CALIFORNIA FISH AND GAME

"CONSERVATION OF WILDLIFE THROUGH EDUCATION"

VOLUME 33 | ISSUED OCTOBER 31, 1947 | No. 4

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A SYSTEM FOR CLASSIFYING VEGETATION IN CALIFORNIA[1]

By Herbert A. Jensen[2]

Among the inventories needed for the management of our game resources are those concerned with vegetation cover. Because this cover involves many plant species and forms growing under a variety of climatic, soil, and moisture conditions while subjected to a wide range of treatment by man and beast, inventorying it usually introduces problems of classification. Many systems for classifying all or parts of this vegetation cover have been devised, but most of them have limitations preventing their general adoption. Most of them also have depended wholly upon ground observations.

While ground observations have many points in their favor and in some instances are indispensable, under certain conditions they are neither the most accurate nor the most economical means for classifying vegetation cover. Chief among the advantages of the ground technique is the ability to see such vegetation details as individual species and undergrowth. However, for area delineation the ground technique depends upon oblique or horizontal views in which the foreground-background factor produces erroneous impressions of both areas and vegetation composition. Thus many classification boundaries are determinable, if at all, only through considerable travel and search.

Aerial photos offer a technique that has many advantages over ground observations alone. This technique is especially useful when the vegetation classification is based upon specified proportions of the cover or ground occupied, when base maps are not of high quality or recent date, and when time and funds are limiting factors. On the essentially vertical views of aerial photos foreground-background differences are negligible, the various parts of the vegetation complex (excluding undergrowth) appear in their true proportions, and most boundaries are clearly evident. The addition of vegetation details (understory, etc.) by ground observation can then be made with a minimum of time and field travel by using the photo classification as the control. On the other hand, users of the photo technique should bear in mind that aerial photos are rarely maps on account of inherent characteristics that cause areas to appear in other than their true sizes and shapes. Chief among these characteristics are: (1) the variation in perspective from vertical at the center of the photos to a degree of obliqueness at their edges, and (2) the variation in distance between subject and camera lens that causes differences in scale whenever the ground is not level. But despite these characteristics the areas will appear in their true relationships to the terrain, and the size and shape distortions can be removed in the process of transferring the photo areas to maps.

[1] Submitted for publication June, 1947.

[2] California Forest and Range Experiment Station, United States Forest Service. The California Forest and Range Experiment Station is maintained at Berkeley in cooperation with the University of California.

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Part of a classification system that has been designed to encompass all of California's natural vegetation without losing the character of its many transitional conditions, that is capable of flexible interpretation, and that is based upon the use of aerial photos [1] will be described here. Although not specifically developed for game management purposes, this classification system is as applicable to game management as it has proven to be in other fields. While the system has been designed for the use of aerial photos, it can also be applied to ground mapping if the photos are unavailable.

By themselves, the classifications presented may not furnish all the information needed for particular localities or projects. Their purpose is to provide, first, simple inventories that effectively stratify the vegetation complex into significant parts, and second, frameworks upon which subsequent intensifications by area, composition, or use can be added without duplicating previous efforts. These simple inventories serve not only the needs of most over-all surveys of large areas but also present a standard for discussions among game managers, foresters, range managers, watershed managers, and others concerned with the natural vegetation cover. The frameworks provide bases for finer breakdowns of areas (edge types, etc.) or species, or for an ecological classification such as that suggested by Graham (1945).[2] Such finer breakdowns also can be used in small blocks as detailed samples of the broader classifications, thereby reducing the amount of detailed work that would otherwise be necessary. Any detailed classification will be facilitated and more accurately located by having the broader classifications to use as a control.

These classifications and techniques of application are products of the California Forest and Range Experiment Station, a unit of the United States Forest Service. More specifically, they represent the joint efforts of several individuals under the leadership of A. E. Wieslander, Chief of the Division of Forest Economics. Their development can be followed through a number of articles and office manuals, the most pertinent of which are Wieslander (1935); Burks and Wilson (1939); Wieslander, Jensen, Wilson, and Burks (1942); Wieslander and Wilson (1942); and Forest Survey staff (1947). In its original form the system was used to inventory a considerable part of California and contiguous western Nevada, and maps of this work are available from the experiment station. The ground-mapping technique of that form became obsolete with the adoption of aerial photos prior to World War II. At the war's end the remainder of California was classified from photos, but only on a very extensive basis to provide certain forest statistics (Wieslander and Jensen, 1946). The over-all distribution of vegetation types, as then determined, by acreage (Table 1) and location (folded map), are reproduced here. The modernized form of the classification system is now an essential part of the station's state-wide timber inventory,[3] for which all commercial timberlands and intermingled areas are being classified

[1] In particular, those covering most of California—vertical photos of around three inches to the mile (1:20,000) scale, taken on panchromatic film with a minus-blue filter and an 8¾-inch lens. Photos that present greater detail than these would, of course, also be usable.

[2] A classification of the vegetation cover's ecological (successional) stages, as determined from a combination of pertinent vegetation and habitat factors.

[3] This project is one unit of the nation-wide forest survey being conducted by the United States Forest Service to ascertain and correlate data on the present supplies of timber and other forest products, growth and loss rates, present consumption, probable requirements, and other facts pertinent to balancing the Nation's timber budget.

down to a 40-acre minimum. In addition, it is a part of the intensification

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TABLE I

Areas of Vegetation Types in California

Type	Thousand acres	Percent
Pine	4,586	4.6
Redwood	1,788	1.8
Douglas-fir	2,289	2.3
Fir	1,757	1.7
Pine—Douglas-fir—Fir[1]	7,236	7.2
Spruce	[2]	
Lodgepole pine—Whitebark pine[3]	2,032	2.0
Pinon pine and Juniper	3,200	3.2
Minor conifers	405	.4
Woodland[4]	2,457	2.5
Woodland—Grass[5]	7,570	7.5
Chaparral	9,866	9.8
Coastal sagebrush	2,249	2.2
Great Basin sagebrush	5,071	5.1
Desert	24,276	24.2
Bushy herbs	[2]	
Grass	10,375	10.3
Marsh	79	.1
Barren	1,414	1.4
Cultivated and Urban—Industrial	13,704	13.7
Total land area	100,354	100.0

[1] Includes pine—Douglas-fir, Pine—Fir, Pine—Douglas-fir—Fir.
[2] Areas too small to be represented.
[3] Includes Lodgepole pine—Mountain hemlock, Whitebark pine—Foxtail pine.
[4] Includes dense stock of Woodland—Chaparral, Woodland—Sagebrush, where the hardwoods predominate.
[5] Includes open stock of Woodland—Chaparral, Woodland—Sagebrush.

Four sections of the system are presented here. The first concerns a basic photo classification of vegetation-cover and other land status elements; the second a vegetation species classification, which is not obtainable from the photos alone; the third a type classification; and the fourth a density classification. While the four together comprise a complementary group, the first can be considered either by itself or in any combination with one or more of the last three. A further classification, that of age classes of tree stands, is also a part of the system, but is not included in the present paper.

Section I. Classification of the Vegetation-cover and Other Land Status Elements

This is the basic classification. It segregates the natural vegetation complex into units that are generally identifiable on aerial photos and that have significantly different uses. Then, to provide for complete area coverage, certain other land-status elements are also included. With a field background in photo interpretation, the classification is wholly obtainable from the aerial photos now generally available. This classification is usable either by itself or as a framework upon which the other classifications can be added.

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The Units Recognized

The elements of this classification, their definitions, and the symbols adopted to designate them are:

C—*Commercial conifers* (Fig. 64)[1]—Coniferous trees such as ponderosa pine,[2] redwood, Douglas-fir, white fir, lodgepole pine, and others that are considered of value for lumber, pulpwood, and related uses.

K—*Noncommercial conifers* (Fig. 65)—Coniferous trees such as whitebark pine, knobcone pine, piñon pines, bigcone-spruce, junipers, and others that are considered of little or no value for lumber, pulpwood, and related uses.

H—*Hardwoods* (Fig. 66)—Broadleaved trees such as oaks and madrone. Aspen and willows are also included.

S—*Chaparral* (Fig. 67)—Shrubs such as manzanitas, scrub oak, chamise, mountain-mahogany, and others that are mostly tall in stature and heavily branched.

T—*Sagebrush* (Fig. 68)—Shrubs such as the sagebrushes, bitterbrush, wildbuckwheats, and others that are mostly low in stature and slenderly branched, together with such taller associates as coyote brush and creosotebush.

F—*Bushy herbs* (Fig. 69)—Herbaceous plants such as ferns, Klamath weed, wooly mules-ears, and others that are bushy in size and character of growth.

G—*Grass* (Fig. 70)—Grasses, sedges, and other associated herbaceous plants that are not under cultivation.

M—*Marsh* (Fig. 71)—Areas of very poorly drained or partially submerged soils supporting herbaceous vegetation such as samphire, cattail, and others characteristic of those situations.

B—*Bare ground* (Fig. 72)—Areas of bare soil and litter-covered ground that are practically devoid of vegetation.

R—*Rock* (Fig. 73)—Lava, talus, cliff, boulders, and other rock conditions that are practically devoid of soil.

A—*Cultivated* (Fig. 74)—Lands that are being cultivated for farm crops, regularly-cropped natural haylands, irrigated pastures, and fallow fields.

U—*Urban—Industrial* (Fig. 75)—Residential, business, and industrial areas.

Classification Principles

On the ground the above elements are found either in single-element stands (Fig. 77), where no more than one element occurs in significant amount or, except for Cultivated and Urban—Industrial, in multi-element or mosaic stands (Fig. 78), where significant amounts of two or more occur intermixed. A mixture may contain any elements but it must be a true mixture, with the elements somewhat uniformly dispersed among one another (Figs. 78 and 80A), and not a patchy occurrence of differing groups of elements (Figs. 79 and 80B). Where the latter condition exists, proper treatment is the recognition of all distinct conditions and elimination of those from the inventory that are below the established minimum-area requirement. For example, the area in Figure 79 is in part hardwoods alone, in part grass alone, and in part chaparral alone or mixed with grass, not an over-all mixture of hardwoods, chaparral, and grass. The chaparral areas and one or more of the grass areas may be too small

[1] Although the aerial-photo technique is emphasized in this article, ground photos are used as illustrations because of the larger and more familiar views thus afforded. Figure 76 shows a few examples of the elements as they appear on 1:20,000-scale aerial photos. Since species and growth characteristics over the State vary, local preliminary ground comparisons and occasional subsequent checks are usually necessary for proper photo interpretation.

[2] The scientific names of all plants mentioned are listed in Table 3, at the end of this article.

to be included in the inventory. Similarly, the aerial view in Figure 80B shows a grass area with stringers, some very small, of hardwoods; not a grass-hardwood mixture such as is illustrated in Figure 80A. If the smaller areas are important to the inventory, provision for them should be made through lowered area-minimums or special designations.

Significant occurrence of the elements is specified in terms of the percentage of ground covered. Although the limits to be given have been arbitrarily established, experience has proven them both adequate to show real economic or ecological differences and practicable to observe under the techniques employed. Each element is considered separately. Commercial conifers are considered significant if they cover 5 percent or more of the ground. Other trees (noncommercial conifers and hardwoods) are likewise considered significant down to 5 percent when they are not in mixture with commercial conifers; but when so mixed their lower limit is 20 percent. For all other elements the lower limit is 20 percent. Figure 59 illustrates the densities represented by these limits. They are applied only to the portions of the elements exposed to the sky; those under the canopy of taller elements are inventoried by supplemental ground observations if wanted. Vegetation elements are judged on the basis of the space their crowns cover.

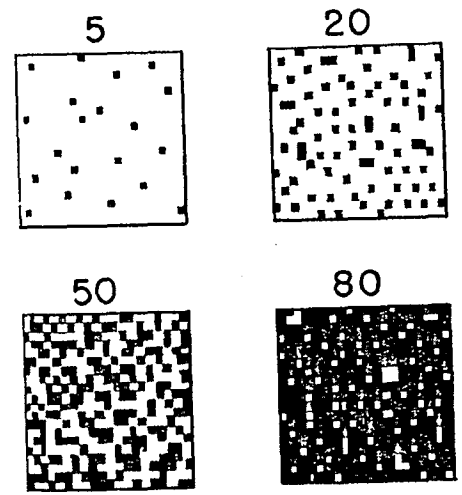

FIGURE 59. Diagramatic representation of the percentage limits used in the classifications. The four squares have, respectively, 5, 20, 50, and 80 percent of their areas blackened.

Limitation to the size of areas given recognition is also necessary if uniformity between workers is to be maintained. Individual vegetation-element areas will range from very large to very small, and somewhere between there is usually a size below which delineation is not profitable. The location of this limit will of course be determined by each particular job's requirements. For the State's intensification of the California Forest Survey referred to earlier, in which the inventory unit is the county, the minimum established is 10 acres for contrasting classes and 40 acres for noncontrasting classes. In general, the former involve changes in the presence of elements (e.g., GSH (Grass, Chaparral, Hardwoods), SG (Chaparral, Grass), HS (Hardwoods, Chaparral), C (Conifers)), while the latter involve changes in relative abundance among a constant group of elements (e.g., GSH, SGH, HSG).

Classifying Techniques

Depending upon the availability of suitable aerial photos and the experience and skills of the workers, the classification is adaptable to either aerial-photo or ground techniques. Reasons have already been given

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why the former is better if it is supported by preliminary ground observations and occasional subsequent ground checks. Stereoscopic study of the photos will yield the maximum information, but is not always essential.

With either method the procedure simply requires observing the composition of the vegetation, drawing boundaries where changes occur, and entering appropriate designations in each delineated area to record its composition (Figs. 81-84). For example, the single-element stand illustrated in Figure 77 would be designated C and the multi-element stand in Figure 78 designated GSH. In the latter case the symbols are given the order that corresponds with the relative abundance of the elements on the ground. This record is made directly on the photo or map, whichever is being used as a base.

Judgment in estimating the percentage of ground covered by vegetation elements is developed and maintained through measurements along representative line transects or comparisons with such guides as appear in Figure 59.

Value of the Classification

The product of this classification will be an in-place record of the gross characteristics of the vegetation cover capable of use in either statistical or map (Fig. 60) form. The classification will be sufficient unto

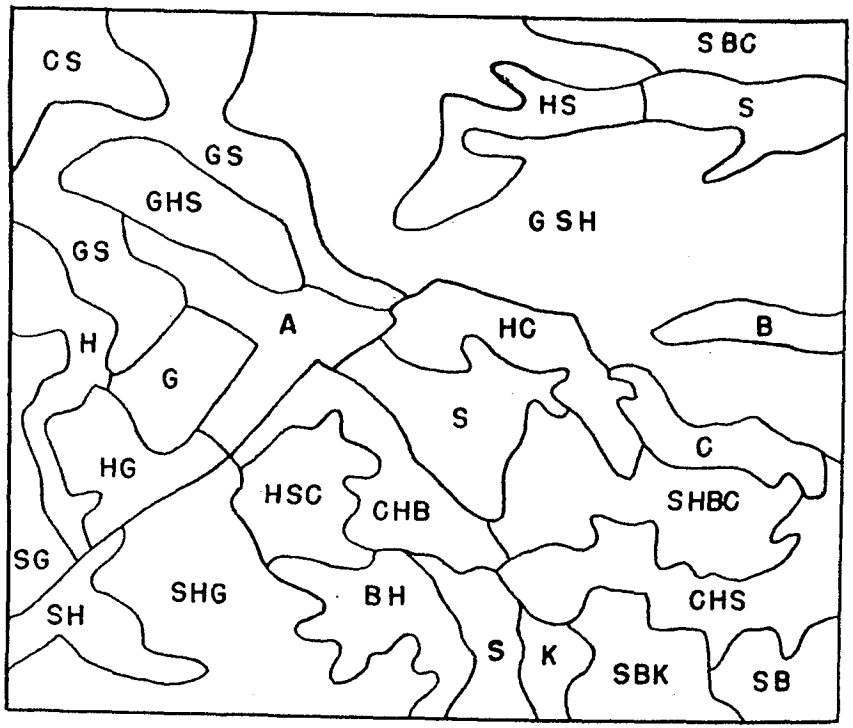

FIGURE 60. A sample map showing the classification of vegetation-cover and other land status elements. C = commercial conifers, K = noncommercial conifers, H = hardwoods, S = chaparral, G = grass, B = bare ground, A = cultivated.

itself as far as the features recorded provide the information needed. The acreage or location of grasslands segregated by their content of shrubs or trees might be cited as one example of information needed in game management. But more frequently this classification will find its greatest use in providing a flexible foundation for the remaining three sections, whose descriptions follow.

Section II. Classification of the Vegetation Species

This is a classification of the dominant-species composition of the vegetation elements recorded under Section I. Inasmuch as this involves the collection of information not generally recognizable on aerial photos, the data must be obtained by ground mapping. The vegetation-element boundaries are used as species-composition boundaries except where subdivisions are needed to bring out important differences.

The Units Recognized

The units of this classification are individual or groups of plant species. A list of California species, as prepared and used by the California Forest and Range Experiment Station in its state-wide Vegetation Type Survey, is presented with symbols to designate them in Table 4.* Figures 85-88 and some of the others that follow illustrate a few of these species.

Classification Principles

Like the vegetation elements, the species units will be found either in single-species stands (Fig. 85), where no more than one species occurs in significant amount, or in multi-species stands (Figs. 86-88), where significant amounts of two or more species occur intermixed. (What was previously stated about mixtures vs. patchy occurrence of the vegetation elements also applies here.) The single-species stands are usually regarded as "pure" stands and the multi-species stands as "mixed" stands, with the latter either simple mixtures (Fig. 86), where only one vegetation element is involved, or mosaic mixtures (Figs. 87-88), where two or more elements are involved.

Significance here is specified in terms of the percentage of crown cover occupied by individual species—determined separately for each vegetation element. Where only one element is present the percentage relates to the total cover, but where two or more are present each element constitutes a separate total against which its own component species are judged. For example, in the single-element stand of Figure 86 all species are considered with respect to the total cover, while in the multi-element stand of Figure 87 the individual sagebrush species are considered only with respect to the sagebrush cover and the commercial-conifer species with respect to the commercial-conifer cover. The lower limit of significance for species within each element recorded is 20 percent; again applying only to the vegetation exposed to the sky. Any species meeting this requirement is considered a dominant part of the complex. Where important species are present in less amounts special designation can be given to them within the framework of the standard classification.

* Since this list also includes those species most commonly found in game management inventories, the author consented to its inclusion in this paper.—*Ed.*

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To take full advantage of the classification system each vegetation-element area delineated under Section I should be considered as a separate species-composition area, subject to boundary change only by subdivision within the established limits. In the state project previously mentioned the subdivision limit has been set at 40 acres (the same as that applied to noncontrasting vegetation-element classes). Thus in the state project, individual species-composition areas may go down to the 10-acre minimum of contrasting vegetation-element classes, where these have been delineated under Section I, but no vegetation-element area will be subdivided for species composition unless each resulting part exceeds 40 acres in size or involves an especially-significant species change over 10 acres in size.

Classifying Techniques

This classification is primarily a ground mapping operation inasmuch as the species units are seldom directly identifiable on the aerial photos now available. Some exceptions occur with very distinctive species or where the photography is of superlative character, but even then the bulk of the local species will be indistinguishable. On the other hand, considerable indirect help is obtainable from the photos. First, they provide control for the ground observation of species composition through the prior delineation of vegetation elements and second, they offer a means for expanding the species classification beyond what is actually seen on the ground through observable terrain and vegetational-association relationships visible both on the ground and from photos. Making full use of these aids cannot help but expedite and increase the accuracy of the species classification over what can be done by ground observations alone.

The procedure first involves determining the dominant-species composition of each vegetation-element area or its subdivisions and then recording that information by symbols on the aerial photos or maps. If aerial photos are not used, all of the areas must be viewed at close enough range that the species can be identified and their abundance estimated, at least with the aid of binoculars; if the photos are used, only a portion of the areas need be viewed directly. The boundaries drawn for the vegetation-element areas also serve for the species-composition areas. Only where subdivisions of the vegetation-element areas are justified will additional boundaries be drawn. When more than one dominant species occurs in an area, their relative abundance on the ground is indicated by the order in which the symbols are recorded. For example, the area represented by Figure 88, composed of vegetation elements GHSK, would be given species symbols B, V for element H, Ce for element S, and Dp for element K. Because of the inconspicuous variations in grassland composition, no species distinctions of the grass element are attempted. The areas represented by Figures 85 and 86, each composed of only one vegetation element, would be given species symbols Ci and Af, Api, respectively. The area in Figure 87, composed of two elements, would be given species symbols Atr, J.

Aids such as those suggested for the classification of vegetation elements will likewise be of help in the judgment of dominant-species composition.

Value of the Classification

This classification brings out differences between the vegetation elements that result from the unequal values of individual species. Knowing that an area has commercial conifers is useful information, but not as useful for many purposes as knowing whether the conifers are sugar pine or ponderosa pine, Douglas-fir or white fir, or mixtures of them. Not only are present stand differences then indicated but also the future developmental differences that would follow logging. Similarly, the information that the hardwood cover of an area is California black oak rather than Canyon live oak has more ecological value than just knowing that the area is covered with hardwoods. And among game management problems the distinctions between shrubs having different forage values (e.g., Figs. 85 and 86) may find important uses. Figure 61 gives the species classification of the same area that is in Figure 60.

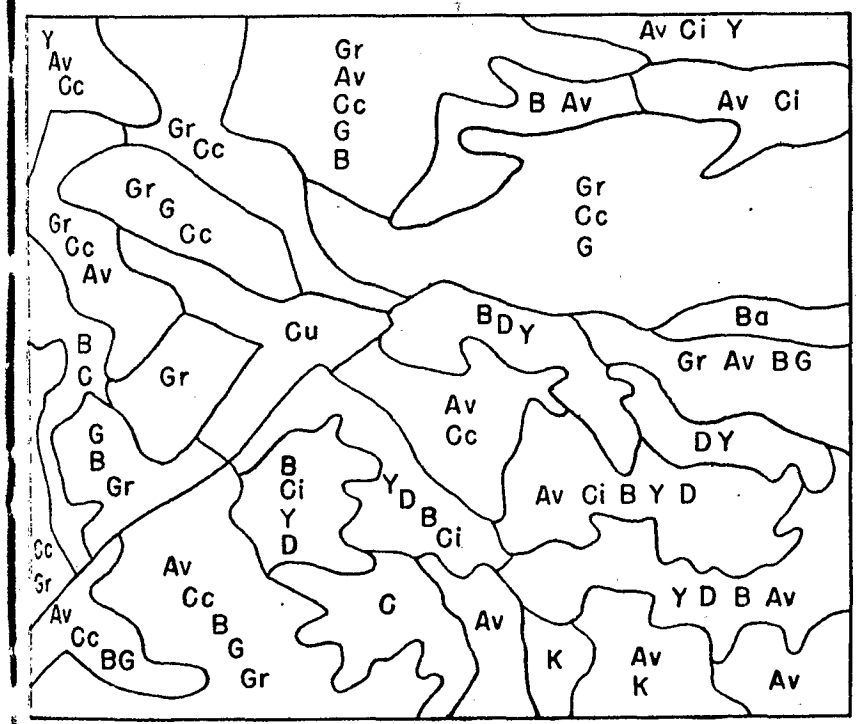

FIGURE 61. A sample map showing the classification of vegetation species for the same area as that in Figure 60. Av = White-leaf manzanita, B = California black oak, B = Barren, C = Canyon live oak, Cc = Wedgeleaf ceanothus, Ci = Deerbrush, Cu = Cultivated, D = Douglas-fir, G = Oregon white oak, Gr = Grass, K = Knobcone pine, Y = Ponderosa pine.

Section III. Classification of the Vegetation Types

This classification groups the vegetation-element areas (Section I) according to broad and specific use patterns. Considerable flexibility is possible within the framework of the basic vegetation-element classification. The specifications for any desired type classification may be quite restrictive (requiring complete similarity of elements for grouping), very

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broad (requiring only the presence or absence of a single element for grouping), or something in between, depending upon the purpose for which they are made. Furthermore, varying sets of specifications can be established to permit study of the same area from different viewpoints. Except for any species identification that may be needed, this classification can be made entirely through office interpretation of the vegetation-element classification.

The Units Recognized

The set of specifications in use on the Forest Survey and Vegetation Type Survey of California is given below. It illustrates the possibilities of this type classification. With some combinations, the types listed correspond with those in Table 1.

(1) VEGETATION TYPES THAT CONTAIN COMMERCIAL CONIFERS:

Pine (Fig. 89)—Ponderosa, Jeffrey, or sugar pines (the timber pines) are dominants[1] of the commercial-conifer stand in the absence of redwood, Douglas-fir, or the true firs.

Redwood (Fig. 90)—Redwood is a dominant of the commercial-conifer stand, or giant sequoia is present.

Douglas-fir (Fig. 91)—Douglas-fir is a dominant of the commercial-conifer stand in the absence of ponderosa, Jeffrey, or sugar pines, singly or mixed, or redwood.

Fir (Fig. 92)—True firs (white or red) are dominants of the commercial-conifer stand in the absence of ponderosa, Jeffrey, or sugar pines, singly or mixed, redwood, or Douglas-fir.

Pine—Douglas-fir (Fig. 93)—Ponderosa, Jeffrey, and sugar pines, singly or mixed, and Douglas-fir are associated dominants of the commercial-conifer stand in the absence of redwood or the true firs.

Pine-Fir (Fig. 94)—Ponderosa, Jeffrey, and sugar pines, singly or mixed, and the true firs are associated dominants of the commercial-conifer stand in the absence of Douglas-fir.

Pine—Douglas-fir—Fir (Fig. 94)—Ponderosa, Jeffrey, and sugar pines, singly or mixed, Douglas-fir, and the true firs are associated dominants of the commercial-conifer stand.

Spruce (Fig. 95)—Sitka spruce is a dominant of the commercial-conifer stand in the absence of redwood, Douglas-fir, or the true firs.

Lodgepole pine—Mountain hemlock (Fig. 96)—Lodgepole pine, western white pine, and mountain hemlock are the only dominants of the commercial conifer stand.

(2) VEGETATION TYPES THAT LACK COMMERCIAL CONIFERS BUT CONTAIN NONCOMMERCIAL CONIFERS IN PREDOMINANCE OVER HARDWOODS:

Whitebark pine—Foxtail pine (Fig. 97)—Whitebark, foxtail, limber, or bristlecone pines are dominants of the noncommercial-conifer stand.

Piñon pine (Fig. 98)—Piñon pines are dominants of the noncommercial conifer stand.

Juniper (Fig. 99)—Junipers are dominants of the noncommercial-conifer stand in the absence of piñon pines.

Minor conifers (Fig. 100)—Knobcone, Monterey, Bishop, Coulter, Torrey or digger pines, bigcone-spruce, bristlecone fir, or cypresses are the only dominants of the noncommercial-conifer stand.

[1] For definition of a dominant, see Classification principles of CLASSIFICATION OF THE VEGETATION SPECIES, page 205. In the following type specifications, reference is made only to key species. Others, not key species, may also be present in any of the types.

(3) VEGETATION TYPES THAT LACK COMMERCIAL CONIFERS BUT CONTAIN HARDWOODS IN PREDOMINANCE OVER NONCOMMERCIAL CONIFERS:

Woodland (Fig. 101)—Hardwoods not associated with chaparral, sagebrush, or herbaceous elements.

Woodland—Chaparral (Fig. 102)—Hardwoods associated with chaparral and the chaparral is more abundant than any sagebrush or herbaceous elements present.

Woodland—Sagebrush (Fig. 103)—Hardwoods associated with sagebrush and the sagebrush is more abundant than any chaparral or herbaceous elements present.

Woodland—Grass (Fig. 104)—Hardwoods associated with herbaceous (other than marsh) elements and the herbaceous elements are more abundant than any chaparral or sagebrush elements present.

Significant subdivisions of the above four Woodland types on the basis of species composition are:

Tanoak—Madrone (Fig. 105)—Tanoak, madrone, or California-laurel are dominants of the hardwood stand.

Black oak—Oregon white oak (Fig. 106)—California black or Oregon white oaks are dominants of the hardwood stand in the absence of Tanoak—Madrone species.

Live oaks (Fig. 107)—Interior, coast, or canyon live oaks are the only dominants of the hardwood stand.

Blue oak—California white oak (Fig. 108)—California blue, California white, or evergreen white oaks are dominants of the hardwood stand in the absence of Black oak—Oregon white oak and Aspen—Cottonwood species. Digger pine is a very common associate of this type.

Alder (Fig. 109)—Red or white alders are the only dominants of the hardwood stand.

Aspen—Cottonwood (Fig. 110)—Aspen, cottonwoods, willows, and California sycamore are dominants of the hardwood stand.

(4) VEGETATION TYPES THAT LACK TREES:

Chaparral (Figs. 111 and 112)—Chaparral is the predominant vegetation element. Two subdivisions based on species composition are generally significant: (Fig. 111) where species other than chamise are most abundant, and (Fig. 112) where chamise is the most abundant chaparral species.

Coastal sagebrush (Fig. 113)—Sagebrush is the predominant vegetation element and the sagebrush species consist of California sagebrush, wild buckwheats, coyote brush, and others of similar distribution.

Great Basin sagebrush (Fig. 114)—Sagebrush is the predominant vegetation element and the sagebrush species consist of big sagebrush, bitterbrush, and others of similar distribution.

*Desert** (Fig. 115)—Sagebrush, including creosotebush, is the predominant vegetation element and the sagebrush species are those characteristic of the Mojave and Colorado Deserts. (Joshua-tree and interior barren areas are also included.)

Bushy herbs (Fig. 116)—Bushy herbs is the predominant vegetation element.

Grass (Fig. 117)—Grass is the predominant vegetation element.

*Marsh** (Fig. 118)—Marsh is one of the predominant elements present.

* As pointed out by the author, the types given here were established for the Vegetation Type Survey of the California Forest and Range Experiment Station. As further pointed out, it is recognized that these types will not necessarily meet all the needs of other workers. For example, game management workers will find it necessary to set up subdivisions of the broad desert and marsh types—*Ed.*

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(5) Other Land-Status Types:

Barren (Fig. 119)—Bare ground and rock, singly or mixed, are the only elements present.

Cultivated (Fig. 120)—Cultivated is the only element present.

Urban—Industrial (Fig. 120)—Urban—Industrial is the only element present.

Classification Principles

Inasmuch as the basic data come from the classification of vegetation elements (Section I), the principles that apply there consequently become parts of this classification. If any supplemental species data, such as are

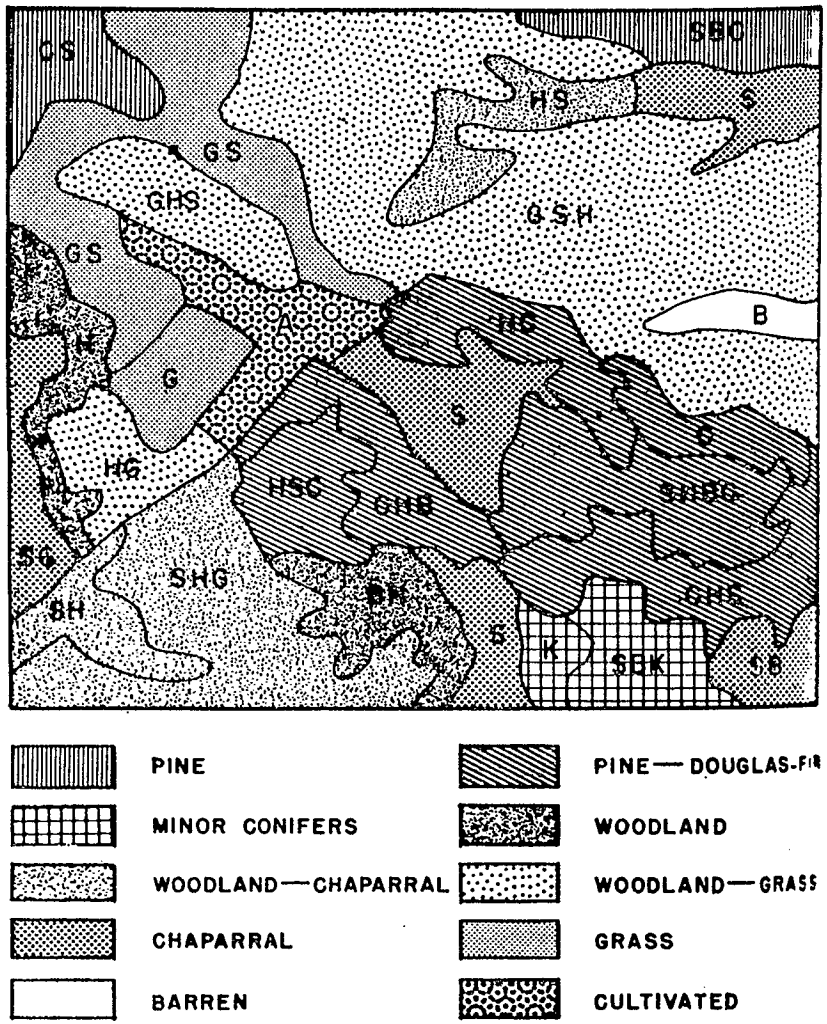

Figure 62. A sample map showing the classification of vegetation types for the same area as that in Figures 60 and 61

in the foregoing scheme, are also required, then the principles controlling the species classification likewise become applicable here.

One additional point of note is that as the classes are broadened so will the range of variation within each class increase and the distinction of transition conditions decrease. A compromise between the minimum of classes and maximum of distinctiveness is therefore to be desired.

Classifying Techniques

This classification is essentially an office translation of the record made under Section I, although the set of specifications given above also requires some ground observations. The office phase requires only a redesignation, by either symbols or colors, of the vegetation-element areas in accordance with the type specifications. Where species are the determining factor the types can be obtained directly from the species classification (Section II) if that has been made; otherwise through the procedure outlined for the species classification. But in either case retention of the basic vegetation-element classification will provide the means for better understanding of what the types include. Figure 62 shows the type classification given above superimposed on the area also covered by Figures 60 and 61.

The most useful way to present such a classification as this is to indicate the types by colors. A suggested color legend that brings out both relationships and contrasts, and that has been widely used in California is as follows:

Green— Commercial conifer types containing redwood or timber pines; the color shades or patterns decreasing in density through Redwood, Pine—Douglas-fir—Fir, Pine—Fir, Pine—Douglas-fir, and Pine.

Blue— Commercial conifer types lacking redwood or timber pines; the color shades or patterns decreasing in density through Douglas-fir, Fir, Spruce, and Lodgepole pine—Mountain hemlock.

Violet— Noncommercial conifer types; the color shades or patterns decreasing in density through Minor conifers, Piñon pine, Juniper, and Whitebark pine—Foxtail pine.

Red—Orange Hardwoods types; the color shades or patterns decreasing in density through Woodland, Woodland — Chaparral, Woodland — Sage, and Woodland—Grass.

Brown— Shrub types (except Desert); the color shades or patterns decreasing in density through Chaparral, Coastal sagebrush, and Great Basin sagebrush.

Yellow— Herbaceous types; the color shades or patterns decreasing in density from Bushy herbs to Grass.

Black— Barren and Desert, with the color shades or patterns decreasing in that order.

Pink— Urban—Industrial and Cultivated, with the color shades or patterns decreasing in that order.

Standard map designation—Marsh.

Value of the Classification

This classification finds its chief value by summarizing the multitudinous vegetation details for particular purposes. Through groupings, specifically desired characteristics are placed in a form that is easily seen,

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and characteristics not required are subordinated. As examples: The desired information may be the acreage or location of timber stands, livestock grazing areas, wildlife food crops, watershed cover conditions, or inflammability classes. While the classification presented will bring out these features, any of the specifications can be changed if the needs require.

Section IV. Classification of the Tree and Shrub Densities

This classification segregates the woody vegetation (the tree and shrub cover) according to its density. Two schemes are presented: (1) a separate photo classification made independently and concurrently with the vegetation-element classification (Section I), and (2) a close approach to the first, but obtainable by direct interpretation of the vegetation-element classification. Both schemes are applicable either to the tree and shrub cover as a whole, to any of its elements alone, or to any combination of its elements.

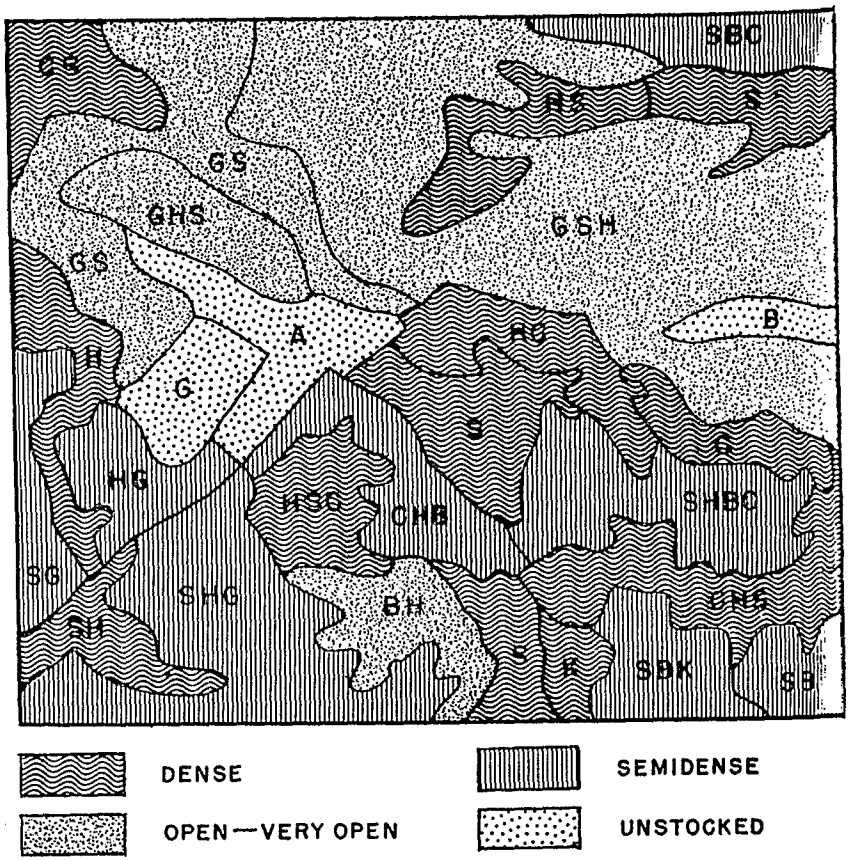

FIGURE 63. A sample map showing the classification of total tree and shrub density for the same area as that in Figures 60, 61 and 62

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 64. Commercial conifers (Ponderosa pine)

FIGURE 65. Noncommercial conifers (Monterey cypress)

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VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 66. H = Hardwoods (California white and California blue oaks)

FIGURE 67. S Chaparral (White-leaf manzanita)

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 68. Sagebrush (Big sagebrush and bitterbrush)

FIGURE 69. Bushy herbs (Bracken)

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VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 70. Grass

FIGURE 71. Marsh (Rushes and cattail)

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

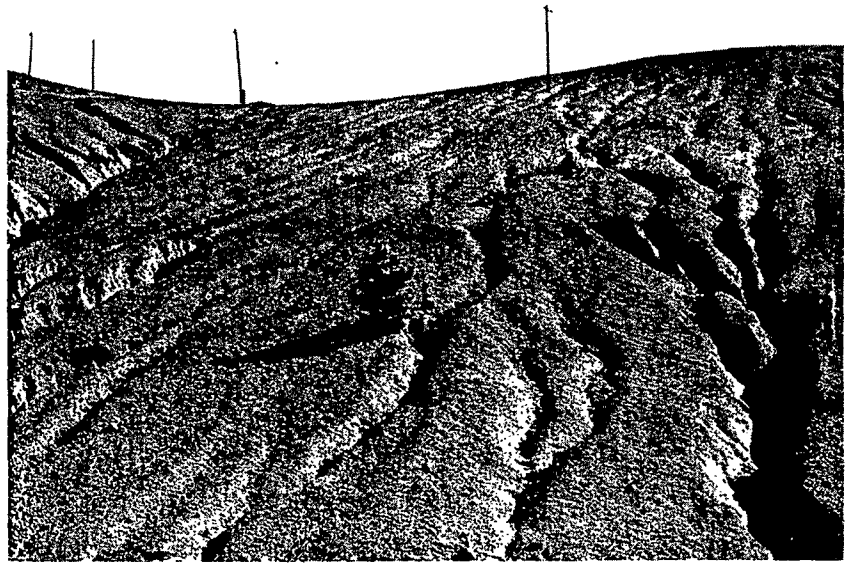

FIGURE 72. Bare ground

FIGURE 73. Rock

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VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

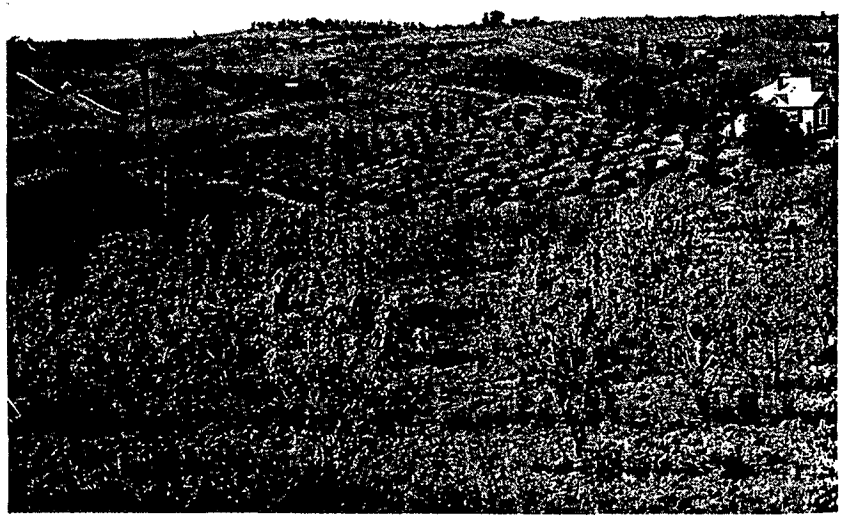


FIGURE 74. Cultivated

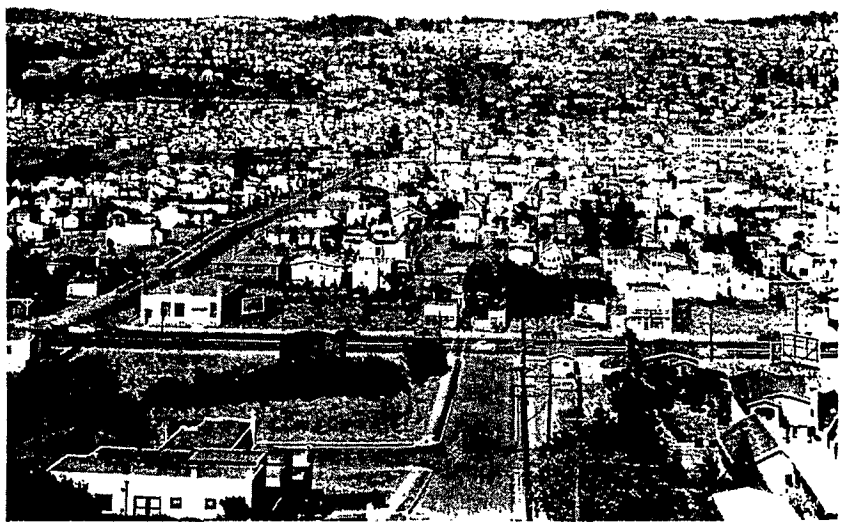
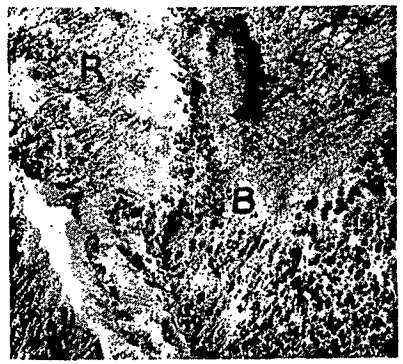


FIGURE 75. Urban-Industrial

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

H = Hardwoods, G = Grass, A = Cultivated

C = Commercial conifers, H = Hardwoods, F = Bushy herbs, G = Grass



K = Noncommercial conifers, B = Bare ground, R = Rock

K = Noncommercial conifers, T = Sagebrush, G = Grass

C = Commercial conifers, H = Hardwoods, S = Chaparral

M = Marsh, U = Urban-Industrial

FIGURE 76. The vegetation-cover and other land status elements on 1:20,000 scale (approximately 3 inches 1 mile) aerial photos

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VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

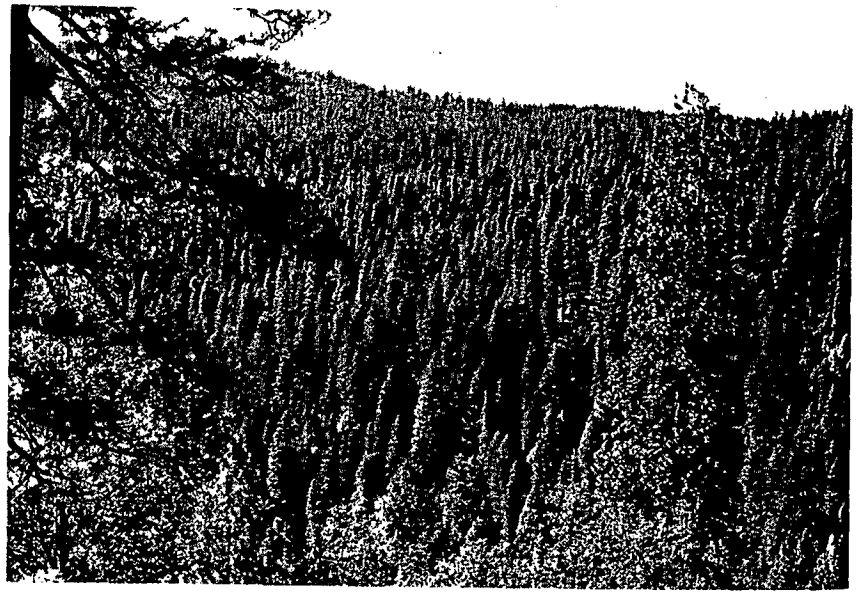

FIGURE 77. A single-element stand composed of commercial conifers

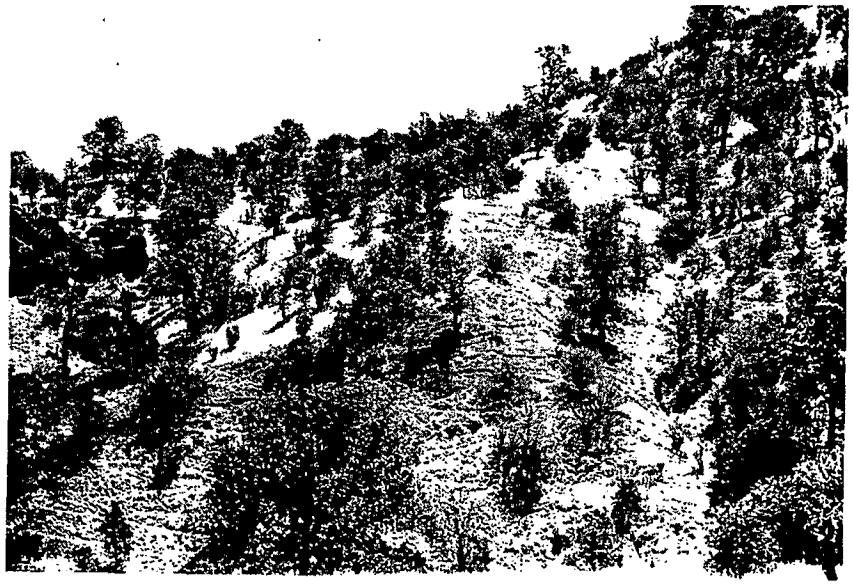

FIGURE 78. A multi-element stand composed of grass, chaparral, and hardwoods

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 79. The proper inventory of this area would show as many of the distinct areas as the job specifications require and omit the others; it would not show a mixture of hardwoods, grass, and chaparral.

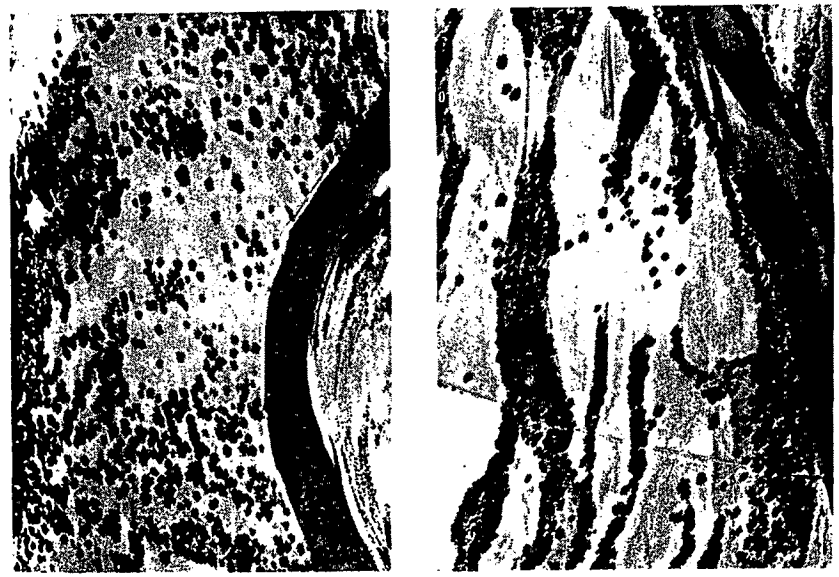

FIGURE 80. Aerial photo views of

(A) a true grass-hardwood mixture and

(B) an area that would be incorrectly classified as such a mixture even though some of the hardwood stringers would otherwise be too small to record.

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VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 81. An example of a classified aerial photo from the Sierra Nevada. B = Bare ground, C = Commercial conifers, G = Grass, H = Hardwoods, S = Chaparral

FIGURE 82. An example of a classified aerial photo from the Sierra Nevada foothills. A = Cultivated, G = Grass, H = Hardwoods, S = Chaparral

VEGETATION-COVER AND OTHER LAND STATUS ELEMENTS

FIGURE 83. An example of a classified aerial photo from the northeastern plateau (Great Basin). B = Bare ground, C = Cultivated, G = Grass, H = Hardwoods, K = Noncommercial conifers, S = Chaparral, T = Sagebrush.

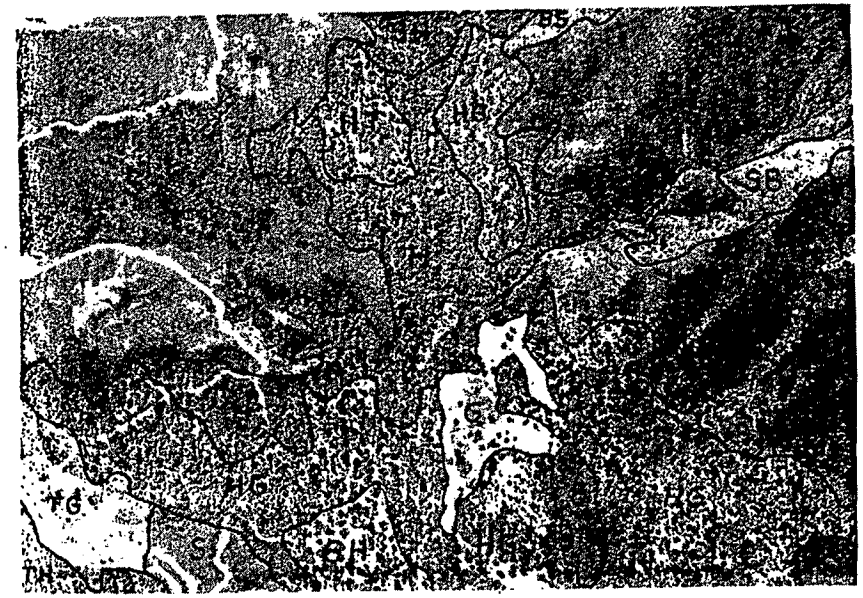

FIGURE 84. An example of a classified aerial photo from the south coastal mountains. B = Bare ground, G = Grass, H = Hardwoods, S = Chaparral, T = Sagebrush

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VEGETATION SPECIES

FIGURE 85. A single-species stand where only one vegetation element (chaparral) is present. The chaparral species is deerbrush

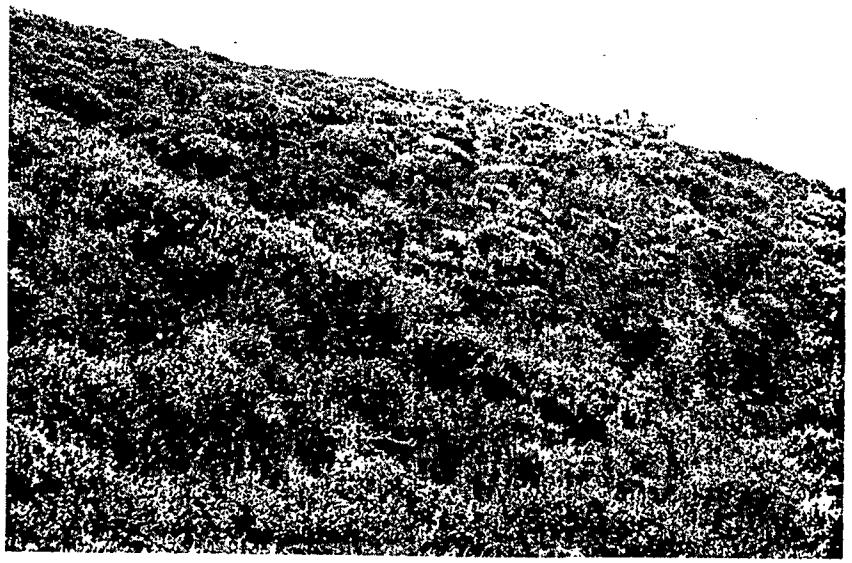

FIGURE 86. A multi-species stand where only one vegetation element (chaparral) is present. The chaparral species are chamise and stripedberry manzanita

VEGETATION SPECIES

FIGURE 87. A multi-species stand where two vegetation elements (sagebrush and commercial conifers) are present. The sagebrush species is big sagebrush and the commercial conifer species is Jeffrey pine.

FIGURE 88. A multi-species stand where more than two vegetation elements (grass, hardwoods, chaparral, and noncommercial conifers) are present. The hardwood species are California black oak and California white oak, the chaparral species is wedgeleaf ceanothus, and the noncommercial conifer species is digger pine. No attempt is made to map the individual grass species. The ponderosa pines appearing on the photo cover too little of the area to be given recognition.

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VEGETATION TYPES

FIGURE 89. Pine

FIGURE 90. Redwood

VEGETATION TYPES

FIGURE 91. Douglas-fir

FIGURE 92. Fir

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VEGETATION TYPES

FIGURE 93. Pine—Douglas-fir

FIGURE 94. Pine—Fir and Pine—Douglas-fir—Fir. (These two types are general similar except for the absence or presence of Douglas-fir.)

VEGETATION TYPES

FIGURE 95. Spruce

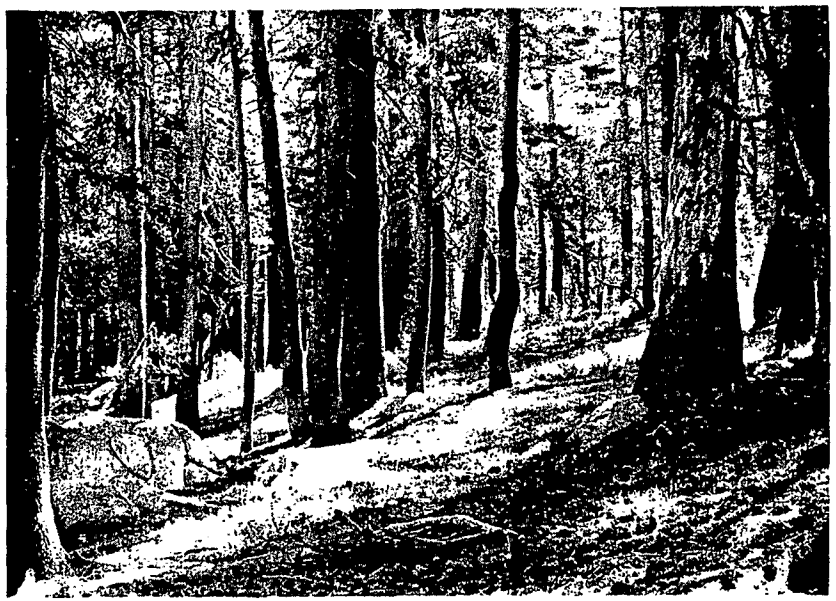

FIGURE 96. Lodgepole pine—Mountain hemlock

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VEGETATION TYPES

FIGURE 97. Whitebark pine—Foxtail pine

FIGURE 98. Piñon pine

VEGETATION TYPES

FIGURE 99. Juniper (Sierra juniper)

FIGURE 100. Minor conifers (Bigcone-spruce)

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VEGETATION TYPES

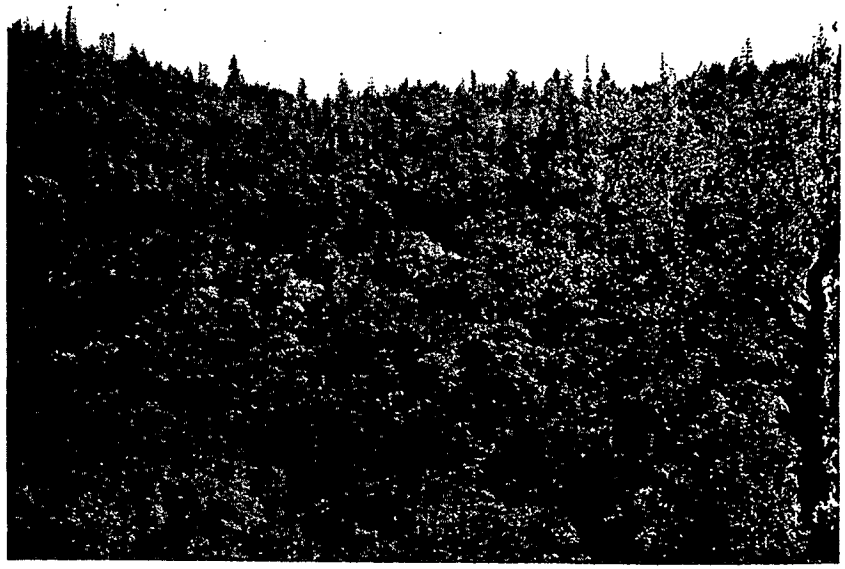

FIGURE 101. Woodland

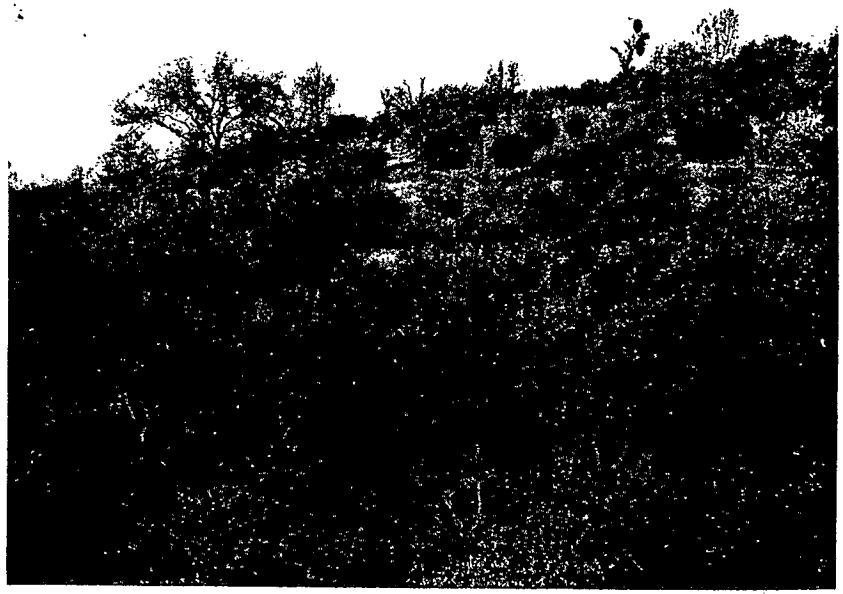

FIGURE 102. Woodland Chaparral

VEGETATION TYPES

FIGURE 103. Woodland—Sagebrush

FIGURE 104. Woodland—Grass

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VEGETATION TYPES

FIGURE 105. Tanoak—Madrone

FIGURE 106. Black oak—Oregon white oak

VEGETATION TYPES

FIGURE 107. Live oaks

FIGURE 108. Blue oak—California white oak

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VEGETATION TYPES

FIGURE 109. Alder

FIGURE 110. Aspen—Cottonwood

VEGETATION TYPES

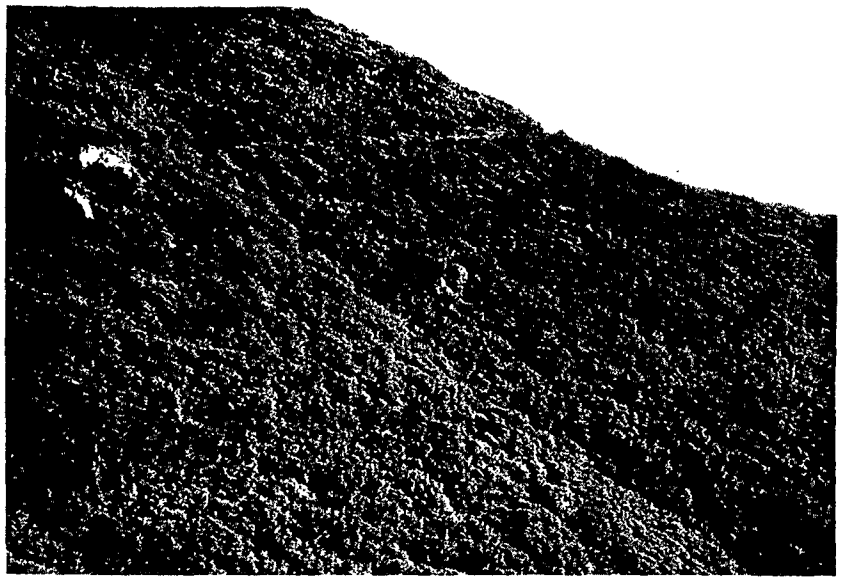

FIGURE 111. Chaparral (Other than chamise)

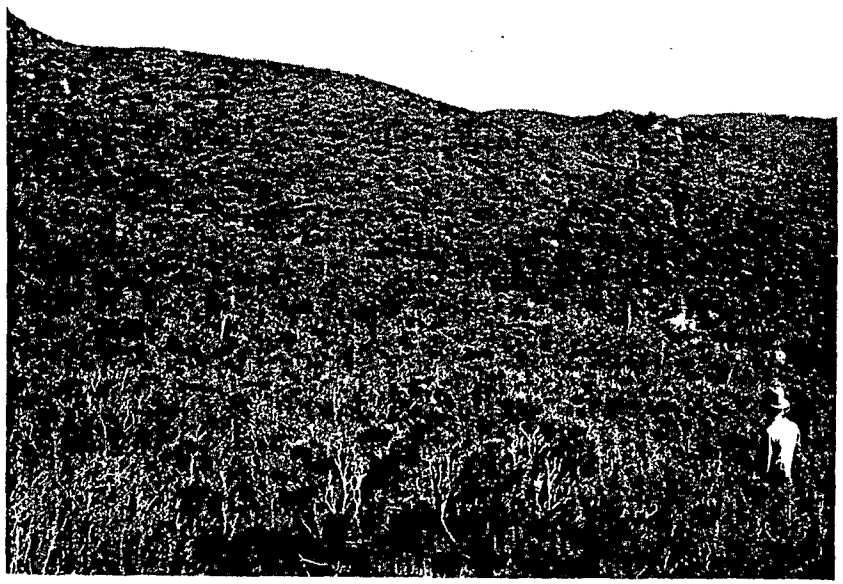

FIGURE 112. Chaparral (Chamise)

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VEGETATION TYPES

FIGURE 113. Coastal sagebrush

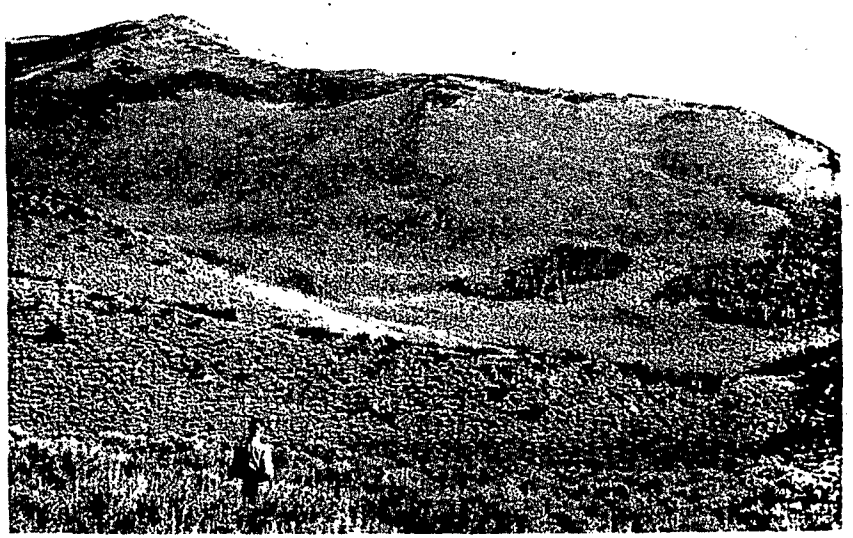

FIGURE 114. Great Basin sagebrush

VEGETATION TYPES

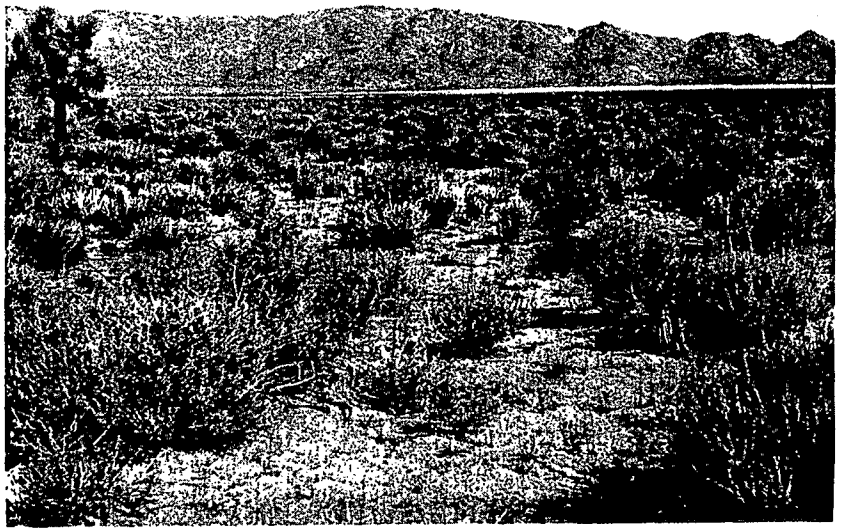

FIGURE 115. Desert

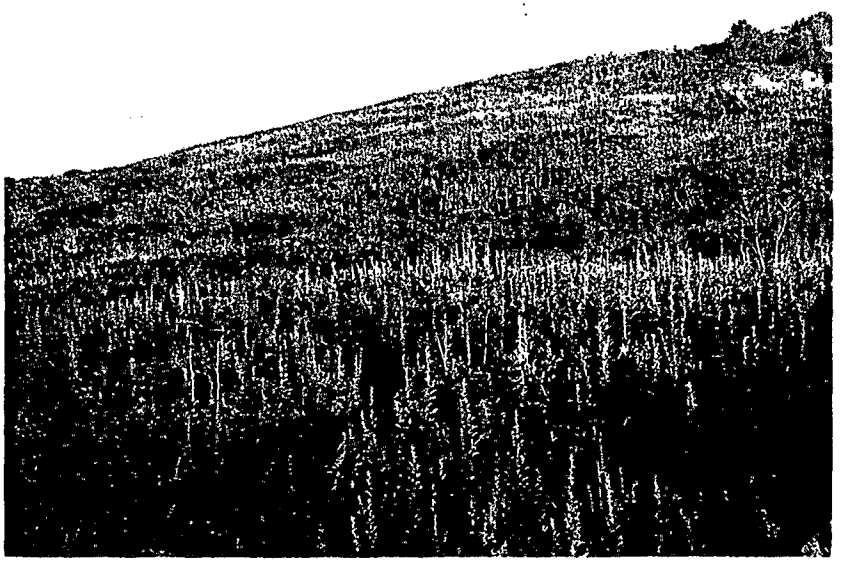

FIGURE 116. Bushy herbs

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VEGETATION TYPES

FIGURE 117. Grass

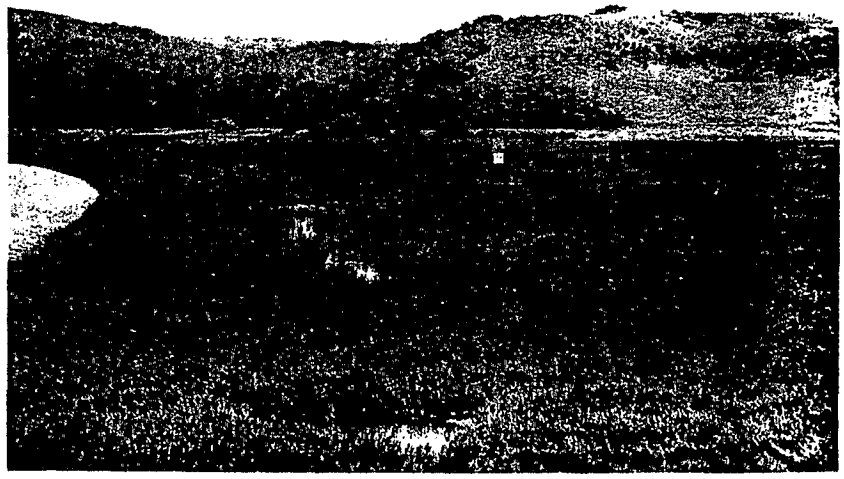

FIGURE 118. Marsh

VEGETATION TYPES

FIGURE 119. Barren

FIGURE 120. Cultivated and Urban-Industrial

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TREE AND SHRUB DENSITIES

FIGURE 121. Dense woody cover; dense for trees alone, unstocked for shrubs alone

FIGURE 122. Semidense woody cover; very open for trees alone, semidense for shrubs alone

FIGURE 123. Open woody cover; very open for trees alone, very open for shrubs alone

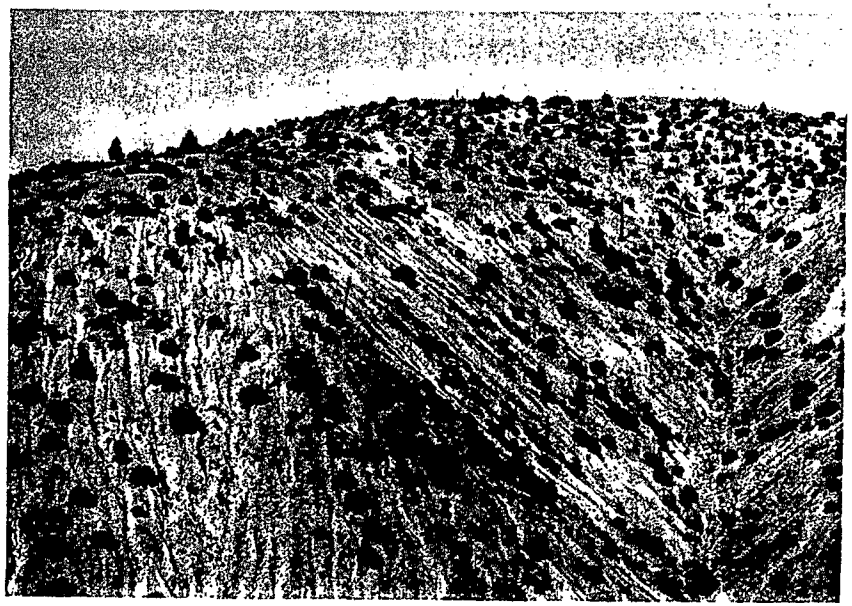

FIGURE 124. Very open woody cover; unstocked for trees alone, very open for shrubs alone

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TREE AND SHRUB DENSITIES

FIGURE 125. Unstocked with woody cover

FIGURE 126. An example of the density classification on an aerial photo. 1, dense; 2, semidense; 3, open; 4, very open; 5, unstocked

The Units Recognized, Scheme 1

This scheme gives the essentially balanced division of density classes by which timber stands are now being stratified on aerial photos for the Forest Survey of California. Its classes and identifying symbols are:

1—*Dense*—Stands in which the crowns of the element or elements being considered cover 80 percent or more of the ground space.

2—*Semidense*—Stands in which the crowns of the element or elements being considered cover from 50 to 80 percent of the ground space.

3—*Open*—Stands in which the crowns of the element or elements being considered cover from 20 to 50 percent of the ground space.

4—*Very open*—Stands in which the crowns of the element or elements being considered cover from 5 to 20 percent of the ground space.

5—*Unstocked*—Areas having less than 5 percent of ground space covered by crowns of the element or elements being considered.

Figure 59 illustrates diagramatically what these percentage limits mean in terms of vertical views. Figures 121-125 show examples of the classes from ground views, and Figure 126 examples on an aerial photo.

TABLE 2

Schedule (Scheme 2) for Translating the Vegetation-Element Classes Into Density Classes

Number of woody elements considered together	Number of diluting elements in designation	Position of diluting elements in designation	Density class
Any	0		Dense
Any	1	Not in first place	Semidense
3 or 4	1	In first place	Semidense
1 or 2	1	In first place	Open—Very open
3	2	Any	Semidense
2	2	Any, except when one of woody elements is in first place	Open—Very open
1	2	Any	Semidense
1 or 2	3 or 4	Any	Open—Very open
0	Any		Open—Very open
			Unstocked

The Units Recognized, Scheme 2

This scheme is designed to classify the densities of all forms of woody vegetation through translation of the vegetation-element classification (Section I); at the same time fitting within the framework of the first scheme. With but minor exceptions and the grouping of open and very open densities together, both of these objectives are satisfied through application of the schedule in Table 2 to the vegetation-element classification. In this schedule "diluting elements" refers to all elements (woody or non-woody) excluded from whatever density classification is being made.

For example, in classifying the density of all woody cover, SH would be dense, CHBS semidense, GSK open—very open, and G unstocked. On the basis of shrub cover alone SH would be semidense, CHBS and GSK open—very open, and G unstocked.

Classification Principles

The principles governing the original classification of tree and shrub density under the first scheme presented are the same as those that apply

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TABLE 3

Common Names of Plants Mentioned in Article, Together With Their Scientific Equivalents

Common name	Scientific name
Alder	*Alnus* spp.
Aspen	*Populus tremuloides*
Bigcone-spruce	*Pseudotsuga macrocarpa*
Big sagebrush	*Artemisia tridentata*
Bishop pine	*Pinus muricata*
Bitterbrush	*Purshia tridentata*
Blue oak (Calif. Blue Oak)	*Quercus douglasii*
Bracken	*Pteris aquilina lanuginosa*
Bristlecone fir (Santa Lucia fir)	*Abies venusta*
Bristlecone pine	*Pinus aristata*
California black oak	*Quercus kelloggii*
California-laurel	*Umbellularia californica*
California sagebrush	*Artemisia californica*
California sycamore	*Platanus racemosa*
California white oak (Valley oak)	*Quercus lobata*
Canyon live oak	*Quercus chrysolepis*
Cattail	*Typha latifolia*
Chamise	*Adenostoma fasciculatum*
Coast live oak	*Quercus agrifolia*
Cottonwoods	*Populus* spp.
Coulter pine	*Pinus coulteri*
Coyote brush (Kidneywort)	*Baccharis pilularis*
Creosotebush	*Larrea tridentata glutinosa*
Cypresses	*Cupressus* spp.
Deerbrush (Sweetbirch ceanothus)	*Ceanothus integerrimus*
Digger pine	*Pinus sabiniana*
Douglas-fir	*Pseudotsuga taxifolia*
Evergreen white oak	*Quercus engelmannii*
Ferns	*Pteridophyta*
Firs (True)	*Abies* spp.
Foxtail pine	*Pinus balfouriana*
Giant sequoia	*Sequoia washingtonia* (*S. gigantea*)
Grasses	Gramineae
Interior live oak	*Quercus wislizenii*
Jeffrey pine	*Pinus jeffreyi*
Joshua-tree	*Yucca brevifolia*
Junipers	*Juniperus* spp.
Klamath weed	*Hypericum perforatum*
Knobcone pine	*Pinus attenuata*
Limber pine	*Pinus flexilis*
Lodgepole pine	*Pinus contorta murrayana*
Madrone (Pacific madrone)	*Arbutus menziesii*
Manzanitas	*Arctostaphylos* spp.
Monterey cypress	*Cupressus macrocarpa*
Monterey pine	*Pinus radiata*
Mountain hemlock	*Tsuga mertensiana*
Mountain-mahogany	*Cercocarpus* spp.
Oaks	*Quercus* spp.
Oregon white oak (Garry oak)	*Quercus garryana*
Piñon pines	*Pinus monophylla* and *P. parryana*
Ponderosa pine	*Pinus ponderosa*
Red alder	*Alnus rubra*
Red fir (California red fir)	*Abies magnifica*
Redwood	*Sequoia sempervirens*
Rushes	Juncaceae
Sagebrushes	*Artemisia* spp.
Samphire	*Salicornia* spp.
Scrub oak	*Quercus dumosa*
Sedges	Cyperaceae
Sierra juniper	*Juniperus occidentalis*
Sitka spruce	*Picea sitchensis*
Stripedberry manzanita	*Arctostaphylos pilosula*
Sugar pine	*Pinus lambertiana*
Tanoak	*Lithocarpus densiflora*
Torrey pine	*Pinus torreyana*
Wedgeleaf ceanothus	*Ceanothus cuneatus*
Western white pine	*Pinus monticola*
White alder	*Alnus rhombifolia*
White fir	*Abies concolor* (inc. *A. grandis*)
Whitebark pine	*Pinus albicaulis*
White-leaf manzanita	*Arctostaphylos viscida*
Wild-buckwheats	*Eriogonum* spp.
Willows	*Salix* spp.
Wooly mules-ears	*Wyethia mollis*

TABLE 4

A. Alphabetical List by Genus of Plants Other Than Grasses

A

W[1]	*Abies concolor*	T
G[1]	*Abies grandis*	T
R[1]	*Abies magnifica*	T
S[1]	*Abies magnifica shastensis*	T
N[1]	*Abies nobilis*	T
B[1]	*Abies venusta*	T
Aba	*Abronia alpina*	H
Abm	*Abronia maritima*	H
Abp	*Abronia pogonantha*	H
Abv	*Abronia villosa*	H
Agr	*Acacia greggii*	S
Acp	*Acaena pinnatifida californica*	H
Acs	*Acamptopappus sphaerocephalus*	Ss
Aci	*Acer circinatum*	S
Acg	*Acer glabrum*	S
M[2]	*Acer macrophyllum*	T
N[2]	*Acer negundo californicum*	T
Aml	*Achillea millefolium lanulosa*	H
Act	*Achlys triphylla*	H
Acm	*Achyrachaena mollis*	H
Aco	*Achyronychia cooperi*	H
Acl	*Acleisanthes longiflora*	Ss
Asa	*Actaea spicata arguta*	H
Ahe	*Adenostegia helleri*	H
Af	*Adenostoma fasciculatum*	S
As	*Adenostoma sparsifolium*	S
Adx	*Adiantum* sp.	H
Ado	*Adolphia californica*	Ss
Aec	*Aesculus californica*	S
H[2]	*Aesculus californica*	T
Agu	*Agastache urticifolia*	H
Agx	*Agoseris* sp.	H
Aga	*Agoseris apargioides*	H
Aggl	*Agoseris glauca laciniata*	H
Aggr	*Agoseris grandiflora*	H
Agh	*Agoseris heterophylla*	H
Ahi	*Agoseris hirsuta*	H
Agg	*Agrostemma githago*	H
Th	*Ailanthus glandulosa*	T
Alc	*Alhagi camelorum*	Ss
Alo	*Allenrolfia occidentalis*	Ss
Alx	*Allium* sp.	H
Alv	*Allium validum*	H
Allx	*Allocarya* sp.	H
A[1]	*Alnus rhombifolia*	T
R[2]	*Alnus rubra*	T
Ate	*Alnus tenuifolia*	S
Avs	*Alnus viridis sinuata*	S
Amp	*Ambrosia psilostachya*	H
Aa	*Amelanchier alnifolia*	S
Aca	*Amorpha californica*	S
Afr	*Amorpha fruticosa*	S
Ams	*Amsinckia douglasiana*	H
Ain	*Amsinckia intermedia*	H
Amx	*Amsinckia* sp.	H
Ana	*Anagallis arvensis*	H
Anm	*Anaphalis margaritacea*	H
Anca	*Anemopsis californica*	H
Anb	*Angelica breweri*	H
Anl	*Angelica lineariloba*	H
Ant	*Angelica tomentosa*	H
Aac	*Anisocoma acaulis*	H
Aal	*Antennaria alpina*	H
And	*Antennaria dioica*	H
Anc	*Anthemis cotula*	H
Ang	*Antirrhinum glandulosum*	H
Ans	*Antirrhinum speciosum*	H
Apap	*Apocynum androsaemifolium pumilum*	H
Apc	*Apocynum cannabinum*	H
Aqt	*Aquilegia truncata*	H
Abl	*Arabis blepharophylla*	H
Abr	*Arabis breweri*	H
Ahf	*Arabis holboellii fendleri*	H
Ahr	*Arabis holboellii retrofracta*	H
Arl	*Aralia californica*	H
M	*Arbutus menziesii*	T
Arm	*Arctomecon merriamii*	H
Aan	*Arctostaphylos andersonii*	S
Aap	*Arctostaphylos andersonii pechoensis*	S
Aaa	*Arctostaphylos auriculata*	S
Ab	*Arctostaphylos bicolor*	S
Acn	*Arctostaphylos canescens*	S
Aco	*Arctostaphylos columbiana*	S
Ade	*Arctostaphylos densifolia*	S
Ad	*Arctostaphylos drupacea*	S
Ae	*Arctostaphylos elegans*	S
Agl	*Arctostaphylos glandulosa*	S
Ag	*Arctostaphylos glauca*	S
Ah	*Arctostaphylos hookeri*	S
Aim	*Arctostaphylos imbricata*	S
Ai	*Arctostaphylos insularis*	S
Am	*Arctostaphylos manzanita*	S
Ama	*Arctostaphylos mariposa*	S
Amb	*Arctostaphylos mariposa bivisum*	S
Amr	*Arctostaphylos morroensis*	S
Amy	*Arctostaphylos myrtifolia*	S
An	*Arctostaphylos nevadensis*	S
Ani	*Arctostaphylos nissenana*	S
Anu	*Arctostaphylos nummularia*	S
Aob	*Arctostaphylos obispoensis*	S
Ao	*Arctostaphylos otayensis*	S
Apj	*Arctostaphylos pajaroensis*	S
Apl	*Arctostaphylos pallida*	S
Apy	*Arctostaphylos parryana*	S
App	*Arctostaphylos parryana pinetorum*	S
Aps	*Arctostaphylos pastillosa*	S
Ap	*Arctostaphylos patula*	S
Ape	*Arctostaphylos pechoensis*	S
Api	*Arctostaphylos pilosula*	S
Apm	*Arctostaphylos pumila*	S
Apu	*Arctostaphylos pungens*	S
Are	*Arctostaphylos regismontana*	S
Ar	*Arctostaphylos rudis*	S
Ase	*Arctostaphylos sensitiva*	S
Asi	*Arctostaphylos silvicola*	S
Ast	*Arctostaphylos stanfordiana*	S
At	*Arctostaphylos tomentosa*	S
Au	*Arctostaphylos uva-ursi*	S
Av	*Arctostaphylos viscida*	S
Ay	*Arctostaphylos ynezensis*	S
Arco	*Arenaria congesta*	H
Ardo	*Arenaria douglasii*	H

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[1] This symbol carries accent, i.e., $\hat{X}$.

[2] This symbol carries underline, i.e., $\underline{X}$.

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Arn	*Arenaria nuttallii*	H
Arx	*Arenaria* sp.	H
Aic	*Argemone intermedia corymbosa*	H
Arp	*Argemone platyceras*	H
Aph	*Argemone platyceras hispida*	H
Arca	*Aristolochia californica*	S
Ard	*Arnica discoidea*	H
Aar	*Artemisia arbuscula*	Ss
Ac	*Artemisia californica*	Ss
Arc	*Artemisia cana*	Ss
Adr	*Artemisia dracunculus*	H
Aty	*Artemisia pycnocephala*	H
Arr	*Artemisia rothrockii*	Ss
Arsp	*Artemisia spinescens*	Ss
Atr	*Artemisia tridentata*	Ss
Ato	*Artemisia tridentata nova*	Ss
Apa	*Artemisia tridentata parishii*	Ss
Atf	*Artemisia trifida*	Ss
Avu	*Artemisia vulgaris*	H
Avh	*Artemisia vulgaris heterophylla*	H
Asy	*Aruncus sylvester*	H
Asac	*Asarum caudatum*	H
Ascc	*Asclepias californica*	H
Asc	*Asclepias cordifolia*	H
Ascr	*Asclepias eriocarpa*	H
Ases	*Asclepias erosa*	H
Asf	*Asclepias fremontii*	H
Asm	*Asclepias mexicana*	H
Ara	*Aspidium rigidum argutum*	H
Asx	*Aspidium* sp.	H
Asad	*Aster adscendens*	H
Asca	*Aster canescens*	H
Asl	*Aster chilensis*	H
Asco	*Aster cognatus*	H
Ame	*Aster menziesii*	H
Asr	*Aster radulinus*	H
Art	*Aster tortifolius*	S
Asbo	*Astragalus bolanderi*	H
Ask	*Astragalus hookerianus*	H
Aho	*Astragalus hornii*	H
Ake	*Astragalus kernensis*	H
Ale	*Astragalus lentiginosus*	H
Alu	*Astragalus leucophyllus*	H
Amz	*Astragalus menziesii*	H
Amo	*Astragalus mohavensis*	H
Asn	*Astragalus nigrescens*	H
Aox	*Astragalus oxyphysus*	H
Aspu	*Astragalus purshii*	H
Ax	*Astragalus* sp.	H
Astr	*Astragalus trichopodus*	H
Affc	*Athyrium filix-foemina californicum*	H
Ata	*Atriplex argentea*	H
Atk	*Atriplex bracteosa*	H
Atb	*Atriplex breweri*	Ss
Atc	*Atriplex canescens*	Ss
Aff	*Atriplex confertifolia*	Ss
Atex	*Atriplex expansa*	H
Atha	*Atriplex hastata*	H
Ath	*Atriplex hymenelytra*	Ss
Atl	*Atriplex lentiformis*	Ss
Atn	*Atriplex nuttallii*	Ss
Apr	*Atriplex parryi*	Ss
Atpa	*Atriplex patula*	H
Atp	*Atriplex polycarpa*	Ss
Ats	*Atriplex semibaccata*	H
Atx	*Atriplex* sp.	H, Ss
Asp	*Atriplex spinifera*	Ss
Att	*Atriplex torreyi*	Ss
Aya	*Ayenia californica*	Ss

B

Bd	*Baccharis douglasii*	Ss
Be	*Baccharis emoryi*	Ss
Bag	*Baccharis glutinosa*	Ss
Bp	*Baccharis pilularis*	Ss
Bpl	*Baccharis plummerae*	Ss
Bsa	*Baccharis sarothroides*	Ss
Bas	*Baccharis sergiloides*	Ss
Bv	*Baccharis viminea*	Ss
Bac	*Baeria chrysostoma*	H
Bap	*Baeria platycarpha*	H
Bax	*Baeria* sp.	H
Bho	*Balsamorhiza hookeri*	H
Bsg	*Balsamorhiza sagittata*	H
Bav	*Barbarea vulgaris*	H
Bj	*Bebbia juncea*	Ss
Bec	*Beloperone californica*	Ss
Baq	*Berberis aquifolium*	Ss
Bcf	*Berberis californica*	S
Bf	*Berberis fremontii*	S
Bn	*Berberis nervosa*	S
Ben	*Berberis nevinii*	S
Bpi	*Berberis pinnata*	S
Bpu	*Berberis pumila*	S
Ber	*Berberis repens*	S
Bem	*Bernardia myricaefolia*	Ss
B[2]	*Betula fontinalis*	T
Bgl	*Betula glandulosa*	S
Bif	*Bidens frondosa*	H
Bil	*Bidens levis*	H
Blc	*Bloomeria crocea*	H
Bad	*Brassica adpressa*	H
Bca	*Brassica campestris*	H
Bng	*Brassica nigra*	H
Brx	*Brassica* sp.	H
Ban	*Brickellia atractyloides arguta*	Ss
Bc	*Brickellia californica*	Ss
Bfr	*Brickellia frutescens*	Ss
Bg	*Brickellia grandiflora*	H
Brm	*Brickellia microphylla*	Ss
Bmu	*Brickellia multiflora*	Ss
Bne	*Brickellia nevinii*	Ss
Bol	*Brickellia oblongifolia linifolia*	Ss
Bkx	*Brickellia* sp.	H, Ss
Brc	*Brodiaea capitata*	H
Bco	*Brodiaea coronaria*	H
Bhy	*Brodiaea hyacinthina*	H
Bi	*Brodiaea ixioides*	H
Bl	*Brodiaea laxa*	H
Brp	*Brodiaea pulchella*	H
Bvo	*Brodiaea volubilis*	H

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[2] This symbol carries underline, i.e., X.

TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

C

Cac	*Calandrinia caulescens*	H
Calb	*Calochortus albus*	H
Caca	*Calochortus caeruleus*	H
Ccat	*Calochortus catalinae*	H
Caco	*Calochortus concolor*	H
Cke	*Calochortus kennedyi*	H
Call	*Calochortus leichtlinii*	H
Calu	*Calochortus luteus*	H
Cama	*Calochortus macrocarpus*	H
Camo	*Calochortus monophyllus*	H
Cnu	*Calochortus nudus*	H
Cap	*Calochortus plummerae*	H
Cpu	*Calochortus pulchellus*	H
Ckx	*Calochortus* sp.	H
Cls	*Calochortus splendens*	H
Cav	*Calochortus venustus*	H
Cabi	*Caltha biflora*	H
Cmo	*Calycadenia mollis*	H
Clm	*Calycadenia multiglandulosa*	H
Clp	*Calycadenia oppositifolia*	H
Clx	*Calycadenia* sp.	H
Cat	*Calycadenia truncata*	H
Cao	*Calycanthus occidentalis*	S
Cal	*Calyptridium umbellatum*	H
Cale	*Camassia leichtlinii*	H
Caq	*Camassia quamash*	H
Cah	*Canotia holocantha*	S
Cab	*Capsella bursa-pastoris*	H
Cxb	*Carex barbarae*	H
Cax	*Carex* sp.	H
Ccl	*Carpenteria californica*	S
Caga	*Carum gairdneri*	H
Caa	*Cassia armata*	Ss
Ctp	*Cassiope mertensiana*	S
Q	*Castanopsis chrysophylla*	T
Ccm	*Castanopsis chrysophylla minor*	S
Cs	*Castanopsis sempervirens*	S
Caf	*Castilleia affinis*	H
Can	*Castelleia angustifolia*	H
Cfl	*Castelleia foliolosa*	H
Cala	*Castilleia latifolia*	H
Cami	*Castilleia miniata*	H
Cpdo	*Castilleia parviflora douglasii*	H
Capi	*Castilleia pinetorum*	H
Cam	*Caucalis microcarpa*	H
Car	*Ceanothus arboreus*	S
Ca	*Ceanothus austromontanus*	S
Cco	*Ceanothus cordulatus*	S
Ccr	*Ceanothus crassifolius*	S
Cc	*Ceanothus cuneatus*	S
Ccy	*Ceanothus cyaneus*	S
Cde	*Ceanothus dentatus*	S
Cim	*Ceanothus dentatus impressus*	S
Cd	*Ceanothus divaricatus*	S
Cdi	*Ceanothus diversifolius*	S
Cfe	*Ceanothus ferrisae*	S
Cfo	*Ceanothus foliosus*	S
Cg	*Ceanothus greggii*	S
Cgp	*Ceanothus greggii perplexans*	S
Cin	*Ceanothus incanus*	S
Ci	*Ceanothus integerrimus*	S
Cj	*Ceanothus jepsonii*	S
Cjp	*Ceanothus jepsonii purpurea*	S
Cle	*Ceanothus lemmoni*	S
Clo	*Ceanothus lompocensis*	S
Cm	*Ceanothus macrocarpus*	S
Co	*Ceanothus oliganthus*	S
Cpl	*Ceanothus papillosus*	S
Cpr	*Ceanothus parryi*	S
Cpv	*Ceanothus parvifolius*	S
Cpi	*Ceanothus pinetorum*	S
Cpo	*Ceanothus prostratus*	S
Cpd	*Ceanothus prostratus divergens*	S
Cpg	*Ceanothus prostratus grandifolius*	S
Cri	*Ceanothus rigidus*	S
Crf	*Ceanothus rigidus fresnensis*	S
Csa	*Ceanothus sanguineus*	S
Cse	*Ceanothus serrulatus*	S
Cso	*Ceanothus sorediatus*	S
Cx	*Ceanothus* sp.	S
Csp	*Ceanothus spinosus*	S
Cpa	*Ceanothus spinosus palmeri*	S
Ct	*Ceanothus thyrsiflorus*	S
Ctc	*Ceanothus thyrsiflorus chandleri*	S
Cto	*Ceanothus tomentosus*	S
Ctl	*Caenothus tomentosus olivaceus*	S
Cv	*Ceanothus velutinus*	S
Cvv	*Ceanothus velutinus laevigatus*	S
Cvl	*Ceanothus velutinus lorenzenii*	S
Cve	*Ceanothus verrucosus*	S
Cvt	*Ceanothus vestitus*	S
Hw	*Celtis mississippiensis reticulata*	T
Cem	*Centaurea melitensis*	H
Ces	*Centaurea solstitialis*	H
Cev	*Centaurium venustum*	H
Cef	*Centromadia fitchii*	H
Cep	*Centromadia pungens*	H
Ceo	*Cephalanthus occidentalis*	S
Cea	*Cerastium arvense*	H
Cvis	*Cerastium viscosum*	H
Pv	*Cercidium torreyanum*	T
Cec	*Cercis occidentalis*	S
Cb	*Cercocarpus betuloides*	S
Cci	*Cercocarpus intricatus*	S
Cl	*Cercocarpus ledifolius*	S
Cmi	*Cercocarpus minutiflorus*	S
Cee	*Cercus emoryi*	Ss
Ce	*Cercus engelmannii*	Ss
Cg	*Cereus gigantea*	T
Cha	*Chaenactis artemisiaefolia*	H
Chc	*Chaenactis carphoclinia*	H
Chd	*Chaenactis douglasii*	H
Chg	*Chaenactis glabriuscula*	H
Cne	*Chaenactis nevadensis*	H
Chs	*Chaenactis santolinoides*	H
Csu	*Chaenactis suffrutescens*	H
Cxa	*Chaenactis xantiana*	H
Cf	*Chamaebatia foliolosa*	S
Cfa	*Chamaebatia foliolosa australis*	S
Chm	*Chamaebatiaria millefolium*	S
O	*Chamaecyparis lawsoniana*	T
Chmn	*Chamaesaracha nana*	H

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Kea	*Chenopodium album*	H
Kam	*Chenopodium ambrosioides*	H
Kca	*Chenopodium californicum*	H
Cpx	*Chenopodium* sp.	H
Chl	*Chilopsis linearis*	S
Cum	*Chimaphila umbellata*	S
Chpo	*Chlorogalum pomeridianum*	H
Czm	*Chorizanthe membranacea*	H
Czs	*Chorizanthe staticoides*	H
Cbr	*Chrysopsis breweri*	H
Cvi	*Chrysopsis villosa*	H
Chb	*Chrysothamnus bloomeri*	Ss
Chn	*Chrysothamnus nauseosus*	Ss
Cnc	*Chrysothamnus nauseosus consimilis*	Ss
Cng	*Chrysothamnus nauseosus gnaphalodes*	Ss
Cnh	*Chrysothamnus nauseosus hololeucus*	Ss
Cno	*Chrysothamnus nauseosus occidentalis*	Ss
Cns	*Chrysothamnus nauseosus speciosus*	Ss
Chp	*Chrysothamnus parryi*	Ss
Cpm	*Chrysothamnus parryi monocephalus*	Ss
Chx	*Chrysothamnus* sp.	Ss
Chv	*Chrysothamnus viscidiflorus*	Ss
Cvp	*Chrysothamnus viscidiflorus puberulus*	Ss
Cic	*Cicuta californica*	H
Cid	*Cicuta douglasii*	H
Cibr	*Cirsium breweri*	H
Cioc	*Cirsium occidentale coulteri*	H
Cix	*Cirsium* sp.	H
Cel	*Clarkia elegans*	H
Cla	*Clematis lasiantha*	S
Cli	*Clematis ligusticifolia*	S
Cpf	*Clematis pauciflora*	S
Cob	*Cleomella obtusifolia*	H
Clpl	*Cleome platycarpa*	H
Cdu	*Cneoridium dumosum*	S
Cnb	*Cnicus benedictus*	H
Cra	*Coleogyne ramosissima*	Ss
Coi	*Collinsia bicolor*	H
Ctt	*Collinsia tinctoria*	H
Cgr	*Collomia grandiflora*	H
Cod	*Comarostaphylis diversifolia*	S
Cly	*Condalia lycioides*	S
Cpy	*Condalia parryi*	S
Com	*Conium maculatum*	H
Coa	*Convolvulus arvensis*	H
Col	*Convolvulus luteolus*	H
Coo	*Convolvulus occidentalis*	H
Cov	*Convolvulus villosus*	H
Cop	*Cordylanthus pilosus*	H
Cbi	*Coreopsis bigelovii*	H
Coca	*Coreopsis calliopsidea*	H
Cog	*Coreopsis gigantea*	Ss
Cosp	*Coreopsis* sp.	H, Ss
Coc	*Corethrogyne californica*	H
Cof	*Corethrogyne flaginifolia*	H
Cca	*Cornus californica*	S
Cgl	*Cornus glabrata*	S
Cn	*Cornus nuttallii*	S
Cos	*Cornus sessilis*	S
Cr	*Corylus rostrata californica*	S
Crt	*Corylus rostrata tracyi*	S
Cot	*Cotula coronopifolia*	H
Kof	*Cotyledon farinosa*	H
Kol	*Cotyledon lanceolata*	H
Klx	*Cotyledon laxa*	H
Kop	*Cotyledon pulverulenta*	H
Cst	*Cowania mexicana stansburiana*	S
Cdo	*Crataegus douglasii*	S
Crb	*Crossosoma bigelovii*	S
Crca	*Crossosoma californicum*	S
Crc	*Croton californicus*	Ss
Crn	*Cryptantha intermedia*	H
Cma	*Cryptantha micrantha*	H
Crp	*Cryptantha pterocarya*	H
Qkf	*Cucurbita foetidissima*	H
Qkp	*Cucurbita palmata*	H
Ty	*Cupressus forbesii*	T
Gy	*Cupressus goveniana*	T
Ny	*Cupressus macnabiana*	T
By	*Cupressus macnabiana bakeri*	T
My	*Cupressus macrocarpa*	T
Ky	*Cupressus nevadensis*	T
Py	*Cupressus pygmaea*	T
Sy	*Cupressus sargentii*	
Dy	*Cupressus sargentii duttoni*	T
Cy	*Cycladenia humilis*	H
Cyg	*Cynoglossum grande*	H
Cyo	*Cynoglossum occidentale*	H
Csc	*Cytisus scoparius*	S

D

Dac	*Darlingtonia californica*	H
Dag	*Datisca glomerata*	H
Dam	*Datura meteloides*	H
Dap	*Daucus pusillus*	H
Dhc	*Delphinium californicum*	H
Dhd	*Delphinium decorum*	H
Dha	*Delphinium hansenii*	H
Dhh	*Delphinium hesperium*	H
Dhn	*Delphinium nudicaule*	H
Dhp	*Delphinium parryi*	H
Dht	*Delphinium trolliifolium*	H
Dhv	*Delphinium variegatum*	H
Dr	*Dendromecon rigida*	S
Dic	*Dentaria integrifolia californica*	H
Dc	*Dicentra chrysantha*	H
Dfo	*Dicentra formosa*	H
Da	*Diplacus aurantiacus*	Ss
Dl	*Diplacus longiflorus*	Ss
Dpu	*Diplacus puniceus*	Ss
Dif	*Dipsacus fullonum*	Ss
Do	*Dirca occidentalis*	S
Doc	*Dodecatheon hendersonii*	H
Drb	*Draba breweri*	H
Drc	*Draba cuneifolia*	H
Dco	*Draba corrugata*	H
Drg	*Draba glacialis*	H
Drl	*Draba lemmonii*	H
Dyc	*Dysodia cooperi*	H

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

E

Ecy	*Echinocactus cylindraceus*	Ss
Ecp	*Echinocactus polycephalus*	Ss
Efa	*Echinocystis fabacea*	H
Ema	*Echinocystis macrocarpa*	H
Eor	*Echinocystis oreganus*	H
Ech	*Ellisia chrysanthemifolia*	H
Elm	*Ellisia membranacea*	H
Emp	*Emmenanthe penduliflora*	H
Emn	*Empetrum nigrum*	S
Ea	*Encelia actoni*	Ss
Enc	*Encelia californica*	Ss
Enf	*Encelia farinosa*	Ss
Efr	*Encelia frutescens*	Ss
Eca	*Ephedra californica*	Ss
Ene	*Ephedra nevadensis*	Ss
Epv	*Ephedra viridis*	Ss
Ean	*Epilobium angustifolium*	H
Epb	*Epilobium brevistylum*	H
Epc	*Epilobium californicum*	H
Epp	*Epilobium paniculatum*	H
Erar	*Erechtites arguta*	H
Erp	*Erechtites prenanthoides*	H
Ese	*Eremocarpus setigerus*	H
Ear	*Erecameria arborescens*	S
Eb	*Ericameria brachylepis*	S
Erc	*Ericameria cooperi*	Ss
Ecu	*Ericameria cuneata*	Ss
Ecs	*Ericameria cuneata spathulata*	Ss
Ee	*Ericameria ericoides*	Ss
Emo	*Ericameria monactis*	Ss
Epa	*Ericameria palmeri*	Ss
Erpa	*Ericameria paniculata*	Ss
Epr	*Ericameria parishii*	Ss
Epi	*Ericameria pinifolia*	Ss
Ert	*Ericameria teretifolia*	Ss
Erca	*Erigeron canadensis*	H
Erk	*Erigeron concinnus*	H
Eka	*Erigeron concinnus aphanactis*	H
Erf	*Erigeron foliosus*	H
Egl	*Erigeron glaucus*	H
Ein	*Erigeron inornatus*	H
Err	*Erigeron radicatus*	H
Ers	*Erigeron salsuginosus*	H
Ec	*Eriodictyon californicum*	Ss
Ecr	*Eriodictyon crassifolium*	Ss
Eto	*Eriodictyon tomentosum*	Ss
Et	*Eriodictyon trichocalyx*	Ss
Etl	*Eriodictyon trichocalyx lanatum*	Ss
Era	*Eriogonum arborescens*	Ss
Eba	*Eriogonum baileyi*	H
Efc	*Eriogonum cinereum*	S
Ed	*Eriogonum deflexum*	H
Erd	*Eriogonum douglasii*	H
Eel	*Eriogonum elatum*	H
Ere	*Eriogonum elongatum*	S
Ef	*Eriogonum fasciculatum*	Ss
Eff	*Eriogonum fasciculatum foliolosum*	Ss
Efp	*Eriogonum fasciculatum polifolium*	Ss
Egi	*Eriogonum giganteum*	Ss
Eg	*Eriogonum gracile*	H
Ehe	*Eriogonum heermannii*	Ss
Ei	*Eriogonum inflatum*	H
Erke	*Eriogonum kennedyi*	H
Elo	*Eriogonum lobbii*	H
Erm	*Eriogonum marifolium*	H
Emi	*Eriogonum microthecum*	Ss
Emv	*Eriogonum mohavense*	H
En	*Eriogonum nudum*	H
Eov	*Eriogonum ovalifolium*	H
Ep	*Eriogonum parvifolium*	Ss
Erx	*Eriogonum* sp.	H, Ss
Eum	*Eriogonum umbellatum*	H
Eru	*Eriogonum ursinum*	H
Evm	*Eriogonum vimineum*	H
Ev	*Eriogonum virgatum*	H
Ew	*Eriogonum wrightii*	Ss
Eco	*Eriophyllum confertiflorum*	Ss
Elc	*Eriophyllum lanatum cuneatum*	H
Elg	*Eriophyllum lanatum grandiflorum*	H
El	*Eriophyllum lanatum integrifolium*	H
Ess	*Eriophyllum staechadifolium*	Ss
Ero	*Erodium botrys*	H
Eci	*Erodium cicutarium*	H
Ems	*Erodium moschatum*	H
Ery	*Eryngium castrense*	H
Erj	*Eryngium jepsonii*	H
Erv	*Eryngium vaseyi*	H
Eas	*Erysimum asperum*	H
Eryc	*Erysimum capitatum*	H
Esc	*Eschscholtzia californica*	H
Esl	*Eschscholtzia lobbii*	H
Esm	*Eschscholtzia minutiflora*	H
Eu	*Eucalyptus* sp.	T
Eur	*Eucnide urens*	Ss
Euc	*Eulobus californicus*	H
Eo	*Euonymus occidentalis*	S
Eua	*Euphorbia albomarginata*	H
Eucr	*Euphorbia crenulata*	H
Em	*Euphorbia misera*	Ss
Eup	*Euphorbia palmeri*	H
Eus	*Euphorbia serpyllifolia*	H
Ux	*Euphorbia* sp.	H, Ss
Eul	*Eurotia lanata*	Ss
Evsp	*Evax sparsiflorus*	H

F

Fac	*Fagonia californica*	Ss
Fap	*Fallugia paradoxa*	Ss
Fic	*Filago californica*	H
Fig	*Filago gallica*	H
Fnm	*Forestiera neo-mexicana*	S
Fs	*Fougieria splendens*	Ss
Fca	*Fragaria californica*	H
Frc	*Fragaria chilensis*	H
Fg	*Frankenia grandifolia*	Ss
Fgc	*Frankenia grandifolia campestris*	Ss
Fpa	*Frankenia palmeri*	Ss
Fra	*Franseria acanthicarpa*	H
Fbi	*Franseria bipinnatifida*	H
Fch	*Franseria chenopodiifolia*	Ss

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Fdu	*Franseria dumosa*	Ss
D[3]	*Fraxinus anomala*	T
Fd	*Fraxinus dipetala*	S
O[3]	*Fraxinus oregona*	T
V[3]	*Fraxinus velutina*	T
Fco	*Fraxinus velutina coriacea*	S
Fc	*Fremontia californica*	S
Fcm	*Fremontia californica mexicana*	S

G

Gan	*Galium andrewsii*	H
Gaf	*Galium angustifolium*	Ss
Gap	*Galium aparine*	H
Gax	*Galium* sp.	H, Ss
Gat	*Galium tricorne*	H
Ge	*Garrya elliptica*	S
Gfl	*Garrya flavescens*	S
Gfb	*Garrya flavescens buxifolia*	S
Gfv	*Garrya flavescens venosa*	S
Gf	*Garrya fremontii*	S
Gv	*Garrya veatchii*	Ss
Gh	*Gaultheria humifusa*	S
Gs	*Gaultherid shallon*	Ss
Gd	*Gayophytum diffusum*	H
Gyr	*Gayophytum ramosissimum*	H
Gec	*Gentiana calycosa*	H
Geh	*Gentiana holopetala*	H
Gen	*Gentiana newberryi*	H
Gdi	*Geranium dissectum*	H
Gi	*Geranium incisum*	H
Gem	*Geum macrophyllum*	H
Get	*Geum triflorum*	H
Ga	*Gilia aggregata*	H
Gca	*Gilia capitata*	H
Gcaa	*Gilia capitata achillaefolia*	H
Gig	*Gilia gilioides*	H
Gii	*Gilia inconspicua*	H
Gla	*Gilia latifolia*	H
Gil	*Gilia leptalea*	H
Gim	*Gilia multicaulis*	H
Gx	*Gilia* sp.	H
Gte	*Gilia tenuiflora*	H
Gtr	*Gilia tricolor*	H
Gis	*Githopsis specularioides*	H
Gls	*Glossopetalon spinescens*	Ss
Gll	*Glycyrrhiza lepidota*	H
Gb	*Gnaphalium beneolens*	H
Gnc	*Gnaphalium chilense*	H
Gdc	*Graphalium decurrens californicum*	H
Gra	*Gnaphalium ramosissima*	H
Goam	*Godetia amoena*	H
Goar	*Godetia arcuata*	H
Gbi	*Godetia biloba*	H
Gobo	*Godetia bottae*	H
Godu	*Godetia dudleyana*	H
Goqu	*Godetia quadrivulnera*	H
Gvi	*Godetia viminea*	H
Grs	*Grayia spinosa*	Ss
Gci	*Greeneocharis circumscissa*	H
Grc	*Grindelia camporum*	H
Gcu	*Grindelia cuneifolia*	H
Gro	*Grindelia robusta*	H
Gru	*Grindelia rubricaulis*	H
Guc	*Gutierrezia californica*	Ss
Gl	*Gutierrezia lucida*	S
Gsa	*Gutierrezia sarothrae*	Ss
Gt	*Gymnogramme triangularis*	H

H

Hca	*Haplopappus carthamoides*	H
Hex	*Haplopappus eximius*	H
Hrz	*Haplopappus racemosus*	H
Hac	*Hazardia cana*	Ss
Hs	*Hazardia squarrosa*	Ss
Haw	*Hazardia whitneyi*	Ss
Heb	*Helenium bigelovii*	H
Hho	*Helenium hoopesii*	H
Hpu	*Helenium puberulum*	H
Hsc	*Helianthemum scoparium*	H
Hsv	*Helianthemum scoparium vulgare*	H
Han	*Helianthus annuus*	H
Hec	*Helianthus californicus*	H
Hgr	*Helianthus gracilentus*	H
Hpe	*Helianthus petiolaris*	H
Hlc	*Heliotropium curassavicum*	H
Hcco	*Hemizonia congesta*	H
Hco	*Hemizonia corymbosa*	H
Hfa	*Hemizonia fasciculata*	H
Hx	*Hemizonia* sp.	H
Hvg	*Hemizonia virgata*	H
Hvh	*Hemizonia virgata heermannii*	H
Hla	*Heracleum lanatum*	H
Hg	*Heterotheca grandiflora*	H
Hde	*Hibiscus denudatus*	H
Hod	*Hoffmanseggia densiflora*	H
Hop	*Hofmeisteria pluriseta*	H
Hoe	*Holacantha emoryi*	S
Hol	*Hollisteria lanata*	H
Hd	*Holodiscus discolor*	S
Hdd	*Holodiscus discolor dumosus*	S
Hdg	*Holodiscus discolor glabrescens*	S
Hud	*Hugelia densifolia*	H
Hug	*Hugelia virgata*	H
Hvf	*Hugelia virgata floccosa*	H
Huv	*Hulsea vestita*	H
Hyo	*Hydrophyllum occidentale*	H
Hym	*Hymenoclea monogyra*	Ss
Hys	*Hymenoclea salsola*	Ss
Hyf	*Hymenopappus filifolius*	H
Hyc	*Hypericum concinnum*	H
Hfs	*Hypericum formosum scouleri*	H
Hp	*Hypericum perforatum*	H
Hyg	*Hypochoeris glabra*	H
Hyr	*Hypochoeris radicata*	H
Hye	*Hyptis emoryi*	Ss

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[3] This symbol carries overline, i.e., $\overline{X}$.

TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

I

Ird	*Iris douglasiana*	H
Ih	*Iris hartwegii*	H
Ilo	*Iris longipetala*	H
Ima	*Iris macrosiphon*	H
Imi	*Iris missouriensis*	H
Iv	*Isocoma veneta acradenia*	Ss
Iva	*Isocoma veneta arguta*	Ss
Ivv	*Isocoma veneta vernonioides*	Ss
Ia	*Isomeris arborea*	Ss
Iax	*Iva axillaris*	H

J

Jac	*Jamesia americana californica*	Ss
Wc	*Juglans californica*	T
Wh	*Juglans hindsii*	T
Jbu	*Juncus bufonius*	H
Jue	*Juncus effusus*	H
Jx	*Juncus* sp.	H
Jc	*Juniperus californica*	T
Ju	*Juniperus californica utahensis*	T
Jm	*Juniperus communis montana*	S
Jo	*Juniperus occidentalis*	T

K

Kpo	*Kalmia polifolia*	S
Kal	*Kalmia polifolia microphylla*	S
Kg	*Kelloggia galioides*	H
Ken	*Kentrophyta montana*	H
Koa	*Kochia americana*	H
Koc	*Kochia americana californica*	H
Kra	*Krameria canescens*	Ss

L

Lsc	*Lactuca scariola*	H
Lt	*Larrea tridentata glutinosa*	Ss
Lac	*Lathyrus californicus*	H
Lgr	*Lathyrus graminifolius*	H
Lpo	*Lathyrus polyphyllus*	H
Lsp	*Lathyrus splendens*	H
Las	*Lathyrus strictus*	H
Lav	*Lathyrus vestitus*	H
Laa	*Lavatera assurgentiflora*	Ss
Lae	*Layia elegans*	H
Lafr	*Layia fremontii*	H
Lag	*Layia glandulosa*	H
Lap	*Layia platyglossa*	H
Lg	*Ledum glandulosum*	S
Lel	*Lepidium lasiocarpum*	H
Ln	*Lepidium nitidum*	H
Lsq	*Lepidospartum squamatum*	Ss
Lcf	*Leptodactylon californicum*	Ss
Lpn	*Leptodactylon nuttallii*	H
Lpu	*Leptodactylon pungens*	Ss
Les	*Lessingia leptoclada*	H
Led	*Leucothoe davisiae*	S
Len	*Lewisia nevadensis*	H
Ler	*Lewisia rediviva*	H
I	*Libocedrus decurrens*	T
Lig	*Ligusticum grayi*	H
Lih	*Lilium humboldtii*	H
Lpa	*Lilium pardalinum*	H
Lip	*Lilium parvum*	H
Lir	*Lilium rubescens*	H
Lw	*Lilium washingtonianum*	H
Lma	*Limnanthes alba*	H
Lmd	*Limnanthes douglasii*	H
Lmr	*Limnanthes rosea*	H
Lia	*Linanthus androsaceus*	H
Lau	*Linanthus aureus*	H
Lib	*Linanthus bicolor*	H
Lid	*Linanthus dichotomus*	H
Lif	*Linanthus filipes*	H
Linl	*Linanthus liniflorus*	H
Lim	*Linanthus montanus*	H
Lix	*Linanthus* sp.	H
Lba	*Linnaea borealis americana*	H
Lle	*Linum lewisii*	H
T	*Lithocarpus densiflora*	T
Lde	*Lithocarpus densiflora echinoides*	S
Laf	*Lithophragma affinis*	H
Lomc	*Lomatium caruifolium*	H
Lomd	*Lomatium dasycarpum*	H
Lomo	*Lomatium mohavense*	H
Lome	*Lomatium nevadense*	H
Lomn	*Lomatium nudicaule*	H
Lomp	*Lomatium piperi*	H
Lps	*Lomatium plummerae sonnei*	H
Lox	*Lomatium* sp.	H
Lout	*Lomatium utriculatum*	H
Lco	*Lonicera conjugialis*	S
Lhc	*Lonicera hispidula californica*	S
Li	*Lonicera interrupta*	S
Lin	*Lonicera involucrata*	S
Lil	*Lonicera involucrata ledebourii*	S
Lsu	*Lonicera subspicata*	S
Lou	*Lonicera utahensis*	S
Lam	*Lotus americanus*	H
Loa	*Lotus argophyllus*	H
Lcr	*Lotus crassifolius*	H
Ldo	*Lotus douglasii*	H
Ldn	*Lotus douglasii nevadensis*	H
Lof	*Lotus formosissimus*	H
Log	*Lotus grandiflorus*	H
Lhu	*Lotus humistratus*	H
Lol	*Lotus leucophyllus*	Ss
Lom	*Lotus micranthus*	H
Lsa	*Lotus salsuginosus*	H
Ls	*Lotus scoparius*	Ss
Lx	*Lotus* sp.	H, Ss
Los	*Lotus stipularis*	Ss
Lst	*Lotus strigosus*	H
Lts	*Lotus subpinnatus*	H
Lal	*Lupinus albicaulis*	H
La	*Lupinus albifrons*	Ss
Lar	*Lupinus arboreus*	Ss

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Lbi	*Lupinus bicolor*	H
Lub	*Lupinus breweri*	Ss
Luca	*Lupinus caudatus*	H
Lch	*Lupinus chamissonis*	Ss
Luc	*Lupinus concinnus*	H
Lud	*Lupinus densiflorus*	H
Lux	*Lupinus excubitus*	Ss
Lfo	*Lupinus formosus*	H
Lug	*Lupinus grayi*	H
Lhi	*Lupinus hirsutissimus*	H
Lla	*Lupinus latifolius*	H
Lul	*Lupinus lyallii*	Ss
Lum	*Lupinus micranthus*	H
Lun	*Lupinus nanus*	H
Lnv	*Lupinus nanus vallicola*	H
Luo	*Lupinus odoratus*	H
Lpx	*Lupinus* sp.	H, Ss
Lust	*Lupinus stiversi*	H
Lus	*Lupinus succulentus*	H
Lut	*Lupinus torreyi*	H
Luv	*Lupinus variicolor*	H
Lan	*Lycium andersonii*	Ss
Lca	*Lycium californicum*	Ss
Lyc	*Lycium cooperi*	Ss
Lyf	*Lycium fremontii*	Ss
Lyp	*Lycium pallidum*	Ss
Lto	*Lycium torreyi*	Ss
Ltw	*Lycium torreyi wrightii*	Ss
Lys	*Lygodesmia spinosa*	H
I′	*Lyonothamnus floribundus*	T

M

Mad	*Macronema discoidea*	Ss
Mag	*Macronema greenei*	Ss
Mas	*Macronema suffruticosa*	Ss
Med	*Madia dissitiflora*	H
Mel	*Madia elegans*	H
Mex	*Madia exigua*	H
Mesa	*Madia sativa*	H
Max	*Madia* sp.	H
Mac	*Malacothrix californica*	H
Msa	*Malacothrix saxatilis*	H
Mpa	*Malva parviflora*	H
Mat	*Mamillaria tetrancistra*	Ss
Mv	*Marrubium vulgare*	H
Mav	*Marsilea vestita*	H
Msu	*Matricaria suaveolens*	H
Meap	*Medicago apiculata*	H
Mhi	*Medicago hispida*	H
Mal	*Melilotus alba*	H
Mli	*Melilotus indica*	H
Mes	*Menodora spinescens*	Ss
Mea	*Mentzelia albicaulis*	H
Mdi	*Mentzelia dispersa*	H
Mzl	*Mentzelia laevicaulis*	H
Meli	*Mentzelia lindleyi*	H
Mzm	*Mentzelia micrantha*	H
Mef	*Menziesia ferruginea*	S
Mcs	*Mertensia ciliata stomatechoides*	H
Ma	*Mesembryanthemum acquilaterale*	H
Mecr	*Mesembryanthemum crystallinum*	H
Mch	*Micromeria chamissonis*	H
Mic	*Micropus californicus*	H
Msp	*Microseris aphantocarpha*	H
Mia	*Microseris attenuata*	H
Mid	*Microseris douglasii*	H
Mcx	*Microseris* sp.	H
Mil	*Militzia glandulifera*	H
Mb	*Mimulus bicolor*	H
Mbo	*Mimulus bolanderi*	H
Mbr	*Mimulus brevipes*	H
Mif	*Mimulus floribundus*	H
Mig	*Mimulus guttatus*	H
Mik	*Mimulus kelloggii*	H
Mle	*Mimulus lewisii*	H
Mm	*Mimulus moschatus*	H
Mix	*Mimulus* sp.	H
Mt	*Mimulus torreyi*	H
Mf	*Mirabilis froebellii*	H
Ml	*Mirabilis laevis*	H
Mod	*Monardella douglasii*	H
Mol	*Monardella lanceolata*	H
Mo	*Monardella odoratissima*	H
Mov	*Monardella villosa*	H
Mog	*Monolopia gracilis*	H
Mom	*Monolopia major*	H
Mpe	*Montia perfoliata*	H
Mc	*Myrica californica*	S
Mh	*Myrica hartwegii*	S

N

Nl	*Nama lobbii*	H
Np	*Nama parryi*	H
Naa	*Navarretia atractyloides*	H
Nac	*Navarretia cotulaefolia*	H
Naf	*Navarretia filicaulis*	H
Nai	*Navarretia intertexta*	H
Nap	*Navarretia pubescens*	H
Nax	*Navarretia* sp.	H
Neh	*Nemophila heterophylla*	H
Nma	*Nemophila maculata*	H
Nem	*Nemophila menziesii*	H
Nep	*Nemophila parviflora*	H
Na	*Nicotiana attenuata*	H
Nbi	*Nicotiana bigelovii*	H
Ng	*Nicotiana glauca*	Ss
Nit	*Nicotiana trigonophylla*	H
Nio	*Nicotiana occidentale*	H
Npa	*Nolina parryi*	Ss
Nyp	*Nymphaea polysepala*	H

O

Oec	*Oenothera contorta*	H
Oed	*Oenothera dentata*	H
Oeh	*Oenothera hookeri*	H
Oeo	*Oenothera ovata*	H
Osc	*Oenothera scapoidea*	H

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Oex	*Oenothera* sp.	H
Oes	*Oenothera spiralis*	H
Dt	*Olneya tesota*	T
Oac	*Opuntia acanthocarpa*	Ss
Oba	*Opuntia basilaris*	Ss
Ob	*Opuntia bigelovii*	S
Ocl	*Opuntia clavata*	Ss
Oe	*Opuntia echinocarpa*	Ss
Oer	*Opuntia erinacea*	Ss
Oo	*Opuntia occidentalis*	Ss
Ooc	*Opuntia occidentalis covillei*	Ss
Ool	*Opuntia occidentalis littoralis*	Ss
Opa	*Opuntia parryi*	Ss
Op	*Opuntia prolifera*	Ss
Or	*Opuntia ramosissima*	Ss
Ox	*Opuntia* sp.	Ss
Opu	*Opuntia ursina*	Ss
Ova	*Opuntia vaseyi*	Ss
Ora	*Orthocarpus attenuatus*	H
Ord	*Orthocarpus densiflorus*	H
Ore	*Orthocarpus erianthus*	H
Orl	*Orthocarpus lithospermoides*	H
Opi	*Orthocarpus pilosus*	H
Orp	*Orthocarpus purpurascens*	H
Orx	*Orthocarpus* sp.	H
Oc	*Osmaronia cerasiformis*	S
Osn	*Osmorrhiza nuda*	H
Oso	*Osmorrhiza occidentalis*	H
Oxc	*Oxalis corniculata*	H
Oxd	*Oxyria digyna*	H

P

Pmy	*Pachystima myrsinites*	S
Pbr	*Paeonia brownii*	H
Pal	*Palafoxia linearis*	H
Pah	*Papaver heterophyllum*	H
Pam	*Parkinsonia microphylla*	H
Paf	*Paronychia franciscana*	H
Par	*Parosela arborescens*	Ss
Pca	*Parosela californica*	Ss
Pae	*Parosela emoryi*	Ss
Pafr	*Parosela fremontii*	Ss
Pmo	*Parosela mollis*	H
Pap	*Parosela parryi*	H
Ppo	*Parosela polyadenia*	Ss
Pas	*Parosela spinosa*	S
Pea	*Pedicularis attollens*	H
Pde	*Pedicularis densiflora*	H
Peg	*Pedicularis groenlandica*	H
Pese	*Pedicularis semibarbata*	H
Po	*Pellaea ornithopus*	H
Pex	*Pellaea* sp.	H
Pep	*Peltiphyllum peltatum*	H
Per	*Pentacaena ramosissima*	H
Pac	*Pentstemon acuminatus*	H
Pan	*Pentstemon antirrhinoides*	S
Pb	*Pentstemon breviflorus*	S
Peb	*Pentstemon bridgesii*	H
Pce	*Pentstemon centranthifolius*	H
Pco	*Pentstemon confertus*	H
Pcc	*Pentstemon confertus caeruleo-purpureus*	H
Pcg	*Pentstemon confertus geniculatus*	H
Pcm	*Pentstemon confertus modestus*	H
Pcp	*Pentstemon confertus procerus*	H
Pcr	*Pentstemon confertus rigidus*	H
Pc	*Pentstemon cordifolius*	S
Pcy	*Pentstemon corymbosus*	S
Ped	*Pentstemon deustus*	H
Pef	*Pentstemon fruticiformis*	Ss
Pgl	*Pentstemon glaber*	H
Pgr	*Pentstemon gracilentus*	Ss
Ph	*Pentstemon heterophyllus*	H
Pja	*Pentstemon jaffrayanus*	H
Pela	*Pentstemon labrosus*	H
Pla	*Pentstemon laetus*	H
Pel	*Pentstemon lemmonii*	S
Pn	*Pentstemon newberryi*	Ss
Pepa	*Pentstemon palmeri*	Ss
Ppa	*Pentstemon parishii*	H
Prt	*Pentstemon rattanii*	H
Pro	*Pentstemon rothrockii*	H
Px	*Pentstemon* sp.	H, Ss, S
Ps	*Pentstemon spectabilis*	H
Pte	*Pentstemon ternatus*	S
Pra	*Peraphyllum ramosissimum*	S
Pem	*Perezia microcephala*	H
Pet	*Petalonyx thurberi*	Ss
Ptp	*Petasites palmata*	H
Pes	*Peucephyllum schottii*	S
Pba	*Phacelia brachyloba*	H
Phca	*Phacelia californica*	H
Pdi	*Phacelia distans*	H
Phdo	*Phacelia douglasii*	H
Pfi	*Phacelia fremontii*	H
Phh	*Phacelia heterophylla*	H
Phi	*Phacelia hispida*	H
Phy	*Phacelia hydrophylloides*	H
Phl	*Phacelia linearis*	H
Pmi	*Phacelia minor*	H
Phr	*Phacelia ramosissima*	H
Phx	*Phacelia* sp.	H
Ptn	*Phacelia tanacetifolia*	H
Pht	*Phacelia thermalis*	H
Pl	*Philadelphus lewisii californicus*	S
Pdo	*Phlox dolichantha*	H
Phd	*Phlox douglasii*	H
Phg	*Phlox gracilis*	H
Phs	*Phlox speciosa*	H
Pa	*Photinia arbutifolia*	S
Phb	*Phyllodoce breweri*	S
Phe	*Phyllodoce empetriformis*	S
Phcr	*Physalis crassifolia*	H
Phc	*Physocarpus capitatus*	S
Ws	*Picea breweriana*	T
Es	*Picea engelmannii*	T
S′	*Picea sitchensis*	T
Pm	*Pickeringia montana*	S
Wp	*Pinus albicaulis*	T
Kp	*Pinus aristata*	T
Fp	*Pinus balfouriana*	T
P	*Pinus cembroides monophylla*	T

The plants in the list have been classified as herbs (H), shrubs (S), and trees (T), with a subdivision of shrubs into those that may be classified as sagebrush type species (Ss). The classification of many species, however, is as yet questionable and is subject to change following further study.

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TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Scb	*Scoliopus bigelovii*	H
Sco	*Scrophularia californica*	H
Sfh	*Securinegea fasciculata hallii*	S
Sepu	*Sedella pumilum*	H
Seo	*Sedum obtusatum*	H
Ser	*Sedum radiatum*	H
Sex	*Sedum* sp.	H
Ses	*Sedum spathulifolium*	H
Sd	*Senecio douglasii*	Ss
Sle	*Senecio lugens exaltatus*	H
Sep	*Senecio pauciflorus*	H
St	*Senecio triangularis*	H
Svu	*Senecio vulgaris*	H
Bт	*Sequoia gigantea*	T
R	*Sequoia sempervirens*	T
Sha	*Shepherdia argentea*	S
Sih	*Sida hederacea*	H
Sid	*Sidalcea diploscypha*	H
Sigl	*Sidalcea glaucescens*	H
Sim	*Sidalcea malvaeflora*	H
Sdm	*Silene douglasii monantha*	H
Sic	*Silene californica*	H
Sig	*Silene gallica*	H
Sil	*Silene lemmonii*	H
Sca	*Simmondsia californica*	Ss
Sia	*Sisymbrium altissimum*	H
Sii	*Sisymbrium incisum*	H
Sio	*Sisymbrium officinale*	H
Sip	*Sisymbrium pinnatum*	H
Spb	*Sisymbrium pinnatum brachycarpum*	H
Sib	*Sisyrinchium bellum*	H
Sms	*Smilacina sessilifolia*	H
Sn	*Solanum nigrum*	H
Sox	*Solanum* sp.	H, Ss
Su	*Solanum umbelliferum*	Ss
Swa	*Solanum wallacei*	Ss
Sxa	*Solanum xantii*	Ss
Sxg	*Solanum xantii glabrescens*	Ss
Soc	*Solidago californica*	H
Soy	*Solidago corymbosa*	H
Soo	*Solidago occidentalis*	H
Sdx	*Solidago* sp.	H
Ssp	*Solidago spathulata*	H
Sol	*Sonchus oleraceus*	H
Sos	*Sorbus sitchensis*	S
Sc	*Sphacele calycina*	Ss
Spa	*Spaeralcea ambigua*	H
Sda	*Sphaeralcea davidsonii*	H
Sf	*Sphaeralcea fasciculata*	Ss
Srf	*Sphaeralcea fremontii*	S
Sro	*Sphaeralcea rotundifolia*	H
Spca	*Sphenosciadium capitellatum*	H
Spc	*Spiraea caespitosa*	S
Sdc	*Spiraea densiflora*	S
Sdu	*Spiraea douglasii*	S
Sbu	*Stachys bullata*	H
Stc	*Stachys californica*	H
Stp	*Stanleya pinnata*	Ss
Sb	*Staphylea bolanderi*	S
Sac	*Statice arctica californica*	S
Stm	*Stellaria media*	H
Stn	*Stellaria nitens*	H
Sli	*Stenotopsis linearifolius*	Ss
Sla	*Stephanomeria lactucina*	H
Str	*Stephanomeria runcinata*	H
Svg	*Stephanomeria virgata*	H
Stl	*Stillingia linearifolia*	H
Sti	*Streptanthus inflatus*	H
Sto	*Streptanthus tortuosus*	H
So	*Styrax officinalis californica*	S
Sof	*Styrax officinalis fulvescens*	S
Suc	*Suaeda californica*	Ss
Sud	*Suaeda depressa*	H
Sum	*Suaeda moquini*	Ss
Sus	*Suaeda suffrutescens*	Ss
Sni	*Swertia nitida*	H
Swr	*Swertia radiata*	H
Sal	*Symphoricarpos albus*	Ss
Syl	*Symphoricarpos longiflorus*	Ss
Smo	*Symphoricarpos mollis*	Ss
Sar	*Symphoricarpos rotundifolius*	Ss
Syx	*Symphoricarpos* sp.	Ss

T

Tag	*Tamarix gallica*	S
Tac	*Tanacetum camphoratum*	H
Tav	*Taraxacum vulgare*	T
U	*Taxus brevifolia*	T
Ted	*Tetracoccus dioicus*	S
Tc	*Tetradymia canescens*	Ss
Tec	*Tetradymia comosa*	Ss
Teg	*Tetradymia glabrata*	Ss
Ts	*Tetradymia spinosa*	Ss
Tst	*Tetradymia stenolepis*	Ss
Thf	*Thalictrum fendleri*	H
Tpo	*Thalictrum polycarpum*	H
Thm	*Thamnosma montana*	Ss
Thfl	*Thelypodium flavescens*	H
Tgv	*Thermopsis gracilis venosa*	H
Tma	*Thermopsis macrophylla*	H
C[2]	*Thuja plicata*	T
Thc	*Thysanocarpus curvipes*	H
Thl	*Thysanocarpus laciniatus*	H
Thx	*Thysanocarpus* sp.	H
Tio	*Tidestromia oblongifolia*	Ss
N	*Torreya californica*	T
Tte	*Tribulus terrestris*	H
Trw	*Tricardia watsonii*	H
Tl	*Trichostema lanatum*	Ss
Tld	*Trichostema lanatum denudatum*	Ss
Tla	*Trichostema lanceolatum*	H
Tlx	*Trichostema laxum*	H
Tx	*Trichostema* sp.	H, Ss
Te	*Trientalis europaea latifolia*	H
Tra	*Trifolium albopurpureum*	H
Tram	*Trifolium amplectens*	H
Tran	*Trifolium andersonii*	H
Trbe	*Trifolium beckwithii*	H
Trb	*Trifolium breweri*	H
Trci	*Trifolium ciliatum*	H
Trde	*Trifolium depauperatum*	H
Trf	*Trifolium fucatum*	H

The plants in the list have been classified as herbs (H), shrubs (S), and trees (T), with a subdivision of shrubs into those that may be classified as sagebrush type species (Ss). The classification of many species, however, is as yet questionable and is subject to change following further study.

[2] This symbol carries underline, i.e., X.

TABLE 4—Continued

A. Alphabetical List by Genus of Plants Other Than Grasses—Continued

Trg	*Trifolium gracilentum*	H
Tin	*Trifolium involucratum*	H
Trmc	*Trifolium microcephalum*	H
Trmi	*Trifolium microdon*	H
Trm	*Trifolium monanthum*	H
Trob	*Trifolium obtusiflorum*	H
Tro	*Trifolium olivaceum*	H
Tpr	*Trifolium pratense*	H
Tre	*Trifolium repens*	H
Trx	*Trifolium* sp.	H
Trt	*Trifolium tridentatum*	H
Trv	*Trifolium variegatum*	H
Tov	*Trillium ovatum*	H
Tsg	*Trillium sessile giganteum*	H
Trc	*Trixis californica*	Ss
Tgr	*Tropidocarpum gracile*	H
H	*Tsuga heterophylla*	T
Hм	*Tsuga mertensiana*	T
Tya	*Typha angustifolia*	H
Tyl	*Typha latifolia*	H

U

Ue	*Ulex europaeus*	S
L′	*Umbellularia californica*	T
Uc	*Umbellularia californica*	S
Uli	*Uropappus linearifolius*	H
Url	*Uropappus lindleyi*	H
Ugh	*Urtica gracilis holosericea*	H

V

Vca	*Vaccinium caespitosum*	S
Vm	*Vaccinium membranaceum*	S
Vmy	*Vaccinium myrtillus*	S
Voc	*Vaccinium occidentale*	S
Vo	*Vaccinium ovatum*	S
Vp	*Vaccinium parvifolium*	S
Vap	*Vancouveria parviflora*	H
Vnc	*Venegasia carpesioides*	H
Vec	*Veratrum californicum*	H
Vev	*Veratrum viride*	H
Vet	*Verbascum thapsus*	H
Vel	*Viburnum ellipticum*	S
Vam	*Vicia americana*	H
Vgi	*Vicia gigantea*	H
Vdp	*Viguiera deltoidea parishii*	Ss
Vl	*Viguiera laciniata*	Ss
Vir	*Viguiera reticulata*	Ss
Vim	*Vinca major*	H
Va	*Viola adunca*	H
Vbe	*Viola beckwithii*	H
Vib	*Viola blanda*	H
Vic	*Viola cuneata*	H
Vil	*Viola lobata*	H
Vio	*Viola ocellata*	H
Vpe	*Viola pedunculata*	H
Vipr	*Viola praemorsa*	H
Vip	*Viola purpurea*	H
Vis	*Viola sarmentosa*	H
Vc	*Vitis californica*	S
Vg	*Vitis girdiana*	S

W

P[3]	*Washingtonia filifera*	T
Whm	*Whipplea modesta*	S
Whde	*Whitneya dealbata*	H
Wos	*Woodsia scopulina*	H
Wor	*Woodwardia radicans*	H
Wya	*Wyethia angustifolia*	H
Wyg	*Wyethia glabra*	H
Wh	*Wyethia helenioides*	H
Wm	*Wyethia mollis*	H
Wyo	*Wyethia ovata*	H

X

Xt	*Xerophyllum tenax*	H

Y

Yb	*Yucca brevifolia*	T
Ym	*Yucca mohavensis*	Ss
Yx	*Yucca* sp.	Ss, T
Yw	*Yucca whipplei*	Ss

Z

Zc	*Zauschneria californica*	H
Zac	*Zauschneria cana*	H
Zl	*Zauschneria latifolia*	H
Zf	*Zygadenus fremontii*	H
Zpa	*Zygadenus paniculatus*	H
Zve	*Zygadenus venenosus*	H

The plants in the list have been classified as herbs (H), shrubs (S), and trees (T), with a subdivision of shrubs into those that may be classified as sagebrush type species (Ss). The classification of many species, however, is as yet questionable and is subject to change following further study.

[3] This symbol carries overline, i.e., $\overline{X}$.

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TABLE 4—Continued

B. Alphabetical List by Genus of Grasses

A

AGc[2]	*Agropyron caninum*
AGd[2]	*Agropyron dasystachyum*
AGpr[2]	*Agropyron pringlei*
AGsm[2]	*Agropyron smithii*
AGx[2]	*Agropyron* sp.
AGs[2]	*Agropyron spicatum*
AGt[2]	*Agropyron tenerum* (*Agropyron pauciflorum*)*
Ae[2]	*Agrostis exarata*
Aha[2]	*Agrostis hallii*
Ah[2]	*Agrostis hiemalis*
Ai[2]	*Agrostis idahoensis*
Ale[2]	*Agrostis lepida*
Ao[2]	*Agrostis oregonensis*
Ap[2]	*Agrostis palustris* (*Agrostis alba*)*
Ar[2]	*Agrostis rossae*
Ax[2]	*Agrostis* sp.
At[2]	*Agrostis thurberiana*
AIc[2]	*Aira caespitosa* (*Deschampsia caespitosa*)*
AId[2]	*Aira danthonioides* (*Deschampsia danthonioides*)*
AIi[2]	*Aira elongata* (*Deschampsia elongata*)*
AIh[2]	*Aira holciformis* (*Deschampsia holciformis*)*
AIx[2]	*Aira* sp. (*Deschampsia* sp.)*
ALa[2]	*Alopecurus aequalis*
ALx[2]	*Alopecurus* sp.
AMa[2]	*Ammophila arenaria*
ADs[2]	*Andropogon saccharoides*
ADx[2]	*Andropogon* sp.
AXo[2]	*Anthoxanthum odoratum*
ASa[2]	*Aristida adscensionis*
ASd[2]	*Aristida divaricata*
ASf[2]	*Aristida fendleriana*
ASo[2]	*Aristida oligantha*
ASpu[2]	*Aristida purpurea*
ASx[2]	*Aristida* sp.
APc[2]	*Aspris caryophyllea* (*Aira caryophyllea*)*
APx[2]	*Aspris* sp. (*Aira* sp.)*
AVb[2]	*Avena barbata*
AVf[2]	*Avena fatua*
AVx[2]	*Avena* sp.

B

BEe[2]	*Beckmannia erucaeformis* (*Beckmannia syzigachne*)*
BEx[2]	*Beckmannia* sp.
BOc[2]	*Bouteloua curtipendula*
BOg[2]	*Bouteloua gracilis*
BOh[2]	*Bouteloua hirsuta*
BOr[2]	*Bouteloua rothrockii*
BOx[2]	*Bouteloua* sp.
BRma[2]	*Briza maxima*
BRm[2]	*Briza minor*
Ba[2]	*Bromus arenarius*
Bb[2]	*Bromus brizaeformis*
Bc[2]	*Bromus carinatus*
Bco[2]	*Bromus commutatus*
Bg[2]	*Bromus grandis*
Bh[2]	*Bromus hordeaceus* (*Bromus mollis*)*
Bl[2]	*Bromus laevipes*
Bma[2]	*Bromus madritensis*
Bm[2]	*Bromus marginatus* (included in *Bromus carinatus*)*
Bo[2]	*Bromus orcuttianus*
Bra[2]	*Bromus racemosus*
Br[2]	*Bromus rigidus*
Bru[2]	*Bromus rubens*
Bse[2]	*Bromus secalinus*
Bx[2]	*Bromus* sp.
Bsu[2]	*Bromus subvelutinus* (*Bromus breviaristatus*)*
Bt[2]	*Bromus tectorum*
Btr[2]	*Bromus trinii*
Bu[2]	*Bromus unioloides* (*Bromus catharticus*)*
Bv[2]	*Bromus vulgaris*

C

CAb[2]	*Calamagrostis breweri*
CAc[2]	*Calamagrostis canadensis*
CAi[2]	*Calamagrostis inexpansa*
CAn[2]	*Calamagrostis nutkaensis*
CAp[2]	*Calamagrostis purpurascens*
CAr[2]	*Calamagrostis rubescens*
CAx[2]	*Calamagrostis* sp.
CEp[2]	*Cenchrus pauciflorus*
CTl[2]	*Chaetochloa lutescens* (*Setaria lutescens*)*
CTx[2]	*Chaetochloa* sp. (*Setaria* sp.)*
CTv[2]	*Chaetochloa viridis* (*Setaria viridis*)*
CHx[2]	*Chloris* sp.
CHv[2]	*Chloris virgata*
CIl[2]	*Cinna latifolia*
CIx[2]	*Cinna* sp.
CYd[2]	*Cynodon dactylon*
CYx[2]	*Cynodon* sp.

D

DCg[2]	*Dactylis glomerata*
Dn[2]	*Danthonia americana* (*Danthonia californica americana*)*
Dc[2]	*Danthonia californica*
Di[2]	*Danthonia intermedia*

* Changes in Nomenclature in Hitchcock's "Manual of the Grasses of the United States."

[2] This symbol carries underline, i.e., X.

TABLE 4—Continued

B. Alphabetical List by Genus of Grasses

Dx[2]	*Danthonia* sp.
Du[2]	*Danthonia unispicata*
DIx[2]	*Distichlis* sp.
DIs[2]	*Distichlis spicata*
DIt[2]	(*Distichlis stricta*)*

E

ECc[2]	*Echinochloa crusgallii*
ECx[2]	*Echinochloa* sp.
Eca[2]	*Elymus canadensis*
Eco[2]	*Elymus condensatus*
Eg[2]	*Elymus glaucus*
Em[2]	*Elymus macounii*
Emo[2]	*Elymus mollis*
Ex[2]	*Elymus* sp.
Et[2]	*Elymus triticoides*
EPr[2]	*Epicampes rigens* (*Muhlenbergia rigens*)*
ERca[2]	*Eragrostis caroliniana* (*Eragrostis pectinacea*)*
ERc[2]	*Eragrostis cilianensis*
ERx[2]	*Eragrostis* sp.

F

Fb[2]	*Festuca bromoides* (*Festuca dertonensis*)*
Fca[2]	*Festuca californica*
Fco[2]	*Festuca confinis* (*Festuca kingii*)*
Fc[2]	*Festuca confusa*
Fel[2]	*Festuca elatior*
Fern[2]	*Festuca elmeri*
Fgr[2]	*Festuca grayi*
Fi[2]	*Festuca idahoensis*
Fm[2]	*Festuca megalura*
Fmv[2]	*Festuca myuros*
Fo[2]	*Festuca occidentalis*
Foc[2]	*Festuca octoflora*
Foh[2]	*Festuca octoflora hirtella*
Fp[2]	*Festuca pacifica*
Fre[2]	*Festuca reflexa*
Fr[2]	*Festuca rubra*
Fx[2]	*Festuca* sp.
Fsb[2]	*Festuca subulata*
Fv[2]	*Festuca viridula*

G

Gv[2]	*Gastridium ventricosum*
GLel[2]	*Glyceria elata*
GLp[2]	*Glyceria pauciflora*
GLx[2]	*Glyceria* sp.

H

HIj[2]	*Hilaria jamesii*
HIr[2]	*Hilaria rigida*
HIx[2]	*Hilaria* sp.
HOh[2]	*Holcus halapensis* (*Sorghum halepense*)*
HOx[2]	*Holcus* sp. (*Sorghum* sp.)*
Hg[2]	*Hordeum gussoneanum*
Hj[2]	*Hordeum jubatum*
Hm[2]	*Hordeum murinum*
Hx[2]	*Hordeum* sp.
HYc[2]	*Hystrix californica*
HYx[2]	*Hystrix* sp.

K

Kc[2]	*Koeleria cristata*
Kp[2]	*Koeleria phleoides*
Kx[2]	*Koeleria* sp.

L

LAa[2]	*Lamarckia aurea*
LPf[2]	*Leptochloa filiformis*
LPx[2]	*Leptochloa* sp.
LEc[2]	*Lepturus cylindricus*
Lp[2]	*Lolium perenne*
Lm[2]	*Lolium multiflorum*
Lx[2]	*Lolium* sp.
Lt[2]	*Lolium temulentum*

M

Ma[2]	*Melica aristata*
Mb[2]	*Melica bella* (*Melica bulbosa*)*
Mbu[2]	*Melica bulbosa* (*Melica californica*)*
Mfr[2]	*Melica frutescens*
Mf[2]	*Melica fugax*
Mg[2]	*Melica geyeri*
Mi[2]	*Melica imperfecta*
Mx[2]	*Melica* sp.
Ms[2]	*Melica spectabilis*
Mst[2]	*Melica stricta*
Msb[2]	*Melica subulata*
Mt[2]	*Melica torreyana*
MOl[2]	*Monanthochloe littoralis*
MUf[2]	*Muhlenbergia filiformis*
MUj[2]	*Muhlenbergia jonesii*
MUmo[2]	*Muhlenbergia montana*
MUp[2]	*Muhlenbergia porteri*
MUr[2]	*Muhlenbergia repens*
MUx[2]	*Muhlenbergia* sp.
MUs[2]	*Muhlenbergia squarrosa*

N

Nl[2]	*Notholcus lanatus* (*Holcus lanatus*)*
Nx[2]	*Notholcus* sp. (*Holcus* sp.)*

[2] This symbol carries underline, i.e., X.

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TABLE 4—Continued

B. Alphabetical List by Genus of Grasses—Continued

O

Oh[2]	*Oryzopsis hymenoides*
Ok[2]	*Oryzopsis kingii*
Ox[2]	*Oryzopsis* sp.

P

PNc[2]	*Panicum capillare*
PNx[2]	*Panicum* sp.
PSd[2]	*Paspalum distichum*
PSx[2]	*Paspalum* sp.
PAa[2]	*Phalaris angusta*
PAr[2]	*Phalaris arundinacea*
PAc[2]	*Phalaris californica*
PAcn[2]	*Phalaris canariensis*
PAm[2]	*Phalaris minor*
PAp[2]	*Phalaris paradoxa*
PAx[2]	*Phalaris* sp.
PHa[2]	*Phleum alpinum*
PHp[2]	*Phleum pratense*
PHx[2]	*Phleum* sp.
POi[2]	*Pholiurus incurvus*
PRo[2]	*Phragmites communis*
PLc[2]	*Pleuropogon californicum*
PLr[2]	*Pleuropogon refractus*
PLx[2]	*Pleuropogon* sp.
Pa[2]	*Poa annua*
Pbv[2]	*Poa biggelovii*
Pbr[2]	*Poa brachyglossa* (*Poa juncifolia*)*
Pc[2]	*Poa compressa*
Pd[2]	*Poa douglasii*
Pf[2]	*Poa fendleriana*
Pg[2]	*Poa gracillima*
Ple[2]	*Poa leibergii*
Pl[2]	*Poa longiligula*
Pn[2]	*Poa nervosa*
Pne[2]	*Poa nevadensis*
Ppa[2]	*Poa palustris*
Pp[2]	*Poa pratensis*
Ps[2]	*Poa sandbergii* (*Poa secunda*)*
Psc[2]	*Poa scabrella*
Px[2]	*Poa* sp.
PYl[2]	*Polypogon lutosus*
PYm[2]	*Polypogon monspeliensis*
PYx[2]	*Polypogon* sp.
PUl[2]	*Puccinellia lemmonii*
PUnu[2]	*Puccinellia nutkaensis*
PUn[2]	*Puccinellia nuttalliana*
PUs[2]	*Puccinellia simplex*
PUx[2]	*Puccinellia* sp.

S

SIh[2]	*Sitanion hanseni*
SIhy[2]	*Sitanion hystrix*
SIj[2]	*Sitanion jubatum*
SIx[2]	*Sitanion* sp.
SPf[2]	*Spartina foliosa*
SOai[2]	*Sporobolus airoides*
SOa[2]	*Sporobolus asperifolius*
SOx[2]	*Sprobolus* sp.
Sc[2]	*Stipa californica*
Scm[2]	*Stipa comata*
Sco[2]	*Stipa coronata*
Se[2]	*Stipa elmeri*
Sle[2]	*Stipa lepida*
Slt[2]	*Stipa lettermanni*
So[2]	*Stipa occidentalis*
Sp[2]	*Stipa pulchra*
Ss[2]	*Stipa speciosa*
Sx[2]	*Stipa* sp.
St[2]	*Stipa thurberiana*
Sv[2]	*Stipa vaseyi*
SYs[2]	*Syntherisma sanguinalis*
SYx[2]	*Syntherisma* sp.

T

TOm[2]	*Torresia macrophylla* (*Hierochloe occidentalis*)*
TRp[2]	*Triodia pulchella*
Tca[2]	*Trisetum canescens*
Tx[2]	*Trisetum* sp.
Ts[2]	*Trisetum spicatum*

[2] This symbol carries underline, i.e., X.

TABLE 4—Continued

C. Supplemental List of Symbols for Plants Other Than Grasses*

A

A	*Quercus agrifolia* T
A[3]	*Populus tremuloides* T

B

B	*Quercus kelloggii* T
B[3]	*Populus trichocarpa* T
B[1]	*Abies venusta* T
Bs	*Pseudotsuga macrocarpa* T
Bt	*Sequoia gigantea* T
Br	*Cupressus macnabiana bakeri* T

C

C	*Quercus chrysolepis* T
C[3]	*Thuja plicata* T
Cp	*Pinus coulteri* T

D

D	*Pseudotsuga taxifolia* T
D[3]	*Fraxinus anomala* T
D[1]	*Quercus douglasii* T
Di	*Olneya tesota* T
Dp	*Pinus sabiniana* T
Dr	*Cupressus sargentii duttoni* T

E

E	*Quercus engelmannii* T
Es	*Picea engelmannii* T

F

F[3]	*Populus fremontii* T
Fp	*Pinus balfouriana* T

G

G	*Quercus garryana* T
G[1]	*Abies grandis* T
Gr	*Cupressus goveniana* T

H

H	*Tsuga heterophylla* T
H[3]	*Aesculus californica* T
Hm	*Tsuga mertensiana* T
Hw	*Celtis mississippiensis reticulata* T

I

I	*Libocedrus decurrens* T
I′	*Lyonothamnus floribundus* T

J

J	*Pinus ponderosa jeffreyi* T

K

K	*Pinus tuberculata* T
Kam	*Chenopodium ambrosioides* H
Kca	*Chenopodium californicum* H
Kea	*Chenopodium album* H
Klx	*Cotyledon laxa* H
Kof	*Cotyledon farinosa* H
Kol	*Cotyledon lanceolata* H
Kop	*Cotyledon pulverulenta* H
Kp	*Pinus aristata* T
Kr	*Cupressus nevadensis* T

L

L	*Pinus contorta murrayana* T
L′	*Umbellularia californica* T
Lb	*Pinus contorta bolanderi* T
Lc	*Pinus contorta* T
Lp	*Pinus flexilis* T

M

M	*Arbutus menziesii* T
M[3]	*Acer macrophyllum* T
M′	*Quercus morehus* T
Mp	*Pinus radiata* T
Mr	*Cupressus macrocarpa* T

N

N	*Torreya californica* T
N[3]	*Acer negundo californicum* T
N[1]	*Abies nobilis* T
Nr	*Cupressus macnabiana* T

O

O	*Chamaecyparis lawsoniana* T
O[3]	*Fraxinus oregona* T
Oa	*Pyrus rivularis* T

* Symbols of plants not occurring in alphabetical sequence in Table 4, B.

[1] This symbol carries accent, i.e., $\hat{X}$.

[2] This symbol carries underline, i.e., X.

[3] This symbol carries overline, i.e., $\overline{X}$.

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TABLE 4—Continued

C. Supplemental List of Symbols for Plants Other Than Grasses—Continued

P

P[3]	*Washingtonia filifera*	T
Pv	*Cercidium torreyanum*	T
Pr	*Cupressus pygmaea*	T

Q

Q	*Castanopsis chrysophylla*	T
Qkf	*Cucurbita foetidissima*	H
Qkp	*Cucurbita palmata*	H

R

R	*Sequoia sempervirens*	T
R[2]	*Alnus rubra*	T
R[1]	*Abies magnifica*	T

S

S	*Pinus lambertiana*	T
S[3]	*Platanus racemosa*	T
S′	*Picea sitchensis*	T
S[1]	*Abies magnifica shastensis*	T
Sp	*Pinus muricata*	T
Sr	*Cupressus sargentii*	T

T

T	*Lithocarpus densiflora*	T
T″	*Quercus tomentella*	T
Tu	*Ailanthus glandulosa*	T
Tp	*Pinus torreyana*	T
Tr	*Cupressus forbesii*	T

U

U	*Taxus brevifolia*	T
Ux	*Euphorbia* sp.	H, Ss

V

V	*Quercus lobata*	T
V[3]	*Fraxinus velutina*	T

W

W	*Quercus wislizenii*	T
W′	*Pinus monticola*	T
W[1]	*Abies concolor*	T
Wc	*Juglans californica*	T
Wh	*Juglans hindsii*	T
Wp	*Pinus albicaulis*	T
Ws	*Picea breweriana*	T

X

Xa	*Salix lasiolepis*	T
Xar	*Salix argophylla*	S
Xb	*Salix nigra vallicola*	T
Xbr	*Salix breweri*	S
Xc	*Salix commutata*	S
Xcr	*Salix cordata*	S
Xe	*Salix exigua*	S
Xg	*Salix geyeriana argentea*	S
Xl	*Salix lemmonii*	S
Xm	*Salix melanopsis bolanderiana*	S
Xp	*Salix petrophila*	S
Xpi	*Salix piperi*	S
Xpm	*Salix phylicifolia monica*	S
Xr	*Salix laevigata*	T
Xs	*Salix scouleriana*	S
Xsh	*Salix sessilifolia hindsiana*	S
Xv	*Salix sitchensis coulteri*	T
Xy	*Salix lasiandra*	T

Y

Y	*Pinus ponderosa*	T

[1] This symbol carries accent, i.e., $\hat{X}$.
[2] This symbol carries underline, i.e., $\underline{X}$.
[3] This symbol carries overline, i.e., $\overline{X}$.

CASTLE LAKE TROUT INVESTIGATION 1946 CATCH, AND CHEMICAL REMOVAL OF ALL FISH[1]

By J. H. Wales

Bureau of Fish Conservation, California Division of Fish and Game

Castle Lake is a fairly typical Northern California lake. It has an area of 47 acres, and is located near Mt. Shasta, Siskiyou County. An intensive investigation has been made of this lake since 1938, and a creel census has been conducted since 1941. The objectives of the investigation were to determine the most suitable species of trout for lakes of this type, and the optimum number and size to plant. The lake contained small self-maintaining populations of mackinaw trout and minnows, but afforded no facilities for significant natural reproduction of rainbow, brook or brown trout, the principal species produced in our hatcheries. It was therefore decided to stock equal numbers of each of these species annually to determine the one best suited to conditions, and later to concentrate on that one to determine the size and numbers to be planted to produce the optimum catch.

The results of the first five years of the census, 1941 to 1945 inclusive, were published in July, 1946 (Wales, 1946). During that period the brown had been the dominant species, providing approximately half of the total catch in numbers, and far more than half in weight. However, there was reason to believe that, while the brown trout might provide the bulk of the fishing when planted together with the other two species, either one of the other two might provide better fishing if planted alone. It was, therefore, decided to begin the second phase of the program, planting one species only, and since brook trout are used in many parts of the State for lakes of this type, this species was selected.

It was realized that, if we merely refrained from planting anything but brook trout in Castle Lake, the brown trout, because of their longevity, would continue for years to be a complicating factor. It was therefore decided to eliminate all fish by "poisoning" (i.e., treatment of the lake with rotenone) in order to get a fresh start, and it was hoped at the same time that we might make a sufficiently complete recovery of the fish killed to get a good idea of the total population in the lake.

The present report gives the data on the anglers' catch in 1946, and on the destruction of all fish in the lake by rotenone in October, 1946, thus concluding the "First phase" of the investigation. The lake, at date of writing this, still contained so much rotenone at 30 feet depth and below as to be lethal to trout. Upon recovery, it will be stocked with 20,000 brook trout, thus initiating the "Second phase" of the investigation, in which a single species of trout will occupy the lake.

[1] Submitted for publication June, 1947.

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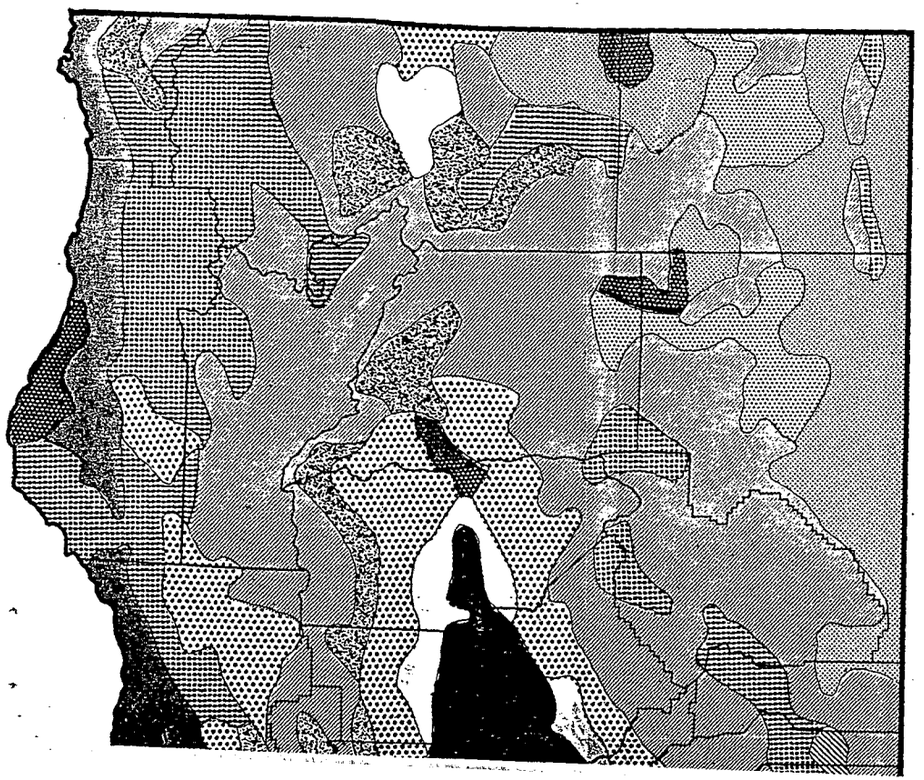

VEGETATION TYPES OF CALIFORNIA

- Ponderosa pine (Ponderosa, Jeffrey, and sugar pines alone or mixed with Douglas-fir or the true firs.)
- Redwood
- Douglas-fir and Fir
- Lodgepole pine — Whitebark pine
- Piñon pine and Juniper
- Woodland — Grass
- Grass
- Chaparral
- Sagebrush
- Desert

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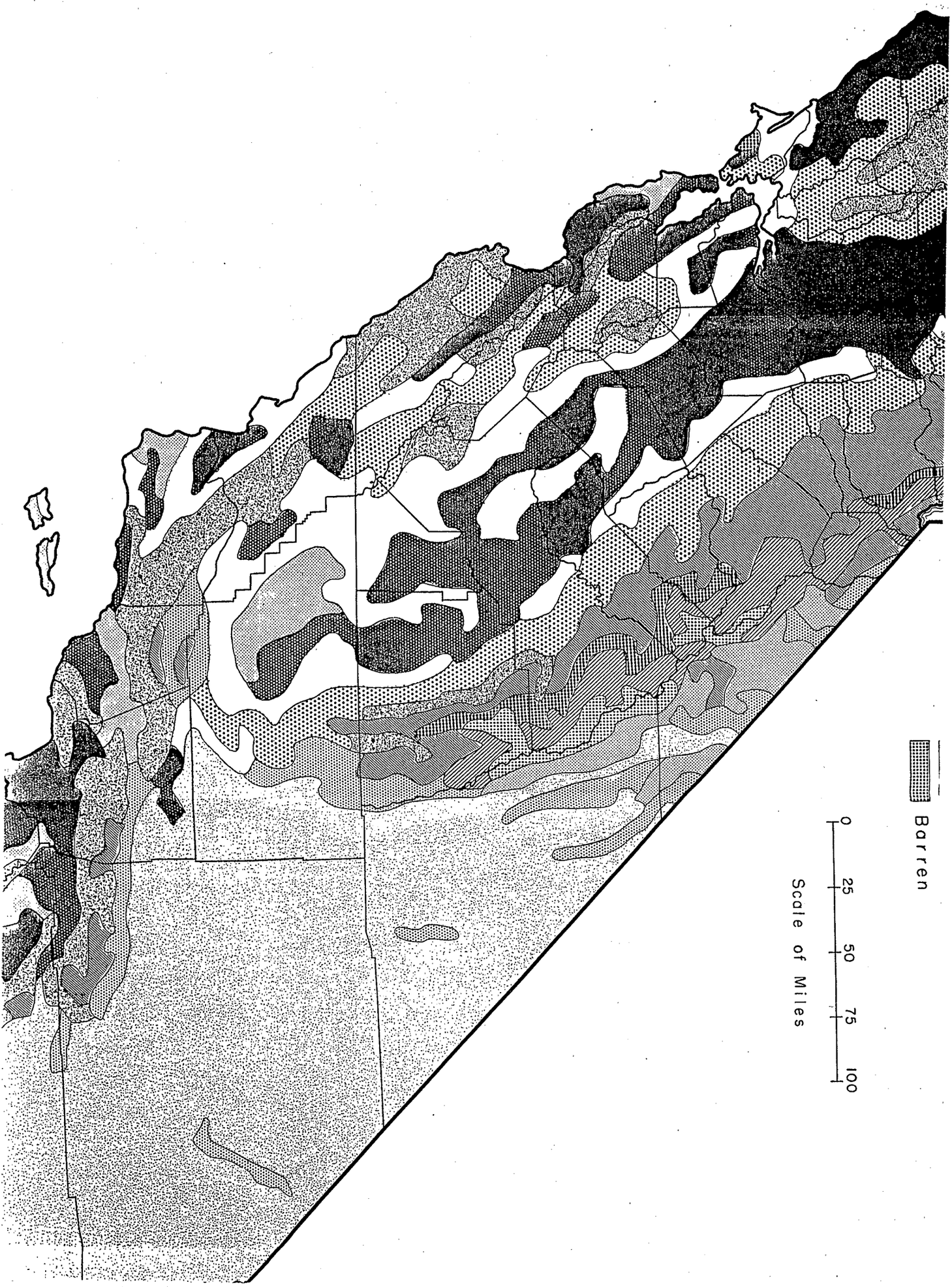

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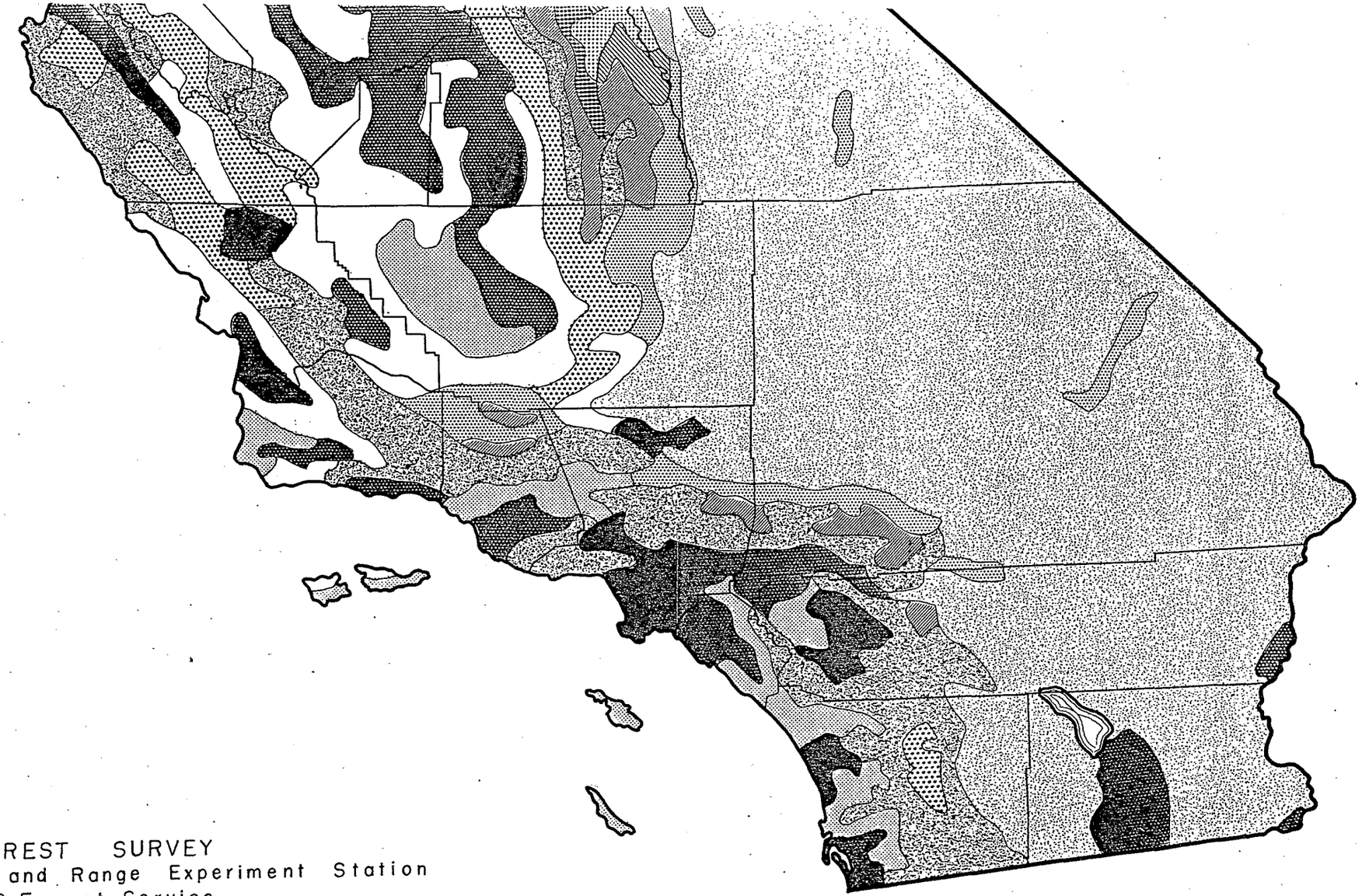

FOREST SURVEY
California Forest and Range Experiment Station
U. S. Forest Service
1945

C-052345

C—052345