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The San Dimas Experimental Forest: 50 Years of Research

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Cover: Flume and stilling well gather hydrologic data in the Bell 3 debris reservoir, San Dimas Experimental Forest. (*Photo:* David R. VanDusen.)

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INTRODUCTION

The San Dimas Experimental Forest (SDEF) is a field laboratory for studies in the ecology of chaparral and related ecosystems. A broad data base together with unique physical features make the SDEF an ideal location for studies of timely topics such as acid deposition, sediment production, biomass production control, and chaparral management systems. Located in the San Gabriel Mountains northeast of Los Angeles, the Forest is a valuable research site because it is close to urban universities, is protected from public disturbance, and because little public land is currently available for field research as a result of pressure for recreation sites.

The SDEF is under the jurisdiction of the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, and has been recognized by national and international organizations. The Man and the Biosphere Program of the United Nations recognizes SDEF as a "Biosphere Preserve." The National Science Foundation and The Institute of Ecology recognize the SDEF as an "Experimental Ecological Reserve." Fern Canyon, a 555-ha (1370 acres) tributary of San Dimas Canyon, was selected as a research natural area in 1972; only nondestructive observational research may be conducted there.

Included in this area is Brown's Flat, a locally unique High Sierra-type meadow supporting a grove of large ponderosa pine.

Modern facilities on the Forest are available to researchers throughout the world. Requests for use of the laboratory and housing should be sent to: Forest Manager—San Dimas Experimental Forest, Forest Service, U.S. Department of Agriculture, 110 North Wabash Avenue, Glendora, California 91740 U.S.A.

The SDEF has been described and its history and research progress noted in many publications (Hamilton 1940; Hill 1963b; Hopkins and others 1958, 1961; Kraebel and Sinclair 1940; Millett 1974; Mooney and Parsons 1973; Robinson 1980; SDEF Staff 1935-1938, 1951; Sinclair and Kraebel 1934; Sinclair and others 1958; Storey 1982).

This report describes the physiography of the San Dimas Experimental Forest and summarizes its research history for amateur biologists, graduate students, and other scientists interested in using its research facilities. Also included is a comprehensive listing of publications related to the Forest or the research conducted there.

PHYSICAL DESCRIPTION

The San Dimas Experimental Forest covers an area of 6945 ha (17,153 acres) near Glendora, California (fig. 1). It is 45 km (28

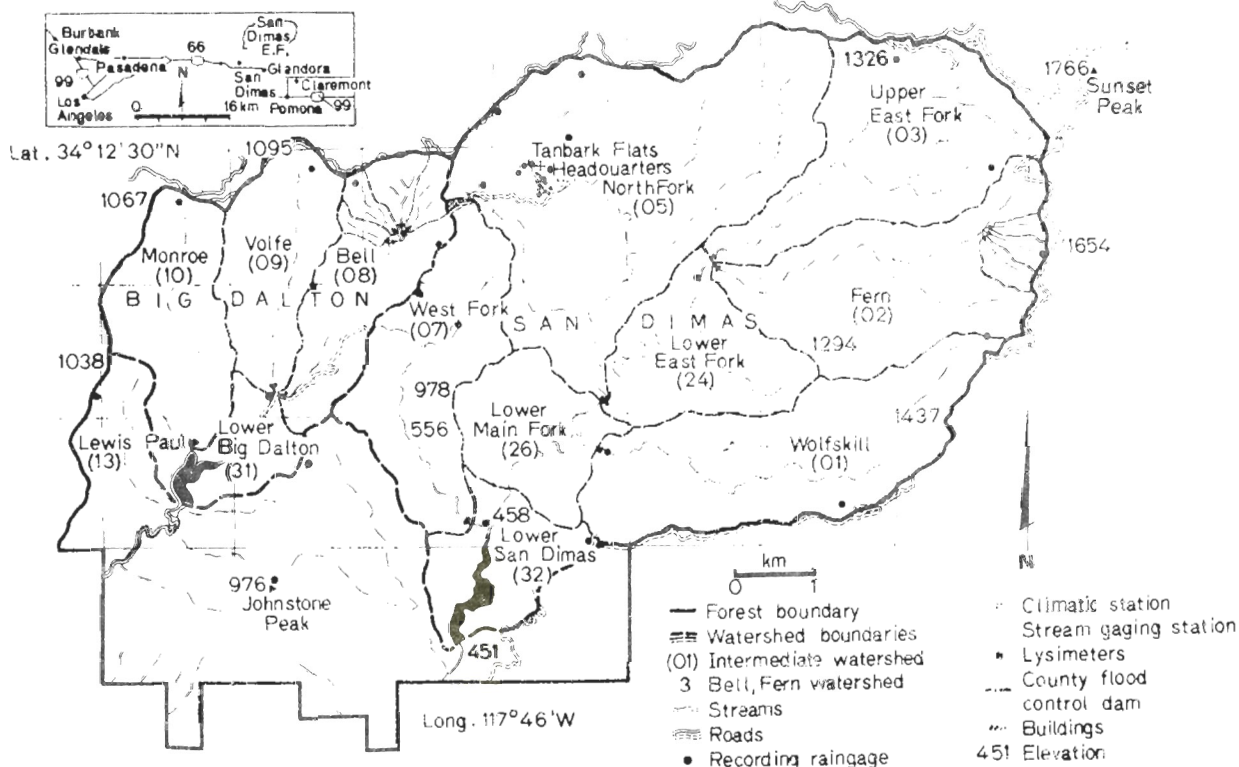


Figure 1—The San Dimas Experimental Forest is in a front range of the San Gabriel Mountains in southern California. This general map also

shows the 2 major watersheds and 10 minor watersheds in the Forest (Source: Hill 1963b). Elevations are in meters.

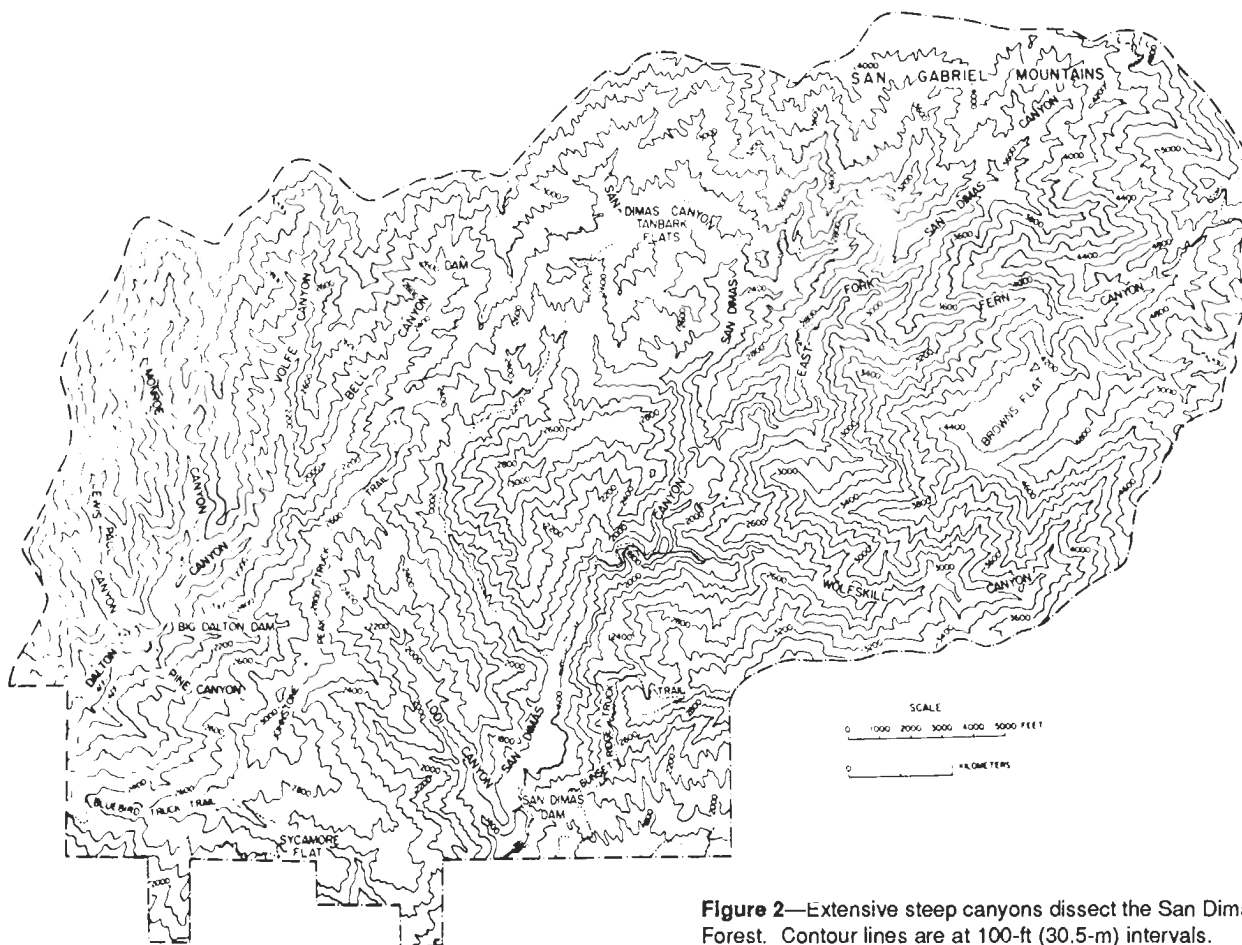


Figure 2—Extensive steep canyons dissect the San Dimas Experimental Forest. Contour lines are at 100-ft (30.5-m) intervals.

mi) northeast of Los Angeles on the northern edge of the Los Angeles basin. The headquarters and laboratory are at Tanbark Flats (latitude 34°12'N, longitude 117°46'W). The Experimental Forest area is within the San Gabriel Mountain fault block, and is extensively dissected by steep canyons. The elevation on the Experimental Forest ranges from 457 to 1677 m (1500 to 5500 ft) (fig. 2). The average slope is 68 percent.

The two major watersheds within the boundaries of the Experimental Forest are Big Dalton (1155 ha or 2853 acres) and San Dimas (4079 ha or 10,075 acres). These watersheds form an ideal experimental area as they have vegetation patterns typical of southern California; they are separated from the main mass of the San Gabriel Mountains by deep canyons (Cow Canyon on the north, San Antonio Canyon on the east, and Little Dalton on the west); the two major drainages have small tributaries suitable for study; and both San Dimas and Big Dalton Canyons are harnessed by County Flood Control Dams (Robinson 1980).

There are also 10 intermediate size watersheds in the Forest: seven in the San Dimas watershed (Wolfskill, Fern, Upper East Fork, East Fork, North Fork, Main Fork, and West Fork); and three in Big Dalton (Bell, Volfe, and Monroe). The two sets of small watersheds on the Forest are Bell (1,2,3,4) within the Big Dalton watershed and Fern (1,2,3) within the San Dimas watershed.

The purpose of initial investigations on the Forest was twofold: first, to determine quantitatively the relation of chaparral vegetation to the yield of useable water from mountain watersheds and its function in decreasing erosion; and second, to develop methods of

vegetation management to obtain maximum water yields with minimum erosion (SDEF Staff 1935). To proceed with this research an understanding of the factors influencing the hydrologic budget was necessary. Such environmental factors as the temperature of air and soil, precipitation, evaporation, relative humidity, windspeed and direction, and even solar radiation were monitored in this endeavor. Soon after the Forest was established in 1935, complete climatological stations were established at San Dimas Canyon, 442 m (1450 ft); Tanbark Flats, 831 m (2725 ft); San Gabriel Divide, 1326 m (4350 ft); and Fern Canyon, 1540 m (5050 ft). These were equipped with air hygrothermographs, soil hygrothermographs, air and soil thermometers, psychrometers, anemometers, wind direction transmitters, evaporation pans, and atmometers (SDEF Staff 1935). Today the only complete weather station on the Forest is located at Tanbark Flats. Past records of temperature (Reimann 1959a), evaporation (Reimann 1959b), and climate (Hamilton 1951) have been reported, but a large amount of this data is still unpublished.¹

The San Dimas Experimental Forest has a typical Mediterranean-type climate, with mild winters and summer droughts. Most of the precipitation falls from December to March in less than 20 storms per year (Hamilton 1951). Average annual precipitation is 678 mm (26.7 in) but varies from 292 to 1224 mm (11.5 to 48.2 in) (Hill and Rice 1963). Annual rainfall data from 1929 to 1983 at

¹Unless otherwise noted, available and unpublished data are on file in the SDEF archives at the Forest Fire Laboratory, 4955 Canyon Crest Drive, Riverside, California 92507.

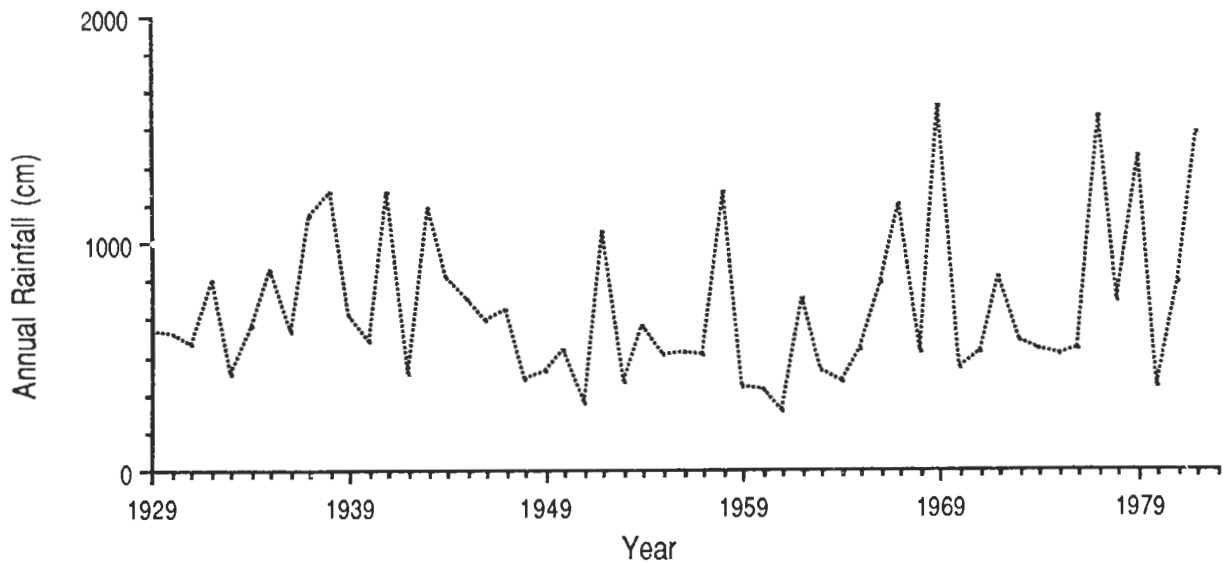


Figure 3—Annual rainfall averages 678 mm (26.7 in) in the San Dimas Experimental Forest. Data shown are from Tanbark Flats, for 1929-1983.

Tanbark Flats (elevation 831 m or 2725 feet) is shown in *figure 3*. Originally, 380 standard 20.3 cm (8 in) rain gauges and 26 intensity rain gauges were distributed along contour trails, sloping trails, and roads at 0.8 km (1/2 mi) intervals in the Experimental Forest. Currently, eight rain gauges are maintained on the Forest. They are located in Wolfskill Canyon, Fern Canyon, Bell Canyon, the Bell Canyon Dams, the ridge above Tanbark Flats, and three along Glendora Ridge Road. For one rain gauge (the West gauge), which is located in the city of Glendora, over 100 years of rainfall data are available. This is the longest continuous record of rainfall in the area. A snow gauge is maintained in Fern Canyon at an elevation of 1585 m (5200 ft). This gauge doesn't measure snow directly, but it contains antifreeze, which causes the snow to melt and measures this as precipitation. When the adjoining intensity rain gauge is buried by snow and unable to function, data is collected from this gauge.

Maximum summer temperatures on the SDEF frequently exceed 37.8 °C (100 °F) but winter minima are rarely below -3.9 °C (25 °F). The average annual temperature is 14.4 °C (57.9 °F) (Hill 1963b). Summarized temperature records for Tanbark Flats are available from 1933 to 1965. The mean monthly mean, maximum, and minimum temperatures for Tanbark Flats are given in *figure 4*. From 1965 to the present, unpublished temperature data are available in chart (unsummarized) form only.

Relative humidity at Tanbark Flats ranges from a high of 68 percent in April and May to a low of 43 percent in September (*fig. 5*). Relative humidity data from Tanbark Flats in the form of

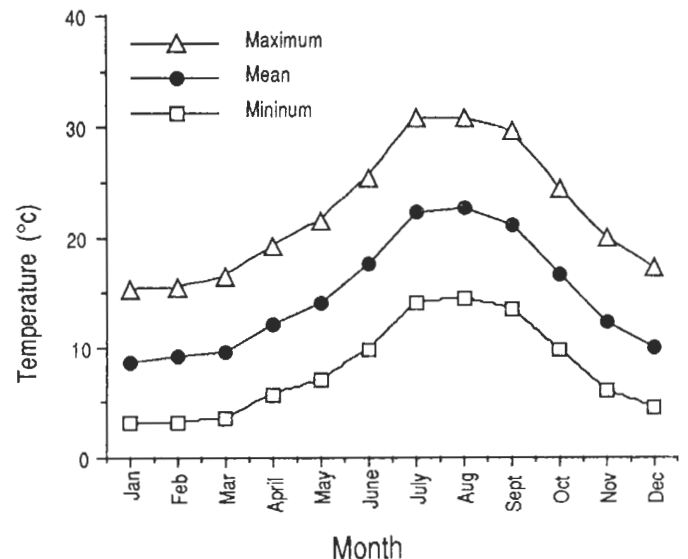


Figure 4—Mean monthly mean (solid line), minimum (nonuniform dash), and maximum (uniform dash) temperatures at Tanbark Flats, averaged for 1933-1965.

untabulated field data sheets are available from 1933 to the present with breaks in data collection occurring from October 1957 to September 1960 and May 1965 to October 1965. Evaporation data were collected between 1935 and 1968 at elevations from 450 to 1555 m (1500 to 1500 ft) (Reimann 1959b) (fig. 6). The average annual evaporation potential on the Forest is 163 cm (64 in).

The predominant windflow in the SDEF is north-south. Diurnal airflow shifts from up-canyon (north) during the day to down-canyon (south) at night. On an annual basis winds occurring May to August have a strong southwest component while in December and January they have a strong northwest component. Wind direction was measured from 1934 to 1944 (fig. 7) on the Experimental Forest and intermittently from 1945 to 1961. From 1934 to 1939, the data were taken as one of the eight points of the compass. From 1940 to 1945, wind direction (eight compass points) and windspeed were recorded.

Solar radiation patterns on the Experimental Forest conform to what one would expect in the Northern Hemisphere. Diurnal peaks in solar radiation occur around noon while annually the summer months of May to July have the highest solar radiation values (table 1). Total solar radiation has been measured since October 1965. Currently an automated weather station is collecting the following data on an hourly basis: wind speed, wind direction, air temperature, relative humidity (percent), and solar radiation. Soil moisture is measured daily from two soil moisture blocks (one on the north- and one on the south-facing slope). Amount of precipitation is also recorded.

The SDEF has periodically been photographed from the air. The first aerial photographs taken, in July 1938, were of Upper Dalton, Bell, Volfe, and Monroe watersheds. The entire SDEF was photographed in March 1961 and June 1965. The Tanbark Flats area was photographed in May 1962. The SDEF west of San Dimas Creek and north of Johnstone Peak was photographed in February-March 1966 and March 1969. Other aerial photos of unknown coverage were taken in June-September 1957 and

August 1960. Full sets of aerial photos, covering most of the Forest, were taken in 1978 and 1985.²

RESEARCH HISTORY

Water

Research on the Experimental Forest was originally directed toward increasing water yields from southern California watersheds (Blythe 1936). Because of the scarcity of adequate baseline data on such essential hydrologic parameters as rainfall, runoff, and streamflow, one of the first orders of business was to begin collecting this data. Emphasis was placed on collecting standard climatic data (measured at six climatic stations); surface runoff and erosion data (at three stations); streamflow data (at 17 stations); and sediment production (at 7 stations). During the course of these studies one of the largest and most concentrated networks of rain gauges in the world was established. At the height of these studies more than 450 rain gauges were in continuous operation on the Experimental Forest³ with densities in some areas reaching as high as one gauge per hectare (250 gauges per square mile). In addition to the collection of baseline data, studies were begun to investigate the various processes associated with the water cycle. These included precipitation, interception, infiltration, overland flow, hillslope erosion, and evapotranspiration.

The reliability of computed rainfall averages was determined by intensively monitoring the two sets of small watersheds and the 10 intermediate watersheds (Wilm and others 1939). The effect of scaling down the network of raingauges in SDEF to one per watershed (a "minimum rainauge network") on accuracy of measurement was tested by Hamilton and Reimann (1958). Reducing the number of gauges from 77 to 21 gave averages which agreed within 3 percent. Hill (1961) described a method of modifying the

²All aerial photos are in the SDEF archives.

³C. J. Kraebel, California Forest and Range Experiment Station. Unpublished field notes (from 6/15/43) on file at the San Dimas Experimental Forest.

Table 1—Mean hourly radiation at Tanbark Flats, San Dimas Experimental Forest, 1983

Hour	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	watts/m ²											
0500	0	0	0	0	0	0	0	0	0	0	0	0
0600	0	0	0	13	66	58	102	67	15	2	0	0
0700	0	0	0	182	250	260	290	204	101	114	38	0
0800	50	49	120	309	387	348	416	307	276	270	198	35
0900	200	208	259	425	479	457	521	435	393	356	315	161
1000	297	297	347	483	556	519	587	475	480	430	387	230
1100	359	345	389	538	570	575	624	535	477	465	414	301
1200	386	372	409	521	622	598	637	512	494	500	414	312
1300	386	347	398	427	595	587	635	499	507	473	356	317
1400	330	326	334	424	553	564	623	476	445	374	286	274
1500	237	251	247	326	501	479	513	387	350	222	145	183
1600	88	146	175	208	369	414	397	249	235	92	31	71
1700	18	46	77	86	196	180	198	117	79	25	0	14
1800	0	7	22	19	54	29	22	21	15	5	0	0
1900	0	1	3	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0

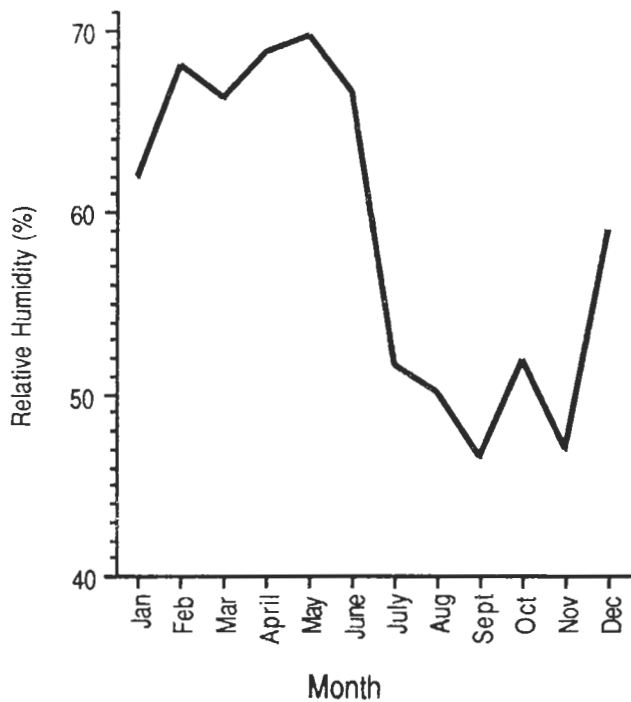


Figure 5—Mean monthly relative humidity at Tanbark Flats ranges from 43 percent in September to 68 percent in May. Data shown are for 1933-1965.

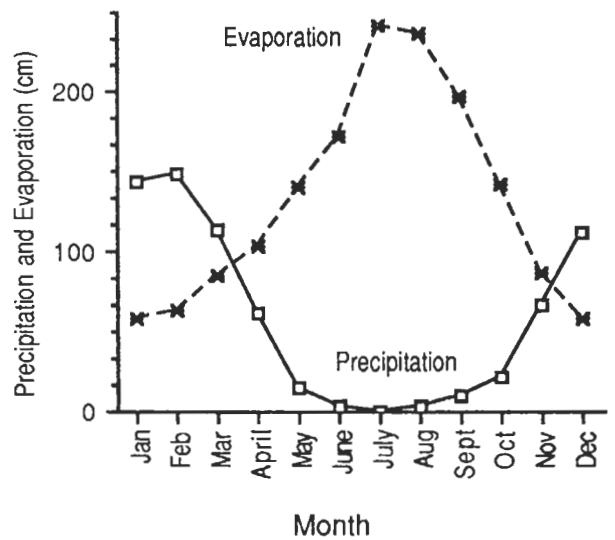


Figure 6—Mean monthly precipitation (average for 1929-1985) and evaporation (average for 1935-1968) from Tanbark Flats. Dashed line is evaporation; solid line is precipitation.

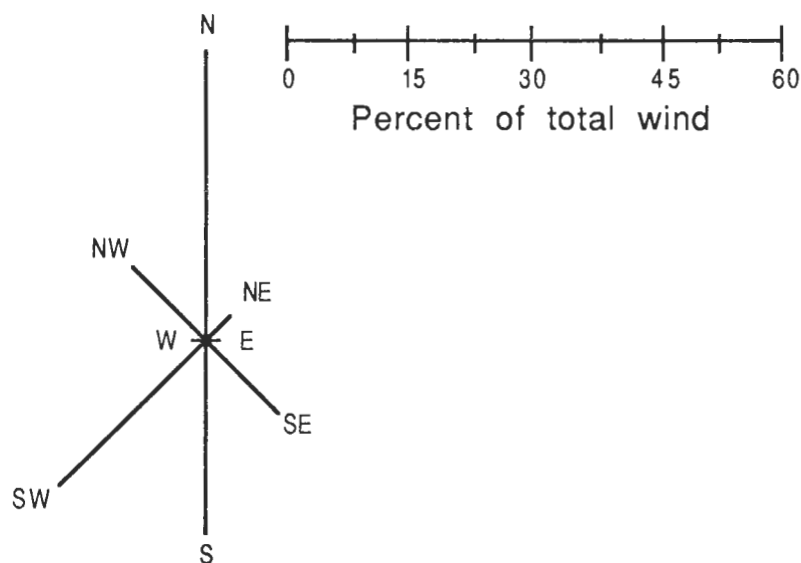


Figure 7—The predominant wind pattern on the San Dimas Experimental Forest is north-south. The mean wind pattern shown for hydrologic year 1944 is representative.

network of rain gauges on the SDEF after the 1960 Johnstone fire. Corbett (1967) summarized the work done on rainfall measurement on the SDEF including the type of instruments used, the selection of sites for rain gauge placement, and the calculations required to convert measured values to annual rainfall figures. A compilation of 25 years of rainfall data encompassing 460 storms was made by Reimann and Hamilton (1959).

A large variation in rainfall throughout mountain watersheds due to changes in topography was noted by Storey (1939). Using rain gauges to measure the vertical and horizontal components of rainfall in open and exposed locations, Hamilton (1944) determined the direction from which rainfall was coming and calculated the average angle of inclination. From this data, graphic representations of storm patterns were developed enabling storms to be classified based on rainfall direction. The problem of measuring rainfall in rugged terrain was addressed in two studies (Hamilton 1949, 1954) that compared rainfall samples from gauges in various placements (vertical and tilted) and exposures. Vertical rain-gauges were not as accurate as rain gauges tilted or oriented normal to the slope. Because the extensively used vertical rain gauges yielded 15 percent less rainfall than tilted rain gauges, a model was developed to correct previous measurements obtained with the vertical gauges.

Vegetation was also found to affect the amount of precipitation reaching the soil. Throughfall, stemflow, and interception by various brush species were found to be directly related to storm size (Hamilton and Rowe 1949). Five percent of gross rainfall was lost annually in a mixed stand of buckeye-ceanothus-oak. Stemflow was related to branching pattern and bark characteristics and was an important component in determining interception. Rowe and Colman (1951) measured soil moisture, precipitation, and interception in the Sierra Nevada and SDEF to determine disposition of rainfall and relation to water yield. A general progress report on water research summarized work-to-date on water yield increases, erosion control, and emergency revegetation (Hopkins and Sinclair 1960).

During the course of these precipitation studies researchers continued to modify existing methods and equipment and develop new ones to better meet their specific needs. Hamilton (1943) described a method of synchronizing the numerous time clocks on the hydrologic equipment in the Forest. Tipping buckets were added to available rain gauges to save the price of purchasing intensity gauges (Hamilton 1947). An instrument that recorded rainfall and wind velocity with one pen was developed for meteorological measurements on the SDEF (Hamilton and Andrews 1951). Other studies showed that the addition of 0.15 inch of oil to rain gauges would protect raincatch from evaporation indefinitely (Hamilton and Andrews 1953). A shock resistant lucite graduate was developed for use in the rain gauges to reduce loss from breakage of glass cylinders (Hamilton and others 1952).

The movement of water in soil also received considerable attention, and several methods for measuring soil moisture, bulk density, and field capacity of soils were developed at the Experimental Forest. Colman (1944, 1947) developed a lab procedure for measuring field capacity of soil and examined effects of soil depth on the point at which the soil reaches field capacity. A rugged, reliable, low cost water stage transmitter for measuring surface runoff from the lysimeters at Tanbark Flats was designed (Colman

and Hamilton 1944). A method of calibrating a fiberglass soil moisture unit was also established (Hendrix and Colman 1951). The nuclear probe, the gravimetric, and the electrical resistance techniques for measuring soil moisture were compared by Merriam (1959). He found that sampling, using the nuclear probe, was limited only by the depth to which the access tube could be installed. Sampling time was intermediate between the gravimetric and electrical resistance (Colman) techniques. Limitations included radiation hazard and high initial costs. A new type of soil corer was designed specifically for San Dimas soils (Andrews and Broadfoot 1958).

Instrumentation to measure streamflow was also developed and improved at the SDEF. Responding to a problem involved in measuring debris laden flow in streams in the SDEF, Wilm and others (1938) designed a new type of critical depth flume (The San Dimas Flume), which accurately measured discharge and was unaffected by velocity approach or presence of bedload. A measuring stick to facilitate calculation of discharges from mountain streams (the velocity head rod) was designed to quickly determine the energy content of streams (Wilm and Storey 1944). An instrument was designed to rapidly determine the zero value of V-notched weirs (Andrews 1960, Johnson and Storey 1948). Trapezoidal flumes were used to evaluate postfire treatments on burned watersheds in the SDEF (Brock and Krammes 1964). Andrews (1957) developed and described an inexpensive maximum water stage recorder which could serve as a back-up to other continuous recorders to insure that peak flows were recorded or could be used alone in cases where a continuous record was not needed or was not available. He also invented a pen attachment to be added to reversal-type measuring devices. The added pen changed positions when the recording pen reached the top or bottom of the chart and thus helped in interpretation of the streamflow charts (Andrews 1958). Streamflow records from 1939 to 1959 on the SDEF have been summarized (Krammes and others 1965), and unpublished, unsystematized streamflow records for the past 50 years are kept in the SDEF archives. More recently, Weirich (1987), studying the dynamics of debris flows, used pressure and velocity sensors (arranged either vertically or horizontally) to detect changes in flow characteristics. Connecting these sensors to data loggers yielded a continuous record of flow velocities and sediment concentrations.

To determine the effects of vegetation removal on water yield, several areas in the SDEF were cleared of vegetation or converted to grass, or both. In Monroe Canyon 38 acres (15.4 ha) of canyon bottom vegetation were removed. On the Bell 2 watershed chaparral vegetation was converted to grass. The conversions were accomplished by physical removal of the vegetation and herbicide treatments. Comparing streamflow from the manipulated Monroe Canyon with an adjacent control watershed (Volfe), Orme and Bailey (1970) found that the stream became perennial and that stabilization of sideslopes and rainfall interception were reduced in the manipulated watershed. Considerable channel widening was noted after major storms in both canyons but to a greater extent in Monroe Canyon.

Water yield increased substantially with removal of riparian vegetation in Monroe Canyon but most of the increase was noted in the light early season storms and in the summer, probably due to differences in evapotranspiration (Rowe 1963). During large

storms, and when soils were wet, differences in streamflow from cleared and control canyons were not observed as the soil water storage capacity was saturated. Dry season streamflow the first season after fire on manipulated watersheds increased appreciably over untreated watersheds (Crouse 1961). Currently work is in progress on the effects of vegetation conversion on water quality (fig. 8, Riggan and others 1985). In October 1984, a series of experimental prescribed burns of different intensities was conducted at San Dimas, and streamflow from these burned areas is currently being monitored to determine effects of fire intensity on water quality.

Lysimeter Studies

Installation of a lysimeter complex at Tanbark Flats in SDEF was completed in 1937. (Design, construction, and purpose of the lysimeters have been described by Colman 1946; Colman and Hamilton 1947; Patric 1961a, 1961b, 1974; and Sinclair and Patric 1959). To allow the soil to settle, the lysimeters remained bare from 1937 to 1940. During 1940 to 1946 most were planted to grass (*Bromus mollis*). In 1946 they were planted to various shrub and tree species. Five types of filled lysimeters (as opposed to Ebermeyer or core cutter lysimeters) were used during the peak research years. Twenty six large lysimeters with a soil capacity of 64 tons (58 tonnes) were used to measure runoff and seepage under plantings of various shrubs and trees. Thirty medium (1800 lb or 818 kg soil capacity) and 72 small (300 lb or 136 kg capacity) lysimeters were used to grow small groups of plants or individual plants and measure transpiration and evapotranspiration. Five unconfined lysimeters allowed plant roots to expand beyond the confines of concrete walls. Finally, five root study lysimeters allowed examination of soil and plant roots by removal of one end wall. The lysimeters were operated for water use studies until 1960 at which time questions about the practicality of their use arose (Patric 1974). Of special concern was the applicability of lysimeter results to field conditions.

Before planting lysimeters to shrubs and trees, Horton (1950) studied field plots to determine if it would be necessary to clear lysimeters of grasses and herbs to insure good establishment of perennial seedlings. He looked at the competition between grass and *Pinus coulteri* (Coulter pine), *Quercus dumosa* (scrub oak), *Ceanothus crassifolius* (hoaryleaf ceanothus), and *Adenostoma fasciculatum* (chamise) seedlings. When he found the presence of weeds decreased survival of all species, clearing of the lysimeters was necessary prior to planting. Hopkins (1958) outlined the progression of studies necessary to ultimately determine how more "good water" could be produced from southern California watersheds by starting with a raingauge network to get the rainfall "story" followed by lysimeter studies, field plot studies, and whole watershed studies.

In several studies the lysimeters were used to examine and compare water use by plants of various species (Hill 1963b, Hill and Rice 1963). Zinke (1959) compared soil moisture regimes under barren lysimeters to those planted to Coulter pine and found that the pines depleted all available soil moisture to the depth of the lysimeter while soil moisture deficit in barren plots was confined to surface layers. Patric (1959b) found scrub oak used water extravagantly while grass saved water if kept clear of weeds and if soil depth was greater than 3 ft (0.91 m). Rowe and Reimann (1961) found that brush and grass produced markedly different drying patterns in soils

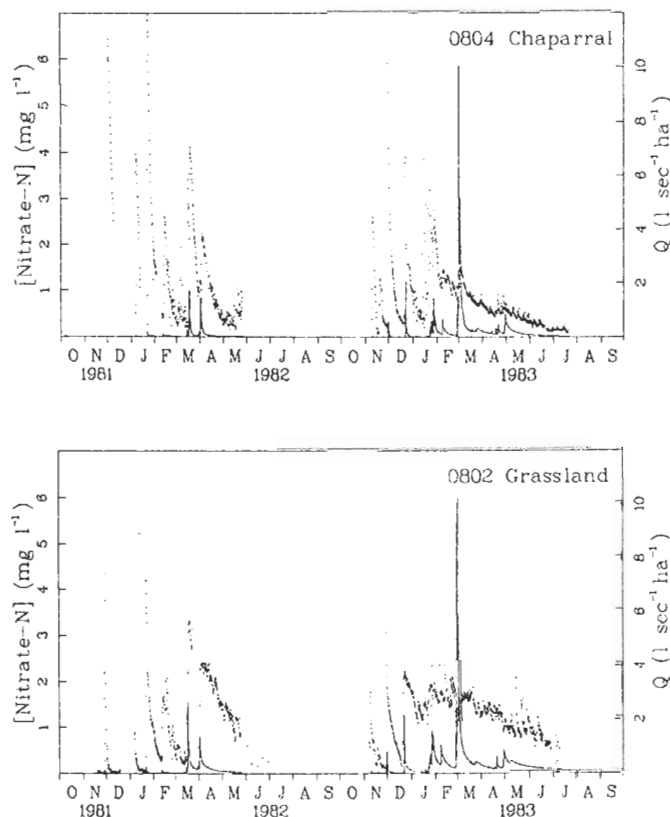


Figure 8—Nitrate nitrogen concentration (dots) in streamwater and discharge rate (solid lines) for representative chaparral and grassland watersheds in the San Dimas Experimental Forest for hydrologic years 1981-82 and 1982-83 show that vegetation conversion influences nitrate yield and thus water quality (Source: Riggan and others 1985).

during both dry and rainy seasons. Brush tended to deplete the deeper soil layers of water, leaving the upper soil layers relatively moister. Grass, on the other hand, depleted only the upper layers leaving the lower layers virtually unaffected (fig. 9). This information had important implications with regard to the expected effects of vegetation type conversion on both water yield and slope stability and led to attempts to increase water yield by such conversions. Oechel⁴ also studied soil moisture in relation to brush biomass on the Experimental Forest (table 2). Sinclair and Patric (1959) found vegetative cover of any kind decreased runoff compared to barren plots; evaporation on bare plots was 2-3 times that on vegetated plots; and the most seepage was observed under grass plots.

Destruction of the lysimeter complex during the 1960 Johnstone Fire set the stage for studies on the effect of former plant cover on herbaceous vegetation. Sections of the large lysimeters, which contained pure stands of 14-year-old *Eriogonum fasciculatum* (buckwheat), chamise, hoaryleaf ceanothus, scrub oak, and Coulter pine received one of three treatments: seeded ryegrass, seeded

⁴Walt Oechel, San Diego State University, San Diego, CA. Unpublished data.

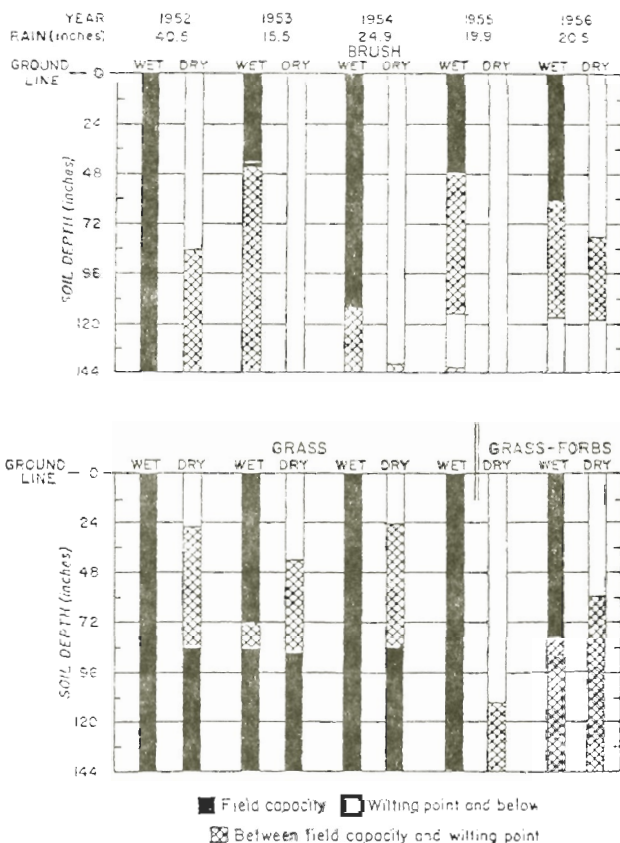


Figure 9—Annual soil wetting and drying under oak-brush, grass, and grass-forb vegetation covers in the San Dimas Experimental Forest show that brush depletes soil water to greater depths than either grass or grass-forb vegetation (Source: Rowe and Reimann 1961). (1 in = 2.54 cm).

Table 2—Soil moisture variation by season on the San Dimas Experimental Forest at 25 cm¹

Biomass (t/ha)	April	July	Sept.	Early Oct.	Late Oct.
	Percent				
64.7	23.59	18.49	11.69	—	21.18
91.2	6.61	7.00	3.95	4.30	2.00

¹Walt Oechel, San Diego State University, San Diego, CA. Unpublished data.

Table 3—Mean and standard deviation (SD) of total soil carbon, nitrogen, and phosphorus from three soil profiles in a chaparral watershed near Tanbark Flats in the San Dimas Experimental Forest. Soils were sampled during April 1979¹

Depth	Carbon		Nitrogen		Phosphorus	
cm	Mean	SD	Mean	SD	Mean	SD
	Percent					
0-3	2.1	0.40	0.27	0.025	0.134	0.041
9-11	0.9	0.55	0.15	0.065	0.110	0.045
29-31	0.5	0.40	0.11	0.047	0.099	0.063
49-51	0.2	0.20	0.09	0.035	0.099	0.062

¹Philip J. Riggan and Mark Poth. Unpublished data on file at the Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Riverside, California.

ryegrass and mustard, or unseeded. Due to several years of below-average rainfall, a good cover of seeded species never developed and native herb cover exceeded it in all cases (Rice and Green 1964). Qashu and Zinke (1964) measured and compared soil temperatures under lysimeter grown grass, scrub oak, and Coulter pine with the temperature of barren lysimeter soil and found that vegetation had a stabilizing effect on soil temperature. Soil under vegetation had lower mean temperatures and temperature amplitudes than did barren soil.

Soils and Slope Stability

The soils of the San Dimas Experimental Forest are typically shallow (average depth less than 0.91 m or 3 ft), azonal, coarse-textured with numerous rock outcrops, and of low fertility (table 3). The soils are underlain by an igneous-metamorphic complex of parent rocks with three major and several minor units (fig. 10). In ascending order of age the major units include: (1) the San Gabriel Complex, a Precambrian assemblage of schists, gneisses, and other metamorphic rocks; (2) a unit of Mesozoic granitics, consisting primarily of diorite and granodiorite, with many intrusions of pegmatite, aplite, dacite, and lamprophyre; and (3) a small unit of Miocene volcanics locally known as the Glendora "volcan-

ics" (Rogers 1967). The San Gabriel Complex, an assemblage of many rock types, forms soils that are highly variable in their physical and hydrologic properties. The granitics weather to the coarse, rocky soils typical of that parent material (Storey 1947). The Glendora volcanics produce a distinctive, fine-textured soil characteristic of volcanic parent material, which has the highest fertility of any soil on the Experimental Forest (Crawford 1962). Zinke (1982) characterized elemental composition and nutrient storage of chaparral soils throughout California including the SDEF and constructed data tables which enable land managers to "rank" their sites.

The soils of the San Dimas Experimental Forest were mapped in detail according to standard soil series criteria by Crawford (1962), although no attempt was made to correlate these soils with the National System of soil surveys. Six soil series were identified and tentatively designated by capital letters (fig. 11). The three most common soils on the Experimental Forest—A, B, and G—are in general well drained, shallow, and loamy. The other four soil types are of minor importance because of their limited extent.

Due to the steepness and tectonic activity of the mountains where the SDEF is located, the area is subject to much soil movement in the dry as well as wet seasons. Most sediment moves in two ways: (1) as granular movements on the soil surface, including dry "creep" (an early term for what is now known as dry

ravel) and slope wash; and (2) as deep-seated movements of soil masses (Sinclair 1953). The amount of erosion varies, depending on vegetation cover, slope aspect, and slope gradient. Wohlgemuth (1986), studying hillslope sediment movement on the SDEF, found vegetation types had significant effect in controlling surface sediment transport. He found no difference in surface transport between upslope and downslope plots and concluded that the surface mantle of the slope moves together as a "quasi-continuous mass by sequential downslope sediment transport." Aspect and slope gradient have been mapped and are available for the major watersheds on the San Dimas Experimental Forest.

Landslides were briefly addressed by Archer (1979). From his study on the origin of the landslide, which resulted in the unique mountain meadow at Brown's Flat in the SDEF, he concluded that a combination of factors, not a single factor, was responsible for this landslide. Soil slips are a more prevalent erosional agent on the Forest. Soil slippage, which involves only the material above the unweathered bedrock, is closely associated with shallow soil, very

steep slopes, heavy or prolonged rainfall, and insufficient vegetative cover (Bailey and Rice 1969). Slope is the most important factor in determining occurrence of slips followed by proximity to streams, rooting habit and density of vegetation, soil texture and hydraulic conductivity (Bailey and Rice 1969, Rice and others 1969). When brush covered chaparral slopes are converted to grass the incidence of soil slips increases (Corbett and Rice 1966, Rice and Foggin 1971).

Erosion and sedimentation are also controlled by the sequence of hydrologic events. When the storms of 1978 and 1980 in the SDEF were compared, Wells (1982) discovered that even though the 1980 storm was the largest recorded on the Forest, 40 percent less sediment was produced from this storm. It was reasoned that the channels had been scoured in the 1978 storms and little sediment had accumulated in the interim from 1978 to 1980. Current storage volumes in high order bedrock channels along the San Gabriel front were found to be much smaller than the volume of sediment produced during large sediment yield events

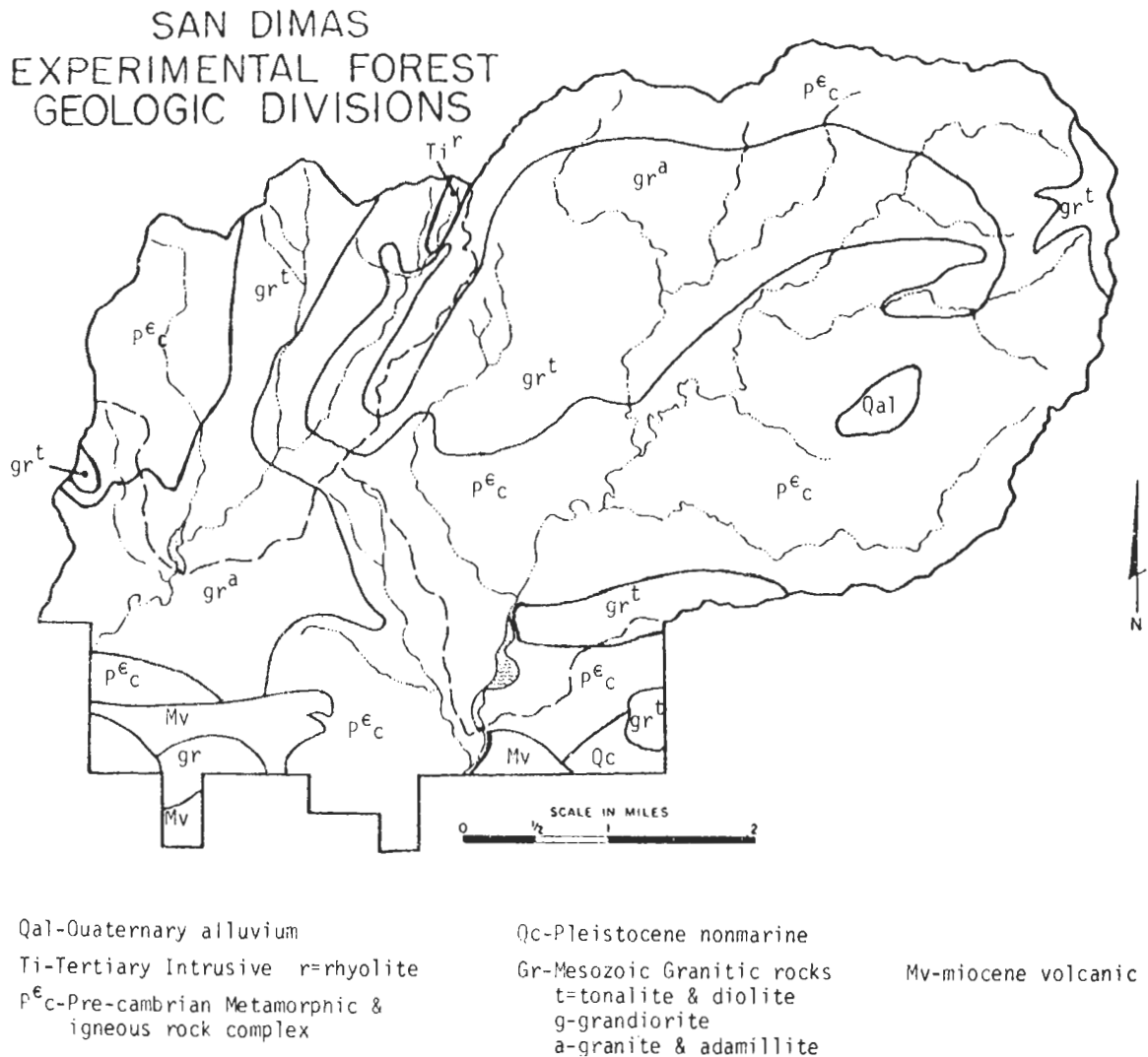


Figure 10—Geological map of the San Dimas Experimental Forest outlines the igneous-metamorphic complex of parent rocks (Source: Rogers 1967).

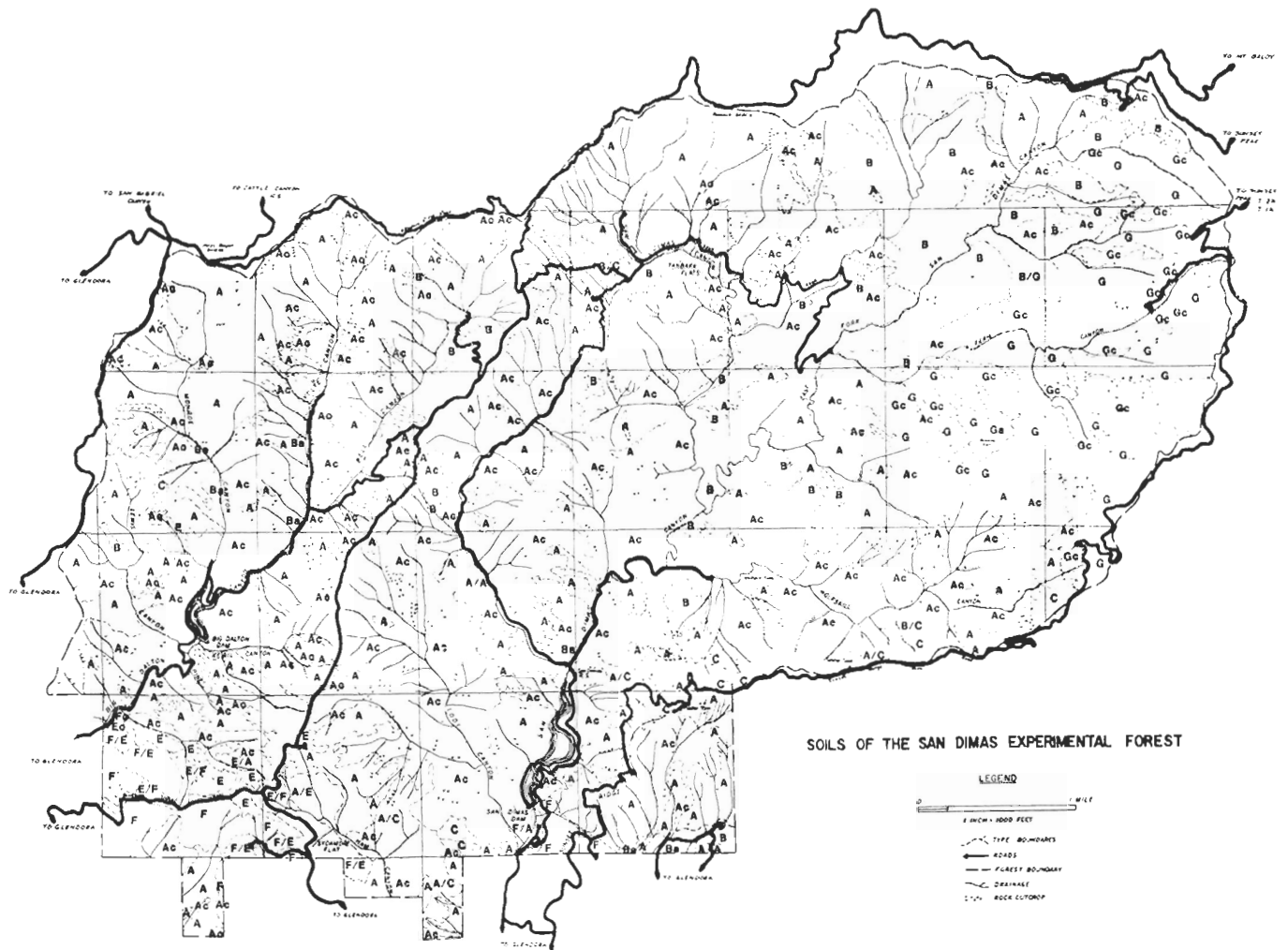


Figure 11—Soils map of the San Dimas Experimental Forest shows six soil series (Source: Crawford 1962):

- A—excessively drained, shallow, and coarse textured
- B—well drained, fairly deep, and moderately coarse textured
- C—well drained, and moderately fine textured,
- E—well drained, fairly deep, and moderately coarse to medium textured
- F—deep, and fine to moderately fine textured
- G—deep, and moderately coarse to medium-textured.

A small c indicates that soil is colluvial.

(Campbell 1986). Campbell speculated that the majority of sediment is contributed from hillslopes and low order tributaries rather than from sediment stored along main channels. Two bibliographies on erosion, streamflow and water yield have been compiled (Gleason 1958, 1960). Surveying problems have been addressed (Colman 1948), and geology of the Forest documented (Bean 1943, 1944; Miller 1934; Storey 1947).

Effects of Fire

Fire plays an essential part in the chaparral ecosystem. Since 1896 there have been nine wildfires in the area now encompassing the SDEF:

Year	Area	
	ha	acres
1896	1,635	4,037
1911	60	148
1919	4,589	11,330
1932	66	163
1938	206	509
1947	52	128
1953	241	595
1960	6,705	16,556
1975	1,200	2,963
1986	26	65

(adapted from Mooney and Parsons 1973)

Two of these fires (1919 and 1960) destroyed more than half of the Forest. Prescribed burning (in 1984 and 1986) has also been conducted there. General reviews on fire effects and postfire problems have been written (Krammes and Rice 1963, Rice 1963).

Fire, the most frequent disturbance on the SDEF, occurs predominately during drought periods in late summer or early fall. Shoots from resprouting shrubs may appear within 10 days of a fire (Plumb 1961, 1963). Germination of soil stored seeds of many shrubs is induced by fire (Horton and Kraebel 1955; Stone and Juhren 1951, 1953). Most seedling establishment occurs the first year after fire. An abundance of annual plants appears in chaparral only immediately after fire and disappears 2 to 3 years later, not returning until the next fire perhaps 50 years later (Horton and Kraebel 1955). Stand densities are highly variable the first year after fire, ranging from 2.5 to 26 individuals per square meter (Horton and Kraebel 1955). After 15 years, shrub densities declined to 1.8 to 2.2 per square meter.

Microorganisms in soil, which function in nutrient cycling, decomposition, and mycorrhizal associations (all of which directly influence plant growth) are affected by fire (Cordes 1974, Dunn and DeBano 1977, Dunn and others 1979). Recent work comparing effects of prescribed fire and wildfire has shown that the response of soil microorganisms can differ dramatically (Dunn and others 1985). Fungi were found to be more sensitive to heat than were bacteria. Also, physiologically active populations in moist soil (prescribed burning conditions) were more susceptible to heat induced mortality than dormant populations in dry soil (wildfire conditions). Frequently the nutrient most limiting to plant growth in the chaparral is nitrogen. Nutrients may be lost during fire by direct volatilization and movement or indirectly through postfire erosion (DeBano and others 1977, 1979a), and the

amount of nitrogen lost is substantial. Various nitrogen replacement mechanisms have been studied to determine appropriate fire frequencies for maintaining nutrient balance in the system (Dunn and Poth 1979, Poth 1981).

Soil particle size (Duriscoe and Wells 1982) as well as other soil physical and chemical characteristics may change during fire (DeBano and Rice 1971; DeBano and others 1976, 1977, 1979a, 1979b). One phenomenon often found after chaparral fires is a water repellent layer in the soil. This layer is produced by the volatilization, movement, and condensation of organic compounds in the soil during fire. The soil layer above this water repellent layer is easily eroded and, therefore, significantly affects erosion rates and debris flow production after fire (Wells in press). Extensive work on water repellent soils has been reported (DeBano 1966, 1969a, 1969b, 1969c, 1969d, 1971, 1974, 1981; DeBano and Krammes 1966; DeBano and Rice 1973; DeBano and others 1970; Krammes and DeBano 1965; Krammes and Osborn 1969; Osborn and others 1964). The use of wetting agents to eliminate the water repellent layer has also been explored (DeBano and others 1967, Krammes and DeBano 1967, Krammes and Hellmers 1963). Osborn and others (1967) looked at the effect of soil nonwettability and wetting agents on seed germination and seedling establishment.

Fire aggravates the erosion problem in the SDEF by removing the brush species that normally aid in slope stabilization. From examining sedimentation records over a 22 year period in the San Gabriel Mountains, Wells (1984) noted that increased erosion rates were more closely linked to incidents of fire than to high rainfall in nonfire years. The mechanism of postfire erosion and debris flow on southern California slopes has been examined by Wells (1981, 1986, in press). He proposed three hypotheses on why erosion is increased after fire: (1) change in particle size distribution, (2) water repellent soils, and (3) rill formation. SDEF Staff (1954) researchers observed and described a debris flow which occurred in January 1954 after a burn in December 1953. They also compared streamflow from control, once burned, and twice burned watersheds. Sinclair and Hamilton (1954) noted changes in streamflow after fire. A popular article on how water repellent soils increase the potential for debris flow postfire and possible remedies was presented by Hay (1974).

Vegetation Management

Emergency Revegetation

An intense fire on July 20, 1960, burned 6705 ha (96.5 percent) of the Experimental Forest. Research then focused on emergency rehabilitation of burned watersheds to decrease postfire erosion and flooding (Corbett and Green 1965, Crouse and Hill 1962, Krammes 1960, Krammes and Hill 1963, Rice and others 1965). Twenty five watersheds were used to study the effects of various treatments on erosion and vegetation recovery. Treatments consisted of broadcast seeding annual grasses at two densities, broadcast seeding perennial grasses at two densities, planting barley on closely spaced contours, building stream channel check dams, and building contour trenches. Establishment of seeded grass species was poor the first year due to low rainfall and the total vegetation cover in seeded watersheds was never significantly greater than

unseeded controls. Response of variously treated watersheds to rainfall was a function of rainfall intensity rather than of storm size. Horton (1949) discussed sources of erosion and environmental conditions in southern California as they related to the establishment and effectiveness of various trees and shrubs planted for erosion control.

A laboratory experiment (Dunn and others 1982) examined the possibility of enhancing populations of heat shock fungi. These fungi occur naturally on burned areas and through production of mycelia may bind soil and ash particles and aid in reduction of rainsplash erosion after fire. Two to three times as much sediment was released from sterile soil than from soils with added fungus, supporting the thesis that these species do function in stabilization of soil.

Brush Manipulation

Defoliation of chaparral shrubs, and type conversion of chaparral from brush to grass were two management practices tested to conserve water. Patric (1959a) described use of sulfur dioxide gas as a defoliant to increase water yield. Merriam (1961) compared water losses on brush plots before and after application of herbicides. In untreated plots 88 percent of the rain received was lost through evapotranspiration while after defoliation only 36 percent was lost. This yielded soil moistures under defoliated plants that were 52 percent higher than under control plants.

Bentley (1961) found that the two factors most strongly influencing success of brush conversion in the San Gabriel Mountains are steepness of slope and depth of soil. Only 4 percent of the Forest has both mild enough gradients (0-55 percent) and deep enough soil (> 3 ft) to make brush conversion for increased water yield feasible. From 1958 through the 1960's the program to convert chaparral to grass continued on the SDEF and over 101 ha (250 acres) were converted. After heavy rainfall in November and December 1965 caused soil slips in both converted and untreated areas, Corbett and Rice (1966) chose matched areas in these watersheds for comparative study. They found five times more slips covering over five times the area in converted watersheds compared with untreated chaparral slopes. Most slips occurred at the interface of the lower depth of maximum rooting zone and the underlying soil. Corbett and Crouse (1968) found the conversion of brush to grass reduced rainfall interception loss by 50 percent if precipitation fell in a few large storms (rather than in a series of small storms). In an average year this amounted to a savings of 7.6 mm (1.3 in) of precipitation. Ultimately, brush conversion to increase water yield proved unfeasible as well as expensive on the steep slopes of the Forest.

Other studies focused on reducing the size of wildfires. Bentley and White (1961) described a system of fuelbreaks on the Forest to break up large expanses of brush as a means of conflagration control. Except for cursory maintenance of fuelbreaks this practice has been discontinued. Prescribed burning under controlled conditions to create a mosaic of vegetation ages is the current practice used by the Forest Service to break up large expanses of even-age brush. The hypothesis is that a wildfire would stop at the edges of a younger stand. Prescribed burns were conducted on the Experimental Forest in October 1984 (in the Bell and West Fork San Dimas Canyons) and in December 1986 and June 1987 (Lodi

Canyon). Vegetation, water quality, and slope movement are being monitored on these sites.

General watershed management (Rice 1963, 1966-1971; SDEF Staff 1957) has been addressed by work done on the SDEF, and most recently, with increasing energy prices, the utilization of chaparral biomass for energy has been examined (Riegan and Dunn 1982, PSW and Angeles National Forest 1976).

Chaparral Ecology and Physiology

The chaparral is a unique community that is subject to periodic fires but has an amazing ability to return to a site afterward through its seeds and resprouting lignotubers. Several researchers have examined succession in chaparral after fire in the SDEF. To examine chaparral succession after fire Horton and Kraebel (1955) located permanent plots on the south slopes of the San Gabriel and San Bernardino Mountains. The sites were located over a 17 year period on seven different burns and were characterized by elevation, soil type, and precipitation. Data on regrowth of chaparral shrubs and herbs on these burns were collected for up to 25 years. They found that long term stand composition was determined in the first winter after fire with few seedlings establishing thereafter and the composition of the plots changing little after subsequent burns. Temporary cover disappeared in 2-5 years.

By comparing shrub composition on similar sites burned in 1896 and 1919, Patric and Hanes (1964) were able to discern certain successional trends occurring on north- and south-facing slopes. On north-facing slopes ceanothus and chamise were being eliminated in favor of scrub oak, *Heteromeles arbutifolia* (toyon), and *Prunus ilicifolia* (holly-leaved cherry). A low oak woodland was predicted if the site remained fire-free. In older stands on south-facing slopes ceanothus was nearly gone but chamise and *Salvia mellifera* (black sage) were increasing.

The same sites on which the above study was conducted burned in the 1960 Johnstone Fire at the ages of 41 and 64 years. Hanes and Jones (1967) reexamined the plots 4.5 years after the fire. They found that the total number of species on similar exposures of the 1896 and 1919 burns did not differ significantly, however north-facing slopes had greater species numbers and diversity than did south-facing slopes.

Hanes (1971) used data from 624, 10 m transects throughout the southern California Transverse Ranges (including some in SDEF) to characterize chaparral succession. He generalized that succession is influenced most by aspect (north- or south-facing), secondarily by exposure (desert or coastal), and finally by elevation. He observed that a chamise chaparral climax usually develops in 30 years while short-lived species may begin to die at 25 years.

Between fires, shrubs produce seeds which are stored in the soil and litter. Davey (1982) found seed production in *C. crassifolius* was highly variable from year to year. A large number of seeds were produced but few remained in the soil for more than 1 year; enough remained, however, to replace mature shrubs after fire. Little seedling establishment is successful in mature stands. Only occasional success of chamise, *Salvia mellifera* (black sage), and ceanothus seedlings has been reported between fires (Horton and Kraebel 1955, Patric and Hanes 1964); openings in senescing

chaparral stands usually remain clear (Horton and Kraebel 1955). Keeley and Keeley⁵ compared the obligate seeder *C. crassifolius* on pole- and equator-facing slopes during a 6-year study started when shrubs were 18 years old (table 4). *C. crassifolius* phenology, seeds, seed dispersal, herbivory, and response to fire were also studied.⁶

Jacks (1984) compared chaparral stand composition in the Bell 4 watershed of SDEF after successive burns in 1919 and 1960. Relying on a 1934 survey of vegetation by Horton (1941) 15 years after the 1919 fire and using a model to extrapolate site composition 15 years after the 1960 fires, she compared species compositions (with special attention to chamise and *Ceanothus crassifolius*). If vegetation composition in chaparral is assumed to remain relatively stable with successive fires, then composition 15 years after the 1960 fire should be similar to composition 15 years after the 1919 fire. Jacks (1984) discovered that ceanothus was much more abundant after the 1960 fire. After comparing drought tolerances of the two species she hypothesized that ceanothus seedlings had higher drought tolerances than chamise. This may have increased ceanothus establishment in the drought years following the 1960 fire. She concluded that environmental conditions (especially moisture availability) the first year after fire may have a major influence on future chaparral stand composition.

Soil moisture is a limiting factor in the southern California chaparral and plants may experience up to 8 months of drought each year. Chaparral plants have various physiological and morphological methods of coping with this stress. Rooting pattern is one parameter that enables shrubs to differentially adapt to drought. Hellmers and others (1955) excavated numerous shrubs and characterized their root systems into three broad groups: (1)

shrubs with roots that grow predominately down, (2) shrubs with major roots that grow laterally, and (3) subshrubs with fibrous roots. Where soils are deep, deep rooted plants deplete soil moisture more than shallow rooted plants. Burk (1978) compared seasonal and diurnal water potential of two deep rooted species (chamise and scrub oak) and one shallow rooted species (*Ceanothus crassifolius*) near Tanbark Flats. The shallow rooted ceanothus adjusted more quickly to changes in water availability in the winter than deep rooted species. However, chamise and scrub oak may be able to grow for longer periods of time because of their access to a larger soil moisture pool. Guntle (1974) correlated growth of two common chaparral shrubs to annual precipitation.

A limited number of studies on photosynthesis have been conducted on the SDEF. Specht (1969) in a general comparison of sclerophyllous vegetation from France, Australia, and SDEF measured photosynthesis. Oechel⁴ (table 5) examined photosynthesis of *C. crassifolius* on SDEF by month.

Vegetation Classification

A useable classification scheme for chaparral is essential in any type of vegetation work as well as in studies examining fundamental relations between vegetation cover and erosion, for example. Several alternate plant community classifications have been applied to the geographic area that encompasses the Experimental Forest. Wright and Horton (1951) outlined six vegetation associations for the SDEF (table 6). Munz (1974) divided the vegetation of the area into coastal sage scrub, chaparral, and southern oak woodland. Jaeger and Smith (1966) added riparian

⁵Jon E. Keeley, Occidental College, Los Angeles, California, and Sterling Keeley, Chapman College, Orange, California. Unpublished data in SDEF archives.

⁶Ronald D. Quinn, California Polytechnic State University, Pomona. Unpublished data in SDEF archives.

Table 4—Characteristics of 30 *Ceanothus crassifolius* shrubs on pole- and equator-facing slopes in the San Dimas Experimental Forest

Characteristic	Pole-facing slope	Equator-facing slope	P
Total plant cover (pct ground surface)	> 100. pct	< 80. pct	—
<i>C. crassifolius</i> Height (m)	2.6	2.6	ns
Aerial coverage (m/individual)	2.6	5.6	<0.01
Mortality over 6 yrs (pct/yr)	2.9	0.0	<0.01
Fruit production over 6 yrs (fruits/m aerial coverage)	254.0	481.0	< 0.01

Table 5—*Ceanothus crassifolius* photosynthesis on the San Dimas Experimental Forest¹

Biomass (t/ha)	Feb.	Apr.	June	July	Sept.	Early Oct.	Late Oct.
	mg CO ₂ /dm ² of leaf/h						
39.2	9.24	10.09	—	11.00	—	9.36	—
53.5	—	7.65	—	12.06	2.08	—	9.02
64.7	—	10.58	—	14.06	—	—	17.04
67.1	9.22	6.58	—	16.96	—	12.24	—
88.4	10.25	9.15	—	17.51	0.72	—	8.60
91.2	8.40	7.03	9.05	13.65	—	15.42	—

¹Walt Oechel. San Diego State University, San Diego, CA. Unpublished data.

Table 6—Vegetation associations of the San Dimas Experimental Forest (after Wright and Horton 1951)

Association	Dominant species	Density	Elevation
Chamise chaparral	<i>Adenostoma fasciculatum</i> <i>Ceanothus crassifolius</i> <i>Arctostaphylos glauca</i>	Open to fairly dense	< 1524 m (5000 ft)
Oak chaparral	<i>Quercus dumosa</i> <i>Quercus wislizenii</i>	Very dense Very dense	<122 m(400 ft) >1067 m (3500 ft)
Stream	<i>Quercus agrifolia</i> <i>Platanus racemosa</i> <i>Acer macrophyllum</i> <i>Populus trichocarpa</i> <i>Alnus rhombifolia</i> <i>Salix</i> species	Open (with grassy areas) to dense	< 1220 m (4000 ft)
Oak woodland	<i>Quercus chrysolepis</i>	Dense	> 1220 m (4000 ft)
Bigcone fir forest	<i>Pseudotsuga macrocarpa</i> <i>Pinus lambertiana</i>	Open to fairly dense	> 1220 m (4000 ft) > 1524 m (5000 ft)
Ponderosa	<i>Pinus ponderosa</i>	Open,	1311 m

Table 7—Comparable physical parameters of three stands of chaparral from the San Dimas Experimental Forest (Winn 1977)

Stand age (yrs)	Soil temperature	Litter moisture (dry weight)	Soil respiration
	°C	Percent	
<i>mg CO₂/2</i>			
1	21.6	23.1	141.6
15	18.9	17.9	172.6
54	15.8	28.1	111.2

woodland. Hanes (1976) subdivided the chaparral vegetation of the San Gabriel Mountains into chamise chaparral and scrub oak chaparral.

Hill (1963a) divided SDEF vegetation into two major formations: chaparral and woodland chaparral. The chaparral was subdivided into three types: chamise-chaparral type, sage-buckwheat type, and scrub oak type. The woodland chaparral formation includes the live oak woodland type and the bigcone Douglas-fir forest type. A vegetation classification system developed for California can be applied to vegetation on the Experimental Forest (Paysen 1982; Paysen and others 1980, 1982).

Jerome Horton mapped the vegetation of all of the watersheds on the SDEF. Many of these maps are still available. He and other researchers established vegetation plots that were followed for many years. The most intense studies were of the vegetation succession after the Fern Canyon Fire of 1938. The vegetation of the triplicate watersheds had been mapped before the burn and plots were established in the subsequent years for intense studies of vegetation development and growth. These plots were sampled yearly for 10 years after the fire.

Jerome Horton, James Patric, and others, over a period of 30 years, assembled a flora for the SDEF (Appendix A). There are over 500 species of plants in the SDEF in 288 genera and 83 families. Nearly 15 percent of this flora is introduced (Mooney and Parsons 1973). Mishler (1978) studied the systematics and ecology of mosses in the SDEF and compiled a moss flora

(Appendix B). An unpublished listing of the SDEF herbarium collection is also available.

Litter Decomposition

Decomposition is seasonal on the SDEF (Winn 1977). Conditions appropriate for effective decomposition in the litter layer occur only 30 days per year. Decomposition rate is controlled by water, temperature, placement in the litter layer, and species of chaparral. Some differences in decomposition are associated with stand age (table 7).

Kittredge (1955) studied the moisture-holding capacity of chaparral litter layers in the SDEF. Some indirect information about decomposition can be inferred from his data: from 13 to 32 percent of the litter layer decomposes annually, and the decomposition rate of organic material in litter equals the deposition of new organic material from overstory shrubs in 8- to 55-year-old stands. Kittredge's data suffer from two shortcomings: first, deposition rates were not measured directly, but were estimated using litter fall and litter accumulation data; and second, litter organic content was measured as a function of litter depth. The measurement of litter organic content by litter depth may lead to erroneous conclusions in chaparral because of the difficulty in distinguishing the point at which litter ends and soil begins.

Fauna

Woodrats (*Neotoma* sp.) were the first animals intensively studied on the Forest; in 1936 they numbered 78,000 or 4.6 per acre (11.4 per ha). Woodrat density is primarily determined by availability of food and especially availability of good nesting sites. The focus of the study was the effect of woodrat food consumption on reproduction and development of natural vegetation (Horton and Wright 1944). At elevations below 4500 ft (1373 m) food storage was primarily new leaves and twigs of scrub oak and other chaparral species. At elevations above 4500 ft (1373 m) acorns of interior live oak (*Quercus wislizeni*) were the preferred food but new leaves of scrub oak, chaparral whitethorn (*Ceanothus leucodermis*), and Eastwood manzanita (*Arctostaphylos glandulosa*) were also eaten. Woodrats were found to have no significant effect on vegetative cover except perhaps on acorn populations.

Effects of fire on animal populations and postfire animal succession have been studied. Some small mammals are killed directly by fire, some flee, and others (such as kangaroo rats) take refuge in burrows (Quinn 1979). Wirtz (1977) observed rapid recovery of burrowing rodents on burn sites and slow reinvasion by other small mammals (i.e., woodrats and *Peromyscus*). Rodent species richness and diversity was found to increase rapidly the first 2-3 years after fire (Wirtz 1982, 1984; Quinn 1979). Rabbits preferred to forage in adjacent coastal sage scrub, perennial grass, annual grass and recently burned areas than in mature chaparral (Larson 1985).

Avian repopulation of burn sites is rapid and limited only by the availability of good nesting sites (Wirtz 1982). Avian diversity and richness appears to increase in the early postfire years probably due to increased availability of food but overall trends were not clear (Alten 1981, Wirtz 1984).

Reptile activity was found to increase over time after fire on south-facing slopes perhaps due to increasing vegetation structure (Simovich 1979). Insects reach their highest richness and diversity the first year after fire on relatively small burn sites where they can easily migrate to the center of the burn (Force 1981). After the initial peak, there is an overall decline in insect richness and diversity the first 3 years followed by a dramatic peak the fourth year (Force 1982). Wright and Horton (1951, 1953) compiled a list of vertebrate fauna of SDEF. Appendix C is an updated list of the vertebrate fauna of the SDEF.

ON-GOING RESEARCH

The accumulated database for replicated watersheds on the San Dimas Experimental Forest is the oldest in the western United States. Much of the current research on the SDEF rests on the large foundation of data developed since 1935. For example, early work on water budgeting in the San Dimas watersheds has led to current research on atmospheric inputs and mobilization of nitrogen and sulfur. Previous quantitative work on soil slips on the Experimental Forest serves as a basis for current work on the geomechanical mechanisms of soil slips. Vegetation plots established in the 1920's and 1930's have been reexamined recently to determine

successional changes in vegetation over time. Lysimeters built in the early years of the Experimental Forest and planted to a number of different species for studies of water use, are now being used in studies of soil nutrients, nitrogen fixation, and atmospheric deposition.

Major studies of national importance are being conducted on the San Dimas Experimental Forest. For example, Tanbark Flats is an acid deposition monitoring site for the National Trends Network and the National Acid Deposition Program. Wet fall samples are monitored for pH, conductivity, and the following ions: Ca^{+2} , Mg^{+2} , K^+ , Na^+ , NH_4^+ , NO_3^- , Cl^- , SO_4^{-2} , PO_4^{-3} , and H^+ . Tanbark Flats has been found to have record high levels of NO_3^- , which at times are above drinking water standards. An intensive study of the gaseous forms and amounts of dry deposition is underway. Data collected from Tanbark Flats and 10 other Forest Service-operated monitoring sites will be used to develop policy recommendations for Congress. The ultimate purpose of this research is to determine effects of acid deposition on forests.

Studies of fire effects on chaparral watershed processes are currently being conducted on replicated watersheds in the San Dimas Experimental Forest that were prescribe-burned in October 1984. Researchers are continuing to examine the effects of fire intensity on sediment production, water yield, and regeneration success of *Ceanothus* chaparral. The study is a collaborative effort with contributions from several universities and Federal, State and local government agencies.

A prescribed burn was conducted in winter 1986 in the 425 ha (1050 acres) Lodi Canyon in SDEF. Another burn was conducted in the same general area to remove vegetation missed in the first fire. The primary objective was to produce a smoke plume, which was monitored by aircraft to determine physical and optical properties of smoke. Secondary objectives included these: characterization of the environment within the primary fire zone, estimation of nitrogen volatilization and energy release, characterization of biomass before and after fire and development of predictive models, and determination of nitrogen and carbon loss and soil temperatures as a result of the fire.

Research on the San Dimas Experimental Forest is expected to continue far into the future. On the Forest research emphasis has changed over the years. It began with basic measurement of meteorologic and hydrologic phenomena as well as development of equipment to facilitate this type of measurement. This was in support of early studies which examined water use by plants and attempted to increase water yields through type conversion. Studies of sediment production and slope stabilization were conducted concurrently. The emphasis changed after the 1960 fire (which burned most of the Forest) and efforts were then focused on emergency rehabilitation and revegetation. Current research examines sediment movement, prescribed burning, nutrient cycling, air pollution impacts as well as basic ecological studies on recovery of flora and fauna after fire. Research planned for the future includes remote sensing of vegetation and fire temperatures. As technology advances and research continues to change focus based on the needs and interests of the day, the San Dimas Experimental Forest will remain as a huge, protected field laboratory to be used by researchers throughout the world.

APPENDIX A—FLORA

Flora of the San Dimas Experimental Forest are listed below alphabetically by family. This list was assembled from the 1930's through the 1950's and updated in August 1984.

ACERACEAE

Acer macrophyllum Pursh. Common, stream woodlands

AGAVACEAE

Yucca whipplei Torr. Abundant throughout

AMARANTHACEAE

Amaranthus albus L. Disturbed areas
Amaranthus retroflexus L. Rare in SDEF

AMARYLLIDACEAE

Allium haematochiton Wats. Grassy areas, < 2000 ft.
Allium peninsulare Lemmon Upper East Fork SDEF
Bloomeria crocea (Torr.) Cov. Occasional in chaparral
Brodiaea terrestris Kell. Rare, in grassy areas, ssp. *kernensis* (Hoov.) Niehaus < 2000 ft
Brodiaea pulchella (Salisb.) Greene Common, open areas
Muilla maritima (Torr.) Wats. Throughout woodland/chaparral

ANACARDIACEAE

Rhus integrifolia (Nutt.) Benth. Rare in Forest, & Hook < 2000 ft
Rhus laurina Nutt. in T. & G. Common open chamise, < 3500 ft
Rhus ovata Wats. Abundant in oak and chamise chaparral
Rhus trilobata Nutt. ex T. & G. Common, cyn. v. *pilosissima* Engler in DC. bottoms, throughout
Toxicodendron diversiloba (T. & G.) Greene Frequent/stream woodlands

APIACEAE

Angelica tomentosa Wats. Oak > 4000 ft; fire stimulated
Apiastrum angustifolium Nutt. Occasional, grassy in T. & G. areas < 2000 ft
Apium graveolens L. Occasional, moist areas
Caucalis microcarpa H. & A. Rare
Conium maculatum L. Weed
Daucus pusillus Michx. Common on dry slopes
Foeniculum vulgare Mill. Weed below Dalton Dam
Lomatium dasycarpum (T. & G.) Coult. & Rose Openings in chamise > 2000 ft
Lomatium lucidum (Nutt.) Jeps. Oak chaparral

Lomatium utriculatum (Nutt.) Coult. & Rose
Osmorhiza brachypoda Torr.
Sanicula arguta Greene ex Coult. & Rose
Sanicula bipinnatifida Dougl. ex Hook
Sanicula crassicaulis Poepp. ex DC.
Sanicula tuberosa Torr.

Tauschia arguta (T. & G.) Macbr.
Tauschia parishii (Coult. & Rose) Macbr.

APOCYNACEAE

Apocynum cannabinum L. Patches in stream
v. *glaberrimum* A. DC. woodland

ARALIACEAE

Aralia californica Wats. Common, stream woodland

ASCLEPIADACEAE

Asclepias eriocarpa Benth. Dry portion of reservoir
Asclepias fascicularis Dcne Occasional in in A. DC. woodlands
Asclepias vestita H. & A. Dry, rocky places, rare

ASPIDACEAE

Cystopteris fragilis D. Bernh. Common, stream woodland
Dryopteris arguta (Kaulf.) Watt. Common in stream and oak, throughout
Polystichum munitum (Kaulf.) Presl. Abundant, oak and spruce woodland, > 4000 ft

ASTERACEAE

Achillea millefolium L. v. Oak and stream
lanulosa (Nutt.) Piper woodlands
Agoseris grandiflora (Nutt.) Greene Rare, Brown's Flat
Agoseris heterophylla (Nutt.) Greene Open grassy areas-rare
Agoseris retrorsa (Benth.) Greene Occasional throughout
Ambrosia acanthicarpa Hook Common weed
Ambrosia psilostachya DC. v. Occasional colonies
californica (Rydb) Blake
Artemisia californica Less. Abundant in sagebrush < 2000 ft
Artemisia douglasiana Bess. in Abundant along streams
Hook.
Aster hesperius Gray Common in stream/woodland
Baccharis glutinosa Pers. Common along streams
Bidens pilosa L. Weed, Tanbark Flats
Brickellia californica (T. & G.) Gray Common, open places
Brickellia nevadensis Gray Occasional, dry/rocky slopes

<i>Calycadenia tenella</i> (Nutt.) T. & G.	Occasional, grasslands, Johnstone Peak	<i>Haplopappus cuneatus</i> Gray	Rock outcrops and cliffs
<i>Carduus tenuiflorus</i> Curt.	Weed, disturbed open areas	<i>Haplopappus parishii</i> (Greene) Blake	Abundant throughout, increases after burn
<i>Centaurea cyanus</i> L.	Weed, disturbed open areas	<i>Haplopappus pinifolius</i> Gray	Openings and disturbed areas, throughout
<i>Centaurea melitensis</i> L.	Common, grassy places	<i>Haplopappus squarrosus</i> H. & A.	Common, dry or disturbed areas
<i>Chaenactis artemisiaefolia</i> (Harv. & Gray) Gray	Occasional, grassy openings	<i>Haplopappus suffruticosus</i> (Nutt.) Gray	Collected-Dalton Rd.
<i>Chaenactis glabriscula</i> DC. v. <i>lanosa</i> (DC.) Hall	Occasional, dry places	<i>Haplopappus venetus</i> (HBK.) Blake ssp. <i>vernonioides</i> (Nutt.) Hall	Disturbed places, low elevations
<i>Chaetopappa aurea</i> (Nutt.) Keck	Dry, grassy places, > 2000 ft	<i>Helenium puberulum</i> DC.	Rare in stream woodland
<i>Chrysanthemum parthenium</i> (L.) Bernh.	Roadsides	<i>Helianthus annuus</i> L. ssp. <i>lenticularis</i> (Dougl.) Ckll.	Occasional colonies
<i>Chrysopsis villosa</i> (Pursh.) Nutt. v. <i>fastigiata</i> (Greene) Hall	Occasional throughout	<i>Helianthus gracilentus</i> Gray	Common/abundant
<i>Chrysothamnus nauseosus</i> (Pall.) Britton ssp. <i>consimilis</i> (Greene) Hall & Clem.	Disturbed areas	<i>Hemizonia ramosissima</i> Benth.	Not common, dry areas < 2000 ft
<i>Chrysothamnus nauseosus</i> (Pall.) Britton ssp. <i>hololeucus</i> (Gray) Hall & Clem.	Disturbed areas	<i>Heterotheca grandiflora</i> Nutt.	Open areas, throughout
<i>Cirsium californicum</i> Gray	Common in chaparral	<i>Hieracium argutum</i> Nutt. v. <i>parishii</i> (Gray) Jeps.	Common in openings
<i>Cirsium occidentale</i> (Nutt.) Jeps.	Common roadside	<i>Hulsea heterochroma</i> Gray	Rare, oak chaparral/ woodland
<i>Conyza bonariensis</i> (L.) Cronq.	Weed-Tanbark Flats	<i>Hypochoeris glabra</i> L.	Weed
<i>Conyza canadensis</i> (L.) Cronq.	Common weed grassy places	<i>Lactuca serriola</i> L.	Weed, common open places
<i>Corethrogyne filaginifolia</i> (H. & A.) Nutt. v. <i>bernardina</i>	Dry Lake, openings in chamise chaparral (Abrams) Hall	<i>Lagophylla ramosissima</i> Nutt.	Open places
<i>Corethrogyne filaginifolia</i> (H. & A.) Nutt. v. <i>pinetorium</i> Jtn.	Common, grassy areas	<i>Lasthenia chrysostoma</i> (F. & M.) Greene	Open grassy areas < 3000 ft
<i>Corethrogyne filaginifolia</i> (H. & A.) Nutt. v. <i>virgata</i> (Benth.) Gray	In dry, grassy places, low elevations	<i>Layia glandulosa</i> (Hook.) H. & A. ssp. <i>glandulosa</i>	Openings in Fern Canyon
<i>Cotula australis</i> (Sieber) Hook.	Weed in disturbed places	<i>Lepidospartum squamatum</i> (Gray) Gray	Dry washes, low elevations
<i>Erigeron foliosus</i> Nutt. v. <i>foliosus</i>	In chamise and oak chaparral, burns	<i>Madia exigua</i> (Sm.) Gray	Outside forest, 4500 ft
<i>Erigeron foliosus</i> Nutt. v. <i>stenophyllus</i> (Nutt.) Gray	Common in disturbed areas, burns	<i>Madia gracilis</i> (Sm.) Keck.	Openings, firebreaks
<i>Eriophyllum confertiflorum</i> (DC.) Gray v. <i>confertifolium</i>	Ridges and dry rocky slopes, abundant	<i>Malacothrix clevelandii</i> Gray	Openings throughout
<i>Filago californica</i> Nutt.	Occasionally abundant, < 2000 ft	<i>Malacothrix glabrata</i> Gray	In burn near Tanbark
<i>Galinsoga parviflora</i> Cav.	Rare weed	<i>Malacothrix saxatilis</i> (Nutt.) T. & G. v. <i>tenuifolia</i> (Nutt.) Gray	Common below 3000 ft
<i>Gnaphalium beneolens</i> A. Davids	Common in openings in chamise chaparral	<i>Matricaria matricarioides</i> (Less.) Porter	Common weed
<i>Gnaphalium bicolor</i> Bioletti	Occasional in openings	<i>Microseris linearifolia</i> (DC.) Sch.-Bip.	Grassy openings
<i>Gnaphalium californicum</i> DC.	Common in chamise/oak	<i>Perezia microcephala</i> (DC.) Gray	Occasional in chamise/ oak < 3000 ft
<i>Gnaphalium chilense</i> Spreng.	Occasional/moist openings	<i>Rafinesquia californica</i> Nutt	Occasional, oak, chamise
<i>Gnaphalium microcephalum</i> Nutt.	Occasional in chamise/oak	<i>Senecio astephanus</i> Greene	Collected on N. firebreak
<i>Gnaphalium purpureum</i> L.	Occasional at low elevations	<i>Senecio douglasii</i> DC. v. <i>douglasii</i>	Abundant throughout washes/dry places
<i>Grindelia camporum</i> Greene	Occasional grassy places < 2000 ft	<i>Senecio vulgaris</i> L.	Common weed
<i>Gutierrezia sarothrae</i> (Pursh.) Britt. & Rusby.	Rare, San Dimas Wash	<i>Solidago californica</i> Nutt.	Common throughout forest
		<i>Sonchus asper</i> (L.) Hill	Weed-disturbed places
		<i>Sonchus oleraceus</i> L.	Disturbed places
		<i>Stephanomeria cichoriacea</i> Gray	Common throughout
		<i>Stephanomeria virgata</i> Benth.	Disturbed places/grassy openings throughout
		<i>Stylocline gnaphalioides</i> Nutt.	San Dimas wash

<i>Taraxacum officinale</i> Wiggers	Occasional weed	<i>Sisymbrium altissimum</i> L.	Weed, open grassy places
<i>Tetradymia comosa</i> Gray	Rare	<i>Sisymbrium irio</i> L.	Common weed
<i>Venegasia carpesioides</i> DC.	Occasional, stream woodland	<i>Sisymbrium officinale</i> (L.) Scop.	Weed, grassy places
<i>Xanthium strumarium</i> L. v. <i>canadense</i> (Mill.) T. & G.	Weed	<i>Thelypodium lasiophyllum</i> (H. & A.) Greene v. <i>lasiophyllum</i>	Occasional
BERBERIDACEAE		<i>Thysanocarpus laciniatus</i> Nutt. ex T. & G. v. <i>crenatus</i> (Nutt.) Brew.	Grassy openings in oak/ chamise
<i>Berberis dictyota</i> Jeps.	Locally common, N. Fork	CACTACEAE	
BETULACEAE		<i>Opuntia</i> hybrid population "occidentalis"	In meadow below San Dimas Dam
<i>Alnus rhombifolia</i> Nutt.	Along stream woodland	CAMPANULACEAE	
BLECHNACEAE		<i>Githopsis specularioides</i> Nutt.	Burns, open or disturbed places/oak and chamise chaparral
<i>Woodwardia fimbriata</i> Sm. in Rees	In wet areas, throughout	<i>Heterocodon rariflorum</i> Nutt.	Rare, grassy areas, incl. Brown's Flat
BORAGINACEAE		<i>Lobelia dunnii</i> Greene v. <i>serrata</i> (Gray) McVaugh	Common along streams
<i>Amsinckia intermedia</i> F. & M.	Occasional, disturbed areas, firebreaks	<i>Triodanis biflora</i> (R. & P.) McVaugh	Open area near stream
<i>Cryptantha flaccida</i> (Dougl.) Greene	Rare, disturbed areas in chamise	CAPRIFOLIACEAE	
<i>Cryptantha intermedia</i> (Gray) Greene	Abundant, disturbed or burned areas, chamise chaparral	<i>Lonicera subspicata</i> H. & A.	Abundant oak/chamise chaparral
<i>Cryptantha maritima</i> (Greene)	Fern Cyn. only	<i>Sambucus mexicana</i> Raf.	Occasional in chaparral
<i>Cryptantha micromeres</i> (Gray) Greene	Disturbed areas	<i>Symphoricarpos mollis</i> Nutt. in T. & G.	Throughout shady slopes in chaparral
<i>Cryptantha microstachys</i> (Greene ex Gray) Greene	Disturbed areas Tanbark	CARYOPHYLLACEAE	
<i>Cryptantha muricata</i> (H. & A.) v. <i>jonesii</i> (Gray) Jtn.	In washes or rocky open slopes	<i>Arenaria douglasii</i> Fenzl. ex T. & G.	Occasional throughout
<i>Pectocarya penicillata</i> (H. & A.) A. DC.	Occasional/sandy washes<1500 ft	<i>Cerastium glomeratum</i> (L.) Thill	Disturbed areas < 3000 ft
<i>Plagiobothrys nothofulvus</i> (Gray) Gray	Rare, open grassy areas < 2000 ft	<i>Polycarpon tetraphyllum</i> (L.) L.	Only at flume West Fork
BRASSICACEAE		<i>Silene antirrhina</i> L.	Only in Sycamore Flat
<i>Arabis glabra</i> (L.) Bernh.	Common, stream/ woodland	<i>Silene gallica</i> L.	Weed along roads/trails
<i>Arabis sparsiflora</i> Nutt. in T. & G. v. <i>arcuata</i> (Nutt.)	Common in openings throughout chaparral	<i>Silene laciniata</i> Cav. ssp. <i>major</i> Hitchc. & Maguire	Openings or shady places, oak/chamise chaparral
<i>Athysanus pusillus</i> (Hook.) Greene	Roll	<i>Silene lemmonii</i> Wats.	Woodland, higher elevation
<i>Brassica genticulata</i> (Desf.) J. Ball	Occasional, grassy openings	<i>Silene multinervia</i> Wats.	Burns/disturbed places
<i>Brassica nigra</i> (L.) Koch.	Occasional weed	<i>Spergula arvensis</i> L.	Openings, lower elevations
<i>Brassica rapa</i> L. ssp. <i>sylvestris</i> (L.) Janchen	Occasional weed	<i>Spergularia villosa</i> (Pers.)Camb.	Weed
<i>Capsella bursa-pastoris</i> (L.) Medic.	Disturbed areas	<i>Stellaria media</i> (L.) Vill.	Common weed/moist places
<i>Cardamine californica</i> (Nutt.) Greene	Rare, stream woodland	<i>Stellaria nitens</i> (Nutt.)	Occasional along trails
<i>Cardamine oligosperma</i> Nutt.	Common in stream/oak woodland	CHENOPODIACEAE	
<i>Erysimum capitatum</i> (Dougl.) Greene	Dry, rocky slopes/chamise	<i>Chenopodium album</i> L.	Occasional weed
<i>Lepidium virginicum</i> L. v. <i>pubescens</i> (Greene) Thell	Disturbed areas	<i>Chenopodium ambrosioides</i> L.	Occasional weed
<i>Rorippa nasturtium-aquaticum</i> (L.) Schinz & Thell	Rare, streams	<i>Chenopodium californicum</i> (Wats.)Wats.	Occasional/stream woodland
		<i>Chenopodium pumilio</i> R.Br.	Occasional weed
		<i>Salsola iberica</i> Sennen & Pau	Throughout weed/ disturbed grassy areas

CISTACEAE			<i>Euphorbia melanadenia</i> Torr.	Chamise chaparral, < 2000 ft
<i>Helianthemum scoparium</i> Nutt. v. <i>vulgare</i> Jeps.	Occasional, in openings < 4000 ft		<i>Euphorbia peplus</i> L.	Weed
CONVOLVULACEAE			<i>Euphorbia polycarpa</i> Benth. v. <i>polycarpa</i>	Rare, dry, rocky openings
<i>Convolvulus occidentalis</i> Gray	Openings, chaparral/ woodland, native to more N. sites		<i>Euphorbia serpyllifolia</i> Pers.	Not common, Tanbark Flats
<i>Cuscuta californica</i> H. & A.	Parasite throughout forest		<i>Euphorbia spathulata</i> Lam.	Grassland, < 2000 ft
<i>Cuscuta ceanothi</i> Ser.	Tanbark Flats parasitic		<i>Ricinus communis</i> L.	Weed along roads
<i>Cuscuta suaveolens</i> Behr.	Introduced weed	FABACEAE		
CRASSULACEAE		<i>Amorpha californica</i> Nutt.		Openings in oaks/ woodland, < 3000 ft
<i>Crassula erecta</i> (H. & A.) Berger	Common, grassy places, < 2000 ft	<i>Astragalus gambelianus</i> Sheld.		Grassy areas, < 2000 ft
<i>Dudleya cymosa</i> (Lem.) Britt. & Rose ssp. <i>minor</i> (Rose) Moran	Common, rocky areas	<i>Lathyrus laetiflorus</i> Greene alefeldii (White) Brads		Common vine in oak chaparral throughout
<i>Dudleya lanceolata</i> (Nutt.) Britt. & Rose	Openings, coastal sagebrush	<i>Lotus argophyllus</i> (Gray) Greene ssp. <i>decorus</i> (Jtn.) Munz, Comb. Nov.		Oak woodland > 4000 ft
<i>Dudleya multicaulis</i> (Rose) Moran Rare		<i>Lotus crassifolius</i> (Benth.) Greene		Common on firebreaks /burns > 4500 ft
<i>Sedum spathulifolium</i> Hook. ssp. <i>anomalum</i> (Britt.) Clausen and Uhl	Only in Fern Canyon, 3000-4000 ft	<i>Lotus hamatus</i> Greene		Firebreaks
CUCURBITACEAE		<i>Lotus heermannii</i> (Dur. & Hilg.) Greene		Opening in streams/ chaparral
<i>Marah macrocarpus</i> (Greene) Greene	Chamise and oak chaparral, < 4000 ft	<i>Lotus micranthus</i> Benth.		Firebreaks/openings
CUPRESSACEAE		<i>Lotus oblongifolius</i> (Benth.) Greene		Occasional, stream woodland
<i>Calocedrus decurrens</i> (Torr.) Florin	Scattered, isolated, > 4000 ft	<i>Lotus purshianus</i> (Benth.) Clem. & Clem.		Occasional, dry open grassy places
CYPERACEAE		<i>Lotus salsuginosis</i> Greene ssp. <i>sasuginosus</i>		Occasional chamise
<i>Carex alma</i> Bailey	Common in stream woodland	<i>Lotus scoparius</i> (Nutt. in T. & G.) Ottley ssp. <i>scoparius</i>		Abundant, dry areas and burns < 4000 ft
<i>Carex globosa</i> Boott.	Openings in oak woodland	<i>Lotus strigosus</i> (Nutt. in T. & G.) Greene		Common throughout
<i>Carex lanuginosa</i> Michx.	Stream woodland	<i>Lotus subpinnatus</i> Lag.		Dry, grassy openings, < 1500 ft
<i>Carex multicaulis</i> Bailey	Common in woodland	<i>Lupinus adsurgens</i> E. Drew		Collected in 1961 burn
<i>Carex nebrascensis</i> Dewey	Stream woodland	<i>Lupinus bicolor</i> Lindl.		Occasional
<i>Carex spissa</i> Bailey	Stream woodland	<i>Lupinus formosus</i> Greene v. <i>formosus</i>		Open places throughout
<i>Carex triquetra</i> Boott.	Lower level grasslands	<i>Lupinus hirsutissimus</i> Benth.		Open places chaparral
DATISTACEAE		<i>Lupinus latifolius</i> Agardh. v. <i>parishii</i> C. P. Sm.		Occasional
<i>Datisca glomerata</i> (Presl.) Baill.	Common throughout	<i>Lupinus longifolius</i> (Wats.) Abrams		Abundant on disturbed and open areas, dominant on burns
EQUISETACEAE		<i>Lupinus sparsiflorus</i> Benth. ssp. <i>sparsiflorus</i>		Openings in chaparral
<i>Equisetum laevigatum</i> A. Br.	Common, stream woodland	<i>Lupinus truncatus</i> Nutt. ex		Openings grassy places H. & A.
<i>Equisetum telmateia</i> Ehrh. v. <i>braunii</i> Milde	Stream woodland	<i>Medicago lupulina</i> L.		Occasional in grassy areas
ERICACEAE		<i>Medicago polymorpha</i> L.		Common weed
<i>Arctostaphylos glandulosa</i> Eastw.	Abundant throughout	<i>Melilotus indicus</i> (L.) All.		Roadside weed
<i>Arctostaphylos glauca</i> Lindl.	Chamise chaparral, destroyed by closely repeated fires	<i>Pickeringia montana</i> Nutt.		Chamise chaparral, Bell Cyn. #1, rare
EUPHORBIACEAE		<i>Psoralea physodes</i> Dougl.		Open spots, streams
<i>Croton californicus</i> Muell. Arg. v. <i>californicus</i>	Dry, sandy area	<i>Trifolium albopurpureum</i> T. & G.		Grassy places, rare
<i>Eremocarpus setigerus</i> (Hook.) Benth.	Occasional, grassy areas, < 3000 ft	<i>Trifolium ciliolatum</i> Benth.		Grassy places < 3000 ft
		<i>Trifolium gracilentum</i> T. & G.		Open, grassy places
		<i>Trifolium microcephalum</i> Pursh.		Occasional, grassy places

<i>Trifolium obtusiflorum</i> Hook. <i>Trifolium tridentatum</i> Lindl. v. <i>aciculare</i> (Nutt.) McDer.	Stream woodland, moist Monroe Canyon only	<i>Phacelia brachyloba</i> (Benth.) Gray <i>Phacelia cicutaria</i> Greene v. <i>hispida</i> (Gray) J. T. Howell	Occasional except after 1938 burn Common in chaparral, abundant after burns
FAGACEAE			
<i>Quercus agrifolia</i> Nee.	Dominant in woodland, v. <i>agrifolia</i> < 3500 ft	<i>Phacelia curvipes</i> Torr. ex Wats. <i>Phacelia distans</i> Benth.	Dry Lake only, openings Dry open grassy places, < 2000 ft
<i>Quercus chrysolepis</i> Liebm.	Above 4000 ft dominant in oak woodland, occasional below 4000 ft	<i>Phacelia grandiflora</i> (Benth.) Gray <i>Phacelia imbricata</i> Greene ssp. <i>patula</i> (Brand) Heckard <i>Phacelia longipes</i> Torr. ex Gray	Open or disturbed area Dry openings, burns
<i>Quercus dumosa</i> Nutt.	Dominant in oak chaparral mostly < 4000 ft	<i>Phacelia minor</i> (Harv.) Thell. <i>Phacelia parryi</i> Torr. <i>Phacelia ramosissima</i> Dougl. ex Lehm. v. <i>suffrutescens</i> Parry <i>Phacelia viscida</i> (Benth.) Torr. <i>Pholistoma auritum</i> (Lindl.) Lilja. <i>Turricula parryi</i> (Gray) Macbr.	Roadside south of Dry Lake Common throughout Rare Common, abundant in burns Occasional Common, < 3000 ft
<i>Quercus engelmannii</i> Greene	Rare, several individuals on SW slope Johnstone Peak		
<i>Quercus morehus</i> Kell.	Rare, only 2 individuals, 5000 ft		
<i>Quercus wislizenii</i> A. DC. v. <i>frutescens</i> Engelm	Dominant in oak chaparral above 4000 ft, common < 4000 ft		On firebreaks, dominant after burning chaparral
GARRYACEAE			
<i>Garrya veatchii</i> Kell.	Abundant in and oak chaparral broadleaved	IRIDACEAE <i>Sisyrinchium bellum</i> Wats.	Moist, grassy places, < 2500 ft
GENTIANACEAE			
<i>Centaurium venustum</i> (Gray) Rob.	Common, grassy places, < 2000 ft	JUGLANDACEAE <i>Juglans californica</i> Wats.	Woodlands < 4000 ft
<i>Frasera parryi</i> Torr.	Grassy areas south of San Dimas Dam	JUNCACEAE <i>Juncus balticus</i> Willd.	Meadow, below San Dimas Dam 1400 ft Only at Big Dalton Dam
GERANIACEAE			
<i>Erodium botrys</i> (Cav.) Bertol.	Grassy places, openings, < 2000 ft	<i>Juncus bufonius</i> L. <i>Juncus macrophyllus</i> Cov. <i>Juncus oxymetris</i> Englem. <i>Juncus rugulosus</i> Englem. <i>Juncus textilis</i> Buch.	Stream woodland Stream woodland Stream woodland Stream woodland
<i>Erodium cicutarium</i> (L.) L'Her.	Common in openings throughout		
<i>Erodium macrophyllum</i> H. & A. <i>Erodium moschatum</i> (L.) L'Her.	Grassy places, < 2000 ft Openings on better sites < 2000 ft		
<i>Geranium carolinianum</i> L.	Stream woodland, oak chaparral	LAMIACEAE <i>Lepechinia fragrans</i> (Greene) Epl. <i>Marrubium vulgare</i> L. <i>Mentha peperita</i> L. <i>Monardella lanceolata</i> Gray <i>Monardella lanceolata</i> Gray v. <i>glandulifera</i> Jtn. <i>Monardella macrantha</i> Gray <i>Monardella viridis</i> Jeps. ssp. <i>saxicola</i> (Jtn.) Ewan <i>Pycnanthemum californicum</i> Torr. <i>Salvia apiana</i> Jeps. <i>Salvia columbariae</i> Benth. v. <i>columbariae</i> <i>Salvia mellifera</i> Greene <i>Scutellaria tuberosa</i> Benth. <i>Stachys albens</i> Gray <i>Trichostema lanceolatum</i> Benth. <i>Trichostema parishii</i> Vasey	Common Common weed Weed at Tanbark Common, dry places Brown's Flat Dry, exposed openings Dry openings Occasional in openings Abundant, dry, rocky places Common on open areas and burns Abundant in chamise Grassy openings < 2500 ft Common in openings Grassy areas Chamise chaparral
HYDROPHYLLACEAE			
<i>Emmenanthe penduliflora</i> Benth. <i>Eriodictyon crassifolium</i> Benth.	Disturbed areas, burns Openings, disturbed areas, west side of Monroe Cyn.		
<i>Eriodictyon trichocalyx</i> Heller	Abundant throughout oak and chamise chaparral		
<i>Eucrypta chrysanthemifolia</i> (Benth.) Greene v. <i>chrysanthemifolia</i> <i>Nemophila menziesii</i> H. & A. ssp. <i>menziesii</i>	Disturbed places Throughout grassy openings		
<i>Nemophila menziesii</i> H. & A. ssp. <i>integrifolia</i> (Parish) Munz	Stream woodland, oak chaparral		

LAURACEAE

Umbellularia californica
(H. & A.) Nutt

Stream and oak
woodland at higher
elevations

Camissonia strigulosa (Fisch. &
Meyer) Raven
Clarkia dudleyana (Abrams) .
Macbr

Recorded from Brown's
Flat only
Common, grassy areas

LILIACEAE

Calochortus albus Dougl. ex
Benth.

Occasional in stream
woodland

Clarkia epilobioides (Nutt.) Nels.
& Macbr.

Occasional < 2500 ft

Calochortus catalinae Wats.

Common, grasslands,
< 2000 ft

Clarkia purpurea (Curt.) Nels. &
Macbr. ssp. *quadrivulnera*
(Dougl.) Lewis & Lewis

Low elevation,
grassy areas

Calochortus clavatus Wats.
v. *gracilis* Ownbey

Rare

Clarkia rhomboidea Dougl.

Dry Lake, open areas,
Fern Cyn.

Calochortus plummerae Greene

Occasional in chamise

Clarkia similis Lewis & Ernst.

East Fork San Dimas

Calochortus splendens Dougl.
ex Benth.

Grassy areas

Clarkia unguiculata Lindl.

Shady places, chamise

Chlorogalum pomeridianum
(DC.) Kunth.

Often abundant

Epilobium adenocaulon Hausskn.

Stream woodland

Fritillaria biflora Lindl.

Common in grassland
< 2000 ft

v. *parishii* (Trel.) Munz

Dry openings, chamise,
Hook. native to more
N. sites

Lilium humboldtii Roetzl. &
Leichtl. v. *ocellatum*
(Kell.) Elwes.

Common < 3000 ft

Epilobium glaberrimum Barb.

Stream woodland

Zigadenus fremontii Torr.
v. *fremontii*

Not common, found
in Little Dalton
chamise

Epilobium minutum Lindl. ex

Openings, disturbed
dry places in chamise

Epilobium paniculatum Nutt. ex
T. & G.

chaparral

Gayophytum ramosissimum
T. & G.

Rare, grassy areas,
5000 ft Dry Lake

Oenothera Hookeri T. & G.

Rare, stream woodland

Oenothera micrantha Hornem. ex
Spreng

Burns, disturbed areas

LOASACEAE

Mentzelia congesta T. & G.
Mentzelia dispersa Wats.

Disturbed, < 5000 ft
Burns or disturbed,
> 4000 ft

Zauschneria californica Presl.
ssp. *californica*

Common throughout

v. *obtusata* Jeps.
Mentzelia laevicaulis (Dougl.
ex Hook.) T. & G.

Occasional roadsides,
dry washes
throughout

Zauschneria californica Presl.
ssp. *latifolia* (Hook.) Keck

Not common, Tanbark
Flats and Fern
Canyon

Mentzelia micrantha

Burns, disturbed places
(H. & A.) T. & G.

Zauschneria cana Greene

Occasional chamise
chaparral

ORCHIDACEAE

Epipactis gigantea Dougl. ex
Hook.

Rare in steep areas

Habenaria elegans (Lindl.)
Bolander

Occasional in
woodlands

Habenaria unalascensis (Spreng.)
Wats.

Rare, grassy areas
< 2000 ft

LYTHRACEAE

Lythrum californicum T. & G.

Occasional, stream
woodland

MALVACEAE

Malacothamnus fasciculatus
(Nutt.) Greene

Openings in chamise
< 4000 ft

OROBANCHACEAE

Orobanche bulbosa (Gray.)
G. Beck.

Parasitic on chamise
roots

Orobanche fasciculata Nutt.

Parasitic

Orobanche uniflora L. ssp.
occidentalis Ferris

Parasitic

NYCTAGINACEAE

Mirabilis laevis (Benth.) Curran.

Dry, stony places

OLEACEAE

Fraxinus dipetala H. & A.

Oak chaparral and
stream woodland

Fraxinus latifolia Benth.

Rare, oak chaparral,
one shrub Bell #4

OXALIDACEAE

Oxalis albicans ssp. *californica*
(Abrams) Knuth. Eiten
Oxalis corniculata L.

Sage brush and grass
< 2000 ft
Weed, Tanbark lawn

ONAGRACEAE

Camissonia bistorta
(Nutt. ex T. & G.) Raven
Camissonia californica (Nutt. ex

Dry washes, south of
SDEF
Burns, disturbed places
T. & G.) Raven

PAEONIACEAE

Paeonia californica Nutt. ex
T. & G.

Common in open
chamise < 3000 ft

Camissonia hirtella (Greene)
Raven

Disturbed areas

PAPAVERACEAE

Dicentra chrysantha (H. & A.)
Walp.

Common on disturbed
places, burned oak
chaparral

Camissonia ignota (Jeps.) Raven

Dry washes, low
elevation

POLEMONIACEAE

Allophyllum divaricatum (Nutt.)
A. & V. Grant

Common in shady
grassy areas,
dominant herb in
woodland and oak
chaparral after fire

Eriastrum sapphirinum (Eastw.)
Mason

Common

Gilia achilleaefolia Benth. ssp.
multicaulis (Benth.) V. & A.
Grant

Grassy areas
< 2000 ft

Gilia angelensis Grant.

Dalton Canyon

Gilia capitata Sims ssp.
abrotanifolia (Nutt. ex
Greene) V. Grant.

Occasional

Gilia latiflora (Gray) Gray

Occasional, common
in burns

Ipomopsis tenuifolia (Gray)
V. Grant

In grassy areas,
dominant in all
types after burn

Leptodactylon californicum
H. & A.

Dry areas and burns
throughout

Linanthus breviculus (Gray)
Greene

Occasional
throughout

Linanthus dianthiflorus (Benth.)
Greene

Not common,
grassland < 2000 ft

Linanthus liniflorus (Benth.)
Greene ssp. *pharnaceoides*
(Benth.) Mason

Rare

Navarretia atractylodes (Benth.)
H. & A.

Chamise, low
elevations

POLYGONACEAE

Chorizanthe procumbens Nutt.

Only in San Dimas wash

Chorizanthe staticoides Benth.
ssp. *staticoides*

Often abundant
< 4000 ft

Eriogonum davidsonii Greene.

Ponderosa pine, dry
rocky places

Eriogonum elongatum Benth.

In chamise chaparral

Eriogonum fasciculatum Benth.
ssp. *foliosum* (Benth.) Stokes.

Abundant, often
dominant, sage, road
slopes

Eriogonum fasciculatum Benth.
ssp. *polifolium* (Benth.)
Stokes.

Common in openings
> 4500 ft

Eriogonum gracile Benth.

Dry, rocky openings

Eriogonum saxatile Wats.

Dry openings, woodland

Polygonum aviculare L.

Rare, weed, disturbed
areas

Pterostegia drymarioides F. & M.

Common, shady places

Rumex crispus L.

Weed of openings

Rumex obtusifolius L. ssp.
agrestis (Fries.) Danser

Openings in stream
woodland, weed

Rumex salicifolius Weinm.

Stream woodland, weed

POLYPODIACEAE

Polypodium californicum Kaulf.

Common, often
abundant

PORTULACACEAE

Calandrinia ciliata (R. & P.)
DC. v. *menziesii* (Hook.) Macbr.

Occasional

Calyptridium monandrum Nutt.
in T. & G.

Occasional, disturbed
areas

Claytonia perfoliata (Donn) v.
perfoliata

Abundant, especially
after fire in
woodland

PRIMULACEAE

Anagallis arvensis L.

Weed, grassy areas

Dodecatheon clevelandii Greene.

Grassy, open places
< 2000 ft

PTERIDACEAE

Adiantum capillus-veneris L.

Common, stream
woodland

Adiantum jordanii K. Muell.

Stream and oak,
woodlands

Adiantum pedatum L. v.
aleuticum Rupt.

Rare stream woodland,
moist seeps.

Cheilanthes californica Mett.

Occasional, shady
slopes

Cheilanthes covillei Maxon.

Common, dry, rocky
slopes

Pellaea andromedaefolia (Kaulf.)
Fee. v. *andromedaefolia*

Common, dry, rocky
places

Pellaea mucronata (D.C. Eat.)
D.C. Eat.

Common, cliffs, dry,
rocky slopes

Pityrogramma triangularis
(Kaulf.) Maxon.

Common, throughout

Pteridium aquilinum (L.) Kuhn v.
pubescens Underw.

Often abundant in
stream and oak
woodland

RANUNCULACEAE

Aquilegia formosa Fisch. in DC.
v. *truncata* (F. & M.) Baker

Common throughout
in moist areas

Clematis lasiantha Nutt. in
T. & G.

Common throughout

Clematis ligusticifolia Nutt. in
T. & G.

Stream woodland
< 3000 ft

Clematis pauciflora Nutt. in
T. & G.

Occasional in sage,
chaparral

Delphinium cardinale Hook.

Common in stream
woodlands

Delphinium parryi Gray

Common, dry, grassy
areas

Delphinium patens Benth.

Common in openings
throughout

Ranunculus californicus Benth.
v. *californicus*

Only on west side of
Johnstone Peak

Thalictrum polycarpum (Torr.)
Wats.

Occasional, stream
woodland

RHAMNACEAE

Ceanothus crassifolius Torr.

Usually a dominant in
chamise chaparral

Ceanothus integerrimus H. & A.

Abundant in oak
woodland > 4000 ft
especially after
recent burns

Ceanothus leucodermis Greene

Dominant shrub in
chaparral > 4000 ft,
occasional below

<i>Ceanothus oliganthus</i> Nutt. in T. & G.	A dominant in oak chaparral < 4000 ft for 25 yrs after burning	<i>Lithophragma affine</i> Gray. <i>Lithophragma heterophylla</i> (H. & A.) T. & G. <i>Ribes amarum</i> McClat. <i>Ribes aureum</i> Pursh v. <i>gracillimum</i> (Cov. & Britt.) Jeps <i>Ribes californicum</i> H. & A. v. <i>hesperium</i> (McClat.) Jeps. <i>Ribes indecorum</i> Eastw.	Openings throughout Stream and woodland throughout. Common in understory Rare, gravel washes, south of Forest
<i>Rhamnus californica</i> Esch.	Common understory, throughout		
<i>Rhamnus crocea</i> Nutt. in T. & G.	Occasional, dry washes < 2000 ft		
<i>Rhamnus illicifolia</i> Kell.	Common, chaparral		Common, stream woodland Few shrubs in chamise < 2000 ft
ROSACEAE			
<i>Adenostoma fasciculatum</i> H. & A.	Dominant throughout	<i>Ribes malvaceum</i> Sm.	Common, canyon bottoms throughout
<i>Cercocarpus betuloides</i> Nutt. ex T. & G.	Abundant in chamise and oak chaparral	<i>Ribes roezlii</i> Regel.	Common, oak woodland > 4000 ft
<i>Cercocarpus ledifolius</i> Nutt.	One shrub in oak chaparral, Brown's Flat	<i>Ribes speciosum</i> Pursh.	One shrub, San Dimas Guard Station
<i>Heteromeles arbutifolia</i> M. Roem.	Abundant, oak chaparral, < 4500 ft	<i>Saxifraga californica</i> Greene.	In shady places, oak chaparral, woodlands
<i>Holodiscus discolor</i> (Pursh.) Maxim.	Uncommon, Johnstone Peak, 3000 ft	SCROPHULARIACEAE	
<i>Potentilla glandulosa</i> Lindl.	Common throughout	<i>Antirrhinum coulterianum</i> Benth. in DC.	Grassy areas and disturbed places
<i>Prunus ilicifolia</i> (Nutt.) Walp.	Common in oak chaparral	<i>Antirrhinum kelloggii</i> Greene <i>Antirrhinum multiflorum</i> Penn. <i>Castilleja applegatei</i> Fern.	Dry slopes, < 2000 ft Disturbed areas, burns Collected in Fern Cyn burn, more common farther north
<i>Rosa californica</i> C. & S.	Common, stream woodland	<i>Castilleja foliolosa</i> H. & A.	Common, dry washes, openings
<i>Rubus ursinus</i> C. & S.	Common, stream woodland	<i>Castilleja miniata</i> Dougl. ex Hook. <i>Castilleja stenantha</i> Gray.	Occasional in woodlands Occasional, stream woodland
RUBIACEAE			
<i>Galium angustifolium</i> Nutt. in T. & G.	Common, chamise chaparral, also burns in woodland	<i>Collinsia childii</i> Parry ex Gray	Dry, shaded places, oak woodland, chaparral, burns
<i>Galium aparine</i> L.	Common, shaded areas	<i>Collinsia heterophylla</i> Buist. ex Grah. <i>austromontana</i> (Newsom) Munz <i>Collinsia parryi</i> Gray. <i>Cordylanthus rigidus</i> (Benth.) Jeps. ssp. <i>brevibracteatus</i> (Gray) Munz <i>Keckiella cordifolia</i> (Benth.) Straw <i>Keckiella ternata</i> (Torr. ex Gray) Straw ssp. <i>ternata</i> <i>Linaria canadensis</i> (L.) Dum.-Cours. v. <i>texana</i> (Scheele) Penn. <i>Mimulus Bolanderi</i> Gray <i>Mimulus brevipes</i> Benth. <i>Mimulus cardinalis</i> Dougl. ex Benth. <i>Mimulus floribundus</i> Dougl. ex Lindl. <i>Mimulus fremontii</i> (Benth.) Gray <i>Mimulus guttatus</i> Fisch. ex DC.	Oak woodland, grassy areas throughout Disturbed or open areas Disturbed places throughout, burns Common vine throughout Common chamise chaparral, abundant on burns Sandy Dalton Wash, 1200 ft Burn in Fern #1, native farther north Common, chamise and oak chaparral Common, stream woodland, oak Stream woodland throughout San Dimas wash Abundant, stream woodland
<i>Galium grande</i> McClat.	Common in oak woodland, burns		
<i>Galium nuttallii</i> Gray	Frequent, chamise chaparral		
<i>Sherardia arvensis</i> L.	Weed, Tanbark Flats		
ALICACEAE			
<i>Populus fremontii</i> Wats. v. <i>fremontii</i>	Scattered trees in San Dimas Cyn. Flume #6 to reservoir		
<i>Populus trichocarpa</i> T. & G.	Dominant in stream woodland		
<i>Salix hindsiana</i> Benth. v. <i>leucodendroides</i> (Rowlee) Ball	Occasional below Dalton Dam		
<i>Salix laevigata</i> Bebb.	Common, stream woodland < 3000 ft		
<i>Salix lasiandra</i> Benth.	Stream woodlands < 3000 ft		
<i>Salix lasiolepis</i> Benth.	Stream woodlands throughout		
SALVINIACEAE			
<i>Azolla filiculoides</i> Lam.	Floating weed in San Dimas reservoir		
SAXIFRAGACEAE			
<i>Boykinia rotundifolia</i> Parry.	Common		
<i>Heuchera elegans</i> Abrams.	Only from a rocky point, south of Dry Lake, 5000 ft		

<i>Mimulus longiflorus</i> (Nutt.) Grant ssp. <i>longiflorus</i>	Abundant throughout
<i>Mimulus longiflorus</i> v. <i>rutilus</i> Grant	Coastal sagebrush
<i>Mimulus pilosus</i> (Benth.) Wats.	Stream woodland/ chaparral
<i>Orthocarpus purpurascens</i> Benth.	Grassy, open places < 2000 ft
<i>Pedicularis densiflora</i> Benth. ex Hook.	Rare, Monroe Cyn.
<i>Penstemon heterophyllus</i> Lindl.	Occasional, openings
<i>Penstemon spectabilis</i> Thurb. ex Gray.	Common, chaparral, abundant on burns
<i>Scrophularia californica</i> C. & S. v. <i>floribunda</i>	Throughout in oak chaparral, woodlands, abundant on burns
<i>Verbascum blattaria</i> L.	Weed
<i>Verbascum virgatum</i> Stokes ex With.	Weed
SELAGINELLACEAE	
<i>Selaginella bigelovii</i> Underw.	Abundant, open areas
SOLANACEAE	
<i>Datura meteloides</i> A. DC.	Sandy, gravelly open places
<i>Datura stramonium</i> L. v. <i>tatula</i> (L.) Torr.	Disturbed places
<i>Nicotiana glauca</i> Grah.	Common, disturbed areas
<i>Physalis philadelphia</i> Lam.	Weed at Tanbark
<i>Solanum douglasii</i> Dunal in DC.	Shady, open places
<i>Solanum xanti</i> Gray	Common in openings, abundant on burns
TYPHACEAE	
<i>Typha latifolia</i> L.	Marshy places, along streams
URTICACEAE	
<i>Urtica holosericea</i> Nutt.	Stream woodland
VALERIANACEAE	
<i>Plectritis ciliosa</i> (Greene) Jeps. ssp. <i>insignis</i> (Suksd.) Morey	Occasional, stream woodland
VERBENACEAE	
<i>Verbena lasiostachys</i> Link.	Occasional in shady woodlands
VIOLACEAE	
<i>Viola pedunculata</i> T. & G.	Rare, < 2000 ft
<i>Viola purpurea</i> Kell. not Stev. ssp. <i>purpurea</i>	Common grassy areas, Dry Lake
<i>Viola sheltonii</i> Torr.	Occasional oak woodland > 4000 ft
VISCACEAE	
<i>Phoradendron villosum</i> (Nutt. in T. & G. Nutt.	Common throughout, parasite on oak and many others

VITACEAE	
<i>Vitis girdiana</i> Munson.	Stream woodland < 3000 ft
ZYGOPHYLLACEAE	
<i>Tribulus terrestris</i> L.	Weed

APPENDIX B—MOSSES

Moss species of the San Dimas Experimental Forest are listed below alphabetically by family. Numbers indicate the presence of the moss species in these plant communities (Mishler 1978):

- 1—Lake, pond, and quiet stream aquatic
- 2—Reservoir semiaquatic
- 3—Riparian woodland
- 4—Inland sage scrub
- 5—Southern mixed evergreen forest
- 6—Southern oak woodland
- 7—Mixed chaparral

AMBLYSTEGIACEAE

<i>Amblystegium juratzkanum</i> Schimp.	3
<i>Amblystegium varium</i> (Hedw.) Lindb.	3
<i>Cratoneuron filicinum</i> (Hedw.) Spruce	3
<i>Leptodictyum riparium</i> (Hedw.) Warnst.	1, 3
<i>Leptodictyum trichopodium</i> (Schultz) Warnst.	3

BARTRAMIACEAE

<i>Anacolia menziesii</i> (Turn.) Paris	3, 5, 6, 7
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BRACHYTHECIACEAE

<i>Brachythecium frigidum</i> (C. Muell.) Besch.	1, 3
<i>Brachythecium velutimum</i> (Hedw.) B.S.G.	3, 5
<i>Homalothecium nevadense</i> (Lesq.) Ren. & Card.	3, 4, 5, 6, 7
<i>Scleropodium cespitans</i> (C. Muell.) L. Koch	3, 5, 6
<i>Scleropodium obtusifolium</i> (Jaeg. & Sauerb.) Kindb. ex Macoun. & Kindb.	3
<i>Scleropodium tourettei</i> (Bird.) L. Koch	3, 4, 5, 6, 7

BRYACEAE

<i>Bryum argenteum</i> Hedw.	3, 4, 5, 6, 7
<i>Bryum bicolor</i> Dicks.	3, 4, 6, 7
<i>Bryum caespiticium</i> Hedw.	3
<i>Bryum capillare</i> Hedw.	3, 4, 5, 6, 7
<i>Bryum gemmiparum</i> De Not.	3
<i>Bryum miniatum</i> Lesq.	3
<i>Leptobryum pyriforme</i> (Hedw.) Wils.	2, 3
<i>Pohlia wahlenbergii</i> (Web. & Mohr.) Andr.	3, 5

CRYPHAEEAE			POLYTRICHACEAE	
<i>Dendroalsia abietina</i> (Hook.) Brid.	3		<i>Polytrichum piliferum</i> Hedw.	7
DICRANACEAE			POTTIACEAE	
<i>Dicranella varia</i> (Hedw.) Schimp.	3, 5		<i>Aloina rigida</i> (Hedw.) Limp.	3, 4, 6
<i>Dicranoweisia cirrata</i> (Hedw.) Lindb. ex Milde	3, 5		<i>Barbula brachyphylla</i> Sull.	3, 6, 7
DITRICHACEAE			<i>Barbula convoluta</i> Hedw.	3, 4, 6, 7
<i>Ceratodon purpureus</i> (Hedw.) Brid.	4, 7		<i>Barbula cylindrica</i> (Tayl. ex Mackay) Schimp. ex Boul.	3, 4, 5, 6, 7
<i>Pleuridium bolanderi</i> C. Muell. ex Jaeg.	7		<i>Barbula vinealis</i> Brid.	3, 4, 5, 6, 7
FABRONIACEAE			<i>Crumia latifolia</i> (Kindb. ex Macoun) Schof.	3, 4, 5, 6, 7
<i>Fabronia pusilla</i> Raddi	3, 6		<i>Desmatodon latifolius</i> (Hedw.) Brid.	3
FISSIDENTACEAE			<i>Didymodon tophaceus</i> (Brid.) Lisa	2, 3, 5
<i>Fissidens grandifrons</i> Brid.	1, 3		<i>Eucladium verticillatum</i> (Brid.) B.S.G.	3
<i>Fissidens limbatus</i> Sull.	3, 4, 7		<i>Gymnostomum calcareum</i> Nees, Hornesch. & Sturm.	3
FUNARIACEAE			<i>Gymnostomum recurvirostrum</i> Hedw.	3
<i>Funaria hygrometrica</i> Hedw.	2, 3, 4, 5, 6, 7		<i>Timmiella crassinervis</i> (Hampe.) L. Koch.	3, 4, 5, 6, 7
<i>Funaria muhlenbergii</i> R. Hedw. ex Tum	3, 4		<i>Tortula bartramii</i> Steere	3, 5, 7
GRIMMIACEAE			<i>Tortula bolanderi</i> (Lesq.) Howe	3, 5, 6, 7
<i>Grimmia alpicola</i> v. <i>dupretii</i> (Ther.)	3, 5, 6		<i>Tortula brevipes</i> (Lesq.) Broth.	6
<i>Grimmia apocarpa</i> Hedw.	3, 4, 5, 6, 7		<i>Tortula inermis</i> (Brid.) Mont.	3
<i>Grimmia hartmanii</i> Schimp. v. <i>hartmanii</i>	3, 5		<i>Tortula laevipila</i> (Brid.) Schwaegr.	3, 5, 6
<i>Grimmia laevigata</i> (Brid.) Brid.	4		<i>Tortula ruralis</i> (Hedw.) Gaertn., Meyer & Scherb. v. <i>crinita</i>	4, 7
<i>Grimmia pulvinata</i> (Hedw.) Sm.	3, 4		<i>Tortula ruralis</i> (Hedw.) Gaertn., Meyer & Scherb. v. <i>ruralis</i>	3, 4, 5
<i>Grimmia tenerrima</i> Ren. & Card.	5		<i>Tortula subulata</i> Hedw.	5
<i>Grimmia trichophylla</i> Grev.	3, 5		<i>Weissia controversa</i> Hedw.	3, 5, 7
LEUCODONTACEAE			THUIDIACEAE	
<i>Antitrichia californica</i> Sull. ex Lesq.	3		<i>Claopodium whippleanum</i> (Sull.) Ren. & Card.	3, 5, 6, 7
<i>Pterogonium gracile</i> (Hedw.) Sm.	3			
ORTHOTRICHACEAE				
<i>Orthotrichum laevigatum</i> Zett.	5			
<i>Orthotrichum lyellii</i> Hook. & Tayl.	5, 6			
<i>Orthotrichum rupestre</i> Schleich. ex Schwaegr.	3, 5			
<i>Orthotrichum tenellum</i> Bruch. ex Brid.	6			

APPENDIX C—VERTEBRATE FAUNA

The following is a list of the vertebrate fauna (except fish) that have been observed, known or predicted to occur, in and within 1 km (0.62 mi) of the San Dimas Experimental Forest. This list incorporates the current taxonomic revisions and gives general plant or aquatic community occurrence and affinity or relationship, and current general status and distribution. The list is adopted from a more detailed treatment of the vertebrate fauna in southern California (Keeney and Loe in prep) and of the Experimental Forest (Keeney and others in prep). The bird species are listed in order of the American Ornithologists Union checklist (A.O.U. 1983). The amphibians, reptiles and mammals are arranged with most primitive groups first and least primitive groups last, (see Jennings 1983, Jones and others 1982).

Plant community names are modified from Wieslander (1934a,b).

The following definitions are used for general plant or aquatic communities and for the general status and distribution.

General plant or aquatic communities:

BDF = Bigcone Douglas-fir
 ChC = Chamise Chaparral
 CoS = Coastal Shrub
 FrM = Freshwater Marsh
 MxC = Mixed Chaparral
 OkW = Woodland (Montane and Valley Foothill Hardwood)
 Plt = Plantation
 Resv = Reservoirs
 Rip = Riparian (Montane and Valley Foothill)

General status and distribution:

Amphibians, reptiles, and mammals

Abundant = Almost always present in high numbers within the range and suitable habitat of the species.

Common = Often present in moderate numbers within the range and suitable habitat of the species.

Uncommon = Occurs in low numbers or only locally within the range and suitable habitat of the species.

Scarce = Very rare or extremely restricted to localized areas within suitable habitat of the species.

Birds

Abundant = Always encountered in proper suitable habitat in large numbers.

Common to Abundant = Almost always encountered in proper suitable habitat, usually in moderate to large numbers.

Fairly Common = Usually encountered in proper suitable habitat in the given season(s), generally not in large numbers.

Uncommon = Occurs in small numbers or only locally under the indicated conditions.

Rare = Occurs annually (or virtually annually) during the season indicated, but generally in very small numbers. Also applies to species which breed extremely locally and in very small numbers.

<i>Amphibians and Reptiles</i>	Plant or Aquatic Community	Status and Distribution
NEWTS		
California Newt <i>Taricha torosa</i>	Rip, Resv, FrM	Common, may be reduced
LUNGLESS SALAMANDERS		
Ensatin <i>Ensatina eschscholtzi</i>	ChC, MxC, Rip, BDF, Plt	Locally common
Pacific Slender Salamander <i>Batrachoseps pacificus</i>	OkW	Locally common
Arboreal Salamander <i>Aneides lugubris</i>	OkW	Locally common
SPADEFOOT TOADS		
Western Spadefoot <i>Schaphiopus hammondi</i>	Rip	Fairly common

	Plant or Aquatic Community	Status and Distribution
TRUE TOADS		
Western Toad <i>Bufo boreas</i>	ChC, MxC, Rip OkW, BDF, Plt FrM	Common
TREEFROGS AND RELATIVES		
California Treefrog <i>Hyla cadaverina</i>	Rip, Resv, FrM	Common
Pacific Treefrog <i>Hyla regilla</i>	Rip, ChC, MxC, OkW, Resv, FrM	Most abundant anuran in the San Gabriel Mountains
TRUE FROGS		
Red-legged Frog <i>Rana aurora</i>	Rip	Uncommon
Foothill Yellow-legged Frog <i>Rana boylei</i>	Rip	San Gabriel River drainage, may represent a relict population
Mountain Yellow-legged Frog <i>Rana muscosa</i>	Rip	Most common <i>Rana</i> species
POND AND MARSH TURTLES		
Western Pond Turtle <i>Clemmys marmorata</i>	Rip, Resv, FrM	Rare
IGUANIDS		
Desert Collared Lizard <i>Crotaphytus insulari</i>	Rip	Scarce; found only in unshaded canyon bottoms and dry rocky stream beds up to 5500 ft
Western Fence Lizard <i>Sceloporus occidentalis</i>	ChC, OkW, BDF Plt, Rip	Most common lizard in the mountains, abundant
Side-blotched Lizard <i>Uta stansburiana</i>	Rip, MxC, ChC, OkW	Common
Coast Horned Lizard <i>Phrynosoma coronatum</i>	ChC	Abundant, may be reduced from former numbers
SKINKS		
Western Skink <i>Eumeces skiltonianus</i>	ChC, MxC, Rip OkW, BDF, Plt	No records on forest, but should be there
Gilbert Skink <i>Eumeces gilberti</i>	Rip, OkW	Rare in mountains, associated with oak savannah
WHIPTAILS AND RELATIVES		
Western Whiptail <i>Cnemidophorus tigris</i>	Rip, ChC, BDF, Plt, OkW	Third most common lizard after <i>S. occidentalis</i> and <i>U. stansburiana</i>
ALLIGATORS, LIZARDS, AND RELATIVES		
Southern Alligator Lizard <i>Elgaria multicarinatus</i>	Rip, OkW, BDF ChC, MxC	Common

	Plant or Aquatic Community	Status and Distribution
CALIFORNIA LEGLESS LIZARDS		
California Legless Lizard <i>Anniella nigra</i>	OkW, Rip	Uncommon
SLENDER BLIND SNAKES		
Western Blind Snake <i>Leptotyphlops humilis</i>	Rip, ChC	Rare (scarce—an artifact of collecting methods?)
BOAS		
Rosy Boa <i>Lichanura trivirgata</i>	ChC, Rip, MxC	Uncommon
COLUBRIDS		
Ringneck Snake <i>Diadophis punctatus</i>	OkW, Rip	Common
Racer <i>Coluber constrictor</i>	OkW, Rip	Rare
Coachwhip <i>Masticophis flagellam</i>	CoS	May not be on forest; rare; observed near Claremont
California Whipsnake <i>Masticophis lateralis</i>	ChC, OkW, Rip	Abundant; most abundant snake in San Gabriels
Western Patch-nosed Snake <i>Salvadora hexalepis</i>	ChC, OkW, Rip	Uncommon
Gopher Snake <i>Pituophis melanoleucus</i>	MxC, ChC, OkW, BDF, Plt, Rip	Common
Common Kingsnake <i>Lampropeltis getulus</i>	ChC, Rip, OkW	Common up to 1900 ft
California Mountain Kingsnake <i>Lampropeltis zonata</i>	Rip, ChC, BDF, Plt	Common, replaces <i>L. getulus</i> above 1500 ft
Long-nosed Snake <i>Rhinocheilus lecontei</i>	ChC, MxC	May not be present on SDEF; Scarce
Two-striped Garter Snake <i>Thamnopsis hammondi</i>	Rip, Resv, FrM	Common
California Black-headed Snake <i>Tantilla planiceps</i>	ChC, MxC, Rip	Rare; may not be in SDEF, or may just be hard to find
Lyre Snake <i>Trimorphodon biscutatus</i>	ChC, MxC	Rare; one specimen from Claremont
Night Snake <i>Hypsiglena torquata</i>	ChC, MxC	Rare: no specimens except near Claremont
VIPERS		
Western Rattlesnake <i>Crotalus viridis</i>	Rip, OkW, ChC MxC, BDF, Plt	Abundant

Birds

	Plant or Aquatic Community	Status and Distribution
GREBES		
Pied-billed Grebe <i>Podilymbus podiceps</i>	Resv	Fairly common resident; breeding not confirmed
Eared Grebe <i>Podiceps nigricollis</i>	Resv, FrM	Common winter visitant; breeds locally and ephemerally; no breeding record for SDEF
CORMORANTS		
Double-crested Cormorant <i>Phalacrocorax auritus</i>	Resv	Uncommon winter visitant
HERONS AND BITTERNS		
Great Blue Heron <i>Ardea herodias</i>	Resv, FrM	Fairly common winter and summer visitant
Snowy Egret <i>Egretta thula</i>	Resv, FrM	Uncommon winter visitant and transient
Green-backed Heron <i>Butorides striatus</i>	Rip, FrM, Resv	Uncommon to fairly common resident
Black-crowned Night Heron <i>Nycticorax nycticorax</i>	Rip, FrM, Resv	Uncommon to rare resident nested in 1936
DUCKS AND RELATIVES		
Green-winged Teal <i>Anas crecca</i>	FrM, Resv	Uncommon winter visitant
Mallard <i>Anas platyrhynchos</i>	FrM, Resv	Fairly common to common winter visitant; uncommon in summer
Northern Pintail <i>Anas acuta</i>	FrM, Resv	Common winter visitant; uncommon local nester; nesting not confirmed on the SDEF
Cinnamon Teal <i>Anas cyanoptera</i>	FrM, Resv	Common spring and fall transient; uncommon winter visitant
Northern Shoveler <i>Anas clypeata</i>	FrM, Resv	Common winter visitant
Gadwall <i>Anas strepera</i>	FrM, Resv	Uncommon winter visitant and transient
American Wigeon <i>Anas americana</i>	FrM, Resv	Common winter visitant
Canvasback <i>Aythya valisineria</i>	Resv	Fairly common winter visitant
Redhead <i>Aythya americana</i>	FrM, Resv	Uncommon winter visitant

	Plant or Aquatic Community	Status and Distribution
Ring-necked Duck <i>Aythya collaris</i>	Resv	Fairly common winter visitant
Lesser Scaup <i>Aythya affinis</i>	Resv	Common winter visitant
Bufflehead <i>Bucephala albeola</i>	Resv	Fairly common winter visitant
Common Merganser <i>Mergus merganser</i>	Resv	Uncommon to fairly common winter visitant
Ruddy Duck <i>Oxyura jamaicensis</i>	FrM, Resv	Common winter visitant
AMERICAN VULTURES		
Turkey Vulture <i>Cathartes aura</i>	CoS, ChC, MxC, OkW, Plt, Resv	Uncommon transient and summer visitant
HAWKS AND HARRIERS		
Osprey <i>Pandion haliaetus</i>	Resv	Rare fall and winter visitant and transient; sometimes observed in late spring and summer
Black-shouldered Kite <i>Elanus caeruleus</i>	Grass, FrM, OkW	Uncommon resident; no nesting records for SDEF
Northern Harrier <i>Circus cyaneus</i>	Grass, CoS, ChC, MxC, OkW, FrM, Resv	Fairly common winter visitant
Sharp-shinned Hawk <i>Accipiter striatus</i>	Rip, OkW, Plt	Fairly common winter resident; nesting records exist for Icehouse and Cyns. adjacent SDEF
Cooper's Hawk <i>Accipiter cooperii</i>	CoS, MxC, ChC, Rip, OkW, Plt	Uncommon resident; breeds
Red-shouldered Hawk <i>Buteo lineatus</i>	Rip, BDF, Plt	Uncommon resident; breeds
Red-tailed Hawk <i>Buteo jamaicensis</i>	All except Resv, FrM	Common resident; breeds
Golden Eagle <i>Aquila chrysaetos</i>	CoS, MxC, ChC OkW, Grass	Uncommon resident; breeds adjacent to SDEF
FALCONS		
American Kestrel <i>Falco sparverius</i>	All except Resv, FrM	Common resident; breeds
Prairie Falcon <i>Falco mexicanus</i>	CoS, MxC, ChC, Grass, OkW	Uncommon transient

	Plant or Aquatic Community	Status and Distribution
QUAILS, PHEASANTS, AND RELATIVES		
California Quail <i>Callipepla californica</i>	CoS, MxC, ChC, Rip, OkW, BDF, Plt	Common resident; breeds
Mountain Quail <i>Oreortyx pictus</i>	MxC, ChC, Rip, OkW, BDF	Uncommon resident; breeding not confirmed
RAILS, GALLINULES, AND COOTS		
Common Moorhen <i>Gallinula chloropus</i>	FrM	Uncommon winter visitant
American Coot <i>Fulica americana</i>	FrM, Resv	Common winter visitant
PLOVERS AND RELATIVES		
Killdeer <i>Charadrius vociferus</i>	Resv	Common resident; influx of winter visitants; breeds
SANDPIPERS AND RELATIVES		
Spotted Sandpiper <i>Actitis macularia</i>	Resv, FrM	Uncommon summer transient
Western Sandpiper <i>Calidris mauri</i>	Resv, FrM	Rare fall migrant, winter visitant
Common Snipe <i>Gallinago gallinago</i>	Resv, FrM, Rip	Uncommon winter visitant
GULLS AND RELATIVES		
Ring-billed Gull <i>Larus delawarensis</i>	Resv	Uncommon winter visitant
California Gull <i>Larus californicus</i>	Resv	Uncommon winter visitant
PIGEONS AND DOVES		
Rock Dove <i>Columba livia</i>	Human habitation	Abundant resident; breeds
Band-tailed Pigeon <i>Columba fasciata</i>	MxC, OkW, Plt, BDF	Common resident; breeds
Spotted Dove <i>Streptopelia chinensis</i>	Human habitation	Common resident; breeds
Mourning Dove <i>Zenaida macroura</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Uncommon resident; breeds
TYPICAL CUCKOOS		
Yellow-billed Cuckoo <i>Coccyzus americanus</i>	Rip	Extirpated
Greater Roadrunner <i>Geococcyx californianus</i>	CoS, MxC, ChC, Rip, OkW	Uncommon resident; breeds

	Plant or Aquatic Community	Status and Distribution
BARN OWL		
Common Barn-Owl <i>Tyto alba</i>	CoS, MxC, ChC, Rip, OkW	Uncommon resident; breeding not confirmed on SDEF
TYPICAL OWLS		
Western Screech-Owl <i>Otus kennicottii</i>	CoS, MxC, ChC, Rip, OkW, BDF, Plt	Uncommon resident; breeds
Great Horned Owl <i>Bubo virginianus</i>	CoS, MxC, ChC, OkW, BDF, Plt, Grass	Common resident; breeds
Burrowing Owl <i>Athene cunicularia</i>	Grass	Rare; status unclear; possibly extirpated
Spotted Owl <i>Strix occidentalis</i>	Rip, OkW, BDF	Uncommon resident; breeds
Long-eared Owl <i>Asio otus</i>	Rip, OkW, BDF, Plt	Rare transient
Short-eared Owl <i>Asio flammeus</i>	Grass, FrM	Rare migrant
Northern Saw-whet Owl <i>Aegolius acadicus</i>	Rip, OkW, BDF	Rare winter migrant
GOATSUCKERS		
Common Nighthawk <i>Chordeiles minor</i>	Rip, BDF, Grass, OkW, Resv, FrM	Rare summer migrant
Common Poorwill <i>Phalaenoptilus nuttallii</i>	CoS, MxC, ChC	Fairly common resident; breeds
SWIFTS		
Black Swift <i>Cypseloides niger</i>	MxC, Rip, OkW, BDF, FrM, Resv	Rare transient
Vaux's Swift <i>Chaetura vauxi</i>	All	Fairly common transient in spring and fall
White-throated Swift <i>Aeronautes saxatalis</i>	All	Fairly common resident; breeds
HUMMINGBIRDS		
Black-chinned Hummingbird <i>Archilochus alexandri</i>	Rip, CoS, MxC, OkW	Common summer resident; breeds
Anna's Hummingbird <i>Calypte anna</i>	CoS, MxC, ChC, Rip, OkW, BDF, Plt	Abundant resident; breeds
Costa's Hummingbird <i>Calypte costae</i>	CoS, MxC, ChC	Fairly common summer resident; breeds
Calliope Hummingbird <i>Stellula calliope</i>	CoS, MxC, ChC, Rip	Uncommon migrant
Rufous Hummingbird <i>Selasphorus rufus</i>	CoS, MxC, ChC, Rip, OkW, BDF	Fairly common transient

	Plant or Aquatic Community	Status and Distribution
Allen's Hummingbird <i>Selasphorus asin</i>	CoS, MxC, Rip, BDF, OkW	Common migrant
KINGFISHER Belted Kingfisher <i>Ceryle alcyon</i>	Rip	Uncommon transient and winter visitant
WOODPECKERS AND RELATIVES Lewis' Woodpecker <i>Melanerpes lewis</i>	Rip, OkW, BDF, Plt	Rare winter visitant; irruptive species; can be common
Acorn Woodpecker <i>Melanerpes formicivorus</i>	Rip, OkW, BDF, Plt	Common resident; breeds
Yellow-bellied Sapsucker <i>Sphyrapicus varius</i>	Rip, OkW, BDF	Rare fall transient and possible winter visitant
Red-breasted Sapsucker <i>Sphyrapicus ruber</i>	Rip, OkW, BDF	Uncommon resident; breeds
Williamson's Sapsucker <i>Sphyrapicus thyroideus</i>	BDF	Uncommon resident; breeds at higher elevations adjacent to SDEF
Nuttall's Woodpecker <i>Picoides nuttallii</i>	Rip, OkW, BDF MxC	Common resident; breeds
Downy Woodpecker <i>Picoides pubescens</i>	Rip, OkW, BDF	Uncommon resident; breeds
Hairy Woodpecker <i>Picoides villosus</i>	Rip, OkW, BDF, Plt	Fairly common resident; breeds
White-headed Woodpecker <i>Picoides albolarvatus</i>	BDF	Rare breeding resident; uncommon winter visitant
Northern Flicker <i>Colaptes auratus</i>	MxC, ChC, Rip OkW, BDF, Plt	Common resident; breeds; winter downslope movement
TYRANT FLYCATCHERS Olive-sided Flycatcher <i>Contopus borealis</i>	Rip, OkW, BDF, Plt	Uncommon summer resident; breeds
Western Wood Pewee <i>Contopus sordidulus</i>	Rip, OkW, BDF	Common summer resident; breeds
Willow Flycatcher <i>Empidonax traillii</i>	Rip, OkW	Rare fall transient; former breeder
Hammond's Flycatcher <i>Empidonax hammondi</i>	MxC, Rip, OkW, BDF	Rare migrant
Dusky Flycatcher <i>Empidonax oberholseri</i>	MxC, Rip, OkW, BDF	Rare migrant
Gray Flycatcher <i>Empidonax wrightii</i>	MxC, Rip, OkW, BDF	Rare migrant

	Plant or Aquatic Community	Status and Distribution
Western Flycatcher <i>Empidonax difficilis</i>	Rip, OkW, BDF	Common summer resident; breeds
Black Phoebe <i>Sayornis nigricans</i>	Rip	Fairly common resident; breeds
Say's Phoebe <i>Sayornis saya</i>	CoS, MxC, OkW	Uncommon transient and winter visitant
Ash-throated Flycatcher <i>Myiarchus cinerascens</i>	CoS, MxC, ChC, Rip, OkW, BDF, Plt	Common summer resident; breeds
Cassin's Kingbird <i>Tyrannus vociferans</i>	Rip, OkW, BDF	Rare summer resident; possible breeding
Western Kingbird <i>Tyrannus verticalis</i>	CoS, MxC, ChC, Rip, OkW	Fairly common summer resident; breeds
LARKS		
Horned Lark <i>Eremophila alpestris</i>	Grass	Fairly common transient and irregular winter visitant
SWALLOWS		
Tree Swallow <i>Tachycineta bicolor</i>	All	Uncommon migrant
Violet-green Swallow <i>Tachycineta thalassina</i>	All	Fairly common summer resident at higher elevations; breeds
Northern Rough-winged Swallow <i>Stelgidopteryx serripennis</i>	CoS, MxC, ChC, OkW, Rip, FrM, Resv	Uncommon migrant
Cliff Swallow <i>Hirundo pyrrhonta</i>	All, especially Rip and Resv	Common summer resident
Barn Swallow <i>Hirundo rustica</i>	CoS, MxC, ChC, Rip, FrM, Resv, OkW	Uncommon migrant
JAYS, MAGPIES, AND CROWS		
Steller's Jay <i>Cyanocitta stelleri</i>	MxC, Rip, OkW, BDF, Plt	Fairly common resident; breeds
Scrub Jay <i>Aphelocoma coerulescens</i>	CoS, ChC, MxC, Rip, OkW, Plt	Common resident; breeds
American Crow <i>Corvus brachyrhynchos</i>	CoS, ChC, MxC, Rip, OkW, Plt, Grass	Fairly common resident; breeds
Common Raven <i>Corvus corax</i>	CoS, ChC, MxC, OkW, BDF, Plt, Grass	Common resident; breeding unrecorded
TITMICE		
Mountain Chickadee <i>Parus gambeli</i>	Rip, OkW, BDF	Fairly common resident; breeds

	Plant or Aquatic Community	Status and Distribution
Plain Titmouse <i>Parus inornatus</i>	CoS, ChC, MxC, Rip, OkW, Plt	Common resident; breeds
BUSHTIT Bushtit <i>Psaltirparus minimus</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common resident; breeds
NUTHATCHES Red-breasted Nuthatch <i>Sitta canadensis</i>	BDF	Irregular fall and winter visitant
White-breasted Nuthatch <i>Sitta carolinensis</i>	Rip, OkW, BDF	Uncommon resident; breeds
Pygmy Nuthatch <i>Sitta pygmaea</i>	BDF	Uncommon resident and winter visitant; breeding
CREEPERS Brown Creeper <i>Certhia americana</i>	OkW, BDF	Uncommon resident and rare winter visitant at lower elevations; breeds
WRENS Cactus Wren <i>Campylorhynchus brunneicapillus</i>	CoS, MxC	Very local resident; breeds
Rock Wren <i>Salpinctis obsoletus</i>	ChC, MxC	Uncommon resident in suitable rocky habitats; breeds
Canyon Wren <i>Catherpes mexicanus</i>	ChC, MxC, Rip	Common but local resident in rocky canyons; breeds
Bewick's Wren <i>Thryomanes bewickii</i>	CoS, ChC, MxC, Rip, OkW	Common resident; breeds
House Wren <i>Troglodytes aedon</i>	CoS, ChC, MxC, Rip, OkW	Common summer resident; breeds
Winter Wren <i>Troglodytes troglodytes</i>	Rip	Very rare transient and winter visitant
Marsh Wren <i>Cistothorus palustris</i>	FrM	Rare winter visitant
DIPPERS American Dipper <i>Cinclus mexicanus</i>	Rip	Rare and very local resident; unrecorded breeding
OLD WORLD WARBLERS, GNATCATCHERS, KINGLETS, THRUSHES, BLUEBIRDS, AND WRENTITS Golden-crowned Kinglet <i>Regulus satrapa</i>	Rip, OkW, BDF	Rare transient
Ruby-crowned Kinglet <i>Regulus calendula</i>	CoS, ChC, MxC, Rip, OkW	Common transient and winter visitant; breeding localized
Blue-gray Gnatcatcher <i>Poliophtila caerulea</i>	CoS, ChC, MxC, OkW	Fairly common summer resident; breeds

	Plant or Aquatic Community	Status and Distribution
Black-tailed Gnatcatcher <i>Poliophtila melanura</i>	CoS	Very rare resident; may be extirpated from the SDEF and adjacent habitat
Western Bluebird <i>Sialia mexicana</i>	MxC, Rip, OkW, BDF Plt	Uncommon resident; breeds; erratic movement downslope in winter
Mountain Bluebird <i>Salia currucoides</i>	OkW, BDF, Grass	Uncommon winter visitant; breeds at higher montane woodlands adjacent to SDEF
Townsend's Solitaire <i>Myadestes townsendi</i>	Rip, OkW, BDF	Fairly common resident; breeds; some winter movement
Swainson's Thrush <i>Catharus ustulatus</i>	Rip	Rare summer resident
Hermit Thrush <i>Catharus guttatus</i>	CoS, MxC, Rip, OkW, BDF, Plt	Fairly common winter visitant
American Robin <i>Turdus migratorius</i>	MxC, Rip, OkW, BDF, Plt	Fairly common resident; irruptive winter visitant
Varied Thrush <i>Ixoreus naevius</i>	Rip, OkW, BDF	Rare and irregular winter visitant
Wrentit <i>Chamaea fasciata</i>	CoS, MxC, ChC, Rip	Common resident; breeds; Common winter visitant to the lower elevations
MOCKINGBIRDS AND THRASHERS		
Northern Mockingbird <i>Mimus polyglottos</i>	CoS, ChC, MxC, Plt	Common resident at lower elevations; breeds
California Thrasher <i>Toxostoma redivivum</i>	CoS, ChC, MxC, Rip	Common resident; breeds
PIPITS		
Water Pipit <i>Anthus spinoletta</i>	Resv, Grass	Fairly common transient and winter visitant
WAXWINGS		
Cedar Waxwing <i>Bombycilla cedrorum</i>	CoS, MxC, Rip, OkW, Plt	Irregular, fairly common transient and winter visitant
SILKY FLYCATCHERS		
Phainopepla <i>Phainopepla nitens</i>	CoS, ChC, MxC, Rip, OkW	Uncommon resident; breeds; status complex involving a seasonal shift
SHRIKES		
Loggerhead Shrike <i>Lanius ludovicianus</i>	CoS, ChC, MxC, OkW	Fairly common resident; breeds

	Plant or Aquatic Community	Status and Distribution
STARLINGS		
European Starling <i>Sturnus vulgaris</i>	CoS, MxC, Rip, OkW, BDF, Plt	Abundant resident with a winter influx at lower elevations; breeds
TYPICAL VIREOS		
Least Bell's Vireo <i>Vireo belli</i>	Rip	Very rare summer resident; probably extirpated
Solitary Vireo <i>Vireo solitarius</i>	Rip, OkW, BDF	Uncommon transient and summer visitant; breeds
Hutton's Vireo <i>Vireo huttoni</i>	MxC, Rip, OkW, BDF	Fairly common resident; breeds
Warbling Vireo <i>Vireo gilvus</i>	Rip, OkW, BDF	Uncommon transient and summer resident; breeds
WOOD WARBLERS, SPARROWS, BLACKBIRDS, AND RELATIVES		
Orange-crowned Warbler <i>Vermivora celata</i>	CoS, MxC, Rip, OkW, BDF, Plt	Fairly common summer resident; breeds
Nashville Warbler <i>Vermivora ruficapilla</i>	CoS, MxC, Rip, OkW, BDF, Plt	Uncommon transient
Yellow Warbler <i>Dendroica petechia</i>	Rip, OkW	Common transient; locally uncommon summer transient; breeds
Yellow-rumped Warbler <i>Dendroica coronata</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common winter visitant
Black-throated Gray Warbler <i>Dendroica nigrescens</i>	CoS, ChC, MxC, Rip, OkW, BDF	Common transient
Townsend's Warbler <i>Dendroica townsendi</i>	CoS, ChC, MxC, Rip, OkW, BDF	Fairly common transient; uncommon winter visitant
Hermit Warbler <i>Dendroica occidentalis</i>	CoS, MxC, Rip, OkW, BDF	Uncommon transient
Common Yellowthroat <i>Geothlypis trichas</i>	Rip	Fairly common resident; local seasonal movement; breeds
Wilson's Warbler <i>Wilsonia pusilla</i>	Rip, OkW	Common migrant; uncommon summer resident; breeding declining
Western Tanager <i>Piranga ludoviciana</i>	Rip, OkW, BDF	Fairly common summer resident and common transient; breeds
Black-headed Grosbeak <i>Pheucticus melanocephalus</i>	CoS, ChC, MxC, Rip, OkW, BDF	Fairly common transient and summer resident; breeds
Blue Grosbeak <i>Guiraca caerulea</i>	Rip	Very rare to uncommon transient

	Plant or Aquatic Community	Status and Distribution
Lazuli Bunting <i>Passerina amoena</i>	CoS, ChC, MxC, Rip	Fairly common transient and summer resident; breeds
Green-tailed Towhee <i>Pipilo chlorurus</i>	ChC, MxC, OkW, BDF	Uncommon summer resident and rare transient at lower elevations; breeds
Rufous-sided Towhee <i>Pipilo erythrophthalmus</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common resident; breeds
Brown Towhee <i>Pipilo fuscus</i>	CoS, ChC, MxC, Rip, OkW, Plt	Common resident; breeds
Rufous-crowned Sparrow <i>Aimophila ruficeps</i>	CoS, ChC, MxC	Uncommon resident; breeds
Chipping Sparrow <i>Spizella passerina</i>	OkW, BDF, Grass	Uncommon summer resident and transient
Black-chinned Sparrow <i>Spizella atrogularis</i>	CoS, ChC, MxC	Uncommon summer resident; breeds
Lark Sparrow <i>Chondestes grammacus</i>	OkW, BDF	Uncommon resident; some winter movement; breeds
Sage Sparrow <i>Amphispiza belli</i>	CoS, ChC	Uncommon local resident; breeding not confirmed
Savannah Sparrow <i>Passerculus sandwichensis</i>	Grass, FrM	Fairly common transient and winter visitant
Fox Sparrow <i>Passerella iliaca</i>	CoS, ChC, MxC, OkW, BDF, Plt	Fairly common summer resident; uncommon winter visitant; breed
Song Sparrow <i>Melospiza melodia</i>	Rip, FrM, OkW	Common resident; breeds
Lincoln's Sparrow <i>Melospiza lincolnii</i>	Rip, FrM	Uncommon winter visitant, local summer resident; breeding not confirmed
Golden-crowned Sparrow <i>Zonotrichia atricapilla</i>	CoS, ChC, MxC, Rip, OkW	Fairly common winter visitant
White-crowned Sparrow <i>Zonotrichia leucophrys</i>	CoS, ChC, MxC, OkW	Common winter visitant
Dark-eyed Junco <i>Junco hyemalis</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Fairly common resident and common winter visitant; breeds
Red-winged Blackbird <i>Agelaius phoeniceus</i>	Rip, FrM	Uncommon transient and resident; breeding not confirmed

	Plant or Aquatic Community	Status and Distribution
Western Meadowlark <i>Sturnella neglecta</i>	Grass	Uncommon local resident; breeds
Brewer's Blackbird <i>Euphagus cyanocephalus</i>	Grass, FrM	Fairly common resident at lower elevations; breeds
Brown-headed Cowbird <i>Molothrus ater</i>	Rip, OkW, BDF	Fairly common summer resident and winter visitant; parasitic breeder
Hooded Oriole <i>Icterus cucullatus</i>	Rip, OkW, BDF	Rare to uncommon summer resident; breeding not confirmed
Northern Oriole <i>Icterus galbula</i>	Rip, OkW, BDF	Fairly common summer resident and transient; breeds
Purple Finch <i>Carpodacus purpureus</i>	MxC, Rip, OkW, BDF, Plt	Fairly common resident; breeds at higher elevations; erratic winter visitant at lower elevations
Cassin's Finch <i>Carpodacus cassinii</i>	Rip, OkW, BDF	Common resident; breeds at higher elevations; some winter movement to lower elevations
House Finch <i>Carpodacus mexicanus</i>	CoS, ChC, MxC, Rip, OkW, Plt, Grass	Abundant resident; breeds
Red Crossbill <i>Loxia curvirostra</i>	BDF	Rare and erratic winter visitant
Pine Siskin <i>Carduelis pinus</i>	ChC, MxC, Rip, BDF, Plt	Fairly common resident and erratic winter visitant at lower elevations
Lesser Goldfinch <i>Carduelis psaltria</i>	CoS, ChC, MxC, Rip, OkW, Plt	Fairly common resident; breeds
Lawrence's Goldfinch <i>Carduelis lawrencei</i>	CoS, ChC, MxC, Rip, OkW, BDF	Uncommon transient
American Goldfinch <i>Carduelis tristis</i>	Rip, OkW, BDF	Uncommon winter visitant
Evening Grosbeak <i>Coccothraustes vespertinus</i>	OkW, BDF	Rare to uncommon irruptive winter visitant
WEAVER FINCHES		
House Sparrow <i>Passer domesticus</i>	Urban dwellings	Abundant breeder

Mammals

Plant or Aquatic Community

Status and Distribution

OPOSSUMS

Virginia Opossum
Didelphis virginian

All

Rare; found below
3500 ft; active yearlong;
nocturnal

LEAF-NOSED BATS

California Leaf-nosed Bat
Macrotus californicus

All

Uncommon; found below
2000 ft; nocturnal

VESPERTILIONID BATS

Little Brown Myotis
Myotis lucifugus

ChC, MxC, Rip,
FrM, OkW, BDF,
Resv

Rare; primarily found
above 5000 ft; hibernator
nocturnal

Long-eared Myotis
Myotis evotis

All

Uncommon; all elevations;
nocturnal

Fringed Myotis
Myotis thysanodes

All

Uncommon; all elevations;
hibernator; nocturnal

California Myotis
Myotis californicus

All

Rare; found below
6000 ft; hibernator;
nocturnal

Small-footed Myotis
Myotis leibii

All

Uncommon; all elevations;
hibernator; nocturnal

Western Pipistrelle
Pipistrellus hesperus

All

Rare; found below
7000 ft hibernator;
crepuscular

Big Brown Bat
Eptesicus fuscus

All

Rare; found below
8000 ft hibernator;
nocturnal

Red Bat
Lasiurus borealis

Grass, CoS, ChC,

Status and distribution
complex; uncommon;
summers above 1000 ft,
spring and fall below
3900 ft; nocturnal;

Hoary Bat
Lasiurus cinereus

All

Rare; found below
1500 ft; active yearlong;
nocturnal

Spotted Bat
Euderma maculatum

All but Plt

Very rare; may be
extirpated from
SDEF

Pallid Bat
Antrozous pallidus

All but Resv.

Rare; found below
6000 ft; hibernator;
crepuscular

FREE-TAILED BATS

Brazilian Free-tailed Bat
Tadarida brasiliensis

All

Rare; found below
4000 ft; hibernator;
nocturnal

	Plant or Aquatic Community	Status and Distribution
Western Mastiff Bat <i>Eumops perotis</i>	All	Rare; found below 6000 ft; nocturnal
RABBITS AND HARES		
Brush Rabbit <i>Sylvilagus bachmani</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common to abundant; found below 7000 ft; active yearlong; nocturnal
Desert Cottontail <i>Sylvilagus audubonii</i>	Grass, CoS, ChC, MxC, Rip, OkW, BDF	Common; found below 7000 ft; active yearlong; nocturnal
Black-tailed Hare <i>Lepus californicus</i>	Grass, CoS, ChC, MxC, Rip, OkW, BDF	Uncommon; all elevations; active yearlong
SQUIRRELS AND CHIPMUNKS		
California Ground Squirrel <i>Spermophilus beecheyi</i>	Grass, CoS, ChC, MxC, OkW, BDF, Plt	Common yearlong at all elevations; diurnal
Western Gray Squirrel <i>Sciurus griseus</i>	Rip, OkW, BDF	Rare; may be extirpated; diurnal
POCKET MICE AND KANGAROO RATS		
California Pocket Mouse <i>Perognathus californicus</i>	Grass, CoS, ChC, MxC, OkW, BDF	Common yearlong at all elevations; nocturnal
Pacific Kangaroo Rat <i>Dipodomys agilis</i>	Grass, CoS, ChC, MxC	Abundant yearlong at all elevations; nocturnal
DEER MICE, VOLES, AND RELATIVES		
Western Harvest Mouse <i>Reithrodontomys megalotis</i>	Grass, CoS, ChC, MxC, Rip, OkW, BDF	Occurs below 2000 ft; abundant yearlong; nocturnal
California Mouse <i>Peromyscus californicus</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common at all elevations yearlong; nocturnal
Deer Mouse <i>Peromyscus maniculatus</i>	CoS, ChC, MxC, OkW, BDF, Plt	Found at all elevations; abundant yearlong; nocturnal
Brush Mouse <i>Peromyscus boylii</i>	CoS, ChC, MxC, OkW, BDF	Occurs at all elevations; uncommon yearlong; nocturnal
Desert Woodrat <i>Neotoma lepida</i>	Grass, CoS, ChC, MxC, Rip, OkW, Plt	Found at all elevations; uncommon yearlong; nocturnal
Dusky-footed Woodrat <i>Neotoma fuscipes</i>	CoS, ChC, MxC, Rip, OkW, BDF, Plt	Common at all elevations yearlong; nocturnal
California Vole <i>Microtus californicus</i>	Grass, CoS, Rip, OkW	Common at all elevations; diurnal and nocturnal
FOXES, WOLVES, AND RELATIVES		
Coyote <i>Canis latrans</i>	All except Resv	Common at all elevations; yearlong; diurnal and nocturnal

	Plant or Aquatic Community	Status and Distribution
Gray Fox <i>Urocyon cinereoargenteus</i>	All except Resv	Common; below 5200 ft elevations; yearlong; nocturnal
BEARS		
Black Bear <i>Ursus americanus</i>	CoS, MxC, Rip, FrM, OkW, BDF, Plt	Uncommon between 1300 ft to 9800 ft elevations; hibernator; diurnal and nocturnal
RACCOONS AND RELATIVES		
Ringtail <i>Bassariscus astutus</i>	All except Resv, OkW	Uncommon below 5900 ft elevations; hibernator; nocturnal
Raccoon <i>Procyon lotor</i>	All	Common at all elevations; hibernator; nocturnal
WEASELS, BADGERS, AND RELATIVES		
Long-tailed Weasel <i>Mustela frenata</i>	All except Resv	Rare to uncommon at all elevations; yearlong; nocturnal and diurnal
Badger <i>Taxidea taxus</i>	All except Resv, OkW	Rare at all elevations; hibernator; diurnal and nocturnal
Western Spotted Skunk <i>Spilogale gracilis</i>	All except Resv	Rare; below 5400 ft; hibernator; nocturnal
Striped Skunk <i>Mephitis mephitis</i>	All except Resv	Rare at all elevations; hibernator; nocturnal
CATS		
Mountain Lion <i>Felis concolor</i>	CoS, ChC, MxC, Rip, OkW, BDF	Scarce; all elevations; yearlong activity; diurnal and nocturnal
Bobcats <i>Lynx rufus</i>	All except Resv, Grass	Rare at all elevations; yearlong activity; diurnal and nocturnal
DEER		
Mule Deer <i>Odocoileus hemionus</i>	All	Common at all elevations; yearlong activity; diurnal and nocturnal
SHEEP		
Nelson's Bighorn Sheep <i>Ovis canadensis nelsoni</i>	Grass, CoS, MxC, Rip, OkW, BDF	Scarce; above 3000 ft elevations; diurnal activity yearlong

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ADDITIONAL READING

The following proceedings volumes are from symposia that dealt with chaparral and related ecosystems similar to those found on the San Dimas Experimental Forest.

- Conrad, C. Eugene; Oechel, Walter C., eds. 1982. **Proceedings, dynamics and management of Mediterranean type ecosystems symposium; 1981 June 22-26; San Diego, CA.** Gen. Tech. Rep. PSW-58. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 637 p.
- Miller, Paul R., tech. coord. 1980. **Proceedings of symposium on effects of air pollutants on Mediterranean and temperate forest ecosystems; 1980 June 22-27; Riverside, CA.** Gen. Tech. Rep. PSW-43. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 256 p.

Mooney, Harold A.; Conrad, C. Eugene, eds. 1977. **Proceedings, environmental consequences of fire and fuel management in Mediterranean ecosystems symposium**; 1977 August 1-5; Palo Alto, CA. Gen. Tech. Rep. WO-3. Washington, DC: U.S. Department of Agriculture, Forest Service; 498 p.

Plumb, Timothy R., ed. 1980. **Proceedings, ecology, management, and utilization of California oaks symposium**; 1979 June 26-28; Claremont, CA. Gen. Tech. Rep. PSW-44. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 368 p.

Rosenthal, Murray, ed. 1974. **Symposium on living with the chaparral, proceedings**; 1973 March 30-31; Riverside, CA. San Francisco, CA: Sierra Club; 225 p.

Tiedemann, Arthur R.; Conrad, C. Eugene; Dieterich, John H.; Hornbech, James W.; Megahan, Walter F.; Viereck, Leslie A.; Wade, Dale D. 1979. **Effects of fire on water: a state-of-knowledge review**; 1978 April 10-14; Denver, CO. Gen. Tech. Rep. WO-10. Washington, DC: U.S. Department of Agriculture, Forest Service; 28 p.

Wells, Carol G.; Campbell, Ralph E.; DeBano, Leonard F.; Lewis, Clifford E.; Fredriksen, Richard L.; Franklin, E. Carlyle; Froelich, Ronald C.; Dunn, Paul H. 1979. **Effect of fire on soil: a state-of-knowledge review**; 1978 April 10-14; Denver, CO. Gen. Tech. Rep. WO-7. Washington, DC: U.S. Department of Agriculture, Forest Service; 34 p.

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The Forest Service, U.S. Department of Agriculture, is responsible for Federal leadership in forestry. It carries out this role through four main activities:

- Protection and management of resources on 191 million acres of National Forest System lands.
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The Pacific Southwest Forest and Range Experiment Station

- Represents the research branch of the Forest Service in California, Hawaii, and the western Pacific.
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Dunn, Paul H.; Barro, Susan C.; Wells, Wade G., II; Poth, Mark A.; Wohlgemuth, Peter M.; Colver, Charles G. 1988. **The San Dimas Experimental Forest: 50 Years of Research.** Gen. Tech. Rep. PSW-104. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, 49 p.

The San Dimas Experimental Forest serves as a field laboratory for studies of chaparral and related ecosystems, and has been recognized by national and international organizations. It covers 6,945 ha (17,153 acres) in the foothills of the San Gabriel Mountains northeast of Los Angeles, and has a typical Mediterranean-type climate. The Forest encompasses the San Dimas and Big Dalton watersheds, which have vegetation typical of southern California, are separated by deep canyons from the rest of the San Gabriel Mountains, have small tributaries suitable for study, and are hamessed by flood control dams. Unique physical features and a broad database covering over 50 years of research make the Forest an irreplaceable resource. Over the years data has been collected on water (precipitation, streamflow, etc.), soils and slope stability, effects of fire, vegetation management, chaparral ecology and physiology, vegetation classification, litter decomposition, and community structure of fauna. On-going studies include these: investigations into erosion processes; sediment movement in streams; particle size shifts with burning; air pollution impacts on vegetation, soil and water; denitrification in streams and nitrogen fixation; regeneration of oaks, postfire vegetation composition changes, dynamics of seed populations in soil; long term changes in site quality including *Ceanothus* dieback; and wildlife interactions.

Retrieval Terms: San Dimas Experimental Forest, chaparral research, watershed monitoring, flora, fauna, mosses, hydrology, physiography