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Sierran Vegetation: A Gap Analysis

ABSTRACT

Gap analysis assesses the distribution of plant community types among land classes defined by ownership and levels of protection of biodiversity. Gap analysis helps to identify which plant communities and species might be especially vulnerable to different human activities that can lead to habitat conversion or degradation.

This chapter presents a gap analysis of plant community types for the Sierra Nevada region, an area of 63,111 km^2 (24,367 mi^2). Ownership of the region is 37% private, 47% national forests, 10% national parks, 5% Bureau of Land Management, and less than 2% other public lands. Land ownership and land management patterns contrast sharply between the northern Sierra Nevada and the central and southern subregions. Parks and reserve lands constitute less than 2% of the northern region versus 27% of the central/southern.

We mapped eighty-eight natural plant community types within the region. Sixty-seven types were mapped over areas greater than 25 km^2 (9.65 mi^2). The ownership profiles of Sierran plant communities systematically reflect the concentration of private lands at lower elevations and of national parks in the central and southern portion of the range. Less than 1% of the foothill woodland zone of the Sierra Nevada is in designated reserves or other areas managed primarily for native biodiversity, and over 95% of the distribution of most foothill community types is available for grazing. Low- to middle-elevation Sierran forests are not well represented in designated reserves, especially in the northern Sierra Nevada. However, large areas of most of these forest types on U.S. Forest Service lands have been administratively withdrawn from intensive timber management based on current forest plans. Many high-elevation forest and shrubland community types are well represented in parks and ungrazed wilderness areas. Our analysis identifies thirty-two widespread community types whose conservation status warrants concern and twelve types that appear well protected based on their present distributions.

INTRODUCTION

Because land ownership and administrative designation establish the kinds of human activities that can occur in an area, they are usually strongly related to biodiversity status and trends. A map showing how native species and communities are distributed with respect to categories of ownership and conservation management helps to identify which elements of biodiversity might be especially vulnerable to habitat conversion or degradation. Gap analysis makes such an assessment by overlaying maps of land ownership and management onto maps of the distributions of plant community types (Scott et al. 1993). Community types and species whose distributions fall largely outside the areas whose primary management objective is to conserve native biodiversity are identified as "gaps" in biodiversity conservation.

The gap analysis of the Sierra Nevada described in this chapter represents a collaboration between the Sierra Nevada Ecosystem Project (SNEP) and the National Biological Service Gap Analysis Program (GAP). The goals of GAP are (1) to identify vegetation types and vertebrate species that are underrepresented in areas managed primarily for native biodiversity, and (2) to locate sites for new management areas where additional conservation measures could efficiently reduce the vulnerability of native biodiversity (Scott et al. 1993). This chapter focuses on the first goal and is confined to a gap analysis of vegetation types.

By quantifying broad patterns of land ownership/management in relation to vegetation, the gap analysis of the Sierra Nevada contributes one piece to SNEP's overall assessment of the region's biodiversity. It is not our objective in this chapter to provide a detailed description of Sierran vegetation, to analyze its past or current ecological condition, or to address

Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

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specific alternatives pertaining to vegetation management and conservation. These questions are addressed by other chapters. We describe and apply a model for siting new management areas based on the results of gap analysis in volume 1 of this report.

ASSESSMENT AREA AND QUESTIONS

The gap analysis of California is being conducted on a regional basis (Davis et al. 1995) using the ten major physical regions of California as defined in The Jepson Manual of Higher Plants of California (Hickman 1993). The Sierra Nevada Region encompasses 63,111 km^2 (24,367 mi^2) extending from Tejon Pass at the southern end to the North Fork of the Feather River at the north. That region overlaps 73% of the SNEP core area. The remainder of the SNEP core area falls within other Jepson regions: Mojave Desert (2.7%), Great Basin East of Sierra Nevada (11.3%), Modoc Plateau (4.2%), and Cascades Region (8.3%) (figure 23.1). The gap analysis reported here pertains only to the Jepson Sierra Nevada Region. The remaining areas will be treated in subsequent regional analyses as part of the statewide gap analysis.

Because of the size and biological heterogeneity of the Sierra Nevada, we also conducted gap analyses for a northern versus a central/southern subregion divided at the Stanislaus River. In The Jepson Manual the Stanislaus River divides the northern from the central and southern Sierra Nevada.

The following digital geospatial data were compiled for this analysis:

- topography (100 m [328 ft] grid)
- vegetation (classified to Holland types using a 100 ha [247 acre] minimum mapping unit [mmu]. The mmu is the nominal extent of the smallest mapped feature.)
- dominant plant species (100 ha [247 acre] mmu)
- land ownership and administrative designation in terms of conservation (200 ha [494 acre] mmu)
- U.S. Forest Service (USFS) grazing allotment boundaries (1 ha [2.47 acre] grid)
- USFS land suitability classes (1 ha [2.47 acre] grid)

These data were analyzed to address four specific questions:

1. How do land ownership and land management vary among elevation zones?
2. What are the sizes and locations of existing parks, wilderness areas, and reserves?
3. How is each terrestrial plant community type distributed with respect to land ownership and conservation management?
4. Which major terrestrial plant community types may be vulnerable to degradation of habitat and which types appear to be relatively well protected based on their current management profile?

METHODS

Detailed descriptions of the gap analysis approach and methods can be found in Scott et al. 1993, Beardsley and Stoms 1993, and Davis et al. 1995.

Land Ownership and Land Management

GAP classifies land ownership and management into four categories intended to capture the degree to which the land is managed to maintain biodiversity (Scott et al. 1993). We depart slightly from the GAP categories by distinguishing lands based on permitted use. We assume that the most pervasive land uses affecting the status and trends of terrestrial biodiversity in the Sierra Nevada are grazing, fire suppression, timber harvest, and urban, residential, and agricultural development. Other activities, such as recreation, trapping, and mining, are certainly important but more localized and/or less readily mapped. Thus we have distinguished five ownership/management classes based on fire policy and on potential for development, timber harvest, or grazing.

Class 1: public or private land formally designated for conservation of native biodiversity and within which economic activities such as development, grazing, and timber harvest are precluded. Natural disturbance events are generally allowed to proceed without interference or are mimicked through management. The areas may be used for primitive recreational activities. Examples include national parks, national monuments, ungrazed lands within USFS wilderness areas, USFS research natural areas, USFS wild and scenic rivers, Blue Ridge National Wildlife Refuge, The Nature Conservancy preserves, and state parks and ecological reserves. (See appendix 23.1 for a listing of Class 1 areas.)

Class 2: national forest land that is generally managed for its natural values but is not formally designated for conservation of native biodiversity. Development and grazing are excluded, and timber harvest is generally excluded because it conflicts with other multiple-use objectives. Wildfires are generally suppressed. The distribution of recreational activities on Class 2 lands is

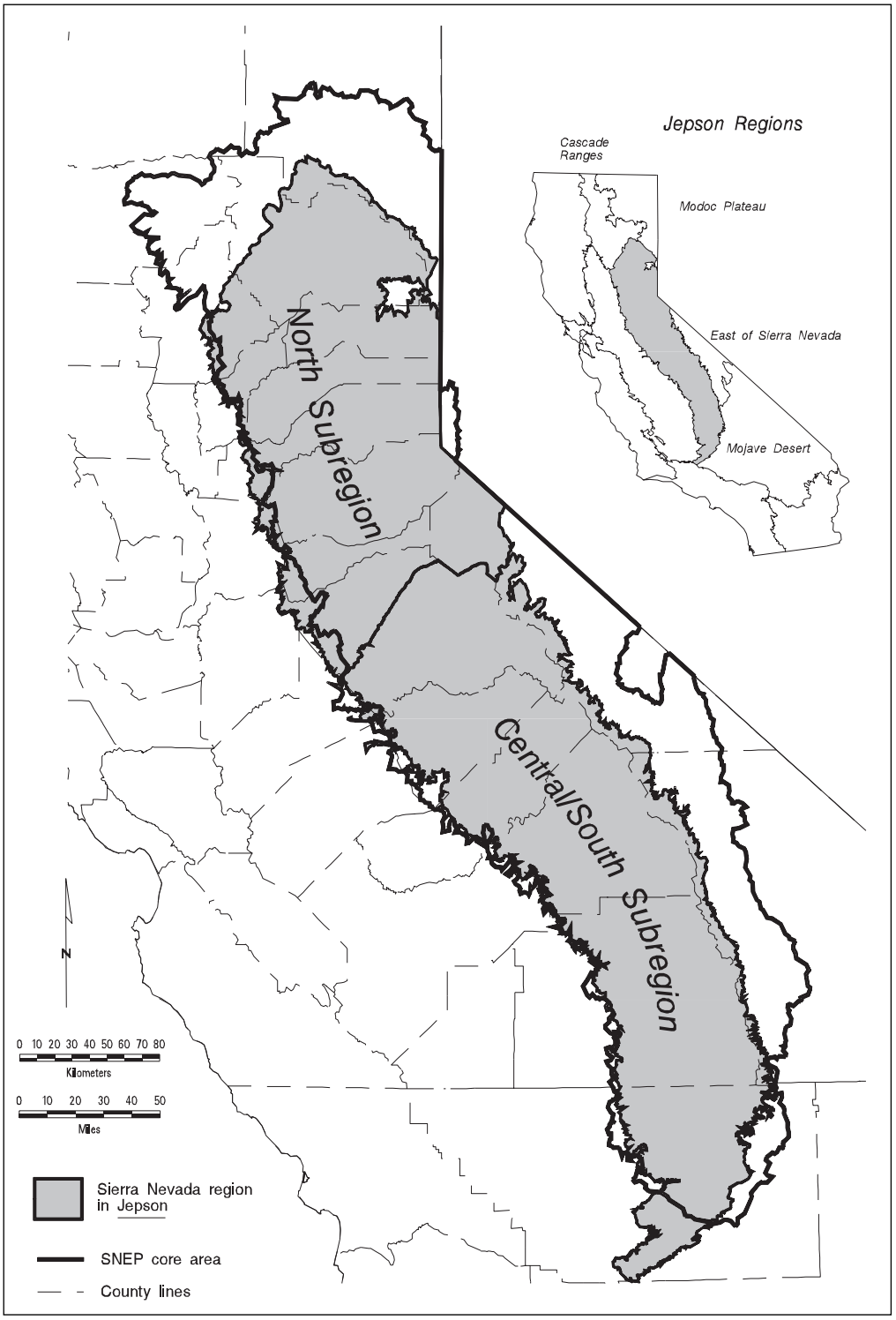


FIGURE 23.1

Regional location map of Jepson Sierra Nevada Region in relation to the SNEP core area.

unknown, but a small fraction of the land is developed for recreational facilities.

Class 3: public land that is generally managed for its natural values, is treated in existing management plans as unsuitable for timber harvest, and may be grazed. Wildfires may be actively suppressed. Examples include grazing allotments within USFS wilderness areas, grazing allotments on national forest lands classified as unsuitable for timber harvest, the San Joaquin Experimental Range, Bureau of Land Management (BLM) areas of critical environmental concern, and BLM wilderness areas.

Class 4: other public lands not included in Classes 1

through 3, mainly multiple-use federal lands managed by the Bureau of Indian Affairs (BIA), Bureau of Reclamation, BLM, and USFS. National forest lands in this category include areas that are classified in existing plans as suitable for timber harvest. These USFS areas can also be within existing grazing allotments. Wildfires are actively suppressed.

Class 5: private lands other than those in Class 1. In the absence of more detailed zoning data, we assume that these lands are potentially available for development, timber harvest, and grazing and that wildfires are actively suppressed.

The base map for land ownership/management is 1:100,000 BLM surface management status maps. A statewide digital coverage was provided by the Teale Data Center. We updated and enhanced this map to include boundaries of managed areas such as wilderness areas and research natural areas that do not coincide with ownership boundaries. To do this, we consulted national forest maps and digital databases and U.S. Geological Survey topographic maps. We obtained additional maps and information from many agencies, conservation organizations, and land trusts. All managed areas in the resulting regional map of land ownership/management were described in an associated database containing fields for the managing agency, the management level with respect to biodiversity conservation, and a managed area code assigned by the California Department of Fish and Game Natural Heritage Division.

The map of land management levels was converted to a 1 ha (2.47 acre) grid and intersected with 1 ha grids of USFS land suitability class maps and grazing allotments. Digital land suitability class maps were obtained directly from the USFS. Digital grazing allotment data were obtained from the USFS for all of the national forests except Lassen, Modoc, and the Lake Tahoe Basin. We digitized the grazing allotment boundaries on these forests from paper maps provided by USFS range conservation staff.

Maps of timber harvest suitability and grazing allotments were converted back to a vector (polygon) representation and overlaid with land ownership. The derived product was reclassified into the five classes defined above. This five-class map was then overlaid with vegetation data.

Vegetation Classification and Mapping

Vegetation types were classified based on overstory structure, cover, and dominant species composition. The overstory is described by one to three species, each contributing more than 20% of the relative canopy cover. These species assemblages (Davis et al. 1995) were subsequently reclassified into natural plant community types used by the California Department of Fish and Game Natural Heritage Division (Holland 1986).

Maps of actual vegetation were produced using summer 1990 Landsat Thematic Mapper satellite imagery, 1985–90 high altitude color infrared photography (1:58,000 scale), draft and published maps of the California vegetation type mapping survey (Wieslander 1946), miscellaneous recent vegetation maps (notably the vegetation databases from the national forests and parks), and ground surveys of selected areas.

Landscape Units

We did not have the resources to map individual stands of vegetation. Instead, we attempted to delimit "landscapes," defined as areas ranging from one to many square kilometers in extent, with uniform climate, physiography, substrate, and disturbance regime. A landscape could be covered by a single plant community type or by a mosaic of a few community types associated with different types of sites (e.g., riparian zones, moist north-facing slopes, dry south-facing slopes). Landscape boundaries were mapped subjectively by photointerpretation of patterns in the satellite imagery and air photos. Final delineation of a landscape unit was an iterative process based on evidence from the satellite imagery, air photos, existing vegetation maps, and field reconnaissance.

Floristic information was derived mainly from published and unpublished maps produced by the vegetation type mapping survey. Where these maps were lacking we relied on USFS soil and vegetation survey notes (alpine and subalpine areas surveyed by R. Taskey), our own 1994/95 field reconnaissance surveys, forest patch type descriptions from the SNEP late seral old-growth (LSOG) database, and the map of foothill woodland types prepared by Pillsbury et al. (1991). Our draft map was extensively updated in timber-producing areas using USFS maps of timber plantations and shrub-dominated timberlands.

Using available imagery and maps, each landscape unit was described by the following attributes (details are provided in a data dictionary accompanying the database):

- from one to three upland vegetation types, each characterized by up to three dominant overstory species, canopy closure (four classes), Holland (1986) community type, wildlife habitat type (Mayer and Laudenslayer 1988), and the fraction of the landscape that each type covers
- the most widespread riparian type as characterized by up to three dominant overstory species
- the presence or absence of nine wetland habitat types as defined by Mayer and Laudenslayer (1988)
- miscellaneous data, including evidence of disturbance in the landscape, occurrence of species of special interest, air photo identification number, information sources, University of California, Santa Barbara (UCSB) analyst, and comments

The draft database for the Jepson Sierra Nevada Region consists of 6,724 landscape units providing distributional in-

formation on 189 dominant species, 88 plant community types, and 35 wildlife habitat types. Analysts can query the database to retrieve distribution data on individual species, unique combinations of species, or vegetation types defined by physiognomy and/or composition.

Vegetation Map Accuracy

Because source information ranged widely in date and reliability, the current database is uneven in both level of detail and accuracy. We did not have the resources to assess the statistical accuracy of the vegetation map and associated database. However, we have appraised the product using less formal methods that have guided our use of the product. Based on UCSB field surveys in 1994 and 1995 and on comparisons with independent sources of vegetation data, the vegetation map probably overestimates the extent of conifer forest types and underestimates the extent of shrubland and middle-elevation hardwood forest types. Floristic information is more reliable in the northern and central subregions than in the southern subregion, which was only partially covered by the mapping survey of vegetation types. Floristic information is also more reliable on public lands than on private lands and better for the national parks than for the national forests. The data on upland community types and wildlife habitat types are more reliable than information on individual species or on wetland or meadow habitats. We will continue to revise the vegetation data based on review and testing by interested parties.

ASSUMPTIONS AND LIMITATIONS OF GAP ANALYSIS

Gap analysis provides a regional overview of the distribution and ownership profile of major terrestrial plant communities and vertebrate species habitats. It is not a substitute for a detailed biological inventory. Our assessment focuses on floristically defined plant community types and does not account for variations in stand age or physical stature within a type. For example, we do not distinguish late seral old-growth forest from younger forest of the same general community type.

The extent and spatial scale of the input maps of vegetation, wildlife habitat, and land management make a formal, statistical analysis of map accuracy impractical for both financial and logistical reasons. As a result, we cannot with confidence place error terms on our estimates of area or management status of plant communities.

The method that we used to map vegetation is not suited to the analysis of most wetland types or other communities that are restricted to very local environments. The mapping method is well suited to analysis of shrubs and trees, but it provides little or no information on the distribution of herbaceous species. Our analyses assume that the vegetation types attributed to a map unit (polygon) are dispersed uniformly throughout the unit.

Estimates of area made from maps are very sensitive to map scale and mapping methods. For example, vegetation types that typically occur in small patches may be overlooked or their extent underestimated using a vegetation map with relatively coarse spatial resolution. Our vegetation map is less sensitive to spatial resolution than traditional paper maps, because we maintain database records of secondary and tertiary vegetation types that are too fine to map using a 100 ha (247 acre) mmu. The point to remember is that our estimates of the acreage and distributions of species and types may differ considerably from areal estimates and from distributions of the same types derived from maps prepared at a finer or coarser resolution.

Land ownership/management profiles provide a crude measure of risk of development or resource overexploitation. We assume that native species are at risk in areas that have no legal or legislative mandate to protect and maintain self-sustaining natural ecosystems. Species and communities can also be at risk due to climatic change, introduced competitors and pathogens, and many other ecological factors. Furthermore, there is wide variation in land management practices within each of our five ownership/management classes. Some private lands are well managed for the maintenance of plant diversity, and some reserves are managed in a way that threatens some native species. Private land management also depends heavily on zoning status. Data on county zoning are needed for a fuller analysis of present and future management of private lands.

The static nature of the gap analysis data also limits their utility in assessing conservation risks. Our database provides a snapshot of a region in which land cover and land ownership are both very dynamic.

MAJOR FINDINGS

Results for the Jepson Sierra Nevada Region as a whole are presented first, followed by analyses of northern versus central/southern subregions.

Sierra Nevada Region as a Whole

We mapped the Jepson Sierra Nevada Region over an area of 63,111 km^2 (24,367 mi^2). We classified 56,587 km^2 (21,848 mi^2) (89.7%) of this area as vegetated (table 23.1). Non-vegetated areas included urban areas, lakes, reservoirs, rock outcrops, and alpine areas with little or no vascular plant cover.

Thirty-seven percent of the region is privately owned. The remainder, in public lands, is largely national forests (47%) and national parks (10%). The Bureau of Land Management

TABLE 23.1

Ownership and area of plant community types of the Sierra Nevada.

Type of Plant Community (Holland 1986)	Holland (1986) Code	Percentage of Mapped Distribution by Ownership									Total Mapped Distribution Area (km^2)
		Private	Nongovernmental Organization(s)	County and Regional	State	Department of Defense	Other U.S. Department of the Interior[a]	National Park Service	Bureau of Land Management	U.S. Forest Service	
Scrub											
Mojave creosote bush scrub	34100	50							39	11	7
Mojave mixed scrub and steppe	34200	28							71	2	261
Mojave mixed woody scrub	34210	71							19	9	8
Blackbush scrub	34300	35							61	4	164
Great Basin mixed scrub	35100	17			4	< 1	< 1		17	61	303
Big sagebrush scrub	35210	22				1		1	16	59	183
Low sagebrush scrub[b]	35211	10			2				8	79	156
Silver sagebrush scrub[b]	35212	10							1	89	16
Subalpine sagebrush scrub	35220	36			5		1		7	51	25
Sagebrush steppe	35300	23			1	< 1	< 1		31	45	822
Rabbitbrush scrub	35400	7								93	46
Cercocarpus ledifolius woodland[b]	35500	4			1			1	1	94	252
Wyethia mollis[b]	35600	27							< 1	73	30
Chaparral											
Upper Sonoran mixed chaparral	37100	39								61	6
Northern mixed chaparral	37110	29			< 1	< 1		4	15	51	176
Chamise chaparral	37200	52			< 1	2	< 1	3	24	18	820
Semidesert chaparral	37400	39						8	26	27	109
Mixed montane chaparral	37510	21			1		< 1	3	1	73	1,388
Montane manzanita chaparral	37520	44			< 1	< 1	1	< 1	5	49	457
Montane ceanothus chaparral	37530	26			1			< 1	1	72	195
Deer brush chaparral	37531	75								25	2
Shin oak brush	37541	60			< 1			22	3	15	42
Huckleberry oak chaparral	37542	22			< 1			12		66	179
Bush chinquapin chaparral	37550	11			1			2	1	85	77
Buck brush chaparral	37810	22			1	< 1	1	1	10	65	155
Scrub oak chaparral	37900	71			4		3		15	8	48
Interior live oak chaparral	37A00	71	< 1		< 1		1	1	8	19	203
Upper Sonoran manzanita chaparral	37B00	18						2	33	47	163
Ione chaparral	37D00	96							4		1
Mesic north-slope chaparral	37E00	16					4	3	11	65	132
Upper Sonoran subshrub scrub	39000	50				1			22	26	42
Herbaceous											
Valley needlegrass grassland	42110	80						3		17	31
Non-native grassland	42200	88	< 1		2	1	< 1	< 1	2	7	1,923
Montane meadow	45100	14						38	< 1	48	127
Wet subalpine or alpine meadow	45210	20			2	< 1		13	3	61	201
Dry subalpine or alpine meadow	45220	10								90	4
Great Basin montane meadow[b]	45230	100								< 1	1
Alkali meadow	45310	82	5			7			6		2
Transmontane alkali marsh	52320	92	1			5			2		17
Riparian Woodland											
Great Valley cottonwood riparian forest	61410	73	8			5			2	13	20
Great Valley mixed riparian forest	61420	63			2	4			< 1	31	12
Great Valley valley oak riparian forest	61430	97			1	2			< 1		16
White alder riparian forest	61510	34								66	5
Aspen riparian forest	61520									100	0.1
Montane black cottonwood riparian forest	61530	40						56	2	1	6
Montane riparian scrub	63500	38			< 1			16	3	43	119

[a]Includes the Bureau of Reclamation, the Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service.
[b]Addition to the standard Holland classification.

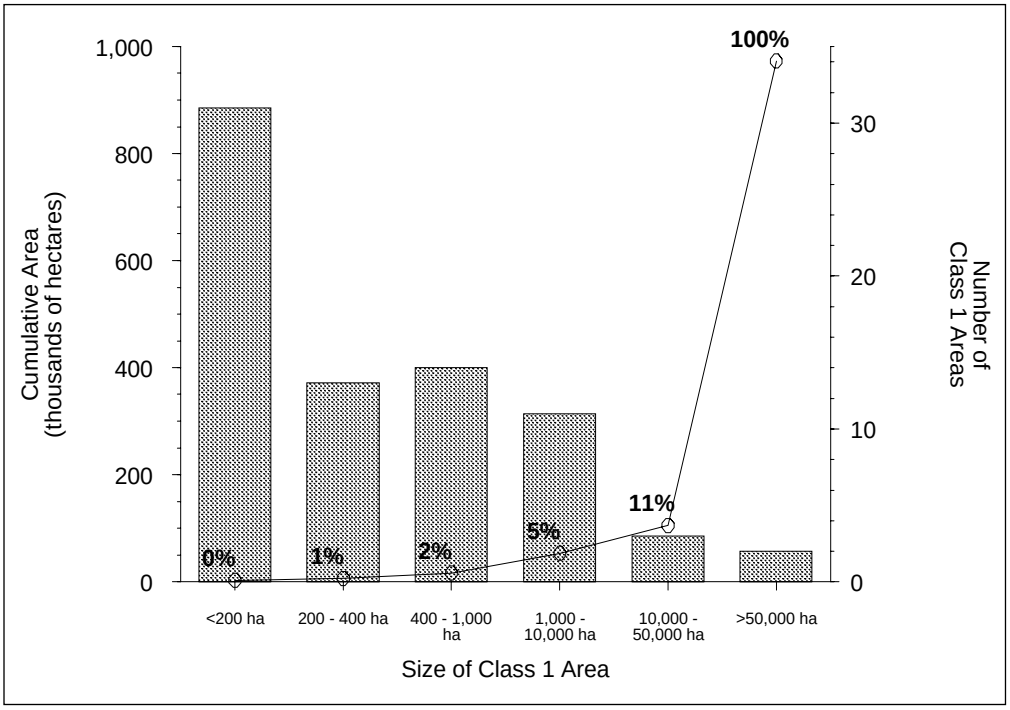
TABLE 23.1 (continued)

Type of Plant Community (Holland 1986)	Holland (1986) Code	Percentage of Mapped Distribution by Ownership									Total Mapped Distribution Area (km^2)
		Private	Nongovernmental Organization(s)	County and Regional	State	Department of Defense	Other U.S. Department of the Interior[a]	National Park Service	Bureau of Land Management	U.S. Forest Service	
Broad-Leaved Woodland											
Oregon oak woodland	71110	43							2	56	21
Black oak woodland	71120	55			< 1	< 1	3	1	8	32	460
Valley oak woodland	71130	98			2	< 1			1	< 1	340
Blue oak woodland	71140	89	< 1		1	1	2	1	3	3	5,430
Interior live oak woodland	71150	71			1	< 1	1	1	4	22	1,299
Conifer Woodland											
Open foothill pine woodland	71310	58			1	1	< 1		21	19	441
Nonserpentine foothill pine chaparral	71322	43			1	1	5	7	22	21	249
Foothill pine–oak woodland	71410	82	< 1		1	1	1		4	10	2,976
Cismontane juniper woodland[b]	71500	< 1			< 1			14		86	155
Oak-piñon woodland[b]	71600	8						4	62	27	117
Northern juniper woodland	72110	3			2			2	7	85	182
Great Basin piñon-juniper woodland	72121	11							42	47	404
Great Basin piñon woodland	72122	21			< 1		< 1	1	25	53	863
Great Basin juniper woodland and scrub	72123	4			15				9	72	9
Mojavean juniper woodland and scrub	72220	67				< 1			27	5	63
Joshua tree woodland	73000	9							91		73
Broad-Leaved Forest											
Canyon live oak forest	81320	24			< 1		3	13	5	55	916
Interior live oak chaparral	81330	76	< 1		2	< 1	2	1	3	17	1,545
Black oak forest	81340	28			1	< 1	2	3	5	60	1,087
Tan oak forest	81400	77								23	24
Aspen forest	81B00	6			1			2	3	89	99
Conifer Forest											
Knobcone pine forest	83210	50			1		< 1		23	26	17
Southern interior cypress forest	83330	23							24	53	3
West-side ponderosa pine forest	84210	35			1	< 1	< 1	8	3	53	4,402
East-side ponderosa pine forest	84220	18			1				4	76	1,614
Sierran mixed conifer forest	84230	32			< 1		< 1	5	1	62	5,935
Sierran white fir forest	84240	23			1			6	< 1	70	540
Big tree forest	84250	5			11		1	52	1	31	71
Jeffrey pine forest	85100	9			1		< 1	13	2	75	1,961
Red fir–western white pine forest[b]	85120	7			< 1			18	< 1	75	1,594
Jeffrey pine–fir forest	85210	11			< 1			9	< 1	80	2,956
Red fir forest	85310	9			< 1			30	< 1	61	3,395
Lodgepole pine forest	86100	3			< 1			42	< 1	55	2,156
Whitebark pine–mountain hemlock forest	86210	1						37		62	378
Whitebark pine–lodgepole pine forest	86220	1		< 1	< 1			12		86	373
Foxtail pine forest	86300	1						77		21	238
Whitebark pine forest	86600	1			< 1			31	< 1	68	219
Limber pine forest	86700	< 1						3		97	21
Lower cismontane mixed conifer–oak forest[b]	87100	45			1	< 1	1	4	4	46	4,234
Upper cismontane mixed conifer–oak forest[b]	87200	20	< 1		< 1	3		14	14	48	261
Alpine Habitats											
Sierra Nevada fell field	91120	1						27		72	122
Alpine dwarf scrub	94000	< 1						1		99	394
Total Area											
Vegetated lands											56,587
Vegetated and unvegetated lands		37	< 1	< 1	1	< 1	1	10	5	47	63,111

[a]Includes the Bureau of Reclamation, the Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service.
[b]Addition to the standard Holland classification.

FIGURE 23.2

Frequency of Class 1 areas by size class (bars) and cumulative area (curve) in the Sierra Nevada.



administers 5% of the region. The Bureau of Indian Affairs, other Department of Interior agencies, and the state oversee the remaining 2% of the region's land base.

We found that 15% of the region is in Class 1 management status. Yosemite and Sequoia–King's Canyon National Parks account for 89% of the Class 1 area. The size distribution of Class 1 areas is strongly skewed toward parcels of less than 200 ha (494 acres) (figure 23.2). These account for nearly half of the Class 1 parcels but contribute less than 1% of the total Class 1 area.

An additional 7% of the Sierra Nevada region is in Class 2 lands in national forests. By summing Classes 3, 4, and 5, we estimate that roughly 80% of the region is available for grazing (89% of vegetated lands). Summing Classes 4 and 5, we estimate that 56.5% of the land area (63.3% of vegetated lands) is available for timber harvest, although not all of this land is actually timberland.

TABLE 23.2

Eleven widespread vegetation types that collectively cover 65% of the vegetated portion of the Jepson Sierra Nevada Region.

Plant Community Type (Holland 1986)			
Name	**Code**	**Area (km^2)**	**Percentage of Total Area**
Mixed conifer forest	84230	5,933	10.5
Blue oak woodland	71120	5,426	9.6
West-side ponderosa pine forest	84210	4,406	7.8
Lower cismontane mixed conifer–oak forest	87100	4,231	7.5
Red fir forest	85310	3,395	6.0
Foothill pine–oak woodland	71410	2,975	5.3
Jeffrey pine–fir forest	85210	2,956	5.2
Lodgepole pine forest	86100	2,156	3.8
Jeffrey pine forest	85100	1,961	3.5
East-side ponderosa pine forest	84220	1,614	2.9
Non-native grassland	42200	1,922	2.8

Based on our system for converting dominant species combinations to natural community types, we mapped eighty-eight natural plant community types within the region. Sixty-seven types were mapped over an area greater than 25 km^2 (9.65 mi^2). Sierran mixed conifer forest and blue oak woodland are the most extensive types, covering 5,933 km^2 (2,290 mi^2) and 5,426 km^2 (2,094 mi^2), respectively. Eleven community types collectively contribute 65% of the region's total vegetated acreage (table 23.2).

The ownership profiles of Sierran plant communities systematically reflect the concentration of private lands at lower elevations and of national parks in the central and southern portion of the range. Many of the foothill community types fall largely on private lands, notably non-native grassland (88% of mapped distribution on private lands), valley oak woodland (98%), blue oak woodland (89%), interior live oak woodland (71%), and foothill pine–oak woodland (82%). These percentages differ somewhat from the statewide estimates of private ownership provided by Bolsinger (1988). His estimates are lower for valley oak woodland (86% private ownership) and blue oak woodland (75%) and higher for interior live oak woodland (82%). Our estimates of private ownership and conservation of blue oak and blue oak–foothill pine community types are comparable to those of Greenwood et al. (1993).

A number of relatively widespread community types fall disproportionately on national forest lands, notably low sage-

TABLE 23.3

Upland rangeland plant community types in areas that can be grazed. These are types with areas greater than 25 km^2 (9.65 mi^2) with more than 90% of their mapped distribution potentially grazed.

Plant Community Type	Holland (1986) Code	Percentage of Mapped Distribution by Land Management Class: Class 1 (Protected)	Classes 1–2 (Ungrazed)	Classes 3–5 (Potentially Grazed)	Total Mapped Distribution Area (km^2)
Shrubland Types					
Mojave mixed scrub and steppe	34200	<0.1	<0.1	100.0	261
Blackbush scrub	34300	<0.1	<0.1	100.0	164
Chamise chaparral	37200	5.8	7.7	92.3	820
Scrub oak chaparral	37900	0.0	6.4	93.6	48
Upper Sonoran subshrub scrub	39000	3.9	6.6	93.4	42
Woodland Types					
Black oak woodland	71120	1.5	9.0	91.0	460
Valley oak woodland	71130	0.0	0.1	99.9	340
Blue oak woodland	71140	1.2	1.8	98.2	5,426
Interior live oak woodland	71150	1.0	6.2	93.8	1,299
Open foothill pine woodland	71310	1.4	6.3	93.7	441
Foothill pine–oak woodland	71410	0.4	5.6	98.4	2,975
Oak-piñon woodland[a]	71600	3.6	7.7	92.3	117
Northern juniper woodland	72110	5.8	10.7	89.3	182
Great Basin piñon woodland	72122	2.3	3.0	97.0	863
Mojavean juniper woodland and scrub	72220	1.3	1.8	98.2	63
Joshua tree woodland	73000	0.0	0.0	100.0	73
Forest Types					
Interior live oak forest	81330	1.8	4.2	95.8	1,545
East-side ponderosa pine forest	84220	0.9	8.5	91.5	1,614

[a]Addition to the standard Holland classification.

brush scrub (79%), rabbitbrush scrub (93%), Cercocarpus ledifolius woodland (94%), mixed montane chaparral (73%), montane ceanothus chaparral (72%), bush chinquapin chaparral (85%), cismontane juniper woodland (86%), northern juniper woodland (85%), aspen forest (89%), east-side ponderosa pine forest (76%), Jeffrey pine forest (75%), Jeffrey pine–fir forest (80%), red fir–western white pine forest (75%), whitebark pine–lodgepole pine forest (86%), and alpine dwarf scrub (99%).

Foxtail pine forest is the only type whose distribution falls mainly inside the national parks (77%). The BLM controls the largest portion of the distribution for a few community types that are marginal to the Jepson Sierra Nevada Region, notably Mojave mixed scrub and steppe (71%), blackbush scrub (61%), oak-piñon woodland (62%), and Joshua tree woodland (91%).

The mapped community types display a wide range of land management profiles. We would call special attention to four distribution types:

1. Upland rangeland plant community types mainly in areas that can be grazed. Table 23.3 lists 18 out of 67 types with areas greater than 25 km^2 (9.65 mi^2) and with more than 90% of their distribution in Classes 3–5 and therefore potentially grazed. These types merit special attention for grazing management and conservation. The main distribution for several of the types lies outside of the Jepson Sierra Nevada Region (e.g., Mojave mixed scrub and steppe, Joshua tree woodland, blackbush scrub, and the sagebrush types). While we have less confidence in our mapping of riparian and wetland types, we should note that all riparian types and most wetland habitats were also mapped with more than 90% of their distribution in Classes 3–5.

2. Forest plant communities mainly located in unprotected areas. Table 23.4 lists six types with areas greater than 25 km^2 and with less than 10% of their distribution in Class 1 land, which is designated for conservation of native biodiversity. These types are of special management concern related to timber harvest and/or fire suppression. However, except for interior live oak forest, these types are widely distributed on national forest lands that are classified in current forest plans as unsuitable for timber harvest (Class 2).

3. Chaparral community types mainly located in unprotected areas. Table 23.5 lists eight types with areas greater than 25 km^2 and with less than 10% of their distribution on Class 1 land. The policy of suppressing wildfire on Class 2–5 public and private lands and the widespread conversion of chaparral to grasslands on private ranchlands raise concern for the long-term sustainability of these fire-adapted plant communities. A similar concern arises for knobcone pine forest, a fire-dependent community that is also very poorly represented in Class 1 areas.

TABLE 23.4

Forest plant community types mainly located in unprotected areas. These are types with areas greater than 25 km^2 (9.65 mi^2) with less than 10% of their mapped distribution in areas formally designated for conservation (Class 1 land).

Plant Community Type	Holland (1986) Code	Percentage of Mapped Distribution by Land Management Class: Class 1 (Protected)	Classes 1–3 (Not Available for Timber Harvesting)	Classes 4–5 (Available for Timber Harvesting)	Total Mapped Distribution Area (km^2)
Interior live oak forest	81330	1.8	18.6	81.3	1,545
Black oak forest	81340	6.5	44.4	55.6	1,087
East-side ponderosa pine forest	84220	0.9	27.6	72.4	1,614
Sierran mixed conifer forest	84230	8.1	32.9	67.1	5,933
Sierran white fir forest	84240	7.7	38.1	61.9	540
Lower cismontane mixed conifer–oak forest[a]	87100	4.9	29.9	70.1	4,231

[a]Addition to the standard Holland classification.

4. Plant community types that are well protected. Table 23.6 lists twelve types with areas greater than 25 km^2 and more than 25% of their distribution in Class 1 areas. These types are of relatively low priority for additional land acquisition or redesignation to reserve status.

Northern Sierra Subregion

The northern subregion totals 27,483 km^2 (10,611 mi^2) in area and is largely national forest or private land. Only 2.1% of the land in this subregion is in Class 1 areas (appendix 23.2). An additional 10.1% is Class 2. Potentially grazed lands (Classes 3–5) account for 87.8% of the area, while 71% is eligible for intensive timber harvesting (Classes 4–5). Private lands constitute 45.3% of the total area.

Ownership and management vary systematically by elevation zone. More than 80% of the land below 1,000 m (3,280 ft) is unreserved private land (Class 5), while less than 0.1% is in Class 1 (figure 23.3). In contrast, Class 5 constitutes less than 10% of areas above 2,000 m (6,560 ft).

Vegetation was mapped into 3,869 polygons with a median polygon size of 371 ha (916 acres). Of the sixty-eight community types mapped, forty-six had mapped distributions greater than 25 km^2 (9.65 mi^2) in extent. Sierran mixed conifer was mapped over 4,523 km^2 (1,746 mi^2) or 17.5% of vegetated lands. Other widespread types include west-side ponderosa pine forest (9% of vegetated lands), lower cismontane mixed conifer–oak forest (9%), east-side ponderosa pine forest (6%), foothill pine–oak woodland (5%), red fir forest (5%), Jeffrey pine–fir forest (4%), and Jeffrey pine forest (4%). These eight community types make up roughly 60% of the total vegetation. Only eight of the forty-six types with areas greater than 25 km^2 have more than 5% of mapped distribution in Class 1 land.

Many of the rangeland types are largely on land available for grazing, notably big sagebrush scrub (93% of distribution), rabbitbrush scrub (96%), chamise chaparral (99%), nonnative grassland (98%), black oak woodland (93%), valley oak woodland (99%), blue oak woodland (99%), interior live oak woodland (99%), open foothill pine woodland (99%), foothill

TABLE 23.5

Chaparral plant community types mainly located in unprotected areas. These are types with areas greater than 25 km^2 (9.65 mi^2) with less than 10% of their mapped distribution in areas formally designated for conservation (Class 1 land).

Plant Community Type	Holland (1986) Code	Percentage of Mapped Distribution by Land Management Class: Class 1 (Protected)	Class 5 (Private—Available for Timber Harvesting, Grazing, or Urban Development)	Total Mapped Distribution Area (km^2)
Chamise chaparral	37200	5.8	51.6	820
Montane manzanita chaparral	37520	4.9	44.3	457
Montane ceanothus chaparral	37530	1.5	25.8	195
Bush chinquapin chaparral	37550	6.0	11.0	77
Buck brush chaparral	37810	1.1	22.1	155
Scrub oak chaparral	37900	0.0	70.6	48
Interior live oak chaparral	37A00	4.3	70.6	203
Upper Sonoran manzanita chaparral	37B00	4.9	18.2	163

TABLE 23.6

Well-protected plant community types.These are types with areas greater than 25 km^2 (9.65 mi^2) with more than 25% of their mapped distribution in areas formally designated for conservation (Class 1 land).

Plant Community Type	Holland (1986) Code	Percentage of Mapped Distribution in Class 1	Total Mapped Distribution Area (km^2)
Montane meadow	45100	54.0	127
Cismontane juniper woodland[a]	71500	31.4	155
Big tree forest	84250	51.6	71
Red fir–western white pine forest[a]	85120	28.8	1,594
Red fir forest	85310	33.2	3,395
Lodgepole pine forest	86100	53.5	2,156
Whitebark pine–mountain hemlock forest	86210	61.7	378
Whitebark pine–lodgepole pine forest	86220	56.1	372
Foxtail pine forest	86300	92.6	238
Whitebark pine forest	86600	58.0	219
Sierra Nevada fell field	91120	27.5	122
Alpine dwarf scrub	94000	89.5	394

[a]Addition to the standard Holland classification.

pine–oak woodland (99%), northern juniper woodland (93%), and Great Basin piñon woodland (99%).

Of the major forest types, interior live oak forest is distinctly concentrated on private lands (90%). Over half of the area in west-side ponderosa pine forest is privately held. Ponderosa pine may have previously dominated much of what we classified as lower cismontane mixed conifer–oak forest, a low-elevation type that is also predominantly on private land (63%). The middle-elevation forest types are more concentrated in the national forests (60% to 90% on public lands).

Treating the five major low- to middle-elevation conifer timber types (west-side ponderosa pine, east-side ponderosa pine, Sierran mixed conifer, Sierran white fir, and lower cismontane mixed conifer–oak forests) collectively, we estimate that 22.5% of lower montane timberlands are in reserve status or are on national forest land classified as unsuitable for intensive timber harvest.

The five high-elevation conifer types that may be used for timber production include red fir–western white pine, red fir, Jeffrey pine, Jeffrey pine–fir, and upper cismontane mixed conifer–oak forests. Currently 50% of the total area in these types is reserved or withdrawn from intensive timber harvesting.

Central and Southern Sierra Subregion

We mapped a total of 35,620 km^2 (13,753 mi^2) as the Jepson central and southern Sierra Nevada subregion. Because both Yosemite and Sequoia–Kings Canyon National Parks fall within this area, its land management profile is strikingly different from that of the northern subregion. Class 1 areas and private lands are roughly equal in extent, respectively 25.7% and 29.8% of the area. Like those in the northern subregion, Class 1 lands are concentrated at higher elevations (figure 23.4).

Approximately 12% of the region was classified as nonvegetated (mainly land at high elevation with little or no ground cover). Vegetation was mapped into 3,143 polygons with a median size of around 500 ha (1,235 acres). The central/southern polygons are larger than their northern counterparts mainly because much of the region was not mapped by vegetation type mapping crews, and thus we relied more heavily on USFS timber type maps and on our own field vis-

FIGURE 23.3

Proportion of land in each management class by elevation zone in the northern Sierra Nevada subregion.

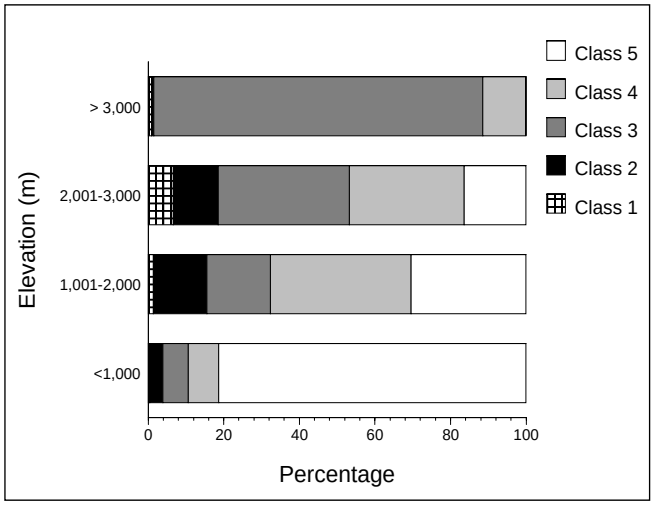
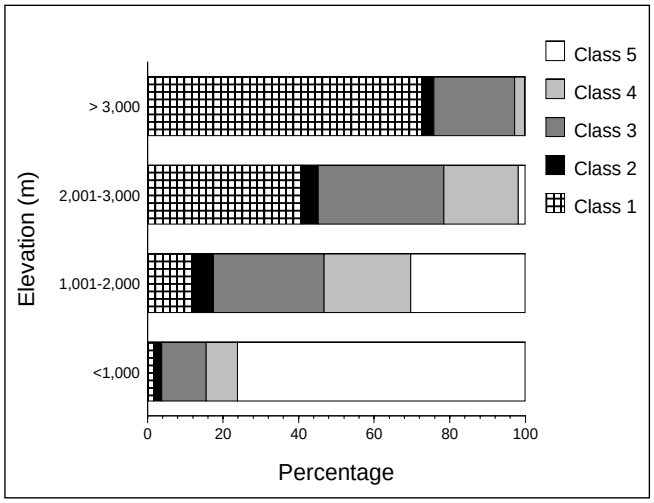


FIGURE 23.4

Proportion of land in each management class by elevation zone in the central/southern Sierra Nevada subregion.



its to about 700 polygons to define polygon boundaries and composition.

Of the seventy-nine mapped community types, fifty-nine are greater than 25 km^2 (9.65 mi^2) in extent. Taken together, blue oak woodland, foothill pine–oak woodland, and nonnative grassland occupy 6,974 km^2 (2,692 mi^2), or 22.3% of the vegetated portion of the subregion. The other extensive community types include red fir forest (7% of vegetated area), west-side ponderosa pine forest (7%), lower cismontane mixed conifer–oak forest (7%), lodgepole pine forest (6%), Jeffrey pine–fir forest (6%), and Sierran mixed conifer forest (4.5%).

Private lands and public grazing allotments cover roughly three-fourths of the vegetated area. Thus, practically the entire distribution of many plant community types is potentially grazed here, as it is in the northern subregion. Especially noteworthy are the foothill woodland and grassland types (more than 97% of mapped area available for grazing), Mojavean scrub and woodland types (98%), blackbush scrub (99%), and Great Basin piñon woodland (96%).

The largest difference between the northern and the central/southern subregions lies in the management profiles of the major forest types. With the exception of the lower cismontane mixed conifer–oak forest and the black oak forest, virtually all of the timber-producing community types have at least 20% of their distribution on Class 1 land.

A number of community types are very well represented in Class 1 areas. Twenty-three of fifty-nine extensive communities show at least 25% of their mapped distribution on Class 1 land, notably montane chaparral types, mixed conifer forest types, and subalpine woodland types.

SUMMARY AND DISCUSSION

The databases used in this gap analysis comprise the most spatially and taxonomically detailed land management and vegetation maps ever assembled for the region as a whole. Nevertheless, producing these maps involved a great deal of generalization, simplification, and distortion of the true complexity of the region. Without a statistically designed accuracy analysis we cannot state with confidence that the data are adequate to answer our assessment questions. For this reason we have tried to focus on very gross differences in ownership and management among subregions and among widespread plant communities, since these are not likely to be severely affected by the mapping scale or by minor errors in the geospatial data.

The Jepson Sierra Nevada Region spans nearly 600 km (372 mi) from south to north, rises over 4,000 m (13,120 ft) in elevation, and encompasses a very wide range of soil and vegetation conditions, human land uses, and land management patterns. The genetic and species composition of Sierran plant community types varies systematically from the northern to the southern end of the range (e.g., Taylor 1977; Walker 1992). For example, Walker (1992) estimated the average plant species turnover in Sierran mixed conifer forest to be one species per kilometer along the long axis of the range. The mixed conifer flora of the far northern Sierra Nevada shares only half of its plant species with its southern counterpart. Many plant taxa are endemic to one subregion. For this reason, the status of plant community types of the Sierra Nevada is best viewed on a subregional basis. Similarly, strategies for maintaining native Sierran biodiversity must account for the systematic and often profound differences, both administrative and biological, between the northern and the central/southern subregions, as well as between the foothill zone and higher elevations, between lower- and middle-elevation mixed hardwood-conifer and conifer community types, and between community types with predominantly west-side versus east-side distributions.

Our general conclusions are:

1. Fifteen percent of the Sierra Nevada is in designated conservation lands. An additional 7% is in national forest lands that are not grazed and/or are deemed unsuitable for timber production.

2. More than 80% of designated Class 1 areas are less than 200 ha (494 acres) in size. These small parcels collectively contribute less than 1% of total Class 1 area. Yosemite and Sequoia–Kings Canyon National Parks contribute 89% of Class 1 lands. Most remaining Class 1 areas are high-elevation, ungrazed parcels within wilderness areas in the national forests.

3. Eighty-nine percent of the vegetated area of the Sierra Nevada is privately held or is public land where grazing is legally permitted.

4. Less than 1% of the foothill zone of the Sierra Nevada is in designated reserves or other areas managed primarily for native biodiversity.

5. Roughly 80% of the lands at elevations below 1,000 m (3,280 ft) are privately held. Biodiversity management in this zone is thus largely in the hands of private landholders as regulated by state and county governments. Over 95% of the distribution of most plant community types in the foothills is potentially grazed.

6. Viewed over the entire range, low- and middle-elevation Sierran forests are not well represented in Class 1 areas. However, substantial areas of most of these forest types are classified as unsuitable for intensive timber harvesting on USFS land suitability class maps. These Class 2 lands appear to be the de facto reserves for lower montane forest types, especially in the northern Sierra Nevada.

7. Land ownership and management patterns contrast sharply between the northern Sierra Nevada and the central/southern subregion. Class 1 lands contribute less

than 2% of the northern region versus 27% of the central/southern.

8. Based on our land management classification, biodiversity of the lower montane forests of the northern Sierra Nevada is considerably more vulnerable than forest biodiversity elsewhere in the range.

9. Many high-elevation forest and shrubland types are well represented in parks and ungrazed wilderness areas. In the central/southern subregion, twenty-three of fifty-nine widespread community types are especially well protected, with over one-quarter of their distribution on Class 1 lands.

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REFERENCES

Beardsley, K., and D. M. Stoms. 1993. Compiling a digital map of areas managed for biodiversity in California. Natural Areas Journal 13:177–90.

Bolsinger, C. L. 1988. The hardwoods of California's timberlands, woodlands, and savannas. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station.

Davis, F. W., P. A. Stine, D. M. Stoms, M. I. Borchert, and A. D. Hollander. 1995. Gap analysis of the actual vegetation of California: 1. The southwestern region. Madroño 42:40–78.

Greenwood, G. B., R. K. Marose, and J. M. Stenback. 1993. Extent and ownership of California's hardwood rangelands. Technical Report. Sacramento: California Department of Forestry and Fire Protection.

Hickman, J. C. (ed.). 1993. The Jepson manual: Higher plants of California. Berkeley and Los Angeles: University of California Press.

Holland, R. F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Sacramento: California Department of Fish and Game.

Mayer, K. E., and W. F. Laudenslayer Jr. 1988. A guide to wildlife habitats of California. Sacramento: California Department of Forestry and Fire Protection.

Pillsbury, N. H., M. J. de Lasaux, R. D. Pryor, and W. D. Bremer. 1991. Mapping and GIS database development for California's hardwood resources. Technical Report. Sacramento: California Department of Forestry and Fire Protection, Forest and Rangeland Resources Assessment Program.

Scott, J. M., F. Davis, B. Csuti, R. Noss, B. Butterfield, C. Groves, H. Anderson, S. Caicco, F. D'Erchia, T. C. Edwards Jr., J. Ulliman, and R. G. Wright. 1993. Gap analysis: A geographic approach to protection of biological diversity. Wildlife Monographs 123:1–41.

Taylor, D. U. 1977. Floristic relationships along the Cascade-Sierran axis. American Midland Naturalist 97:333–49.

Walker, R. E. 1992. Community models of species richness: Regional variation of plant community species composition on the west slope of the Sierra Nevada, California. Master's thesis, Department of Geography, University of California, Santa Barbara.

Wieslander, A. E. 1946. Forest areas, timber volumes, and vegetation types in California. Forest Survey Release 4. Berkeley: California Forest and Range Experiment Station.

APPENDIX 23.1

List of Designated Biological Reserves in the SNEP Core Region

Agency/Organization, Area Name	Area (ha)	Subtotal (ha)
Private		**12,683**
The Nature Conservancy Preserves		12,683
Dye Creek	10,312	
Kern River	337	
Mary Elizabeth Miller	152	
Table Mountain	1,882	
State		**58,549**
Department of Parks and Recreation		
State Parks and Reserves		11,670
Burton Creek	789	
Calaveras Big Trees	2,450	
Donner Memorial	155	
Emerald Bay/D. L. Bliss	646	
Grover Hot Springs	182	
Plumas-Eureka	1,885	
Red Rock Canyon	4,833	
Sugar Pine Point	730	
Department of Fish and Game		
Ecological Reserves		846
Blue Ridge Condor	623	
Fish Slough	74	
Limestone Salamander	48	
Pine Hill	101	
Wildlife Areas		46,033
Antelope Valley	1,781	
Bass Hill	1,312	
Biscar	226	
Coon Hollow	212	
Crocker Meadows	730	
Daugherty Hill	967	
Doyle	5,734	
Fay Canyon	159	
Hallelujah Junction	2,630	
Heenan Lake	524	
Honey Lake	2,963	
Hope Valley	1,199	
Red Lake	315	
Slinkard/Little Antelope	4,706	
Smithneck Creek	607	
South Fork (Corps of Engineers)	535	
Spenceville	3,463	
Tehama	16,618	
Warner Valley	277	
Willow Creek	1,075	
Federal		**1,732,984**
Bureau of Land Management		
Areas of Critical Environmental Concern and Wild and Scenic Rivers		84,399
Blue Ridge Condor	1,299	
Bodie Bowl	2,427	
Conway Summit	724	
Crater Mountain	2,325	
El Dorado Manzanita	42	
Fish Slough	13,986	
Fossil Falls	664	
Jawbone Butterbredt	52,827	
Last Chance Canyon	774	
Limestone Salamander	641	
Merced River	106	
Red Hills	2,917	
Sand Canyon	1,269	
Slinkard Valley	4,259	
Tuolumne River (Wild and Scenic River)	139	
Wilderness Areas		124,053
Bright Star	3,244	
Chimney Peak	5,081	
Coso Range	19,744	
Domeland	951	
Golden Valley	3,917	
Inyo Mountains	17,287	
Ishi	77	
Kiavah	15,843	
Malpais Mesa	8,294	
Owens Peak	29,530	
Piper Mountain	7	
Sacatar Trail	20,078	
U.S. Fish and Wildlife Service		
National Wildlife Refuge		457
Blue Ridge	457	
National Park Service		
National Monuments and Parks		666,120
Devils Postpile	326	
Lassen Volcanic	15,370	
Sequoia and Kings Canyon	348,473	
Yosemite	301,951	
U.S. Forest Service		
Research Natural Areas		18,461
Babbitt Peak	541	
Backbone Creek	164	
Bell Meadow	273	
Big Grizzly Mountain	310	
Bishop Creek	660	
Bourland Meadow	210	
Church Dome	592	
Clark Fork	946	
Cub Creek	1,545	
Graham Pinery	351	
Grass Lake	130	
Green Island Lake	445	
Harvey Monroe Hall	1,579	
Indiana Summit	422	
Indian Creek	1,481	
Jawbone Ridge	316	
Last Chance Meadow	249	
Long Canyon	954	
Lyon Peak/Needle Lake	306	
McAffee Meadow	1,408	
Moses Mountain	383	
Mount Pleasant	581	
Mountaineer Creek	678	

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Agency/Organization, Area Name	Area (ha)	Subtotal (ha)
Mud Lake	183	
Peavine Point	453	
Secate Ridge	1,689	
Sentinel Meadow	277	
Snow Canyon	327	
Soda Ridge	467	
Station Creek	287	
Sugar Pine Point	254	
Wilderness Areas[a]		803,488
Ansel Adams	94,973	
Bucks Lake	8,737	
Caribou	7,593	
Carson-Iceberg	63,980	
Desolation	25,504	
Dinkey Lakes	12,280	
Dome Land	35,197	
Emigrant	45,587	
Golden Trout	121,416	
Granite Chief	9,857	
Hoover	19,484	
Inyo Mountains	7,966	
Ishi	15,903	
Jennie Lakes	4,257	
John Muir	220,833	
Kaiser	8,977	
Kiavah	17,709	
Mokelumne	40,843	
Monarch	17,862	
South Sierra	24,530	
Special Interest Areas		22,224
Ancient Bristlecone Pine Forest	2,097	
Bodfish Piute Cypress	237	
Butterfly Valley	192	
California Bighorn Sheep	14,377	
Carpenteria	180	
Feather Falls	3,643	
Kings River	178	
Little Last Chance Canyon	546	
McKinley Grove	183	
Neider Grove	591	
Wild and Scenic Rivers		13,782
Feather River	7,447	
Kern River	2,025	
Merced River	1,656	
Tuolumne River	2,654	
Total Area		**1,804,216**

[a]Wilderness areas include grazing allotments.

APPENDIX 23.2

Management Status (Classes 1–5) by Subregion for Plant Communities of the Jepson Sierra Nevada Region

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Type of Plant Community (Holland 1986)	Holland (1986) Code	Percentage of Mapped Distribution by Land Management Class															Total Mapped Distribution (km^2)		
		Class 1			Class 2			Class 3			Class 4			Class 5					
		North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total
Scrub																			
Mojave creosote bush scrub	34100		0.1	0.1					50.0	50.0					49.9	49.9		7	7
Mojave mixed scrub and steppe	34200		<0.1	<0.1					69.5	69.5		2.9	2.9		27.6	27.6		261	261
Mojave mixed woody scrub	34210					0.1	0.1		9.3	9.3		19.2	19.2		71.4	71.4		8	8
Blackbush scrub	34300		<0.1	<0.1					63.2	63.2		1.9	1.9		34.9	34.9		164	164
Great Basin mixed scrub	35100	0.1	13.3	2.7	18.8	22.0	19.5	20.8	14.0	19.5	39.1	48.6	41.0	21.1	2.2	17.4	243	60	303
Big sagebrush scrub	35210	2.2	14.1	11.2	5.0	1.5	2.3	59.8	43.3	47.2	29.3	13.0	16.9	3.8	28.1	22.4	43	140	183
Low sagebrush scrub[a]	35211	0.7	0.2	0.7	15.0	39.5	15.5	44.9		43.9	29.0	59.6	29.6	10.4	0.8	10.2	153	3	156
Silver sagebrush scrub[a]	35212				48.1		32.2	30.4	19.4	26.8	7.2	78.3	30.6	14.3	2.3	10.3	11	5	16
Subalpine sagebrush scrub	35220	10.3		10.3	11.0		11.0	21.5		21.5	20.8		20.8	36.4		36.4	25		25
Sagebrush steppe	35300	1.0	1.9	1.6	26.3	2.5	12.1	29.8	47.4	40.3	30.6	18.1	23.2	12.4	30.0	22.9	333	489	822
Rabbitbrush scrub	35400	0.9		0.9	3.6		3.6	23.6		23.6	65.0		65.0	7.0		7.0	46		46
Cercocarpus ledifolius woodland[a]	35500	0.5	42.5	18.6	4.0	40.8	19.9	35.1	7.9	23.4	54.8	7.7	34.5	5.6	1.1	3.7	143	109	252
Wyethia mollis[a]	35600	6.8		6.8	13.1		13.1	30.2		30.2	23.2		23.2	26.7		26.7	30		30
Chaparral																			
Upper Sonoran mixed chaparral	37100				44.1		44.1				16.6		16.6	39.3		39.3	6		6
Northern mixed chaparral	37110		15.1	13.8	1.7	11.6	10.8	0.9	23.3	21.4	15.4	25.9	25.0	82.0	24.0	28.9	15	161	176
Chamise chaparral	37200	0.1	10.4	5.8	0.8	2.7	1.9	3.4	24.1	14.9	14.4	34.9	25.8	81.3	27.9	51.6	364	456	820
Semidesert chaparral	37400		15.2	15.2		6.1	6.1		11.7	11.7		28.4	28.4		38.7	38.7		109	109
Mixed montane chaparral	37510	6.2	30.5	12.1	16.8	13.8	16.1	21.7	34.4	24.8	29.8	13.6	25.9	25.5	7.8	21.1	1,048	340	1,387
Montane manzanita chaparral	37520	0.1	9.0	4.9	9.2	7.6	8.4	8.5	20.4	14.9	16.7	37.3	27.6	65.5	25.6	44.3	214	243	457
Montane ceanothus chaparral	37530	1.2	8.2	1.5	6.0	14.8	6.4	20.6	13.3	20.3	46.0	48.7	46.1	26.2	15.0	25.8	187	8	195
Deer brush chaparral	37531							25.3		25.3				74.7		74.7	2		2
Shin oak brush	37541		23.4	23.4		4.9	4.9		7.4	7.4		4.0	4.0		60.3	60.3		42	42
Huckleberry oak chaparral	37542	<0.1	42.8	23.4	26.6	0.7	12.5	17.8	45.0	32.7	6.7	11.4	9.3	48.8	0.1	22.2	81	98	179
Bush chinquapin chaparral	37550	4.6	48.9	6.0	8.1		7.9	26.2	48.5	26.9	49.7	2.6	48.2	11.4		11.0	75	3	77
Buck brush chaparral	37810		1.2	1.1	0.9	17.7	15.3	15.9	50.4	45.6	14.9	16.0	15.9	68.3	14.7	22.1	21	133	155
Scrub oak chaparral	37900			0.0	39.8	3.9	6.4	36.6	4.0	6.2	18.8	16.7	16.8	4.9	75.4	70.6	3	45	48
Interior live oak chaparral	37A00		4.4	4.3		7.0	6.8	18.4	8.1	8.4	14.4	9.8	9.9	67.2	70.7	70.6	5	199	203
Upper Sonoran manzanita chaparral	37B00		5.2	4.9	1.5	4.9	4.7		25.6	24.3	27.3	49.0	47.8	71.2	15.2	18.2	9	154	163
Ione chaparral	37D00										3.8		3.8	96.2		96.2	1		1
Mesic north-slope chaparral	37E00		11.5	10.2	8.2	9.9	9.7	6.8	49.3	44.6	8.9	20.5	19.2	76.1	8.8	16.3	15	118	132
Upper Sonoran subshrub scrub	39000		3.9	3.9		2.7	2.7		28.0	28.0		15.4	15.4		50.0	50.0		42	42
Herbaceous																			
Valley needlegrass grassland	42110		64.7	12.7	<0.1	6.0	1.2	0.1	29.3	5.9	0.2		0.1	99.7		80.1	25	6	31
Non-native grassland	42200	<0.1	0.8	0.4	2.4	1.2	1.8	6.2	8.4	7.2	2.0	2.7	2.3	89.5	86.9	88.3	1,026	897	1,922
Montane meadow	45100		73.0	54.0	8.4	4.3	5.4	28.5	17.8	20.6	19.6	1.5	6.2	43.5	3.5	13.9	33	94	127
Wet subalpine or alpine meadow	45210	1.9	33.1	14.8	10.8	1.8	7.1	35.9	52.9	42.9	20.2	7.4	14.9	31.2	4.8	20.3	118	83	201
Dry subalpine or alpine meadow	45220		0.7	0.7		14.8	14.8		69.3	69.3		5.3	5.3		9.9	9.9		4	4
Great Basin montane meadow[a]	45230							0.5		0.5				99.5		99.5	1		1
Alkali meadow	45310		4.9	4.9					8.8	8.8		3.9	3.9		82.4	82.4		2	2
Transmontane alkali marsh	52320		3.9	1.4					17.3	6.3	0.6	0.4	0.5	99.4	78.4	91.7	11	6	17

[a]Addition to the standard Holland classification.

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		Class 1			Class 2			Class 3			Class 4			Class 5					
		North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total
Riparian Woodland																			
Great Valley cottonwood riparian forest	61410		19.8	9.6	1.2	0.8	1.0	0.3	31.9	15.6	1.1	0.5	0.8	97.4	46.9	73.0	10	10	20
Great Valley mixed riparian forest	61420								37.0	37.0		0.5	0.5		62.5	62.5		12	12
Great Valley valley oak riparian forest	61430								2.6	2.6		0.4	0.4		97.0	97.0		16	16
White alder riparian forest	61510		65.3	65.3					0.3	0.3		<0.1	<0.1		34.4	34.4		5	5
Aspen riparian forest	61520							85.0		85.0	15.0		15.0				0.1		0.1
Montane black cottonwood riparian forest	61530	0.7	100.0	56.7	0.6		0.3	1.4		0.6	5.9		2.6	91.3		39.9	2	3	6
Montane riparian scrub	63500	3.2	37.7	23.5	3.9	1.8	2.6	22.2	14.0	17.3	17.8	19.8	19.0	52.9	26.8	37.5	49	70	119
Broad-Leaved Woodland																			
Oregon oak woodland	71110					<0.1	<0.1	40.9	70.3	53.6	4.3	3.2	3.8	54.8	26.5	42.6	12	9	21
Black oak woodland	71120	<0.1	5.4	1.5	6.9	9.2	7.5	9.5	21.0	12.7	21.8	28.0	23.5	61.8	36.5	54.7	332	128	460
Valley oak woodland	71130					0.1	0.1	6.5	0.1	1.8	0.9	0.4	0.5	92.6	99.5	97.6	92	248	340
Blue oak woodland	71140		1.4	1.2		0.7	0.6	5.3	6.8	6.5	2.6	3.3	3.2	92.2	87.7	88.6	1,031	4,395	5,426
Interior live oak woodland	71150		1.4	1.0	0.1	7.1	5.1	6.4	17.8	14.6	4.4	9.8	8.3	89.1	63.9	71.0	364	935	1,299
Conifer Woodland																			
Open foothill pine woodland	71310		1.9	1.4	0.7	6.4	4.9	2.6	21.2	16.4	5.1	24.3	19.3	91.7	46.3	58.1	114	327	441
Nonserpentine foothill pine chaparral	71322		12.9	8.4	1.8	4.5	3.5	19.0	31.1	26.9	9.4	23.4	18.5	69.8	28.2	42.7	87	162	249
Foothill pine–oak woodland	71410	<0.1	0.7	0.4	0.2	2.0	1.2	5.4	15.6	11.2	3.3	6.8	5.2	91.2	74.9	82.0	1,293	1,682	2,975
Cismontane juniper woodland[a]	71500	6.6	34.9	31.4	3.4	0.6	1.0	75.4	62.3	63.9	14.5	2.1	3.6	0.1	0.2	0.2	20	135	155
Oak-piñon woodland[a]	71600		3.6	3.6		4.1	4.1		82.1	82.1		2.6	2.6		7.6	7.6		117	117
Northern juniper woodland	72110	2.4	17.6	5.8	5.0	4.6	4.9	46.1	12.6	38.7	42.7	64.7	47.5	3.8	0.6	3.1	142	40	182
Great Basin piñon-juniper woodland	72121		12.3	12.0		4.8	4.7	14.7	45.6	44.8	81.8	26.1	27.5	3.6	11.4	11.2	10	394	404
Great Basin piñon woodland	72122	0.4	2.6	2.3		0.9	0.8	2.1	50.6	43.8	82.6	24.5	32.7	14.9	21.4	20.5	122	741	863
Great Basin juniper woodland and scrub	72123				27.3		27.3	48.6		48.6	20.4		20.4	3.8		3.8	9		9
Mojavean juniper woodland and scrub	72220		1.3	1.3		0.5	0.5		4.4	4.4		26.8	26.8		66.9	66.9		63	63
Joshua tree woodland	73000								85.8	85.8		4.9	4.9		9.3	9.3		73	73
Broad-Leaved Forest																			
Canyon live oak forest	81320	5.4	22.8	17.9	22.4	9.6	13.2	23.5	33.0	30.3	15.1	14.1	14.4	33.7	20.6	24.3	258	658	916
Interior live oak forest	81330		3.2	1.8	0.9	3.7	2.4	4.3	22.3	14.4	5.4	6.0	5.7	89.5	64.9	75.7	676	870	1,545
Black oak forest	81340	2.3	12.2	6.5	17.8	9.8	14.4	22.2	25.2	23.5	23.9	32.3	27.4	33.9	20.5	28.2	624	463	1,087
Tan oak forest	81400				9.5		9.5	3.5		3.5	9.8		9.8	77.3		77.3	24		24
Aspen forest	81B00	1.9	27.4	18.0	13.3	23.3	19.6	30.6	25.3	27.3	44.1	20.8	29.4	10.2	3.3	5.8	37	63	99
Conifer Forest																			
Knobcone pine forest	83210		0.8	0.6	40.3	2.1	12.6	7.9	5.2	5.9	22.4	34.1	30.9	29.5	57.8	50.0	5	12	17
Southern interior cypress forest	83330		3.5	3.5		1.1	1.1		39.1	39.1		33.4	33.4		22.8	22.8		3	3
West-side ponderosa pine forest	84210	1.4	19.9	10.3	6.6	4.4	5.5	9.2	26.8	17.7	29.0	34.7	31.8	53.8	14.2	34.7	2,286	2,120	4,406
East-side ponderosa pine forest	84220	0.9		0.9	7.4	42.8	7.6	19.1	26.8	19.2	54.0	29.8	53.9	18.6	0.6	18.5	1,605	9	1,614
Sierran mixed conifer forest	84230	1.3	29.8	8.1	10.8	4.3	9.2	12.9	24.4	15.6	37.4	29.5	35.5	37.6	12.1	31.6	4,523	1,411	5,933
Sierran white fir forest	84240	0.5	28.9	7.7	16.0	5.1	13.2	17.8	15.1	17.1	38.5	40.5	39.0	27.2	10.3	22.9	403	138	540
Big tree forest	84250		51.6	51.6		2.6	2.6		24.4	24.4		16.7	16.7		4.7	4.7		71	71
Jeffrey pine forest	85100	2.7	34.0	16.9	10.5	5.6	8.3	33.8	27.0	30.7	40.6	28.1	34.9	12.4	5.3	9.2	1,073	888	1,961

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		Class 1			Class 2			Class 3			Class 4			Class 5					
		North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total	North	South	Total
Red fir–western white pine forest[a]	85120	12.4	52.4	28.8	10.7	3.2	7.6	48.1	33.7	42.2	17.9	10.4	14.8	10.9	0.3	6.5	942	653	1,594
Jeffrey pine–fir forest	85210	3.1	22.9	15.6	13.2	5.0	8.0	28.1	36.3	33.2	30.1	33.2	32.1	25.5	2.6	11.1	1,095	1,861	2,956
Red fir forest	85310	2.4	49.1	33.2	14.0	2.0	6.1	24.0	32.7	29.7	35.9	15.2	22.2	23.7	1.0	8.7	1,153	2,241	3,395
Lodgepole pine forest	86100	4.1	60.0	53.5	11.6	3.1	4.1	39.8	30.8	31.9	23.2	5.6	7.7	21.4	0.5	2.9	252	1,904	2,156
Whitebark pine–mountain hemlock forest	86210	20.8	72.0	61.7	5.7	1.9	2.6	61.5	19.8	28.1	8.6	6.4	6.8	3.5	0.1	0.7	76	303	378
Whitebark pine–lodgepole pine forest	86220	3.1	65.3	56.1	3.8	20.4	18.0	68.6	6.9	16.1	16.6	7.0	8.4	7.8	0.4	1.5	55	317	372
Foxtail pine forest	86300		92.6	92.6		1.0	1.0		5.2	5.2		0.1	0.1		1.1	1.1		238	238
Whitebark pine forest	86600	9.5	67.7	58.0	7.2	7.3	7.3	35.2	2.9	8.3	43.4	22.1	25.6	4.8		0.8	37	182	219
Limber pine forest	86700		5.4	5.4		16.9	16.9		77.6	77.6		0.1	0.1		<0.1	<0.1		21	21
Lower cismontane mixed conifer–oak forest[a]	87100	0.6	9.7	4.9	8.6	8.6	8.6	8.9	24.8	16.4	19.2	32.4	25.4	62.8	24.6	44.7	2,229	2,002	4,231
Upper cismontane mixed conifer–oak forest[a]	87200	18.0	20.6	20.1	8.6	6.0	6.6	16.0	33.4	29.7	50.1	16.5	23.6	7.4	23.4	20.0	55	205	261
Alpine Habitats																			
Sierra Nevada fell field	91120		27.7	27.5	0.7		<0.1	16.5	54.1	53.9	82.8	17.7	18.2		0.5	0.5	1	121	122
Alpine dwarf scrub	94000		89.5	89.5		7.1	7.1		3.1	3.1		0.2	0.2		0.2	0.2		394	394
Total Area																			
Vegetated lands																	25,381	31,198	56,580
Vegetated and unvegetated lands		2.1	25.7	15.4	10.1	4.1	6.7	16.8	24.9	21.4	25.7	15.6	20.0	45.3	29.8	36.5	27,483	35,619	63,102

[a]Addition to the standard Holland classification.