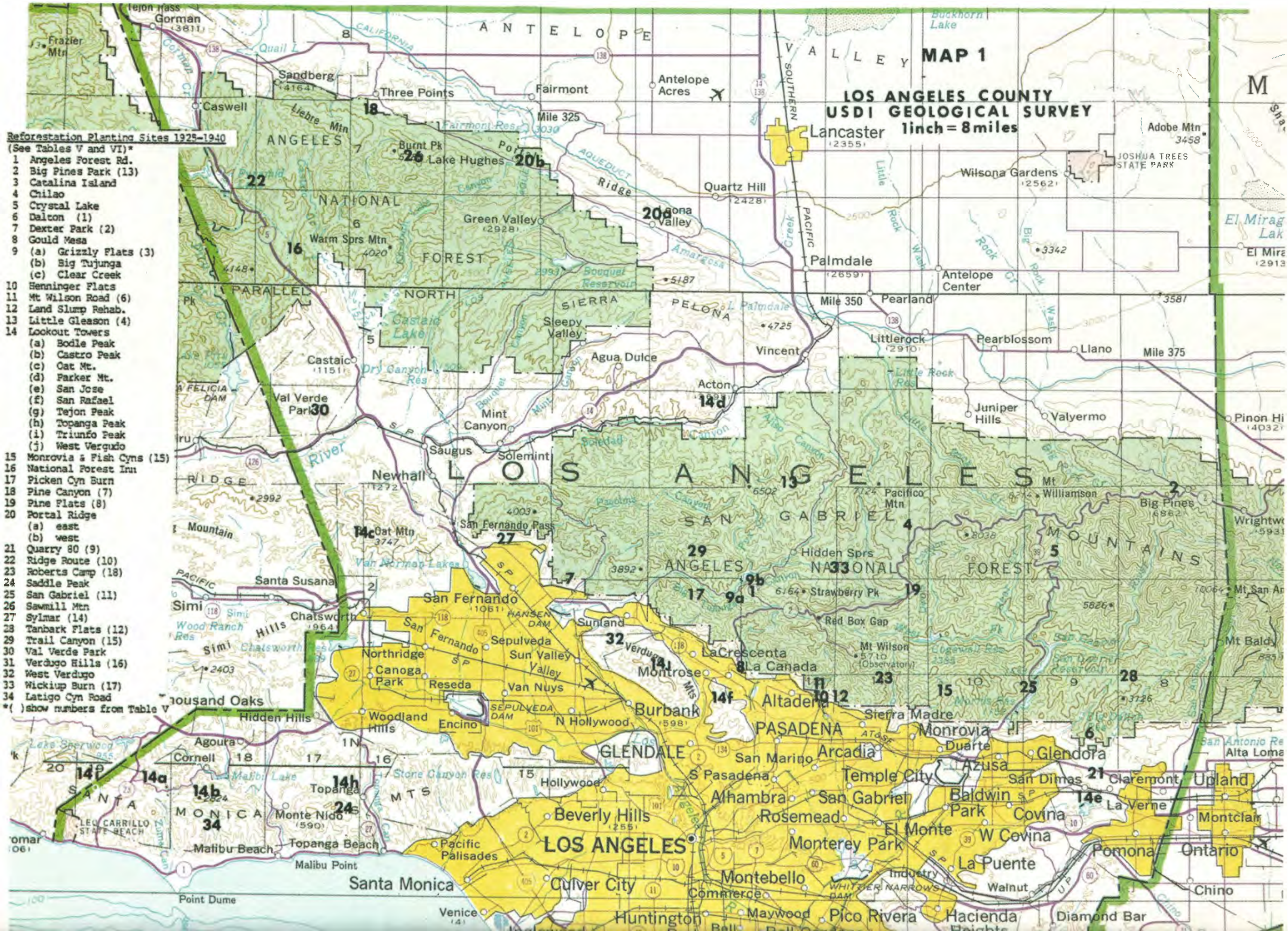


Fig. 1 TOTAL NUMBER OF TREES PLANTED (1925-1940)

Photo 7: Henninger Flats Nursery July 20, 1929. Cone extractor for Coulter pine (Pinus coulteri) is shown on right and drying flats on left. Roger Bodine on left.

Photo 8: Pacoima ornamental nursery prior to 1932.


MAP 1
LOS ANGELES COUNTY
USDI GEOLOGICAL SURVEY
1 inch = 8 miles
Reforestation Planting Sites 1925-1940
(See Tables V and VI)*
1 Angeles Forest Rd.
2 Big Pines Park (13)
3 Catalina Island
4 Chilao
5 Crystal Lake
6 Dalton (1)
7 Dexter Park (2)
8 Gould Mesa
9 (a) Grizzly Flats (3)
(b) Big Tujunga
(c) Clear Creek
10 Henninger Flats
11 Mt Wilson Road (6)
12 Land Slump Rehab.
13 Little Gleason (4)
14 Lookout Towers
(a) Bodle Peak
(b) Castro Peak
(c) Oat Mt.
(d) Parker Mt.
(e) San Jose
(f) San Rafael
(g) Tejon Peak
(h) Topanga Peak
(i) Triunfo Peak
(j) West Vergudo
15 Monrovia & Fish Cyns (15)
16 National Forest Inn
17 Picken Cyn Burn
18 Pine Canyon (7)
19 Pine Flats (8)
20 Portal Ridge
(a) east
(b) west
21 Quarry 80 (9)
22 Ridge Route (10)
23 Roberts Camp (18)
24 Saddle Peak
25 San Gabriel (11)
26 Sawmill Mtn
27 Sylmar (14)
28 Tanbark Flats (12)
29 Trail Canyon (15)
30 Val Verde Park
31 Verdugo Hills (16)
32 West Verdugo
33 Wickiup Burn (17)
34 Latigo Cyn Road
*( )show numbers from Table V
ANTELOPE VALLEY
ANGELES NATIONAL FOREST
LOS ANGELES
SAN GABRIEL MOUNTAINS
SANTA MONICA MTS
Lancaster
Palmdale
PASADENA
GLENDALE
LOS ANGELES
Santa Monica

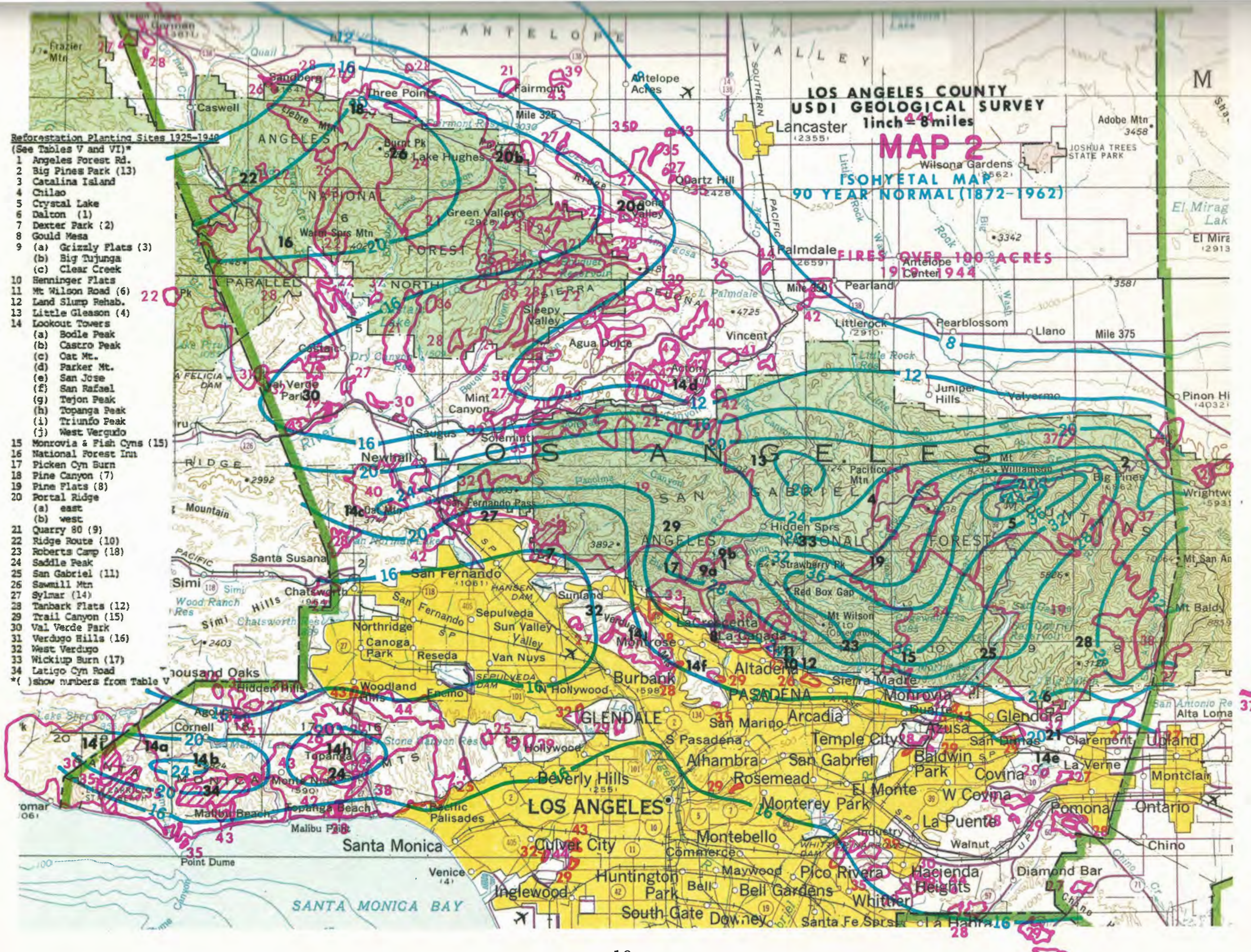

LOS ANGELES COUNTY
USDI GEOLOGICAL SURVEY
1inch = 8miles
MAP 2
ISOHYETAL MAP
90 YEAR NORMAL (1872-1962)
FIRES OVER 100 ACRES
1919-1944
Reforestation Planting Sites 1925-1940
(See Tables V and VI)*
1 Angeles Forest Rd.
2 Big Pines Park (13)
3 Catalina Island
4 Chilao
5 Crystal Lake
6 Dalton (1)
7 Dexter Park (2)
8 Gould Mesa
9 (a) Grizzly Flats (3)
(b) Big Tujunga
(c) Clear Creek
10 Henninger Flats
11 Mt Wilson Road (6)
12 Land Slump Rehab.
13 Little Gleason (4)
14 Lookout Towers
(a) Bodie Peak
(b) Castro Peak
(c) Oat Mt.
(d) Parker Mt.
(e) San Jose
(f) San Rafael
(g) Tejon Peak
(h) Topanga Peak
(i) Triunfo Peak
(j) West Vergudo
15 Monrovia & Fish Cyns (15)
16 National Forest Inn
17 Picken Cyn Burn
18 Pine Canyon (7)
19 Pine Flats (8)
20 Portal Ridge
(a) east
(b) west
21 Quarry 80 (9)
22 Ridge Route (10)
23 Roberts Camp (18)
24 Saddle Peak
25 San Gabriel (11)
26 Sawmill Mtn
27 Sylmar (14)
28 Tanbark Flats (12)
29 Trail Canyon (15)
30 Val Verde Park
31 Verdugo Hills (16)
32 West Verdugo
33 Wickiup Burn (17)
34 Latigo Cyn Road
*( )show numbers from Table V
ANTELOPE VALLEY
LOS ANGELES
SAN GABRIEL MTS
ANGELES NATIONAL FOREST
Lancaster
Palmdale
Pasadena
Glendale
Burbank
San Fernando
LOS ANGELES
Santa Monica
SANTA MONICA BAY

Table VI REFORESTATION PLANTING SITES 1931-1940

1. Angeles Forest Road - elevation 3,400 feet

   Planting along newly constructed portion of County road which has its junction with the Angeles Crest Highway near Waterman Ranger Station, Arroyo Seco Canyon. This road, when completed, will traverse part of the Tujunga drainage and will connect with the Mint Canyon Road near Vincent Summit. Traverses national forest land.

2. Big Pines Park - elevation 5,900-7,100 feet

   Near Swartout Valley. Plantings between Blue Ridge and Table Mountain on County-owned property and area under special use from the United States Forest Service.

3. Catalina Island - elevation 500-900 feet

   Several plantings located at various accessible sites for demonstration areas.

4. Chilao - elevation 5,000 feet

   Near the divide between Tujunga and San Gabriel drainages. Area denuded by the 1924 San Gabriel Fire. Forest Service land.

5. Crystal Lake - elevation 5,600 feet

   Head of San Gabriel River near foot of Mt. Islip. Area under special use from United States Forest Service.

6. Dalton - elevation 2,600 feet

   On divide between Dalton Canyon and San Gabriel Valley. Land controlled by California Forest and Range Experiment Station. West of Johnstone Peak.

7. Dexter Park - elevation 1,400-1,600 feet

   In Dexter Canyon, tributary to Kagel Canyon, Little Tujunga drainage. Area under special use from United States Forest Service.

8. Gould Mesa - elevation 1,560 feet

   On edge of Arroyo Seco Canyon and north of Flintridge. Demonstration area.

9. Grizzly Flats (a), Big Tujunga, Clear Creek (b) - elevation approximately 3,300 feet

   Plantings throughout the area which lies entirely within the Tujunga

drainage. Grizzly Flats accessible by Forest Service Motorway; Clear Creek by Southern California Edison Company road.

10. Henninger Flats - elevation 2,600 feet

Plantings on County-owned property, site of Department's forestation nursery on Mt. Wilson Road, three miles from Altadena.

11. Mt. Wilson Road - elevation 3,100-3,600 feet

Plantings along road, principally big cone spruce underplanting; overstory canyon live oak. On Forest Service land.

12. Land Slump Rehabilitation - elevation 2,000-2,500 feet

Plantings on land slump areas which resulted from the 1938 flood on County, Forest Service, and privately owned land.

13. Little Gleason - elevation 5,700 feet

Special use area of 160 acres near divide of Tujunga and Santa Clara River drainages. About four miles east of Mt. Gleason. Accessible by either Forest Service Motorway or Southern California Edison Road.

14. Lookout Towers

Small demonstration plantings have been made around County lookout towers, property either County-owned or leased. Location and elevation are as follows:

a. Bodle Peak - 2,450 feet
b. Castro Peak - 2,800 feet
c. Oat Mt. - 3,740 feet
d. Parker Mt. - 4,100 feet
e. San Jose
f. San Rafael - 1,880 feet
g. Tejon Peak - 4,850 feet
h. Topanga Peak - 2,470 feet
i. Triunfo Peak - 2,325 feet
j. West Verdugo - 2,975

15. Monrovia and Fish Canyons - elevation 3,000 feet

Area on the divide between Fish and Sawpit Canyons, tributary to San Gabriel River near Monrovia Peak. Forest Service land. Area denuded by San Gabriel Fire.

16. National Forest Inn - elevation 3,200 feet

Near National Forest Inn adjacent to Old Ridge Route on Forest Service land.

17. Pickens Canyon Burn - elevation 4,400 feet

Experimental plot at head of Cook Canyon on Forest Service land. Area denuded by 1933 fire.

18. Pine Canyon - elevation 3,500 feet

Near Three Points, Pine Canyon. Trees planted on private and Forest Service land following the 1928 Liebre Mountain Fire.

19. Pine Flats - elevation 5,500 feet

Area now known as Charlton Flats, a Forest Service recreation area. Following the 1924 San Gabriel Fire the Department planted many trees in this area which is controlled by the Forest Service.

20. Portal Ridge-east (a) and west (b) - elevation 3,600 feet and 3,700 feet

On ridge between Antelope Valley and Leonis Valley, in proximity to desert influences. Private land.

21. Quarry 80 - elevation 1,450 feet at Camp 5

Near San Dimas on County-owned property. Demonstration and arboretum area.

22. Ridge Route - elevation 3,100 -3,600 feet

Head of Cherry Canyon near Reservoir Summit on old Ridge Route on land controlled by the Forest Service.

23. Roberts Camp - elevation 1,800 feet

Big Santa Anita Canyon on Forest Service land.

24. Saddle Peak - elevation 2,400 feet

Adjacent to Saddle Peak Road near Fernwood, Santa Monica Mountains, on privately owned land, denuded by the 1936 fire.

25. San Gabriel - elevation 1,300-2,200 feet

Near Berry Flats. Now under water (Pine Canyon Dam). New state highway up the San Gabriel passes near the planting which is on Forest Service land.

26. Sawmill Mountain - elevation 4,700 feet

Adjacement to Forest Service Motorway to Atmore Meadows, about two-thirds distance to summit of Sawmill Mountain on Forest Service land. Area denuded by 1928 Liebre Mountain Fire.

27. Sylmar - elevation 1,500-1,900 feet

County-owned property adjacent to Olive View Sanatorium near Sylmar, San Fernando Valley.

28. Tanbark Flats, San Dimas Canyon - elevation 2,500-2,900 feet

Plantings in vicinity of Tanbark Flats, now the field headquarters of the California Forest and Range Experiment Station. Planting began following the 1919 fire and continued until 1932.

29. Trail Canyon - elevation 2,200 feet

Adjacent to foot trail from Tujunga Canyon to Mt. Gleason on Forest Service land.

30. Val Verde Park - 1,350-1,685 feet

County-owned property in Little San Martinez Canyon, tributary to the Santa Clara River near Ventura County line.

31. Verdugo Hills - elevation 3,000 feet

Junction of Whiting firebreak and top of ridge on privately owned property. Planting and seeding done following the 1927 Sunset Canyon Fire.

32. West Verdugo - elevation 1,400-1,800 feet

Demonstration areas on private property on ridge between Sunland and Tuna Canyon.

33. Wickiup Burn - elevation 3,300 feet

Junction of Wickiup and Tujunga Canyons on Forest Service land.

34. Latigo Canyon Road - elevation 1,600 feet

Low-fuel plant test plot for 27 species of succulents established after the 1935 Malibu Fire.

Table VII taken from the 1940 Division reforestation report lists all tree species planted in the 1930s. The 123 species listed indicate a much greater species diversity than the 1925-30 reforestation period discussed previously. However, outplantings of individual species were greatly curtailed. Thus, only 26,137 Pinus coulteri were planted in this period compared to 386,224 for 1925-30. One must remember that this was the Foresty Division's era of intensified research. Considerable experimental work was undertaken, including testing of tree species introduced from around the world, detailed experimentation with various age classes of nursery stock, studying different methods of handling the stock in the field, comparing different types of site prepartion and maintenance methods, continuous container studies, brush seeding trials and erosion control studies, evaluation of chemicals for brush control, continued studies on rodent control and reduction of browsing mortality, direct seeding experiments, bark beetle identification and control, growth studies, and fire protection of plantations. Some of these studies were done cooperatively with the U.S. Forest Service San Dimas Experimental Station; others were conducted through personal initiative. Outside agencies, such as U. C. Berkeley, received full support with their chaparral studies carried out in Los Angeles County. Many in-house reports were published and forwarded to the U. S. Forest Service, the State Forester, and, upon request, to interested agencies. The Appendix gives excerpts from these reports or summaries of field planting data and shows the change in policies that swept through the Forestry Division with curtailment in planting. There had to be a record of virtually every tree planted by the Division personnel.

The poor quality of labor given Foresters up to this time in the form of welfare workers, temporary and transient help, prompted Forester and Fire Warden Turner to involve qualified personnel, such as trained fire patrolmen in tree planting and subsequent maintenance operations. Nursery pot beds were established at selected patrol stations for the potting and public distribution of trees for watershed rehabilitation. Patrolmen would help Foresters with potting of trees and proudly water the trees they had helped establish along roadsides.

It should be noted that, in addition to reforestation, the Division had a large erosion control program in which primarily brush species were used that are not listed in any of the tables shown in this report. In addition to the tree species, some species are occasionally listed which are used primarily for erosion control and land slump rehabilitation.

In the 1930s, much work was done in cooperation with the U. S. Forest Service in hand seeding of wild mustard, Brassica nigra, for erosion control on motorways and on burns. The quickly spreading rosette of the germinating mustard plant proved to be excellent for erosion control. However, in the mid-1930s, Clark Gleason, Forester with the USFS San Dimas Experimental Station, noticed that mustard may be persistent in the chaparral community once seeded. Even after mustard disappears from the site, it is often the first species to reappear after a fire. Drought-resistant and aesthetically pleasing castor bean was also planted and seeded for erosion control on motorways, but plantings were discontinued in the late 1940s along with the mustard seeding because both species

proved to be too aggressive. In agricultural and urban areas, they were classified as noxious weeds. Castor bean had the additional objection of having poisonous seeds.

Another problem that faced the Forestry Division was weed eradication on the large number of firebreaks constructed since about 1915. Establishment of firebreaks to create barren areas void of fuel seemed to be a good idea, but no one had foreseen the almost instant invasion of these firebreaks by annual weeds. These annual weeds created a dry flash-fuel with the onset of soil moisture stress in late spring and had to be removed by hand or limited motor power. Public involvement in finding and recommending low-fuel (fire-retardant plants) that could smother out the annual weeds and thrive on limited soil moisture was always high after wildfires. Most species recommended were tested with the exception of noxious weeds like Johnson grass which posed a threat to the agricultural community in the lowlands.

The most ambitious fire-retardant plant testing was done in the Santa Monica Mountains following the 1935 Malibu Fire which burned over 28,000 acres of watershed cover. Twenty-seven species of succulents were outplanted in a test plot at Latigo Canyon Road about one mile north of the old Lechuza patrol station. The detailed report written in 1938 by Forester Gerhardy concluded that all species died within two years of outplanting because of one or a combination of these factors: rodent and deer depredation, drought, cold temperatures, and competition from resprouting chaparral. The experiment indicated that some of the succulents tested thrived well with some care and were good for erosion control. Since these succulents were already being made popular in the landscape trade research ceased. Low-growing, drought-resistant species were still tested here and there on an individual basis, but no intensive studies were done until the late 1960s when the Division became actively involved in supporting the Forest Service Fire Laboratory at Riverside in its field research efforts.

Table VII

SPECIES AND CLASSES OF STOCK PLANTED 1931-1940 INCLUSIVE

	Species	Potted	Bare Root	Total
	Abies concolor	671		671
	Acacia arabica		7	7
	" dealbata	501	50	551
	" karo	134		134
	" retinodes	205		205
	Acer macrophyllum	147		147
	Aesculus californica	193		193
	Ailanthus glandulosa	255	1,217	1,472
	Arundo donax		100	100
	Carpenteria californica	30		30
	Cedrus deodara	4,197	200	4,397
	" libani	55		55
	Ceratonia siliqua	211		211
	Cercocarpus betuloides	45		45
	Chiloppsis linearis	63		63
	Cornus nuttallii	19	315	334
	Cotyledon orbiculata		785	785
	Cupressus arizonica	1,772	230	2,002
	" forbesii	304		304
	" lusitanica	40		40
	" macnabiana	105		105
	Elaeagnus angustifolia		1,063	1,063
	Erythea armata	125		125
	Eucalyptus sp.	134		134
	Eucalyptus astringens	15		15
	" botryoides	245		245
	" citriodora	95		95
(a)	" cladocalyx	15		15
	" cornuta	35		35
(a)	" corynocalyx	165		165
	" crebra	140		140
	" diversicolor	95		95
	" ficifolia	95		95
	" lolophleba	68		68
	" globulus	60		60
	" globulus compacta	98		98
	" gomphocephala	15		15
	" gunnii	109		109
	" leucoxylon	136		136
	" polyanthemos	139		139
	" redunca	79		79
	" rostrata	190		190
	" rudis	298		298
	" salmonophloia	15		15
	" sideroxylon rosea	388		388
	" tereticornis	225		225

	Species	Potted	Bare Root	Total
	Eucalyptus torquata	79		79
	" viminalis	333		333
	Eulalia zebrinus	19		19
	Forestiera neo-mexicana		2,928	2,928
	Fremontia mexicana	107		107
	Garrya veatchii	293		293
	Juglans californica	210	791	1,001
	" nigra	65		65
	Leptospermum laevigatum	30		30
	Libocedrus decurrens	8,115	891	9,006
	Ligustrum lucidum		293	293
	Lithocarpus densiflora	102		102
	Lyonothamnus floribunda	40		40
(b)	Melaleuca 3 sp.	63		63
	Melia azedarach umbraculiformis		50	50
	Miscellaneous	90	92	182
	Oleander nerium	28	371	399
	" verrucosa	1,080		1,080
	Photinia arbutifolia	344		344
	Phytolacca dioica	96	60	156
	Pinus attenuata	15,997	6,479	22,476
	" bungeana	16		16
	" canariensis	3,356		3,356
	" contorta	145		145
	" coulteri	18,099	8,098	26,197
	" halepensis	4,579	1,423	6,002
	" jeffreyi	3,338	1,499	4,837
	" lambertiana	234		234
	" massoniana	69	68	137
	" monophylla	1,299		1,299
	" muricata	767		767
	" pinea	150		150
	" ponderosa	3,091	536	3,627
	" radiata	2,131		2,131
	" remorata	139		139
	" sabiniana	2,508	1,019	3,527
	" sylvestris	150		150
	" torreyana	375		375
	Platanus racemosa		75	75
	Podocarpus macrophylla	5		5
	Populus sp.		20	20
	Prunus americana		74	74
	" ilicifolia	310		310
	" integrifolia	109		109
	Pseudotsuga macrocarpa	8,940		8,940
	" taxifolia	150		150
	Pterocarya stenoptera	78	324	402
	Quercus agrifolia	203		203
	" californica	756		756
	" chrysolepis	877		877

Species	Potted	Bare Root	Total
Quercus douglasii	657	270	927
" dumosa	100		100
" ilex	39		39
" lobata	593	310	903
" suber	61		61
" wislizenii	270	50	320
Rhamnus californica	709		709
Rhus copollina	104	24	128
" erosa	100		100
" laurina	75		75
" viminalis	306	50	356
Robinia pseudoacacia		190	190
Sambucus glauca	200		200
Schinus molle	2,083	150	2,233
" terebinthifolius	21		21
Sequoia gigantea	1,055		1,055
" sempervirens	96		96
Simmondsia californica	37		37
Sterculia diversifolia	197		197
Tamarix parviflora	100		100
Tetraclinus articulata	80		80
Toxylon pomiferum	155	305	460
Ulmus pumila		260	260
Umbellularia californica	185		185
Vitex agnus-castus	187	283	470
Washingtonia filifera	50		50
Zizyphus mucronata	92		92
Total	98,443	30,950	129,393

(a) Species names are synonymous.

(b) Three species of Melaleuca planted in 1932-33; M. armillaris, M. hypericifolia, and M. nesophila.

E. THE TRANSITION PERIOD 1941-1952

This period started with the formation of the Department of Parks and Recreation. It closed with the impending expansion of the Division by placing branch nurseries in juvenile camps to give inmates work experience and assure the Forestry Division of a steady labor force. The 1945 loss of the Division's Park Section to the Department of Parks and Recreation resulted in a large cut of its labor force. The Division was relieved of its responsibility of roadside tree planting and maintenance, ornamental forestry, and landscaping. Henninger Flats, the Division's reforestation nursery, remained as the only operating nursery.

By 1949, the Division's staff had been reduced to a Divison head, a field crew of three men, and a nursery crew of four men. Curtailment of extensive reforestation plantings continued throughout most of the 1940s but was again on the upswing by the end of this period and reached its peak during 1950-60. The war and immediate postwar years undoubtedly put a damper on many ambitious forestry projects. Foresters were eager to put into practice on a large scale the lessons learned during the more than 10 years of practical field research started in the late 1920s. Lacking labor for large-scale projects, more emphasis was placed on intensified maintenance of existing plantations, better site preparation for new plantations, and continued tree planting in areas of greater public use. Research continued on a limited scale either through personal dedication, such as the Vitamin B-1 studies in 1941 by Forester J. Drnovich, or dictated by the needs of the times. An example of the latter is the cork oak studies carried out jointly with the USFS during World War II to find a substitute source for European cork.

The torrential rains of February 28-March 2, 1938 which practically washed out all mountain roads in the San Gabriel Mountains, reemphasized watershed improvement through soil erosion measures as the Division's top priority. Erosion control on the many miles of motorways established over the years by the Department of Forester and Fire Warden was of continuing concern. Stabilization of both new and old road cuts and fills presented a constant challenge. Floods, fires, and public and political pressure to quickly rehabilitate burned watersheds prior to winter rains required a flexible Forestry Division that could quickly respond to emergencies. Vegetative erosion control measures continued to consist of planting of tree and brush species, heeling-in of large rooted and non-rooted cuttings, such as Arundo donax and Baccharis viminea, seeding of brush species as well as native and introduced grass species, and the use of primarily barley on contour terraces. With the cooperation of the Forest Service, initial hand seeding and since 1947 the helicopter seeding of black mustard on burned watershed and along motorways, was continued.

As the 1950s approached, Forestry Division reforestation activities took a

great upswing. Mustard seeding for erosion control on burned watersheds gave way to seeding of annual ryegrass, Lolium multiflorum, and the Division was called upon to direct many more new projects. Division personnel became urban Foresters in the true sense with total public involvement through conservation education, varied expertise developed by individual Foresters, and its continuously evolving watershed management program.

F. REFORESTATION 1953-1977

The changes within the Division over the last 25 years were related directly to reforestation and watershed rehabilitation activities and public awareness of the County's natural resources.

In 1955, after repeated disastrous wildfires, the County Board of Supervisors expanded the forestry program by establishing branch nurseries at three juvenile probation camps. These branch nurseries were to utilize juvenile labor for forestry projects and give the juvenile offender a chance to rehabilitate himself through discipline and good work habits. In anticipation of the expansion, the Henninger Flats Nursery greatly increased its tree production and outplanting schedule. It was then able to immediately supply trees for plantation establishment and soil erosion projects, while the branch nurseries were being built.

The newly established Unit 4 nursery concentrated efforts on upgrading plantation establishment methods through the first large-scale site preparation projects using contour terracing. The success of these experiments led to the policy of complete site preparation through use of heavy equipment and removal of all chaparral and follow-up disking. The natural next step was intensive plantation maintenance, constant hazard reduction, and the use of chemicals to control resprouting chaparral and weedy species. With the establishment of Special Projects, Unit 8 to manage fuel modification and low-fuel plant research, and the Conservation Education Forester to serve the increased public demand for forestry related programs, the Division assumed its modern shape. The recent addition of the Mt. Gleason Nike Site as a future Conservation Education Center is geared to larger groups and programs.

REFORESTATION ACTIVITIES ANALYZED

Planting Sites and Precipitation

Map 3 shows the location of Forestry Division Units, their boundaries, and also planting sites where in excess of 10,000 trees were planted over the last 25 years. The numbers on the map correspond to the names of the plantations or roadside plantings as shown in Table VIII. An asterisk marks a few selected plantations, well established with less than 10,000 trees. The number of trees alone does not indicate the quality or size of the plantations or roadside plantings as some harsh sites had to be replanted or interplanted to achieve the desired stocking rate. Many more plantations using less than 10,000 trees were established by the Division on the Angeles National Forest, but they are not shown on the map.

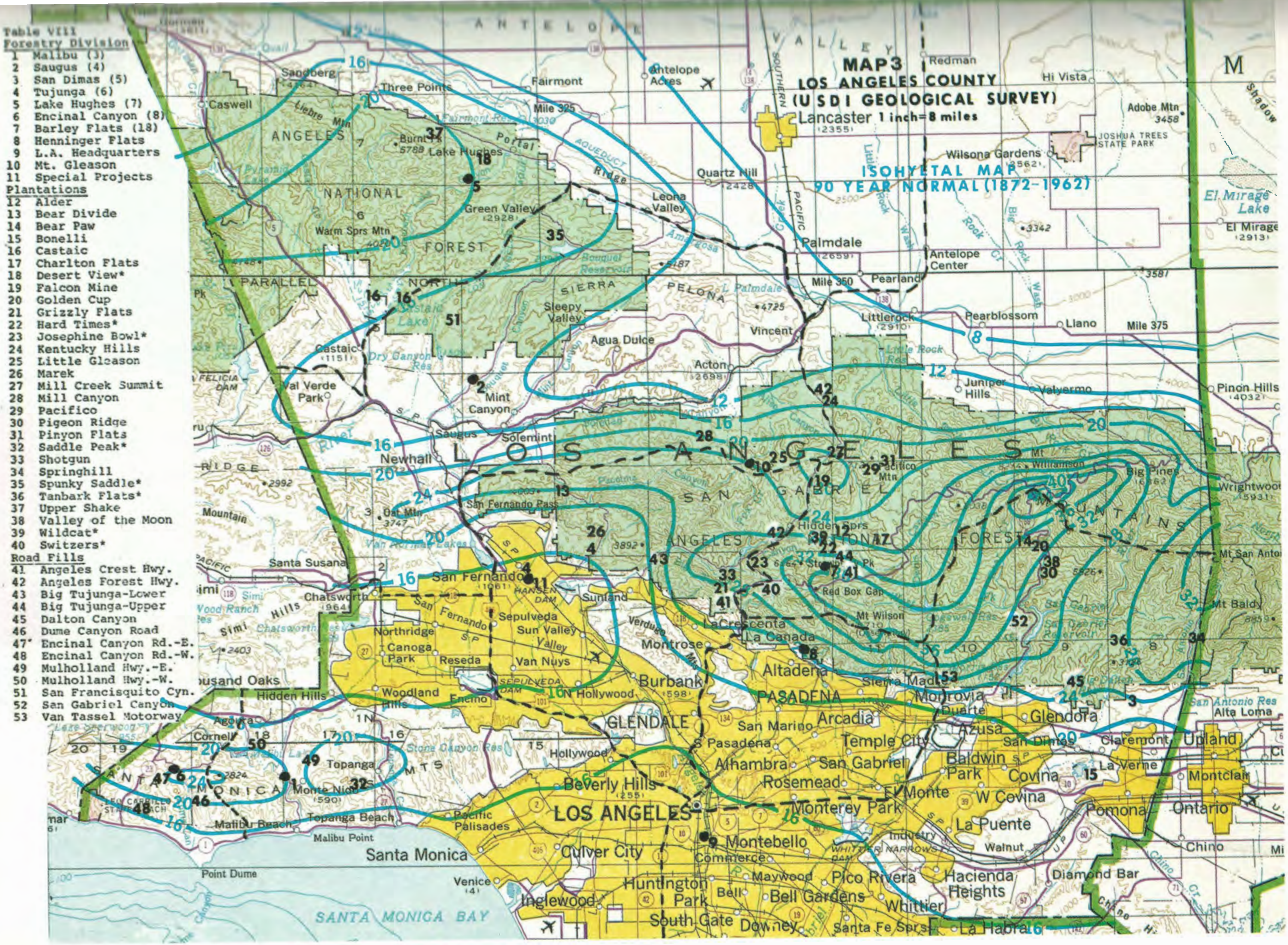
Maps 3-6 illustrate some of the limitations placed upon the choice of planting sites. Plantations are shown in black, rainfall in blue, and fires in red. Maps 4 and 5 depict watershed fires over 100 acres for the period 1945-1961 and 1962-1977, respectively. Map 6 is a composite of all watershed fires over 100 acres that occurred between 1919-1977. Catalina and the Palos Verdes Peninsula have been omitted as few large-scale plantings were done there over the years.

Map 3 shows that planting sites are concentrated in the Angeles National Forest above 3,000' elevation and can be classified as medium-to-high elevation sites. The rainfall isohyetal lines point out that all of the sites located on the windward side (facing the ocean) of the San Gabriel Mountains receive in excess of 24" rainfall. On the other hand, all planting sites located on the leeward side of the San Gabriel Mountain Range (facing the desert) average less than 24". The Liebre-Sawmill Mountain Range in the northwestern section of the County and the coastal ranges also receive less than 24" precipitation. The climate in the coastal ranges is modified by marine influence; whereas, the Liebre-Sawmill Mountain Range is the forerunner to the deserts to the north and thus presents the toughest planting sites.

Fig. 2 on page 37 shows yearly rainfall of three selected plantations from 1953-77. The plantations shown; namely, Castaic (16), Little Gleason (25), and Valley of the Moon (38) demonstrate the low, average, and high rainfall pattern of our planting sites. The constant peaks and valleys of the graphs point to the great variability in rainfall received from year-to-year. Initial watering of potted stock on low elevation sites and in the low rainfall areas or intermixing of potted stock with bare root stock in the upper elevations to assure at least partial survival when trees are not watered-in is sound forestry. Tree survival, even with excellent site preparation, but without these precautionary measures, depends on the chance of adequate precipitation.

Years of extreme rainfall alternate with years of drought so that much rainfall is lost as runoff from the site. Average rainfall thus is not as important as it seems. Tree survival is largely dependent upon specific site characteristics, such as adequate soil depth (3' plus is preferred), adequate infiltration rates, and collection of runoff by contours or waterbars.

The large, low elevation plantation complexes at Bonelli Park (15), and Castaic (16) are being developed for recreational use along reservoirs. They represent a shift away from the intensive high-elevation plantings in the Angeles National Forest. A combination of intensive site preparation by heavy equiment, wide spacing of up to 20' x 20' to accommodate the equipment for future site maintenance, and intensive care during the initial establishment period in the form of watering and weed control is being used for the first time. The wide spacing does not give the flexibility for larger mortality due to drought and competition which was expected at earlier planting sites as part of nature's thinning regime. Watering at planting time and during the first few years of tree establishment is required. Initial watering has the added advantage of fall planting thereby extending the planting season.



MAP3
LOS ANGELES COUNTY
(U S D I GEOLOGICAL SURVEY)
1 inch=8 miles
ISOHYETAL MAP
90 YEAR NORMAL (1872-1962)
Table VIII
Forestry Division
1 Malibu (3)
2 Saugus (4)
3 San Dimas (5)
4 Tujunga (6)
5 Lake Hughes (7)
6 Encinal Canyon (8)
7 Barley Flats (18)
8 Henninger Flats
9 L.A. Headquarters
10 Mt. Gleason
11 Special Projects
Plantations
12 Alder
13 Bear Divide
14 Bear Paw
15 Bonelli
16 Castaic
17 Charlton Flats
18 Desert View*
19 Falcon Mine
20 Golden Cup
21 Grizzly Flats
22 Hard Times*
23 Josephine Bowl*
24 Kentucky Hills
25 Little Gleason
26 Marek
27 Mill Creek Summit
28 Mill Canyon
29 Pacifico
30 Pigeon Ridge
31 Pinyon Flats
32 Saddle Peak*
33 Shotgun
34 Springhill
35 Spunky Saddle*
36 Tanbark Flats*
37 Upper Shake
38 Valley of the Moon
39 Wildcat*
40 Switzers*
Road Fills
41 Angeles Crest Hwy.
42 Angeles Forest Hwy.
43 Big Tujunga-Lower
44 Big Tujunga-Upper
45 Dalton Canyon
46 Dume Canyon Road
47 Encinal Canyon Rd.-E.
48 Encinal Canyon Rd.-W.
49 Mulholland Hwy.-E.
50 Mulholland Hwy.-W.
51 San Francisquito Cyn.
52 San Gabriel Canyon
53 Van Tassel Motorway
ANTELOPE VALLEY
LOS ANGELES
ANGELES NATIONAL FOREST
SAN GABRIEL MOUNTAINS
SANTA MONICA MTS
SANTA MONICA BAY
Lancaster
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Pasadena
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Glendale
Burbank
Santa Monica
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Table VIII

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35 Spunky Saddle*
36 Tanbark Flats*
37 Upper Shake
38 Valley of the Moon
39 Wildcat*
40 Switzers*

Road Fills

41 Angeles Crest Hwy.
42 Angeles Forest Hwy.
43 Big Tujunga-Lower
44 Big Tujunga-Upper
45 Dalton Canyon
46 Dume Canyon Road
47 Encinal Canyon Rd.-E.
48 Encinal Canyon Rd.-W.
49 Mulholland Hwy.-E.
50 Mulholland Hwy.-W.
51 San Francisquito Cyn.
52 San Gabriel Canyon
53 Van Tassel Motorway

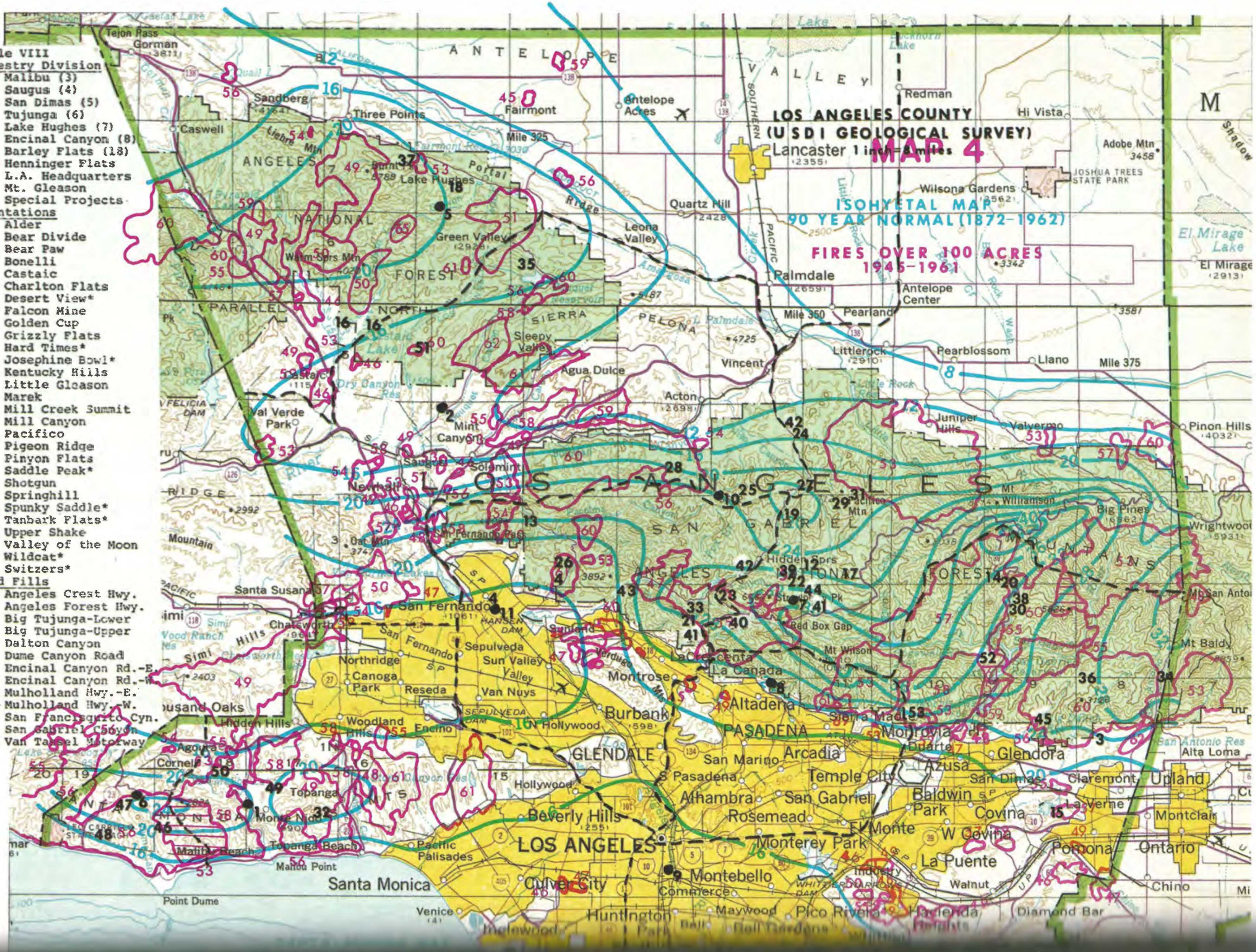

Table VIII

Forestry Division

1 Malibu (3)
2 Saugus (4)
3 San Dimas (5)
4 Tujunga (6)
5 Lake Hughes (7)
6 Encinal Canyon (8)
7 Barley Flats (18)
8 Henninger Flats
9 L.A. Headquarters
10 Mt. Gleason
11 Special Projects

Plantations

12 Alder
13 Bear Divide
14 Bear Paw
15 Bonelli
16 Castaic
17 Charlton Flats
18 Desert View*
19 Falcon Mine
20 Golden Cup
21 Grizzly Flats
22 Hard Times*
23 Josephine Bowl*
24 Kentucky Hills
25 Little Gleason
26 Marek
27 Mill Creek Summit
28 Mill Canyon
29 Pacifico
30 Pigeon Ridge
31 Pinyon Flats
32 Saddle Peak*
33 Shotgun
34 Springhill
35 Spunky Saddle*
36 Tanbark Flats*
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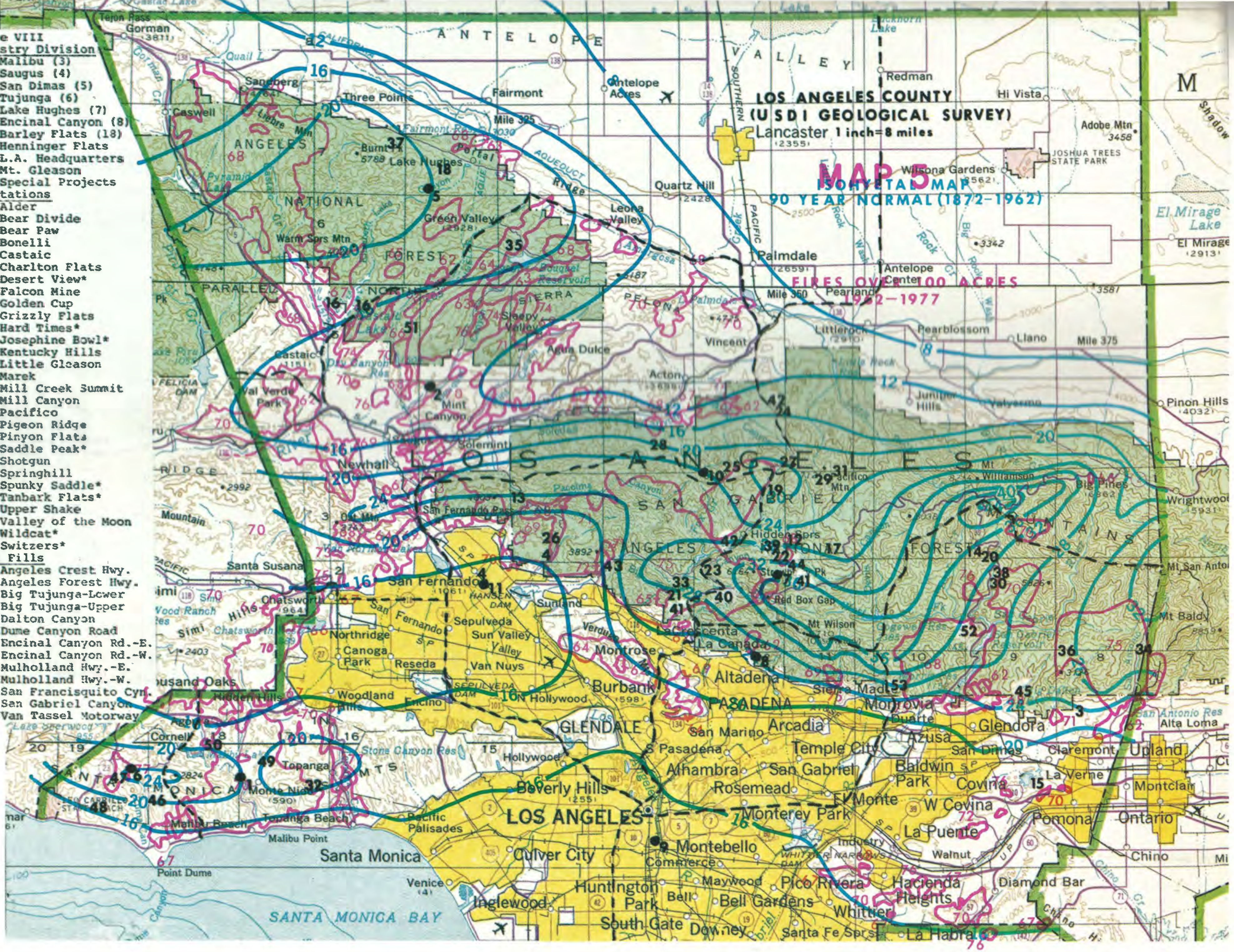

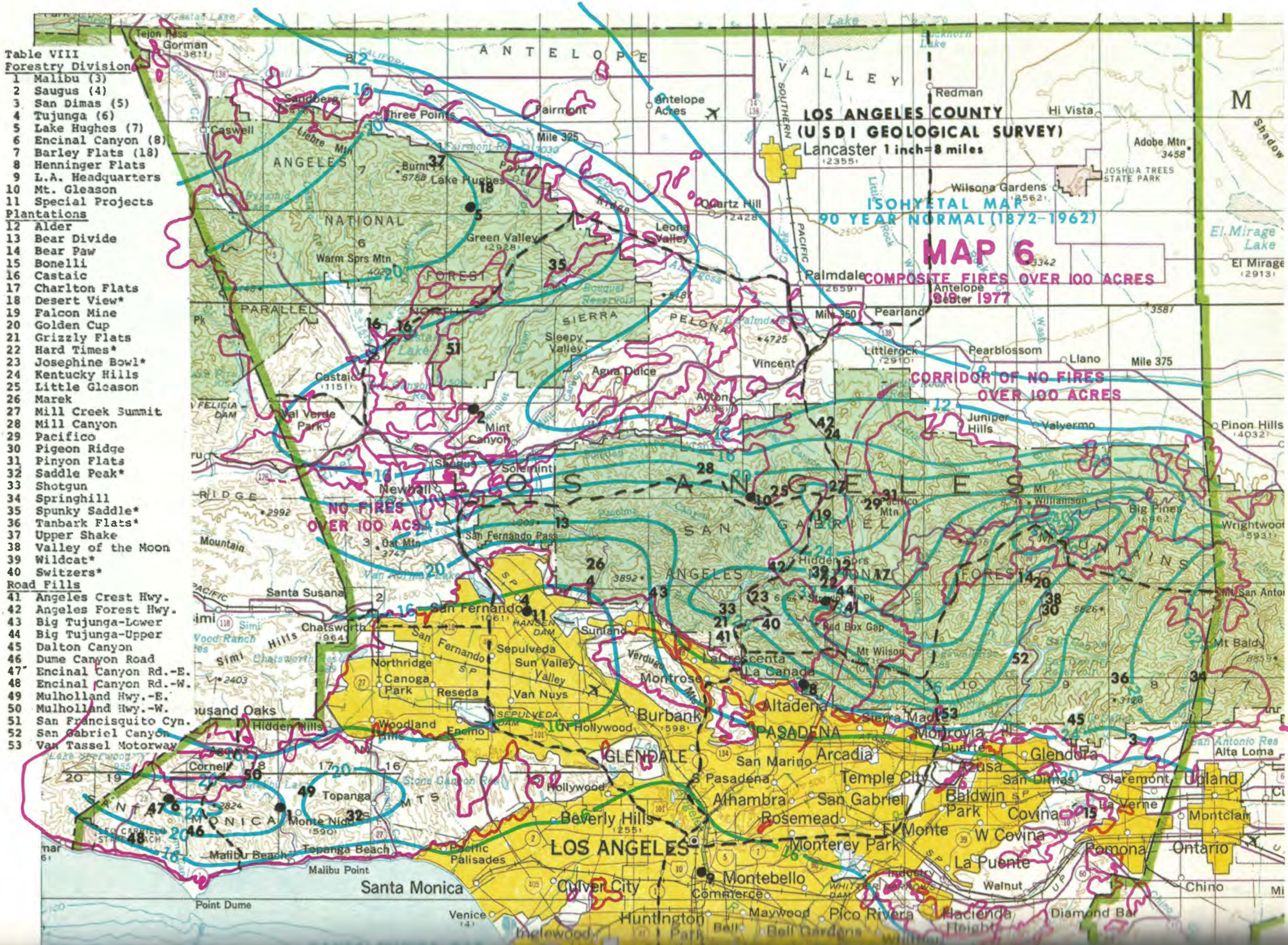
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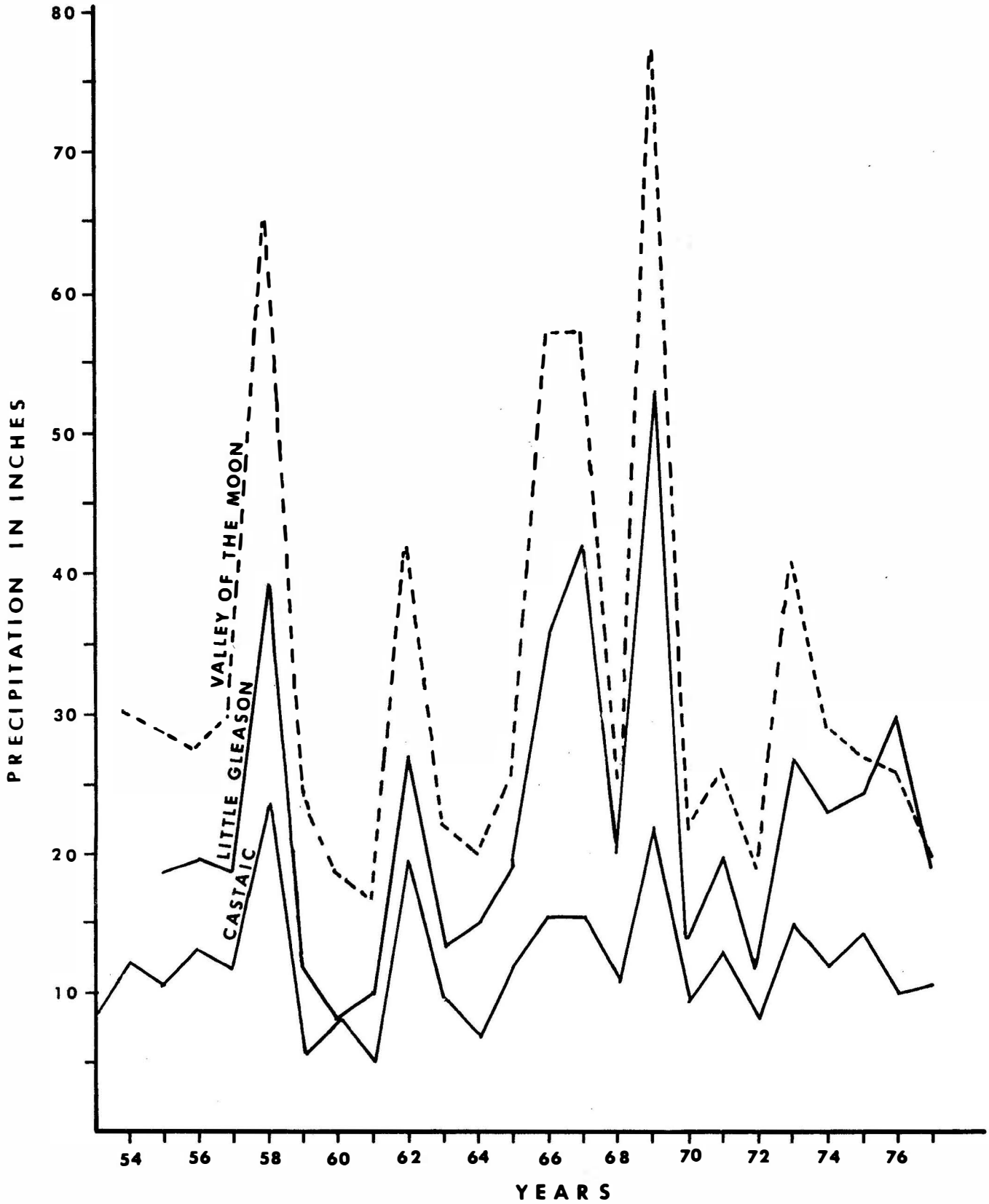
53 Van Tassel Motorway
LOS ANGELES COUNTY
(U S D I GEOLOGICAL SURVEY)
1 inch=8 miles
ISOHYETAL MAP
90 YEAR NORMAL (1872-1962)
MAP 6
COMPOSITE FIRES OVER 100 ACRES
1977
CORRIDOR OF NO FIRES
OVER 100 ACRES
NO FIRES
OVER 100 ACS.
ANTELOPE VALLEY
ANGELES NATIONAL FOREST
LOS ANGELES
SAN GABRIEL MOUNTAINS
SANTA MONICA MTS
Lancaster
Palmdale
Pasadena
Glendale
Burbank
Santa Monica
Beverly Hills
Pomona
Ontario

Fig. 2 YEARLY PRECIPITATION AT SELECTED PLANTATIONS (1953–1977)



Planting Sites and Fire

Maps 4-5 show watershed fires in excess of 100 acres for the periods 1945-61 and 1961-77 respectively. It is evident that fires are a natural phenomenon of Los Angeles County's watershed cover. Chaparral fires can be expected almost any time of the year but are most prevalent during the dry season, especially when coupled with strong Santa Ana (Foehn) winds. This extreme fire condition normally exists from August until as late as December, or whenever the winter rains put an end to the dry season. It is therefore of utmost importance that plantations are established in less fire-prone areas and are maintained year-round. Most of the present plantations were established as the result of site conversion on a recent burn and not, except perhaps for local topography, with overall fire frequencies in mind. Site conversions through population pressures and more efficient fire fighting agencies cannot be depended upon to keep fires small and thus save plantations. The large fires of 1960, 1967, 1968, and 1970 are cases in point. If fire conditions are right, wildfires just cannot be stopped even with the most modern fire fighting equipment and an army of men. Fire personnel from various agencies may point out that during critical periods on the fire lines "trees are the first to go through backfiring to reduce fuel load." During extreme fire conditions, nature is in control. Changes in weather, enlargement of the fire into recently burned areas, or running out of fuel at the desert or ocean normally decide the size of such fires.

Analyzing the fire losses of trees planted during the last 25 years in Los Angeles County, several regions stand out because of their fire frequency. The following areas are examples of constant tree losses to fire: the San Gabriel Canyon-Dalton Canyon complex, the Little Tujunga Canyon-Angeles Crest-Angeles Forest Highway Triangle, and the Santa Monica Mountains. The first two sites, characterized by rugged terrain, are in the downward path of the Foehn winds. The third site, composed of the steeply rising coastal mountain ranges, also gives rise to complex fire fighting problems. When the desert Foehn winds meet the local mountain winds, unpredictable wind patterns are often set up. This makes erratic burning of fires and spotting ahead of fires by flying embers a common occurrence. Even with wind shifts, it is not an uncommon occurrence that the offshore currents are dry and warm during these critical fire periods. Rapidly resprouting chaparral encouraged in the Santa Monica Mountains by the mild ocean influence and in the other areas by higher precipitation add to the higher fire frequencies and tree losses. In the above three areas, tree mortality over the last 25 years has ranged anywhere from 5-100 percent. Erosion control plantings on fills and roadsides showed the highest mortality.

Initial investigations showed that of all trees planted in excess of 50 percent died within 25 years after outplanting from various causes, such as drought, rodent activity, rabbit depredation, deer browsing, excessive erosion after major storms, insects and disease, vandalism, and road alignment and grading. Fire removed an additional 20 percent of the trees so that thinning accounted for less than 1 percent. The drought losses or failure of trees to adapt to the site are expected in arid regions and in the past were compensated for by closer spacing of 8' x 8' to 10' x 10'.

Discounting fire for a 50 percent survival rate after 25 years or including fire and thinning for a 25 percent survival rate would be quite acceptable at the above initial stocking rates if fire would remove trees in an orderly manner such as in natural thinning. However, fire acts at random, destroying whole plantations and large roadside plantings. This often leaves the forester with nothing but ashes and memories of hard work.

Plantations can be protected from fire. A study undertaken by the Division in 1961 to evaluate survival of coniferous plantations following recent wildfires showed that losses could be greatly reduced if the findings below would be remembered during tree plantings and follow-up maintenance:

1. The presence or absence of brush understory is a prime factor in determining whether trees in coniferous plantations will survive a large fire.

2. Trees planted on ridge tops or near upper parts of slopes have a poor chance of survival even if brush is removed in the immediate vicinity of the trees. Convection heat is carried uphill a considerable distance.

3. Brushing, pruning, and thinning contribute to increased vigor and greater diameter and height growth; thus giving the taller trees a better chance of survival.

4. If there is no brush understory, normal accumulation of duff does not appear to produce sufficient heat either to kill the cambium or cause crown fires. However, if the buildup of needles is scraped back away from the tree, a greater margin of safety can be acquired.

5. If brush understory and lower branches are removed, coniferous trees can survive fires in Southern California.

6. To reduce fire mortality in Southern California plantations, it is necessary to maintain a firebreak for the life of the plantation.

Additionally, one could add that it is more prudent to establish a plantation complex of many small sites (Bonelli, Castaic) than just one huge plantation. Here, sites should be selected because their geology or local topography are less frequently visited by fires than the surrounding areas.

Numbers Planted

Fig. 3 shows tree planting activities broken down into potted stock, bare root, and seed spots (incomplete). Planting activities with Forest Service trees are not included. Compared to less than 20,000 trees planted a year for the period 1931-40, planting activities steadily increased and, by 1953, reached 50,000 a year. This would be the average for the next 25 years. Except for seed spots, planting activities were reduced from

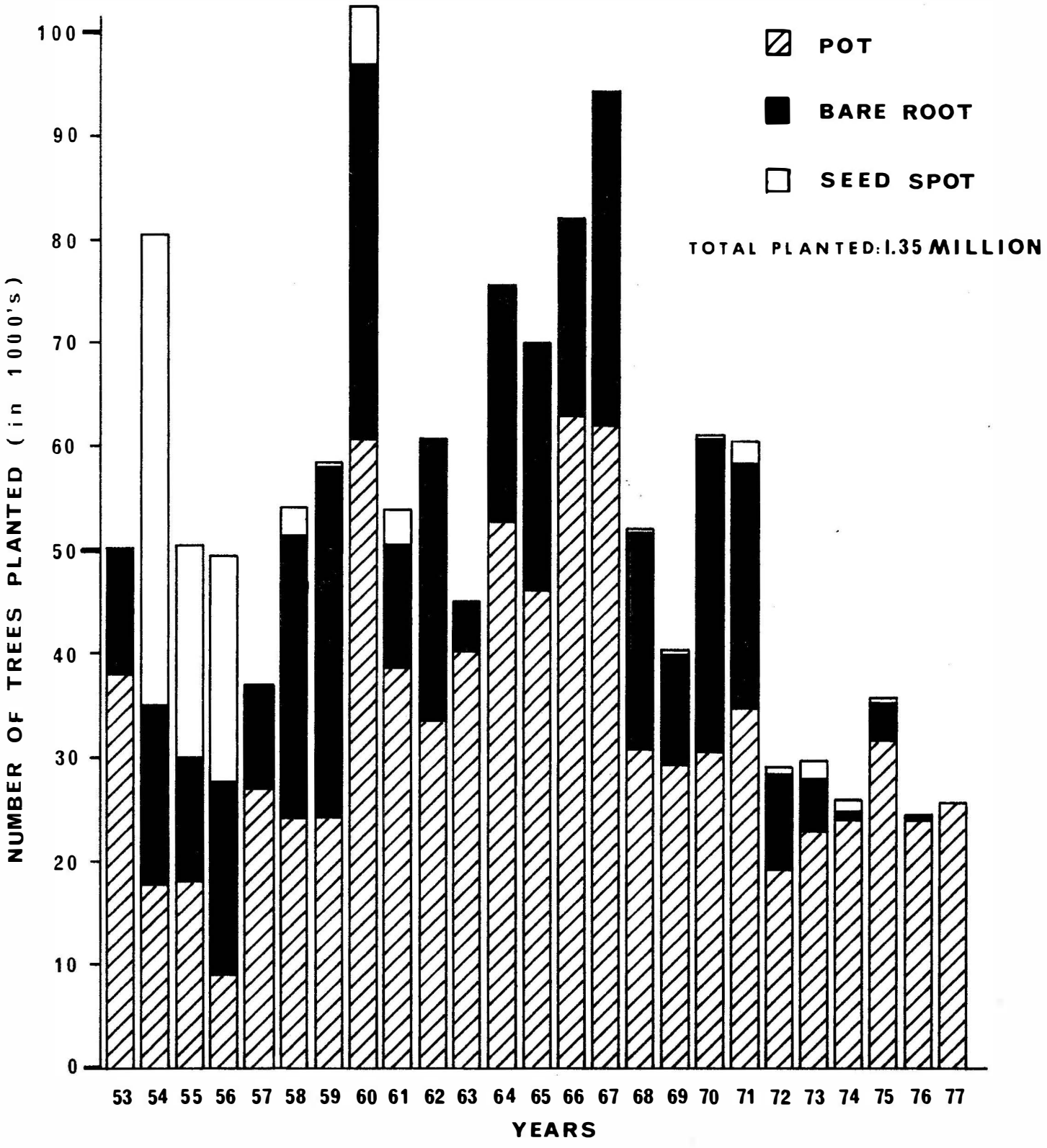


Fig. 3 TOTAL NUMBER OF TREES PLANTED (1953-1977)

1955-57, while branch nurseries were being established.

Planting activities reached a peak in 1960 with the intensive development of recreational sites primarily by Unit 5 and Henninger Flats and erosion control planting along Big Tujunga Canyon, Woodwardia Burn, and other sites by the other Units. Concentrated planting efforts from 1965-68 on the Castaic project and continued development of recreational sites by Henninger Flats and Units 4, 5, 6, 7, and 18 in the Angeles National Forest resulted in the most intensive period of planting activities since the early 1920s.

The 1970s showed a great decline primarily in bare root planting. This is not only attributable to the drought, but also to new Division policies of planting less on high elevation sites and testing new plantation establishment methods. Less trees were planted in burns or in areas without site preparation. Roadside plantings were reduced as new planting sites became limited and tree spacing was increased on new plantations in order to accommodate follow-up maintenance by heavy equipment.

Species Planted

Fig. 4 lists the 20 most common tree species planted. The number at the top of each column gives the percentage of trees planted of this particular species as compared to the total number of all species planted. Large bare root plantings and seed spot trials indicate that the species is either a high-elevation tree or readily adapted to high elevations.

Pinus coulteri with 30.7 percent was the most commonly planted tree in all categories. Libocedrus decurrens, Pinus halepensis, and Robinia pseudoaccacia were distant seconds with 11.9 percent, 11.7 percent, and 9.8 percent respectively. They were followed by Pinus attenuata with 7.1 percent, Cupressus arizonica with 6.0 percent, and Pinus jeffreyi with 5.5 percent. Pinus canariensis, the only fire-sprouting pine planted by the Division, Pinus radiata, and Cupressus forbesii ranked next with 2.8 percent, 2.0 percent, 1.6 percent respectively. All other species amounted to 10.9 percent of the total number planted.

Fig. 5 conveys the planting frequency of the same species described in Fig. 4. Each line segment indicates that the species was planted for the year shown. Despite the small number planted, Cedrus deodara, Cupressus forbesii, Pinus radiata, and Pinus canariensis were planted in at least 20 of the previous 25 years.

Division plantings on the Angeles National Forest, especially high-elevation plantings, were greatly reduced in the early 1970s when emphasis was placed on low-elevation sites. Plantings of Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Pseudotsuga macrocarpa, and Sequoia gigantea therefore declined.

Species Adaptability

The tree species presently used for reforestation projects have evolved over the years and were chosen for important characteristics such as drought tolerance, elevation requirements, cold tolerance, insect and

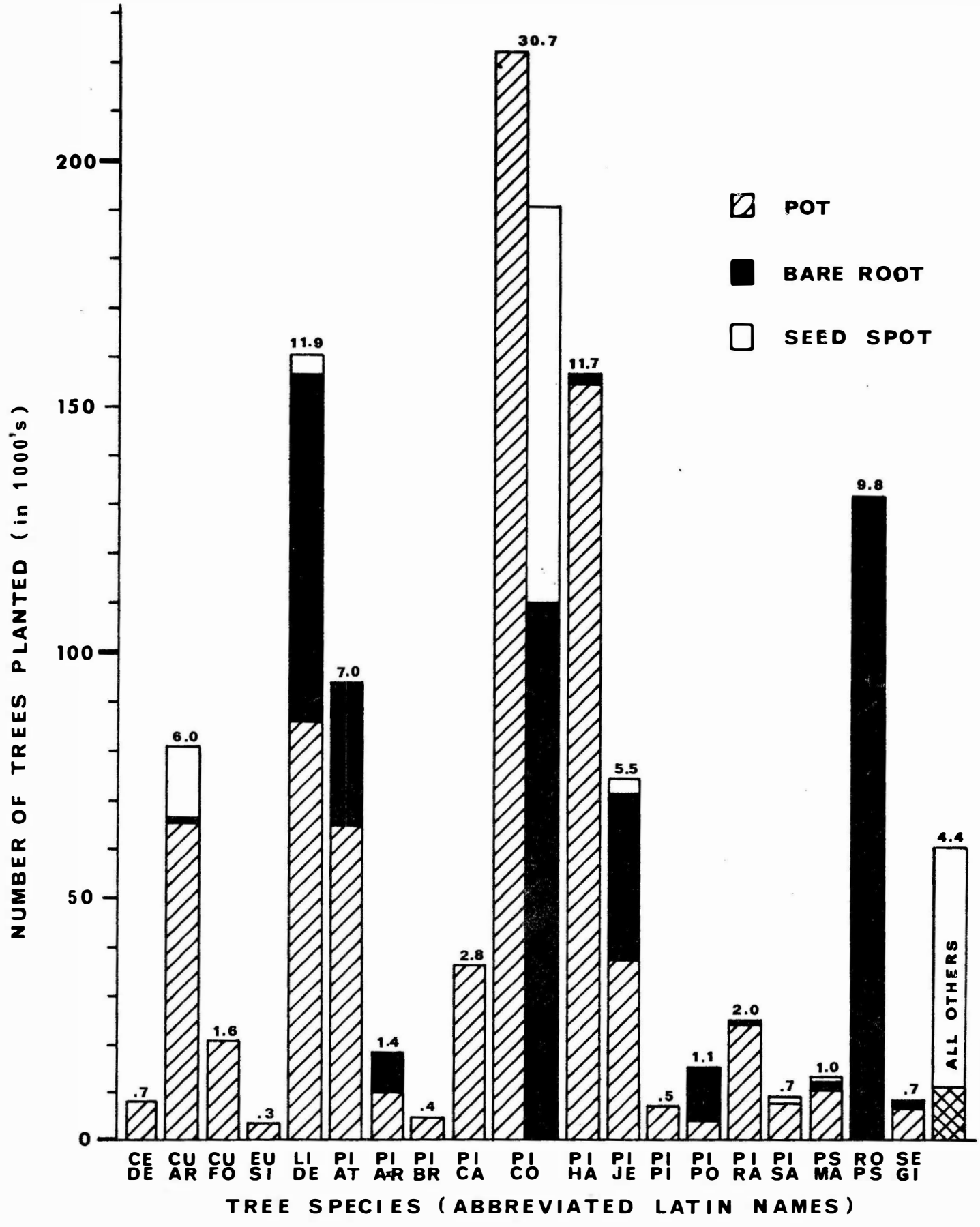


Fig. 4 20 MOST COMMON TREE SPECIES PLANTED (1953 - 1977)

NUMBERS PLANTED IN PERCENTAGE

disease resistance, ease in growing and handling, and special characteristics, such as aesthetics, specific niche adaptation or fire tolerance. Most species tested adapted well to the soils in the area. Major species have changed little, except for the addition of the more recent introductions of Pinus brutia and the 1974 introduction of Pinus eldarica from Iran.

Indigenous Species

Pinus coulteri and Libocedrus decurrens are the two most versatile species used. They can be planted from sea level to above 6,000' on virtually all but the harshest sites. The latter's primary drawback is its great susceptibility to browsing. Pinus jeffreyi and Pinus ponderosa, on the other hand, are limited to the drier sites primarily above 6,000', but are found as low as 4,500' on north slopes. Both species have found limited use primarily for bare root planting at the higher elevations. Pinus lambertiana prefers the more mesic sites at the same elevation range as the above species and has been outplanted as potted stock on a very limited scale in high elevation plantations. Pseudotsuga macrocarpa, the only indigenous fire-sprouting conifer, prefers the more mesic sites of the Angeles National Forest and is found scattered on northern exposures and in canyons at medium to high elevations (below 6,000'). Since it is not drought tolerant, it is adapted only to the few above-mentioned microclimatic niches. It is also readily browsed and presently grown only on an as-needed-basis. The trees planted in the 1950s along portions of the Angeles Forest Highway near the junction of Little Tujunga Canyon Road are the only conifer plantings that have survived recent fires because of their ability to fire-sprout.

Exotics to Los Angeles County

Robinia pseudoacacia is the most versatile hardwood grown by the Division and is the only species entirely grown as bare root stock. It can grow equally well on dry or moist sites from sea level to above 6,000' elevation. Its ability to root sprout, especially after fires, and its showy white flowers make it a favorite for roadside soil erosion plantings. However, much young bare root stock has been lost over the years because of the species great susceptibility to rabbit clipping and deer browsing.

Pinus halepensis is grown for reforestation in arid regions throughout the world and is the major component of the Division's low elevation plantings. It is a Mediterranean tree with origin in Syria and believed to be the ancient parent to the present Pinus halepensis-brutia-eldarica complex. Along with Pinus attenuata and Pinus coulteri, it is the most drought tolerant pine outplanted and can thrive on as little as 10" rainfall.

Pinus radiata, whose range does not extend quite as far south as Los Angeles County, is presently used on a limited scale from sea level to

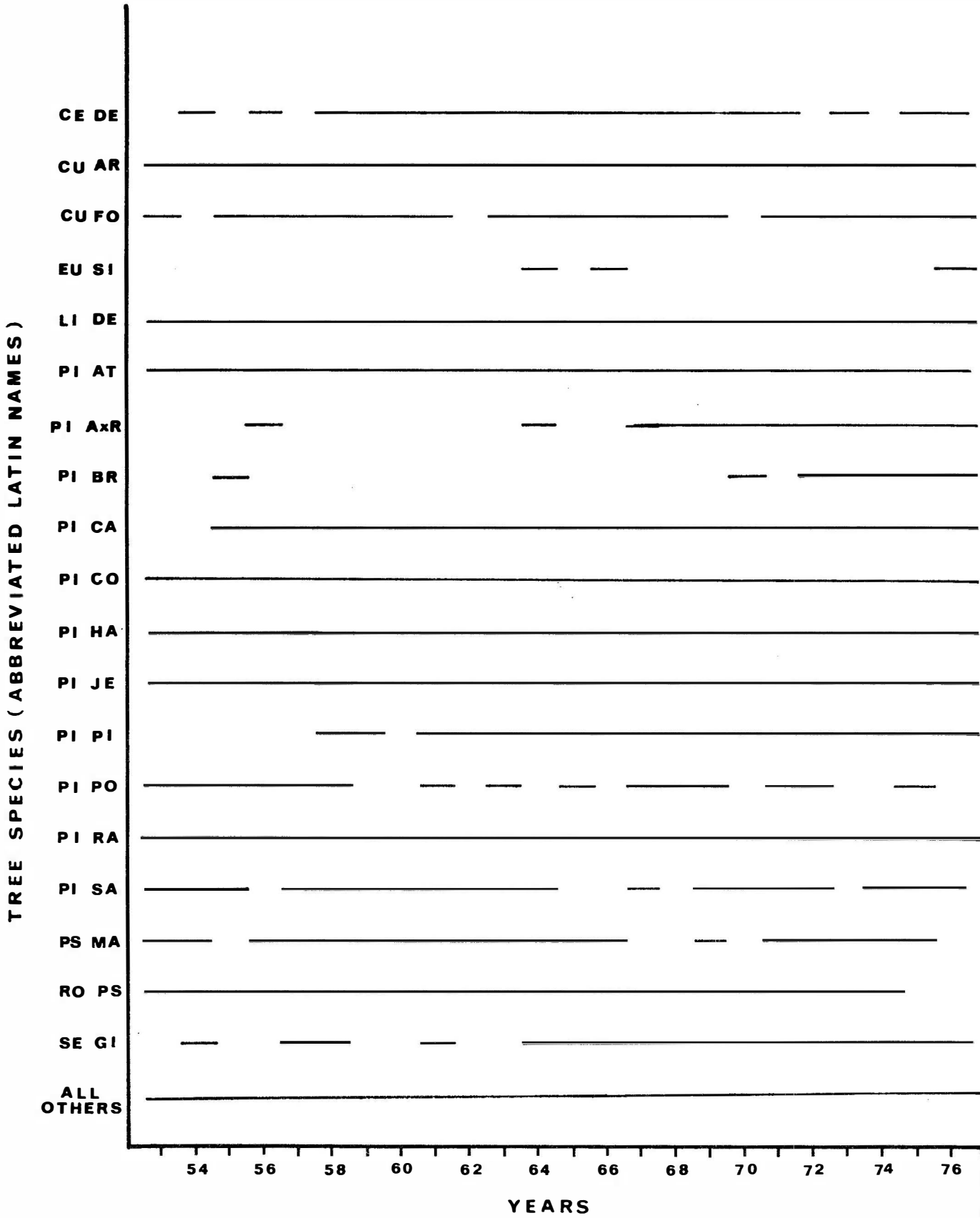


Fig. 5 20 MOST COMMON TREE SPECIES PLANTED
(1953-1977)

about 3,500' elevation, but has done well on a few selected sites as high as 4,500'. Its strong points are fast growth, dark green color, and a beautiful and evenly tapered crown. Its great drawbacks are short longevity and quick decline in vigor as it matures.

Pinus attenuata for many years was the major species for watershed rehabilitation on some of the harsher sites. A member of the closed-cone fire type pines, it can survive and compete with chaparral on some of the harshest sites where other trees tested have not survived. As understory to other trees, it is not shade tolerant and prefers elevation ranges from sea level to about 4,000' on south slopes. Its use has greatly declined in recent years because of objections to its irregular growth form and its great susceptibility to the Ips bark beetle caused by its thin bark. Thousands of trees have been lost over the years due to this beetle.

Pinus canariensis, a native to the Canary Islands, is the only exotic conifer species grown by the Division. The tree readily sprouts from eopicormic roots and shoots. It is therefore a valuable species for the Mediterranean fire-prone regions and is often the only low elevation conifer found in areas frequented by fires. The species is susceptible to frost and cannot be grown above 3,500' elevation, except for a few limited southern exposures. Experiments with supposedly frost-resistant strains from the Canary Islands and other parts of the world have not yet yielded a frost-resistant strain.

Cupressus arizonica and Cupressus forbesii are primarily used for soil erosion plantings and their special value thus is watershed rehabilitation. Their drought tolerance is comparable to Pinus attenuata. Because of their elevation elasticity, they can be noted along roadsides from sea level to above 6,000' elevation. In plantations, both species are only sparingly used because their dense, narrow tapered crown does not provide shade. However, the blue color of Cupressus arizonica and the rich light green color of Cupressus forbesii add contrast to the plantings.

Sequoia gigantea along with the indigenous high elevation pine species has not shown its dependability for reforestation. It is susceptible to drought and heavy deer and rabbit browsing, and survival of it and the indigenous high elevation pines has normally been less than 5 percent. However, Sequoia gigantea over the years has received considerable attention from a few Foresters because of its beautiful broad tapered crown, its overall pleasant appearance, use for Christmas tree plantations, and as specimen tree for landscape settings. These Foresters through paying attention to details of planting, watering at planting time, and follow-up maintenance have shown that this species can be a beautiful addition to our plantations located on north slopes as low as 4,500' elevation and in some isolated instances as low as 3,500'.

Direct Seeding

The possibility of establishing plantations through seed spots of both pre-germinated and non-pregerminated seeds has fascinated Foresters

throughout the history of the Division. The Pinus coulteri plantation at the Little Gleason plantation complex, a section of the Mill Canyon plantation, and a small section of other plantations like the Falcon Mine, can be attributed to the pioneering efforts of Ezra Miller, the common sense approach of Bill Krelle, and the curiosity of Jim Anderson.

Ezra Miller in one experiment in the 1950s covered his seed spots of non-pregerminated seeds with toilet paper. Weather conditions accounted for a bumper crop of seedlings that grew into the present plantation; however, subsequent trials proved failures and both rodent and bird depredation were problems.

Bill Krelle's 1971 trials were the simplest of all. After the plantation site was disked, Mr. Krelle dragged a chain link fence behind a small rototiller and dropped the seeds in front of the chain link fence. The seeds were incorporated into the soil at different depths and some found the right conditions for germination and subsequent survival. A one-half acre Pinus coulteri section was thus added to the Mill Creek plantation.

Jim Anderson's experiments with pregerminated seeds in the 1960s and early 1970s showed like others before him that Pinus coulteri was the best species for direct seeding. Pregerminated seeds with a .5" to 1.5" radicle, if protected by screens from birds and rodents, showed a much higher survival than bare root stock. Here, one must remember that bare root stock is not very dependable for dry site reforestation. A few warm days or drying winds after planting, which are a common occurrence with the quick changing Southern California weather, can foil the best bare root planting efforts.

Pregerminated seeds can certainly supplement the traditional high elevation planting methods of using a combination of potted and bare root stock. However, it requires great attention to detail and timing of planting with weather.

Site Preparation, Planting, Maintenance

Intensive field evaluations, excerpts of which are shown in the Appendix under the heading "Planting History", have shown that lack of proper site preparation, next to drought, is the greatest factor in tree mortality. Many sites in the 1950s and 1960s were hand grubbed and cleared only to resprout vigorously. Follow-up maintenance under these conditions proved to be very labor intensive and thus expensive for many years to come, even perhaps for the lifetime of the plantation. Chemicals often could not control the resprouting chaparral. The close spacing of some of these plantations also prevented the use of equipment until after the first heavy thinning.

The Division, in recognizing chaparral's priority in the watershed areas of Los Angeles County, therefore recommends that for recreational site establishment the following two alternatives be considered:

1. Select areas where native shade producing species predominate, such as remnants of the mixed conifer, oak-woodland, or riparian

vegetation types, and totally grub unwanted chaparral species. Then, manage the site for the perpetuation of the species selected. The Little Gleason plantation complex has some excellent examples of shade producing scrub oaks, Quercus dumosa, that with several prunings have developed into shade producing "tree oaks." Thus, recognize the versatility of native vegetation.

2. Do a complete site preparation job with heavy equipment where a conifer plantation is considered.

The site preparation must be fitted to the chaparral type. Chamise, Adenostoma fasciculatum, and certain manzanita, Arctostaphylos spp., can be readily eliminated by tractor blade and ripper, whereas for oak, Quercus spp, and resprouting Ceanothus spp, the most complete site preparation that can be done by D-8 tractor is mandatory. If this is ecologically questionable, no plantation should be established as the follow-up maintenance costs of keeping the resprouting chaparral in check is prohibitive and the extensive use of chemicals is ecologically objectionable. An example is the 400 acres cleared and planted by the Division under contract for the Forest Service in 1977. The job and follow-up planting were done with great reservations by the Unit Forester involved according to the specifications set forth by the Forest Service. A year later most of the sites are heavily overgrown by resprouting Quercus dumosa and Ceanothus species and dead proof is abundant everywhere of the folly of planting extensively bare root stock in Southern California, especially if the stock is raised in Northern California nurseries. Here the Division is concerned that its own mistakes are not repeated by other agencies and that its lessons learned are readily applied.

Once site preparation is done, the next important step is planting the right stock properly. Field evaluations found stock selection to be adequate with some exceptions shown under "Planting History" in the Appendix.

Proper tree planting is the responsibility of each individual crew member and crew leader. Present planting methods use the Little Beaver Backpack Drill or tractor mounted drill to dig holes for potted stock. The simple but important planting steps to follow are removal of the tar paper, backfilling of the hole so that the top of the root ball is slightly below the top of the hole, and then completely filling in the soil around the root ball while tamping. A basin is normally established for watering on near level ground. On slopes, trenches to catch runoff may be added one to two feet above the planted tree and the tree should be planted perpendicular to the slope. Local conditions may alter tree planting methods slightly.

It must be emphasized that there is no secret to planting trees in Southern California. Like anywhere else, it is necessary to plant in the right place, at the right time, with the right stock, and in the right way. In Southern California, the margin for mistakes is much smaller than elsewhere and one has to add to the above rules two modifiers: after right site preparation and with right follow-up maintenance.

In conclusion, the Division's policy on plantation establishment should be reemphasized. Trees should only be planted after complete site preparation which consists of extracting all chaparral stumps and large roots capable of resprouting and then completely disking the site. Deep disking turns the top soil under and brings the B horizon to the surface, thereby reducing weed competition the first year. Spacing of trees should be wide enough to allow for later maintenance with heavy equipment. Initial maintenance should consist of watering the trees to prevent losses due to drought, as drought losses may be critical at this wide spacing. Use of pre-emergent chemicals or yearly disking to reduce weed competition until crown closure is at the option of the Forester. Disking should be considered near bodies of standing water like the reservoir areas presently being planted. A firebreak or a wide fuelbreak is mandatory for the long range survival of conifer plantations and should be maintained periodically to reduce fuel buildup of weedy annuals and brush species.

While trees grow, they should be pruned occasionally to reduce ladder fuels from the ground to the crown. Care should be taken not to prune so heavily that the crown cannot shade the soil at the base of the tree most of the day. Pruning of exterior trees should therefore proceed at a slower rate. Once trees start crowding each other out, thinning is a necessary silvicultural practice. It should be light, as unexpected mortality due to gophers, drought, insects, disease, and especially fire constantly carry out natural thinning.

Intensive desert type arid region planting methods as practiced in other parts of the arid world have not been discussed in this report because the Division has not faced the need to expand into this direction.

Highlights of Field Evaluations

During the 1970s, Division policy slowly deemphasized the intensive planting and follow-up maintenance in the Angeles National Forest. This came about because of the desire of the Forest Service to manage the plantations under its jurisdiction and the restrictions placed on the Division for site preparation, species selection, and overall maintenance of new plantings. By 1975 most former County plantations were taken over by the Angeles National Forest and the Division emphasized low elevation plantation establishment outside the Forest, such as Bonelli and Castaic. It also put more emphasis on its watershed, fuel modification, and service related functions.

When field evaluations were done for this report in the summer of 1977, it was disappointing to see that most of the former Forestry Division plantations with the exception of those still managed by Unit Foresters or kept up through personal dedication of a few District Rangers were plainly not managed at all.

The Angeles National Forest personnel coming to Southern California for perhaps a three year assignment prior to moving on for a promotion, must

take enough interest in the natural resources of Los Angeles County to realize that out-of-state forestry methods need to be greatly modified for semi-arid Southern California. In-service seminars sponsored jointly by both agencies to further the understanding of the different phases of chaparral management should be held. Meetings between District Rangers and Unit Foresters to work out management aspects of the County's chaparral watersheds might be held on an ongoing basis. It is in the interest of the profession that both agencies work more closely together. If this cannot be accomplished through field personnel, then perhaps the Forest Supervisor could have County Foresters on an advisory or steering committee regarding chaparral management.

Highlights of the outplanting evaluation for the Angeles National Forest and the Santa Monica Mountains follow. Specific examples will be shown for the points discussed above.

Angeles National Forest

Over 70 percent of former County plantations are in dire need of hazard reduction work and firebreak maintenance. Even a light fire can kill the greater part of these plantations as thinning, pruning, and the build-up of fuel within the plantation and on the surrounding firebreak have been completely overlooked.

A case in point is the Hardtimes Plantation which was more than 50 percent destroyed during 1977 by an abandoned campfire. Accumulated ground fuels, ladder fuels of unpruned branches reaching into the crowns, and a firebreak overgrown with weeds were the prime factors for the fire to get a foothold in the plantation and then expand into a major conflagration.

The Bear Divide Plantation is another prime example of a neglected site. By 1977 this beautiful plantation was a firetrap and a prime example of how not to manage plantations in Southern California. Little thinning or pruning apparently has been done within the plantation, and the slash from the little pruning that had been done was left in the middle of the plantation. The firebreak is virtually nonexistent. Maintained nature trails lead through thickets of trees that reminds one occasionally of a rainforest.

An example of a well maintained plantation is Desert View. A continuous hazard reduction program gives this plantation a good chance to survive the next brush fire. On the other hand, the former Marek plantation is a prime example that proper management and hazard reduction cannot guarantee survival. The plantation is located in Little Tujunga Canyon, an area where frequent and intense fires are the result of the geology of the area. The Division initially planted this site in 1962 but excessively drained soils, and the hot, dry site, caused above normal mortality. It was replanted and expanded for the next two years and with greater care survival was drastically increased. The trees grew into a healthy plantation which was 80 percent destroyed by the 1968 Limerock Fire. The Division replanted the burn in 1970 and, with follow-up maintenance, again managed much better survival than in 1962. The 1975 Mill Fire destroyed virtually the whole plantation, and only a few dozen trees remain from both planting efforts. The Division then abandoned the site; however, 5 acres were replanted in 1976 as a public relations effort by the Forest Service and the California Conservation

Project under the direction of Andy Lipkis. No follow-up maintenance was done on the site, and by mid-summer of 1977 over 95 percent of the trees had died. Planting on other burns by both agencies during 1976 showed similar disappointing results. The lessons relearned here by other agencies are that tree plantings without follow-up maintenance is poor forestry in Southern California.

These are just some of the examples cited for the history and present conditions of plantations. Additional information may be found for selected plantations and roadside plantings in the Appendix under Planting History.

Santa Monica Mountains

Plantings were done primarily on road fills for roadside stabilization and erosion control. Soil, for the most part was rocky overcast clay-loam with low-organic material and ranged in pH from 5.5-7.0 with sites occasionally as high as 8.0. Planting sites were therefore often poor. Spacing of earlier plantings along road fills was primarily random 8' x 8'; spacing of later plantings was increased to random 10' x 10'.

Roadside plantings not in the planting summaries (prior to 1953) were established primarily by Ezra Miller in the 1940s and early 1950s. Lingenfelter was responsible for most plantings between 1955-66. Early season plantings with optimum soil moisture showed good survival; however, late season plantings (late February-March) were handicapped by decreasing soil moisture and showed greater mortality.

Heavy fire kill of conifers has occurred over the years but fire sprouting broadleaves like Ailanthus glandulosa, Eucalyptus spp., Fraxinus spp., Juglans californica, Robinia pseudoacacia, and Schinus molle have persisted here and there. Evergreen plantings were heavy on Pinus halepensis, Pinus radiata, and Cupressus species and low on Pinus canariensis and Pinus coulteri. Pinus canariensis when not killed by drought, overcast soil, or occasional cold spells resprouted well after fires. Larger pruned Pinus coulteri survived fires well. Pinus halepensis, partly because of its low stature and thin bark was the most fire-prone pine species.

Most mature conifers notic d in residential areas are the earlier remnants of the Division's tree distribution program. Unfortunately, in places like Fernwood, they now contribute directly to the fire danger facing this community. A community hazard reduction program here is urgently needed to reduce future fire losses of life and property. An active roadside tree pruning program has been underway for the last five years with labor furnished from the Adult Inmate Camp 13 and paid Fire Suppression Camp 8. However, some sites still need heavy thinning, especially the stunted trees along Encinal Canyon Road-West.

IV. 1977 - THE MODERN FORESTRY DIVISION

A. PURPOSE

One of the prime objectives of the Los Angeles County Fire Department is the protection of the County's watershed areas. In addition to direct fire protection activities in watershed areas, the Department, through the Forestry Division, is active in watershed improvement.

The major programs of the Forestry Division are:

1. Fuel management and fuel modification
2. Soil erosion control
3. Reforestation - afforestation
4. Watershed fire fighting
5. Conservation education

Fuel Modification (a form of fire protection)

Most fire experts consider the future of effective watershed fire control to be in the development of new devices and fuel modification techniques. The Forestry Division program consists of developing brushland fuelbreaks and carrying out fire control research with low-fuel volume plants grown at its Encinal Canyon Unit located in Malibu. New techniques of brush removal and modification with mechanical and chemical methods are being refined and updated. Through cooperative studies with the U. S. Forest Service Fire Laboratory, the California Department of Forestry, and the Los Angeles County and State Arboretum, new and vital low-fuel plant information has been made available to all concerned. The Division is considered to be the leader in this research field.

Soil Erosion Control

The Department is recognized as an authority in soil erosion control through the use of plantings and hydroseeding. The Division's Special Projects Section operates a nearly self-supporting soil erosion control program of planting trees, shrubs, and grasses on disturbed watershed areas in Los Angeles County for State and local agencies. In addition, burned watershed areas with high erosion potential are seeded to establish temporary vegetative cover for reducing downstream flood damage.

Reforestation-Afforestation

Watershed protection through reforestation and afforestation has been the

basic function of the Forestry Division since 1915. Its Henninger Flats Conservation Education Unit has continued operations uninterrupted since 1928. Since 1955, when the Board of Supervisors expanded the forestry program, seven branch nurseries were established over the next ten years in association with juvenile probation camps. The nurseries are spaced strategically throughout the County to provide planting stock and conservation education activities to specific areas. Silvicultural advice is continuously provided to requesting parties.

Integrated Fire Fighting

All County Foresters have emergency operation assignments on major watershed fires. Response to emergencies supersedes all other Division activities.

Conservation Education

Conservation education is mandated by the County Charter. Programs are developed for professional and service groups, teacher workshops, home-owners' associations, school groups from kindergarten through college, and Scout groups to name just a few. The geographic location of the for-estation nurseries makes them ideal conservation centers as substantiated by the continued use by Scout, school, and other interested groups.

In 1970, the Division added the position of Conservation Education Officer to its structure. His primary job is to organize and coordinate educational activities between the public and the Division's eight conservation forestry units. Duties include program scheduling, program development, display and educational material development, and information distribution to the public as well as to Division personnel. The Conservation Education Officer also represents the Department on various committees and advisory functions and is directly responsible to the Head Deputy Forester.

Other activities include development of demonstration forests in cooperation with Federal, State, and local agencies and private timber associations, setting up teacher workshops in conservation education, teaching outdoor education at various schools, sponsoring Forest Explorer Posts, serving in advisory positions with local Boy Scout Councils, counseling for Boy Scout merit badges, etc.

Several of the Division Foresters have earned teaching credentials to add to their expertise and education abilities. Some are teaching forestry courses in local schools and colleges.

Henninger Flats is the main conservation center and offers a wide variety of programs, such as self-guided nature trails, museum displays of the history of flora and fauna of the area, outdoor study areas, overnight campgrounds, numerous hiking trails, and weekend conservation education programs. Since 1967, the influx of hikers and campers visiting the area has steadily risen.

To plan ahead, the Division is currently renovating an abandoned Nike site at Mt. Gleason for another conservation education center. Site use will include resident programs for school groups, programs for the handicapped, teacher in-service training, vocational education, and many more.

B. ORGANIZATION

The Forestry Division is organized into East and West Sections and Special Projects. The East Section covers the eastern part of the County and includes Henninger Flats and Forestry Units 5, 6, and 18. The West Section covers the western half of the County including the Santa Monica Mountains and Forestry Units 3, 4, 7, and 8. Special Projects coordinates outside agency soil erosion projects and includes its warehouse facilities and Mt. Gleason.

The Forestry Unit concept was established in 1955 to provide work therapy rehabilitation for juvenile wards of the court and to increase reforestation projects through a large, readily available work force. The Units were also able to grow stock unique to the area and serve as conservation education centers which are readily available to the public. Over the years, the Unit concept proved itself through its ability to respond quickly, economically, and with flexibility to the needs of County, city, state, and federal agencies on projects such as soil erosion control, plantation establishment, fuel modification, and chaparral management studies.

Following is a short history of the Forestry Units.

1. East Section

   a. Henninger Flats

      The development of Henninger Flats, located in the San Gabriel Mountains above Altadena, was started by William K. Henninger, a native of Virginia and of German stock. Henninger settled there about 1880 but was soon driven out by lack of water. In 1884, after a winter of ample rains, he returned from Arizona and built a house and cistern for water storage. After clearing the chaparral, he planted hay, corn, melons, vegetables, and fruit and nut trees.

      Peter Steil, a Pasadena restaurant owner, held the original homestead on the Flats. Henninger bought it from him in August, 1893. Henninger's supplies during the last years of his life were left at the Flats by pack trains that supplied the resort Steil built about 1888 in the saddle between Mount Harvard and Mount Wilson. This resort was more familiarly known as Martin's Camp, named after its second owner, Clarence Martin. Henninger died on May 4, 1894, and Peter Steil arranged his final affairs.

      In February, 1895, the Henninger Flats property was sold at an administrator's auction to Harry C. and Harriet M. Allen of Pasadena. In October of the same year, the Allen's sold to a group of four men (William Morgan, John W. Vandevort, John H. Holmes, and William R. Staats), who in turn immediately sold it to the Mount Wilson Toll Road Company in December, 1895. This company retained control of

the area until the Los Angeles Department of Forester and Fire Warden bought it in 1928 for the relocation of the Lake Avenue Forest Nursery.

During the winter of 1902-03, Theordore P. Lukens (later supervisor of the San Gabriel Timberland Reserve and one-time trustee of the City of Pasadena) started several nurseries for reforesting the San Gabriel Mountains. Henninger Flats was eventually chosen and leased from the Toll Road Company as the location for its main U. S. Bureau Forestry Nursery. Many trees planted in the San Gabriel and San Bernardino Reserves during the years 1903-1907 were grown at Henninger Flats.

The first firebreaks established in the San Gabriel Mountains in 1905 were located at Henninger Flats to protect the nursery and the newly established plantations of some 62,000 experimental plantings. These plantings, under the supervision of Lukens, were accomplished by Avery T. Searle, George W. Peavy (later Dean of Forestry for many years at Oregon State University), and Edward C. Clifford. Some of these trees are still alive today.

The first telescope to be set up in the vicinity of Mount Wilson was located on a ridge south of Martin's Camp. This promontory is now known as Harvard Peak, in honor of that event. In 1903, Dr. George Hale, Director of the Yerkes Observatory in Madison, Wisconsin, initiated the establishment of a solar observatory on Mt. Wilson. In December, 1904, the Carnegie Institute of Washington, DC allotted an annual appropriation to establish and maintain the solar instruments being installed. At this time, the name of the institution became the Mount Wilson Solar Observatory of the Carnegie Institute of Washington.

In 1904, work was started on widening the toll road first constructed in 1891 to accommodate the new observatory. The project was completed in 1906. The materials for the dome and attending buildings were carried through Henninger Flats on the Mount Wilson Toll Road in 1915 and 1916. After delays caused by World War I, the Hooker glass was carefully transported up the toll road in June of 1917. Full-time operation of the world's largest telescope began several months later.

In 1928, the Department of County Forester purchased Henninger Flats from the Mount Wilson Toll Road Company for use as a high-elevation nursery. The location was determined to be ideal for growing conifers for reforestation of the San Gabriel Mountains.

During the 1930-1940 era, extensive experimental plantings were carried out at Henninger Flats. These experiments were to determine the best species and methods for growing trees in Southern California's Mediterranean climate. As a result of these plantings, the area has become a restful wooded site that is a welcome

contrast to the chaparral that covers much of the surrounding San Gabriel Mountains.

Most of the trees grown at Henninger Flats today are directed towards the Division's field planting activities. These plantings may be for reforestation of burned areas, soil erosion control, or to stabilize mountain roads. A limited number of trees are set aside each year for free distribution to the public for non-ornamental use in the watershed areas of Los Angeles County.

Henninger Flats is accessible to the public by way of the Mount Wilson Toll Road. Thousands of hikers take this historic three-mile walk from Altadena every year to either visit the facilities and perhaps camp overnight or use it as gateway to the Angeles National Forest. To meet the needs of these people, Henninger Flats, as the only Forestry Division facility offering overnight camping, has geared much of its efforts toward conservation education. The casual hiker can enjoy displays on early history, wildlife and vegetation of the area at the Visitor Center Museums, or he can observe Scouts and Foresters busy with the daily operations of running a nursery. Tours of the facilities are offered to even small groups. Overnight camping is made more attractive to Scouts and individual groups through self-guided nature trail tours and through the many merit badges Scouts can achieve. A Forester is on duty 24 hours a day. Today, as in the past, Henninger Flats, with its more than seventy years of proud urban forestry history, not only provides a retreat from the busy city life but also offers an opportunity for people to become involved in the changing phases of their urban forestry. It is the only government facility in the front country of Los Angeles County that offers these various services.

Map 7 shows the layout of Henninger Flats. Table IX gives information on the current campground capacity. Fig. 6 shows the camper-hiker dynamics at Henninger Flats over the last twelve years; Fig. 7 shows the monthly average precipitation, and Fig. 8 the monthly average temperature.

b. San Dimas Forestry Unit

During the winter of 1953-54, Fire Department Head Chief Keith Klinger and Head Forester Ralph Van Wagner met with County Probation Officer Carl Holton to plan the establishment of branch nurseries at juvenile probation camps. In September, 1954, Don Rimpau was hired as a Forestry Aid I to establish the Unit 5 Forestry Nursery.

During the early 1930s depression, the Construction and Maintenance Section of the Los Angeles County Fire Department utilized the facility to give work to stranded and unemployed young people. People would work at the camp until they had accumulated enough cash to buy themselves a railroad ticket back home. About 1940 the Probation Department juvenile camp moved from Cow Canyon Saddle,

west of Camp Baldy, to Quarry 80 and a work therapy program for the wards was started under direction of the Construction and Maintenance Section.

By establishing a nursery at a juvenile camp, a convenient "captive" labor force was available to provide work therapy for the wards of the court and to handle growing and field planting operations of the Forestry Unit. The Unit's central location in East Los Angeles County at the edge of the national forest made it an ideal site as liaison between the County, the Forest Service, and public groups. As time went on, higher education programs were developed to serve the surrounding community colleges.

During the 1950s, 60s, and 70s, most plantings were done in old watershed burns, road fills, and potential recreational sites. The majority of locations planted were on Angeles National Forest land, such as the Glendora Ridge Road, San Antonio Canyon Road, Sunset Peak Motorway, Van Tassell Motorway, and various locations throughout San Gabriel Canyon. Penny Pines money was used on several plantings, but mainly covered only site preparation costs. The Los Angeles County Forestry Division supplied most trees and manpower for actual establishment of the sites, and also did extensive follow-up maintenance. Valley of the Moon, Bear Paw, Tecolote, and Golden Cup were some of the Penny Pines sites.

With most plantings being done by juvenile and inmate labor, costs were kept relatively low. However, as time passed, the availability of a continuous labor supply from these sources dwindled due to lack of a sufficient number of inmates being placed into camps, reduction in the number of camps and shorter periods of internment for the young men. In 1975, utilization of juvenile labor was greatly reduced with the advent of a paid fire crew placed within the Unit 5 compound. The Unit, therefore, took on a contract from the Los Angeles County Parks and Recreation Department to afforest areas around the Bonelli Reservoir and create a park-like setting. As of December, 1977, more than 28,000 trees have been planted at various locations on the southside of the park with results generally good to excellent. A low-fuel volume plant "green belt" is also being established along an equestrian trail within the park.

Thus the shift from less to more expensive labor took place. To combat this, contracts for planting and maintaining parks and horse trails have been received, offsetting the cost to the Forestry Division. Results from this change seem to have worked out well; a more flexible, interested work force has been developed.

In conclusion, from the time a branch unit was established at Camp 5 (also known as Camp Glenn Rocky) numerous successful outplantings have taken place throughout the East Los Angeles County area. From Grant Brown, to Tony Baal, Warren Ristow, Paul Rippens, John Haggenmiller, Ross Johnson, Clyde Sims, and Tom Osipowich, Foresters have strived to develop sites where potential recreational facilities may be established.

MAP 7 HENNINGER FLATS

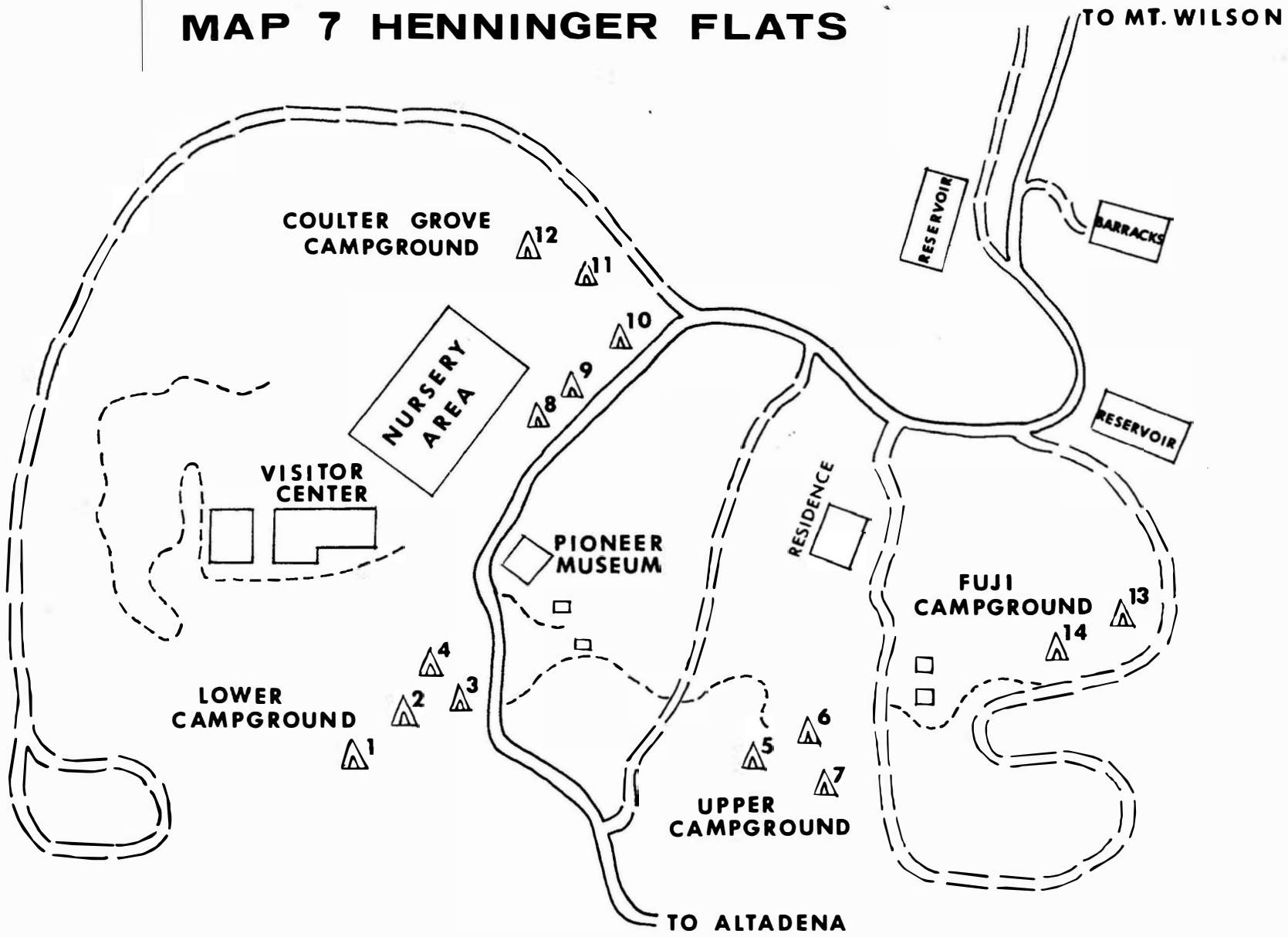


Table IX CURRENT CAMPGROUND CAPACITY INFORMATION*

Camp Name		Stove Type	Approximate Peak Capacity	Remarks
LOWER CAMPGROUND	#1	single	15	Girl, Boy Scout
	#2	single	15	family, or mixe
	#3	single	10	groups
	#4	single	5	usually saved f
				day use only
UPPER CAMPGROUND	#5	double	10	equestrian grou
				mixed groups, c
				family
	#6	single	15	Girl Scouts or
	#7	single	10	family
COULTER GROVE	#8	double	15	Boy Scouts or
	#9	double	20	unorganized gro
	#10	double	15	of boys
	#11	double	20	
	#12	double	20	
FUJI CAMPGROUND	#13	single	15	only used for
	#14	single	15	overflow until latrines are built--organize groups
			200 campers	

*Capacity based on number of flat places available for sleeping.

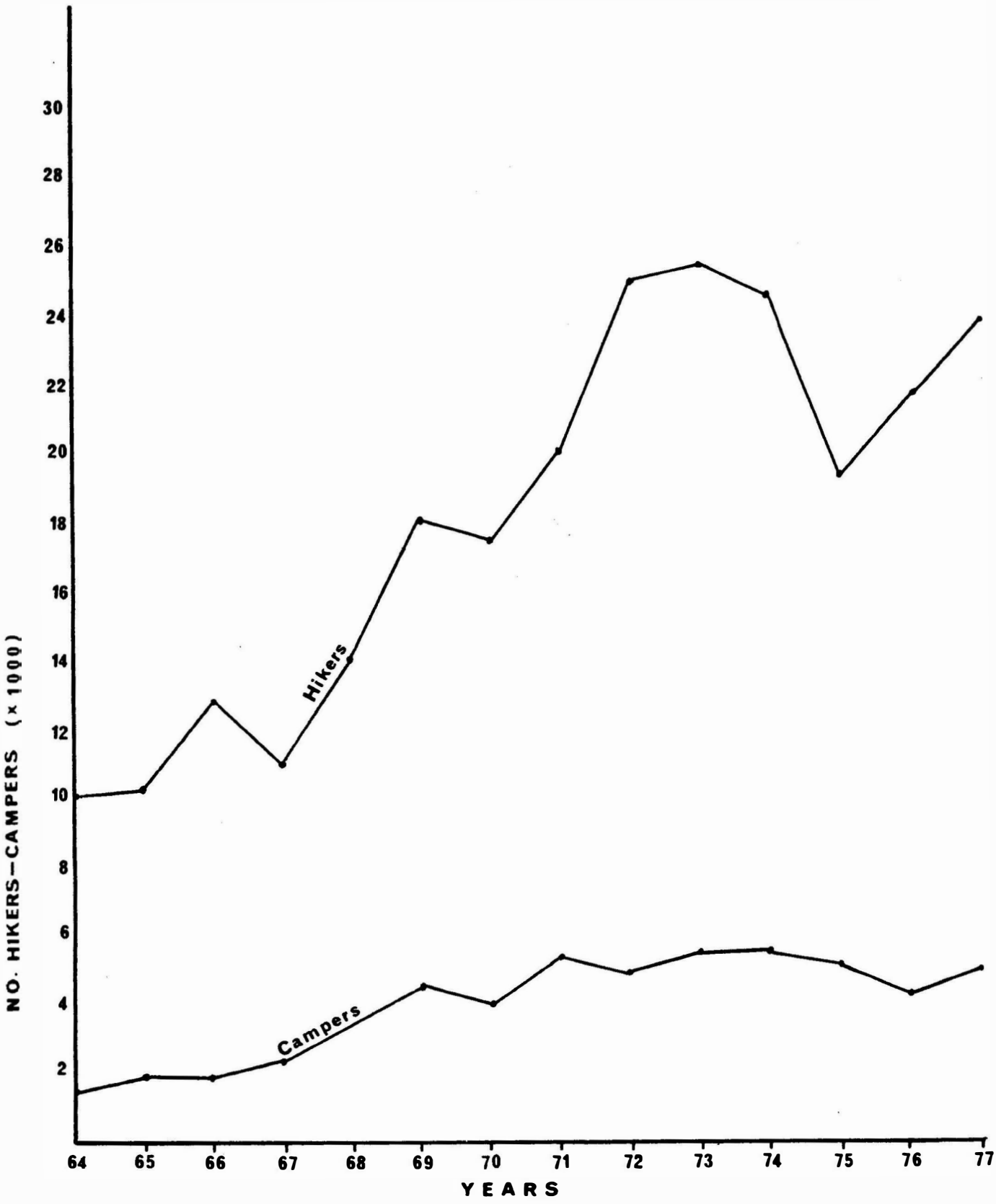
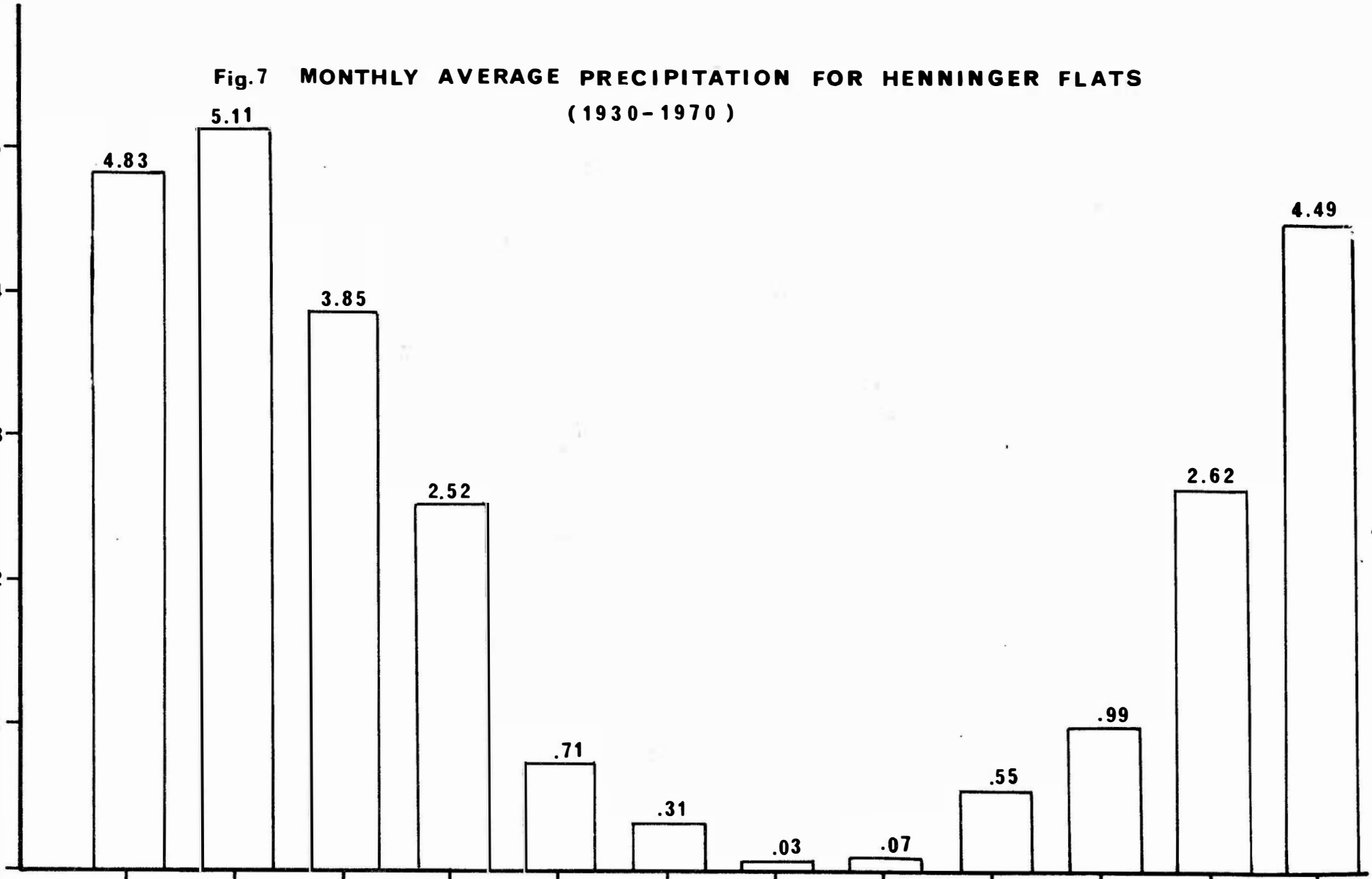


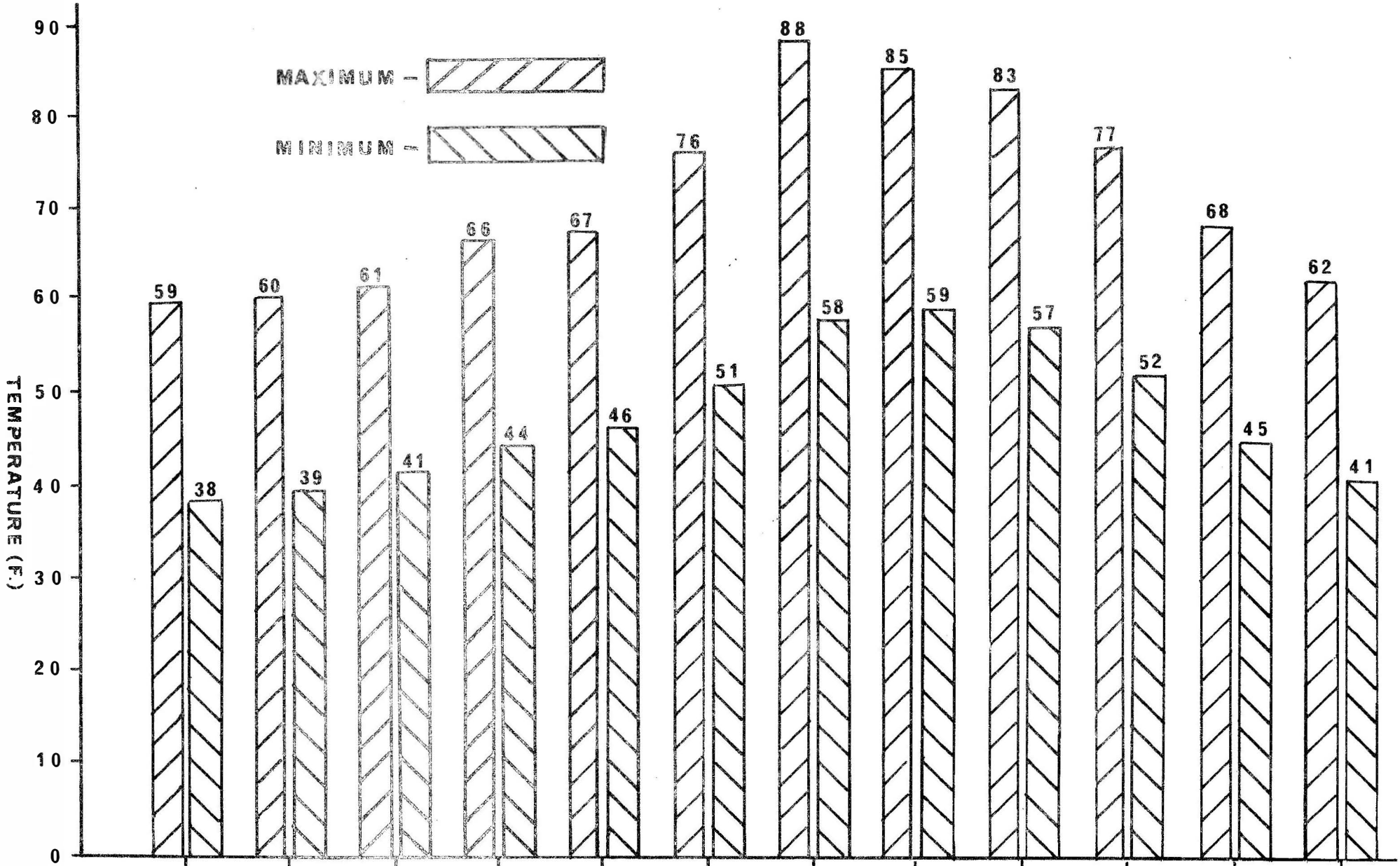
Fig.6 HIKER-CAMPER DYNAMICS FOR HENNINGER FLATS (1964 - 1977)

Fig.7 MONTHLY AVERAGE PRECIPITATION FOR HENNINGER FLATS
(1930-1970)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAXIMUM	30.91	18.57	17.28	10.19	4.47	1.56	.61	.62	8.72	5.44	23.55	12.20
YEAR	1969	1941	1938	1965	1930	1963	1935	1972	1939	1936	1965	1936
MINIMUM	0	0	0	.02	0	0	0	0	0	0	0	0
YEAR	1972	1961	1956&59	1970	1942&46	7yrs.	32yrs.	19yrs.	15yrs.	4yrs.	3yrs.	1938

Fig. 8 MONTHLY AVERAGE TEMPERATURES FOR HENNINGER FLATS
(1930 - 1970)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAXIMUM	84	86	89	98	94	105	108	108	111	102	89	87
YEAR	1971	1957	1931&66	1961	1934&73	1961	1934	1933	1954	1950	1949&66	1958
MINIMUM	20	22	24	29	31	31	31	35	34	32	26	25
YEAR	1937	1953	1942	1933	1942	1942	1941	1942	1941	1949&56	1931	1972

c. Tujunga Forestry Unit

The Tujunga Forestry Unit was established in 1958 by Deputy Forester Robert E. Johnson at Little Tujunga Canyon in conjunction with Camp Carl Holton, a Probation Department facility. With the help of juvenile inmates, plantations and roadside soil erosion plantings were established both in the Angeles National Forest and on County owned land. Table X summarizes these outplantings and shows that 187,000 trees and shrubs were planted or distributed to the public or other agencies from 1959-1975.

In 1968 when Mr. Johnson was promoted, Charles Hudson took over the nursery. Deputy Forester Hudson upgraded nursery facilities with makeshift greenhouses for the propagation of trees and shrubs with cuttings. Many low-fuel plants and native plants were grown this way for soil erosion projects in the Angeles National Forest. Conservation education and public service calls were expanded. In 1970 Mr. Hudson assumed the duties of the Division's Conservation Education Forester and Deputy Forester Dave Drennan took over the Unit. Mr. Drennan steered the Unit towards specialization in the use and prescription of herbicides.

The February 9, 1971 earthquake severely damaged the Unit. The nursery complex was abandoned and all supplies and equipment moved to its present site at the Department's Pacoima Warehouse. Deputy Forester Carl Fisher, who took over the nursery when Mr. Drennan left to accept a position with the California Department of Forestry, emphasized service aspects with the expansion of the herbicide program, responsibility for and storage of all chemicals, and the manufacture of plant containers. Today, Forester Dave Leininger, as licensed herbicide specialist, is in charge of all of the Department's herbicide operations.

d. Barley Flats Forestry Unit

The Barley Flats Forestry Unit was established in 1963 at the Los Angeles County Sheriff's Adult Detention Camp 18 located at Barley Flats in the Angeles National Forest. This high elevation forest nursery facility was established to utilize adult inmate labor on forestry related projects in cooperation with the USFS Valyermo and Arroyo Seco Districts. It is the only Division Unit whose boundaries lie entirely within the national forest.

The first major project facing Deputy Forester Michael Suggs was the construction of the nursery facility. The site was graded and transplant and pot beds were built. Field plantings were initiated at Pinyon Flats, Switzers, Grizzly Flats, Wildcat, Barley Flats, Clear Creek, and Mt. Hillyer.

Major emphasis was directed toward the establishment of the Grizzly

Table X TUJUNGA UNIT FIELD PLANTING AND DISTRIBUTION

	PLANTATION/YEAR & ROADSIDE PLANTINGS	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	TOTALS
1	Angeles Crest Hwy.		7000																	7000
2	Angeles For. Hwy.						5244	1000	1285											7529
3	Barrel Springs				514	600	430	400	400											2344
4	Bear Divide						6350	4137	9587											20074
5	Big T. Road		420									53		110						583
6	Big T. Low Fuel															1200				1200
7	Blue Bird			1652		500														2152
8	Buckhorn		960																	960
9	Camp 6	3395	1207	353	5189	1221	3917	3097	1070	2544		390	12							22395
10	Camp 9															150		688		838
11	Chilao Campground					375														375
12	Deer Cyn. Mtwy.							4797	3580											8377
13	Dillon Divide			1195																1195
14	Fan												3242							3242
15	Grizzly Flats																3885			3885
16	Herreres Mtwy.						1150													1150
17	Hidden Springs									255										255
18	Indian Cyn. Mtwy.			1550	3000															4550
19	Josephine Bowl				706					75										781
20	LaTuna Cyn. Rd.			450																450
21	Little Gleason	2000			1259	380														3639
22	Little T Road								200											200
23	Magic Mtn. Rd.								1266											1266
24	Maple Canyon					125						2560	3496							6181
25	Marek				2944	1432	1850													6226
26	Marek Alluvial						3813													3813
27	Mission Peak													574						574
28	Olive View				50															50
29	Pacoima Mtwy.				1500															1500
30	Pig Pen Flat Trl.		1469																	1469
31	Scholl Dump				505				615											1120
32	Shotgun		2146			1903	1535	750												6334
33	Upper Pad							3300												3300
34	Verdugo Hills															100				100
35	Public Dist. & Other Agencies	2600		7630	5268	2534	2482	2597	2760	10596	6164	8204	10440	1077				370		62722
	TOTALS	7995	13202	12830	20935	9070	26771	20078	20763	13470	6164	11207	17190	1761		1450	3885	1058		187829

Flats plantation where 11,959 trees were located. Plantations established at Josephine Bowl, Blue Bird, Charlton Burn, and Mt. Pacifico by the Forestry Division before the Unit's inception were placed under the Unit's jurisdiction. Plantation maintenance in the form of brush removal for plantation expansion took place at Switzers, Wildcat, and Pinyon Flats. In the field of conservation education, two schools, Morningside and Arcadia, were contacted.

On March 20, 1964, all personnel assigned to this Unit were transferred and the Unit partially deactivated. The Henninger Flats Unit took over responsibility for the management of Barley Flats until it was reactivated in 1967 by Deputy Forester James Anderson. Mr. Anderson greatly expanded the plantation establishment and maintenance program, the conservation education programs, and started cooperative studies with the Forest Service. Outplantings and public distribution are summarized in Table XI.

When Mr. Anderson accepted a position with the California Department of Forestry in 1974, Deputy Forester Clyde Sims ran the Unit for three months. After a ten-month vacancy, Deputy Forester Paul Downing took over the Unit in October, 1975. In 1975, fire destroyed part of the Wickiup and Lynx Gulch plantations which were replanted the following winter. In 1976, another major brush fire swept through the Unit area and destroyed many of the trees planted along the Angeles Forest Highway and a major portion of the Josephine Bowl plantation.

In June of 1976 Mr. Downing was placed in charge of the Federal Excess Property Program for the Department and the operation of this Unit was turned over to the Tujunga Unit Forester.

2. West Section

a. Malibu Forestry Unit

The Malibu Forestry Unit located on Las Virgenes Canyon Road across from Tapia Park, began operations in 1955 as part of a program which established forestry nurseries in association with County juvenile probation camps. Juvenile camp crews helped build the nursery and were used in its operation until 1973 when the juvenile fire crew program was abolished in the Malibu area.

In the early days, emphasis was placed on growing and planting of trees. These trees were mainly planted on County road right-of-ways for erosion control on fill slopes. Tree plantings on roadside plantation projects have continued over the years, but are declining because land in the Santa Monica Mountains is mostly privately owned with little opportunity for large scale plantation establishment. Now, emphasis has been placed on conservation education. The Unit's close proximity to urban areas makes it an attractive location for school field trips. The Unit Foresters also spend much time in the field giving programs to school groups, private organizations, and

Table XI NUMBER OF TREES PLANTED BY THE BARLEY FLATS UNIT 1964-76

	PLANTATION	DATE ESTAB.	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	TOTALS
1	Alder	1970							10855							10855
2	Alimony	1970							1639							1639
3	Angeles Crest Hwy.	1962	18				350	53			200	1315				1936
4	Angeles Forest Hwy.	1964	200		750				1258		500					2708
5	Ball Flats	1970							400							400
6	Barley Flats	1964	4085	3005				1456			5000	200				13746
7	Bear Canyon	1970							3460			2240				5700
8	Chase	1974											4262			4262
9	Chilao Campground	1972									302					302
10	Clear Creek-Aldo	1976													840	840
11	Eagle Roost	1970							37							37
12	Falcon Mine	1969						14550	5300							19850
13	Fat Cat	1971								2400			925			3325
14	Fire School	1971								700						700
15	Gould Mesa	1974											274			274
16	Grizzly Flats	1964	11959	1500		5000										18459
17	Hardtimes	1966			5421			100								5521
18	Jackson Flats	1968					1240	690	770		200					2900
19	Josephine Bowl	1962				750		670								1420
20	Kentucky Hills	1971								7055	3605	6800		5178		22638
21	Little Rock Cyn. Rd.	1971								1850	800	1050				3700
22	Lynx's Gulch	1966			3270	2157								2346		7773
23	Mill Creek Summit	1966				20452	7224									27676
24	Monte Cristo	1971								1500						1500
25	Mt. Emma Rd.	1967				2235	2900									5135
26	Mt. Hillyer	1964	1000	3570												4570
27	Pinyon Flats	1964	6780	10288												17068
28	Pipeyard	1968					325	152								477
29	Short Cut	1972									100		1400			1500
30	Switchback	1969						180								180
31	Switzers	1964	1985	1324				300								3609
32	Table Mtn.	1968					6500		1610							8110
33	Upper Big T Rd.	1966			6722	4200	8056				5000	3333	48		1005	28364
34	Upper Fish Fork	1971								2000						2000
35	Valley Forge	1971								178	20					198
36	West Fork	1971								3450						3450
37	Wickiup	1966			1539									1250		2789
38	Wildcat	1964	567		8340											8907
39	Woodwardia	1974											225			225
	TOTALS		26594	19687	26042	34794	26595	18151	25329	19133	15727	14938	7134	8774	1845	244743

other interested agencies. Furthermore, they help set up and guide many outdoor education programs.

Another service provided is the public tree distribution program. A large percentage of the coniferous trees growing in the Santa Monica Mountains originated at the Unit. These trees have assisted property owners in their efforts toward protecting their homes from excessive erosion and have contributed to the general aesthetics of populated portions of the mountains.

Service forestry is another activity that is strongly emphasized. Erosion and pest control inspections are often made, and advice concerning chaparral management is available to property owners.

The Foresters who operated this Unit over the years, namely Dick Lingenfelter, Ken Delfino, Ray Utterback, David Boyd, and currently Russ Stallings and his assistant, Mike Hudson, have always put priority on conservation education in its wide range capacity of urban forestry.

b. Saugus Forestry Unit

The Saugus Forestry Unit was established at Camp Scudder in 1956 by Arthur Arndt. The Unit's purpose was to utilize juvenile inmates on forestry projects throughout the northwestern section of the County and to serve as afforestation and production nursery for the semi-arid Saugus-Newhall areas.

From 1956-61, practical forestry research was revived. A close look was taken at site preparation methods and planting techniques. It was noted that trees survived well on new fills but did poorly on old fills and on most other sites where competing chaparral was a factor. One outcome of these studies was the use of contour site preparation for plantings. This type of planting represented the first large-scale mechanical method of site preparation accomplished by the Forestry Division. The feasibility of a new Forestry Unit concept was also investigated. It was decided that the urban forestry concept could best be served through the continuous establishment of branch nurseries throughout the County.

During the 1960s, emphasis of the Saugus Unit turned to erosion control and new recreational plantings. Several hundred thousand cuttings, trees, and low-fuel plants were established on Interstate Highway 5, Templin Highway, Lake Hughes Road, Spunky Saddle, and others.

During the 1970s, the Saugus Unit continued this work, but recently has directed all of its efforts to the second phase of the Castaic recreational plantings. With the use of heavy equipment and modern methods of site preparation, one small plantation after another is being established. Wide plant spacing is used to accommodate

the heavy equipment for follow-up maintenance and watering until trees are firmly established.

From Arthur Arndt through Louis Place, Joe Ferrara, Dave Drennan, Larry Rankin, and presently Paul Okstad, with his two Assistant Foresters Martin Gubrud and Eldon Anderson, all have left their distinctive marks on this Unit in the many changes that have taken place since 1956.

c. Lake Hughes Forestry Unit

The Lake Hughes Unit in Juvenile Camp Mendenhall was founded in 1962 by Deputy Forester Louis Place to utilize the juveniles as a labor force for semi-arid afforestation projects and to serve the Antelope Valley community. During the first few years, emphasis was directed towards construction of the nursery. First plantings were undertaken in 1964 through the Forest Service "Penny Pines" program. Lake Hughes personnel planted approximately 50 acres at what is now known as the Upper Shake Plantation. In the fall of 1964, Deputy Forester Tony Baal, who had been assigned to develop recreation sites surrounding the Castaic Reservoir, made the Unit his headquarters. Juveniles from Camp Mendenhall were utilized for the Castaic tree plantings. Today these young adults can look back with pride as being the major force that helped develop one of the largest recreation areas in Los Angeles County.

In 1973, the Probation Department phased out its facilities at the adjoining Camps Mendenhall and Munz. The camps were taken over by the Department of Hospitals, which started the Lake Hughes Rehabilitation Center. At this time, the County Fire Department started the Fire Suppression Camp 7 with CETA workers. The same year the Forestry Unit entered into a five-year contract with the California Department of Fish and Game which called for "wildlife enhancement" planting along 26 miles of the California Aqueduct running through the Antelope Valley. Patients from the Rehabilitation Center served as a labor source for this project. When the Probation Department moved back into the camps during 1974 and the Rehabilitation Center was forced to move to Acton and Warm Springs, they still supplied labor for the Aqueduct project. However, the Fire Department switched from CETA back to juvenile workers.

In 1975, Rehabilitation labor was terminated because the Fair Labor Law required that crews be paid minimum wages. Juvenile crews from Camp Mendenhall and paid crews from Fire Suppression Camp 4 were then utilized for all forestry projects. In 1976, Rehabilitation labor was again utilized because of a court ruling that exempted them from the Fair Labor Law. They, along with the juveniles, have been the nurseries' labor source ever since.

In 1976, Lake Hughes tree planting activities accelerated. This

came about because of a direct policy change by the Forest Service that finally involved them in plantation establishment in the Angeles National Forest on a larger scale. Unit personnel acted as liaison to the Forest Service during the layout and site preparation of 400 acres for tree plantations. The County Fire Department's Construction and Maintenance Section prepared the site under contract according to Forest Service specifications and Unit personnel took care of planting stock furnished primarily by the Forest Service. Preparation for another planting program of 400 acres is presently being discussed with the Forest Service and modifications in site preparation and the selection of planting stock is anticipated.

The Lake Hughes Unit, since 1962, has established and maintained 15 different planting sites encompassing approximately 165 acres. In addition to soil erosion revegetation projects, much time is also spent on conservation education programs, such as classroom presentations, demonstrations of proper tree planting methods, and tree and erosion control advisory calls. Field programs involve 4-H groups, church groups, Scouts, and school groups from kindergarten through college. Tree improvement classes offered by Antelope Valley College have used the Unit facilities for many years as their outdoor laboratory and classroom. Presently, more emphasis is being placed on conservation programs that bring school groups and other citizen groups to the nursery on field trips.

d. Encinal Canyon Forestry Unit

The Encinal Canyon Forestry Unit was established in 1965 by Deputy Forester Russ Stallings. Its purpose was to utilize juvenile inmate labor from Camp Miller for its forestry projects including researching, growing and outplanting of low-fuel, fire-retardant plants. At the Unit's inception, its personnel were responsible for the staffing and operation of a fullfledged fire camp. Later, the operation of the fire camp was taken over by the Construction and Maintenance Section of the Department. Many changes also went on within the Probation Department. They ranged from 8-hour juvenile work programs to 4-4 programs (four hours work and four hours school) to closing of the camp and reopening it with an 8-hour school program. The latter forced Unit personnel to depend on a combination of adult inmate labor, CETA workers, and welfare workers for its labor source. Since 1973, labor for the various programs has been supplied by both Fire Suppression Camp 8 (CETA) and Adult Detention Camp 13 (adult inmates).

Almost since its inception, the Unit has been cooperating in field testing of fire-retardant plants with personnel from the Forest Service Fire Laboratory at Riverside. Funding for upgrading the nursery facilities for more efficient plant propagation was made available in 1970 when Grant High School in Van Nuys donated $700 for this purpose in return for trees to be planted for watershed

rehabilitation of the 1970 Malibu burn. The County Board of Supervisors graciously accepted this gift in behalf of the Unit personnel.

Less than two years later, the students of Grant High School offered the Unit another $1,300 collected from their bike rally. The money was used to enlarge the glasshouse and modernize the propagation house. With this modernization, more efficient propagation of a greater variety of plant species was feasible. This led to the first cooperative agreement with the Fire Laboratory in 1973 on outplanting and testing of low-fuel, fire-retardant plants. Low-fuel plant test plots were continuously established throughout the County and a research trip to selected Mediterranean countries of Europe, Africa, and Asia was taken by Klaus Radtke in search of new low-fuel plant species. Seed accession plots for these species were established at the Encinal Canyon Research Unit and at Wayside Honor Rancho, so that today enough seeds of selected species are on hand for large-scale fuel modification trials. Seed exchanges are being carried out with arid and semi-arid research stations in the United States and other parts of the world. Many of the plants introduced have shown their multiple use other than low-fuel, such as wildlife enhancement, range improvement, soil erosion control, soil rehabilitation and landscaping. However, emphasis is not only placed on introduced species; native plant species have proven themselves as low-fuel plants and their potential for dry site landscaping is almost unlimited.

Because of Russ Stallings' reassignment as fuel modification Forester, the Unit was staffed from 1970 to 1973 by Forestry Assistant Klaus Radtke. In 1973, Klaus Radtke was promoted to Deputy Forester in charge of forestry research activities for the Division, as well as Encinal Canyon low-fuel plant research. He is currently heading this Unit.

To meet the many commitments for specialized plants within the Division and for cooperating agencies, the Unit facilities have been constantly modernized. The present addition is a 50' x 70' aluminum lath house which replaces the 16 pot beds built in the 60s. This gives the Unit the capability to fully automate its operations, if so desired. All this effort went almost up in smoke. The November 15, 1977, Carlisle Fire raced up to Probation Camps Miller and Kilpatrick and forced their evacuation. Only the combined efforts of the Los Angeles City and County Fire Departments and dedicated Forestry Division personnel (and Divine Intervention) prevented the fire from erasing the nursery facilities.

3. Special Projects

The Division's Special Projects Section including herbicides was initiated in 1968 and headed by Senior Deputy Forester Joe Ferrara. The responsibility for herbicides was later given to Deputy Forester Dave Drennan. When Dave Drennan transferred to Unit 6, he

established the Unit as headquarters for the Division herbicide operations.

Special Projects came about because outside agencies often were in need of expert personnel to tackle tough site rehabilitation projects. The Forestry Division had the expertise to do this and outside agencies selected the Special Projects Section to do the jobs. Special Projects soon became the expert in rehabilitation of disturbed sites when these four criteria were needed:

a. Soil Erosion Control
b. Aesthetics
c. Wildlife Enhancement
d. Fuel Modification

Potted low-fuel and erosion control plants were furnished primarily by the Encinal Canyon Unit. Trees and miscellaneous erosion control plants were grown by Saugus and other Units.

In 1970, Special Projects branched off into its present two units of soil erosion control and landscaping. The erosion control unit has the responsibility of revegetating disturbed sites; primarily road fills and road cuts. The landscape unit conducts landscaping and some maintenance of Fire Department facilities, installation of campgrounds and rest areas, and landscape revegetation of debris disposal areas and flood channels.

To manage its revenue offset projects more effectively, Special Projects soon acquired power equipment and two equipment operators, plus a hydroseeder. Its equipment and operators are used by the entire Forestry Division for site preparation on planting projects. The hydroseeder doubles as a mobile base unit for mixing fire-retardant Phos-chek for helicopter use during fires.

On its tough road cuts and fills, Special Projects guarantees to outside agencies funding the job a certain plant cover percentage within a given time. Seed spotting at six-foot centers the first year with interplanting of potted stock the following years, along with more seed spots, has proven very effective to quickly provide a dependable cover. Broadcasting a seed mixture of brush species, and then straw punching the seed into the soil so the straw acts as a mulch to retain moisture works well on fills.

Over the years, Special Projects has found that with proper site preparation, appropriate plant selection, and perhaps drip irrigation as needed, most sites can be rehabilitated. Some sites are non-productive at any cost; thus, the proper site selection can cut down on much wasted time and effort which translates into money for the funding agency.

In the summer of 1977, Special Projects took over the operation of the Mt. Gleason Conservation Education Center on a temporary basis. The aim is to utilize some of its manpower to quickly finish rehabilitation of an old Army Nike site into a much needed year-round outdoor conservation education center situated in the remnants of Los Angeles County's natural forest.

CONCLUSION

The improvement of the vegetative cover of the watersheds in Los Angeles County has been the Forestry Division's principal objective since 1915. This has been accomplished through watershed management projects aimed at preventing excessive soil erosion and through afforestation/reforestation plantings. This report focused on the latter because of intensive pressures put on recreational sites by a continuously increasing population and the demands urban foresters in California are facing in developing future recreational areas. The word reforestation was used in this report for almost all plantings, but strictly speaking reforestation was practiced primarily above 5,000' in the mixed conifer stands of the Angeles National Forest. Afforestation occurs below this elevation in the chaparral plant community. An exception is the matrix of forest and chaparral found at the interface of these two vegetation types. Chaparral pushes into the higher elevations on dry slopes and the forest extends into the lower elevations on moist north slopes and canyons.

Initial reforestation/afforestation efforts by the Forest Service at the turn of the century were geared toward species adaptation trials. When the County Forestry Department expanded these efforts in 1915, little was known about the chaparral vegetation. Most public and private agencies believed that California's brush types could be readily converted to forest. The Forestry Department, as one of its functions, set out to do this task in Los Angeles County. Within 15 years, the impossibility of this undertaking was realized as large-scale brush to forest conversion in Southern California had not proven feasible either through legislation efforts or large-scale plantings. During the 1930s emphasis was therefore directed toward forest research coupled with small-scale outplantings and more intensive watershed rehabilitation projects. The importance of chaparral as a valuable though fire-dependent watershed cover was emphasized and its protection through fire exclusion to minimize erosion became the Forester and Fire Warden Department's policy.

Since the mid-1950s tree planting efforts again accelerated in Los Angeles County in response to the recreational pressures facing the relatively few forested areas in Los Angeles County. With the development of the California Aqueduct, more recreational sites were made available and the Forestry Division was called upon to develop forested areas around Castaic and Bonelli reservoirs. The emphasis shifted from large-scale, higher elevation plantation establishment, to low elevation, arid region afforestation.

Since 1915 the Forestry Division has planted many harsh sites, mostly under marginal planting conditions because of the unpredictable rainfall of Southern California's Mediterranean climate. The lessons learned through planting failures and successes seem to be applied common sense. Principles however are often ignored by both individuals and agencies doing reforestation/afforestation work in Southern California.

From the Division's own experience and evaluations of past tree planting reports in Southern California, the following conclusions are drawn:

Reforestation/afforestation work should not be attempted in Southern California unless complete site preparation, continuous fire hazard reduction, and regular T.S.I. maintenance (as discussed in this report) are included in the work plan as standard practices (or liability) of plantation establishment.

When selecting a planting site, local fire corridors, geology, climatic variables, soil limitations, site accessibility, and species adaptation must be considered. Since the plantings are mainly for future intensive recreational use, seemingly minor details such as steepness of slope and aspect must not be overlooked.

The development of natural sites through applied fuel modification has shown great promise wherever attempted. It requires the liberation of selected tree species such as oaks from surrounding chaparral and the pruning and reshaping of tall chaparral species; however, for it to be successful requires a follow-up maintenance schedule.

Planting sites must be preplanned in order to survive major fires. This can be accomplished by employing, whenever feasible, more fire type tree species, selecting mixtures of hardwoods and evergreens, or mixtures of evergreens if hardwoods are not adapted to the site, and concentrating plantings in scattered groups instead of establishing large plantations. Green belts, fuelbreaks, firebreaks, and sanitization efforts must accompany plantations to minimize fire losses.

Semi-arid region recreational plantings have proven successful if the guidelines mentioned in this study are adhered to. They will continue to be an important aspect of the management of Southern California wildlands, because they provide two scarce resources for Southern California, namely trees and shade.

Photo 9: Castaic Reservoir Afforestation Project - One of the many plantations established here is awaiting its visitors.

Photo 10: Bonelli Afforestation Project - Trees are beginning to replace the degraded chaparral. Puddingstone Reservoir in background.

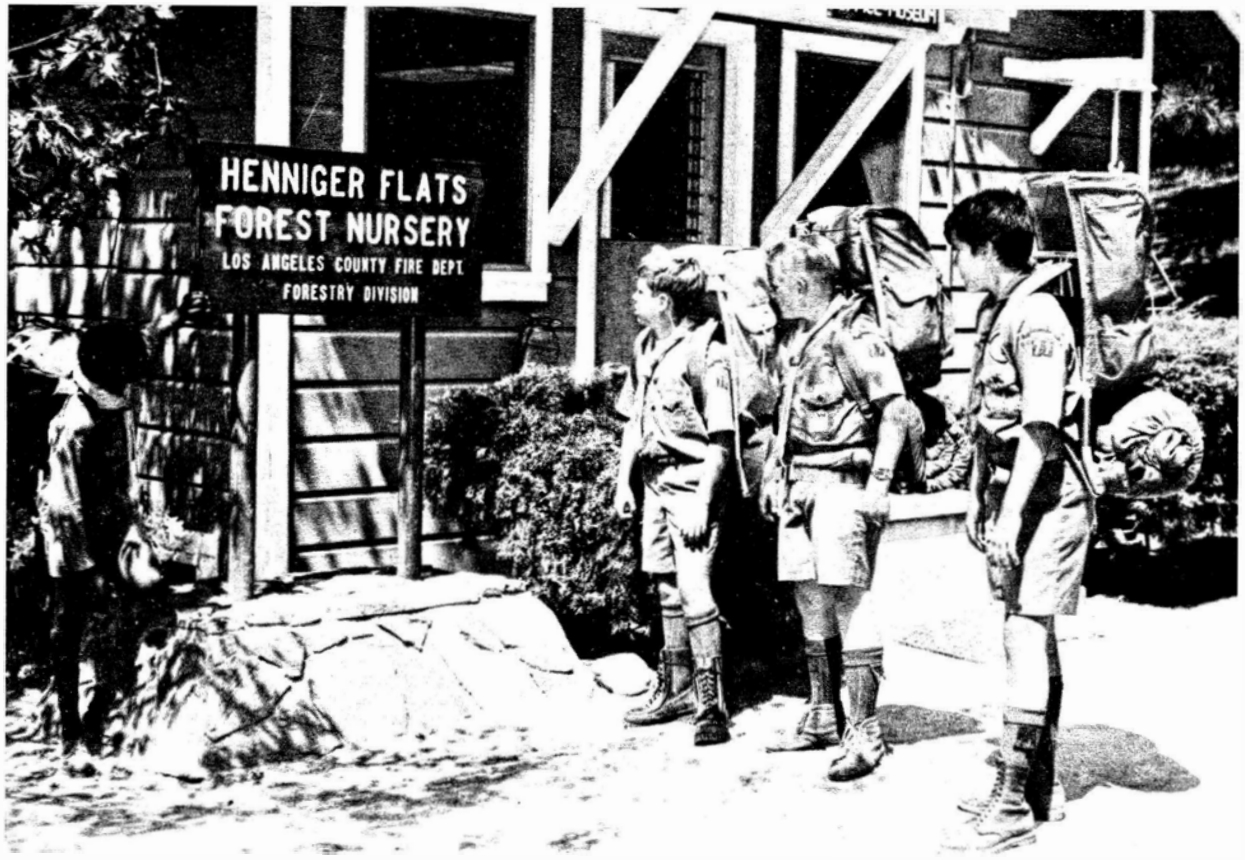


Photo 11: Henninger Flats Conservation Education Center. Boyscouts have arrived at the museum after a three-mile hike from Altadena along the old Mt. Wilson Toll Road.

Photo 12: Henninger Flats seed beds. High school forestry students are preparing the seed beds during a Saturday class taught by Division Foresters.

A P P E N D I X

LIST OF TABLES, FIGURES, MAPS, AND PHOTOGRAPHS

TABLE XII YEARLY PRECIPITATION IN INCHES 1953-1977 - SELECTED PLANTATIONS & ROADSIDE PLANTINGS

PLANTATIONS/ ROAD PLANTINGS	L*	90 YR AVG	52 53	53 54	54 55	55 56	56 57	57 58	58 59	59 60	60 61	61 62	62 63	63 64	64 65	65 66	66 67	67 68	68 69	69 70	70 71	71 72	72 73	73 74	74 75	75 76	76 77
1. Barley Flats	AA	34	--	--	--	--	--	56	19	17	14	28	20	19	28	52	58	29	80	24	27	16	45	35	28	29	24
2. Bear Divide	AT	26	14	23	17	23	21	41	12	12	10	28	16	16	20	33	50	22	44	--	21	11	26	22	20	21	19
3. Bear Paw	AB	37	25	42	20	28	34	65	30	24	19	51	27	29	37	61	70	34	95	26	33	25	54	36	38	42	23
4. Big "T" Cyn Rd	AT	20	15	24	23	21	19	45	15	11	11	31	19	16	24	41	39	19	66	18	27	11	40	26	23	15	15
5. Bonelli	P	18	12	16	12	16	13	32	8	10	16	20	11	9	14	17	24	15	31	12	12	9	21	15	15	11	15
6. Castaic	C	17	8	12	11	13	12	23	6	8	5	19	9	7	12	16	16	11	22	9	13	8	15	12	14	10	11
7. Chilao	AA	25	12	19	19	17	18	43	12	11	10	30	17	13	22	40	32	20	49	16	21	13	27	22	23	24	21
8. Encinal Cyn F.U.	M	23	17	24	22	25	18	44	13	16	10	40	19	13	22	37	43	24	52	18	26	14	35	26	24	14	14
9. Hard Times	AA	25	12	15	14	14	12	30	9	9	7	19	13	18	13	25	23	15	37	13	15	10	18	18	13	15	14
10. Josephine Bowl	AT	30	--	--	16	16	16	38	13	9	9	25	15	12	16	35	33	17	48	13	18	11	24	18	16	17	12
11. Kentucky Hills	AV	11	--	8	8	6	7	14	5	5	5	11	6	6	8	12	10	9	15	5	9	6	10	7	10	9	9
12. LA Headquarters	LA	17	11	14	13	17	10	25	7	10	5	21	11	8	14	21	21	12	30	10	13	8	20	15	14	10	13
13. Little Gleason	AT	24	--	--	18	19	18	39	12	8	10	27	13	15	--	36	42	20	53	14	20	12	27	23	24	30	19
14. Mill Cr. Summit	AA	20	10	17	16	13	12	28	9	10	9	22	12	12	15	25	27	21	27	15	14	10	19	15	14	16	19
15. Monte Cristo	AA	25	13	23	19	19	19	47	15	12	11	33	16	15	20	39	44	22	67	17	23	13	33	21	20	23	19
16. Pacifico	AA	22	12	16	16	13	10	22	7	6	5	13	13	12	21	27	--	8	--	15	19	--	22	23	20	19	19
17. Pidgeon Ridge	AB	33	--	30	28	26	30	65	24	18	16	42	22	20	26	57	57	26	77	23	26	19	41	29	27	26	20
18. Portal Los Cant.	AS	13	--	--	--	13	--	28	8	--	6	17	9	8	13	19	20	10	24	10	12	7	15	14	11	9	10
19. Rincon Flats	AB	32	15	24	23	22	24	54	16	16	12	35	15	15	20	46	49	20	71	19	20	14	39	22	21	20	21
20. Saddle Peak	M	20	14	20	16	21	17	33	10	14	7	33	16	12	20	27	43	21	42	12	20	10	29	23	18	10	16
21. Springhill	AB	30	17	29	21	21	22	58	17	16	13	34	19	20	25	48	52	--	80	19	19	13	36	25	23	26	18
22. Spunky Saddle	AS	17	9	15	13	13	12	32	9	8	8	20	11	11	13	21	26	14	33	10	14	9	19	10	15	12	10
23. Tanbark	AB	29	17	25	19	20	19	48	14	14	11	29	18	16	22	33	44	20	--	16	20	12	34	23	22	22	11
24. Tumble Inn	AS	16	9	12	13	11	12	26	10	7	11	25	11	11	13	19	25	16	25	12	16	8	21	13	16	16	17
25. Upper Shake	AS	19	--	--	--	--	15	--	11	10	10	26	10	12	17	28	38	15	46	11	21	13	27	21	22	--	16
26. Valley of Moon	AB	35	--	30	28	26	30	65	24	18	16	42	22	20	26	57	57	26	77	23	26	19	41	29	27	26	20
27. Wayside Honor Rn.	C	14	8	12	11	13	12	23	6	8	5	19	9	7	12	16	16	11	22	9	13	8	15	12	14	9	11

Key for symbols: L* - Location

AA - Angeles National Forest - Arroyo Seco District
AB - " " " - Baldy District
AS - " " " - Saugus District
AT - " " " - Tujunga District
AV - " " " - Valyermo District
C - Castaic

M - Malibu
P - Pomona
LA- Los Angeles

#	District	1 PLANTATION DESC Name & Location	Date	2 STOCK DESCRIPTION Type	Age	Specie	#	3 SITE DESCRIPTION Aspect Ht.-Ft	Soil & pH	Vegetation	4 ESTABLISHMENT Pl. Method Spacing	S.Moist Weather	5 SURVIVAL % 1 YR	2 YR	3 YR	75 76	76 77	6 MORTALITY Reason	7 SILVIC. TREATMENT Site Prep.	Maint. & Pest C.	8 RECOMMEND Evaluat.& Forester
A		Bear Divide Plantation 3N14-9	W-64	BR	2-0	LIDE	2750	Mostly East 5°	Sandy clay loam	Ce & Qu chap	Shovel & tamp 8' x 8'	NA	50					deer browsing, frost, BR= drought	Brush removal, disking	1970 brushed 1971 Selective thinning. Limbing of older trees 1975 brushed, 10% thin, 2 whorls prune	B. Johnson Plantation varies in crown closure. Vigorous looking trees. Excellent recreation spot. Lack of recent maintenance makes this extremely fire prone. Much crew time needed for brush removal and further pruning and selective thinning.
				Pot	1-1	PICA	550						80								
				BR	2-0	PICO	2000						30								
							5300	2,500' to 2,800'	pH 5-6.5												
			W-65	BR	2-0	LIDE	3237						30 (overall)				25	Drought (bare root), poor planting			
				Pot	1-1	PIAT	200														
				Pot	1-1	PICA	400														
				Pot	1-1	PICO	100														
				Pot	1-1	PIHA	100														
							4037														
			W-66	Pot	1-1	CUAR	200														
				Pot	1-1	LIDE	62														
				Pot	1-1	PICA	330														
				Pot	1-1	PIHA	520														
				Pot	1-1	PIRA	25														
				Pot	1-1	SEGI	50														
							1187														
B		Bear Paw Plantation	Jan. 1965	Pot	1-1	PIJE	1217	Mostly South-east, some North 5,200'	D.G. pH 6.0	Ar spp Ce spp Ad fa Chap	Shovel & tamp, planting bar, Little Beaver type back-pack 6 x 6 10 x 10	NA						All SIF plots suffered great losses due to rodents and dry conditions. Some areas had no site preparation. Winds at the time of planting the bare root stock caused high mortality.		1970 brushed 1971 Selective thinning. Limbing of older trees 1975 brushed, 10% thin, 2 whorls prune	Ristow T. Baal Haggenmiller Due to improper site preparation (in some areas) brush is heavily competing with trees. Trees show good growth rate. Brush, prune. A fire could easily destroy the plantation.
				Pot	1-1	PIPO	400														
				Pot	1-1	PICO	238						95	90							
				Pot	1-1	PSMA	62														
				Pot	1-2	LIDE	238														
							2155														
		3N9-7	Dec. 1965	Pot	1-2	PICO	2060						80	80							
				Pot	1-2	PSMA	419														
							2479						80	80							
			Nov. 1966	Pot	1-1	LIDE	984														
				Pot	1-1	PIJE	850														
				Pot	1-1	PICO	100														
				2 g.		SEGI	13														
				Pot	0-2	PICA	45														
							1992														
			Jan. 1968	BR	2-0	LIDE	1201														
				BR	2-0	PICO	300														
							1501														

#	District	1 PLANTATION DESC Name & Location	Date	2 STOCK DESCRIPTION Type	Age	Specie	#	3 SITE DESCRIPTION Aspect Ht.-Ft	Soil & pH	Vegeta tion	4 ESTABLISHMENT Pl. Method Spacing	S.Moist Weather	5 SURVIVAL % 1 YR	2 YR	3 YR 75 76	6 MORTALITY Reason	7 SILVIC. TREATMENT Site Prep.	Maint. & Pest C.	8 RECOMMEND Evaluat.& Forester
		Bear Paw Plantation	Jan. 1970	SIF		PICO	150												
				BR	1-0	PILA	100												
							250						20 (overall)	1	1				
			Jan. 1971	BR	2-0	PIJE	500						96	90	90				
			Jan. 1972	BR	2-0	PIJE	1000												
				"	1-0	LIDE	200												
				"	2-0	PICO	500												
							1700												
			Jan. 1973	BR	2-0	LIDE	110												
			Jan. 1974	Pot	1-1	PICO	1769							90	90				
				"	1-1	LIDE	200												
				BR	2-0	PICO	1800												
				"	2-0	PIJE	225												
				"	1-0	PILA	300												
							4294												
			Jan. 1975	Pot	1-1	PICO	160												
				"	1-1	LIDE	44												
							204												

#	District	1 PLANTATION DESC Name & Location	Date	2 STOCK DESCRIPTION Type	Age	Specie	#	3 SITE DESCRIPTION Aspect Ht.-Ft	Soil & pH	Vegetation	4 ESTABLISHMENT Pl. Method Spacing	S.Moist. Weather	5 SURVIVAL % 1 YR	2 YR	3 YR	75 76	6 MORTALITY Reason	7 SILVIC. TREATMENT Site Prep.	Maint. & Pest C.	8 RECOMMEND Evaluat.& Forester
		BONELLI PLANTATION COMPLEX																		
		Alphabet	W-76	Pot	1-1	PIHA	363	SE-NW level to 15° - pH 5.5-6	V.rocky clay loam, clay pan at 2' (upper) - - 3'depth lower		prim.pick, shovel & tamp	watered in	(both sites)			85				(all sites) R.Johnson (75) C. Sims (76), T. Osipowich, E.Oldar, D. Neff, M.Wilkinson
			"	"	1-2															
			"	"		CEDE	347													
			W-77	1 g.		EUSI	450													
							1160													
		Bicentennial Grove	W-75	Pot	1-2	PIBR	83	N 15°	1-3' pH 5.5-6	.5	"	"								watered first season
		Dynamite Gulch 1S9	W-75	Pot	1-1	PIPI	717	various aspects to level 25°	loam to clay loam 1-5' in depth - pH	Herbaceous veget.,	prim.pick, shovel & tamp	trees watered in	(overall)			95	gophers, rabbits	prior to planting a section was dynamited to fracture bedrock for better root penetration. stripped, ripped & disked	disked yearly	
			"	"	1-1	PIBR	153									95				
			"	"	1-2	PIMO	9													
			"	"	1-3	PIRO	16													
			"	"	0-2	PICA	67													
			"	"	0-3															
			"	"	1-1	PIHA	2423													
			W-76	"	1-2											95				
			W-77	"	1-2	SCMO	540									100				
				1 g.		EURU	21													
				"		EUSI	282													
				"		EUPO	163													
				5 g.		CUAR	1													
							4392													
		Indian Valley	W-75	Pot	1-1	PIBR	90	N-NE & SE level-15°	sandy loam 3'+ depth pH 5.5-6	Herbaceous veget., Er fa cacti	"	watered in				95	insect damage		disked yearly	
			"	"	1-2															
			W-76		1-1	PIHA	727						(overall)			95				
					1-2															
					1-2	SCMO	150													
							967													
		Intersection	W-75	Pot	1-1	PIBR	90	NW & SE 5-10°	loam 2' + - pH 4.5-6	Er fa& annual grasses .0	"	"				97	tractor damage when disking		disked yearly	
			W-76	Pot	1-1	SCMO	163									99				
							253													

#	District	1 PLANTATION DESC Name & Location	Date	2 STOCK DESCRIPTION Type	Age	Specie	#	3 SITE DESCRIPTION Aspect Ht.-Ft	Soil & pH	Vegetation	4 ESTABLISHMENT Pl. Method Spacing	S.Moist Weather	5 SURVIVAL % 1 YR	2 YR	3 YR	75	76	6 MORTALITY Reason	7 SILVIC. TREATMENT Site Prep.	Maint. & Pest C.	8 RECOMMEND Evaluat.& Forester
		Inter-state	W-76	Pot	1-1	PIHA	995	SW 0-10°	rocky loam 1-3' pH 6.0	Er fa, cacti, annuals	"	"								watered first season	
				"	1-2																
				"	1-1	PIBR	300														
				"	1-2																
				"	0-2	PICA	30														
			W-77	1 g.		EURU	274														
				5 g.		PIPI	1														
				"		CUAR	1														
				1 g.		EUSI	3														
							1604														
		Kriss-knoll	W-75	Pot	1-1	PIHA	1724	N-W (upper)	rocky, clay loam	Ad fa, cacti, annuals	"	"	(upper)		95				stripped & ripped both ways not disked - stripped & ripped one way only -	large rocks prevent disking, mustard removed by hand	
			W-76	"	1-2																
				"	"	PICA	179	NW 5-30° (Middle) -	6"-1' pH 5.5-6.5 rocks incr. on higher sites				(middle)		30			grass-hoppers protected by heavy stands of dead mustard injured tree bark killing trees			
				"	1-1	PIPI	745														
				"	"	SCMO	165						(lower)		90						
			W-77	"	"	PIEL	40														
				1 g.		EUSI	710	NW&SW 20-30° (lower)													
				"		EUPO	99														
				Pot	1-1	PIBR	23														
							3685														
		Mac's Mesa	W-76	Pot	1-2	PIBR	100	varies 0-15°	varies quite rocky 1'-3' pH 5.5-6.5		"	"						mustard& rocky sites	rip & partially disked (rocky)	watered as needed beyond first season	
				"	1-1	SCMO	28														
			W-77	"	1-1	PIHA	1442														
					1-2																
			W-76,77	"	0-2	PICA	563														
			W-77	1 g.		EUSI	265														
							2398														
		Moxie	W-76	Pot	1-1	PIPI	44	NE & W 0-10°	loam clay loam 2'+ pH 5.5-6	Er fa, annual grasses										watered first season	
				"	"	SCMO	267														
							311														

#	District	1 PLANTATION DESC Name & Location	Date	2 STOCK DESCRIPTION Type	Age	Specie	#	3 SITE DESCRIPTION Aspect Ht.-Ft	Soil & pH	Vegetation	4 ESTABLISHMENT Pl. Method Spacing	S.Moist. Weather	5 SURVIVAL % 1 YR	2 YR	3 YR	75 76	76 77	6 MORTALITY Reason	7 SILVIC. TREATMENT Site Prep.	Maint. & Pest C.	8 RECOMMEND Evaluat.& Forester
	B	19th Hole	W-75	Pot	1-1	PIHA	797	N-NW 15°	loam to light clay loam 4' pH 5.5-6.5	Er fa, Ar ca, annuals	prim. pick, shovel& tamp	watered in				95	99			disked yearly	
			W-76	"	1-2																
				"	1-1	SCMO	168														
				"	1-1	PIBR	9														
				"	1-2		974														
		Ridge-top	W-76	Pot	1-1	SCMO	65	S 5° -	v. rocky loam clay loam 1'+ pH 5.5-6.5	Er fa, annual grasses	"	"			(overall)	95		thin soils, drought		watered first season	
				"	"																
				"	1-2	PIHA	59														
							124														
		Rossdale	W-75 W-76	Pot	0-2	PICA	227	N,S,W, E, level 15°	heavy clay loam 3'+ - pH 5.5-7.0	Er fa, Sa me, annual grasses	"	"				95 95			stripped & disked		Mature trees tree-spaded in 1960s: PIHA-wind-blow tendency in heavy soils,flag-ging. PIRA-drought stress (heavy inner needle drop) PICA-vigorous. Little smog damage on mature trees
				"	"																
				"	1-1	PIHA	808														
				"	1-2	PIRO	20														
				"	"	PIBR	250														
				"	"	EURU	173														
				1 g.	"	EUSI	42														
							1520														
	1	Shangra-la	W-75 W-76	Pot	1-2	CEDE	148	N-S 0-10°	clay loam 1-3' pH 5.5-6.0	Er fa Ar ca annuals cacti	"	"			(overall)	95					
				"	1-1	PIBR	19														
							167														