Technical Report No. 296

COMPREHENSIVE NETWORK SITE DESCRIPTION

SAN JOAQUIN

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San Joaquin Experimental Range

Coarsegold, California

GRASSLAND BIOME

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ABSTRACT

The San Joaquin Site is briefly described in terms of location, size, climate, soils, vegetation, and fauna; and previous studies on the experimental area are highlighted. Detailed appendix material is included for: (1) vegetation, (2) fauna, (3) soils, and (4) publications, 1935-1975.

I. *Site Name: San Joaquin*

The study site is located on the San Joaquin Experimental Range, a field location of the Pacific Southwest Forest and Range Experiment Station, U.S. Forest Service. The Experimental Range is owned by the Forest Service and, since its establishment in 1934, has been the site of a wide variety of biological investigations by station scientists and cooperators from a number of state and federal organizations, agencies, and universities.

II. *Location and Elevation*

The experimental range is in the lower Sierra Nevada foothills of central California, about 25 miles (40 km) northeast of Fresno on State Highway 41. The closest air terminal is Fresno. Fig. 1, 2, and 3 show the location of the study area. Elevation extends from 700 to 1700 feet (214 to 518 m).

III. *Size*

The Experimental Range is approximately 4,500 acres (1,822 ha) in size. It has been grazed, primarily by cattle, for many years, with the exception of the Research Natural Area, which has been ungrazed and unburned since 1934. A variety of range livestock grazing, animal husbandry, range improvement (fertilization, reseeding, brush control, etc.), wildlife habitat, and zoological studies have been conducted.

IV. *Type of Grassland*

California's annual grasslands, often called the annual, annual plant, or annual grass types, make up a unique vegetation type which consists largely of about 400 introduced species, with the aliens

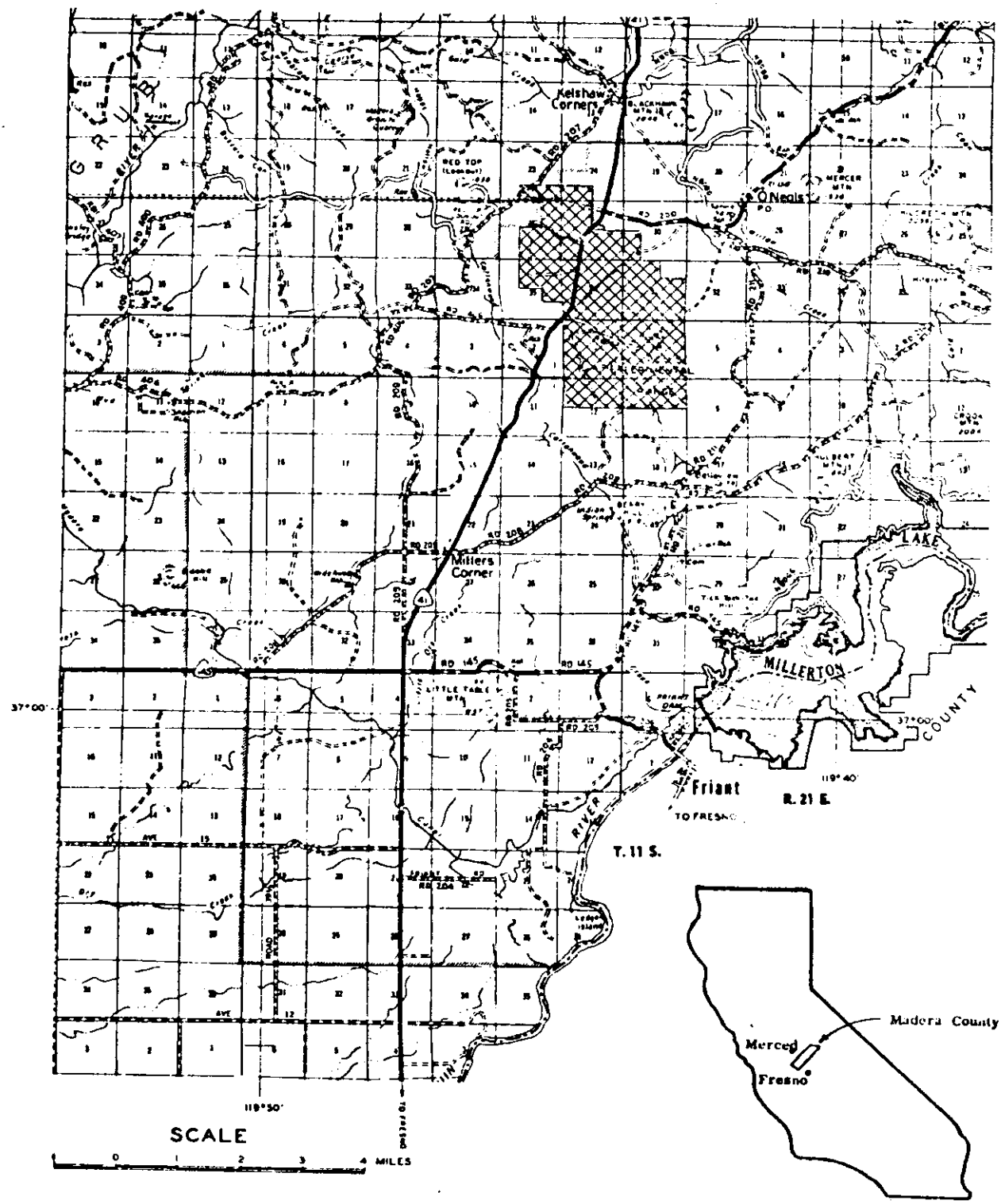

Fig. 1. Location of San Joaquin Experimental Range (cross hatched area) in Madera County. Inset shows location of Madera County in California. Source: C. E. Erickson Assoc., Madera County Maps.

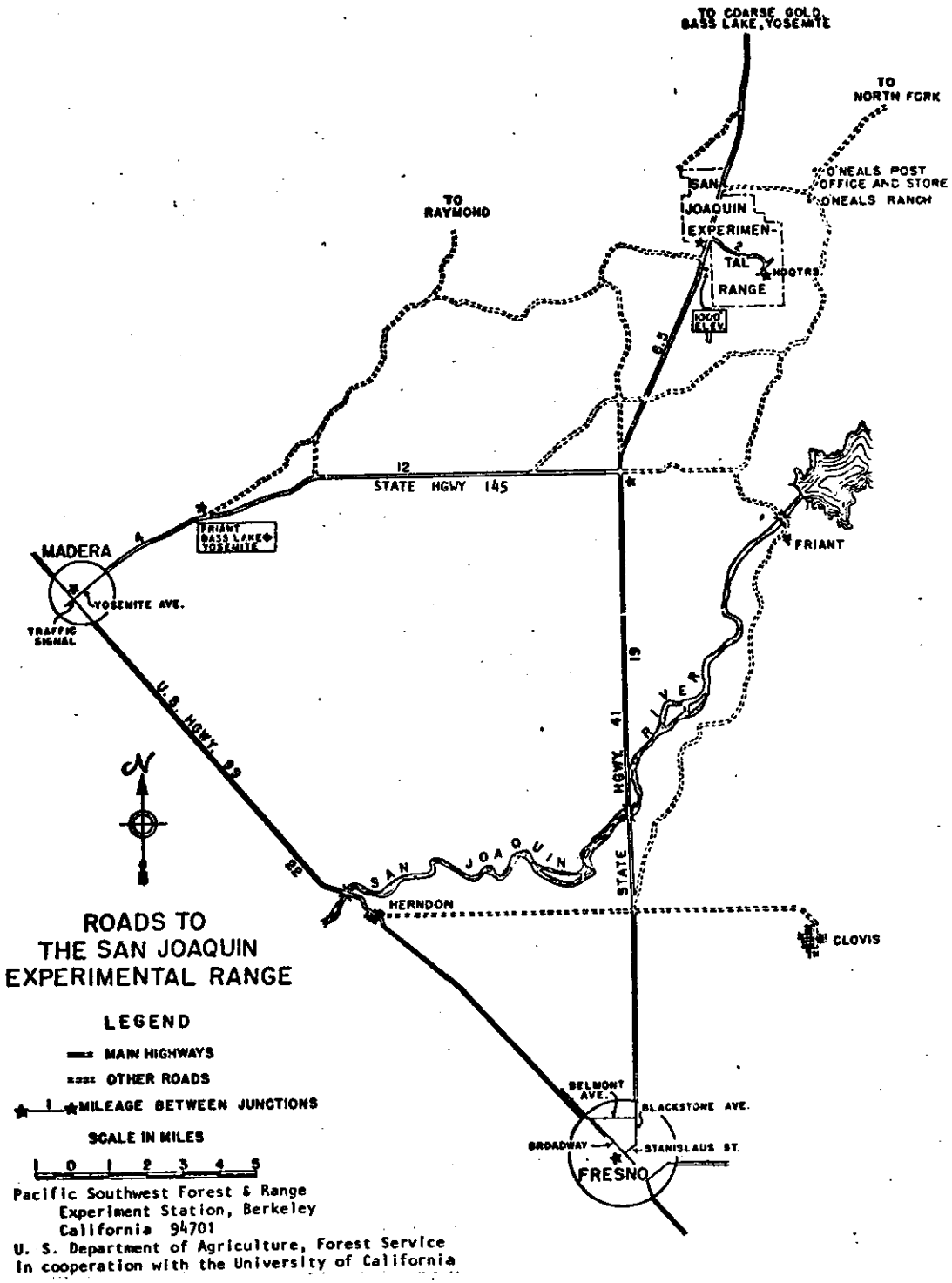

Fig. 2. Roads to the San Joaquin Experimental Range.

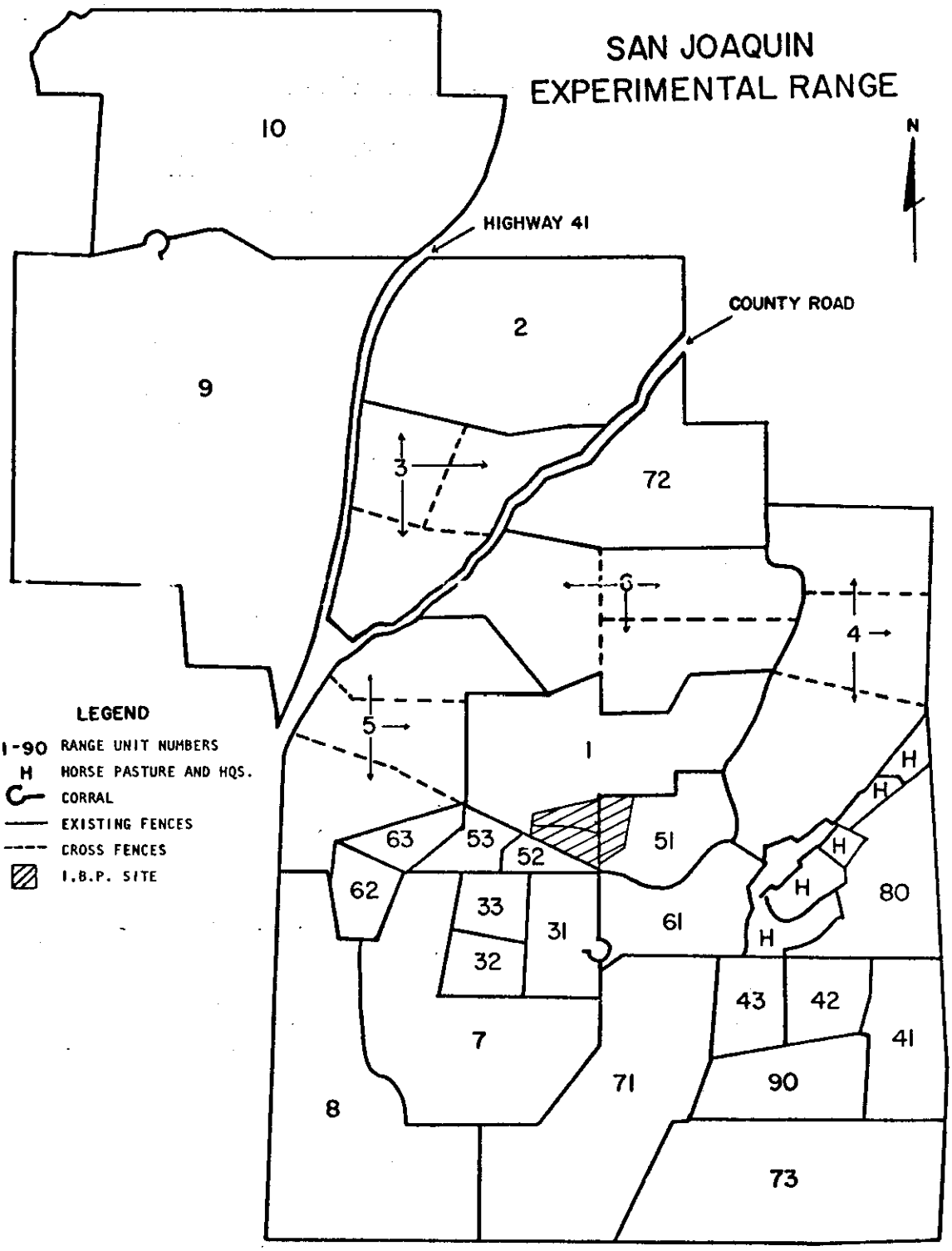

Fig. 3. Location of I.B.P. site.

constituting the major vegetative cover in most areas (Biswell 1956). There is considerable speculation about which alien species replaced which native species, and since no early records have been found, the question may never be fully answered. Many of the alien plants are aggressive and adaptable, accounting for 90% or more of the plant cover of many areas. However, Beetle (1947) stated there was no evidence that any grass ever recorded for California had become extinct.

Usually the annual grasslands are associated with the Central Valley and adjacent foothills and the Pacific Coast Range. Biswell (1956) estimated there were 17.5 million acres which provided 80% of the forage for domestic stock grazing on California wildlands. He divided the "grassland" into two major vegetational types: the grass of 10 million acres and the woodland-grass of 7.5 million acres. Inclusion of the foothills, where the herbaceous vegetation is certainly of the annual type in most areas, means the annual grasslands are made up of two of the phytocoenoses of Küchler (1964, 1970), the California steppe and the lower elevation of the California oakwoods.

The ecology of the annual plant type was described by Bentley and Talbot (1948), who reviewed the characteristics of the annual plant range and emphasized the importance of basing range management upon the annual vegetation, by Talbot, Biswell, and Hormay (1939), Biswell (1956), Heady (1956, 1958), Burcham (1957), McNaughton (1968), and others. Since the herbaceous vegetation is reconstructed each growing season, with the annual vegetation capable of rapid response to habitat changes, yearly changes in both amounts and composition have long been recognized. The adaptability and rapid response of the annual vegetation to changing conditions and cultural practices, plus comprehensive

computer analyses of data in many reports on herbage production, cattle production, fertilization, costs and returns, etc., resulted in the following statement by the Forest-Range Task Force (1972): "The annual plant type, as might be expected, has shown the most consistent and profitable response to range fertilization practices of any range type."

The California foothills make up the most important range area in the state. The statement by Bentley and Talbot (1951) that the primary use of foothill rangelands was production of livestock is still valid. The San Joaquin Experimental Range was established by the U.S. Forest Service in 1935 and in the words of Hutchison and Kotok (1942), the Experimental Range, "located in the granitic area near the center of the state, exemplifies range lands of rather medium value and reflects many of the unsolved problems dealing with season variabilities and nutritive deficiencies."

Actual fluctuation in herbage yield and composition caused by each year's combination of precipitation and temperature are great and are well documented, particularly by Bentley and Talbot (1951) and Wagnon, Guilbert, and Hart (1959). Burcham (1975) states,

> "Throughout the grassland ecosystem, annual plants are the dominant life form even where aspect dominance is maintained by open woodlands. The original perennial bunchgrass dominants have been superseded by annual bromegrasses, fescues, wild oats, and wild barleys. Associated with the grasses are a host of forbs, both native and introduced, the most constant and most abundant being filarees, legumes (bur clover, lupines, and trefoils), and tarweeds. The abundance and variety of forbs create marked seasonal differences in appearance of these grasslands, probably without parallel in any other plant community. At certain seasons, the forbs may be so conspicuous as to obscure the grasses, creating the illusion of being the dominant vegetation."

Bentley and Buttery (1957) reviewed past precipitation records and herbage production data on the San Joaquin Experimental Range and found

that timely rainfall distribution was the key to abundant herbage production. Murphy (1970) was able to show a fairly good correlation between November rainfall and subsequent herbage production at the Hopland Field Station in northern California. However, Duncan and Woodmansee (1975) found at the San Joaquin Experimental Range (half as much rainfall and shallower soil than at Hopland) there was poor correlation between fall rains or even total annual rainfall and subsequent herbage production over a period of more than 30 years. Duncan and Reppert (1960) documented the lowest rainfall on record at the Experimental Range (the 1958-1959 season) which resulted in the lowest herbage yields (less than half the long-time average) and the shortest green season (11 weeks) on record.

On the San Joaquin Experimental Range as a whole, scattered trees and occasional dense patches of brush occur. The most numerous trees are blue oak (*Quercus douglasii* Hook. & Arn.), interior live oak (*Quercus wislizenii* DC.) and California buckeye (*Aesculus californica* Nutt.). Wedgeleaf canothus (*Ceanothus cuneatus* (Hook.) Nutt.) is by far the most common shrub; a few plants of poison oak (*Rhus diversiloba* T. & G.) and manzanita (*Arctostaphylos mariposa* Dudl., in Eastw.) are also present.

However, the Grassland Biome site is located in an open grassland area. The herbaceous vegetation on the study area may include more than 300 species, listed by Buttery and Green (1958) in Appendix I and well described and illustrated by Hutchison and Kotok (1942). The species that make up the great majority of the herbage are in Table 1.

V. *Fauna*

The vertebrate fauna of the Experimental Range is characteristic of the Upper Sonoran life zone. The most abundant reptiles are the

Table 1. Botanical and common names of the most important herbage species/group.

Herbage Species/ Group	Botanical Names	Common Names
Abundant grasses	*Bromus mollis* L.	Soft chess
	Bromus diandrus Roth.	Ripgut brome
	Festuca megalura Nutt.	Foxtail fescue
Other grasses and grasslikes	*Bromus arenarius* Labill.	Australian chess
	Bromus rubens L.	Red brome
	Avena barbata Brot.	Slender oat
	Juncus bufolis L.	Toad rush
Clovers	*Trifolium microcephalum* Pursh.	Maiden clover
	Trifolium variegatum Nutt.	White-tip clover
Other legumes	*Lotus purchianus* (Benth.) Clem. & Clem.	Spanish clover
	Lotus strigosus (Nutt. in T. & G.) Greene	Fine-leaved deervetch
	Lupinus bicolor Lindl.	Ground lupine
Filaree	*Erodium botrys* Bertol.	Broadleaf filaree
	Erodium obtusiplicatum (Maire, Weiller, and Wilczek) J. T. Howell	Broadleaf filaree
Other broad-leaved herbs	*Plagiobothrys nothofulvus* A. Gray	Popcorn flower
	Amsinckia douglasiana DC.	Fiddleneck
	Hypochoeris glabra L.	Smooth cats-ear
	Silene gallica L.	Windmill pink

western fence lizard, Gilbert skink, Pacific gopher snake, and Pacific rattlesnake. Common mammals include several species of mice, Beechy ground squirrel, Audobon cottontail, coyote, bobcat, and mule deer. Among the more abundant birds are the Acorn Woodpecker, Scrub Jay, California Quail, and Red-tailed Hawk. The recorded fauna on the Experimental Range is made up of 7 fish, 8 amphibians, 19 reptiles, 38 mammals, and 149 birds as listed by Newman and Duncan (1973) (see Appendix II).

VI. *Soils*

The soils are of granitic origin and most are less than 2.5 feet (76.2 cm) in depth. About 90% of the area is residual and was reclassified in a detailed soil survey by the U.S. Soil Conservation Service in 1965 as the Ahwahnee series. The alluvial or swale area (Visalia series) soils are in general darker, deeper, and more productive, resulting in a larger period of green, nutritious forage than on the upland sites.

A detailed description of each series is found in the report of the detailed 1965 soil survey (Appendix III). The aerial photographs used and the maps prepared from the survey are available for use but not for general distribution.

VII. *Climate*

The climate of the area is of the Mediterranean type, usually moist, mild winters and long, hot, dry summers. Long-term weather records reveal an annual average precipitation (39 years) of 19.04 inches with a low of 10.12 and a high of 32.44 (Table 2). Monthly mean air temperatures (39-year average) range from about 42°F (5.6°C) in January to over 80°F (26.7°C) in July. Monthly minimum temperatures vary from a low of

Table 2. Precipitation in inches, San Joaquin Experimental Range, 1934-1973.

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Total
1934-35	0.00	2.22	3.79	3.64	5.76	3.21	4.85	6.33	0.00	0.00	0.00	0.00	29.80
1935-36	0.00	1.63	0.52	1.56	3.67	11.20	2.47	1.35	0.15	0.04	0.06	0.00	22.65
1936-37	0.00	2.17	0.10	5.16	3.22	7.08	4.58	0.65	0.00	0.00	0.00	0.00	22.96
1937-38	0.00	0.03	0.50	6.23	5.99	7.75	5.69	2.69	0.02	0.00	0.19	0.00	29.09
1938-39	0.14	1.37	0.75	1.28	2.87	2.50	2.89	0.26	0.03	0.14	0.00	0.02	12.25
1939-40	1.29	0.86	0.03	0.64	9.94	5.87	2.15	0.43	0.00	0.02	0.00	0.00	21.23
1940-41	0.00	1.56	0.10	8.26	3.68	7.50	2.76	4.44	0.02	0.00	0.00	0.01	28.33
1941-42	0.00	1.13	1.21	8.11	2.93	2.06	1.98	2.81	1.31	0.00	0.00	0.00	21.54
1942-43	0.00	0.00	1.98	2.14	4.63	2.23	5.09	1.17	0.00	0.00	0.00	0.00	17.24
1943-44	0.00	0.23	0.56	2.37	2.45	4.73	1.05	1.78	0.58	0.04	0.00	0.00	13.79
1944-45	0.05	1.05	4.98	2.83	0.31	4.48	4.56	0.32	0.35	0.05	0.00	0.01	18.99
1945-46	0.07	1.69	1.46	3.83	0.91	2.02	3.26	0.06	0.56	0.00	0.00	0.00	13.86
1946-47	0.00	1.58	4.26	3.68	0.51	1.51	0.94	0.44	0.57	0.03	0.00	0.00	13.52
1947-48	0.28	1.64	0.68	0.64	0.06	1.34	4.27	4.13	1.26	0.01	0.00	0.00	14.31
1948-49	0.00	0.26	0.21	2.28	2.06	1.95	4.10	0.02	1.51	0.00	0.00	0.00	12.39
1949-50	0.00	0.00	1.45	2.00	5.29	2.64	2.50	2.01	0.09	0.00	0.02	0.00	16.00
1950-51	0.19	2.17	7.10	4.03	3.04	2.55	0.82	1.42	0.03	0.03	0.00	0.00	21.38
1951-52	0.00	0.75	2.46	5.68	6.01	1.60	5.83	2.30	0.03	0.03	0.00	0.00	24.69
1952-53	0.24	0.10	2.38	6.49	2.22	0.18	1.32	1.72	0.62	0.44	0.00	0.00	15.71
1953-54	0.00	0.44	2.49	1.36	2.69	2.50	4.15	1.24	0.07	0.64	0.00	0.00	15.58
1954-55	0.00	0.00	2.52	2.58	5.78	1.92	0.40	2.08	1.46	0.00	0.00	0.00	16.74
1955-56	0.08	0.02	2.54	13.45	4.57	1.00	0.03	2.41	2.35	0.00	0.00	0.00	26.45
1956-57	0.00	1.78	0.00	0.93	2.52	2.26	2.52	1.56	2.78	0.17	0.00	0.00	14.52
1957-58	0.39	1.25	1.41	3.03	4.56	6.70	10.46	3.70	0.43	0.03	0.09	0.00	32.05
1958-59	0.33	0.00	0.25	0.54	3.26	4.58	0.04	1.02	0.10	0.00	0.00	0.00	10.12
1959-60	3.70	0.00	0.00	0.36	2.35	4.63	1.98	2.33	0.08	0.00	0.00	0.00	15.43
1960-61	0.08	0.88	4.08	0.88	2.16	0.54	1.80	0.67	0.76	0.10	0.06	0.08	12.00
1961-62	0.02	0.10	3.31	1.90	2.61	10.04	2.37	0.21	0.06	0.00	0.06	0.00	20.68
1962-63	0.14	1.47	0.12	1.26	3.49	4.05	4.14	4.75	0.52	0.10	0.00	0.00	20.04
1963-64	0.29	1.58	4.72	0.44	1.28	0.00	2.10	1.46	0.84	0.04	0.00	0.00	12.75
1964-65	0.25	1.80	3.22	5.23	2.97	0.54	1.44	4.12	0.01	0.00	0.00	0.02	19.60
1965-66	0.00	0.40	5.55	3.06	1.08	1.41	0.15	0.76	0.30	0.07	0.01	0.00	12.79
1966-67	0.08	0.00	3.02	5.83	4.12	0.89	4.04	8.76	0.70	0.53	0.00	0.00	27.97
1967-68	0.33	0.18	1.87	2.18	1.57	1.70	2.67	0.46	0.78	0.00	0.05	0.04	11.83
1968-69	0.00	1.58	2.68	4.05	9.80	8.11	2.52	2.86	0.00	0.44	0.30	0.10	32.44
1969-70	0.03	0.75	1.24	2.91	6.29	1.55	3.40	0.19	0.00	1.02	0.00	0.00	17.38
1970-71	0.00	0.08	4.00	4.89	1.25	0.44	1.43	0.91	2.30	0.00	0.00	0.00	15.30
1971-72	0.15	0.03	1.88	4.82	0.40	1.49	0.00	0.74	0.26	0.95	0.01	0.00	10.73
1972-73	0.34	0.26	5.13	2.47	3.74	7.19	4.24	0.55	0.02	0.07	0.00	0.00	24.01
Means for 39 years	0.22	0.85	2.16	3.42	3.38	3.45	2.92	1.93	0.55	0.13	0.02	0.01	19.04

slightly above freezing in January to over 60° in July and monthly maximums range from about 50° in January to almost 100° in July (Table 3).

VIII. *Physical facilities*

One resident scientist and several technicians are permanently located at the Experimental Range. Shop and limited laboratory (equipped to handle routine drying, sorting, freezing, washing, and ashing of above- and belowground biomass samples plus a simple soils laboratory) facilities are available. There are limited dormitory facilities; most visitors prefer, especially in the summer, to obtain food and air-conditioned lodgings at Fresno or Madera (25 miles or 40 km). Restrictions on the use of laboratory or other facilities are those imposed by prior scheduled use. Inquiries should be addressed to Don A. Duncan, Resident Scientist, San Joaquin Experimental Range, Coarsegold, California 93614 or phone 209-868-3349 (O'Neals).

IX. *Previous Studies on the Area*

In 1934, the U.S. Forest Service established the San Joaquin Experimental Range, with the University of California cooperating on several projects. The foremost of these projects was the experimental cattle herd of the University Agricultural Experimental Station, placed on the Experimental Range to study the best way of maintaining commercial cattle on a year-round basis on the foothill rangelands. As scientists from the University of California's Division of Animal Husbandry studied the grazing management and animal husbandry aspects of how best to utilize the forage on the ground by adding supplements to meet seasonal nutritional deficiencies, Forest Service scientists studied the effect of grazing on the plants, the botany of the area, and the possibility of

Table 3. Average monthly air temperatures, San Joaquin Experimental Range, 1934-1973.

	39-Year Average Temperature (°F)											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Max.	53.3	57.9	62.3	70.0	80.2	89.7	98.3	96.7	90.2	78.2	64.5	54.6
Min.	33.0	36.3	38.5	42.7	48.0	54.3	61.2	59.8	55.2	47.0	38.4	34.1
Mean	41.9	46.2	49.3	56.0	64.3	73.0	80.4	78.3	72.1	61.2	49.8	42.9

introducing new species. The land was purchased by the Forest Service, and coordination of all studies and administration of the area have been the responsibility of the Forest Service. From the outset, the importance of the wildlife species on the area has been recognized and cooperative wildlife studies with numerous agencies and institutions have been conducted. Newman and Duncan (1973) cited references to major wildlife on zoological studies on the ground squirrel, pocket gopher, cottontail, rattlesnake, and California Quail. A detailed description of the area and an account of early investigations were reported by Hutchison and Kotok (1942). As listed by Duncan and Westfall (Appendix IV) more than 250 publications have now resulted from work by the staff and cooperators at the Experimental Range.

The objectives of the early animal husbandry research on the San Joaquin Experimental Range are summarized (Hutchison and Kotok 1942) as "the objectives in the experimental work reported here placed major emphasis upon long-time investigations bearing on the general problems of yearlong utilization. It was desired to ascertain the kinds and amounts of supplements necessary to correct nutritional deficiencies of the range, and thereby increase efficiency of utilization and promote productive efficiency of the breeding herd and normal economical development of the young animals. One major objective was to ascertain what degree of forage utilization is consistent with the animals' welfare and with maintenance or improvement of the range."

Duncan and Westfall (Appendix IV) list about 100 publications on animal science-oriented or closely related work from the San Joaquin Experimental Range. Several of the more comprehensive reports include the summary of beef cattle investigations from 1935 to 1948 (Wagnon et

al. 1959), a report on the behavior of beef cows (Wagnon 1963), Wagnon's (1965) treatment on social dominance in range cows and its effects on supplemental feeding, and the results of a study on the utilization by cattle of 10 different classes of rangeland (Wagnon 1968). Duncan and Reed (1973) reported on the cattle results of a more recent grazing management study.

The possibility of increasing production by fertilization on foothill rangelands has been closely studied. Bentley (1946) noted that fertilization of annual type ranges, particularly with gypsum, showed more promise of positive results than any other cultural practice. Conrad (1950) and Martin (1958) reported that sulfur deficiency was common over a wide area of California. Bentley and Green (1954) showed increased production of both clovers and grasses at relatively small expense through sulfur fertilization. The importance of annual legumes at the San Joaquin Experimental Range was described by Green and Graham (1958) and Green (1959).

In 1958, three articles were published on a long-term study of grazing management of sulfur fertilized ranges. Bentley, Green, and Wagnon (1958) reported that sulfur fertilization (60 lb S/acre) on two pastures increased herbage production by almost 60% over two unfertilized pastures; actual carrying capacity was increased by about 50%. Reporting on the same study, Green, Wagnon, and Bentley (1958) described how fertilization produced desirable changes in plant species which in turn influenced the diet and grazing habits of steers. Wagnon, Bentley, and Green (1958) noted that sulfur fertilization increased both the carrying capacity and steer gains during both green and dry seasons.

In a lysimeter study of sulfur fertilization on an annual range soil (conducted at the San Joaquin Experimental Range), McKell and Williams (1960, 1961) and Williams, McKell, and Reppert (1964) described how the lysimeter tests proved gypsum (calcium sulfate) was a readily available source of sulfur for plants, but that it was highly susceptible to leaching. Elemental sulfur, more slowly available, was less susceptible to leaching. Interestingly, sulfur contributed by rainfall amounted to 21.4 lb/acre in 1958. Since the amount of sulfur absorbed from the atmosphere by the soil surface was almost negligible (0.1 lb/acre), the sulfur brought down in the rain was apparently picked up in air masses some distance from the site.

Sulfur fertilization was used in another study on the San Joaquin Experimental Range that compared several systems of grazing, using cows and calves. One of the treatments was yearlong grazing of sulfur fertilized range. The study area was too large and too steep for application with ground equipment, so helicopter application was used. Reppert and Duncan (1963) and Duncan and Reppert (1966) noted that helicopter applications of sulfur were fast and practical. In reporting the cattle response results of this long-term study, Duncan and Reed (1973) concluded that yearlong grazing of sulfur fertilized ranges was the most productive of the four systems of grazing in the study.

In a rancher test of sulfur fertilization, Westfall (1966) cited even greater increases from addition of sulfur to plots on his ranch than those reported from the nearby San Joaquin Experimental Range.

Until recently most of the research on fertilization at the San Joaquin Experimental Range was on sulfur fertilization. Unpublished small plot trials showed nitrogen to be deficient. McKell, Graham, and

Wilson (1960), reporting on a study involving different rates of nitrogen, sulfur, and phosphorus in a dry year, concluded that addition of nitrogen improved range readiness and increased production and protein content of herbage. Sulfur and phosphorus further increased protein content when nitrogen was not a limiting factor.

From the results of a long-term study, Duncan (1974) noted that although the greatest increases in total herbage production and steer gains were on nitrogen-fertilized areas, the intermediate increases obtained on sulfur-fertilized areas (sulfur cost about one-third as much as nitrogen during the 9-year study period) indicate that sulfur fertilization may provide the most return per dollar invested in fertilizing central California foothill ranges.

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APPENDIX I

A CHECK LIST OF PLANTS OF THE SAN JOAQUIN EXPERIMENTAL RANGE

by

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PREFACE

The San Joaquin Experimental Range is located near the center of the State in the granite-soil section of the Sierra Nevada foothills. It is in Madera County, 28 miles north of Fresno, California. This 4600-acre experimental area was established in 1934 as a branch station of the California Forest and Range Experiment Station, U. S. Forest Service. Research aimed at increased production from California foothill range through improved management, fertilization, brush control, and livestock management has been carried out since establishment.

The area lies in the "annual grass type" and is characterized by grassy rolling hills with a sparse covering of trees and occasional dense stands of brush. It is in the lower part of the woodland zone between the treeless valley floor and the higher brush and timber belts.

The herbaceous ground cover consists mostly of annual grasses and forbs. In contrast, perennials dominate most western range areas. Ecologically speaking, the area is near the lower limits of the Upper Sonoran Zone. The elevation varies from 700 to 1700 feet, with most of the area lying between 1000 and 1500 feet. Exposures are generally southwesterly.

The drainage basin empties into a small tributary of the San Joaquin River. No permanent streams flow through the area, but springs are numerous and the small drainages carry surface flows during the winter months.

The slope soils are shallow, residual, of granitic origin, and are classed in the Vista series. The swale soils are deeper, alluvial, and are classed in the Visalia series. Both have a low water-holding capacity.

The climate is characterized by mild, rainy winters and hot, dry summers. Snow is rare. Seasonal precipitation usually begins in September and has averaged 19.4 inches, with extremes of 12.3 and 32.1 inches, during the past 23 years. On the average, over 70 percent of the precipitation falls during 4 months, December through March. From mid-May to mid-September there is practically no rain at all.

Seeds of most herbaceous plant species germinate with the first 1/2 to 1 inch of fall rain and grow slowly during the winter. The plants grow rapidly when warm temperatures return in March, reach maturity in April, and are mostly dry by mid-May.

Plant species listed in the text have been collected at the Range during the past 23 years. Standards of abundance for herbaceous vegetation are as follows:

Abundant -- species appears on at least 75 percent of sample quadrats.[1] Only 3 species fall in this category.

Very common -- species appears on at least 15 percent of sample quadrats. There are 18 species in this category.

Common -- species appears on at least 1 sample quadrat.

Uncommon -- species appears each year on the Range and in most pastures, but infrequently in pasture samples.

Rare -- species appears in 1 or 2 locations on the Range, or in especially favorable years, but seldom if ever in herbage samples.

All plant species listed herein were identified by the Division of Range Management Research, U. S. Forest Service, Washington, D. C. The following authority was used for recent changes in nomenclature:

Abrams, Leroy. 1951. Illustrated Flora of the Pacific States. Stanford University Press, Stanford, California.

Botanical names in parentheses are synonyms which have been used at the Range. The following source was used for common names:

Kelsey, H. P., and Dayton, W. A. 1942. Standardized Plant Names. Second Edition. J. Horace McFarland Co., Harrisburg, Pennsylvania. 675 p.

Locally well established common names are also listed for some plants.

INDEX

GRASSES AND GRASS-LIKE PLANTS

Botanical and common name	Occurrence	Habitat
TYPHACEAE Cattail family		
Typha latifolia L. Common cattail Broad-leaved cattail	Rare	Wet swale
GRAMINEAE Grass family		
Aira caryophyllea L. (Aspris caryophyllea Nash) Silver hairgrass	Common	Slope, on shallow soil
Avena barbata Brot. Slender wild oat	Very common	Slope, especially south
Avena fatua L. Wild oat	Rare	Slope
Briza minor L. Little quakinggrass	Common	Swale
Bromus arenarius Labill. Australian brome	Common	Slope, especially south
Bromus mollis L. (Bromus hordeaceus L.) Soft brome or chess	Abundant	Slope and dry swale
Bromus rigidus Roth. Ripgut brome	Very common	Slope, especially shaded, and dry swale
Bromus rubens L. Foxtail brome Red brome	Very common	Slope, all exposures
Cynodon dactylon (L.) Pers. Bermuda grass	Uncommon	Wet swale
Deschampsia danthonioides (Trin.) Munro ex Benth. Annual hairgrass	Uncommon	Lower slope and swale
Digitaria sanguinalis (L.) Scop. (Syntherisma sanguinalis Dulac, Fl. Haut.) Hairy crabgrass	Uncommon	Gardens

GRASSES AND GRASS-LIKE PLANTS

Botanical and common name	Occurrence	Habitat
Distichlis stricta (Torr.) Rydb. Inland saltgrass	Rare	Creek bank
Elymus triticoides Buckl. Creeping wildrye Beardless wildrye	Rare	Dry swale
Eragrostis cilianensis (All.) Lutati Stinkgrass	Rare	Barnyard and garden
Eragrostis diffusa Buckl. Spreading lovegrass	Rare	Barnyard
Festuca confusa Piper Klickitat fescue Hairy-leaved fescue	Uncommon	Slope
Festuca grayi (Abrams) Piper Gray's fescue	Common	Slope, especially south
Festuca megalura Nutt. Foxtail fescue	Abundant	Slope, all exposures and dry swale
Festuca pacifica Piper Pacific fescue	Uncommon	Slope, especially north
Festuca reflexa Buckl. Twoflower fescue	Uncommon	Slope, especially south
Gastridium ventricosum (Gouan) Schinz and Thell Nitgrass	Common	Slope, on shallow soil
Hordeum brachyantherum Nevski (Hordeum nodosum L.) Meadow barley	Uncommon	Dry swale
Hordeum hystrix Roth. (Hordeum gussenianum Parl.) Mediterranean barley	Very common	Wet swale

GRASSES AND GRASS-LIKE PLANTS

Botanical and common name	Occurrence	Habitat
Hordeum leporinum Link (Hordeum murinum L.) Mouse barley Common foxtail	Common	Disturbed soil or lower slope
Koeleria phleoides (Vill.) Pers. Annual koeleria	Rare	Swale
Lolium multiflorum Lam. Italian ryegrass Annual ryegrass	Seeded	Swale and lower slope
Melica californica Scribn. California melicgrass	Uncommon	Rock outcrop
Melica imperfecta Trin. Coastrange melicgrass Small-flowered melicgrass	Uncommon	Rock outcrop
Oryzopsis miliacea (L.) Benth. Smilo	Seeded	Lower slope
Panicum capillare occidentale Rydb. Common witchgrass	Uncommon	Swale
Phalaris californica Hook. and Arn. California canarygrass	Rare	
Phalaris caroliniana Walt. Carolina canarygrass	Uncommon	Wet swale
Phalaris coerulescens Sunol grass	Seeded	Lower slope and swale
Phalaris tuberosa stenoptera (Hack.) Hitchc. Hardinggrass	Seeded	Swale
Poa annua L. Annual bluegrass	Common	Swale

GRASSES AND GRASS-LIKE PLANTS

Botanical and common name	Occurrence	Habitat
Poa scabrella (Thurb.) Benth. ex Vassey Pine bluegrass	Common	Slope, especially north
Polypogon monspeliensis (L.) Desf. Rabbitfoot polypogon Beardgrass	Common	Creekbed
Scribneria bolanderi (Thurb.) Hack. Scribneria	Rare	Slope
Setaria viridis (L.) Beauv. Green bristlegrass	Uncommon	Gardens
Sorghum halepense (L.) Pers. Johnsongrass	Rare	Swale
Stipa cernua Stebbins and Love. Nodding stipa	Seeded	Slope
Stipa pulchra Hitchc. California needlegrass Purple stipa	Seeded	Slope
CYPERACEAE Sedge family		
Cyperus inflexus Muhl. Flatsedge Awned cyperus	Uncommon	Creekbed
Cyperus vegetus Willd. (Cyperus virens) Green flatsedge Tall cyperus	Uncommon	Creekbed
Eleocharis macrostachya Britton (Eleocharis palustris R. and S.) Spikesedge Common spikerush	Common	Wet swale

GRASSES AND GRASS-LIKE PLANTS

Botanical and common name	Occurrence	Habitat
LEMNACEAE Duckweed family		
Lemna sp. Duckweed	Uncommon	Seep
JUNCACEAE Rush family		
Juncus bufonius L. Toad rush	Common	Dry swale
Juncus oxymeris Engelm. Slenderleaf rush Pointed rush	Common	Wet swale
Juncus macrophyllus Coville Long-leaved rush	Common	Wet swale

FORBS

Botanical and common name	Occurrence	Habitat
POLYPODIACEAE Fern family		
Pityrogramma triangularis (Kaulf.) Maxon (Gymnogramme triangularis Kaulf.) Goldfern	Common	Shaded rock outcrop
Pellaea mucronata (D.C. Eaton) D.C. Eaton Birdsfoot cliffbrake	Common	Shaded rock outcrop
LILIACEAE Lily family		
Allium hyalinum Curran Eldorado onion Paper-flowered onion	Uncommon	Slope
Brodiaea capitata Benth. (Dichelostemma capitatum [Benth.] Wood) Bluedicks brodiea Common brodiea	Very common	Slope
Brodiaea coronaria (Salisb.) Engler Harvest brodiea	Common	Swale and lower slope
Brodiaea laxa (Benth.) Wats. (Triteleia laxa Benth.) Grassnut brodiea	Uncommon	Slope
Brodiaea volubilis (Kell.) Baker (Dichelostemma californicum [Torr.] Wood) Vine brodiea Twining brodiea Snake lily	Uncommon	Steep rocky slope
Calochortus luteus Dougl. Yellow mariposa	Uncommon	Slope

FORBS

Botanical and common name	Occurrence	Habitat
Calochortus luteus oculatus Wats. Mariposa	Uncommon	Slope
Chlorogalum pomeridianum (DC.) Kunth. Common soapplant Amole soapplant	Common	Rock outcrop
Muilla tenuis Congdon (Muilla maritima [Torr.] Wats.) Muilla Common muilla	Common	Slope
POLYGONACEAE Buckwheat family		
Chorizanthe membranacea Benth. Pink chorizanthe Spineflower	Common	Slope, on shallow soil
Chorizanthe stellulata Benth. Starlet chorizanthe Spineflower	Common	Slope, on shallow soil
Eriogonum gracillimum Wats. Slender eriogonum	Uncommon	Slope
Eriogonum nudum Benth. Barestem eriogonum	Uncommon	Slope
Eriogonum virgatum Benth. Virgate eriogonum	Common	Slope
Polygonum aviculare L. Prostrate knotweed Knotweed Knotgrass	Uncommon	Barnyard and gardens
Polygonum punctatum Elliot (Polygonum acre H.B.K.) Dotted smartweed Water smartweed	Uncommon	Creekbed

FORBS

Botanical and common name	Occurrence	Habitat
Pterostegia drymarioides Fisch. and Mey. Pterostegia	Common	Shaded slope
Rumex crispus L. Curly dock	Common	Creekbed
CHENOPODEACEAE Goosefoot family		
Chenopodium album L. Lambsquarters goosefoot	Uncommon	Disturbed soil
Chenopodium ambrosiordes chilense (Schrad.) Spegaz. Wormseed goosefoot, Pigweed	Uncommon	Disturbed soil
Chenopodium leptophyllum Nutt. Slimleaf goosefoot	Common	Disturbed soil
Chenopodium pumilio R. Br. Goosefoot	Uncommon	Disturbed soil
AMARANTHACEAE Amaranth family		
Amaranthus graecizans L. Tumbleweed amaranthus Tumbling pigweed	Uncommon	Disturbed soil
Amaranthus retroflexus L. Redroot amaranthus Rough pigweed	Uncommon	Disturbed soil
AIZOACEAE Carpetweed family		
Mollugo verticillata L. Carpetweed Indian chickweed	Uncommon	Seep

FORBS

Botanical and common name	Occurrence	Habitat
PORTULACACEAE Purslane family		
Calindrina caulescens menziesii Gray (C. ciliata var. menziesii [Hook.] J.F.Macbride) Redmaids	Very common	Slope
Montia fontana L. Indian lettuce Water chickweed	Common	Wet swale
Montia perfoliata (Donn.) Howell Indian lettuce Miners' lettuce	Common	Shaded slope
Portulaca oleracea L. Common purslane	Uncommon	Gardens
CARYOPHYLLACEAE Chickweed family		
Arenaria douglasii Fenzl. Douglas sandwort	Uncommon	Slope
Cerastium viscosum L. Sticky cerastium Mouse-ear chickweed	Common	Lower slope
Herniaria cinerea DC. Gray burstwort Gray herniaria	Uncommon	Slope
Sagina apetala barbata Fenzl. Dwarf pearlwort	Uncommon	Slope
Silene gallica L. French silene Common catchfly Windmill pink	Very common	Slope
Spergula arvensis L. Corn spurry	Uncommon	Lower slope and dry swale

FORBS

Botanical and common name	Occurrence	Habitat
Spergularia marina (L.) Griseb. (S. salina J. and C.) Saltmarsh sand spurry	Uncommon	Lower slope
Stellaria media (L.) Cyrill. Chickweed	Common	Lower slope
RANUNCULACEAE Buttercup family		
Delphinium decorum patens (Benth.) Gray Yellowtinge larkspur Coast larkspur	Uncommon	Slope, especially north
Delphinium hanseni Greene Hansen larkspur	Common	Shaded lower slope
Ranunculus aquatilis L. (R. aquatilis var. capillaceus [Thuill.] DC.) Watercrowfoot buttercup Water buttercup	Common	Creekbed
Ranunculus californicus Benth. California buttercup	Common	Wet swale
Ranunculus hebecarpus Hook. and Arn. Pubescent-fruited buttercup	Uncommon	Shady slope
PAPAVERACEAE Poppy family		
Eschscholtzia caespitosa Benth. Gold poppy	Uncommon	Slope, especially south
Eschscholzia californica Cham. California poppy	Common	Slope, especially south
Eschscholzia lobbii Greene Frying pans	Common	Slope

FORBS

Botanical and common name	Occurrence	Habitat
Papaver heterophyllum (Benth.) Greene Wind poppy	Uncommon	Shady north slope
Platystemon californicus Benth. Creamcups platystemon	Common	Creekbank
CRUCIFERAE Mustard family		
Arabis maxima Greene (Arabis arcuata Gray (Arabis holboellii var. arcuata Jepson) Rockcress	Uncommon	Rocky slope
Athysanus pusillus (Hook.) Greene Dwarf athysanus	Common	Slope
Capsella bursa-pastoris (L.) Medic. Shepherdspurse	Common	Slope
Lepidium nitidum Nutt. Tongue pepperweed Shining peppergrass	Common	Swale
Radicula nasturtium-aquaticum (L.) Britt. and Rendle Watercress	Uncommon	Seep
Sinapsis arvensis L. (Brassica arvensis [L.] B.S.P.) Field charlock	Uncommon	Creekbank
Streptanthus coulteri (Wats.) Greene Twistflower	Common	Slope
Streptanthus diversifolius Wats. Varied-leaved streptanthus	Uncommon	Slope

FORBS

Botanical and common name	Occurrence	Habitat
Streptanthus tortuosus Kell. Mountain streptanthus	Uncommon	Slope
Streptanthus heterophyllus Nutt. San Diego streptanthus	Uncommon	Slope
Thysanocarpus curvipes Hook. Hairy fringepod	Common	Slope
Tropidocarpum gracile Hook. Dobie pod	Common	Slope
CRASSULACEAE Stonecrop family		
Tillaea erecta Hook. and Arn. Sand pygmyweed	Very common	Slope
SAXIFRAGACEAE Saxifrage family		
Lithophragma heterophylla (Hook. and Arn.) Torr. and Gray. Hillstar	Common	Shady north slope
Saxifraga californica Greene California saxifrage	Uncommon	Slope, especially north
Saxifraga integrifolia Hook. Hooker's saxifrage	Uncommon	Slope, especially north
ROSACEAE Rose family		
Alchemilla occidentalis Nutt. (A. arvensis [L.] Scop.) Field ladysmantle Western ladysmantle	Common	Slope

FORBS

Botanical and common name	Occurrence	Habitat
LEGUMINOSAE, Pea family		
Astragalus asymmetricus Sheldon (A. leucophyllus Torr. and Gray) Woolyleaf loco San Joaquin locoweed	Rare	Slope
Astragalus gambellianus Sheldon (A. nigrescens Nutt.) Gambel's dwarf locoweed	Common	Slope, especially south
Lotus americanus (Nutt.) Bisch. (Hosackia americana [Nutt.] Piper) Spanish clover Deervetch	Very common	Lower slope
Lotus argophyllus decorus (Jtn.) Ottley (Hosackia argophylla Gray) Silver deervetch	Uncommon	Slope
Lotus micranthus Benth. (Hosackia parviflora Benth.) Littleflower deervetch	Uncommon	Slope
Lotus scoparius (Nutt.) Ottley (Hosackia glabra [Vogel] Torr.) Broom deervetch Deerweed	Uncommon	Slope, especially north
Lotus strigosus (Nutt.) Greene (Hosackia strigosa Nutt.) Fine-leaved deervetch	Common	Slope, especially south
Lotus subpinnatus Lag. (Hosackia subpinnata [Lag.] Torr. and Gray) Chilean deervetch Hairy lotus	Common	Slope
Lupinus albifrons Benth. Whiteface lupine Bush lupine	Common	Rocky slope

FORBS

Botanical and common name	Occurrence	Habitat
Lupinus benthami Hel. Spider lupine Bentham's lupine	Common	Slope
Lupinus bicolor Lindl. Bicolor lupine Ground lupine	Very common	Slope
Lupinus densiflorus Benth. Gully lupine Dense-flowered lupine	Uncommon	Slope
Lupinus formosus Greene Lunara lupine Summer lupine	Common	Slope
Lupinus nanus Dougl. Sky lupine	Uncommon	Slope
Medicago apiculata Willd. Smoothbur medic	Uncommon	Lower slope and dry swale
Medicago hispida Gaertn. California burclover	Uncommon, except as seeded	Lower slope and dry swale
Trifolium albopurpureum Torr. and Gray Rancheria clover Indian clover	Uncommon	Slope
Trifolium amplectens Torr. and Gray. Bladder clover Pale sack clover	Uncommon	Slope
Trifolium ciliolatum Benth. (Trifolium ciliatum Nutt.) Foothill clover Tree clover	Common	Lower slope
Trifolium depauperatum Depauperate clover Dwarf sack clover	Uncommon	Slope

FORBS

Botanical and common name	Occurrence	Habitat
Trifolium dichotomum Hook. and Arn. Branched Indian clover	Uncommon	Slope, especially north
Trifolium hirtum All. Rose clover	Where seeded	Lower slope
Trifolium incarnatum Crimson clover	Where seeded	Dry swale
Trifolium microcephalum Pursh. Littlehead clover	Very common	Slope
Trifolium obtusiflorum Hook. Clammy clover Creek clover	Uncommon	Creekbed
Trifolium subterraneum Subterranean clover	Where seeded	Dry swale
Trifolium tridentatum Lindl. Tomcat clover	Common	Lower slope
Trifolium variegatum Nutt. Whitetip clover	Very common	Wet swale
LINACEAE Flax family		
Linum usitatissimum L. Common flax	Uncommon	Slope
OXALIDACEAE Oxalis family		
Oxalis corniculata L. Creeping oxalis Woodsorrel	Uncommon	Gardens and shaded slope
GERANIACEAE Geranium family		
Erodium botrys Bertol. Big heronbill Broadleaf filaree	Abundant	Slope and dry swale

FORBS

Botanical and common name	Occurrence	Habitat
Erodium cicutarium L'Her. Alfileria Redstem filaree	Common	Lower slope
Erodium obtusiplicatum (Maire, Weiller and Wilczek) J.T. Howell (E. botrys f. montanum Brumhard) Big heronbill Broadleaf filaree	Very common	Slope
Erodium moschatum L'Her. Musk heronbill Whitestem filaree	Uncommon	Lower slope
Geranium carolinianum L. Carolina geranium	Uncommon	Lower slope
Geranium sphaerospermum Fern. Geranium	Uncommon	Lower slope
LIMNANTHACEAE Meadowfoam family		
Limnanthes douglasi R. Br. Douglas meadowfoam	Common	Creekbank
Limnanthes montana Mountain meadowfoam	Uncommon	Creekbank
EUPHORBIACEAE Spurge family		
Euphorbia ocellata D. and H. Euphorbia	Common	Slope
Eremocarpus setigerus **Turkey mullein**	Common	Lower slope and swale
ZYGOPHYLLIACEAE Caltrops family		
Tribulus terrestris L. Punctarevine Goathead	Rare	Disturbed soil

FORBS.

Botanical and common name	Occurrence	Habitat
MALVACEAE Mallow family		
Malva parviflora L. Little mallow Cheeseweed	Uncommon	Disturbed soil
Sidalcea hartwegii Gray Checkermallow	Common	Lower slope and swale
LOASACEAE Loasa family		
Mentzelia lindleyi T. and G. Lindley mentzelia	Rare	Slope, especially south
DATISCACEAE Datisca family		
Datisca glomerata Brew. and Wats. Durangoroot	Rare	Creekbed
CUCURBITACEAE Gourd family		
Cucurbita foetidissima H.B.K. Calabazillia	Rare	Slope
Echinocystis fabacea Naud. Mockcucumber	Common	Slope, climbing on shrubs
Echinocystis macrocarpa Greene Chilicothe mockcucumber	Common	Slope, climbing on shrubs
LYTHRACEAE Loosestrife family		
Lythrum hyssipifolia L. Hyssop lythrum Loosestrife	Common	Swale, especially on disturbed soil
ONAGRACEAE Evening primrose family		
Boisduvalia densiflora (Lindl.) Wats. Dense spikeprimrose	Uncommon	Swale

FORBS

Botanical and common name	Occurrence	Habitat
Boisduvalia stricta (Gray) Greene Brook spikeprimrose	Uncommon	Swale
Epilobium paniculatum Nutt. Autumn willowweed	Uncommon	Slope
Clarkia dudleyana Abrams (Godetia dudleyana Abrams) Dudley's godetia	Common	Slope, especially north
Clarkia elegans Dougl. Rose clarkia	Common	Slope, especially north
Clarkia nitens Lewis and Lewis (Godetia nitens) Clarkia	Common	Slope
Clarkia purpurea quadrivulnera (Dougl.) Lewis and Lewis (Godetia quadrivulnera [Dougl.] Spach.) Clarkia	Uncommon	Slope
Clarkia williamsonii (Durand and Hilgard) Lewis and Lewis (Godetia viminea Spach.) Orchid godetia	Common	Slope, especially north
Oenothera dentata Cav. Field primrose	Common	Slope, especially south
Oenothera graciflora Hook. and Arn. Slender primrose	Common	Lower slope
UMBELLIFERAE Parsley family		
Daucus pusillus Michx. Southwestern carrot Rattlesnake weed	Common	Slope
Eryngium globosum Jepson Button snakeweed	Common	Swale

FORBS

Botanical and common name	Occurrence	Habitat
Lomatium utriculatum (Nutt.) Colt and Rose (Cogswellia) Common lomatium	Uncommon	Slope, especially north
Perideridia pringlei (C. and R.) Nels. and Macbr. (Eulophus pringlei C. and R.) Pringle's yampah	Rare	Slope
Sanicula bipinnatifida Dougl. Purple sanicle	Common	Slope
Sanicula tuberosa Torr. Tuber sanicle	Common	Rock outcrop
PRIMULACEAE Primrose family		
Dodecatheon patulum Greene Dwarf shootingstar	Uncommon	Shaded slope
GENTIANACEAE Gentian family		
Centaurium venustum (Gray) Rob. Pink centaurium	Common	Dry swale
ASCLEPIADACEAE Milkweed family		
Asclepias cordifolia (Benth.) Jepson Purple milkweed	Uncommon	Slope
Asclepias mexicana Cav. Mexican milkweed	Uncommon	Dry swale or lower slope
Asclepias vestita Hook. and Arn. Wooly milkweed	Common	Slope

FORBS

Botanical and common name	Occurrence	Habitat
POLEMONIACEAE Phlox family		
Eriastrum pluriflorum (Heller) H. L. Mason (Gilia brauntonii Jepson and Mason) Gilia	Uncommon	Slope, on shallow soil
Gilia capitata Dougl. Globe gilia	Uncommon	Slope
Gilia tricolor Benth. Birdseye gilia	Very common	Slope
Linanthus bicolor (Nutt.) Greene Bicolored linanthus	Common	Slope
Linanthus ciliatus (Benth.) Greene Bristly-leaved linanthus	Common	Slope
Linanthus dichotomus Benth. Eveningsnow linanthus	Uncommon	Slope, especially north
Linanthus filipes (Benth.) Greene Filiform linanthus	Common	Slope, on shallow soil
Linanthus serrulatus Greene Madera linanthus	Uncommon	Slope, especially north
Navarretia pubescens (Benth.) Hook. and Arn. Downy navarretia	Common	Slope, on shallow soil
HYDROPHYLLACEAE Phacelia family		
Nemophila aurita Lindl. Purple nemophila	Uncommon	Shaded slope
Nemophila heterophylla F. and M. Small white nemophila	Common	Shaded slope

FORBS

Botanical and common name	Occurrence	Habitat
Nemophila maculata Benth. Spotted nemophila Fivespot nemophila	Uncommon	Creekbank
Nemophila menziesii Hook. and Arn. Babyblue-eyes nemophila	Common	Lower slope
Phacelia californica Cham. California phacelia	Uncommon	Rock outcrop
Phacelia hispida Gray Caterpillar phacelia	Common	Rock outcrop
Phacelia platyloba Gray Broadlobed phacelia	Uncommon	Shaded slope
BORAGINACEAE Borage family		
Allocarya trachycarpa (Gray) Greene Rough-fruited allocarya	Common	Wet swale
Amsinckia douglasiana DC. Douglas fiddleneck	Common	Shaded slope
Amsinckia intermedia Fisch. and Mey. Fireweed fiddleneck	Common	Slope
Amsinckia retrorsa Suksd. Rigid fiddleneck Harvest fireweed	Uncommon	Slope
Cryptantha flaccida (Dougl.) Greene Cryptantha	Common	Slope
Cryptantha hooveri I. M. Johnston Hoover's cryptantha	Uncommon	Slope
Heliotropium curassavicum L. Salt heliotrope	Rare	Disturbed soil

FORBS

Botanical and common name	Occurrence	Habitat
Plagiobothrys canescens Benth. Valley popcornflower	Common	Lower slope and dry swale
Plagiobothrys nothofulvus Gray Redstain popcornflower	Very common	Slope and dry swale
Plagiobothrys tenellus Gray Slender popcornflower	Common	Slope, on shallow soil
VERBENACEAE Verbena family		
Verbena lasiostachys Link. (Verbena prostrata R. Br.) Western verbena	Uncommon	Slope
LABIATAE Mint family		
Marrubium vulgare L. Common hoarhound	Uncommon	Disturbed soil
Monardella candicans Benth. Sierra monardella	Common	Swale
Monardella lanceolata Gray Mustang mint	Uncommon	Swale
Pogogyne douglasi Benth. Douglas pogogyne	Common	Swale
Salvia carduacea Benth. Thistle sage	Common	Slope
Salvia columbariae Benth. California chia	Uncommon	Shaded slope
Scutellaria bolanderi Gray Bolander's skullcap	Uncommon	Wet swale and seeps
Scutellaria tuberosa Benth. Tuberous skullcap	Uncommon	Shaded slope

FORBS

Botanical and common name	Occurrence	Habitat
Stachys albens Gray Whitehedge nettle	Uncommon	Seeps
Trichostema lanceolatum Benth. Vinegar bluecurls	Common	Slope
Trichostema oblongum Benth. Mountain bluecurls	Uncommon	Swale
SOLANACEAE Nightshade family		
Datura meteloides DC. Sacred datura Tolguacha	Uncommon	Disturbed soil
Nicotiana attenuata Torr. Coyote tobacco	Uncommon	Disturbed soil or swale
Solanum nigrum L. Black nightshade	Rare	Lower slope
Solanum xanthi Gray Purple nightshade	Uncommon	Lower slope
SCROPHULARIACEAE Figwort family		
Antirrhinum cornutum Benth. Spurred snapdragon	Uncommon	Slope, especially south
Collinsia bartsiaefolia Benth. Seaside collinsia	Uncommon	Slope
Collinsia bicolor Benth. Pagoda collinsia Chinese houses	Common	Shaded slope
Collinsia tinctoria Hartw. Brownstain collinsia Sticky Chinese houses	Uncommon	Shaded creekbed

FORBS

Botanical and common name	Occurrence	Habitat
Cordylanthus compactus Pennell Muleweed	Uncommon	Rocky slope
Mimulus pilosus (Benth.) Wats. Downy mimulus	Uncommon	Lower slope
Mimulus bolanderi Gray Tobacco mimulus	Uncommon	Shaded slope
Mimulus floribundus Dougl. Monkeyflower	Uncommon	Wet swale
Mimulus nasutus Greene (Mimulus guttatus nasutus Jepson) Common monkeyflower	Common	Wet swale
Mimulus nanus Hook. and Arn. Dwarf monkeyflower	Uncommon	Slope
Mimulus viscidus Congdon. Viscid monkeyflower	Uncommon	Slope
Mimulus pictus (Curran) Gray Painted monkeyflower	Uncommon	Slope
Orthocarpus erianthus micranthus (Gray) Jepson Johnnytuck owlclover	Common	Slope
Orthocarpus linearilobus Benth. Pallid owlclover	Common	Slope
Orthocarpus purpurascens Benth. Escobita owlclover Common owlclover	Common	Slope
Penstemon breviflorus Lindl. Stubflower penstemon	Common	Rocky slope
Scrophularia californica Cham. and Sch. California figwort	Uncommon	Rock outcrop

FORBS

Botanical and common name	Occurrence	Habitat
Verbascum blattaria L. Moth mullein	Rare	Lower slope
PLANTAGINACEAE Plantain family		
Plantago erecta Morris Dotseed plantain	Very common	Slope
RUBIACEAE Madder family		
Galium aparine L. Catchweed bedstraw	Common	Shaded slope or swale
Galium nuttalli Gray Nuttall bedstraw	Uncommon	Shaded slope or swale
VALERIANACEAE Valerian family		
Plectritis ciliosa (Greene) Jepson Plectritis	Common	Shady lower slope or creekbank
Plectritis macrocera T. and G. Longhorn plectritis	Uncommon	Shady lower slope
CAMPANULACEAE Bellflower family		
Githopsis specularioides Nutt. Githopsis	Uncommon	Slope
LOBELIACEAE Lobelia family		
Downingia bicornuta Gray Downingia	Uncommon	Wet swale
Nemacladus rigidus interior Kunz Nemacladus	Uncommon	Lower slope or swale

FORBS

Botanical and common name	Occurrence	Habitat
COMPOSITAE Sunflower family		
Achillea lanulosa L. Western yarrow	Uncommon	Lower slope
Agoseris heterophylla (Nutt.) Greene Annual agoseris	Common	Slope
Anaphalis margaritacea (L.) B. and H. Common pearleverlasting	Uncommon	Rocky slope
Baeria chrysostoma gracilis Hall Branchy goldfields	Very common	Slope
Baeria uliginosa (Nutt.) Gray Goldfields	Uncommon	Slope
Balsamorhiza deltoidea Nutt. Balsamroot	Rare	North slope
Bidens frondosa L. Devils beggarticks	Uncommon	Lower slope
Brickellia californica T. and G. Californica brikellia	Uncommon	Rocky slope
Calycadenia mollis Gray Rosinweed	Common	Slope
Calycadenia multiglandulosa DC. Rosinweed	Common	Slope
Calycadenia villosa DC. Rosinweed	Uncommon	Slope
Centaurea melitensis L. Malta centaurea Tocalote Napa thistle	Common	Slope
Centromadia pungens (T. and G.) Greene Common spikeweed	Uncommon	Lower slope

FORBS

Botanical and common name	Occurrence	Habitat
Chaenactis glabriuscula DC. Chaenactis	Common	Slope
Cirsium occidentale (Nutt.) Jepson Western thistle	Common	Slope
Coreopsis bigelovi (Gray) Hall Bigelow coreopsis	Uncommon	Shaded slope
Coreopsis douglasi (DC.) Hall Douglas coreopsis	Uncommon	Shaded slope
Coreopsis stillmani (Gray) Jepson Stillman coreopsis	Uncommon	Shaded slope
Erigeron canadensis L. Horseweed fleabane	Uncommon	Disturbed soil
Erigeron foliosus stenophyllus (Nutt.) Gray Leafy fleabane	Uncommon	Rocky slope
Eriophyllum confertiflorum Gray Goldenyarrow eriophyllum	Common	Rocky slope
Evax caulescens Benth. Evax	Uncommon	Slope, on shallow soil
Filago gallica L. Fluffweed	Common	Slope
Gnaphalium californicum Gray California everlasting	Uncommon	Rocky slope
Gnaphalium palustre Nutt. Lowland cudweed	Uncommon	Lower slope
Grindelia camporum Greene Field gumweed	Uncommon	Slope, especially south

FORBS

Botanical and common name	Occurrence	Habitat
Hemizonia heermannii (Hemizonia virgata heermannii Jepson) Yellow tarweed	Very common	Lower slope and swale
Hemizonia kelloggii Greene (Hemizonia wrightii Gray) Wright's tarweed	Common	Rocky slope
Hypochoeris glabra L. Smooth catsear	Very common	Lower slope and dry swale
Lactuca serriola (Lactuca scariola L.) Prickly lettuce	Uncommon	Disturbed soil
Layia gaillardioides Hook. and Arn. Layia	Common	Shady slope
Layia pentachaeta hansenii (Jepson) Keck Layia Tidytips	Common	Shady slope
Lessingia germanorum vallicola Cham. Lessingia	Common	Slope
Lessingia sp. Lessingia	Common	Slope
Madia elegans densifolia Jepson Madia	Uncommon	Creekbed
Matricaria matricarioides (Less.) Porter Pineappleweed	Uncommon	Disturbed soil
Micropus californicus F. and M. Micropus	Common	Slope, on shallow soil
Pentachaeta exilis Gray Pentachaeta	Common	Slope, on shallow soil

FORBS

Botanical and common name	Occurrence	Habitat
Senecio douglasi DC. Douglas groundsel	Uncommon	Slope
Silybum marianum (L.) Gaertn. Milkthistle	Rare	Creekbank
Stephanomeria pauciflora (Torr.) Nels. Wirelettuce	Uncommon	Slope
Uropappus lindeyi Nutt. Uropappus	Uncommon	Lower slope
Xanthium canadense Mill. Cocklebur	Uncommon	Creekbed

WOODY PLANTS

Botanical and common name	Occurrence	Habitat
PINACEAE Pine family		
Pinus sabiniana Dougl. Digger pine	Very common	Slope
SALICACEAE Willow family		
Populus fremontii Wats. Fremont cottonwood	Uncommon	Creekbank
Salix laevigata Bebb. Red willow	Uncommon	Creekbank
FAGACEAE Oak family		
Quercus douglasii Hook. and Arn. Blue oak	Very common	Slope
Quercus morehus Kell. Oracle oak	Rare	Slope
Quercus wislizenii DC. Interior live oak	Very common	Slope
LORANTHACEAE Mistletoe family		
Arceuthobium campylopodum Engelm. Western dwarf mistletoe Pine mistletoe	Common	Parasitic on digger pine
Phoradendron villosum Nutt. Common mistletoe	Very common	Parasitic on blue oak and live oak
ANACARDIACEAE Sumac family		
Rhus diversiloba T. and G. Pacific poisonoak	Common	Rocky slope

WOODY PLANTS

Botanical and common name	Occurrence	Habitat
Rhus trilobata Nutt. Skunkbush sumac Squawbush	Rare	Slope
SAPINDACEAE Buckeye family		
Aesculus californica (Spach) Nutt. California buckeye	Common	Slope
RHAMNACEAE Buckthorn family		
Ceanothus cuneatus (Hook.) Nutt. Buckbrush ceanothus Wedgeleaf ceanothus	Very common	Slope, especially north
Ceanothus leucodermis Greene (Ceanothus divaricatus) Chaparral whitethorn ceanothus	Uncommon	Slope
Rhamnus californica cuspidata (Greene) Wolf California buckthorn California coffeeberry	Common	Slope
Rhamnus crocea ilicifolia Greene Hollyleaf buckthorn Redberry buckthorn	Common	Slope
ERICACEAE Heath family		
Arctostaphlos mariposa Dudley Mariposa manzanita	Common	Rocky slope
HYDROPHYLLACEAE Phacelia family		
Eriodictyon californicum (Hook. and Arn.) Greene Yerba santa	Uncommon	Slope

WOODY PLANTS

Botanical and common name	Occurrence	Habitat
RUBIACEAE Madder family		
Cephalanthus occidentalis L. Common buttonbush	Uncommon	Seep
CAPRIFOLIACEAE Honeysuckle family		
Lonicera interrupta Benth. Chaparral honeysuckle	Rare	Slope, especially north
Sambucus caerulea Raf. (Sambucus glauca Nutt.) Blueberry elder Blue elderberry	Uncommon	Rocky slope

APPENDIX II

VERTEBRATE FAUNA OF THE SAN JOAQUIN EXPERIMENTAL RANGE, CALIFORNIA: A CHECKLIST

Thomas F. Newman and Don A. Duncan

VERTEBRATE FAUNA OF THE SAN JOAQUIN EXPERIMENTAL RANGE, CALIFORNIA: a checklist

Thomas F. Newman Don A. Duncan

PACIFIC SOUTHWEST
Forest and Range Experiment Station

FOREST SERVICE
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1973. **Vertebrate fauna of the San Joaquin Experimental Range, California: a checklist.** Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. 17 p. (USDA Forest Serv. Gen. Tech. Rep. PSW-6)

This report updates an earlier checklist, published in 1955, of vertebrate fauna found on the San Joaquin Experimental Range, in Madera County, California. Nineteen new species have been recorded since 1955. This report records the occurrences of seven fish, eight amphibians, 19 reptiles, 38 mammals, and 149 birds. References to research on individual species are included.

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The Authors

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Since research began at the San Joaquin Experimental Range, Madera County, California, in the 1930's, the relationships between wildlife, vegetation, and cattle have been integral parts of the research program. In cooperation with individuals and other organizations, the Pacific Southwest Forest and Range Experiment Station has participated in and encouraged studies of many basic biological subjects. Agencies and institutions that have taken part include the U.S. Fish and Wildlife Service, California Department of Fish and Game, University of California, and California State University, Fresno. A list of the publications about research at the Experimental Range (Sanderson and Duncan 1966) is currently being revised.

The San Joaquin Experimental Range lies in the lower Sierra Nevada foothills of central California. Elevations range from 700 to 1,700 feet on the 4,500 acres. Soils (Awahnee and Visalia series) are of granitic origin, and have low capacity for storing water. Winters are mild and moist; summers are hot and dry. Rainfall averages about 19 inches, with extremes of about 10 and 32 inches. The Experimental Range is in the annual plant-oak woodland type, and includes grassland, savanna, and occasionally dense stands of trees and brush.

The zoologically oriented studies on the Experimental Range have dealt chiefly with life histories of major rodent species, their impact on range forage, food habits and management of quail, and food habits of predators. Most recorded occurrences of birds are the result of occasional observations by scientists and technicians--not from formal studies.

This report updates an earlier checklist of vertebrate fauna of the Experimental Range (Childs and Howard 1955), and provides additional information. It lists all species recorded since 1955. That earlier list is now out of print. Specimens of most species are in a collection at the Experimental Range. Only species seen within the Range boundary are included in this updated list.

Scientific names used are in accordance with these sources: fish--Kimsey and Fisk (1960); amphibians and reptiles--Stebbins (1966); mammals--Ingles (1965); birds--American Ornithologists Union (1957) and Grinnell and Miller (1944).

FISH (7)

The occurrence of fish at the Experimental Range depends on introduction into artificial ponds. Two dry years (1971-72) in a row caused the one reservoir with a fish population to become dry. In January 1973, no fish populations occurred on the Range except mosquito fish in a few large concrete water troughs. In early 1973, large-mouth bass, bluegill, Sacramento perch, and mosquito fish were stocked in an experiment designed to provide baseline fish production data from foothill ranch ponds.

Checklist of Fish

Mosquito fish	*(Gambusia affinis)*
Large-mouth bass	*(Micropterus salmoides)*
Hitch	*(Lavinia exilicauda)*
Green Sunfish	*(Lepomis cyanellus)*
Bluegill	*(Lepomis macrochirus)*
Red-ear Sunfish	*(Lepomis microlophus)*[1]
Sacramento perch	*(Archoplites interruptus)*[1]

AMBHIBIANS (8)

The semi-arid conditions in the foothill belt of California are not suitable for a large or varied amphibian population. One introduced species, the bullfrog, is found in reservoirs. Two Anurans, the Pacific tree frog and the Western spadefoot toad, are the most abundant members of this group (Cohen and Wood 1953).

[1] New species recorded since 1955.

Checklist of Amphibians

California newt	Western toad
Tiger salamander	Pacific tree frog
Slender salamander	Red-legged frog
Western spadefoot toad	Bullfrog

California newt *(Taricha torosus sierrae).* Rare.

Kenneth A. Wagnon recalls observing the California newt occasionally in the 1930's. Although no newts were seen in 1950-51, two specimens were taken in spring 1952. Several were seen in spring 1963 by Don A. Duncan.

Tiger salamander
(Ambystoma tigrinum californiense). Rare.

Found in limited numbers near the dams in the headquarters area. On February 22, 1952, eggs were found where the horse pasture dam used to be. Several albino larvae were taken in 1950-51. One found by William H. Kruse in headquarters area July 10, 1963. One or two seen most years by Don A. Duncan since 1963.

Slender salamander
(Batrachoseps a. attenuatus). Uncommon.

Found under rocks and logs in the wet season.

Western spadefoot toad
(Scaphiophus h. hammondi). Abundant.

The spadefoot breeds in vernal pools and intermittent streams in varying numbers depending on weather conditions in early spring. Singing begins in late January with most egg production in March. Albino larvae are occasionally found. Reference: Childs (1953).

Western toad
(Bufo boreas halophilus). Common.

These toads may be found foraging at night. Eggs were found on February 22, 1952, where the horse pasture dam used to be.

Pacific tree frog *(Hyla regilla).* Rare.

Found in wet areas throughout the year where it breeds in streams and vernal pools.

Red-legged frog *(Rana aurora draytoni).* Rare.

One was observed in October 1951. The yellow-legged frog *(Rana boylii)* has not been observed at the Range, although both of these species are present at O'Neals, 3 miles away.

Bullfrog *(Rana catesbeiana).* Common.

Formerly abundant before the destruction of the horse pasture dam in 1951. References: Cohen and Howard (1958), Howard (1950).

REPTILES (19)

Reptiles appear well suited to the climate of the Experimental Range as indicated by their numbers and diversity of kinds. Three lizards—Gilbert skink, whiptail lizard, Western fence lizard—and two snakes —Pacific gopher snake and Pacific rattlesnake—are the most abundant species.

Checklist of Reptiles

Lizards (6)	*Snakes (12)*
Western fence lizard	Western ring-necked snake
Side-blotched lizard	Western yellow-bellied racer
Pacific Coast	California striped whipsnake
horned lizard	Pacific gopher snake
Gilbert skink	King snake
Whiptail lizard	Mountain king snake[1]
Southern alligator	Long-nosed snake
lizard	Sierra Nevada garter snake
	Giant garter snake[1]
Turtles (1)	Red-sided garter snake
	California spotted night snake
Pacific mud turtle	Pacific rattlesnake

Lizards (6)

Western fence lizard
(Sceloporus o. occidentalis). Abundant.

The first lizard to become active in the spring, generally on warm days in February or March. Found around buildings, rock outcrops, and trees.

Side-blotched lizard
(Uta stansburiana hesperis). Common.

Found in sandy areas where escape burrows are present.

Pacific Coast horned lizard
(Phynosoma coronatum frontale). Rare.

Observed in the later 1930's, but only one has been recorded in recent years (1966).

Gilbert skink
(Eumeces g. gilberti). Abundant.

This species and the whiptail lizard are taken abun-

[1]New species recorded since 1955.

dantly in drift traps. The skink appears to be active only from April to June in dense vegetation.

Whiptail lizard
(Cnemidophorus tigris mundus). Abundant.

Found in sparse vegetation and along roads; active during the entire summer.

Southern alligator lizard
(Gerrhonotus multicarinatus webbii). Rare.

Only a few have been recorded in the headquarters area. One collected May 28, 1961 by Jack N. Reppert on patio of guest rooms. One found at northern edge of Experimental Range by Don A. Duncan, May 2 1973.

Turtles (1)

Pacific mud turtle
(Clemmys marmorata). Uncommon.

Presence of the reservoir allows a few introduced individuals to reproduce themselves.

Snakes (12)

Western ring-necked snake
(Diadophis amabilis pulchellus). Rare.

A few have been recorded along the swale in headquarters area. One collected February 20, 1961 under rocks in Range Unit 5-1 by Don A. Duncan. One seen in Range Unit 9 in 1962 by Stanley L. Anderson.

Western yellow-bellied racer
(Coluber constrictor mormon). Uncommon.

Taken occasionally in the drift traps in headquarters area.

California striped whipsnake
(Coluber lateralis). Common.

Widespread on the Range.

Pacific gopher snake
(Pituophis c. catenifer). Abundant.

Widely distributed over the Experimental Range, perhaps more abundant than the rattlesnake (Howard 1949).

King snake
(Lampropeltis getulus californiae). Common.

Found in small numbers on the Experimental Range. One found ingesting a rattlesnake and photographed by Stanley E. Westfall in 1972.

Mountain king snake
(Lampropeltis zonata).[1] Rare.

One found dead on road in 1965 by Don A. Duncan; live specimen found in Range Unit 5-3 in April 1967 by Duncan.

Long-nosed snake
(Rhinocheilus l. lecontei). Rare.

Drift trap records indicate a greater abundance of this snake than was once believed.

Sierra Nevada garter snake
(Thamnophis elegans couchii). Common.

Found along streams (Fitch 1941).

Giant garter snake
(Thamnophis elegans gigas).[1] Rare.

First seen March 1972, in pond in Range Unit 9. Specimen captured, identified, and released May 21, 1972 by Don A. Duncan. Thomas F. Newman observed one attempting to swallow a 5-inch bluegill at the reservoir in Range Unit 9 on July 2, 1972. Listed as a "Rare" species in California (Leach and Fisk 1972).

Red-sided garter snake
(Thamnophis sirtalis tetrataenia). Common.

Limited to moist areas.

California spotted night snake
(Hypsiglena torquata nuchalata). Rare.

Recorded in rock outcrops in walls of wells.

Pacific rattlesnake
(Crotalus viridis oreganus). Abundant.

A thorough study of the habits of this species has been made. A population of one per acre is estimated (Fitch 1949; Fitch and Glading 1947; Fitch and Twining 1946; Fitch and Wagnon 1947).

MAMMALS (38)

Most of the mammalian investigations have concerned rodents because these animals occur in great numbers and also because their undesirable effects on forage production become of economic significance.

Checklist of Mammals

Virginia oppossum	Adorned shrew
Broad-footed mole	Yuma myotis

[1] New species recorded since 1955.

California myotis	Botta pocket gopher
Western pipistrelle	San Joaquin Pocket mouse
Red bat	California pocket mouse
Pallid bat	Heermann kangaroo rat
Mexican free-tailed bat	Muskrat[1]
Raccoon	Southern grasshopper mouse
Long-tailed weasel	Western harvest mouse
Spotted skunk	Deer mouse
Striped skunk	Brush mouse
Badger	Pinon mouse
Gray fox	Dusky-footed wood rat
Coyote	California meadow mouse
Mountain lion	House mouse
Bobcat	Yellow-haired porcupine
Beechey ground squirrel	Black-tailed hare
Merriam chipmunk	Audubon cottontail
Gray squirrel	Mule Deer

Virginia opossum
(Didelphis v. virginiana). Common.

One was recorded in an owl pellet (Fitch 1947b). First live animal reported by Donald L. Neal, December 1, 1957. Second live record by Jack N. Reppert, June 10, 1958. Several live animals were reported seen during the 1960's and the early 1970's.

Broad-footed mole
(Scapanus l. latimanus). Rare.

Two specimens were taken in gardens at headquarters in March 1953. Don A. Duncan reports moles are fairly common in the headquarters area; burrows are apparent, but animal not often seen.

Adorned shrew *(Sorex o. ornatus).* Rare.

One was caught in a drift trap on April 1, 1951. The specimen is located at the University of California Museum of Vertebrate Zoology, Berkeley.

Yuma myotis
(Myotis yumanensis sociabilis). Common.

Found at night in barns and around adobe buildings.

California myotis
(Myotis c. californicus). Common.

Habits are the same as the Yuma myotis.

[1] New species recorded since 1955.

Western pipistrelle
(Pipistrellus hesperus merriami). Common.

This early evening flyer was first collected in June 1950.

Red bat *(Lasiurus borealis teliotis).* Rare.

Recorded only in an owl pellet by Fitch (1947b).

Pallid bat
(Antrozous pallidus pacificus). Abundant.

Not recorded on the Range by J. T. Wright in 1937, but the pallid bat is now an abundant night roosting bat in the barns and adobe buildings. Jay C. Quast observed them flying out of holes in a blue oak at dusk during summer 1949. Studies on this species have been conducted by Sherman F. Wood and Henry E. Childs, Jr.

Mexican free-tailed bat
(Tadarida mexicana). Common.

Only a few records in early spring have been obtained while they were night roosting with the pallid bat.

Raccoon *(Procyon lotor psora).* Common.

Widespread over the Range along swales.

Long-tailed weasel
(Mustella frenata xanthogenys). Rare.

One was captured in the drift traps on May 6, 1950.

Spotted skunk
(Spilogale gracilis phenax). Rare.

Two, both road kills, found in 1951-52.

Striped skunk
(Mephitis mephitis occidentalis). Uncommon.

A few individuals have been trapped or seen.

Badger *(Taxidea taxus neglecta).* Common.

Although badgers are not often seen—even at night—their diggings indicate they are present.

Gray fox
(Urocyon cinereoargenteus townsendi). Rare.

Few foxes have been seen in recent years. Childs and Howard (1955) listed this species as common, but only three separate sightings were reported in 1971 and 1972. On January 28, 1973, Thomas F. Newman saw an individual near the stone bridge on the entrance road.

Coyote *(Canis latrans).* Common.

No control effort has been made since 1960. Coyotes have been commonly seen and heard in recent years. No cattle have ever been reported killed by coyotes. Calves dying from other causes have been scavenged by coyotes. Fitch (1948b) reported on the coyote at the Experimental Range.

Mountain lion
(Felis concolor californica). Rare.

Several sight records have been made since 1934. A few deer kills have been made on the Experimental Range by mountain lions.

Bobcat *(Lynx rufus californicus).* Common.

Frequently sighted now. No control effort has been made since 1960. Population is thought to be increasing. No cattle losses from bobcats have ever been reported.

Beechey ground squirrel
(Spermophilus beecheyi fisheri). Abundant.

This species is very important ecologically and economically to foothill rangelands. Many investigators have studied the life history of this animal, including Fitch 1947c, 1948c; Fitch and Bentley 1949; Horn and Fitch 1946; Howard 1951, 1959; Howard and Wagnon 1951; Howard, Wagnon, and Bentley 1959. The movements, population dynamics, and food habits of these squirrels and their relationship to cattle grazing are being studied in cooperation with the U.S. Fish and Wildlife Service. No control measures have been applied since 1962.

Merriam chipmunk
(Eutamias m. merriami). Uncommon.

This species seems restricted to rock outcrops where brush or fallen trees are found. J. T. Wright indicates that it may have been more abundant in former years. Seems to be rather common in suitable habitat. Frank Schitoskey (pers. commun.) reports that now (1973) chipmunks are more common than the San Joaquin pocket mouse.

Gray squirrel *(Sciurus g. griseus).* Uncommon.

The gray squirrel is found in association with digger pines. It is probably exposed to greater predation here than in most parts of its range because of the necessity of moving from tree to tree on the ground.

Botta pocket gopher
(Thomomys bottae mewa). Abundant.

Howard and Childs (1955) reported that: "This species perhaps surpasses the ground squirrel for the title of the most destructive rodent on rangelands, because they occur in much greater numbers. It was found that 32 per acre reduced forage by 25 percent. . . . An aboveground dispersal has been demonstrated by the drift trap study." Others who have reported on the species are Howard (1952a, 1952b, 1953), Howard and Childs (1959), Morejohn and Howard (1956), and Ratliff and Westfall (1971). Movements and food habits are being studied in cooperation with the U.S. Fish and Wildlife Service.

San Joaquin pocket mouse
(Perognathus i. inornatus). Common.

Appears to be common where vegetation is sparse.

California pocket mouse
(Perognathus californicus ochrus). Uncommon.

Only irregularly taken.

Heermann kangaroo rat
(Dipodomys heermanni tularensis). Common.

At one time very abundant. A change from "perhaps 30 per acre to only one," during the period 1935 through 1946 was reported (Fitch 1948). Frank Schitoskey reported this species is even less abundant than one per acre from study results in 1972-73.

Muskrat *(Ondatra zibethica).*[1] Rare.

Three were seen on the reservoir in Range Unit 9 during 1971. Two were killed September 10, 1971; a dead muskrat was seen at the reservoir on July 2, 1972. One live one seen July 8, 1972.

Southern grasshopper mouse
(Onychomys torridus tularensis). Rare.

Reported only in association with *Lotus scoparius* in the big canyon below headquarters. An attempt to find them in this area in the summer of 1952 was unsuccessful.

Western harvest mouse
(Reithrodontomys megalotis longicaudus).
Uncommon.

Found in the swale areas in ungrazed pastures.

Deer mouse
(Peromyscus maniculatus gambeli). Abundant.

The deer mouse is found in open grazed pastures away from rocks or brush.

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[1] New species recorded since 1955.

Brush mouse *(Peromyscus b. boylei).* Abundant.
Found generally in rock outcrops (Howard 1957).

Pinon mouse
(Peromyscus truei gilberti). Abundant.

This species is most abundant in ungrazed brush. The relative abundance of the three species of *Peromyscus* may be interpreted from the following summary of total catch in standardized trap lines in two grazed pastures and in the ungrazed natural area during October 1951, April and October 1952, and April 1953. The numbers caught were: *P. boylei,* 43; *P. Truei,* 20; *P. maniculatus,* 11; *Peroganthus inornatus,* 6; *Dipodomys,* 5; *Neotoma,* 2; *Riethrodontomys,* 1; *Eutamias,* 1; Total 89.

Dusky-footed wood rat
(Neotoma fuscipes streatori). Common.

The wood rat is widely found in brush and rock outcrops.

California meadow mouse
(Microtus californicus mariposae). Uncommon.

The meadow mouse is restricted to ungrazed areas where it may become abundant. A cyclic peak in abundance was observed in 1951. In 1972 and 1973 Frank Schitoskey reported no captures of this species with intense trapping effort in suitable habitat.

House mouse *(Mus musculus).* Rare.
Only an occasional individual was taken in the headquarters area.

Yellow-haired porcupine
(Erethizon dorsatum). Rare.

One was reported some years ago by Kenneth A. Wagnon and one was found dead on the entrance road in June, 1953. No live specimens reported from 1960 through 1972.

Black-tailed hare
(Lepus c. californicus). Uncommon.
Occasional individuals or family groups are seen.

Audubon cottontail
(Sylvilagus audubonii vallicola). Abundant.

It is widely distributed over the Experimental Range, often seen in numbers in the evenings during summer on lawns around headquarters (Fitch 1947a; Herman and Jankiewiez 1942).

Mule deer *(Odocoileus hemionus).* Common.

Apparently deer have greatly increased in numbers since 1934. Horn and Fitch (1942) fail to mention deer as occurring on the Experimental Range. Childs and Howard (1955) estimated the resident population at about a dozen animals, with no apparent migrants. Deer continued to increase during the 1960's until the population is now probably in excess of 100 animals.

BIRDS (149)

Much has been written of the avifauna of California. Yet works restricted to the upper Sonoran zone, and to particular localities in it, are rare. The following accounts picture the bird populations in the foothill areas of the central part of the State as shown by the records made at the San Joaquin Experimental Range. The following definitions of status are used:

Permanent resident—a nesting bird found throughout the year.

Summer resident—a nesting bird found only during the nesting season.

Winter resident—a non-nesting species found only in winter.

Migrant—a non-nesting species found in the fall and/or spring, but rare or absent at other times.

Vagrant—a bird that has drifted from normal migration routes or its usual seasonal life zone; may also be a pioneer.

Casual—a species that is markedly irregular in occurrence from one year to another.

Residents are classed according to relative abundance: 1 (most abundant), 2, and 3 (least abundant).

For detailed accounts of the distribution of the birds recorded, see Grinnell and Miller (1944). Where species status has been determined from specimens, this has been added to the scientific name; the common name of the species has been used in every instance.

Checklist of Birds

The following three lists include only the nesting species and winter residents. The migrants, casuals, and vagrants appear in the annotated list. The status of some birds is tentative; further observations are needed to clarify their status.

Permanent Residents (38)

Wood duck[1]	Sparrow hawk
Cooper's hawk	California quail
Red-tailed hawk	Killdeer

[1] New species recorded since 1955.

Mourning dove
Roadrunner
Barn owl
Screech owl
Great horned owl
Anna's hummingbird
Red-shafted flicker
Acorn woodpecker
Downy woodpecker
Nuttall's woodpecker
Black phoebe
Scrub jay
Common raven
Plain titmouse
Common bushtit
White-breasted nuthatch
Brown creeper
Wrentit
Bewick's wren
Canyon wren
California thrasher
Western bluebird
Loggerhead shrike
Starling[1]
House sparrow
Western meadowlark
Brewer's blackbird
House finch
Lawrence's goldfinch
Brown towhee
Lark sparrow
Rufous-crowned sparrow

Summer Residents (14)

Turkey vulture
Western kingbird
Ash-throated flycatcher
Western wood pewee
Violet green swallow
Barn Swallow
Cliff swallow
House wren
Blue-gray gnatcatcher
Phainopepla
Red-winged blackbird
Bullock's oriole
Brown-headed cowbird
Black-headed grosbeak

Winter Residents (15)

Sharp-shinned hawk
Lewis' woodpecker
Yellow-bellied sapsucker
Say's phoebe
Rock wren
Mockingbird
Robin
Ruby-crowned kinglet
Audubon's warbler
Purple finch
Rufous-sided towhee
Oregon junco
Gambel white-crowned sparrow
Golden-crowned sparrow
Lincoln's sparrow

Eared grebe
(Podiceps caspicus).[1] Casual winter visitant.

One seen on reservoir in Range Unit 9 on October 8, 1958 by Robert F. Buttery.

Pied-billed grebe
(Podilymbus podiceps). Casual winter visitant.

Between September 29, 1951 and March 21, 1952, individuals were observed on six occasions on the reservoir; however, none were seen the following year.

[1]New species recorded since 1955.

White pelican
(Pelecanus erythrorhynchos). Rare migrant.

A flock of 40 was observed in flight March 30, 1953.

Great blue heron
(Ardea herodias). Summer visitant.

Can be seen at reservoirs fairly often.

Green heron *(Butorides virescens).*[1] Casual.

Seen at reservoir on April 18, 1957 and May 18, 1958 by Robert F. Buttery.

Common egret
(Casmerodius albus). Casual summer visitant.

Formerly found at the horse pasture dam during the summer, but has not been recorded since September 1951.

Black-crowned night heron
(Nycticorax nycticorax). Casual.

One was heard calling in flight at night October 7, 1952.

Least bittern *(Ixobrychus exilis).* Casual.

One female was trapped alive in a drift trap along the swale at headquarters April 16, 1950, and released.

Canada goose *(Branta canadensis).*
Winter migrant.

Flocks have been seen in December and January in flight perhaps either to or from Lake Millerton, 6 miles away. Occasionally flocks have been seen feeding on new grass in open areas.

White-fronted goose
(Anser albifrons). Casual winter migrant.

A flight of 35 was recorded on December 7, 1951.

Snow goose
(Chen hyperborea).[1] Casual winter migrant.

A flock of 25 reported December 12, 1967 by Don A. Duncan.

Mallard
(Anas platyrhrynchos).
Sporadic resident–winter migrant.

Mallards formerly bred in the region of the horse pasture dam. Pairs were seen regularly in vernal pools in spring. A male collected March 5, 1953 had been feeding on caddis fly larvae. Sometimes a pair will nest along intermittent streams–seldom successfully.

Green-winged teal
(Anas carolinensis).[1] Casual winter migrant.

Recorded on the pond in Range Unit 9 on December 5, 1972 by Don A. Duncan.

Cinnamon teal
(Anas cyanoptera).[1] Casual winter migrant.

Several seen February 1965 on pond in Range Unit 9. Occasional birds seen on reservoir in Range Unit 9 during winters of 1970-72.

Blue-winged teal
(Anas discors). Vagrant.

A group was reported at the horse pasture dam March 8, 1937 by Ben Glading.

American widgeon
(Mareca americana).[1] Casual winter migrant.

Seen occasionally on reservoir during winters of 1970-72.

Wood duck
(Aix sponsa).[1] Permanent resident–1.

A pair nested at reservoir in Range Unit 9 during the spring of 1971. A brood was successfully hatched. Occasional birds seen at the reservoir during the year.

Gadwall
(Anas strepera).[1] Casual winter migrant.

Occasionally seen on reservoir in Range Unit 9 during winter of 1970-71.

Redhead
(Aythya americana). Casual winter migrant.

Five or six were seen on reservoir by Jay R. Bentley.

Ring-necked duck
(Aythya collaris). Casual winter migrant.

Six individuals were seen in March 1952. They were absent, as were nearly all ducks, the following season.

Greater scaup
(Aythya marila). Casual winter migrant.

A flock of 20 was seen on February 24, 1952.

Ruddy duck
(Oxyura jamaicensis). Casual.

One male was collected June 4, 1937.

[1] New species recorded since 1955.

Hooded merganser
(Lophodytes cucullatus). Casual winter migrant.

Three individuals were noted in February and March 1952. Several seen on ponds in 1960's.

Common merganser
(Mergus merganser). Casual winter migrant.

One flock of five was recorded February 5, 1952.

Turkey vulture
(Cathartes aura teter). Summer resident–1.

A nest was found in a rock outcrop May 22, 1951. Migrating flocks of more than 500 birds have roosted overnight in digger pines during September or October.

California condor
(Gymnogyps californianus). Casual.

A flock of six to nine individuals was seen August 30, 1950 (Cohen 1951). None has been seen since.

Sharp-shinned hawk
(Accipiter straitus). Winter resident–3.

This hawk was recorded between September 12 and April 4.

Cooper's hawk
(Accipiter cooperii). Permanent resident–3.

Habits of this species on the Experimental Range were studied by Fitch, Glading, and House (1946).

Red-tailed hawk *(Buteo jaimaicensis calurus).* Permanent resident–1.

This species is the most abundant raptor occurring on the Experimental Range. Its habits were reported in detail by Fitch, Swenson, and Tillotson (1946).

Rough-legged hawk
(Buteo lagopus s. johannis). Casual.

One was recorded on September 26, 1951, and another on March 20, 1952.

Golden eagle
(Aquila chrysaetos). Casual.

Fitch, Swenson, and Tillotson (1946) recorded it as frequent in the area. Don A. Duncan reported seeing a few each year during the 1960's. Several were sighted in 1971 and 1972. One was observed on April 12, 1973. And one was observed flying over Range Units 3-3 and 6-3 on April 20, 1973 by Frank Starkey and Thomas F. Newman.

Bald eagle
(Haliaeetus leucocephalus). Sporadic.

Recorded once by Fitch, Swenson, and Tillotson (1946). One was recorded during a snowstorm on January 27, 1957 by Robert F. Buttery. One was observed by Don A. Duncan December 27, 1970 in Range Unit 4-2. A mature individual was seen in Range Unit 10 by Duncan, Frank Starkey, and Thomas F. Newman on December 28, 1972.

Marsh hawk *(Circus cyaneus).* Casual.

One was recorded November 28, 1950. Don A. Duncan observed one in 1970 and one on April 24, 1971. Most sightings occur where bluffs meet the open valley.

Osprey *(Pandion haliaetus).*[1] Casual.

Don A. Duncan reports that a pair stayed at a neighbor's pond for several months in spring 1968. They flew over the Experimental Range occasionally. One was found dead, probably shot, under a snag in the lake.

Prairie falcon
(Falco mexicanus). Casual.

Seen October 6, 1951. Two were seen at the corrals April 21, 1972. Arlene Wilkinson[2] recorded one on December 28, 1953.

Sparrow hawk
(Falco sparverius). Permanent resident–3.

J. T. Wright found a nest in a digger pine in 1937; another nest was found in a telephone pole March 28, 1953. Childs (1952) reports the taking of a kangaroo rat by a sparrow hawk.

California quail
(Lophortyx c. californicus).
Permanent resident–1.

This bird is the most abundant avian resident, nesting from May to mid-August. Much of the work serving as the basis for quail management in California was done by Ben Glading and others at the Experimental Range (Duncan 1968, 1971; Duncan and Shields 1966; Emlen and Glading 1938; Glading 1938a, 1938b, 1941; Glading, Biswell, and Smith 1940; Glading and Saarni 1944; Herman and Chattin 1943; Herman and Glading 1942; Herman, Jankieweiz, and Saarni 1942; Philpot, Howard, and Graham 1948; Shields and Duncan 1966). Much research has been done from 1960 to date on food habits and reproductive success. A cooperative study with California Department of Fish and Game and the University of California, Berkeley, was begun in 1971.

Chukar *(Alectoris graeca).*[1] Vagrant.

One seen in May 1972 by Don A. Duncan; probably a release from a neighboring ranch.

Turkey *(Maleagris gallopavo).*[1] Vagrant.

One was seen on April 19, 1972 in Range Unit 3-1 by Thomas F. Newman and Don A. Duncan. A single bird was seen on May 6, 1972 in Range Unit 3-2 by Duncan. The California Department of Fish and Game released wild turkey in the Raymond area about 6 miles away.

Peafowl *(Pavo cristatus).*[1] Vagrant.

Two adult females were seen July 7, 1971 by Stanley L. Anderson and Don A. Duncan.

Virginia rail *(Rallus limicola).* Casual.

One specimen has been taken.

American coot *(Fulica americana).* Casual.

Recorded in an owl pellet (Fitch 1947b). Seen occasionally on ponds during 1970-71.

Killdeer
(Charadrius vociferus). Permanent resident–2.

Nests of this species were found with four eggs in each on February 28, April 3, May 29, and June 1, 1952.

Common snipe
(Capella gallinago). Casual migrant.

One individual was observed twice in late March 1953.

Dunlin *(Erolia alpina).* Casual.

Observed by J. T. Wright in April 1937.

Band-tailed pigeon
(Columba fasciata). Sporadic winter visitant.

The numbers of this species were high in 1951. During 1952 and 1953 only an occasional flock was recorded in February and March. Abundant in some years when acorns are plentiful, such as winter of 1972-73.

[1] New species recorded since 1955.

[2] Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Mourning dove
(Zenaidura macroura). Permanent resident–1.

Very abundant in the fall when there is a good crop of turkey mullein *(Eromocarpus setigerus).* Ranch pond construction has greatly increased the use of foothill areas by doves.

Road-runner
(Geococcyx californianus). Permanent resident–3.

A covey of quail was seen "mobbing" one of these unusual birds July 31, 1952. Population has been down, but is apparently starting to recover. Thomas F. Newman and Stanley E. Westfall observed a road-runner drinking at a water trough in Range Unit 5-1 on August 31, 1972 and several were seen in the fall of 1972. One was seen January 5, 1973 in Range Unit 3-2 by Thomas F. Newman.

Barn owl
(Tyto alba pratincola). Permanent resident–3.

This ground feeding species, although not common, takes many pocket gophers for food.

Screech owl
(Otus asio quercinus). Permanent resident–2.

Heard frequently in the blue oaks on the Range.

Great horned owl
(Bubo virginianus pacificus).
Permanent resident–1.

A detailed account of the horned owl is provided by Fitch (1940, 1947b) and Howard (1958).

Pygmy owl
(Glaucidium gnoma).[1] Status undetermined.

Thomas F. Newman found one dead in a water trough November 8, 1971.

Long-eared owl
(Asio otus). Status undetermined.

A specimen was taken March 4, 1937.

Poorwill
(Phalaenoptilus nuttallii). Vagrant.

One was reported calling by Jay C. Quast in August 1949.

Common nighthawk
(Chordeiles minor). Casual.

Recorded in April, May, and October in small numbers.

Black swift *(Cypseloides niger).* Vagrant.

One reported May 9, 1961 by Robert F. Buttery.

[1] New species recorded since 1955.

Anna's hummingbird
(Calypte anna). Permanent resident–3.

Observed January 20, 1957 and all winter of 1957; January 3, 1958 by Robert F. Buttery. Arlene Wilkinson[2] reported them present during March, April, and May during 1953. Present in small numbers year-round.

Rufous hummingbird
(Selasphorus rufus). Migrant.

Two have been recorded: April 1952 and March 1953.

Allen's hummingbird
(Salasphorus sasin). Migrant.

Several were seen in March 1953 and on March 23, 1959 by Robert F. Buttery.

Belted kingfisher *(Megaceryle alcyon).*
Resident-breeding status uncertain.

An occasional bird is seen at the reservoir.

Red-shafted flicker *(Colaptes cafer collaris).*
Permanent resident–2.

Resident birds are uncommon, but the red-shafted flicker is often seen in winter.

Acorn woodpecker *(Melanerpes formicivora bairdi).* Permanent resident–1.

Very abundant and frequently observed. Acorn storing habits often damage buildings, power poles, and fence posts.

Lewis' woodpecker
(Asyndesmus lewis). Winter resident.

Often present during winter, but was not recorded in the 1952-53 season, although abundant a few hundred feet below the Experimental Range. Robert F. Buttery reports they were fairly common on the lower part of the range before digger pines were felled prior to a controlled burn. Don A. Duncan reports that the abundance increased during the 1960's, and a population stayed the fall and winter of 1970-71. In 1965 hundreds could be seen on a drive on Experimental Range roads.

Yellow-bellied sapsucker *(Sphyrapicus varius daggetti).* Winter residents–2.

The sapsucker arrives as early as September 6 and it remains until late April.

[2] Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Downy woodpecker
(Dendrocopos pubescens). Permanent resident–3.

Two have been recorded: July 26, 1952 and January 15, 1953.

Nuttall's woodpecker
(Dendrocopos nuttallii). Permanent resident–2.

A notably territorial species frequently seen in blue oaks and digger pines.

Western kingbird
(Tyrannus verticalis). Summer resident–1.

The kingbird arrives in late March and departs in September.

Ash-throated flycatcher
(Myiarchus c. cinerascens). Summer resident–1.

Found between mid-April and mid-September in small numbers.

Black phoebe *(Sayornis nigricans semiatra).*
Permanent resident–3.

Nests in culverts around headquarters and in Pasture 1.

Say's phoebe *(Sayornis s. saya).*
Winter resident–2.

The Say's phoebe arrives in mid-September and leaves in mid-March. It roosts commonly during the winter in protected places around the headquarters building, where 10 were banded.

Hammond's flycatcher
(Empidonax hammondii). Migrant.

Specimens were taken April 15, 19, and 28, 1937.

Gray flycatcher
(Empidonax wrightii). Migrant.

Specimens were taken April 19 and 21, 1937. Observations of Empidonax flycatchers since 1951 have been few, and the birds remain quiet, making specific identification impossible.

Western wood pewee
(Contopus sordidulus). Summer resident–2.

Resident status has not been fully determined. Arlene Wilkinson[2] reported sighting a few during December 1953.

[2]Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Olive-sided flycatcher
(Nuttallornis borealis). Migrant.

A few have been seen during April and May.

Horned lark *(Eremophila alpestris).* Casual.

Recorded once in a drift trap.

Violet-green swallow *(Tachycineta thalassina lepida).* Summer resident–1.

This swallow arrives around March 1 and leaves by early October. It nests in woodpecker holes in blue oaks and digger pines.

Tree swallow *(Iridoprocene bicolor).* Migrant.

J. T. Wright considered tree swallows to be resident in 1937. None has been observed since 1951.

Rough-winged swallow
(Stelgidopteryx ruficollis). Casual.

One was observed April 26, 1953.

Barn swallow *(Hirundo rustica erythrogaster).*
Summer resident–3.

A nest was found in a culvert under the main road July 5, 1952.

Cliff swallow *(Pentrochelidon albifrons).*
Summer resident–3.

One was observed May 13, 1953. A pair successfully nested in a tile vent of headquarters building in May 1958. Also observed May 11, 1961 by Robert F. Buttery.

Purple martin *(Progne subis).* Casual.

A flock was recorded on May 22, 1948.

Steller's jay *(Cyanocitta stelleri).*[1]
Sporadic winter visitant.

One seen for two days in the winter of 1966 by Don A.Duncan. One seen October 29, 1972 by Frank S. Starkey. One seen December 2, 1972 by Thomas F. Newman and Don A. Duncan. Three seen December 3, 1972 by Duncan in Range Unit 9. Multiple sightings during December 1972 in Range Units 2, 9, and 10. Last recorded sighting of these overwintering birds was on April 20, 1973 by Bill Webb and Thomas F. Newman in Range Unit 9.

Scrub jay *(Alphelocoma coerulescens superciliosa).* Permanent resident–1.

These birds are perhaps the most commonly seen

[1]New species recorded since 1955.

birds on the Experimental Range. Young birds have been found in the nest as early as March 31, in 1952. Arlene Wilkinson[2] has described the nesting activity of scrub jays.

Common raven *(Corvus corax).*
Permanent resident–2.

First two sightings were on April 21, 1952 and April 1, 1953. Pairs and singles have been seen on many occasions 1965 to 1972.

Clark's nutcracker
(Nucifraga columbians). Casual.

One observed during the period September 15 to October 28, 1950. Conditions in the high country brought many unusual records of this species over California during that year.

Plain titmouse *(Parus i. inornatus).*
Permanent resident–1.

The titmouse is a common species in blue oaks, but it is rarely heard calling after nesting starts in March.

Common bushtit *(Psaltriparus minimus californicus).* Permanent resident–1.

Most commonly seen in association with evergreen plant species such as Ceanothus and live oaks.

White-breasted nuthatch *(Sitta carolinesis aculeata).* Permanent resident–2.

This bird has essentially the same ecological requirements as the titmouse.

Brown creeper *(Certhia familiaris zelotes).*
Permanent resident–3.

Several have been recorded: November 30, 1951; January 15, and February 5, 1952; December 5 to April 18, 1953.

Wrentit *(Chamaea fasciata henshawi).*
Permanent resident–3.

Nesting status uncertain. A specimen was collected March 31, 1937.

House wren *(Troglodytes aedon parkmanii).*
Summer resident–3.

Presence of a few house wrens in May and June in suitable breeding area suggests that breeding does occur.

[2]Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Bewick's wren *(Thryomanes bewickii drymoecus).* Permanent resident–2.

Regularly found in the brush areas of the Range.

Canyon wren *(Catherpes mexicanus conspersus).* Permanent resident–2.

Found commonly in the rocky canyons.

Rock wren *(Salpinctes o. obsoletus).*
Winter resident–2.

Seen occasionally in winter.

Mockingbird *(Mimus polyglattos leucopterus).*
Winter resident–3.

About 10 individuals were present around headquarters during the period October 1952 to March 1953, but the mockingbird is rare over most of the Experimental Range. The numbers around headquarters have declined.

California thrasher
(Toxostoma r. redivivum).
Permanent residents–2.

This secretive species is heard singing commonly in February and March in brushy areas. One observed October 20, 1964 by Crystal A. Burns and Juanita Anderson. Arlene Wilkinson[2] reported one on February 15, 1953.

Robin *(Turdus migratorius propinquus).*
Winter resident–2.

Generally arrives in late December and leaves in early April, but the actual dates may be 1 to 2 months earlier or later.

Varied thrush *(Ixoreus naevius).*
Sporadic winter visitant.

One was recorded December 31, 1951. Many seen during December 1972 by Don A. Duncan and Thomas F. Newman.

Hermit thrush
(Hylocichla guttata). Migrant.

Seen between January 22 and April 18, 1952, but was not present the following year. Seen February 10, 1957 and January 19, 1958 by Robert F. Buttery. One taken away from a Cooper's hawk December 28, 1972.

Swainson's thrush
(Hylocichla u. ustulata). Status undetermined.

One was recorded May 31, 1953.

Western bluebird *(Sialia mexicana occidentalis).* Permanent resident–3.

Nests in holes in blue oaks. In winter, flocks of 10 to 20 individuals are common.

Mountain bluebird
(Sialia currucoides). Sporatic.

One was collected from a flock of six on December 31, 1951. Don A. Duncan saw a flock of four April 25, 1971.

Blue-gray gnatcatcher *(Polioptela caerulae amoenissima).* Summer resident–2.

Recorded only in the natural area and in April and May.

Ruby-crowned kinglet *(Regulus calendula cineraceus).* Winter resident–2.

The kinglet is seen commonly in winter, feeding in the foliage of oaks.

Water pipit *(Anthus spinoletta).* Casual.

Two have been recorded; April 9, 1937, and March 30, 1952.

Cedar waxwing
(Bombycilla cedrorum). Casual winter visitant.

Small flocks are occasionally seen between October and May.

Phainopepla *(Phainopepla nitens lepida).*
Summer resident–2

Generally arrives in May and leaves in late fall. Nesting is underway by June 1. Commonly seen during the spring and summer. Thomas F. Newman saw a male in Range Unit 8 on November 11, 1972. Early arrival observed February 14, 1957 in headquarters area by Robert F. Buttery.

Loggerhead shrike *(Lanius ludovicianus gambeli).* Permanent resident–3.

Nesting status uncertain. The shrike is recorded occasionally in the open areas. One observed January 10, 1957 by Robert F. Buttery and May 10, 1973 by Don A. Duncan.

Starling
(Sturnus vulgaris).[1] Permanent resident–3.

Don A. Duncan reports a few were present in the late 1960's, by 1970 there were several nesting pairs on the Experimental Range. Numbers seem to be increasing substantially.

Solitary vireo *(Vireo solitarius).* Migrant.

One was seen April 18, 1952.

Warbling vireo *(Vireo gilvus).* Casual.

Two were recorded: April 18 and May 15, 1952.

Orange-crowned warbler
(Vermivora celata). Casual.

One was seen April 18, 1952.

Nashville warbler
(Vermivora ruficapilla). Migrant.

Two were recorded: April 18 and September 5, 1952.

Yellow warbler
(Dendroica petechia). Migrant.

Heard regularly between April 20 and June 4.

Myrtle warbler
(Dendroica coronata). Migrant.

One was collected on March 2, 1937.

Audubon's warbler
(Dendroica a. auduboni). Winter resident–1.

This warbler is present in numbers from October to May.

Black-throated gray warbler
(Dendroica nigrescens). Migrant.

Several were seen in April 1952.

Townsend's warbler
(Dendroicia townsendi). Migrant.

Several were seen in April and May, 1951.

Hermit warbler
(Dendroica occidentalis). Migrant.

One was recorded April 23, 1952.

Yellow-throat
(Geothlypis trichas). Vagrant.

One was collected April 7, 1952.

Yellow-breasted chat
(Icteras virens auricollis). Migrant.

One was collected May 10, 1937.

Wilson's warbler
(Wilsonia pusilla chryseola). Migrant.

Four individuals were seen on April 30, 1952.

[1] New species recorded since 1955.

Robert F. Buttery reported two on September 15, 1958. One female seen at headquarters by Don A. Duncan and Jack N. Reppert, September 16, 1960. One male seen at headquarters on September 11, 1972.

House sparrow
(Passer d. domesticus). Permanent resident–2.

A few individuals are resident around headquarters. In spring 1953, house sparrows nesting in woodpecker holes in blue oaks increased noticeably, a possible result of woodpecker control in that area the previous season. Starlings may be competing for available nesting holes; house sparrow numbers down; starlings, up.

Western meadowlark
(Sturnella neglecta). Permanent resident–2.

Abundant in winter but nests sparingly in summer.

Red-winged blackbird
(Agelaius phoeniceus). Summer resident–2.

Arrives in late February and leaves in September. Most of red-winged blackbirds are found in swale near headquarters.

Bullock's oriole
(Icterus bullockii). Summer resident-1.

The oriole arrives in April and it leaves by mid-August. It nests in blue oaks.

Brewer's blackbird
(Euphagus cyanocephalus). Permanent resident–2.

Most abundant in the headquarters area, where breeding activity starts in March. Nests are found in mistletoe, blue oaks, and in vines on various buildings during April and May.

Brown-headed cowbird
(Molothrus ater). Summer resident–3.

Occasional individuals are heard calling from February to June.

Western tanager
(Piranaga ludoviciana). Casual.

Observed May 15, July 31, and September 16, 1952.

Black-headed grosbeak *(Pheucticus melanocephalus maculatus).* Summer resident–3.

Recorded between April 10 and August 8, 1952. Stanely E. Westfall and Thomas F. Newman saw two females in a buckeye in the headquarters area on August 8, 1973.

Lazuli bunting
(Passerina amoena). Casual.

Recorded on April 18, 1952.

Purple finch *(Carpodacus purpureus californicus).* Winter resident–3.

Seen occasionally during the winter of 1951-52. Reported February 16, 1958 by Robert F. Buttery. Arlene Wilkinson[2] recorded a few from March 15 to April 19, 1953.

House finch *(Carpodacus mexicanus frontalis).* Permanent resident-2.

The linnet is found mainly in the inhabited area of the Range where it nests from May to July.

Pine siskin *(Spinus pinus).* Casual.

One flock was observed in May 1952.

Lesser goldfinch
(Spinus psaltria). Casual.

Three were collected March 18, 1937. One observed in headquarters area on February 15, 1957 by Robert F. Buttery. Two seen May 2, 1953. Several flocks sighted during December 1972.

Lawrence's goldfinch
(Spinus lawrencei). Permanent resident–3.

Occasional groups of these birds are seen over the Range.

Green-tailed towhee
(Chlorura chlorura). Casual.

One was collected April 29, 1937.

Rufous-sided towhee
(Pipilo erythrophthalmus). Winter resident–1.

Arrives in late September and leaves in early April.

Brown towhee
(Pipilo fescus carolae). Permanent resident–1.

In 1952 nest building began in early April. Arlene Wilkinson[2] reported nesting in March 1953.

[2]Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Savannah sparrow *(Passervulus sandwichensis nevadensis).* Vagrant.

One was collected May 13, 1937, and another October 21, 1952. One recorded by Wilkinson[2] on December 14, 1953.

Vesper sparrow
(Pooecetes gramineus). Casual.

One was collected October 12, 1951.

Lark sparrow *(Chondestes grammacus strigatus, strigatus).* Permanent resident–2.

Sparingly resident over the Range.

Rufous-crowned sparrow
(Aimophila r. ruficeps). Permanent resident–3.

Noted only on the walls of the big canyon below headquarters. J. T. Wright believed their distribution dependent on the deer weed *(Lotus scoparius).* But Arlene Wilkinson[2] observed them foraging in grassy areas, in 1953.

Slate-colored junco
(Junco hyemalis). Casual.

One was seen December 31, 1951.

Oregon junco
(Junco oreganus thurberi). Winter resident–1.

This junco arrives in mid-October and it leaves in April.

Chipping sparrow
(Spizella passerina arizonae). Migrant.

Has been recorded in April, May, September, and October in small numbers.

Gambel white-crowned sparrow
(Zonotrichia leucophrys gambeli).
Winter resident–1.

Arrives in late September and leaves in late April. Mixed flocks of this species with golden-crowned sparrows and Oregon juncos are a common sight in winter.

Golden-crowned sparrow
(Zonotrichia antricapilla). Winter resident–1.

The golden-crowned sparrow arrives about a week later than the white-crowned but departs about the same time.

[2]Wilkinson, Arlene. *Birds of the foothill woodland community.* 1953. (Unpublished M.A. Thesis on file at California State University, Fresno.)

Lincoln's sparrow
(Melospiza lincolnii). Winter resident-3.

A few are present along the swales from early October to April.

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The Station's range-wildlife environmental research unit, headquartered at Fresno, California, is developing the scientific base for multiple-use management of central California ecosystems. This report adds a facet of knowledge for the ecosystem of the Sierra Nevada foothills.

EDITOR'S NOTE: *General Technical Report* is a new series of Forest Service research publications that complements the three existing series: *Research Paper, Research Note,* and *Resource Bulletin.* The General Technical Report series serves as an outlet for information of a technical nature but not necessarily the product of a specific piece of original research or resource survey.

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The Pacific Southwest Forest and Range Experiment Station

represents the research branch of the Forest Service in California and Hawaii.

GPO 794–472/4615

APPENDIX III

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IN COOPERATION WITH
FOREST SERVICE
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION

DETAIL SOIL SURVEY
of the
SAN JOAQUIN EXPERIMENTAL RANGE
O'NEALS, CALIFORNIA

FIELD WORK BY KAN KIM CHANG (Party Chief),
VERNON WEBB - GRIFFITH HONES

REPORT BY KAN KIM CHANG
Fresno, California
December, 1965

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DETAIL SOIL SURVEY OF THE SAN JOAQUIN EXPERIMENTAL RANGE

INTRODUCTION

On April 12, 1965, field operations were initiated for a detail soil survey of the San Joaquin Experimental Range (SJER) at O'Neals, California. The survey is being conducted under the direction of the U.S.D.A, Soil Conservation Service, with cooperation and assistance from the U.S.D.A., Forest Service. The soil survey party consisted of Kan Kim Chang, Party Chief, SCS Fresno; Vernon Webb, SCS Fresno; and Griffith Jones, SCS Madera.

The survey area covers the complete San Joaquin Experimental Range (SJER), comprising some 4,514 acres. It is located within the woodland annual grass vegetation type in the Sierra Nevada foothills on the east side of the San Joaquin Valley and approximately 25 miles (airline) north of Fresno. Elevation of the experimental area is from about 700 to 1700 feet above sea level. Additional information on location and functions of the SJER can be found in Bentley and et al (1) and Hutchinson and et al (4). A thorough check list of plants of the SJER can be found in Buttery and et al (3).

Two other soil survey reports were made in the SJER area. The oldest, Soil Survey of the San Joaquin Experimental Range by R. E. Storie (9) and party was done in 1939. In this report, soil descriptions were given for each soil series, however, they were not described in sufficient detail to meet present day standards and the depth classes overlapped between soil mapping units. The most recent, Soil Survey of Madera Area California survey (8) was made in 1951. In this survey, less detail was mapped since aerial photographs at a 1:20,000 scale were used as compared to 1:7920 scale photograph used in this survey. At the SJER an intensified range research program is being followed, therefore, a more detailed soil survey at greater intensity was requested.

The Vista soil series mentioned in the soil survey report by R. E. Storie and party (9) and in the Madera soil survey report (8) was not mapped in this survey. In accordance with the new system of soil classification (7), the soil survey party concluded that the characteristics of the soil profile, particularly the surface horizon, met the requirements of the Ahwahnee soils rather than the Vista soils.

The Fallbrook series mentioned in the soil survey report by R. E. Storie and party (9) was not mapped in this survey. Most of the Fallbrook soils mapped by Storie and party showed a slightly redder, color (7.5 YR) with no substantial clay increase in the subsoil. These bodies usually of small acreage were included in the Ahwahnee soils.

Each mapping unit delineated is identified by symbols expressing the kind of soil and slope class. Additional symbols were used to indicate significant depth, rockiness and drainage conditions.

Aerial photograph coverage was obtained by the Forest Service for the area. These photographs are contact prints at an approximate scale of 1:7920 (8 inches to the mile). The original field sheets of the soil survey are on file at San Joaquin Experimental Range, O'Neals Calif.

The procedures and methods used in this soil survey were taken from the soil survey staff (5) and (6) and the new system of soil classification used in this report was proposed by the soil survey staff (7).

Special acknowledgment should be extended to Don A. Duncan, Range Conservationist (Research) of the SJER, who because of his knowledge of the area provided invaluable assistance to the survey party.

INDEX LEGEND

Symbol	Soil	Acres	Page
Amd-B	Ahwahnee coarse sandy loam, 0 to 5% slopes	15.2	7
Amd-C	Ahwahnee coarse sandy loam, 5 to 15% slopes	834.9	5
Amd-D	Ahwahnee coarse sandy loam, 15 to 30% slopes	1756.2	7
Amd-E	Ahwahnee coarse sandy loam, 30 to 50% slopes	126.3	7
Ad-B	Ahwahnee coarse sandy loam, deep, 0 to 5% slopes	13.0	7
Ad-C	Ahwahnee coarse sandy loam, deep 5 to 15% slopes	4.0	7
Ad-D	Ahwahnee coarse sandy loam, deep, 15 to 30% slopes	6.0	8
As-C	Ahwahnee coarse sandy loam, shallow, 5 to 15% slopes	35.3	9
As-D	Ahwahnee coarse sandy loam, shallow, 15 to 30% slopes	302.2	8
As-E	Ahwahnee coarse sandy loam, shallow, 30 to 50% slopes	33.0	9
Avs-E/R3	Ahwahnee extremely rocky coarse sandy loam, very shallow, 30 to 50% slopes	44.0	9
Amd-D/R1	Ahwahnee rocky coarse sandy loam, 15 to 30% slopes	283.1	9
Amd-E/R1	Ahwahnee rocky coarse sandy loam, 30 to 50% slopes	111.5	9
As-D/R1	Ahwahnee rocky coarse sandy loam, shallow, 15 to 30% slopes	347.2	9
As-E/R1	Ahwahnee rocky coarse sandy loam, shallow, 30 to 50% slopes	221.2	9
Amd-D/R2	Ahwahnee very rocky coarse sandy loam, 15 to 30% slopes	24.5	10

Index Legend

Symbol	Soil	Acres	Page
As-D/R2	Ahwahnee very rocky coarse sandy loam, shallow, 15 to 30% slopes	95.9	10
As-E/R2	Ahwahnee very rocky coarse sandy loam, shallow, 30 to 50% slopes	75.3	10
Ca-B	Chualar loam, 0 to 5% slopes	3.9	11
RL	Granitic rock land	13.2	13
Ba-B	Hanford coarse sandy loam, 0 to 5% slopes	19.4	15
Ba-C	Hanford coarse sandy loam, 5 to 15% slopes	98.9	14
Ba-B/W	Visalia coarse sandy loam, 0 to 5% slopes	39.6	17
Ba-C/W	Visalia coarse sandy loam, 5 to 15% slopes	10.2	16
	TOTAL ---------	4514.0	

DESCRIPTIVE LEGEND

AHWAHNEE SERIES

The AHWAHNEE series consists of Mollic Haplustalfs, members of a coarse loamy, mixed, thermic family. The AHWAHNEE series comprise roughly 95.9 percent of the San Joaquin Experimental Range.

Characteristically the A horizons have grayish brown to brown, slightly acid, massive breaking to blocky structures, and low (less than 1%) organic matter contents. The B horizons, are lower in organic matter content, are brown, medium acid, coarse sandy loams which has a slightly higher clay content and a weak blocky structure. The C horizons consists of varied colored weathered quartz-diorite that grades into unweathered rock at variable depths. About 73 percent of the AHWAHNEE soils in this area have soil depths to weathered quartz-diorite material ranging from 24 to 36 inches and about 0.5 percent, have depths greater than 36 inches. About 25.5 percent are shallow and have soil depths ranging from 10 to 24 inches and about 1 percent have depths less than 10 inches.

The climate is Mediterranean, mild, wet winters with hot, dry summers. The average annual precipitation is about 20 inches. The mean January temperature is about 42°F and the mean July temperatures is about 81°F. The mean annual temperature is about 60°F.

The AHWAHNEE soils are developed from intrusive acid igneous rocks, usually quartz diorite or granodiorite.

The AHWAHNEE soils range in elevation from about 850 to 1700 feet. They occur on gently undulating to very steep ridges and hills. These soils are somewhat excessively to excessively drained, depending on slope. The permeability is moderately rapid to rapid; runoff is slow to medium depending on slope. The available water-holding capacity is very low to low depending on depth.

The natural vegetation is annual grasses, forbs, trees, and shrubs. Some typical grass species are soft chess, ripgut brome, slender wild oaks, foxtail fescue, red brome and Australian brome. Typical forb species are broadleaf filaree, redstem filaree, littlehead clover, Spanish clover, common catchfly, popcorn flower, bicolor lupine, fiddleneck, dotseed platnain, goldfields, smooth catsear, downy Navarretia, and spineflower. Common tree species are blue oak, interior live oak, and diger pine. Typical shrub species are Ceanothus spp., and poison oak.

The AHWAHNEE soils, as mapped, include bodies of other soils too small to delineate separately. Up to about 2% of the area consists of soils with reddish brown sandy clay loam subsoils, 1% with dark brown sandy clay subsoils and 2% rock outcrops.

Ahwahnee coarse sandy loam 5 to 15 percent slopes. This is one of the largest mapping units of the Ahwahnee soils. Most of this unit is located on both sides of the entrance road from State Highway 41 to the San Joaquin Experimental Range Headquarter's building.

The following description of a representative profile was taken on an easterly slope of 8% under a cover of annual grasses (soft chess, Fescue, and ripgut brome), forbs (broadleaf filaree and Spanish clover), shrubs (Ceanothus spp.) and trees (blue oak and interior live oak and digger pine). The elevation is about 1100'. It lies about 1-1/4 (airline) miles west of the San Joaquin Experimental Range Headquarter's building and located in the SW-1/4 of NE-1/4 of NW-1/4 of Sec. 1, T. 10S., R. 20E., M.D.B. & M.

O1	1/4-0"	Loose organic litter of grasses and forbs.
A11	0-5"	Grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; massive breaking to a weak subangular blocky structure; slightly hard, friable nonsticky, nonplastic; few fine roots; common micro and very fine tubular and common very fine interstitial pores; slightly acid (pH 6.5); clear wavy boundary. 4 to 6 inches thick.
A12	5-20"	Brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) when moist; massive to weak medium angular blocky structure; slightly hard, friable, nonplastic, nonsticky; plentiful micro and very few fine tabular and common micro interstitial proes; slightly acid (pH.6) abrupt smooth boundary. 10 to 18 inches thick.
B2t	20-26"	Brown (10YR 5/3) coarse sandy loam, brown (7.5YR 4/4) when moist; weak medium subangular blocky structure; hard, firm slightly sticky and nonplastic; few micro and very fine roots; few very fine tubular and many micro interstitial pores; few thin clay films in pores and as bridging and grain coatings; medium acid (pH 6.0; abrupt smooth boundary. 5 to 10 inches thick.
C	26"+	Varied colored weathered quartz-diorite, glassy, colorless quartz grains, whitish to yellowish brown feldspar grains, and scattered black to dark yellowish brown fragments of biotite and other dark minerals; granitic rock fabric clearly visible in place; detached fragments crush readily to a loose loamy coarse sand; grades to unweathered rock at variable depths.

Variations: The A horizons have colors predominantly of hue 10YR with values of 5 and 4 and chromas of 2 and 3. Moist colors are of similar hue with values and chromas of 3 and 2. Structure is predominantly massive breaking to a weak subangular blocky and weak medium granular structure under oak trees with dense grass-forb vegetation cover. The organic matter ranges from 1 to 2 in the top 0-4" and from 0.4 to 0.6% in the 8-12" depth. The clay content ranges from 3 to 8% with an average of 6%. The reaction ranges from slightly to medium acid (pH 6.5-6.0). The B horizons have hues ranging from 10YR to 7.5YR with

value of 5 and chroma of 3. Moist colors are of similar hue with values of 5 and 4 and chromas of 3. Structures are predominantly weak medium subangular blocky. Reaction ranges from medium (pH 6.0) to slightly acid (pH 6.8), and is usually more acid than the A horizons. Clay content ranges from 7 to 16% with an average content of 11%. The C horizon is strongly weathered acid igneous rock which is pervious to some moisture but not to roots. Depth of soil to the C horizon usually ranges from about 24 to 36 inches, but deeper in places. Occasional rock outcrops are scattered throughout this unit.

Drainage is somewhat excessive, runoff is medium and erosion hazard is slight.

Ahwahnee coarse sandy loam, 0 to 5 percent slopes. The soils of this unit are similar to those of Ahwahnee coarse sandy loam, 5 to 15 percent slopes. This unit differs in occupying less steeper slopes. Drainage is somewhat excessive, runoff is slow, and erosion hazard is slight. The largest body of this mapping unit is located near the wood exposure plots.

Ahwahnee coarse sandy loam, 15 to 30 percent slopes. This unit differs from Ahwahnee coarse sandy loam, 5 to 15 percent slopes, only in having somewhat steeper slopes and a hilly rather than a rolling surface relief. Drainage is somewhat excessive, runoff is medium and erosion hazard is moderate.

Bodies of this unit are located throughout the survey area.

Ahwahnee coarse sandy loam, 30 to 50 percent slopes. This soil is similar to Ahwahnee coarse sandy loam, 15 to 30 percent slopes but differs in having somewhat steeper slopes and a steep rather than a hilly surface relief. Drainage is excessive, runoff is medium and erosion hazard is moderate to high.

Large bodies of this unit are located in the north westerly section of the Range.

Ahwahnee coarse sandy loam, deep, 0 to 5 percent slopes. This soil is similar to Ahwahnee coarse sandy loam, 5 to 15 percent slopes but differ in having gentler surface slopes and deeper solum. The solum ranges in thickness from about 36 to 48 inches. Drainage is somewhat excessive, runoff is slow and erosion hazard is slight.

Ahwahnee coarse sandy loam, deep, 5 to 15 percent slopes. This soil is similar to Ahwahnee coarse sandy loam, 5 to 15 percent slopes, the unit differing only in having deeper solum. Drainage is somewhat excessive, runoff is slow to medium and erosion hazard is slight to moderate.

Ahwahnee coarse sandy loam, deep, 15 to 30 percent slopes. The steeper slopes and thicker solum of this unit distinguish it from Ahwahnee coarse sandy loam, 5 to 15 percent slopes. Drainage is somewhat excessive, runoff is medium and erosion hazard is moderate.

Ahwahnee coarse sandy loam, shallow, 15 to 30 percent slopes. This is one of the largest units of the shallow phase of the Ahwahnee soils. Most of this unit occurs in the W-1/2 of Sec. 31. T. 9 S., R 21 E., M.D.B. & M.

The following description of a representative profile was taken on a north northeasterly slope of 17%, under a cover of annual grasses (red brome and soft chess), and forbs (dot seed plantain, goldfield, smooth catsear, downy navarretia, and spineflower). The elevation is about 1100 feet. It lies about 50 yards southeast of the main corral gate and located in the SW-1/4 of NW-1/4 of NE-1/4 of Sec. 1, T. 10 S., R. 20 E., M.D.B. & M.

O1	1/2-0"	Loose organic litter of grasses and forbs.
A11	0-5"	Grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky, nonplastic; abundant micro and plentiful fine roots; common micro tubular pores; neutral (pH 7.0); abrupt boundary. 4 to 6 inches thick.
A12	5-12"	Grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; massive breaking to weak medium angular blocky structures; slightly hard, friable nonsticky, nonplastic; abundant micro and few fine roots; common micro and few fine tubular and many micro interstitial pores; slightly acid (pH 6.5); clear smooth boundary. 6 to 8 inches thick.
B2t	12-20"	Brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3), when moist; weak medium subangular blocky structure; hard, friable, slightly sticky, nonplastic; few micro roots; few micro tubular and common micro interstitial pores; few thin clay films in pores and as bridging and coating of grains; medium acid (pH 6.0); abrupt wavy boundary. 8 to 10 inches thick.
C	20"	Varied colored weathered quartz-diorite, grades to unweathered tock at variable depths.

Variation: The colors, structures reactions and organic matter percentage of the A and B horizons have similar variations as to the Ahwahnee coarse sandy loam, 5 to 15 percent slopes. The A horizons ranges in clay content from 3 to 7% with an average of 5%. The B horizon averaged 9% clay content with a range of 7 to 12%. The

weathered C horizon vary in depth to unweathered rock from 3 to 10 feet. Depth of soil to the C horizon usually ranges from 18 to 24 inches but pockets of 30 inch depth are included in places. Rock outcrops too small to delineate are included in this unit.

Ahwahnee coarse sandy loam, shallow, 5 to 15 percent slopes.
This soil is similar to Ahwahnee coarse sandy loam, shallow, 15 to 30 percent slopes but differs in having gentler slopes and rolling rather than hilly surface relief. Drainage is somewhat excessive, runoff is medium, and erosion hazard is moderate.

Ahwahnee coarse sandy loam, shallow, 30 to 50 percent slopes.
This soil is similar to Ahwahnee coarse sandy loam, shallow, 15 to 30 percent slopes but differ in having steeper slopes and having steep rather than hilly surface relief. Drainage is excessive, runoff is medium and erosion hazard is moderate to high.

Ahwahnee extremely rocky coarse sandy loam, very shallow, 30 to 50 percent slopes.
This soil is similar to Ahwahnee very rocky coarse sandy loam, 30 to 50 percent slopes but differes only in having shallower depths and having rock outcrops occupying more than 50 percent of the surface area of a given body. The solum thickness ranges from 6 to 10 inches with inclusions of deeper depths. Rock outcrops range from 57 to 81 percent with an average of 69 percent. Drainage is excessive, runoff is medium and erosion hazard is high.

Body of this unit is located in the south boundary of the Range.

Ahwahnee rocky coarse sandy loam, 15 to 30 percent slopes.
This soil is similar to Ahwahnee coarse sandy loam, 15 to 30 percent slopes, the unit differs only having rock outcrops occupying from 10 to 25 percent of the surface area of a given body. Drainage is somewhat excessive, runoff is medium, and the erosion hazard is moderate.

Ahwahnee rocky coarse sandy loam, 30 to 50 percent slopes.
This soil is similar to Ahwahnee rocky coarse sandy loam, 15 to 30 percent slopes but the unit differs in having much steeper slopes and having steep rather than hilly surface relief. Drainage is excessive, runoff is medium and erosion hazard is moderate to high.

Ahwahnee rocky coarse sandy loam, shallow, 15 to 30 percent slopes.
This unit differs from Ahwahnee coarse sandy loam, shallow, 15 to 30 percent slopes only in having rock outcrops occupying from 10 to 25 percent of the surface area of a given body. Drainage is somewhat excessive, runoff is medium, and erosion hazard is moderate.

Ahwahnee rocky coarse sandy loam, shallow, 30 to 50 percent slopes.
This unit is similar to Ahwahnee rocky coarse sandy loam, shallow, 15 to 30 percent slopes, differing only in its steeper slopes. It

occupies steep rather than hilly surface relief. Drainage is excessive, runoff is medium and erosion hazard is moderate to high.

Ahwahnee very rocky coarse sandy loam, 15 to 30 percent slopes. This unit differs from Ahwahnee rocky coarse sandy loam, 15 to 30 percent slopes, only in having more rock outcrops occupying from 25 to 50 percent of the surface area of a given body. Drainage is somewhat excessive, runoff is medium, and erosion hazard is moderate.

Ahwahnee very rocky coarse sandy loam, shallow, 15 to 30 percent slopes. The soils of this unit are similar to those of Ahwahnee rocky coarse sandy loam, shallow, 15 to 30 percent slopes. This unit differs in having rock outcrops occupying from 25 to 50 percent of the surface area of a given body. Drainage is somewhat excessive, runoff is medium and erosion hazard is moderate.

Ahwahnee very rocky coarse sandy loam, shallow, 30 to 50 percent slopes. This soil is similar to Ahwahnee rocky coarse sandy loam, shallow, 30 to 50 percent slopes, differing only in having more rock outcrops occupying 25 to 50 percent of the surface area of a given body. Rocky outcrops average 33 percent in this unit. Drainage is excessive, runoff is medium and erosion hazard is moderate to high.

CHUALAR SERIES

The CHUAIAR series consists of Mollic Haplustalfs, members of a fine loamy, mixed, thermic family. The CHUALAR series comprise only a small area which consists of about 0.1 percent of the San Joaquin Experimental Range.

Characteristically, the CHUALAR soils have grayish brown, moderately coarse to medium textures, slightly acid to neutral A horizons and gray to brown, moderately fine textured, neutral to mildly alkaline Bt horizons.

The climate is Mediterranean, mild, wet winters with hot, dry summers. The mean annual precipitation is about 20 inches. The mean January temperature is about 42°F and the mean July temperature is about 81°F. The mean annual temperature is about 60°F.

The CHUALAR series are developed from granitic alluvium.

These soils are moderately well drained, runoff is slow, and erosion hazard is none to slight. Permeability is moderately slow. The available water holding capacity is high. They range in elevation from 800 to 1000 feet. They occur in swale bottoms of the Range area. They are often subject to slow seepage from higher lying soils and as a result are moist for a longer period of time.

The natural vegetation is annual grasses, grass-like and forbs. Typical grasses and grass-like species are Mediterranean barley, perennial rush, toad rush and spikerush. Some forb species are whitetip clover and monkey flower. They support late vegetation into the early dry period of the summer.

The Hanford and Visalia soils have similar colors and positions in the landscape, and have formed from similar parent material but lack the finer textured B horizons.

CHUALAR loam, 0 to 5 percent slopes.

This is the only unit of the Chualar soils and occupies about 0.1 percent of the Range area.

The following description of a representative profile was taken in a cover of annual grasses and grass-like (Mediterranean barley, Toad rush, and Spikerush) and forbs (Whitetip clover and Monkey flower) on a north northwesterly slope of 4 percent. The elevation is about 950 feet. It lies about 1/4 mile southwest of the main corral and located in the SW-1/4 of NE-1/4 of Sec. 1, T. 10 S., R. 20 E., M.D.B. & M.

01	1-0"	Loose organic litter of grasses and forbs.
A1	0-4"	Grayish brown (10YR 3/2) when moist; moderate medium subangular blocky structure; slightly hard, friable,

slightly sticky, slightly plastic, abundant micro and very fine roots; many micro and few very fine tubular pores; slightly acid (pH 6.5); gradual wavy boundary. 4 to 6 inches thick.

A3 4-14" Dark grayish brown (10YR 4/2) light sandy clay loam, very dark gray (10YR 4/1) when moist; weak medium subangular blocky structure; hard, firm, sticky, slightly plastic, abundant micro and very fine roots; many micro and few very fine tubular and common micro interstitial pores; few thin clay films in pores; neutral (pH 6.7); clear smooth boundary. 10 to 12 inches thick.

B2t 14-28" Dark gray (10YR 4/1) heavy sandy clay loam, very dark gray (10YR 3/1) when moist; weak coarse angular blocky structure; very hard, firm, sticky, slightly plastic; plentiful micro roots; common micro tubular pores; common moderately thick clay films in pores and common thin clay films on pad faces; moderately alkaline (pH 8.0); abrupt boundary. 12 to 14 inches thick.

IIR 28"+ On weathered quartz-diorite of considerable depth.

Variations: The color of the A horizon is usually of hue 10YR with values of 4 or 5 of chromas of 1 or 2. Moist color is of similar hue with values of 2 or 3 and chromas of 1 or 2. Textures include "gritty" clay loams.

The color of the B horizon is of hue 10YR with values ranging from 4 to 5 and chromas 1 and 2. Moist color is similar hue with values of 2 or 3 and chromas of 1 and 2. Textures include sandy clay loams and "gritty"[1/] clay loams. Reaction ranges from neutral to moderately alkaline.

1/ The term gritty refers to a noticeable percentage of soil particles with diameters between 1 and 2 millimeters.

Granitic rock land

From 50 to 90 percent of the surface area of this land type consists of granitic outcrops mainly of quartz diorite. These areas are generally more than 50 percent slopes. The soils between the outcrops are similar to adjoining bodies of soils derived from the same kind of rocks.

The vegetative cover supported by existing soils, or accumulations of soil materials, ranges from annual grasses and forbs to woodland shrub.

This unit is very limited in extent. Most of this unit is located near the southern property boundary of the Experimental Range.

HANFORD SERIES

The Hanford soils consist of Typic Haplorthents, members of a coarse loamy, mixed, nonacid, thermic family. The extent of the Hanford soils is about 2.6 percent of the soil survery area.

Characteristically, the Hanford soils have gray to dark gray, coarse sandy loams to fine sandy loams, massive to weak medium subangular blocky structure and slightly acid to neutral in reaction A horizons. The C horizons are grayish brown to brown, massive, noncalcareous and grading into a lithological discontinuity zone of weathered quartz-diorite which is partially impervious to plant roots and moisture.

The Climate is mediterranean, mild, wet winters with hot dry summers. The mean annual precipitation is about 20 inches. The mean January temperature is about 42°F and the mean July temperature is about 81°F. The mean annual temperature is about 60°F.

The Hanford series are developed from moderately coarse textured granitic alluvium.

These soils are moderately well to well drained, permeability is moderately rapid and runoff is slow to very slow. Erosion hazard is none to slight. They occur in swales throughout the area. They range in elevation from 800 to 1200 feet.

The natural vegetation is annual grasses and forbs. In the Hanford series some typical grass species are ripgut brome, Australian brome, soft chess, slender wild oats, and Fescue. Typical forb species are tarweed, turkey mullein, and popcorn flower.

The Chualar soils occur also in the swale areas and having similar colors but have moderately fine textured Bt horizons.

Hanford coarse sandy loam, 5 to 15 percent slopes

This is the largest unit of the Hanford soils in the survey area.

The following description of a representative profile was taken in a cover of annual grasses (soft chess, ripgut brome, and Australian brome) and forbs (white-tip clover, filaree, and Trifolium spp.) on a south slope of 6 percent. The elevation is 950 feet. It lies about 300 feet southwest of the San Joaquin Experimental Range Headquarter's building and located in the NE-1/4 of the NE-1/4 of the SW-1/4 of Sec. 6, T. 10 S., R. 21 E., M.D.B. & M.

01	1/4-0"	Loose organic litter of grasses and forbs.

Hanford Series

A11	0-5"	Grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2 when moist; massive breaking to weak medium subangular block structure; soft, very friable nonsticky, nonplastic, abundant micro and few fine roots; many micro tubular and few micro interstitial pores; medium acid (pH 5.8); gradual wavy boundary 4 to 6 inches thick.
A12	5-15	Grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, nonsticky, nonplastic; abundant micro roots; many micro tubular and interstitial pores; slightly acid (pH 6.1); clear smooth boundary 10 to 12 inches thick.
C	15-55"	Light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, friable, slightly sticky, nonplastic; few micro roots; many micro and very fine tubular and many micro interstitial pores; slightly acid (pH 6.5), abrupt smooth boundary 38-40 inches thick.
IIR	55"+	Weathered quartz-diorite.

Variations: The A horizons ranges in color with value of 5 and chromas of 2 and 3. The hue is predominantly 10YR. Moist colors are of similar hue with values of 3 and occasionally 2 and chroma of 2. The structure is usually massive with occasional weak granular and blocky structures. Reaction ranges from slightly acid to neutral. The C horizon have similar hues as above with dry colors of values 5 and 6 and chromas of 2 and 3. Moist colors having values of 3 and 4 and chromas of 2 and 3. Structures are predominantly massive and reaction slightly acid. Depth to the weathered quartz-diorite normally range from 36 to 48 inches.

This unit is subject to seepage from higher lying soils during the rainy season but is moist only for a short period of time.

Drainage is moderately well to well drained, runoff is slow to very slow and erosion hazard is slight.

Hanford coarse sandy loam, 0 to 5 percent slopes

This soil is similar to Hanford coarse snady loam 5 to 15 percent slopes but differs in having gentler slopes and undulating rather than rolling surface relief. In areas, fine sandy loam surface textures prevails. Drainage is moderately well to well drained, runoff is slow to very slow and erosion hazard is non to slight.

VISALIA SERIES

The VISALIA soils consist of Cumulic Haploxeroll, members of a coarse loamy, mixed, thermic family. The extent of the Visalia soils is about 1.1 percent of the soil survey area.

Characteristically, the Visalia soils have gray to grayish brown, coarse sandy loams, massive and slightly acid to neutral A horizons. The C horizons are grayish brown to light brownish gray, massive, noncalcareous, which grades into a lithological discontinuity zone of weathered quartz-diorite which is partially impervious to plant roots and moisture.

The climate is Mediterranean, mild, wet winters with hot, dry summers. The mean annual precipitation is about 20 inches. The mean January temperature is about 42°F and the mean July temperature is about 81°F. The mean annual temperature is about 60°F.

The VISALIA soils are developed from moderately coarse textured granitic alluvium.

These soils are somewhat poorly drained, permeability is moderately rapid to rapid and runoff is slow to very slow. Erosion hazard is none to slight. They range from elevation from 800 to 1200 feet.

The natural vegetation is annual grasses and forbs. Grass and grass-like species are Mediterranean barley, toad-rush, and spikerush. Typic forb species are white tip clover and monkey flower.

The Chualar and Hanford soils occur also in the swale areas, but the Chualar soils with similar colors but have moderately fine textured Bt horizons, and the Hanford soils are lighter in color and have less than 1 percent of organic matter in the upper 10 inches of the profile.

Visalia coarse sandy loam, 5 to 15 percent slopes

This is the largest unit of the Visalia soils.

The following description of a representative profile was taken in a cover of annual grasses and grass-like (soft chess, Mediterranean barley, perennial rush, and toad rush) and forbs (whitetip clover, etc.) on a southernly slope of 8 percent. The elevation is 1,000 feet. It lies about 500 feet southwest of the San Joaquin Experimental Range Headquarter's building and located in the SW-1/4 of NE-1/4 of SW-1/4 of Sec. 6, to 10 S., R. 21 E., M.D.B. & M.

O1	1/2-0"	Loose organic litter of grasses and forbs.
A1	0-19"	Gray (10YR 5/1) coarse sandy loam, black (10YR 2/1)

when moist; massive; hard, friable, nonsticky, nonplastic; abundant micro and few very fine and fine roots; common very fine tubular and common very fine interstitial pores; slightly acid (pH 6.5); gradual smooth boundary 18 to 22 inches thick.

C1 19-68"+ Light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, nonsticky, nonplastic; plentiful micro roots; few micro tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

Variations: The A horizon ranges in color with values of 4 and 5 and chromas of 1 and 2. The hue is predominantly 10YR. Moist colors have similar hue with values of 2 and 3 and chromas of 1 and 2. Structures are predominantly massive and reaction ranges from slightly acid to neutral. The C horizon have similar hue with colors ranges in value of 5 and 6 and chromas of 2 and 3. Moist colors have values of 3 and 4 and chromas of 2 and 3. Depth to the weathered quartz-diorite ranges from 36 inches to 48 inches with occasional deeper depths.

This soil is subject to slow seepage from higher lying soils and as a result, is moist for a longer period. Late green grass during the early periods of summer does occur. Water tables at depths of 3 to 5 feet usually occurs until late May.

Soils are moderately well drained, runoff is medium to rapid depending on wetness of soil profile and erosion hazard is slight.

Visalia coarse sandy loam, 0 to 5 percent slopes.

This soil is similar to Visalia coarse sandy loam, 5 to 15 percent slopes but differ in having gentler slopes, and undulating rather than rolling surface relief. Drainage is imperfectly drained, runoff is medium to rapid depending on wetness of soil profile and erosion hazard is none.

LAND CAPABILITY CLASSIFICATION LEGEND

Symbol

III e 3

Class Subclass Unit Number

Descriptions of Capability Class:

Class I

Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland, or wildlife.

Class II

Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class III

Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class IV

Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class V

Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, range, woodland, or wildlife.

Class VI

Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Land Capability Classification Legend - continued

Class VII

Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII

Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

Description of Subclass:

e: Shows water erosion hazard as the most serious problem. Slope is the main type; or stream overflow damage.

w: Shows wetness of woil as the most serious continuing problem. May be caused by high water table, seepage, ponding.

s: Shows that some characteristic of the soil itself is the most serious problem. Such features are: shallow effective depth, heavy or coarse texture, stoniness, plant nutrient deficiencies.

Often two or more limitations apply equally to an area. Where this is so, the first factor on the list is shown as the governing one.

Description of Unit Numbers:

1- Erosion or slope, or both. Used to indicate a problem resulting from past erosion or a problem of erosion hazard.

2- Drainage problems including overflow to the extent that they are assumed to be continuing problems.

3- Soils with limitations because of slow and very slow subsoil and substratum permeability. Includes conditions such as soils with claypans and semiconsolidated substrata. Subsoils and substrata yield significant amounts of water for plant growth. Internal drainage is slow.

4- Coarse textured and gravelly soils that have low water holding capacity.

7- Cobbly, rocky or stony conditions that interfere with cultivation. Available water capacity is not significantly reduced.

8- Soils with root zone limitations (usually within 36" for Class VI and 2-" for Class VII) due to relatively impermeable hardpans, massive bedrock and other layers that do not provide appreciable moisture for plant growth.

LAND CAPABILITY CLASSIFICATION

Capability Units IIw2

These imperfectly drained soils are on low recent alluvial fans. These soils are not more than 5 feet deep. Permeability ranges from moderate to moderately rapid.

These soils developed under natural conditions of very slow to slow runoff and a high ground water level. A hazard of a seasonal high water table caused by seepage of water from higher areas does occur.

Ba-B/W	Visalia coarse sandy loam, 0 to 5 percent slopes
Ba-C/W	Visalia coarse sandy loam, 5 to 15 percent slopes
Ca-B	Chualar loam, 0 to 5 percent slopes.

Capability Unit IIs3

The soils in this unit occupy the nearly level to gently sloping recent alluvial fans. They are underalin, at a depth of more than 3 feet, by an unrelated weathered quartz-diorite. In texture, they are predominantly moderately coarse textured.

Ba-B	Hanford coarse sandy loam, 0 to 5 percent slopes
Ba-C	Hanford coarse sandy loam, 5 to 15 percent slopes

Capability Unit IIIe8

This land consists of upland soils on slopes of 0 to 5 percent. This soil is 20 to 48 inches deep over weathered quartz-diorite material. Surface and sub-surface textures are coarse sandy loam; subsoil permeability varies from moderately rapid to rapid, available water holding capacity ranges from 4 to 6 inches. These soils tend to be less erosive on slopes of 0 to 5 percent.

Amd-B	Ahwahnee coarse sandy loam, 0 to 5 percent slopes
Ad-B	Ahwahnee coarse sandy loam, deep, 0 to 5 percent slopes

Capability Unit IVe4

This unit consists of shallow, somewhat excessively drained upland soils on slopes ranging from 5 to 15 percent. They are 20 inches in depth to the weathered quartz-diorite material. They consist of moderately coarse textures and water holding capacity of about 2.5 inches for the soil profile.

As-C	Ahwahnee coarse sandy loam, shallow, 5 to 15 percent slopes.

Capability Units

Capability Unit IVe8

The soils of this unit are on slopes 5 to 15 percent. The soils are 20 to 48 inches over weathered quartz-diorite. Surface and subsurface textures are coarse snady loam; subsoil permeability is moderately rapid to rapid and available water holding capacity is from 4 to 6 inches.

Ad-C	Ahwahnee coarse sandy loam, deep, 5 to 15 percent slopes
Amd-C	Ahwahnee coarse sandy loam, 5 to 15 percent slopes.

Capability Unit VIe1

The soils in this unit are over 24 inches deep to weathered quartz-diorite material. They have coarse sandy loam surface and subsurface textures. They are somewhat excessively drained and occur on slopes ranging from 15 to 30 percent.

Ad-D	Ahwahnee coarse sandy loam, deep, 15 to 30 percent slopes
Amd-D	Ahwahnee coarse sandy loam, deep, 15 to 30 percent slopes.

Capability Unit VIe41

The soil of this unit have coarse sandy loam textures, 10 to 20 inches deep over weathered quartz-diorite material. The soil is somewhat excessively drained and slopes of 15 to 30 percent.

As-D	Ahwahnee coarse sandy loam, shallow, 15 to 30 percent slopes.

Capability Unit VIs1

The soil of this unit is over 24 inches deep to weathered granitic material. They have coarse sandy loam surface and subsurface textures. They occur in slopes of 15 to 30 percent with rock outcrops occupying from 10 to 25 percent of the surface area of a given body.

Amd-D/R1	Ahwahnee rocky coarse sandy loam, 15 to 30 percent slopes.

Capability Unit VIs41

The soil in this unit is 10 to 20 inches deep to weathered granitic material. They have coarse sandy loams surface and subsurface texture with rock outcrops occupying from 10 to 25 percent of the surface area of a given body. The soil ranges in slope from 15 to 30 percent.

As-D/R1	Ahwahnee rocky coarse sandy loam, shallow, 15 to 30 percent slopes.

Capability Units

Capability Unit VIIe1

The soil in this unit is over 24 inches deep to weathered granitic material. They are coarse sandy loam throughout and occur on slopes over 30 percent.

Amd-E Ahwahnee coarse sandy loam, 30 to 50 percent slopes

Capability Unit VIIe4

The soil in this unit have coarse sandy loam textures, 10 to 20 inches deep over weathered granitic material. The soil is excessively drained and has slopes over 30 percent.

As-E Ahwahnee coarse sandy loam, shallow, 30 to 50 percent slopes.

Capability Unit VIIs1

The soil in this unit is more than 24 inches deep to weathered quartz-diorite material. This soil has rock outcrops that occupy from 10 to 25 percent of the surface area of a given body. They are excessively drained and erosion hazard is moderate to high.

Amd-E/R1 Ahwahnee rocky coarse sandy loam, 30 to 50 percent slopes

Capability Unit VIIs41

The soil in this unit consists of coarse sandy loam textures, less than 20 inches deep to weathered granitic material and have rock outcrops occupying 10 to 25 percent of surface area in a given body. The available water holding capacity is less than 2 inches.

As-E/R1 Ahwahnee rocky coarse sandy loam, shallow, 30 to 50 percent slopes.

Capability Unit VIIs7

The soils in this unit are extremely rocky with rock outcrops occupying 25 to 50 percent of the surface area of a given body and having moderately coarse texture. They vary in depths from 6 to 36 inches and slopes ranging from 15 to 50 percent.

Amd-D/R2 Ahwahnee very rocky sandy loam, 15 to 30 percent slopes

As-D/R2 Ahwahnee very rocky coarse sandy loam, shallow, 15 to 30 percent slopes.

As-E/Rs Ahwahnee very rocky coarse sandy loam, shallow, 30 to 50 percent slopes.

Avs-E/R3 Ahwahnee extremely rocky coarse sandy loam very shallow, 30 to 50 percent slopes.

Capability Units

Capability Unit VIIIs1

The soils between exposed rocks are coarse sandy loams that are less than 10 inches deep to weathered granite. They occur on slopes steeper than 51 percent and have rock outcrops occupying more than 50 percent of the surface area of a given body.

RL Granitic rockland

LABORATORY ANALYSIS

Mechanical Analysis of Soil Samples

The procedure in the test was taken from Bouyoucos (2). A composite sample of the A horizons and Bt horizon was taken at random at various places on the range.

Soil	Depth (inches)	Sand (%) (2 to 0.05mm)	Silt (%) (0.05 to 0.002)	Clay (%) <0.002
Ahwahnee coarse sandy loam, (mod. deep)	0-11	77	15	8
	11-33	71	13	16
Ditto	0-12	77	16	7
	12-24	79	12	9
Ditto	0-16	79	15	6
	16-30	73	12	15
Ditto	0-5	77	18	5
	5-12	71	20	9
Ditto	0-17	77	17	6
	17-32	73	17	10
Ahwahnee coarse sandy loam, (shallow)	0-10	77	16	7
	10-22	75	13	12
Ditto	0-8	85	12	3
	8-18	81	12	7

SOIL ANALYSES
Soil Morphology Laboratory
University of California Davis
Oct., 1965

Horizon (1)	Depth (2)	Sand (3)	Silt (3)	Clay (3)	FAP (4)	CEC (5)	BS (6)	pH (7)	O. C. (8)	C/N (9)	P (10)
Ahwahnee coarse sandy loam, 5 to 15 percent slopes SW-1/4 NE-1/4 NW-1/4 Sec. 1 T10S, R20E											
A11	0-5	81.6	9.4	9.0	2.2	7.0	59	6.4	.886	10	10.0
A12	5-20	82.9	9.1	8.0	1.7	5.2	54	6.4	.294	12	8.1
B2t	20-26	80.5	6.5	13.0	2.4	5.0	44	6.1	.136	7	5.3
C	26+	91.0	--	9.0	1.5	3.0	53	6.0	.043	1	6.3
Chualar loam, 0 to 5 percent slopes SW-1/4 NE-1/4 Sec. 1 T10S R20E											
A1	0-4	73.6	11.7	14.7	5.1	13.8	51	5.4	1.32	12	3.8
A3	4-14	69.5	13.8	16.7	4.8	13.4	73	6.2	.498	14	2.8
B2t	14-28	66.1	11.9	22.0	7.3	17.7	89	7.3	.249	17	1.4
Hanford coarse sandy loam, 5 to 15 percent slopes NE-1/4 NE-1/4 SW-1/4 Sec. 6., T10S, T21E											
A11	0-5	77.6	11.9	10.5	3.9	13.7	50	6.3	.135	13	65.3
A12	5-15	76.6	11.9	11.5	2.7	6.2	80	6.3	.060	5	24.1
C	15-55	75.9	10.6	13.5	3.5	5.5	96	6.6	.017	7	6.8
Visalia coarse sandy loam, 5 to 15 percent slopes SW-1/4 NE-1/4 SW-1/4 Sec. 6., T10S, R21E											
A1	0-19	78.4	9.1	12.5	3.8	8.1	59	5.6	.732	15	3.5
C	19-68	84.5	5.0	10.5	3.0	6.0	86	6.3	.169	14	2.1

1. U.S.D.A. Hdbk No. 18
2. Inches
3. Percent by wt., hydrometer methods; an average of all samples showed 40% of the sand particles were very coarse and coarse sizes
4. Fifteen atmosphere percentage moisture over dry basis
5. Cation exchange capacity, ammonium acetate pH 7.0
6. Base saturation percentage
7. Glass electrode, saturated paste
8. Organic carbon, percent
9. Carbon nitrogen ration
10. Phosphorous, ppm, sodium carbonate extractable

LITERATURE CITED

(1) BENTLEY, J. R. and TALBOT, M. W.
1951. Efficient use of Annual Plants on Cattle Ranges in the California Foothills. U.S.D.A. Cir. No. 870 Wash. D.C.

(2) BOUYOUCOS, G. J.
1965. Hydrometer Method Improved for Making Particle Size Analysis of Soils. Agronomy Journal, Vol. 54, No. 5, p. 464-465

(3) BUTTERY R. F. AND GREEN, L. R.
1958. A check List of Plants of the San Joaquin Experimental Range. California Forest and Range Expt. Sta. Misc. Paper No. 23, Berkeley, Calif.

(4) HUTCHINSON, C. B. AND KOTOK, E. I.
1942. The San Joaquin Experimental Range.
Uni. of Calif. Bull. 663 pp 145

(5) SOIL SURVEY STAFF
1951. Soil Survey Manual.
U. S. Dept. Agr. Hdbk. 18. Washington D. C.

(6) SOIL SURVEY STAFF
1962. Supplement to U.S. Dept. Agr. Hdbk. 18 (replaces pp. 173-188)

(7) SOIL SURVEY STAFF
1960. Soil Classification, A comprehensive System, 7th Approximation. U. S. Dept. Agr., Washington, D. C.

(8) ULRICH, R. AND STROMBERG, L. K.
1962. Soil Survey of the Madera Area, California. U.S.D.A., SCS, Series 1951, No. 11

(9) STORIE, R. E. and PARTY
1939. Soil Survey of the San Joaquin Experimental Range, unpublished, Uni. of Calif., Berkeley, Calif.

SOIL SURVEY FIELD SHEETS

The field mapping was done on aerial photographs from a special flight contracted by the U. S. Forest Service, California Forest and Range Experiment Station. Thirty-three aerial photographs, numbers 1-02 to 10; 1-16 to 21; 1-27 to 31; 1-37 to 45; and 1-51 to 54, were used in the soil mapping. (See photo index map in this report.) These contact photos have a scale of approximately 10 inches = 1 mile. The original field sheets showing the soil survey are located at the San Joaquin Experimental Range, O'Neals, California. Copies are available at the Soil Conservation Service office at Madera, California.

APPENDIX IV

PUBLICATIONS FROM THE SAN JOAQUIN EXPERIMENTAL RANGE, 1935-1975

Don A. Duncan and Stanley E. Westfall

USDA Forest Service,
Pacific Southwest Forest and Range Experiment Station,
Berkeley, California

FOREWORD

The San Joaquin Experimental Range is in the western foothills of the Sierra Nevada in Madera County, California, at an elevation of 700 to 1700 feet (214 to 518 m). Soils are shallow, of granitic origin, and are low in water-storing capacity. Average annual precipitation since 1934 is about 19 inches (48.3 cm), with extremes of about 10 (25.4 cm) and 32 inches (81.3 cm). Vegetation is of the annual plant and oak-woodland types.

As the reader will see from the subject index, a variety of subjects have been investigated by Forest Service researchers and cooperators since the Experimental Range was established in 1934, with emphasis on range, range livestock, and wildlife/zoologically-oriented research. Beginning with the 1973 season an area on the Experimental Range has been intensively studied as the San Joaquin Comprehensive Network Site of the US/IBP Grassland Biome Program. Abiotic, producer, consumer, and decomposer aspects of the annual grassland ecosystem are being monitored throughout the year. Thus previously little-known aspects, such as belowground biomass, invertebrates, and decomposers are now being studied and preliminary results are furnishing clues toward a better understanding of the ecosystem's structure and function.

This publication updates earlier bibliographies by Reppert and Green (1958) and Sanderson and Duncan (1966) and includes works by staff members and cooperators who carried out studies at, or in conjunction with, the Experimental Range from 1934 through 1973. It lists primarily works available in public and university libraries; a few unpublished works are listed to make it a more useful compilation. The bibliography

is arranged alphabetically by senior author. Each entry is numbered consecutively for cross-indexing in the subject and author indices.

Literature Cited

Reppert, J. N., and L. R. Green. 1958. Annotated bibliography of publications from the San Joaquin Experimental Range. U.S. Forest Serv. Calif. Forest and Range Exp. Sta. Tech. Paper 27. 32 p.

Sanderson, H. R., and D. A. Duncan. 1966. Publications from the San Joaquin Experimental Range, 1935-1965. USDA Forest Service Unnumbered Publ. Pacific Southwest Forest and Range Exp. Sta., Berkeley, Calif. 30 p.

AUTHOR INDEX

SUBJECT INDEX

(1) Aigner, D. J. 1965. An estimation procedure for range composition problems. Am. Statist. Assoc. J. 60(309):308-319 + illus.

Describes a procedure that allows considerable savings in field sampling time for estimating species composition by weight.

(2) Augustson, G. F., and S. F. Wood. 1953. Notes on California mammal ectoparasites from the Sierra Nevada foothills of Madera County. Bull. South. Calif. Acad. Sci. 52(2):48-56.

Lists 21 species of ectoparasites found on 520 mammal hosts, including man.

(3) Benson, L., E. A. Phillips, P. A. Wilder, and others. 1967. Evolutionary sorting of characters in a hybrid swarm. I. Direction of slope. Am. J. Bot. 55:1017-1026.

A blue oak population on the San Joaquin Experimental Range was used as a control in comparing with some hybrid populations elsewhere.

(4) Bentley, J. R. 1941. Some characteristics of the annual type range of central California. Utah Juniper 12:12-14.

Describes the annual-type range and compares it with the perennial range.

(5) Bentley, J. R. 1943. Reseeding trials in Sierra Nevada foothills. West. Livestock J. 21(49):44, 46-48, 50-51, illus.

Reviews nursery trials, and discusses several annual and perennial range forage species that showed promise from the 250 species tested.

(6) Bentley, J. R. 1946. Range fertilization--one means of improving range forage. Calif. Cattleman. 1946 (Sept.):6-24 + illus.

Fertilization of annual-type ranges, particularly with gypsum, gave more promise of positive results than any other cultural practices studied.

(7) Bentley, J. R. 1946. Forage species tested for more extensive reseeding trials on central California rangelands. U.S. Forest Serv., Calif. Forest and Range Exp. Sta., Forest Res. Note 48. 13 p.

Recommends further plantings of 75 species which looked promising in nursery and extensive field trials.

(8) Bentley, J. R., and R. F. Buttery. 1957. Bumper forage crops--It takes more than just high rainfall. West. Livestock J. 35(47):152-154 + illus.

Review of past precipitation records and herbage production date reveals the prime importance of timely rainfall distribution to insure abundant herbage production.

(9) Bentley, J. R., and R. L. Fenner. 1958. Soil temperatures during burning related to postfire seedbeds on woodland range. J. Forest. 56(10):737-740 + illus.

Depth of charring and incineration within the mineral soil proved better criteria than did surface appearances for judging soil temperatures reached and favorable conditions for postfire seeding.

(10) Bentley, J. R., and L. R. Green. 1954. Stimulation of native annual clovers through application of sulfur on California foothill range. J. Range Manage. 7(1):25-30 + illus.

Increased production of both clovers and grasses was obtained at relatively small expense by fertilization of the range.

(11) Bentley, J. R., L. R. Green, and K. A. Wagnon. 1958. Herbage production and grazing capacity on annual-plant range pastures fertilized with sulfur. J. Range Manage. 11(3):133-140 + illus.

Sulfur fertilization of two pastures increased herbage production by 57% and 59% over two unfertilized pastures. It increased grazing capacity by about 50%.

(12) Bentley, J. R., and M. W. Talbot. 1945. How many head? Moderate grazing best range practice for plant life. West. Livestock J. 23(43):21, 40 + illus.

Study of the effects of intensity of grazing upon range plants shows a moderate degree of use to be most satisfactory in maintaining the forage resource.

(13) Bentley, J. R., and M. W. Talbot. 1948. Annual-plant vegetation of the California foothills as related to range management. Ecology 29(1):72-79 + illus.

Reviews the characteristics of the California annual-type range and emphasizes the importance of basing range management upon the annual vegetation.

(14) Bentley, J. R., and M. W. Talbot. 1950. Seeding burns--value of proper improved range management cited. West. Livestock J. 28(64):60-61.

Seeding a burn is a tool in converting dense brushland to open grassland as well as for improving the quality of growing herbage.

(15) Bentley, J. R., and M. W. Talbot. 1951. Efficient use of annual plants on cattle ranges in the California foothills. U.S. Dep. Agric. Circ. 870. 52 p. + illus.

Provides data from which recommendations can be made concerning fitting ranch operations to forage growth, adjusting ranch stocking to herbage production, and selecting the most efficient degree of grazing.

(16) Biswell, H. H. 1939. A change in our California forage plants. Calif. Cattleman 1939 (Sept.):4-5.

Whether a change has taken place from a perennial-type to the present annual-type since the coming of white man is difficult to determine, but an influx of introduced annuals has occurred.

(17) Biswell, H. H. 1940. Subterranean clover growing well at the San Joaquin Experimental Range. Calif. Wool Grower 16(39):4-5.

Describes strains of a promising range plant introduced into Australia from Europe then to the United States. Reports findings from Australia and California. Makes recommendations for further testing.

(18) Biswell, H. H., and C. A. Graham. 1956. Plant counts and seed production on California annual-type ranges. J. Range Manage. 9(3):116-118 + illus.

Counting seedlings and mature plants in this type was found to have limited inventory value because of the great numbers of plants and the time required for counting. Production of seed was high under normal weather and grazing conditions.

(19) Biswell, H. H., and J. F. Street. 1948. Range brush studies and control methods. Calif. Cattleman 1948 (Dec.):23-24.

Recommends burning or cutting to keep stands of wedgeleaf ceanothus from becoming dense.

(20) Brock, E. M., and W. E. Howard. 1962. How to control snakes. Pest Control 30(8):30, 32, 34, 36 + illus.

Describes various methods for keeping snakes out of homes and gardens.

(21) Buttery, R. F., and L. R. Green. 1958. A checklist of plants of the San Joaquin Experimental Range. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Misc. Paper 23. 32 p.

Lists local flora, telling of the abundance and habitat for each species.

(22) California Forest and Range Experiment Station. 1936. San Joaquin Experimental Range--a research area for investigation of problems of foothill range management in central California. U.S. Forest Serv. 11 p. + illus.

Tells of the need for intensive study of problems related to California foothill range management. Discusses the first research projects at the Experimental Range.

(23) Carneggie, D. M. 1965. Herbage growth of four California annual range plants in response to frequency and time of clippings. M.S. Thesis. Univ. California, Berkeley. 61 p.

Discusses the growth pattern and herbage yield of Bromus rigidus, B. mollis, Trifolium microcephalum, and Erodium botrys. Considers the effect of herbage removal at different dates and frequencies on the growth rate and herbage yield of B. rigidus and E. botrys.

(24) Carneggie, D. M., S. D. Degloria, and R. N. Colwell. 1974. Usefulness of ERTS-1 and supporting aircraft data for monitoring plant development and range conditions in California's annual grassland. Remote Sensing Research Program, School of Forestry and Conservation, Univ. California, Berkeley. 53 p.

Documents research findings from the analysis of Earth Resource Technology Satellite (ERTS) imagery and ground data collected at 16 sites (including the San Joaquin Experimental Range) within the annual grassland of California for the 1972-1973 growing season.

(25) Childs, H. E., Jr. 1952. The kangaroo rat preyed upon by the Sparrow Hawk. J. Mammal. 33(4):493-494.

Records the observation of a diurnal bird preying upon a nocturnal mammal.

(26) Childs, H. E., Jr. 1953. Selection by predation on albino and normal spadefoot toads. Evolution 7(3):228-233 + illus.

Reports statistically significant reduction in the albino form of tadpoles owing to natural predation by racoons.

(27) Childs, H. E., Jr., and W. E. Howard. 1955. The vertebrate fauna of the San Joaquin Experimental Range. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Misc. Paper 19. 20 p.

Provides a listing of the vertebrate fauna and brief notes on its abundance.

(28) Clifton, W. 1958. Range studies show...improving rangeland is good investment. Calif. Farmer 208(5):250 + illus.

Reports a 14% gross annual return from costs of $25 per acre for converting brushland range to grass, with about a 133% increase in range carrying capacity--based on a 3-year record.

(29) Cohen, N. W. 1951. California condors in Madera County, California. Condor 53(3):158.

Reports the observation of nine of the rare birds passing over the Experimental Range.

(30) Cohen, N. W., and W. E. Howard. 1958. Bullfrog food and growth at the San Joaquin Experimental Range, California. Copeia (3):223-235 + illus.

Bullfrogs appeared to be omnivorous. Their life cycle from egg through metamorphosis was completed in about 6 or 7 months during successive dry years.

(31) Cohen, N. W., and S. F. Wood. 1953. Vertebrate census of an earth, stone, concrete check dam at the San Joaquin Experimental Range. Bull. South. Calif. Acad. Sci. 52(1):35-37 + illus.

The removal of a granite boulder, earth-fill dam afforded the opportunity to list the 16 species of vertebrate fauna found in the structure.

(32) Conrad, C. E., and C. A. Graham. 1967. Brush control--an unfinished job. J. Range Manage. 20(2):84-88.

A series of photographs from 1952 to 1965 illustrate a common fault of many so-called brush control jobs--a good start but no follow through.

(33) Conrad, C. E., and W. G. O'Regan. 1973. Two-stage stratified sampling to estimate herbage yield. USDA Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-278. Berkeley, Calif. 5 p.

A two-stage stratified procedure for sampling herbage yield is described. In stage one, plots are stratified; in stage two, selected plots are clipped, and the clippings are weighed. Equations were developed to calculate the mean and variance of the mean. To achieve minimum variance when time for sampling is limited, equations were developed for determining the sample size and the distribution of the plots between stages one and two. The procedures were demonstrated by using data from the San Joaquin Experimental Range. Results showed that two-stage sampling could produce a 15% reduction in variance of mean weight compared with that from simple random sampling.

(34) Conrad, C. E., and M. J. Reed. 1962. Automatic data processing of range vegetation information. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PWS-201. Berkeley, Calif. 5 p. + illus.

More than 2.25 man-months of field and laboratory time were saved in 1961 compared to earlier years in a large-scale continuing study of vegetation.

(35) Conrad, C. E., and M. J. Reed. 1963. Cattle weights and punch cards--a weight form and procedure in use in California range research, p. 50-51. In 16th Annu. Meeting, Am. Soc. Range Manage., Rapid City, S. Dakota. (Abstr.)

Describes an efficient procedure used at the Experimental Range for reducing large amounts of cattle performance and related range data from grazing studies.

(36) Conrad, C. E., E. J. Woolfolk, and D. A. Duncan. 1966. Fertilization and management implications on California annual-plant range. J. Range Manage. 19(1):20-26.

Reports interim results of long-term range fertilization studies. Some of the effects these results may have on the costs of grazing cattle, especially in the green-forage season, are discussed.

(37) Countryman, C. M., and M. J. Schroeder. 1958. Prescribed burn fireclimate survey 1-57. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Tech. Paper 29. 14 p. + illus.

Observes that there can be an increase in wind speed on the lee side of a fire under some conditions in the lower foothills of the central Sierra Nevada.

(38) Duncan, D. A. 1965. Grazing management on annual plant rangeland. 1st Annu. Range Improvement Conf., Proc. Stockman's Weekly 6(34):1, 4-5.

Outlines grazing management studies underway at the San Joaquin Experimental Range on both fertilized and natural foothill rangeland, and summarizes major results.

(39) Duncan, D. A. 1967a. Blue oak canopy effect on herbage yield of central California foothill rangeland, p. 61-62. In 20th Annu. Meeting, Am. Soc. Range Manage., Seattle, Wash. (Abstr.)

Contrary to popular belief and published information from other areas, blue oak (Quercus douglasii) trees on the San Joaquin Experimental Range are an asset instead of a liability in terms of herbage production under canopies.

(40) Duncan, D. A. 1967b. How range fertilization can increase forage and beef yields, p. 1-6. In X Anniversario Centro Nacional de Investigacciones Pecurias, S.A.G., Memorias de la Session Technica, Chihuahua, Mexico.

Reports on using range fertilization to increase forage and beef yields.

(41) Duncan, D. A. 1968. Food of California Quail on burned and unburned central California foothill rangeland. Calif. Fish and Game 54(2):123-127.

Provides some facts on the sometimes controversial subject of the effects of fire on wildlife. There was little difference in food taken by quail on burned and unburned areas.

(42) Duncan, D. A. 1971a. Save a nickel, save a dime. West. Livestock J. (Mountains, Plains, Southwest Ed.) 49(10):97; West. Livestock J. (Pacific Slope Ed.) 49(64):42.

Fence posts of local or nearby species (on the San Joaquin Experimental Range) held up when treated; when not treated most rotted rapidly.

(43) Duncan, D. A. 1971b. Integration of cattle grazing and production of California Quail on foothill rangeland, p. 23. In 24th Annu. Meeting, Am. Soc. Range Manage., Reno, Nevada. (Abstr.)

Years of data on quail food and reproductive success on grazed areas indicate good range management is good quail management in one area of the foothills.

(44) Duncan, D. A. 1974. Vegetation and cattle responses to fertilization and season of grazing at the San Joaquin Experimental Range, California. Ph.D. Diss. Univ. Wyoming, Laramie. 73 p.

Results of a 9-year study showed nearly all animal gain occurred in the green season, regardless of fertilizer treatment. Nitrogen fertilization resulted in the greatest increase in total herbage production and steer-gain per acre, but was questionable from the economic viewpoint. Weather had a pronounced effect on both herbage yield and composition.

(45) Duncan, D. A. 1975. San Joaquin Site of the Grassland Biome; its relation to annual grassland ecosystem synthesis, p. 30. In Proceedings of the 1975 California Plant and Soil Conference Calif. Chap., Am. Soc. Agron., Anaheim, Calif.

Highlights preliminary information on producer, consumer, and abiotic components of the ecosystem collected on the San Joaquin Site during 1973 and 1974.

(46) Duncan, D. A., and S. L. Anderson. 1961. Portable feeders for range grazing studies. J. Range Manage. 14(3):159-160 + illus.

Describes two feeders--one commercial and one homemade.

(47) Duncan, D. A., and S. L. Anderson. 1963. Chronicle of a great feed year in the Golden State. West. Livestock J. 41(49):3.

Extension of rains into late April 1963 produced unusually heavy herbage yields and doubled grazing capacity on foothill ranges.

(48) Duncan, D. A., and C. E. Conrad. 1964. Vegetation and cattle responses to fertilization on central California foothill range, p. 36-37. In 17th Annu. Meeting, Am. Soc. Range Manage., Wichita, Kansas. (Abstr.)

Reports interim results of range fertilization studies, particularly the significant effect of the weather each year on vegetation and cattle responses.

(49) Duncan, D. A., and H. F. Heady. 1969. Grazing systems in the California annual type, p. 23-24. In 22nd Annu. Meeting, Am. Soc. Range Manage., Calgary, Alberta, Canada. (Abstr.)

Grazing systems as such have not proven effective on annual-plant ranges; yearlong grazing is more productive.

(50) Duncan, D. A., and L. O. Hylton, Jr. 1970. Effects of fertilization on quality of range forage, p. 57-62. In USDA Misc. Publ. No. 1147.

A review paper which summarized literature and pointed out the critical need for more standardization of techniques, units of reporting, etc.

(51) Duncan, D. A., and M. J. Reed. 1973. Yearlong tops seasonal grazing in extended rangeland study. West. Livestock J. 51(21):32, 53.

Reports important cattle results from long-term study. In contrast to many perennial-grass areas, yearlong grazing proved far superior to other seasonal systems of grazing in terms of cattle responses on annual-plant ranges.

(52) Duncan, D. A., and J. N. Reppert. 1960. A record drought in the foothills. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Misc. Paper 46. 6 p. + illus.

Very low rainfall at the Experimental Range during 1959 reduced range herbage production to less than half of average and the adequate green grazing season from 18 to 11 weeks.

(53) Duncan, D. A., and J. N. Reppert. 1961. Even dry--fertilized ranges produce more meat. West. Livestock J. 39(35):15 + illus.

Despite severe drought in the 1959 growing season, sulfur fertilization caused moderate increases in cattle weight gains during the dry forage season. Nitrogen-plus-sulfur more than tripled herbage yield and animal days of grazing per acre and doubled amount of animal gain.

(54) Duncan, D. A., and J. N. Reppert. 1966. Helicopter fertilization of foothill range. USDA Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-108. Berkeley, California. 3 p.

Helicopters may prove the best method of applying sulfur fertilization on rangeland too steep for ground application or with no nearby landing strip for fixed-wing aircraft. Helicopter fertilization of 457 acres in 1960 and 1963 was fast and practical.

(55) Duncan, D. A., and P. W. Shields. 1966. Fall-winter food of California Quail as influenced by weather, p. 93-100. In 1966 Trans., California-Nevada Section, The Wildlife Soc.

First report of a long-term effort to gain insight into quail diets on foothill rangeland, with emphasis on the vital rate of each year's weather on food availability.

(56) Duncan, D. A., and H. W. Wolfram. 1970. Fenceposts butt-soaked in pentachlorophenol still sound after 22 years. USDA Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-221. Berkeley, California. 3 p.

Seventeen types of fenceposts from 15 trees species were examined after being in place for 22 years on the Experimental Range. The half of each type that had been treated were mostly still sound and serviceable; the untreated half had all rotted except the manzanita and split incense-cedar heartwood.

(57) Duncan, D. A., and R. G. Woodmansee. 1975. Forecasting forage yield from climatic variables in California's annual-plant rangeland. J. Range Manage. 28(4):327-329.

Total forage yield from 1936 to 1970 and yields of grasses, legumes, and forbs other than legumes for 24 years on the same area on the San Joaquin Experimental Range in central California were correlated with total annual precipitation and combinations of the best 2 and 3 months. Yield of components of the vegetation were only poorly correlated with any month's or annual rainfall.

(58) Emlen, J. T., Jr., and B. Glading. 1938. California ground squirrel robs nest of Valley Quail. Condor 40(1):41-42.

A ground squirrel repeatedly returned to a quail nest and removed eggs despite attacks by the parent quail.

(59) Fitch, H. S. 1940. Some observations on Horned Owl nests. Condor 42(1):73-75.

Observations made of five nests revealed loss of young owing to weather, predators, and unsanitary conditions caused by uneaten prey.

(60) Fitch, H. S. 1941. The feeding habits of California garter snakes. Calif. Fish and Game 27(2):2-32 + illus.

Discusses field behavior, habitat preference, and feeding habits of 10 different garter snakes.

(61) Fitch, H. S. 1947a. Ecology of a cottontail rabbit (Sylvilagus auduboni) population in central California. Calif. Fish and Game 33(3):159-184 + illus.

Reports that the rabbit is an important prey of many mammals, birds, and snakes.

(62) Fitch, H. S. 1947b. Predation by owls in the Sierran foothills of California. Condor 49(4):137-151 + illus.

Presents a breakdown of mammals, birds, reptiles, amphibians, invertebrates, and carrion consumed by the Horned Owl, Barn Owl, and Red-tailed Hawk.

(63) Fitch, H. S. 1947c. Ground squirrels...mean destroyed forage. West. Livestock J. 25(60):37, 109-110, 112.

Reports that ground squirrels may account for a loss of 1,000 pounds per acre of the herbage crop when at the abnormally high population of 12 per acre.

(64) Fitch, H. S. 1948a. Habits and economic relationships of the Tulare kangaroo rat. J. Mammal. 29(1):5-35 + illus.

Finds that the Tulare kangaroo rat is of minor economic importance, compared to the ground squirrel and pocket gopher.

(65) Fitch, H. S. 1948b. A study of coyote relationships on cattle range. J. Wildl. Manage. 12(1):73-78.

Coyotes had little effect on ground squirrel, cottontail, kangaroo rat, or gopher populations.

(66) Fitch, H. S. 1948c. Ecology of the California ground squirrel on grazing lands. Am. Midl. Nat. 39(3):513-596 + illus.

An intensive study involving census counts, feeding records, and general observations show ground squirrel competition with livestock to be most severe during late fall, winter, and spring.

(67) Fitch, H. S. 1949. Study of snake populations in central California. Am. Midl. Nat. 41(3):513-579 + illus.

Discusses nine species of snakes which occur on the Experimental Range; deals mostly with the abundant rattlesnake and gopher snake.

(68) Fitch, H. S., and J. R. Bentley. 1949. Use of California annual-plant forage by range rodents. Ecology 30(3):306-321 + illus.

Use of forage by ground squirrels, gophers, and kangaroo rats in a typical range population accounted for one-third of the annual herbage crop.

(69) Fitch, H. S., and B. Glading. 1947. A field study of a rattlesnake population. Calif. Fish and Game 33(2):103-123 + illus.

Relates information on the growth, movement, seasonal habits, and feeding of rattlesnakes.

(70) Fitch, H. S., B. Glading, and V. House. 1946. Observations on Cooper Hawk nesting and predation. Calif. Fish and Game 32(3): 144-154 + illus.

A Cooper Hawk nest was closely watched from incubation until young were raised.

(71) Fitch, H. S., F. Swenson, and D. F. Tillotson. 1946. Behavior and food habits of the Red-tailed Hawk. Condor 48(5):205-237 + illus.

Describes in detail the many activities of this resident of the Digger pine belt.

(72) Fitch, H. S., and H. Twining. 1946. Feeding habits of the Pacific rattlesnake. Copeia (2):64-71.

Stomach and scat examinations were used to determine diet. Ground squirrels were the most common food.

(73) Fitch, H. S., and K. A. Wagnon. 1947. Rattlesnakes on the range. Pac. Stockman 13 (6):8-9 + illus.

Discusses weight loss and deaths in cattle herds caused by rattlesnakes.

(74) Gaylord, V. J. 1972. A method for the correlation of range sites with land association classes in the Sierra foothills. M.S. Thesis. Fresno State College, Fresno. 32 p.

Proposes a method for correlating information from the original range sites and capability classification mapping of the San Joaquin Experimental Range with a later Soil Conservation Series land association mapping of the area.

(75) Gaylord, V. J., and S. E. Westfall. 1971. Wedgeleaf ceanothus canopy does not affect total herbage yield. USDA Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-253. Berkeley, California. 4 p.

The canopy effect of Ceanothus cuneatus did not significantly affect total herbage yield, but yields of individual species were affected.

(76) Glading, B. 1938a. A male California Quail hatches a brood. Condor 40(6):261.

A male California Quail was observed hatching and caring for a brood after the death of the female.

(77) Glading B. 1938b. Studies on the nesting cycle of the California Valley Quail in 1937. Calif. Fish and Game 24(4):318-340 + illus.

Describes courting and nesting behavior, nesting cover, number of nests, size of the clutch, and predator relationships of the California Valley Quail.

(78) Glading, B. 1941. Valley Quail census methods and populations at the San Joaquin Experimental Range. Calif. Fish and Game 27(2):33-38 + illus.

Describes the "horseback" method of Valley Quail census, which gives an estimated 90% accuracy when used in relatively open country after birds are in definite coveys and if the weather is suitable.

(79) Glading, B., H. H. Biswell, and C. F. Smith. 1940. Studies on the food of the California Quail in 1937. J. Wildl. Manage. 4(2): 128-144 + illus.

Reports the plant species and parts that make up the diet of quail at various seasons of the year; develops an expression of relative "desirability" for quail foods.

(80) Glading, B., and R. W. Saarni. 1944. Effect of hunting on a Valley Quail population. Calif. Fish and Game 30(2):71-79.

Hunting a known quail population by a known number of hunters showed that the quail population withstood an annual bag kill of 25%.

(81) Gordon, A., and A. W. Sampson. 1939. Composition of common California foothill plants as a factor in range management. Calif. Agric. Exp. Sta. Bull. 627. 95 p. + illus.

Reports the chemical composition of many plant species collected at various growth stages, including fluctuations in crude protein, silica-free ash, calcium, phosphorus, potassium, and crude fiber for species of grasses, grasslike plants, broad-leaved herbs, deciduous shrubs and trees, half-shrubs, and nondeciduous shrubs.

(82) Graham, C. A. 1956. Some reactions of annual vegetation to fire on Sierra Nevada foothill rangeland. M.S. Thesis. Univ. California, Berkeley. 26 p.

Reports that total forage yield was substantially reduced the first year after burning, mainly because of the adverse effect upon grass plants. Recommends only spring grazing during this first year of low production.

(83) Graham, C. A. 1958. Killing brush sprouts on open woodland range in California. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Forest Res. Note 136. 5 p. + illus.

Chemical control of brush sprouts following controlled burning was shown to be most effective and still economical if done for 3 years.

(84) Graham, C. A. 1964. Costs and returns of brush range improvement in central California. In 17th Annu. Meeting, Am. Soc. Range Manage., Wichita, kansas. (Abstr.)

Brush was cleared from four small range units totaling 120 acres. Costs of clearing and increased grazing and livestock production were evaluated.

(85) Green, L. R. 1959. Some effects of sulfur fertilization on nodulation and growth of annual range legumes. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-156. Berkeley, California. 7 p.

Reports increased numbers and size of root nodules along with increased top growth.

(86) Green, L. R., and J. R. Bentley. 1954. Some costs and returns from applying sulfur fertilizers on rangeland. Calif. Cattleman 1954 (May):8-9 + illus.

Reports economical results fertilizing extensive acreages of rangeland.

(87) Green, L. R., and J. R. Bentley. 1957. Seeding and grazing trials of Stipa on foothill ranges. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Forest Res. Note 128. 9 p. + illus.

Two seeded species of native Stipa have competed well with the annuals for 11 years. Fall and winter grazing of Stipa is recommended.

(88) Green, L. R., and D. R. Cornelius. 1957. Pampasgrass in the Sierra foothills. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Forest Res. Note 132. 7 p. + illus.

This perennial plant shows promise of providing green forage in the summer and fall where summer moisture is available in deep, medium to fine textured soils.

(89) Green, L. R., and C. A. Graham. 1957. Observations on growth and control of tarweed. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Forest Res. Note 130. 8 p. + illus.

Good results were obtained in tarweed control by both mowing in early full flowering stage and broadcast chemical spraying.

(90) Green, L. R., and C. A. Graham. 1958. Annual legumes on granitic soil in the central Sierra foothills. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Tech. Paper 24. 11 p. + illus.

Stands of introduced annual legumes have been successfully established only on bottomland soils. Fertilization of native clovers offers the best possibility of forming a legume range.

(91) Green, L. R., and K. A. Wagnon. 1954. Sulfur fertilization at the San Joaquin Experimental Range. Calif. Livestock News 30(3):3-4.

Sulfur fertilization resulted in increased grass, legume, and forb production but decreased filaree production with an overall increase in grazing capacity. A change in cattle diet favored more clover and less grass.

(92) Green, L. R., K. A. Wagnon, and J. R. Bentley. 1958. Diet and grazing habits of steers on foothill range fertilized with sulfur. J. Range Manage. 11(5):221-227 + illus.

Fertilization produced desirable changes in species production and chemical composition in turn influenced the diet and grazing habits of steers.

(93) Guilbert, H. R. 1941. Grass...brings best returns when supplemented. West. Livestock J. 20(1):18-20 + illus.

Relates the advantages of supplementing on the range.

(94) Guilbert, H. R. 1942. Supplemental feeding of range cattle. Pac. Stockman 8(6):5, 11 + illus.

Outlines an economical method for obtaining good calf crops, animal gains, and quality of product on nutritively inadequate dry range forage.

(95) Guilbert, H. R. 1943. Producing beef for war needs. West Livestock J. 21(17):24, 26.

Advises a high level of nutrition for cattle on the range to obtain continuous growth and more efficient use of the range, time and manpower.

(96) Guilbert, H. R., G. H. Hart, and K. A. Wagnon. 1948. Value of urea tested as a partial substitute for protein in range supplemental feeding. Calif. Agric. 2(2):10, 13.

Describes experimental data concerning the partial substitution of urea (nonprotein nitrogen) for protein in the diet of range cattle.

(97) Guilbert, H. R., G. H. Hart, K. A. Wagnon, and H. Goss. 1944. The importance of continuous growth in beef cattle. Calif. Agric. Exp. Sta. Bull. 688. 35 p. + illus.

Data and photographs stress the desirability of supplementing the diet of steers during the dry season from July to January to obtain continuous growth.

(98) Guilbert, H. R., and K. A. Wagnon. 1938. Supplemental feeding of steers on range profitable in California experiment. West. Livestock J. 17(4):14.

Three years of data show how range supplementing can be economical.

(99) Guilbert, H. R., K. A. Wagnon, and G. H. Hart. 1943. Continuous growth important in beef production. West. Livestock J. 22(7):13, 30-31.

Stresses the importance and method of obtaining a continuous gain of 1 to 1.25 pounds per head per day when wintering young cattle.

(100) Guilbert, H. R., K. A. Wagnon, and G. H. Hart. 1944. Finishing steers and heifers on the range. Pac. Stockman 10(10):17-18 + illus.

Feeding supplements to cattle upon the range to promote continuous growth after weaning can be a method of marketing finished animals from the range.

(101) Guilbert, H. R., A. Wahid, K. A. Wagnon, and P. W. Gregory. 1948. Observations of pigmentation of eyelids of Hereford cattle in relation to occurrence of ocular epitheliomas. J. Anim. Sci. 7(4):426-429.

Suggests breeding for red around the eyes to lessen susceptibility of cattle to this important malady.

(102) Hart, G. H., H. R. Guilbert, and K. A. Wagnon. 1945. Supplemental feeding--how much gain? Pac. Stockman 11(11):9, 34.

Experimental evidence shows the desirability of securing continuous growth by supplemental feeding during the deficient dry forage season.

(103) Hart, C. H., H. R. Guilbert, K. A. Wagnon, and H. Goss. 1947. "Acorn calves" a nonhereditary congenital deformity due to maternal nutritional deficiency. Calif. Agric. Exp. Sta. Bull. 699. 24 p. + illus.

Acorn calf condition is nonhereditary and instead is caused by maternal nutritional deficiency.

(104) Hart, G. H., and K. A. Wagnon. 1943. Does slaughter of pregnant cows reduce poundage of beef and financial returns? West. Livestock J. 22(1):86, 88.

Study of six animals revealed the economic advantages for holding pregnant cows for sale after calves are produced.

(105) Hart, G. H., K. A. Wagnon, and H. R. Guilbert. 1945a. How many head? Overstocking range cuts profits in cattle production. West. Livestock J. 23(22):19, 77-79 + illus.

Discusses the effects of intensity of grazing upon the animals, and recommends moderate to close use of California annual-type ranges.

(106) Hart, G. H., K. A. Wagnon, and H. R. Guilbert. 1945b. Factors in culling range breeding herds. Pac. Stockman 11(5):4, 8, 16.

Stresses the importance of keeping accurate records of the performance of individual cows and calves as a means of making wise choices for culling.

(107) Hart, G. H., K. A. Wagnon, and H. R. Guilbert. 1946. Calf crop percentage variations. West. Livestock J. 24(27):40.

Discusses the advantages of feeding a beef breeding herd supplements on California annual-plant range.

(108) Herman, C. M., and J. E. Chattin. 1943. Epidemiological studies on coccidiosis of California Quail. Calif. Fish and Game 29(4):168-179 + illus.

Indicates that the incidence of infection was often large, ranging upward to more then 90% of the birds.

(109) Herman, C. M., and B. Glading. 1942. The protozoan blood parasite Haemoproteus lophortyx O'Roke in quail at the San Joaquin Experimental Range, California. Calif. Fish and Game 28(3): 150-153 + illus.

Reports the presence of the infection in 84% of the 503 quail examined.

(110) Herman, C. M., and H. A. Jankiewicz. 1943. Parasites of cottontail rabbits on the San Joaquin Experimental Range, California. J. Wildl. Manage. 7(4):395-400.

Describes many types of internal parasites found in rabbits.

(111) Herman, C. M., H. A. Jankiewicz, and R. W. Saarni. 1942. Coccidiosis in California Quail. Condor 44(4):168-171.

Fecal droppings examined demonstrated the presence of coccidian infection in quail.

(112) Holland, V. L. 1969. Canopy effect of Quercus douglasii H. & A. M.A. Thesis. Fresno State College, Fresno. 71 p.

Soil and other factors under the blue oak canopies result in conditions more favorable for plant growth and local annuals grow taller and denser inside the canopy.

(113) Holland, V. L. 1974. A study of soil and vegetation under Quercus douglasii H. & A. compared to open grassland. Ph.D. Diss. Univ. California, Berkeley. 369 p.

Primary sites for field studies were the San Joaquin Experimental Range and the University of California Hastings Natural History Reservation where detailed data on frequency, vegetation density, productivity, etc., were collected under oak canopies and outside. A number of laboratory, greenhouse, and environmental chamber investigations were carried out. Vegetation under canopies was quite different from that in open areas, as was the soil.

(114) Hormay, A. L. 1944. Moderate grazing pays on California annual-type ranges. U.S. Dep. Agric. Leaflet 238. 8 p. + illus. (Revised 1946, 1960)

Relates advantages of moderate grazing and gives standards for judging different degrees of range use.

(115) Hormay, A. L., and J. R. Bentley. 1949. The land-variability factor in cattle-grazing experiments, p. 465-467. In Proceedings of the Berkeley Symposium on Mathematical Statistics and Probability. Univ. California Press, Berkeley.

Discusses the many variables encountered in a range research study and suggests a new statistical approach to future experiments.

(116) Hormay, A. L., and A. Fausett. 1942. Standards for judging the degree of forage utilization of California annual-type ranges. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Tech. Note 21. 13 p. + illus.

Provides a pictorial and word description of degree of forage use and range condition.

(117) Horn, E. E., and H. S. Fitch. 1942. Interrelationships of rodents and other wildlife of the range, p. 96-129. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

Describes cooperative studies to determine the economic importance and interrelationships of wildlife, with emphasis on rodents, which have bearing on the question of grazing and land utilization of foothill range.

(118) Horn, E. E., and H. S. Fitch. 1946. Trapping the California ground squirrel. J. Mammal. 27(3):220-224 + illus.

Describes a wire box trap with a sensitive pendulous trigger used successfully to catch the wary ground squirrel.

(119) Howard, W. E. 1949. Gopher snake killed trying to swallow cottontail. Copeia 4:289 + illus.

Notes a factor which may occasionally account for some deaths of snakes.

(120) Howard, W. E. 1950a. Birds as bullfrog food. Copeia 2:152.

Briefly reports observing a frog catch and ingest a Brown Towhee.

(121) Howard, W. E. 1950b. Wildlife depredations on broadcast seedings of burned brushlands. J. Range Manage. 3(4):291-298 + illus.

Failure of broadcast seedings because of depredations by rodents, birds, and harvester ants may be prevented by treating the seed coats with yellow dye and Compound 1080.

(122) Howard, W. E. 1951a. Poison-dye combinations can save brush burn seedings from wildlife. Calif. Cattleman 1951 (Feb.): 14-16.

Coating seeds with yellow dye and Compound 1080 prevented losses caused by birds, rodents, and harvester ants.

(123) Howard, W. E. 1951b. Wildlife control--depredations on seedings require protective action. West. Livestock J. 29(27):92-94.

Reports treatment procedures and precautions for Compound 1080 and strychnine to be used in treatment of range seeds.

(124) Howard, W. E. 1951c. Relation between low temperature and available food to survival of small rodents. J. Mammal. 32(3):300-312.

Explains the effects of insufficient food intake and cold weather in causing "cold weather" starvation.

(125) Howard, W. E. 1952a. A live trap for pocket gophers. J. Mammal. 33(1):61-65 + illus.

Describes an improved gopher trap which can be placed in the soil before being set and can be checked as to whether the trap is sprung without digging it up.

(126) Howard, W. E. 1952b. Concerning our predators. Calif. Farmer 196(4):184-185.

Outlines predator-prey relationships, with considerable application of studies conducted at the Experimental Range.

(127) Howard, W. E. 1952c. The pesky pocket gopher. Spreckels Sugar Beet Bull. 16(3):21-22 + illus.

Describes the activities and effects of California's most important burrowing rodent.

(128) Howard, W. E. 1953a. Tests of pocket gophers gnawing electric cables. J. Wildl. Manage. 17(3):296-300 + illus.

Indicates that pocket gophers are able to gnaw through non-metallic armored cables and soft metallic armor but not certain harder metals and small wires.

(129) Howard, W. E. 1953b. A trigger mechanism for small mammal live traps. J. Mammal. 34(4):513-514.

Describes a triggering device that is simple to construct, easy to repair, and free from the floor of the trap.

(130) Howard, W. E. 1953c. Rodent control on California ranges. J. Range Manage. 6(6):423-434.

Discusses the interrelations between rodents, predators, and man upon rangeland.

(131) Howard, W. E. 1957a. Melanism in Peromyscus boylei. J. Mammal. 38(3):417.

Reports the finding of a completely black, female white-footed mouse.

(132) Howard, W. E. 1957b. Amount of food eaten by small carnivores. J. Mammal. 38(4):516-517.

The daily intake of rodents and birds was determined with three caged carnivores: the ring-tailed cat, house cat, and long-tailed weasel.

(133) Howard, W. E. 1958. Food intake and pellet formation of a Horned Owl. Wilson Bull. 70(2):145-150.

Average daily intake of a captive owl about equaled 10% of its body weight; pellet size and frequency varied inversely in relation to size of prey.

(134) Howard, W. E. 1959a. California ground squirrel breeding in captivity. J. Mammal. 40(3):445-446.

The success of one of two females mating and rearing young is attributed to starting with subadult females and providing a fairly large cage.

(135) Howard, W. E. 1959b. Survival of hamsters on California rangeland. J. Mammal. 40(4):613.

Domesticated golden hamsters could become a serious pest if favorable food and cover are available where the animals are released and if they are not controlled before starting to breed.

(136) Howard, W. E. 1960. Innate and environmental dispersal of individual vertebrates. Am. Midl. Nat. 63(1):152-161 + illus.

Discusses dispersal movements of several rodents at the Experimental Range, and reviews dispersion studies by others.

(137) Howard, W. E., and E. M. Brock. 1961. A drift-fence pit trap that preserves captured rodents. J. Mammal. 42(3):386-391 + illus.

Small rodents follow lead fences of hardware cloth, enter a trap, fall through a trap door, and are preserved in alcohol or formalin.

(138) Howard, W. E., and H. E. Childs, Jr. 1959. Ecology of pocket gophers with emphasis on Thomomys bottae mewa. Hilgardia 29(7):277-358 + illus.

Reports on the life history and ecology of the Digger pine pocket gopher.

(139) Howard, W. E., R. L. Fenner, and H. E. Childs, Jr. 1959. Wildlife survival in brush burns. J. Range Manage. 12(5):230-234 + illus.

Suggests little chance of vertebrates being caught in situations that would lead to their death during controlled burns; most species ultimately benefit by improvement of the habitat.

(140) Howard, W. E., and L. G. Ingles. 1951. Outline for an ecological life history of pocket gophers and other fossorial mammals. Ecology 32(3):537-544.

Lists a number of general problems and study methods for the purpose of aiding future research.

(141) Howard, W. E., and K. A. Wagnon. 1951. Guard those spuds--voracious squirrels show appetite for cull potatoes. West. Livestock J. 29(7):81, 83 + illus.

Ground squirrels showed preference for cull potatoes left in a pasture to dry as cattle feed.

(142) Howard, W. E., K. A. Wagnon, and J. R. Bentley. 1959. Competition between ground squirrels and cattle for range forage. J. Range Manage. 12(3):110-115.

Heifer weights during the inadequate green season indicated that ground squirrels can influence cattle gains; however, the degree of competition was highly variable from year to year.

(143) Hutchison, C. B., and E. I. Kotok. 1942. The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663. 145 p. + illus.

Describes much of the background of the Range and the many studies conducted upon it. Separate contributions included.

(144) Hylton, L. O., D. R. Cornelius, and A. Ulrich. 1968. Sulfur needs of Spanish clover and the relation of sulfur to other nutrients as diagnosed by plant analysis. J. Range Manage. 21:129-135.

Sulfur needs of Spanish clover (Lotus purshianus) were determined by plant analysis in a nutrient solution study. Top growth was affected more than root growth by changes in sulfur supply.

(145) Hylton, L. O., A. Ulrich, and D. R. Cornelius. 1967. Potassium and sodium interrelationships in growth and mineral content of Italian ryegrass. Agron. J. 59:311-314.

Growth and mineral content of Italian ryegrass were affected by K and Na treatments; potassium influenced plant growth more than did sodium.

(146) Laude, H. M. 1958. Use of herbicides in competition studies of range vegetation. Ecology 39(3):537-538 + illus.

Results suggest that herbicides may be useful in controlling the density of natural vegetation.

(147) McDougald, N. K. 1966. Herbage growth of five California annual range plants in response to frequency and time of clipping. M.S. Thesis. Univ. California. 77 p.

Seeds and soil from the Experimental Range were used in this clipping study on slender wild oat, soft chess, red brome, foxtail fescue, and white-tip clover.

(148) McKell, C. M., C. A. Graham, and A. M. Wilson. 1960. Benefits of fertilizing annual range in a dry year. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-172. Berkeley, California. 9 p. + illus.

Nitrogen fertilization improved range readiness and increased production and protein content of herbage but at reduced levels compared to more favorable years. Sulfur and phosphorus further increased protein content when nitrogen was not a limiting factor.

(149) McKell, C. M., and W. A. Williams. 1960. A lysimeter study of sulfur fertilization of an annual range-soil. J. Range Manage. 13(3):113-117.

Gypsum as a sulfur source on sandy loam soil may be subject to considerable leaching during a wet year. But during a succession of dry years, a substantial amount will remain available for plant use.

(150) McKell, C. M., and W. A. Williams. 1961. A lysimeter study of sulfur fertilization of an annual range-soil. Calif. Agric. 15(4):4-5 + illus.

Gypsum as a sulfur source on sandy loam soil may be subject to considerable leaching during a wet year. But during a succession of dry years, a substantial amount will remain available for plant use.

(151) Metcalf, W. 1954. Progress report on penta-treated fence posts. Calif. Agric. Ext. Serv. Man. 4 p.

Reports the results of treating 17 species used for fence posts after 7.5 years of service.

(152) Miller, M. A., and W. E. Howard. 1951. Size of bait for pocket gopher control. J. Wildl. Manage. 15(1):62-68.

Reports that any size of bait within practical limits may be effectively used for pocket gopher poisoning--provided enough dosages of poison are used.

(153) Morejohn, G. V., and W. E. Howard. 1956. Molt in the pocket gopher, Thomomys bottae. J. Mammal. 37(2):201-213 + illus.

Study of 600 pocket gophers by various techniques revealed certain molt patterns and variations in these patterns.

(154) Morris, M. J. 1963. The use rating or ranking in vegetation measurement, p. 40-42. In Range research methods. U.S. Dep. Agric. Misc. Publ. 940.

The ranked sets method shows promise for sampling attributes that can be ordered by visual inspection.

(155) Morris, M. J. 1973. Estimating understory plant cover with rated microplots. U.S. Forest Serv., Rocky Mountain Forest and Range Exp. Sta. Res. Paper RM-104. Fort Collins, Colorado. 12 p.

Plant cover measurements are used to detect changes caused by grazing, fire, and other factors. Tests on both high and low production sites of 17 areas in the West indicate that trained range personnel rate small plots similarly in respect to the area occupied by aerial and basal plant cover. Plots used ranged from 1/8 square inch to 8 square inches. Equal area rectangles and circles were used. All are well suited for rating plant cover, although the smaller sizes tended to be slightly more precise.

(156) Neal, D. L., and L. R. Neal. 1965. A new electronic meter for measuring herbage yield. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-56. Berkeley, California. 4 p.

The pilot model of an electronic instrument to estimate herbage weight by measuring its electronic capacitance was tested. Results on annual range at the San Joaquin Experimental Range and on perennial range in the southern Cascade Mountains were promising. The instrument proved to be a fast and accurate estimator of herbage weight.

(157) Newman, T. F., Jr., and D. A. Duncan. 1973. Vertebrate fauna of the San Joaquin Experimental Range. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Gen. Tech. Rep. PSW-6. Berkeley, California. 17 p.

Records the occurrences of 7 fish, 8 amphibians, 19 reptiles, 38 mammals, and 149 birds found on the Experimental Range since 1934.

(158) Philpot, G. W., W. E. Howard, and C. A. Graham. 1958. A method of managing sportsmen on rangeland. J. Range Manage. 11(6):200-292 + illus.

Describes a permit-registration card to simplify regulating access and improve farmer-sportsmen relations.

(159) Quast, J. C. 1950. Habitat preferences of rodents on grazed and ungrazed foothill pastures in California. M.A. Thesis. Univ. California, Berkeley. 51 p.

Intensive studies involving small rodent populations in areas of heavy, moderate, and no use by cattle showed populations of some species to be the same or less on grazed areas; other species tended to be more plentiful in areas that were grazed.

(160) Quast, J. C. 1954. Rodent habitat preferences on foothill pastures in California. J. Mammal. 35(4):515-521.

Reports effects of use of forage by cattle upon small rodent habitats and populations.

(161) Quast, J. C., and W. E. Howard. 1953. Comparison of catch of two sizes of small mammal live traps. J. Mammal. 34(4):514-515.

A much larger percentage of white-footed mice, and to a lesser extent, of kangaroo rats were caught in the larger traps.

(162) Ratliff, R. D., and S. E. Westfall. 1971. Non-grazing and gophers lower bulk density and acidity in annual-plant soil. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-252. Berkeley, California. 3 p.

Soils in an exclosure that was ungrazed for 34 years had a lower surface bulk density and lower acidity than soil on an adjacent grazed area.

(163) Ratliff, D., and S. E. Westfall. 1973. A simple stereophotographic technique for analyzing small plots. J. Range Manage. 26(2):147-148.

An inexpensive stereo adapter for a camera provided stereo pairs on a single color print. Good resolution of a square-foot area at a scale of 1:17 was obtained at a camera height of 48 inches. Stereo prints are used with a dot grid overlay and a pocket stereoscope to estimate foliar cover and composition.

(164) Ratliff, R. D., S. E. Westfall, and R. W. Robarts. 1972. More California-poppy in stubble field than in old field. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-271. Berkeley, California. 4 p.

The density and flowering of California-poppy (Eschscholzia californica var. peninsularis Green), amount of bare ground, and occurrence of other plants were studied in an old-field and a stubble field near Madera, California. Results suggest that a site disturbance that produces a harsh microclimate or reduces competition or both will favor California-poppy and that this variety tends to associate more readily with certain plants than others.

(165) Reed, M. J. 1962. Adapting electronic data processing to plant ecological studies. Am. J. Bot. 49:677-678. (Abstr.)

Describes coding systems devised for California wildland plants and associated ecological elements as primarily developed from experience with the foothill annual-plant type.

(166) Reed, M. J. 1974. Rhamnaceae--Buckthorn family. Ceanothus L. Ceanothus, p. 284-290. In C. S. Schopmeyer [tech. coord.] Seeds of woody plants in the United States. Div. Timber Manage. Res. U.S. Dep. Agric. Handbook 450.

Ceanothus nomenclature, occurrence, uses, and phenology. Seed collection, extraction, storage and pregermination treatments, germination tests, and nursery and field practices for reproduction.

(167) Reed, M. J., and J. R. Bentley. 1960. Conversion from brush to grass for multiple land use, p. 147-149 + illus. In Soc. Am. Forest., Proc.

Suggests that the key to permanent conversion on adapted brushlands in California is suitable chemical control of brush regrowth after initial removal.

(168) Reed, M. J., W. R. Powell, and B. S. Bal. 1963. Electronic data processing codes for California wildland plants. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-20. Berkeley, California. 314 p.

Presents systematized codes for more than 9,000 vascular plants reported growing in California.

(169) Reed, M. J., and J. M Skolvin. 1963. Estimating grazing values for layout and calibration of experimental ranges, p. 142-148 + illus. In Range research methods. U.S. Dep. Agric. Misc. Publ. 940.

Evaluates existing methods and makes recommendations based on present knowledge.

(170) Reppert, J. N., and C. E. Conrad. 1964. Estimation of herbage composition of annual ranges using inclined pins, p. 30. In 17th Annu. Meeting, Am. Soc. Range Manage., Wichita, Kansas. (Abstr.)

Herbage weight composition is often similar to foliar composition as determined by plants first hit by slanting pins. This relationship is improved when modified by a correction factor. Formulae are shown for both the easily computed correction factor and the rather complex variances. Use of this procedure in a grazing study is explained. The method is evaluated and plans are outlined for needed improvement.

(171) Reppert, J. N., and D. A. Duncan. 1960. A tough year but tougher plants: Range annuals endure record fall drought. West. Livestock J. 38(57):23-24.

Despite a 112-day drought which killed many plants, the remainder showed remarkable ability to respond to late winter and spring moisture.

(172) Reppert, J. N., and D. A. Duncan. 1963. Rangeland fertilization by "copter" proves successful. West. Livestock J. 41(17):33 + illus.

In this first attempt, application of soil-sulfur by helicopter was accurate and uniform, time requirement short, and costs reasonable.

(173) Reppert, J. N., and L. R. Green. 1958. Annotated bibliography of publications from the San Joaquin Experimental Range. U.S. Forest Serv., Calif. Forest and Range Exp. Sta. Tech. Paper 27. 32 p.

Lists 135 publications dealing with range management, livestock production, and zoological and other aspects of the cooperative research program.

(174) Reppert, J. N., R. H. Hughes, and D. A. Duncan. 1963. Herbage yield and its correlation with other plant measurements, p. 15-21. In Range research methods. U.S. Dep. Agric. Misc. Publ. 940.

Discusses methods of estimating herbage yield including shortcomings and improvements.

(175) Reppert, J. N., M. J. Morris, and C. A. Graham. 1962. Estimation of herbage yield on California annual-type range. J. Range Manage. 15(6):318-323 + illus.

Reports a new approach for estimating yield using the product of average density and average weight of individual plants. When compared with results from the clipped-plot method, absolute yield estimates were greatly different, but relative yields between sites were similar.

(176) Reppert, J. N., M. J. Reed, and P. Zusman. 1962. An allocation plan for range unit sampling. J. Range Manage. 15(4):190-193 + illus.

Describes a formula for allocating total number of sampling units within limits of cost and study objectives. Discusses method of "once over" field placement of sampling units, and appropriate analysis procedures.

(177) Reppert, J. N., and E. J. Woolfolk. 1960. Research at the San Joaquin Experimental Range. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. 11 p. + illus. (Slightly revised, 1963.)

Provides a brief description of the Experimental Range and its past and present research programs.

(178) Restani, M. 1974. Aquatic insects of an intermittent stream on the San Joaquin Experimental Range, Madera County, California. M.A. Thesis. California State Univ., Fresno. 85 p.

An intermittent stream was sampled from after the first rains in November 1972 until the stream dried in June 1973 to establish the diversity of insect forms and their temporal sequences. Results include a taxonomic list, an analysis of the species habitat preferences, and a discussion of phenological patterns of the stream's insect fauna.

(179) Rollins, W. C., and K. A. Wagnon. 1956a. A genetic analysis of weaning weights in a range beef herd operated under optimum and suboptimum nutritional regimes. J. Anim. Sci. 15(1):125-133 + illus.

Analysis of both a supplemented and an unsupplemented herd showed that differences in nutritive levels did not affect heritability of weaning weights.

(180) Rollins, W. C., and K. A. Wagnon. 1956b. Heritability of weaning grade in range beef cattle. J. Anim. Sci. 15(2):529-536.

A statistical study showed no significant difference in heritability of weaning grade between supplemented and non-supplemented cow herds, although heritability for both herds averaged an estimated 36%.

(181) Rowe, P. B. 1948. Influence of woodland chapparal on water and soil in central California. California Div. Forest. Unnumbered Pub. Sacramento, California. 70 p.

Presents results of a 9-year study near North Fork, California on influences of woodland chaparral vegetation of the Sierra Nevada foothills on surface runoff, erosion, and water yield. Data from runoff plots on a green-type at the San Joaquin Experimental Range are used in one comparison.

(182) Sanderson, H. R. 1967. Herbage production on high Sierra Nevada meadows. J. Range Manage. 20(4):255-256.

A preliminary sample of five high Sierra Nevada meadows in California ranged from 835 to 1436 lb/acre of herbaceous material. Sedges contributed more than grasses.

(183) Sanderson, H. R., and D. A. Duncan. 1966. Publications from the San Joaquin Experimental Range, 1935-1965. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Unnumbered Pub. Berkeley, California. 30 p.

Lists publications for the 30-year period since establishment of the Experimental Range.

(184) Savelle, G. D. 1966. Report of results obtained from clipping four species of annual range plants, under various intensities and frequencies, during different segments of the 1964-65 growing season. M.S. Thesis. School of Forestry, Univ. California, Berkeley. 56 p.

Describes growth characteristics and growth response to herbage removal of soft chess, slender oat, little-head clover, and white-tip clover.

(185) Schitoskey, F., Jr. 1973. Energy requirements and diet of the California ground squirrel, Spermophilus beecheyi. Ph.D. Diss. Univ. California, Davis. 52 p.

The resting metabolic rate of the California ground squirrel is 94.48 cal/g per cay. Legumes are important diet items in the spring; nonlegume forbs compare the bulk of ground squirrel diets in the winter and summer. In the fall, acorns and grasses are the primary sources of food. Although grass seeds are a major energy source in the summer, ground squirrels also consume herbage from the summer growing annuals Holocarpha heermannii and Eriogonum sp.

(186) Schitoskey, F., Jr. 1975. Annual grassland ecosystem processes: heterotrophic components. Proceedings of the 1975 California Plant and Soil Conference Calif. Chap. Am. Soc. Agron., Anaheim, California. p. 32.

Summarizes the heterotrophic components of the annual grassland ecosystem and mentions that some consumers, such as the California ground squirrel, which has been considered a serious competitor with livestock, apparently consumes less than 1% of the annual forage production.

(187) Shields, P. W., and D. A Duncan. 1966. Fall and winter food of California Quail in dry years. Calif. Fish and Game 52(4):275-282.

Data from 3 years were quite different from the scanty older information in the literature; different weather conditions explained the apparently conflicting results.

(188) Smith, F. M., and D. M. Swift. 1974. Theoretical solar data for the IBP Grassland Biome sites in North America, San Joaquin Site. US/IBP Grassland Biome Spec. Rep. Colorado State Univ., Fort Collins. 35 p.

Contains monthly tables of theoretical solar energy data for the San Joaquin Experimental Range, plus tables of day length, time of sunrise, time of sunset, time of solar noon plus a graph of theoretical solar energy.

(189) Storer, T. I., F. P. Cronemiller, E. E. Horn, and B. Glading. 1942. Studies on Valley Quail, p. 130-135. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

Describes early quail studies and presents preliminary results of census methods, nesting, predation, and food habits.

(190) Talbot, M. W., and H. H. Biswell. 1942. The forage crop and its management, p. 13-49. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

Describes the forage, its growth and behavior, and reports on early experiments on grazing management.

(191) Talbot, M. W., H. H. Biswell, and A. L. Hormay. 1939. Fluctuations in the annual vegetation of California. Ecology 20(3): 394-402 + illus.

Describes characteristics of the California annual-type vegetation, including the importance of Old World annuals, the variability in the vegetation from season to season and within seasons, and the quick response of the vegetation to various treatments.

(192) Talbot, M. W., H. H. Biswell, P. B. Rowe, and A. W. Sampson. 1942. Other studies and experiments in the program at the San Joaquin Experimental Range, p. 136-142. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

A brief description of early studies involving artificial reseeding, rainfall runoff and erosion, and chemical composition of plants.

(193) Talbot, M. W., J. W. Nelson, and R. E. Storie. 1942. The experimental area, p. 7-12. In The San Joaquin Experimental Range, Calif. Agric. Exp. Sta. Bull. 663.

Describes soil, climate, vegetation, and life zones.

(194) Ulrich, A., and L. O. Hylton, Jr. 1968. Sulfur nutrition of Italian ryegrass measured by growth and mineral content. Plant and Soil 29:274-284.

Sulfur nutrition of Italian ryegrass was studied by a nutrient solution technique. Sulfur-deficient plants were stunted and erect; upper leaves were an abnormal yellow-green. Shoot growth was affected more than root growth by changes in the amount of sulfur supplied.

(195) Voorhies, E. C., L. A. Crawford, R. L. Adams, and G. A. Carpenter. 1942. Ranch organization and management in the granitic area, p. 83-95. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

Describes the general ranch management practices in the region surrounding the Experimental Range.

(196) Wagnon, K. A. 1941. Grazing habits of range cattle. West. Livestock J. 20(6):35-36.

Reports the species of range forage selected by cattle at various times of the year as determined by climatic conditions, relative abundance of different plant species, stage of growth, and availability.

(197) Wagnon, K. A. 1943. More calves, more beef--care of cows, bulls, and forage helps calf crop. West. Livestock J. 21(17):20.

Relates important factors in obtaining a desirable calf crop in a time of high demand for meat.

(198) Wagnon, K. A. 1943a. Finishing long-yearling heifers upon the range. Pac. Rural Press 145(8):236.

Discusses advisability of supplemental feeding to finish heifers on the range, and describes rations used.

(199) Wagnon, K. A. 1943b. Great steers from little acorns do not grow. Pac. Rural Press 146(13):335.

Cattle fed acorns during the dry forage season suffered severe weight loss, but made good gains when a protein supplement was added.

(200) Wagnon, K. A. 1945. Poison! Durango root found toxic to livestock. West. Livestock J. 23(54):108.

Discusses experiments with a native plant only recently discovered to be highly toxic to livestock.

(201) Wagnon, K. A. 1946. Acorns as feed for range cattle. West. Livestock J. 25(6):92-94.

Heavy consumption of acorns when other dry forage is deficient in protein may result in excessive weight loss unless the cattle are given protein supplement.

(202) Wagnon, K. A. 1948. Elastration--University reports experiment results. West. Livestock J. 26(59):127.

A then relatively new method of castration using the elastrator was tested successfully on 23 bull calves.

(203) Wagnon, K. A. 1950. Supplemental feeding of cattle on the range. Calif. Cattleman 1950 (June):17-19 + illus.

Reports results shown by supplemental feeding experiments consisting of seasonal diet changes.

(204) Wagnon, K. A. 1951a. Range specialist explains differentiation among common alfilaria. Calif. Wool Grower 27(36):6-7 + illus.

Provides a chemical and taxonomic description of several species of the important range forage genus of Erodium.

(205) Wagnon, K. A. 1951b. Nontoxic ferns--feeding tests with cattle find gold fern, birdsfoot fern nontoxic. Calif. Agric. 5(10): 13 + illus.

Quantities of fern fed in excess of any amount taken by grazing cattle indicated they were nontoxic.

(206) Wagnon, K. A. 1952. Range bull study--University program results in top growth, development, and condition. West. Livestock J. 30(10):86-87, 89 + illus.

Several supplemental feeding methods were used before an acceptable one was devised for maintaining good growth, development, and condition of range bulls.

(207) Wagnon, K. A. 1953. Another slant on range management. Calif. Farmer 199(3):136.

A review of work done at the Experimental Range and other areas points out the importance of basing foothill range management upon the annual vegetation.

(208) Wagnon, K. A. 1945a. The use of molasses-urea as a supplement to dry range forage for weaner calves. Calif. Cattleman 1954 (July):8-9 + illus.

Reports a study showing that good gains may be obtained from dry forage by spraying molasses-urea on the swale vegetation.

(209) Wagnon, K. A. 1954b. Pounds of beef produced when produce is sold at different ages. Calif. Livestock News 30(25):4.

Reviews the results of 13 years of study in which range produce was marketed as weaners, yearlings, or 2-year-olds.

(210) Wagnon, K. A. 1959. A study of bracken fern poisoning of cattle on a California forest range. J. Range Manage. 12(5):249-255 + illus.

Although bracken fern was suspected of being responsible for cattle deaths, it was not clearly established as poisonous to cattle.

(211) Wagnon, K. A. 1960a. Lupine poisoning as a possible factor in congenital deformities in cattle. J. Range Manage. 13(2):89-91 + illus.

Establishes the toxicity of Lupinus laxiflorus, but does not establish nor rule it out as a cause of congenital deformities.

(212) Wagnon, K. A. 1960b. Agricultural gypsum as a regulator for self-feeding cottonseed meal to cattle on the range. J. Range Manage. 13(6):279-282 + illus.

Gypsum is not considered satisfactory because excessive consumption under adverse conditions resulted in illness.

(213) Wagnon, K. A. 1960c. Cattle feeding trials with acorns and oak leaves indicate need for supplementing dry range forage. Calif. Agric. 14(11):10-12 + illus.

Supplemental feeding prevents excessive weight losses when acorns are plentiful.

(214) Wagnon, K. A. 1963. Behavior of beef cows on a California range. Calif. Agric. Exp. Sta. Bull. 799. 58 p. + illus.

Reports behavior on an annual-plant range as affected by natural conditions and managerial factors of heavy and light levels of stocking and supplemental feeding as against none used.

(215) Wagnon, K. A. 1965. Social dominance in range cows and its effects on supplemental feeding. Calif. Agric. Exp. Sta. Bull. 819. 32 p. + illus.

Reports on the variation in social dominance among different age classes of cows. Suggests that understanding such dominance factors may result in better herd management.

(216) Wagnon, K. A. 1968. Use of different classes of range land by cattle. Calif. Agric. Exp. Sta. Bull. 838. 13 p.

Reports a study of the utilization by cattle of ten different classes of rangeland.

(217) Wagnon, K. A., J. R. Bentley, and L. R. Green. 1958. Steer gains on annual-plant range pastures fertilized with sulfur. J. Range Manage. 11(4):177-182 + illus.

Sulfur fertilization increased both carrying capacity and average steer gains during the green and dry seasons. No increases were evident during the inadequate green season.

(218) Wagnon, K. A., and H. H. Biswell. 1943. Two types of broad-leaf Erodium in California. Madroño 7(4):118-125 + illus.

Includes a detailed taxonomic description of two forms of Erodium botrys and a key.

(219) Wagnon, K. A., and F. D. Carroll. 1966. Reproduction difficulties in range beef cattle. Calif. Agric. Exp. Sta. Bull. 822. 27 p.

Summarizes data on reproductive losses from 22 years of observation on several experimental cattle herds exposed to different management methods. Suggests probable causes for some losses, describes factors that may be involved in others, and discusses some which are unexplained.

(220) Wagnon, K. A., and H. Goss. 1953. Molasses-urea as a supplement to dry range forage for weaner heifers. Calif. Cattleman 1953 (Oct.):20-22.

Reports data from a study concerned with feeding cattle various range supplements, including forage sprayed with a molasses-urea mixture.

(221) Wagnon, K. A., and H. Goss. 1961. The use of molasses to increase the utilization of rank, dry forage and molasses-urea as a supplement for weaner calves. J. Range Manage. 14(1):5-9 + illus.

Low palatability forage was completely used after spraying with molasses mixtures. A molasses-urea mixture self-fed alone on dry protein-deficient range was an ineffective supplement, but when fed with cottonseed pellets, the urea replaced a third of the pellets.

(222) Wagnon, K. A., H. R. Guilbert, and G. H. Hart. 1942. Experimental herd management, p. 50-82. In The San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 663.

Describes objectives of early studies with cattle on the Experimental Range.

(223) Wagnon, K. A., H. R. Guilbert, and G. H. Hart. 1945. Death losses in experimental range herd. Calif. Cultivator 92(7): 184-185.

Discusses various sources of cattle loss over a 9-year period as to cause, importance, and treatment.

(224) Wagnon, K. A., H. R. Guilbert, and G. H. Hart. 1959. Beef cattle investigations on the San Joaquin Experimental Range. Calif. Agric. Exp. Sta. Bull. 765. 70 p. + illus.

Discusses the effects of unimproved range and of certain management practices on the production of breeding animals.

(225) Wagnon, K. A., and G. H. Hart. 1945. Durango root (Datisca glomerata) poisoning of range stock. J. Am. Vet. Med. Assoc. 107(820):3-5 + illus.

Sheep and cattle were subjected to sublethal and lethal doses of durango root to observe the symptoms and causes of death.

(226) Wagnon, K. A., G. H. Hart, and H. R. Guilbert. 1947. How, where, when to supplement deficient range. West. Livestock J. 25(33):45-46.

Results of a 10-year study show the advantages of supplemental feeding during the dry and inadequate green forage periods.

(227) Wagnon, K. A., G. H. Hart, and H. R. Guilbert. 1949. Nutrition--supplementing the deficient range. Pac. Stockman 15(9):3-5, 30.

Stresses need for a flexible supplementary program regulated by severity, length, and season of the deficiency.

(228) Wagnon, K. A., W. E. Howard, and R. Albaugh. 1953. In memoriam: Harold Reed Guilbert. J. Range Manage. 6(3):200.

Gives a biographical sketch of Harold Reed Guilbert, who was in charge of the University of California's cattle research program and supervised cattle studies at the Experimental Range.

(229) Wagnon, K. A., J. J. Meyer, and F. D. Carroll. 1959. Pelleted alfalfa--new form of feed supplement for beef heifers on protein-deficient dry range. Calif. Agric. 13(11):10-11.

Alfalfa pellets were as effective as cottonseed pellets in producing gains when fed at rates of 1.5 pounds or more per head per day, but not at the 1.0 pound rate.

(230) Wagnon, K. A., and W. C. Rollins. 1959. Heritability estimates of post-weaning growth to long yearling age of range beef heifers raised on grass. J. Anim. Sci. 18(3):918-924 + illus.

Suggests that paternal half-sib estimates of heritability may be lowered in an unsupplemented herd with interrupted growth.

(231) Wagnon, K. A., and W. C. Rollins. 1962. Factors affecting fill and consequently overnight shrinkage in range cattle. J. Range Manage. 15(3):158-162.

Animal weights obtained after a 12- to 14-hour period without food and water were more precise than those taken without a shrink.

(232) Westfall, S. E. 1966. A rancher tests range fertilization. West. Livestock J. 44(47):102, 104, 106.

Describes a test plot and methods and cites results showing it is possible for a rancher to economically test recommended fertilizer treatments and come up with enough worthwhile information to plan a fertilizer program tailored to his own ranch situation.

(233) Westfall, S. E., and D. A. Duncan. 1961. The San Joaquin cage. J. Range Manage. 14(6):335 + illus.

Describes a wire cage developed to protect a 1-square-foot range plot from cattle grazing; total cost per cage was $1.21 and life expectancy of cages about 10 years.

(234) Wilkinson, A. 1953. Birds of the foothill-woodland community. M.S. Thesis. Fresno State College, Fresno, California. 43 p.

Reports observations made of 46 species of birds seen during winter and spring.

(235) Williams, W. A., C. M. McKell, and J. N. Reppert. 1964. Sulfur fertilization of an annual-range soil during years of below-normal rainfall. J. Range Manage. 17(1):1-5 + illus.

No difference in herbage yield resulted from elemental sulfur or gypsum as sulfur sources in this lysimeter test, but sulfur loss by leaching was considerably less for elemental sulfur.

(236) Winans, S. S., and C. M. McKell. 1963. Tarweed...a nuisance plant on California ranges. Calif. Agric. 17(4):11-13 + illus.

Reports characteristics that make Holocarpha virgata well adapted for survival. Clipping or heavy grazing and nitrogen fertilization offer possibilities for reducing seedling densities.

(237) Wood, S. F. 1950. The distribution of California insect vectors harboring Trypanosoma cruzi Chagas. Bull. South. Calif. Acad. Sci. 49(3):98-100.

Reports location of collections made of cone-nosed bugs with the causative agent of Chagas' disease often present.

(238) Wood, S. F. 1951a. Importance of feeding and defecation times of insect vectors in transmission of Chagas' disease. J. Econ. Entomol. 44(1):52-54.

Certain species of cone-nosed bugs were shown to be more important than others as a source of contamination because they tended to defecate immediately after feeding.

(239) Wood, S. F. 1951b. Bug annoyance in the Sierra Nevada foothills of California. Bull. South. Calif. Acad. Sci. 50(2):106-112.

Reports various house-invading arthropods discovered in a dwelling house during a 58-day period.

(240) Wood, S. F. 1951c. Development of California Trypanosoma cruzi in the bat bedbug. J. Parasitol. 37(3):330-331.

Describes a laboratory technique used to develop and observe the causative agent of Chagas' disease in the bat bedbug.

(241) Wood, S. F. 1952a. Mammal blood parasite records from southwestern United States and Mexico. J. Parasitol. 38(1):85-86.

Parasites from blood samples of 215 mammals collected at the Experimental Range make an important contribution to the records collected in southwest United States and Mexico.

(242) Wood, S. F. 1952b. Trypanosoma cruzi revealed in California mice by zenodiagnosis. Pan-Pac. Entomol. 28(3):147-153.

Reports results of allowing 186 mammals to be fed upon by cone-nosed bugs to determine the incidence of infection with Trypanosoma cruzi.

(243) Wood, S. F. 1953. Survival time of metacyclic Trypanosoma cruzi in human sweat. J. Parasitol. 39(5):569-570.

Outlines a study devised to determine how well Trypanosoma cruzi survives in human sweat.

(244) Wood, S. F. 1954. Environmental temperature as a factor in development of Trypanosoma cruzi in Triatoma protracta. Exp. Parasitol. 3(3):227-233.

Reports on a study designed to determine the effect of temperature upon the number of Trypanosoma cruzi released from cone-nosed bugs.

(245) Wood, S. F. 1959. Hatching time and first feeding interval for first instar Triatoma protracta and rubida nymphs under field conditions. Bull. South. Calif. Acad. Sci. 58(2):115.

Hatching time for protracta and rubida uhleri eggs averaged 18.2 and 14.9 days, respectively; average number of hours before first voluntary feeding was 65.3 and 61.9 hours, respectively.

(246) Wood, S. F. 1962. Blood parasites of mammals of the California Sierra Nevada foothills, with special references to Trypanosoma cruzi Chagas and Hepatozoon leptosoma sp.n. Bull. South. Calif. Acad. Sci. 60(3):161-176 + illus.

Reports that 125 bacterial, protozoal, and helminthological blood infections were found in 513 mammals representing 19 genera and 22 species. Describes Hepatozoon leptosoma sp. n.

(247) Wood, S. F., and F. D. Wood. 1952. A water cooler for transporting heat sensitive animals, especially insects. Bull. South. Calif. Acad. Sci. 51(3):108-111 + illus.

Describes a method for keeping heat-susceptible animals cool and alive while they are traveling across hot regions of California.

(248) Woodmansee, R. G. 1975. An overview of the annual grassland ecosystem synthesis effort, p. 29-30. In Proc., 1975 Calif. Plant and Soil Conf. Calif. Chap., A.S.A., Anaheim, California.

Gives an overview of the systems approach and outlines characteristics and purposes of the proposed volume on structure, function, and utilization of the annual grassland ecosystem, for which the San Joaquin will be an example site.

(249) Woolfolk, E. J. 1962. Identification marking of experimental animals. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-205. Berkeley, California. 4 p. + illus.

Describes a method of using notched, plasticized nylon ribbon and numbered ear buttons for both individual and group identification of cattle.

(250) Woolfolk, E. J., and D. A. Duncan. 1962. Fertilizers increase range production. J. Range Manage. 15(1):42-45 + illus.

The first 2 years of a study involving sulfur and sulfur-plus-nitrogen fertilizers showed both effectively increased herbage production, grazing capacity, and cattle gains on annual-plant range.

(251) Woolfolk, E. J., and J. N. Reppert. 1963. Then and now: Changes in California annual-type range vegetation. U.S. Forest Serv., Pacific Southwest Forest and Range Exp. Sta. Res. Note PSW-24. Berkeley, California. 9 p. + illus.

Illustrates the rapid increase of undesirable woody plants without fire or livestock grazing; little change in vegetation with moderate to light (locally heavy) livestock grazing and no fire; and deterioration of woody plants with moderate to close yearlong livestock use both with and without fire.

(252) Wyckoff, S. N. 1952. Growing and using the forage crop on California national forest lands. Calif. Cattleman 1952 (Oct.):12-16.

Reviews many of the principles evolved for efficient use of California foothill ranges, emphasizing stocking rates, fertilization, and brush conversion.