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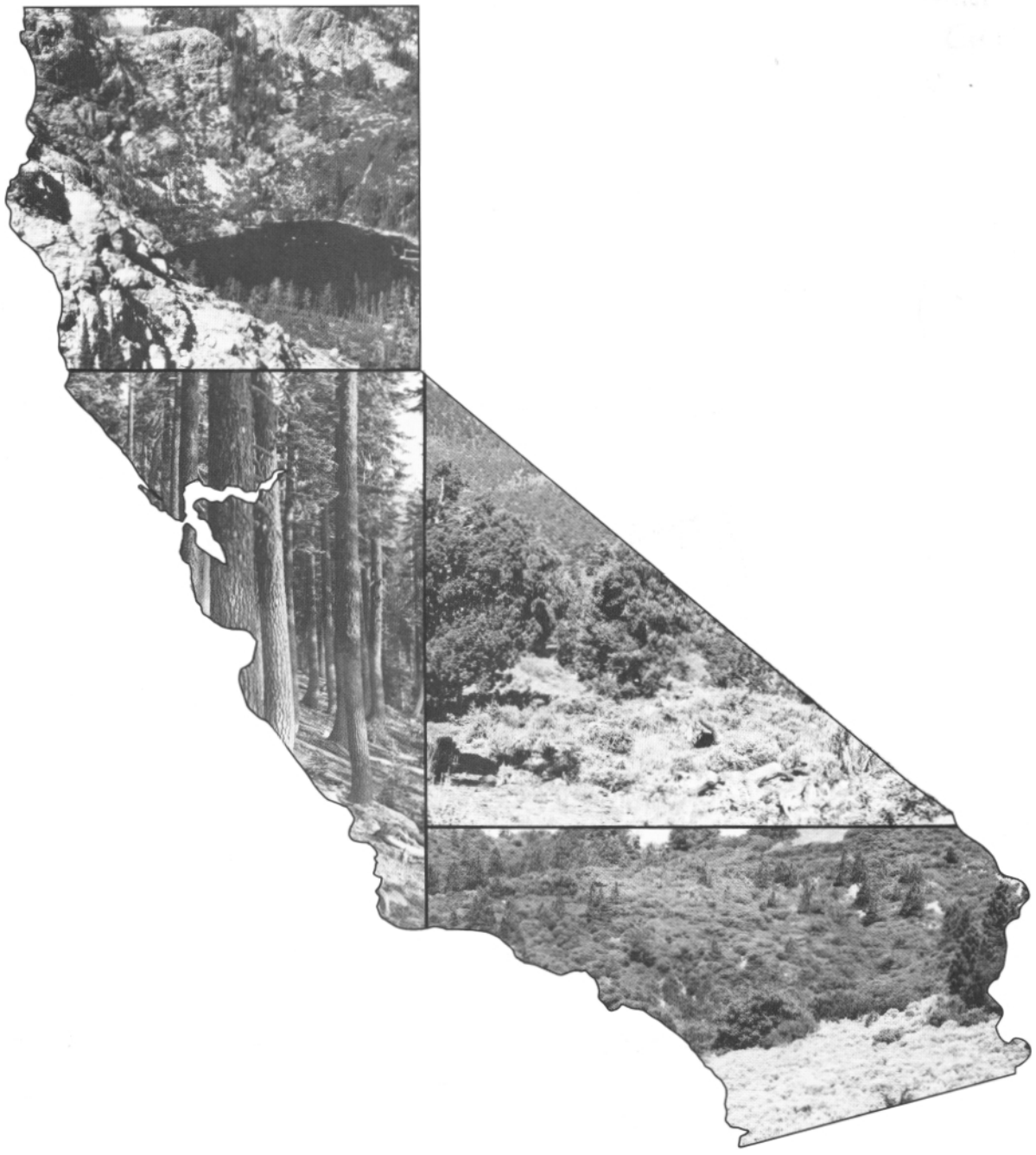
Ecological Surveys of Forest Service Research Natural Areas in California

Todd Keeler-Wolf



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This report summarizes each of 68 ecological surveys conducted from 1975 through 1988 on candidate and established Research Natural Areas in the Pacific Southwest Region of the USDA Forest Service. These surveys represent an important but largely unknown contribution to the ecological literature of California. For each summary, information on location, target elements, distinctive features, physical characteristics, association types, plant diversity, and conflicting impacts is provided. Comparisons are made between similar vegetation types at different sites. Tables and appendices summarize the plant communities, target elements, rare plants, and trees occurring on all areas. Maps of all areas and photographs of most areas are included.

Retrieval Terms: ecological surveys, Research Natural Areas, vegetation association, vegetation type mapping

The Author:

TODD KEELER-WOLF is a consulting ecologist, Oakland, California.

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Cover Photographs:
Top: Steep cirque headwalls above Cliff Lake, Cedar Basin RNA.
Left Center: Mature Shasta red fir forest, Antelope Creek Lakes RNA.
Right Center: Open pinyon-juniper woodland, Whippoorwill Flat RNA.
Bottom: Big sage scrub and Coulter pine-chaparral, Cahuilla Mountain RNA.

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Ecological Surveys Of Forest Service Research Natural Areas In California

Todd Keeler-Wolf

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INTRODUCTION

The lands managed by the Forest Service, U.S. Department of Agriculture, account for about one-fifth of the 158,693 square miles (41.1 million ha) in California *(fig. 1)*. Since 1975 the agency's Pacific Southwest Region 5 Research Natural Areas (RNA) Committee of the Forest Service has contracted for the preparation of over 70 ecological surveys of established or proposed RNAs on Forest Service land in the state. The committee is a joint effort of the Pacific Southwest Region (R-5) and the Pacific Southwest Forest and Range Experiment Station (PSW) (now Pacific Southwest Research Station), and the surveys have been jointly financed.

Produced by more than 30 plant ecologists and botanists outside the Forest Service, the surveys contain a wealth of information on a wide range of habitats, from the coast to the desert and from valley grassland to alpine fell-field. They provide detailed descriptions of many natural plant communities heretofore poorly described in ecological literature. Typically included in the surveys are vegetation sampling, successional relationships, detailed plant lists, growth rates of important components of the major communities, and maps of the vegetation. Collectively the surveys make up a significant body of ecological information on California's vegetation, particularly its forests and woodlands.

Little of this information is widely accessible, although it is generally of high quality and valuable for understanding the natural ecology of the state. Copies of the completed, unpublished surveys are filed in the Station library at Berkeley and the Forestry Library of the University of California, Berkeley, but few have been published or even alluded to in print (e.g. Keeler-Wolf 1988a, Sawyer and others 1977).

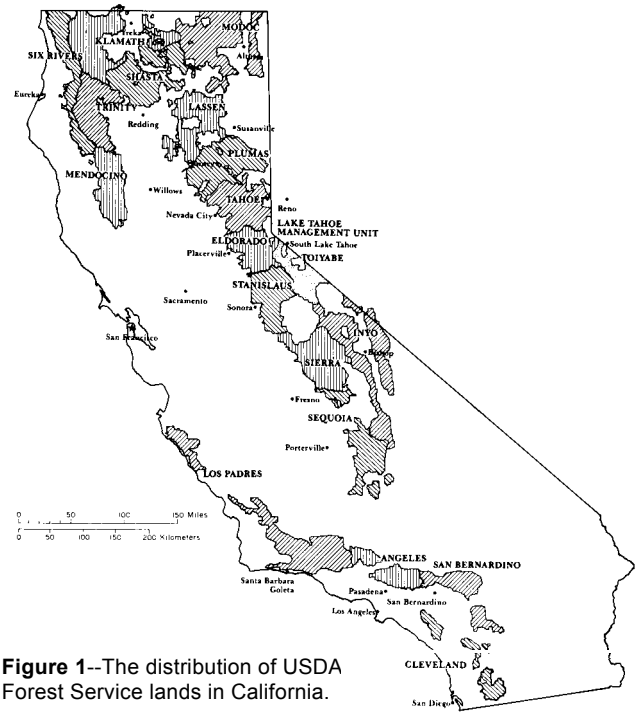


Figure 1--The distribution of USDA Forest Service lands in California.

This publication is intended to bring these reports and the data they contain to the attention of the scientific community and the general public. The original reports are much too long and too detailed to incorporate into a single publication, but this report summarizes the most significant information covered in the surveys. All ecological surveys completed before October 1988 are discussed.

Sixteen of the 68 surveys describe established RNAs *(table 1)*. These areas were formally set aside by the Chief of the USDA Forest Service and are managed to perpetuate examples of natural ecosystems for research and study, to preserve gene pools, and where appropriate, to protect the habitats of rare and endangered plants and animals. The oldest RNA in California is Indiana Summit, established in 1932 on the Inyo National Forest; the most recent are Moses Mountain on the Sequoia National Forest and Hall Canyon on the San Bernardino National Forest, both established in 1990.

The other 52 surveys cover areas selected as candidate RNAs since 1973. Most are still candidates and will eventually be formally established, but a few have been combined and others have been dropped because they duplicate more desirable candidates or were more appropriately classified in some other way (e.g., as Botanical Areas or Special Interest Areas).

Selection of RNAs

The selection of candidate RNAs is based on the identification of "target elements" on all the National Forests in R5. These target elements are most frequently plant communities from California described in various ecological reference works (e.g., Barbour and Major 1977, Eyre 1980, Kuchler 1966, Munz and Keck 1959). In addition, flexibility in selecting targets is allowed under the category of "other unique ecosystems," which are determined on a case-by-case basis by the RNA Committee.

Where possible, a representative RNA is selected for each of the target elements in each of the major physiographic provinces of the State. A list of the 61 target elements together with the physiographic regions and surveyed RNAs in which they occur is shown in *table 2*.

The California RNA system is being revised as this report goes to press. Target elements are being changed, and many new nonforest and aquatic types are being added. It is hoped that this revision will more accurately reflect the natural diversity of habitats on Forest Service lands in California and will lead to the identification, preservation, and study of examples of all types.

Most areas contain a far greater diversity of vegetation types than just the designated target elements. *Appendix 1* cross-references the occurrence of vegetation types on all 68 surveys

Table 1--Established Research Natural Areas in the California Region, USDA Forest Service

Name	National Forest	Establishment date	Ecological survey date	Target vegetation
Backbone Creek	Sierra	3/71	no survey	*Carpenteria californica* (endemic chaparral shrub)
Blacks Mountain	Lassen (Experimental Forest)	2/76	no survey	eastside ponderosa pine
Cahuilla Mountain	San Bernardino	7/89	1986	Coulter pine —California black oak
Cone Peak Gradient	Los Padres	7/87	1976,1977	coast live oak, canyon live oak, mixed evergreen, chaparral, redwood
Cub Creek	Lassen	10/81	1976	mixed conifer forest
Devil's Garden	Modoc	2/33	1984	western juniper
Fern Canyon	Angeles (Experimental Forest)	7/72	1979	chamise chaparral, canyon live oak
Frenzel Creek	Mendocino	1/71	1983	serpentine chaparral, Sargent cypress, McNab cypress
Hall Canyon	San Bernardino	3/90	1986	mixed conifer forest
Harvey Monroe Hall	Inyo	1/33	1984	subalpine forest, meadow, fell-field
Indiana Summit	Inyo	6/32	1982	Jeffrey pine
Last Chance Meadow	Inyo	7/82	1976	foxtail pine
Moses Mountain	Sequoia	2/90	1989	giant Sequoia
Mud Lake	Plumas	7/89	1985	Baker (Modoc) cypress
San Joaquin-Experimental Range	Sierra (Experimental Forest)	8/71	no survey	blue oak–Digger pine
Sentinel Meadow	Inyo	3/83	1978	lodgepole pine, limber pine
Shasta Mudflow	Shasta-Trinity	10/71	1984	Pacific ponderosa pine, successional mudflow
White Mountain	Inyo	11/53	1982	bristlecone pine
Yurok	Six Rivers (Experimental Forest)	5/76	1982	coast redwood

Table 2--Region 5 RNA target elements, arranged by physiographic province, represented in the 68 surveyed candidate or established areas[1]

Target	Physiographic provinces									
	Klamath	Cascade	Modoc	S Basin R	N Coast R	S Coast R	Sierra N	Sierra S	Transverse	Peninsular
Forest Elements: Aspen (SAF 217)[3]	—	—	—	30 ± [2],32	—	—	44, 45, 48, 49	53, 56, 60	—	—
California Black Oak (SAF 246)	8, 10 ±, 16±	24	—	34, 38	—	50,	52	54	—	64, 66
Canyon Live Oak (SAF 249)	2, 8, 13, 18	24	—	—	34, 35	42, 43	50	54, 55 ±, 58,	61, 62, 63	64, 65 ±, 66
Bristlecone Pine (SAF 209)	—	—	—	30, 31	—	—	—	—	—	—
Douglas-fir–Western Hemlock (SAF 230)	20	—	—	—	—	—	—	—	—	—
Interior Ponderosa Pine (SAF 237)	—	25		—	—	—	—	—	—	—
Jeffrey Pine (SAF 247)	7, 16, 19	—	—	29, 30	—	—	—	53	—	—
Knobcone Pine (SAF 248)	2, 7, 10, 13, 15	—	—	—	36, 37	—	—	—	—	—
Limber Pine (SAF 219)	—	—	—	30, 31, 32	—	—	—	59	—	—
Lodgepole Pine (SAF 218)	19 ±,	—	—	29, 30	—	—	45, 46, 47, 48	53, 56, 57, 59, 60	—	—
Sierra Nevada Mixed Conifer (SAF 243)	3, 14, 16, 19	23, 25, 27	—	—	35, 38	—	48, 51, 52	55,	61 ±, 63 ±	66
Douglas-fir–Tanoak–Pacific Madrone (SAF 234)	1, 2, 6, 10, 14, 17, 18, 20, 21	—	—	—	34 ±, 35 ±, 37 ±, 38 ±, 39 ±	42, 43	—	—	—	—
Mountain Hemlock (SAF 205)	3, 4, 19	22, 26	—	—	—	—	47 ±, 49 ±	57	—	—

Table 2 (continued)

Target	Physiographic provinces									
	Klamath	Cascade	Modoc	S Basin R	N Coast R	S Coast R	Sierra N	Sierra S	Transverse	Peninsular
Pacific Douglas-fir (SAF 229)	2, 6, 9, 10 ±, 12 ±, 13, 17, 18, 20, 21	23 ±	—	—	35 ±,39 ±	—	—	—	—	—
Pacific Ponderosa Pine (SAF 245)	—	—	—	—	—	—	50, 52	55	62	66
Ponderosa Pine–Douglas-fir (SAF 244)	8, 10 ±, 16±	23	—	—	34 ±, 35, 37 ±, 39	—	—	—	—	—
Port Orford–Cedar (SAF 231)	1, 3, 7, 15, 20	—	—	—	—	—	—	—	—	—
Red Fir (SAF 207)	3, 4, 5, 9, 12, 13, 15, 19	22, 23, 26, 27 ±	—	—	35 ±	—	44, 45, 46, 47, 48 ±, 49	53, 56, 60	—	—
Redwood (SAF 232)	—	—	—	—	41	42	—	—	—	—
Sugar Pine–White Fir	—	—	—		—	—	—	51	—	66
White Fir (SAF 211)	2, 5, 9, 10, 13, 19	23, 27	—	29	35, 38	—	44, 47, 48, 49, 51, 52 ±	53, 60	—	66
Woodland Elements: Black Cottonwood–Willow (SAF 222)	—	27 ±	—	—	—	—	—	53 ±	—	—
Blue Oak–Digger Pine(SAF 250)	10 ±	24	—	—	34 ±, 40 ±,	—	—	57,	—	—
Coast Live Oak (SAF 255)	—	—	—	—	—	42	—	—	62 ±	65, 67, 68
Engelmann Oak	—	—	—	—	—	—	—	—	—	67, 68
Foothill Woodland (K 26)	8, 10	24	—	—	34, 35, 37, 39 ±, 40	42	50	54, 55, 58	62, 63	64
Oregon White Oak (SAF 233)	8 ±, 10, 21 ±,	24	—	—	34 ±, 35 ±, 38, 39, 40	—	—	—	—	—
Pinyon–Juniper (SAF 239)	—	—	—	31	—	—	—	—	—	—

Table 2 (continued)

Target	Physiographic provinces									
	Klamath	Cascade	Modoc	S Basin R	N Coast R	S Coast R	Sierra N	Sierra S	Transverse	Peninsular
Western Juniper (SAF 238)	—	—	28	—	—	—	—	—	—	—
Scrub and Chaparral Elements:										
Chamise Chaparral (K-29)	—	—	—	—	36 ±, 37	42	—	58	62, 63	64, 65, 68
Coastal Sage (K 30)	—	—	—	—	—	42 ±	—	—	63	64, 67, 68
Coulter Pine–Chaparral	—	—	—	—	—	43 ±	—	—	63	64, 66, 67
Montane Chaparral (K 31)	2, 3, 5, 8, 9, 10, 12, 13, 15, 19	22, 23, 25, 26, 27	—	—	—	—	46, 47, 48, 49, 52	53, 60	63 ±	66 ±
Mountain Mahogany	4, 19	—	—	30, 31, 32	—	—	44	—	63 ±	—
Serpentine Chaparral	7 ±, 16	—	—	—	36	—	—	—	—	—
Grassland and Meadow Elements:										
Alpine Meadow	—	26 ±	—	32	—	—	—	57	—	—
Fescue–Oatgrass (K 40)	—	—	—	—	34 ±, 39 ±, 40 ±	42 ±	—	—	—	—
Montane Wet Meadow	3 ±, 5, 2, 19	22, 23, 26, 27	—	—	35	—	45, 46, 47, 48, 49	53, 56, 60	—	—
Subalpine Wet Meadow	19	22, 26	—	32	—	—	47 ±	57, 59	—	—
Marsh and Bog Elements:										
Darlingtonia Bog	3, 7, 11, 14	—	—	—	—	—	—	—	—	—
Moss Bog	19 ±	—	—	—	—	—	45, 46 ±, 47	—	—	—
Special Elements:										
Alpine Fell-Fields	11	26	—	31, 32	—	—	—	56	—	—

continues

Table 2 (continued):

Target	Physiographic provinces									
	Klamath	Cascade	Modoc	S Basin R	N Coast R	S Coast R	Sierra N	Sierra S	Transverse	Peninsular
Bigcone Douglas-fir	—	—	—	—	—	—	—	—	61, 62, 63	—
Brewer Spruce	5 ±, 9, 13, 15, 19	—	—	—	—	—	—	—	—	—
Cuyamaca Cypress	—	—	—	—	—	—	—	—	—	67
Enriched Conifer	3 ±, 15 ±, 19	—	—	—	—	—	—	—	—	—
Foxtail Pine	4, 11, 19	—	—	—	—	—	—	59	—	—
McNab Cypress	—	—	—	—	36	—	—	—	—	—
Modoc Cypress	—	—	—	—	—	—	48	—	—	—
Parry Pinyon	—	—	—	—	—	—	—	—	—	—
Piute Cypress	—	—	—	—	—	—	—	—	—	—
Santa Lucia Fir	—	—	—	—	—	42, 43	—	—	—	—
Sargent Cypress	—	—	—	—	36	—	—	—	—	—
Giant Sequoia	—	—	—	—	—	—	—	—	—	—
Tecate Cypress	—	—	—	—	—	—	—	—	—	65
Washoe Pine	—	—	—	—	—	—	44	—	—	—
Western White Pine	11	—	—	—	—	—	44	—	—	—
Giant Chinqapin	17	—	—	—	—	—	—	—	—	—
Limestone Ecosystem	8	—	—	—	—	—	—	—	—	—
Successional Mudflow	—	25	—	—	—	—	—	—	—	—

[1] Includes all target elements represented on each surveyed RNA.

[2] Numbers coincide with those of the surveyed RNAs as they are listed in this report. The ± symbol indicates partial representation of the target element, defined either by somewhat different characteristics than the description, or by small area.

[3] Indicates the SAF type (Eyre 1980) or Kuchler (1966) type, if applicable, used to describe each target element.

derived from the most recent detailed summary of terrestrial plant communities in California (Holland 1986).

The following are included in most RNA ecological surveys:

- General overview of topography, geology, soils, climate, and flora of the study area for descriptive purposes
- Vegetation map and narrative descriptions (size, general characteristics, successional relationships, and scientific/educational values) of the principal plant communities in the study area
- Notation on the occurrence of any endangered, threatened, sensitive, or rare plant or animal species in the study area
- Estimates of composition, density, basal area, and growth rate for representative stands of timber types

Many ecological surveys include more than the above, such as detailed sampling in nontimber vegetation types, and additional information on recommendations for protection and management, the ecological significance of real or potential human impact, boundary options based on ecological information, and other natural values (e.g., anthropological, paleontological). They also usually include a list of vascular plants identified during the field work. Depending on the expertise of the researcher, such additional information as detailed lists of vertebrates, bird censuses, or data on mammal trapping may be included.

Format of the Summaries

The summaries that follow are arranged by the physiographic provinces defined for California by the Region 5 Research Natural Area Program *(fig. 2)*. A 1:2,000,000 map showing the location of the surveyed RNAs within the province is shown at the beginning of each province chapter. Within each province the summaries are arranged alphabetically. For each summary the following information is provided:

- Location: including latitude and longitude, distance to nearest town or standard map location, sections and Township and Range, National Forest, USGS 7.5 minute topographic quadrangle coverage (if available, 15 minute quadrangle if not), and if a candidate, soon to be established (establishment record contracted for or completed, but not formally designated), or established RNA. Immediately following, there is a 1 inch = 2 miles scale map of each area (excepting areas 42 and 43, which are shown on the same map). These maps indicate the RNA study area for candidates and previously dropped candidates, and the established boundaries for RNAs with written establishment records. The maps are based on the most recent Forest Service administrative maps and show Forest Service ownership in gray shading with private inholdings unshaded. The RNA or study area is shown by stippling or vertical hatching (see map captions for further information).
- Target Elements Represented: based on the table of target elements for R5 in the Forest Service Manual (see *table 2)*
- Distinctive Features: including all important ecological features distinguishing each area. These may include features of the plants or plant communities represented, and also paleontological, geological, archaeological, or zoological distinctions. If extensive information regarding a community type or other feature of the area has been amassed (e.g., vegetation structure, growth rates, successional history) as a result of the survey or other previous study, it is discussed here.
- Physical Characteristics: acreage, elevational range, brief topographical description with principal rock types, soils, and climatic summary
- Association Types: brief descriptions of all plant associations represented with important species listed, Holland (1986) community equivalents, areal extent, data on density, basal area cover, seedling and sapling densities, and sizes of dominant species, if available
- Plant Diversity: based on numbers of taxa (specific and infraspecific) listed from area, includes only vascular plants unless otherwise noted
- Conflicting Impacts: includes real or potential human impact which may need consideration in research plans or management of the area in a natural state

Figure 2--The physiographic provinces of mainland California defined by the USDA Forest Service: 1. Klamath Mountains, 2. Cascade Range, 3. Modoc Plateau, 4a. Northern Basin Ranges, 4b. Southern Basin Ranges , 5a. North Coast Ranges, 5b. South Coast Ranges, 6. Central Valley, 7a. Northern Sierra Nevada, 7b. Southern Sierra Nevada, 8. Transverse Ranges, 9. Mojave Desert, 10. Peninsular Ranges, 11. Colorado Desert.

Standards and Conventions

- Measurements under all summary headings are given in English (and metric) except for vegetation sampling data, which are given in metric only, to avoid profusion of numbers and parentheses. Units of density and cover data have all been converted to "per hectare" to facilitate comparisons.
- All association types are listed in order of decreasing size, except those that do not have areal measurements given. In those

cases they are listed in the order they are given in the original survey.

• All association types are listed with their Holland (1986) community type equivalent. A table of Holland types and their representation on the surveyed areas is presented as *appendix 1*. Society of American Foresters (SAF, Eyre 1980) and Kuchler (1966) types are not specifically listed, as these are not usually as precise as the Holland types. The target elements that are named for these classifications are listed in the table of target elements for California *(table 2)*.

• Rare plants: Rare plants known from an area are always listed under the distinctive features section. Citations of"CNPS" refer to the most recent California Native Plant Society Inventory of Rare and Endangered Vascular Plants (Smith and Berg 1988). The rare plants of a given area are mentioned with reference to the particular list on which they are placed by Smith and Berg: either List 1a (plants presumed extinct); List 1b (plants of highest priority and plants rare and endangered in California and elsewhere); List 2 (plants rare or endangered in California, but more common elsewhere); List 3 (plants about which we need more information); or List 4 (plants of limited distribution; a watch list). A complete list of CNPS plants occurring on the surveyed areas is given in *appendix 2*.

• Plant names: All species names are in accordance with Munz (1968, 1974). In some cases the authors of individual surveys have used other authorities. When nomenclature varies from Munz, the Munz synonym has been added in parentheses. Both common (and scientific) names are given for trees (considered as such by Griffin and Critchfield 1976) the first time they are mentioned in each summary. Subsequently, they are referred to by their common name. A list of scientific names of trees and the areas on which they occur is provided in *appendix 3*. All other names of shrubs, herbs, grasses, etc., are scientific. This decision was made to shorten the summaries and also because most popular books on wildflowers and shrubs that may be used as references by the interested layperson list common and scientific names in their indices.

Editorial Policy

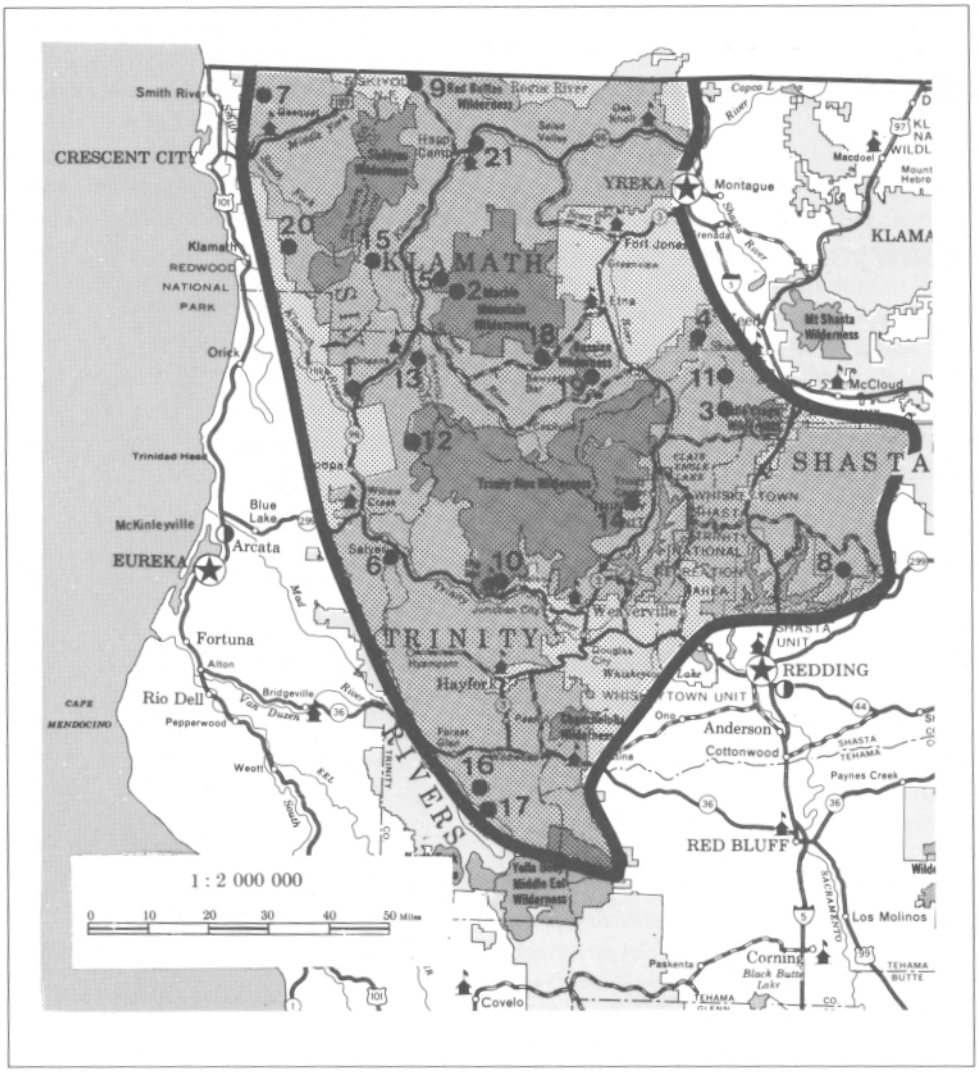
In condensing the information for these summaries I have, for the sake of consistency, occasionally drawn conclusions not explicitly stated by the authors. These involve the equating of various vegetation types for *appendix 1*, the discussion of certain real or potential impacts, and certain distinctive features of the areas. In general, however, I have left the statements of the authors as they are. If basic information is unavailable in the survey report (e.g., rock types, climate, or other physical characteristics), I have drawn from published references and cited them in the summary.

Literature citations are few. The principal references (ecological survey and other important work specific to the RNA) are cited at the beginning of the summary, next to the area's name. Typically, I cite additional references in the text only when substantiating the distinctiveness of a particular feature of an area. Other references may be found in the original surveys. In addition to the information available in the ecological surveys, some areas have recently been reanalyzed as a result of the final process of RNA establishment. These establishment records consider management implications, and may have redefined certain vegetation types, or added to the plant list based on more recent field work. Establishment records are on file at PSW Berkeley and also at the Forest Supervisor's Office on each particular National Forest.

No attempt has been made to standardize the format by which plant communities or associations have been defined or described in these surveys. Usually, the survey authors have named communities on the basis of local characteristics at the study site and then compared these with more general published accounts elsewhere. The principal divisions in the description of vegetation in the summaries are generally referred to as associations with subcategories referred to as subtypes, phases, or unions. The words "vegetation type" (or simply, "type") and "association" are synonymous in this report. Estimates of tree density and basal area cover may vary as a result of sampling conventions. For example, some authors (e.g., Sawyer, Thornburgh) do not count trees below 4 cm dbh, whereas Keeler-Wolf counts trees down to 1.5 cm dbh.

Use of RNAs

The USDA Forest Service welcomes research and educational use of RNAs from interested parties within and outside of the Forest Service. Use of an RNA or candidate RNA requires permission from the District Ranger on the Forest in which the RNA is located, and notification (with justifications) of the Director, Pacific Southwest Research Station, P.O. Box 245, Berkeley, CA 94701.



I. THE KLAMATH MOUNTAINS PROVINCE

1) Adorni
2) Bridge Creek
3) Cedar Basin
4) Crater Creek
5) Haypress Meadows
6) Hennessy Ridge
7) L.E. Horton
8) Hosselkus Limestone
9) Indian Creek Brewer Spruce
10) Manzanita Creek
11) Mount Eddy
12) North Trinity Mountain
13) Pearch Creek
14) Preacher Meadow
15) Rock Creek Butte
16) Smoky Creek
17) South Fork Mountain
18) Specimen Creek
19) Sugar Creek
20) Upper Goose Creek
21) Williams Point

THE KLAMATH MOUNTAINS PROVINCE

1. ADORNI (Sawyer 1981a)

Location

This soon-to-be-established RNA is on the Six Rivers National Forest. It lies ca. 3 miles (5 km) N. of Weitchpec, covering portions of sects. 25 and 26 Tl0N, R4E HBM (41°13' N., 123° 41'W.), USGS Weitchpec quad *(fig. 3).*

Target Element

Port Orford-cedar *(Chamaecyparis lawsoniana)*

Distinctive Features

Port Orford-cedar (POC): This species is restricted to the Klamath Mountains and the adjacent southern Oregon Coast Ranges. Throughout much of its range it is threatened by root rot disease *(Phytophthora lateralis),* and suitable areas for protection are needed. The area is representative of the low elevation, mesic portion of the western Klamath Mountains. In comparison with Upper Goose Creek (# 20), it is less mesic, and such species as *Rhododendron macrophyllum,* western hemlock *(Tsuga heterophylla),* and giant chinquapin *(Chrysolepis chrysophylla)* are rare or absent. POC is more widespread in the forest away from drainage bottoms than at Upper Goose Creek. In comparison to Cedar Basin, L.E. Horton, and Rock Creek Butte (# 3, 7, 15), Adorni is a warmer, less montane environment largely without ultramafic substrate, where POC is less restricted to streamcourses.

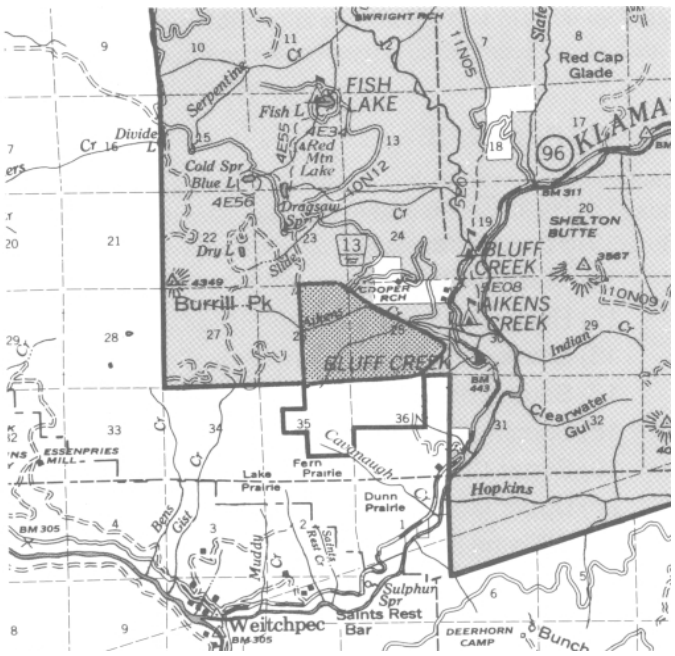


Figure 3--The Adorni RNA.

Rare Plants: *Erythronium citrinum* and *Lilium rubescens* are members of CNPS List 4.

Large Tanoak *(Lithocarpus densiflorus):* A small area in the SW part of the site has several exceptionally large specimens of tanoak. The largest individuals reach 4 ft (1.2 m) dbh and heights of 170 ft (52 m).

Physical Characteristics

The area covers 600 acres (243 ha) and is drained by Aikens Creek, a tributary of the Klamath River. Topography is steep (30-70 percent slopes) with few terraces and typically abrupt ridges, particularly in the lower eastern portion. Active slumping occurs along both of the major streams. Elevations range from 900 to 2900 ft (274-884 m).

The area is underlain by phyllites, schists, and outcroppings of sheared black slate; all part of the Upper Galice Formation. There are also small outcroppings of Josephine Peridotite (serpentinite). Soils are primarily of the Sheetiron series with ca. 20 percent of Hugo series. Precipitation is estimated as 70 inches/year (1778 mm/year), concentrated between November and March. Snow falls commonly during this period, but does not accumulate. High temperatures in the 80's and 90's °F (ca. 27-32 °C) are expected in the summer, whereas winter average lows are in the low 30's °F (ca. 0 °C).

Association Types

Thirty releves are compiled to form association tables, which suggest that two types of forest occur in the area. Sizes of associations are not indicated.

Douglas-fir/*Goodyera oblongifolia* (81100): This association is typical of the two-storied Douglas-fir-hardwood forest of the Klamath Province *(fig. 4).* A canopy of Douglas-fir (138 trees/ha) and Port Orford-cedar (109 trees/ha) overlies a subcanopy of tanoak (198 trees/ha), Pacific madrone *(Arbutus menziesii,* 40 trees/ha), and California bay *(Umbellularia californica,* 10 trees/ha). Total basal area for this forest averages 149 m^2/ha with Douglas-fir comprising 52 percent; Port Orford-cedar, 25 percent; and Pacific madrone, 15 percent of the cover. All trees are reproducing in these uneven-aged stands. The dense understory is dominated by *Vaccinium ovatum* and patches of *Gaultheria shallon.* Herbs include *Goodyera oblongifolia, Trillium ovatum, Oxalis oregana, Clintonia unifora,* and *Hierochloe occidentalis.* In all, 22 species of shrubs and 22 species of herbs are noted in the releves.

The Douglas-fir/*Goodyera oblongifolia* forest has deeper and less rocky soils with steeper and more unstable slopes than the tanoak/*Rhamnus* type. One active slump (Holland 6510) is being colonized by white alder *(Alnus rhombifolia),* tanoak, Douglas-fir, and Port Orford-cedar. Much of the Douglas-fir/*Goodyera* forest in the sample was selectively logged in 1965. This disturbed area shows a heterogeneous mix of species depending on the degree of disturbance. *Ceanothus velutinus* and white alder are common with dense *Vaccinium ovatum,* and Douglas-fir, Pacific madrone, and tanoak reproduction.

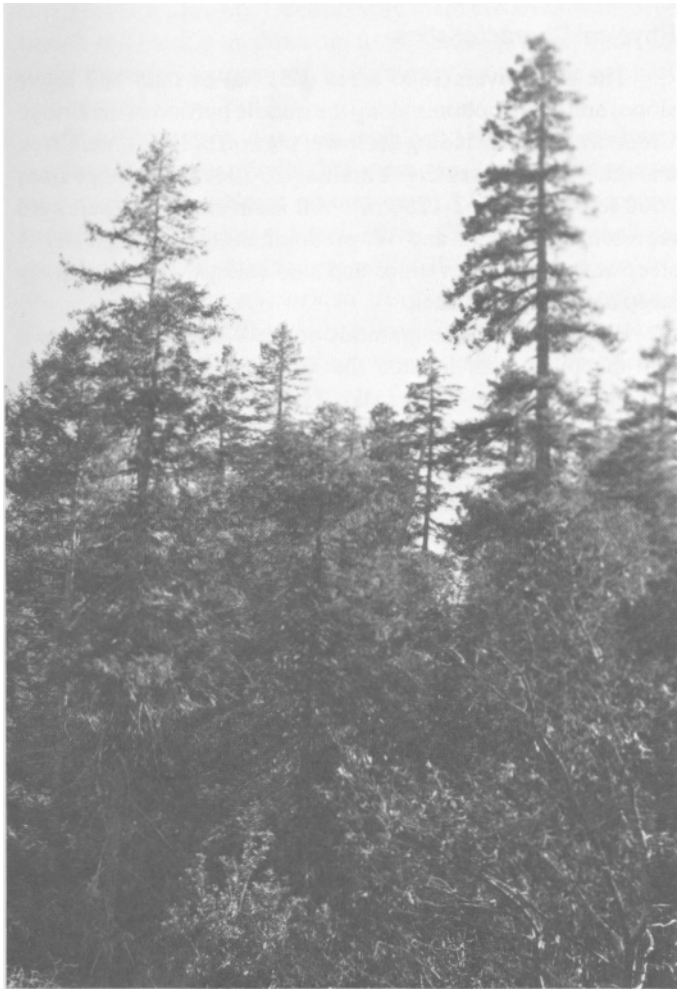


Figure 4--Adorni: Mid-level view of old-growth forest with Douglas-fir, tanoak, and Pacific madrone (berries in foreground), Port Orford-cedar to left.

Tanoak/*Rhamnus californica* (81400): This is a more open forest, differing primarily in structure from the previous type. Trees have higher average density (674/ha), but lower average basal area (65 m^2/ha). Tanoak has the highest relative densities (35 percent) followed in order by Pacific madrone (22 percent), Douglas-fir (18 percent), sugar pine *(Pinus lambertiana)* (12 percent), Port Orford-cedar (5 percent), and incense-cedar *(Calocedrus decurrens)* (5 percent). Douglas-fir has the highest relative cover (37 percent) followed by sugar pine (24 percent), tanoak (12 percent), madrone (12 percent), Port Orford-cedar (10 percent), incense-cedar (4 percent), and canyon live oak *(Quercus chrysolepis)* (2 percent). This forest is less productive than the previous type because it contains slower growing Port Orford-cedar. The understory is more xeric than the other forest with *Rhamnus californica, Arctostaphylos manzanita, Toxicodendron diversilobum,* and *Xerophyllum tenax* common (11 shrub and 18 herb species encountered on releves).

Both forest types appear to be climax with compositional and structural differences related to soil depth, slope steepness, and aspect.

Plant Diversity

One hundred thirty-one taxa of vascular plants are listed.

Conflicting Impacts

Road building associated with clear-cutting upstream from the area threatens the Port Orford-cedar through potential root rot invasion, but the disease was not present in the area as of 1988. A portion of the western third of the area was logged in the 1960's; however, the operation was selective enough so that large continuous areas were not affected.

2. BRIDGE CREEK (Keeler-Wolf 1985a, 1989a)

Location

This soon-to-be-established RNA is on the Klamath National Forest, Siskiyou County, approximately 10 miles (16 km) NE. of Somes Bar. It occupies portions of sects. 23, 26, 27, 28, 34, and 35 T13N, R7E HBM (41°30'N., 123°21' W.), USGS Medicine Mtn., Orleans Mtn., and Forks of Salmon quads. It lies entirely within the Marble Mountain Wilderness Area *(fig. 5)*.

Target Element

Pacific Douglas-fir *(Pseudotsuga menziesii)*.

Distinctive Features

Old-Growth Douglas-fir Forest: The majority of Douglas-fir/hardwood forest at Bridge Creek has not been burned for more than 150 years. Thus, the forest has a distinctly multilayered structure. Tall (up to 220 ft, 67 m) canopy trees overlie a subcanopy of hardwoods and young conifers up to 120 ft tall (37

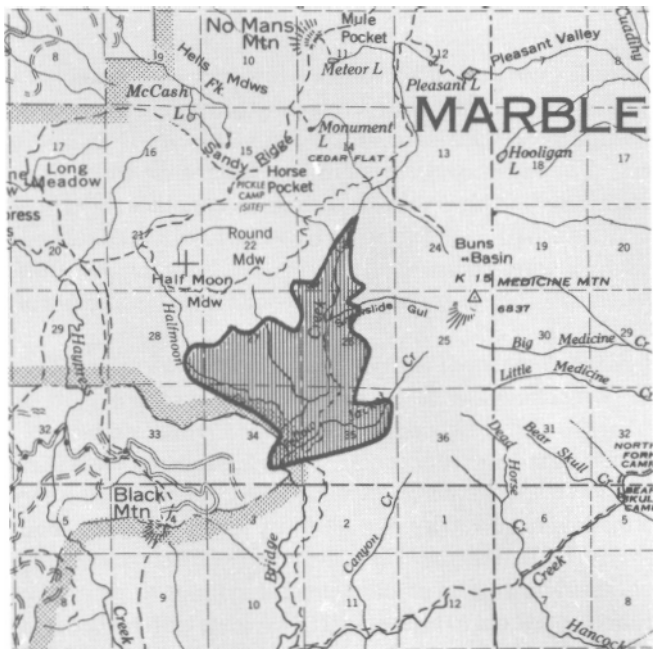


Figure 5--The Bridge Creek RNA.

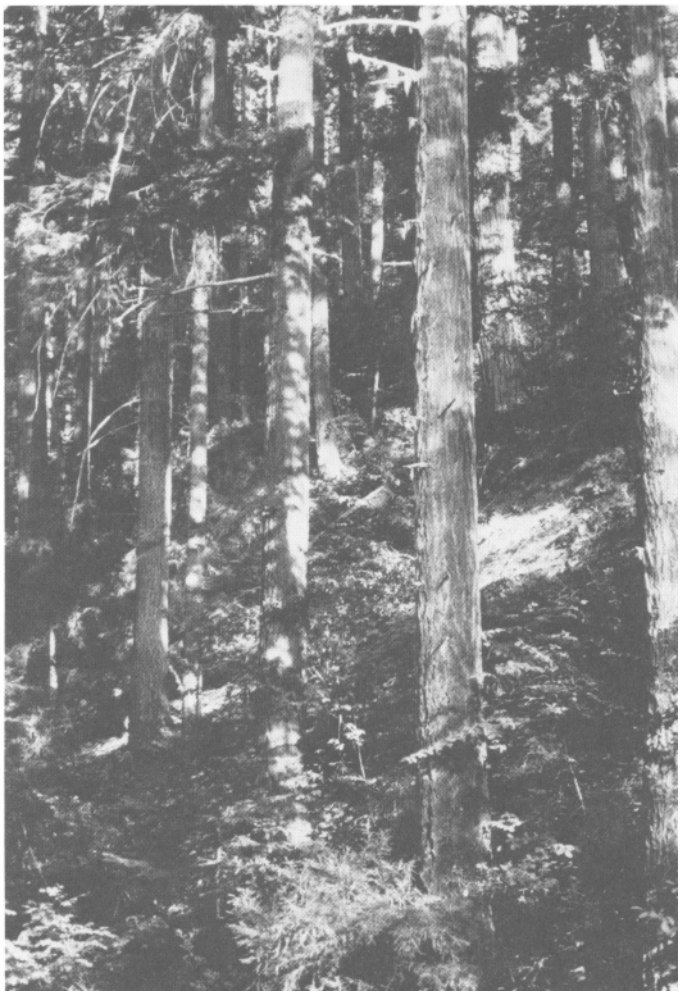


Figure 6--Bridge Creek: Old-growth Douglas-fir towering over understory of Pacific dogwood, Pacific yew, and giant chinquapin.

m), which overlies well-developed low tree, shrub, and herb strata *(fig. 6).* These mature multilayered forests are uncommon in California and demonstrate the climax type of Douglas-fir forest. Young Douglas-fir is growing faster than white fir at mid-elevation and thus should continue to reproduce and dominate without the threat of takeover by white fir *(Abies concolor).*

Rare Plants: *Rubus nivalis*, a rare understory component of the upper elevation Douglas-fir/hardwood forest, is a member of CNPS List 2.

Giant Chinquapin *(Chrysolepis chrysophylla)* Reproduction: Giant chinquapin is the major hardwood subdominant in the Douglas-fir/hardwood forest of Bridge Creek. Compared to very mesic coastal sites and more xeric inland sites, this area has the highest rate of sexual reproduction for giant chinquapin and also the highest diversity of understory species (Keeler-Wolf 1988a). The first distinction is the result of mesic understory conditions allowing giant chinquapin seedlings to germinate and survive, but not to be so moist as to create extremely dense shrub understories, which shade out giant chinquapin seedlings.

Physical Characteristics

The area covers 1806 acres (731 ha) of mid- and lower slopes and creek bottoms along the middle portion of the Bridge Creek drainage, including the lower portion of Halfmoon Creek and the Yellowjacket Creek drainages. Elevations range from 2500 to 4200 ft (762-1280 m). All main slope exposures are represented, with E. and W. predominating. Topography is steep at the upper elevations and side valleys, and moderately steep along Bridge Creek.

Rocks are Jurassic granitics of the Wolley Creek Pluton. Soil-mapping units include the Gilligan-Goldridge families association, Gilligan-Chawanakee families association, and Entic Xerumbrepts-Gerle family association. Average annual precipitation is estimated between 65 and 70 inches (1651-1778 mm) with much falling as snow above 4000 ft (1219 m). Maritime fog occasionally enters the lower valleys during summer. Mean annual temperature is estimated to be about 55 °F (12.7 °C) at the lowest elevations.

Association Types

Twenty-nine 100 m^2 plots are sampled in the Douglas-fir/hardwood forest. For additional sampling in this area, see Keeler-Wolf (1988a).

Douglas-fir/Hardwood Forest (82420): 1400 acres (567 ha). On E.-facing plots, Douglas-fir dominates (basal area) on 14 of 20 plots, and white fir dominates six. On W.-facing plots, Douglas-fir dominates eight of nine plots and giant chinquapin dominates one. Importance values (rel. density + rel. frequency + rel. basal area X 100) for all plots are: Douglas-fir 114, giant chinquapin 55, white f r 73, tanoak *(Lithocarpus densiflorus)* 8, sugarpine *(Pinus lambertiana)* 6, Pacific yew *(Taxus brevifolia)* 7, Pacific madrone *(Arbutus menziesii) 4,* Pacific dogwood *(Cornus nuttallii)* 15, *Acer circinatum* 13, incense-cedar *(Calocedrus decurrens) 3,* canyon live oak *(Quercus chrysolepis)* 1, big-leaf maple *(Acer macrophyllum)*1, and *Salix scouleriana* 1. Total basal area cover is 163 m^2/ha, and total stem density for trees is 1750/ha. Douglas-fir seedlings have highest importance values (rel. density + rel. frequency X 100), whereas, among saplings, white fir has the highest values. Giant chinquapin follows white fir and Douglas-fir in sapling importance, but giant chinquapin seedlings are rare.

Sixteen species of shrubs and 36 species of herbs are noted in the sample. These species form a relatively dense ground cover averaging ca. 65 percent. The most important species include *Berberis nervosa, Quercus sadleriana, Rosa gymnocarpa, Rubus ursinus, Chimaphila umbellata, Goodyera oblongifolia, Achlys triphylla,* and *Linnaea borealis.*

Mixed Evergreen Forest (81100, 81320, 81400): 246 acres (100 ha). This association has a higher density of broad-leafed sclerophyllous evergreens than conifers. Typically, there is an overstory of Douglas-fir with less than 50 percent cover and a closed canopy of tanoak, Pacific madrone, and canyon live oak. On most sites tanoak is dominant. Most mixed evergreen forest in the area is on relatively xeric exposures (S. and W.) and is characterized by numerous stems of 8-12 inches (20-31 cm) dbh tanoak with scattered clumps of Pacific madrone and scattered

emergent Douglas-fir. Occasionally there are areas with large tanoak and Pacific madrone up to 36 inches (91 cm) dbh. On steep upper xeric exposures, low shrubby canyon live oak may dominate (Holland 81320).

The understory is poorly developed on xeric exposures dominated by sclerophylls, but more mesic lower-slope sites may average 25 percent ground cover. Understory species include *Toxicodendron diversilobum, Chimaphila umbellata, Pyrola picta, Symphoricarpos mollis, Whipplea modesta, Iris* sp., *Rosa gymnocarpa, Arnica discoidea, Vicia americana, Pteridium aquilinum, Goodyera oblongifolia, Disporum hookeri, Bromus marginatus,* and *Polystichum munitum* var. *imbricans.*

White fir/Douglas-fir Forest (84240): 133 acres (54 ha). This is a transitional forest between upper elevation white fir- and lower elevation Douglas-fir-dominated forests. It occurs along the upper elevation boundary on northerly-facing exposures. Douglas-fir usually dominates the canopy, with white fir strongly dominating the understory. Average canopy height is ca. 150 ft (46 m) with emergent Douglas-fir to 180 ft (55 m). As a result of heavy snows and shade, the shrub and herb layers are poorly developed, averaging 10-25 percent. Shrub species include *Corylus cornuta, Rubus parviflorus, Quercus sadleriana, Rosa gymnocarpa,* and *Paxistima myrsinites.* Herbs include *Apocynum pumilum, Anemone quinquefolia, Vancouveria hexandra, Achlys triphylla, Chimaphila umbellata, Smilacina racemosa* var. *amplexicaulis, Trillium ovatum, Penstemon anguineus, Trientalis latifolia,* and *Pyrola pieta.*

Knobcone Pine *(Pinus attenuata)* Forest (83210): 29 acres (12 ha). Small areas of this vegetation occur in xeric upper slope localities, which may have incurred recent fires. Montane chaparral species form the understory and include *Quercus vaccinifolia, Arctostaphylos patula, Ceanothus velutinus,* and *Garrya fremontii.*

Riparian Zone (61510, 63500): No acreage given. The steep gradient of all of the streams and frequent high runoff conditions tend to restrict riparian growth. However, sporadic clumps of riparian species occur along all of the major streamcourses. Typical species adjacent to permanent water are *Alnus sinuata, Peltiphyllum peltatum, Salix sp.,* and *Carex nudata.* In seasonally inundated alluvium away from the main streambeds, such species as big-leaf maple *(Acer glabrum* var. *torreyi),* white alder *(Alnus rhombifolia), Salix scouleriana, Petasites palmata, Aruncus vulgaris, Stachys rigida, Actaea rubra* ssp. *arguta, Penstemon deustus, Rubus leucodermis, Ribes sanguineum,* and *Castilleja miniata* occur.

Spring, Seep and Rivulet (45400): No acreage given. Numerous small springs and other moist spots occur which vary in their degree of shadiness and moisture. The following species are typical: *Euonymus occidentalis, Cornus stolonifera, Rhododendron occidentale, Sorbus cascadensis, Equisetum hymale* var. *robustum, Thelypteris oregana, Glyceria elata, Juncus effusus* var. *gracilis, Juncus xiphoides, Lotus oblongifolius* var. *nevadensis, Agrostis exarata, A. alba, Epilobium glaberrimum, E. angustifolium, Aralia californica, Carex nervina, Tellima grandiflora, Boykinia elata, Adiantum pedatum,* and *Aquilegia formosa.*

Plant Diversity

One hundred forty taxa are listed.

Conflicting Impacts

The area is relatively free of human alteration. A little-used trail passes through the area. The low elevation and steep slopes tend to discourage recreational use, despite its wilderness area status. Access to the area is somewhat difficult and time consuming, requiring a 4.5-mile (7.2-km), 3-hour walk to the central portion of the RNA.

3. CEDAR BASIN (Keeler-Wolf 1982, 1989b)

Location

This soon-to-be-established RNA is on the Shasta-Trinity National Forest. It is about 12 miles (19 km) SE. of the town of Mt. Shasta. The area falls partly within sects. 30 and 31 T39N, R5W and sects. 25 and 36 T39N, R6W MDBM (41°12'N., 122°27'W.) USGS Seven Lakes Basin and Mumbo Basin quads *(fig. 7).*

Target Element

Port Orford-cedar *(Chamaecyparis lawsoniana)*

Distinctive Features

Port Orford-cedar: The stands of Port Orford-cedar at this site are the highest elevation ones known (up to 6400 ft, 1950 m). These make up part of the inland distribution of the species concentrated along the headwaters of the Trinity and Sacramento rivers. This inland distribution is geographically separate

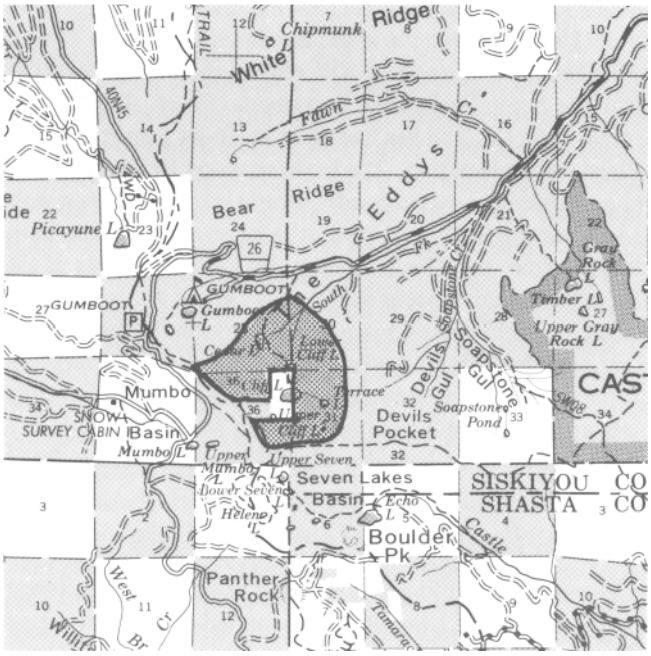


Figure 7--The Cedar Basin RNA.

from the more coastal stands of NW. California and SW. Oregon which have suffered varying degrees of infection from the introduced and lethal root rot *Phytophthora lateralis.* This inland population may be genetically distinct from the coastal populations. The RNA encompasses an entire basin and thus affords good protection from the water-borne fungus. A variety of vegetation types are associated with Port Orford-cedar (POC) in this area including Shasta red fir *(Abies magnifica* var. *shastensis),* lodgepole pine *(Pinus contorta* ssp. *murrayana),* mixed conifer, and mountain hemlock *(Tsuga mertensiana)* forests.

Rare Plants: A new species of manzanita *(Arctostaphylos klamathensis)* was discovered and named from Cedar Basin as a result of field studies for this ecological survey (Edwards and others 1983). This species is a member of CNPS List 1b and is considered by the Shasta-Trinity National Forests as sensitive. Additional rare species *include Polystichum lonchitis* (CNPS List 3), *Darlingtonia californica* (CNPS List *4), Lilium washiingtonianum* var. *purpurascens* (CNPS List 4), and *Carexgigas* (CNPS List 4). There is also a distinctive population of *Penstemon rupicola* with purple-blue flowers (flowers are typically rose red), which may be an undescribed taxon.

Zoological Values: A number of uncommon vertebrate predators are known in the RNA. These include spotted owl *(Strix occidentalis),* pine martin *(Martes americana),* mountain lion *(Felis concolor),* fisher *(Martes pennanti),* and wolverine *(Gulo gulo).*

Paleoenvironment: A pollen core sample has been taken from Cedar Lake in the RNA and represents a continuous record of over 10,000 years (West 1986). Analysis has shown a shift from cool-moist through warm-dry, and back to cool-moist periods over the record.

Physical Characteristics

This RNA covers 972 acres (394 ha). Elevations range from 5420 ft (1652 m) along the upper Sacramento River to 7149 ft (2179 m) atop the ridge on the SW. edge of the area. It lies at the head of the South Fork of the Sacramento River. The basin is oriented to the NE. and has had all of its major features shaped by Pleistocene glaciation. The basin contains 10 permanent or semi-permanent lakes and ponds, several lateral moraines, polished gabbro bedrock, and peridotite morainal deposits (both rock types from the Trinity Ultramafic Pluton). Soils of six major mapping units occur in the area. These are Jumpe-Zeb families, Endlich-Typic Cryaquolls, Crags family-rubbleland-Nanny complex, Toadlake-Hungary families, basic intrusive rock outcrop, and Inville-Jayar complex. Precipitation falls mostly as snow from November through March with a yearly average estimated at between 60 and 80 inches (1524-2032 mm).

Association Types

Vegetation sampling is conducted in several of the forest associations. Ten 0.1-ha plots are sampled in relatively open coniferous vegetation including five on serpentinite mixed conifer and five in red fir-mountain hemlock forest. Five additional 100-m^2 plots are sampled in Port Orford-cedar forest. The remaining associations are described qualitatively.

Mixed Conifer Forest (84180, 85420): 392 acres (159 ha). Two subtypes occur in this area: an open xeric subtype growing on SE.-facing serpentinite glacial moraine, and a more mesic subtype growing on gabbro at the lower elevations of the basin. The serpentinite subtype is sampled, and results indicate basal areas ranging from 23.9 to 69.6 m^2/ha, and tree densities of from 180 to 971 per hectare. Dominance is traded between Jeffrey pine *(Pinus jeffreyi)* on driest exposures, to white fir *(Abies concolor)* and Douglas-fir on mesic low sites, to western white pine *(Pinus monticola)* on upper elevation sites. Incense-cedar *(Calocedrus decurrens) is* widely scattered throughout. The open understory is dominated by scattered clumps of *Quercus vaccinifolia, Arctostaphylos nevadensis,* and other mountain chaparral shrubs. Within the RNA, two shrubs *(Rhamnus californicus* ssp. *occidentalis* and *Ribes roezlii)* appear locally restricted to this type.

The gabbro subtype differs by its high abundance of Shasta red fir and lodgepole pine. All other tree species from the serpentinite subtype also occur here, although Jeffrey pine and incense-cedar are less important. The moist aspect of this association, and perhaps a more fertile substrate than the previous subtype, combine to create a denser canopy and understory. Although the understory is dominated by mountain chaparral species, *Chrysolepis sempervirens* is often most important, and some mesophilic species such as *Leucothoe davisiae* and *Vaccinium arbuscula* are locally common.

Herbs and subshrubs are widely scattered in both subtypes although a much higher diversity of species occurs on the gabbro subtype (21 species listed as characteristic). A few such as *Lupinus croceus, Eriophyllum lanatum* var. *lanceolatum, Calystegia malacophylla, Lotus crassifolius, Angelica californica,* and *Cirsium andersonii* seem locally restricted to the serpentinite subtype.

Mountain Chaparral (37510, 37542): 213 acres (86 ha). This association covers large areas of shallow, rocky soil, especially on the W.-facing slopes. Dominants are *Quercus vaccinifolia, Arctostaphylos nevadensis,* and *A. patula.* Other important shrubs are *Ceanothus prostratus, Amelanchier pallida,* and *Holodiscus boursieri,* the latter is particularly abundant on stabilized talus and rock outcrops. *Prunus emarginata, Ceanothus velutinus,* and *Chrysolepis sempervirens* are locally important. The endemic *Arctostaphylos klamathensis* dominates locally W. and SW. of Terrace Lake. A number of herbs (26 of the most common species are listed) occur in this association, many of which are shared with the xeric rock outcrop association. Large portions of the mountain chaparral are not rapidly succeeding to coniferous vegetation, probably as a result of the xeric exposure and poor, ultramafic, rocky soil.

Red Fir-Mountain Hemlock Forest (85310, 86210): 192 acres (78 ha). This association dominates on all northerly exposures at higher elevations. Five plots are sampled. Basal area ranges from 34.0 to 87.9 m^2/ha and density ranges from 561 to 2392 trees/ha. The forest ranges from dense closed stands of primarily red fir on NE. and NW.-facing plots, to stands dominated by mountain hemlock with some lodgepole pine in cold, mesic valley bottoms, to open senescent red fir forest, and

finally to very open forest codominated by red fir, western white pine, and lodgepole pine on very rocky soils. In the establishment record, this association is broken down into mountain hemlock (139 acres, 56 ha) and red fir (53 acres, 22 ha) forests. However, there is much overlap, and even at the highest, snowiest portions of the basin, mountain hemlock is not usually exclusively dominant.

The understory of open forests is dominated by mountain chaparral shrubs. The endemic *Arctostaphylos klamathensis* is locally important, covering up to 60 percent in some areas of the Terrace Lake sub-basin. In closed-canopy, shady stands, the understory is sparse with scattered herbaceous species such as *Chimaphila umbellata, Pyrola picta,* and *Corallorhiza maculata* predominating. *Leucothoe davisiae, Vaccinium arbuscula, V. scoparium, Anemone quinquefolia* var. *minor,* and *Pyrola secunda* occur in mesic stands. Stature of the dominant trees is somewhat smaller than other sampled red fir areas in the N. Sierra (e.g., #47, and #49). This may be the result of the relatively poor, rocky gabbroic soil.

Port Orford-cedar Forest (82500): 74 acres (30 ha). This is an edaphic association reliant upon permanent moisture. POC forest fringes all of the major lakes and streams in the basin. Two subtypes are distinguishable: a bottomland form occurring around Lower Cliff and Cedar lakes as well as around the slow-flowing portions of the Sacramento River at the lower elevations, and a rocky streamside and lakeshore type which occurs at the upper elevations along fast-flowing streams and around Cliff and Terrace lakes *(fig. 8).*

The bottomland type has the highest density stands of any forest in the area, averaging 4033 trees/ha (range 2900-5300 trees/ha). POC strongly dominates (total mean cover 80 m^2/ha, of which POC comprises 73 percent). The trees are shallow rooted, and because of the saturated soil, are often windthrown. The understory is usually littered with fallen trunks, and shallow, boggy, water-filled depressions left by uprooted trees are plentiful. Saplings and seedlings of POC are common in the understory. Understory shrubs and herbs form a dense cover in many areas. Hydrophilic, shade-tolerant species predominate, including *Ledum glandulosum, Gaultheria humifusa, Leucothoe davisiae, Physocarpus capitatus, Alnus tenuifolia, Cornus stolonifera, Darlingtonia californica, Linnaea borealis, Allium validum, Listera convallarioides, Caltha howellii,* and *Athyrium filix femina* (20 species listed as characteristic). Much of this forest, despite its moist substrate, appears to have suffered a fire ca. 100 years ago.

The streamside rocky lakeshore type of POC forest has lower densities, but higher basal area than the previous type. This subtype has the highest basal area of any forest in the RNA, up to 226 m^2/ha. The largest POC in this type is ca. 4 ft (1.2 m) dbh and is estimated to be 400-500 years old. The understory species in this type includes *Leucothoe davisiae, Goodyera oblongifolia, Chimaphila umbellata, Pyrola picta, Vaccinium arbuscula, Pteridium aquilinum* var. *pubescens,* and *Pedicularis semibarbata.*

Rock Outcrop (91200): 76 acres (31 ha). A large portion of the upper elevation is open, rocky slopes and cliffs. This environment harbors a group of herbaceous or sub-shrubby plants growing in crevices and small hollows in the rocks. The species may be divided into mesic and xeric groups. Many of the xeric type species also occur in mountain chaparral and include *Penstemon rupicola, Sitanion hystrix, Lewisia leana, Arenaria nuttallii* ssp. *gregaria, A. congesta, Eriogonum umbellatum, Sedum obtusatum* ssp. *boreale, Juncus parryi,* and many others (28 species listed as characteristic).

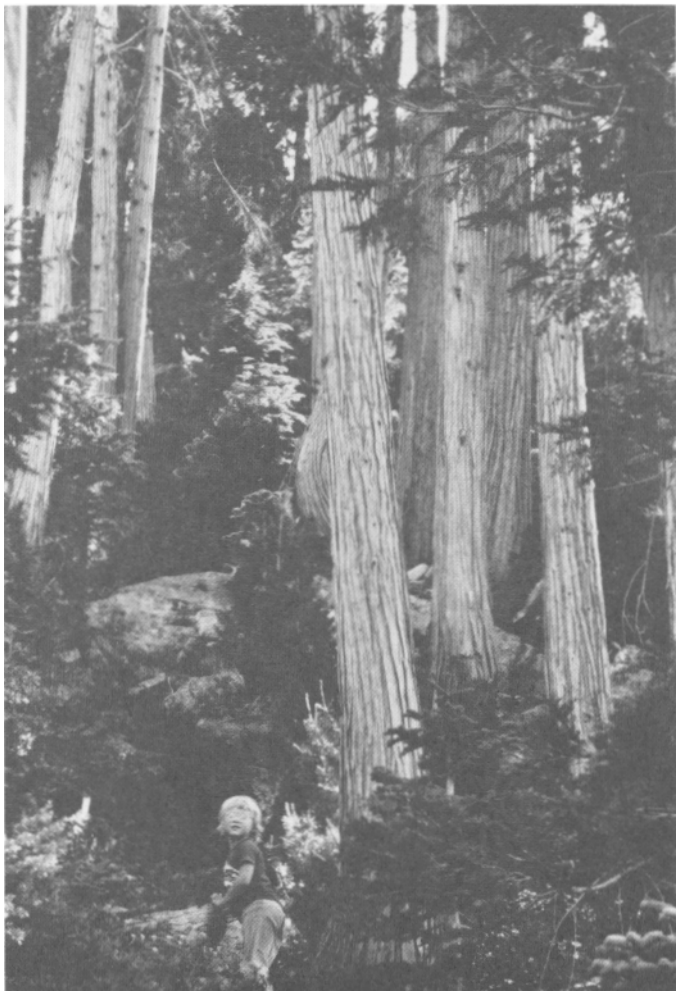


Figure 8--Cedar Basin: Steep streamside Port Orford-cedar forest along outlet to Terrace Lake with saplings of mountain hemlock and shasta red fir.

The mesic type includes such species as: *Cryptogramma acrostichoides, Adiantum pedatum* var. *aleuticum, Polystichum lonchitis, P. lemmonii, Athyrium alpestre, Phyllodoce empetriformis, Casiope mertensiana, Romanzoffia sitchensis, Carex spectabilis, Saxifraga ferruginea,* and many others (30 species listed as characteristic).

Shallow Lakes and Ponds (52430): 25 acres (10 ha). With the exception of Cliff Lake and Terrace Lake, all 10 ponds and lakes in the basin have a zone of aquatic vegetation. Cedar Lake and Lower Cliff Lake have the best-developed aquatic associations. Characteristic species include *Isoetes occidentalis, I. bolanderi, Nuphar polysepalum, Menyanthes trifoliata, Potemogeton natans, Sparganium angustifolium, Scirpus validus, Heleocharis montevidensis* var. *parishii, Dulichium*

arundinaceum, and *Carex rostrata.*

Bog and Meadow (51120, 45100): No acreage given. Well-developed bogs occur at Cedar and Lower Cliff lakes. These consist of both raised hummocky areas topped with ericaceous shrubs and lower mucky areas dominated by *Darlingtonia californica* and various members of the Cyperaceae. The raised areas support a near-continuous layer of the shrubs *Kalmia polifolia* var. *microphylla, Ledum glandulosum, Vaccinium occidentale,* and *Spiraea douglasii. Drosera rotundifolia, Tolfieldia glutinosa* ssp. *occidentalis, Narthecium californicum, Carex buxbaumii,* and *Carex aquatalis* are characteristic of the edges of the hummocks.

The low mucky bog is dominated by *Darlingtonia californica, Heleocharis montevidensis, Carex ormantha, C. integra, Aster alpigenus* ssp. *andersonii,* and *Hastingsia (Schoenolirion) alba.* A number of other species occur where more soil has developed such as near inlet streams and lakes. A total of 50 species are listed as characteristic of this association. Meadow vegetation is not well developed in the area and is grouped with bog vegetation in the ecological survey.

Plant Diversity

Two hundred sixty taxa of vascular plants are listed in the establishment record, an updated version of the list in the ecological survey.

4. CRATER CREEK (Keeler- Wolf 1987a)

Location

This candidate RNA is on the Klamath National Forest, Siskiyou County. It is ca. 16 miles (26 km) NW. of Mount Shasta City. It occupies portions of sections 18 T41N, R6W and 13 T41N, R7W MDBM (41°24' N., 122°35' W.) USGS China Mtn. quad *(fig. 9).*

Target Elements

Curl-leaf mountain mahogany *(Cercocarpus ledifolius),* and California mixed subalpine forest.

Distinctive Features

Dense and Diverse Subalpine Forest: The high density and basal area cover of the Crater Creek subalpine forest are exceptional. Other measurements of subalpine forests in California over relatively large areas have not approached these figures (e.g., see #'s 19, 3 1, and 58). These maybe the most productive subalpine forests in the state. Trees are typically not only dense, but relatively tall and well-formed. In addition, these subalpine forests may be the most diverse in the state with seven regularly occurring tree species. These forests contain mixtures of all the important subalpine trees of the eastern Klamath Province. The codominance of foxtail pine *(Pinus balfouriana),* whitebark pine *(P. albicaulis),* and mountain hemlock *(Tsuga mertensiana)* in certain stands is particularly unique.

Curl-leaf Mountain Mahogany Vegetation: This area displays an excellent array of curl-leaf mountain mahogany

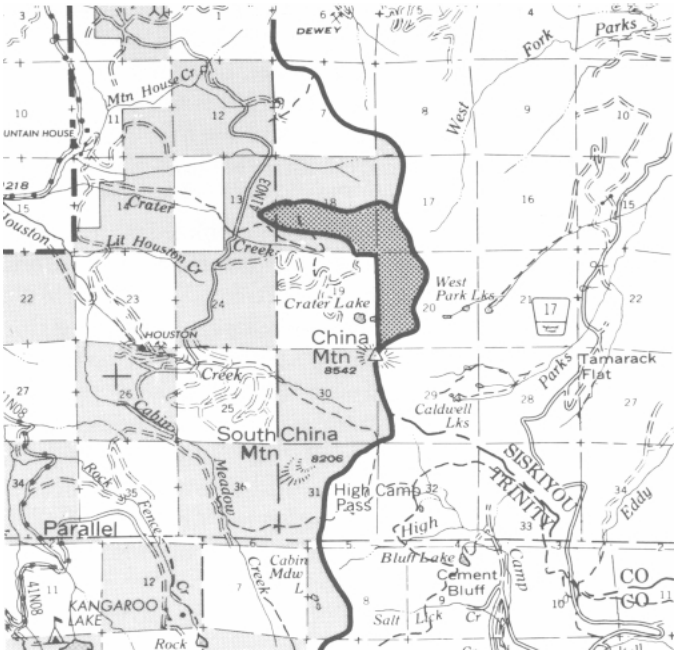


Figure 9--The Crater Creek study area.

(further known as simply, mountain mahogany) vegetation types with respect to variations in slope exposure, steepness, parent material, and elevation. Though mountain mahogany associations are widespread in the western United States little is known about their successional relationships and ecological position relative to adjacent vegetation types. Many gaps in the knowledge of the species could be answered at this site.

Rare Flora: Three members of CNPS List 4 *(Allium siskiyouense, Lomatium engelmannii,* and *Eriogonum siskiyouense)* occur in the area. Because of the early date of study (late May), several other rare species known from the vicinity may have been overlooked.

Physical Characteristics

This proposed area covers ca. 240 acres (97 ha), but the study area was enlarged during the survey to encompass ca. 550 acres (223 ha). Elevations within the area studied range from approximately 5760 to 8420 ft (1756-2566 m). The site occupies the S.-facing slopes of a major spur ridge of the Scott Mountains crest as well as the western side of a portion of the main crest itself, stretching for ca. 1.5 miles (2.4 km) north of China Mountain. In addition to the predominantly S.-facing exposures on the spur ridge, areas of N., NW., W., and SE. exposures also occur on the 300-acre (121-ha) addition. Slopes are moderate to steep throughout. The principal rock type is gabbro of the Trinity ultramafic pluton, with the western portion of the area underlain by serpentinized peridotite. Soils are typically shallow, rocky, and poorly developed. However, soil derived from the peridotite tends to be less rocky, less fertile, and more clay-rich than the gabbroic soils. Precipitation is estimated at between 40 and 60 inches (1016-1525 mm) annually with estimated mean January minima of -10 °F (-23° C) at the upper

elevations and mean July maxima ca. 90 °F (32 °C) at the lowest elevations.

Association Types

Ten 100-m^2 plots each were sampled in the mountain mahogany and the subalpine forest associations.

• Subalpine forest (86210,86220,86300,86600):305 acres (123 ha). The diverse subalpine forest above 7600 ft (2317 m) shows clinal variation with respect to exposure. Four main subtypes are distinguished.

Subtype 1. The Foxtail pine subalpine forest (46 acres, 19 ha) is the most highly insolated subtype, occurring on S.- to SW.-facing exposures at lowest elevations. It is dominated by foxtail pine with lesser amounts of mountain mahogany; lodgepole, western white, and whitebark pines; and red fir. It is an open forest with relatively deep, rocky soil. Reproduction is scattered in openings and dominated by foxtail pine and red fir. The understory is similar to the adjacent mountain mahogany woodland (subtype 3). As with other subalpine trees at Crater Creek, the foxtail pine are not particularly old. Five trees 27-35 inches (69-89 cm) dbh were between 370 and 435 years. The largest foxtail pines in this type are 44-48 inches (1.1-1.2 m) dbh and are probably 600-700 years old.

Subtype 2. The mixed subalpine forest (108 acres, 44 ha) lies above the previous subtype on W.-facing exposures. It is denser than the previous, with the deletion of mountain mahogany and many of its associated understory species. Foxtail and whitebark pines are codominants with western white pine, lodgepole pine, and red fir as relatively minor components. Heights of dominant whitebark and foxtail pines are typically between 66 and 82 ft (20-25 m). The tall whitebark pines are particularly noteworthy *(fig. 10).*

Subtype 3. The mountain hemlock subalpine forest (117 acres, 47 ha) occurs at higher elevations than the previous subtypes on NW.-facing slopes. This is the densest form of subalpine forest, characterized by the addition and regular dominance of mountain hemlock. Whitebark pine remains an important subdominant and occasional codominant, but foxtail pine becomes rare, as do the other tree species associated with previous subtypes.

Subtype 4. The whitebark pine subalpine forest (34 acres, 14 ha) is the highest and most exposed of the subalpine types. It occurs on the summit ridge above 8200 ft (2500 m) and is dominated by semi-krummholz whitebark pine. Mountain mahogany again becomes the most important subdominant as it is in the open forests of subtype 1. Foxtail pine is scattered on deeper soil within this ridgetop type.

The sample plots are concentrated within the first two subtypes. Of the seven tree species in the sample, whitebark pine dominates (basal area cover 37 m^2/ha, density 660/ha, frequency 90 percent), followed by foxtail pine (basal area cover 32 m^2/ha, density 130/ha, frequency 70 percent). The other species in order of importance are: red fir, mountain mahogany, mountain hemlock, western white pine, and lodgepole pine. Total basal area cover is ca. 80 m^2/ha and total density is 1150/ha.

• Mountain Mahogany (no Holland equivalent): 240 acres (97 ha). This type may be broken into three subtypes considered as a gradient ranging from open shrub-steppe on the lowest, driest, most highly serpentinized areas, through a taller dwarf woodland or scrub in rocky gabbroic areas at mid-elevations, to a taller woodland on deeper gabbroic soil with scattered trees of several species of conifers at high elevations.

Figure 10--Crater Creek: Dense mixed subalpine forest with foxtail pine, whitebark pine and mountain hemlock.

Subtype 1. The serpentinite shrub-steppe (82 acres, 33 ha) has the lowest cover of the three types. It is restricted to the serpentinite belt on the W. side of the area, ranging from 5760 to 6880 ft (1756-2097 m). Slopes are relatively steep (30-45°) with xeric W.- to SW. exposures. The area is dominated by low (4- to 6-ft, 1.2- to 1.8-m) mountain mahogany with large grass and herb-dominated patches intervening *(fig.* 11). Average shrub density on 200 m^2 was 900/ha and average shrub cover was 27 percent. Saplings and seedlings of mountain mahogany average 130/ha. The dominant herbs and grasses include *Festuca idahoensis, Elymus glaucus, Phlox diffusa,* and *Poa pringlei.* Species apparently restricted to this subtype include *Sedum lanceolatum, Arenaria congesta, Allium siskiyouensis, Cryptantha affinis, Phacelia linearis,* and *Eriogonum siskiyouensis.*

Subtype 2. The rocky gabbro scrub (98 acres, 40 ha) occurs at elevations between 6800 and 7500 ft (2073-2286 m). Stature

Figure 11--Crater Creek: Open curl-leaf mountain mahogany woodland with *Festuca idahoensis* bunchgrass on serpentinite.

of mountain mahogany increases, grass cover decreases, and additional small shrubs increase compared to the previous subtype. Gabbro boulders cover 40-50 percent of the ground. On 400 m^2, the stem cover for mountain mahogany averages 9 m^2/ha whereas shrub density (not stem density) averages 575/ha. Other shrubs on the four plots include *Symphoricarpos vaccinoides, Berberis pumila, Amelanchier pallida, Ceanothus prostratus, Prunus virginiana* var. *demissa, P. emarginata,* and *Arctostaphylos patula.* Herbs and grasses are sparse in cover, but are represented by 25 species on the four sample plots. These include *Viola purpurea, Achillea lanulosa, Monardella odoratissima* ssp. *pallida, Hackelia jessicae,* and *Senecio integerrimus.*

Subtype 3. The mixed mountain mahogany woodland (60 acres, 24 ha) occurs on gentle S. to SW. exposures with deep, relatively unrocky soil. Mountain mahogany attains its greatest size in this type, which ranges between 7200 and 7760 ft (2195-2365 m) in the SE. quarter of section 18 and the adjacent part of sect. 19. Tree-size individuals of mountain mahogany up to 20 inches (51 cm) dbh and 25 ft (7.6 m) tall are interspersed with scattered trees of foxtail pine, whitebark pine, western white pine *(Pinus monticola),* Jeffrey pine *(P. jeffreyi),* lodgepole pine *(P. contorta* ssp. *murrayana),* white fir *(Abies concolor),* and Shasta red fir *(A. magnifica* var. *shastensis).*

Only one of the four 100-m^2 plots is clearly dominated by mountain mahogany, whereas two are marginally dominated by foxtail pine with mountain mahogany as the major subdominant, and the other plot is dominated by Jeffrey pine. On all four plots, mountain mahogany stems outnumber all trees with an average density of 1300/ha (range 300-2600). Some mountain mahogany are single-stemmed, but most have 3-6 basal stems. Reproduction of mountain mahogany is better than in other subtypes, with seedlings or saplings occurring on 75 percent of the plots and averaging 1000/ha.

Artemisia tridentata is characteristic and conspicuous in many areas as the major low shrub (12-25 percent cover). Eight other species of shrubs occur in this subtype, including *Ceanothus prostratus* (12-35 percent cover), *Symphoricarpos vaccinoides* (2-10 percent cover), and *Ribes binominatum.* Herbs and grasses are more conspicuous (26 species) on this type than the rocky gabbro subtype. This subtype is clearly ecotonal with subalpine forest and shows that mountain mahogany is limited by competition to poorer sites where conifers cannot dominate.

Plant Diversity

One hundred two taxa are listed.

Conflicting Impacts

A recent selective logging operation encroaches on the lower elevations of the proposed area, though does not appear to have affected any of the major vegetation types within the proposed boundaries.

5. HAYPRESS MEADOWS (Imper 1988a)

Location

This candidate RNA is within the Marble Mountain Wilderness on the Klamath National Forest. It lies within portions of sects. 17, 18, 19, and 20 T13N, R7E HBM (41°30'N., 122°23' W.) USGS Somes Bar quad *(fig. 12).*

Target Element

Red Fir *(Abies magnifica)*

Distinctive Features

• Red Fir: Approximately 80 percent of the area is described as Shasta red fir *(Abies magnifica* var. *shastensis)* forest. Some small areas are dominated by exceptional old-growth stands. However, the actual area of canopy dominance of Shasta red fir is only ca. 9 percent of the total. The remaining area has red fir

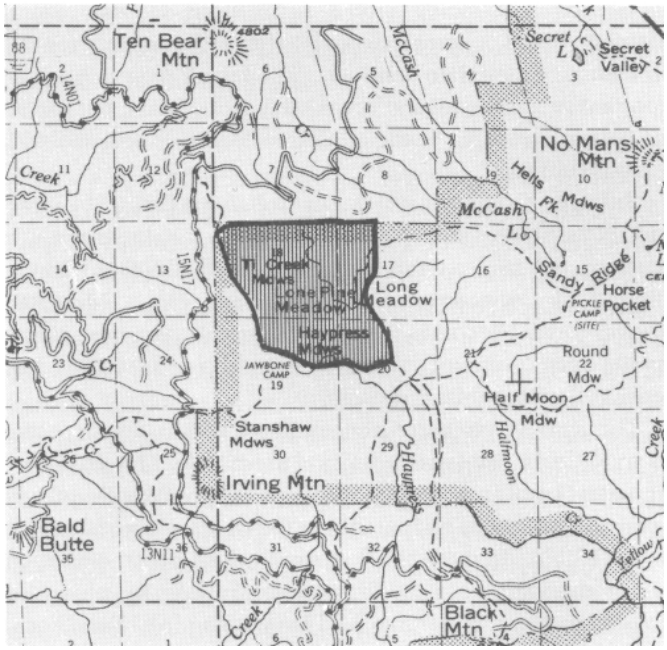


Figure 12--The Haypress Meadow study area.

in the understory. Other species such as white fir *(Abies concolor),* incense-cedar *(Calocedrus decurrens),* Douglas-fir *(Pseudotsuga menziesii),* and sugar pine *(Pinus lambertiana)* are important canopy constituents. The study area offers a good cross-section of habitats at the lower elevation range of the red fir zone.

The area is unusual for its undetermined genetic status of firs. Some attributes of the local fir populations are more like noble fir *(Abies procera)* than typical Shasta red fir. These include the extreme exsertedness of the cone bracts and the characteristic way "red fir" locally codominates with mountain hemlock *(Tsuga mertensiana).* However, definitive genetic determinations have not been made. The name Shasta red fir is used loosely in this report to describe all trees with red or noble fir characteristics.

• General Habitat Diversity: Habitat diversity in the area is high, given the narrow elevational range. The diversity is related to the abundance of surface water and varied fire history of the area. Several wet and dry meadow associations are present. Forests range from the open, sparse understory of the Shasta red fir/prince's pine association to the dense lush understory Shasta red fir/Vanilla leaf association, and the dense shrub layer of the Shasta red fir/Sadler oak association. Well-developed riparian vegetation lines several miles of creeks in the area, and mountain chaparral dominates burned sites.

• Meadow Ecology: The broad range of wet meadow types, their exceptional floristic diversity, and proximity to trailheads makes them conducive to study. Livestock grazing has declined over the past several decades, and some of the meadows that were overgrazed are undergoing successional changes *(fig. 13).* Other meadows suffered little impact from grazing and are essentially pristine. A number of potential succession-related studies focusing on the meadows could be undertaken. These include meadow recovery processes following heavy grazing, grazing impact on soil loss, general successional relationship between meadows and surrounding coniferous vegetation, and factors governing *Alnus viridus (sinuata)* invasion of meadows.

• Rare Plants: *Carex halliana* (CNPS List 2) and *Gentiana setigera* (CNPS List 3) are present in the meadows. The following species are members of CNPS List 4: *Lupinus tracyi, Lilium wigginsii, Epilobium oreganum, Veronica cusickii,* and *Collinsia linearis.* Two hybrids, *(Veratrum californicum* X *V. viride* and *Vaccinium membranaceum* X *V. uliginosum* ssp. *occidentale)* are unusual and occur in the meadow-forest ecotone.

Physical Characteristics

The area covers ca. 1250 acres (506 ha). Elevations range from 4400 to 5400 ft (1341-1646 m). Most of the area is gently sloping, with slopes of all aspects represented. The steepest slopes (up to 60 percent) are in the Cub Creek valley, the major N.-flowing drainage in the E. of the area. The series of flats supporting meadows is in the S. half of the area. The area is underlain by granitic rock (Wooley Creek Pluton). Soils are classified as the Entic Xerumbrepts-Gerle Family-Tallac Family association 15-50 percent slopes. Climate is moderately marine influenced. Precipitation averages somewhat above 70 inches (1778 mm) annually (Rantz 1972).

Association Types

A total of twenty 0.1-acre (0.04-ha), circular plots are sampled in four forest associations.

• Shasta Red Fir/Vanilla Leaf Forest (84240, 85310): 310 acres (125 ha). This association occupies moist N. slopes and meadow borders between 4700 and 5400 ft (1432-1646 m). Soils may be well developed and moist, but rocky. Most of this association occurs as narrow borders along meadows. The canopy is dominated by white fir with Shasta red fir, Douglas-fir, incense-cedar, and sugar pine as subdominants. Shasta red fir is the principal reproducer. Fire is less important than in other forest associations in the red fir zone. Stands may be even or uneven aged *(fig. 14).*

Productivity is the highest of any forest, and on four plots basal area ranges from 57.4 to 82.6 m^2/ha. Dominant Shasta red fir and white fir average 30-50 inches (76-127 cm) dbh, and

Figure 13--Haypress Meadows #1 with Mountain hemlock, Shasta red fir, and lodgepole pine invading drier portions, meadow has had a history of grazing (D. Imper).

Figure 14--Haypress Meadows: Shasta red fir/vanilla leaf forest at base of N.-facing slopes, the lushest and most species-rich of the local forest types (D. Imper).

occasional sugar pines and Douglas fir are greater than 75 inches (190 cm) dbh. Many of the larger trees have been protected from fire by their mesic meadow border location.

The understory is rich and well developed, the most diverse of any forest association. Twenty-eight typical species are listed, including *Achlys triphylla, Trillium ovatum, Linnaea borealis, Rubus lasiococcus, Gaultheria ovatifolia, Adenocaulon bicolor, Pyrola secunda, Anemone deltoidea, Penstemon laetus, Disporum hookeri,* and *Mahonia (Berberis) nervosa.*

• Shasta Red Fir/Prince's Pine Forest (84240,85310): 310 acres (125 ha). This forest occurs at similar elevations and contains the same tree species as the previous association, but occurs on distinctly more xeric locations. Ponderosa and Jeffrey pines (*Pinus ponderosa* and *P. jeffreyi,* respectively) are uncommon indicators of the more xeric conditions as is the typical scattered understory dominated by *Chimaphila umbellata* (to>40 percent cover). An open shrub layer of *Quercus sadleriana, Rhamnus purshiana,* and/or *Rosa gymnocarpa* is also typical. *Lilium washingtonianum* is common along with other species such as *Pteridium aquilinum, Hieracium albiflorum, Chrysolepis chrysophylla, Symphoricarpos mollis, Arctostaphylos nevadensis, Corylus cornuta, Trientalis latifolia, Penstemon anguineus,* and *Viola sheltonii.*

Productivity is second only to the previous association, and basal area on five plots ranges from 60 to 83 m^2/ha. The largest Douglas fir are ca. 60 inches (152 cm) dbh. Fire history in this type is complex, with several even-aged cohorts dating to 35, 65, 105, and 165 years. Many stands are distinctly two-layered with young understory and a mature overstory. Large relict Douglas-fir, ponderosa pine, or incense-cedar are conspicuous. Some areas on warmer slopes may never become dominated by Shasta red fir. A number of shade-suppressed *Quercus sadleriana* seedlings are present in the understory and *Q. sadleriana* dominates the understory of stands with less than 69 m^2/ha basal area and less than 60 percent canopy cover. Some of the many fires may have been caused by humans, to improve the range capabilities of the meadows.

• Shasta Red Fir/Sadler Oak Forest (84240, 85310): 140 acres (57 ha). This is another forest dominated by white fir, but with reproduction predominantly from red fir. Relative cover figures are similar to those of the previous forest; however, the canopy is more open (<60 percent). There are many snags and down logs. *Quercus sadleriana* dominates the understory in dense cover of 60-90 percent. A few other species occur including *Chimaphila umbellata, Apocynum androsaemifolium, Rosa gymnocarpa, Pyrola secunda, Arctostaphylos nevadensis, Symphoricarpos mollis,* and *Rhamnus purshiana.*

Dominant white and red fir are typically 40-50 inches (1.02-1.27 m) dbh, and basal areas on three plots range from 34 to 51 m^2/ha. The largest Douglas-firs are 6.8 ft (2.08 m) dbh and 500 years old.

• Wet Meadow/Riparian Complex (45100, 63500): 136 acres (55 ha). This category includes a range of association types in the wet meadows and the riparian corridors. There are four main subtypes:

• *Alnus* scrub: 82 acres (33 ha). This association is dominated by *Alnus viridus* with *Salix* spp., *Cornus stolonifera, Sorbus californica, Ribes marshallii, Rhododendron occidentale, Acer glabrum, Prunus emarginata,* and a rich variety of understory herbs. It occurs as dense thickets over many of the hydric openings, especially in the N. half of the area such as along Cub Creek and Haypress Creek.

Vaccinium meadow is an open meadow type, generally near saturation in early summer. It is dominated by *Vaccinium uliginosum* ssp. *occidentale* with many herbs.

Carex meadow is the predominant type of wet meadow with high species diversity. It is saturated or immersed much of the growing season. *Carex rostrata* dominate the wettest areas. Other species include *Pedicularis attolens, Dodecatheon alpinum, Lupinus polyphyllus, Gentiana setigera, Viola macloskeyi, Veratrum viride, Lilium wigginsii, Scirpus congdonii, Glyceria elata, Caltha leptosepala,* and *Ranunculus gormanii.*

Helenium meadow is the driest of the wet meadow types. It is dominated by *Helenium bigelovii, Castilleja miniata,* and other herbs.

• White Fir/Prince's Pine Forest (84240): 125 acres (51 ha). This association occurs on dry upper slopes and is characterized by nearly pure stands of white fir with local concentrations of Douglas-fir, sugar pine, and incense-cedar, with occasional ponderosa or Jeffrey pine. Shasta red fir occurs in mesic sites. The understory is depauperate with occasional individuals of *Rhamnus purshiana, Chimaphila menziesii,* and *Pteridium aquilinum.* Older stands have scattered *Quercus sadleriana* and sparse mats of *Chimaphila umbellata.* The even-aged structure of the forest underscores the importance of fire. No sampling was done in this forest.

• Shasta Red Fir/Thinleaf Huckleberry Forest (85310): 110 acres (45 ha). This is the only association clearly dominated by Shasta red fir in the canopy and understory. It occurs in canyons and sheltered N.-facing slopes. Substrate is rocky and moist. Mountain hemlock is the principal subordinate tree, and there are occasional Douglas-fir, Brewer spruce *(Picea breweriana),* western white *(Pinus monticola),* and lodgepole *(Pinus contorta* ssp. *murrayana)* pines. The shrub layer is generally dense, dominated by *Quercus sadleriana* and *Vaccinium membranaceum.* The herb layer includes *Gaultheria ovatifolia, Rubus lasiococcus, Clintonia uniflora, Linnaea borealis, Achlys triphylla, Smilacina stellata,* and *Paxistima myrsinites.*

Basal area on seven plots ranges from 37 to 74 m^2/ha. Shasta red fir is represented by several age classes with dominants ranging from 35 to 50 inches (89-127 cm) dbh. Largest individuals are 57 inches (1.45 m) dbh, 160 ft (49 m) tall, and 400+ years old.

• White Fir/Vanilla Leaf Forest (84240): 105 acres (43 ha). This is a mesic low-elevation association ranging from 4400 to 4700 ft (1341-1433 m) on N.-facing slopes and to over 5100 ft (1554 m) on gentle S.-facing exposures. The understory is lush with well-developed shrub and herb layers; the substrate is often rocky. Stands are typically uneven-aged, and fire is not an important factor.

• Pussypaws/Western Needlegrass Dry Meadow Complex (45120): 7 acres (3 ha). This category includes a variety of associations in the Haypress Meadows area. These are all apparently related to past overgrazing. Typical herb cover in the

dry sandy meadows includes *Calyptridium umbellatum, Lupinus albicaulis,* occasional *Carex* spp., *Eriogonum umbellatum,* and *Stipa occidentalis.* More mesic sites have greater species diversity including such taxa as *Sanicula graveolens, Ipomopsis aggregata, Monardella odoratissima, Penstemon laetus, Linanthus nuttallii, Gayophytum nuttallii, Phacelia mutabilis,* and *Rumex acetosella.*

• Tobacco brush/Greenleaf Manzanita Scrub (37510): Six acres (2 ha). This chaparral is seral to either association 2 or 3. It is associated with relatively recently burned patches on ridgetops or steep S.-facing slopes. Conifer reproduction is typically poor. Species include *Ceanothus velutinus, Arctostaphylos patula, A. nevadensis, Chrysolepis sempervirens, Apocynum androsaemifolium, Anemone deltoidea, Quercus sadleriana,* and *Lilium washingtonianum.*

• White Fir/Pinemat Manzanita Forest (84240): Three acres (1 ha). This association occurs as a small patch on a xeric, steep S.-facing slope. Douglas-fir and sugar pine dominate the canopy, and white fir the understory. *Arctostaphylos nevadensis* may cover 50 percent of the surface. Soil is poorly developed and rocky. The rare *Collinsia linearis* occurs here along with *Silene campanulata, Chrysolepis chrysophylla, Polystichum imbricans, Arctostaphylos patula,* and *Eriogonum nudum.*

Plant Diversity

Two hundred twelve taxa are listed.

Conflicting Impacts

Because the area is entirely within the Marble Mountain Wilderness, there may be some conflict with recreational use. Several of the lush meadows are adjacent to trails, and the meadows are attractive camping sites. Thus, some impact on potential meadow research projects may be expected. Apparently some cattle still graze the meadow and riparian zones. It is suggested that the actual area of Shasta red fir dominance could be increased by adding land S. of the proposed boundary.

6. HENNESSYRIDGE(Thornburgh 1987)

Location

This candidate RNA is on the Six Rivers National Forest, Trinity County. It is ca. 4 miles (6 km) SE.of the town of Salyer. It is divided into two units. The east unit includes part of sects. 29, 30, 31, and 32, T6N, R6E HBM, and the west unit includes part of sect. 31 T6N, R6E and sects. 5 and 6 T5N, R6E HBM (40°55'N., 123°32'W.) USGS Hennessy Peak quad *(fig. 15).*

Target Element

Pacific Douglas-fir *(Pseudotsuga menziesii)*

Distinctive Features

• Variation in Forest Structure: Analysis of a grid system of ten 0.2-acre plots indicates a high degree of irregularity in the stand structure of the local mixed Douglas-fir/hardwood forest. The dumpiness of the stand structure suggests that both hardwoods and Douglas-fir regenerated in small (<10-acre, 4-ha)

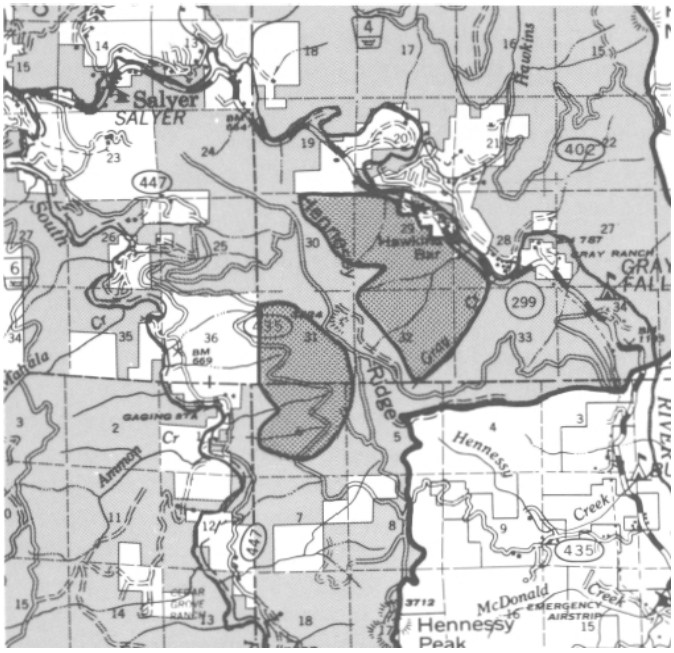


Figure 15--The Hennessy Ridge study area.

gaps. The presence of small clumps of different ages lends support to the concept that Douglas-fir-dominated forest in the Klamath Province is capable of maintaining its climax status by relying on relatively small stand disturbances for regeneration.

• Successional Status: Most of the forest stands were determined to be at or near climax. Stands are all-aged and have all sizes of the dominant species: Douglas-fir, tanoak, canyon live oak *(Quercus chrysolepis),* and a small, but consistent amount of sugar pine *(Pinus lambertiana) (fig. 16).* Ground fires, small areas of crown fire, and tree-falls create light gaps. Gaps of these types are the principal sources of successful tree reproduction throughout the study area.

• Relationship to Other Areas: Relative to other studies in

Figure 16--Hennessy Ridge: All-aged stand of Douglas-fir and tanoak with large madrone and clumped seedlings of tanoak and Douglas-fir (D. Thornburgh).

the Klamath Province (e.g., Atzet and Wheeler 1984, Mize 1973, #2), the local Hennessy Ridge Douglas-fir-hardwood forests are on the dry end of the scale, and many plant indicators of the more mesic types of Douglas-fir hardwood forest are missing from this study area.

Physical Characteristics

The E. unit includes approximately 1008 acres (408 ha) with elevations ranging from 800 to 3020 ft (244-921 m). The W. unit includes ca. 772 acres (312 ha) and ranges from 1000 to 3280 ft (305-1000 m) in elevation. The two units lie on the mid- and lower slopes of the west and northeast sides of Hennessy Ridge, a prominent ridge which separates the South Fork and the main Trinity rivers. In the E. unit, small streams have deeply dissected these slopes into several draws and gulches with steep north- and south-facing slopes. Most slopes are extremely steep (averaging ca. 75 percent). The W. unit is dissected into four "gulches" with the NW. slopes extremely steep (80 percent), whereas the SW. slopes are only moderately steep.

The rock type is upper Jurassic marine sedimentary and metasedimentary rocks, consisting of slaty and phyllitic sandstones, shale, and minor conglomerates. Soils are skeletal, often deep, with at least 35 percent of the total volume occupied by rock fragments. The surface is typically covered with loose stones, and slumps and slope failures up to 500 ft (152 m) long are common along the gulches. Precipitation averages ca. 55 inches (1397 mm) annually with most occurring from November to March. January mean minimum is ca. 32 °F. (0 °C), and the July maximum is ca. 90 °F (32 °C).

Association Types Represented

On the basis of 77 releves sampled, the forests are divided into three association types distinguished by the dominant reproducing hardwood tree species and characteristic shrubs.

• Douglas-fir-Tanoak-Poison Oak Association (81100, 81400, 82420): 1141 acres (462 ha). This forest is located on mesic sites, but also occurs on steep slopes with high surface rock cover. Typical stands have a broken canopy of old-growth Douglas-fir with occasional sugar pine, lying over a solid canopy of mixed evergreen hardwoods with a few Douglas-fir and sugar pine of mixed ages. The mid-canopy is dominated by tanoak with variable madrone and canyon live oak. Tanoaks range from seedlings to 70 inches (1.78 m) dbh. There is a fair amount of stand variability, some areas being dominated by young stands of Douglas-fir, others with large old tanoak and madrones, others still with large old-growth Douglas-fir making up 70 percent canopy cover, some with higher dominance of ponderosa pine, and others still with an equivalent mixture of young Douglas-fir and tanoak. Understory shrubs and herbs are poorly represented, with poison oak *(Toxicodendron diversilobum)* and *Whipplea modesta* most important.

• Douglas-fir-Canyon Live Oak (81100, 82420). 521 acres (211 ha). This forest is characterized by a two-story canopy with old-growth Douglas-fir forming a broken canopy up to 200 ft (61 m) high while the evergreen hardwoods form a lower continuous canopy up to 120 ft (37 m) high. This type occurs on the warmer, drier sites, on low-elevation, S. exposures, and on steep rocky slopes. The stands are dominated by large Douglas-firs with occasional sugar or ponderosa pines. The subcanopy is usually dominated by canyon live oak, and this species also dominates the seedling layer. Canyon live oak may be the only hardwood in some stands, whereas, in others, canyon and tanoak may be more evenly mixed. Other species of the subcanopy are occasional pole-sized Douglas-fir, sugar pine, and ponderosa pine *(Pinus ponderosa)*. The major species are typically all-sized and all-aged. Herbaceous ground cover is low and in some stands almost nonexistent. This type is considered to be among the most xeric of the Douglas-fir-hardwood associations in the Klamath Province.

• Douglas-fir-Tanoak-Oregon Grape Association (82420): 118 acres (48 ha). This is the most mesic of the three associations, occurring on the highest elevations on north- and northeast-facing slopes. Typical stands of this type have an upper old-growth Douglas-fir canopy over a mid-canopy of all-aged tanoak with a few Douglas-firs. The upper Douglas-fir canopy is usually denser than the upper canopy of the average stand in the Douglas-fir-Tanoak-Poison oak association. The understory in these stands is almost nonexistent, with only a very few Oregon grape *(Berberis nervosa)* shrubs and clumps of sword fern occurring on the forest floor. *Chimaphila menziesii, Vancouveria hexandra,* and *Whipplea modesta* are the most common herbs with a total cover of less than 2 percent.

• Riparian (61510): Small patches and narrow stringers of riparian vegetation dominated by white alder *(Alnus rhombifolia), Acer circinatum, Woodwardia fimbriata, Adiantum pedatum,* and *Oxalis oregana* occur along the six small streams in the area.

Plant Diversity

Seventy taxa are listed.

Conflicting Impacts

Several recent non-natural disturbances occur in the area. These include installation of plastic water pipes running from some of the creeks on the east unit of the area to the town of Hawkins Bar, two old water ditches in the lower portion of the eastern unit, one old water ditch in the western unit, a county road bisecting the western unit, and a series of clearcuts which lie above both units. The clear-cut blocks were logged between 1958 and 1977 and have been planted with ponderosa pine or Douglas-fir. A small, 15-acre clearcut, harvested in 1957, lies within the east boundary.

7. L.E. HORTON (STONE CORRAL-JOSEPHINE PERIDOTITE) (Keeler-Wolf 1986a)

Location

This soon-to-be-established RNA is on the Six Rivers National Forest. It is only four miles (6 km) S. of the Oregon border and is ca. six miles (10 km) NW. of Gasquet. It includes portions of sects. 24, 25, 26, and 36 T18N, RIE HBM and sects. 19 and 20 T18N, R2E (41°56'N., 124°01'W.) USGS High Plateau and High Divide quads *(fig. 17)*.

Target Element

Darlingtonia californica (California pitcher plant) bog.

Distinctive Features

• Rare Plants: This area contains a higher percentage of rare plants than any other established or candidate RNA in California. A total of 40 taxa (25 percent of the known flora of the area) are considered on CNPS lists. These include the following:

List 1b: *Arabis macdonaldiana* (also Federal and State listed as endangered).

List 2: *Arabis aculeolata, Castilleja elata, Calamagrostis crassiglumis, Eriogonum pendulum, Pinguicula macroceras, Senecio macounii.*

List 3: *Aster paludicola, Gentiana setigera.*

List 4: *Angelica arguta, Antennaria suffrutescens, Arnica spathulata, Aster brickelloides, Darlingtonia californica, Epilobium rigidum, Eriogonum ternatum, Gentiana affinis, Haplopappus racemosus* ssp. *congestus, Horkelia sericata, Iris innominata, Lathyrus delnorticus, Lilium bolanderi, L. vollmeri, Lomatium howellii, L. tracyi, Monardella purpurea, Poa piperi, Salix delnortensis, S. tracyi, Sanicula peckiana, Sedum laxum* ssp. *flavidum, Tauschia glauca, Trillium rivale, Vancouveria chrysantha, Veratrum insolitum.*

Considered, but rejected due to taxonomic questions: *Arctostaphylos cinerea, A. parviflora, Juniperus communis* ssp. *jackii.*

Considered, but rejected due to commonness: *Arctostaphylos intricata, Viola cuneata.*

In addition to the species on the CNPS lists, a form of beach pine (*Pinus contorta* ssp.) may also be considered rare. The pine has been referred to as an endemic to the ultramafic terrain of Del Norte County by Griffin and Critchfield (1976).

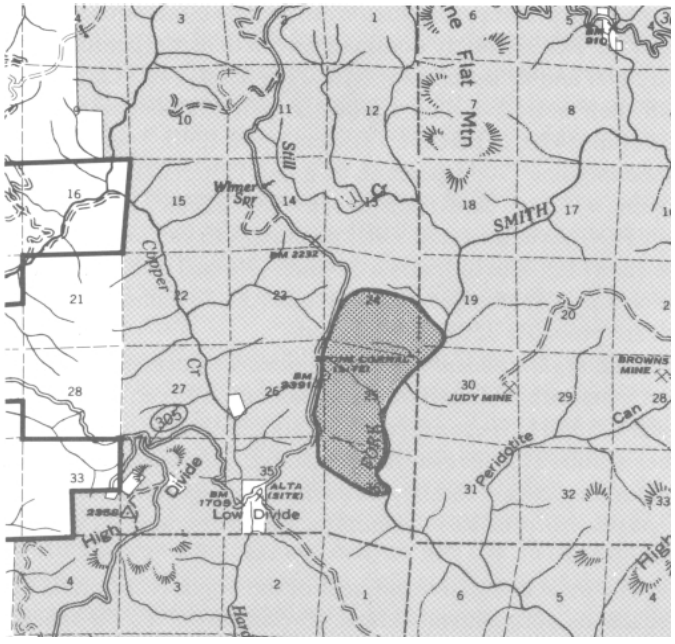


Figure 17--The L.E. Horton RNA.

• Klamath Province Serpentine Endemics: A total of 53 taxa or 33 percent of the known flora of the study area are Klamath endemics. It is likely that almost all of these species will prove to be serpentine endemics or indicator species (*sensu* Kruckeberg 1984). This is a remarkably high percentage of endemics. Another RNA, Frenzel Creek (#36), is in an area known for its high endemism, the central Coast Ranges (Stebbins and Major 1965), and yet only 17 percent of its flora is endemic to that area.

• The *Darlingtonia* Bog: The extensive bogs in the N. portion of the area represent the best-developed *Darlingtonia* bog habitat in the California RNA system *(fig. 18).* Although California pitcher plant is widespread in N. California, the flora of the coastal type of which this area is representative is different than the inland higher-elevation types, which occur in several other Forest Service RNA's or Botanical Areas (e.g., #'s 3 and 11).

• Port Orford-cedar *(Chamaecyparis lawsoniana):* This species also occurs in several other RNAs. Although the stands of POC in this area are not as dense and as large as in some other areas (e.g.,#l, #3, #20), they represent a different association type listed from the Siskiyou Mountain region by Atzet and Wheeler (1984). They also represent the oldest trees and the highest volume forest in the study area. Some of the individuals are clonal, a feature which has occasionally been reported from other POC stands with very wet substrates. This population has not been infected with root rot *(Phytophthora lateralis).*

Physical Characteristics

The proposed RNA covers 1305 acres (528 ha) of eastward-facing slopes above the N. Fork of the Smith River *(fig. 19).* Terrain is steep and rugged in most of the S. and central portions, but becomes more gradual in the N. where the *Darlingtonia* bogs occur. Elevations range from ca. 600 ft (183 m) along the Smith River to 2400 ft (732 m) at the summit of the ridge near Stone Corral. The area is underlain by the lower or mid-Jurassic Josephine Peridotite Body, which stretches for 93 miles (150 km) along the W. border of the Klamath Province. Most of the rock is serpentinized peridotite with small inclusions of gabbro.

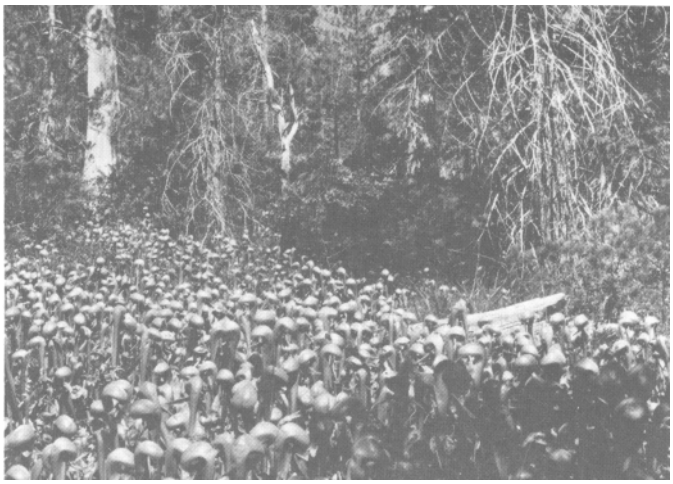


Figure 18-L..E. Horton: Dense aggregation of *Darlingtonia californica* in bog forest.

Figure 19--L.E. Horton: view N. along the N. Fork Smith River with surrounding Josephine Peridotite terrain.

Soils are generally shallow and poorly developed except in the wet bog area. They are typically poor in calcium and extremely high in magnesium. Precipitation totals are among the highest in the state, averaging between 115 and 125 inches (2921-3175 mm) per year. Temperatures are moderate, with some snow falling in winter and summer fog frequent at lower elevations.

Association Types

Portions of the dwarf forest, bog forest, Jeffrey pine *(Pinus jeffreyi)* woodland, and Douglas-fir *(Pseudotsuga menziesii)* forest were sampled using 10 m by 10 m quadrats. The remaining vegetation is described qualitatively.

• Dwarf Forest (no Holland equivalent, perhaps part of 84160): 815 acres (330 ha). The stunted compact nature of many of the trees and shrubs of this association and the presence of several typically high montane taxa give this low elevation forest a peculiar subalpine quality. This forest is best developed on the relatively gentle (10-30°) upper slopes.

Ten plots are sampled. The forest is nearly continuous and dense (1960 stems/ha), dominated by spindly trees (total basal area cover 9.5 m^2/ha) of beach pine (*Pinus contorta* ssp.), knobcone pine *(P. attenuata),* western white pine *(P. monticola),* and Douglas-fir. The canopy is broken occasionally by small herbaceous openings on more steeply sloping, rocky sites. The density (trees/ha), relative cover, and importance values (IV) are given, respectively, following the dominants: beach pine (1040, 30 percent, 101), knobcone pine (490, 20 percent, 74), western white pine (250, 30 percent, 66), Douglas-fir (160, 20 percent, 51), Jeffrey pine (10, 1 percent, 4), Port Orford-cedar (10, trace percent, 3.4).

Dominant trees are no larger than 11 inches (28 cm) dbh and are typically western white pine. Beach and knobcone pines are typically no larger than 5 inches (13 cm) dbh. The numerous small knobcone and beach pines average 40 years old, whereas the sampled dominant western white pines are 86-104 years. The oldest tree sampled in this forest is a 20-inch (51-cm) dbh Douglas-fir with an age of 209 years. Disease (blister rust, dwarf mistletoe, other fungus) is extremely common in all trees. Disease appears to be the principal cause of early death in these trees, as recent fire has not been widespread. A small fire burned ca. 5 acres (2 ha) in 1981 and killed all dominant trees.

Shrubs may cover more than 50 percent of the area. The most significant species are *Lithocarpus densiflorus* var. *echinoides, Quercus vaccinifolia, Rhamnus californica, Arctostaphylos nevadensis,* and *Umbellularia californica.* All of these species resprout after fire. The herb layer is well-developed, consisting of at least 41 taxa. Such species as *Xerophyllum tenax, Festuca californica, Stipa lemmonii, Agrostis hallii,* and *Poa piperi* may locally cover up to 35 percent.

• Lower Dwarf Forest (no Holland equivalent, perhaps partially 37600): 393 acres (159 ha). Below ca. 1200 ft (366 m) in the steep inner canyon of the N. Fork of the Smith River, beach pine drops out, and the density of western white pine and knobcone pine decreases. Densities of Douglas-fir and incense-cedar *(Calocedrus decurrens)* increase. Tree densities are lower than at upper elevations. Shrub cover also changes from the upper elevation dwarf forest, with such species as *Arctostaphylos cinerea* and *Garrya buxifolia* increasing in cover while *Lithocarpus densiflorus* var. *echinoides* and *Quercus vaccinifolia* decrease. Other shrub species particular to this association include *Eriogonum pendulum, Eriodictyon californica, Arctostaphylos parviflora,* and *A. intricata.*

The herbaceous component also differs from the dwarf forest of higher elevations and includes as important members *Phlox speciosa, Penstemon azureus, Chrysopsis oregona, Sedum laxum* ssp. *flavidum, Selaginella wallacei, Toxicodendron diversilobum, Arabis aculeolata, Lomatium tracyi, Stipa lemmonii, Phacelia nemoralis,* and *Arenaria* sp.

• Bog Forest (51120, 82500): 48 acres (19 ha). In this area a forest dominated by Port Orford-cedar (POC) alternates with hillside bogs dominated by California pitcher plant. Both forest and bog are related in the area, hence the combined name of this association. The association occurs on gentle (5-15°) E.-facing slopes. Ten plots are sampled. The average tree stem density is 1350/ha. POC strongly dominates, with density (per ha), relative cover and IV as follows: 510, 79 percent, 149. Other trees with their corresponding figures in parentheses are western white pine (420,17 percent, 77), beach pine (340,3 percent, 54), knobcone pine (70, 1 percent, 16), and Douglas-fir (10, trace percent, 4). Total basal area cover averages 58 m^2/ha. All of the large POC have fire scars. One specimen 146 years old has light fire charring. The oldest is a 31-inch (79-cm) dbh individual, which is 282 years. Several large trees 39-48 inches (1-1.2 m) dbh are probably 350-400 years old.

Ledum glandulosum and *Rhododendron occidentale* are the principal shrubs indicative of this association (mean cover on 10 plots: 8.5 and 5.5 percent, respectively). However, a number of other shrubs (12 species in the sample) are shared with the surrounding dwarf forest. Of particular importance is *Lithocarpus densiflorus* var. *echinoides,* which averages 11 percent cover.

The most distinctive element of the bog forest flora is the herbaceous component. About 53 percent of the 38 species encountered on the sample plots are locally restricted to this association. The dominant herbaceous species include

Darlingtonia californica, Scirpus criniger, Carex serratodens, Sanguisorba microcephala, and *Narthecium californicum.* These and other characteristic species such as *Aster paludicola, Rudbeckia californica* var. *glauca, Deschampsia caespitosa* ssp. *beringensis, Calamagrostis nutkaensis* and *Juncus orthophyllus* tend to dominate the wetter portions of this association (often concave slopes with small rivulets) to the exclusion of woody species.

• Canyon Forest (81100±): 25 acres (10 ha). This association is similar to the classic mixed evergreen forest in that it is dominated by tanoak *(Lithocarpus densiflorus),* Pacific madrone *(Arbutus menziesii),* and canyon live oak *(Quercus chrysolepis).* However, the scattered canopy of Douglas-fir typical of most mixed evergreen forests is here augmented with western white pine, POC, and incense-cedar. This forest occupies ravines with permanent or intermittent stream channels, a more mesic environment than the surrounding dwarf forest. The dominant broad leaf sclerophylls form a dense canopy with stems averaging ca. 10 inches (25 cm) dbh. The largest tree seen anywhere in the study area was a western white pine in this association measuring 45 inches (114 cm) dbh.

Understory species are shared with dwarf and lower dwarf forest and include *Garrya buxifolia, Lithocarpus densiflorus* var. *echinoides, Quercus vaccinifolia, Rhamnus californica,* and *Vaccinium ovatum. Berberis piperiana* is the only shrub apparently restricted to this type.

• Jeffrey Pine Woodland (84171): 11 acres (5 ha). A small portion of the upper elevation near Stone Corral supports an open woodland of Jeffrey pine. This is a relatively young forest with dominant Jeffrey pines averaging ca. 20-22 m tall, 51 cm dbh, and 100 years old. Growth rates vary considerably depending on substrate (those on or near gabbro grow faster and taller than those on peridotite). Three plots are sampled in this association. Total tree density averages 730/ha, and total basal area cover averages 75 m^2/ha. The only other tree species, western white pine, is an insignificant member.

Shrub cover is much lower than in adjacent dwarf forest. Eight species are in the sample with *Arctostaphylos nevadensis* dominating (mean cover 16 percent). Of the 19 species of herbs noted in the sample, the highest cover is provided by the grass *Festuca californica* which may cover up to 40 percent of the plots. Other frequent species include *Erigeron foliosus* ssp. *confinis, Achillea millefolium, Hastingsia serpentinicola* (recently described by Becking *1989), Haplopappus racemosus* ssp. *congestus, Calystegia occidentalis, Trifolium oreganum,* and *Horkelia sericata.*

• Douglas-fir Forest (82420): 8 acres (3 ha). A small pocket of relatively lush young Douglas-fir forest occurs on gabbro near the Stone Corral Jeffrey pine woodland. The forest is locally dense (2150 trees/ha) with relatively high basal area cover (112 m^2/ha). Typical dominant Douglas-firs are 50-60 cm dbh, 26 m tall, and 95-111 years old. Also occurring are trees of POC, Pacific madrone, tanoak, and canyon live oak. The shrub and herb layers are depauperate with only six species of shrubs and seven herbs tallied on two plots. *Gaultheria shallon, Polystichum munitum,* and a thick carpet of moss are the most important understory members. The young age of the trees and the multiple stems of the sclerophylls suggest a crown fire somewhat over 100 years ago.

Plant Diversity

One hundred sixty-two taxa are listed.

Conflicting Impacts

The N. portion of the area has been subjected to exploratory chromite and nickel mining over the past 10 years. This has resulted in a small network of bulldozer tracks and pits (up to 6 m deep). The impact of these excavations on the rare flora is not particularly severe because of the even dispersion of most of these species throughout the area of affected dwarf forest. The area has not been affected by any additional mining since it was proposed as an RNA. The rough nature of the tractor trails precludes vehicular access into the heart of the area. Dirt roads bound the W. and N. of the area. These may possibly act as vectors for transporting POC root rot into the area.

8. HOSSELKUS LIMESTONE (Keeler-Wolf and Keeler-Wolf 1975, Keeler-Wolf 1989c)

Location

This soon-to-be-established RNA (incorporated with the Devil's Rock candidate RNA, which has had no ecological survey) is on the Shasta-Trinity National Forest. It is centered approximately 24 miles (39 km) NE. of Redding. The area includes all or portions of sects. 21, 22, 23, 26, 27, 28, 32, 33, 34 T35N, R2W and sects. 3, 4, 5, 8, 9, and 16 T34N, R2W MDBM (40°51' N., 122°06' W.) USGS Devil's Rock, Goose Gap and Minnesota Mtn. quads *(fig. 20).*

Target Elements

Limestone ecosystem (unique element), California black oak *(Quercus kelloggii),* canyon live oak *(Quercus chrysolepis)*

Distinctive Features

• Limestone Values: A variety of important values can be attributed to the presence of extensive beds of Triassic limestone in the area (fig. 21). These include the localized endemic plant *Eupatorium shastensis,* wider ranging plants endemic to limestone substrates (e.g., *Cheilanthes cooperae, Adiantum capillaris-veneris*), localized endemic land snails (*Monodenia troglodytes,* and others), a localized endemic salamander (*Hydromantes shastae,* the Shasta salamander), a rich Triassic invertebrate fossil assemblage (including ammonites, brachiopods, corals, in all over 200 species of invertebrates), the best representation of North American Triassic marine reptiles (including five species and three genera of icthyosaurs and the only known remains of the order Thalatosauria in the Western Hemisphere), and more recent Pleistocene vertebrate fossils in cave deposits (including at least one representative of every vertebrate class). These combined values cannot be duplicated in any other area.

• California Black Oak: This is the only designee for this fire-adapted target element in the Klamath Province. The

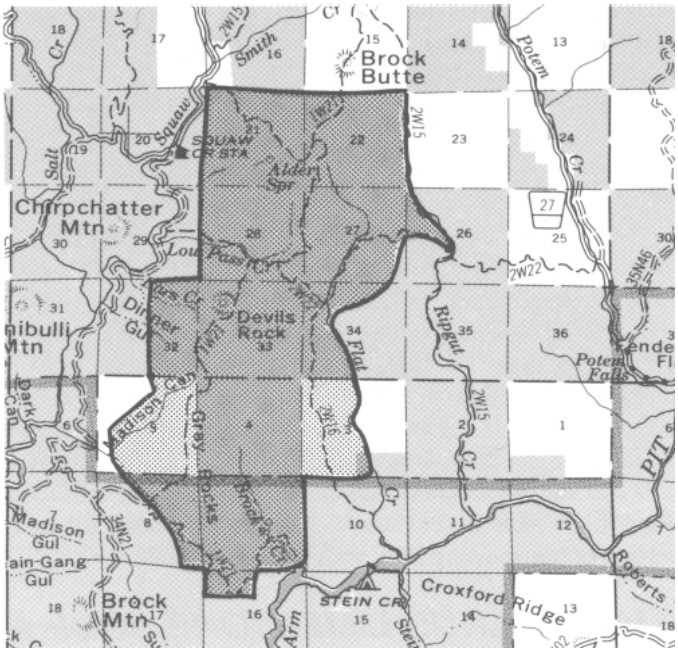


Figure 20--The Hosselkus Limestone RNA.

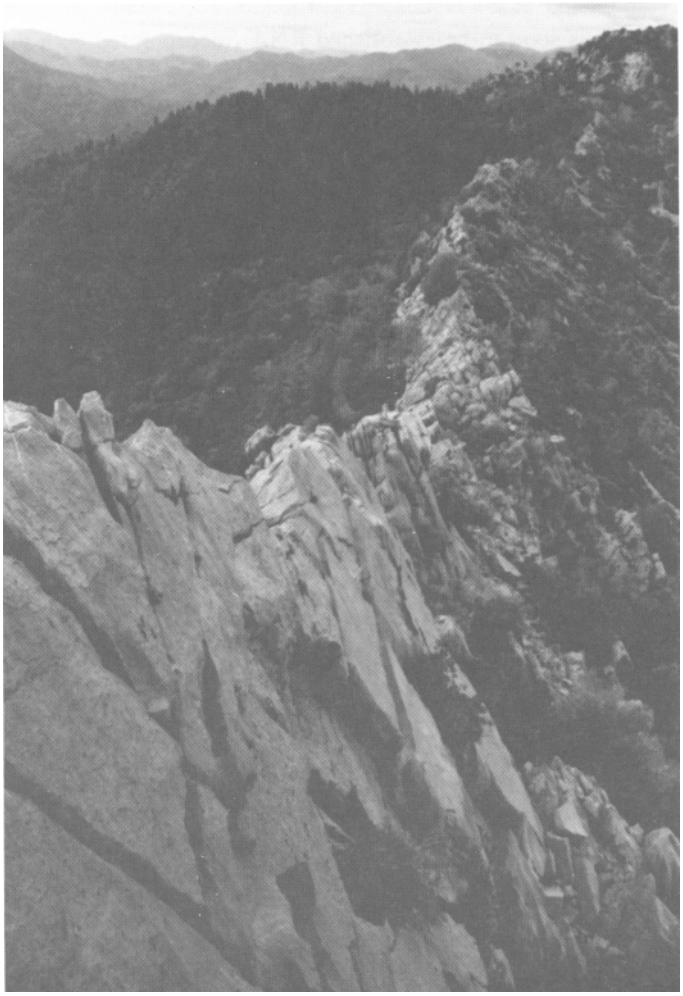


Figure 21--Sharp-edged outcrop of Hosselkus limestone at Gray Rocks, looking N.

extensive forests dominated by California black oak in the E. portion of the area (the former Devil's Rock candidate RNA) cover a larger area on more varied slope exposures, and a greater diversity of stocking densities and subtypes than the other RNAs currently designated for representation of this target element in California *(fig. 22).* The variety of successional states including Douglas-fir *(Pseudotsuga menziesii)* invasion on mesic exposures and ponderosa pine *(Pinus ponderosa)* and Digger pine *(P. sabiniana)* on more xeric exposures is of particular interest. On steeper slopes, California black oak merges with and gives way to canyon live oak forest.

• Biogeographic Significance: This area, at the junction of the Klamath and the Central Valley Provinces, is the meeting place for a number of plants and animals at or near their distributional limits. Nineteen species of vascular plants are thought to be at or near their northern range limits (including *Salvia sonomensis, Collinsia tinctoria, Aesculus californica, Dendromecon rigida, Fraxinus dipetala, Styrax officinalis* var. *californica,* and *Calycanthus occidentalis),* while 10 species are at or near their most inland occurrences (including *Whipplea modesta, Viola ocellata, Acer circinatum, Aruncus vulgaris,* and *Cacaliopsis nardosmia).* Several animals such as California newt *(Taricha torosa),* striped racer *(Masticophis lateralis),* and Nuttall's woodpecker *(Picoides nuttallii)* are near their N. limits, whereas species such as black salamander *(Aniedes flavipunctatus),* tailed frog *(Ascaphus truei),* and Pacific giant salamander *(Dicamptodon ensatus)* are near their most inland locations in California.

• Archaeological Values: This RNA is adjacent to a significant multilevel cultural deposit dating back at least 6500 years. Although no excavations or thorough search for artifacts have been conducted in the RNA, several Indian occupation sites have been discovered in caves in the S. of the area.

• Rare Plants: The endemic *Eupatorium shastensis* is considered to be a member of List 4 by CNPS.

• Rare Animals: The Shasta salamander is listed by the State as threatened, and sensitive by the Shasta-Trinity National Forest, and the land snail *Monodenia troglodytes* is a candidate

Figure 22--Hosselkus limestone: Open ridgetop stand of California black oak.

for State listing.

Physical Characteristics

The RNA covers 6439 acres (2608 ha). Elevations range from 1100 to 3272 ft (335 to 997 m). This area occupies the upper Brock Mountain peninsula between the Squaw Creek and the Pit River arms of Lake Shasta. It is bisected by a prominent N.-S. trending ridge of rugged, resistant gray limestone, stretching for ca. 5 miles (8 km). This limestone rises above 3000 ft (914 m) in several locations, but is deeply cut by the canyon of Low Pass Creek in the N. portion of the area. The area to the E. of the limestone is more gentle topography, dominated by the valleys of southward-flowing Flat and Ripgut creeks. Slopes of all aspects are well represented.

Rocks include the previously discussed Hosselkus Limestone, the Brock Shale (which underlies the majority of the E. portion), and the Pit Formation (shaley-siltstone, metadacite, and limestone, underlying a small portion of the NW. side of the area). Soils within the area are relatively complex and have been divided into 12 mapping units. The families represented include Neuns, Marpa, Kidig, Goulding, Boomer, and Speaker, with extensive areas of limestone rock outcrop. Precipitation is estimated at 60-70 inches (1524-1778 mm) annually. Highest and lowest annual temperatures are estimated to be 109°F (42.8 °C) and 24 °F (-4.4 °C).

Association Types

The associations are described qualitatively; no vegetation sampling is conducted.

• California Black Oak Forest (81340,81320,71110,71120): 3246 acres (1315 ha). Oak-dominated vegetation in the RNA is a result of past widespread fires. Typically the upper S., W., and E. exposures with relatively deep soil and slope angles of <45 percent are clothed in black oak. The majority of these forests are younger than 100 years (mean 74 years). Growth rates and understory composition depend primarily on slope exposure. Several types are present. The following are brief descriptions of the variants:

W.-facing slope with black oak dominant over an understory of *Elymus glaucus* with *Toxicodendron diversilobum, Corylus cornuta* var. *californica, Symphoricarpos mollis, Galium aparine, Trillium chloropetalum, Osmorhiza chilensis, Aristolochia californica,* among others. There may be saplings of ponderosa pine and Douglas-fir. Some of the larger black oak occur here (0.6 m dbh and 21 m tall).

SE.-facing slopes on W. side of RNA with high percentage of ponderosa pine and sparse understory including *Iris tenuissima, Brodiaea lutea* var. *analina, Hypericum concinnum, Collomia heterophylla, Viola lobata, Silene campanulata,* and *Brodiaea multiflora.* This type is transitional to the ponderosa pine phase of the low elevation mixed conifer forest discussed in a following section.

SW.-facing slopes at higher elevations on E. side of RNA. This is a spindly woodland with black oak 15-51 cm dbh with an understory of *Styrax officinalis* var. *californica, Melica californica, Carex multicaulis, Toxicodendron diversilobum,* and reproduction by Douglas-fir and Digger pine.

SE.-facing slopes on E. side of RNA with black oak 31-46 cm dbh and 15-17 m tall with a shrubby understory of *Styrax officinalis* var. *californica, Philadelphus lewisii* ssp. *californicus, Toxicodendron diversilobum, Cercis occidentalis,* and *Ceanothus integerrimus.* There are scattered grassy patches dominated by *Melica californica* and *Elymus glaucus.*

Highest elevation ridgetop stands where black oak dominates over a well-developed grassy understory with *Festuca californica, Elymus glaucus, Microseris nutans, Senecio aronicoides, Silene lemmonii, Agoseris grandiflora, Daucus pusillus, Cynosurus echinatus, Hydrophyllum occidentale,* and *Claytonia perfoliata* (among others).

On gentle NW.-facing slopes with deep soil, black oak dominates along with big-leaf maple *(Acer macrophyllum)* and canyon live oak with a dense understory dominated by *Corylus cornuta* var. *californica.*

Steep E.-facing slopes with shallow soils have spindly black oak codominant with canyon live oak and a sparse understory.

At highest elevations with steep S. exposures or on rocky slopes of shale or limestone, black oak gives way to stands of Oregon white oak *(Quercus garryana).* These stands (similar to Holland 71110) are typically stunted and compact (5-13 cm dbh, 2.4-3.7 m tall).

On very steep slopes of virtually any exposure, canyon live oak tends to dominate in dense stands with little understory except scattered *Toxicodendron diversilobum* and *Corylus cornuta* var. *californica* (Holland 81320). These steep locales may be spared from fire for long periods, and thus some canyon live oak may attain dbhs of over 3 ft (1 m) and heights of over 70 ft (21 m).

• Limestone Scrub (37110,37541,71420): 1631 acres (661 ha). This vegetation resembles mixed chaparral in its principal constituents except for Brewer oak (typical of montane chaparral). It is more open than most chaparrals as a result of the abundant jagged limestone outcrops. *Cercocarpus betuloides* dominates most xeric rocky sites along with such herbs as *Arabis breweri.* Other dominants on less xeric sites include Brewer oak, *Philadelphus lewisii* ssp. *californicus,* California buckeye *(Aesculus californica), Rhamnus crocea* ssp. *ilicifolia, Garrya fremontii, Fraxinus dipetala, Cercis occidentalis, Holodiscus discolor, Clematis lasiantha,* and Digger pine. The most mesic N.-facing cliffs have a scattering of canyon live oak and such characteristic species as *Eupatorium shastensis.* Occasional patches of similar vegetation exist on S.-facing slopes off of limestone on Brock Shale.

• Low Elevation Mixed Conifer Forest (84110, 81100, 84131): 1562 acres (633 ha). This association occupies the ravine bottoms and sheltered exposures. It is divisible into two subtypes: one which bears a resemblance to the coastal mesic Douglas-fir-mixed evergreen forests and one more similar to xeric ponderosa pine-Douglas-fir type (SAF type 244, Eyre 1980).

The Douglas-fir canyon-bottom subtype is well-protected from crown fire, and the largest dominants are 150 ft (46 m) tall and between 5 and 6 ft (1.5-1.8 m) dbh. Typical Douglas-fir dominants are 2-4 ft (0.6-1.2 m) dbh and are associated with

large individuals of canyon live oak, big-leaf maple, Pacific madrone *(Arbutus menziesii),* and California black oak (up to 4 ft, 1.2 m dbh). Beneath the taller trees is an understory of woody species including Pacific dogwood *(Cornus nuttallii), Corylus cornuta* ssp. *californica, Holodiscus discolor, Physocarpus capitatus, Toxicodendron diversilobum, Rosa gymnocarpa,* and *Ribes sanguineum.* The herb layer, which is diverse and variable in cover, includes *Viola ocellata, Trientalis latifolia, Asarum hartwegii, Smilacina racemosa* var. *amplexicaulis, Campanula prenanthoides, Dryopteris arguta, Polystichum munitum, Adiantum jordanii,* and *Heuchera micrantha* var. *pacifica.*

The ponderosa pine-dominated subtype occurs on higher N.-facing slopes and on relatively sheltered W.- and E.-facing slopes. California black oak is also a common component of the tree strata, and occasional individuals of sugar pine *(Pinus lambertiana)* may occur at upper elevations. Shrub and herb cover is sparser than in the Douglas-fir type and includes the shrubs *Arctostaphylos viscida, Ceanothus prostratus, C. lemmonii,* and *Lupinus albifrons* over a scattered low herbaceous cover of *Balsamorhiza deltoidea, Hieracium albiflorum, Apocynum pumilum, Lotus stipularis* ssp. *balsamifera, Lupinus albicaulis, Carex multicaulis, Festuca californica,* and *Horkelia tridentata* (among others).

• Canyon Riparian Forest (61510): Acreage small (<100 acres or 40 ha). This association lines the deeper canyon bottoms, surrounds springs, and follows trickles up shady N. slopes. The association is best developed along Low Pass, Flat, and Ripgut creeks. Dominant trees and shrubs include white alder *(Alnus rhombifolia),* Oregon ash *(Fraxinus latifolia),* big-leaf maple, *Cornus sessilis, Calycanthus occidentalis,* and *Prunus virginiana* var. *demissa.* In sunny locations *Vitis californica, Rubus ursinus,* and *Smilax californica* climb over trees and shrubs. In deep shady canyons Pacific yew *(Taxus brevifolia)* and vine maple *(Acer circinatum)* may be locally common, and *Cornus sessilis* tends to dominate. The herb understory varies depending on shading and water availability. Typical species include *Woodwardia fimbriata, Aralia californica, Peltiphyllum peltatum, Mimulus guttatus,* and *Luzula divaricata.*

Plant Diversity

A total of 257 taxa are listed in the establishment record, an updated version of the list in the ecological survey.

Conflicting Impacts

Despite the fact that the S. end of the area is within the Whiskeytown-Shasta-Trinity National Recreation Area, it is relatively remote and receives little visitation except from hunters and spelunkers visiting the caves in the Low Pass region. Some cave vandalism has occurred in the past, and a jeep road enters Low Pass Canyon, traversing the limestone in a sensitive area (caves and associated flora and fauna and fossil deposits). The road will be closed following designation as an RNA, and recreational entry of the caves will be prohibited.

9. INDIAN CREEK BREWER SPRUCE (Sawyer, Stillman, and Stekel 1978)

Location

This candidate RNA (dropped from consideration as of 1982) is on the Klamath National Forest, Siskiyou County, and is approximately 15 miles (24 km) NW. of Happy Camp. It occupies portions of sections 32 and 33 T19N, R6E and sects. 4 and 5 T18N, R6E, HBM (41°59'N., 123°31' W.) USGS Polar Bear Mtn. quad. It lies less than 0.5 miles (0.8 km) south of the Oregon border *(fig. 23).*

Target Element

Brewer Spruce *(Picea breweriana)*

Distinctive Features

• Dominant Brewer Spruce: This area was rated as one of the best stands of Brewer spruce seen in the Klamath Region by the authors of the ecological survey *(fig. 24).* Particularly notable is the large area of dominance by this unique Klamath Province endemic.

• Accessibility of Brewer Spruce Stands: Many Brewer spruce stands are relatively isolated and thus difficult to study. However, the proximity of this stand to a major paved Forest Service road (Happy Camp-O'Brian road) facilitates access and study.

• Variability in Successional State: The recent cutting at the southern end of the area adds some variability to the vegetation, providing different conditions in which to study Brewer spruce regeneration from the adjacent forest stands.

• Rare Plant Taxa: Three CNPS rare plants have been identified from the area. These are *Bensoniella oregona* (List

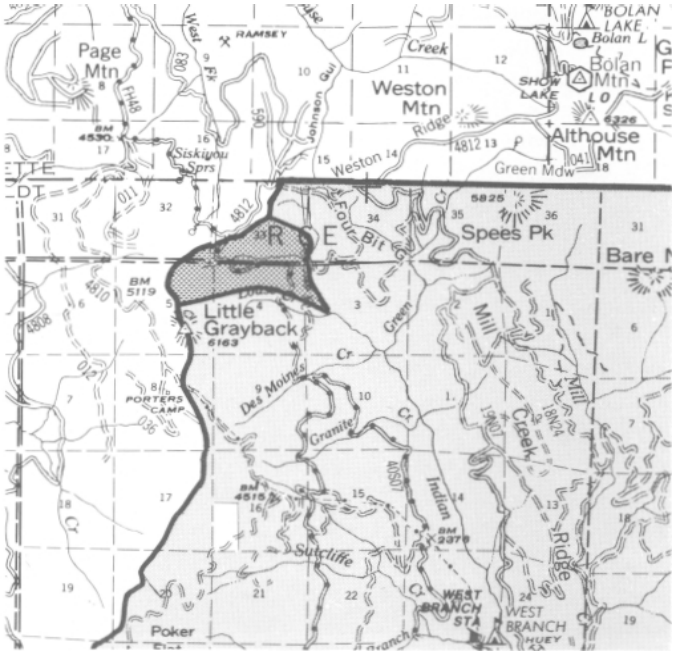


Figure 6--The Indian Creek Brewer Spruce study area.

1b), *Pedicularis howellii* (List 4), and *Vaccinium coccinium* (List 3). The *Vaccinium* is a major component of the understory of the mesic phase forest.

Physical Characteristics

The area covers ca. 500 acres (202 ha) of the upper headwaters of Indian Creek, a major southeastward-flowing tributary of the Klamath River. Elevations range from ca. 3500 to 5700 ft (1067-1737 m). Slopes are largely NE.-and S.-facing with N.- and E.-facing slopes also well-represented. Slopes range from moderate to steep. Rocks are pre-Cretaceous metasediments. Soils show moderate development and appear to be internally well-drained. Precipitation at the site averages between 70 and 80 inches (1778-2032 mm) annually (Rantz 1972). January mean minimum temperatures are on the order of 20 °F (-7 °C), and July maximum temperatures are ca. 87 °F (31 °C).

Association Types

Twenty releves and 30 points (point-centered quarter method) were chosen to sample the only forest described from the area. Acreages are not given for the associations.

• Brewer Spruce/*Quercus sadleriana* (85410, 85310): This association is placed in the red fir *(Abies magnifica)* zone of the western Klamath Region (Sawyer and others 1977). It can be classified as representing the Brewer spruce/*Quercus sadleriana* type. Two phases occur locally: a mesic *Achlys triphylla* phase, and a more xeric *Arctostaphylos patula* phase. Only minor differences exist between samples in these phases.

Figure 7--Indian Creek Brewer Spruce: Brewer spruce and noble fir at edge of Sadler oak-dominated chaparral (L. Johnson).

The mid-slope *Achlys triphylla* phase has a relatively high diversity of understory herbs and shrubs (19 shrub and 21 herb species indicated). Both mid-slope and upper-slope phases are dominated by Brewer spruce and white fir *(Abies concolor).* Secondary associates are noble fir *(Abies procera),* Douglas-fir *(Pseudotsuga menziesii),* and sugar pine *(Pinus lambertiana).* Tree reproduction is mainly spruce and white fir. Of the understory species, *Vaccinium coccinium, Quercus sadleriana, Pyrola secunda, Chimaphila umbellata, Achlys triphylla, Rubus lasiococcus, Linnaea borealis, Clintonia uniflora,* and *Nothochelone (Penstemon) nemorosa* are among the most conspicuous in the mesic *Achlys* phase.

In the more xeric upper-slope, or *Arctostaphylos patula* phase, 14 shrub and 13 herb species are listed from the releves. *Quercus sadleriana, Arctostaphylos patula, Vaccinium coccinium, Chimaphila umbellata, Pyrola secunda,* and *Pyrola picta* are among the most important species. Brewer spruce loses its dominance to white fir in this phase of the forest.

Stand analysis is made largely from the mesic *Achlys* phase. Tree densities are 219/ha with white fir represented by 72 and Brewer spruce by 87 trees/ha. Douglas-fir dominates in basal area (14.2 m^2/ha), followed by spruce (12.7 m^2/ha) and white fir (5.3 m^2/ha). The relatively low density and basal area values (see # 15) for the forest reflect the open nature of the stand. Growth rates are sampled from several cored trees of the major species. Brewer spruce has a mean radial growth of 8.3 years/cm (n=10), whereas that of white fir was 5.8 years/cm (n=7).

• Rock Outcrops (no Holland equivalent): Small areas on the upper slopes near ridges are dominated with a sparse cover of rupicolous species such as *Quercus garryana* var. *breweri, Arctostaphylos nevadensis, Amelanchier alnifolia, Penstemon newberryi* ssp. *berryi,* and *Sedum obtusatum.*

• Successional Montane Chaparral (37510): An old clear-cut block dominated by successional montane chaparral is located south of the main Brewer spruce area. Brewer spruce seedlings are scattered among the shrubs of *Arctostaphylos patula* and *Quercus sadleriana. Penstemon anguineus, Nothochelone nemorosa,* and *Chimaphila umbellata* are also common here.

Plant Diversity

Ninety-nine taxa of vascular plants are listed.

Conflicting Impacts

The main stand of Brewer spruce is bisected by the Happy Camp-O'Brian road. The area has been dropped as a candidate RNA since the ecological survey was written because of its relatively small size and the presence of a major road within the Brewer spruce stand. It is still designated as a Special Interest Area because of its superior representation of Brewer's spruce.

10. MANZANITA CREEK (TRELORITA) (Taylor and Teare 1979a)

Location

This candidate RNA is on the Shasta-Trinity National Forest. The S. end of the area lies ca. 1 mile (1.6 km) E. of Big Bar along State Route 299. The area includes all or portions of fourteen sects. of T34N, R12W MDBM (40°48'N., 123°14'W.) USGS Helena, DeLoma, and Big Bar quads *(fig. 25).*

Target Element

Ponderosa pine-Douglas-fir *(Pinus ponderosa-Pseudotsuga menziesii)*

Distinctive Features

• Large Pristine Watershed: This area contains the entire watershed of Manzanita Creek. There is a gauging station at the mouth of the creek which would be useful for watershed and ecosystem studies. The entire area is relatively undisturbed by human activity. Old trails provide access to much of the area. Because of the area's size and topographic relief, at least nine SAF forest types are included. Seventeen plant associations were recognized after extensive sampling of the area. These include riparian types as well as a series of forest types ranging from foothill Digger pine *(Pinus sabiniana)* to montane white fir *(Abies concolor).*

• Rare Plants: *Lewisia cotyledon* var. *heckneri,* a diagnostic member of the high ridgetop flora, is a member of CNPS List 1b.

Physical Characteristics

The study area covers ca. 6180 acres (2500 ha). Elevations range from 1200 ft (365 m) at Big Bar to 5932 ft (1808 m) atop Twin Sisters Mountain. Manzanita Creek flows to the S. with the prominent Treloar and Manzanita ridges bounding the W. and E. sides of the drainage, respectively. Slopes are generally steep (20-40°) with small terraces at lower elevations and relatively broad ridgetops. Manzanita Creek is a perennial stream with several minor ephemeral tributaries. The average gradient of Manzanita Creek is 296 ft/mile (56 m/km). Several springs occur in the drainage.

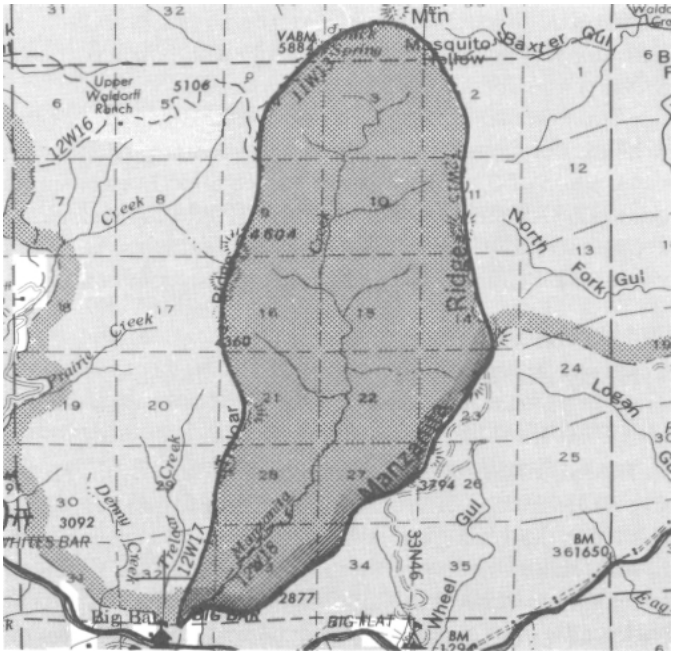


Figure 25--The Manzanita Creek study area.

The area is underlain by Pre-Cretaceous metamorphic rocks (primarily noncalcarious). A fault cuts across the upper part of the drainage separating the metasediments from metavolcanics of the same approximate age in the upper basin. There are slivers of serpentinized rock along this fault line. Soils are assumed to be Sheetiron-Josephine, Dubakella-Neuns, and Henneke-Stonyford complexes. Annual precipitation at Big Bar is 40 inches (1018 mm) with a mean annual temperature of 56°F (13.4 °C). Temperatures are substantially lower, and precipitation is substantially higher at the highest elevations.

Association Types

Vegetation is sampled extensively with twenty-six 314-m^2 plots where density and cover data are obtained in addition to 70 releves where these and other characters are estimated. Association tables are constructed from the releve data, resulting in the following classification. Acreages are not given for the various associations. Six major alliances are defined and are further broken down into associations.

White Alder-*Peltiphyllum peltatum* Alliance

• White alder-miner's dogwood *(Alnus rhombifolia-Cornus sessilis)* Association (61510): This riparian association occurs along Manzanita Creek and on the lower reaches of its tributaries with year-round flow. Other trees include Oregon ash *(Fraxinus latifolia),* and big-leaf maple *(Acer macrophyllum).* Pacific yew *(Taxus brevifolia)* is occasional along with Douglas-fir and canyon live oak *(Quercus chrysolepis).* Shrubs are diverse and include *Acer circinatum, Corylus cornuta* ssp. *californica, Symphoricarpos mollis, Crataegus douglasii, Rhamnus purshiana, Philadelphus lewisii* ssp. *gordanianus,* and *Ribes roezlii. Lonicera hispidula, Rubus leucodermis, R. procerus,* and *Vitis californica* festoon the trees and shrubs in sunnier areas. Herbs are few and large including *Aralia californica.*

• White Alder-Creek Dogwood *(Alnus rhombifolia-Cornus stolonifera)* Association (61510): This is the upper elevation equivalent of the previous association. It occurs generally above 4000 ft (1200 m). Creek dogwood, *Rhododendron occidentale,* and the willow *Salix commutata* dominate under a scattered canopy of white alder. Shrubs are rare and herb cover is high, often dominated by *Carex amplifolia* and *Torreyochloa (Puccinellia) pauciflora.*

Digger Pine Alliance

• Digger Pine-*Cercis occidentalis* Association (71322): This association occupies the lower S. and E.-facing steep, rocky slopes. It includes a canopy of scattered (119 stems/ha) Digger pine (basal area 21.5 m^2/ha), canyon live oak, and Oregon white oak *(Quercus garryana)* with chaparral shrubs such as *Ceanothus cuneatus, Cercis occidentalis,* and *Toxicodendron diversilobum.*

Annual herbs are important, but not identified.

• *Ceanothus cuneatus* Association (37810): This chaparral association occurs on rocky, xeric slopes at low elevations. It is patchy in distribution. The dominant is the only important shrub. Annual herbs are dense, but not discussed.

Douglas-fir Alliance

• Oregon White Oak Association (71110): Many understory taxa are shared among these next three associations (associations 5 through 7). Douglas-fir is the principal invader of seral forms of this association. The nonseral form occupies steep rocky, but mesic slopes. This type has a dense canopy of Oregon white oak with a very sparse shrub layer. Herbaceous cover is principally the native grass *Bromus marginatus.*

• Douglas-fir-Canyon Live Oak Association (81100): This is the most widespread association type in the study area. It occurs at lower elevations on N. slopes but ranges to S. slopes at mid- to upper elevations. Douglas-fir forms an open canopy over a subcanopy of dense canyon live oak. Big-leaf maple and Pacific madrone *(Arbutus menziesii)* are important codominants. Douglas-fir averages 20.4 m^2/ha and 254 stems/ha. Canyon live oak averages 9.2 m^2/ha and 593 stems/ha.

• Ponderosa pine-California black oak *(Pinus ponderosa-Quercus kelloggii)* Association (84110, 84131): This distinct association is less mesic than the previous one. Open park-like stands of ponderosa pine and sugar pine *(Pinus lambertiana)* form a high canopy over large scattered California black oak. Ponderosa pine averages 62.5 m^2 /ha basal area, and Douglas-fir averages 34.8 m^2/ha with sugar pine at 18.7 m^2/ha. Densities of these species are 190, 55, and 310/ha, respectively. Dense reproduction of Douglas-fir occurs in areas that have been spared from recent fire. Following crown fire, *Ceanothus integerrimus* is the pioneer shrub. Stands with various successional states occur, indicating a clear trend toward Douglas-fir-canyon live oak forest with infrequent fire.

White Fir Alliance

• Douglas-fir-Pacific Dogwood *(Cornus nuttallii)* Association (82420): This association occurs on the most mesic, lower elevation sites. White fir-dominated forest replaces it at upper (cooler) elevations. Douglas-fir forms a dense closed canopy averaging 67 m^2/ha basal area and 106 stems/ha. White fir is codominant, averaging 19.6 m^2 /ha basal area and 403 stems/ha. Pacific dogwood and big-leaf maple form a subcanopy. The shrub and herb layers are well-developed and include *Symphoricarpos mollis, Toxicodendron diversilobum, Polystichum munitum* var. *imbricans,* and *Rosa pisocarpa.*

• White fir-Douglas-fir Association (84240): This is a minor transitional association between Douglas-fir and white fir dominance. Two plots indicate an average basal area of 50 m^2/ha and 33 m^2 /ha for white fir and Douglas-fir, respectively.

• White Fir-*Acer glabrum* Association (84240): This is the dominant climax vegetation on upper mesic slopes *(fig. 26).* White fir dominates with an average basal area of 90 m^2/ha. *Acer glabrum* forms a low subcanopy along with *Sorbus scopulina.* A diverse shrub layer includes *Sambucus melanocarpa,* and *Ribes nevadense.* The herb layer is also well-developed and diverse with such species as *Castilleja miniata, Actaea rubra* ssp. *arguta, Agastache urticifolia, Chamaenerion (Epilobium) angustifolium,* etc. Following fire, *Quercus vaccinifolia* or knobcone pine, or both establish. Succession leads to stands in the white fir-Douglas-fir association or white fir association, followed by the establishment of the white fir-mountain maple association.

• White Fir Association (84240): This association is seral after crown fire in the former association type. A typical stand has dense even-aged white fir over dead or senescent *Quercus vaccinifolia.* The understory is sparse or absent.

• Knobcone Pine-*Quercus vaccinifolia* Association (83210): This association develops on steep slopes at mid-elevation after intense fire. It is seral to the white fir-dominated forests. Knobcone pine forms a dense even-aged canopy averaging 34 m^2/ha and 594 stems/ha. *Quercus vaccinifolia* forms a dense shrub understory. *Pedicularis densiflora* and *Apocynum pumilum* are among the few herbs.

• *Salix jepsonii-Paxistima myrsinites* Association (63500): This distinctive minor association occurs in ravines and N.-facing hollows at upper elevations. Its successional status is unclear. Typical stands have a scattered overstory of white fir over a tall-shrub canopy of *Salix jepsonii, Euonymus occidentalis, Rhamnus purshianus, Acer glabrum, Amelanchier pallida, and Ribes nevadense. Paxistima myrsinites* is a conspicuous, small shrub. Herbs such as *Elymus glaucus, Trientalis latifolia, Disporum hookeri* ssp. *trachyandrum, Smilacina racemosa* var. *amplexicaulis, Ligusticum californicum, Eupatorium occidentale, Campanula prenanthoides,* and *Adenocaulon bicolor* line the rocky ravine bottoms.

Quercus vaccinifolia Alliance

• *Cercocarpus betuloides* var. *macrourus* Association (37510): This vegetation occurs on the steepest slopes at the head of the drainage. On rocky sites it is climax, but it is seral after intense fires on deeper soils, succeeding to white fir-dominated forests. The most conspicuous species of the seral type are the shrubs *Quercus vaccinifolia, Garrya fremontii, Arctostaphylos patula, Prunus emarginata, Ceanothus*

Figure 26--Manzanita Creek: View of sharp boundary between white fir forest and rocky site *Holodiscus* type (D. Taylor).

integerrimus, and *C. velutinus.* The nonseral ridgetop phase is dominated by *Cercocarpus betuloides, Quercus vaccinifolia,* and *Q. garryana* var. *breweri.*

Holodiscus microphyllus Alliance

• *Holodiscus microphyllus-Eriogonum compositum* Association (no Holland equivalent): This association occurs on flat and rolling rock outcrop areas at the head of the drainage. The vegetation is sparse with scattered large *Holodiscus microphyllus* shrubs and clumps of *Eriogonum compositum.*

• *Holodiscus microphyllus-Silene grayi* Association (no Holland equivalent): This vegetation occurs on the highest xeric, rocky summit of Twin Sisters Mountain. Along with the two species defining this association are the herbs *Luina hypoleuca* and *Galium grayanum.*

• *Holodiscus microphyllus-Lewisia cotyledon* var. *heckneri* Association (no Holland equivalent): This association is restricted to near vertical cliff faces. *Selaginella wallacei, Pellaea brachyptera,* and the two previously named species occur in the small crevices and ledges of the rocks.

Plant Diversity

Two hundred forty-nine taxa are listed.

Conflicting Impacts

An old homestead exists with remnants of a cabin and water ditch. The forests are mostly young and vigorously growing stands, with only scattered patches of old growth present. The general youth of the forest stems from the occurrence of 11 major fires in the drainage from 1927 to 1936. From 1917 to 1927, there was only 1 fire.

11. MOUNT EDDY (Whipple and Cope 1979)

Location

This candidate RNA is on the Shasta-Trinity National Forest ca. 9 miles (15 km) west of Mount Shasta City. It lies within portions of sect. 24 T40N, R6W and sect. 18 T40N, R5W MDBM (41° 20'N., 122° 30'W.) USGS Mount Eddy quad *(fig.* 27).

Target Element

Foxtail Pine *(Pinus balfouriana)*

Distinctive Features

• Rare Flora: The following species known from the area are listed by CNPS: *Darlingtonia californica* (List 4; clumps at 7400 ft [2256 m] may be the highest elevation for the species), *Veronica copelandii* (List 4), *Eriogonum alpinum* (List 1b), *Eriogonum siskiyouense* (List 4), *Draba aureola* (List 1b), *Cryptantha subretusa* (List 2), *Campanula scabrella* (List 4), and *Thelypodium brachycarpum* (List 4). An additional species, *Lupinus lapidicola* (List 4) occurs just east of the proposed boundary.

• Extensive Foxtail Pine Forest: The more than 200 acres (81 ha) of foxtail pine forest included in the study area is an excellent example of the Klamath Province type of this forest.

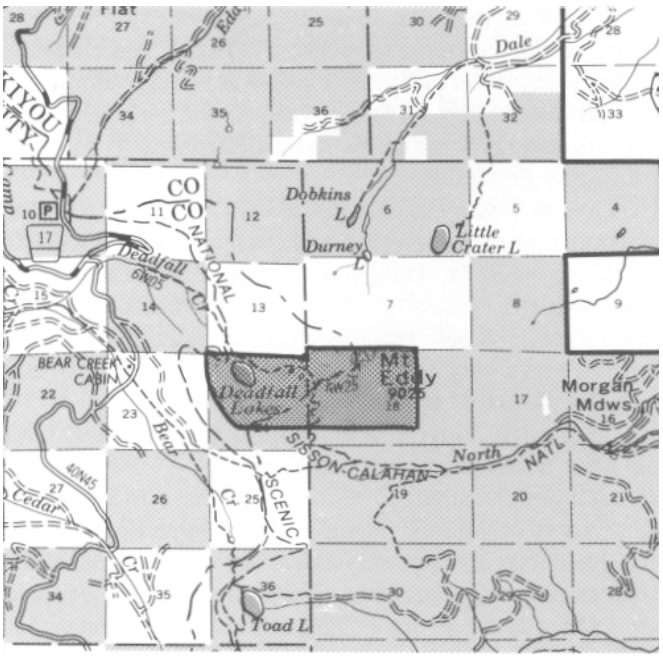


Figure 27--The Mount Eddy study area.

Physical Characteristics

The area covers ca. 940 acres (380 ha). Mt. Eddy at 9025 ft (2751 m) is the highest peak in the Klamath Province *(fig. 28).* The area includes a ridge extending S. from the summit, one trending SW., and a lower ridge to the S. of the Deadfall Lakes. It also includes the majority of the Deadfall Lakes basin. The lowest elevation is ca. 7200 ft (2195 m). W.- and S.-facing slopes predominate, varying from 20 to 50 percent.

The area is underlain by the Trinity Ultramafic Pluton. Rock is primarily peridotite in varying degrees of serpentization. Pleistocene glaciation is evident particularly in the Deadfall Lakes drainage. Soils are typically thin, gravelly, and unstable.

Figure 28--View to summit of Mt. Eddy across ultramafic subalpine forest of foxtail, whitebark and western white pines (L. Johnson).

Throughout the region, surface rock covers 50-75 percent of the ground. Climate is relatively dry by Klamath montane standards with the Deadfall Lakes snow course averaging 33 inches (84 cm) of water (40 percent moisture content) on April 1. Estimates from Rantz (1972) suggest total precipitation of between 50 and 60 inches (1270-1524 mm). Mean daily temperatures extrapolated from Mt. Shasta City would be 24 °F (-4 °C) in January and 59°F (15 °C) in July at the lower elevations of the area.

Association Types

Data is provided from 20 releves and eighteen 0.1-acre (0.04-ha) plots each in the western white pine *(Pinus monticola)* forest and foxtail pine forest.

• Western White Pine/*Angelica arguta* (84160, 45100, 45210,51120): 480 acres (194 ha). This association occurs at the lowest elevations of the area. It is typically an open forest (20 percent cover) dominated by western white pine with white fir *(Abies concolor) as* an important subdominant. Whitebark pine *(Pinus albicaulis)* is also a regular constituent at the upper elevational limits of this type. Results from plots sampled in this type indicate a density of 109 trees/ha and a total basal area of 31.8 m^2/ha with *P. monticola* comprising 85 percent relative density. Based on 10 cored *P. monticola,* the age-height curve ascends gradually with dominant trees ca. 70-80 ft (21-24 m) tall and between 300 and 400 years.

Typically the understory covers no more than 15 percent and is dominated by *Arctostaphylos nevadensis* and *Quercus vaccinifolia* with only two other shrub species listed. On more xeric and higher elevation S.-facing slopes (unsampled), the understory may reach 65 percent. Other unsampled understory species include *Cercocarpus ledifolius,* and local understory dominance (on N. slopes) by *Artemisia tridentata, Lonicera conjugialis, Lupinus croceus,* and *Bromus marginatus.*

The meadow, streamside, and lakeside vegetation is also grouped within this forest type. *Dodecatheon alpinum, Caltha howellii, Helenium bigelovii, Darlingtonia californica, Veronica copelandii,* and several *Carex* and *Heleocharis* species dominate the meadows. In addition to these species, streamsides and lakesides also have *Potentilla fruticosa* and lodgepole pine *(Pinus contorta* ssp. *murrayana).* The total number of herbs listed on releves is 40. Those with the highest presence include *Anemone drummondii, Crepis pleurocarpa, Arenaria nuttallii, Polygonum davisiae, Hydrophyllum occidentale, Monardella odoratissima, Senecio integerrimus, Achillea lanulosa, Phlox diffusa,* and *Erysimum perenne.*

• Foxtail Pine/*Anemone drummondii* (86300): 240 acres (97 ha). This is the other forest in the area and occurs at elevations above ca. 7800-8000 ft (2377-2438 m). This association is even more open than the previous one with average canopy cover ca. 18 percent. Foxtail pine is the only tree present in 50 percent of the samples and the major component of all releves. Foxtail pine strongly dominates the sample. The total basal area for this type is 42.5 m^2/ha, and the total density is 108 trees/ha. The age-height relationship for 10 *P. balfouriana* trees in this forest is more curvilinear than for *P. monticola,* with rapid vertical growth taking place in the first 100-150 years and leveling off at ca. 30-40 ft (9-12 m) after ca. 200 years. The oldest tree sampled is 330 years. Scattered individuals of *Pinus albicaulis* with occasional *P. monticola* at lower elevations are the only trees other than *P. balfouriana.*

Shrub understory ranges from practically nil at upper elevations to ca. 25 percent at the lower levels of this type. *Anemone drummondii* is virtually ubiquitous with 33 other herbs listed on the releves including *Phlox diffusa, Achillea lanulosa, Eriogonum umbellatum, Astragalus whitneyi, Poa pringlei, Arenaria nuttallii, Erysimum perenne,* and *Polygonum davisiae.*

• *Penstemon procerus/Potentilla glandulosa* (91200): 220 acres (89 ha). This herb-dominated association occurs on the summit ridges. It has been divided into two phases. The *Lesquerella occidentalis* phase is the highest elevation form and occurs between 8500 and 9000 ft (2591-2743 m). It contains more *L. occidentalis, Poa pringlei, Erigeron compositus, Hulsea nana, Potentilla fruticosa,* and *Ivesia gordonii* than the other phase. The *Eriogonum siskiyouense* phase occurs at elevations between 7900 and 8100 ft (2408-2469 m) on the southern slopes of the ridge above Deadfall Lakes. It contains more *Crepis pleurocarpa, Phlox diffusa, Sedum lanceolatum, Arenaria congesta,* and *Eriogonum siskiyouense* than the *Lesquerella* phase. Typical cover on the rocky slopes of this type is ca. 25 percent.

Plant Diversity

Two hundred eighty-nine taxa are listed.

Conflicting Impacts

The area is relatively heavily used by recreationists. The trail to the summit is heavily used, and the lakes and meadows of the lower elevations are under relatively heavy impact (including some off-road vehicle use in recent years). The large quantity of private land surrounding the proposed RNA may necessitate unnatural and undesirable boundaries to the area and not allow for inclusion of the largest populations of several of the rare plant taxa. An additional threat to the area not apparent at the time of the ecological survey is the possible alpine skiing development of the summit area of Mt. Eddy.

12. NORTH TRINITY MOUNTAIN (Sawyer 1981b)

Location

This candidate RNA is on the Six Rivers National Forest. It lies ca. 11 miles (18 km) NE. of the town of Hoopa, Humboldt County, in sects. 3, 4, and 5 T8N, R6E and sects. 32 and 33T9N, R6E, HBBM (41°7N., 123°30'W.) USGS Tish Tang Point and Trinity Mtn. quads *(fig. 29).*

Target Element

White fir *(Abies concolor)*

Distinctive Features

• White Fir Forest: This type of forest is the major cover over large portions of the upper elevation Klamath Mountains

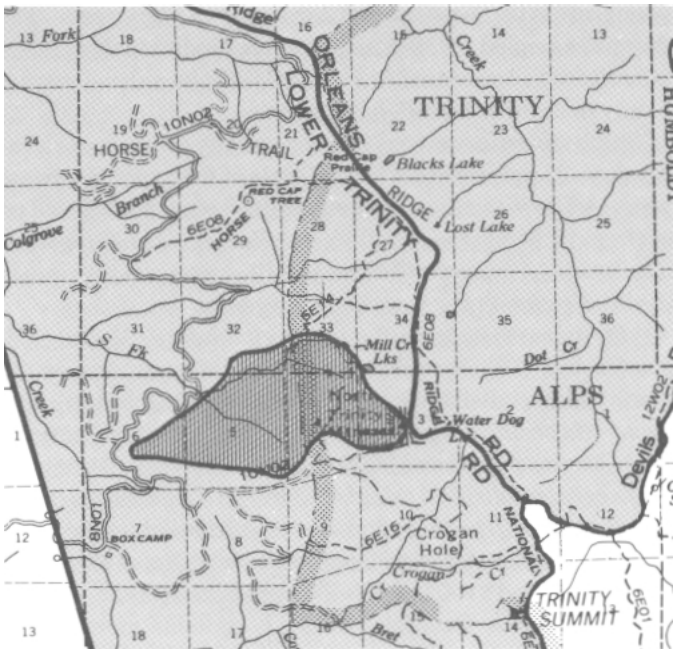


Figure 29--The North Trinity Mountain study area.

Province. Although it occurs in several other candidate and established RNA's of the Klamath region (e.g., #'s 2, 5, 10, 13, 19), it is not particularly well represented at those sites. The varied slope exposure and the broad elevational range within the area enable a wide representation of this important vegetation type, including some overlap with lower elevation forests dominated by Douglas-fir *(Pseudotsuga menziesii)* and upper elevation forests dominated by noble fir *(Abies procera)* forest.

• Noble Fir Forest: Although not specifically discussed in the ecological survey, the North Trinity Mountain area has been singled out as having one of the best stands of this species in California (Sawyer and Thornburgh 1969). The area should also be known and studied for this value.

• Rare Flora: One species, *Gentiana setigera, is* on List 3 of CNPS. It occurs locally in the meadows of Red Cap Hole.

• Research Precedent: Because this montane forest is the most accessible to Humboldt State University, the University has already used the area for research and educational purposes.

Physical Characteristics

The area includes ca. 640 acres (259 ha) of slopes drained by the S. Fork of Mill Creek (study area shown is larger). Slopes range from gentle to steep and include N., W., and S. exposures. Terraces are minor, especially at lower elevations. Slopes in the lower W. portion are most abrupt. Elevations range from 4500 to 6362 ft (1372-1939 m).

The area is underlain by quartz diorite of the Ironside Mountain Batholith. Glacial action created Mill Creek Lakes and the slopes behind the lake are scoured. Morainal deposits are common. Soils are likely to be of the Chawanakee (sand loamy drying by mid-summer) and Chiquito (shallow, on upper slopes and ridges) series, but also include large areas of rock outcrop and coarse loamy mixed soils typical of glacial till. Snow typically lingers until July on high N. slopes. Mean annual temperatures are estimated at being somewhat lower than 50 °F with average annual precipitation ca. 70 inches (1778 mm).

Association Types

Twenty-one releves and ten 0.1-acre strips are sampled in the white fir forest. Areal cover is not given for the associations.

• White Fir Forest (84240): The majority of the area is classified as a part of this forest type, which is divided locally into two series. Evaluation of the samples results in the classification of the white fir forest into the white fir/*Pteridium aquilinum* and the white fir/*Quercus sadleriana* subtypes. Sampling is conducted primarily on the mid-slopes of the area. The canopy is dominated by white fir (89 percent of the 403 trees/ha). Basal area for the forest is 118 m^2/ha, of which white fir makes up 73 percent. There area few large sugar pines *(Pinus lambertiana),* which make up a moderate portion of the basal area, but the two most important subdominants are incense-cedar *(Calocedrus decurrens)* (basal area 15 m^2/ha) and noble fir (12 m^2/ha). Trees older than 100 years reach heights of ca. 120 ft (37 m).

The first subtype is an extensive closed forest with canopy and understory dominated by white fir *(fig. 30).* The shrub layer

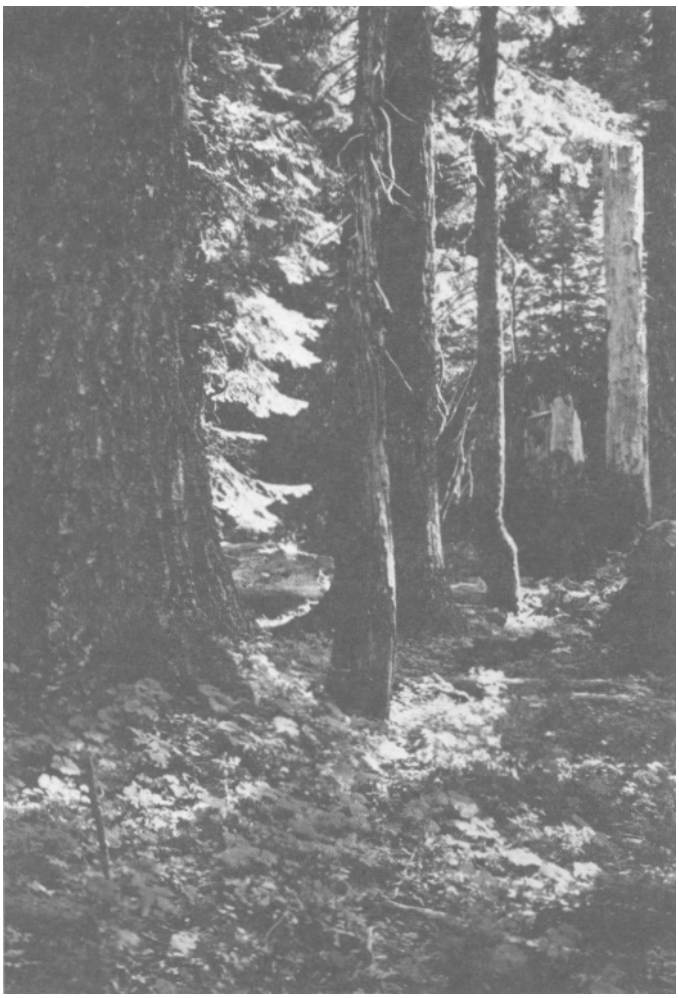


Figure 30--North Trinity Mountain: General structure of the white fir/*Pteridium aquilinum* type (J. Sawyer).

is not well-developed, although 12 species are noted, with *Acer glabrum, Rubus parviflorus,* and *Symphoricarpos hesperius* most common. Some 25 herb taxa are restricted to this type, and eight more are most common here. *Linnaea borealis is* common and suggests the mesic affinities of this forest type. Other important species include *Anemone deltoidea, Achlys triphylla, Chimaphila umbellata, Vancouveria hexandra, Rubus vitifolius,* and *Clintonia uniflora.*

The white fir/*Quercus sadleriana* subtype is also dominated by white fir in both canopy and understory (reproduction), but Douglas-fir is also an important component. This type is more extensive on steeper slopes at lower elevations than the previous one. *Quercus sadleriana* dominates the shrub layer with few herbs in the ground layer. Nine shrubs and 20 herbs are listed for the subtype. However, none of these species except *Q. sadleriana* accounts for more than 25 percent cover. The most conspicuous herb is *Chimaphila umbellata.*

• Montane Chaparral (37510): This type is termed white fir/*Quercus vaccinifolia* and is dominated by *Arctostaphylos patula* and *Quercus garryana* var. *breweri.* White fir and incense-cedar are frequent along with the shrubby sclerophylls. Only one herb is noted in the sample of this type, and it *(Apocynum androsaemifolium)* has very low cover.

• Noble Fir Forest (85310): This forest type is not discussed in depth, but does occur at the upper elevations near the top of North Trinity Mountain. It is probably similar in structure and density to other noble fir forests of the western Klamath Province (see #'s 5, 13, and 15).

• Meadows (45100): Although not specifically discussed, many of the taxa in the species list are typical meadow species, and a photograph of a small meadow with such species as *Veratrum californicum* is included in the survey.

Plant Diversity

Two hundred twenty-one taxa are listed.

Conflicting Impacts

Some logging has taken place in the past along the western boundary. Some trespass cattle grazing has occurred in the small meadows of Red Cap Hole. Some ORV use is reported on the access trail (an old jeep road) to Mill Creek Lakes.

13. PEARCH CREEK (Keeler-Wolf 1987b)

Location

This candidate RNA (dropped in 1987) is on the Six Rivers National Forest. It is ca. 3 miles (5 km) E. of the town of Orleans. It lies within portions of sects. 26, 27, 28, 32, 33, 34, 35 T11N, R6E and sects. 2, 3 and 4 T10N, R6E HBM (41°18'N., 123°30' W.) USGS Orleans and Orleans Mtn. quads *(fig. 31).*

Target Element

Douglas-fir- tanoak-Pacific madrone (mixed evergreen forest)

Distinctive Features

• Great Elevation Span: This relatively small area has an elevational difference of nearly one mile (1.6 km) in three horizontal miles (4.8 km). The diversity of slope exposures ensures a broad sample of Klamath Province vegetation from low to moderately high elevations. However, none of these vegetation associations is particularly well represented. This is particularly true for the upper elevation noble fir *(Abies procera)* forest, montane chaparral, rock outcrop, and white fir *(Abies concolor)* forest.

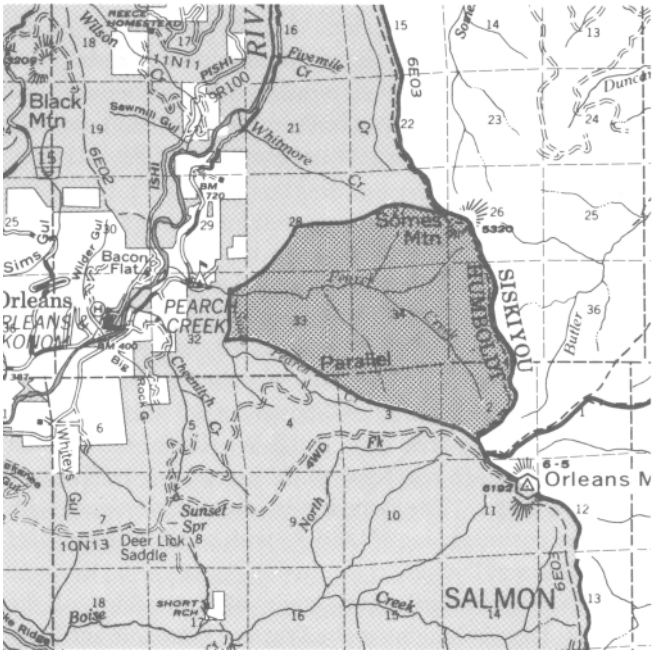


Figure 31--The Pearch Creek study area

• Mixed Evergreen Forest Formation: The potential variety of mixed evergreen vegetation types is limited by the effects of the 1959 Pearch Fire, which burned nearly all of the area *(fig. 32).* Much of the canopy was destroyed in the S.- and W.-facing exposures while the understory of N.-facing forests was virtually eliminated. Thus, much of the area is in relatively early

Figure 32--Pearch Creek: successional resprouts of tanoak, Pacific madrone, and giant chinquapin surrounding dead and damaged Douglas-fir, the result of the 1959 Pearch Fire. Sommes Mountain in background.

stages of secondary succession. Unlike many areas of the western Klamath Province, there is no pronounced band of giant chinquapin *(Chrysolepis chrysophylla)* subdominance on mesic northerly exposures. This may be the result of fire and relatively low precipitation for this vegetation type (Keeler-Wolf 1988a).

Physical Characteristics

The area (ca. 2800 acres, 1133 ha) includes the upper watershed of Pearch Creek, a four-mile long permanent tributary to the Klamath River. Elevations range from 700 to 5865 ft (213-1788 m). Topography is relentlessly steep with upper slopes ranging from 50 to 90° and lower slopes averaging only slightly less steep. Elevation gradients of up to 3300 ft/mile (625 m/km) occur. This area lies on the W. side of the Salmon Mountains 4 miles (6 km) south of the junction of the Klamath and Salmon rivers. The drainage is oriented westward with principal exposures being N. and S., with some W. exposures along the Salmon Divide.

Rocks are primarily low-grade metamorphics of the greenschist faces belonging to the Western Paleozoic and Triassic Plate of the Klamath Mountains Province. There are also small outcroppings of gabbro, andesite, and graywacke. Soils are generally thin and rocky with many upper slope areas having small cliffs and outcrops. Climate is variable because of the great elevational range. Upper slopes may receive up to 70 inches (1778 mm) precipitation per year with much snow, while lower elevations average ca. 50 inches (1270 mm) of, primarily, rain per year. Summer temperatures at the lower elevations may occasionally approach 100 °F (38 °C) although upper elevation maxima may be ca. 85 °F (29 °C). Winter minima at highest elevations may drop to 15 °F (-9 °C).

Association Types

Mixed Evergreen Forest Formation (81100, 82420): 1972 acres (798 ha). This general vegetation formation covers the majority of the area, and is divided into the following six associations. Nine 100-m^2 quadrats are sampled in this vegetation zone.

• Douglas-fir *(Pseudotsuga* menziesii)-dominated forest (82420). 576 acres (233 ha). This association occurs largely on N.-facing slopes below 4500 ft (1372 m). It has a canopy of even-aged Douglas-fir averaging 2-3 ft (61-91 cm) dbh and 120-140 ft (37-43 m) tall with ages between 180 and 220 years.

The most mesic of these forests have understories of *Acer circinatum,* Pacific yew *(Taxus brevifolia), Linnaea borealis,* and *Corylus cornuta* var. *californica.* The modal type has a dense understory dominated by spindly tan oak *(Lithocarpus densiflorus)* with *Berberis piperiana, Rosa gymnocarpa,* and *Smilacina racemosa* var. *amplexicaulis.* Forests on NW. exposures tend to have lower density of Douglas-fir with more xerophilic understory species such as Pacific madrone *(Arbutus menziesii),* canyon live oak *(Quercus chrysolepis),* and *Toxicodendron diversilobum* along with tanoak.

On five plots in this forest Douglas-fir has an importance value (relative density + rel. frequency + rel. basal cover X 100) of 155 with tanoak 97, Pacific dogwood *(Cornus nuttallii)* 32, Pacific madrone 8, and Pacific yew 8. Total basal area cover is 126 m^2/ha, and total stem density is 1460/ha. Douglas-fir clearly dominates in relative cover (91 percent) while tanoak dominates in relative density (55 percent). Big-leaf maple *(Acer macrophyllum)* also occurs in this forest, although is not represented in the sample. Understory shrubs and herbs of this association cover 25-60 percent and include *Gaultheria shallon, Berberis piperiana, Polystichum munitum, Rosa gymnocarpa, Vancouveria hexandra,* and *Disporum hookeri.*

• Canyon live oak woodland (81320): 488 acres (197 ha). This association, dominated by low canyon live oak, is extensive on upper S.-facing slopes. It suffers frequent fire damage, and most trees are shrubby resprouts. Very few other species occur.

• Successional N.-facing forest (81400): 466 acres (189 ha). Fire damaged much of the vegetation of the area in 1959. When fire destroys the canopy of Douglas-fir on N.-facing slopes, tanoak resprouts dominate much of the area. Pacific madrone, canyon live oak and occasionally giant chinquapin also occur as sprouts. Douglas-fir has densely colonized logging spurs and skid trails in a portion of the area which was logged after the 1959 fire. The remainder of the clearcut is strongly dominated by 25-year-old sprouts of tanoak.

• Forests on W.-and S.-facing exposures (81100): 366 acres (148 ha). Douglas-fir decreases in importance on these exposures relative to ponderosa pine *(Pinus ponderosa),* Pacific madrone, and canyon live oak. On xeric S. exposures tanoak is reduced in density, but remains important on most W.-facing exposures. This trend is present regardless of fire history. Certain W.-facing slopes contain large Douglas-fir up to 5ft (1.5 m) dbh which have survived fire damage for several hundred years. This forest is the classic mixed evergreen forest with sclerophylls and conifers codominant.

• Transitional mixed evergreen-white fir-Douglas-fir forest (84240, 82420): No acreage given. This association takes in the narrow mixing zone between lower-slope Douglas-fir forest and upper-slope white fir forest. This zone generally occurs on N.-facing slopes between 3600 and 4100 ft (1097-1250 m).

Four 100-m^2 plots are sampled. Douglas-fir dominates the tree stratum with an importance value (IV) of 178. White fir follows (IV 67), along with Pacific yew *(Taxus brevifolia)* (IV 37) and tanoak (IV 19). Total basal area is 101 m^2/ha, and total stem density is 530/ha. The understory sclerophylls are typically stunted as a result of frequent snow loading. Average ground cover is 30 percent. Shrubs and herbs are represented by 27 species in the sample. The most frequent species are *Berberis piperiana, Rosa gymnocarpa, Quercus vaccinifolia, Holodiscus discolor, Vancouveria hexandra, Achlys triphylla,* and *Whipplea modesta.*

• Knobcone Pine *(Pinus attenuata)* woodland (83210): 76 acres (31 ha). One dense stand of knobcone pine occurs adjacent to canyon live oak woodland on upper S.-facing slopes. It is essentially a subtype of canyon live oak woodland with little else to distinguish it floristically.

• White fir-Douglas-fir Forest (84240): 490 acres (198 ha). Above ca. 4400 ft (1341 m) white fir becomes the principal reproducer. The sclerophylls characteristic of the understory and subcanopy of the lower elevation Douglas-fir-dominated forest and transitional mixed evergreen-white fir forest drop

out, and the understory is very sparse and herb-dominated. Seven 100-m^2 plots are sampled in this type. Douglas-fir dominates the canopy (88 percent relative basal area, total 158 m^2/ha), with white fir the most abundant species (67 percent relative density, total 630 trees/ha). There are very few saplings and seedlings with an average density of only 20/ha, probably because the 1959 fire thinned the understory and because of slow subsequent reestablishment in the dense shade of the canopy.

The shrub and herb understory is poorly developed, averaging less than 15 percent cover and represented by 11 shrub species and 25 herb species. Among the most important species are *Berberis piperiana, Rosa gymnocarpa, Symphoricarpos acutus, Vaccinium membranaceum, Disporum hookeri, Achlys triphylla, Chimaphila umbellata, Polystichum munitum, Chimaphila menziesii, Stellaria jamesiana, Arnica latifolia, Campanula prenanthoides, Vancouveria hexandra,* and *Hieracium albiflorum.*

• Sugar Pine *(Pinus lambertiana)*-Douglas-fir Forest (84110):139 acres (56 ha). On a few W.- and NW.-facing slopes between 3800 and 4500 ft (1158-1372 m), sugar pine dominates, with Douglas-fir, white fir, and incense-cedar *(Calocedrus decurrens)* as subdominants. This forest is similar to more interior mixed conifer forests of the eastern Klamath Province. The understory is open and sparse.

• Rock Outcrop (no Holland equivalent): 81 acres (33 ha). Numerous small rock outcrops occur through the area, most conspicuous are those along the Salmon Divide. These outcrops include *Lewisia cotyledon, Streptanthus tortuosus, Hieracium greenei, Holodiscus boursieri, Zauschneria californica* ssp. *latifolia, Eriogonum lobbii, Brickellia greenei,* and *Sedum obtusatum* ssp. *boreale. Saxifraga fragarioides, Cheilanthes gracillima, Cryptogramma acrostichoides, Sedum purdyi,* and *Polystichum munitum* var. *imbricans* are characteristic of sheltered mesic sites. Brewer spruce is also typical of mesic upper elevation rock outcrops, but does not occur in high enough density to be considered a distinct vegetation type. The largest Brewer spruce seen is 450 years with a diameter 30 inches (76 cm) from the base of 35.5 inches (90 cm).

• Riparian Vegetation (61510, 63500): 35 acres (14 ha). Many of the small drainages within the study area have permanent moisture. At elevations below ca. 3500 ft (1067 m), riparian vegetation is dominated by *Salix lasiolepis* (and other willows), white alders *(Alnus rhombifolia),* and Oregon ash *(Fraxinus latifolia),* along with understory species such as *Aralia californica, Rubus ursinus, Dicentra formosa,* and *Mimulus cardinalis.* Above ca. 3500 ft (1067 m) along steeper gradient rivulets, montane species such as *Alnus sinuata* dominate with understory species such as *Circaea alpina* var. *pacifica.*

• Noble Fir Forest (85310): 28 acres (11 ha). This type, dominated by trees with several noble fir characteristics (with a lower number of Shasta red fir, *A. magnifica* ssp. *shastensis* characteristics), dominates the highest N.-facing slopes of the area. At ca. 5700 ft (1737 m), the forest is composed of 100-to 150- ft (31- to 46-m) tall noble fir with noble fir saplings and seedlings common in areas of light shade. Dominants are between 28 and 33 inches (71-84 cm) dbh. Western white pine *(Pinus monticola)* also occurs occasionally at the highest elevations.

At slightly lower elevations on Antenna Ridge the forest is more mixed. A sample plot in this forest at ca. 5600 ft (1707 m) indicates a mixed canopy of noble fir, Douglas-fir, and white fir, with Douglas-fir dominant, but with noble fir in highest density. There is a sparse shrub and herb understory averaging 15 percent cover. Typical understory species include *Vaccinium membranaceum, Rosa gymnocarpa, Berberis piperiana, Ribes sanguineum, Penstemon anguineus, Pyrola secunda, Arnica latifolia, Campanula prenanthoides, Hieracium albiflorum, Goodyera oblongifolia, Corallorhiza maculata, Chimaphila umbellata,* and C. *menziesii.*

• Montane Chaparral (37510, 37542): 11 acres (4 ha). Little of this vegetation occurs in the area. A few patches exist on the upper portions of S. and W.-facing slopes and are dominated by *Arctostaphylos nevadensis, A. patula, Prunus emarginata,* and *Holodiscus boursieri.* A slightly different type occurs on small areas of the upper, rocky NE.-facing slopes of Antenna Ridge. *Quercus vaccinifolia, Amelanchier pallida,* and *Arctostaphylos nevadensis* are the dominants. Herbs associated with the montane chaparral are sparse and include *Monardella odoratissima* ssp. *pallida, Polygonum davisiae, Streptanthus tortuosus, Lomatium macrocarpum,* and *Apocynum pumilum.*

Plant Diversity

One hundred fifty taxa are listed.

Conflicting Impacts

The previously mentioned fire, the clear-cutting and road construction within the SW. portion of the area, as well as the possibility of the construction of a small hydroelectric plant are among the real and potential conflicts. These points, in conjunction with the extremely difficult travel within the area because of the steep slopes and the successional nature of much of the vegetation, combine to make this area undesirable for scientific use. The Region 5 RNA committee elected to remove this area from further RNA consideration in 1987.

14. PREACHER MEADOWS (Sawyer, Palmer, and Cope 1978)

Location

This candidate RNA is on the Shasta-Trinity National Forest. It lies ca. 6 miles (10 km) W. of Trinity Center and consists of sects. 17 and 20 T36N, R8W, MDBM (40°58'N., 122°48'W.) USGS Covington Mill quad. About half of the area is included within the Trinity Alps Wilderness *(fig.* 33).

Target Element

Mixed conifer forest

Distinctive Features

• Ultrabasic Mixed Coniferous Forest: This, the predominant forest type in the area, is typical both in composition and quality to forests throughout much of the ultramafic terrain at mid-elevations of the eastern Klamath Province. Its uniformity

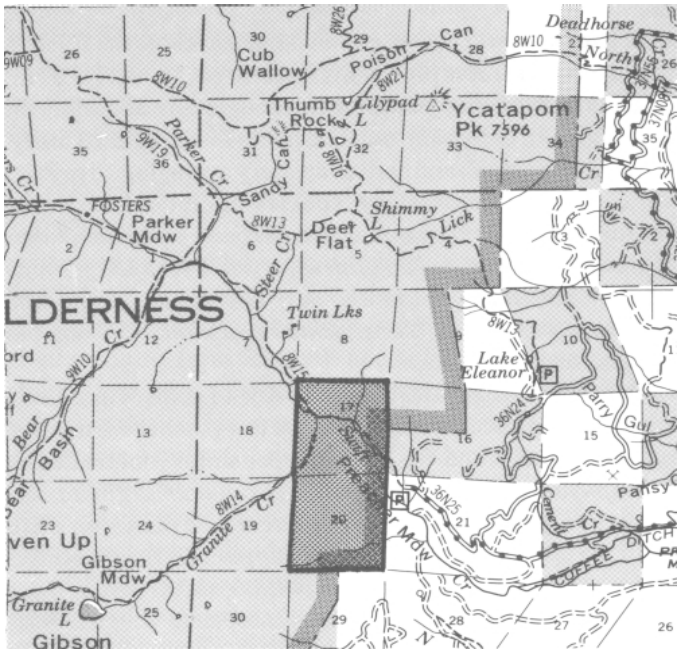


Figure 33--The Preacher Meadow study area.

of cover and openness is a result of the overriding influence of the substrate on vegetation.

• Rare Flora: Two species *(Cypripedium californicum* and *Darlingtonia californica)* are on List 4 of CNPS.

• *Ceanothus* Diversity: The following species and apparent hybrids are listed: *Ceanothus cordulatus, C. cuneatus, C. integerrimus, C. prostratus, C. pumilus, C. velutinus, C. prostratus* x *pumilus, C. velutinus* x *prostratus.* This diversity of congeners may be useful for systematic and hybridization studies.

Physical Characteristics

The surveyed area covers 600 acres (243 ha), but the candidate has since been enlarged to 1878 acres (760 ha). Elevations range from 3800 to 5800 ft (1158-1768 m). Topography is moderate to steep (30-95 percent slopes) with SE.- and E.-facing slopes predominating, with some NW.- and SW.-facing slopes. Swift Creek has carved a gorge 90 ft (27 m) deep in one area, and meadowy and forested flats and benches occur above the creek in other areas. The area is underlain by ultrabasic intrusives (primarily peridotite) with moraines and other glacial deposits occurring along the canyons and at higher elevations. Talus slopes are common. Soils are shallow, and one slide area is mentioned. Climatological records for nearby Trinity Dam indicate an annual precipitation of ca. 38 inches (965 mm) with average annual high temperatures of 100.8 ° F (38.2 °C) and lows of 15.5 ° F (-9.2 °C).

Association Types

After analysis of 31 releves, the forested regions of this area are all classified as one type. Density and basal area cover are determined by sampling thirty 0.1-acre (0.04-ha) plots.

• Douglas-fir *(Pseudotsuga menziesii)/Quercus vaccinifolia* (84180): 540 acres (219 ha). Uniformity of composition in this forest is striking on all slope aspects and elevations sampled. Canopy cover averages 30-40 percent with Douglas-fir dominant in most of the area. A few of the highest sites have sugar pine *(Pinus lambertiana)* and white fir *(Abies concolor)* dominant with some Shasta red fir *(Abies magnifica* var. *shastensis)* and western white pine *(Pinus monticola).* At lower elevations and mesic sites, incense-cedar *(Calocedrus decurrens)* codominates with Douglas-fir. Ponderosa pine *(Pinus ponderosa)* is also abundant at lower elevations particularly on SW.-facing aspects or flats. White fir is the predominant reproducer. The high fire frequency (most dominants have scars) may be the reason for relatively low density of mature white fir.

Sampling indicates an average density of 313 trees/ha and a basal area average of 50.0 m^2/ha. A high productivity bench area in the NE. comer of sect. 17 has densities of 470 trees/ha with average basal area of 99.9 m^2/ha. A site index curve based on 10 Douglas-fir trees suggests modest site quality for the area.

The shrub layer is well-developed averaging 80-100 percent cover, with *Quercus vaccinifolia* comprising 95-100 percent of the shrubs. Driest sites also tend to have *Ceanothus prostratus.* Along streams, *Rhododendron occidentale* is the dominant shrub (80-100 percent relative cover) occurring with *Ribes roezlii, Rhamnus purshiana,* and *Spiraea densiflora.* Herbs are sparse (ca. 5 percent cover) throughout this association, the most ubiquitous being *Polygala cornuta.*

• Meadows (45100, 51120): 60 acres (24 ha). Three distinctive meadow phases occur locally:

Dry meadows occurring on vernally wet sites, drying later in the season. They are characterized by *Danthonia unispicata, Sisyrinchium bellum, Lotus purshianus, Dichelostemma (Brodiaea) multiflorum,* and *Calochortus nudus.*

Moist meadows occurring on sites that are wet through much of the season, but dry late in the summer. They include such species as *Hastingsia (Schoenolirion) alba, Deschampsia caespitosa, Helenium bigelovii,* and *Danthonia californica.*

Perennially wet meadows occur along the margins of small creeks and in seeps and contain such species as *Darlingtonia californica, Mimulus guttatus, Juncus* spp., *Carex* spp., *Narthecium californicum,* and occasionally *Cypripedium californicum.*

Plant Diversity

One hundred sixty-four taxa are listed.

Conflicting Impacts

Although the Granite Creek and Swift Creek trails pass through the area and are well-used, most if not all recreation users are traveling upstream to higher elevation sites in the wilderness area. There is little or no impact away from the trails in the proposed RNA except at one small campsite at a bridge crossing in the central portion of sect. 17.

15. ROCK CREEK BUTTE (Keeler-Wolf 1987c)

Location

This candidate RNA is on the Klamath National Forest along the crest of the southern Siskiyou Mountains in westernmost Siskiyou County. It is ca. 2 air miles (3 km) SE. of the present terminus of the eastern segment of the Gasquet-Orleans (G-O) road near the SE. boundary of the Siskiyou Wilderness Area, and 17 miles (27 km) NNW. of Orleans. The area lies within portions of sects. 5, 7, and 8 T13N, R8W HBM (41°33'N., 123°38'W.) USGS Chimney Rock and Dillon Mtn. quads *(fig. 34).*

Target Elements

Brewer spruce *(Picea breweriana),* montane chaparral

Distinctive Features

• Brewer Spruce: The stands of Brewer spruce at Rock Creek Butte are extensive, covering 138 acres (56 ha) in varying densities and age classes. The largest Brewer spruces in the mesic enriched conifer forest are giants up to 48 inches(1.22 m) dbh and 130 ft (40 m) tall. These trees are likely to be over 400 years old. Notable also are the young Brewer spruce recolonizing areas burned 50-100 years ago on both NW. and, more surprisingly, SE. exposures. Compared to the four other RNA and candidate RNAs with Brewer spruce (#'s 5, 9, 13, 19), these stands include the largest individuals, the highest measured densities, and the highest basal area cover. The age and high cover of Brewer spruce on the NW.-facing slopes are a result of the seemingly serendipitous absence of major fires from these often gradual slopes for several hundred years.

• Montane Chaparral: The stands of this vegetation are representative of both seral and semi-climax forms found throughout the Klamath Geologic Province. Although less extensive than in some other Klamath RNAs (see #'s 3, 19), the local stands are relatively diverse both in species and in slope exposure and compare favorably with other stands of this type.

• Rare Plants: *Vaccinium coccinium* is on CNPS List 3.

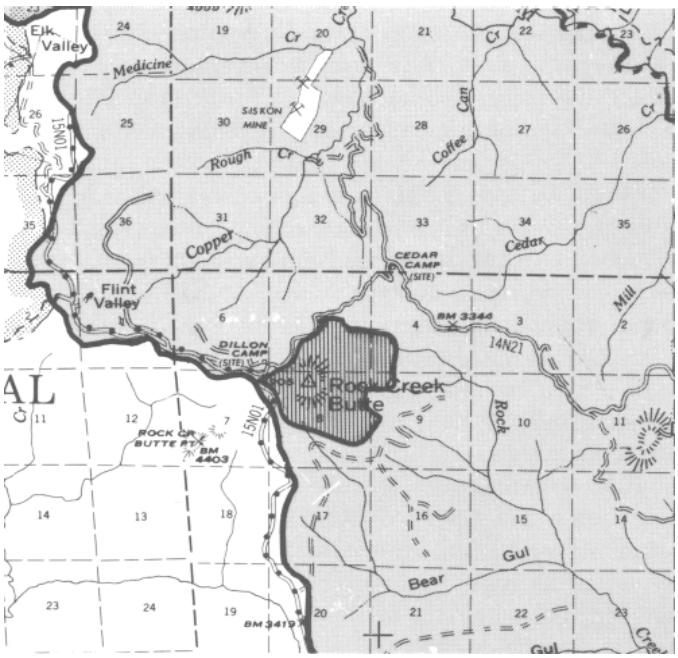


Figure 34--The Rock Creek Butte study area.

Physical Characteristics

The area covers ca. 500 acres (203 ha) and ranges in elevation from 4000 ft to 5205 ft (1219-1586 m). It occupies the upper slopes and summits of Rock Creek Butte with principal exposures of NW. and SE. Slopes on the NW. are gradual to moderate, while those on the E. and SE. are typically steep. The main NE.- to SW.-trending ridge is greater than 5000 ft (1524 m) for over 0.6 mile (1 km).

Rocks in the area are primarily granitic, with some approaching gabbro. Peridotite occurs in small portions of the N. summit ridge, and schistose metasedimentary rock occupies much of the SE. side of the area. Soils are generally shallow and rocky with the best soils in NW.-facing hollows as near Dillon Camp and infertile, shallow types occupying the upper ridges and SE.-facing slopes. Precipitation is great, estimated at ca. 110 inches (2794 mm) annually. Snowfall accumulates heavily along the ridgetop, but melts rapidly at slightly lower elevations. Temperatures are moderate due to the relative proximity to the Pacific Ocean.

Association Types

Two parts of the enriched conifer forest are sampled: thirteen 100-m^2 plots on the lower NW. slope and ten 100-m^2 plots on the upper NW. slope.

• Mountain Chaparral (37510, 37520, 37542, 83210): 196 acres (79 ha). Two subtypes are represented. The most extensive is successional, dominated by *Quercus vaccinifolia.* It covers ca. 175 acres (71 ha) to the SE. of the main ridge. The cover of dense 3- to 5-ft (1- to 1.5-m) shrubs is relatively continuous on moderate slopes and broken with small rocky openings on steeper slopes. *Ceanothus velutinus, Arctostaphylos patula,* and *Garrya fremontii* are also locally common. Most areas are being invaded by conifers (largely Douglas-fir and sugar pine) ca. 45-55 years old, dating back to the last major fire. On xeric S.-facing slopes, conifer invasion is slower as a result of more complete destruction of the former coniferous canopy. Here knobcone pine *(Pinus attenuata)* and white fir augment the other two conifers. Brewer spruce and noble fir *(Abies procera)* are also invading this type near the summit of Rock Creek Butte. Understory species are few and widely scattered.

The second subtype is dominated by *Arctostaphylos nevadensis* and covers 21 acres (8.5 ha) on a few patches on the NW. side of the ridge. The substrate is generally ultramafic. Low shrubs of *Quercus vaccinifolia, Q. sadleriana, Holodiscus discolor,* and *Prunus emarginata* also occur. The more open and mesic nature of this phase allows a better development of understory herbs including *Penstemon newberryi, P. parvulus, Lomatium macrocarpum, Sedum laxum* ssp. *heckneri, Koeleria macrantha, Eriogonum umbellatum, Selaginella wallacei, Erigeron bloomeri* var. *nudatus, Lewisia cotyledon, Carex*

brevipes, Cryptogramma acrostichoides, and *Sitanion jubatum.* This is a more stable phase than the *Q. vaccinifolia* subtype. The largest areas of *A. nevadensis* chaparral are not being actively invaded by conifers. However, smaller patches are associated with dense young forest dominated by noble fir and Brewer spruce and are successional.

• Siskiyou Enriched Conifer Forest (85410, 85310): 185 acres (75 ha). This forest occupies the NW. and NE. sides of the main ridge and is the densest, most productive, and most extensive of the forest associations in the area. The typical phase of this forest is moderately dense (930 trees/ha), dominated by large Douglas-fir *(Pseudotsuga menziesii)* up to 6 ft (1.8 m) dbh and 170 ft (52 m) tall. Associated with these relicts of the last major disturbance 200-400 years ago are the more abundant, but smaller species: noble fir and Brewer spruce. Both species are in nearly equal abundance as trees, but noble fir is more common as saplings and seedlings. Additional species include white fir *(Abies concolor)* and sugar pine *(Pinus lambertiana)* and occasional incense-cedar *(Calocedrus decurrens)* and western white pine *(Pinus monticola)*. Total basal area cover of the forest is relatively high, averaging 185 m^2/ha. Douglas-fir comprises 62 percent, noble fir 16 percent, and Brewer spruce 11 percent of that value.

The understory of this forest has occasional small trees of Pacific dogwood *(Cornus nuttallii), Acer glabrum* var. *torreyi,* Pacific yew *(Taxus brevifolia),* and *Salix scouleriana.* The shrub layer is dense, dominated by *Quercus sadleriana* and *Vaccinium membranaceum,* with 11 other shrub taxa encountered in the sample. Herbs include 17 species with only a few such as *Chimaphila umbellata* and *Xerophyllum tenax* having more than a trace of cover.

On W. and NE. exposures the forest composition shifts to a higher Douglas-fir dominance with less Brewer spruce and noble fir (this phase is called xeric enriched conifer). White fir, sugar pine, and incense-cedar increase in dominance. The shrub layer shifts to *Quercus vaccinifolia* dominance with some *Arctostaphylos nevadensis, Garrya fremontii,* and *Symphoricarpos acutus.* This more xeric forest has a scattering of such understory herbs as *Xerophyllum tenax, Iris* sp., *Whipplea modesta, Bromus marginatus,* and *Hieracium albiflorum.*

The most mesic form of the enriched conifer forest occurs adjacent to moist seeps on NW. slopes as near Dillon Camp. Douglas-fir, noble fir, and Brewer spruce co-occur with Port Orford-cedar *(Chamaecyparis lawsoniana)* in the canopy *(fig. 35).* The understory is dominated by *Quercus sadleriana* and *Vaccinium membranaceum,* but also includes *Vaccinium parvifolium* and *Alnus sinuata.* Herbs are dense and diverse including *Linnaea borealis, Achlys triphylla, Polystichum munitum, Clintonia uniflora, Trientalis latifolia,* and *Vancouveria hexandra.*

The highest elevation form of this forest occurs just below the ridgeline on the NW.-facing slope. Douglas-fir is much less important than at lower elevations, with Brewer spruce and noble fir holding near equal dominance. The forest is relatively dense (1090 trees/ha) but has substantially lower basal area than the typical phase (112 m^2/ha). The relatively small stature of the trees is a result of the harsh ridgetop environment and a large

Figure 35--Rock Creek Butte: Mature enriched conifer forest near Dillon Camp with Brewer spruce (4 ft, 1.2 m dbh, right foreground), Port Orford-cedar, noble fir, white fir, and Douglas-fir.

number of young trees. This upper ridge forest is structurally variable with several lobes of dense young trees dropping down from the ridge to interfinger with the more mature, open forest. These dense lobes have their origins from one or more fires over the past 100 years. Several virtually pure groves of Brewer spruce occur in steep or rocky areas, or both, along the ridges. These groves have been spared from fire for several hundred years. Reproduction is strongly dominated by noble fir, with Brewer spruce the second most important reproducer. The understory of this forest is poorly developed. *Quercus sadleriana* and *Vaccinium membranaceum* are dominant, but account for less cover than at lower elevations.

• Douglas-fir-Sugar Pine Forest (84110): 111 acres (50ha). This association covers moderate to steep slopes on SE. exposures. It is an open forest with numerous mature trees, survivors of the last fire ca. 1932. The canopy is dominated by Douglas-fir and sugar pine with discrete patches of *Quercus vaccinifolia* forming the principal understory. Ponderosa pine *(Pinus ponderosa)* and incense-cedar are more common at lower elevations.

• Rock Outcrop (no Holland equivalent): Although there are no large areas of continuous outcrops, many small rocky areas exist. These may be divided into mesic and xeric subtypes. Species of the mesic subtype (either on NW. exposures or shaded by trees) include *Acer glabrum* var. *torreyi, Amelanchier pallida, Cheilanthes gracillima, Cryptogramma acrostichoides, Heuchera macrantha, Holodiscus discolor, Polystichum imbricans, Sedum laxum,* and *Saxifraga fragarioides.* The xeric subtype includes *Luina hypoleuca, Penstemon newberryi* ssp. *berryi, Streptanthus tortuosus,* and *Eriogonum umbellatum.*

• Spring and Seep (45400, 63500): Minimal acreage. Hydrophilic vegetation is restricted to small springy areas on the NW. side of the ridge. These may be either sunny or shaded. The shady type lies within the mesic phase of the enriched conifer forest and includes such species as *Alnus sinuata, Cornus occidentalis, Rosa gymnocarpa, Paxistima myrsinites, Sorbus cascadensis,* and *Vaccinium parvifolium* along with such herbs

as *Aquilegia formosa, Boykinia major, Habenaria saccata, Senecio triangularis, Tiarella unifoliata, and Tolmiea menziesii.* On sunnier exposures species include *Salix coulteri, S. jepsonii, S. leavigata, Agrostis exarata, Aruncus vulgaris, Carex cusickii, C. diandra, C. nervina, Epilobium adenocaulon, E. angustifolium, E. hornemannii, Galium aparine, Juncus effusus* var. *exiguus,* and *Petasites palmatus.*

Plant Diversity

One hundred fifteen taxa of vascular plants are listed.

Conflicting Impacts

Although the area is bounded on three sides by roads, these have little effect. A small dilapidated, radio-transmitting shack on the summit ridge is the only structure within the proposed boundaries. The long-established campsite at Dillon Camp is not heavily used, and associated woodcutting and litter are not strongly evident. Several years ago a lightning strike was actively suppressed by cutting a few stems of Douglas-fir near Dillon Camp. Management of the montane chaparral and Brewer spruce target elements will have divergent requirements: the former needs regular fire, and the latter requires protection from fire.

16. SMOKY CREEK (Taylor and Teare 1979b)

Location

This candidate RNA is located in Trinity County ca. 5 miles (8 km) SE. of Forest Glen. It includes portions of sects. 20, 21, 28, and 29 of T27N, R12W MDBM (40°22'N., 125°15'W.) USGS Pony Buck Peak quad (SW 1/4 Dubakella 15' quad) *(fig. 36).*

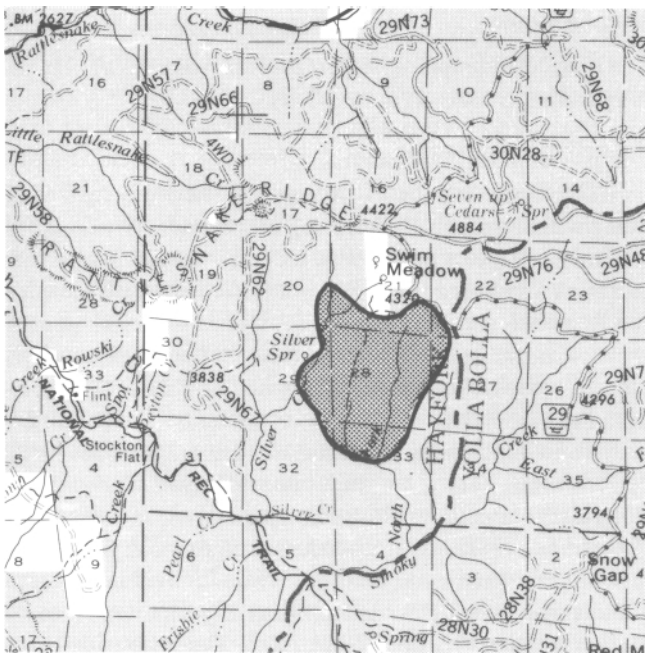


Figure 36--The Smoky Creek study area.

Target Elements

Pacific ponderosa pine-Douglas-fir *(Pinus ponderosa-Pseudotsuga menziesii)* forest, Jeffrey pine *(Pinus jeffreyi).*

Distinctive Features

• Rare Plants: Five species of rare plants occur in the vicinity of the RNA. These are all serpentine endemics. Two species *(Haplopappus ophitidis* [CNPS List 1b] and *Helianthus exilis* [CNPS List 3]) occur on the study site.

• Serpentine Jeffrey Pine Forest: Although this vegetation type is widespread on drier serpentine areas of the Klamath Mountains Province, this area is the only candidate RNA currently considered as representative of this vegetation in California. Numerous endemic plants occur in this association, and it has been well-studied in other parts of the Klamath province (Waring 1969, Whittaker 1960).

Physical Characteristics

This area of 601 acres (243 ha) lies at the head of the easternmost fork of Silver Creek and on the N. Fork of Smoky Creek, both of which drain into the S. Fork of the Trinity River. Elevations range from ca. 3200 to 4200 ft (975-1280 m). Slopes average 10-20° with extensive interfluves of lesser slope between Smoky and Silver Creeks. Both streams are intermittent within the area, although several seeps and springs (e.g., Swim Meadow, Silver Springs) flow year-round. The area is underlain by pre-Cretaceous metamorphic rocks, with extensive outcrops of altered ultrabasic rock (serpentine). Soils are probably Sheetiron-Josephine families over the metamorphics and Dubakella-Neuns over the serpentine. Mean annual temperature is estimated at somewhat under 51 °F (10.8 °C). Mean annual precipitation is estimated at ca. 62 inches (1572 mm).

Association Types

Fifteen plots (10-m radius) and 24 releves are employed to sample the various types of vegetation in the area. The releve data are arranged by computer to form an association table. Acreages are not given.

• Douglas-fir *(Pseudotsuga menziesii)*-Ponderosa Pine *(Pinus ponderosa)* (84110): This is the most extensive vegetation in the area. This forest develops only over nonserpentine areas. A typical stand is open to semi-dense. The overstory is composed of older age-class individuals in low density. Dense conifer reproduction is patchy. Douglas-fir dominates the canopy, averaging 49.4 m^2/ha basal area and 498 stems/ha. Sugar pine *(Pinus lambertiana)* and ponderosa pine share codominance at 14.6 and 18.2 m^2/ha, respectively, and both occur in approximately equal densities of ca. 100 stems/ha. California black oak *(Quercus kelloggii)* and canyon live oak *(Q. chrysolepis)* form a subcanopy. The shrub understory is open with *Toxicodendron diversilobum* and occasional *Arctostaphylos viscida, Corylus cornuta* var. *californica,* and *Ceanothus integerrimus.* The herb layer is sparse, with few constant species. These include *Pyrola picta, Chimaphila umbellata* var. *occidentalis, Hieracium albiflorum, Bromus marginatus, Lathyrus polyphyllus,* and *Apocynum pumilum.*

• White Alder *(Alnus rhombifolia)-Galium triflorum* (61510): This association lines the ephemeral streams. This type has a sparse overstory of white alder with big-leaf maple *(Acer macrophyllum),* and Douglas-fir as codominants, averaging 11.0, 1.1, and 3.1 m^2/ha basal area, respectively. Mesic shrubs such as *Rosa pisocarpa, Philadelphus lewisii* ssp. *gordonianus, Rubus parviflorus,* and *Euonymus occidentalis* are common. *Galium triflorum* dominates the sparse herb layer.

• *Prunella vulgaris* ssp. *lanceolata-Carex bolanderi* (45400): This association is typical of seeps and small springs. Occasional riparian species of the previous type are present, but this type has primarily a meadow physiognomy. *Carex bolanderi* is common with *C. amplifolia, Torreyochloa (Puccinellia) pauciflora,* and the constant *Prunella vulgaris.*

• *Deschampsia caespitosa-Carex buxbaumii* (45100, 45400): This is the seep and meadow vegetation characteristic of serpentine areas such as Silver Spring and Swim Meadow. Swim Meadow is dominated by *Deschampsia caespitosa, Juncus covillei,* and *J. effusus,* with *Carex buxbaumii* and *Helenium bigelovii* as codominants. Silver Spring is more heavily mineralized than Swim Meadow and has *Sisyrinchium idahoense, Cirsium breweri,* and *Hastingsia (Schoenolirion) alba* along with *Rhynchospora glomerata* var. *minor (fig. 37).*

• *Carex exsiccata* (52430): One small pond is dominated by this sedge, related to the montane species *C. vesicaria* and *C. rostrata.*

• Jeffrey pine/*Haplopappus ophitidis* (84171): This association is typical of the most sparsely vegetated serpentine areas. The two namesake species characterize the tree and shrub layer, respectively. Jeffrey pine is widely spaced (300/ha), but represented by relatively large individuals (36 m^2/ha basal area). Scattered small shrubs of *Ceanothus cuneatus* dominate the shrub layer, *Calamagrostis koelerioides* is the dominant grass of the herb layer. Other species characteristic of this open forest include *Phacelia corymbosa, Cirsium callipes, Senecio greenei, Arenaria rosei, Eriogonum strictum, Onychium densum, Rhamnus californica* ssp. *tomentella,* and *Allium* sp.

• *Ceanothus cuneatus/Sitanion hystrix* (37810, 37600): This association occurs on very rocky soils or serpentine outcrops. *Ceanothus cuneatus* forms a dense (50 percent cover) shrub layer, ca. 3 ft (1 m) high. Herbs and occasional shrubs typical of the previous type also occur here, along with such serpentine chaparral species as *Quercus durata.* Soils are too poorly developed to allow widespread establishment of Jeffrey pine, although occasional stunted individuals occur.

Figure 37--Smoky Creek: Silver Spring-a seep on serpentinite with distinctive vegetation, Douglas-fir/ponderosa pine forest surrounding (D. Taylor).

• Jeffrey Pine/*Calamagrostis koelerioides* (85100): This association resembles the Jeffrey pine/*Haplopappus ophitidis* association, with an open overstory of Jeffrey pine (32.8 m^2/ha cover and 381 stems/ha). It occurs on less heavily mineralized, more highly weathered soil than that association and consequently has a different set of associated species. These include incense-cedar, *Rhamnus californica* ssp. *tomentella, Toxicodendron diversilobum, Balsamorhiza sagittata, Monardella odoratissima* ssp. *pallida,* and *Iris tenuissima.*

Plant Diversity

One hundred sixty-six taxa are listed.

Conflicting Impacts

Current impacts include a lightly used jeep road which enters the RNA, and a number of recent timber sales which border the area.

17. SOUTH FORK MOUNTAIN (YOLLA BOLLA) (Taylor 1975 a,b)

Location

This candidate RNA is on the Shasta-Trinity National Forest, Trinity County. The area lies ca. 16 miles (26 km) SE. of Forest Glen. The area lies within portions of sects. 14, 15, and 16 T28N, R12W MDBM (40°17'N., 123°11' W.) USGS Pony Buck Peak quad (SW 1/4 Dubakella 15' quad) *(fig. 38).*

Target Element

Giant chinquapin *(Chrysolepis chrysophylla),* Pacific Douglas-fir *(Pseudotsuga menziesii)*

Distinctive Features

• Old-Growth Douglas-fir Forest: The study area is included within a relatively large region of productive Douglas-fir-dominated forest, which also includes the Chinquapin and the Rough Gulch candidate RNAs (neither of which have had joint Regional- and PSW-funded ecological surveys.) In comparison to the adjacent candidates (also chosen to represent the giant chinquapin element, as well as the Douglas-fir target), the South Fork candidate bears some distinctions. First of all it is located on a more easterly aspect than the average slopes for the adjacent areas. Thus, the importance of giant chinquapin is relatively reduced, while such species as incense-cedar *(Calocedrus decurrens)* and ponderosa pine *(Pinus ponderosa)* are relatively more important. The girths of individual Douglas-fir and sugar pine are far greater than any reported from the adjacent two sites (Keeler-Wolf 1984a). The easterly exposure also brings in a more xeric component with species such as

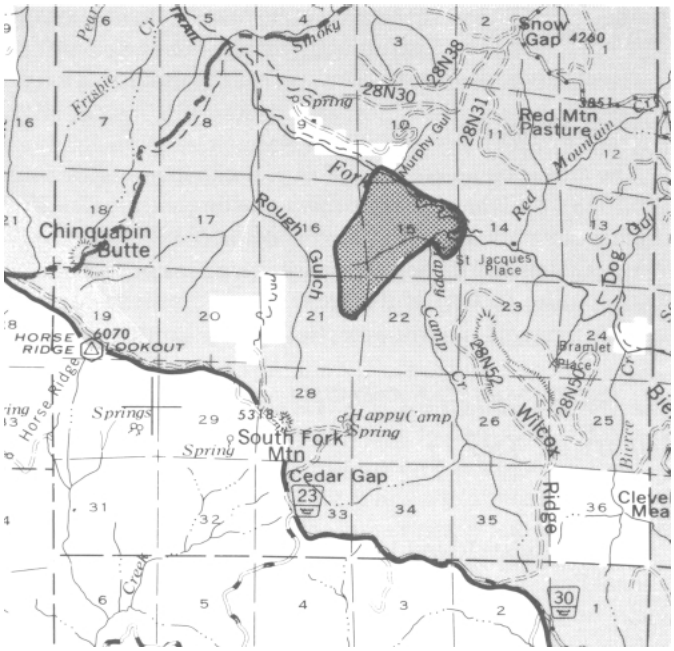


Figure 38--The South Fork Mountain study area.

canyon live oak *(Quercus chrysolepis),* California black oak *(Q. kelloggii),* and Pacific madrone *(Arbutus menziesii)* attaining greater importance than in the adjacent predominantly NE.- and N.-facing areas.

This entire area of old-growth forest on South Fork Mountain is reported to contain one of the most productive Douglas-fir forests remaining in the State (from the standpoint of board-feet per unit area) (Shasta Trinity National Forest Land and Resource Management Plan 1988). It is a prime example of a relatively interior type climax Douglas-fir forest and shows characteristic gap regeneration dominated by Douglas-fir with white fir *(Abies concolor)* as a subordinate reproducer except at the upper elevations (see # 6).

• Well-Studied Vegetation: Research by Taylor (1975a, b) and Keeler-Wolf (1984a,1988a) on the forest vegetation of the South Fork Mountain forests is relatively thorough. Taylor ordinated his plots and releves in relation to moisture availability, basal area, relative dominance, density, relative density, and importance value. A number of conclusions can be drawn from these data. For example, the lowest basal area and densities of trees generally occur at the driest, most exposed (ridgecrest) sites, whereas cover diversity of the releves increases with moisture availability. Keeler-Wolf (1988a) documents the requirements for giant chinquapin subdominance in these and other forests of the Klamath Province. Some of his study plots are within the proposed boundaries of this candidate RNA.

• Riparian Vegetation and Riverine Values: The S. Fork of the Trinity River forms the northern boundary of the area, and in the vicinity of the study area is one of the least-disturbed major streams in NW. California. It is being considered for wild and scenic status by the State (Shasta-Trinity N.F. Land and Resource Management Plan 1988). It is a major salmon (*Oncorhynchus* spp.) and steelhead *(Salmo gairdneri gairdneri)* spawning stream and also is used by Pacific lamprey *(Lampetra tridentata).* The riparian zone has numerous well-developed white alder *(Alnus rhombifolia)* and an interior stand of red alder *(A. oregona),* both of which may attain large size along the narrow riparian fringe *(fig. 39).* The rather rare Oregon race of the Ruffed Grouse *(Bonasa umbellus sabini) is* generally restricted to the riparian zone in the area.

• Uncommon and Sensitive Fauna: Several uncommon, rare, or sensitive vertebrates are known from the area including spotted owl *(Strix occidentalis),* fisher *(Martes pennanti),* and mountain lion *(Felis concolor).*

Physical Characteristics

The area treated by Taylor covers 3212 acres (1380 ha) although several additional proposals of varying size for this and adjacent candidate RNA's (Chinquapin Ridge, Rough Gulch) have been made, ranging from 800 to 5000 acres (324-2024 ha). Elevations range from 2953 ft (900 m) at the banks of the South Fork of the Trinity River to 4495 ft (1370 m) atop the divide separating the drainages of Happy Camp Creek and Rough Gulch. Slopes average ca. 30° (20-50°) and face generally ENE. with smaller areas of NE., SE., E., and N. exposures.

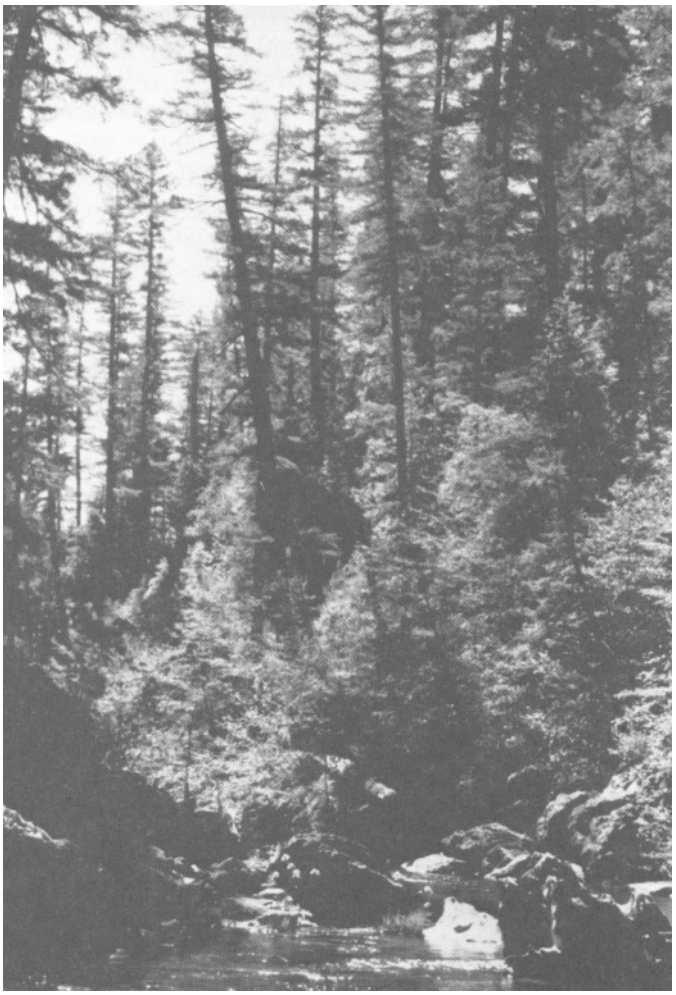


Figure 39--South Fork Mountain: The S. Fork Trinity River with surrounding white alder riparian zone and Douglas-fir/giant chinquapin forest.

Rocks are largely South Fork Mountain Schist, a pre-Cretaceous metasediment. A few small lenses of serpentinite outcrop in sect. 15. Soils are generally well-drained, moderately acid, clay-loam or gravelly loam of moderate depth (1-1.5 m). They fall into the Hugo and Josephine series. Precipitation is estimated as 60 inches (1525 mm), and records at Forest Glen indicate a mean annual temperature of 52 °F (11 °C) with an annual range of mean monthly temperatures of 67.8°F (19.9°C). Snow is common in winter months, but typically does not linger for more than a few days.

Association Types

A total of 28 releves and 18 plots ranging in area from 314 to 2827 m^2 are sampled in the one forest association. Additional vegetation sampling in this area is performed by Keeler-Wolf (1988a). Sizes of associations are not given.

• Douglas-fir/*Berberis nervosa* (82420, 81100, 45400): The entire forested portion of the area is classified as this association. Plot data for trees indicate a mean basal area of 36.2 m^2/ha (range 14.5-104.7 m^2/ha) with Douglas-fir comprising 71.1 percent of this value. The highest basal area for Douglas-fir on any plot is 74.5 m^2/ha. Sugar pine *(Pinus lambertiana),* ponderosa pine, and white fir are the major canopy subdominants. Together they contribute an average relative basal area of ca. 8 percent. The canopy trees are 164-197 ft (50-60 m) in height with average crown cover of ca. 50 percent. The largest individuals of Douglas-fir may be 9.8 ft (3.0 m) dbh, and the largest sugar pine may attain 11.5 ft (3.5 m) dbh. A second tree stratum is composed of the hardwoods: big-leaf maple *(Acer macrophyllum),* Pacific madrone, giant chinquapin, Pacific dogwood *(Cornus nuttallii),* canyon live oak, and California black oak reach heights of 65-82 ft (20-25 m). Giant chinquapin is the dominant member of the subcanopy and attains dbh's of up to 30 inches (75 cm).

A shrub layer occurs in scattered, open patches and is dominated by *Berberis nervosa, Amelanchier pallida, Corylus cornuta* var. *californica, Rosa pisocarpa, Rubus parviflorus,* and *Toxicodendron diversilobum.* Herbs and low shrubs including *Adenocaulon bicolor, Chimaphila umbellata* var. *occidentalis, Disporum hookeri, Iris tenuissima, Lathyrus polyphyllus, Rubus leucodermis, Trientalis latifolia,* and *Xerophyllum tenax* form the fourth layer.

Six unions within the main association are identified by construction of an association table. The unions are: *Silene californica-Erigeron inornatus, Iris tenuissima-Xerophyllum tenax,* Giant chinquapin-*Chimaphila umbellata,* canyon live oak-*Toxicodendron diversilobum, Trientalis latifolia-Lathyrus polyphyllus,* and *Vaccinium parvifolium-Thelypteris oregana* (Holland 45400). The dominant young trees and saplings are Douglas-fir and white fir. Abundant evidence of past fire (ground fire with small areas of canopy destruction) indicates that fire is an important natural element in the forest.

• *Carex senta/Peltiphyllum peltatum* (61510, 61130): This association is confined to the riverbed below the annual flood level. Other species associated with this type include *Aralia californica,* Pacific yew *(Taxus brevifolia), Rhamnus purshiana,* white alder *(Alnus rhombifolia),* and red alder *(Alnus oregona).*

Plant Diversity

Ninety-five species are listed.

Conflicting Impacts

The area is being considered as part of a major timber sale (as of 1988). Soils are subject to mass-wasting and are classified as high to severely sensitive (Scott and others 1980). Access at present is relatively difficult because there are no roads within five trail-miles (8 km) of the area. Access from the north is limited to times of low river water (late spring through early fall).

18. SPECIMEN CREEK (Sawyer and Stillman 1977)

Location

This candidate RNA (dropped as of 1984) is on the Klamath National Forest. It lies ca. 4 miles (6 km) NW. of Sawyer's Bar. It includes portions of sects. 12 and 13 T40N, R12W and sect. 7 T40N, R13W MDBM (41°19'N., 123°10'W.) USGS Sawyers Bar quad *(fig. 40).*

Target Element

Pacific Douglas-fir *(Pseudotsuga menziesii)*

Distinctive Features

Typical Interior Klamath Douglas-fir/Hardwood Forest: The Douglas-fir-dominated forest at Specimen Creek is representative of the most interior phase of the Douglas-fir/hardwood forest in the Klamath Province. It is a climax vegetation with Douglas-fir regeneration in gaps and partial shade, unlike the most coastal Douglas-fir forests, which are largely seral to

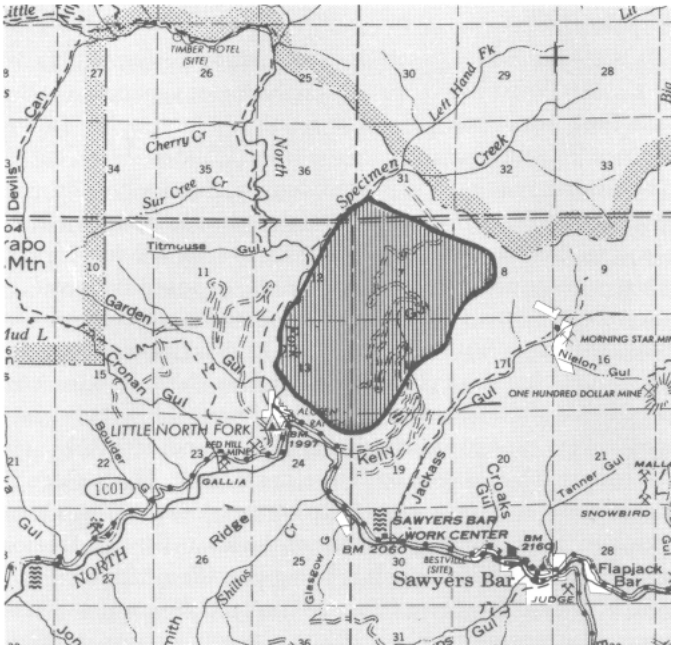


Figure 40--The Specimen Creek study area.

western hemlock and other coastal species. There is no tanoak *(Lithocarpus densiflorus),* Pacific madrone *(Arbutus menziesii)* is not as important as in more westerly forests, giant chinquapin *(Chrysolepis chrysophylla) is* restricted to localized mesic sites, and several other species indicative of more mesic coastal conditions are lacking.

Physical Characteristics

The area includes ca. 600 acres (243 ha). Elevations range from 2100 to 4400 ft (640-1341 m). The area is composed of W.- and SW.-facing slopes on a ridge bounded by the Little N. Fork of the Salmon River, the N. Fork of the Salmon River, Kelly Gulch, and a small tributary of Specimen Creek. Slopes range from nearly level alluvial terraces to steep (60-100 percent) upper slopes. The majority of the area is steeply sloping.

Mesozoic granitics occur at low elevations with pre-Cretaceous metavolcanics on the upper slope and ridgetop areas. Soils are generally thin and rocky with some exposed rock on the upper slopes. Some of the SW.-exposures have lithosolic scree with little vegetation. Climate is similar to that of much of the central Klamath Province with an estimated annual precipitation of 50-55 inches (1270-1397 mm). Mean daily temperatures at Sawyer's Bar range from 38-40°F (3-4°'C) in the coldest months to 72-75 °F (22-24 °C) during the warmest summer months.

Association Types

Releves are sampled to construct an association table, and point-center quarter method is employed to estimate density and basal cover. Size of associations is not given.

• Douglas-fir/*Adenocaulon bicolor* (82420): This association is divided into three topographic categories: terraces, lower slopes, and steep slopes. It is also divided into two phases based on releve analysis: The Douglas-fir/*Linnaea* and Douglas-fir/*Chimaphila menziesii* phases.

The Douglas-fir/ *Linnaea* phase is characterized by being relatively herb-rich and mesic, occupying the terraces and lower slopes. This phase also has characteristic patches of the subcanopy trees, Pacific yew *(Taxus brevifolia)* and giant chinquapin, on the most mesic exposures. The point-centered quarter samples in portions of this phase (low slope stands) are the densest and highest cover of any in the area (669 trees/ha, 162.5 m^2/ha). However, the terrace stands, which also largely fall into this phase, show the least density and basal area (464 trees/ha, and 104 m^2/ha).

A total of 16 species of shrubs and 38 species of herbs are included in the 7 releves taken in the Douglas-fir/*Linnaea* phase. Among the most important are *Berberis nervosa, Symphoricarpos* sp., *Corylus cornuta, Rosa gymnocarpa, Toxicodendron diversilobum, Trillium ovatum, Viola sempervirens, Whipplea modesta, Viola glabella, Lupinus latifolius, Lathyrus polyphyllus, Adenocaulon bicolor, Fragaria californica, Osmorhiza chilensis, Disporum hookeri, Trientalis latifolia, Galium triflorum, Chimaphila umbellata, Vancouveria hexandra, Melica sp., Vicia californica, Pteridium aquilinum, Hieracium albiflorum,* and *Campanula prenanthoides.*

The Douglas-fir/*Chimaphila menziesii* phase is drier than the *Linnaea* phase. Here ponderosa pine *(Pinus ponderosa)* and sugar pine *(P. lambertiana)* become more important than in the previous phase in a canopy dominated by Douglas-fir. On the upper slope plots, both pine species taken together account for 17 trees/ha and 10.3 m^2/ha, whereas Douglas-fir accounts for 267 trees/ha and 121 m^2/ha. Pacific madrone is relatively more common in the understory than the previous phase (57/ha, 3 m^2/ha), and many of the more mesophilic herbs do not occur. In the Douglas-fir/*Chimaphila* phase, 15 species of shrubs and 34 species of herbs are tallied on 11 releves. These include *Symphoricarpos* sp., *Corylus cornuta, Rosa gymnocarpa, Toxicodendron diversilobum, Disporum hookeri, Trientalis latifolia, Pyrola picta, Pteridium aquilinum, Campanula prenanthoides, Hieracium albiflorum,* and *Arnica discoidea.*

Productivity (measured by mean radial growth increment, cored at breast height) for the steep slope portions of the Douglas-fir/*Adenocaulon* forest appears higher (17.5 years/inch, n=9) than the average for terrace areas (24.9 years/inch, n=10).

• Ponderosa pine/canyon live oak *(Quercus chrysolepis)* (84110, 81320): This forest occurs on the most xeric slopes. It typically has a more open canopy and herb-poor understory than the previous association. This association also has two phases. The ponderosa pine/*Arctostaphylos manzanita* phase occurs on mid- and upper SW.-facing slopes with relatively well-developed soils. The canopy is codominated by ponderosa pine (16.2 m^2/ha), *P. lambertiana* (7.8 m^2/ha), and Douglas-fir(10.3 m^2/ha). Herb and shrub cover is often less than l0 percent with the following species most common: *Ceanothus integerrimus, Toxicodendron diversilobum, Iris purdyi, Hieracium albiflorum, Galium californicum, Carex* sp., and *Polystichum imbricans.*

The canyon live oak/*Polystichum imbricans* phase occurs on the driest ridges and rock outcrops. Although canyon live oak is not a member of the canopy, it is the dominant. Here ponderosa pine, sugar pine, and Douglas-fir comprise a total basal area of only 18.8 m^2/ha, while canyon live oak makes up 61 m^2/ha. The density of canyon live oak averages 973 trees/ha, or 82 percent relative density. Productivity of Douglas-fir is lower than that of the terrace stands (29.7 years/inch). The most common shrub is *Toxicodendron diversilobum* (of only three species listed for the releves), and the most common of the eight species of herbs listed for the releves are *Galium californicum, Polystichum imbricans,* and *Festuca idahoensis.*

Plant Diversity

One hundred eighty-nine taxa of vascular plants are listed.

Conflicting Impacts

The area has been dropped from candidate RNA status (with #2 chosen to replace it) and is presently under multiple-use management. Before it was dropped, the authors noted several conflicts, including the need for enlargement of the original boundaries to include other slope aspects, the potential impact of trail use adjacent to the terrace stands along the Little N. Fork of the Salmon River, and the high degree of insect damage to the Douglas-fir forest.

19. SUGAR CREEK (Keeler-Wolf 1984b, 1989d, Sawyer and Thornburgh 1971)

Location

This soon-to-be-established RNA is on the Klamath National Forest. The area is located largely within the Russian Wilderness and is ca. 6 miles (9.7 km) W. of Callihan. It occupies portions of sects. 18,19,20,29,30, and 31 T40N, R9W and sects. 25 and 36 T40N, R10W MDBM (41°17' N., 122°56' W.) USGS Eaton Peak quad *(fig. 41).*

Target Elements

Enriched conifer forest, mixed conifer forest

Distinctive Features

• Enriched Conifer Forest: This RNA (hereafter referred to as SCRNA) was selected primarily to preserve the richest known assemblage of conifers in the world. It contains 17 species of conifers within one square mile (2.59 km^2). This diversity and composition cannot be duplicated elsewhere *(fig. 42).*

The diversity of the coniferous forests at SCRNA is a result of several factors. The presence of relict species such as Brewer spruce *(Picea breweriana),* Engelmann spruce *(Picea engelmanii),* subalpine fir *(Abies lasiocarpa),* foxtail pine *(Pinus balfouriana),* and whitebark pine *(Pinus albicaulis),* in conjunction with the typical overall regional dominants of the white fir *(Abies concolor),* Shasta red fir *(Abies magnifica* var. *shastensis),* and mountain hemlock *(Tsuga mertensiana)* forests have much to do with the enrichment. Although not unique to the area, the abrupt alternes between mesic, hydric, and xeric habitats and the great range in elevation (and thus, climate) over short distances also contribute to the diversity. These last two factors allow the juxtaposition of numerous species that are normally separated from one another in the California region.

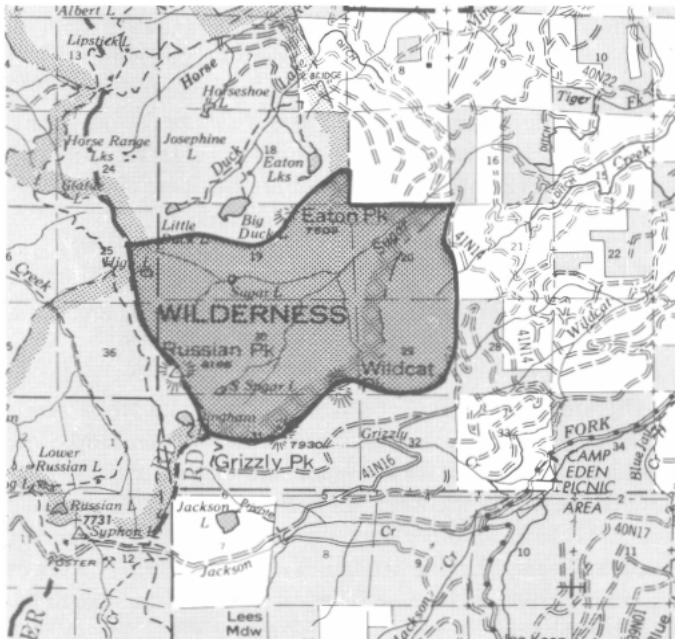


Figure 41--The Sugar Creek RNA.

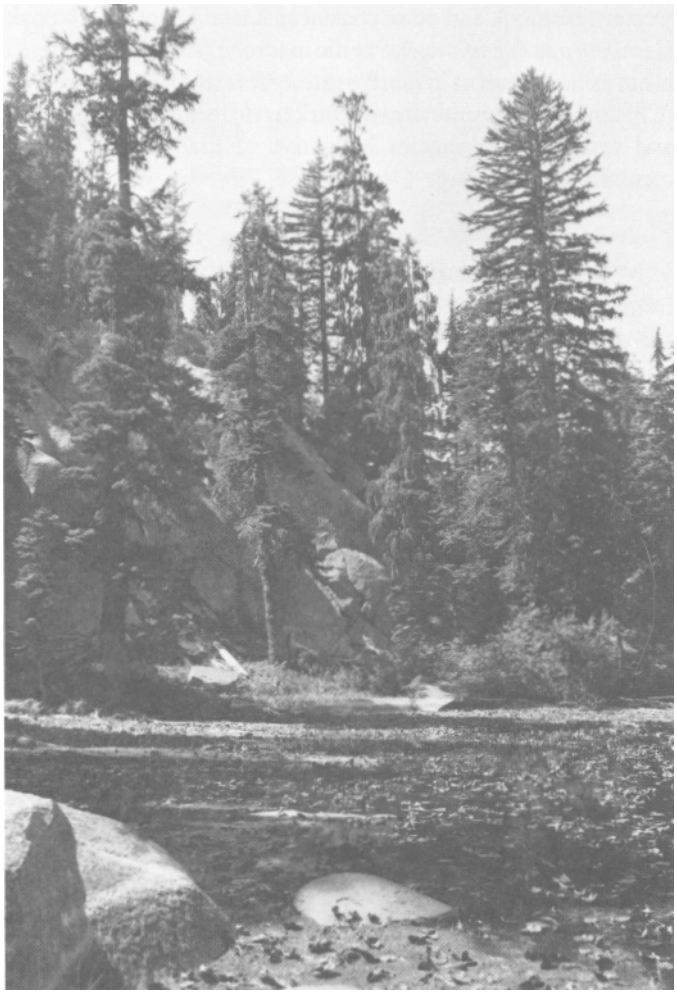


Figure 42--Sugar Creek: Enriched conifer forest adjacent to small lateral moraine-dammed pond. Trees in photo include Englemann and Brewer spruces, Shasta red and white firs, western white pine, mountain hemlock, and lodgepole pine.

Although Holland (1986) and others have defined an enriched mixed conifer forest type to characterize these locally diverse forests, Sawyer (1987) has argued that the diversity of conifers in the area does not constitute a single forest type. The fact that these forests are not replicated throughout the eastern Klamath Mountains or even in adjacent drainages with very similar environments suggests that Sawyer's contention is correct. It appears that they are agglomerations of species brought together by the vagaries of present-day climate and historical forces.

The highest conifer diversity in a single stand of uniform habitat at SCRNA is 10 species. This occurs in several sites between 5400 and 6000 ft (1645-1829 m) along the major branches of Sugar Creek where Engelmann spruce tends to dominate and a mixture of upper and lower elevation conifers are subdominants. In general, average stands in this forest contain 7-8 conifer species.

Surprisingly, xeric exposures at high elevations may also contain high diversities of conifers. An open subalpine forest on a south exposure at 7200 ft (2195 m) contains up to 9 species of conifers in a stand. Such forests understandably have little species overlap with the mesic creekside forests, and contain such xerophytic subalpine species as foxtail pine, whitebark pine, and *Juniperus communis.*

• Type Locality for Klamath Montane Vegetation: As a result of research by Sawyer and Thornburgh (1969,1970,1971) a great deal of data was collected on the vegetation of the area. Over 200 stands were sampled in the vicinity of the RNA and a vegetation classification system based on the data collected locally has become widely accepted as the standard way of viewing the vegetation of the entire montane and subalpine zone of the Klamath Mountains (Sawyer and Thornburgh 1977). Thus, this area provides not only a unique diversity of conifers, but also exemplifies the typical vegetation zonation for the entire physiographic province.

• Rich Flora: In addition to the diversity of conifers in the area, the vascular flora in general is rich. Nearly 400 taxa of vascular plants are known from the RNA. This wealth of species is in large part due to the diversity of habitats ranging from xeric to hydric and from lower montane to subalpine. Sawyer and Thornburgh (1971) describe 15 forest associations from the area, and Keeler-Wolf (1984b) indicates 26 mapping units.

• Sierran Mixed Conifer Forest: The mixed conifer forest is characteristic of the lower elevation slopes in the area. It has a variety of subtypes, including ponderosa pine *(Pinus ponderosa)*,- white fir-, and Douglas-fir *(Pseudotsuga menziesii)*-dominated types. California black oak *(Quercus kelloggii)* is occasional on lower xeric sites, and sugar pine *(Pinus lambertiana)* and incense-cedar *(Calocedrus decurrens)* are widespread. The mixed conifer forest is represented by large old-growth stands and by younger successional stands associated with past crown fire.

• Rare Plants: Several rare plants are known from the area. Subalpine fir and Engelmann spruce are both considered members of CNPS List 2. *Angelica arguta, Cypripedium fasciculatum, Draba howellii, Poa rhizomata,* and *Lomatium engelmanii* are all members of CNPS List 4.

• Entire Basin Included: The SCRNA encompasses the entire upper drainage of Sugar Creek. It includes three major subwatersheds, each of which has essentially remained unchanged by humans since before the European colonization of California. This not only gives the area excellent ecological integrity, but also enables watershed studies of various sorts to be carried out.

Physical Characteristics

The area covers 3963 acres (1603.8 ha). Elevations range from 4800 to 8196 ft (1463-2498 m). The RNA is dominated by Russian Peak on the west with two roughly equal-sized glacial valleys (S. Sugar and the main Sugar Creek drainages) incising the Salmon-Scott Divide immediately to the north and south of the peak. These valleys converge about 2 miles (3.2 km) northeast of Russian Peak and form the main Sugar Creek Valley, which continues northeastward another mile (1.6 km) to the eastern edge of the RNA. The ridges bounding these valleys have several points rising above 7600 ft (2317 m), creating valley depths over 2000 ft (610 m) in many places. Upper and middle slopes are typically steep with gradually sloping valley floors. Slope aspects are primarily NW.- and SE.-facing. The effects of Pleistocene glaciation are widespread. Two ponds above the south side of the main valley were formed by a lateral moraine dam. South Sugar Lake and High Lake lie in glacially scoured cirque bowls. The small tam ca. 0.65 miles (1 km) NNE. of Russian Peak and Sugar Lake ca. 1 mile (1.6 km) downstream together constitute a short series of Paternoster lakes.

The entire area is underlain by granitic rock (Russian Peak Pluton). Soils have been divided into six mapping units with the most extensive being Teewinot-Endlich families association and the Gerle family-Entic Xerumbrepts association. The Nanny family occupies the valley bottom morainal deposits. Precipitation is estimated at 30-50 inches (762-1270 mm) with snow as the major form.

Association Types

Sawyer and Thomburgh (1971) and Keeler-Wolf (1984b) treat the vegetation differently. Sawyer and Thornburgh base their summary on extensive sampling (221 releves analyzed) of the four major forested vegetation zones in the area. Keeler-Wolf bases his mapping units on canopy dominance of various forest types and, in addition, treats the nonforest vegetation. This present summary of the vegetation is the same as used in Keeler-Wolf (1989d) and relies largely upon the classification system of Holland (1986). One type, the mountain mahogany scrub, is not described by Holland and more closely resembles Kuchler's (1966) type 31. Another type, the Brewer spruce woodland, is described as a result of the fieldwork for the establishment report. It has no Holland, Kuchler, or SAF (Eyre 1980) analog. Comparisons to the Sawyer and Thornburgh (1971) and Keeler-Wolf (1984d) types are made. References to "S and T" signify Sawyer and Thornburgh (1971), whereas mention of "K-W" refers to Keeler-Wolf (1984d).

• Red Fir Forest (85310, 86100): 1053 acres (426 ha). This forest dominates on mid-elevation mesic slopes and upper elevation xeric slopes with well-developed soil. The most extensive essentially pure Shasta red fir forests occur on E.- and W.-facing exposures between 6800 and 7200 ft (2073-2195 m). These forests are typically dense with relatively even-aged canopies and abundant reproduction only in sunny openings. These are mapped as RF (red fir) in K-W. K-W maps several additional types with red fir as an important canopy member. Many of these are transitional forests between true red fir and types from lower or upper elevations. These include WF-RF (white fir-red fir), RF-WF-MH (red fir-white fir-mountain hemlock), RF-LP-WF (red fir-lodgepole pine [*Pinus contorta* ssp. *murrayana*]-white fir), RF-MH (red fir-mountain hemlock), RF-MH-WP (red fir-mountain hemlock-western white pine [*Pinus monticola*]), MH-RF, and RF-WP-LP. These forests vary from open to closed and from relatively mesic to xeric.

S and T describe red fir-dominated forests from both their Shasta red fir and mountain hemlock zones. Their *Abies magnifica* var. *shastensis/Quercus vaccinifolia* type includes the relatively

open forests with montane chaparral-dominated understory. S and T also include the species-rich forests of the mesic valley bottoms (treated herein as enriched conifer forest) and the shrub-dominated montane chaparral as part of the red fir zone. Their closed forests dominated by red fir are included as part of the mountain hemlock zone. Their type most descriptive of the closed, well-developed fir-dominated forests is termed *Abies magnifica* var. *shastensis/Pyrola picta.* This type occurs on fairly deep, high elevation soils. The related *Tsuga mertensiana/ Pyrola picta* type occurs under similar conditions at higher elevations or more mesic sites. Both types have trees averaging 80 ft (24.4 m) tall and canopy cover approaching 90 percent. Shrub and herb cover is light.

• Whitebark Pine-Mountain Hemlock Forest (86210): 921 acres (373 ha). The forests of the highest mesic slopes are dominated by mountain hemlock. These may be dense, shady groves or range to open and rocky. Typically these forests occur on relatively sheltered slopes except at the highest elevations, as on the summit area of Russian Peak, where they may occupy S.-facing slopes. The typical closed forest is described as *Tsuga mertensiana/Pyrola picta* by S and T and called mountain hemlock (MH) by K-W. Canopy dominance may be shared with Shasta red fir on less mesic slopes. Shrubs are scattered and associated with openings. Herbs are typically sparse. Characteristic understory species include *Luetkea pectinata, Cassiope mertensiana, Phyllodoce empetriformis, Vaccinium scoparium, V. arbuscula, Pyrola secunda,* and *P. picta.*

Whitebark pine is typically not an important constituent except on the steep north slopes of Russian Peak where it occurs scattered with hemlock among the granite slabs and boulders. Western white pine is occasional throughout in more open stands.

• Sierran Mixed Coniferous Forest (84230, 84210): 857 acres (347 ha). This, one of the two target elements selected, is an extensive forest at the lower elevations (<6000 ft, 1829 m). This association includes K-W map units MCF-pp (mixed conifer forest-ponderosa pine dominant) and MCF-wf (mixed conifer forest-white fir dominant). S and T consider all forests of this type in the RNA to be in the white fir zone. They define two types, the *Abies concolor/Berberis nervosa* type and the *Abies concolor/Ceanothus prostratus* type. The latter is analogous to MCF-pp of K-W, and the former is equivalent to MCF-wf.

On warm sunny exposures ponderosa pine dominates the canopy with white fir and Douglas-fir as secondary species. Also present are sugar pine *(Pinus lambertiana)* and incense-cedar *(Calocedrus decurrens).* A subcanopy of scattered California black oak and canyon live oak *(Quercus chrysolepis)* is common especially along ridges. Shrubs such as *Chrysolepis sempervirens, Quercus vaccinifolia,* and *Ceanothus prostratus* form a scattered to dense understory. Herbs are uncommon and include *Pyrola picta, Apocynum pumilum,* and *Goodyera oblongifolia.* Certain areas on the southeast-facing slopes above Sugar Creek have been affected by crown fire in the past 100 years and have dense even-aged young ponderosa pine.

On mesic slopes with deep soils, white fir dominates the canopy and reproduction. The other four typical mixed conifer species are subordinate. Ponderosa pine is represented by the largest individuals, but has poor reproduction, except in openings. This is a moderately dense forest with characteristic shared dominance of the canopy species. Productivity is high, and trees commonly attain heights of 165 ft (50.3 m) and dbh's of 5 ft (1.5 m). The ground layer is moderately developed and includes *Campanula prenanthoides, Disporum hookeri* var. *trachyandrum, Chimaphila umbellata* var. *occidentalis, Hieracium albiflorum, Pteridium aquilinum,* and *Linnaea borealis.*

A third type dominated by Douglas-fir occurs in the lowest elevation valley bottoms (below 5000 ft, 1524 m). This type is alluded to in S and T, but not discussed in K-W (similar to Holland 84110). In addition to other typical conifers of the zone, it contains scattered Engelmann spruce in semi-riparian areas.

• Alpine Talus and Scree Slope (91200, 91300): 310 acres (126 ha). This association occurs on all open rocky substrates at the upper elevations. It is not discussed by S and T, but is called RO (rock outcrop) in K-W. Though sparsely vegetated, this association is an important constituent of the area. It may be divided into xeric (S.-facing) and mesic (N.-facing) types. Although many species are shared between the two subtypes, there is a well-defined split. Typical taxa of N.-facing outcrops include *Saxifraga tolmiei, S. ferruginea, S. nidifica, Juncus drummondii, Luetkea pectinata, Polemonium pulcherrimum, Sibbaldia procumbens, Penstemon davidsonii,* and *Phyllodoce empetriformis.* Species of S.-facing outcrops include *Arenaria congesta, Sedum obtusatum* ssp. *boreale, Arabis platysperma, Juncus parryi, Koeleria macrantha, Eriogonum umbellatum, Melica stricta, Stipa californica,* and *Penstemon newberryi* ssp. *berryi.*

• Salmon-Scott Enriched Conifer Forest (85420): 195 acres (79 ha). This type occurs along the valley bottoms and moist, sheltered slopes from low to mid-elevations in the RNA. It is a poorly defined vegetation association with variable mixture of species. In general, it is characterized by the presence of Engelmann spruce or subalpine fir, or both, along with numerous other conifers overlapping from adjacent habitats including red fir, white fir, mountain hemlock, western white pine, lodgepole pine, Brewer spruce, incense-cedar, sugar pine, ponderosa pine, and Jeffrey pine *(Pinus jeffreyi).* The mesophilic Pacific yew *(Taxus brevifolia) is* a characteristic subcanopy species of lower elevations. K-W map units analogous to this association include ES (Engelmann spruce), ES-SAF (Engelmann spruce-subalpine fir), and SAF (subalpine fir). Analogs in S and T are *A. magnifica/Leucothoe davisiae, A. magnifica/ Linnaea borealis,* and *Tsuga mertensiana/ Phyllodoce empetriformis.*

Stand density in one 2000-m^2 sample dominated by Engelmann spruce (Sawyer and Thornburgh 1969) is 1515 trees/ha and basal area 71.8 m^2/ha. Stand density in a subalpine fir-dominated area sampled by Sawyer and Thornburgh (1969) is 1710 trees/ha with a basal area of 53.8 m^2/ha. Upper (rocky) elevations are typically dominated by subalpine fir *(fig. 43),* with lower (poorly drained) elevations dominated by Engelmann spruce. This pattern reflects the dominance patterns of these two species as they occur in their extensive range in the central and northern Cascades and mountains of Idaho and Montana (Alexander 1980).

Figure 43--Grove of subalpine fir surrounding mountain alder thicket in basin N. of Wildcat Pk.

The understory is typically well developed with a diversity of mesophyllic species. Thirty-eight shrub species are listed by S and T for the *A. magnifica/Leucothoe* type alone. Among the most important species are *Leucothoe davisiae, Ribes lacustre, Alnus tenuifolia, Vaccinium scoparium, V. membranaceum,* and *Berberis nervosa.* The herb layer is also rich with such species as *Linnaea borealis, Anemone deltoidea, Adenocaulon bicolor, Clintonia uniflora, Disporum hookeri, Mitella pentandra, Streptopus amplexifolius, Viola glabella,* and *Senecio triangularis.*

• Mixed Montane Chaparral (37510): 156 acres (63 ha). This vegetation occurs on xeric exposures within the red fir zone of S and T. It is dominated by a number of shrubs that generally cover 70-80 percent of the surface. These include *Quercus vaccinifolia, Arctostaphylos patula, A. nevadensis, Ceanothus velutinus, Holodiscus microphyllus,* among others. Herbs are scattered and include *Senecio integerrimus, Monardella odoratissima, Phlox diffusa, Castilleja applegatei,* and *Penstemon newberryi.* This association is called *Quercus vaccinifolia/ Arctostaphylos patula* by S and T and is included in map units MC (mountain chaparral), MC-JP-RF-WF (mountain chaparral-Jeffrey pine-red fir-white fir), and MC-JP-WP-RF-LP (mountain chaparral-Jeffrey pine-western white pine, red fir-lodgepole pine) of K-W.

• Jeffrey Pine-Fir Forest (85100, 85210): 125 acres (51 ha). This is an open forest typical of shallow soils and xeric exposures. It is discussed by K-W as Jeffrey pine-red fir-white fir-lodgepole pine forest. It occurs in similar situations as mixed montane chaparral (open, rocky understory on S.- and SE.-facing slopes), but usually in areas with somewhat deeper soil. Typically, Jeffrey pine dominates the scattered canopy, but fir species (red fir at higher, and white fir at lower elevations) dominate the reproduction layers. Lodgepole pine is occasional. All species of shrubs typical of montane chaparral occur.

• Sierran White Fir Forest (84240): 88 acres (35 ha). This forest is not well developed in the RNA. Mature stands strongly dominated by white fir typically occur on mid- and lower E.-facing exposures between mixed coniferous and red fir-dominated vegetation. Some dense young stands are the result of recent crown fire. This type is included in K-W MCF-WF and WF-RF (white fir-red fir) and is included within the *Abies concolor/Berberis nervosa* type in the white fir zone of S and T.

• Montane Riparian Scrub (63500): 46 acres (19 ha). This shrub-dominated association lines the sunnier seeps and creeks. The typical dominants are *Alnus tenuifolia* and *Salix commutata,* both species forming extensive thickets. Characteristic species above ca. 6000 ft (1829 m) include *Sambucus microbotrys, Spiraea douglasii, Lonicera conjugialis,* and the willow *Salix lemmonii.* In general, willows dominate on warmer SE. exposures while mountain alder dominates on E. and N. exposures. At lower elevations between 5000 and 6000 ft (1524-1829 m), the riparian zone along Sugar Creek is shaded by surrounding coniferous forest and the numerous large boulders and frequent scouring floods restrict riparian growth. In this area *Alnus sinuata* may dominate with other relatively shade-tolerant species such as *Salix scouleriana, Cornus stolonifera,* and *Sorbus scopulina.*

• Brewer Spruce Woodland: 46 acres (19 ha). This type is distinctive for its strong dominance by Brewer spruce. The trees form an open woodland on extremely steep rocky northwest-facing slopes between ca. 6400 and 7200 ft (1951-2195 m) above the main Sugar Creek valley. Scattered western white pine, mountain hemlock, and red fir are of low importance, and in many stands Brewer spruce is the only tree. Shrubs and herbs are typical of mesic rock outcrops. This type is included within MH-BS-WP-RF of K-W and may be considered part of *Abies magnifica/Quercus vaccinifolia* or *Tsuga mertensiana/A. magnifica/Pyrola picta* of S and T.

• Whitebark Pine Forest (86600): 42 acres (17 ha). This is the forest with the most severe climate in the RNA. It occupies ridgetops and adjacent upper slopes of the highest parts of the Sugar Creek drainage from ca. 7500-8200 ft (2286-2499 in). Mountain hemlock is the principal tree associate. Trees are typically low, gnarled, and twisted with multiple crowns. Shrubs include *Haplopappus greenei, Holodiscus microphyllus, Cercocarpus ledifolius,* and *Chrysolepis sempervirens.* Herbs are similar to the next described association. This association is called WBP-MH (whitebark pine-mountain hemlock) in K-W and *Pinus albicaulis/Holodiscus microphyllus* in S and T.

• Foxtail Pine Forest (86300): 30 acres (12 ha). This forest is restricted to two groves: one on rocky shallow soil on a S.-facing slope, and the other on deep, decomposed granite on an E.-facing exposure. Both stands are small and are marginally dominated by foxtail pine. The S.-facing stand has a higher diversity of subdominant species including red fir, mountain hemlock, lodgepole pine, western white pine, Jeffrey pine, whitebark pine, and white fir. The E.-facing stand has red fir and *Cercocarpus ledifolius* as the principal associates. Stand density for two samples in the south-facing stand is 260 and 658/ha, and basal area is 19.0 and 29.3 m^2/ha (Sawyer and Thornburgh 1969).

Understory species are sparse in the E.-facing stand and include *Arctostaphylos patula, Stipa occidentalis, Lupinus breweri,* and *Eriogonum ovalifolium.* In the S.-facing grove, mountain chaparral species such as *Arctostaphylos patula, A. nevadensis,* and *Holodiscus microphyllus* dominate the under-

story. Other species include *Juniperus communis, Arenaria congesta, Achillea lanulosa, Senecio integerrimus, Phlox diffusa, Lewisia leana,* and *Penstemon newberryi.*

• Mountain Mahogany *(Cercocarpus ledifolius)* Scrub (No Holland equivalent): 16 acres (7 ha). This association is not discussed by either K-W or S and T. It occupies a small area of steep, windy, rocky W.-facing slopes at ca. 7000-7300 ft (2134-2225 m) to the west of the E.-facing foxtail pine grove. The soil is virtually nonexistent, and the substrate is dominated by fractured granitic boulders. Reproduction of the dominant *C. ledifolius is* moderate. Other species in this association include red fir, *Arctostaphylos patula,* and *Ceanothus velutinus.*

• Wet Montane Meadow (45100,45210,51110,51200): 9 acres (4 ha). Wet meadow associations occur along narrow riparian borders, seeps, and lakesides. K-W discusses three types: Seep--dominated by *Aster* spp., *Dodecatheon* spp. *Ligusticum grayi, Carex spectabilis,* etc.; open meadow--dominated by such species as *Carex gymnoclada, C. interior, Juncus mertensianus, J. dubius, Perideridia gairdneri,* etc.; and bog (fen)--dominated by *Kalmia polifolia* var. *microphylla, Ledum glandulosum* var. *californicum, Drosera rotundifolia, Narthecium californicum, Tolfieldia glutinosa* ssp. *occidentalis,* etc. The best developed bog and meadow complex occurs around the shallow tam NNW. of Russian Peak.

• Montane Freshwater Marsh (52430): 7 acres (3 ha). This association occurs in several shallow ponds with muddy bottoms and fluctuating water levels. It is also well developed at Sugar Lake. This type was mapped as L (shallow lake) in K-W. Characteristic species include *Carex rostrata, Sparganium angustifolium, Nuphar polysepalum, Callitriche verna, Isoetes occidentalis,* and *Ranunculus aquatalis.*

Plant Diversity

Three hundred eighty-six species are listed in the establishment record.

Conflicting Impacts

The area receives light recreational use. The wilderness status of most of the area precludes other multiple-use impacts.

20. UPPER GOOSE CREEK (Keeler-Wolf 1987d)

Location

This candidate RNA is on the Six Rivers National Forest, Del Norte County. The two small units lie ca. 7 miles (11 km) NE. of Klamath Glen. The NE. unit lies in TI3N, R3E sects. 29, 30, and 31. The SW. unit lies in T13N, R3E, sect. 6 and insect. 31 of T14N, R3E, MDBM (41°33'N., 123°52'W) USGS Summit Valley and Klamath Glen quads *(fig. 44).*

Target Elements

Selected as a representative of the Douglas-fir-western hemlock type *(Pseudotsuga menziesii-Tsuga heterophylla),* but actually more representative of Port-Orford cedar *(Chamaecyparis lawsoniana).*

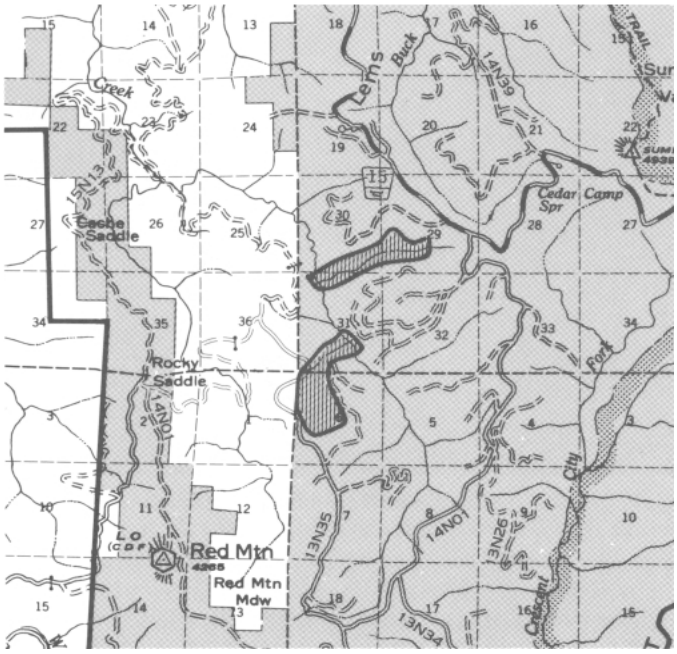


Figure 44--The Upper Goose Creek study area.

Distinctive Features

• Port-Orford Cedar-Douglas-fir-Western Hemlock Forest: This forest is poorly represented in California on Federal lands (most stands on private lands have been logged) and was once more widespread in SW. Oregon. However, root rot *(Phytophthora lateralis)* has decimated some of the best Oregon stands. The ravine bottom stands are characterized by very large individuals of all three species: Port Orford-cedar (POC) between 5-6 ft (1.5-1.8 m) dbh and 200-225 ft (61-69 m) tall; Douglas-fir 6-6.5 ft (1.8-2 m) dbh and 240-250 ft (73-76 m) tall; and western hemlock between 2.5-3.5 ft (0.76-1.1 m) dbh and 160-175 ft (49-53 m) tall. These forests are remnants of moist Tertiary environments when western hemlock and POC coexisted over a much larger area. POC and western hemlock are climax species indicated by abundant regeneration in shade of forest, whereas Douglas-fir is seral. Ages of some of the largest POC may exceed 1000 years. The Adorni RNA (#1) also contains similar vegetation. However, it has no hemlock, is dominated by Douglas-fir throughout, and has smaller and younger individuals of POC.

• Douglas-fir-Hardwood Forests: These locally most extensive forest types are typical of many lower elevation areas in the western Klamath Province. The various slope aspects and successional states of the Upper Goose Creek forests will provide important baseline information on the ecology of this most economically important forest in the Klamath Province. Many effects of fire and logging succession on these forests can be elucidated with study including the differential effects of slope exposure and history of disturbance on the composition of the forests.

Physical Characteristics

Both units occupy portions of two small side drainages of the E. Fork of Goose Creek. The NE. unit covers 140 acres (57 ha), the SW. 320 (130 ha). Elevations range from 1830 to 2450 ft (558-747 m) at the NE. unit and 1840-3440 ft (561-1049 m) in the SW. unit. The NE. unit has the predominant NW.- and SE.-facing slopes about equally represented, whereas the SW. unit has virtually all slope aspects except due S. Inner gorges of both small drainages are steep, and both units have permanent streams.

The rock type is Late Jurassic metasediment (Galice Formation). Soils belong to the Sheetiron and Hugo complexes, the former predominating. Very wet winters and occasional summer storms provide the area with an average annual rainfall of somewhat over 100 inches (2540 mm). Coastal summer fog is occasional, and temperatures are moderate.

Association Types

Eighteen 100-m^2 plots are sampled in the POC-Douglas-fir -western hemlock forest. For additional vegetation sampling in this area, see Keeler-Wolf (1988a).

• Douglas-fir dominated forests (82420): 111 acres NE. unit, 222 acres SW. unit (45 ha NE. unit, 90 ha SW. unit). These forests cover the majority of the area. They occur upslope from the POC-Douglas-fir-western hemlock types in relatively xeric situations. They may be divided into N.- and S.-facing slope types.

The N.-facing type is characterized by a canopy of Douglas-fir with a subcanopy layer dominated by giant chinquapin *(Chrysolepis chrysophylla)* and a dense shrub layer dominated by *Rhododendron macrophyllum.* Other important understory species are tanoak, *Vaccinium ovatum, Gaultheria shallon,* and *Xerophyllum tenax.* Total shrub and herb cover averages ca. 90 percent.

On S.- and W.-facing slopes without recent crown fire damage, the Douglas-fir canopy is more open relative to N.-facing slopes. There is a hardwood subcanopy dominated by tanoak, with Pacific madrone *(Arbutus menziesii)* and canyon live oak *(Quercus chrysolepis).* The understory also differs from N.-facing Douglas-fir forests with *Gaultheria shallon* frequently dominant in relatively low total cover, along with smaller amounts of *Berberis nervosa, Pteridium aquilinum, Rubus ursinus, Arctostaphylos cinerea, Toxicodendron diversilobum, Iris* sp., *Xerophyllum tenax,* and *Campanula prenanthoides.*

• Port Orford-Cedar-Douglas-fir-Western Hemlock (82200): 31 acres on SW. unit, 32 acres NE. unit (12.5 ha SW. unit, 13 ha NE. unit). This association is restricted to very mesic ravines and bottomlands and may be divided into two subtypes: POC-Douglas-fir, and western hemlock. Characterized by tall dense trees with heights of up to 250 ft (76 m) and dbh's up to 6.5 ft (2 m), this forest averages 1440 trees/ha and a basal area cover of 204 m^2/ha. POC has a higher overall importance value than Douglas-fir, but a lower basal area. Western hemlock is the third in importance. Small understory trees form a scattered layer including *Acer circinatum,* tanoak, big-leaf maple *(Acer macrophyllum),* Pacific dogwood *(Cornus nuttallii),* and giant chinquapin. Ericaceous shrubs dominate the understory, covering an average of 40 percent of the ground. *Gaultheria shallon, Rhododendron macrophyllum, Berberis nervosa, Vaccinium parvifolium* and *V. ovatum* are the principal species. Although 25 species of herbs were recorded in the samples, only three *(Polystichum munitum, Blechnum spicant,* and *Coptis lacinata)* account for anything more than trace cover.

The second subtype is characterized by hemlock dominance and tends to be best developed on alluvial flats and relatively gentle slopes. The understory is sparser than the former type because of dense shade and litter. *Oxalis oregana* and *Polystichum munitum* are the most characteristic understory species. The western hemlock-dominated forest typically occurs on the most mesic sites with the deepest soils and the gentlest topography.

• Successional Forest (81100, 81400, 37530): 43 acres SW., 12 acres NE. unit (17.5 ha SW. unit and 5 ha NE. unit). Large areas of surrounding vegetation have been disturbed by crown fire, clear-cutting, or a combination of both over the past 60+ years. Recent clearcuts are frequently dominated by *Ceanothus velutinus* var. *laevicaulis* with resprouts of tanoak, madrone, giant chinquapin, and canyon live oak along with shrubs such as *Rosa gymnocarpa, Rubus leucodermis,* and *Toxicodendron.* Skid trails and more heavily disturbed areas are dominated by naturally seeding thickets of Douglas-fir saplings. In addition, Douglas-fir has been planted uniformly throughout most of these cuts. Older successional forests tend to have broadleaf evergreens dominant in a low 35- to 40-ft (11- to 12-m) canopy with occasional emergent survivor Douglas-fir. Tanoak and madrone tend to dominate on southerly-facing exposures while giant chinquapin is an additional codominant on more northerly-facing exposures.

• Riparian Woodland (61130, 81 A00): the low-volume side streams have a scattered bordering layer of red alder *(Alnus oregona) up* to 32 inches (81 cm) dbh and over 100 ft (31 m) tall overlying a dense, largely deciduous shrub layer dominated by *Ribes bracteosum, Euonymus occidentalis, Rubus spectabilis,* and *Rhamnus purshiana.* Herbs of this association include *Boykinia elata, Mitella ovalis, Aralia californica, Athyrium filix femina, Adiantum pedatum, Tellima grandiflora, Carex ormantha, Agrostis longiligula, Calamagrostis foliosus, Woodwardia fimbriata, Petasites palmatus,* and *Aquilegia formosa (fig. 45).*

The riparian zone along the main east fork of Goose Creek is characterized by more sun, flooding, and alluvium. The red alder trees are relatively small, and many of the more shade-loving species are absent. *Phacelia bolanderi is* characteristic of the gravelly alluvium areas along this stream.

Plant Diversity

Ninety-six taxa listed.

Conflicting Impacts

Logging roads may potentially act as transport routes for *Phytophthora lateralis,* the root rot fungus lethal to POC. The SW. unit has more integrity because most of the drainage is

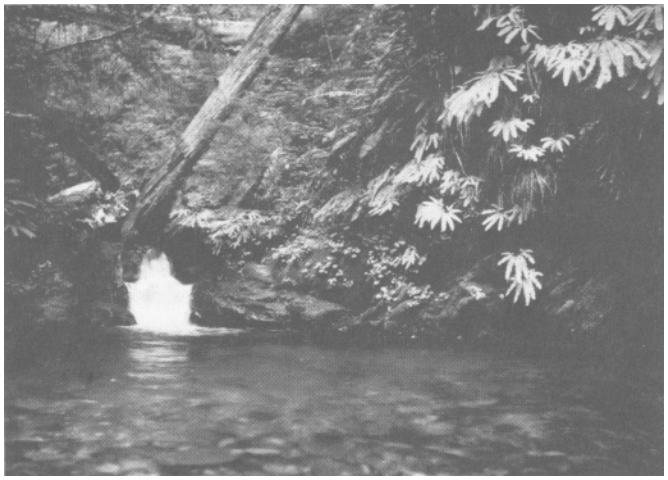


Figure 45--Upper Goose Creek: plunge pool of small waterfall in western hemlock/Port Orford-cedar forest in NE. unit, *Adiantum pedatum* var. *aluticum* on cliff walls.

within proposed boundaries of RNA. The NE. unit is more vulnerable because its drainage is heavily roaded. Clearcuts and other human disturbances affect edges of units, but not core areas of the target element. There is no erosion associated with human-mediated impacts on side streams, but the main E. Fork of Goose Creek shows some increased downcutting probably resulting from clear-cutting upstream. Despite shortcomings, this RNA probably contains best available examples of POC-Douglas-fir-western hemlock forest in California.

21. WILLIAM'S POINT (Sawyer and Stillman 1978)

Location

This candidate RNA is on the Klamath National Forest ca. 3 miles (5 km) E. of Happy Camp along the western side of the Klamath River Canyon. It lies within portions of sections 7 and 8 T16N, R8E HBM (41°48'W., 123°19'W.) USGS Slater Butte quad *(fig. 46).*

Target Elements

Pacific Douglas-fir *(Pseudotsuga menziesii),* mixed evergreen forest

Distinctive Features

This area is representative of inner Klamath River stands of Douglas-fir and tanoak *(Lithocarpus densiflorus)* on N. and E.-facing slopes. The area is clearly warmer-coastal than the Specimen Creek candidate as indicated by the presence of tanoak, but is also somewhat drier than that area as indicated by the lack of giant chinquapin *(Chrysolepis chrysophylla).*

Physical Characteristics

The area occupies 150 acres (61 ha). It includes N. and E.-facing slopes of a promontory surrounded on three sides by the Klamath River. The fourth side is bounded by State Highway 96. Most slopes are steep (60-90 percent). Those at the E. end

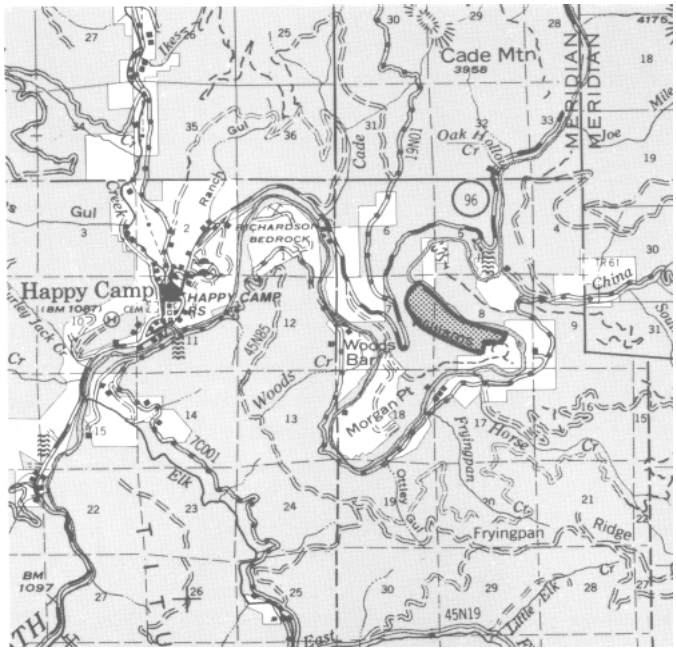


Figure 46--The William's Point study area.

are more moderate (30-50 percent). Elevations range from 1100 ft (335 m) at the edge of the Klamath River to 2250 ft (686 m) atop William's Point. The area is composed of pre-Silurian metasedimentary rock. Most soils are moderately developed except for the unstable thin and rocky soils of the central portion. Rainfall averages 46.7 inches (1186 mm) at Happy Camp. There are occasional winter snows and summer thundershowers. At Happy Camp the mean winter temperature is 42.2 °F (24.4 °C) and mean summer temperature is 76.3 °F (24.6 °C).

Association Types

Forty releves are sampled as well as 40 points (point-centered quarter method). Sizes of associations are not given.

• *Pseudotsuga menziesii/Achlys triphylla* (81100, 82420): This is the major forest type in the area. The releves are analyzed with an association table which divides the type into two phases: a lower slope relatively mesic Douglas-fir/*Polystichum* phase and a relatively xeric upper slope Douglas-fir/*Ligusticum* phase. The Douglas-fir/*Polystichum* phase is characterized by a dense lower canopy dominated by tanoak (100 percent presence, 440 trees/ha, basal area 20 m^2/ha). Pacific yew *(Taxus brevifolia) is* restricted to this phase (27 percent presence, 27 trees/ha, 0.6 m^2/ha). Pacific madrone *(Arbutus menziesii)* is the other major hardwood (73 trees/ha, 4.6 m^2/ha). Douglas-fir is the major canopy dominant (100 percent presence, 257 trees/ha, 155.8 m^2/ha). Productivity for Douglas-fir (measured from the outer 5 inches [13 cm] of trunk cored) in the *Pseudotsuga/Polystichum* phase is similar to the *Pseudotsuga/Ligusticum* phase (7.7 years/cm vs. 7.0 years/cm, respectively), while basal area is substantially higher.

Important shrubs of this phase include *Berberis nervosa, Corylus cornuta, Symphoricarpos mollis, Rosa gymnocarpa,*

Toxicodendron diversilobum, and *Holodiscus discolor.* Many herbs are common to both phases. Some of the most important include *Polystichum munitum, Achlys triphylla, Trientalis latifolia, Disporum hookeri, Pteridium aquilinum, Galium triflorum,* and *Lonicera hispidula.*

The Douglas-fir/*Ligusticum californicum* phase is dominated by Douglas-fir (198 trees/ha, 63 m^2/ha), but with a higher cover of sugar pine *(Pinus lambertiana*) (6 trees/ha and 4.8 m^2/ha) than in the previous phase. Tanoak is greatly reduced in the subcanopy compared to the previous phase (7 trees/ha, 0.1 m^2/ha). Big-leaf maple *(Acer macrophyllum)* becomes relatively important in the lower canopy (80 percent presence, 83 trees/ha, 4.0 m^2/ha), and Pacific madrone remains in similar values to the previous phase (38 trees/ha, 5.0 m^2/ha).

This phase has a more distinctive herb stratum with *Madia madioides, Ligusticum californicum,* and *Lathyrus polyphyllus* restricted to it, along with such common shared species as *Pteridium aquilinum, Disporum hookeri, Galium triflorum, Trientalis latifolia,* and *Arnica* sp. Shrubs are similar to the previous phase with the notable absence of *Berberis nervosa.*

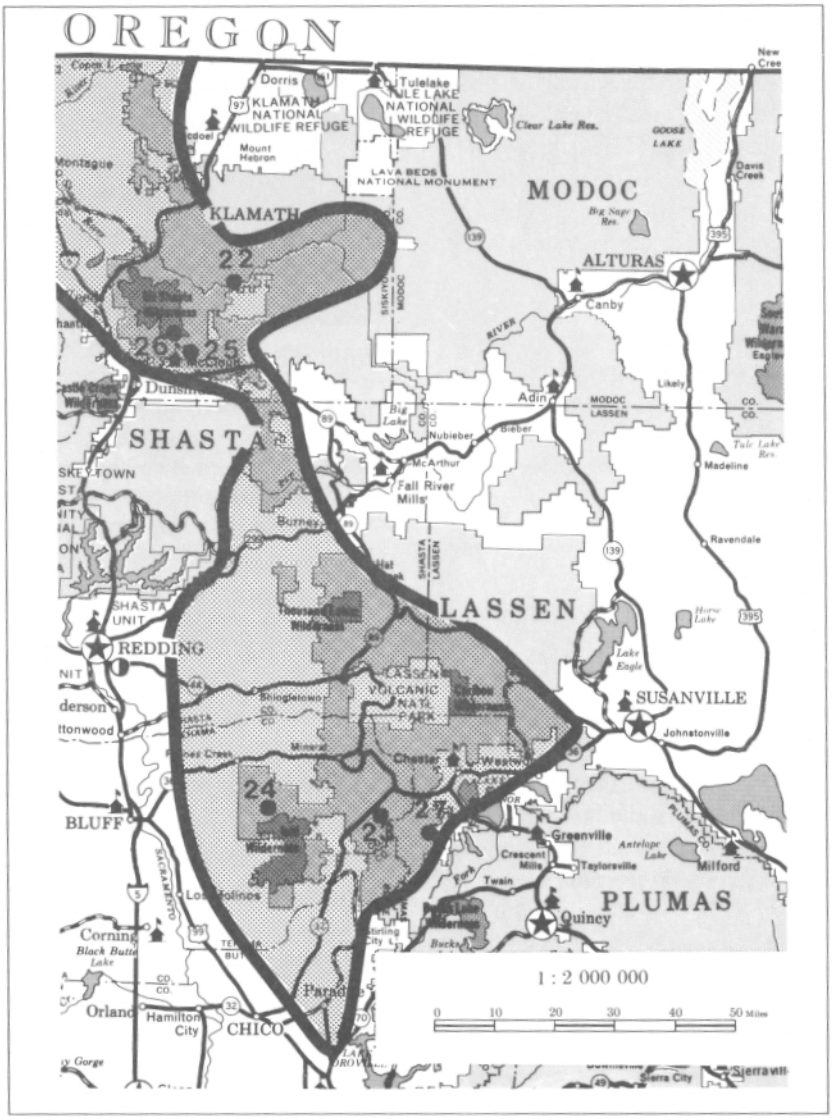
• Canyon Live Oak-Oregon White Oak/ *Pityrogramma triangularis* (71110, 81320): This association occurs on dry, steep unstable slopes. Ten points are sampled in this type. It is characterized by an open woodland dominated by small canyon live oak (134 trees/ha, 5.5 m^2/ha) and Oregon white oak (166 trees/ha, 2.4 m^2/ha). Total basal area of this type averages 7.8 m^2/ha, and total density is 316 trees/ha. The herb layer is distinct with xerophytic species such as *Pityrogramma triangularis, Heuchera micrantha, Selaginella wallacei, Aira praecox, Polypodium californicum,* and *Eriogonum umbellatum* predominating. The major shrub is *Toxicodendron diversilobum* with lesser species including *Holodiscus discolor, Ceanothus integerrimus, Lonicera ciliosa, Cercocarpus betuloides,* and *Philadelphus lewisii* ssp. *gordonianus.*

Plant Diversity

One hundred eleven taxa are listed.

Conflicting Impacts

The area is small and does not represent a variety of slope aspects. This restricts research potential. A clear-cut block prevents enlargement of the area to the N. The area was partially burned in a 1987 fire.



II. THE CASCADE RANGE PROVINCE

22) Antelope Creek Lakes
23) Cub Creek
24) Indian Creek
25) Mount Shasta Mudflow
26) Shasta Red Fir
27) Soda Ridge

CASCADE RANGE PROVINCE

22. ANTELOPE CREEK LAKES (Fiedler 1987, Keeler-Wolf 1989e)

Location

This soon-to-be-established RNA is on the Klamath National Forest. The center of the area lies ca. 12 miles (19 km) NE. of the summit of Mt. Shasta. It occupies the majority of sect. 20 T42N, R1W, MDBM (41°27'N., 121°59'W.) USGS Rainbow Mountain quad *(fig. 47)*.

Target Element

Subalpine wet meadow

Distinctive Features

• Meadow Vegetation: The meadows, though small in area, are diverse and include about half of the meadow types described for the Sierra Nevada (Ratliff 1985). They include stringer types along creeks, and lake margin types *(fig. 48)*.

• Aquatic Resources: The four lakes are largely unstratified with continuous circulation due to their shallow depth and wind action. They vary in their physical and biotic characteristics. One has introduced brown trout, and some have breeding populations of long-toed salamanders *(Ambystoma macrodactylum)* and Pacific tree frogs *(Hyla regilla)*. All are rich in aquatic invertebrates. Aquatic plants such as *Isoetes bolanderi* and *Sparganium angustifolium* occur in some lakes.

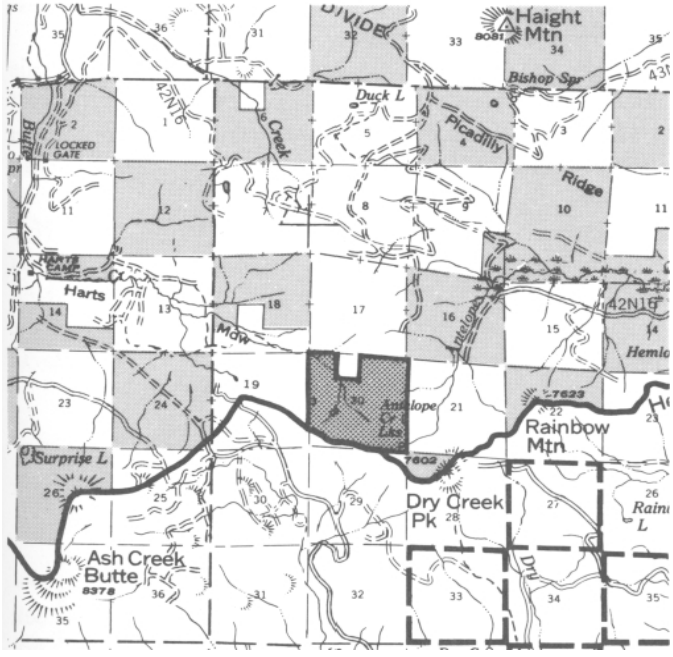


Figure 47--The Antelope Creek Lakes RNA.

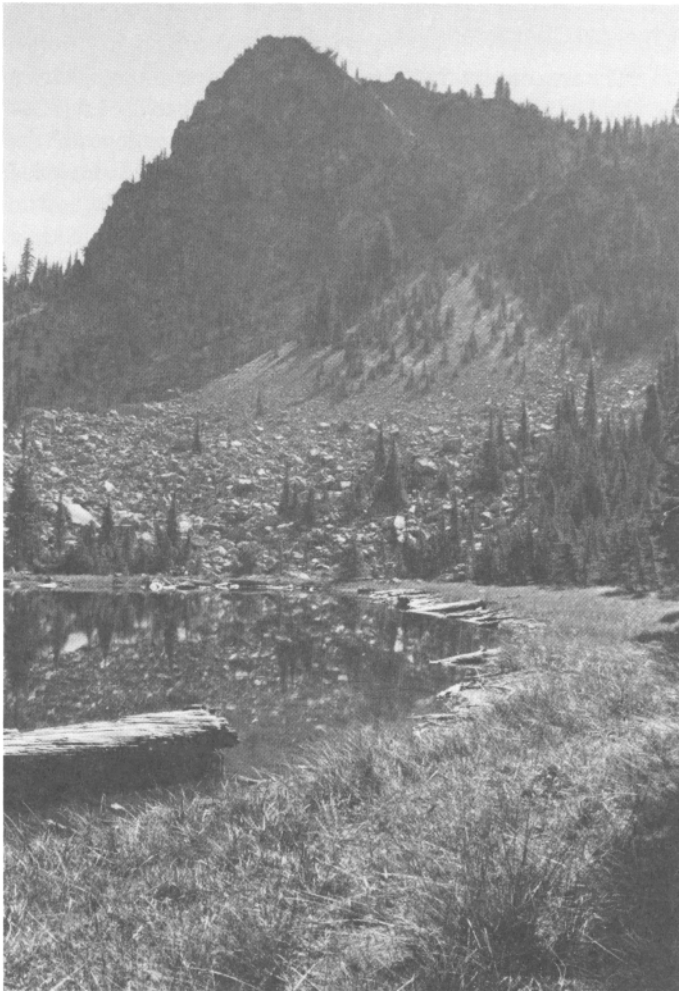


Figure 48--The southern Antelope Creek Lake looking south to ridgecrest near Dry Creek Peak. Lake border meadow with mountain hemlock forest surrounding.

• Rare and Uncommon Vertebrates: Wolverine *(Gulo gulo),* goshawk *(Accipiter gentilis),* golden eagle *(Aquila chrysaetos),* and prairie falcon *(Falco mexicanus)* have been sighted in the area.

• Well-Developed Mountain Hemlock *(Tsuga mertensiana)* and Shasta Red Fir *(Abies magnifica* var. *shastensis)* Forests: The mountain hemlock forests range from dense young stands in avalanche or high snow accumulation areas to large mature trees to 4 ft (1.2 m) dbh in sheltered areas. Shasta red fir forest occupies relatively xeric exposures and is also represented by a range of types from young to senescent (See cover photo).

• Rare Flora: One rare species, *Polystichum lonchitis* (CNPS List 3), is known from the area.

• Low Elevation Subalpine Vegetation: Whitebark pine *(Pinus albicaulis)* forest occurs as low as 6900 ft (2103 m) along ridgetops in the area. This is the lowest elevation whitebark pine forest represented in the California RNA system. Associated with this forest in shady crevices and on talus slopes are several plant species characteristic of high elevation subalpine or alpine zones in the S. Cascades.

Physical Characteristics

The area covers 544 acres (220 ha). Elevations range from ca. 6000 ft (1829 m) in the valley of Butte Creek to 7361 ft (2244 ha) at a high point along the ridge dividing the Antelope and the Butte Creek drainages. Four permanent lakes are included within the boundary. They are glacially formed and rest in cirques at the head of the aforementioned drainages. Slopes range from very gradual at the valley bottoms to very steep at the headwalls. Slopes are predominantly W.-, N.-, and E.-facing.

Rocks are entirely Pliocene andesite resulting from volcanic episodes of the local Cascade Mountains. Soils are Sheld-Iller families complex and Oosen-Avis families complex, the latter occupying the valley bottom of Butte Creek. Climate is cool. Mean January temperatures are estimated at 16.7 °F (-8.5 °C), mean July 53.5° F (11.9 °C), and mean annual 34.9 °F (1.6 °C). Mean annual precipitation is ca. 40 inches (1016 mm) while mean April 1 snow depth probably averages 75-100 inches (191-254 cm).

Association Types

This discussion of associations follows the arrangement in the establishment record, because more attention is given to the target element and other forest types than in the ecological survey. The sampling (point center-quarter method) of the mountain hemlock (34 points) and Shasta red fir (7 points) forests is all done in conjunction with the ecological survey.

• Whitebark Pine-Mountain Hemlock Forest (86210,86600): 245 acres (99 ha). This forest is divided into two subtypes: mountain hemlock, and whitebark pine. The mountain hemlock forest occurs on most slopes N. of W. and E. aspects above 6200 ft (1890 m). This subtype has sparse understory vegetation and less litter and duff than typical red fir forest. Reproduction occurs mainly in areas of disturbance such as avalanche sites or heavy snow accumulation sites. In a mixed red fir-mountain hemlock sample mountain hemlock has 83 percent frequency, 59 percent cover, and a mean distance of 15.3 ft (5.1 m) between trunks. The mean diameter is 14.8 inches (37.6 cm). Other trees in the sample include Shasta red fir (57 percent frequency) and lodgepole pine *(Pinus contorta* ssp. *murrayana)* (3 percent frequency).

The whitebark pine subtype occurs in a narrow strip along the southern boundary ridge. Whitebark pine is often dominant, but occasionally codominates with mountain hemlock and Shasta red fir. The trees are typically widely spaced, wind-flagged, and stunted. The open understory has scattered individuals of *Chrysolepis sempervirens, Arctostaphylos patula, Haplopappus bloomeri,* and *Stipa occidentalis.*

• Shasta red fir forest (85310): 194 acres (79 ha). This forest occurs on W.- and SW.-facing slopes in the Butte Creek drainage and on steep ESE.-facing slopes in the NE. portion of the site. Typically it is even-aged with trees 2-3 ft (0.6-0.9 m) dbh and heights of 140-160 ft (43-49 m). There is little understory vegetation and reproduction is most prolific in tree fall gaps. A young (ca. 90-year-old) stand on SW.-facing slopes is a result of crown fire. Samples indicate a mean cover of 90 percent for fir with 10 percent for hemlock, and an average distance between trees of 20 ft (6.1 m). Mean dbh for red fir is 20.4 inches (51.8 cm), and for hemlock 18.7 inches (47.5 cm). However, there are two distinct cohorts of both species, the older averaging 33 inches (84 cm) dbh and the younger 3.5 inches (8.9 cm) dbh. Fir is present at 100 percent of the samples, whereas hemlock occurs at only 14.3 percent.

• Alpine Talus and Scree Slope (91200): 47 acres (19 ha). On N.-facing slopes of the S. boundary, ridge outcrops and active talus areas support populations of several high-montane species. Cover is light, precluded by boulders, scree and bedrock. The following species are characteristic: *Cryptogramma acrostichoides, Phyllodoce breweri, Oxyria digyna, Cardamine bellidifolia, Arnica longifolia* ssp. *myriadenia, Epilobium angustifolium, Sambucus microbotrys, Athyrium alpestre* var. *americanum, Solidago multiradiata,* and *Potentilla glandulosa* ssp. *pseudoruprestris.*

• Wet Montane Meadow (45100,45210): 27 acres (11 ha). Ten subtypes of meadow are discussed in the establishment record. These are named by their dominant species and include *Deschampsia caespitosa; Carex rostrata; Phyllodoce breweri-Ligusticum grayi; Calamagrostis canadensis; Heleocharis acicularis;* sedge meadow; *Muhlenbergia filiformis; Trifolium longipes; Trifolium monanthum,* and *Mimulus guttatus.*

• Montane Chaparral (37510): 16 acres (7 ha). This may be broken into two subtypes. The most extensive is the *Holodiscus microphyllus-Chrysothamnus nauseosus* ssp. *albicaulis* subtype. It occurs on stabilized talus and ridgetops at high elevations (up to 7361 ft, 2244 m) in the N. part of the RNA. Other species include *Eriogonum umbellatum, Haplopappus bloomeri, Purshia tridentata,* and *Chrysolepis sempervirens.*

The *Arctostaphylos patula-Ceanothus velutinus* subtype occupies small openings in red fir forest. On SW.-facing slopes *Ceanothus velutinus* often dominates. Other species include *Arctostaphylos nevadensis, Chrysolepis sempervirens,* and *Monardella odoratissima* ssp. *pallida.* This subtype is successional except on rocky ridgetops.

• Montane Freshwater Marsh (52430): 10 acres (4 ha). This vegetation is not well developed. It occurs sporadically at all four lakes. The most characteristic species are *Sparganium multipedunculatum, Carex rostrata,* and *Potamogeton richardsonii.*

• Montane Riparian Scrub (63500): 5 acres (2 ha). This association is dominated by *Alnus tenuifolia.* It occurs around springs, rivulets, and in patches along the main Butte Creek channel. Associated species include several willows *(Salix* spp.*), Sorbus cascadensis, Senecio triangularis, Aquilegia formosa* var. *truncata,* and *Aconitum columbianum.*

Plant Diversity

One hundred sixty-two taxa are listed in the establishment record.

Conflicting Impacts

Cattle grazing in the stringer meadows along Butte Creek is the major impact, although it is not severe. Grazing is not apparent around the lake margin meadows. Few other impacts occur except the periodic stocking of the streams and lakes.

Recreational impact associated with fishing is light.

23. CUB CREEK (Taylor and Randall 1978)

Location

This established RNA is on the Lassen National Forest. It lies ca. 12 miles (19 km) south of Mineral, occurring in portions of sects. 13, 14, 15, 23, 24, and 25 T27N, R4E and sects. 18,19, 20, 29, and 31 T27N, R 5E MDBM (40°10' N,.121°9'W.) USGS Butte Meadows and Jonesville 15' quads *(fig. 49).*

Target Element

Mixed Conifer Forest

Distinctive Features

• Successional Trends in Mixed Conifer Forest: Throughout the elevational range of forest in the drainage only white fir *(Abies concolor)* shows an abundance of individuals of smaller size classes. At present there are no data suggesting white fir mortality patterns change with age. Thus, barring fire intervention, forest composition may change towards strong white fir dominance and reduced diversity of associated canopy species. The Cub Creek watershed shows a wide variety of possible study sites for investigations of long-term successional trends within the mixed conifer and adjacent zones.

• Large Size and Ecological Integrity: The preservation of the area as an entire watershed will be useful for ecosystem-wide studies, and the large area of the RNA will enable many studies to take place within its boundaries without the need to select additional locations *(fig. 50).*

Physical Characteristics

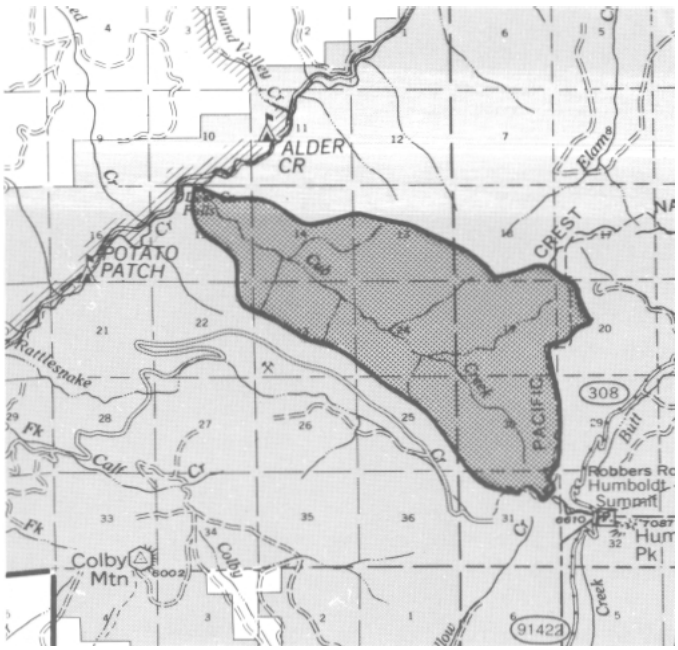


Figure 49--The Cub Creek RNA.

The area covers 3922 acres (1587 ha) that include the majority of the Cub Creek watershed. Cub Creek is a low-order tributary of Deer Creek draining the western slope of the S. Cascades. Elevations range from 3727 to 6706 ft (1136-2044 m). Gross topography is moderately steep (25-40°). However, because of many small cliffs less than 66 ft (20 m), the microtopography is more rugged than indicated on topographic maps. The stream runs in a northwesterly direction, making NE. and SW. slopes the predominant aspect in the area.

Rocks are entirely Pliocene volcanics. Vertical cliffs are primarily breccia and often capped by resistant andesite. Soil depth is greatest on NE.-facing slopes, but no detailed account of soils was available at the time of the survey. Climate is typical summer-dry, winter-wet with total precipitation at Mineral averaging 51.5 inches (1309 mm)/yr. Mineral's average annual temperature is 46 °F (7.6 °C) with a January average of 30.6 °F (-0.8 °C) and a July average of 63.0 °F (17.2 °C).

Association Types

Seven plots are sampled in the mixed conifer forest and four in the red fir zone.

• *Arctostaphylos patula-Quercus vaccinifolia* (37510): 981 acres (397 ha). This is a seral brush association that is trending toward forest in most sites. *A. patula, Ceanothus integerrimus,* and *Q. vaccinifolia* dominate the vegetation, forming a closed canopy 1-1.5 m tall. Herbs are sparse. On very rocky sites at lower elevations within the drainage this may be a climax type.

• Ponderosa Pine/Douglas-fir/Incense-cedar *(Pinus ponderosa-Pseudotsuga menziesii-Calocedrus decurrens)* (84230): 902 acres (365 ha). This association shows the typical variation in dominance between the five principal dominants of the Sierran mixed conifer forest: ponderosa pine, Douglas-fir, sugar pine *(Pinus lambertiana),* incense-cedar, and white fir. Incense-cedar has the highest frequency of occurrence followed by Douglas-fir, ponderosa pine, and sugar pine. Basal area ranges from 89 to 124 m^2/ha, and density ranges from 808 to 1050 trees/ha. Shrubs are not indicated on the samples, and

Figure 50--View N. across head of Cub Creek drainage through red fir-white fir-western white pine forest, mixed conifer forest in valley bottom, montane chaparral on S-facing ridge, Mt. Lassen in right distance.

herbs are represented by *Bromus marginatus, Polygala cornuta, Viola lobata, Pedicularis densiflora, Iris hartwegii, Carex multicaulis, Arceuthobium campylopodum, Hieracium albiflorum,* and *Galium bolanderi,* most of which are less than one percent cover.

• *Sitanion hystrix-Chrysothamnus nausiosus* (35400): 471 acres (191 ha). This association occupies rocky or shallow soil sites at the highest elevations within the Cub Creek basin. These sites are dry and well-drained with little snow cover in winter because of wind exposure. The vegetation is composed of cold-desert type species. Other species beside the two definitives include *Penstemon laetus, Phacelia frigida* ssp. *dasyphylla, Calyptridium umbellatum, Eriophyllum lanatum* ssp. *integrifolium. Artemisia arbuscula, Leptodactylon pungens* ssp. *hookeri, Calochortus leichtlinii, Sanicula tuberosa, Phlox diffusa, Pteryxia terebinthina* var. *californica, Allium plauticaule, Galium hypotrichium, Eriogonum microthecum, Penstemon deustus, Collomia tinctoria,* and *Eriogonum ursinum.*

• Red Fir *(Abies magnifica)*-White Fir-Western White Pine *(Pinus monticola)* (84240, 85310): 314 acres (127 ha). The four plots yield basal area cover of from 56 to 123 m^2/ha, with white fir, red fir, and western white pine dominating the canopy. Densities of tree stems range from 301 to 1902/ha. This forest shares some species of shrubs and herbs with the montane chaparral, and it appears that most of the montane chaparral in the drainage will succeed to this type of forest. Shrub and herb species include *Quercus vaccinifolia, Smilacina racemosa amplexicaulis, Penstemon gracilentus, Monardella odoratissima* ssp. *pallida, Arctostaphylos nevadensis, Ribes viscossum* ssp. *hallii, Chrysopsis breweri, Acer glabrum, Pyrola picta,* and *Chimaphila menziesii.*

• Douglas-fir-Pacific Dogwood *(Cornus nuttallii)* (84110): 157 acres (64 ha). Douglas-fir is the dominant canopy species and occurs with white fir, incense-cedar, Pacific dogwood, California black oak *(Quercus kelloggii),* and big-leaf maple *(Acer macrophyllum).* This type occurs on only the lower NE.-facing slopes of the area. One plot sampled in this type indicates a near-equal importance of Douglas-fir and incense-cedar with much lower importance of other tree species. Shrubs are apparently very sparse (none listed), and herbs include *Goodyera oblongifolia, Pteridium aquilinum pubescens, Disporum hookeri* var. *trachyandrum, Corallorhiza maculata, Trientalis latifolia, Asarum hartwegii,* and *Chimaphila umbellata* ssp. *occidentalis.*

• *Carex microptera-Glyceria striata* (45100): 39 acres (16 ha). Meadows are few in number and small-sized. Among the species included in this association are *Veratrum californicum, Muhlenbergia filiformis, Deschampsia elongata, Mimulus primuloides* ssp. *pilosellus, Sagina saginoides* ssp. *hesperia, Hypericum anagalloides, Taraxacum officinale, Epilobium oregonense, Mimulus guttatus, Trifolium longipes, Veronica americana,* and *Viola adunca.*

Plant Diversity

Two hundred thirty-one plant taxa are listed.

Conflicting Impacts

No conflicts of major importance are indicated. Access is somewhat difficult to the lower reaches of the drainage, and slopes are steep and rugged, limiting to some degree the ease of scientific study.

24. INDIAN CREEK (Keeler-Wolf 1986b, 1990)

Location

This soon-to-be-established RNA is on the Lassen National Forest, Tehama County. It is ca. 9 miles (14 km) SE. of Paynes Creek. It occupies portions of sects. 33 and 34 T28N, R1E, sects. 3, 4, 9,10,11,12,13,14, and 15 T27N, R1E MDBM (40°13' N., 121°50'W.) USGS Panther Spring and Dewitt Peak quads *(fig. 51).*

Target Element

Blue Oak/Digger Pine *(Quercus douglasii/Pinus sabiniana)*

Distinctive Features

• Blue Oak Woodland: Many blue oak stands throughout California are not reproducing as a result of varying effects of livestock browsing, rodent predation, and insect predation. The relatively even size-class representation at Indian Creek is indicative of a healthier population than in several other areas sampled elsewhere in the state (Griffin 1977). Recent reproduction is fairly good with seedlings and small saplings on 32 percent of the sample points. Four size classes encompassing trees ranging from 2 to 16 inches (5-41 cm) dbh have frequencies greater than 15 percent.

• Rare Plants and Range Extensions: *Calycadenia fremontii* and *Fritillaria eastwoodiae (phaenthera)* are members of CNPS List 3. The following species are on List 4 of CNPS: *Mimulus*

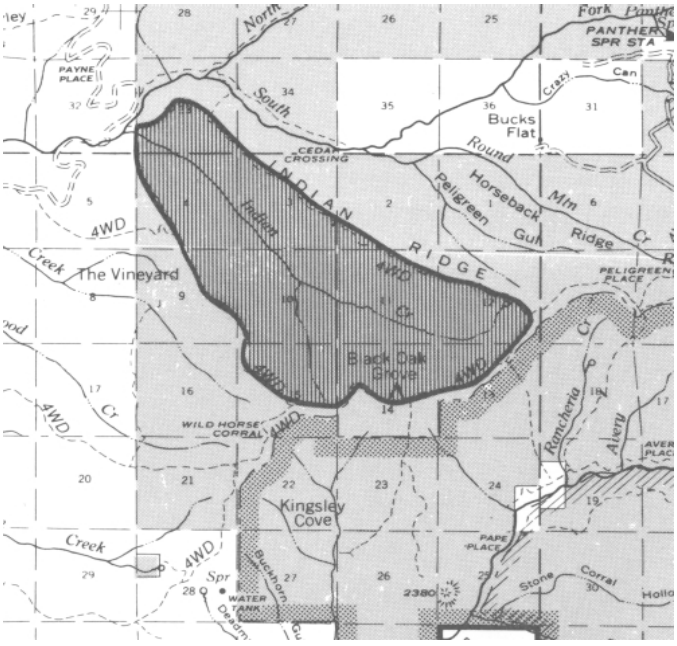


Figure 51--The Indian Creek RNA.

glaucescens, Astragalus pauperculus, Navarretia subuligera, and *Polygonum bidwelliae.* A number of species were found N. of their listed ranges in Munz (1968). These include *Dydleya cymosa, Clarkia arcuata, Centaurium floribundum, Parvisedum pumilum, Fritillaria eastwoodiae (phaenthera), Filago californica, Polygonum bolanderi, Layia platyglossa* ssp. *campestris, Polypodium californicum, Limnanthes alba, Melica torreyana, Githopsis pulchella,* and *Navarretia prolifera.* Two species *(Symphoricarpos mollis, Lomatium californicum)* are typically North Coast Range species, not reported from the Cascade Range of California.

• Riparian and Stream Biota: For a relatively small stream, Indian Creek contains a diverse mixture of plants and animals associated with it. Large populations of rainbow trout *(Salmo gairdneri)* and other fish as well as western pond turtles *(Clemmys marmorata),* California newts *(Taricha torosa),* aquatic garter snakes *(Thamnophis couchii),* and many species of aquatic invertebrates are associated with the stream. The riparian vegetation is well-developed and shows little evidence of human disturbance.

Physical Characteristics

The area covers ca. 3900 acres (1578 ha) and includes nearly all of the Indian Creek drainage, a small permanent tributary to Antelope Creek. The basin is ca. 1.5 miles by 4 miles (2.4 km by 6.4 km). Elevations are 1325-3120 ft (404-951 m). The drainage is oriented NW.- SE. with Indian Creek flowing NW. Predominant exposures are SW. and NE. Slopes are variable, from gentle atop the ridges, to moderate in the majority of the drainage, and steep on many small escarpments.

Rocks are late Pliocene volcanic breccias (Tuscan Formation), which are deposited in horizontal layers of varying resistance. The vegetation often conforms to these layers, showing up as distinct bands along the slopes. Soils are largely Toomes and Supan series. The latter series is deeper and supports denser oak woodland, whereas the former is shallow and rocky, dominated by grassland and scrub.

Association Types

Twenty-two random points (point center-quarter method) are sampled in the blue oak woodland. The remainder of the vegetation is qualitatively described.

• Live Oak Woodland-scrub (37110, 37900, 37A00, 71150, 71322, 81330): 1265 acres (512 ha). This is a dense sclerophyll vegetation intermediate between woodland and chaparral. It is most extensive on NE.-facing slopes, but also occurs on sheltered W. and SW.-facing slopes on rocky soil. Interior live oak *(Quercus wislizenii)* dominates typically as shrubby, multistemmed individuals. Other woody species include California buckeye *(Aesculus californica), Rhamnus crocea, R. californica, Juniperus californica, Ceanothus cuneatus, Toxicodendron diversilobum, Cercocarpus betuloides, Cercis occidentalis, Arctostaphylos manzanita, Lonicera interrupta,* and scrubby canyon live oak *(Quercus chrysolepis).*

Digger pine is unevenly distributed, tending to be most common on lower SW.-facing slopes. Beneath the scattered emergent Digger pines the shrub layer is variable with some species (e.g., *Fraxinus dipetala* and *Cercocarpus betuloides)* attaining heights of 13-20 ft (4-6 m). Herbs are uncommon.

At higher elevations and on more sheltered slopes *Quercus dumosa* tends to replace interior live oak, and other species such as *Fraxinus dipetala, Rhus trilobata, Ceanothus integerrimus, Fremontodendron californicum,* and *Ptelea crenulata* become more important. *Eriodictyon californica* may be common in rocky areas. These sites resemble Holland's N. mixed chaparral and scrub oak chaparral (37110, 37900).

• *Ceanothus* Scrub (37810): 945 acres (382 ha). This association occurs on NE.-E.-, and S.-facing slopes. It is dominated by one species, *Ceanothus cuneatus.* The scrub is relatively open and appears senescent with no evidence of fire for the past 50-75 years. The shrubs are more widely spaced than in most *Ceanothus* chaparral. This scrub frequently surrounds areas of grassland, and has small grassy openings between the shrubs.

• Grassland (42110, 42200, 45400): 875 acres (354 ha). Dominants of this grassland do not change appreciably with varying slope exposure and include *Bromus mollis, B. diandrus Avena barbata,* and *Erodium cicutarium,* all introduced. Many native herbs also occur. These subordinates do tend to vary more in composition as a result of slope. Those species characteristic of SW.-facing slopes include *Orthocarpus lithospermoides, O. attenuatus, Clarkia arcuata, Astragalus pauperculus, Filago californica, Lupinus vallicola, Linanthus ciliatus, Trifolium microcephalum, T. ciliolatum, T. tridentatum, Lotus humistratus, Vulpia (Festuca) myuros, Dichelostemma multiflorum,* and *Centaurium floribundum.*

Native species of more sheltered NE.-facing slopes include *Lotus denticulatus, Linanthus dichotomus* ssp. *meridianus, Vulpia (Festuca) microstachys, Sanicula tuberosa, Trifolium depauperatum, Dichelostemma pulchella, Allium amplectens, Draba verna,* and *Platystemon californicus.*

In very rocky soils where rocks cover more surface area than vegetation, the grassland changes in character and becomes dominated by such species as *Selaginella hanseni, Dudleya cymosa, Lasthenia chrysostoma, Erodium cicutarium, Phacelia egena, Tunica prolifera, Parvisedum pumilum, Polygonum bolanderi, P. bidwelliae, Tillaea erecta, Triteleia (Brodiaea) hyacinthina* var. *greenei, Gilia tricolor, Arenaria douglasii, Chorizanthe stellulata, C. polygonoides, Githopsis pulchella,* and *Navarretia prolifera.*

The annual grassland also contains small springy areas with several characteristic species. These include *Mimulus glaucescens, Trifolium varigatum, T. cyathiferum, Limnanthes alba, Briza minor, Hypericum anagalloides, Scutellaria austinae, Boisduvalia stricta, Juncus bufonius, Sisyrinchium bellum,* and *Epilobium sp.*

• Blue Oak Woodland/Savanna (71140,71410): 485 acres (196 ha). This association occurs largely on S.- and SW.-facing slopes. Blue oak is the most important species averaging 128 stems/ha with a relative density of 80 percent. Basal area cover for blue oak averages 8.3 m^2/ha. Other species on the plots in order of importance include canyon live oak, *Rhamnus crocea, Rhamnus californica,* Digger pine, and *Juniperus californica.* Interior live oak also occurs in rocky areas. Areas on shallow

soil tend to be more open savanna, whereas on deep Supan soil they are a woodland (>100 stems/ha) *(fig. 52).*

The understory of typical woodland is dominated by herb and grass (over 50 species noted) with only scattered shrubs of *Ceanothus cuneatus, Rhamnus californica, R. crocea,* and *Toxicodendron diversilobum.* The shrubs are characteristic of rocky areas. Herbs and grasses include *Bromus mollis, Avena barbata, Erodium botrys, Tunica prolifera, Trifolium microcephalum,* and *T. ciliolatum.* Several native perennial grasses occur; the most common are *Stipa lemmonii* and *Poa scabrella.* Saplings and seedlings of blue oak are fairly common.

• Deciduous Oak Woodland/Scrub (71120, 37541): 147 acres (60 ha). At higher elevations on NE.-facing slopes small California black oaks *(Quercus kelloggii)* and dense thickets of Brewer oak *(Quercus garryana* var. *breweri)* occur. Both of these deciduous species tend to occur adjacent to one another under similar ecological conditions. California black oak forms islands of 30-50 ft (9-15 m) tall stands surrounded by low scrubby (10 ft, 3 m) Brewer oak. Brewer oak covers a larger area than California black oak.

There are occasional small shrubs of *Ribes roezlii* and *Berberis dictyota* and a moderate cover of herbs and grasses including *Agoseris grandiflora, Crepis monticola, Senecio integerrimus, Calochortus monophyllus, Bromus marginatus, Cynoglossum grande, Lithophragma bolanderi,* and *Delphinium nudicaule.*

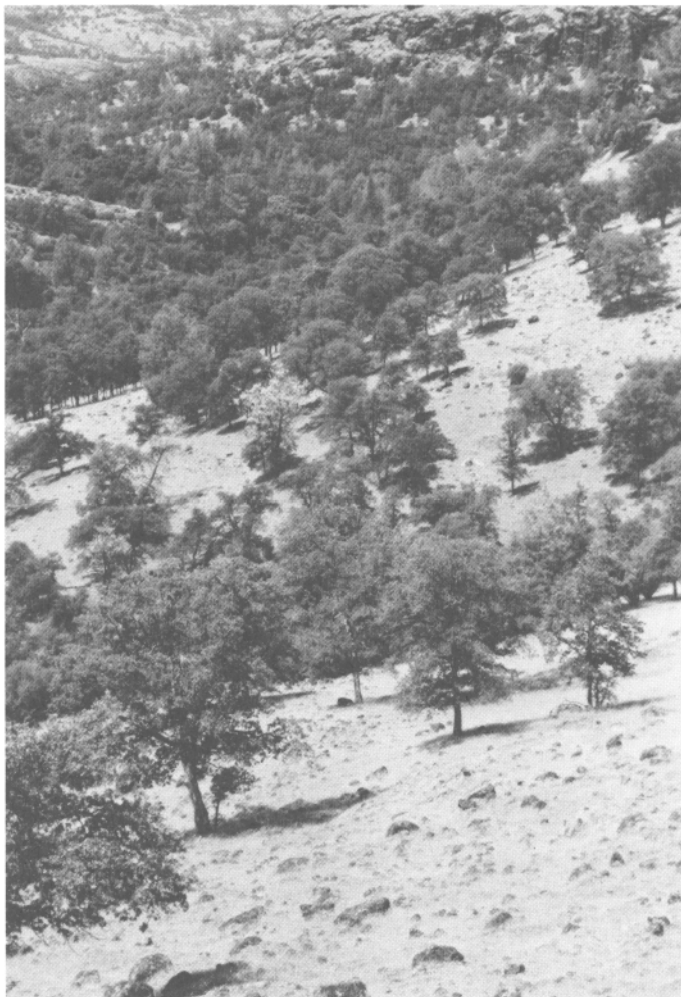


Figure 52--Blue oak woodland on SW.-facing slopes of lower Indian Creek watershed.

This association occurs on rocky, well-drained soil and is often bordered by open *Ceanothus* scrub. The deciduous oak woodland is analogous to the live oak woodland scrub at slightly higher, and more mesic sites.

• Canyon Bottom Woodland (81320): 147 acres (60 ha). Canyon live oak dominates the mesic canyon bottoms in the area. The dominants may be large, up to 3 ft dbh (1 m) and 70 ft (21 m) tall. The canyon live oaks coexist with smaller numbers of valley oak *(Quercus lobata),* California black oak, Big-leaf maple *(Acer macrophyllum),* California bay *(Umbellularia californica),* and isolated individuals of ponderosa pine *(Pinus ponderosa)* and incense-cedar *(Calocedrus decurrens).*

The overall dominant understory species are *Toxicodendron diversilobum* and *Symphoricarpos mollis.* However, a number of other mesophilic species occur, including *Philadelphus lewisii, Aristolochia californica, Asarum hartwegii, Saxifraga californica, Erythronium multiscapoideum, Trientalis latifolia, Adiantum jordanii, Dryopteris arguta, Polypodium californicum, Dicentra formosa, Melica torreyana, Osmorhiza chilensis, Galium aparine, Aquilegia formosa, Potentilla glandulosa, Heuchera micrantha, Lomatium californicum,* and *Hydrophyllum occidentale.*

• Riparian Woodland (61510): 36 acres (15 ha). This association occurs along the perennially flowing part of Indian Creek in the lower half of the drainage. It is dominated by white alder *(Alnus rhombifolia).* Stem density is high along this creek, and there are several areas where an uninterrupted arching canopy of the dominant species covers several hundred meters of creekbed. Typical dominant white alders are 12-14 inches (31-36 cm) dbh and 50-70 ft (15-21 m) tall. Also occurring are occasional individuals of Fremont cottonwood *(Populus fremontii),* California sycamore *(Platanus racemosa),* Big-leaf maple, and *Salix laevigata.* These species may attain large girth, up to 37 inches (94 cm) dbh in California sycamore.

Vitis californica is a common liana, and other common woody understory species include *Calycanthus occidentalis, Cornus glabrata, Clematis ligusticifolia, Philadelphus lewisii, Symphoricarpos rivularis, Rubus ursinus* and *R. leucodermis.* Herbaceous species include *Carex senta, Erigeron philadelphicus, Mimulus cardinalis, Peltiphyllum peltatum, Artemisia douglasiana, Woodwardia fimbriatum,* and *Adiantum pedatum.*

Plant Diversity

Two hundred twenty-nine taxa are listed in the establishment record, an updated version of the list in the ecological survey.

Conflicting Impacts

Grazing by cattle has had some negative impact by increasing browsing pressure on trees and reproduction of blue oak and also by trampling and eroding stream banks and hillsides. A

network of fences occurs throughout much of the area. These are in various states of repair, but may serve to act as exclosures for cattle once the area is established.

25. MOUNT SHASTA MUDFLOW (Keeler-Wolf 1984c)

Location

This established RNA is on the Shasta-Trinity National Forest. Its center is ca. 3 miles (5 km) NE. of the town of McCloud. It occupies portions of 13 sections in T40N, R2W MDBM (41°18'N., 122°6' W.) USGS Elk Spring quad *(fig. 53).*

Target Elements

Pacific ponderosa pine *(Pinus ponderosa),* successional mudflows (unique element)

Distinctive Features

Successional Status: The glacial outwash floods of 1924-1931 deposited millions of cubic yards of new substrate on the RNA. Many similar events occurred before these floods. The result of these periodic deposits has been a chronosequence of soils with associated variations in vegetation and physical and chemical properties. The floods and the soils they produced have been studied by several soil scientists, geologists, and ecologists since the 1930's (see Hill and Egenhoff 1976, and Sollins and others 1985).

Primary succession on these mudflows progresses from bare mineral soil with no successful colonization of woody species for several years to *Purshia tridentata* dominance, followed by ponderosa pine colonization and growth, and finally to development of a mature forest with variable mixtures of other mixed conifer species. The early dominance of *Purshia* is made possible by nitrogen-fixing bacteria on its root nodules. The success of ponderosa pine has much to do with rapid root growth and tolerance of deep droughty soils.

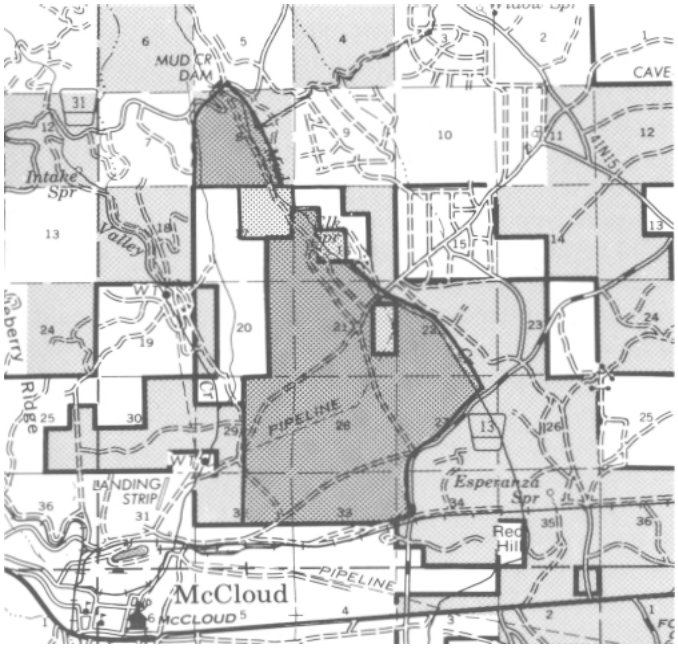


Figure 53--The Mount Shasta Mudflow RNA.

The idealized succession on a series of progressively older soils is confounded by fire history, logging, mudflow depth, flow rockiness, distance from seed sources, and climatic variations across the area. Much more information must be accumulated to have an accurate view of the successional trends on the area. Comparative research on the two most recent flows in the RNA is also lacking.

A larger portion of the RNA (ca. 1640 acres, 664 ha) has been affected by secondary succession, resulting from extensive fires between the late 1800's and early 1900's, than by mudflow succession. Secondary succession is markedly different from primary succession with longer-persisting shrub stages dominated by different species and different tree colonizers than on mud flows.

Physical Characteristics

The area covers 3467 acres (1403 ha) of gently southward-sloping terrain on the lower S. slopes of Mt. Shasta. Elevations range from ca. 5040 ft (1536 m) in the NW. comer to ca. 3440 ft (1049 m) about 4.5 miles (7.2 km) away at the SE. corner. Mud Creek traverses the length of the area and volcanic mud flows resulting from glacial outburst floods have created large areas of volcanic mud deposits throughout.

The entire area is underlain by deep andesitic ash, boulders, and gravel. Soils are regosolic and are considered vitrandepts. Advancing ages of soils tend to have more organic material. Precipitation averages between 45 and 50 inches (1143-1270 mm) annually. Twenty to fifty percent of this falls as snow with average April 1 snow depths ranging from 10 to 25 inches (25-64 cm). Mean January temperatures are ca. 36°F (2.2 °C); mean July temperatures are 65°F (18.3 °C).

Association Types

A total of forty-two 100-m^2 plots are sampled on a series of transects in the ponderosa pine, mixed conifer, and white fir associations.

• Ponderosa Pine Forest (84220): 2462 acres (996 ha). As a result of different successional histories in this association, there is great variation in tree size, tree density, and understory composition. The ponderosa pine forest also varies clinally as a result of differing climatic conditions across the RNA. Thirty-two 100-m^z plots are sampled in this vegetation type. Basal area cover ranges from 21 to 300 m^2/ha. The association is divided into five subtypes. Four of these are arranged along a successional series.

Subtype 1 occurs on very deep recent mudflow deposits (> 15 ft, 5 m). Growth of ponderosa pine is slow, taking 40 yr to attain 5.5 inches (14 cm) in dbh and 16 ft (5 m) in height. *Purshia tridentata* dominates the understory (25-45 percent cover) with *Haplopappus bloomeri, Penstemon deustus* ssp. *heterander, Elymus glaucus, Sitanion hystrix,* and *Eriogonum nudum.* Bare soil covers 30-50 percent of the surface *(fig. 54).*

Subtype 2 occurs on the recent ('A') mudflow where depths

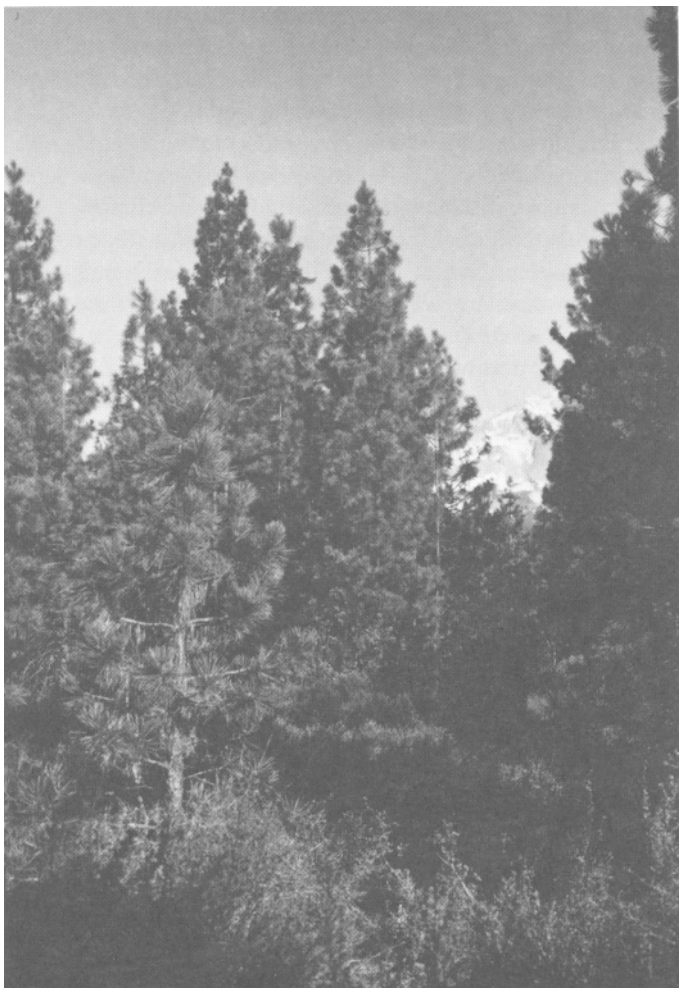


Figure 54--Mount Shasta Mudflow: Ponderosa pine and dense *Purshia tridentata* understory on deep 1924-26 mudflow.

are 10-17 ft (3.0-5.2 m). Here, ponderosa pine is denser and larger than subtype 1. Dbh's of most dominants range from 6 to 12 inches (15-31 cm) with heights of 25-45 ft (7.6-13.7 m). *Purshia tridentata* covers 20-70 percent. Few other shrub and herb species occur. *Arctostaphylos patula, Haplopappus bloomeri, Ribes roezlii, Ceanothus prostratus, Arabis holboellii* var. *retrofracta, Linanthus ciliatus, Vulpia* sp., *Sitanion hystrix, Stipa occidentalis,* and *S. columbiana* are occasional.

Subtype 3 is widespread on the recent 'A' flow with depths of 2-6 ft (0.6-1.8 m). Dominant trees average 15-22 inches dbh (38-56 cm) with heights from 65 to 100 ft (20-31 m). Ponderosa pine dominates with small numbers of incense-cedar *(Calocedrus decurrens)* and white fir *(Abies concolor)*. The understory is relatively shady and very sparse with large areas having no herbs or shrubs *(fig. 55)*.

Subtype 4 occurs on the `B' flows at the S. end of the area. Ponderosa pines average ca. 90 years old, 25-36 inches (64-91 cm) dbh, and 93-116 ft (28-35 m) tall. This subtype is relatively open with fewer trees/area than subtype 3. California black oak *(Quercus kelloggii) is* frequently an important subdominant, and grasses such as *Bromus marginatus* and *B. orcuttianus* are often common. Herbs such as *Agoseris heterophylla, Lagophylla* sp.,

Figure 55--Mount Shasta Mudflow: Ponderosa pine on shallow 1924-26 mudflow. Note senescent *Purshia* in understory.

Osmorhiza chilensis, Lupinus adsurgens, Rumex angiocarpus, Pteridium aquilinum, and *Horkelia fusca* are common.

Beyond these four types there are more advanced successional stages. These may be viewed as members of an E.-W. continuum ranging from a drier, more interior type on the E. side of the RNA with *Purshia tridentata* the understory dominant, to a more mesic W.- side type which is transitional with mixed conifer forest, having an understory of mountain chaparral sclerophylls and other typical mixed conifer forest species. Many of these older forests are dominated by ponderosa pine largely because of its resistance to fire. Younger trees of Douglas-fir *(Pseudotsuga menziesii),* white fir, and incense-cedar are certain to increase in importance barring future fire or other disturbance.

• Mixed Conifer Forest (84230): 924 acres (374 ha). This association is dominated by variable mixtures of Douglas-fir, incense-cedar, white fir, sugar pine *(Pinus lambertiana),* ponderosa pine, and California black oak. The best examples occur on the W. side of the area on older surfaces, which were lightly logged 80-90 years ago. Nine 100-m^2 plots are sampled in this type. Total basal area varies from 85 to 234 m^2/ha. White fir is the most ubiquitous species, occurring on all plots, but the dominants are ponderosa pine and Douglas-fir, both averaging ca. 43 m^2/ha basal area. Densities average between 600 and 4900 stems (>2 m tall)/per hectare. All species are reproducing, and barring further disturbance, forest composition should remain similar. Typical understory is sparse with scattered individuals of *Symphoricarpos acutus, Chimaphila menziesii, C. umbellata, Pyrola picta, Goodyera oblongifolia, Corallorhiza maculata, Galium bolanderi,* and *Viola lobata.*

• White Fir Forest (84240): 123 acres (37 ha). This association occurs at the upper elevations. It may be a closed climax forest or a young successional forest. Both types are strongly dominated by white fir. The successional phase results from fires in the late 1800's and early 1900's which killed all but a few trees. Survivor trees are largely ponderosa pine 4-6 ft (1.2-1.8 m) dbh and 130-160 ft (40-49 m) tall. These tower over the dense canopy of 10-14 inches (25-36 cm) dbh white fir with heights of

50-60 ft (15-18 m). There is a senescent shrubby understory dominated by *Chrysolepis sempervirens, Arctostaphylos patula,* and *Ceanothus velutinus.* Before the fires this forest was probably a mixed conifer type, as young incense-cedar, Douglas-fir, and sugar pine also occur in the area.

The old-growth type was spared from fire by its valley-bottom location. Basal area cover for old-growth white fir forest averages 120 m^2/ha with white fir comprising 78 percent of the cover. Basal area on the successional plots averages 198 m^2/ha with white fir comprising 37 percent of the total cover. Tree density is 1200/ha on mature plots and 2500/ha for the successional plots. White fir relative density is 92 percent on mature plots and 52 percent on the successional plots.

• Mountain Chaparral (37510, 37530): No acreage given. Several small patches of chaparral dating from the fires of 80-120 years ago occupy the NW. portion of the RNA adjacent to white fir forest. These are dominated by a varying mixture of *Ceanothus velutinus, Chrysolepis sempervirens, Arctostaphylos patula,* and *Prunus emarginata.* Most have numerous *Abies concolor* saplings and young trees associated with them. Herbs and grasses are few and include *Hackelia californica, Apocynum pumilum, Carex languinosa,* and *Melica aristida.*

Another form of mountain chaparral occurs at lower elevations in the S. portion of the RNA. This subtype is typically dominated by *Arctostaphylos patula* with *Ceanothus cordulatus, C. prostratus* and occasionally *Arctostaphylos nevadensis, Purshia tridentata, Amelanchier pallida, Ribes roezlii,* and *Prunus emarginata.* Unlike the previous subtype, *Chrysolepis sempervirens* is rare. This subtype is more open than the previous subtype.

• Riparian (61510, 61530, 63500): No acreage given. Unstable banks and variable water levels in Mud Creek are not conducive to good riparian growth. Small areas of riparian vegetation exist at the diversion dam at the upper end of the RNA and along Squaw Creek on the NW. boundary. The following woody species are characteristic: *Alnus tenuifolia, Salix lemmonii,* and black cottonwood *(Populus trichocarpa).* Herbs include *Juncus mertensianus, Luzula comosa, Agrostis scabra, A. exarata, A. variabilis, Glyceria elata, Carex jonesii, Epilobium glaberrimum, Gnaphalium chilense, Stellaria crispa, Mimulus guttatus, Castilleja miniata, Achillea millefolium,* and *Potentilla glandulosa* ssp. *nevadensis.*

Plant Diversity

Ninety-five species are listed.

Conflicting Impacts

Portions of the area were logged in 1885 and 1900. Three dirt roads and a water pipeline cross various parts of the RNA. The remnants of a small diversion dam exist at the N. boundary along Mud Creek. However, the majority of the area shows little effect of human alteration.

26. SHASTA RED FIR (Imper 1988b)

Location

This candidate RNA is located on the Shasta-Trinity National Forest. The area is ca. 6.5 miles (10.5 km) N. of McCloud and occupies portions of sects. 34, 35, and 36 T41N, R3W MDBM (41°21' N., 122°10'W.) USGS Mt. Shasta quad *(fig.* 56).

Target Element

Red Fir *(Abies magnifica)*

Distinctive Features

• Shasta. Red Fir Forest: The Shasta red fir *(Abies magnifica* var. *shastensis)* was described from Mt. Shasta. Before logging, the red fir forest formed a continuous ring around the mountain. Despite the type location, some trees exhibit the non-exerted bract cones of typical red fir, of the N. and central Sierra. The local red fir forests are variable successionally ranging from exceptionally old (ca. 650 yr) to young stands, the latter stemming from past fires as well as selective logging (in one part of the area). The area's broad elevational span includes most of the local range of red fir forest. The soils are uniform throughout this range.

• General Habitat Diversity: This area includes all typical plant associations on the S. side of Mt. Shasta above 6500 ft (1981 m). Along with red fir, these include mountain hemlock *(Tsuga mertensiana)* and mixed subalpine forests, wet and dry meadows, alpine, and riparian vegetation. The glacier-fed wet subalpine meadow areas are thought to be the best examples of this type on the mountain. The mountain hemlock stands are

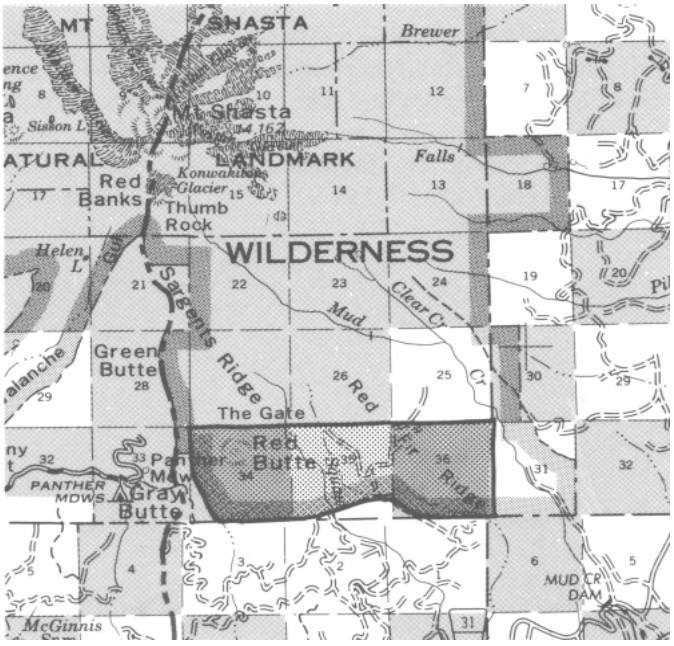


Figure 56--The Shasta Red Fir study area.

perhaps the oldest (700+ yr) and best developed on the mountain.

• Rare Plants: Several very rare (CNPS List 1a or 1b) species *(Phacelia cookei, Botrychium pumicola,* and *Campanula wilkinsiana)* are known from sites near the study area. The only plant on CNPS lists known from the RNA is *Arnica viscosa* (List 4).

Physical Characteristics

This area covers ca. 1800 acres (728 ha). Elevations range from 6000 to 8400 ft (1829-2560 m). The general aspect of the area is SE., although some SW. and NE. exposures exist. The W. part is dominated by Red Butte, a recent cinder cone rising 400-800 ft (122-244 m) above surrounding terrain. The E. part is dominated by Red Fir Ridge, which separates the Squaw Valley drainage on the W. with Mud Creek drainage on the E. Slopes in the E. portion are moderate, but strongly dissected by NW.-SE.-trending gullies up to 30 ft (9 m) deep. Parts of the Mud Creek canyon are very steep as are the upper slopes of Red Butte.

Rocks are entirely Pleistocene andesite erupted from Mt. Shasta. Soils are primarily Andic Cryumbrept-Rock outcrop complex (>90 percent of area). A small portion of the E. area is Andeptic Cryotherents with 40-100 percent slopes. These soils have a deeper A horizon than the andic Cryumbrept-Rocks and are derived from recent deep volcanic ash deposits. Precipitation averages 60 inches (1524 mm) annually, mostly from snowfall. Normal winter snow depth is ca. 8 ft (2.4 m) judged by lichen growth on trees. Temperatures in winter range from 0 to 30 °F (-18 to-1 °C), and winds may be in excess of 100 mph (161 km/hr).

Association Types

Fourteen 0.1-acre (404-m^2) plots are sampled in five association types including all forested associations except for cutover forest.

• Shasta Red Fir/Slender Penstemon Forest (85310): 712 acres (288 ha). Stands typifying this association are pure Shasta red fir with a dense canopy and sparse understory. *Penstemon gracilentus* is often the only herb, with total understory often less than one percent cover. This association occurs from lowest elevation up to ca. 7400 ft (2256 m). At upper elevations and moist areas, mountain hemlock becomes important and may be slowly replacing red fir as the dominant. White fir *(Abies concolor)* becomes important below ca. 6500 ft (1981 m). Western white pine *(Pinus monticola)* and Jeffrey pine *(Pinus jeffreyi)* are occasional at lower elevations. Other species associated with this type include *Arctostaphylos nevadensis, Carex rossii, Chimaphila menziesii, Corallorhiza maculata, Hieracium albiflorum, Lupinus albicaulis, L. obtusilobus, Pyrola picta,* and *Viola purpurea.*

A typical stand is even aged (200 yr) with a closed canopy and 80 m^2/ha basal area. Much of this association appears to have experienced crown fire, initiating the even-aged canopy.

• Mountain Buckwheat/Western Needlegrass Dry Meadow (45120, 91220): 200 acres (81 ha). Several types of dry meadows are included in this category. They occur in both subalpine and red fir forest zones. *Polygonum newberryi* and *Stipa occidentalis* are consistent throughout. Soils vary from coarse cinders and cobbles to fine ash and range from steep to gradual slopes. Other species include *Arctostaphylos nevadensis, Calyptridium umbellatum, Carex multicaulis, Eriogonum marifolium, E. pyrolaefolium, Haplopappus bloomeri, Lupinus albicaulis, Monardella odoratissima* ssp. *pallida, Phlox diffusa,* and *Viola purpurea.*

Several variants include (1) *Anemone* scree slopes. This phase is dominated by a sparse cover of *Anemone occidentalis, Penstemon davidsonii, Streptanthus tortuosus, Phlox diffusa, Eriogonum marifolium* (Similar to Holland 91220); (2) Onion/hemlock barrens. This phase is associated with areas of snow accumulation and characterized by young mountain hemlock and *Allium obtusum;* (3) *Cycladenia* cinder barrens. Some of the red cinder slopes in sect. 34 have a sparse cover of *Cycladenia humilis;* and (4) Typical dry meadow. Most of the dry meadows in the area are characterized by species listed in the first paragraph of this association.

• Shasta Red Fir/Pinemat Manzanita Forest (85310): 120 acres (49 ha). This association occupies upper slopes and ridges. It has an open canopy and low basal area (<57 m^2/ha). The understory is dominated by *Arctostaphylos nevadensis.* The soil is poorer and rockier than association 1. This forest is not well represented in the area, and it is confined to small stands. Other species include *Carex multicaulis, Carex rossii, Monardella odoratissima* ssp. *pallida, Penstemon gracilentus,* and *Stipa occidentalis.* Whitebark pine *(Pinus albicaulis)* and *Holodiscus dumosus (microphyllus)* may occur at high elevations.

Typical stands of this association are uneven aged (average canopy dominants 290 yr) and have a low canopy dominance compared to association 1. The successional state of these open forests is not clear. It may be a later stage of association 1 based on fire history, or it may be controlled by microclimate *(fig. 57).*

• Whitebark Pine/Rock Spiraea Woodland (86210): 105 acres (43 ha). This association occurs between 7600-8000 ft (2317-2438 m) and is the typical timberline woodland on the S. side of Mt. Shasta. Canopy cover is very open (<20 percent), and basal area ranges from 9.2 to 23.0 m^2/ha with the highest cover

Figure 57--Shasta Red Fir: Well-developed Shasta red fir/pinemat manzanita forest at 7200 ft on S.-facing slope (D. Imper).

at the lowest elevations. Stands occur on all slope aspects and are generally dominated by uneven-aged whitebark pine with some red fir and mountain hemlock. Dominant trees are more than 400 years old and greater than 49 ft (15 m) tall. The substrate is rocky and steep. This association grades into the mountain hemlock/heather forest at lower elevations on mesic sites and into the mountain hemlock/alpine rush association on cool, but drier sites and into association 3 on warm, xeric sites.

Species include Shasta red fir, *Arctostaphylos nevadensis, Chrysolepis sempervirens, Castilleja affinis, Cryptogramma acrostichoides, Holodiscus (microphyllus) dumosus, Juniperus communis, Pinus albicaulis, Penstemon davidsonii,* and *P. newberryi.*

• Mountain Hemlock/Alpine Rush (86210): 90 acres (36 ha). This association occurs between 7300-7800 ft (2225-2377 m) on gentle, partially sheltered slopes. The canopy is more closed than the previous association, but more open than typical association 1. Soils are well developed with an A horizon ca. 13 inches (33 cm) deep. Dominant trees may be 4 ft (1.3 m) dbh and are the oldest in the study area (600-800 years). Tree height is usually under 100 ft (30 m). Mountain hemlock is dominant and climax, but ancient red firs up to 700 years old are present. Mountain hemlock reproduces well in older stands, but requires shade. Red fir requires disturbance for appreciable reproduction. Fire is of minor importance.

Understory vegetation is sparse and includes *Allium obtusatum, Arctostaphylos nevadensis, Carex multicaulis, C. rossii, Eriogonum marifolium, Juncus parryi, Phyllodoce empetriformis,* and *Viola sheltonii.*

• Mountain Hemlock/Mountain Heather Forest (86210): 70 acres (28 ha). This association occupies relatively moist flats. It is similar to the previous type, but the soil is more rocky. The canopy is also more open (ca. 30 percent) and contains more whitebark pine than the previous association. Basal areas average 23-55 m^2/ha with stands tending to be old (up to 650 years). There is good regeneration of mountain hemlock. The sparse understory is dominated by scattered clumps of *Phyllodoce empetriformis,* but is otherwise similar to the previous association. This association also follows creeks and meadows to elevations as low as 6300 ft (1920 m). There it is associated with many riparian zone species. No specific discussion of the riparian association is given, but such species as *Allium validum, Luzula subcongesta, Arnica viscosa, Juncus parryi, Carex spectabilis, Ligusticum grayi, Mitella pentandra,* and *Viola macloskeyi* are typical.

• Alpine Saxifrage/Alpine Sedge Rockland (91200,91300): 70 acres (28 ha). This association occurs in the highest and coldest parts of the area. The two characteristic species *Saxifraga tolmiei* and *Carex breweri* are scattered, with cobbles and boulders composing up to 95 percent of the surface. Slopes may be very steep. Occasional krummholz whitebark pines are present. Other species include *Agoseris glauca, Arabis platysperma, Calyptridium umbellatum, Cardamine bellidifolia, Juncus parryi, Penstemon davidsonii, Phlox diffusa,* and *Polygonum shastense.*

• Greenleaf Manzanita/Pennyroyal Shrubland (37520, 37510): 15 acres (6 ha). This scrub association with its two *indicators, Arctostaphylos patula and Monardella odoratissima* ssp. *pallida, is* usually seral to the two red fir associations. The conversion of this type to forest is slow with many areas still scrub-dominated 80 years after fire. This association occurs on steep S.-facing slopes and is surrounded by dense young stands of red fir. White fir and sugar pine *(Pinus lambertiana)* are more conspicuous than in any other association. Other species include *Arctostaphylos nevadensis, Apocynum androsaemifolium, Boschniakia strobilacea, Carex rossii, Chrysolepis sempervirens, Ceanothus velutinus, and Penstemon newberryi.* A more mesic subtype atop Red Fir Ridge includes *Ribes roezlii, Ceanothus velutinus, Holodiscus discolor, Acer glabrum* var. *torreyi, Prunus emarginata, Potentilla glandulosa, Hieracium horridum, Phacelia mutabilis,* and *Bromus marginatus.*

• Mountain Heather/Showy Sedge Wet Meadow (45100, 45210): 11 acres (5 ha). Four principal meadow areas occur in the area. All are associated with creeks *(fig. 58).* The dominants include dense stands of *Phyllodoce empetriformis, Kalmia microphylla,* and *Vaccinium nivictum,* with a number of other species including *Allium validum, Antennaria alpina, Carex spectabilis, Castilleja miniata, Luetkea pectinata, Saxifraga aprica, Sibbaldia procumbens,* and *Veratrum californicum.* The grass *Trisetum spicatum* acts as a border around one of the meadows. A subtype of wet meadow dominated by *Carex nigricans* occurs in a moist N.-facing scree area. Two temporary ponds just outside the area contain dense stands of *Muhlenbergia jonesii* with a ring of *Juncus parryi.*

Plant Diversity

Eighty-seven species are listed. Diversity of the area is notably low considering the variety of habitats.

Conflicting Impacts

The most serious impact involves a history of selective logging in the central section of the study area. The high subalpine valleys in this section are recovering very slowly from logging and will show its impact for many years. However, the integrity of the area is increased by the inclusion of this section,

Figure 58--Shasta Red Fir: Largest of the wet meadows in the study area, *Phyllodoce empetriformis/Carex spectabilis association,* Mt. Shasta behind (D. Imper).

which connects the two undisturbed sections, provides a useful post-logging comparison to adjacent undisturbed lands, and includes the oldest stands of hemlock and good examples of red fir/pinemat manzanita and wet meadow associations. The entire RNA is part of the Mount Shasta Wilderness and receives relatively heavy recreational use. This use may be increased if the proposed Mt. Shasta Ski Area is developed. Access to part of the area is difficult because of gated private roads adjacent to the E. side.

27. SODA RIDGE (Conard and Robichaux 1980)

Location

This soon-to-be-established RNA is on the Lassen National Forest. It lies just 1.5 miles (2.4 km) NE. of the Green Island Lake RNA (#46) and is ca. 14 miles (23 km) SW. of Canyon Dam. It occupies portions of sects. 21, 22, 27, 28 T26N, R6E MDBM (40°05' N., 121°18'W.) USGS Jonesville 15' quad *(fig.* 59).

Target Element

White Fir *(Abies concolor)*

Distinctive Features

• Mature White Fir Forest: This area contains large areas of mature white fir forest on the N.-facing slope of Soda Ridge. The dominants average at least 200-300 years on the steeper slopes with younger forests (100-120 years) on gentle slopes near Soda Creek. Understory vegetation varies from sparse and species-poor under old forest to relatively diverse and dense on the creek benches. White fir forest is frequently affected by fire with the largest and oldest forests occurring on steep mesic slopes where fire is less prevalent. There is a mosaic of stands locally representing different successional stages and fire histories. The broad elevational band represented includes transitional types to Douglas-fir *(Pseudotsuga menziesii)*-dominated forest at low elevations and red fir *(Abies* magnifica)-dominated forest at highest elevations.

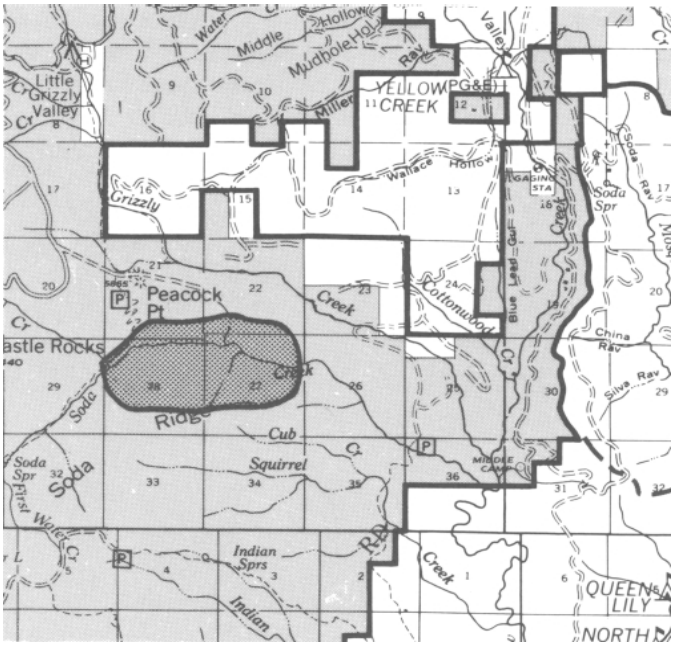


Figure 59--The Soda Ridge RNA.

• Mixed Conifer Forest: The area on the SE. exposures above Soda Creek has a well developed ponderosa pine *(Pinus ponderosa)*-dominated mixed conifer forest with an open understory and many large trees.

• Meadow Vegetation: A series of wet meadows arises from a line of seeps on the N. side of Soda Creek. These meadows are diverse and relatively unspoiled. They include *Drosera rotundifolia* and a number of other montane hydrophilic species.

Physical Characteristics

This area covers ca. 1300 acres (525 ha). Elevations range from 4560 ft to slightly over 6000 ft (1390-1829 m). The SW.- to NE.-trending canyon of Soda Creek dominates the area. The canyon slopes are steep (25-30°) on both NE. and SW.-facing slopes from the summits of the ridges (5600-6000 ft, or 1707-1829 m) down to ca. 5200 ft (1585 m) where a series of creekside benches occur with 5-15° slopes. The summit of Soda Ridge is broad and relatively flat (<5° slope). The flat ridges and steep valley slopes are influenced by the Pliocene basalt flows that underlie the area. These flows are considered part of the Cascade Geologic Province. Climate data are given for Canyon Dam, indicating a typical Mediterranean climate with 95 percent of the precipitation falling October-May. Average annual precipitation is estimated (Rantz 1972) at 60-70 inches (1524-1778 mm).

Association Types

The white fir forest is sampled using the point-centered quarter method along several transects adding up to 44 points. The remainder of the association types are described qualitatively.

• White Fir-Mixed Conifer Forests (84240, 84230): 601 acres (243 ha). Sampling indicates that relative density of white fir is high (mean 82 percent, range 73-88 percent) with overall tree density ranging from 290-350 stems/ha on steep slopes to 550-650 stems/ha in younger stands along the creek *(fig. 60).* The relative cover of white fir varies depending on the number of surviving large old trees of sugar pine *(Pinus lambertiana),* Douglas-fir, and Jeffrey pine *(Pinus jeffreyi)* after fires. In most areas the basal area of white fir is relatively low compared to its high density. Red fir is represented by smaller trees in the upper elevations, indicating a trend toward red fir dominance in the absence of fire. White fir is reproducing well throughout the area, indicative of the stability of this type. Average cover of saplings is 10 percent with white fir dominant.

Understory cover averages less than 5 percent throughout this association. *Pyrola picta, Chimaphila menziesii,* and *Corallorhiza maculata* predominate on the steep slopes while additional species such as *Achillea millefolium, Amelanchier pallida, Galium triflorum, Goodyera oblongifolia, Hieracium albiflorum, Osmorhiza chilensis, Potentilla glandulosa,*

Figure 60--Soda Ridge: A dense white fir forest on a N.-facing slope (K. Berg).

Smilacina racemosa ssp. *amplexicaulis, Symphoricarpos acutus,* and *Viola* spp. occupy the understory of the bench areas.

• Ponderosa Pine-Mixed Conifer Forest (84210, 84230): 512 acres (207 ha). This is the major vegetation association on the S.-facing slopes. The forest is dominated by ponderosa pine, but Jeffrey pine, sugar pine, Douglas-fir, and incense-cedar *(Calocedrus decurrens)* are common associates. The forest is almost uniformly mature with many dominants over 3.3 ft (1 m) dbh. The understory is extremely open.

• Montane Chaparral (37510): 121 acres (49 ha). This vegetation occurs as patches within the white fir forest. It is entirely seral in this area with 75-100 years required for white fir to fully emerge from the shrub canopy. A large ridgecrest patch is dominated by *Quercus vaccinifolia* (30 percent cover), *Arctostaphylos patula* (5-10 percent), and *A. nevadensis* (5-10 percent). There is 5-10 percent cover of white and red fir saplings. Several large residual Jeffrey pine also occur. Other areas of young fir forest have skeletons of montane chaparral shrubs in the understory. Other smaller patches of this vegetation are dominated by *Arctostaphylos patula, Quercus chrysolepis* var. *nana, Ceanothus velutinus, Prunus emarginata, Salix scouleriana,* and *Ribes* spp.

• Rock Outcrop and Talus Slopes (no Holland equivalent): 47 acres (19 ha). This type is not specifically discussed although species such as *Onychium densum, Penstemon deustus,* and *Streptanthus tortuosus* var. *orbicularis* (among others in the plant list) are likely members.

• Wet Meadows (45100, 45400): 12 acres (5 ha). Species noted for this association include *Veratrum californicum, Senecio triangularis, Drosera rotundifolia, Dodecatheon jeffreyi, Lilium pardalinum, Mimulus guttatus, Veronica americana,* two species of *Habenaria,* and *Vaccinium* sp.

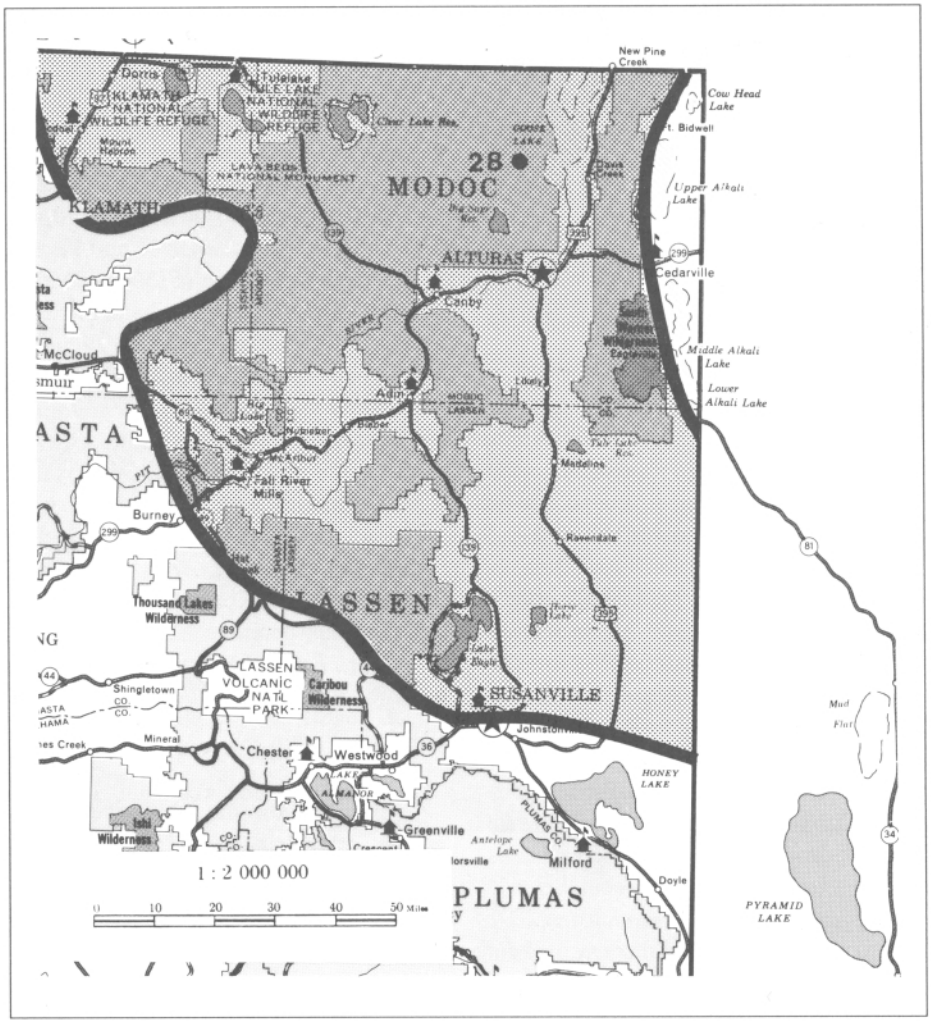
• Riparian Zone (61530, 63500): 12 acres (5 ha). Soda Creek supports a narrow band of riparian vegetation with scattered tall black cottonwood *(Populus trichocarpa)* and intermittent dense thickets of mountain alder *(Alnus tenuifolia)* with scattered aspen *(Populus tremuloides).* Mountain alder also occurs in thickets along swales away from the creek. One such area had a cover of 75 percent of mountain alder, 20 percent *Salix caudata,* and <5 percent S. *scouleriana.* Other species characteristic of such thickets include *Heracleum lanatum, Adiantum pedatum, Acer glabrum, Cornus stolonifera,* and *Stachys rigida.* Rocky alluvial flats along the creek have some herbaceous species such as *Calystegia malacophyllus, Eriogonum nudum, E. umbellatum, Monardella villosa, Scutellaria californica, Silene californica,* and *Verbascum thapsus.*

Plant Diversity

One hundred sixty-eight taxa of vascular plants are listed.

Conflicting Impacts

The Peacock Point timber sale may have affected the N. boundary of the area. The sale had been proposed, but not logged at the time of the survey. Other human impacts are minimal in the area.



III. MODOC PLATEAU PROVINCE

28) Devil's Garden

THE MODOC PLATEAU PROVINCE

28. DEVIL'S GARDEN (Keeler-Wolf 1984d)

Location

This established RNA is on the Modoc National Forest. It lies 23 miles (36 km) NNW. of Alturas, occurring in portions of sects. 28, 29, 32, and 33 T46N, R12E MDBM (41°48'N., 120°36'W.) USGS South Mtn. 15' quad *(fig. 61).*

Target Element

Western Juniper *(Juniperus occidentalis* ssp. *occidentalis)*

Distinctive Features

• Western Juniper Woodland: The Devil's Garden RNA contains the only specifically designated scientific reserve of this major plant association of NE. California. The RNA is positioned within the most extensive single stand of western juniper anywhere, and is within its zone of optimal development *(fig. 62).*

• *Artemisia* Shrub-Steppe: This widespread transmontane vegetation, characterized by a mixture of shrubs and grasses, is not well represented in the California RNA system (see #'s 29, 30, 31, 32, 33, 44, 48, and 64), but is extensive in this RNA. The low grazing pressure in this type locally has preserved a diversity of native grasses and herbs frequently reduced in other sagebrush communities in the region.

• High Plant Diversity in a Stressful Environment: The Devil's Garden RNA has a substantially higher diversity of vascular plants (up to 52 species/0.1 ha) than has been listed for other western juniper and sagebrush-steppe associations (West 1988). This raises questions about the origins of this diversity within an area of such habitat uniformity, yet high environmental stress.

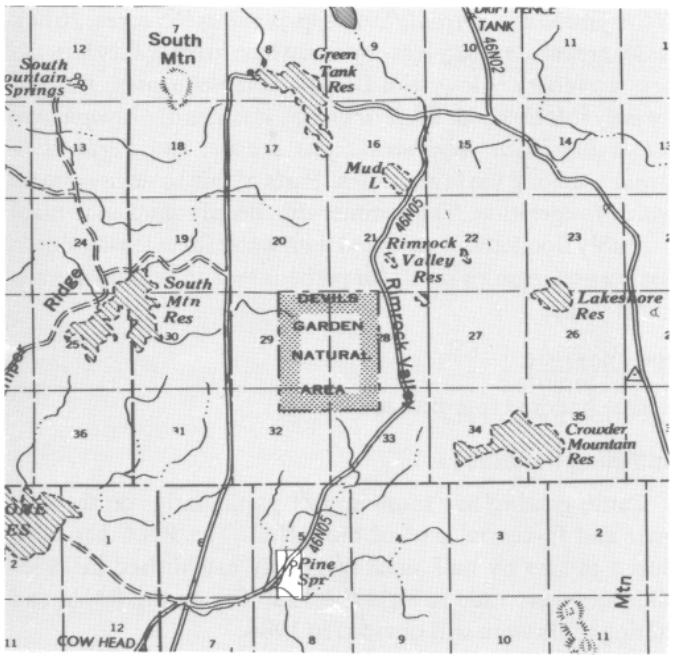


Figure 61--The Devil's Garden RNA.

Figure 62--Devil's Garden: Open western juniper woodland looking W. from NE. corner of RNA.

• Succession on the 1959 Bum: Little is known about succession in western juniper woodland. Twenty-four years after a fire in the southeastern part of the area, there was a surprisingly high density of juniper saplings as well as young shrubs of *Artemisia tridentata* and *Purshia tridentata.* Comparisons with descriptive accounts of the vegetation from 10 years after the bum indicate distinct trends such as replacement of once extensive ruderal vegetation (e.g., *Verbascum, Cirsium)* by later successional native species.

• Patterned Ground: Frost mounds and frost lines occur in several places within and adjacent to the RNA. These features are usually associated with periglacial activity and these northeastern California examples are among the lowest elevation of any known in the state. The cold, dry continental climate of the area and the predominant heavy clay soil, subject to much expansion and contraction during freezing and thawing, may be

responsible for their presence.

• Rare Flora: *Erigeron elegantulus (List4), Hackelia cusickii* (List 4), *Penstemon cinereus* (List 4), *Poa fibrata* (List 3), and *Polygonum polygaloides* ssp. *esotericum* (List 1b, type locality, Devil's Garden) are considered rare by CNPS.

Physical Characteristics

The area covers 800 acres (324 ha). Elevations range from 5100 ft to 5190 ft (1555-1582 m). Topography is very gradual and gently-rolling, with one shallow, vernally flooded depression located in the south-central portion. A small area of fault-raised rimrock escarpment occurs on the NE. corner. Patterned ground related to frost heaving occurs in portions of the area.

Rocks are entirely late Pliocene to early Pleistocene volcanics (Devil's Garden Basalt). Soils vary from haplargids to haploxerolls and vertisols. Climate is relatively harsh. Annual precipitation is estimated between 15-20 inches (380-500 mm). It is mostly snow, which is often blown clear over large areas. Temperatures range from January minima of ca. 14 °F (-10 °C) to July maxima of ca. 86 °F (30 °C).

Association Types

Two 0.1-ha plots are sampled in the western juniper woodland.

. Western Juniper Woodland (72110): 592 acres (240 ha). This major association may be broken down into three phases, locally: rimrock juniper, open juniper, and successional juniper. Rimrock juniper covers 7 acres (3 ha), has the highest density of western juniper and other large woody species such as *Cercocarpus ledifolius* and *Prunus virginiana* var. *melanocarpa* (average stem density; 600/ha). Other representative shrubs and herbs include *Artemisia tridentata, Amelanchier pallida, Chrysothamnus viscidiflorus, C. nauseosus* ssp. *albicaulis, Ribes cereum, Sambucus caerulea, Cirsium utahense, Elymus triticoides,* and *Scrophularia lanceolata.*

Open juniper covers 505 acres (204 ha). On 0.2 ha of sampled area juniper densities are 200-340 trees/ha. Shrub layer is dominated by *Artemisia arbuscula* with occasional *Ribes velutinum.* A surprising diversity of herbs and grasses are encountered on the sample plots including 11 species of grasses and 40 species of herbs. The majority of these species are shared with *Artemisia arbuscula* shrub-steppe, but several shade and duff-tolerant species characteristic beneath junipers include *Senecio integerrimus, Fritillaria pudica, Hackelia cusickii, Lithophragma tenellum, Plectritis macrocera* var. *grayi,* and *Collinsia parviflora.* The openings are generally rockier than true *Artemisia arbuscula* shrub-steppe and contain certain species that are less common on the open, treeless *A. arbuscula* flats including *Agropyron spicatum, Arabis holboellii* var. *retrofracta, Cordylanthus ramosus, Crepis modocensis, Erigeron elegantulus, Eriogonum douglasii, Penstemon laetus,* and *Thelypodium flexuosum.*

Successional juniper occupies ca. 80 acres (*32* ha) burned in 1959. Although not presently dominated by juniper, the density of stumps and snags indicates that it once had a heavy juniper cover. Several herbaceous species appear restricted to this area, including *Geum ciliatum, Cirsium vulgare, Achillea millefolium, Crepis acuminata, Phacelia imbricata, Madia citriodora,* and *Arenaria nuttallii* ssp. *fragilis.* Regeneration of juniper is better than on typical undisturbed open woodland (ca. 70 vs. 30 saplings and seedlings/ha). Also characteristic of the burned area is a lower diversity of grasses and herbs than in adjacent undisturbed juniper woodland.

• *Artemisia* shrub-steppe (35300, 35400, 44131): 270 acres (109 ha). This association generally occurs on less rocky and more poorly drained sites than the juniper woodland and may also be divided into three phases: rocky scabland, upland, and closed basin.

The rocky scabland type covers five acres (2 ha), has the lowest cover of *A. arbuscula* and other species including *Eriogonum umbellatum, E. douglasii, Arenaria congesta, Festuca idahoensis,* and *Sitanion hystrix.* These species are scattered among nearly continuous outcroppings of basalt, with only small pockets of soil.

The upland phase is the most diverse and extensive, covering ca. 200 acres (81 ha). *Artemisia arbuscula is* the dominant woody species. However, cover is often exceeded by perennial grasses including *Festuca idahoensis, Koeleria macrantha, Poa juncifolia, Stipa columbiana, Danthonia unispicata,* and *Sitanion hystrix.* This phase may be briefly flooded in spring. Scattered rocks pepper the surface of the soil, which is intermediate in depth between the other two phases of shrub-steppe. Drainage channels leading into the small basin contain several vernally hydrophilic species such as *Perideridia bolanderi, Polygonum polygaloides* ssp. *esotericum* and *Navarretia minima.* Other typical species of this modal *A. arbuscula* type include *Penstemon speciosus, Lomatium triternatum, L. nudicaule, Zigadenus paniculatus, Blepharipappus scaber, Poa fibrata, Phlox douglasii* ssp. *rigida, Antennaria luzuloides, Plagiobothrys cusickii, Gilia leptalea,* and *Erigeron linearis.*

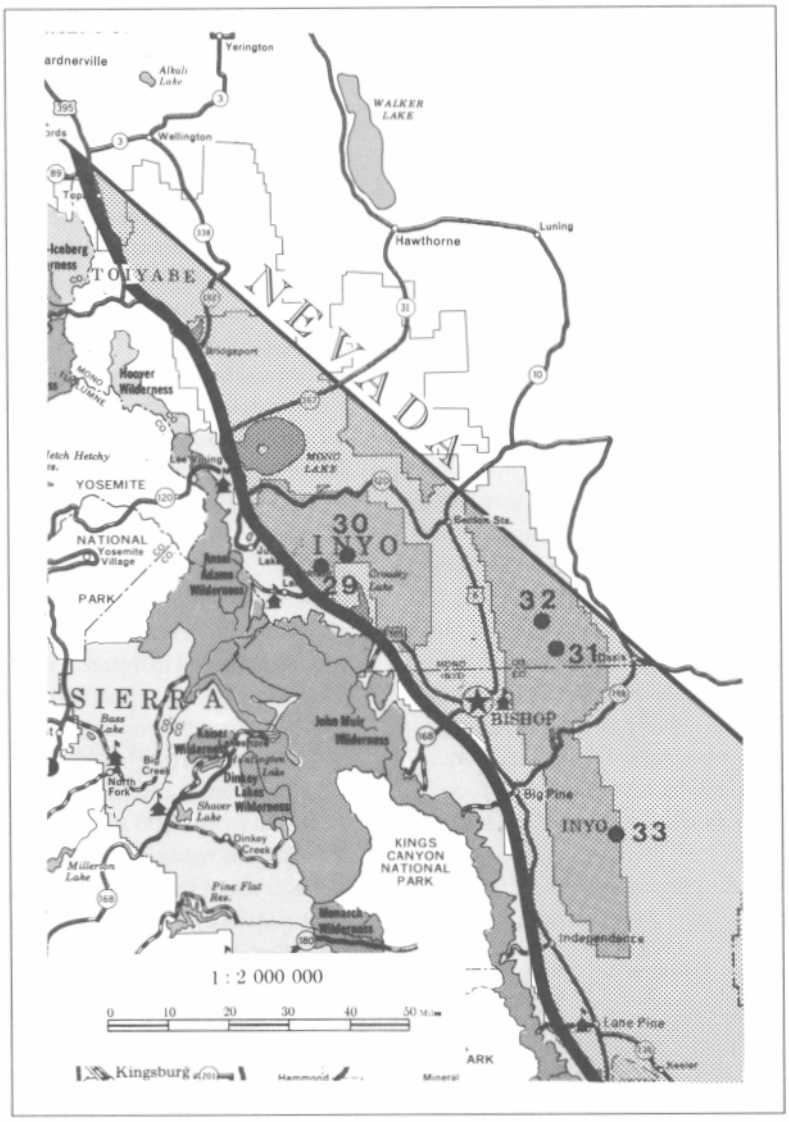
The closed basin type is dominated by *Artemisia arbuscula* and *Chrysothamnus viscidiflorus* ssp. *pumilus* (65 acres, 26 ha). Grasses are substantially less important than in other *A. arbuscula* types. Diversity is low with *Lomatium leptocarpum, Polygonuni polygaloides* ssp. *esotericum, P. douglasii, Gayophytum sp. Poa juncifolia, Blepharipappus scaber,* and *Perideridia bolanderi* among the few species. Parts of this basin are almost devoid of vegetation. The summer-dry, deeply cracked vertisol is probably flooded and saturated with water for at least a month in spring and remains moist for perhaps two additional months in most years.

Plant Diversity

One hundred four taxa are listed.

Conflicting Impacts

Cattle grazing has some impact particularly on the NE. corner and E.-central part of the RNA. The RNA has been reduced in size by half since originally established in 1933. Bulldozers were used to fight the 1959 fire on the RNA, and resulting trails were still obvious in 1984.



IV. SOUTHERN BASIN RANGES PROVINCE

29) Indiana Summit
30) Sentinel Meadow
31) Whippoorwill Flat
32) White Mountain
33) White Mountain Summit

SOUTHERN BASIN RANGES PROVINCE

29. INDIANA SUMMIT (Taylor 1980)

Location

This established RNA is on the Inyo National Forest in Mono County. It is ca. 8.5 miles (13.7 km) E. of June Lake. It includes portions of sects. 5, 6, 7, and 8 of T2S, R28E MDBM (37°49'N., 118°55'W.) USGS Crestview quad *(fig. 63).*

Target Element

Jeffrey Pine *(Pinus jeffreyi)*

Distinctive Features

• Extensive Virgin Jeffrey Pine Forest: The Jeffrey Pine forest at Indiana Summit is part of a large tract of essentially pure Jeffrey pine forest stretching from the eastern flank of the Sierra Nevada across the divide between the Mono Basin and the Owens River drainage. Much of this forest has been harvested for timber, and the RNA preserves a rare pristine example.

• First California RNA: The Indiana Summit RNA was the first RNA established in California (1932). It has been used as an example of a coniferous forest ecosystem in widely used textbooks on ecology (Whittaker 1975), and also by the American Museum of Natural History (a diorama based on Indiana Summit).

• Fire History: Fire is important in shaping the Jeffrey pine forest. A fire recurrence interval of ca. 15 years is obtained from cut stumps adjacent to the RNA. No fires have occurred recently. Canopy structure indicates only ground fires in the past. Natural fires were apparently light and patchy. Reproduction of Jeffrey pine is also patchy, and the scales of fuel density and reproduction patches overlap, suggesting successful Jeffrey pine reproduction may depend on fire. Jeffrey pine reproduction especially in the white fir *(Abies concolor)* forest appears to be tied strongly to fire, with this species excluded from these sites if succession proceeds without disturbance. Crown fire potential has likely increased on adjacent lands through increased stocking rates and lower canopies. Because of the xeric nature of the forest, brush densities following fires are low and do not alter stand regeneration times.

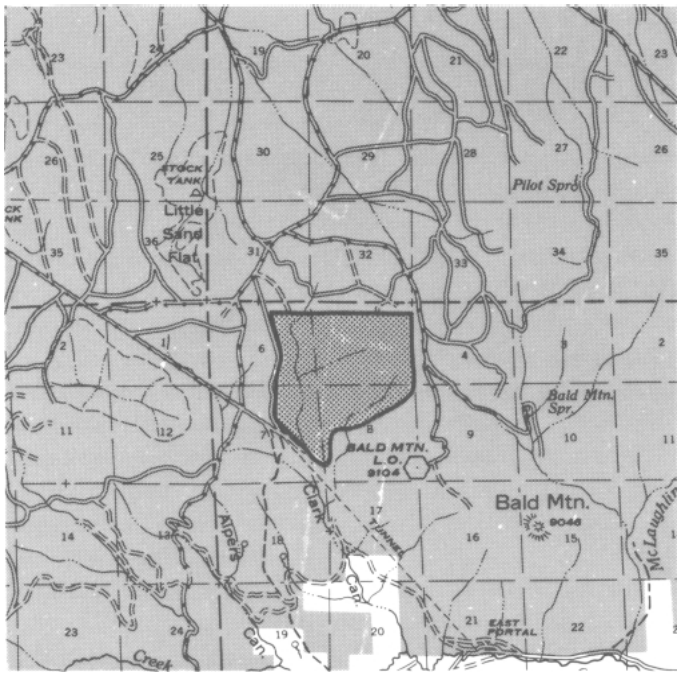


Figure 63--The Indiana Summit RNA.

• Rare and Endemic Plants: *Lupinus duranii is* a conspicuous member of the open Jeffrey pine forest and pumice flat area. It is a member of CNPS List 4. *Artemisia cana* ssp. *bolanderi* is endemic to the Mono Basin, but not considered rare by CNPS.

• Archaeological Value: The Paiute Indians harvested larvae of the moth *Coloradia pandora,* which cyclically attacks Jeffrey pine, by digging trenches encircling the trunks of mature trees. These piagi trenches may still be seen surrounding some of the larger Jeffrey pines, although their evidence has been largely obliterated by logging and other disturbance in other adjacent areas *(fig. 64)*.

• Rare Fauna: A state-listed prairie falcon *(Falco mexicanus)* was seen nesting in the area in 1977 during the field work for this report.

Physical Characteristics

The area encompasses 1156 acres (468 ha) and ranges in elevation from 7800 to 8500 ft (2377-2590 m). It is located on the southernmost margin of an extensive recent volcanic plateau characterized by small pumice basins interspersed between rolling uplands formed by recent tuffaceous ash falls and volcanic flows. At the S. end, tuffaceous cliffs resulting from recent erosion create bold relief. The entire area is covered by recent ash-fall deposits, making for very well drained soils.

Rocks are loosely welded volcanic tuff (Bishop Formation)

Figure 64--Indiana Summit: Open Jeffrey pine forest with piagi trenches around base of trees and stump in foreground. Photo from outside RNA (D. Cheatham).

aged at 700,000 years. The recent ash deposits are 700-10,000 years, originating from the nearby Mono and Inyo Craters. Soils are Orthic Humic Entisols. Most precipitation falls as snow from November to March. Snow reaches 3.2 ft (1 m) deep and may last three months. Winter daily temperatures are estimated to range from 23 to 41 °F (-5 to +5 °C), while summer daily ranges are ca. 50-81 °F (10-27 °C). Rainfall is estimated at ca. 12-16 inches (305-406 mm) annually.

Association Types

Seven association types are defined using releves and following the construction of an association table. An additional fifteen 15-m radius plots are sampled to estimate basal area cover and stem density for forest types. Acreage is not given for all types.

• Jeffrey Pine/*Purshia tridentata* (85100): 869 acres (352 ha). Jeffrey pine is often the only conifer species in this association, but scattered lodgepole pine *(Pinus contorta* ssp. *murrayana)* occur. This is an open forest with typically less than 50 percent canopy cover. *Purshia tridentata* is the low shrubby dominant, covering up to 70 percent of the ground. Density of Jeffrey pine ranges from 113 to 877 stems/ha on eight plots. Basal area of Jeffrey pine ranges from 28.4 to 77.9 m^2/ha. The site-index estimate for Jeffrey pine is less than 32 ft (10 m)/100 years. This low index indicates low productivity and probably low recruitment and regeneration rates.

Herb cover is sparse with only a few species tallied. These include *Carex rossii, Gayophytum diffusum* ssp. *parviflorum, Stipa californica, Stephanomeria tenuifolia, Lupinus duranii, Leptodactylon pungens* ssp. *pulchriflorum,* and *Linanthus nuttallii.*

• Lodgepole Pine/*Calyptridium umbellatum* (86100): 173 acres (70 ha). In this association lodgepole pine is the dominant with occasional large Jeffrey pine. The shrub layer is the most poorly developed of all the forest types. *Artemisia tridentata* and *Purshia* are predominant with a low herb cover including *Calyptridium umbellatum, Chrysothamnus parryi,* and *Stipa elmeri.*

Lodgepole pine basal area ranges from 9.0 to 37.3 m^2/ha on the four plots, and tree density ranges from 71 to 212/ha.

• White Fir/*Prunus emarginata* (84240, 85210): 116 acres (47 ha). This type occurs on N.-facing slopes. It is codominated by white fir and Jeffrey pine, the former species the climax dominant. The N. exposures increase mesicness and shrub cover and diversity compared to the Jeffrey pine-*Purshia tridentata* forest. The relatively deep snow pack not only provides more water with relatively low evapotranspiration rates (due to N.-facing slopes), but also reduces the threat of dessication to winter drought-susceptible species.

The basal area of white fir ranges from 27.6 to 38.5 m^2/ha in three plots. Total basal area ranges from 49.1 to 80.6 m^2/ha. The mean dbh of white fir is 17.3 inches (44 cm) and for Jeffrey pine 15 inches (38 cm). Total stem density ranges from 424 to 452/ha. Sapling density (49/ha) is lower than in Jeffrey pine-dominated forest. After fire this type becomes dominated by *Artemisia tridentata-Symphoricarpos vaccinioides* vegetation.

Herb cover is sparse with only occasional individuals of *Bromus carinatus, Arabis holboellii* var. *retrofracta, Carex rossii, Poa fendleriana,* and *Leptodactylon pungens* ssp. *pulchriflorum.* Shrubs include *Prunus emarginata, Artemisia tridentata, Ribes cereum, Symphoricarpos vaccinioides, Ceanothus velutinus,* and *Chrysolepis sempervirens.*

• *Artemisia tridentata-Symphoricarpos vaccinioides* (35210): This association occupies shallow soils on steep wind-swept slopes with light snow cover. It is subclimax on some sites, successional to the white fir-*Prunus emarginata* forest. Additional species include *Ribes cereum, Ceanothus velutinus, Bromus carinatus, Purshia tridentata, Stipa californica,* and *Leptodactylon pungens* ssp. *pulchrifolium.*

• *Haplopappus bloomeri-Gayophytum diffusum* (no Holland equivalent): This is a successional type following fire in the *Pinus-Purshia* type. Other species include *Ceanothus velutinus, Purshia tridentata, Stephanomeria tenuifolia, Eriogonum vimineum, Arabis platysperma, Eriogonum spergulinum* ssp. *reddingianum, Eriogonum nudum* ssp. *deductum,* and *Stipa elmeri.*

• *Chrysothamnus parryi-Stipa elmeri* (35400): This type occurs on excessively drained pumice flats. Other species contributing to the sparse cover include *Artemisia tridentata, Calyptridium umbellatum, Lupinus duranii, Mimulus coccineus, Agoseris glauca* ssp. *monticola, Hulsea vestita, Oenothera xylocarpa,* and *Sitanion hystrix.*

• *Artemisia cana* ssp. *bolanderi-Carex douglasii* (no Holland equivalent): This type occurs in moist areas in centers of large pumice basins and around moist flats. The dominant shrub is endemic to Mono County. Additional species include *Calyptridium umbellatum, Mimulus coccineus, Muhlenbergia richardsonis, Draba stenoloba* ssp. *nana, Juncus mertensianus, Haplopappus apargioides, Lupinus confertus, Thelypodium crispum,* and *Heleocharis palustris.*

Plant Diversity

Seventy-three taxa are listed.

Conflicting Impacts

ORV tracks have been observed within the RNA although disturbance is minimal. Recent woodcutting, including standing snags useful as wildlife habitat, has occurred within the RNA. These problems could be lessened if signs around the periphery of the area were maintained and increased in frequency. There has been logging on three sides of the RNA up to the boundaries.

30. SENTINEL MEADOW (DeDecker 1975a, Talley 1978)

Location

This established RNA is on the Inyo National Forest, Mono County. It is ca. 14 miles (27 km) NE. of the town of Mammoth Lakes. It lies within portions of sects. 7, 8, 9, 10, 15, 16, 17, and 18 of T2S, R29E MDBM (37°46' N., 118°46' W.) USGS Crestview and Dexter Canyon quads *(fig. 65).*

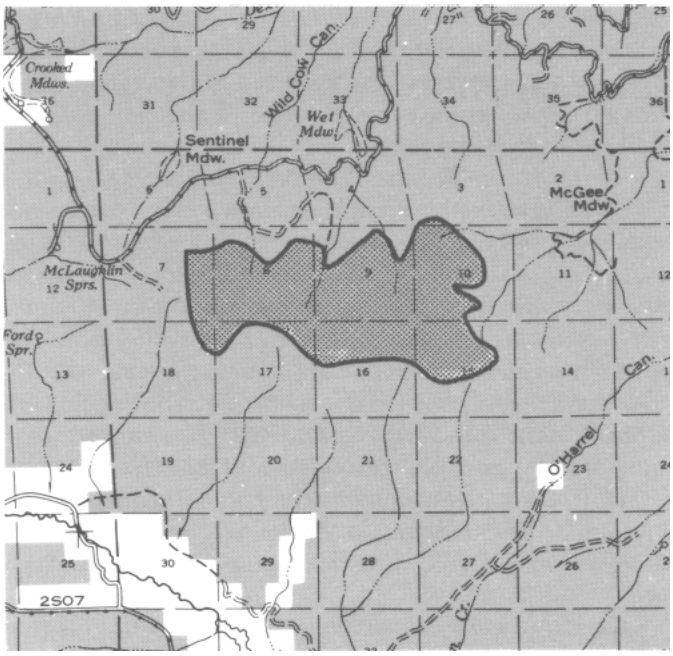


Figure 65--The Sentinel Meadow RNA.

Target Elements

Lodgepole pine *(Pinus contorta* ssp. *murrayana),* limber pine *(Pinus flexilis)*

Distinctive Features

• Tree Growth: A large number of trees of lodgepole pine, Jeffrey pine *(Pinus jeffreyi),* whitebark pine *(P. albicaulis)* and limber pine are sampled throughout the area, and quantitative estimates of diameter and height growth rates are made. These are too detailed to summarize here, but the information is valuable and may be compared to the same species at other sites or to different species under similar climatic regimes (e.g., the extensive dendrochronological data for White Mountains bristlecone pine [*Pinus longaeva*] stands, Fritts 1969).

• Structure and Forest History: By using the data accumulated for growth rate estimates, establishment times and age-classes for the major tree species are constructed. Thus, a large body of knowledge exists for the structure of the major tree-dominated associations at Sentinel Meadow. For example, the clusters of the few Jeffrey pine age-classes are found to be closely associated with periods in history when climate was relatively moist. Fire history of the Jeffrey pine forest suggests that fires were frequent between 1800 and the start of the 20th century. Evidence of only one widespread fire (ca. 1800) is evident in the lodgepole pine forest.

• Solar Beam Irradiation: The major plant associations are evaluated for solar intensity on the basis of estimates calculated for their characteristic slope exposures. Highest insolation sites include *Cercocarpus ledifolius* and Jeffrey pine types, whereas the lowest ones contained whitebark and western white pine mixed with lodgepole pine.

• Mesicness of an East-Side Range: The presence of such species as *Chrysolepis sempervirens,* whitebark pine, western white pine *(Pinus monticola),* and according to C. Millar (pers. comm. 1989), mountain hemlock *(Tsuga mertensiana)* in this area was unknown before this survey and suggests that, perhaps because of the gap in the Sierra Crest to the W. near Mammoth Mountain, a relatively high quantity of precipitation falls at this site given its E.-side location.

Physical Characteristics

The ecological survey of this RNA covers 3840 acres (1554 ha) (actual size of the established RNA is 2041 acres, or 827 ha). Elevations range from 7546 to 10,006 ft (2300-3050 m). Steep (40 percent and greater) slopes on N. and S. aspects comprise 914 acres (370 ha) and 1364 acres (552 ha), respectively. A gently sloping plateau occupies 1092 acres (442 ha) on the main (Sentinel) ridge, and the remainder of the area, 470 acres (190 ha), is gently sloping terrain at the northern base of Sentinel Ridge.

S. slopes are underlain by granite and are steeper than N.-facing slopes which are underlain by rhyolite with local obsidian outcrops. Climate is somewhat moister than other similar ridges lying east of the main Sierra Crest with estimated precipitation at between 18 and 22 inches (450 and 550 mm)/year. Seasonal temperature variation is relatively high with estimated average January lows at 7 °F (-14 °C) and July highs at 78 °F (25.4 °C).

Association Types

The area is sampled using 0.07-ha plots. Jeffrey pine forest has 16 plots, lodgepole pine forest 18 plots, lodgepole-whitebark pine forest seven plots, and limber pine forest nine plots.

• Lodgepole Pine Forest (86100, 81B00): 1289 acres (522 ha). Pure or nearly pure stands of lodgepole pine occur on level or gently sloping ground on the E., N., and W. flanks of Sentinel Ridge and on the W. and NE. slopes of the Sentinel Ridge plateau. The sample plots indicate an average of 245 stems/ha and a basal area of 29 m^2/ha. Frequency, cover, and basal area of lodgepole pine decline with increasing elevation and exposure. Upper plateau stands exposed to strong S. winds are composed of scattered trees with wind-trained branches, but significant girth.

Combined understory and tree stratum cover is estimated at 43 percent on gentle W.- facing slopes, but is much reduced at upper elevations. Total herb stratum cover seldom exceeds 25 percent. Typical understory species include *Carex* spp., *Gayophytum nuttallii, Sitanion hystrix, Stipa elmeri, Poa nervosa, Ribes cereum, R. roezlii, Symphoricarpos vaccinifolia, Lupinus breweri,* and *L. alpestris.* Species apparently locally confined to this type include *Chaenactis douglasii, Frasera puberulenta,* and *Pterospora andromedea.* Scrubby aspen *(Populus tremuloides)* occur in this type on gentle slopes on the N. edge of the RNA.

• Jeffrey Pine Forest (85100): 862 acres (349 ha). This association occurs on southerly exposures. Soil is a coarse friable granite. Stocking is relatively uniform (124 stems/ha), accounting for 41 m^2/ha basal area and 43 percent cover. Jeffrey pine is the sole dominant at most sites with some admixture of western juniper *(Juniperus occidentalis* ssp. *australis)* on con-

vex slopes and elevations of ca. 8038 ft (2450 m), and *Cercocarpus ledifolius* on rocky or exposed convex slopes. All mature Jeffrey pines are wind-sheared at their tops with crooked stems. At 9842 ft (3000 m) Jeffrey pine and limber pine forest form an ecotone. The Jeffrey pine are strongly stunted and may not produce viable seed at this level.

Ecotones with sagebrush scrub indicate invasion by Jeffrey pine with good cone production. Common associates with Jeffrey pine are shared with sagebrush scrub and mountain mahogany woodland. A few species locally restricted to this type include *Chrysolepis sempervirens, Streptanthus tortuosus, Cryptantha muricata* var. *dentata,* and *Eriogonum spergulinum* var. *reddingianum.*

• Lodgepole Pine-Whitebark Pine Forest (86220): 709 acres (287 ha). Mixed stands of lodgepole and whitebark pines are largely restricted to N. slopes. Some of these forests contain occasional western white pine *(Pinus monticola).* Whitebark and lodgepole pine have near equal density and cover (292 vs. 218 stems/ha and 12 vs. 8 percent cover, respectively). Locally (one plot) basal area cover of whitebark pine may be as high as 200 m^2/ha, but the average for the other six 0.07-ha plots is 7.8 m^2/ha, one-third that of typical lodgepole pine forest basal area. Lodgepole pines in this mixed forest are smaller than those in pure lodgepole pine forest. However, cover is similar. Understory species include *Arabis holboellii, A. inyoensis, A. platysperma, Calyptridium umbellatum* var. *caudiciferum, Carex* sp., *Erysimum argillosum, Lupinus alpestris, Poa nervosa, Stipa elmeri,* and *Eriogonum lobbii.*

• Limber Pine Forest (86700): 507 acres (205 ha). Limber pine forest extends over S. and E. exposures between 9462-10,000 ft (2884-3048 m) in the eastern half of the study area. Open stands (10-15 percent tree cover) are typical of exposed sites. Jeffrey pine may occur in these forests on S. slopes below 9514 ft (2900 m). More gradual slopes at the plateau rim or other exposed sites with N. to NW. exposures may have mixed stands of limber, whitebark, and lodgepole pines. Tree cover and density varies widely throughout the sampled plots (1-30 percent, 14-290 stems/ha, respectively) as does basal area (0.1-17.0 m^2/ha). Establishment of limber pines is limited to xeric exposures.

Herb and shrub stratum taxa are typically widespread species from other types. *Lesquerella kingii* and *Chamaebatiaria millefolium* are locally confined to this type.

• Subalpine Forest (86600): 177 acres (54 ha). This type occurs above 9810 ft (2990m) on the S. half of the plateau. Soil is loose and rhyolitic, with local obsidian outcrops. Clusters of whitebark, limber, and lodgepole pine dominate. Total tree cover is less than 1 percent. Three subtypes occur on the basis of varying degrees of slope exposure and wind action.

Subtype 1 occurs at the southern and eastern rims of the high 9842 ft (3000 m) plateau and is characterized by stony soil pavement because of removal of fine particles by wind. This type has isolated clusters of primarily limber and whitebark pine and a sparse (5-15 percent) understory including *Chrysothamnus viscidiflorus* ssp. *viscidiflorus, Haplopappus macronema, Leptodactylon pungens* ssp. *hallii, Phlox covillei, Eriogonum ovalifolium* var. *nivale, Eriophyllum lanatum* var. *monoense, Holodiscus microphyllus, Lupinus breweri,* and occasional *Cercocarpus ledifolius.*

Areas characterized by alternating removal and deposition of sandy soil (subtype 2) comprise well over half of the subalpine forest. Vegetation is dominated by patches of *Ribes cereum* with largely open ground dotted with sparse cover of most species mentioned in subtype 1 scattered between. In addition to those species, several others including *Hulsea vestita, Raillardella argentea, Senecio spartioides, Cryptantha confertiflora, Lupinus montigenus,* and *Mimulus coccineus* appear to occur only in this type.

The third subtype is characterized by sand deposition areas in depressions left by two volcanic craters. Vegetation is virtually absent except for widely spaced *Lupinus breweri.*

• Sagebrush Scrub (35100,35210): 158 acres (64 ha). This association occurs on gradual S.-to-SE. aspects at ca. 9600 ft (2926 m). It is characterized by deep sandy soil, and most of it is relatively undisturbed by grazing. Cover is ca. 50 percent, 20-50 percent of which *is Artemisia tridentata.* Other significant species include *Symphoricarpos vaccinioides, Monardella odoratissima* ssp. *parviflora, Haplopappus suffruticosus, Leptodactylon pungens, Holodiscus microphyllus, Purshia tridentata, Ribes cereum, Eriogonum umbellatum* var. *umbellatum, Sitanion hystrix, Stipa elmeri, Orobanche corymbosa, Tetradymia canescens, Silene montana* ssp. *bernardina, Oryzopsis hymenoides,* and *Stephanomeria tenuifolia.*

• Mountain Mahogany Woodland (no Holland equivalent): 118 acres (36 ha). This type is concentrated along the upper margin of the Jeffrey Pine forest and is restricted to windy sites below 9842 ft (3000 m) with steep convex south exposures and rocky soil. *Cercocarpus* accounts for at least 700 stems/ha, but only 20 percent cover and 10 m^2/ha basal area. Most species are shared with the sagebrush scrub with the possible exception of *Abronia turbinata* and *Lygodesmia spinosa.*

Plant Diversity

Seventy-one species are listed.

Conflicting Impacts

Domestic grazing in the sagebrush scrub has significantly disturbed portions of that community. No other impacts are mentioned.

31. WHIPPOORWILL FLAT (Keeler-Wolf and Keeler-Wolf 1976, Keeler-Wolf 1989f)

Location

This soon-to-be-established RNA is on the Inyo National Forest and is ca. 18 miles (29 km) SSE. of the town of Big Pine. The RNA falls partly or wholly within sects. 23, 24, 25, 26, 35, and 36 of T10S, R36E MDBM and also within sects. 1 and 2 of T11S, R36E MDBM (37°3' N., 118°0'W.) USGS Waucoba Mtn. and Waucoba Spring quads *(fig. 66).*

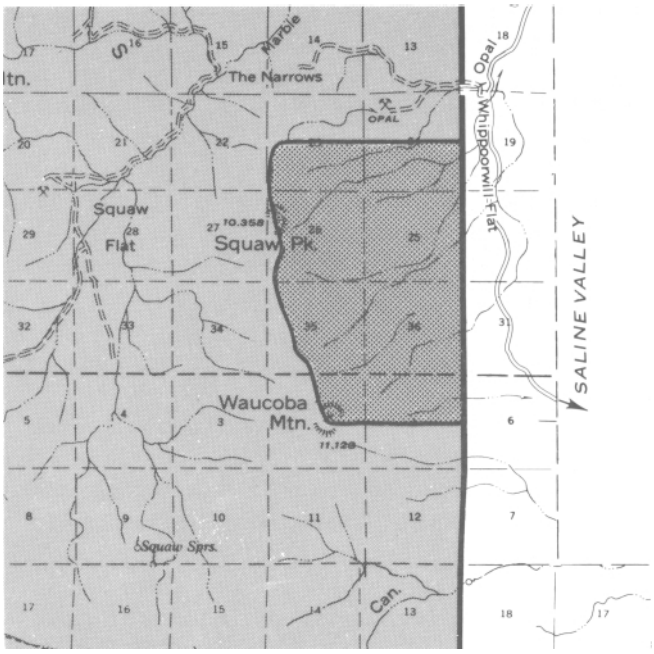


Figure 66--The Whippoorwill Flat RNA.

Target Elements

Pinyon-juniper *(Pinus monophylla-Juniperus osteosperma), limber* pine *(Pinus flexilis)*

Distinctive Features

• Dense, Well-Developed Pinyon Forest: The granitic alluvium in the east-central portion of the RNA appears to be optimal substrate for single-leaf pinyon pine. Numerous specimen trees exist with single, straight trunks and spreading crowns. Growth rates are relatively rapid (16 inches [41 cm] dbh in 100 yr), and densities are high. The high density and large stature of the pinyon pines provide an excellent habitat for many animal species, some not typically found in high numbers in pinyon associations. For example, gray flycatchers *(Empidonax wrightii),* hermit thrushes *(Catharus guttatus),* western tanagers *(Piranga ludoviciana),* mountain chickadees *(Parus gambeli),* and pinyon mice *(Peromyscus truei)* are notable for their high densities.

• Substrate Differences: The diverse rock types ranging from granite through shale and limestone provide a backdrop for comparative work on ecological amplitudes of many species within several communities of the Great Basin mountains, including bristlecone pine forest, sagebrush scrub, pinyon forest, and *Cercocarpus* scrub.

• Effect of Climate on Vegetation Types: Although the area is notable for its large area of contact between the bristlecone-limber pine forest and the pinyon-juniper zone, several small bare zones--largely uncolonized by trees--separate the two coniferous associations. Upon close inspection, it appears that these zones, with a tendency towards NE. exposures, are a dynamic boundary between the two associations. At present, dead stems of limber and bristlecone pines are scattered through these bare patches, many dead and dying bristlecones and limbers occur above the bare areas, and numerous young pinyons occur at the lower edges of them. This suggests that over the past several hundred years there has been a trend for the local subalpine forest to retreat upslope, while pinyon forest has advanced somewhat to replace it. The long persistence of stands of dead bristlecone pine stems elsewhere has been shown to indicate climatic change (LaMarche and Mooney 1967, Mooney 1973).

• Archaeological: The large supply of pinyon pine nuts in the dense forest on the eastern side of the RNA was an important source of food for the Paiute and Shoshone Indians. Many signs of their inhabitance have been discovered including wickiup circles, obsidian chips and tools, pinyon nut storage cairns, etc. The name Waucoba (from the prominent mountain along the W. boundary of the RNA) means "pine" in Paiute.

Physical Characteristics

The area covers 3328 acres (1,346.8 ha). Elevations range from ca. 6800 ft (2073 m) on the NE. corner of the area to 11,123 ft (3390 m) atop Waucoba Mountain. The area occupies the eastern flanks and upper bajada slopes of Squaw Pk. (10,358 ft, 3157 m) and Waucoba Mountain. Topography is steep and rugged on the upper slopes of the mountains, but becomes moderate to gradual on the lower slopes.

The lower slopes are predominately Quaternary granitic alluvium brought down from the slopes of Waucoba Mtn. The coarse alluvium is cut by several arroyos up to 35 ft (11 m) deep and is broken by several small outcrops and ridges of Precambrian metasedimentary shale (Wyman Formation). All of Squaw Pk. is composed of Wyman Formation, which also includes oolitic limestones locally transformed into marbles and dolomite. The main canyon separating Squaw and Waucoba has a conspicuous outcrop of this marble. The Papoose Flat quartz monzonite is the Cretaceous granitic rock in the area and underlies virtually all of Waucoba Mtn. A small amount of the Precambrian Reed Dolomite occurs in the eastern portion of sect. 36.

Soil units include Abgese-Berent-MacKey families 2-15 percent slopes, Brad Family--rock outcrop, granitic complex 15-30 percent slopes, Mescamp-Summing families--Rock outcrop, metasedimentary complex; 30-60 percent slopes, Rock outcrop -- rubbleland complex, Rock outcrop, granitic-Brad-Hartig families complex, 30-60 percent slopes, Rock outcrop, granitic-Brad-Hartig Families complex, 60 to 80 percent slopes, and Washoe-Checkett-Mulett families association, 30 to 60 percent slopes.

Precipitation is thought to be relatively high locally, ranging between 15-22 inches (381-559 mm) per year, the majority falling as snow in the winter, with occasional significant summer thundershowers. Temperatures range from July maxima of ca. 86-93 °F (30-34 °C) to January minima of ca. 0 °F (-18 °C).

Association Types

Seven 100-m^2 plots are sampled in the dense pinyon forest, and three 100-m^2 plots are sampled in the mixed pinyon juniper phase.

• Pinyon Forest and Pinyon-Juniper Woodland (72122, 72121): 1954 acres (791 ha). This association may be divided into two types including a mixed *Pinus monophylla* and *Juniperus osteosperma* woodland on the slopes and ridges underlain by Wyman Formation and Papoose Flat granite, and a *Pinus monophylla* forest phase on the granitic alluvium in sects. 25 and 36.

The sample from the dense pinyon forest on the alluvium has an average density of 730 pinyon pines/ha. Ten shrubs are typical of this association, the most important of which are *Artemisia tridentata, Lupinus palmeri, Ribes velutinum* var. *glanduliferum, Opuntia erinacea* var. *erinacea,* and *Chrysothamnus viscidiflorus.* Thirty species of grasses and herbs are enumerated in the sample with such species as *Gilia ophthalmoides, Cryptantha echinella, Mimulus densus, Gayophytum diffusum* ssp. *parviflorum, Lomatium nevadense, Poa* sp., *Sitanion hystrix, Eriogonum panimentense, Cryptantha flavoculata,* and *Erysimum capitatum* among the most frequent.

In the typical pinyon-juniper phase *P. monophylla* dominates over *J. osteosperma* at a ratio of ca. 2:3. Total density of stems (including multiple trunks of juniper) on the small sample is 930 trees/ha. However, most areas appear substantially lower in density than the sample. Typical shrubs include *Artemisia arbuscula* ssp. *nova, Chrysothamnus nauseosus, Ribes velutinum* var. *glanduliferum,* and *Opuntia erinacea.* Herbs include *Penstemon floridus* ssp. *austinae, Petalostemum searlsiae, Gilia ophthalmoides, Cordylanthus helleri, Stanleya elata,* and *Astragalus minthorniae* var. *villosus.*

Sizes of the typical mature *P. monophylla* on the alluvium are between 16-20 inches (41-51 cm) dbh and 35-45 ft (11-14 m) tall. The ages of these trees range between 100-150 years with occasional dominants slightly over 200 years. Reproduction of the trees is good on both types.

Nearly the entire elevational range of the local pinyon association is represented. At the NE. comer of the area the pinyon-juniper association gives way to the sagebrush scrub of lower elevations, whereas at elevations between 8300 and 8600 ft (2530-2621 m), the pinyon forest commonly grades abruptly into the bristlecone-limber pine forest (on N. exposures) or *Cercocarpus* scrub (on S. exposures) *(fig. 67).*

• Bristlecone-Limber Pine Forest (86400, 86700): 711 acres (288 ha). This association covers the upper slopes of Squaw and Waucoba mountains from the summits down to as low as 8300 ft (2530 m) in N.-facing canyons on limestone. Bristlecone pine dominates on steep northerly-facing exposures and limber pine tends to dominate on more gently sloping exposures. The two species also form extensive mixed forests on the upper eastern exposures of Waucoba Mtn. and on the NE. slope of Squaw Pk. *(fig. 68).* Both species are replaced by sagebrush scrub on the exposed summits of Waucoba Mtn. and Squaw Pk. and tend to occur primarily on E.- and N.-facing slopes. At lowest elevations bristlecone pine appears restricted to calcarious soils. However, it occurs widely off them at upper elevations, growing exceptionally well on granitic soils on Waucoba Mtn.

No sampling is conducted in these forests. Tree densities are estimated as averaging between 300 and 700 trees/ha. Many

Figure 67--Whippoorwill Flat: From big sagebrush scrub in NE. corner of RNA to Waucoba Mountain showing dense single leaf pinyon forest on lower slopes and bristlecone and limber pine subalpine forest on upper slopes.

of the limber and bristlecone pines are moderate aged and reproducing well. The largest bristlecones noted are ca. 60 inches (1.5 m) dbh and estimates by University of Arizona dendrochronologists suggest several trees are more than 3000 years old. Largest limber pines are 40-44 inches (1-1.1 m) dbh. Typical canopy height is 40-45 ft (12-14 m) with dominants of both species up to 55 ft (17 m). The understory is moderately sparse to very sparse with occasional *Ribes cereum, Cercocarpus ledifolius, Artemisia tridentata* and scattered subalpine herbs in low duff areas. Fire charring from lightning strikes is common, but fires rarely spread beyond one or a few trees, as a result of the light duff and open understory.

• Sagebrush scrub (35210,35220):476 acres (193 ha). This association varies somewhat, depending on soil depth, substrate, and elevation. In general, however, it is dominated by either *Artemisia tridentata* (on deeper soils) or *Artemisia arbuscula* ssp. *nova* (shallower and calcarious soils) with *Purshia glandulosa, Ephedra viridis, Chrysothamnus viscidiflorus* ssp.

Figure 68--Whippoorwill Flat: Dense, mixed bristlecone and limber pine forest on NE.-facing slope of Waucoba Mountain.

viscidiflorus, Chrysothamnus viscidiflorus ssp. *pumilus,* and *Chrysothamnus nausiosus* ssp. *albicaulis.* At low and mid-elevations herbs include *Eriastrum wilcoxii, Gilia ophthalmoides, Eriogonum panamintense, Allium atrorubens* var. *inyoensis, Astragalus minthorniae, Lomatium nevadense, Mentzelia montana, Calyptridium roseum, Penstemon confusus, Cryptantha circumscissa, C. watsonii, Arabis holboellii* var. *retrofracta, Oxytheca dendroidea,* and *Sphaeralcea ambigua.*

The high elevation sagebrush scrub on the summits of Squaw and Waucoba has many subalpine herb species intermixed and may be considered subalpine sagebrush scrub (Holland 35220). This phase covers 114 acres (46 ha) and includes such species as *Astragalus lentiginosus* var. *semotus, A. calycosus, Cymopterus cinerarius, Oxytropis viscida, Erigeron clokeyi, Arenaria nuttallii* ssp. *gracilis, Eriogonum ovalifolium* var. *nivale, Castilleja nana, Artemisia norvegica* var. *saxatilis,* and *Ipomopsis congesta* ssp. *montana.*

Density of shrubs and herbs vary, with typically the lowest elevation and deepest soil stands having the highest shrub density, while the subalpine ridgetop stands maintain lowest densities.

• *Cercocarpus* scrub (no Holland equivalent): 187 acres (76 ha). This minor association covers the upper rocky slopes of Squaw Pk. and Waucoba Mtn. on harsh southerly and westerly exposures as well as a few low elevation outcrops of limestone in the eastern portion of Sect. 36. *Cercocarpus ledifolius* dominates on most sites except dry limestone or marble outcrops where *C. intricatus* is important. Shrub densities may be open-to-dense, depending on slope steepness and rockiness. Associated species are relatively few and include *Chamaebatiaria millefolium, Holodiscus microphyllus,* and *Ribes cereum.* At lower elevations *Juniperus osteosperma* and occasional *Pinus monophylla* may occur with the mountain mahoganies and *Tetradymia canescens, Artemisia arbuscula, Eriogonum heermannii, Astragalus calycosus, A. purshii* var. *tinctus* and *Cryptantha confertiflora.*

At higher elevations as at the saddle between Squaw Pk. and Waucoba Mtn. more subalpine species such as *Lesquerella kingii, Trifolium andersonii* ssp. *monoense, Erigeron clokeyi, Ipomopsis congesta* ssp. *montana, Stipa comata, Poa epilis, P. incurva,* and *Sitanion hystrix* occur.

Plant Diversity

One hundred forty-five species are listed.

Conflicting Impacts

Feral burros had an impact on the shrubby and herbaceous vegetation before the late 1970's, but have been controlled, with good vegetation recovery. Some woodcutting and prospecting have taken place in the area adjacent to two poor dirt roads which just enter the extreme eastern portion of the area. Litter and other disturbance around informal campgrounds are minimal.

32. WHITE MOUNTAIN NATURAL AREA (Taylor 1979)

Location

This established RNA is on the Inyo National Forest, Mono County. It lies in the southern White Mountains ca. 16 miles (26 km) northeast of Bishop. It occupies portions of sects. 1, 12, 13, 14, of T5 S, R34 E and sects. 6, 7, 8, 18 of T5S, R35E MDBM (37°31'N., 118°11' W.) USGS Mt. Barcroft quad *(fig. 69).*

Target Element

Bristlecone pine *(Pinus longaeva)*

Distinctive Features

• Research in Bristlecone Pine Woodland: The area has been used extensively by scientists since the early 1950's as a site for dating ancient bristlecone pines (e.g., Schulman 1954). Additional studies on the vegetation patterns exhibited by the local bristlecone pine stands have also been done in the RNA (e.g., edaphic restrictions between woodland and *Artemisia* scrub, Wright and Mooney 1965), as has paleoclimatic work relating to fossil timberlines (LaMarche and Mooney 1967).

• Rare Plants: The following species known from the RNA are listed by CNPS: *Astragalus kentrophyta* var. *danaus* (List 4), *Lomatium foeniculaceum* ssp. *inyoense* (List 4), bristlecone pine (List 4), and *Scirpus rollandii* (List 2). *Carex scirpiformis,* although not listed by CNPS, is apparently a first record for California.

Physical Characteristics

The area covers 2303 acres (932 ha) and ranges in elevation from 9439 to 11,434 ft (2877-3485 m). The area lies on the E.

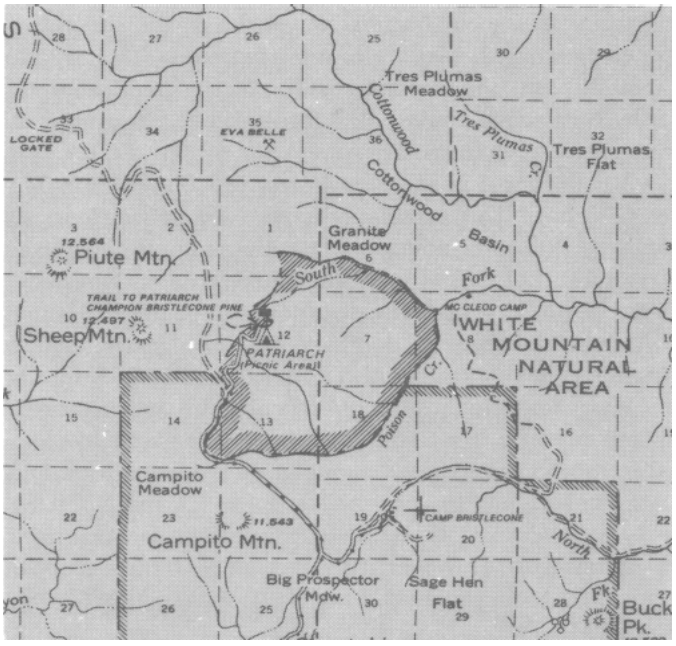


Figure 69--The White Mountain RNA.

side of the White Mountain crest and is drained by Poison Creek and the S. Fork of Cottonwood Creek, both of which are ephemeral in the RNA. Slopes are steep, averaging 30° and are E.- to SE.-trending for the most part. No evidence of Pleistocene glaciation occurs within the area, although Pleistocene patterned ground is evident at the summit area.

Bedrock varies from the Precambrian Reed Dolomite and Wyman Formation (also calcarious) to extensive outcrops of granitic rock (Jurassic quartz monzonite), which outcrop mostly north of the area. Soils are shallow lithosols. Precipitation is ca. 14 inches (347 mm)/yr, and temperatures are cold, with the mean annual temperature about 34 ° F (1.3 °C).

Association Types

Seven 706-m^2 plots are sampled in the bristlecone pine association. No acreages are given for the associations.

• Bristlecone Pine Association (86400): Bristlecone pine forms an open subalpine woodland in the upper reaches of the area *(fig. 70).* Canopy cover is ca. 15-20 percent maximum. Bristlecone pines in this vegetation are almost always multi-trunked, and massive. Basal area and density of bristlecone pine average 59.7 ml/ha and 127.9 stems/ha.

• Bristlecone pine/*Cercocarpus intricatus* Association (86400): Subalpine forests on dolomite below ca. 10,170 ft (3100 m) are an admixture of bristlecone pine with or without the shrub *Cercocarpus intricatus.* No sampling is provided, although there is a limited description.

• Limber Pine/*Cercocarpus ledifolius* association (86400, 86700): Limber pine codominates the tree canopy of the lower slopes in the area with bristlecone pine on rocky sites. Canopy cover is higher than the upper slope bristlecone pine woodland, approaching 50 percent, and bristlecone pine trunks are more tapered. *Cercocarpus ledifolius* replaces C. *intricatus,* and hybrids are common.

• *Phlox covillei-Eriogonum gracillipes Association* (91140): This type is limited to alpine sites underlain by Reed Dolomite. Vegetation is sparse (<30 percent cover). *P. covillei* and *E. gracillipes* are diagnostic and dominant. Other common species include *Linum lewisii, Astragalus calycosus, A. kentrophyta* var. *danaus,* and *Hymenoxys cooperi.* The type is restricted to the upper slopes of the area just at timberline on north slopes or snow accumulation areas. It covers ca. 10 percent of the area.

Figure 70--White Mountain: Ancient bristlecone pine with long-dead snags at upper elevations of RNA (D. Cheatham).

• *Artemisia rothrockii* Association (35220): Low shrubs dominate this type, predominately *A. rothrockii* and *Chrysothamnus viscidiflorus.* Additional species include *Stipa pinetorum, Lupinus meionanthus, Agoseris glauca,* and *Cryptantha jamesii.* This vegetation is limited to calcarious substrates at the upper elevations of the area. *A. rothrockii* dominates shallow depressions or drainages filled with colluvium. Cover is moderately high. This association covers ca. 10 percent of the area.

• Aspen *(Populus tremuloides)* Association (81B00): Aspen forms dense clones on mesic lower sites along Poison and the S. Fork of Cottonwood creeks. The understory is dense with such species as *Elymus cinereus, Agropyron trachycaulum,* and *Artemisia dracunculus.*

• Meadows (45210, 45220): Meadow vegetation occurs at the junction of Poison and the S. Fork of Cottonwood creeks, and on the southwestern corner on rolling slopes. The latter locale is dominated by *Juncus balticus, Poa fendleriana, Muhlenbergia richardsonis,* and *Carex douglasii.* Meadows along the lower reaches of the area are perennially wet, whereas the upper meadow is dry by mid-summer. The lower meadows have a willow border *(Salix leutea* and *S. pseudocordata)* with *Artemisia cana* dominant at high calcium sites along with *Carex praegracilis, Melica bulbosa,* and *Muhlenbergia richardsonis.* The meadow proper is dominated by *Deschampsia caespitosa, Carex nebrascensis, C. scirpiformis, Scirpus pumilis,* and *Sisyrinchium idahoense.*

Plant Diversity

One hundred seventy-six species of vascular plants are listed.

Conflicting Impacts

A gravel road leading to the Patriarch Grove, a well visited tourist site, forms the upper boundary. A short trail with rest benches enters the area for several hundred meters. However, direct human impact is negligible over most of the area except the nature trail, where some litter and cut snags are apparent. The meadow areas are grazed fairly heavily (considered a serious threat to the populations of *Carex scirpiformis* and *Scirpus rollandii* in 1979), and there is some trespass of livestock into the upper edge of the area near Campito Meadow.

33. WHITE MOUNTAIN SUMMIT (McAFEE MEADOW) (Taylor 1976)

Location

This candidate RNA is on the Inyo National Forest. It lies within T4S, R 34E MDBM and includes portions of sects. 4, 5, 6, 8, 9, 16, 17, 19, 20, 21, 22, 27, 28, 29, 32, and 33 (37°35'N., 118°15' W.) USGS Chalfant Valley, White Mtn. Peak, and Mount Barcroft quads *(fig. 71).* This area coincides with the

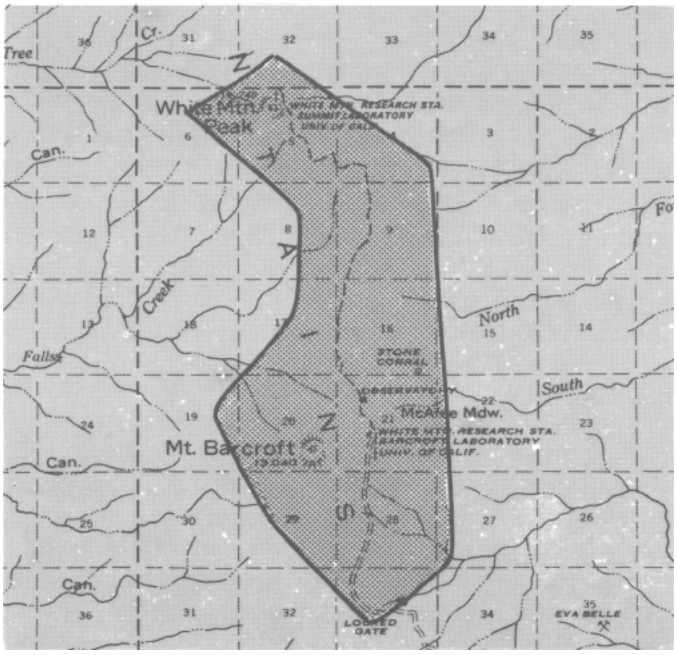


Figure 71--The White Mountain Summit study area.

White Mountain Scientific Area shown on old Forest Service maps.

Target Elements

Alpine Fell Fields

Distinctive Features

• Previous Alpine Research: The summit plateau of the White Mountains contains the largest continuous area of alpine steppe vegetation in California and the Great Basin *(fig. 72)*. It is also the most accessible large alpine area in California. The area is well studied and has been used as a high altitude research center since the early 1950's. Many important physiological experiments were conducted at the two laboratories (Barcroft and White Mountain) within the area, although detailed ecological surveys of the vegetation are lacking.

• Alpine Geomorphology: Several types of frost patterning occur in the area. These include frost polygons and congeliturbation. Unlike many areas with relictual patterned ground (e.g., Devil's Garden # 28), these geomorphic processes are still active as a result of the cold climate. Solifluction lobes are also present, but relatively rare. Two plant associations are restricted to areas where these processes occur.

• Rare Plants: Several rare plants are endemic to the alpine zone of the White Mountains. *Heuchera duranii* is a member of CNPS List 1b, and *Astragalus kentrophyta* ssp. *danaus* and *Lomatium foeniculaceum* ssp. *inyoense* are members of CNPS List 4. Other rare species include *Carex eleocharis* (List 2), bristlecone pine *(Pinus longaeva,* List 4), and *Polemonium chartaceum* (List 4).

Figure 72--White Mountain Summit: Extensive alpine flat (ca. 12,600 ft, 3840 m) to the south of White Mountain Peak (on skyline).

Physical Characteristics

This study area covers ca. 5760 acres (2331 ha), although the proposed changes in boundary and name (McAfee Meadows RNA) would result in a smaller area. Elevations range from 11,598 to 14,242 ft (3535-4341 m). The region within the scientific area is a rolling plateau with fairly gentle relief. It is flanked to the N., W., and E. by steep canyons actively cutting into the plateau. White Mountain Peak is the highest point at the N. of the area and is steep-sloped with active talus.

Parent rocks are Reed Dolomite (Precambrian), Campito Formation (sandstones and hornfels), Barcroft Pluton (granodiorite), and undifferentiated metavolcanics (underlying White Mtn. Pk.). Soils are shallow and poorly developed. Climate is severe, although not discussed in the report. Temperatures are lower, and precipitation is somewhat higher than the White Mountain Natural Area (# 32).

Association Types

The associations described are not mapped and no areal coverage for them is given. (Note: This report was contracted as a vegetation reconnaissance. A complete ecological survey has been contracted for the reduced McAfee Meadow candidate RNA in 1990.) A total of 47 plots (releves) are sampled and arranged into an association table to define the following seven plant associations.

• *Phlox covillei-Linum lewisii* (91140)

• *Phlox covillei-Eriogonum gracilipes* (91140): Both associations are dominated by the small cushion plant *Phlox covillei.* They are limited to dolomitic soils (dolomite barrens) where cover is sparse (<50 percent). The first association is limited to the most barren sites, with severe solifluction. The second association occurs where solifluction is less intense. Species characteristic of association 1 include *Cryptantha nana, Hymenoxys cooperi* ssp. *canescens,* and *Linum lewisii* (15 species total for the sample). Species characteristic of association 2 include *Arenaria kingii, Eriogonum gracillipes, Hesperochloa*

kingii, and *Astragalus calycosus* (17 species total for the sample).

• *Artemisia arbuscula* (35220): This low sagebrush dominates this type, and often covers over 50 percent of the surface. It is mainly confined to areas of Campito sandstone. Other characteristic species include *Lupinus caespitosus, Agoseris glauca* ssp. *monticola, Koeleria macrantha, Phlox covillei, Trifolium monoense,* and *Hesperochloa kingii* (15 species in the sample).

• *Carex albonigra-Koeleria macrantha* (91140):

• *Ivesia lycopodioides* ssp. *scandularis* (91140): These two associations dominate the granitic soils of the Barcroft Pluton. The first occurs on relatively dry sites and the next association dominates the more mesic sites. *Carex albonigra* is common atop large solifluction lobes and congeliturbation polygons. In areas of less pronounced congeliturbation, *Koeleria macrantha* dominates with *Trifolium monoense.* At the margins of large polygons among the boulders and rocks, *Ivesia lycopodioides* ssp. *scandularis* dominates. Mesic species typical of meadow associations occur occasionally. These species include *Draba breweri, Antennaria alpina* ssp. *media, Festuca brachyphylla,* and *Poa alpicola.*

• *Carex subnigricans Deschampsia caespitosa* (45210, 91300): This association occurs wherever there is a surface supply of water, either from snowmelt or seepage. *Carex subnigricans* forms a dense sod, and *Deschampsia caespitosa* indicates standing water during the growing season. They are interspersed with drier, elevated areas dominated by *Carex albonigra-Koeleria macrantha* and *Ivesia lycopodioides* ssp. *scandularis* associations.

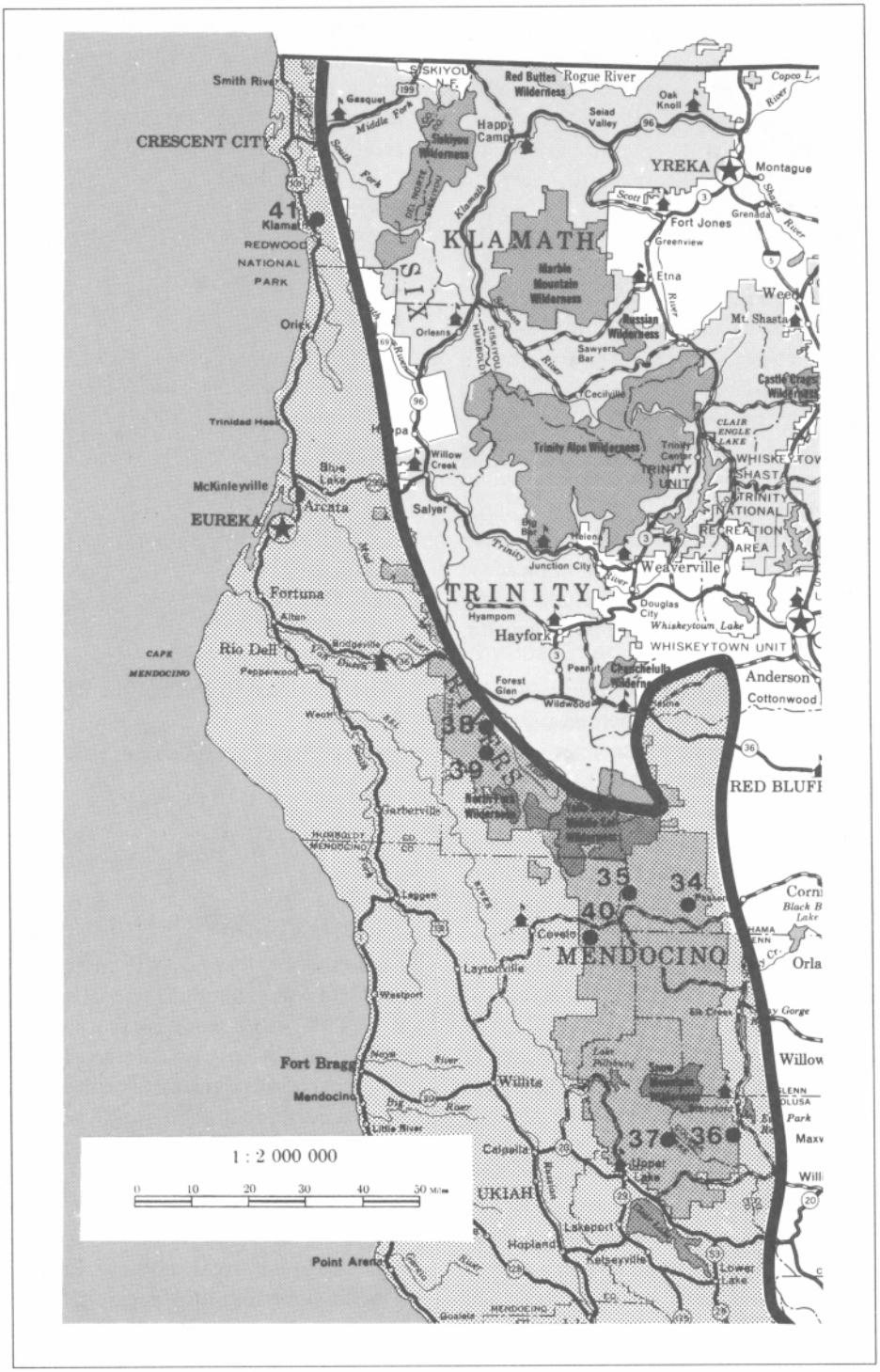
• *Polemonium chartaceum-Erigeron vagus* (91200): This association is typical of the steep scree slopes with severe congeliturbation and active talus. *Sitanion hystrix is* another common species.

Plant Diversity

One hundred ninety-seven taxa are listed, although this list is made by checking the plants noted for the entire White Mountains above 11,500 ft (3505 m) in Lloyd and Mitchell (1973) and is not substantiated by collections in the study area.

Conflicting Impacts

This survey was requested because of a proposal by the University of California to expand the facilities in the scientific area. Observatory sites were suggested at two areas of intense congeliturbation. These have not been built. Currently the area is still a candidate for RNA status, although the boundaries are more restricted to include the area primarily around McAfee Meadows.



V. NORTH COAST RANGES PROVINCE

34) Devil's Basin
35) Doll Basin
36) Frenzel Creek
37) Hale Ridge
38) Ruth
39) Soldier
40) Twin Rocks
41) Yurok

NORTH COAST RANGES PROVINCE

34. DEVIL'S BASIN (Newton 1987)

Location

This soon-to-be-established RNA is on the Mendocino National Forest and is located ca. 10 miles (16 km) SW. of the town of Paskenta in Tehama County. It includes parts of sects. 11, 12, 13, and 14 T23N, R8W, MDBM (39° 50'N., 122° 43'W.) USGS Hall Ridge quad *(fig. 73).*

Target Element

California black oak *(Quercus kelloggii)*

Distinguishing Features

• Diversity of Black Oak Types: The presence of relatively young and mature California black oak stands in addition to mixed stands with Douglas-fir *(Pseudotsuga menziesii)* and ponderosa pine *(Pinus ponderosa)* provide a varied background for an array of ecological studies on the California black oak target element. The Devil's Basin California black oak stands are within the range of optimum development of the forest type in California.

• Wildlife Values: California black oak is an important source of food for a variety of acorn-consuming vertebrates including black-tailed deer *(Odocoileus hemionus columbianus),* mountain quail *(Oreortyx pictus),* California quail *(Callipepla californica),* band-tailed pigeon *(Columba fasciata),* and gray squirrel *(Sciurus griseus).* The older stands of black oak in the area are probably near peak acorn-producing capability and thus serve as important resources to a large number of animals.

• Rare Plant: California black walnut *(Juglans hindsii)* is a member of CNPS list 1b. The local individuals may be naturalized from planted trees.

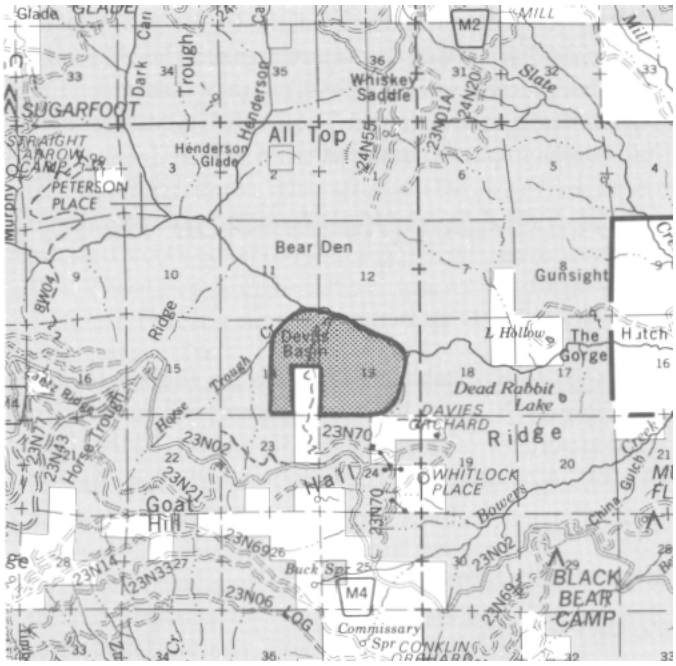


Figure 73--The Devil's Basin RNA.

Physical Characteristics

The area covers 646 acres (261 ha). Elevations range from 1400 to 3660 ft (427-1116 m). Topography is rugged with steep N.- to NE.-facing slopes predominating *(fig. 74).* It is centered on the toe of an ancient slope failure and includes surrounding steep to moderately steep slopes and ridgelines. Slope instability is prevalent throughout much of the steeper areas.

Rocks are entirely Franciscan Assemblage and are locally schistose metasediments. Soil series are of two main types, Tyson (poorest sites, with canyon live oak) and Sheetiron (better sites; with California black oak and Douglas-fir). Small portions of Laughlin series (blue oak savanna) and Hulls series occur, as well as small areas of rockland and colluvial soils. Climate is mild with estimated mean annual precipitation of 30+ inches

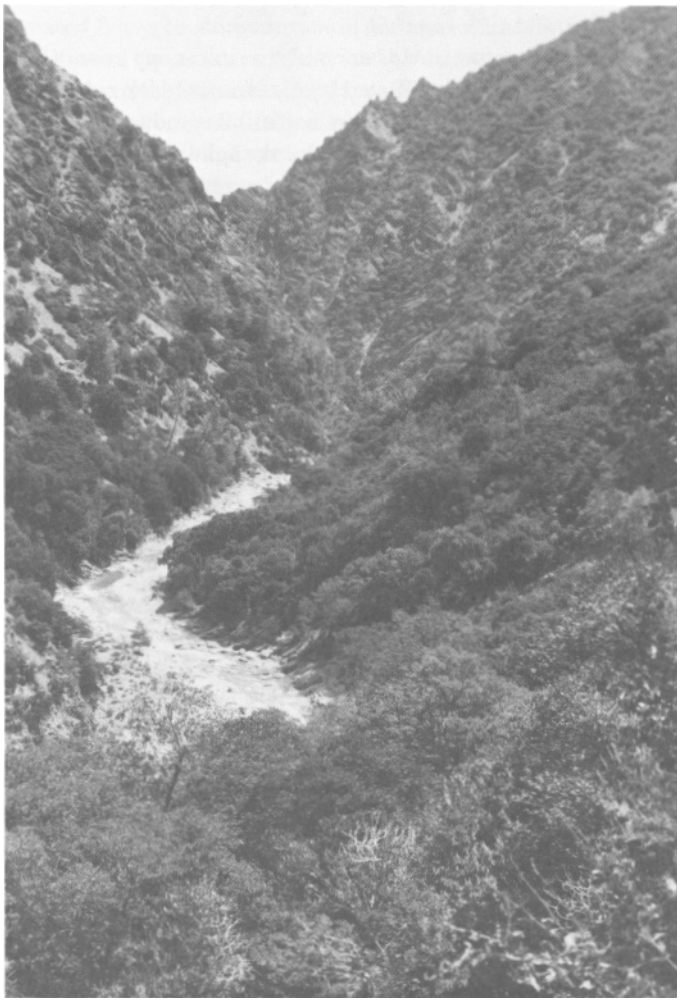


Figure 74--Devil's Basin: View E. down Thomes Creek gorge, canyon live oak forest in middleground mixed California black oak and buckeye brush in foreground (G. Newton).

(762+ mm). Mean summer temperature maxima are slightly over 100°F(38 °C), whereas mean winter minima are 28 to 30°F (-2 to -1 °C) at lower elevations.

Association Types

The size of the associations and the numbers and sizes of plots and releves are not given.

• California Black Oak/*Festuca californica* (71120, 81340): The California black oak-dominated forest at the site is composed of both persistent subclimax stands and of seral stages, successional to Douglas-fir-dominated forest. These forests may be divided into young and old stands.

The young stands have 60 percent canopy cover dominated by California black oak, with occasional Douglas-fir and canyon live oak *(Quercus chrysolepis).* California black oak reproduction is low, but widespread. This is primarily a young black oak forest, showing little evidence of succession to Douglas-fir dominance. Most oaks are 60-70 years old (4-8 inches, 10-20 cm dbh) with 23-30 m^2/ha basal area. Shrubs in the young stands are dominated by *Toxicodendron diversilobum,* with *Rhus trilobata,* and *Cercis occidentalis* as secondary species. The herb layer (15-30 percent cover) is dominated by *Festuca californica* with *Galium triflorum, Lathyrus nevadensis, Silene californica,* and *Chlorogalum pomeridianum.*

The more mature stands are variable in canopy cover (50-90 percent), and are dominated by California black oak, with some ponderosa pine and Douglas-fir. Reproduction of all canopy species is present with black oak saplings and seedlings covering up to 20 percent. Basal area cover ranges from 14.5-82.6 m^2/ha, and trees range from 70-120+ years (8-30 inches, 20-76 cm dbh). The shrub layer (5-20 percent cover) is more diverse than in younger stands. In addition to the previously mentioned shrubs, *Cercocarpus betuloides* and *Ribes roezlii* also occur. The herb layer is much more diverse than in young stands (with often 60 percent cover) and is dominated by *Festuca californica,* but also includes *Trientalis latifolia, Osmorhiza chilensis, Bromus mollis, Collinsia sparsiflora, Galium bolanderi, Monardella villosa, Wyethia angustifolia, Viola sheltonii, Asclepias cordifolia, Delphinium nudicaule, Dichelostemma (Brodiaea) multiflora,* and *D. pulchella.*

• Douglas-fir/ *Mahonia (Berberis) dictyota* (84110): The upper canopy of this forest is open (20 percent cover), dominated by Douglas-fir, with smaller amounts of ponderosa and knobcone pine *(Pinus attenuata).* The subcanopy averages 70 percent cover, is 50-70 ft (15-21 m) tall, and is dominated by California black oak. Reproduction of both major trees is low. Basal area averages 50.5 m^2/ha with trees averaging 150-200 years. Shrub and herb layers are low in cover (10 percent). *Berberis dictyota, Cynoglossum grande, Osmorhiza chilensis, Galium triflorum, Viola sheltonii,* and *Symphoricarpos mollis* are the principal understory species.

• Blue Oak *(Quercus douglasii)/Stipa lemmonii* (71140, 41200): This blue oak savanna has an open canopy (5 percent cover) dominated by blue oak ca. 50 ft (15 m) tall and 100 years old with some Oregon white oak *(Quercus garryana)* interspersed. Basal cover averages ca. 9.2 m^2/ha. No shrubs occur and the herb layer (100 percent cover) is dominated by a mixture of native and introduced species including *Stipa lemmonii, Aira caryophyllea, Avena barbata, Bromus mollis, B. rubens, Melica hartfordii, Vulpia (Festuca) microstachys* var. *ciliata, V. myuros* var. *hirsuta, Eriogonum nudum, Delphinium hesperium, Torilis arvensis, Thysanocarpus curvipes, Trifolium albopurpureum,* and *T. ciliolatum.*

• Canyon Live Oak/*Sedum* sp. (81320): This forest occurs on the poorest sites (steep, rocky slopes). Canopy height averages 60 ft. (18 m) and is dominated by multiple-trunked canyon live oak. California buckeye *(Aesculus californica)* and a few California bay *(Umbellularia californica)* are also present. Reproduction of canyon live oak is occasional. Shrub and herb layers are variable (10-90 percent) depending on canopy openness and slope characteristics. Shrubs range from 5 to 30 ft (1.5-9.1 m) tall and include *Toxicodendron diversilobum, Cercocarpus betuloides,* and shrubby California black walnut. Herbs include *Sedum* sp., *Galium bolanderi, Dichelostemma (Brodiaea) volubilis,* and in some areas with better soil development, grasses similar to those of the blue oak savanna.

• *Quercus dumosa/California* buckeye (37900, 71420): This brushy woodland type has a very low canopy cover (<5 percent). Canopy species include sparse Digger pine *(Pinus sabiniana)* up to 50 ft (15 m) with occasional black oak and canyon live oak. Shrubby trees of the two canopy oaks and of California buckeye are fairly common. Shrubs are dense (90 percent cover) and dominated by *Quercus dumosa,* along with *Cercocarpus betuloides, Toxicodendron diversilobum, Rhus trilobata, Adenostoma fasciculatum, Ceanothus integerrimus,* and *Heteromeles arbutifolia.* Herbs are generally low in cover and include *Festuca californica, Trientalis latifolia,* and *Dichelostemma volubilis.*

Plant Diversity

One hundred forty-five species are listed.

Conflicting Impacts

Controlled burning may be necessary to maintain black oak stands on better sites where succession may lead to conifer dominance. The area is within the Thomes Creek roadless area, and little human impact is apparent.

35. DOLL BASIN (Keeler-Wolf 1986c, 1988b)

Location

This soon-to-be-established RNA is on the Mendocino National Forest. It is ca. 17 miles (27 km) NE. of Covelo, occurring in portions of sects. 25, 26, 35, and 36 T24N, R10E MDBM (39° 54' N,122° 30'W) USGS Buck Rock quad *(fig. 75).*

Target Elements

Mixed conifer forest

Distinctive Features

• Mixed Conifer Forest: Doll Basin was selected for its excellent representation of Sierran mixed coniferous forest.

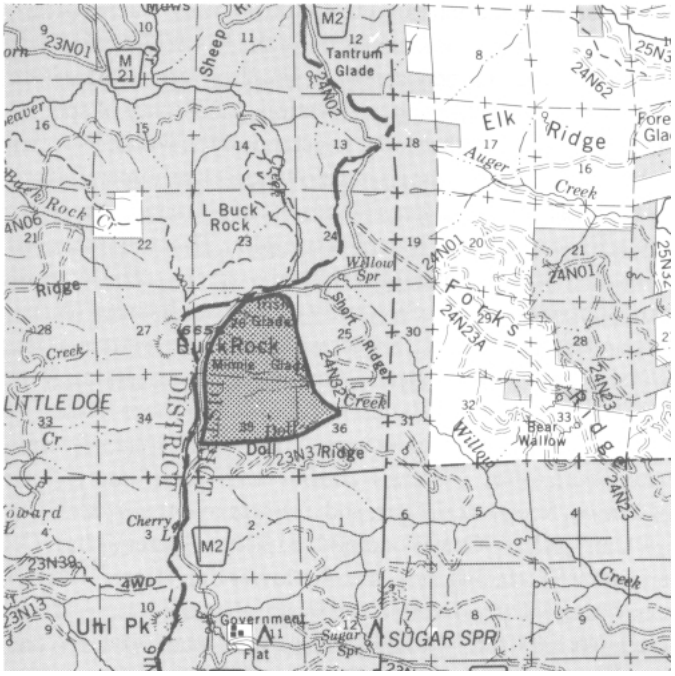


Figure 75--The Doll Basin RNA.

This forest is extensive and economically important in California. This and # 38 are the only two RNA's in the North Coast Ranges having this vegetation. The Doll Basin mixed coniferous forest is similar to many areas of this vegetation type throughout N. California, and exhibits the standard distribution of dominants and subdominants over such an elevational gradient. Its relatively pristine nature is indicated by typically uneven-aged stands, not overly crowded with recent saplings.

• Undisturbed Habitat for Large Vertebrates: Although the Doll Basin RNA is a relatively small island of unaltered habitat surrounded by selectively logged and clear-cut forests, it retains its complement of large montane animals (at least for the present). Sensitive species such as spotted owl *(Strix occidentalis)* and goshawk *(Accipiter gentilis)* have been sighted within the area as has the federally endangered peregrine falcon *(Falco peregrinus).* Many other large vertebrates such as black bear *(Ursus americanus),* blue grouse *(Dendragapus obscurrus),* black-tailed deer *(Odocoileus hemionus columbianus),* and pileated woodpecker *(Dryocopus piliatus)* have been seen in the area. These include eight of the 12 species listed in the Mendocino National Forest's management plan (1987) as management indicator species.

• Archaeological Value: Two of the meadows in the white fir zone, Minnie and Irish Glades, are significant archaeological sites. These sites are important, particularly as windows on past climate. Because of continuous use of these and nearby sites for more than 8000 years, a good record of vegetational change (indicated by differing types of artifacts) may occur. No thorough excavation of these sites has been made. However, midden deposits to a depth of ca. 3.5 ft (1 m) have been unearthed by stream erosion.

• Transition Forests: With an elevational span of over 2000 ft (610 m) the transition between the mixed conifer and Douglas-fir *(Pseudotsuga menziesii)*-dominated forest at lower elevations and white fir *(Abies concolor)* -dominated forest at higher elevations is well-marked. This is important in the understanding of the mixed conifer type in relation to adjacent forest types and also affords research possibilities in the additional adjacent forest types.

• Rare Plants: *Penstemon purpusii* is a CNPS List 4 species known from the area.

Physical Characteristics

The area covers 821 acres (333 ha) on the east side of the Inner North Coast Range crest. Elevations range from 4100 to 6200 ft (1250-1890 m). Topography is relatively rugged. The area is dissected by six small drainageways which converge into Doll Creek on the eastern side of the RNA. All slopes are moderately to very steep (30-60°).

Rocks are all of the Franciscan Assemblage with two- to three-rock units within the area. These are the Hellhole Graywacke Faces, the Williams Chaos Faces, and possibly the Taliaferro Metamorphic Complex. All are Upper Jurassic in age. Soils are divided into two major units, the Sheetiron and the Yolla Bolly series. Sheetiron soils, derived from graywacke and metasediments, are the most extensive. Precipitation is estimated between 45 inches (1143 mm) at the lowest eastern portion of the area and 65 inches (1651 mm) near the summit area along the western boundary. Temperatures are relatively mild with average estimated January lows between 15 and 26 °F (-9.4 to -3.3 °C) and average July highs between 80 and 87 °F (26.6-30.5 °C), depending on elevation.

Association Types

Thirty 100-m^2 plots are sampled in the area.

• The Sierran Mixed Conifer Forest (84230): 402 acres (163 ha). In this zone all five major coniferous species (Douglas-fir *[Pseudotsuga menziesii],* ponderosa pine *[Pinus ponderosa],* sugar pine *[P. lambertiana],* white fir [*Abies concolor],* and incense-cedar *[Calocedrus decurrens]*), may dominate individual stands. Of the eleven 100-m^2 plots sampled in this zone, the most important species are in order: white fir, incense-cedar, ponderosa pine, Douglas-fir, sugar pine, and California black oak *[Quercus kelloggii]*. Tree density is 1420/ha and basal area cover 160 m^2/ha. Many mature dominants approach 200 ft (61 m) tall and 5-6 ft (1.5-1.8 m) dbh. The relatively young and small white firs are responsible for the largest percentage of the stems (40 percent).

Fire history of Doll Basin mixed conifer forest has changed dramatically in the past 80 years. Analyses of cut stems adjacent to the RNA indicate fire frequencies before 1900 of between 9 and 53 years (mean 14.5, n=24). Saplings and seedlings are mostly white fir, but other major species are well-represented and indicate that under present conditions (despite the reduction of fire frequency), the mixed nature of the species composition should continue. Densities of saplings are highest on the southeast slopes where occasional over-dense thickets are encountered. However, much of the NE.-facing slope understories are relatively open. Shrubs and herbs are poorly represented with *Symphoricarpos acutus, Galium ambiguum,* and *Hieracium*

albiflorum the only species occurring on more than 5 percent of the plots. On southerly exposures ponderosa pine and California black oak increase relative to other tree species and in such situations the large tufted bunchgrass *Festuca californica* may cover up to 50 percent of the ground.

• White Fir Forest (84240, 85310): 271 acres (110 ha). At elevations over ca. 5800 ft (1768 m) on E.-facing slopes and ca. 5600 ft (1707 m) on N.-facing slopes tree diversity decreases with ponderosa pine, California black oak, and Douglas-fir becoming uniformly scarce and incense-cedar becoming more localized along drainage channels. On eight 100-m^2 plots white fir is the uniform dominant of the tree (relative cover 72 percent, basal area cover 92 m^2/ha, importance value 222.5) and reproduction (combined sapling and seedling density 780/ha, frequency 88 percent, relative density 62 percent, relative frequency 64 percent) layers. Age and size of the white firs are generally small and young (80-100 yr, 45-65 ft [14-20 m] tall). This is a result of a major crown fire ca. 100 years ago. Shasta red fir *(Abies magnifica* var. *shastensis)* occurs on sheltered N.-facing slopes at the higher elevations (approaching Holland 85310). Occasional surviving patches of more mature forest with trees up to 4 ft (1.2 m) dbh and 160 ft (49 m) tall occur on steeper slopes and ridges. Total tree density is 1040/ha and total basal area 128 m^2/ha. Understory vegetation is very sparse because of shade and duff accumulation.

• Douglas-fir Canyon Bottom Forest (84110): 123 acres (50 ha). This forest occurs in the lower reaches of the RNA on relatively mesic northerly-facing slopes. It is dominated by Douglas-fir (70 percent relative cover, basal area cover of 167 m^2/ha, and importance value of 122 on ten 100 m^2 plots). White fir, sugar pine, ponderosa pine, Pacific dogwood *(Cornus nuttallii),* canyon live oak *(Quercus chrysolepis),* incense-cedar, and big-leaf maple *(Acer macrophyllum)* also occur in this type. Total basal area cover for trees is very high (241 m^2/ha) and total stem density is 1200/ha. Douglas-fir is consistently the largest tree, up to 6.5 ft (2 m) dbh and 200 ft (61 m) tall. White fir dominates the sapling and seedling layers, but in general, does not form an overcrowded understory. Understory herbs and shrubs form a sparse cover (10-15 percent). Although 29 taxa of understory species are noted on the sample plots, only four species *(Symphoricarpos acutus, Rosa gymnocarpa, Hieracium albiflorum,* and *Chimaphila menziesii)* occur on 50 percent or more of the plots. Ground fire has played a regular role in this forest with most of the mature trees fire-scarred.

• Stream Riparian (61510): 9 acres (4 ha). This association is scattered along the main branches of Doll Creek below ca. 4600 ft (1402 m) elevation. It is a simple community dominated by white alder *(Alnus rhombifolia)* with very few other indicator species, save occasional individuals of *Salix scouleriana* and *Epilobium adenocaulon* var. *holosericeum.* This type is best developed along the branch of Doll Creek forming the eastern boundary. This stream has a relatively sunny southerly exposure and is characterized in summer by intermittently flowing water and pools interspersed with large outcrops, log jams, and dry cobble beds. The south branch of Doll Creek is a shadier stream in a narrow gulch with low cover of alder and higher cover of such species as big-leaf maple and *Aralia californica.*

• Meadow-Riparian (45100, 45400, 63500): 9 acres (4 ha). This is the major hydric association in the RNA. The meadow portion is well-developed at several small springy areas within the white fir zone of the upper elevations. Diversity of species is higher than at any other local vegetation type with 23 species listed as typical for the moist meadow border subtype. Inward from the meadow fringe areas lies a zone of permanent moisture where soil is dark and organically rich. Thirty herbaceous species are listed as typical for the wet subtype. The riparian thicket subtype is relatively poorly developed locally. A few patches of *Alnus tenuifolia, Salix caudata* var. *bryantiana* and S. *ligulifolia* are widely scattered along the rivulets issuing from the springy meadows. A larger area bordering these rivulets is dominated by herbaceous species such as *Athyrium felix-femina, Carex amplifolia, Circaea alpina* var. *pacifica, Lilium pardalinum, Scirpus criniger,* and *Senecio triangularis.*

• Canyon Live Oak Woodland (81320): 7 acres (3 ha). On steep rocky SE.-facing slopes at the lower elevations, canyon live oak may locally dominate without a coniferous overstory. These areas are usually no larger than 1-2 acres (0.5-1 ha) and have a low species diversity. Douglas-fir and ponderosa pine occur as scattered individuals, and the shrub layer is represented by patches of *Arctostaphylos canescens* and *A. patula.* Few herbs are present.

• Douglas-fir/Pine/Oak Woodland (84110): 7 acres (3 ha). This is the less steeply-sloped analog to the canyon live oak woodland. In the establishment record this type is included within the southerly-facing phase of the Sierran mixed coniferous forest. It is characterized by an open canopy of Douglas-fir, sugar pine and ponderosa pine over a denser subcanopy of canyon live oak and California black oak. The understory is sparse with occasional patches of *Arctostaphylos canescens, A. patula,* and *Ceanothus integerrimus.* Tree regeneration is patchy and contains some overly dense thickets of conifer saplings.

• Incense-Cedar Gully Forest (no Holland equivalent): 5 acres (2 ha). This minor association occurs along rills and gullies and around the edges of meadows at the upper elevations of the RNA, largely within the white fir zone. It is dominated by incense-cedar up to 5 ft (1.5 m) dbh and 145 ft (44 m) tall, with scattered sugar pine and white fir. Incense-cedar may dominate here because of its tolerance of the high water table and because of the protection against crown fires offered by the mesic semi-riparian or meadowside locations.

• Gravelly Openings (no Holland equivalent): 5 acres (2 ha). Small open areas between stands of white fir occur on relatively steep east- and southeast-facing exposures throughout the upper elevations of the study area. These are on Yolla Bolly rocky loam and are covered sparsely by *Lomatium ciliolatum, Haplopappus greenei, Crepis monticola, Stipa columbiana, Calyptridium umbellatum, Penstemon purpusii, Chrysothamnus nausiosus* var. *albicaulis, Eriogonum nudum, E. spergulinum* var. *reddingianum, Sitanion hystrix, Arabis platysperma,* and *Monardella odoratissima* ssp. *pallida.* Some openings have small clumps of Brewer oak *(Quercus garryana* var. *breweri)* and maybe considered shin oak brush (Holland 37541). Successionally these openings are enigmatic, some appearing very stable while others are being slowly colonized by white fir.

Plant Diversity

One hundred ninety taxa are listed.

Conflicting Impacts

Cattle grazing has heavy impact on some of the meadows, particularly Irish Glade. Portions of Irish Glade are eroding at unnaturally fast rates. The patches of dense conifer reproduction in the mixed conifer and Douglas-fir-dominated forests may require prescription bums. There may be some increased gullying within the area as a result of the construction (ca. 1975) of road 24N02 up-slope from the western boundary.

36. FRENZEL CREEK (Keeler-Wolf 1983)

Location

This established RNA is on the Mendocino National Forest. The northern end of the area (39°127' N., 122°32'W.) lies six miles (10 km) SSW. of the town of Stonyford, Colusa County. It includes portions of sects. 31 and 32 T17N, R6W and sects. 5 and 6 T16N, R6W MDBM, USGS Gilmore Peak quad *(fig.* 76).

Target Elements

Serpentine chaparral, Sargent cypress *(Cupressus sargentii),* and MacNab cypress *(Cupressus macnabiana).*

Distinctive Features

• Distribution and Regeneration of Sargent and MacNab Cypress: These are the only two sympatric species of cypress in California. MacNab cypress is an interior, xerophilic cypress, occurring on ridgetops, never overlapping with Sargent cypress in the drainage. Sargent cypress is a mesophilic coastal type cypress near its most inland distribution here *(fig. 77).* Hybridization was not seen in RNA, and is rare elsewhere (Griffin and Critchfield 1976). Sargent is apparently less fire-dependent than MacNab, regularly reseeding in riparian areas of drainage, without fire. MacNab cypress rarely reseeds without fire. Sargent cypress is relatively shade-tolerant in the seedling stage.

• Numbers and Types of Serpentinite Endemics: About 36 taxa in the RNA are generally considered serpentinite endemics or indicators (Kruckeberg 1984). Most are herbaceous neo-endemics; five are likely to be paleoendemics (Raven and Axelrod 1978).

• Rare Flora: Eight taxa found in the drainage are listed by CNPS, including; *Astragalus clevelandii* (List *4), Antirrhinum subcordatum* (List 1b), *Hersperolinum drymarioides* (List 1b), *Mimulus brachiatus* (List 3), *Mimulus glaucescens* (List 4), *Nemacladus montanus (appendix 1), Senecio clevelandii* (List 4), and *Streptanthus morrisonii* (List 1b).

• New and Undetermined Taxa: Two plant taxa, *Castilleja miniata* ssp. nov. and *Allium cratericola* ssp. nov., have been collected in the RNA. The *Castilleja* was collected for the first time during the field work for the RNA ecological survey. It is a serpentine riparian species locally common at Frenzel Creek

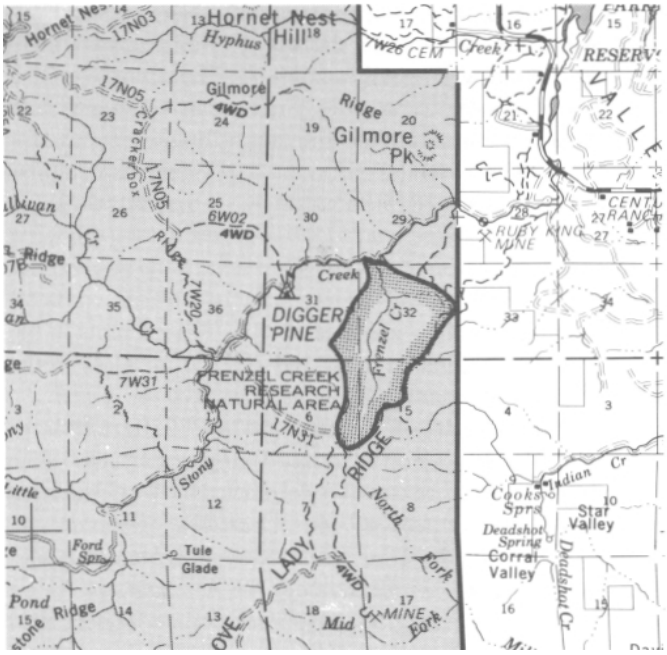


Figure 76--The Frenzel Creek RNA.

and along portions of Little Stony Creek. It was also seen at Cook's Springs ca. 2 miles (3 km) E. of the RNA. L. Heckard of the Jepson Herbarium (see ecological survey) believes this is a distinctive subspecies of the widespread *C. miniata* complex. The *Allium* occurs on serpentinite barrens and has previously been collected in the Inner North Coast Ranges by Dale McNeal and his students at University of the Pacific, but is still undescribed.

Physical Characteristics

The area covers 830 acres (336 ha). Elevations range from 1390 to 3090 ft (424-942 m). The entire drainage of Frenzel Creek, a small northward flowing, permanent tributary of Little

Figure 77--Frenzel Creek: Sargent Cypress riparian grove along upper Frenzel Creek, surrounded by highly serpentinized slopes (D. Cheatham).

Stony Creek, is included. Slopes are predominantly E.- and W.-facing, and steep, except for the majority *of* the two main ridgetops. Rocks are primarily serpentinized peridotite, with a small area of Lower Cretaceous Franciscan sediments and metasediments at the head *of* the drainage. Climate is typical for this elevation in N.-central California. Annual mean precipitation is ca. 32-38 inches (813-965 mm); more than 90 percent is rain.

Association Types

Vegetation sampling consists of five 100-m^2 plots in the Sargent cypress-dominated area, and six 100-m^2 plots in the MacNab cypress stands.

• Serpentinite Chaparral (37600,71321,83220): 580 acres (235 ha). Two subtypes divided into four phases occur. The mixed subtype (a) is most extensive, dominated by *Arctostaphylos viscida* and *Quercus durata,* with *Ceanothus jepsonii* var. *albiflorus, Garrya congdoni, Heteromeles arbutifolia,* and *Eriodictyon californicum.* It includes the *A. viscida* phase on most xeric exposures; the *Q. durata* phase dominates on E., NE., and NW. exposures. Digger pine *(Pinus sabiniana)* forms a very open canopy in some places. Thirty-five species of herbs are listed as typical for this subtype including the serpentine endemics: *Allium falcifolium, Clarkia gracilis* ssp. *albicaulis, Claytonia gypsophylloides, Calystegia subacaulis, Nemacladus montanus, Senecio greenei, Silene campanulata* ssp. *glandulosa,* and Streptanthus breweri.

Subtype (b) is dominated by MacNab Cypress (51 acres, 21 ha). Two phases occur: exposed and sheltered. The exposed phase on ridgetops is most extensive with subdominant serpentine chaparral shrubs and relatively high cover of *Adenostoma fasciculatum.* Stands are of uniform height (3-4 m) and age (most 60-80 years). Herbs are similar to mixed serpentinite chaparral. The sheltered phase is restricted to N. slopes and heads of ravines. MacNab Cypress is more often a tree up to 7 m and 64 cm dbh. Density of woody plant stems varies from 2400 to 9600/ha. Basal area of MacNab cypress ranges from 2.7 m^2/ha on the 1950 bum to 86 m^2/ha on the sheltered phase.

• Serpentinite Barrens (no Holland equivalent): 81 acres (33 ha). Vegetation is very sparse and herb-dominated. Species include *Streptanthus morrisonii, S. breweri, Allium cratericola* ssp. nov., *Asclepias cordifolia, A. solanoana, Eriogonum vimineum, E. nudum, E. dasycarpum,* and *E. ursinum* var. *nervulosum*.

• Non-serpentinite Chaparral (37110, 37E00): 66 acres (27 ha). Two subtypes (mesic and xeric) occur. The mesic subtype occurs on NE.-facing slopes and is dominated by tall shrubs of *Cercocarpus betuloides, Ceanothus cuneatus, Quercus wislizenii* var. *fructescens,* and *Heteromeles arbutifolia.* Herbs are often dense including 20 typical species, the majority of which are not present on serpentinite chaparral.

The xeric subtype occurs on ridgetops and is dominated by thick stands of *Adenostoma fasciculatum* and *Ceanothus cuneatus* with lesser numbers of *Arctostaphylos manzanita, A. glandulosa, A. canescens, Quercus wislizenii* var. *fructescens, Q. durata, Q.* x *morehus, Heteromeles arbutifolia, Cercocarpus betuloides, Ribes malvaceum,* and *Haplopappus linearifolius.* Herbs and grasses are few with annual *Bromus* dominant.

• Serpentinite Riparian and Valley Bottom (83220 in part): 57 acres (23 ha). This is the most hydrophilic vegetation in the RNA. It is subdivided into three types: strict riparian (permanent water), mesic valley bottom (moist and shady, but not year-round water), and rivulet herbaceous association (along intermittent, sunny streams). Characteristic woody species of the strict riparian type include *Rhododendron occidentale, Salix breweri, Calycanthus occidentalis,* Sargent cypress, and *Rhamnus californica* ssp. *crassifolia.* Understory species include: *Aquilegia exima, Achillea millefolium, Lilium pardalinum, Stachys albens, Epipactis gigantea, Castilleja miniata* ssp. nov., *Carex serratodens, Scirpus americanus, Senecio clevelandii, Heleocharis* sp., *Helenium bolanderi, Angelica tomentosa,* and *Juncus mexicanus.*

The mesic valley bottom type is dominated by Sargent cypress and California bay *(Umbellularia californica)* (often mutually exclusive). Other woody species include: *Ceanothus integerrimus* var. *californicus, Rhamnus californicus* ssp. *crassifolius, Toxicodendron diversilobum,* and *Cercis occidentalis.* Many species of herbs are shared with adjacent serpentinite chaparral. Tree densities range from 700 to 6200/ha. Seedling densities (all Sargent cypress) range from 100 to 600/ha. Basal area ranges from 6.5 to 72.3 m^2/ha. Mean dbh's range from 3.5 to 31.0 cm.

The rivulet herbaceous association type species include *Mimulus brachiatus, Centaurium* sp., *Mimulus bicolor, M. glabrescens, Epilobium minutum,* and *Gayophytum* sp. Shading restricts growth of the characteristic herbs.

• Pine-oak Woodland (71322, 83210): 36 acres (15 ha). This association occurs on N., NE., and NW.-facing slopes at the head *of* the drainage, off serpentinite. Canyon live oak *(Quercus chrysolepis)* is dominant with knobcone pine *(Pinus attenuata),* Digger pine *(Pinus sabiniana), Cercocarpus betuloides, Heteromeles arbutifolia, Arctostaphylos manzanita, A. canescens, Toxicodendron diversilobum, Berberis dictyota, Lotus crassifolius, Cynoglossum grande, Symphoricarpos acutus, Ribes californicum, Dodecatheon hendersonii, Sanicula crassicaulis,* and *Keckiella lemmonii.*

• Non-serpentinite Riparian (no Holland equivalent): 3 acres (1 ha). This association is restricted to a small area of Frenzel Creek on Franciscan rocks. Species include California bay (dominant), Fremont cottonwood *(Populus fremontii), Salix laevigata, Sambucus mexicana, Vitis californica, Rubus ursinus, Rhus trilobata, Clematis ligusticifolia, Potentilla glandulosa, Cystopteris fragilis, Adiantum jordanii, Perideridia kelloggii, Lotus* sp., and *Datisca glomerata.*

Plant Diversity

One hundred eighty species are listed.

Conflicting Impacts

ORV use adjacent to RNA may have light impact on upper drainage. Fire suppression practices may necessitate controlled burning to maintain MacNab Cypress stands in the future.

37. HALE RIDGE (Keeler-Wolf 1987e)

Location

This candidate RNA is on the Mendocino National Forest ca. 10 miles (16 km) NE. of Upper Lake. It lies within portions of sects. 30, 31, and 32 T17N, R8W; sect. 36 of T 17N, R9W; and sects. 5 and 6 of T16N, R8W MDBM (39°15'N., 122°48'W.) USGS Potato Hill quad *(fig. 78).*

Target Element

Knobcone pine *(Pinus attenuata)*

Distinctive Features

• Knobcone Pine Woodland: This is the only surveyed candidate RNA currently selected to represent this most widespread of the closed-cone vegetation types. The local Lake County stands are among the best developed in the species' range, and the most extensive off ultramafic soils. The ecology of this species remains relatively unknown particularly in the realm of vegetation ecology and soil/parent material relationships. Questions regarding effectiveness of post-fire reseeding, wind-dispersal effectiveness onto non-burned areas, and growth rates on differing exposures could be answered here in conjunction with a program of prescribed burning. The presence of large areas of adjacent and intermixed chaparral and Douglas-fir *(Pseudotsuga menziesii)-dominated* vegetation provides a typical context in which to view the successional patterns of the knobcone pine woodland *(fig. 79).*

• Serpentinite Indicator Species not on Serpentinite: Certain species such as the leather oak *(Quercus durata),* commonly considered as being highly restricted to serpentine soils (Kruckeberg 1984), are locally common in the proposed RNA where no serpentine soil occurs. In addition, a number of other species considered by Kruckeberg as local or regional indicators of serpentine soils such as *Arctostaphylos stanfordiana, A. glandulosa, Castilleja foliolosa, Chaenactis glabriscula, Eriophyllum lanatum, Galium ambiguum, Phacelia imbricata,* and knobcone pine also occur in the study area. Perhaps the generally poor, infertile soils of Franciscan graywacke form less competitive environments than typical non-serpentine soils for these species, thus allowing them to occur here.

Physical Characteristics

The area covers 865 acres (350 ha). Hale Ridge is a west-trending spur of Goat Mountain. The ridge is relatively steep-sloped, but generally flat-topped. The Rice Fork of the Eel River and Salt Creek delimit the boundaries on the N., S., and W. Slope exposures are varied, but predominantly N.- and S.-facing. Elevations range from 2400-3600 ft (732-1097 m). Rocks are all Franciscan Assemblage, dominated by graywacke sandstone with some shale. Soils are generally shallow and infertile and include the Boomer-Hoda-Speaker, the Maymen-Etsel-Speaker, and the Speaker-Maymen-Marpa associations. Mean annual precipitation is estimated at between 45 and 55 inches (1143-1397 mm). July maximum temperatures are ca. 102-106 °F (39-41 °C) and January minima, ca. 22 °F (-6 °C).

Association Types

Ten 10 by 10 m plots are sampled in knobcone pine forest and six 10 by 10 m plots are sampled in the Douglas-fir dominated forest.

• Knobcone Pine Woodland (83210): 350 acres (142 ha). This association may be divided into high, moderate, and low density phases. All are a result of a fire which swept through the area in 1932. Basal area cover varies depending on density of the trees from 18 m^2/ha on high density plots to 47 m^2/ha on low density plots.

High density stands (2500-3500 knobcone pine/ha) have a NW. NE. aspect, have low cover (trees average ca. 3 inches [8 cm] dbh), sparse shrub understory, and virtually no herbs.

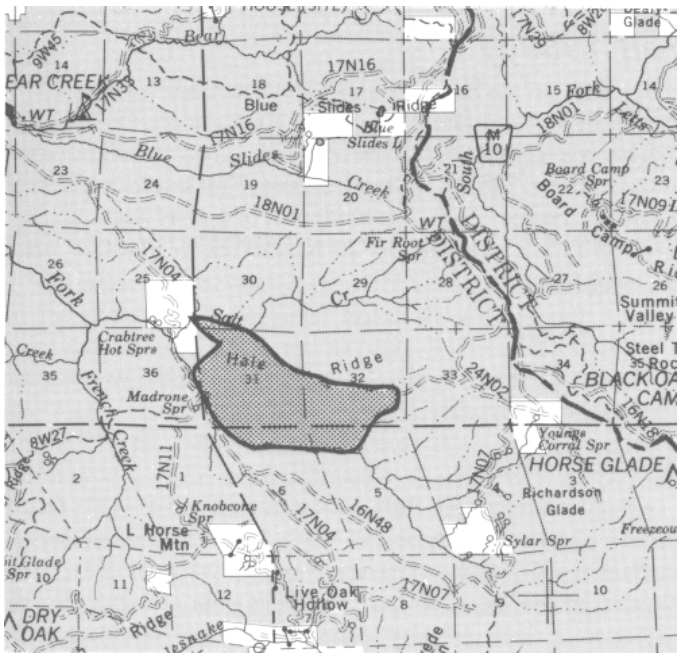


Figure 78--The Hale Ridge study area.

Figure 79--Hale Ridge: View south from the eastern edge of the RNA across mixed chaparral and open phase of knobcone pine woodland.

Arctostaphylos canescens and interior live oak *(Quercus wislizenii)* are the dominant shrubs. Occasional canyon live oak and Douglas-fir saplings suggest future dominance by these species.

The moderately dense phase occurs on WNW.- to SW.-facing slopes and averages 1600 knobcone pine/ha. The understory is well-developed, dominated by *Arctostaphylos glandulosa* and interior live oak *(Quercus wislizenii). Toxicodendron diversilobum, Ceanothus lemmonii,* and *Adenostoma fasciculatum* are also characteristic. Total understory cover ranges between 25 and 80 percent. Successional stage varies from site to site. Douglas-fir forest may colonize the most mesic sites, but in general, the poor soil and xeric exposures are conducive to chaparral dominance.

The open phase, primarily on southerly exposures, is characterized by low density knobcone pine (800-1300/ha). These trees are the largest-boled individuals in the area ranging up to 13 inches (33 cm) dbh, although their heights (ca. 13-16 m) are only 2-3 m taller than average trees in denser types. A relatively dense shrub layer dominated by xerophilic species such as *Adenostoma fasciculatum, Arctostaphylos glandulosa, Pickeringia montana,* and *Quercus wislizenii* var. *fructescens* covers ca. 35-65 percent of the surface.

Portions of the open phase have burned in several small controlled bums in recent years. Typical regenerating species do not include knobcone pine, but *Adenostoma fasciculatum, Arctostaphylos glandulosa,* interior live oak, *Haplopappus linearifolius, Ceanothus lemmonii, Eriodictyon californicum,* and *Rhus trilobata.* Early successional herbs not otherwise noted in the type such as *Hypericum concinnum, Gilia capitata, Lotus humistratus, Clarkia rhomboidea, Cirsium vulgare, Wyethia angustifolia,* and *Mentzelia dispersa* add to the cover provided by the resprouting and seedling shrubs for a total of ca. 65 percent.

• Douglas-fir-dominated forest (84110): 320 acres (130 ha). This type is dominated by Douglas-fir with a subcanopy of scattered canyon live oak *(Quercus chrysolepis).* Substantially less important are sugar pine *(Pinus lambertiana),* incense-cedar *(Calocedrus decurrens),* knobcone pine, Pacific madrone *(Arbutus menziesii),* and ponderosa pine *(Pinus ponderosa).* Total tree density is 1410/ha and total cover is 112 m^2/ha. Dominant trees are 3-4 ft (0.9-1.2 m) dbh and ca. 250-350 yr old. Saplings and seedlings average ca. 980/ha with canyon live oak most important, followed by Douglas-fir, sugar pine and madrone. Cover of herbs and shrubs is low (averaging 4 percent) with no clearly dominant species (8 shrub and 12 herb and grass species recorded). This forest occurs primarily on N.-facing slopes, but may also occur in slightly different form in sheltered southerly aspect ravines.

• Chaparral (37110, 37200, 37530, 37E00): 165 acres (67 ha). The chaparral may be divided into three phases including mixed, chamise, and mechanically-disturbed successional. The mixed phase is most extensive. It varies from 60-100 percent cover of such species as *Arctostaphylos glandulosa, A. canescens, A. stanfordiana, Adenostoma fasciculatum, Ceanothus cuneatus, Pickeringia montana, Quercus durata, Q. wislizenii* var. *fructescens, Lonicera interrupta, Cercocarpus betuloides,* and *Garrya fremontii.* Herbs are rare. A few young Digger pine *(Pinus sabiniana)* occur. This phase has the greatest potential for longevity and productivity with the lowest fire frequency. It typically occupies relatively mesic sites on SW., SE. and even locally N.-facing slopes.

Chamise chaparral is most xerophilic of the three types. It occupies driest S.-facing slopes with shallow, rocky soils. It has low species diversity with *Adenostema fasciculatum* composing 65-100 percent of the woody cover, with only occasional shrubs of *Arctostaphylos glandulosa, Ceanothus cuneatus* or *Pickeringia montana.* Herbs are rare, except on portions that were recently control-burned, where they are similar to the previously described knobcone pine burns. Areas with annual grass-dominated openings between shrubs are senescent.

The mechanically disturbed chaparral occupies the periodically cleared fire trail through the area. On most sites *Ceanothus integerrimus, C. cuneatus,* and C. *lemmonii* dominate along with *Pickeringia* and *Adenostoma.* This type is the tallest form of chaparral, reaching 15-20 ft (4.6-6.1 m). Successional trends vary depending on slope exposure; mesic northerly facing slopes are invaded by Douglas-fir and young knobcone pine, whereas on SW. slopes chaparral species from surrounding mixed types are the only species in evidence.

Plant Diversity

One hundred four taxa are listed.

Conflicting Impacts

Because the knobcone pine woodland is fire-dependent, the vegetation is likely to require management through controlled burning. Impacts include light ORV use along the existing fuel break through the center of the proposed RNA and erosion (gullying) on the steeper portions of the fuel break.

38. RUTH (Thornburgh 1981, Keeler-Wolf 1989g)

Location

This soon-to-be-established RNA is on the Six Rivers National Forest, Trinity County. It is ca. 3 miles (5 km) SW. of the town of Forest Glen. It includes all or part of sects. 27, 34, 35, and 36T1S, R7EHBM (40°20'N., 123°22' W.) USGS Forest Glen quad *(fig. 80).*

Target Element

Pacific ponderosa pine-Douglas-fir *(Pinus ponderosa-Pseudotsuga menziesii)*

Distinctive Features

• Pacific Ponderosa Pine-Douglas-fir Forest: This forest type described as SAF type 244 (Eyre 1980) is not well represented in the California RNA system (see #'s 35, 37). The definition of this type, where ponderosa pine and Douglas-fir together comprise a majority of the stocking and where white fir *(Abies concolor) is* only a minor associate, is well met in the 166 acres (67 ha) of the Douglas-fir-ponderosa pine phase of the

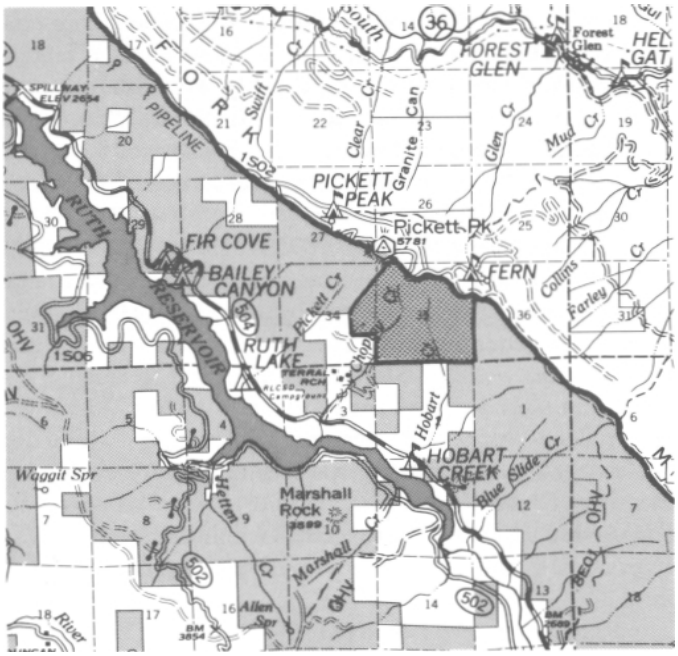


Figure 80--The Ruth RNA.

mixed conifer forest.

• Other Related Vegetation Types: Adjacent to the ponderosa pine-Douglas-fir forest are related coniferous forests. In the fir-pine-Douglas-fir phase of mixed conifer forest, most young trees are white fir and thus, could be considered mixed conifer forest (Holland type 84230). The lower elevation mixed evergreen type contains a small amount of ponderosa pine and is similar to the ponderosa pine phase of the mixed evergreen forest described in Sawyer and others (1977). The oak-conifer woodland and the montane chaparral associations are successional series and represent various seral conditions within the general realm of the target element, thus indicating typical successional directions after fire or prolonged slope disturbance.

Together the relatively large size and elevational span of the area include a wide variety of association types typical of xeric exposures in the inner North Coast Ranges and adjacent southern Klamath Mountains Province.

Physical Characteristics

This soon-to-be-established RNA covers 630 acres (255 ha) on the SW.-facing slopes of South Fork Mountain (original surveyed area is 1339 acres, 542 ha). Elevations in the survey range from 2800 ft near the Mad River to 5760 ft (853-1756 m) atop Pickett Peak (final boundary elevations are 3920-5760 ft, 1195-1756 m). Small streams have dissected the relatively uniform slope into several draws with steep W.- and S.-facing slopes. The area has some unstable slopes with evidence of recent movement.

The S. Fork Mountain Fault crosses the area at ca. 4000 ft (1219 m) elevation. Most of the area is above this fault, where moderate slopes (5-50 percent) and benches prevail. Below the faultline slopes are steeper (70-100 percent). Rocks NE. of the fault are S. Fork Mountain Schist. Rocks SW. of the fault are Franciscan Assemblage graywacke. However, only a few areas have outcrops. Soils include Bins-Nanny-Woodseye families, Skalan-Kistirn-Holland families, and Albus-Race families. Climate is typical for the inner North Coast Ranges with average annual precipitation estimated at 70 inches (1778 mm), most falling from November to March. For the mid- elevations the January mean minimum temperature is 32 °F (0 °C), and the July mean maximum is 90 °F (32 °C).

Association Types

Thirty-six releves are sampled, and the information is arranged in an association table. Several additional 100 by 50 ft (465 m^2) plots are sampled for density and basal area of trees.

• Mixed Conifer Forest (84110, 84230, 84240): 500 acres (202 ha). This association has been divided into three phases: Douglas-fir-ponderosa pine (target, 84110), white fir (84240), and fir-pine-Douglas-fir (84230).

The Douglas-fir-ponderosa pine phase (ca. 166 acres, 67 ha) is similar to Pacific ponderosa pine-Douglas-fir (SAF type 244), the target element for the area. It occurs between 4000 and 4800 ft (1219-1463 m) elevation on SW.- to SE.-facing slopes. It is the most xeric of the three phases. The forest is dominated by scattered large Douglas-fir and ponderosa pine over dense young understory Douglas-fir and ponderosa pine. Diameter of the typical dominants ranges from 50-60 inches (1.27-1.52 m) with occasional large specimens up to 85 inches (2.2 m) dbh. Understory trees are typically ca. 14 inches (36 cm) dbh (range 6-34 inches or 15-86 cm). These trees resulted from a fire 80-90 years before the survey. Variation in proportion of Douglas-fir to pine is high. Incense-cedar, sugar pine, canyon live oak, and California black oak also occur as young understory individuals. Average basal area is 88 m^2/ha (range 71-106). Site index for Douglas-fir is 140 ft (43 m) for 100 years and for ponderosa pine 128 ft (39 m) for 100 years.

The understory is very sparse with a few scattered saplings of canyon live oak and *Toxicodendron diversilobum* and a very sparse representation of such herbs as *Pteridium aquilinum* and *Hieracium albiflorum*.

The fir-pine-Douglas-fir phase represents the true mixed phase of the mixed conifer forest with white fir, ponderosa pine, and Douglas-fir in an all-aged stand (280 acres, 113 ha). This phase occurs between 4400 and 5200 ft (1341-1585 m). Topography is moderate with large areas of level benches and slight SW.-facing slopes. Stand structure is quite varied, and either white fir, sugar pine, ponderosa pine, incense-cedar, or Douglas-fir may dominate. White fir has the highest densities in the younger age classes, ponderosa pine dominates the larger size classes with Douglas-fir as the second dominant species *(fig. 81)*. Incense-cedar is scattered as individuals and small groves. Sugar pine is the least common tree, occurring typically as widely scattered giants. Average basal area for this type is 138 m^2/ha (range 61-235) with 100 year site index for Douglas-fir averaging 130 ft (40 m). Shrub and herb layers average less than 5 percent cover and include *Bromus tectorum, Hieracium albiflorum, Pyrola picta, Pteridium aquilinum,* and *Adenocaulon bicolor*.

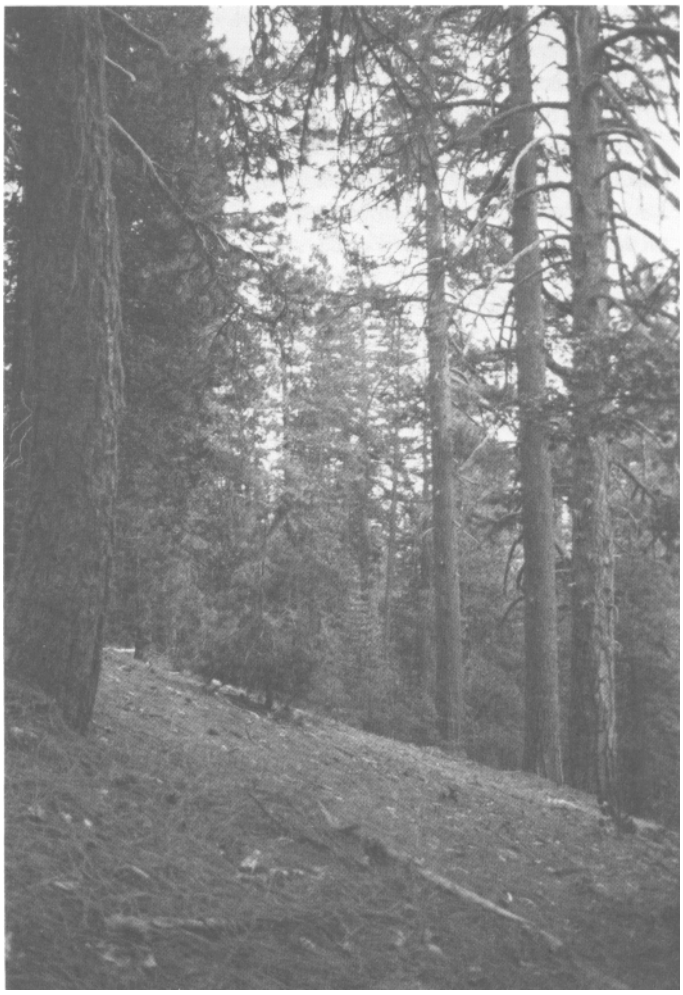


Figure 81--Ruth: Ponderosa pine dominated stand of mixed coniferous forest on SW.-facing exposure.

The white fir phase (60 acres, 24 ha) occupies the upper elevations of the mixed conifer forest, usually above 5000 ft (1524 m). Typical sites are moderately SW.-facing slopes with gravelly loam soils. White fir is the only species with an all-age distribution in this phase, the other species (e.g., ponderosa pine and incense-cedar) usually occur only as large individuals. The average basal area is 150 m^2/ha (range 126-172). The 100 year site index for white fir is 100 ft (31 m). Understory is very sparse (<1 percent) with scattered *Amelanchier alnifolia, Rosa gymnocarpa, Elymus glaucus, Pyrola picta,* and *Pteridium aquilinum.* This type is similar to the white fir types described in Sawyer and Thornburgh (1977).

• Oak-Conifer Woodland (71120, 81340): 243 acres (98 ha). This type is actually a mosaic of California black oak stands, small grassy meadows, and clumps of Douglas-fir and/or ponderosa pine, which lies between the upper limit of the mixed evergreen forest and the lower end of the montane chaparral. Typical stands consist of an even canopy of large California black oak, ponderosa pine, and Douglas-fir over saplings of Douglas-fir or ponderosa pine. Some stands area true woodland of California black oak with a thick fern-grass understory dominated by *Pteridium aquilinum* and *Elymus macounii.*

Soils are clay-rich, and occasional slumps and bare erosional slopes indicate instability. The combinations of mobile soils and SW.-facing xeric slopes probably explain the presence of oak-conifer woodland and not forest at this site. Succession appears to be proceeding toward white fir phase of the mixed conifer forest type. Very little of this forest is actually included within the final RNA boundaries.

• Montane Chaparral (37510, 37541, 71110): 128 acres (51 ha). Above 5000 ft (1524 m) the area is covered by a large expanse of chaparral dominated by *Quercus garryana* var. *breweri, Q. vaccinifolia, Symphoricarpos mollis,* and *Arctostaphylos patula.* Slopes are moderate to steep SW.-facing, and soils are very rocky gravelly loam. Within the chaparral are patches of medium-sized Oregon white oak *(Quercus garryana)* with a grass-fern understory containing some white fir seedlings (Holland 71110). There are also some young, pure clumps of white fir located within the chaparral. The successional trend is toward the white fir phase of mixed conifer forest.

• Mixed Evergreen Forest (81100): 92 acres (37 ha). This forest is dominated by Douglas-fir and is characterized by the presence of the hardwoods Pacific madrone *(Arbutus menziesii),* California black oak *(Quercus kelloggii),* and canyon live oak *(Q. chrysolepis).* Ponderosa pine occurs as an occasional codominant. This association occurs below the S. Fork Mountain Fault. Throughout, the forest stands are dominated by large Douglas-fir and ponderosa pine, overlying younger pole-size mixture of Douglas-fir and the hardwoods. This younger size class became established 80-90 years before, after a fire. Most stands contain a few saplings and seedlings.

Four different stands are described from 0.2- acre (0.08- ha) samples. These stands are a few large Douglas-fir over smaller California black oak and Douglas-fir; large Douglas-fir and ponderosa pine over smaller madrone, canyon live oak, and black oak; even-aged canyon live oak and madrone with a few Douglas-fir, and large black oak with pole size Douglas-fir and ponderosa pine.

The understory is usually sparse with less than 2 percent cover. A small amount of sapling canyon live oak and Douglas-fir are scattered throughout. *Hieracium albiflorum* and *Bromus tectorum* are the most ubiquitous herbs. Basal area for trees averages 121 m^2/ha (range is 78-152m^2/ha). One-hundred-year-old Douglas-fir average 120 ft (37 m) tall.

• White Alder *(Alnus rhombifolia)* Riparian (61510, 45400): This association is limited to very small areas adjacent to streams and seeps. Other woody species besides white alder include big-leaf maple *(Acer macrophyllum),* giant chinquapin *(Chrysolepis chrysophylla), Rubus ursinus, Corylus cornuta* ssp. *californica,* and large incense-cedars. Herbs include Asarum *hartwegii, Mimulus guttatus, M. moschatus, Viola glabella, Tolmiea menziesii, Lilium pardalinum, Athyrium felix femina, Juncus effusus, Hypericum anagalloides,* and *Cystopteris fragilis.*

Plant Diversity

One hundred fifty-eight taxa are in the updated list in the establishment record.

Conflicting Impacts

Past and present cattle grazing may have encouraged the relatively high densities of non-native grasses such as *Bromus tectorum* now present. However, cattle grazing does not appear to have affected conifer establishment and is not a significant factor in most of the RNA. An old tractor trail crosses part of the area, and scattered trees have been felled near it.

39. SOLDIER (Leitner and Leitner 1988)

Location

This soon-to-be-established RNA is on the Six Rivers National Forest ca. 12 miles (19 km) ENE. of Alderpoint. It lies within portions of sects. 4 and 5 T3S, R7E and sects. 32 and 33 T2S, R7E HBM (40° 14'N., 123° 23'W.) USGS Zenia quad *(fig. 82)*.

Target Element

Oregon White Oak *(Quercus garryana)*

Distinctive Features

• Oregon White Oak Forest: Oregon white oak is considered a successional species throughout much of its range. In this part of California the dominance of the species was favored by natural and Indian-caused fires. As a result of fire suppression in recent decades, Douglas-fir *(Pseudotsuga menziesii) is* rapidly replacing Oregon white oak as the dominant in many areas, including parts of the Soldier candidate RNA *(fig. 83)*.

In addition to increases in Douglas-fir, recent poor reproduction by Oregon white oak has been noted in this area. The lack of historical information on fire frequencies, grazing and browsing pressure, acorn predation, and other possible factors limit the understanding of this association.

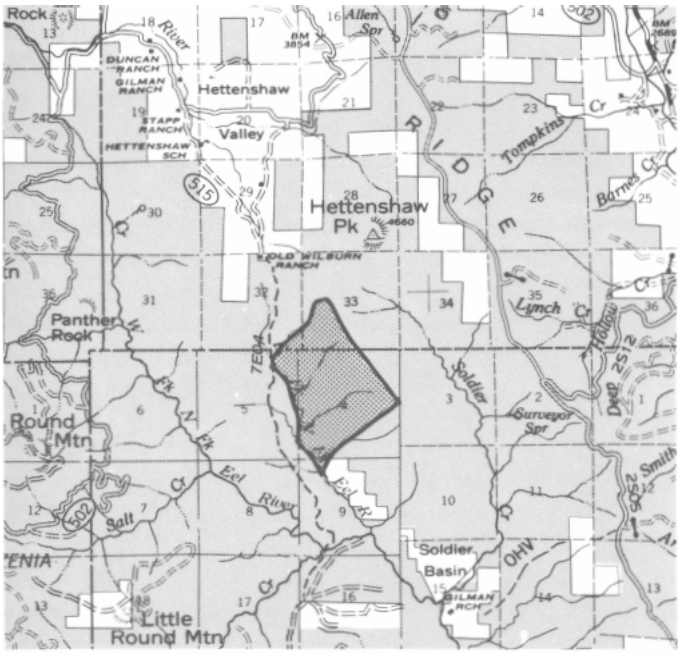


Figure 82--The Soldier RNA.

Figure 83--Soldier: View of annual grassland with Oregon oak woodland and island of Douglas-fir (B. Leitner).

The area is at the southern end of the range of the Oregon white oak woodlands and is relatively xeric compared to other such woodlands to the N. in Redwood National Park and elsewhere. The mixed Digger pine and Oregon white oak association described at Soldier may be relatively stable and less susceptible to conifer invasion and dominance. Local site conditions may represent the dry rocky edaphic limit of Oregon white oak and other Douglas-fir associates, and the high elevation, high rainfall limit for Digger pine *(Pinus sabiniana)*.

• Rare Plant: This area contains populations of *Sanicula tracyi* (CNPS List 1b).

Physical Characteristics

The area covers 709 acres (287 ha) between 2300 and 3650 ft (701-1113 m) elevation within the drainage of the North Fork of the Eel River. It occupies SW.-facing slopes above the E. Fork of the N. Fork of the Eel River. These slopes are dissected by six small ravines affording small areas of NW. and SE.-facing exposures.

The geology is Franciscan Assemblage dominated by late Jurassic graywacke and shale. Soils are considered part of the Doty-Hecker family association mapping unit, ranging from fine to heavy loam in the Doty family to gravelly or gravelly clay loam in the Hecker family. Annual precipitation is estimated at 65 inches (1651 mm) with about 60 days at or below freezing per year.

Association Types

Four associations are described in the survey. Nine 0.1-ha vegetation samples were taken in the three forested types. The grassland is qualitatively described. Acreages of the associations are not given.

• Oregon White Oak-Digger Pine (71110, 71410): This is the most extensive association in the area. It is dominated by medium-sized moderately-spaced Oregon white oaks with

younger, faster growing Digger pines overtopping the oaks. A small number of young Douglas-fir also occur. Oregon oak 3.5-6.3 inches (9-16 cm) dbh dominate with 300-590 individuals/ha. Digger pine is substantially less dense with most individuals in the smaller size classes 0-3.5 inches (0-9 cm) dbh, but with occasional individuals (<50/ha) 22-25 inches (56-64 cm) dbh. California black oak *(Quercus kelloggii),* canyon live oak *(Q. chrysolepis),* and Douglas-fir are scattered and of low cover and density. Canopy closure on three plots is estimated at 70 percent. Shrub and herb layers are well-developed and include *Toxicodendron diversilobum, Elymus glaucus, Clarkia* sp., *Agoseris apargioides, Brodiaea laxa,* and *Arctostaphylos canescens.*

• Upland Douglas-fir (82420): Douglas-fir dominates with California black oak, Pacific madrone *(Arbutus menziesii),* ponderosa pine *(Pinus ponderosa),* sugar pine *(Pinus lambertiana),* and Oregon white oak. Much of the understory is covered with litter and duff. The shrub and herb layers are sparse. This association is most extensive on the main ridgeline along the eastern boundary and on smaller ridgelines with well-developed deep soils. Two types of this forest are described.

The climax type is exclusively dominated by Douglas-fir. The sparse understory is made up of *Toxicodendron diversilobum, Hieracium albiflorum, Cacaliopsis nardosmia,* and *Viola* sp. The largest Douglas-fir are between 31 and 35 inches (80-88 cm) dbh, but the majority are seedlings (330/ha) or in the 0-3.5 inches (0-9 cm) dbh size class (380/ha).

The late successional type is successional from oak woodland to Douglas-fir forest. Here Oregon white oak has become overtopped by Douglas-fir. Seedlings and saplings of Douglas-fir are abundant (670/ha in 0-9 cm size class). Shrub and herb layers are diverse, a carryover from the oak woodland which preceded it. Understory species include *Cynosurus echinatus, Arctostaphylos manzanita, Clarkia* spp., *Cynoglossum occidentale,* and *Eriophyllum lanatum.*

• Oregon White Oak, Dense Stands (71110): This association consists of dense, small diameter, nearly pure Oregon white oak stands ca. 20-26 ft (6-8 m) tall. The canopy is nearly closed. Minor tree associates include Douglas-fir, California black oak, and Digger pine. Digger pine and Douglas-fir are of approximate equal frequency. Some shrubs and herbs here also occur in Douglas-fir forest, while some occur in Oregon white oak-Digger pine forest. The most abundant shrub is *Toxicodendron diversilobum.* Others include *Cercocarpus betuloides, Arctostaphylos manzanita,* and shrubby canyon live oak. Herbs include *Cynosurus echinatus, Brodiaea* sp., *Elymus glaucus, Silene californica, Agoseris* sp., and *Ranunculus* sp.

• Grassland (42200 and 41200): Grassland occurs mainly on the lower, steep S. or W.-facing slopes on soils high in clay and prone to slumping. The local grassland is a mixture of non-native annual grassland and bald hills prairie. Dominants include *Bromus mollis, B. diandrus, Avena barbata, Cynosurus echinatus, Festuca* ***spp.,*** *Melica californica, Poa scabrella, Elymus glaucus,* and *Stipa lemmonii.*

Plant Diversity

One hundred fifty-seven taxa of vascular plants are listed.

Conflicting Impacts

Fire will likely be necessary to maintain or enlarge the cover of the target element. Little is known about the requirements of the Oregon white oak association. Thus, management of the target element will require some research.

40. TWIN ROCKS (Jokerst 1987)

Location

This candidate RNA (dropped as of 1988) is on the Mendocino National Forest ca. 12 miles (19 km) ESE. of Covelo. It lies within sect. 1 T22N, R11W and sect. 6 T22N, R10W MDBM (39°47'N., 123°01' W.) USGS Newhouse Ridge quad *(fig. 84).*

Target Element

Foothill woodland

Distinctive Features

• Affinities of the Target Vegetation: The target vegetation of this area is best considered northern oak woodland (Oregon white oak woodland) and not foothill woodland. The dominant oak is Oregon white oak *(Quercus garryana)* which occurs in mixed hardwood stands, dominates mixed oak stands, and forms extensive pure stands. Although the typical California foothill woodland dominants, blue oak *(Quercus douglasii)* and Digger pine *(Pinus sabiniana),* are present, blue oak is a sub-dominant of some phases of oak woodland, and Digger pine is uncommon.

The oak woodlands at Twin Rocks may be considered as a mixing zone between xeric California foothill woodland and the

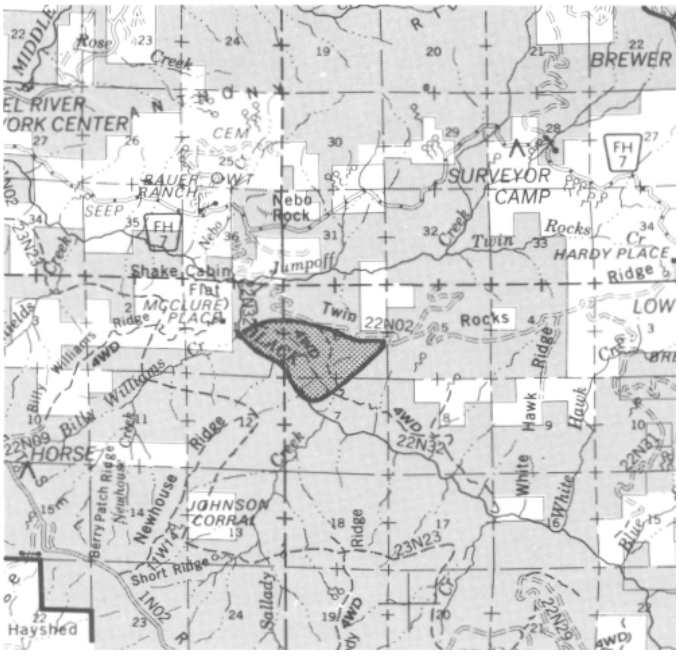


Figure 84--The Twin Rocks study area.

Oregon white oak woodlands of more northerly and mesic areas. Such trees as Oregon white oak, California black oak *(Quercus kelloggii),* Pacific madrone *(Arbutus menziesii),* and ponderosa pine *(Pinus ponderosa)* are not typical foothill woodland species. Some relationship with the Oregon white oak woodlands of the more northerly coastal mountains of California and Oregon is inferred by the presence of these species (see #39). However, most of the other species at Twin Rocks are typical of California foothill woodland. These include most of the grasses and shrubs, and the trees: blue oak, Digger pine and interior live oak *(Quercus wislizenii).*

The woody vegetation of the area is trending from open to dense stands of trees. In the past, frequent fire maintained an open oak woodland. However, with current reduced frequencies the vegetation in much of the area is gradually changing to a dense mixed oak-hardwood forest. Poor Oregon white oak regeneration may be related to browsing pressure from the large wintering mule deer herds.

• Manzanita Hybrids: Several different forms of stump-sprouting manzanitas were collected from the site. These represent five taxa *(Arctostaphylos glandulosa* forma *cushingiana, A. manzanita, A. canescens, A. manzanita* ssp. *roofii,* and *A. stanfordiana)* and six different hybrid combinations. Although hybrid manzanita stands are not uncommon, the presence of a three-way hybrid, and putative crosses between diploid and tetraploid species is unusual.

Physical Characteristics

This site (340 acres, 138 ha) is in the Black Butte River drainage, a tributary of the Middle Eel River. It lies on the SW.-facing slope of Twin Rocks Ridge. Elevations range from 1740 ft (530 m) along the Black Butte River to 3400 ft (1036 m) atop the ridge. Slopes range from 10 to 60 percent and average 30 percent. The river is confined to a steep narrow channel with no pronounced terraces. The mid- and upper slopes are geomorphically active and contain several landslides.

Rocks are derived from the Franciscan Assemblage and are primarily graywacke and shale. Soils are divided into three mapping units: Los Osos complex 10-50 percent slopes, Maymen gravelly loam 30-50 percent slopes, and Madonna Gravelly loam 30-50 percent slopes. The Los Osos unit is the most widespread and is characterized by the most unstable slopes with the tendency to slide, slump, and produce severe erosion gullies. Mean annual precipitation is estimated between 40 and 60 inches (1016-1524 mm) with a frost free season of 130-180 days per year. Most precipitation falls as rain.

Association Types

No quantitative sampling is conducted. However, estimates of tree density and cover are made.

• Oregon Oak Woodland (71110, 71410, 41200, 42200): 263 acres (106 ha). This association is divided into pure and mixed phases. The pure phase covers 122 acres (49 ha). Oregon white oak is the sole dominant with cover ranging from 60 to 100 percent. Blue oak is infrequent in the canopy. Understory species include California buckeye *(Aesculus californica), Arctostaphylos manzanita, Gallium porrigens,* and *Toxicodendron diversilobum.* Lower canyon slopes support *Lonicera hispidula* var. *vacillans,* madrone, big-leaf maple *(Acer macrophyllum),* and *Cercis occidentalis,* and indicate more mesic conditions than on upper slopes. Tree density ranges from 494 to 988 per hectare. Most trees are even-aged and under 12 inches (30 cm) dbh. Regeneration is significant only on steep slopes unused by livestock.

Grasses dominate the herb layer comprising from 50 to 100 percent cover. Some understories are dominated by native bunchgrasses including *Festuca idahoensis, Stipa pulchra, Melica californica, Poa scabrella,* and *Bromus marginatus.* Other herbs of the mixed grass and herb understories include *Iris macrosiphon, Ranunculus occidentalis, Eriophyllum lanatum* var. *achillaeoides, Lupinus nanus, Dodecatheon hendersonii, Brodiaea* spp., *Silene californica, Sanicula bipinnata,* and *Lathyrus vestitus.* The pure Oregon oak phase is largely restricted to the lower elevations of the area.

The mixed Oregon oak phase covers 141 acres (57 ha) of upper slopes. Oregon white oak is the most common species comprising 40-60 percent of the total canopy cover. Cover varies from open savanna-like stands to 60-80 percent in woodlands *(fig. 85).* The other trees include interior live oak, blue oak, and California black oak with occasional madrone. Digger pine is uncommon except for one small cluster. Oaks attain their largest size in and near the savanna openings. Some Oregon white oak have dbh's of 2-3 ft (0.6-0.9 m).

Shrub cover is higher than in the pure phase. *Arctostaphylos manzanita* predominates, often in dense thickets. The same bunchgrasses and herbs that occur in the pure phase also occur here, except in arid openings where annuals dominate. The arid openings range from 0.25 to several acres in size and are characterized by *Avena barbata, Bromus mollis, B. rubens, Vulpia* spp., *Stipa pulchra, Poa scabrella, Sitanion hystrix, Dichelostemma (Brodiaea) pulchellum, Erodium botrys, Lotus micranthus, L. subpinnatus, Lupinus bicolor, Orthocarpus attenuatus, Plagiobothrys tenellus, Trifolium ciliolatum, T. bifidum,* and *T. olivaceum.*

Figure 85--Twin Rocks: View from open grassland to mixed Oregon oak phase with upper fringe of North Coast Range mixed coniferous forest (J. Jokerst).

Two types of the mixed phase occur: one has a relatively open canopy (total canopy cover of 20-40 percent) dominated by Oregon white oak with large grassy openings (Holland 41200, 42200). The other type has higher canopy cover with ca. 30-50 percent composed of interior live oak. This type has a relatively shady understory and supports such species as *Calochortus coeruleus, Cynoglossum grande, Melica geyeri, Ranunculus occidentalis, Sanicula crassicaulis,* and *Torilis japonica.*

• Mixed North Slope Cismontane Woodland (71420): 51 acres (21 ha). This woodland has a dense canopy 40-60 ft (12-18 m) tall, dominated by madrone, interior live oak, California black oak, and ponderosa pine *(Pinus ponderosa).* Canopy cover ranges from 60 to 100 percent. Rocky sites are dominated by interior live oak, whereas steep sites with deeper soils are dominated by madrone. California black oak and ponderosa pine are scattered throughout, and big-leaf maple and Oregon white oak occur in low numbers. Shrubs are sparse to dense and are dominated by *Arctostaphylos manzanita,* with *A. stanfordiana.* Other species include *Cercocarpus montanus* var. *glaber (C. betuloides), Lonicera hispidula* var. *vacillans, Sanicula tuberosa,* and *Scutellaria tuberosa.*

• North Coast Range Mixed Conifer Forest (84110): 13 acres (5 ha). This association is restricted to a narrow band of Madonna soils along the ridgeline. The nearly closed 80- to 120-ft (24- to 37-m) tall canopy is composed of a mix of ponderosa pine and Douglas-fir *(Pseudotsuga menziesii),* big-leaf maple, madrone, and California black oak. This forest has a mid-layer composed of saplings of the canopy species with interior live oak. The shrub layer ranges from sparse to dense, with *Arctostaphylos manzanita* and *Cercocarpus montanus (betuloides)* var. *glaber.* Herbs are frequent and include *Agoseris retorsa, Carex multicaulis, Erythronium californicum, Hieracium albiflorum, Iris macrosiphon, Melica geyeri,* and *Viola purpurea* var. *dimorpha.*

• Northern Mixed Chaparral (37110, 37B00): 13 acres (5 ha). This association occurs on thin, rocky soils of low rounded spur ridges. Cover is open to very dense. The dominant on three isolated stands is *Arctostaphylos manzanita* with some *Adenostoma fasciculatum.* A larger stand entering the S. portion of the area includes mostly *Arctostaphylos glandulosa* with *A. manzanita* ssp. *roofii, A. stanfordiana, A. canescens,* and various hybrids. Also present are *Adenostoma fasciculatum, Ceanothus cuneatus, C. integerrimus, Eriodictyon californicum,* and *Quercus dumosa.*

• Seeps, Intermittent Creeks, and Riparian Habitats (Holland 45400, 61510): These associations are lumped because they are poorly developed. Seep vegetation is strictly herbaceous and includes *Aquilegia formosa, Athyrium filix femina, Brickellia californica, Cirsium vulgare, Delphinium nudicaule, Erigeron philadelphicus, Juncus patens, Limnanthes douglasii* var. *nivea, Phalaris tuberosa* var. *stenoptera, Scutellaria californica,* and *Trifolium obtusiflorum.* The very sparse vegetation along Black Butte River includes white alder *(Alnus rhombifolia),* big-leaf maple, *Brickellia californica,* and a species of willow (*Salix* sp.).

Plant Diversity

One hundred sixty-three taxa of vascular plants are listed from the area.

Conflicting Impacts

The area was dropped from consideration by the RNA committee in 1988 primarily because of its small size, its history of disturbance (see below), and because the area is not representative of the foothill woodland target element as it is commonly understood.

A four-wheel drive road, an old cleared right-of-way pack trail, numerous small and large erosion gullies (probably initiated by the construction of the trails and roads), and livestock use all detract from the pristine conditions of the area. Although grazing pressure is light and mostly concentrated in the upper portion of the site, it may influence the poor oak regeneration. The area is still used by occasional off-road vehicles and the erosion gullies are continuing to enlarge.

41. YUROK (Taylor 1982)

Location

This established RNA is on an isolated holding of the Six Rivers National Forest, Del Norte County. It occurs on the Yurok Experimental Forest, which lies just E. of Highway 101 ca. 4 miles (6 km) NW. of the town of Klamath, near the mouth of the Klamath River. The area lies within portions of sects. 21 and 28T14N, R1EHBM(41°35'N., 124°05'W.) USGS Requa quad *(fig. 86).*

Target Element

Coast redwood *(Sequoia sempervirens)*

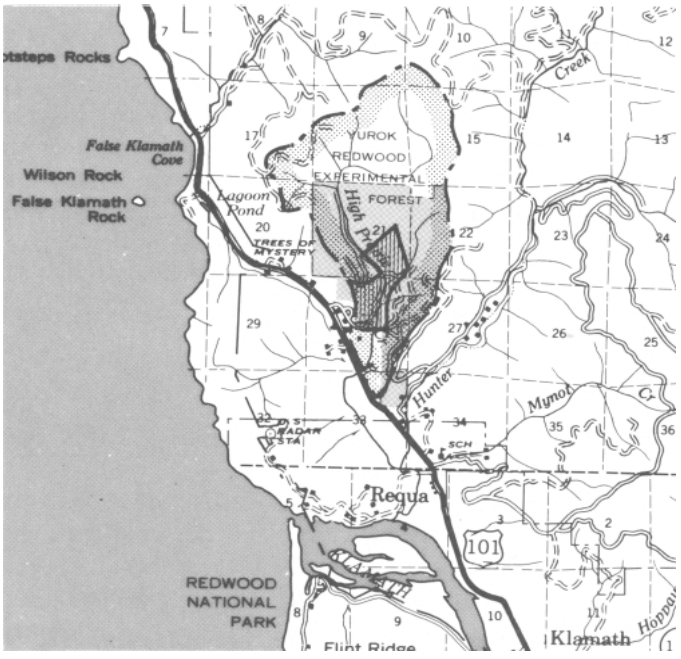


Figure 86--The Yurok RNA (vertical hatching).

Distinctive Features

This is the only Forest Service RNA in the California Region representing the coast redwood forest. The RNA was established in 1976 and is now one of only three federal Research Natural Areas designated specifically for coast redwood forest, the most productive forest type known in the world (Franklin 1988). The great biomass of this forest at Yurok compares favorably with other values obtained for mature redwood forest. The RNAs' proximity to the experimental forest and to electrical and dormitory facilities will facilitate detailed long-term research on redwood-related projects.

Physical Characteristics

The RNA covers ca. 150 acres (61 ha) on the coastal front of the N. Coast Ranges, about two miles (3 km) inland from the Pacific Ocean. High Prairie Creek flows through the area, forming a shallow valley. Exposures are primarily SW. and E. with a large area of valley bottom flat. Elevations range from under 40 ft (12 m) along the Creek to 920 ft (280 m) at the N. end of the RNA.

Rocks are Franciscan Assemblage soft sediments and metasediments and soil development is good with unweathered parent material reached at ca. 4 ft (1.2 m). Typical soils are sandy loams with moderate fertility and include the Melbourne series and an undescribed alluvial series. Climate is humid coastal with much fog during the relatively dry summer months. Annual precipitation is estimated to average ca. 87 inches (2210 mm). The mean annual temperature is ca. 53 °F (11.5 °C).

Association Types

The coast redwood forest is sampled with 100 points (point center-quarter method, with 10 points/transect). Areal extent of the associations is not given.

• Coast Redwood-*Polystichum munitum* (82320, 82310): This is the most common vegetation type of the RNA. It occurs on upland soils and is uniform in species composition. Redwood is clearly dominant with western hemlock *(Tsuga heterophylla)* the only other constant tree associate. Douglas-fir *(Pseudotsuga menziesii)* is occasional as outliers or following habitat disturbance. Other occasional seral species include red alder *(Alnus oregona),* grand fir *(Abies grandis),* tanoak *(Lithocarpus densiflorus),* and big-leaf maple *(Acer macrophyllum).* Total canopy cover is 80-100 percent. Average basal area of coast redwood is 231 m^2/ha (94 percent relative basal area). Relative basal area of Douglas-fir and western hemlock is less than 10 percent in most stands. Stem density averages ca. 200/ha with coast redwood comprising 23 percent of the stems. Some transects have high densities of sapling and pole-size seral tree species. Total wood volume from a cruise plot within the RNA is very high (4500 m^3/ha). Tree heights for coast redwood regularly exceed 250 ft (76 m).

The shrub understory is well developed in some stands with 6-8 species represented and poorly developed in others. The dominant shrub in all stands is *Vaccinium ovatum* with *V. parvifolium, Gaultheria shallon,* and *Ribes sanguineum* as important codominants. *Rubus spectabilis, R. parviflorus, Corylus cornuta* var. *californica,* and *Sambucus callicarpa* are more typical of disturbed areas (e.g., windfalls).

Herbs of the understory are few, with *Polystichum munitum* dominant. Other typical species include *Vancouveria planipetala, Oxalis oregana, Viola sempervirens,* and *Hierochloe occidentalis.*

Total shrub and herb cover is often >80 percent. Shrubs and herbs exhibit a mosaic distribution. Where *Vaccinium ovatum* is dominant, there is a tendency for other species to be less common. Where dense shrub cover occurs without *V. ovatum,* a fairly rich herb layer develops. *Oxalis oregana* and *Chimaphila umbellata* are typical of areas of low shrub cover, often in dense shade of the canopy.

• Red Alder-*Rubus spectabilis* (61130, 81A00): This type occurs along the alluvial soils adjacent to High Prairie Creek. Trees are primarily red alder and big-leaf maple in ca. equal proportions. Port Orford-cedar *(Chamaecyparis lawsoniana)* is a subdominant. Shrub understory is dense and dominated by deciduous species such as *Rubus spectabilis, R. parviflorus, Sambucus callicarpa* and *Menziesia ferruginea.* Herbaceous cover is mostly dominated by *Polystichum munitum, Blechnum spicant, Equisetum laevigatum,* and *Epilobium angustifolium.* Other characteristic species include *Salix lasiolepis, Myrica californica, Polypodium scouleri,* and *Mimulus dentatus. Polypodium scouleri* and *P. glycyrrhiza* often occur as epiphytes on mossy big-leaf maple trunks.

Plant Diversity

Eighty-two species are listed. Only ca. 36 species occur in the undisturbed forest, whereas the additional species are mostly from disturbed habitats.

Conflicting Impact

A gravelled road runs along the valley bottom within the RNA, and the area is surrounded by variously managed lands within the Yurok Experimental Forest. The small area of the undisturbed forest may not be sufficient for extensive studies.

VI. SOUTH COAST RANGES PROVINCE

42) Limekiln Creek
43) South Fork Devil's Canyon

SOUTH COAST RANGES PROVINCE

42. LIMEKILN CREEK (Keeler-Wolf and Keeler-Wolf 1977, Borchert 1987)

Location

This established RNA (incorporated with #43 to constitute the Cone Peak Gradient RNA) is on the Los Padres National Forest. It lies ca. 1.5 miles (2.4 km) SE. of Lucia. The study area includes a portion of sect. 34 T2 IS, R4E and all or portions of sects. 1,2,3,10,11,12,13,14,15,22, and 23 T 22S, R4E MDBM (36°01'N., 121°29'W.) USGS Cone Peak and Lopez Point quads *(fig. 87).*

Target Elements

This area falls in part under the category of unique ecosystem, resulting from the juxtaposition of many biogeographic elements. It also has been selected to represent the canyon live oak woodland, mixed evergreen forest, California coast live oak *(Quercus agrifolia)* woodland, redwood *(Sequoia sempervirens),* and chaparral target elements for the South Coast Range province.

Distinctive Features

• Highly Varied Ecological Structure: A high number of plant associations exist in this small drainage. North coastal scrub, coastal sage scrub, redwood forest, coast live oak woodland, mixed evergreen forest, valley grassland, and several types of chaparral are well represented. The mixtures of such communities as coastal scrub and chaparral, valley grassland and coastal prairie, and north coastal scrub and south coastal scrub provide for some unique mixing of species. The unusual elevation cline of related associations such as mixed evergreen forest, and coast live oak and canyon live oak *(Quercus chrysolepis)* woodlands may provide answers to questions concerning the tolerance and requirements of the individual species comprising these various associations.

Figure 87--The Limekiln Creek (vertical hatching) and South Fork Devil's Canyon (stippling) study areas. Established Cone Peak Gradient RNA boundary in white.

Several closely related species that are typically segregated geographically such as *Eriophyllum confertiflorum* and *E. staechadifolium, Mimulus aurantiacus* and *M. bifidus* ssp. *fasciculatus,* and *Eriogonum parvifolium* and *E. fasciculatum* ssp. *foliolosum* co-occur here and may provide useful information on species relationships and environmental tolerances.

The area's complex group of plant associations has much to do with its varied climate, geology, and topography. The elevational difference of nearly one mile within a 3-mile (5-km) distance, a variety of slope exposures and rock types, the influence of the cool marine layer at the lower elevations, and the very steep gradient of precipitation from low to high elevations all combine to create a great diversity of environments within this relatively small area.

• Biogeographical Significance: This area contains several biogeographically significant taxa, either reaching their distributional terminus in the area or representing isolated populations. The largest of these groups represent whole associations. For example, the local coast redwood forest contains several characteristic plants such as *Oxalis oregana, Viola sempervirens, Whipplea modesta, Hierochloe occidentalis,* among others, which all reach their S. limits within a few miles of the RNA. The north coastal scrub reaches its S. limits in the vicinity of the RNA. The south coastal sage scrub reaches its N. limits within the vicinity of the RNA with certain of its species such as *Salvia leucophylla* reaching its N. limits very near the RNA.

A group of species of the upper elevations of the RNA are characteristic montane California plants and may be over 100 miles (161 km) from the nearest known populations. These include such species as sugar pine *(Pin us lambertiana), Cycladenia humilis* var. *venusta, Cheilanthes gracillima,* and *Lotus argophyllus* var. *fremontii.*

Another group of plants has a relatively continuous distribution, but reaches its range limits within or near the RNA. Species at or near their N. limits include Yucca *whipplei* ssp. *percursa, Monardella villosa* var. *subglabra, Penstemon heterophyllus* ssp. *australis, Collinsia childii,* and *Mimulus subsecundus.* Species at or near their S. limits include *Arabis breweri, Calochortus albus* var. *rubellus, Penstemon corymbosus, Nemophylla parvifolia, Streptanthus tortuosus,* and *Erigeron petrophilus.*

The fauna of the region also has some biogeographical significance. Two species of slender salamanders *(Batrachoseps)* inhabit the Big Sur coast, and the RNA is a meeting ground for the northern *Batrachoseps pacificus.* and the southern *B. nigraventris.* The area may harbor a hybrid swarm and thus be of interest to evolutionary zoologists. Such species as the

sagebrush lizard *(Sceloporus graciosus)* and mountain chickadee *(Parus gambeli)* have isolated occurrences near the summits of Cone and Twin peaks. A recent record of a night snake *(Hypsiglina torquata) is* the most coastward record for the species in central California.

• Geological Significance: The geologic terrane within the RNA is varied with outcrops of sedimentary, metamorphic (including marble and gneiss), and crystalline basement rocks. The area is geologically unique, containing the oldest (Pre-Cambrian) rocks known between the Transverse Ranges and the North Cascades, a major thrust fault (the Sur-Nacimiento Fault), and the only charnockitic terrain described west of the Continental Divide.

• Rare Plants: Several rare species occur at the upper elevations. These are species shared with the Devil's Canyon portion of this RNA (#43). They include Santa Lucia fir *(Abies bracteata)* (CNPS List 4), *Galium californicum* ssp. *luciense* (CNPS List 1b), and *Galium clementis* (CNPS List 4).

Physical Characteristics

The area covered by the ecological survey includes the entire Limekiln Creek drainage (5478 acres, 2217 ha). The actual size of the established RNA is 2787 acres (1128 ha). The topography of the area is extremely rugged. The summit of Cone Peak is 5154 ft (1571 m); the mouth of Limekiln Creek, at sea level, is ca. 3.25 miles (5.2 km) from Cone Peak (the low point of the established RNA is 540 ft, 165 m). The drainage is oriented to the S. with the two highest points at its N. end. The deep canyons of the W and main branches of Limekiln Creek divide the area. In general, the slopes are steepest at the upper reaches of canyons and at the foot of ridges. Numerous limestone outcrops add to the rugged nature at the upper elevations.

Rocks include the Pre-Cretaceous metamorphic Sur Series, Jurassic-Cretaceous Franciscan metasediments, and Mesozoic granitic rocks. The Sur Series covers over75 percent of the area. These rocks include limestone, quartzite, granofelses, and gneises with many layers of amphibolites, schists, calcite marbles, and metadolomites (the latter two being broadly classified as limestone). Soils include Cieneba-Rock outcrop, Cieneba-Sur-Rock Outcrop, Gamboa-Sur, Los Osos Clay loam, Pfeiffer-Rock outcrop, Rock outcrop, and Sur-Junipero complexes.

Climate is highly varied, with precipitation at the lower elevations ca. 28 inches (711 mm) to amounts in excess of 90 inches (2286 mm) on the lee side of Cone Peak. Less than 2 percent of the average annual precipitation falls between June and September. Snow is common in the winter at the highest elevations, whereas the lower elevations rarely freeze. Temperature inversions resulting from the strong summer marine layer are very stable between May and October. Summer fog is common below ca. 2000 ft (610 m). Average winter temperatures vary as much as 19 °F (7.2 °C) between the highest and lowest elevations.

Association Types

Many of the plant associations in this area are complex and not easily separated into distinct types. No quantitative vegetation sampling is conducted for the ecological survey. Description and mapping of the types were based on extensive field observation.

• Mixed Evergreen Forest (81100, 81400): 1200 acres (486 ha). This is the most diverse of the three sclerophyllous forests or woodlands present. It is dominated by varying mixtures of tanoak *(Lithocarpus densiflorus),* madrone *(Arbutus menziesii),* California bay *(Umbellularia californica),* big-leaf maple *(Acer macrophyllum),* coast live oak, interior live oak *(Quercus wislizenii),* canyon live oak *(Quercus chrysolepis),* and Coulter pine *(Pinus coulteri).*

Mesic lower N.-facing slope stands have diverse understories of *Trientalis latifolia, Smilacina racemosa* var. *amplexicaulis, Osmorhiza chilensis, Dryopteris arguta, Symphoricarpos mollis, Adiantum jordanii, Rhamnus californicus, Symphoricarpos mollis, Rosa gymnocarpa,* among others (28 typical understory species listed). The density of native grasses including *Festuca californica, Melica hartfordii, M. imperfecta, Elymus glaucus, Calamagrostis rubescens,* and *Bromus grandis* is frequently high.

• Redwood Forest (82320, 82310,61210): 800 acres (324 ha). This forest is restricted to mesic valley bottoms and is difficult to separate from a true riparian element containing such trees as California sycamore *(Platanus racemosa),* white alder *(Alnus rhombifolia),* and the willow *Salix coulteri.* A number of other riparian or semi-riparian species are closely associated with redwood *(Sequoia sempervirens)* including big-leaf maple, California wax myrtle *(Myrica californica), Petasites palmatus, Boykinia elata, Aralia californica, Adiantum pedatum* var. *aleuticum,* and *Woodwardia fimbriata (fig. 88).*

The most well-developed redwood forests occur in the lower drainages and include characteristic understory species such as *Oxalis oregana, Viola sempervirens, Vaccinium ovatum,* and *Hierochloe occidentalis.* In the upper canyons redwood forest is more patchy, non-diverse, and very closely tied to canyon bottoms. Redwood is generally the only dominant tree, but in some areas tanoak, California bay, and Douglas-fir *(Pseudotsuga menziesii)* may be subdominants. Occasionally, Santa Lucia fir *(Abies bracteata)* occurs in redwood groves in

Figure 88--Limekiln Creek: *Adiantum pedatum, Oxalis oregana,* and *Vaccinium ovatum* of the redwood riparian forest along W. Fork Limekiln Creek.

the upper drainages. Most redwood forest in the RNA tends to form a mosaic with mixed evergreen forest.

• Grassland (41100, 42110, 42200): 750 acres (304 ha). There is a gradual transition between coastal prairie grassland below the typical summer inversion layer to the more interior valley grassland at higher elevations. The coastal prairie-type is not particularly well-developed, with few species characteristic of the true coastal prairie of more northern locations. Such species as *Ranunculus californicus, Pteridium aquilinum, Zigadenus fremontii,* and *Dichelostemma (Brodiaea) pulchella* occur with the introduced annual *Bromus, Avena, Vulpia (Festuca),* and *Erodium* species.

Upslope from this coastal grassland, *Stipa pulchra* becomes locally common, signifying the grassland of more interior affinities. Also in this more extensive upland grassland are such species as *Paeonia californica, Chlorogalum pomeridianum, Eremocarpus setigerus, Trichostema lanceolatum, Plagiobothrys nothofulvus, Phacelia imbricata, Linanthus ciliatus, L. androsaceus, L. linifolius, Lagophylla ramosissima, Poa howellii, P. scabrella, Sitanion jubatum, Festuca megalura,* and several annual species of the following genera: *Chorizanthe, Lotus, Trifolium,* and *Bromus.* These higher elevation grasslands have a more open habit than the lower elevation coastal prairie type, with herbs often just as important as grasses.

Some areas of grassland are being replaced by transitional scrub, and much of this association may be maintained only by periodic fire. However, atop the central ridges on the clay-rich Los Osos soils grassland exists in a relatively stable state. These areas are bordered by coast live oak woodland and contain a number of perennial grasses and native herbs characteristic of well-developed valley grassland.

• Chaparral (37110, 37200): 690 acres (279 ha). This association is easily broken down into two subtypes, which are often treated as separate associations. The first is the chamise *(Adenostoma fasciculatum)* chaparral (450 acres, 182 ha). It dominates on xeric S.- or W.-facing steep slopes at mid- to upper elevations. Typically chamise occurs as almost pure, dense stands with little understory cover and few associated herbs or shrubs. In some cases such species as *Heteromeles arbutifolia, Ceanothus papillosus* var. *roweanus,* and *Arctostaphylos glandulosa* occur as important members.

The other subtype is mixed chaparral (240 acres, 97 ha). It occurs in various forms from ca. 1500 to 4800 ft (457-1463 m) elevation. Overall dominants are *Arctostaphylos glandulosa, Heteromeles arbutifolia, Adenostoma fasciculatum, Mimulus bifidus* ssp. *fasciculatus, Ceanothus integerrimus,* and *Yucca whipplei* ssp. *percursa.* This association occurs on all major rock types and is on S.-, W.-, or E.-facing exposures of more moderate steepness than most chamise stands. In rocky stands with low shrub density numerous herbs may be present including *Selaginella bigelovii, Clarkia rhomboidea, Cordylanthus rigidus, Monardella villosa* var. *subserrata, Stephanomeria chicoriacea, Galium californicum, G. nuttallii,* and *Zauschneria californica.* Scrubby forms of canyon live oak, interior live oak, and tanoak also may occur as important members.

• Sage Scrub (32300, 37000): 550 acres (223 ha). This association occurs on S.-facing slopes away from the immediate coast between ca. 200 and 2500 ft (61-762 m). Stands are generally lower with less crown overlap of shrubs than in the coastal scrub association. Dominants include *Artemisia californica, Salvia mellifera, Mimulus aurantiacus* (lower elevations), *M. bifidus* ssp. *fasciculatus* (upper elevations), *Eriogonum fasciculatum, Rhamnus crocea* ssp. *ilicifolia, Toxicodendron diversilobum, Lupinus albifrons,* and *Lotus scoparius.* This association is more xeric than the coastal scrub and intergrades with chaparral at higher elevations *(fig. 89).*

This association reaches its peak diversity on open rocky E.-facing exposures where numerous grasses and herbs occur with the shrubs. These additional species include: *Castilleja affinis, Gnaphalium bicolor, G. microcephalum, Sitanion jubatum, Galium angustifolium, G. californicum, Clarkia rhomboidea, C. speciosa, Stephanomeria virgata, Lupinus hirsutissima, Chorizanthe douglasii, C. membrenacea, Eriogonum elongatum,* and *Stipa pulchra.* In contrast, xeric S.-facing stands may frequently be strongly dominated by *Artemisia californica* or *Salvia mellifera* with few associated species.

A subtype of this association, the transitional scrub, occurs in scattered, largely successional patches associated with sage scrub, chaparral, and grassland. This low scrub may develop into sage scrub, chaparral, or coast live oak woodland depending on site locations. The dominants are *Eriogonum fasciculatum, Lotus scoparius, Chrysopsis villosa* var. *sessiliflora, Penstemon breviflorus, Haplopappus squarrosus, Lupinus albifrons,* and *Yucca whipplei* ssp. *percursa.* At most of the sites where it occurs this subtype is replacing grassland which was maintained by burning before the 1950's. This subtype is an important indicator of relatively rapid vegetational change in the drainage.

• Coast Live Oak Woodland (71160, 81310, 81200): 520 acres (210 ha). This association occupies slopes and knolls of the main ridges. It normally is adjacent to and interdigitates with mixed evergreen forest, but occurs on somewhat drier exposures. It is usually a more open association than the mixed evergreen forest with a more poorly developed understory. It is strongly dominated by coast live oak. *Rhamnus californica, Toxicodendron diversilobum,* and *Rubus vitifolius,* among other

Figure 89--Limekiln Creek: Sage scrub dominated *by Artemisia californica, Eriogonum fasciculatum,* and *Mimulus bifidus* ssp. *fascicularis* on W.-facing slope.

shrubs, are widely spaced with a sparse herb cover consisting of *Collinsia heterophylla, Gnaphalium californicum, Madia elegans,* and *Sanicula crassicaulis.* A number of herbs and shrubs from chaparral, grassland and sage scrub associations may occur where coast live oak woodland borders on those associations.

A California bay subtype (Holland 81200) of this association often occurs around rock outcrops adjacent to grassland. These are generally small clonal stands interspersed within more extensive stands of coast live oak.

• Canyon Live Oak Woodland (81320): 510 acres (206 ha). This association covers very steep upper slopes of the drainage on all major exposures. On the upper S. and W. slopes of Cone Peak it is typically composed of low scrubby trees. The small size and high frequency of multiple stems within this association in indicative of past fire. This association is transitional between lower elevation broad-leafed sclerophyll forests and the higher more mesic coniferous forests. A taller forest with scattered Coulter or ponderosa pine *(Pinus ponderosa)* occurs on gentler and less exposed slopes. On the ridgetops, this association may merge with mixed chaparral. The understory is sparse, but contains some interesting taxa including the three rare taxa and several of the disjunct species listed under distinctive features.

• Santa Lucia Mixed Conifer Forest (84120, 84131, 84140): 320 acres (130 ha). This association is best represented in the S. Fork of Devil's Canyon (#43). Locally, this forest is divisible into three types. These include a mixed phase containing Santa Lucia fir, Coulter Pine, canyon live oak, and occasional madrone and tanoak on NW.- or E.-facing slopes well protected from fire (90 acres, 36 ha); a ponderosa pine phase, occurring as an open woodland of coast live oak, madrone, and canyon live oak with a broken canopy of ponderosa pine (140 acres, 57 ha); and a Coulter pine phase (90 acres, 36 ha) which occurs in small stands on higher xeric ridgetops and S.-facing slopes, and has a sparse understory related to adjacent xeric mixed evergreen and canyon live oak forests.

• Bluebush Scrub (37820): 180 acres (73 ha). This scrub association is closely associated with the coastal scrub and sage scrub, but is dominated by bluebush *(Ceanothus thyrsiflorus)* or the similar *Ceanothus griseus* (at lower elevations) or *C. sorediatus* (at higher elevations). This type of scrub is taller than coastal scrub and is generally found on steeper, rockier slopes than the two related scrub associations. It is considered a form of chaparral by Holland.

• Coastal Scrub (32200): 170 acres (69 ha). This association occurs along steep to moderate SW. or E.-facing slopes directly above the ocean. Dominants include the shrubs *Artemisia californica, Toxicodendron diversilobum, Baccharis pilularis* var. *consanguinea, Eriophyllum staechadifolium, Rhamnus crocea,* and *Mimulus aurantiacus.* Herbs include *Achillea millefolium, Agrostis diegoensis, Astragalus nuttallii, Galium nuttallii, Eriogonum parvifolium, Phacelia malvifolia* var. *loasaefolia, Eucripta chrysanthemifolia, Calystegia cyclostegius, Gnaphalium bicolor, G. californicum, G. ramosissimum,* and *Castilleja foliolosa.* Dominants vary from stand to stand and a number of species more typical of the upper elevation scrub associations such as *Salvia mellifera, Haplopappus squarrosus, Lotus scoparius, Yucca whipplei* var. *percursa,* may occur.

Plant Diversity

More than 380 taxa of vascular plants have been identified from the RNA (Borchert 1987). The number listed in this ecological survey is 288.

Conflicting Impacts

The greatest recent influence in the area has been the 1985 Rat Fire, which burned virtually the entire RNA. At present, it is unclear what the effects on the various vegetation associations are from this fire. Certainly much of the information on the structure and extent of a number of the associations described in this survey have changed dramatically after the fire. The area is within the Ventana Wilderness and receives light hiking and camping use.

Grazing, browsing (deer and cattle), and cattle wallowing within the coast live oak woodland appear to have affected the relatively poor recent seedling reproduction in this association. Seedlings are becoming established primarily in sheltered locations within transitional and other scrubs. Reproduction of coast live oaks within the grassland is virtually nil. Some areas of heavy disturbance from cattle congregation were noted in the lower grassland.

43. SOUTH FORK OF DEVIL'S CANYON (Griffin 1976, Borchert 1987)

Location

This established RNA (comprising part of the Cone Peak Gradient RNA, #42) is on the Los Padres National Forest about 23 miles (37 km) SE of the town of Big Sur, Monterey County. The study area is included in portions of sects. 33, 34, and 35 T21S, R4E and sect. 2 T22S, R4E MDBM (36°02'N., 121°30' W.) USGS Lopez Point and Cone Peak quads (note: for map of this area see *fig. 87).*

Figure 90--South Fork Devil's Canyon: A high-density stand of Santa Lucia fir characterized as a transitional type of fir-pine-oak woodland (J.R. Griffin).

Figure 91--South Fork Devil's Canyon: The sugar pine dominated pine/oak woodland on the N. slope of Twin Peak (J.R. Griffin).

Target Elements

This area falls in part under the categories of special elements and unique ecosystems, resulting from the juxtaposition of many biogeographic elements. Santa Lucia Fir *(Abies bracteata)* and disjunct stands of sugar pine *(Pinus lambertiana)* are perhaps the most significant special elements along with a set of isolated and endemic herbaceous species. It has also been selected to represent the canyon live oak *(Quercus chrysolepis)* woodland and mixed evergreen forest targets.

Distinctive Features

• Disjunct and Unusual Vegetation: The Cone Peak area (including both this and #42) is a unique location with values that cannot be duplicated anywhere else. More specifically, the Devil's Canyon vegetation involves a combination of plants in an unusual topographic setting including extensive groves of the Santa Lucia Mountains endemic bristlecone fir *(fig. 90),* impressive disjunct old-growth sugar pine stands *(fig. 91),* interesting southern and northern montane disjuncts, three restricted endemic vascular plant species, and several types of mixed hardwood forest. The value of the area is not in its representation of typical or exemplary types of vegetation, but in its unique plant communities.

• Rare Flora: The following Devil's Canyon taxa are listed by CNPS: Santa Lucia fir (List 4), *Galium californicum* ssp. *luciense* (List 1b), *Galium clementis* (List 4), *Arctostaphylos hooveri* (List 4), and *Lupinus cervinus* (List 4).

• Disjunct Taxa: Several plant species including *Allium burlewii, Carex multicaulis, Chimaphila menziesii, Chrysothamnus nausiosus* ssp. *albicaulis, Cycladenia humilis* var. *venusta, Holodiscus microphyllus, Lotus argophyllus* var. *fremontii,* sugar pine, *Pleuricospora fimbriolata,* and *Streptanthus tortuosus* are disjunct for their main population centers in the higher mountainous parts of California. The mountain chickadee *(Parus gambeli)* is also a disjunct bird known from the Santa Lucia Range in this area only.

• Botanical Collecting History: A number of noted collectors including David Douglas, Thomas Coulter, Theodor Hartweg, Willis Jepson, and Alice Eastwood, among others, have collected in the area.

Physical Characteristics

The study area covers 542 acres (219 ha). Elevations range from ca. 2800 ft. (853 m) in the lower canyon bottom to 5155 ft (1571 m) atop Cone Peak. Topography is steep to extremely steep throughout with N. and S. slope aspects predominating, but all other aspects are represented.

The geology is predominantly pre-Cretaceous metasediments of the Sur series (primarily crystalline schist with local marble outcrops at the upper elevations of Twin and Cone Peaks). Three soil units are known from the area. These are rock outcrops-xerothents, Cieneba-Sur-rock outcrops complex, and Sur-Junipero complex. The best developed forest vegetation occurs on Junipero sandy loam, whereas the most open hardwood forest occurs on Cieneba fine gravelly sandy loam.

Climate is varied with occasional summer maritime influence at the lower elevations (temperature inversions relating to the cool maritime layer and associated fog generally occur below the lowest elevations in this area) and warm, dry interior climate in the summer above the inversion layer. Winter snows are common at the upper elevations. Annual average precipitation is estimated to range from 70 inches (1778 mm) at most of the area to up to 90 inches (2286 mm) on the E. flank of Cone Peak.

Association Types

Twelve 300-m2 plots are sampled in the sugar pine/tanoak-canyon live oak/*Toxicodendron* forest, twelve 250-m^2 plots are sampled in the sugar pine/tanoak-canyon live oak-madrone/*Toxicodendron* forest, and twelve 500-m^2 plots are sampled in pine/oak woodland.

• Pine/mixed hardwood forest (84110): 260 acres (105 ha). This association has been broken into two phases. The first is the sugar pine/tanoak-canyon live oak/*Toxicodendron* phase. This phase covers 92 acres (37 ha). Compared to the pine/oak woodland (see last association type on following page) tree cover is substantially greater (73 percent average). There is a pronounced increase (>10-fold) in tanoak density and cover relative to pine/oak woodland. Pacific madrone *(Arbutus menziesii)* is rare.

Sugar pine reaches its best development in the area in the first phase. Heights and dbh's of sugar pine are significantly greater than in the pine/oak woodland (averaging 149 ft. [45 m] tall and up to 70 inches [1.8 m] dbh). Most (86 percent) have basal fire scars. Sugar pine reproduction is abundant in tree fall gaps and good elsewhere. Almost all hardwoods in this phase are sprouts with no old growth. Maximum canyon live oak dbh is 8 inches (20 cm), and 12 inches (31 cm) for tanoak. Both species of hardwoods are well-represented in the reproduction layers. Average densities (trees/ha) and basal area (m^2/ha), respectively, are given after the species in the following list: sugar pine (121, 64.5), canyon live oak (210, 1.8), tanoak (403, 7.3),

Santa Lucia fir (5, trace), total trees (741, 73.7).

Toxicodendron diversilobum is a conspicuous shrub (up to 25 percent cover). The rare or disjunct species *Allium burlewii, Cycladenia humilis* var. *venusta, Chimaphila menziesii,* and *Lupinus cervinus* occur as scattered individuals.

The second phase of this forest type is described as the sugar pine/tanoak-canyon live oak-Pacific madrone/*Toxicodendron* phase (168 acres, 68 ha). This phase occurs at lower elevations than the previous phase and is characterized by a higher density and cover of hardwoods. Tanoak is ubiquitous, Pacific madrone is locally common, California bay *(Umbellularia californica)* is a minor component, and canyon live oak may be locally absent. Fire history is similar to that of the above phase with few older hardwood stems.

Maximum dbh for tanoak and madrone sprouts is ca. 14 inches (36 cm). Sugar pine tends to be smaller than in the previous phase with a maximum recorded dbh of 61 inches (1.6 m), and may average younger and shorter than the previous stands. Only 29 percent of the mature trees have fire scars. Density of pines is similar to that of the woodland plots whereas basal area is intermediate between that of the woodland and the previous phase. Pine seedlings and saplings are considerably less common than at the previous phase. Average densities (trees/ha) and basal area (m^2/ha), respectively, are given after the species name in the following list: sugar pine (59, 46.8), *Quercus chrysolepis* (408, 7.3), Santa Lucia fir (7.4, trace), Pacific madrone (126, 3.4), California bay (54, trace), total trees (1184, 67.3). Herbs are rare and mostly in rocky openings.

Toxicodendron is the most widespread and conspicuous understory plant. *Pleuricospora fimbriolata* was noted for the first time in the Santa Lucia Mountains in this phase.

• Mixed hardwood forest (81100, 81320): 117 acres (47 ha). This forest is also broken down into two phases. The first is the tanoak-oak-Pacific madrone/*Toxicodendron* phase (66 acres, 27 ha). This is a typical mixed hardwood forest without significant representation by sugar pine. Tanoak is the most important species with canyon live oak and Pacific madrone locally dominant. Interior live oak *(Quercus wislizenii)* is scattered, but not important. A few Coulter pine and ponderosa pine *(Pinus ponderosa)* are present. *Toxicodendron diversilobum* remains the dominant understory plant. This phase is better represented in the adjacent Limekiln Creek drainage (#42).

The second phase is dominated by canyon live oak (51 acres, 21 ha). It occurs on S. aspects. Compared to the previous type it has a low diversity with only widely scattered sugar or Coulter pine rising above the closed canyon live oak canopy. Fire history varies in this phase with some canyon live oak ranging up to 3 ft. (1 m) dbh whereas other stands may be much smaller as a result of recent and frequent burns.

• Santa Lucia fir-pine-oak woodland-rock-land (84120): 92 acres (37 ha). This vegetation complex is divided into three landscape classes based on Talley (1974). The first of these is the summit phase (65 acres, 26 ha). This is characterized by very steep (average 96 percent) rocky slopes with tree and shrub cover <25 percent. This phase is the best represented. Here scrubby sugar and Coulter pines are scattered with the firs. Stunted canyon live oaks are the principal hardwoods. Some colonies of *Arctostaphylos glandulosa* occur, but these are not extensive. Landscape features at this type almost preclude serious fires, thus the firs may be large and relatively old.

The cliff-outcrop-talus mosaic between the conifers and oaks has a rich flora including healthy populations of: *Arabis breweri, Cheilanthes gracillima, Cheilanthes intertexta, Erigeron petrophilus, Eriogonum saxatile, Galium californicum* ssp. *luciense, G. clementis, Holodiscus microphyllus, Lotus argophyllus,* var. *fremontii, Penstemon corymbosus, Stipa coronata,* and *Streptanthus tortuosus.*

The other two types are the transition phase occurring below the summits on steep (average 84 percent) rocky slopes without cliffs or sudden breaks in slope, an average tree cover of 40 percent, and shrub cover of 25 percent; and the ravine phase with an average slope of 70 percent and a tree cover of >50 percent. These types are mapped together and are estimated to cover ca. 27 acres (11 ha).

• Pine/oak woodland (no Holland equivalent): 51 acres (21 ha). Between the ridgecrest at Twin Peak (4843 ft, 1476 in) and ca. 4400 ft (1341 m) on N.-facing slopes, a woodland with average tree cover of 45 percent occurs. It is dominated by widely spaced sugar pine up to 58 inches (1.5 m) dbh and 125 ft (38 m) tall. Sixty percent of these dominants have basal fire scars. Beneath the pines is a broken subcanopy of canyon live oak, many of which have been spared from fire for many years and have large boles. Average densities (trees/ha) and basal area (m^2/ha), respectively, are given after the species in the following list: sugar pine (59, 27), Coulter pine *(Pinus coulteri)* (47, 2), canyon live oak (136, 5), tanoak (40, 0.4), Santa Lucia fir (2, trace), total trees (284, 33.5).

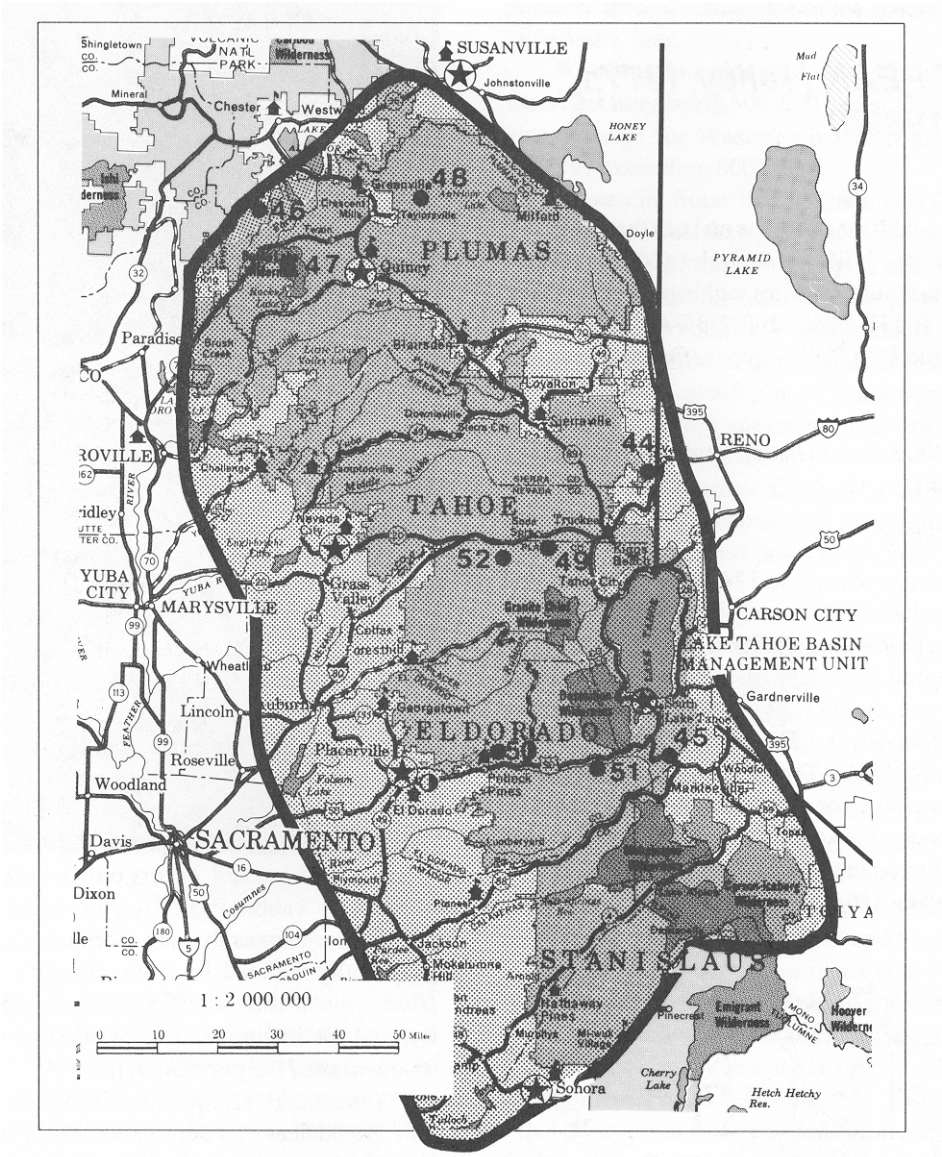
The shrub stratum is primarily composed of saplings of the oaks and pines. Herbs have a low cover-abundance value. Among the most conspicuous are *Galium californicum* ssp. *flacidum, Galium clementis, Lupinus cervinus,* and *Polystichum munitum* var. *curtum.*

Plant Diversity

One hundred seven taxa are listed.

Conflicting Impacts

The few minor impacts listed by Griffin such as the lightly used campsites within the area are vastly overshadowed by the effects of the extensive 36,500-acre (14,772-ha) Rat Fire of 1985. Fire suppression was limited to handline construction and fire retardant drops. This fire consumed much of the sugar pine and adjacent forests of the area. The prior amount of vegetation sampling will provide important baseline information on the monitoring of succession over the ensuing decades. The area lies within the Federally designated Ventana Wilderness. However, recreational use has traditionally been light.



VII. NORTHERN SIERRA NEVADA PROVINCE

44) Babbitt Peak
45) Grass Lake
46) Green Island Lake
47) Mount Pleasant
48) Mud Lake-Wheeler Peak
49) Onion Creek
50) Peavine Point
51) Station Creek
52) Sugar Pine Point

NORTHERN SIERRA NEVADA PROVINCE

44. BABBITT PEAK (Talley 1977a, Keeler- Wolf 1989h)

Location

This soon-to-be-established RNA is on both the Tahoe and Toiyabe National Forests. It lies ca. 16 miles (26 km) NW. of Reno, Nevada, in Sierra County and lies within portions of sects. 4, 5, 8, and 17 T20N, R 17E MDBM (39°36'N., 120°06'W.) USGS Sardine Peak and Dog Valley quads *(fig. 92).*

Target Elements

Washoe Pine *(Pinus washoensis),* mountain mahogany *(Cercocarpus ledifolius).*

Physical Characteristics

The ecological survey covers ca. 1747 acres (707 ha), but the final boundaries include 1400 acres (567 ha). Babbitt Peak, the highest point of the Bald Mountain Range (8760 ft, 2670 m), lies along the east-central boundary of the area. Watersheds within the area drain to the W. as a portion of the upper tributaries of the Feather River. The main ridge of the Bald Mountain Range runs NW.-SE. The topography on the central ridge consists of gentle convex or concave slopes interrupted by occasional rock outcrops. Two lateral spur ridges occur in the area. One runs for over a mile (1.6 km) before dropping below 7808 ft (2,380 m) elevation *(fig. 93).* W.- and E.-facing slopes

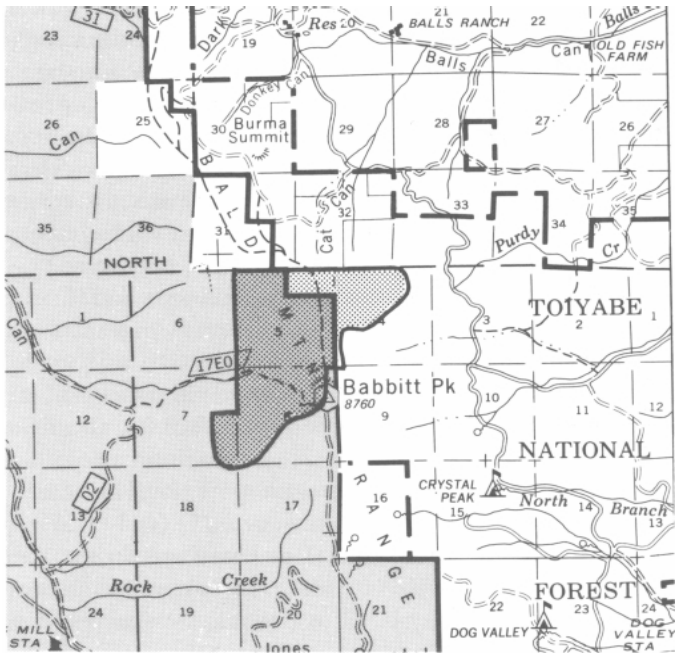


Figure 92--The Babbitt Peak RNA.

Figure 93--Babbitt Pk.: N. from ridge in NE. 1/4 Sect. 4 showing extensive Great Basin desert scrub communities to the E. and mixed western white pine, washoe pine and white fir forest in middle ground.

predominate and become increasingly convex away from the main ridge.

The area is underlain by Tertiary volcanic rock (primarily andesite). Soils are divided into 11 mapping units comprising the Aldi, Kyburz, Fugawee, Tahoma, Trojan, Meiss, Waca, Franktown, and Windy complexes. Average annual precipitation is slightly more than 30 inches (762 mm). Prevailing SW. winds have flagged many of the trees along the main ridge. Average annual temperature is estimated to be 33.5 °F (0.8 °C).

Distinctive Features

• Washoe Pine: The species is endemic to the western Great Basin mountains and occurs only in a few areas. The populations on the Babbitt Peak RNA and to the south on Mt. Rose are the only large ones that are morphologically distinct and geographically isolated from the closely related ponderosa pine *(Pinus ponderosa)* (Griffin and Critchfield 1976). This site is unusual for its pure stands of Washoe pines and the genetic uniqueness of the population *(fig. 94).*

The ecological requirements for local restriction of Washoe pine are unclear. Its dominance solely on E.-facing (leeward) slopes suggests that desiccating winds on the S.- and W.-facing slopes, and the fires they occasionally carry upslope from the lower elevation Jeffrey pine-white fir forests may inhibit growth elsewhere in the area. The natural rock barriers surrounding the best stand of Washoe pine and the small fire scars at the base of mature trees also suggest that the Washoe pine forest has been protected from crown fire for at least the past 500 years. The limited distribution, long intervals between periods of successful establishment, and slow growth of mature Washoe pine suggest that intense fires would be detrimental. There is some danger that the lower slope Washoe pine forests, which are being invaded by western white pine *(Pinus monticola)* and white fir *(Abies concolor),* may soon lose their resistance to fire through the increased fuel buildup by the invading species.

• Pure Western White Pine Forest: Western white pine does not commonly form pure forests in the Sierra Nevada. At Babbitt Peak, pure stands result from the presence of N.-facing

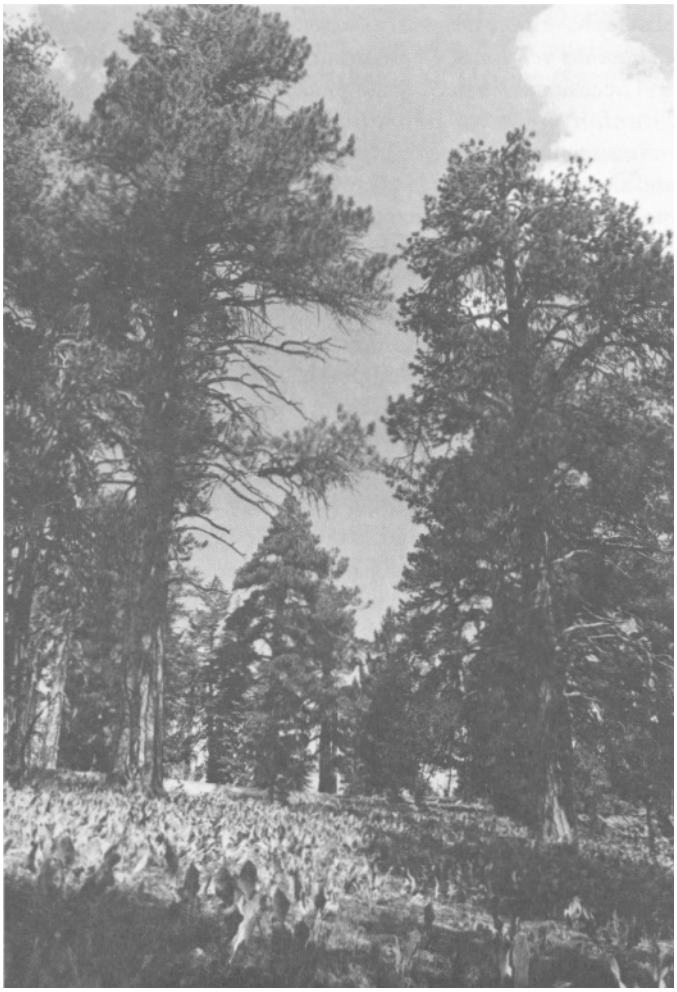


Figure 94--Babbitt Peak: Looking N. through main Washoe Pine stand, open understory dominated by *Wyethia mollis*.

slopes above the climatic limits of white fir, but too dry for red fir *(Abies magnifica),* the normal dominant on these aspects and elevations in the Sierra Nevada. The relatively xeric climate of Babbitt Peak has provided the conditions for western white pine dominance and indicates the subtle differences between ecological requirements of the typically co-occurring red fir and western white pine in the California region.

• Growth Rate and Forest Structure: Many saplings and trees have been aged at breast height, establishing growth trends for red fir, white fir, western white, and Washoe pines. To summarize: maximum growth rates for both white fir and western white pine occur under similar conditions at lower elevations. Early growth rates for Washoe pine are relatively rapid (breast height in ca. 38 years). Young ridgetop and low elevation E.-facing slope trees are particularly slow growing (5 inches or 13 cm in height/year between 20 and 100 years and 44.3 ft, 13.5 m tall at 100 years).

Diameter growth for white fir and red fir are ca. equal (16 inches or 40 cm dbh in 100 yr). Subsequent growth slows greatly, with an additional 120 years required to reach 2 ft (60 cm) dbh. Washoe pine growth is more uniform over time, attaining similar dbh after 100 years, but attaining 60 cm after only 180 years. Given their slow growth rate for mature trees, the largest of the local white firs (1.24 m dbh) may be among the oldest specimens known for this species (ca. 600 years). Years having heavy white fir reproduction correlate well with moist periods. Recent resurgence of the species may result from lack of periodic fires.

Western white pine regeneration is strongly gap-phase with the oldest trees being 500-600 years. Gap-phase regeneration is also the rule for Washoe pine with greatest ages up to and possibly exceeding 800 years.

• Potential Solar Beam Irradiation (PSBI): According to theoretical calculations, the red fir-western white pine forests receive the least amount of light, and white fir-Jeffrey pine forests receive the highest. Washoe pine PSBI is nearly as high as that of the previous type. These calculations are discussed in conjunction with other microclimatic influences (e.g., undulating topography creating local snow traps, etc.) and provide a good view of basic environmental situations for each major vegetation type.

• Rare Vertebrates: Goshawk *(Accipeter gentilis),* prairie falcon *(Falco mexicanus),* and mountain lion *(Felis concolor)* have been seen several times in the area.

Association Types

Vegetation is sampled using 75 by 100 ft (0.07-ha) plots. A total of 23 plots are sampled, covering all major vegetation types. The data are arranged into an association table.

• White Fir Forest (84240,85210): 425 acres (172 ha). This forest varies from nearly pure dense 100-year-old white fir stands to more mature forest with white fir and western white pine co-dominating. The young forest has densities of over 1000 stems/ha with canopy cover of 90 percent and basal area cover of ca. 70 m^2/ha. The mature white fir-western white pine forests have lower density, lower cover and greater basal area.

White fir-western white pine forest varies from dominance by white fir at lower elevations to a broad mixing zone at mid-elevations and finally to western white pine dominance at higher elevations. Average density is 329 stems/ha, percent cover 64, and basal area cover 82 m^2/ha.

Jeffrey pine *(Pinus jeffreyi) is* also important in some white fir forest on S. and W.-facing slopes. Although Jeffrey pine individuals are few, they are large and contribute ca. 20 percent each to basal area cover and canopy cover figures. Low relative density of Jeffrey pine is a result of prolific regeneration by white fir.

There is a trend toward total dominance by white fir in these forests, with the dense white fir creating a severe fire hazard. Burned forest similar to this results in dominance by *Ceanothus velutinus* (Holland 37530).

• Western White Pine (no Holland equivalent): 232 acres (94 ha). This association occurs between 7600-8695 ft (2316-2650 m) elevation on gentle NW.- to NE.-facing exposures near ridge summits. Two sampled essentially pure western white pine stands average 400 stems/ha for 57 percent cover and 78 m^2/ha basal area. On steep concave N.-facing slopes or below ridge crests, white fir and red fir may co-dominate. Ecotones between western white pine forest and sagebrush scrub are typically

sharp.

• Red Fir Forest (85310): 212 acres (86 ha). This type is restricted to concave N.-facing slopes between 7800-8400 ft (2377-2560 m). Largest stands occur at the far N. end in a selectively logged area. A smaller grove (54 acres, 22 ha) of old-growth red fir occurs on NW.-facing slopes of the spur ridge running SW. from Babbitt Peak. Here red fir, western white pine, and, to a lesser extent, white fir form mixed stands with red fir dominant (importance values >200). There are complex boundary relationships with bordering vegetation types adjacent to this small old-growth stand. Atop ridges this may grade into a mixed community with red fir, western white pine, Jeffrey pine, lodgepole pine *(Pinus contorta* ssp. *murrayana),* western juniper *(Juniperus occidentalis)* and white fir occurring among *Ceanothus velutinus,* mountain mahogany and other sagebrush scrub species. Other boundaries are with white fir forest (W. and N.) and mixed white fir, Jeffrey pine, and Washoe pine forest (along the NE. boundary). A few old Washoe pines still occur within the WNW. aspect red fir forest, suggesting that this area was once more open.

Annual and perennial understory species are similar among all the coniferous forests and include *Pyrola picta* ssp. *dentata, P. picta, Kelloggia galioides, Penstemon heterodoxus, Poa* sp., and *Paeonia brownii. Pterospora andromedea* and *Hieracium albiflorum* are largely confined to Washoe pine and white fir forests, respectively, and *Chimaphila umbellata* occurs only in western white pine and red fir forests. Widespread subordinate species in several coniferous types include *Viola purpurea, Symphoricarpos vaccinioides, Bromus marginatus, Sitanion hystrix, Monardella odoratissima, Lupinus* sp., *Gayophytum ramosissimum, Haplopappus* sp., *Osmorhiza occidentalis, Penstemon speciosus, Ribes roezlii, Phacelia* sp., and *Ceanothus velutinus.*

• Mountain Mahogany Woodland (no Holland equivalent): 194 acres (79 ha). This scrubby woodland occurs on SW.-, S.- and SE.-facing exposures (best developed on steep convex S.- and SE.-facing slopes above 8000 ft, 2438 m). On gentle SW.-SE. aspects this type overlaps with sagebrush scrub, degraded sagebrush scrub, aspen groves, and coniferous forest species. On gentle slopes the soil is either rocky or there is exposure to SW. winds, or both.

Stands may be pure or have occasional Washoe pine or western white pine, or both. Typical mountain mahogany importance is high (on three 0.07-ha plots, averaging 1052 stems/ha, 34 percent cover, and 41 m^2/ha basal area). Such herbs as *Penstemon newberryi, Cryptantha microstachys,* and *Chrysopsis breweri* are common, with several other taxa spilling over from adjacent coniferous associations (e.g., *Pedicularis semibarbata, Silene lemmonii, Poa* sp.) and the sagebrush association (e.g., *Artemisia tridentata, Wyethia mollis).*

• Sagebrush Scrub (35210, 37510): 170 acres (69 ha). This association occurs on even-graded slopes of S. to W. aspects and steep slopes with E. aspect. *Artemisia tridentata* is dominant. Other common shrubs and subshrubs include *Ribes cereum, Purshia tridentata, Symphoricarpos vaccinoides, Monardella odoratissima, Eriogonum umbellatum, Ribes roezlii, Eriophyllum confertiflorum,* and mountain mahogany. Steep E.-facing exposures have more mesic taxa such as *Arctostaphylos nevadensis, Ceanothus velutinus, C. prostratus, Holodiscus microphyllus,* and occasional western white pine. Herbaceous taxa include *Sitanion hystrix, Bromus marginatus, Gayophytum ramosissimum, Carex* sp., *Lupinus* sp., *Leptodactylon pungens,* and an overgrazed area (44 acres, 18 ha) dominated by *Wyethia mollis* (this latter dominance type is termed the degraded sagebrush scrub).

• Washoe Pine Forest (85220): 102 acres (41 ha). This association prevails on gentle to moderate upland slopes and benches with S. and, less importantly, W. and E. aspects at elevations between 7600-8500 ft (2316-2590 m). The majority of this population (86 acres, 35 ha) is a nearly pure stand on the spur ridge extending NE. from Bald Mountain. Here Washoe pine accounts for 90 percent frequency, cover, and basal area. On the W. slope of Bald Mountain only a small grove exists; however, it contains large specimens up to 112 ft (34 m) high and 4.6 ft (1.4 m) dbh. Mixed Washoe pine, western white pine, and white fir forest occurs in the NE. corner of the RNA. In the mixed forest Washoe pine accounts for ca. 50 percent of basal area and cover but only 30 percent frequency. White fir has recently increased densities, accounting for lower relative density.

Washoe pine also occurs as a subordinate member of Jeffrey pine, white fir, and western white pine forest and within 20 acres (8 ha) of white fir and Jeffrey pine forest, and marginal red fir forest.

• Aspen Forest (81B00): 67 acres (27 ha). Several groves of aspen *(Populus tremuloides)* are scattered within sagebrush scrub. They occur on gentle S. to W.-facing slopes and range from shrubby ridgetop thickets to dense clusters of small trees with verdant understories, adjacent to coniferous forests. These aspen forests are not currently being invaded by coniferous forest. Associated taxa vary depending upon location of the grove, but typically do not have moist or wet meadow species.

Plant Diversity

A partial list of 85 taxa is given in the establishment record.

Conflicting Impacts

Controlled burning may be required to maintain viable populations of Washoe pine because of increasing colonization of western white pine and especially white fir. Should a fire occur, the increased density of these species may cause a devastating effect to the Washoe pines. Past heavy grazing of the sagebrush scrub has degraded portions of it to *Wyethia mollis*-dominated herbland. Selective logging (ca. 1960) of the largest stand of red fir has altered the natural regeneration cycle and age structure of that association.

45. GRASS LAKE (Beguin and Major 1975, Burke 1987)

Location

This soon-to-be-established RNA is in the Lake Tahoe Basin Management Unit in the El Dorado National Forest. It lies

immediately W. of Luther Pass on State Highway 89 and is ca. 12 miles (19 km) SSE. of South Lake Tahoe. It lies within sects. 13, 14, 15, 22, 23, and 24 TI IN, R8E MDBM (38°46' N., 119°59'W.) USGS Freel Peak quad *(fig. 95).*

Target Element

Moss bog.

Distinctive Features

• Significance of the Bog: Peatlands and bogs are rare in California. Grass Lake is the largest *Sphagnum* bog in California and is considered the best representative floating bog in the Sierra Nevada *(fig. 96).* Grass Lake has been the focus of several scientific surveys including palynological and phytosociological research.

• Varied and Pristine Environment: This is a large site with a complex association of habitat types ranging from aquatic and meadow types through upland forest types. This diversity, plus the presence of a largely intact watershed surrounding the marshlands and meadows, contributes to the value of this site. This site supports a number of boreal plant species unusual in the Sierra Nevada. In addition, several species of plants occur locally at substantially lower elevations than typical elsewhere in the Sierra Nevada. Along with a few uncommon or disjunct plants, the wetlands support three species of carnivorous plants and four species of orchids. The plant associations are relatively pristine with virtually no introduced plants in the bog and meadow associations. The bog and meadow associations are diverse with 11 types described.

Physical Characteristics

The area covers ca. 2400 acres (972 ha) although the final established area is much smaller. Grass Lake is a small body of water surrounded by a large *Sphagnum* bog. Portions of the marshland are underlain by water, forming a true quaking bog. Grass Lake is in a low-lying basin between peaks in the Carson Range, east of the main Sierra Crest. Elevations range from 7716 to 9497 ft (2352-2895 m). Slopes vary from 0° to 50°. Three streams feed the lake and bog from the N. and one stream plus several small seeps feed it from the S. The basin was glacially scoured in the Pleistocene. The Grass Lake Basin drains to the W., but before the damming by a Pleistocene terminal moraine it had drained to the E. over Luther Pass.

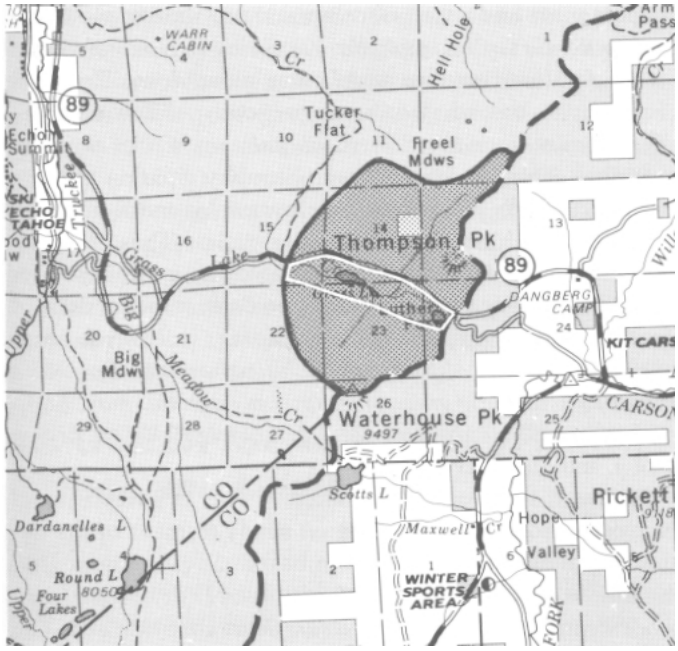


Figure 95--The Grass Lake study area (latest proposed RNA boundary in white).

Figure 96--The Grass Lake RNA contains the largest and best example of a *Sphagnum* fen in the Sierra Nevada. Note dense stand of *Eriophorum gracile* in foreground (M. Burke).

Rocks are all granitic including the Bryan Meadow Granodiorite, the Echo Lake Granodiorite, and the Waterhouse Peak Granodiorite. The first is the most extensive. Quaternary Alluvium underlies the meadow and lake of the main basin. Soils include marsh soils, Meeks very stony loamy coarse sand, 15-30 percent slopes; Meeks extremely stony loamy coarse sand, 15-30 percent slopes; Tallac stony coarse sandy loam, 5-15 percent slopes; Rock Land, Rock Outcrop-Cagwin Complex, 30-50 percent slopes; and Rock Outcrop-Toem Complex, 30-50 percent slopes. Precipitation is estimated at ca. 40 inches (1016 mm) annually with the majority as snow. Average minimum temperatures are 15 to -24 °F (-9 to -31 °C), and average maximum temperatures are 72-82 °F (22-28 °C). There is an average of 70-120 frost-free days per year.

Association Types

The plant associations of the Grass Lake RNA are divided into five main groups. Four of these are tree-dominated; the fifth includes the *Sphagnum* bog and meadow associations. Extensive sampling was conducted by Beguin and Major (1975) in the bog and associated wet meadow vegetation. However, no additional sampling is done for this survey.

• Jeffrey Pine Forest (85100, 85210): 1274 acres (516 ha). This is typically a tall, open forest dominated by Jeffrey pine *(Pinus jeffreyi)* and white fir *(Abies concolor),* occurring on S.-facing slopes. The understory is relatively sparse and includes *Artemisia tridentata, Chrysolepis sempervirens, Chrysothamnus nauseosus, Symphoricarpos* spp., *Ceanothus cordulatus,* and

Arctostaphylos nevadensis.

On the steepest S.-facing slopes the forest is very open (ca. 30 percent canopy cover), and Jeffrey pine is associated with white fir and lodgepole pine *(Pinus contorta* ssp. *murrayana).* Open ground or rocks may cover up to 75 percent of the surface. However, scattered shrubs of *Artemisia tridentata, Eriogonum umbellatum, Symphoricarpos acutus,* as well as herbs such as *Wyethia mollis, Cirsium andersonii, Castilleja* spp., *Hieracium albiflorum,* and *Lupinus* spp. may sometimes cover up to 50 percent of the surface.

In hollows on steep slopes *Arctostaphylos nevadensis* or *Ceanothus cordulatus* form thickets of up to 100 percent cover under a very open canopy. On relatively level slopes with deeper soil the understory is similar to an open meadow with such species as *Chrysothamnus nauseosus, Sitanion hystrix, Wyethia mollis, Monardella odoratissima* ssp. *pallida, Stipa* spp., and *Erigeron* spp. averaging 25-30 percent cover.

• Red Fir Forest (85310): 819 acres (332 ha). Locally red fir *(Abies magnifica)* grows to be 197 ft (60 m) tall and 300-400 years old. The forest is typically dense and casts heavy shade. Understory vegetation is very sparse with scattered species such as *Pyrola picta, Chimaphila menziesii, Poa* sp., and *Monardella odoratissima* ssp. *pallida.* At high elevation, occasional mountain hemlock *(Tsuga mertensiana)* may be intermixed along with western white pine *(Pinus monticola).* At lower elevation adjacent to the wetlands lodgepole pine also occurs.

Slopes are typically steep. On open avalanche slopes, *Arctostaphylos nevadensis* forms low thickets. Around rocks, *Penstemon newberryi* and *Heuchera* sp. may occur. Rock cover in this association varies from 10 to 85 percent.

• Meadow and Bog Vegetation (45100, 45210, 51110, 51200, 52430, 63500): Beguin and Major (1975) sampled 73 stands (releves) in the meadows and wetlands of Grass Lake. They described 11 associations. These are listed below with common names rather than the original Latin names:

Brown Moss-Bladderwort Association: The most aquatic grouping, this association occupies the open water (up to 3-4 m deep). Brown moss *(Drepanocladus flutitans)* and the bladderwort *Utricularia vulgaris* dominate along with *Myrophyllum spicatum* ssp. *exaltescens, Nuphar polysepalum,* and *Potemogeton natans. Potentilla palustris* may also co-dominate at some sites.

Monkeyflower-Shortsedge Association: This association is the classic quaking bog. It is dominated by *Menyanthes trifoliata, Carex limosa,* a dense understory of brown moss, and *Sphagnum squarrosum. Potentilla palustris* and *Mimulus primuloides* var. *pilosellus* are widespread. *Eriophorum gracile* may form conspicuous dense stands. This association typically borders the brown moss-bladderwort association in shallower water.

The Long- and Short-Beaked Sedge Association: This association also often lines the edge of open water and is dominated by the large sedges *Carex rostrata* and *C. simulata. Sparganium angustifolium, Heleocharis palustris, and Glyceria grandis* also may be important. *Drepanocladus flutitans* and *Utricularia vulgaris* from the Brown Moss-Bladderwort Association overlap frequently.

The Shortbeak-Inflated Sedge Association: This association occurs some distance away from the deepest water and is dominated by *Carex vesicaria.* It is similar to the Long- and Short-Beaked Association, but the presence of *Juncus balticus, Deschampsia caespitosa,* and occasionally *Muhlenbergia filiformis* indicate drier conditions. There is some species overlap with the previous three associations, but those species show reduced vigor and coverages compared to their optimum habitats.

Nebraska Sedge Association: *Carex nebrascensis* is blue-green and, thus, this association is clearly distinguished from others adjacent to it. This association occurs between the drier meadow and the wetter sedge associations. Other common species include *Deschampsia caespitosa, Muhlenbergia filiformis,* and *Aster andersonii* var. *alpigenus.*

Nevada Rush-Spikerush Association (Holland 51200): The outer edges of the bog intergrade into a wet meadow with *Juncus nevadensis, Heleocharis quinqueflora* var. *suksdorfiana,* and *Carex simulata.* This association is restricted to areas where cold spring water and melt water keep the soil above field capacity throughout the summer.

Mountain Bluegrass-Smooth Beaked Sedge Association: This dry meadow association intergrades with surrounding lodgepole pine forest. It is dominated by *Poa epilis, Carex integra, Penstemon oreocharis,* and *Erigeron peregrinus.* Lodgepole pine is scattered often with an understory of *Poa pratensis.* Two subassociations occur: a xerophytic type with *Artemisia tridentata, Cirsium drummondii,* and *Stipa columbiana* (typical of open disturbed areas, e.g., high gopher activity or human disturbance), and a more hydric type characterized by *Mimulus primuloides, Aster andersonii,* and *Polygonum bistortoides.*

Alpine Laurel-Lodgepole Pine Association: This association occurs on the land bridge between the two main parts of Grass Lake. It is a relatively open community with stunted lodgepole pines and a well-developed shrub stratum including *Kalmia polifolia* ssp. *microphylla, Vaccinium occidentale, Salix orestera, Lonicera caurina,* and *Ledum glandulosa.* Herbs include *Luzula comosa, Saxifraga oregana, Allium validum, Pedicularis groenlandica, Carex aquatalis,* and *Carex capitata.*

Willow Thicket Association: Shrubby riparian thickets dominated by *Salix rigida* dominate low swales and along some streamcourses within the Grass Lake basin. These thickets intergrade with meadow associations in wet fine-grained soils or with red fir and lodgepole pine forest on coarser, better drained soils. Associated species include *Lupinus polyphyllus* ssp. *supurbus, Veratrum californicum, Achillea lanulosa, Potentilla glandulosa, Castilleja miniata, Aconitum columbianum, Aquilegia formosa, Senecio triangularis, Thalictrum fendleri, Allium validum,* and *Mimulus guttatus.*

Sandwort-Cudweed Association: This is an ephemeral streamside association occurring on sandy terraces of the numerous meandering rivulets in the basin. *Sagina saginoides, Gnaphalium palustris, Rorippa curvisiliqua, Tofieldia glutinosa* ssp. *occidentalis,* and *Mimulus suksdorfii* are characteristic. The high proportion of annuals is remarkable for such a boreal association.

Few-Flowered Alkali Grass Association: This association,

dominated almost exclusively by *Torreyochloa (Puccinellia) pauciflora,* occurs on wet sandy soils covered with decomposing matter. Other infrequent species include *Deschampsia caespitosa, Carex vesicaria,* and *Juncus balticus.*

• Lodgepole Pine Forest (86100): 57 acres (23 ha). This association occurs around the meadows of the Grass Lake Basin. Lodgepole pine accounts for most of the 50 percent average canopy cover, with red fir and mountain hemlock as occasional associates. At the ecotone between this forest and the meadows, mountain alder *(Alnus tenuifolia)* forms thickets. Understory associates include *Ribes* spp., *Holodiscus microphyllus, Chrysolepis sempervirens,* and *Arnica* spp. In moist sites *Epilobium angustifolium, Aster andersonii, Castilleja miniata, Aquilegia formosa, Thalictrum fendleri, Senecio triangularis,* and *Equisetum* spp. occur. In drier sites *Ledum glandulosum, Pedicularis* spp., and *Rubus parviflorus* are typical understory members.

• Aspen Riparian Forest (61520): This association is of limited extent and is not mapped in this study. A fairly open riparian growth dominated by aspen *(Populus tremuloides)* follows the streams which feed Grass Lake from the N. Perennial, and annual understory species are often dense and include *Aquilegia formosa, Veratrum californicum, Habenaria sparsiflora, Mertensia ciliata, Smilacina stellata, Sphenosciadium capitellatum, Thalictrum fendleri,* and *Castilleja miniata.*

Plant Diversity

Two hundred seventy-six species of lower and higher vascular plants are listed.

Conflicting Impacts

A major State highway (89) runs through the area and borders the sensitive bog on its N. side. Several turnouts have been built along the marsh and bog area, and these areas are frequently used as scenic viewing sites. Until recently, gravel roads led into meadow areas and were a serious impact on the vegetation. The roads have been closed and ripped and sewn with non-native grasses (which are unlikely to invade the wet meadow and bog). Recreational impact on the most sensitive areas is not heavy, most people appreciating the wetlands from afar. It is suggested that the accessibility of Grass Lake to the public may be useful for publicizing the values of RNAs. The most serious potential impact to the area may be road salting in the winter. Illegal gathering of firewood has been a problem in the N. part of the area.

46. GREEN ISLAND LAKE (Fiedler, Carnal, and Leidy 1986)

Location

This soon-to-be-established RNA is on the Lassen National Forest. It lies ca. 16 miles (26 km) SW. of Canyon Dam. The area occupies portions of sect. 6 T25N, R6E and sect. 1 T25N, R5E MDBM (40°03' N., 121°22' W.) USGS Jonesville and Belden quads *(fig. 97).*

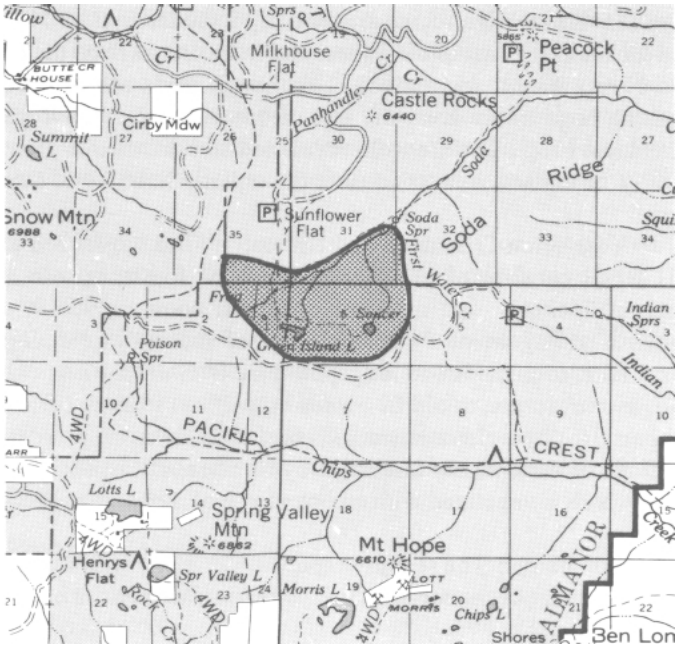


Figure 97--The Green Island Lake RNA.

Target Element

Moss bog

Distinctive Features

• Meadow and Aquatic Resources: Meadows are found throughout the area either as small patches in forest openings or as large successional types surrounding lakes *(fig. 98).* Four permanent lakes and five ephemeral ponds occur in the area. The large lakes are described individually. They vary in their productivity with Saucer Lake being deeper and less productive than Green Island Lake, which contains a large population of introduced, but reproducing brook trout as well as numerous aquatic insects and plants. Frog Lake is also relatively produc-

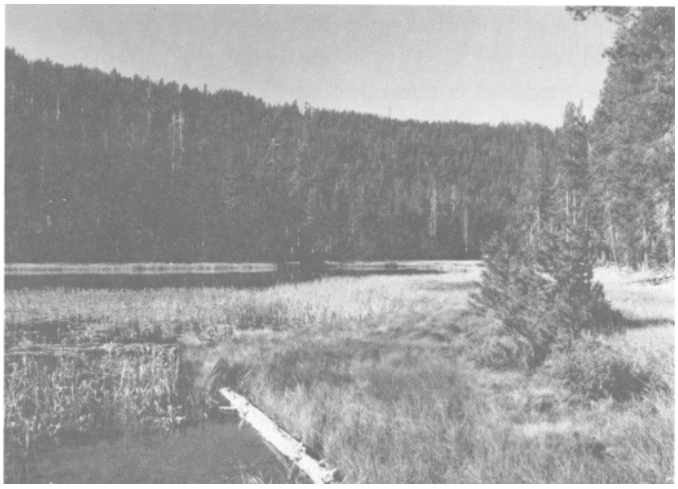


Figure 98--Green Island Lake's diverse aquatic vegetation includes a *Sphagnum* meadow (K. Berg).

tive. Several small streams are partially included in the RNA, and the main streams of Firstwater and Soda creeks form the E. and N. boundary, respectively. Although there are no true quaking bogs in the area, the wet meadows bordering Green Island and Frog lakes are well-developed and diverse. A great variety of aquatic insects inhabit the aquatic habitats of this basin.

• Vegetation Dynamics and Diversity: The vegetation at this RNA consists of an interdigitation of forest, meadow, riparian thickets, and montane chaparral communities in a dynamic arrangement. Various stages of succession ranging from lake, to meadow, to lodgepole pine *(Pinus contorta* ssp. *murrayana)* forest, to red fir *(Abies magnifica)* forest, or from chaparral to upper elevation mixed coniferous forest are present. Portions of the area are underlain by ultramafic (serpentinite) rock, which is vegetated with an open form of montane chaparral.

• Rare Fauna: The sensitive species wolverine *(Gulo gulo)* and goshawk *(Accipeter gentilis)* have been seen in the basin.

Physical Characteristics

This area covers 1185 acres (480 ha). Elevations range from 5280 ft (1609 m) at the junction of Firstwater and Soda creeks to 7088 ft (2160 m) atop the ridge at the SW. corner. The area drains to the NE. with moderate to steep topography. The lakes occupy a cirque basin and were formed by Pleistocene glacial action and in some cases by organic damming of outlet streams. Lakes range from less than one acre to 14-acre (6-ha) Green Island Lake.

The area is near the northernmost extension of the Sierra Geologic Province, with Cascades volcanic rocks within 1 mile (1.6 km) to the N. and W. Most of the area is mapped as underlain by the Calaveras Formation (primarily metasedimentary phyllite, quartzite, and metachert, but also some metavolcanics). However, there are large areas of ultramafic rock, perhaps associated with the Melones Fault Zone. Soils are not described. Weather records are summarized from Canyon Dam and Chester, both with different climates than the RNA. Precipitation is estimated (Rantz 1972) at between 70 and 80 inches (1778-2032 mm) with most falling as snow in the winter.

Association Types

The montane coniferous forest is sampled along three transects using the point-centered quarter technique. Vegetation of the hydric associations is qualitatively described.

• Montane Coniferous Forest (84180, 85310): 820 acres (332 ha). In general, this forest is open (boulders scattered throughout) and dominated by red fir *(Abies magnifica).* One transect at the upper elevations on N.-NE.-facing slopes was relatively closed forest strongly dominated by red fir (88 percent relative cover) with 337 trees/ha and 79 m^2/ha basal area. In the more open sites (transects 2 and 3), red fir still dominates and averages 220 trees/ha with a basal area of 28 m^2/ha. However, red fir makes up only 40 percent of the cover. Other important species include white fir *(Abies concolor),* western white pine *(Pinus monticola),* and lodgepole pine *(Pinus contorta* ssp. *murrayana).* The density and cover values of these three species are 183/ha, 23 m^2/ha; 22/ha, 15 m^2/ha; and 44/ha, 19 m^2/ha, respectively. At elevations below the transects, Jeffrey pine *(Pinus jeffreyi)* and sugar pine *(P. lambertiana)* also occur.

Understory vegetation is dominated by scattered to dense montane chaparral shrubs including *Quercus vaccinifolia, Arctostaphylos nevadensis, Prunus emarginata, and Ribes roezlii.* A number of herbs (44) are listed for this forest. These vary depending on site conditions and include *Aster elatus, Allium campanulatum, Aquilegia formosa, Calyptridium umbellatum, Corallorhiza maculata, Delphinium depauperatum, Gayophytum decipiens, Hackelia nervosa, Ligusticum grayi, Osmorhiza occidentalis, Phacelia purpusii, Pyrola secunda, Sarcodes sanguinea,* and *Trifolium productum.*

• Chaparral (37510): 311 acres (126 ha). This association is broken into two phases. The larger portion is a sparse type on ultramafic ridges and openings. *Arctostaphylos nevadensis* and *Quercus vaccinifolia* occur as scattered shrubs with large rocky openings with perennial forbs such as *Calochortus leichtlinii, Erysimum* spp., *Monardella odoratissima* ssp. *pallida, Achillea millefolium,* and *Sanicula tuberosa.* A smaller area of closed chaparral is dominated by *Arctostaphylos patula* with occasional *Quercus vaccinifolia* and *Spiraea densiflora.* The herb understory of this type is sparse.

• Alder Riparian (63500): 34 acres (14 ha). Streams of the area support a riparian scrub of *Alnus tenuifolia* with occasional *Acer glabrum* var. *torreyi* at the higher elevations. A small clone of aspen *(Populus tremuloides)* occurs along upper Soda Creek. *Alnus tenuifolia* thickets also occur adjacent to meadows at the lower elevations. The herbaceous flora includes *Sphenosciadium capitellatum, Senecio triangularis, Heracleum lanatum, Lilium* sp., *Perideridia parishii,* and *Polygonum bistortoides.*

• Wet Meadow (45100): 20 acres (8 ha). Wet meadows occur most extensively adjacent to the three main lakes. These are densely vegetated meadows bordering forest vegetation in recently glaciated terrain. Most can be classified as stringer type meadows. Eighteen species are listed as characteristic including *Achillea millefolium, Calochortus nudus, Carex* spp., *Danthonia unispicata, Dodecatheon jeffreyi, Erythronium purpurascens, Juncus howellii, J. nevadensis, Potentilla glandulosa,* and *Veratrum californicum.*

• Aquatic Communities/Submerged Macrophytes (52430): 29 acres (12 ha). This association is well developed in the area and includes the submerged macrophytes *Potemogeton filiformis* var. *macounii, Isoetes bolanderi,* and *Ranunculus aquatalis* var. *capillaceus.* The floating macrophytes are concentrated near the shores of all three main lakes. They include *Ruppia maritima, Potemogeton* spp., and *Sagittaria cuneata.*

The emergent zones are well-developed at all three lakes and were considered as the "floating bog" target during initial reconnaissance. Species (24 listed) include *Carex rostrata, C. vessicaria, C. hystricina, Menyanthes trifoliata, Potentilla palustris,* and *Heleocharis acicularis.*

Plant Diversity

One hundred fifty taxa are listed.

Conflicting Impacts

The area is relatively isolated and undisturbed. All three lakes have introduced populations of either brook or rainbow trout.

47. MOUNT PLEASANT (Keeler- Wolf and Keeler-Wolf 1981, Keeler-Wolf 1989i)

Location

This soon-to-be-established RNA is on the Plumas National Forest, Plumas County. It is five miles (8 km) N. of the resort area along the S. shore of Bucks Lake. It lies within portions of sects. 1, 2, 10, 11, 14, and 15 of T24N, R7E, MDBM (39°57' N., 121°'10'W.) USGS Bucks Lake quad *(fig. 99)*.

Target Elements

Red fir *(Abies magnifica)*

Distinctive Features

• Distinctions Between Mt. Pleasant and Other Red Fir RNAs: Compared to other surveyed Sierra red fir candidate RNAs (#'s 46, 49, 55, and 60) Mt. Pleasant has the following distinctions:

Red fir is overwhelmingly the dominant tree throughout forested portions.

Red fir is reproducing in many different cover and stand types including S. and W. aspects rare or absent at other sites. Growth rates appear very rapid on SW. exposures, and the RNA may have one of the most quickly maturing and reproducing red fir forests known.

The local mode of red fir reproduction differs from the standard type for the species (e.g., continual versus the typical pulse type, as described in Rundel and others 1977). There is regular reseeding and a high percentage of uneven age classes throughout the area in different stands. Continual reestablishment may result from high annual precipitation providing mesic conditions necessary for optimum germination and growth of seedlings.

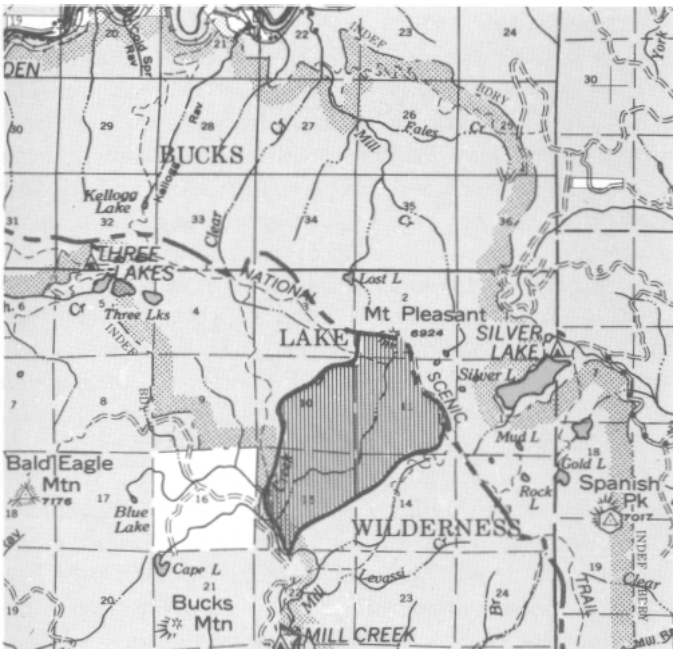


Figure 99--The Mount Pleasant RNA.

All trees are short-cone bract *A. magnifica,* but only ca. 30 miles (48 km) N., most red fir is exerted-bract *A. magnifica* var. *shastensis.*

Mt. Pleasant is the only red fir RNA with a well-represented bog flora, rare in the Sierra Nevada (see #45).

It is the only red fir RNA completely on granitic rock, the most widespread rock in the higher Sierra Nevada.

• Rare Plants: *Penstemon neotericus* is a member of CNPS List 4.

Physical Characteristics

The area studied in the ecological survey is ca. 1785 acres (722 ha); however, the established RNA area is 1416 acres (573 ha). Elevations range from 5910 to 7120 ft (1801-2170 m). Slope aspect is primarily SW. with a gentle gradient to the summit of Mt. Pleasant. The survey also encompasses portions of the steep, glaciated NE.-facing escarpment of the mountain (not within the established RNA).

The principal rock type is granodiorite. Near the summit area are small andesitic dikes. The climate is montane Californian with exceptionally high winter precipitation. Mean April 1 snowfall at the snowcourse at the edge of the area (5910 ft, 1801 m) is 95 inches (241 cm). Mean winter depth may be over 144 inches (366 cm) at the higher elevations. Estimated mean annual precipitation is between 85 and 90 inches (2159-2286 mm) (Rantz 1972).

Association Types

A total of fifteen 0.1-ha plots are sampled in the red fir forest.

• Red Fir Forest (85310, 84240): 1260 acres (510 ha). Red fir forests range from sheltered 175 ft (53 m) tall groves of 60-70 inches (1.5-1.8 m) dbh trees with little understory to open park-like stands with well-developed shrubby to herbaceous understories. Over the elevation gradient, red fir occurs as a codominant with white fir *(Abies concolor)* at low elevations, forms extensive monospecific forests throughout the mid-elevations, and codominates with western white pine *(Pinus monticola)* and locally with mountain hemlock *(Tsuga mertensiana)* at the highest elevations. Tree densities on the plots vary from 200 to 720/ha (mean 381), seedlings and saplings (all individuals < 6 ft, or 1.8m) range from 100 to 6030/ha, and basal area cover ranges from 32 to 189 m^2/ha (mean, 98 m^2/ha). Herb and shrub cover varies greatly from open to closed stands.

Three main subtypes of *A. magnifica* forest are identified: a relatively xeric, shallow-soil, open forest characterized by the presence of mountain chaparral shrubs (5 shrub and 6 herb species characteristic); an open forest with poor shrub layer, but dense herbs (22 species characteristic) in the *Monardella-*

Chrysopsis union of Oosting and Billings (1943); and a closed forest with no shrub layer and sparse herbs (15 species listed) ranging from shade-tolerant meadow border species to more xerophilic ericaceous interior forest species *(fig. 100).*

• Mountain Riparian (63500): 179 acres (72 ha). This association is dominated by *Alnus tenuifolia* with *Salix orestera* and *S. caudata.* Other woody species include *Sorbus californicus, Cornus stolonifera, Sambucus microbotrys, Salix ligulifolia, Spiraea douglasii, Lonicera conjugialis, Leucothoe davisiae,* and *Kalmia polifolia* var. *microphylla.* There are many hydrophilic herbs and grasses including *Aconitum columbianum, Athyrium felix femina, Boykinia major, Circaea alpina* var. *pacifica, Epilobium angustifolium, Lilium pardalinum, Mitella breweri, Thalictrum fendleri,* and *Viola glabella* (23 species listed as characteristic).

A distinctive phase on the NE. escarpment is dominated by *Salix orestera* with *Rhamnus alnifolia,* aspen *(Populus tremuloides), Sorbus californica, Spiraea douglasii,* and *Athyrium alpestre* var. *americana.*

• Rock Outcrops (91200): 125 acres (51 ha). Mostly on NE.-facing granitic escarpment, this association includes a shrub-dominated mesophilic subtype with *Acer glabrum* var. *torreyi, Ribes nevadense, Spiraea densiflora, Heuchera rubescens* var. *glandulosa, Juncus nevadensis, Luzula divaricata, Phyllodoce breweri, Poa hanseni, Primula suffrutescens, Saxifraga bryophora,* and *Silene douglasii.* There is also a xeric subtype with *Sedum obtusatum* ssp. *boreale, Zauschneria californica* ssp. *latifolia, Penstemon newberryi, P. deustus, Cheilanthes gracillima, Eriogonum lobbii, Streptanthus tortuosus* var. *orbicularis,* and *Arenaria nuttallii* ssp. *fragilis.*

Figure 100--Mt. Pleasant: A complex of wet and moist meadow habitat surrounded by montane riparian thicket and dense red fir forest.

• Mountain Chaparral (37510, 37542, 37520): 101 acres (41 ha). This association is primarily an edaphic climax in this area, occurring on rocky ridgetops or escarpments. Dominants vary with *Quercus vaccinifolia, Chrysolepis sempervirens,* and *Ceanothus velutinus* on relatively mesic or deeper soils. *Arctostaphylos nevadensis* and *A. patula* commonly dominate on shallowest or driest exposures. There are few herbs.

• Meadow (45100, 45210): 69 acres (28 ha). Three subtypes occur, varying from wet to moist. Thirty-six species are listed as typical for wet subtype including *Cardamine breweri, Carex jonesii, C. nervina, Deschampsia caespitosa, Epilobium hornemannii, Glyceria elata, Habenaria dilitata* var. *leucostachys, H. sparsiflora, Juncus nevadensis, Luzula subcongesta, Saxifraga oregana, Sphenosciadium capitellatum,* and *Viola adunca.*

The moist subtype is more extensive with 22 typical species including *Achillea lanulosa, Aster elatus, Delphinium depauperatum, Deschampsia danthonoides, Gilia capillaris, Lewisia nevadensis, Ligusticum grayi, Mimulus breweri, Penstemon oreocharis, Perideridia parishii,* and *Veratrum californicum.*

The moist NE.-facing granite bench subtype has 14 species not present in other subtypes including *Agrostis variabilis, Arnica diversifolia, Aster campestris* var. *bloomeri, Carex spectabilis, Phyllodoce breweri, Poa epilis, Phacelia procera, Potentilla drummondii,* and *Saxifraga bryophora.* It bears some similarities with subalpine meadows (Holland 45210).

• Dry Meadow (45100): 23 acres (9 ha). This is a minor association within the red fir zone at the head of valleys above meadows and riparian scrub, often on N. or NW. exposures. The soil is deep decomposed granite. Late snow melt and well drained soil here may preclude establishment of forest. Herbs include *Astragalus bolanderi, Calyptridium umbellatum, Castilleja paynae, Eriogonum umbellatum* var. *polyanthum, E. ursinum, Haplopappus bloomeri, Lupinus obtusilobus, Penstemon laetus* ssp. *leptosepalus,* and *Phlox diffusa.*

• Bog-Fen (51110, 51200): 20 acres (8 ha). Two subtypes occur: submerged and raised. Submerged bog species include *Menyanthes trifoliata, Sparganium minimum, Potemogeton natans, Nuphar polysepalum, Heleocharis acicularis* var. *bella, H. montevidensis, Carex rostrata, C. limosa.* Raised bog species include *Sphagnum* sp. *Drosera rotundifolia, Mimulus primuloides* var. *pilosellus, Castilleja lemmonii, Pedicularis attolens, Aster alpigenus* ssp. *andersonii, Carex angustior, C. gymnoclada, C. senta, Camassia leichtlinii* ssp. *suksdorfii, Poa palustris, Polygonum bistortoides, Viola macloskeyi, Vaccinium occidentale,* and *Kalmia polifolia* var. *microphylla.*

• Lodgepole Pine *(Pinus contorta ssp. murrayana)* Forest (86100): 19 acres (8 ha). This association forms narrow border

groves along larger meadows and stream courses. Regeneration is healthy with several age classes; some trees are up to 45 inches (1.1 m) dbh and 135 ft (41 m) tall. Some areas of dead snags suggest water level fluctuations or infestations of needle miners. The understory is a subset of adjacent meadow and riparian associations.

Plant Diversity

Two hundred forty-five species of vascular plants are listed for the area.

Conflicting Impacts

Cattle grazing has been a consistent pressure on the area for many years. By the end of the summer, grazing exerts a strong visual impact on the vegetation of the bog, meadow, and riparian areas. There is evidence of increased erosion and habitat degradation in hydric associations. The area is now part of Bucks Lake Wilderness Area, ca. 2 miles (3.2 km) of lightly used portion of the Pacific Crest Trail traverses the upper elevations.

48. MUD LAKE (Keeler-Wolf 1985b, Keeler- Wolf 1988c)

Location

This established RNA is on the Plumas National Forest. It is divided into two units: Mud Lake and Wheeler Peak. The first unit is within sects. 23 and 26 T27N, RI IE MDBM (40°10'N., 120°42'W.), the second unit is ca. 5 miles (8 km) S., lying entirely within sect. 23 T26N, R11E MDBM (40°06' N.,122°42' W.). Both areas lie ca. 13 miles (21 km) E. of Greenville. USGS Kettle Rock and Genesee Valley quads *(fig. 101).*

Target Element

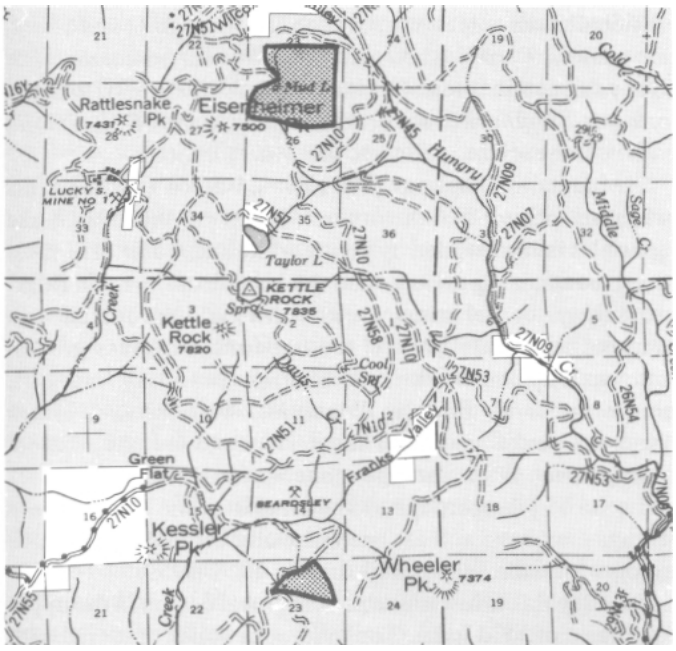


Figure 101--The Mud Lake RNA (both units).

Baker (Modoc) Cypress *(Cupressus bakeri)*

Distinctive Features

• Baker Cypress: The two stands of this species within this RNA are unique for several reasons:

They are the only stands of this species in Plumas County, marking the S.-most range limit for this species.

No other stands of any species of cypress in the state are known above 6000 ft (1829 m), and none are further from the coast. Both of these stands are above 6500 ft (1981 m) and ca. 175 miles (282 km) from the nearest point along the coast. Thus, these stands are probably subjected to more snowfall and colder temperatures than any cypresses in the state or the world.

These stands are isolated by ca. 76 miles (122 km) from the nearest Baker cypress in Shasta County. The cool climate and isolation have undoubtedly influenced the genetic composition of these stands and research is currently being done to determine their taxonomic position (C. Millar pers. comm. 1989).

The S. unit (Wheeler Peak) contains several large cypress individuals over 1 m dbh *(fig. 102).* One is the largest known Baker cypress (4.7 ft [1.42 m] dbh, 71 ft [21.6 m tall]), and may be well over 300 years old. These large trees occur at the edges of dense monospecific cypress stands just N. of a largely unvegetated rounded ridgetop.

The number of large individuals at Wheeler Pk. contrasts sharply with the situation at the N. unit (Mud Lake). Here trees occur in dense spindly stands under 100 years old, or as senescent individuals scattered in a dense, young forest of white fir *(Abies concolor).* The oldest tree is less than 150 years, and most are under 90, indicating an extensive crown fire 90+ years ago. The competition for light with the white fir at Mud Lake has produced some of the tallest known Baker cypress (ca. 92 ft, 28 *m) (fig. 103).*

• Biogeographic Significance: This area represents the NE. extension of the N. Sierra Nevada province and is only a few miles from the edge of the N. Great Basin. This cold desert influence is apparent on the xeric ridgetops of both units, where vegetation is dominated by typical Great Basin species (e.g.,

Figure 102--Mud Lake: One *of* the several large Baker Cypress (49 inches, 125 cm dbh) at edge *of* ridgetop cap *of* volcanic breccia, Wheeler Peak unit.

Artemisia tridentata, Purshia glandulosa, Wyethia mollis). Species associated with these ridgetops include several other Great Basin forms such as *Bromus richardsonii, Penstemon speciosus, Thelypodium flexuosum, Poa nevadensis,* and *Stipa williamsii,* which are atypical of the western side of the Sierra-Cascades Divide.

• Rare Plants: Baker cypress *(Cupressus bakeri* ssp. *bakeri)* is a member of CNPS List 4.

Physical Characteristics.

The Mud Lake unit covers 307 acres (124 ha), and the Wheeler Peak unit covers 73 acres (30 ha). Elevations at Mud Lake range from 6160 to 7320 ft (1878-2231 m). Elevations at Wheeler Peak range from 6080 to 6560 ft (1853-2000 m). The Mud Lake unit occupies the NE. slope of Eisenheimer Pk. and includes a small glacial cirque containing the shallow 2.5-acre (1-ha) Mud Lake. The Wheeler Pk. unit occupies the N.-facing slope of a spur ridge running W. from Wheeler Pk. Both areas have slopes averaging 25-35°.

Rocks at both units are Tertiary volcanics, primarily andesite of the Penman and Ingalls formations. The summit ridge at Wheeler Pk. is capped by mudflow breccia. Soils are described as one principal mapping unit at both sites; the Inville-Woodseye-Goodlow Complex covers the Mud Lake site, and the Inville-Woodseye Complex covers the Wheeler Pk. The Goodlow Family is a moist soil which underlies the meadows and lake at Mud Lake. Annual precipitation is estimated at ca. 40 inches (1016 mm) at both sites, with the majority as snow. Drifts of over 6 ft (2m) occur regularly at the highest elevations. Temperatures average ca. 27 °F (3 °C) in January with annual minima at or below 5 °F (-15 °C). The July mean is ca. 61 °F (16 °C).

Figure 103--Mud Lake: Dense accumulation of dead stems of Baker cypress, the result of shading by the surrounding over-topping white fir/red fir forest at Mud Lake unit.

Association Types

Mixed conifer and cypress stands are sampled using a total of nineteen 100-m^2 plots. The remaining vegetation is qualitatively described.

• Mixed Conifer Forest (84230, 84240): 307 acres (124 ha). Both units contain large areas of this forest type. The majority of the Mud Lake forest is dominated by white fir *(Abies concolor)* with the major subdominants Baker cypress and red fir *(Abies magnifica),* whereas the Wheeler Pk. forest is more mixed with white fir, sugar pine *(Pinus lambertiana),* Jeffrey pine *(P. jeffreyi),* incense-cedar *(Calocedrus decurrens),* and Douglas-fir *(Pseudotsuga menziesii)* co-dominating.

Thirteen 10- by 10-m plots are sampled in the Mud Lake forest. Most of these are in the young forest strongly dominated by white fir. Trees in this forest average only 6 inches (15 cm) dbh (maximum ca. 20 inches, 51 cm). Canopy height is 89-100 ft (27-30 m) in the areas with deepest soil. Tree density is high (3340/ha) with white fir accounting for 77 percent of the stems. Basal area cover is correspondingly low, averaging 77 m^2/ha, with white fir accounting for 69 percent of the total. Baker cypress accounts for 16 percent of the stems and 20 percent of the cover. Portions of this association at the lower elevations at Mud Lake and most of it at Wheeler Pk. contain large mature trees with dbh's up to 5 ft (1.5 m) and heights of 161 ft (49 m).

The understory of the dense, young forest is sparse with occasional shade-tolerant herbs such as *Chimaphila umbellata, C. menziesii, Pyrola picta,* and *Corallorhiza maculata.* The more open, mature forests have occasional shrubs of *Ceanothus prostratus, Symphoricarpos acutus, S. vaccinioides, Ribes roezlii, Amelanchier pallida,* and *Arctostaphylos patula.*

• Mountain Chaparral (37510): 24 acres (10 ha). This association occurs at both units. Much of the Mud Lake chaparral is being invaded by young white and red fir. The most extensive remaining areas are on the N. side of the main ridge. Here thickets border on sagebrush scrub and are mixed with young red and white firs and the uppermost cypress groves. *Arctostaphylos nevadensis* dominates the rocky margins, whereas taller *A. patula, Ceanothus velutinus, Prunus emarginata,* and *Chrysolepis sempervirens* dominate adjacent to young forest. A similar type of successional chaparral occurs at Wheeler Pk. in openings on the N. side of the ridge. These openings may have at least been partially created by selective logging within the Wheeler Pk. unit in 1957-1959.

An edaphic climax mountain chaparral occurs in the upper cirque basin of Mud Lake. The thin rocky soil is scattered with andesite boulders and supports a sparse cover of *Arctostaphylos nevadensis, Ceanothus velutinus, C. cordulatus, Symphoricarpos*

vaccinioides, Ribes cereum, Spiraea densiflora, and *Amelanchier pallida.* Perennial herbs such as *Penstemon newberryi* and *Monardella odoratissima* ssp. *pallida* are common.

• Ridgetop Scrub and Herb Association (35210): 13 acres (5 ha). This association is called big sagebrush scrub in the establishment record. It is dominated by a sparse to moderate cover of *Artemisia tridentata, Purshia tridentata, Chrysothamnus nausiosus* ssp. *albicaulis,* and *Haplopappus bloomeri.* Other characteristic species include *Eriogonum umbellatum, E. ursinum, E. marifolium, Penstemon speciosus, P. deustus, Crepis occidentalis,* and *Wyethia mollis* (31 species listed as characteristic). Certain areas of the ridgetops are vegetated with scattered Jeffrey pine and white fir. These areas tend to have higher representation of mountain chaparral shrubs such as *Ceanothus velutinus* and *Prunus emarginata.* A large-leafed form of *Ceanothus prostratus* is conspicuous at the Wheeler Pk. site.

• Riparian Associations (61520, 63500): 11 acres (4 ha). The Mud Lake unit has willow *(Salix ligulifolia, S. pseudocordata, S. drummondiana* var. *subcoerulea),* mountain alder *(Alnus tenuifolia),* and aspen *(Populus tremuloides)* riparian areas surrounding the lake, its outlet stream, and several seeps. The aspen type is limited to a few acres along the outlet stream. It is not well-developed, with only scattered moderate-sized trees. It is closely associated with the willow-dominated riparian thickets.

The willow thickets are particularly common on the margins of the lake, but also occur as patches along the intermittent outlet stream. Beneath them is a rich herb layer including *Mertensia ciliata, Bromus marginatus, Elymus glaucus, Cirsium andersonii, Aster occidentalis, A. integrifolius,* and *Senecio triangularis.*

Mountain alder is locally dominant at the S. end of the lake and also occurs in shadier areas along the outlet stream and in several seep areas surrounded by coniferous forest.

• Northern Interior Cypress Forest (83220): 9 acres (4 ha). This association is considered within the mixed conifer forest in the ecological survey, but treated separately in the establishment record. This classification pertains largely to the monospecific stands of Baker cypress at Wheeler Pk. and to the few dense high elevation stands at Mud Lake. The Mud Lake stands are crowded and spindly, and are becoming senescent as they are shaded out by the competing white and red firs.

In contrast, most of the stands at Wheeler Pk. are isolated from surrounding mixed conifer forests and border on the open ridgetop. These stands appear to be healthy, although often dense. They are exposed to more sun and less competition than the Mud Lake stands. Densities for six plots in this forest at the Wheeler Pk. site average 3100/ha with Baker cypress comprising 44 percent of the stems and white fir (mostly pole size) comprising ca. 56 percent. Basal area cover averages 52 m^2/ha with Baker cypress comprising 72 percent of the cover and white fir 26 percent. The understory is poorly developed because of the dense nature of the canopy.

• Red Fir Forest (85310): 6 acres (2 ha). This forest occurs at the head of the Mud Lake cirque above 7000 ft (2134 m). It is associated with the edaphic climax form of mountain chaparral and is relatively open. Some of the successional fir forest surrounding the uppermost cypress stands may also be considered as this type.

• Riparian Border Forest (Holland 86100): 6 acres (2 ha). This association forms an intermittent border lying between the young mixed conifer forest and the riparian and meadow associations at the Mud Lake unit. It is dominated by lodgepole pine *(Pinus contorta* ssp. *murrayana)* with occasional aspen, red fir, white fir, Baker cypress, and Jeffrey pine intermixed. This is the most mesic situation for Baker cypress, and some of the largest and oldest individuals at the Mud Lake unit occur here (up to 76 cm dbh and 130 years old). The understory is shady and contains some of the more shade-tolerant of the riparian and meadow species.

• Meadow (45110,45120): 4 acres (2 ha). This association is interspersed with the riparian shrubs and trees around the lake and its outlet. Both wet and dry phases occur. A large number of herbs occur in this association (35 species listed as characteristic). Typical meadow species include *Agrostis variabilis, Carex heteroneura, C. stipata, Danthonia intermedia, Glyceria striata, Juncus xiphioides, J. nevadensis, Perideridia gairdneri, Sisyrinchium idahoense,* and *Trifolium varigatum* var. *pauciflorum.*

• Montane Freshwater Marsh (52430): Three acres (1 ha). This association is restricted to Mud Lake. This shallow lake harbors a patchy cover of shallow-rooted and floating-leaved hydrophytes including *Carex rostrata, Sparganium multipedunculatum,* and *Potamogeton natans. Carex rostrata* forms a dense band around the lake. This association was termed aquatic association in the ecological survey.

Plant Diversity

One hundred eighty-one taxa are listed in the ecological survey. An additional six species were noted in the establishment record (total 187).

Conflicting Impacts

The cypress stands at the Mud Lake unit must be rejuvenated by fire or they will soon be shaded out by the dense young white fir forest. Prescribed burning at Mud Lake will be difficult because of the dense fir forest. Wheeler Peak will also require burning to rejuvenate the cypress stands there, but this will be less difficult because of the surrounding open vegetation. Some of the Wheeler Pk. unit was selectively logged between 1957 and 1959. However, the scattered cypress in this part of the area justifies its inclusion in the RNA.

49. ONION CREEK (Talley 1977b)

Location

This candidate RNA (dropped in 1982) is on the Tahoe National Forest, Placer County. It lies about 2 miles (3 km) S. of Norden. It lies within portions of sect. 36 T 17N, R 14E, sects. 1 and 12 T16N, R14E, sect. 29 T17N, R15E, and sect. 32 T16N, R15E MDBM (39°19'N., 120°20' W.) USGS Norden quad *(fig. 104).*

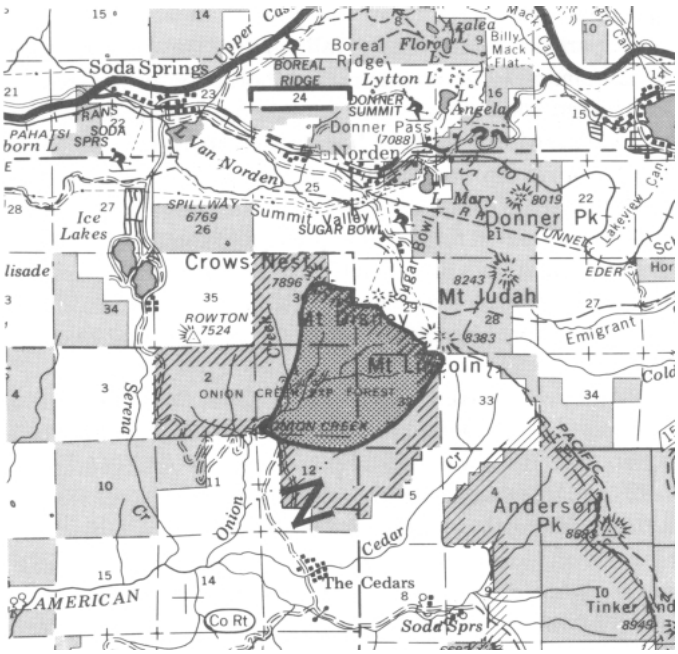


Figure 104--The Onion Creek study area.

Target Elements

White fir *(Abies concolor),* red fir *(Abies magnifica)*

Distinctive Features

• Tree Growth: A large body of data is presented on this topic. To summarize: growth of red and white fir within closed stands is essentially equal and linear between 5 and 30 years after establishment. Fastest growth of both species occurs on gentle S. to W.-facing aspects. Trees growing in open sites attain breast height in 15 and 30 years. Slowest red fir growth is on high steep N.-facing slopes (70 years to breast height), and slowest white fir growth is on glacial moraines on S.-facing slopes (100 years to breast height).

• Structure: Much of the present white fir forest was dominated by red fir up to 150 years ago. Establishment of sugar pine *(Pinus lambertiana)* and Jeffrey pine *(P. jeffreyi)* within white fir forest has been gap-phase. Incense-cedar *(Calocedrus decurrens) is* also largely gap-phase. Dry meadows formerly dominated by large individuals of incense-cedar are now often characterized by forests of dense, young white fir, indicating recent invasion of these habitats. Before an increase in establishment ca. 1750 for white fir, other gently sloping meadow borders were probably co-dominated by incense-cedar, white fir, sugar pine, and Jeffrey pine, forming an open mixed conifer forest.

The steady upsurge of white fir in the past 350 years coincides with increasing warmth, which was augmented by above-average precipitation 50-100 years ago. Reduction in fire frequencies may also explain the recent white fir invasion of dry meadows at elevations below 6562 ft (2000 m).

The increase in density and extent of white fir forest contrasts with the situation for red fir, which shows stability over the past 400 years. Red fir forest is regionally stable, but locally gap-phase in its reproductive strategy. In some areas where wind-throw was extensive there are large even-aged and dense stands of young red fir. Western white pine *(Pinus monticola)* is much less common than red fir, but has a similar negative log-linear relationship in size classes. In general, recent changes in densities of tree species in red fir forest will probably not result in major changes in composition of this climax forest over coming centuries. Lower elevation sites experiencing upsurges in white fir will combine with a red fir increase within upper elevation white fir forest to produce a broader overlap zone of red and white fir forest.

Physical Characteristics

This site encompasses 1035 acres (419 ha) between 6040 and 8382 ft (1840-2555 m) on the W. slope of the Sierra Nevada in the uppermost watershed of Onion Creek, a tributary of the N. Fork of the American River. S.-, SW.-, and W.-facing slopes predominate, with slopes steepening to vertical cliffs and talus at the upper elevations.

Rocks are Miocene and Pliocene volcanic pyroclastic deposits. At Norden 88 percent of the precipitation falls between November 1 and April 30, with 91 percent of all precipitation falling as snow. Mean annual precipitation is ca. 53 inches (1346 mm). Mean maximum summer temperatures are 64-75 °F (18-24 °C), whereas winter temperatures below -13 °F (-25 °C) are very rare.

Association Types

Eight 0.07-ha plots are sampled in white fir forest; nine are sampled in red fir forest.

• Rock Scree, Cliff, and Talus (91200): 400 acres (162 ha). This association forms a topographic timber line above ca. 7220 ft (2200 m). There are occasional trees of Jeffrey pine and Sierra (western) juniper *(Juniperus occidentalis* ssp. *australis),* but the majority of the vegetation (usually <50 percent total cover) is herbaceous or shrubby. The following species are typical: *Eriogonum umbellatum* ssp. *polyanthum, E. lobbii, Artemisia tridentata, Arctostaphylos nevadensis, Ceanothus cordulatus, C. prostratus, Collinsia parviflora, Gayophytum ramosissimum, Helianthella californica, Monardella odoratissima, Phlox diffusa, Sitanion hystrix,* and *Wyethia mollis.*

• Red Fir Forest (85310): 363 acres (147 ha). Red fir forest is restricted to higher elevations and cold air pockets where drought stress is low. Red fir is strongly dominant on N.-facing slopes above 6890 ft (2100 m) and along canyon bottoms at lower elevations. Importance values are consistently high (227 ± 23). Density is variable, ranging from 101 to 1823 stems/ha, as is basal area (72 ± 25 m^2/ha), but cover is more stable (55±14 percent). Principal associates with red fir are western white pine (high elevations) and white fir (low elevations). Average importance value for white fir in this forest is 62 with a density of 125 stems/ha, 18 percent crown cover, and basal area of 19 m^2/ha. Western white pine occurs in low density at five plots with an average importance value of 29, a density of 34 stems/ha, crown cover of 7.2 percent, and basal area cover of 6 m^2/ha. Sugar pine and Jeffrey pine also occur as isolated large individuals at lower elevations. Mountain hemlock *(Tsuga mertensiana)*

occurs in the highest N.-facing slope stands.

Subordinate species (herbs and shrubs) for both red and white fir forest are similar and include *Asclepias cordifolia, Chimaphila umbellata, Corallorhiza maculata, Hieracium albiflorum, Kelloggia galioides, Osmorhiza chilensis, Phacelia hydrophylloides, Pedicularis semibarbata, Pterospora andromedea, Pyrola picta, Ribes roezlii,* and *Symphoricarpos vaccinoides.* Species confined to low elevation forests believed previously to have been mixed conifer include mesophilic taxa such as *Goodyera oblongifolia, Adenocaulon bicolor, Smilacina stellata,* and *Thalictrum fendleri. Arabis platysperma* and *Chrysopsis breweri* are most typical of red fir forest.

• White Fir Forest (84240): 250 acres (101 ha). White fir dominates all forest sites sampled below 6400 ft (1950 m) and higher elevation sites with steep to moderate S. or W. aspects. Average white fir importance value is 181. Basal area is variable averaging 91± 81 m^2/ha, and density averages 634 stems/ha.

Reproduction within all white fir sites is dense. White fir appears to be proliferating at the expense of sugar pine, Jeffrey pine, and incense-cedar. Invasions of incense-cedar stands by white fir are noted, but incense-cedar is still reproducing at the ecotones between forest and meadows, and in such situations may be rapidly increasing in abundance. Jeffrey pine is not currently reproducing within the main body of white fir forest and is generally scattered as older individuals. Sugar pine is common on gentle topography below 6560 ft (2000 m) elevation, especially around dry meadows where it may have been the principal dominant 200 years ago. At present, intermediate and young sugar pines are uncommon or absent. Red fir is abundant as saplings and seedlings in portions of the white fir forest, but is not common as mature trees below 6400 ft (1950 m). Red fir abundance within white fir forest is related to the closeness of red fir-dominated forests.

Before the increase of white fir and red fir, a more even mixture of the principal species of the mixed conifer canopy in a semi-open forest is hypothesized for most sites on gentle topography below 6400 ft (1950 m). White fir cannot successfully compete with red fir at higher elevation primarily because of its intolerance of high winter snow packs in the sapling stage.

• Huckleberry Oak Scrub (37542,37510): 79 acres (32 ha). *Quercus vaccinifolia* forms a dense chaparral on S.-facing exposures. Other species present include *Allium campanulatum, Arctostaphylos nevadensis, A. patula, Carex* sp., *Calochortus leichtlinii, Ceanothus cordulatus, C. prostratus, Poa* sp., *Melica* sp., *Pellaea bridgesii,* and *Penstemon speciosus.* Moderate exposures of this type are being invaded by white fir and red fir with lesser numbers of Jeffrey pine and incense-cedar. Invasion fronts of white fir are typical of ecotones between fir forest and chaparral. The core of this association is resistant to invasion because of long snow-free periods and resulting critically low water potentials of summer and fall conifer seedlings, and because of its adaptation to crown fires.

• Dry Meadows (45100): 35 acres (14 ha). This association is characterized by an abundance of *Lotus nevadensis, Madia exigua, Poa* sp., *Trifolium* sp., *Verbascum thapsus, Cirsium* sp., etc. Encroachment by white fir and, to a lesser extent, Jeffrey pine has significantly reduced dry meadow habitats below 6600 ft (2012 m).

• Mountain Alder Thicket (63500, 61520): This riparian scrub is restricted to seepy areas. *Alnus tenuifolia* usually dominates (75 percent cover) with scattered specimens of *Acer glabrum* var. *torreyi,* and *Salix scouleriana.* There are many mesophytic understory species (15 species listed in association table). A cluster of aspen *(Populus tremuloides)* also occurs in the ecotone between dry meadow and *Alnus* thickets. Typically *Acer glabrum* occurs around the periphery of the *Alnus* thickets.

Plant Diversity

One hundred eight taxa are listed for all habitats, but total diversity is undoubtedly higher.

Conflicting Impacts

The area is part of the Onion Creek Experimental Forest, and as such, its candidacy as RNA was rejected.

50. PEA VINE POINT (Taylor and Randall 1977a)

Location

This soon-to-be-established RNA is on the El Dorado National Forest, El Dorado County. It lies 2 miles (3.2 km) NE. of Pollock Pines in portions of sects. 18, 19, 20, and 21 T11N, R13E and sect. 24T11N, R13E MDMB(38°47'N.,120°35'W.) USGS Riverton and Pollack Pines quads *(fig. 105).*

Target Element

Pacific ponderosa pine *(Pines ponderosa),* California black oak *(Quercus kelloggii)*

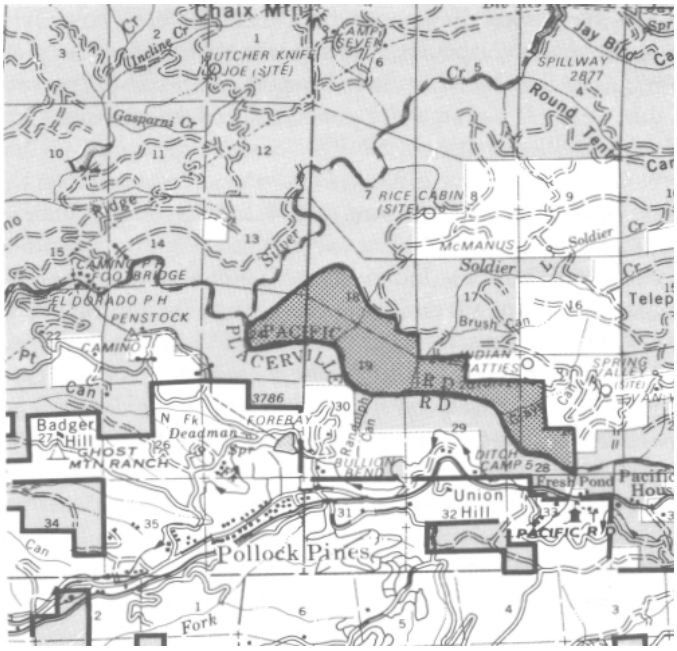


Figure 105--The Peavine Point RNA.

Distinctive Features

Old-Growth Ponderosa Pine: This vegetation type is not well represented in the RNA system and is relatively scarce in the Sierra Nevada because of timber harvesting over the past 100 years. The understory of this forest has been subject to regular ground fires, typical of this association. The forest is within easy access by road.

Physical Characteristics

The area covers 1140 acres (461 ha) of the lower W. slope of the Sierra Nevada in the canyon of the S. Fork of the American River. It occupies the N. and S. walls of the canyon. Elevations range from ca. 1968 to 3842 ft (600-1171 m). S.- and N.-facing slopes are predominant and are generally steep (30-40°). The river gradient in the area is ca. 132 ft/mile (25 m/km). One additional small permanent stream (Soldier Cr.) and an intermittent stream flow through the area.

The area is underlain by Mesozoic granodiorite, although Pliocene pyroclastics and Paleozoic metamorphics are immediately adjacent to the area. Soils fall within the Mariposa and Josephine series (both moderately deep to deep silt loams), whereas much of the steep outcrop areas are mapped as acidic rock land (poorly weathered regoliths). The area receives moderate precipitation, 28-51 inches (700-1300 mm) per year. Snow may fall regularly in winter months, but lingers on the ground only for a few days. Mean January temperature at Placerville (14 miles or 23 km W. of the area) is 40.8°F (4.9 °C), and mean July temperature is 72.9 °F (22.7 °C).

Association Types

Ten plots are sampled. No acreages for the associations are given.

• Ponderosa pine-*Chamaebatia foliolosa* (84210): This is the most extensive of the associations in the area. Ponderosa pine is the canopy dominant with California black oak as the major subcanopy species. Basal area on the sample plots averages 63.9 m^2/ha with ponderosa pine comprising 78 percent of this value. Basal areas for ponderosa pine range from 15 to 97 m^2/ha, with densities of 57-309 stems/ha (mean 169). Total stem density averages 239/ha. Other trees represented on the plots, in order of basal area cover, are canyon live oak *(Quercus chrysolepis),* white fir *(Abies concolor),* and California nutmeg *(Torreya californica).* Individuals of ponderosa pine are typically large with stands relatively open, but averaging high basal area. Mean dbh for sampled ponderosa pine is 23.3 inches (59.2 cm). *Chamaebatia is* the major understory species, often covering nearly 100 percent, but it is patchy. *Ceanothus integerrimus* and *Toxicodendron diversilobum* are also important understory shrubs. Twenty-five other herbs and shrubs are represented on the association table for this type. However, most have less than 1 percent cover. Among the most conspicuous are *Lupinus latifolius, Galium bolanderi, Aster radulinus,* and *Lathyrus nevadensis.*

• Douglas-fir - Pacific Dogwood *(Pseudotsuga menziesii-Cornus nuttallii)* (84230): Large areas of this vegetation (on N.-slopes) occur on the S. side of the river. This type also occurs on the N. side of the river in small areas of N.-facing slopes near Soldier Creek. Douglas-fir is the dominant tree with white fir and incense-cedar *(Calocedrus decurrens)* subdominant and occasional ponderosa and sugar pines as lesser associates. California black oak *(Quercus kelloggii),* canyon live oak *(Q. chrysolepis),* Pacific yew *(Taxus brevifolia),* big-leaf maple *(Acer macrophyllum),* and Pacific dogwood *(Cornus nuttallii)* are common subcanopy species.

• Canyon live oak-*Arctostaphylos mewukka* (81320, 37520): This association is limited to rocky sites (e.g., granitic outcrops) where soil development is minimal. Canyon live oak is the principal species often forming a partially closed canopy. *Arctostaphylos mewukka* is important only where the stand is open and canyon live oak density is low.

• White Alder *(Alnus rhombifolia)-Peltiphyllum peltatum* (61510): This association is limited to the immediate riparian area of the S. Fork of the American River below the mean high water level. White alder is the major dominant reaching 20 inches (50 cm) dbh and 50 ft (15 m) in height. The major conifers from the surrounding associations also occur sporadically in this type. *Peltiphyllum* is the dominant herb. Other species include Pacific yew, *Boykinia elata, Aralia californica, Mimulus cardinalis, Athyrium filix femina, Aquilegia formosa* var. *truncata, Corylus cornuta* var. *californica, Disporum hookeri* var. *trachyandrum, Rosa gymnocarpa, Adenocaulon bicolor,* and *Galium triflorum.*

Plant Diversity

One hundred fifty-three taxa are listed.

Conflicting Impacts

No potential impacts are listed. However, prescribed bums will be necessary to maintain the open understory of the *Pinus ponderosa* forests without natural fire in the near future.

51. STATION CREEK (BALD MOUNTAIN) (Taylor and Randall 1977b)

Location

This soon-to-be-established RNA is on the El Dorado National Forest, El Dorado County. It is ca. 6 miles (10 km) east of Kyburz and 3 miles (5 km) west of Strawberry. It lies within portions of sects. 21, 22, 23, 26, 27, and 28 of T11N, R16E, MDBM (38°47'N., 120° 12' W.) USGS Pyramid Peak quad *(fig. 106).*

Target Element

Transitional forest type: sugar pine *(Pinus lambertiana)*-white fir *(Abies concolor)-Goodyera oblongifolia.*

Distinctive Features

This area is located on the important transition between the relatively species-rich, cool, moist mixed conifer forest of the mid-elevations of the Sierra, and the species-poor, cold, moist montane forests. It supports old-growth stands of sugar pine and white fir as well as Douglas-fir *(Pseudotsuga menziesii)* at its

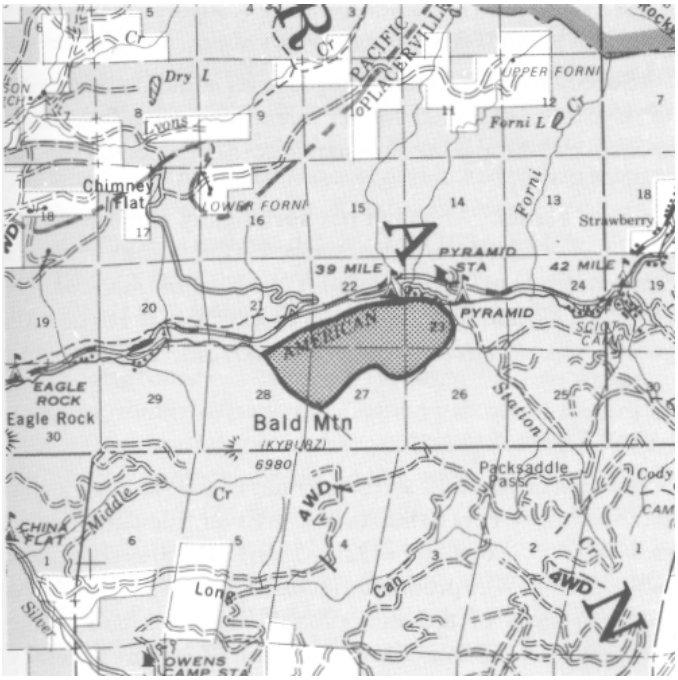


Figure 106--The Station Creek RNA.

upper elevation limit. Site indices for sugar pine are probably highest in this part of the mixed conifer zone, a fact which has not been commonly recognized because widespread logging activity has removed large, healthy sugar pine from this type throughout most of the Sierra Nevada *(fig. 107).*

Physical Characteristics

This site covers 738 acres (299 ha). Elevations range from 5348 to 6798 ft (1630-2072 m). Slope aspect is primarily N. and NE. The area occupies the slopes immediately above the S. Fork of the American River. Glaciation may have occurred in the Tahoe stage, but not the most recent Tioga stage. Slopes are generally uniformly steep (30-40°) with a few large outcrops.

Parent material is entirely Mesozoic granitics. Soils are probably related to the Cagwen-Totem series, excessively drained loamy coarse sands and gravelly coarse sands derived from granodiorite. Precipitation is estimated as averaging 51 inches (1300 mm) per year with a mean annual temperature of 42 °F (5.3 °C). Snow is on the ground for up to two months at the upper elevations.

Association Types

Nine plots (from 315 to 700 m^2) are sampled in the main forest association. Three plots are sampled in the white fir-*Goodyera oblongifolia* association. No acreages are given for the associations.

• Sugar Pine-White Fir (84230): This is generally an open forest dominated by sugar pine and white fir with the canopy cover ranging typically from 50 to 75 percent. Important associates are incense-cedar *(Calocedrus decurrens)* and Douglas-fir, the latter species attaining dbh's of up to 7.9 ft (2.4 m). Average basal area of sugar pine is 61.8 m^2/ha and for white fir, 39.9 m^2/ha. Douglas-fir is important in only three of the plots.

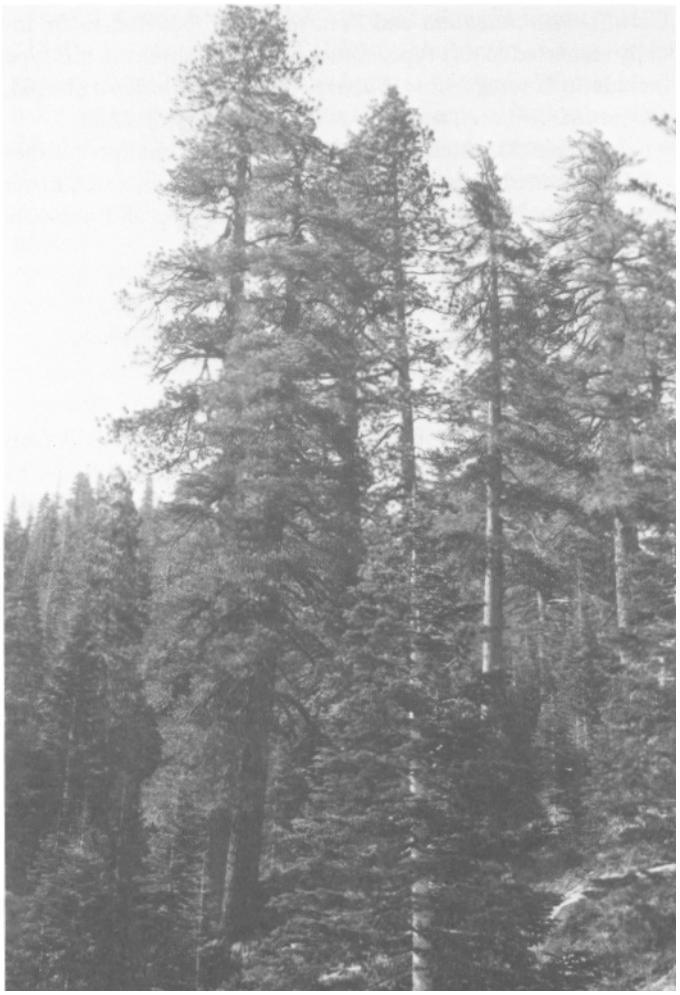


Figure 107--Station Creek: Steep slope with multi-aged forest dominated by sugar pine and white fir (L. Johnson).

Total mean basal area is 121.6 m^2/ha, and total mean density is 1111.5 stems/ha. White fir is the principal species in the sapling and seedling layer. Average stem density for trees of white fir more than 2 cm dbh is 950/ha.

Chrysolepis sempervirens is a constant understory shrub. A total of 25 understory species are recorded on the sample plots and include *Symphoricarpos acutus, Pyrola picta, Smilacina racemosa* ssp. *amplexicaulis, Hieracium albiflorum, Pedicularis semibarbata, Apocynum pumilum, Galium bolanderi, Carex rossii, C. multicaulis, Adenocaulon bicolor, Pteridium aquilinum* var. *pubescens,* and *Chrysopsis breweri.*

• White fir-*Goodyera oblongifolia* (84240): This association forms a matrix with the previous association and predominates where snow cover is deeper (higher elevations or more directly N.-facing exposure) than the previous type. There is a dense and closed canopy of *A. concolor* with only occasional larger individuals of sugar pine (though seedlings are more common). Sampling indicates a mean tree density of 1018 stems/ha and mean basal area cover of 97.4 m^2/ha. White fir comprises 95 percent of the total cover and 94 percent of the total number of stems.

The understory is very sparse (<5 percent cover).

Corallorhiza maculata and *Pleuricospora fimbriolata* are locally restricted to this type. Other herbs and shrubs in this type include *Salix scouleriana, Rubus parviflorus, Galium triflorum, Chrysopsis breweri,* and *Arceuthobium campylopodum.*

• Hydric Associations (45400, 63500): Although not specifically treated in the survey, a number of species listed in the plant list are hydrophilic and suggest that seep and montane riparian situations exist in the area.

Plant Diversity

One hundred eleven species are listed.

Conflicting Impacts

The N. boundary of the area is formed by the S. Fork of the American River. Summer homes and campsites adjacent to Highway 50 border the river on the opposite side from the study area. Thus, the area is accessible to a potentially large number of people. However, no negative impacts are discussed. Recent observation following the survey shows the sugar pines to be infected with white pine blister rust.

52. SUGAR PINE POINT (Palmer 1981)

Location

This soon-to-be-established RNA is located on the Tahoe National Forest about 4 miles (6 km) S. of Cisco Grove. The area encompasses sect. 20 T16N, R13E MDBM (39°15' N., 120°32' W.) USGS Duncan Peak quad *(fig. 108).*

Target Element

Mixed conifer forest

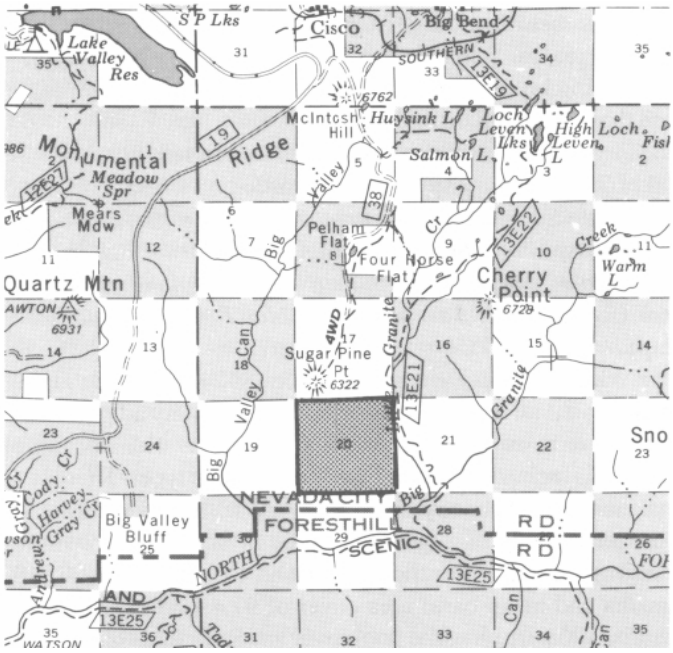


Figure 108--The Sugar Pine Point RNA.

Distinctive Features

• Succession: This study site provides numerous examples of the dynamics of mixed conifer forest succession from montane chaparral through mature stands co-dominated by several species *(fig. 109).*

• Rare Plants: Although not specifically listed from the study site, several rare plants are mapped in the vicinity of the site and may occur here. These include *Cypripedium fasciculatum* (CNPS List 4), and three members of CNPS List 1b: *Lewisia pygmaea* ssp. *longipetala, Lewisia serrata,* and *Phacelia stebbinsii.*

Physical Characteristics

The area covers 640 acres (259 ha) of a S.-facing canyon slope above the N. Fork of the American River. Elevations range from 4500 ft to ca. 6080 ft (1372-1853 m). The area consists of a bowl-like slope with promontories extending southward on the E. and W. edges of the area. Small drainages and rolling topography exist in the middle of this bowl. Slopes are generally moderate within the bowl, but drop steeply at the lower (S.) edge of the area toward the riverbed.

The area is underlain by Paleozoic and Jurassic marine sediments and metasediments. There are minor exposures of granitic rock (Sierra Nevada Batholith) in the area. Soil development is poor except on the more level portions of the bowl, which also support the largest trees. Precipitation at Lake Spaulding (7.5 miles, 12.1 km N.) averages 65.8 inches (1673 mm) per year. Temperature averages are 34 °F (1.1 °C) for January and 63 °F (17.3 °C) for July with annual average of 48 °F (8.7 °C).

Association Types

Based on 14 releves and subsequent construction of an association table, four associations are recognized. Five releves also double as sample plots where density and basal area cover for trees are recorded.

• Ponderosa Pine *(Pinus ponderosa)*-Sugar Pine *(P.*

Figure 109--Sugar Pine Point: Open Sierran mixed conifer forest is interspersed with California black oak forest and montane chaparral (K. Berg).

lambertiana)-White Fir *(Abies concolor)* (84230,84240): 256 acres (104 ha). Eight releves are located on this association, dominated by the three namesake species or incense-cedar *(Calocedrus decurrens)* or both. There is a wide variation in size class distribution and dominance, ranging from dense stands of young white fir to mature forest codominated by large sugar and ponderosa pine and white fir. Total basal area cover ranges from 9.7 to 110 m^2/ha and tree density from 308 to 764/ha. Douglas-*fir (Pseudotsuga menziesii)* is occasional. Red fir *(Abies magnifica)* and Jeffrey pine *(Pinus jeffreyi)* also occur at the upper elevations.

Young forest has senescent shrubs of *Quercus vaccinifolia* and *Arctostaphylos patula,* indicating past dominance by these mountain chaparral species, as a result of fire. Shrubs vary in density and composition depending on the history of the individual plot. *Arctostaphylos patula, Quercus vaccinifolia, Ceanothus fresnensis,* and *C. integerrimus* are among the most common shrubs. Herbs also vary with plot history. Among the most ubiquitous are *Gayophytum humile, Apocynum androsaemifolium, Pteridium aquilinum* var. *pubescens, Chimaphila menziesii,* and *Penstemon deustus.*

• Montane chaparral (37510): 224 acres (91 ha). The largest portion of this association is on the steepest part of the central bowl area. This montane chaparral is maintained by fire, which carries well up the steep slopes. Typical species are the same as those shrubs listed for the ponderosa pine-sugar pine-fir association.

• California Black Oak *(Quercus kelloggii)* Forest (71120, 81340): 96 acres (39 ha). California black oak is an important species of the lower elevation forests. Many California black oak are resprouts from previous fires. Some root crowns are 3-5 ft (1-1.5 m) in diameter. One sample stand is representative of this type and has a number of young ponderosa pine, sugar pine, incense-cedar, and white fir in it. California black oak comprises 67 percent of the basal area and 50 percent of the stems. Average stem diameter of California black oak in this stand is 6.7 inches (17 cm).

• Rocky Herbaceous Association (no Holland equivalent): In open, rocky sites the montane chaparral gives way to this type, dominated by scattered herbs and grasses. These include *Poa palustris, Arabis holboellii, Penstemon deustus, Zauschneria californica, Onychium densum, Zigadenus venosus, Pterixia* sp., and *Sitanion hystrix.*

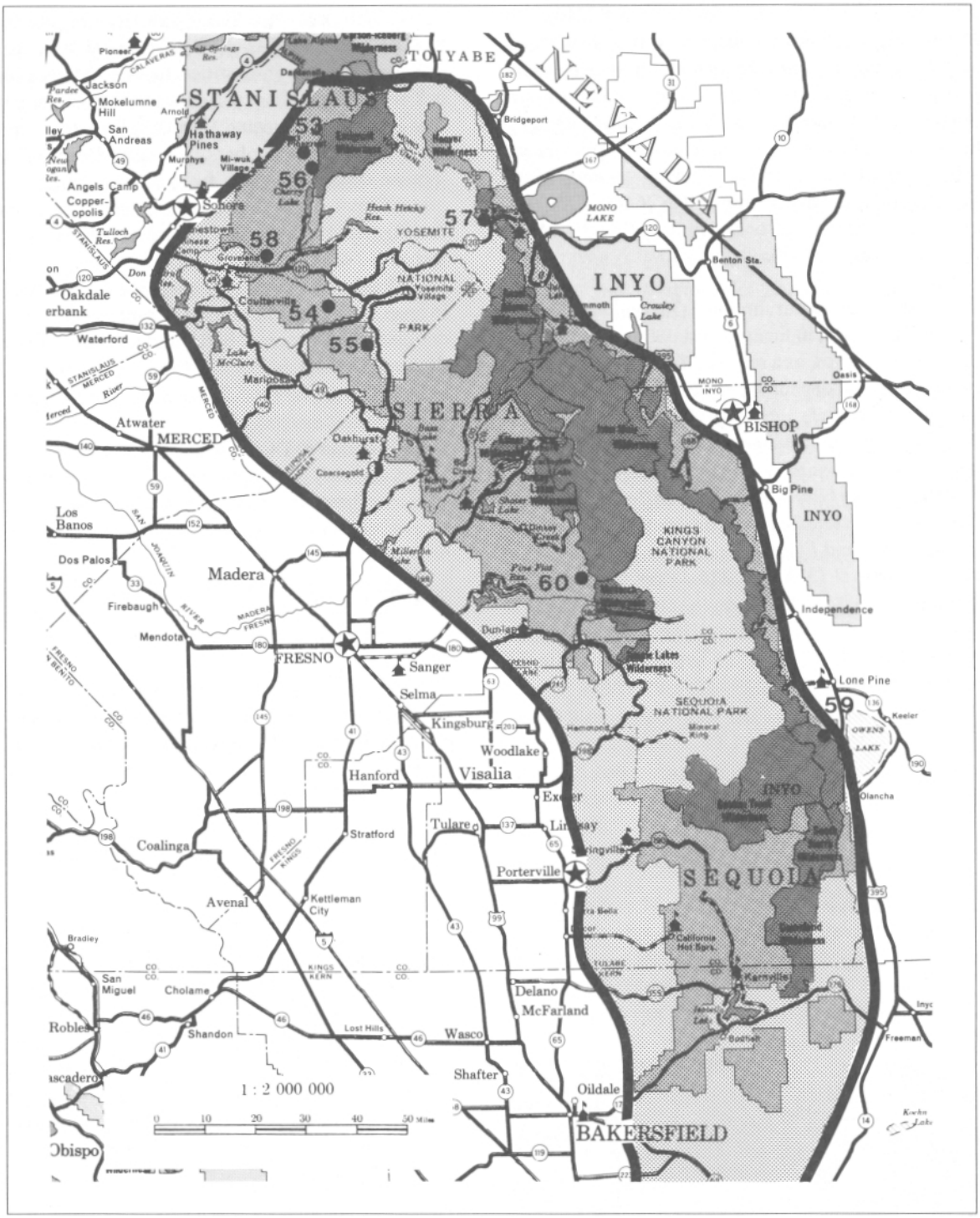
• Riparian (63500): Along the streambed of Little Granite Creek, a weakly developed riparian association occurs with such species as *Acer glabrum* var. *torreyi, Spiraea densiflora, Lonicera conjugialis, Lilium parvum, Senecio triangularis,* and *Navarretia propinqua.*

Plant Diversity

One hundred nine taxa are listed.

Conflicting Impacts

None are mentioned. However, the area is surrounded by private land necessitating unnatural boundaries to the RNA.



VIII. SOUTHERN SIERRA NEVADA PROVINCE

53) Bell Meadow
54) Big Grizzly Mountain
55) Bishop Creek
56) Bourland Meadow
57) Harvey Monroe Hall
58) Jawbone Ridge
59) Last Chance Meadow
60) Teakettle Creek

SOUTHERN SIERRA NEVADA PROVINCE

53. BELL MEADOW (Keeler-Wolf 1985c, 1989j)

Location

This soon-to-be-established RNA is on the Stanislaus National Forest ca. 3 miles (5 km) S. of Pinecrest. It lies within portions of sects. 25 and 26 T4N, R 18E and sects. 29, 30, 31, and 32 T4N, R19 MDBM (38°10'N., 119°56'W.) USGS Pinecrest quad *(fig. 110).*

Target Element

Aspen *(Populus tremuloides)*

Distinctive Features

• Aspen Forest: The aspen stands are extensive and well-developed *(fig. 111).* They occur on both flat, deep meadow soil and on sloping, shallower upland soil. Variation in sucker reproduction, understory density and species composition, and conifer invasion add to the research potential. Typical meadow aspens are over 90 ft (27 m) tall, and some attain dbh's of over 40 inches (1.02 m).

Aspen vegetation of the Sierra Nevada is usually stable and not successional to coniferous vegetation. This distinguishes it from the extensive seral stands of the species in the Rocky Mountains. Local rejuvenation of stands appears to take place largely when the short-lived stems die and create light gaps,

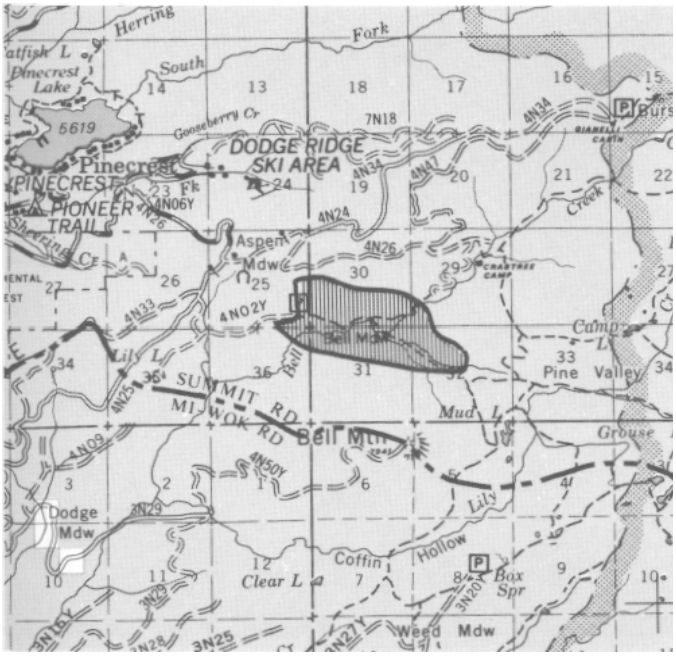


Figure 110--The Bell Meadow RNA.

Figure 111--Bell Meadow: Upper meadow aspen forest with *Elymus glaucus* and *Mertensia ciliata* dominant in understory.

initiating renewed sucker sprouting. Conifer invasion, largely from white fir *(Abies concolor), is* not pronounced in most areas of aspen dominance.

• History of Meadow Change: A combination of monitoring studies (on grazing and browsing pressure from both livestock and deer), and records of aerial photography in the Bell Meadow area dating from the early 1950's have provided a useful history of the area. An important change in the upper meadow occurred over a short period in the mid- 1960's when a large area of wet meadow was converted by stream downcutting to dry meadow. This event coincided with the major flood year of 1964, but may have also been exacerbated by heavy grazing pressure. At present the woody riparian vegetation has not suffered as a result of the downcutting. However, the process will continue relatively rapidly until the entire upper meadow is lowered by several feet.

• Significance of Riparian Vegetation to Wildlife: Bell Meadow is an excellent summer range for Sierra mule deer *(Odocoileus hemonius californicus)* because of the interspersion of wet meadow, timber, brush, and open areas. The foliage of abundant willows (*Salix* spp.) and aspens is relished by pregnant and lactating does. Many deer have been seen in the area. In addition, the riparian habitats afford forage, breeding sites, and protection for many other animal species including over 60 species of birds.

Physical Characteristics

The area covers 655 acres (265 ha) and ranges in elevation from 6540 to 6800 ft (1993-2073 m). The area occupies a part of the bottom and lower slopes of the Bell Creek drainage. Bell Meadow is divisible into upper and lower sections, which are separated by a narrow area ca. 300 ft (91 m) wide between granitic outcrops. The entire meadow stretches ca. 1.25 miles (2 km) from E. to W. and is up to 2700 ft (823 m) wide. It slopes gradually from ca. 6600 ft (2012 m) at the E. to ca. 6550 ft (1996 m) on the W.

Surrounding slopes are both granitic (quartz monzonite and granodiorite) and volcanic (Miocene latites of the Stanislaus

Formation), with the granitics prevailing. The meadow is underlain by up to 14 ft (4.3 m) of fine sandy to gravelly alluvium. Soils have been differentiated into seven mapping units. The meadow is underlain by deep Entic Cryumbrepts. The other units principally comprise combinations of Gerle family and rock outcrop. Climate is typical Sierran montane with precipitation averaging ca. 50-55 inches (1270-1397 mm). Mean annual temperature is ca. 44-46 °F (6.7-7.8 °C).

Association Types

Twenty-one 100-m^2 plots are sampled in three forest associations. The remaining associations are qualitatively described.

• Jeffrey Pine *(Pinus jeffreyi)* Woodland (85100): 267 acres (108 ha). This open to very open woodland occupies the shallow soils of the slopes surrounding the meadow. A variant with western juniper *(Juniperus occidentalis* ssp. *australis)* as a subdominant occurs on the Miocene volcanics at the E. edge of the area. The shrub understory is dominated by mountain chaparral species and forms a mosaic with tree-dominated vegetation and sparse herbaceous cover on rock outcrops.

A fine-grained view of this association would differentiate Jeffrey pine woodland from mixed montane chaparral (Holland 37510), huckleberry oak *(Quercus vaccinifolia)* scrub (Holland 37542), and rock outcrop (Holland 91200). Overall shrub dominants include *Quercus vaccinifolia, Arctostaphylos nevadensis,* and *A. patula. Holodiscus boursieri* and *Acer glabrum* var. *torreyi* occur on N.-facing slopes. Herbs include many species typical of mid-elevation rock outcrops such as *Raillardella scaposa, Stipa occidentalis, Eriogonum umbellatum, E. marifolium, Cryptogramma acrostichoides, Arenaria kingii* var. *glabrescens, Sedum lanceolatum, Lomatium tracyi, Penstemon laetus, P. newberryi,* and *Hieracium horridum.*

• Aspen Riparian (81 BOO, 61520): 91 acres (36 ha). Of the three deciduous plant associations, this is the driest with little or no surface water and a water table in mid-summer ranging from 2 to 14 ft (0.6-4.3 m). The largest aspen groves occur on the E. end of the meadow with smaller fringing stands surrounding most of the remainder and a broad band covering the central portion of the lower meadow (together making up the meadow flat subtype). Typically, aspen forms an even monospecific canopy from 60 to 90 ft (18-27 m) tall with few young small stems. However, in the central lower meadow stands are multilayered resulting from numerous young- to middle-aged suckers growing among a sparse canopy of large, senescent stems. On 11 plots, total tree density averages 910 trees/ha with a cover of 69 m^2/ha. On these plots aspen averages an importance value of 240 with both a relative density and relative cover of 89 percent. In addition to the aspen, only a few small white fir, Jeffrey pine, and lodgepole pine *(Pinus contorta* ssp. *murrayana)* occur in the tree strata.

Shrub cover is light, but the herbaceous understory is dense (typically nearly 100 percent) and diverse (63 taxa in the sample). Only seven herbaceous species have a frequency of 50 percent or greater. These are *Elymus glaucus, Lupinus andersonii, Veratrum californicum, Hackelia jessicae, Descurania richardsonii, Thalictrum fendleri,* and *Osmorhiza chilensis.* The height of *Elymus* may reach 6 ft (2 m) in wet years. *Rudbeckia californica* may dominate in certain areas of heavy grazing.

An upland subtype occurs in several small stands at the edge of the main meadow or on benches above it. These stands are similar to the meadow flat subtype, but there may be more white fir and Jeffrey pine present. Herbaceous understory is less dense compared to the main meadow stands, relating primarily to the higher grazing pressure on these areas.

• *Salix* Riparian (63500): 60 acres (24 ha). This association is extensive on the upper and lower meadow flats *(fig. 112).* It is dominated by the willow *Salix ligulifolia,* which forms thickets 10-13 ft (3-4 m) tall. These thickets are interspersed with small openings dominated by wet meadow vegetation. Other shrubs include *Salix melanopsis, S. lasiandra, S. drummondiana* var. *subcaerulea, S. scouleriana, Sambucus microbotrys,* and *Sambucus caerulea.* A number of herbaceous species are typical of the shady thickets and include *Delphinium glaucum, Heracleum lanatum, Epilobium adenocaulon, Castilleja miniata, Senecio triangularis, Habenaria sparsiflora, Circaea alpina* var. *pacifica, Smilacina stellata, Lilium kelleyanum,* and *Aquilegia formosa.*

• White Fir-Red Fir Forest (85310): 56 acres (23 ha). This dense forest occurs in the valley of the S. branch of Bell Creek

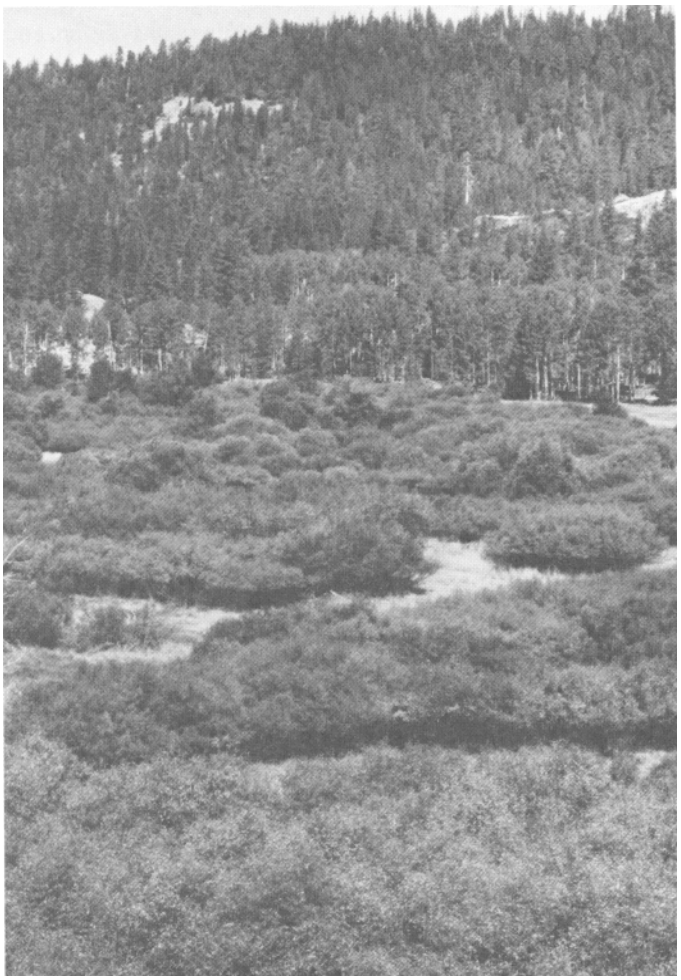


Figure 112--Bell Meadow: Extensive willow scrub in western upper meadow, aspen forest bordering meadow with Jeffrey pine forest beyond.

upstream from the meadow. Dominant red fir *(Abies magnifica)* attain heights of 200 ft (61 m) and dbh's of 5 ft (1.5 m). Red fir dominates the basal area (157 m^2/ha, relative cover 46 percent), but white fir may occur in higher density (460 trees/ha, relative density 59 percent). Both species have near equal importance values on the five sample plots (white 141, red 127). The understory is typically sparse, and duff cover is heavy. Density of saplings and seedlings is higher for red fir than white fir.

• White Fir-Jeffrey Pine Forest (84240, 85210): 52 acres (21 ha). This forest typically occurs as a narrow fringe surrounding the meadow flat. The soil is rockier than the meadow, but deep. The dominants are white fir and Jeffrey pine with lodgepole pine and red fir as subdominants (total density on five plots averages 920/ha, total basal cover averages 108 m^2/ha). White fir has the highest IV (150) followed by Jeffrey pine (77), lodgepole pine (59), and red fir (14). White fir has the highest IVs for seedlings and saplings, as well. The most frequent shrubs are *Quercus vaccinifolia* and *Symphoricarpos acutus*. Both account for 20-40 percent cover in many areas. The most conspicuous herbs are *Pteridium aquilinum* and *Kelloggia galioides*.

• Wet Meadow (45100, 52430): 49 acres (20 ha). Since the recent erosion cycle in the upper meadow the reduction in this association has been drastic, although extensive areas of wet meadow still exist, particularly in the lower meadow. This association is divided into three types. The saturated subtype (Holland 52430) occurs in slough-like channels of Bell Creek and around an ephemeral pond in the S. of the area. *Carex rostrata* dominates as a ring around open water (which remains through mid-summer). Additional species include *Sparganium multipedunculatum, Elatine gracilis, Potemogeton nutans, Puccinellia pauciflora, Scirpus microcarpus, Juncus orthophyllus, Carex aquatalis, C. athrostachya,* and *C. fracta.*

• A wet subtype is dominated by sedges and grasses, often forming a well-consolidated sod. This type has standing water in the spring and remains moist throughout the summer. A number of species are shared with the *Salix* riparian association. Other typical members include *Carex fracta, C. nebrascensis, C. straminiformis, C. paucicaustata, C. festivala, C. hoodii, C. jonesii, Trifolium cyathiferum, T. montanum, Ranunculus orthorhynchus, Epilobium brevistylum, Polygonum bistortoides, Juncus howellii, Glyceria elata, Allium validum, Deschampsia caespitosa, Agrostis exarata,* and *Dodecatheon alpinum.*

A moist subtype is the most extensive and diverse. It commonly is interspersed with *Salix* riparian vegetation. Ground cover ranges from 50 to 100 percent. The drier fringing sections are dominated by *Danthonia californica* var. *americana, Perideridia parishii, Trifolium longipes, Deschampsia elongata, Calamagrostis inexpansa, Penstemon rydbergii, Achillea millefolium, Solidago californica, Horkelia fusca,* and *Gilia capillaris.* Slightly moister areas are dominated by *Hordeum brachyantherum, Erigeron peregrinus* ssp. *callianthérus, Aster occidentalis, Agrostis scabra, A. oregonensis, Poa pratensis, Ranunculus occidentalis, Juncus confusus, J. balticus, Luzula comosa, Helenium hoopesii,* and *Veratrum californicum.*

• Dry Meadow (45100): 48 acres (19 ha). This association is dominated by grasses and herbs with cover ranging from 10 to 90 percent. The largest dry meadows are in upper Bell Meadow on deep, well-drained soil that supported wet meadow before stream downcutting. Three subtypes occur. The most extensive is dominated by *Stipa columbiana.* Additional species include *Agropyron trachycaulum, Elymus macounii, Madia glomerata, Perideridia parishii, Polygonum douglasii, Navarretia divaricata, Cryptantha torreyana, Cordylanthus tenuis, Bromus orcuttianus, Lotus purshianus,* and *Gayophytum diffusum* ssp. *parviflorum.*

The second subtype occurs in peripheral areas of the upper meadow. It is characterized by a coarse, sandy substrate with low vegetation cover (<25 percent) dominated by *Madia glomerata.*

The third subtype is dominated by the annuals *Lotus argophyllus* and *Euphorbia spathulata.* It occurs on more pebbly or rocky soils than the previous type, typically bordering on Jeffrey pine and lodgepole pine forests.

• Lodgepole-Fir Forest (86100): 31 acres (13 ha). This association borders meadow and riparian vegetation. The forest is dominated by lodgepole pine, but Jeffrey pine, white fir, and red fir also occur. Stem density is high, but because of the moist substrate and deep soil, the understory is well developed. Many herbs are shared with aspen and meadow associations, but several are characteristic. These include *Botrychium multifidum* ssp. *silaifolium, Antennaria rosea, Prunella vulgaris,* and *Hypericum anagalloides.* Other common species include *Aster occidentalis, A. integrifolius, Deschampsia elongata, Calamagrostis inexpansa, Perideridia parishii, Muhlenbergia filiformis, Pyrola secunda,* and *Juncus confusus.*

• Rocky Stream Riparian (61530): 1 acre (0.4 ha). This association occurs sporadically along the main branch of Bell Creek largely on rocky stretches with steeper gradients than in the main meadow area. Black cottonwood *(Populus trichocarpa)* is the most conspicuous tree. Cottonwoods are typically scattered in small clumps and attain heights of 100 ft (30 m) and dbh's of 49 inches (1.25 m). Shrubby species include *Cornus stolonifera, Rhamnus purshiana, Spiraea densiflora, Ribes nevadense, Rosa gymnocarpa,* and occasionally *Alnus tenuifolia.*

Plant Diversity

Two hundred forty-seven taxa are listed in the establishment record, which updates the list in the ecological survey.

Conflicting Impacts

The area has been used for grazing for over 100 years. After establishment, most of the area will be excluded from grazing. However, the downcutting of the upper meadow stream may have been initiated because of reduced vegetation cover caused by overgrazing. At present the core area of the meadow is fenced, and herbaceous cover is generally high, indicating good potential for recovery of the entire area. Recreational use of the area has been high. After establishment, a major trail to the adjacent Emigrant Wilderness Area will be re-routed around the RNA. Various options for dealing with the downcutting problem in the upper meadow are discussed in the ecological survey and the establishment record. Downcutting in the meadows will be allowed to continue unimpeded. So far, no detrimental

impact to the aspen or the *Salix* riparian zones has occurred.

54. BIG GRIZZLY MOUNTAIN (Keeler-Wolf 1987f)

Location

This candidate RNA is on the Stanislaus National Forest and is ca. 8 miles (13 km) NW. of El Portal, the entrance to Yosemite National Park. The area lies within portions of sects. 29, 30, 31, and 32 of T2N, R19E MDBM (37°43'N., 119°55' W.) USGS Kinsley quad *(fig. 113).*

Target Element

California Black oak *(Quercus kelloggii)*

Distinctive Features

• Fire History and California Black Oak Forest Structure: The California black oak vegetation type is fire-adapted and has burned locally several times in the recent past. The most recent fire occurred in September 1987, and affected most of the area. The field work for the ecological survey took place one year before this burn; hence the opportunity exists for pre- and post-fire study.

Analysis of charred and fire-scarred stems of oaks and other trees indicates that the penultimate major fire was in the mid-1930's. This fire burned the N. slopes of Big Grizzly Mtn. more completely than the N. slopes of Little Grizzly Mtn. Hence, survivor stems of black oak (up to 31 inches, 79 cm dbh) were found in the latter locality as well as several ponderosa pines *(Pinus ponderosa)* and incense-cedar *(Calocedrus decurrens)* that pre-dated the 1930's. Before the 1930's, the last fire appeared to have occurred ca. 1885. The Big Grizzly area has thus had a major fire on the average of once every 50 years for the past 100 years. It is likely that fires have maintained the California black oak forest in this area for centuries.

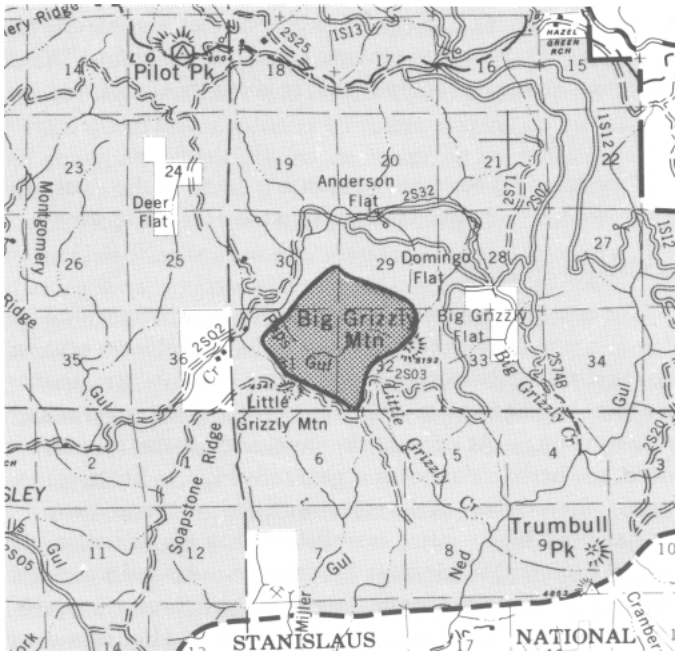


Figure 113--The Big Grizzly Mountain study area.

• Comparisons With Other California Black Oak RNAs: Several other areas in California have been selected to represent this target element (#'s 8, 34, and 64). Each of these areas has unique features, but also many similarities. Compared to the others, Big Grizzly has the largest percentage of its area dominated by California black oak, and has a relatively uniform stocking and cover of California black oak, making it less variable than the other areas. The local forest is restricted to N. exposures, whereas #8 has largely S. and W. and #64 W. and E. The N. restriction at Big Grizzly may relate to less summer moisture than at the other two sites. *Toxicodendron diversilobum* dominates the understory at most sites, and a number of other species of herbs are shared between the sites.

Physical Characteristics

The area covers ca. 668 acres (270 ha) on the N. slopes of Big and Little Grizzly Mountains, which are separated by a small canyon with an intermittent stream (Paps Gulch). Elevations range from 3200 ft (975 m) in Paps Gulch to about 5160 ft (1573 m) near the summit of Big Grizzly Mountain. Slopes are moderate throughout the lower elevations, steepen at mid-elevations, and become moderate again at the upper elevations. Exposure is generally N. with some S.- and W.-facing slopes in Paps Gulch.

Rocks are mesozoic granitics of the Sierra Nevada Batholith and shaley to schistose Paleozoic metasediments. Gneissic intergrades between granite and metamorphics occur on upper Big Grizzly Mtn. Two soil mapping units occur. These are the Josephine family, moderately deep Dystric Lithic Xerochrepts association derived from metasediments, and the granitically derived Lithic Xerumbrepts-Holland Family deep association. Precipitation averages ca. 60 inches (1524 mm) annually with very little between April and October. Estimated mean annual temperatures range from 51.4 to 53.6 °F (10.8-12 °C) with January means from 35.1 to 37.2 °F (1.7-2.9 °C) and July means from 69.4 to 71.6 °F (20.8-22 °C).

Association Types

Twenty 100-m^2 plots are sampled in the California black oak forest.

• California Black Oak Forest (71120, 81340): 484 acres (196 ha). California black oak strongly dominates with an average of 1090 stems/ha (relative density 85 percent). California black oak has highest frequency, density, and basal area cover (IV 230.3). Only occasional small trees of ponderosa pine, incense-cedar, knobcone pine *(Pinus attenuata),* canyon live oak *(Quercus chrysolepis),* and California bay *(Umbellularia californica)* occur. California black oak cover averages 49 m^2/ha (89 percent relative cover). As a result of a fire in the mid-1930's, most stems of black oak are of uniform dimensions, averaging ca. 10 inches (25 cm) dbh and 45 ft (14 m) tall and 3.5 stems per resprout clump *(fig. 114).* Seedlings of California black oak are abundant; however, saplings and young trees are rare.

The shrub layer is strongly dominated by *Toxicodendron*

Figure 114--Big Grizzly Mountain: California black oak forest on NW.-facing slope showing typical multiple stems from base and arching interlocking canopy ca. 45 ft (14 m) high.

diversilobum, averaging 35 percent cover. *Ribes roezlii, Chamaebatia foliolosa,* and *Rubus glaucifolius* occur irregularly along with five other shrub species. Herbs are uncommon except for *Clarkia unguiculata* and *Dryopteris arguta.* Twenty-four other species occur as trace cover on less than 50 percent of the plots. The understory is conspicuously affected by density of oak canopy with the occasional small opening having a grassy understory including *Achillea millefolium, Bromus tectorum, Calochortus venustus, Centaurea melitensis, Clarkia rhomboidea, Daucus pusillus, Festuca pacifica, Madia elegans, Plectritis* sp., *Rumex angiocarpus,* and *Trifolium microcephalum.* Openings in the rocky upper elevations near the summit of Big Grizzly Mtn. house several native perennials including *Melica aristida, Koeleria macrantha, Bromus carinatus, Calochortus venustus, Arabis* sp., and *Stipa lemmonii.*

• Ponderosa Pine Forest (84210): 107 acres (43 ha). Small lobes of ponderosa pine forest extend into the lower portion of the area on deep soils. This forest was also burned in the 1930's, and trees are uniformly young with average dimensions of ca. 19 inches (48 cm) dbh and 66 ft (20 m) height. Other trees are sparse and include scattered young incense-cedar, which may have colonized later than the pines. There are also occasional knobcone pine, California black oak, canyon live oak and California bay. The understory is sparse with scattered senescent chaparral shrubs. In small openings, such understory species as *Dichelostemma volubilis, Agoseris grandiflora, Calochortus* sp., *Bromus tectorum, Calystegia* sp., *Hieracium albiflorum, Trifolium microcephalum, Vicia americana, Pteridium aquilinum,* and *Lupinus* sp. occur.

• Chaparral (37110, 37520, 37810): 65 acres (26 ha). This type covers the S. exposures of upper Paps Gulch. *Arctostaphylos mariposa* marginally dominates with *Ceanothus cuneatus* as the major subdominant. Shrubby canyon live oak is important particularly on SW. exposures. The dispersion of *A. mariposa* is fairly uniform, but *C. cuneatus is* more clumped with occasional small pockets of dominance. Occasional snags and a relatively large number of ponderosa pine at the upper reaches of the chaparral suggest that at least portions of this type may have been an open ponderosa pine-dominated forest before the mid-1930's fire.

• Canyon Live Oak Forest-Woodland (81320): 32 acres (13 ha). Canyon live oak dominates small areas on steep, concave N. slopes. These forests contain trees of similar age and diameter to surrounding California black oak forest, but are typically up to 15 ft (5 m) shorter (30-35 ft, or 9-11 m tall). The understory is rockier than California black oak forest, but still dominated by *Toxicodendron.* On shallow soils with a SW. exposure, canyon live oak forms a shrubby woodland mixed with chaparral shrubs such as *Arctostaphylos mariposa* and *Ceanothus cuneatus.*

• Riparian (61510): No acreage given. The lower part of Paps Gulch has permanent moisture and some associated riparian growth. This includes white alder *(Alnus rhombifolia)* in the overstory, with an understory of *Rubus lacinatus, R. ursinus, Urtica holosericea, Artemisia douglasiana, Ribes nevadense, Rumex californicus, Woodwardia fimbriata, Vitis californica, Datisca glomerata,* and *Aquilegia formosa.*

Plant Diversity

Ninety taxa are listed.

Conflicting Impacts

In general, human impact has been slight in the area. However, prior use by Miwok Indians may have been relatively heavy. Several inventoried archaeological sites are in and adjacent to the area. The 1987 fire has greatly altered the vegetation from the type discussed in the survey. However, this is a natural occurrence and will provide the potential for a great deal to be learned about succession in, and stability of, this forest type. Portions of the ponderosa pine forest were thinned ca. 1976. An overgrown, unused jeep road barely enters the N. part of the area at Paps Gulch.

55. BISHOP CREEK (SOUTH FORK MERCED RIVER) (Talley 1981)

Location

This soon-to-be-established RNA is on the Sierra National Forest between the S. Fork of the Merced River and the boundary of Yosemite National Park. It was originally called S. Fork of the Merced candidate RNA, but it is now known as Bishop Creek. It is ca. 2 miles (3 km) W. of the Wawona Road (State Route 41) via the Alder Creek Trail. It occupies portions of sects. 1, 12, and 13 T4S, R20E and sects. 8 and 17 T4S, R21E MDBM (37°34'N., 119°41' W.) USGS Wawona quad *(fig. 115).*

Target Element

Pacific ponderosa pine *(Pinus ponderosa)*

Distinctive Features

• Growth: Relatively detailed age-height and age-diameter relationships are given for ponderosa pine. Fastest height growth (37 m/100 years) occurs on moist level sites, toes of slopes, and gentle upland slopes. Slowest rates (20 m/100years)

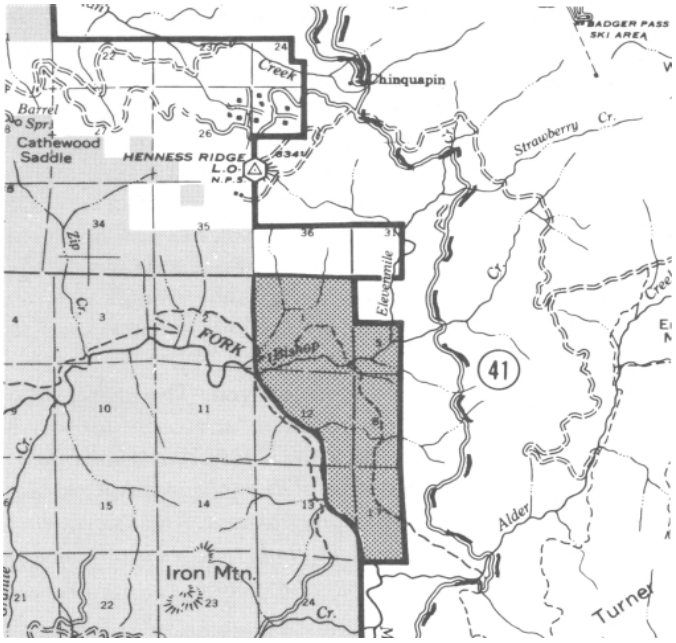


Figure 115-The Bishop Creek RNA.

occur in trees on S.-facing slopes in mixed stands with Digger pine *(Pinus sabiniana).* Age-diameter relationships are less sensitive to crowding than age-height relationships. Greatest rates occur in pines at level-mesic sites (80 cm dbh in 100 years), toes of major slopes, and at gently sloping sites in the terrace conifer forest. Lesser diameter growth occurs at all other sites with ponderosa pine. Mature incense-cedar *(Calocedrus decurrens)* have age-diameter growth rates similar to ponderosa pine.

• Structure: There is a log-linear decrease in tree numbers with increasing age (typical of shade-tolerant species which form all-aged stands), rather surprising for the shade-intolerant ponderosa pine. There is a recent invasion of incense-cedar, which accounts for 75 percent of all conifers 50 years old or less. Conifer invasion has been from mesic to xeric sites with initial establishment of ponderosa pine 100+ years ago followed by a more prolonged period of incense-cedar establishment. At more xeric sites as along ridgecrests, open ponderosa pine-California black oak *(Quercus kelloggii)* forest still exists. However, what was an open ponderosa pine-California black oak forest over much of the mesic terrace area has recently become a two-tiered forest with dense reproduction primarily from incense-cedar.

• Fire: Older ponderosa pine and incense-cedar have basal scars indicating fire intervals of once every 5-15 years before 1870. Some trees 70-100 years old possess only basal scars from fires over 50 years ago. Other areas with trees of similar ages have no evidence of fire. Thickets of conifers less than 50 years old have never been thinned by fire. The sharp increase in reproduction of understory conifers coincides with the elimination of Miwok Indian culture (ca. 1870), and establishment of an effective forest fire suppression system in the 1920's.

• Bark Beetles: Between 1974 and 1979 there was a 10-fold increase in bark beetle mortality in ponderosa pine. At the time of this survey, 1 in 20 ponderosa pine had succumbed to bark beetles in the previous 2 years, including young trees under 100 years old. The crowded nature of the present forest may have at least partially reduced the vigor of the trees and precipitated the beetle attack.

Physical Characteristics

This area occupies 1764 acres (714 ha). Elevations range from ca. 3200 to 4800 ft (975-1463 m). Approximately 1137 acres (460 ha) are steep S.-,W.-, or N.-facing exposures rising from the S. Fork of the Merced River. Another 618 acres (250 ha) is gently sloping terrain of all aspects resulting from a terrace between 4068-4530 ft (1240-1380 m) elevation on the W. slope of a ridge separating Bishop and Alder creeks. This terrace houses the best old-growth forest.

The area is underlain largely by granitics typical of the central Sierra. Soils are not described. Precipitation is estimated to average between 40 and 50 inches (1016-1270 mm) annually.

Association Types

The area is sampled using 0.07-ha plots, most of them in mixed conifer forest.

• Scrub Forest (71322, 81320, 81330): 648 acres (262 ha). This association occurs on steep to moderate W.-, SW.-, and SE.-facing slopes. It is a transitional forest between chaparral and ponderosa pine forest with mixed dominants from chaparral *(Ceanothus cuneatus, Arctostaphylos viscida, Cercocarpus betuloides),* oak woodland (California buckeye *Aesculus californica,* Digger pine, interior live oak *Quercus wislizenii,* and canyon live oak *Quercus chrysolepis),* and ponderosa pine forest (ponderosa pine and California black oak). Abundant sprouts of canyon live and California black oaks suggest that, barring disturbance from fire, these two species would come to dominate much of the area.

Transition from chaparral to scrub forest is gradual with increased sprout clusters of canyon live oak, interior live oak, California black oak, or Digger pine or combinations of those and a decrease in *Cercocarpus* and *Ceanothus.* The transition from scrub forest to ponderosa pine forest is usually sharp along ridgecrests, with scrub forest on S.- or W.-facing slopes and ponderosa pine forest on adjacent N.- and E.-facing slopes.

• Mixed Conifer Forest (84210, 84230): 568 acres (230 ha). Most of this association is on gentle W.-, N.-, or E.-facing slopes between 4400 and 4560 ft (1340-1390 m) elevation. At least three phases of mixed conifer forest occur. These include open ponderosa pine-California black oak forest with dense *Chamaebatia foliolosa* understory, closed ponderosa pine-California black oak forest with a sparsely vegetated understory, and riparian conifer forest dominated by incense-cedar.

The first phase occurs on gentle terrain and contains open stands of ponderosa pine, California black oak, and incense-cedar. Some sites occur with dense reproduction, but in general, the understory is covered with well-developed populations of *Chamaebatia foliolosa* with occasional *Arctostaphylos mariposa, A. viscida,* and saplings of incense-cedar and ponderosa pine. Percent cover, density, and basal area are variable with respective averages being 47±22 percent (SD), 448±406 stems/ha, and 47.6± 29.2 m^2/ha over seven 0.07-ha sample plots. In-

cense-cedar never accounts for more than 10 percent of the basal area, but density of incense-cedar is occasionally higher than ponderosa pine, resulting from numerous saplings. More xeric stands in this phase are dominated by scrubby California black oak with *Chamaebatia foliolosa* and *Arctostaphylos mariposa* in the understory.

The lower elevation (<3610 ft or 1100 m) mixed conifer zone is the second phase. Typically it is dominated solely by ponderosa pine with only occasional Digger pine or Douglas-fir *(Pseudotsuga menziesii)* in the canopy. A nearly continuous cover of California black oak shades the understory, precluding a well-developed ground cover. Several woody species are present in this phase which are absent in the previous one. These include California bay *(Umbellularia californica),* California buckeye, *Toxicodendron diversilobum,* and *Ceanothus integerrimus.* Canyon live oak is infrequent in both phases 1 and 2 except along canyon bottoms.

Riparian mixed conifer forest (the third phase) occurs above 3940 ft (1200 m) elevation on level to gently sloping topography. Dominant incense-cedar are all ca. 95 years old and are intermixed with more mature specimens of ponderosa pine, California black oak, white alder *(Alnus rhombifolia),* and white fir *(Abies concolor).* Pacific dogwood *(Cornus nuttallii)* and *Corylus cornuta* are common in the understory. Ponderosa pine and California black oak are not reproducing nearly as abundantly, nor growing as fast as incense-cedar.

• Chaparral (37110): 116 acres (47 ha). This association occurs on S.- to SW.-facing slopes between 3480 and 5410 ft (1060-1650m) elevation. Slopes are mostly 20-35°. Cercocarpus *betuloides is* dominant, accounting for ca. 45 percent cover, 600 stems/ha density, 6 m^2 /ha basal area and an average importance value of ca. 200. *Ceanothus cuneatus* contributes another 25 percent cover, but has low basal area. *Arctostaphylos viscida* and *A. mariposa* both contribute 5-10 percent cover. *Bromus tectorum* and other annual grasses provide some cover along with occasional individuals of Digger pine, *Eriodictyon californica, Fremontodendron californicum,* and *Rhamnus crocea* ssp. *ilicifolia.*

Plant Diversity

No list is included.

Conflicting Impacts

Uncontrolled fire entering the area from the lower chaparral- and scrub forest could eliminate much of the canopy of the best-developed terrace ponderosa pine-California black oak forest. Fires entering from the E., NE., or SE. would be less destructive, but still run the risk of crowning. Implementation of a controlled burning program to thin the understory of overly dense regeneration is necessary to maintain and improve the target element at this site.

56. BOURLAND MEADOW (Talley 1976)

Location

This candidate RNA (dropped in 1984) is on the Stanislaus

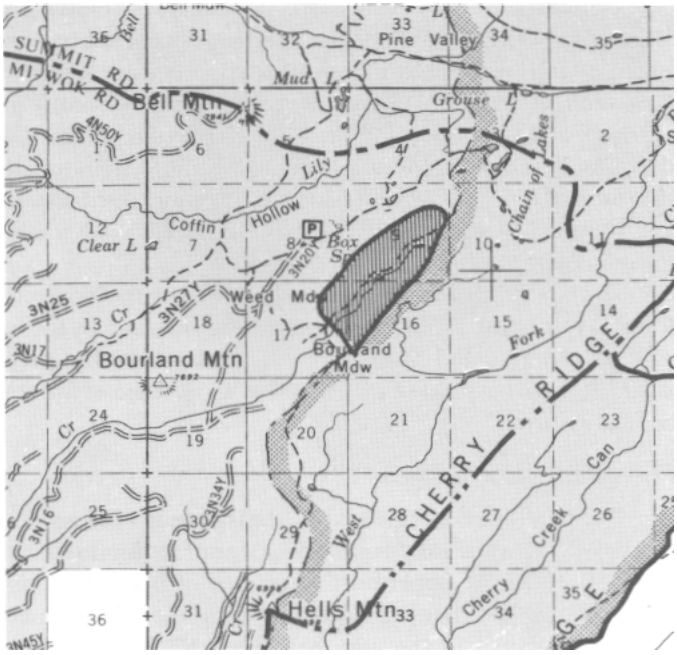


Figure 116--The Bourland Meadow study area.

National Forest ca. 7 miles (11 km) SE. of Pinecrest. It lies within sects. 8, 9, 16, and 17 T3N, R19E MDBM (38°6'N., 119°54' W.) USGS Pinecrest and Cherry Lake North quads *(fig. 116).*

Target Element

Red fir *(Abies magnifica)*

Distinctive Features

• Red Fir Growth, Recruitment, and Succession: Growth rates of red fir vary widely, depending on exposure, with open S.-facing slopes providing the fastest growing conditions. There, trees average 16 inches (41 cm) in height per year between 20 and 100 years age. Median growth rates are 14 inches (35 cm) per year for trees between 30 and 110 years old on dense stands with S. slopes, forested stands on gentle ridge crests, and young developing stands on N. slopes.

The red fir forest at Bourland Meadow has a stable all age-class distribution, although, on a small scale, individual plots show marked gap-phase reproduction with thickets of young fir and pines developing in openings created by wind-falls. The heavy shade of developing and mature stands suppresses saplings and seedlings, causing slow growth rates in the reproduction layer away from gaps.

There is evidence of primary succession in dry meadow sites. Here red fir is invading sites not characterized by porous sandy soil and also is colonizing lodgepole pine *(Pinus contorta* ssp. *murrayana)* and aspen *(Populus tremuloides)* forest. In other areas such as some *Quercus vaccinifolia* scrub, red fir also appears to be advancing. These types of invasions into adjacent habitats have been noted elsewhere (e.g., Oosting and Billings 1943) and appear to be a widespread phenomenon in the Sierra Nevada.

Unlike red fir sites in the extensive samples of Oosting and Billings (1943), those at Bourland Meadow appear to have lower relative basal area resulting from other important associated tree taxa such as white fir *(Abies concolor),* Jeffrey pine *(Pinus jeffreyi),* and western white pine *(P. monticola).* This added diversity of trees in this normally monospecific forest is possibly the result of a slightly warmer and slightly more open nature of the Bourland Meadow red fir forests compared to other red fir locations sampled in the Sierra Nevada.

The lack of fire as an important influence on the local red fir forest is typical for this association and is evidenced by the lack of pine saplings and such fire indicators as *Arctostaphylos nevadensis* in the understory, as well as an absence of fire scars on mature trees.

Physical Characteristics

The area covers 1003 acres (406 ha) between 7200 and 7923 ft (2195-2415 m) elevation on the W. slope of the Sierra Nevada. The site covers the uppermost watershed of Bourland Creek. The Emigrant Wilderness Area lies along the SE. boundary. About 75 percent of the area has either SE. or NW.-facing exposures. The site is underlain by both Mesozoic granitic rock and by Pleistocene volcanics, with volcanics predominating. Quaternary alluvium underlies the meadow area. Soils vary from non-existent on granitic outcrops to deep organic-rich meadow soils. Annual precipitation is 50-60 inches (1270-1524 mm).

Association Types

Nineteen 700-m^2 plots are sampled in the red fir forest.

• Red Fir Forest (85310): 568 acres (230 ha). Four subdominants occur with red fir, not exceeding 25 percent of total tree stratum cover either singly or in combination. These are lodgepole pine, western white pine, Jeffrey pine, and white fir. Importance values on the sample plots average over 200 for red fir with red fir basal area ranging from 30 to 80 m^2/ha and density ranging from 150 to 1808 stems/ha. Average basal area on 11 plots is 68.8 m^2/ha of which 80 percent is red fir.

Four subtypes are recognized: red fir-lodgepole pine, red fir-western white pine-lodgepole pine, red fir white fir, and red fir-white fir-Jeffrey pine. Red fir-lodgepole pine forests cover 242 acres (98 ha) on well-drained NW.-facing exposures. Western white pine occurs as an additional associate as at the head of Bourland Creek underlain by granitic rock. On SE.-facing slopes white fir is the principal associate within 76 acres (31 ha) of red fir forest. White fir is particularly common along ecotones between red fir and aspen forests. *Ceanothus cordulatus* is common in the understory of open red fir-white fir stands. Jeffrey pine occurs within 62 acres (25 ha) of red fir-white fir forest with a S.-facing aspect.

Throughout the various phases of red fir forest the most common herbs include *Viola purpurea, Pedicularis semibarbata, Smilacina amplexicaulis, Erigeron peregrinus* var. *angustifolius, Kelloggia galioides, Thalictrum fendleri, Chrysopsis breweri, Hieracium albiflorum, Phacelia hydrophylloides, Pyrola picta,* and *Pterospora andromedea.* In more open types of red fir forest additional species such as *Collinsia parviflora, Bromus marginatus, Poa bolanderi, Monardella odoratissima, Streptanthus tortuosus,* and *Allium campanulatum* occur. There is no clear association between slope exposure and herb species composition.

• Huckleberry Oak Scrub (37542): 156 acres (63 ha). This form of mountain chaparral covers either open granitic outcrop with patches of soil, rocky ridges, or steep slopes with S.-facing exposures. The largest patch occurs on the granitic rock at the head of the Bourland Creek watershed. Some of this area supports Jeffrey pine. Total cover for both Jeffrey pine and *Quercus vaccinifolia* is usually less than 10 and 30 percent, respectively. One stand of *Q. vaccinifolia* on a S.-facing slope at 7350 ft (2240 m) had scrubby California black oak *(Quercus kelloggii)* growing at near its upper elevational limits.

• Scrubby Lodgepole Pine and Red Fir (85300, 86100): Stands of this type occur over 91 acres (37 ha) of dry meadow terrain. Density of both species is limited by germination sites. Stem breakage is high. The understory is poorly developed because of the dry, sandy substrate. *Streptanthus tortuosus, Calyptridium umbellatum, Eriogonum* sp., and *Collinsia parviflora* are among the most common species.

• Wet and Dry Meadow (45100, 52430): These meadow types cover 84 acres (34 ha), most of which can be classified as wet type. Several shallow ponds with some aquatic vegetation also occur *(fig. 117*). Cattle grazing was so heavy during the time of study that most plants were not identifiable.

• Aspen Forest (811300): 74 acres (30 ha). This association occurs on a SE. exposure and is surrounded by red fir forest on rocky soil at the lower half of a 0.6-mile (1-km) wide incline. The location probably concentrates subterranean water movement. Density of stems is high (670 stems/ha), though cover is low. There is a large assemblage of woodland and wet and dry meadow species associated with the aspen grove.

• Lodgepole Pine Forest (86100): 42 acres (17 ha). Lodgepole pine may occur as nearly pure stands adjacent to wet meadows (wet subtype) or as forests on slopes bordering meadows (dry subtype). Wet types cover 37 acres (15 ha) around Bourland Meadow with some aspen *(Populus tremuloides)* and

Figure 117--Bourland Meadow: View N. across "Heart Lake" with lodgepole pine forest beyond (L. Johnson).

white fir. Lodgepole pine is the clear dominant with importance values of nearly 300.

Many wet meadow species occur in these forests including *Dodecatheon alpinum, Senecio triangularis, Veratrum californicum,* and species of *Carex, Juncus, Melica, Viola, Bromus, Gentiana,* and *Erysimum.* The understory in the dry phase includes many species associated with red fir forests and also *Elymus glaucus, Galium aparine, Montia perfoliata, Ribes roezlii, Rumex pauciflorus, Calochortus leichtlinii, Lupinus densiflorus, Brodiaea exioides* var. *lugens, Castilleja lemmonii,* and *Ligusticum grayi.*

Plant Diversity

Approximately 75 taxa are listed in an association table; actual diversity is certainly much higher.

Conflicting Impacts

The area was removed from candidacy as a result of multiple use conflicts (primarily logging). A portion of the area was logged in 1967. The meadow area, though well-developed, shows strong evidence of overgrazing with the upper portion of the meadow suffering rapid downcutting by Bourland Creek. In a recent review (1990) of the area by the RNA committee, Bourland Meadow was again recommended for candidacy for its aquatic (bog) values, largely undiscussed in the survey.

57. HARVEY MONROE HALL (Taylor 1984)

Location

This established RNA is on the Inyo National Forest. The S. end of the RNA is only 1 mile (1.6 km) N. of Tioga Pass (Highway 120). It occupies all or portions of sects. 34 and 35 T2N, R24E and sects. 1, 2, 3, 10, 11, 12, 13, and 14 T1N, R24E MDBM (37°58'N., 119°19' W.) USGS Tioga Pass quad *(fig. 118).*

Target Element

Alpine meadows, Sierran mixed subalpine forest

Distinctive Features

• Long History of Research: This RNA was one of the first established in California (1933). The Carnegie Institute of Washington's classic studies on genotype-environment interactions made much use of the transplant gardens at the S. end of the RNA. Many related studies were carried out in the 1940's and 1950's at these gardens. Since then other researchers have made use of the area, studying social organization of Belding ground squirrels, dynamics of wind-blown detritus in snow banks, and community structuring of subalpine forest birds. A partial bibliography listed by the author of this survey cites 41 references pertaining to the RNA.

• High Floristic and Vegetational Diversity: Despite the high elevation of the RNA, a great variety of plants and association types occur. The many studies and botanical collections made in the area have made this one of the best known RNAs

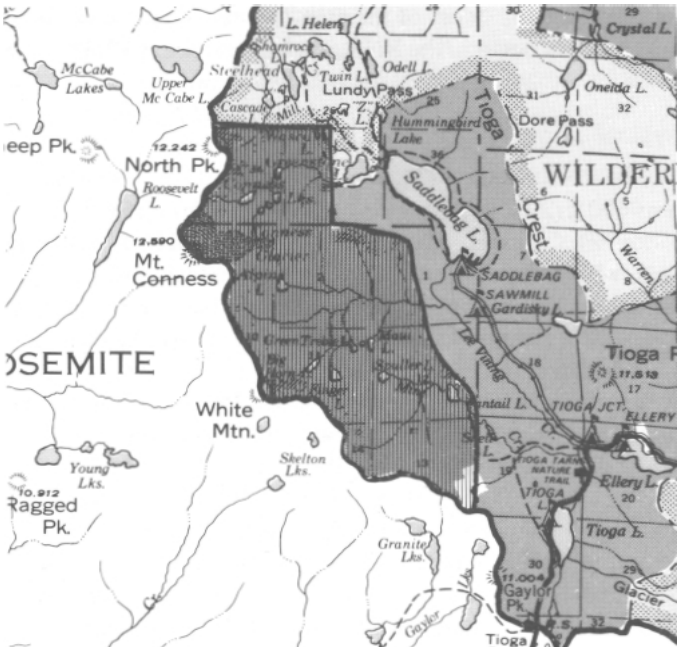


Figure 118--The Harvey Monroe Hall RNA (vertical hatching).

botanically. Three hundred ninety-eight taxa of vascular plants in 190 genera and 55 families are represented. An extensive program of vegetation sampling conducted in this survey revealed 10 major habitat types, which were broken down into 31 vegetation alliances and 66 plant associations.

• Rare Plants: Two species present in the RNA are members of CNPS List 2: *Salix brachycarpa, Salix reticulata* ssp. *nivalis.* The following are members of CNPS List 4: *Astragalus kentrophyta* var. *danaus, Podistera nevadensis,* and *Scirpus clementis.*

• Aquatic Values: Fifteen lakes occur in the RNA in addition to a number of smaller perennial and ephemeral ponds *(fig.119).* Lakes occur on various substrates (metamorphic and granitic), which affect their chemistry and biota. Eight small watersheds of approximately equal size are present, each with a

Figure 119--Harvey Monroe Hall: Gardisky Lake with *Artemisia rothrockii* association in foreground (D. Taylor).

perennial stream. Most of the streams arise from snow melt. Three glaciers occur in the RNA; the largest is ca. 160 acres (65 ha).

Physical Characteristics

The RNA covers 3888 acres (1573 ha). Elevations range from 9600 ft (2926 m) along Lee Vining Creek to 12,590 ft (3837 m) atop Mt. Conness. The entire area is drained by Lee Vining Creek which flows from NW. to SE. Glaciation strongly affected the topography. Several deeply glaciated NE.-facing cirques are present with steep headwalls and flats or lakes at their floors. Much of the lower elevation area is stepped topography resulting from differential erosion along jointing planes in the granitic bedrock. The granitic rocks are part of the Cathedral Peak Quartz Monzonite and the Half Dome Quartz Monzonite. They occupy the W. part of the area. The E. portion is underlain by various metamorphic rocks including Paleozoic and Mesozoic metasediments, metadacite, banded calc-silicate hornfels, calc-silicate hornfels varying to limestone-marble, and basic metavolcanics. Soils are typically shallow and poorly developed except in meadow areas. The climate is high Sierran montane with copious winter snowfall. Average annual precipitation is estimated to be more than 25 inches (635 mm). There is great variation in temperature and growing season, between S. and N.-facing slopes, valley bottoms and ridges, etc.

Association Types

A total of 374 stands of vegetation are sampled (releve method), and the results classified using the computer-generated TWINSPAN hierarchical system and detrended correspondence analysis ordination to produce the association tables. The primary division is between xeric and hydric sites. Within dry sites the next division is made between alpine and subalpine communities (a reflection primarily of temperature differences). The next level of division within xeric sites is related to late and early-snow melt patterns. Wet site classification is based on site productivity with graminoid-dominated meadows being 2-3 times less productive than tall herb-dominated associations. The following summary lists the major habitat types with their corresponding alliances and associations. Sizes for associations are not given.

1) Rock Fissures (91200):
   - *Cystopteris fragilis* alliance
   - *Heuchera rubescens-Cystopteris fragilis* association
   - *Oxyria digyna* alliance
   - *Draba lemmonii-Oxyria digyna* association
2) Scree, Talus and Rock Outcrop Communities (91200):
   - *Carex congdonii-Arnica amplexicaulis* alliance
   - *Arnica amplexicaulis-Carex congdonii* association
   - *Sambucus microbotrys-Carex congdonii* association
   - *Artemisia rothrockii* alliance
   - *Holodiscus dumosus (H. microphyllus)-Mimulus suksdorfii* association
   - *Stipa occidentalis-Eriogonum nudum* association
   - *Artemisia rothrockii-Monardella odoratissima* association
   - *Saxifraga nidifica-Mimulus rubellus* alliance
   - *Saxifraga nidifica-Mimulus rubellus* association
   - *Rhodiola integrifolia-Selaginella watsonii* association
   - *Saxifraga bryophora* association
   - *Polygonum minimum* association
   - *Penstemon newberryi-Streptanthus tortuosus* alliance
   - *Sedum obtusatum-Muhlenbergia montana* association
   - *Spiraea densiflora* association
   - *Pentaphylloides floribunda (Potentilla fruticosa)* alliance
   - *Pentaphylloides floribunda-Danthonia unispicata* association
3) Xeric Alpine Communities (91120):
   - *Minuartia nuttallii (Arenaria nuttallii)-Haplopappus macronema* alliance
   - *Minuartia nuttallii* association
   - *Calamagrostis purpurascens* alliance
   - *Calamagrostis purpurascens-Leptodactylon pungens* association
   - *Chrysothamnus monocephalus-Leptodactylon pungens* association
   - *Elymus (Sitanion) hystrix-Phlox covillei* alliance
   - *Festuca minutiflora-Penstemon davidsonii* association
   - *Podistera nevadensis-Erigeron pygmeaus* association
   - *Astragalus kentrophyta-Draba oligosperma* association
   - *Elymus hystrix-Phlox covillei* alliance
   - *Phlox covillei-Eriogonum incanum* association
   - *Ivesia muirii* association
   - *Hulsea algida* alliance
   - *Macronema discoideum (Haplopappus macronema)-Phacelia frigida* association
4) Subalpine Forests (86100, 86210, 86220, 86600):
   - *Pinus contorta* (lodgepole pine) alliance
   - *Pinus contorta-Carex rossii* association
   - *Pinus contorta-Thalictrum fendleri* association
   - *Pinus contorta-Ledum glandulosum* association
   - *Pinus albicaulis* (whitebark pine) alliance *(fig. 120)*
   - *Pinus albicaulis-Poa nervosa* association

Figure 120--Harvey Monroe Hall: Krummholz whitebark pine with *Chrysothamnus monocephalus-Leptodactylon pungens* association in foreground (D. Taylor).

Pinus albicaulis-Penstemon davidsonii association
Tsuga mertensiana (mountain hemlock) alliance
Tsuga mertensiana Arnica cordifolia association

5) Snowpatch Communities (91300):
Juncus parryi alliance
Juncus parryi-Eriogonum incanum association
Phyllodoce breweri association
Carex spectabilis-Sibbaldia procumbens association
Carex helleri alliance
Eriogonum incanum Raillardella argentea association
Carex helleri-Ivesia lycopodioides association
Saxifraga tolmiei-Luzula divaricata association
Carex breweri alliance
Carex breweri association

6) Well-Drained Meadows (45220, 45210):
Carex exserta alliance
Carex exserta-Saxifraga aprica association
Calamagrostis breweri alliance
Calamagrostis breweri-Vaccinium caespitosum association
Calamagrostis breweri-Kalmia microphylla association
Salix orestera-Calamagrostis breweri association
Juncus drummondii-Calamagrostis breweri association
Danthonia unispicata alliance
Piltagrostis (Oryzopis) kingii-Senecio scorzonella association
Phleum alpinum-Danthonia unispicata association
Melica bulbosa alliance
Stipa lemmonii-Carex straminiformis association
Juncus balticus association

7) Tall-Herb and Willow Thickets (63500, 45210):
Salix orestera Allium validum alliance
Salix orestera Allium vallidum association
Salix orestera-Senecio triangularis association
Salix planifolia-Carex scopulorum association
Veratrum californicum alliance
Veratrum californicum-Senecio triangularis association
Senecio triangularis-Carex spectabilis association
Arnica mollis alliance
Arnica mollis-Arabis davidsonii association

8) Poorly-drained Meadows (45210):
Carex luzulaefolia alliance
Carex luzulaefolia-Ranunculus alismaefolius association
Carex scopulorum-Pedicularis groenlandica alliance
Eriophorum crinigerum-Carex scopulorum association
Carex scopulorum-Pedicularis groenlandica association
Heleocharis paucifora association
Carex deweyana alliance
Rorippa curvisiliqua-Carex deweyana association
Juncus mertensianus association
Carex nigricans alliance
Salix arctica association
Carex subnigricans-Dodecatheon alpinum association
Carex nigricans-Kalmia microphylla association
Carex vernacula Antennaria alpina association

9) Flowing Springs and Shallow Streams (45210, 63500):
Mimulus tilingii alliance
Claytonia nevadensis association
Mimulus tiningii-Poa gracillima association
Deschampsia caespitosa alliance
Deschampsia caespitosa-Solidago multiradiata association

10) Shallow Ponds and Standing Water (52430):
Carex rostrata alliance
Torreyochloa (Puccinellia) pauciflora-Isoetes bolanderi association
Carex rostrata association

Plant Diversity

Three hundred ninety-eight taxa of vascular plants are listed.

Conflicting Impacts

The area is bounded on the SE. by a good gravel road to Saddlebag Lake and is only a few miles by road from Tioga Pass (Yosemite National Park E. entrance). However, recreational use of the area is apparently not a significant impact in most areas. In the late 1800's and in the early 1900's sheep apparently overgrazed much of this area. However, no certain evidence of this impact remains.

58. JAWBONE RIDGE (Fiedler 1986)

Location

This candidate RNA (dropped in 1987) is located in S. Tuolumne County on the Stanislaus National Forest. It lies ca. 6.5 miles E. of Groveland and occupies portions of sects. 13, 14, 15, 22, 23, and 24 T1S, R17E MDBM (37°50'N., 120°6'W.) USGS Jawbone Ridge quad *(fig. 121).*

Target Element

Chamise *(Adenostoma fasciculatum)* chaparral

Distinctive Features

• Rare Plants: A list including 16 rare plant species believed to occur in the area is included. However, because no actual field work was conducted in the study area and this list encompasses the entire lower elevation area of the Stanislaus National Forest, it is not accurate for the area.

• Rare Land Snails: Two Federal candidate endangered species *(Monodenia circumcarinata* and *M. tuolumneana),* endemic to the Tuolumne River Canyon, may occur in the area.

• Rare Birds: The bald eagle *(Haliaaetus leucocephalus)* and peregrine falcon *(Falco peregrinus),* which are considered by the Federal government to be endangered species, may occur in the area.

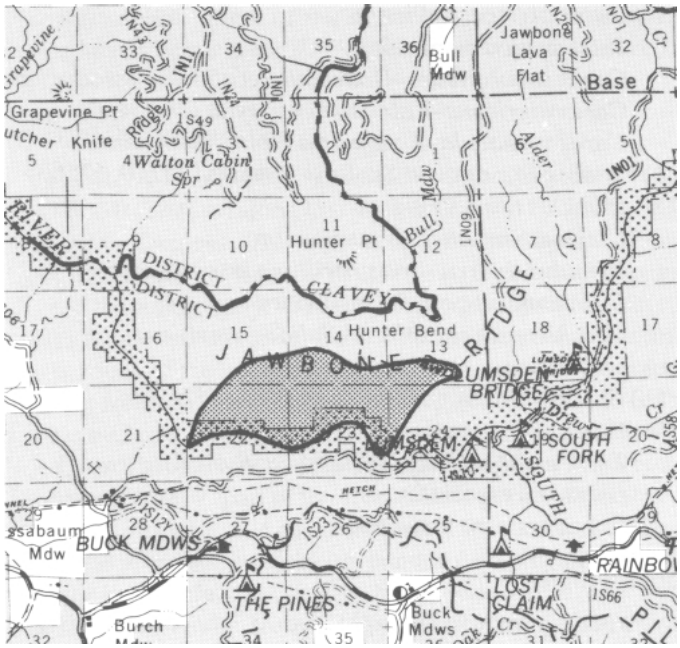


Figure 121--The Jawbone Ridge study area.

• Jawbone Deer Herd: This study area and adjacent Jawbone Lava Flat are critical wintering ranges for mule deer *(Odocoileus hemionus californicus).*

Physical Characteristics

The area is rugged and remote, covering ca. 1442 acres (584 ha). Elevations range from 1250 ft (381 m) along the Tuolumne River to four summits between 2841 and 3397 ft (866-1035 m) atop Jawbone Ridge. The S.-facing slopes of the Tuolumne River Canyon vary from 30 to 110 percent.

Rocks consist of two formations. The most extensive is the Paleozoic Calaveras Formation composed of argillite, limestone, quartzite, and mica schist. The E. portion of the area is underlain by the late Cretaceous Chico Formation. This formation is characterized by sandstone, shale and conglomerate. Four soil mapping units occur. These are Dystric Lithic Xerochrepts/Rock Outcrop/Josephine Family, Dystric Lithic Xerochrepts/Rock Outcrop/Typic Xerumbrepts, Fiddletown Family/Lithic Xerumbrepts Complex, and Ultic Haploxeralfs/Red Bluff Family. The first unit is the most extensive. Mean annual temperature is estimated to be 59 °F (15 °C), mean December low 46 °F (7.8 °C), and mean July high 77 °F (25 °C). Precipitation estimates are 0.02 inches (0.5 mm) in August to 6.01 inches (153 mm) in January with a mean total of ca. 32 inches (813 mm).

Association Types

No sampling is conducted, and sizes of associations are not given.

• Chamise Chaparral (37200, 37110): Typically this association has 20-100 percent cover composed of *Adenostoma fasciculatum* with less than 20 percent of remaining vegetation composed of herbs, grasses, or other shrub species. In some areas *Arctostaphylos manzanita, A. mewukka, Ceanothus cuneatus, C. diversifolius,* and C. *integerrimus* may exceed 20 percent cover. Occasional emergent Digger pine *(Pinus sabiniana)* are also present. Other species include *Lonicera* sp., *Chlorogalum pomeridianum, Eriodictyon californicum, Quercus chrysolepis, Castilleja* spp., and *Chamaebatia foliolosa.*

Chaparral covers the western third of the area on S.- and W.-facing slopes, forming a distinct border with the pine/oak vegetation type *(fig. 122).*

• Grassland and Savanna (42200, 71140, 71310): This association is composed of 10-100 percent cover by grasses and herbs. Digger pine, blue oak *(Quercus douglasii),* and California buckeye *(Aesculus californica)* comprise less than 10 percent cover. The most common herbs include *Avena* spp., *Bromus* spp., *Elymus* spp., *Poa* spp., *Festuca* spp., *Aira caryophyllea,* and several members of Polemoniaceae, Liliaceae, Scrophulariaceae, and Apiaceae.

This association occurs in the W. corner of the area throughout the entire elevational range of the area. Slopes are very steep with rock outcrops and talus throughout.

• Oak Woodland (71140, 71410, 81320): This type occupies the smallest acreage of the area, occurring in upper draws and along the river. Dominant species include canyon live oak *(Quercus chrysolepis),* blue oak, and Digger pine. Other species of lesser importance include *Fraxinus dipetala, Umbellularia californica,* and *Cercocarpus betuloides.* Oak species cover 20-100 percent of the community. This is probably the most species-rich community in the area.

• Ponderosa Pine *(Pinus ponderosa)*/Oak forest (71310, 71322): *Editor's note:* Despite the name, ponderosa pine is not likely to occur here except rarely. The typical pine species is Digger pine. Aspect is largely ESE. From photos in the report, Digger pine appears to dominate the canopy with a subcanopy dominated by oaks of varying density. These are primarily canyon live oak, interior live oak *(Quercus wislizenii),* and blue oak.

Figure 122--Jawbone Ridge: chamise chaparral and oak woodland/savanna (P. Fiedler).

Plant Diversity

The included list represents a much larger area than the study site, encompassing the entire Clavy-Wards Ferry Area. It is thus inaccurate for the specific study area.

Conflicting Impacts

Because of the inaccessible nature of the area, this ecological survey bears the distinction as being the only one not actually visited by the author. This inaccessibility as well as the steep slopes once within the area greatly reduces its usefulness as a research area, and consequently the candidate has been dropped for further consideration.

59. LAST CHANCE MEADOW (Ball 1976, DeDecker 1975b)

Location

This established RNA is located on the Inyo National Forest. It lies on the E. side of the crest of the S. Sierra Nevada ca. 13 miles (21 km) SW. of Lone Pine. It lies within portions of sects. 13, 14, 23 and 24 T17S, R 35E, MDBM (36°27'N., 118°9'W.) USGS Cirque Peak quad *(fig. 123).*

Target Element

Foxtail pine *(Pinus balfouriana)*

Distinctive Features

• Foxtail Pine Forests: Foxtail pine is a principal dominant of the S. Sierra subalpine forests, yet little ecological information exists for these forests. Factors limiting growth, structure, productivity, and distribution of the S. Sierra stands are not clearly understood, nor is the role of fire, or the explanation for the extremely sparse understory characteristic of the type. The extensive stands at this RNA, ranging over a variety of site conditions, could also prove useful in comparative study with the N. California populations of foxtail pine represented at #'s 4, 11, and 19. The information gathered in this survey and by the Laboratory of Tree-Ring Research (cited in ecological survey) on growth of foxtail pine suggests that local dominants typically exceed 600 years and attain ages of 1000-1500 years *(fig. 124).* The ease of access (edge of RNA only 0.5 mile [0.8 km] from paved road) also will facilitate and encourage research on this typically rather inaccessible forest type.

• Stream Study: The inclusion of the entire upper portion of a small permanent stream drainage makes the RNA useful for watershed-related studies.

• Rare and Unusual Plants: Two species, *Frasera tubulosa* and *Ivesia campestris,* are listed as rare on the survey list. However, both of these species are now considered as being too common *(appendix 1)* by CNPS to warrant special consideration. *Sarcodes sanguinea,* though not rare, grows in an unusual situation in the very low duff-understory of the foxtail pine forest.

Physical Characteristics

This area covers ca. 1869 acres (756 ha) which spreads over portions of three ridges and includes an entire small drainage-head between the ridges. Land varies in elevation from ca. 9700 to 10,930 ft (2957-3332 m). Significant facets of the area are exposed to all major azimuth angles, but the majority faces N. and S. Slope angles vary from 75° on the E. escarpment to virtually level on the meadows in the SW. portion. Average N. slopes are ca. 25°, whereas S. slope averages are ca. 15°.

Rocks are entirely Mesozoic granitics. Soils are poorly developed in most of the area, consisting of decomposed granite or scree, depending on slope. Organically rich meadow soils lie over a thin layer of alluvium in a small area of the SW. portion. The area probably receives an annual average of between 20 and 30 inches (508-762 mm) precipitation, with snow accounting for

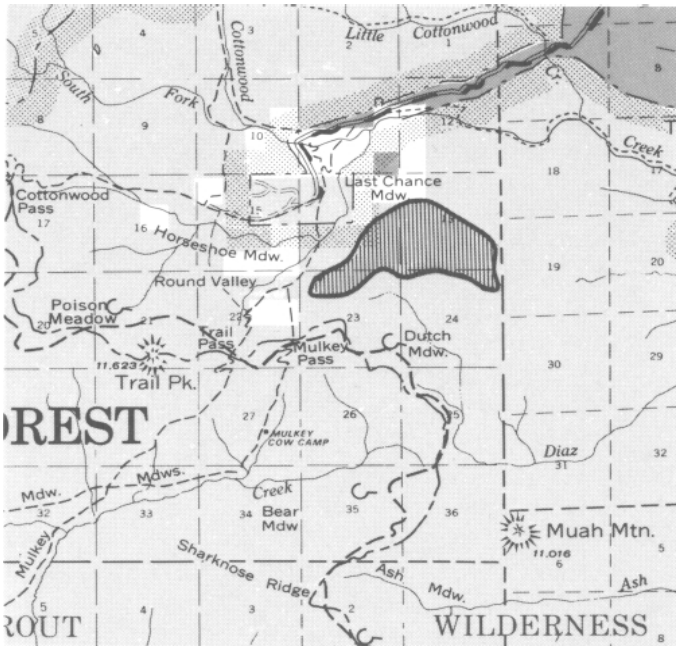


Figure 123--The Last Chance Meadow RNA.

Figure 124--Last Chance Meadow: Granitic outcrop surrounded by wind-eroded 800- to 1500-year-old foxtail pine (L. Johnson).

the vast majority. Snow depth on April 1 in this area averages between 25 and 50 inches (64-127 cm).

Association Types

Fourteen plots of unlisted area are sampled in the subalpine forest; acreage for associations is not given.

• Subalpine Forest (86100, 86300, 86700): This vegetation has been grouped into four types. These are a mixed forest dominated by lodgepole pine *(Pinus contorta* ssp. *murrayana)* with foxtail pine subdominant, a mixed forest dominated by foxtail pine with lodgepole pine subdominant, a mixed forest co-dominated by limber pine *(Pinus flexilis)* and foxtail pine, and a monospecific forest of foxtail pine. These types are not discussed individually.

Lodgepole pine is most common along water courses and at lower elevations, whereas foxtail pine cover is negatively correlated with lodgepole pine cover. Limber pine tends to increase in basal area at higher altitudes (e.g., on ridge S. of Last Chance Meadow), while there is a general reduction in basal area of all species as the highest elevations of this ridge are approached. On the S.-facing slope of this ridge, foxtail pine occurs in high cover. In the SE. quarter of sect. 13 on a boulder-strewn plateau, foxtail pine attains high basal area cover in pure stands. Reproduction throughout the subalpine forest is good for all three main species. Based on 14 sampling sites, basal area cover for the three major tree species are (average, with range and sample size): foxtail pine 36 (1-56, n=14) m^2/ha, lodgepole pine 9 (0.25-28.5, n=12) m^2/ha, and limberpine 4.1(0.5-10, n=5) m^2/ha. Total basal area for the plots averages 43.4 (11-54.25) m^2/ha.

In general, the shrub and herb layers are extremely sparse (<25 plants/100 m^2), particularly in the pure foxtail pine areas. The most conspicuous species include *Selaginella watsonii* and several species of *Eriogonum.*

• Meadow (45210, 45220): Although not specifically discussed, numerous species (at least 36) derived from the species list are typical meadow plants of the high S. Sierra. These taxa may be divided into moist, wet, and meadow-riparian situations *(fig.125).*

Figure 125--Last Chance Meadow: Looking N. across nameless meadow to foxtail pine-dominated S. slope (L. Johnson).

Plant Diversity

Seventy-one taxa are listed.

Conflicting Impacts

There has been some grazing by domestic livestock in the meadow area. However, the principal impact comes from recreationists, mainly hikers using the Pacific Crest Trail, which passes along the S. border of the area. As of 1976 an undesignated trail, which traverses the meadowy SW. portion of the RNA, was experiencing increasing use.

60. TEAKETTLE CREEK (Griffin 1975)

Location

This candidate RNA (now dropped) is on the Teakettle Experimental Forest, Sierra National Forest. It occupies portions of sects. 16, 17, 20, 21, and 22T11S, R27E MDBM (36°58' N., 119°02'W.) USGS Patterson Mountain *(fig. 126).*

Target Element

Red fir *(Abies magnifica)*

Distinctive Features

• Well-Developed Southern Sierra Red Fir Forest: Red fir-dominated forest covers several hundred acres. These acres are divided up into many small stands with a wide range of density and basal areas *(fig. 127).* These are augmented with brushy stands and extensive transitions to white fir *(Abies concolor)*-dominated forest. This site is an excellent example of a S. Sierra red fir forest.

• Watershed Values: The site includes three distinct watersheds, each of which has a gauging station. Watershed studies

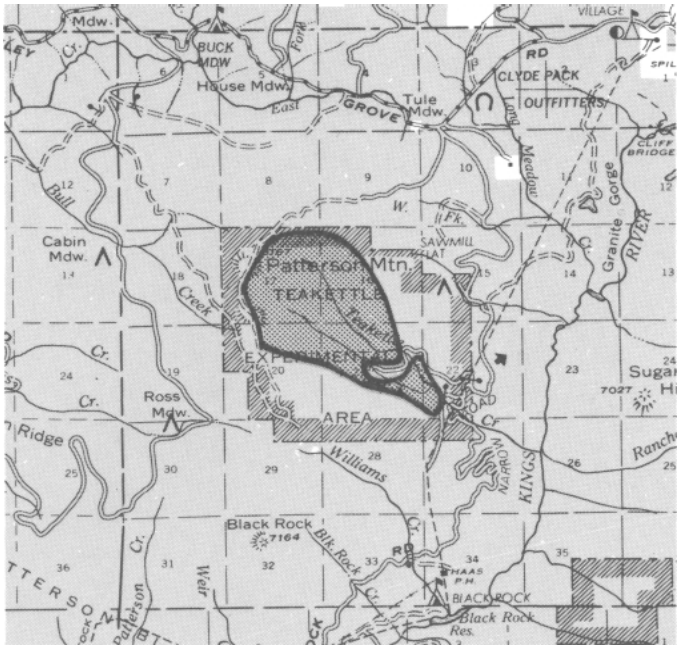


Figure 126--The Teakettle Creek study area (stippled).

Figure 127--Teakettle Creek: A closed-canopy stand of mature red fir representing the most highly productive type of red fir forest locally (J. R. Griffin).

relating to ecosystem input and output would thus be easily undertaken.

• Well-Developed Meadows: The area contains several meadows including wet and dry types. Some are being invaded by conifers, but many of the meadow-forest boundaries are sharp.

• Rare Plants: *Raillardella muirii* (CNPS List 1b) has been collected adjacent to the study site and is probably in the area.

Physical Characteristics

The area covers 1250 acres (506 ha). Elevations range from 6400 to 8050 ft (1951-2454 m). The area is drained by Teakettle Creek, a tributary of the Kings River. The creek flows to the SE. with slopes of E., NE., and SE. predominating. Slopes are generally gradual with the average gradient being ca. 720 ft/mile (136 m/km).

Most of the area is on Triassic metamorphics, mainly quartzite. Small areas of Miocene basalt overlie the quartzite. The lowest elevations are underlain by granitic rocks. The gentle topography and the unglaciated surface have produced deep soils in some areas. The Corbett series predominates with depths of 4-5 ft (1.2-1.5 m). Climate is not discussed, but precipitation is likely to average 50 inches (1270 mm) /year (Rantz 1972).

Association Types

Twenty 20 m by 50 m plots are sampled in the area. These are equally divided between red fir and mixed conifer vegetation. The remainder of the associations are qualitatively described.

• White Fir-Red Fir Forest (85310, 84240): 295 acres (119 ha). This is a transitional forest between red-fir and mixed conifer forests, occurring at the mid-elevations of the study area. Dominance is traded between red fir and white fir *(Abies concolor).* Stand structure between this and the pure red fir forest of higher elevations is similar. In general, there is more red fir than white fir regeneration. Unlike many other mid-montane areas in California there seems to be no well developed zone of white fir dominance here. Floristically, the scattered shrubs and herbs under the canopy are little different from those of the red fir forest. Three plots sampled in this association have tree densities, seedling densities, and basal area (respectively) ranging from 30 to 131/ha, from 0 to 111/ha, and from 25.7 to 104.5 m^2 /ha for white f r and from 161 to 351 /ha, from 59 to 400/ ha, and from 26.4 to 109.3 m^2 /ha for red fir.

• Open Mixed Conifer-Brush (Holland 84230, 37510): 255 acres (103 ha). Parts of the higher elevation mixed conifer stands are open with low shrub cover and may be considered a lower extension of the open red fir forest-brush (association 5) with similar understory composition. At lower elevations this association has many tall shrubs and may be dense. In rocky areas or on concave slopes *Prunus emarginata* dominates along with *Chrysolepis sempervirens* and *Ceanothus cordulatus.* The most exposed brush patches have considerable *Arctostaphylos patula* and colonies of shrubby California black oak *(Quercus kelloggii)* and *Chamaebatia foliolosa.* Portions of this area are dominated by Jeffrey pine *(Pinus jeffreyi).* These are very open stands (40 trees/ha, 9.6 m^2/ha on one 0.1-ha sample).

• Mixed Conifer Forest (84230, 85210): 236 acres (96 ha). This is an upper elevation mixed conifer forest with white fir, Jeffrey pine, sugar pine *(Pinus lambertiana),* incense-cedar *(Calocedrus decurrens),* red fir, and occasional scrubby California black oak. The mixed conifer stands are more uneven-aged than the fir stands. White fir is the dominant seedling, and red fir also is present as seedlings over all but the shallowest soils and most xeric exposures. Ten plots are sampled in this association. Following is a listing of means of tree density, seedling density, and basal area (respectively) for the dominant trees: White fir: 350/ha, 346/ha, 31.6 m^2/ha; incense-cedar: 57/ha, 17/ha, 13.3 m^2/ha; Jeffrey pine: 25/ha, 10/ha, 13.1 m^2/ha; sugar pine: 25/ha, 7/ha,12.9 m^2/ha; red fir: 40/ha, 49/ha, 5.7 m^2/ha. Growth rates are slower in this forest (mean ring width =1.38 mm) than in the following red fir association.

• Red Fir Forest (85310): 200 acres (81 ha). This forest has a patchy distribution of closed stands where density and basal area are high. Much of the local red fir forest has many small openings with a senescent canopy. These openings contain scattered shrubs of *Chrysolepis sempervirens, Ceanothus cordulatus,* and occasional mats of *Arctostaphylos nevadensis.* Plots are all sampled in the denser areas, and basal area ranges from 71.9 to 168.5 m^2 /ha (mean 114.1 m^2/ha, N=10). Maximum diameters of red fir are 6.5-7 ft (2.0-2.1 m), and many trees are more than 4.25 ft (1.3 m) dbh. Variation is noted in growth rates, but ring-width averages 1.69 mm. Total tree density varies from 220 to 581/ha with an average of 341/ha. Red fir comprises an average relative density of 85 percent and an average relative cover of 84 percent. Average relative densities (per ha) and cover (m^2/ha), respectively, of the two other sampled species are 49 and 18.3 (white fir) and 2 and 0.2 (sugar pine).

• Open Fir Forest-Brush (37510,85310): 167 acres (68 ha). Well-developed montane chaparral does not exist locally. All the chaparral has scattered red and white fir at mid- and upper elevations and other mixed conifer species at lower sites. These open "fir woodlands" average less than 50 percent canopy cover and are dominated by extensive understories of *Arctostaphylos*

nevadensis, with *Chrysolepis sempervirens, Ceanothus cordulatus,* and *Arctostaphylos patula* locally common. Tall shrub cover is usually open enough to allow easy passage. These openings are being colonized by fir and may indicate areas of past intense fires.

• Wet Meadow (45100): 56 acres (23 ha). Over 20 individual wet meadows are mapped in the area. They are characterized as well-developed and, in general, diverse. All appear to be associated with streams and gullies, and thus, may be classified as stringer-type meadows. A list of characteristic species is not provided, but photographs indicate species such as *Veratrum californicum, Senecio triangularis,* and *Lupinus polyphyllus* ssp. *supurbus* among the tall herbaceous dominants.

• Dry Meadow (45120): 16 acres (7 ha). Several dry meadows are scattered on shallow soils. These are dominated by *Astragalus bolanderi* with other species such as *Lupinus andersonii* locally common. They may be invaded by conifers, but many of the meadow borders are sharp and apparently stable.

• Subalpine Fir-Pine Woodland (85210): 9 acres (4 ha). On the highest summit areas the open fir forest-brush association merges into a rocky situation with a discontinuous understory of *Arctostaphylos nevadensis* and several rock outcrop herbs such as *Allium campanulatum, Hieracium horridum, Pellaea bridgesii, Sedum* sp., and *Stipa elmeri.* The scattered trees include red fir, Jeffrey pine, and western white pine *(Pinus monticola).*

• Forest-Meadow Lodgepole Pine Ecotone (86100): 8 acres (3 ha). A sporadic fringe of lodgepole pine *(Pinus contorta* ssp. *murrayana)* exists along meadow margins. This association is not well-developed in the study area, but becomes more extensive at slightly higher adjacent elevations.

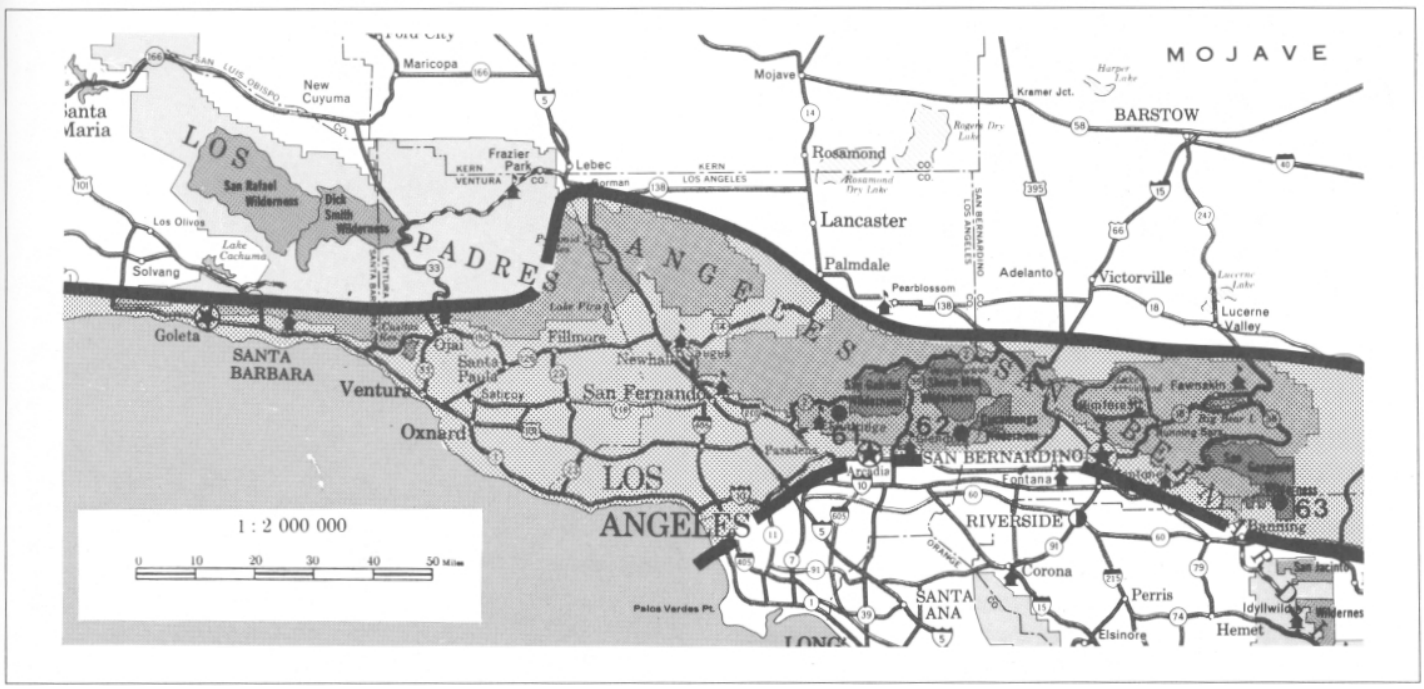
• Riparian (63500): No acreage given. This association is mapped, but not discussed in the report. Several species are listed as riparian. These include *Agastache urticifolia, Aquilegiaformosa, Athyrium felix-femina* var. *californicum, Epilobium angustifolium, Equisetum* sp., *Heracleum lanatum, Ledum glandulosum* var. *californicum, Lilium* sp., *Parnassia* sp., *Polygonum bistortoides, Salix* spp. and *Senecio triangularis.*

Plant Diversity

One hundred twelve taxa are given in a partial list (many meadow species not identified).

Conflicting Impacts

Light cattle grazing in the meadows is mentioned. This candidate has been dropped because of the current policy for the Pacific Southwest Region of not establishing RNAs within experimental forests.



IX. TRANSVERSE RANGES PROVINCE

61) Falls Canyon
62) Fern Canyon
63) Millard Canyon

TRANSVERSE RANGES PROVINCE

61. FALLS CANYON (Sproul 1981)

Location

This soon-to-be-established RNA is on the Angeles National Forest. It is only 8 air miles (13 km) NE. of Pasadena and lies in portions of sects. 18, 19, 20, 29, and 30 T2N, R11W and sects. 13 and 24 T2N, R12W SBBM (34°14'N., 118°05'W.) USGS Mt. Wilson quad *(fig. 128).*

Target Elements

Bigcone Douglas-fir *(Pseudotsuga macrocarpa),* canyon live oak *(Quercus chrysolepis)*

Distinctive Features

• Bigcone Douglas-fir and Fire: Bigcone Douglas-fir (BDF) is scattered throughout the Transverse and Peninsular Ranges of S. California. Its modern distribution has been altered by the frequency and severity of fires. In many places it appears to be dwindling as a result of very intense modem fires. Although the species is known to resprout and to have thick, fire-resistant bark, it cannot survive extremely hot fires *(fig. 129).* The relatively extensive dense stands at Falls Canyon are less likely to suffer from fires than the sparse phases, because of lighter understory fuel loads. Reproduction of BDF occurs in both dense and sparse stands.

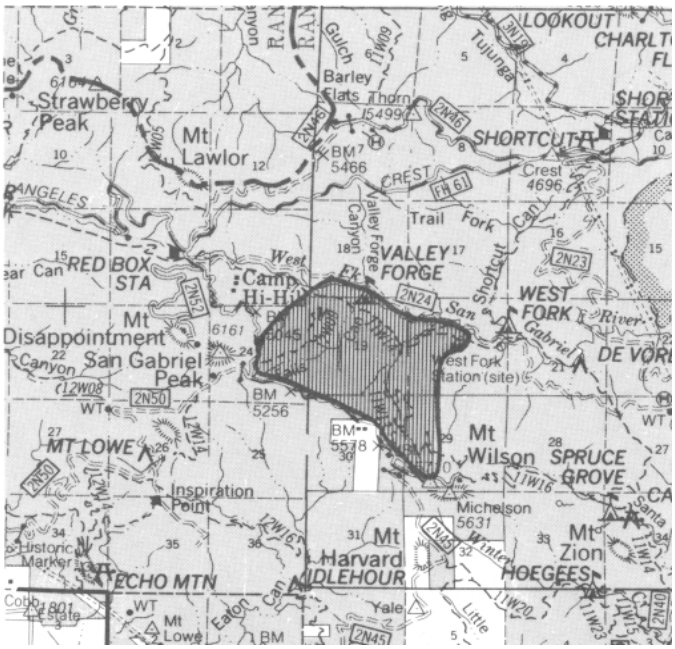


Figure 128--The Falls Canyon RNA.

Figure 129--Falls Canyon: Bigcone Douglas-fir resprouting from bole, Mt. Disappointment (F.T. Sproul).

• Canyon Live Oak: This species is the most widely distributed oak in California (Griffin and Critchfield 1976). In S. California it is the dominant member of the southward extension of the mixed evergreen forest (Sawyer and others 1977, Thorne 1976). It occurs in typical fashion for the region in Falls Canyon, dominating on several slope exposures and co-dominating with BDF on mesic N. slopes.

• Rare Plants: Two species are listed by CNPS (both List 4). They are *Heuchera elegans,* a locally important member of the ridge flora; and *Boykinia rotundifolia,* a fairly widely distributed species of the riparian subcommunity of the S. mixed evergreen forest.

Physical Characteristics

The area has had at least three boundary proposals from 623 to 2400 acres (252-971 ha). The latest proposal is 900 acres (364 ha). Falls Canyon is a tributary of the W. Fork of the San Gabriel River. Strayns Canyon and Rush Creek are also tributaries of the W. Fork and partially occur within the area. Slopes are steep (60-100 percent) throughout, and are generally N. -facing. However, because of the greatly dissected N. slope of the Mt. Wilson-San Gabriel Pk. Ridge significant areas of W. and E. exposures also

occur. Elevations range from ca. 3400 to 5700 ft (1036-1737 m).

The rocks of the area are entirely Mesozoic granitics. Soils are of one family, the Stukel, Sur-Winthrop complex. These are recent soils with a very high erosion hazard, although they may be relatively deep with a rich humus layer. The area receives an annual average of 30+ inches (762+ mm) of precipitation.

Association Types

Accurate estimates of association sizes are not given. Point-centered quarter samples are taken in three stands of BDF.

• Southern California Mixed Evergreen Forest (61510, 84150, 61330, 81320): A mixed forest of canyon live oak *(Quercus chrysolepis)* and BDF covers between 80 and 87 percent of the three boundary proposals discussed. This type is described following Thome (1976). However, the BDF stands are treated separately in the vegetation analysis. All 21 major species listed by Thome for the S. mixed evergreen forest are present locally, except two. The densest stands of BDF are intricately mixed with canyon live oak and to a lesser extent incense-cedar *(Calocedrus decurrens),* and sugar pine *(Pinus lambertiana).*

The Southern California Mixed Evergreen forest grades into a riparian community along the major streams of the area. Here, such hydrophilic species as big-leaf maple *(Acer macrophyllum),* white alder *(Alnus rhombifolia),* California sycamore *(Platanus racemosa),* Fremont cottonwood *(Populus fremontii), Aralia californica, Boykinia rotundifolia,* and *Salix lasiolepis* occur along with California bay *(Umbellularia californica)* and coast live oak *(Quercus agrifolia),* and the other previously mentioned species.

In the Mt. Disappointment and Valley Forge Campground area (20 sampled points), BDF averages 16 m^2 /ha (all species 21 m^2/ha) with an average density of 52 trees/ha. BDF averages 14 m spacing (average for all trees: 6.4 m), 66 cm dbh (all tree species: 41 cm dbh), and 20 m tall (all tree species: 12 m). Canyon live oak is the most abundant species in this sparse phase with often twice the density of BDF. Most canyon live oak are multi-stemmed, inferring past fire history. This sparse phase is typical of the smaller stands of BDF in the San Gabriel Mountains.

Stands sampled (20 points) in Strayns and Rush Creek canyons comprise a less common, but denser phase of BDF *(fig. 130).* At these sites BDF represent 48 percent of all trees. Mean BDF density is 131 /ha (total trees 272/ha), while mean basal area cover is 34.4 m^2/ha (total average 31.0 m^2/ha). The average heights and diameters for BDF are somewhat smaller than for the sparse phase (17 m and 58 cm dbh, respectively), and spacing is substantially less (8.8 m).

Twenty increment cores are taken from BDF. In general, there is a great variation in growth rates, with some ca. 2-ft (61-cm) dbh individuals as much as twice as old (200 vs. 100 yr) as others the same size. The oldest sampled tree is 384 years and is 40 inches (102 cm) dbh. The largest of any measured is 54 inches (137 cm) dbh. There seems to be no major difference in growth rates between sparse and dense phases.

Although diameter does not necessarily reflect age, diameter classes indicate that more small trees are in the sparse than the dense phases. Whether this indicates an expansion of young trees in the former phase is not clear from the data. Many seedlings of BDF and canyon live oak are present in both sparse and dense phases. BDF seedlings are abundant in shaded forest, in openings, on stabilized road cuts, and slides. This diversity of regeneration sites suggests perpetuity of BDF.

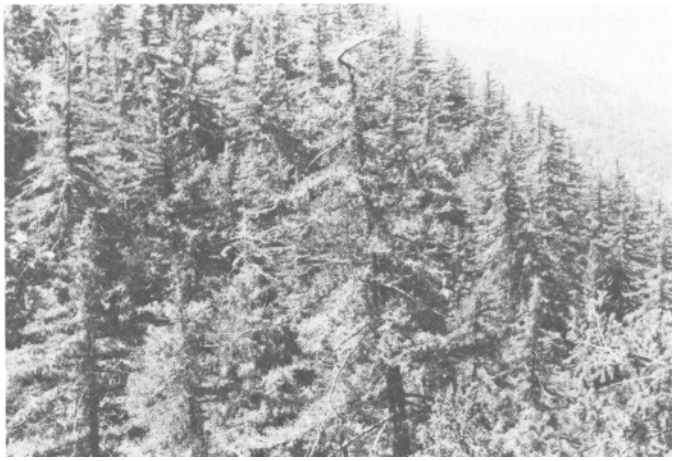


Figure 130--Falls Canyon: Densest phase of bigcone Douglas-fir in Strayns Canyon, ca. 131/ha (F.T. Sproul).

Regeneration following two major fires ca. 1890 and 1900 accounts for only a small percentage of all BDF in the area. Many of the older trees either survived the fires by resprouting from the burned trunk and larger branches or were passed over completely by the fires.

• Transitional or High Altitude Southern California Mixed Evergreen Forest (84230): 100 acres (40 ha). Above ca. 5500 ft (1676 m), near the summit of Mt. Wilson the canyon live oak-dominated forest becomes more heavily infused with ponderosa pine *(Pinus ponderosa),* sugar pine and incense-cedar to a point where these conifers become co-dominant with canyon live oak.

• Mountain talus (no Holland equivalent): This type has also been described as the "Ridge Flora" on the vegetation map of Falls Canyon RNA. It corresponds well to Thorne's (1976) mountain talus community. It covers a small area along the uppermost ridges and outcrops. Among the members of this largely shrub and herb-dominated association are *Arabis sparsiflora* var. *arcuata, Brickellia californica, Castilleja martinii* var. *ewanii, Diplacus (Mimulus) longiflorus* ssp. *calycinus, Dudleya cymosa* ssp. *minor, Eriogonum saxatile, Haplopappus cuneatus, Heuchera elegans, Hulsea heterochroma, Leptodactylon californicum* ssp. *glandulosum, Poa scabrella, Turricula parryi,* and *Zauschneria californica* ssp. *latifolia.*

• Chaparral (37110, 37200, 37520, 37A00): The chaparral at Falls Canyon is described as mixed chaparral; however, there are small monospecific stands of *Arctostaphylos glauca, Cercocarpus betuloides, Quercus wislizenii* var. *fructescens,* and *Adenostoma fasciculatum.* Other plants of this association are much lower in relative dominance, and do not form pure stands. *Arctostaphylos glauca* and *C. betuloides* may occur as small trees up to 20 ft (6 m) tall. The generally large quantity of dead

wood in all chaparral indicates its relatively senescent nature. All chaparral types are confined to island-like enclaves surrounded by canyon live oak-dominated associations, rather than by BDF. However, some individuals of BDF are scattered in some steep, sparse chaparral.

Plant Diversity

One hundred twenty taxa are listed.

Conflicting Impacts

The area is heavily used by recreationists on the northern and southern peripheries. However, the uniqueness of the BDF stands is not easily duplicated and largely overrides the recreational impact. Other impacts include the unnatural slides along the Mount Wilson road and the introduced plantings of both native and non-native species along the roads and campgrounds. In general, steep topography and dense vegetation will limit the study of BDF to the vicinity of trails.

62. FERN CANYON (Meier 1979)

Location

This established RNA is on the San Dimas Experimental Forest, within the Angeles National Forest. It is ca. 6 miles (10 km) N. of the city of Claremont. It occupies portions of seven sects. in T1N, R8W SBBM (34°12'N., 117°43'W.) USGS Mt. Baldy quad *(fig. 131)*.

Target Elements

Chamise chaparral *(Adenostoma fasciculatum),* canyon live oak *(Quercus chrysolepis)*

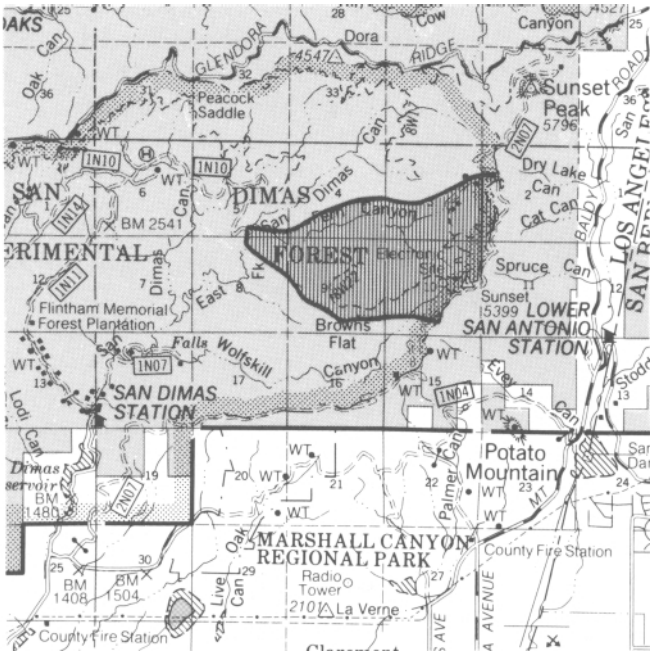


Figure 131--The Fern Canyon RNA.

Distinctive Features

• Well-Monitored Site: The RNA is located within an experimental forest. There is a good record of the impact and extent of fires in the area dating back to 1914 (six major fires have occurred). This record extends to the relative volume of pre- and post-fire stream flow in the three subdrainages within the RNA. Stream flow has changed appreciably among the three drainages since a major fire in 1938.

• Low Elevation Ponderosa Pine: Brown's Flat, a shallow 80-acre (32-ha) bowl created by an ancient land slump, contains the lowest elevation stand of *Pinus ponderosa* in S. California (ca. 3900 ft, 1189 m). This relictual stand, composed of 81 individuals, is well-isolated from other ponderosa pine stands in the San Gabriel Mountains and is strongly affected by air pollution. There is almost no recent reproduction.

• Chaparral: This extensive vegetation formation occurs as chamise *(Adenostoma fasciculatum)* and *Ceanothus*-dominated types. It was extensively burned in 1975 and, thus, is vigorous *(fig. 132).*

• Oak Woodlands: The area covered by this vegetation is extensive and varied. It occurs primarily on N.-facing exposures and in canyon bottoms. Much of the woodland was burned in 1975. The bottomland stands are dominated by coast live oak *(Quercus agrifolia)* with a significant mixture of riparian trees. Many of the upper-slope oaks are apparent hybrids between coast live oak and scrub oak *(Quercus dumosa).* At high, sheltered sites canyon live oak is dominant. On exposed sites at lower elevations interior live oak *(Quercus wislizenii)* dominates a scrubby woodland with many chaparral shrubs. Hybrids between California black oak *(Quercus kelloggii)* and interior live oak, the so-called oracle oak *(Q.* X *morehus),* also occur at low elevations.

• Bigcone Douglas-fir *(Pseudotsuga macrocarpa):* The stands of bigcone Douglas-fir (BDF) at Fern Canyon have burned recently (1975). Poor reproduction suggests that the fire had a negative effect on seedling and sapling establishment. However, many of the larger trees, though scarred, have sur-

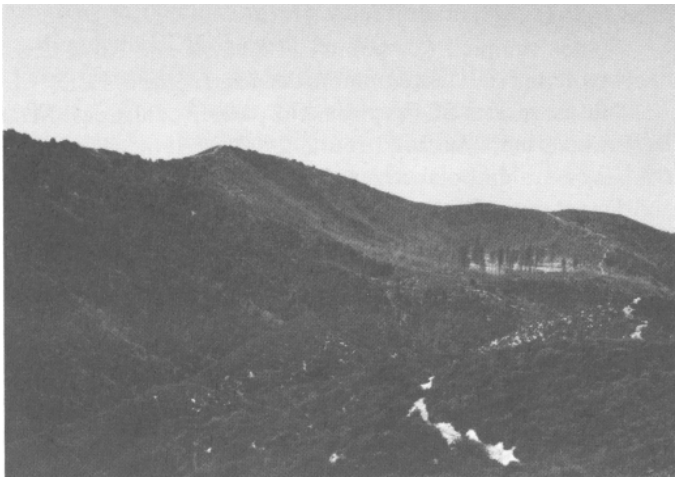


Figure 132--Fern Canyon: Various chaparral and oak woodland types in Fern Canyon with Brown's Flat in right background (D. Cheatham).

vived the fire. The local stands should provide interesting comparisons with other stands in Millard Canyon (# 63) and Falls Canyon (# 61), which have not been affected by fire for many years.

Physical Characteristics

The RNA covers 1369 acres (554 ha). Elevations range from 2592 to 5512 ft (790-1680 m). Fern Canyon drains E.-W. and is a tributary to San Dimas Canyon. The RNA contains the entire drainage of Fern Canyon. Slopes are primarily N.- and S.-facing, but some W.- and E.-facing slopes occur at the head of the drainage. Average slopes are steep (ca. 68 percent). The three previously mentioned subdrainages occupy the head of the main drainage below Sunset Peak. Rapids and falls occur along the main canyon. The distinctive Brown's Flat occupies a bench created by a massive landslide S. of the main canyon.

Geology is relative complex and includes schists and gneisses, derived from diorite, aplite, and pegmatite dikes, and unaltered diorites. Soils are varied, and five principal types occur in the RNA. Most are relatively fine textured and well drained. One type has much clay with high water retention. Climate is well monitored with recording stations close to the RNA. At the highest elevations mean temperatures range from 41.9 °F (5.5 °C) in February to 73.9 °F (23.3 °C) in August. Low elevation temperatures vary from 46 °F (7.8 °C) in January to 72 °F (22.2 °C) in August. Annual precipitation averages 34.3 inches (871 mm) at the upper elevations and 26.8 inches (680 mm) at the lower elevations. About 92 percent of the precipitation falls from November through April, with much as snow at the upper elevations.

Association Types

The line intercept method is used to sample most of the vegetation of the area. In addition, diameters are taken of all individuals of ponderosa pine at Brown's Flat and a number of BDF. Acreage of the vegetation associations is not given.

• Chaparral (37200, 37110, 37530): This extensive vegetation is represented by both *Adenostoma fasciculatum* and *Ceanothus*-dominated types. The *Adenostoma* (chamise) type dominates the xeric S.-facing slopes where it may occur as dense monospecific stands on steepest slopes, or as a dominant on relatively gradual slopes. Transect data for *Adenostoma* include frequency 100 percent, relative density 54 percent, relative cover 76 percent. Associated species with their respective relative densities and relative covers include *Ceanothus leucodermis* (9 percent, 9 percent), *Salvia mellifera* (9 percent, 2.4 percent), *Salvia leucophylla* (18 percent, 14 percent), *Garrya veatchii* (3 percent, 4 percent), *Arctostaphylos glandulosa* (3 percent, 5 percent), *Yucca whipplei* (3 percent, 4 percent), and the post-fire invader *Turricula parryi* (3 percent, 1.8 percent). Eight other species are listed for this type.

Most of the chamise chaparral burned in 1975. However, taller stands (2.5 m) at the lower reaches of the canyon have not burned since 1960. Certain species such as *Toxicodendron diversilobum, Marah macrocarpus,* and *Pycnanthemum californicum* are characteristic of the understory. At lowest elevations this vegetation grades into coast live oak woodland.

Ceanothus species dominate the chaparral on the exposed N.-facing slopes. This vegetation grows to 13 ft (4 m) tall, and much has not burned within the last century. The dominants include *Ceanothus integerrimus, C. leucodermis, C. tomentosus, C. oliganthus,* and a possible hybrid C. *integerrimus* x *cordulatus.* Other shrubs include *Rhamnus crocea, Garrya fremontii, Arctostaphylos glauca, A. glandulosa, Cercocarpus betuloides, Prunus ilicifolia, Leptodactylon californicum,* California bay *(Umbellularia californica),* and *Quercus* x *morehus*. In openings the mesophytic species *Solanum douglasii, Achillea millefolium, Cystopteris fragilis,* and *Polystichum munitum* occur.

• Oak Woodland (71150, 71160, 81310, 81320, 81330, 37A00, 61310, 61330): Several subtypes occur in the drainage. On N.-facing slopes at the head of the canyon the putative hybrid between coast live and scrub oak dominates (relative cover 56 percent). Other species with their relative covers include *Turricula parryi* 4 percent, *Lupinus adsurgens* 27 percent, *Penstemon* spp. 8 percent, *Ceanothus leucodermis* 2 percent, *Ceanothus integerrimus* x *C. cordulatus* 12 percent, *Garrya veatchii* 7 percent, *Arctostaphylos glandulosa* 4 percent, *Lonicera subspicata* 7 percent, and *Ribes amarum* (unspecified).

Canyon live oak dominates on upper N.-facing slopes forming dense stands with virtually complete canopy cover in some areas. This type does not appear to have been affected strongly by the 1975 fire (ca. 25 percent critical stem damage). Average relative cover is 43 percent for canyon live oak, relative frequency 19 percent. Other species (with percent relative frequency and percent relative cover, respectively) include *Turricula parryi* (15, 14), *Ceanothus integerrimus* x *cordulatus* (28, 29), *Ribes amarum* (22, 13), *Ceanothus leucodermis* (10, 2), *Ribes speciosum* (4, 1), and *Solanum xantii* (2, 1). Typically this vegetation occurs at sufficiently high and sheltered sites to receive winter snow. However, it may also occur in low gullies associated with bigcone Douglas-fir.

A dense scrubby woodland of interior live oak surrounds much of the Brown's flat area. *Ceanothus integerrimus* x *cordulatus, Ribes amarum, Lupinus longifolius, Rhamnus crocea,* California bay, and *Prunus ilicifolia* are associated with this species. *Toxicodendron diversilobum is* common at the lower elevations of this type (<1280m). This type was largely spared from the 1975 fire.

Between 3510 and 3937 ft (1070-1200 m) elevation on the S. boundary ridge *Quercus* x *morehus* dominates a scrubby woodland with many of the same species as the interior live oak woodland.

Along the canyon bottom, coast live oak dominates with riparian species such as big-leaf maple *(Acer macrophyllum),* white alder *(Alnus rhombifolia),* and moisture-tolerant species such as California bay and bigcone Douglas-fir (Holland 61310). Beneath these trees a mesophytic understory of such species as *Adiantum jordanii, Cystopteris fragilis, Dryopteris arguta, Ribes speciosum, Holodiscus discolor, Marah macrocarpus, Arabis glabra, Delphinium parryi,* and *Heuchera elegans* occurs.

• Mixed Conifer Association (84150): This association is dominated by BDF and includes rare individuals of white fir *(Abies concolor)* and sugar pine *(Pinus lambertiana)* at the uppermost elevations. BDF occurs principally on N.-facing slopes at

the upper elevations or in sheltered canyon bottoms. At the upper elevations BDF forms an overstory (65-82 ft, 20-25 m) over canyon live oak and *Quercus agrifolia* x *dumosa.* Many trees have suffered fire damage. The paucity of young BDF in this forest also indicates the effect of the recent 1975 fire. The larger BDF (3.2-8.2 ft, 1-2.5 m dbh) are well-represented and, though scarred, survived the fire. Associated species are similar to the understory of the canyon live oak forest.

• Ponderosa Pine (84210, 42110): This type is restricted to the area of Brown's Flat and is an open stand of ponderosa pine up to 164 ft (50 m) tall over a grassy understory dominated by *Agropyron elongatum, A. intermedium, Elymus condensatus, Festuca megalura,* and *Poa scabrella.* There has been poor reproduction in recent years, but the size class structure of more mature trees (> 16 inches, 40 cm dbh) suggests that this stand has been reproducing normally up until recently. Air pollution combined with the marginal habitat and possibly high seed predation may have caused the recent decline in reproduction.

Plant Diversity

One hundred eighty-nine taxa are listed.

Conflicting Impacts

Air pollution has a strong effect on the ponderosa pine stand at Brown's Flat. The frequency of natural fire appears high enough to maintain chaparral and oak woodland associations without intervention for several years.

63. MILLARD CANYON (Keeler-Wolf 1988d)

Location

This soon-to-be-established RNA is on the San Bernardino National Forest ca. 9 miles (14.5 km) NE. of Banning in extreme N. Riverside County. The area lies within portions of sects. 2, 3, 10 and 11 T2S, R2E SBBM (34°01'N., 116°45'W.) USGS San Gorgonio Mountain quad *(fig. 133).*

Target Element

Interior live oak *(Quercus wislizenii)*

Distinctive Features

• Interior Live Oak: Interior live oak is a widespread foothill species endemic to cismontane California. It is represented elsewhere most extensively on the Indian Creek RNA (#24) where it is typically shrubby. At Millard Canyon this species occurs primarily as a woodland or low forest in the relatively flat alluvium-filled valleys *(fig. 134).* It also occurs as a shrub in the chaparral on steep exposed slopes. The variety of situations in which this species is represented locally will provide a number of topics for researchers interested in this little-studied species.

• Bigcone Douglas-fir *(Pseudotsuga macrocarpa)*-Canyon Live Oak *(Quercus chrysolepis)* Forest: This association is endemic to southern cismontane California and is one of the associations least commonly affected by fire in this area. It occupies northerly facing slopes and has substantial variation in density and frequency of bigcone Douglas-fir, reflecting variation in fire history and moisture availability. This vegetation should provide an important comparison to a more coastal high density type of this association represented at the Falls Creek (#61) and Fern Canyon (#62) RNAs.

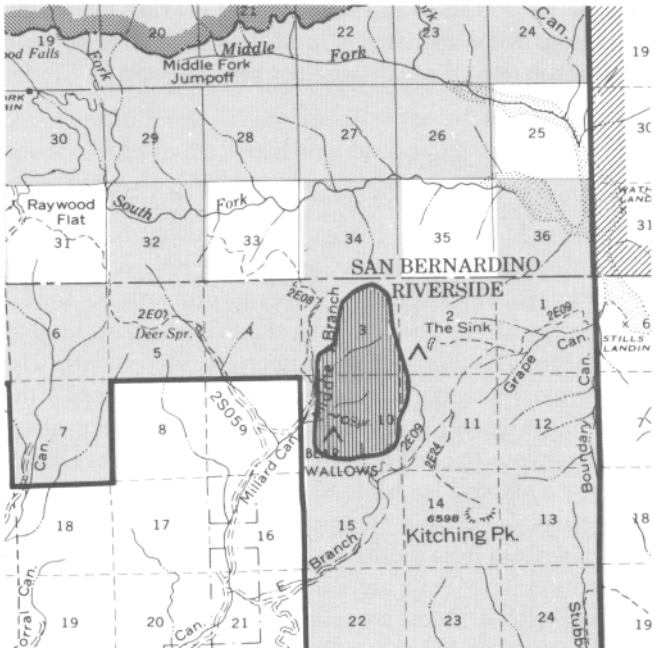


Figure 133--The Millard Canyon RNA.

• Rare Plants: Two taxa known from the RNA are listed by CNPS. These are *Heuchera parishii* (List 4) and *Streptanthus bernardinus* (List 1b). Both species are endemics to the San Bernardino Mountains.

• Wildlife Values: The dense interior live oak woodland in the valleys provides food and shelter for numerous birds and small mammals. A breeding bird census in this habitat records a total of 128 individuals/10 ha. The most abundant species are rufuous-sided towhee *(Pipilo erethrophthalalmus),* wrentit *(Chamaea fasciata),* and black-headed grosbeak *(Pheuticus melanocephalus),* all with densities of 1 to 2/ha. There is also a

Figure 134--Millard Canyon: Ecotone of canyon live oak and interior live oak forests at N.-facing base of slope SW 1/4 Sect. 10.

high density of dusky-footed woodrat *(Neotoma fuscipes)* houses in this association. Bear Wallow Spring, in the S. part of the RNA, has been developed for wildlife (with a cement trough) and is regularly used by black bear *(Ursus americanus)* and other species.

Physical Characteristics

The study area covers 793 acres (321 ha). Elevations range from ca. 4500 to 6970 ft (1372-2125 m). Topography is highly varied from the three gently sloping, relatively broad valley bottoms to the extremely steep and rocky escarpment at the N. end. The area contains three separate subdrainages of the Middle Branch of Millard Canyon with the valley bottoms sloping to the SW. Slopes face primarily NW. and SE.

Ridges are typically sharp and topped with crumbly outcrops of Precambrian igneous and metamorphic rocks (gneiss and schist). Many of these rocks are intruded and altered by Mesozoic granitics. Soils are mapped in three units: Lithic Xerothents-Springdale Family-Rubble Land Association, 50-100 percent slopes; Lithic Xerothents-Rock Outcrop Complex 50-100 percent slopes; and Soboba-Avawatz-Morical dry families. The latter type is characteristic of the deep alluvium of the valleys. The area is estimated to average between 25 and 30 inches (635-762 mm) of precipitation per year. Mean annual temperature at the mid-elevations is ca.52°F (11 °C). Prevailing westerly winds have shaped the vegetation of the upper slopes *(fig. 135).*

Association Types

Vegetation sampling is limited to the interior live oak woodland and the bigcone Douglas-fir-canyon live oak forest where ten 10 by 10 m quadrats are established in each association. Other associations are described qualitatively.

• Canyon Oak-Bigcone Douglas-fir (81320, 84150, 45400): 477 acres (193 ha). This association occurs in three phases: a low- to mid-elevation mesic NW.- to NE.-facing type with variable mixtures of bigcone Douglas-fir (BDF) over a dense canopy of canyon live oak *(Quercus chrysolepis);* a semi-riparian, very mesic phase with the above two species as well as incense-cedar *(Calocedrus decurrens),* big-leaf maple *(Acer macrophyllum),* and California sycamore *(Platanus racemosa);* and an upper elevation S. to SW.-facing type dominated solely by canyon live oak.

Vegetation sampling is conducted in only the first described phase (351 acres, 142 ha). This steeply sloping forest is relatively dense, averaging 1810 trees more than 6.5 ft (2 m) tall/ha. Mean canopy cover is 74 percent and basal cover about 32.8 m^2/ha. Canyon live oak has a relative density of 89 percent; however, BDF makes up 43 percent of the basal area. High stem density of canyon live oak results from the preponderance of multiple-stemmed individuals, reflecting past fires. Tree reproduction is relatively low and dominated by canyon live oak. The understory is generally sparse with locally abundant herbs and grasses in scattered small openings. *Melica aristata is* most common with an average cover of 12 percent. Another fairly common species is *Silene lemmonii* (22 species are listed from the sample).

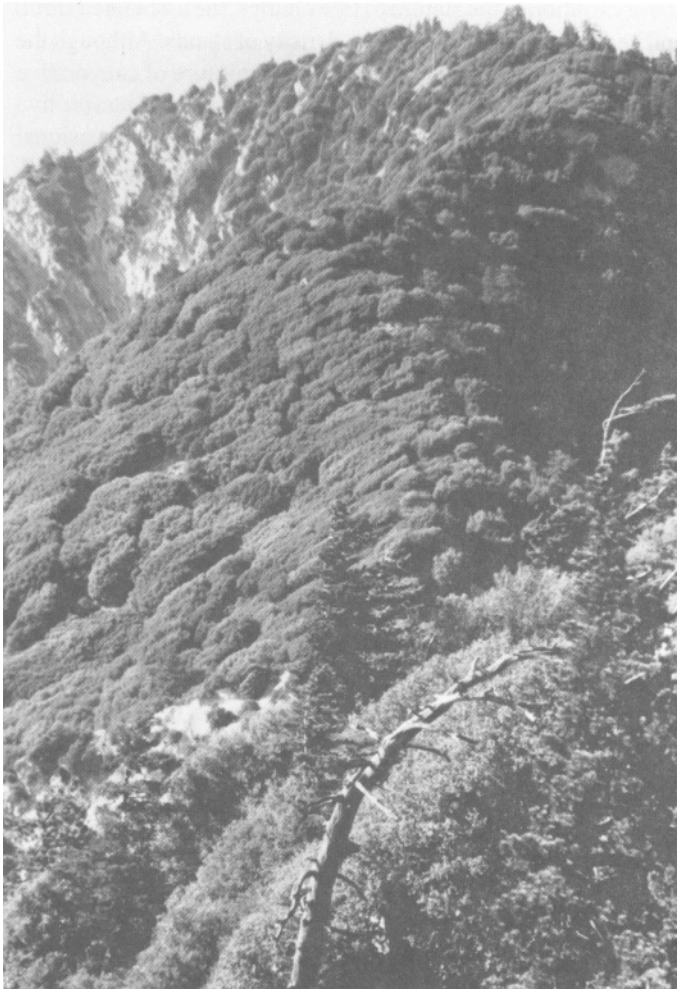


Figure 135--Millard Canyon: Wind-pruned vegetation on upper W.-facing slope along the E. boundary.

A small area of ca. 4 acres (1.5 ha) surrounding Bear Wallow Spring is considered a semi-riparian phase of this association. The moist, shady conditions around the spring, coupled with an absence of fire, have combined to produce a tall, well-developed forest of bigcone Douglas-fir (up to 5.7 ft [1.73 m] dbh and 121 ft [37 m] tall), canyon live oak (up to 3.3 ft [1 m] dbh), incense-cedar (up to 4.6 ft [1.4 m] dbh), big-leaf maple, and California sycamore. The understory in the immediate vicinity of the spring is dominated by *Potentilla glandulosa, Aquilegia formosa,* and *Ribes nevadense* (Holland 45400). However, once away from the spring, the understory is sparse with much duff and only occasional herbs such as *Polystichum munitum* and scattered tree seedlings and saplings.

On the S.-facing slopes at upper elevations canyon live oak forms continuous or broken stands depending on slope rockiness and steepness (122 acres, 49 ha). These stands are typically wind-sculpted dwarfs no taller than 20 ft (6 m) with average dbh of 10 inches (25 cm). The understory of these stands is sparse.

• Interior Live Oak Woodland (37A00, 71150, 81330): 128 acres (52 ha). In general, the best developed of the interior live oak vegetation has a woodland aspect, with scattered small openings between clumps of small trees. However, there is

some variation in the stature of tree clumps, the associated shrub and herbaceous species, and the density of stands. Although the northernmost valley has a significant admixture of canyon live oak, the remaining two are strongly dominated by interior live oak, largely to the exclusion of other trees. Only occasional young individuals of white fir *(Abies concolor),* bigcone Douglas-fir, incense-cedar, and Coulter pine *(Pinus coulteri)* rise above the short canopy of the oaks.

All of the trees aged in this association have stems under 75 years old, reflecting the date of the last extensive fire (1911). Average tree stem density is 1300/ha. Frequency for interior live oak is 100 percent on ten plots, and basal area cover averages 16 m^2/ha. Sapling density for interior live oak averages 260/ha and seedling density 90/ha. Estimated mean canopy cover is 65 percent. The number of shrub species encountered is 13. Twenty-one herbs are noted. The most important subordinate species are *Rhamnus californica, Lonicera interrupta, Rhus trilobata, Eriodictyon californicum, Vulpia (Festuca) myuros,* and *Bromus tectorum.* A small subset of herbs does not occur in chaparral or sage scrub. These include *Bloomeria crocea, Brodiaea pulchella, Microseris linearifolia, Melica imperfecta, Lupinus adsurgens,* and *Bromus diandrus.*

• Chaparral (37110, 37200, 37520): 106 acres (43 ha). Chaparral typically occurs as small islands or in impure mixtures with sage scrub, interior live oak woodland, canyon live oak forest, and mixed conifer forest. Four main subtypes may be distinguished.

-Chamise chaparral dominated by *Adenostoma fasciculatum is* the most xeric subtype. It occurs as small, nearly pure patches on W.- and SW.-facing slopes. There is virtually no herb layer.

-The next subtype (37110) is mixed chaparral. It occurs on low and mid elevations on W.- and SW.-facing slopes. Dominants vary and include shrubby interior live oak, *Arctostaphylos glandulosa,* and *Ceanothus leucodermis.* Lesser species include *Cercocarpus betuloides, Arctostaphylos pringlei* var. *drupacea, Dendromecon rigida, Prunus ilicifolia,* and *Yucca whipplei* ssp. *parishii.*

-The third subtype (no Holland equivalent) is strongly dominated by *Cercocarpus betuloides.* This species forms an open scrub along the low and mid-elevation ridge lines. It prefers extremely rocky sites where perhaps relatively large quantities of surface water are channeled into cracks and crevices.

-The final subtype (37520) has amore montane character, occurring at the higher elevations along ridgetops above ca. 6200 ft (1890 m). The dominant is *Arctostaphylos patula* ssp. *platyphylla,* a low nodal-rooting manzanita.

• Riversidian Sage Scrub (32700): 38 acres (15 ha). This association occurs on the most xeric exposures in the study area on relatively deep sandy soils. It occupies S.-facing exposures between 4600 and 6100 ft (1402-1959 m). On relatively gentle slopes at low elevations it intergrades with interior live oak woodland. At upper elevations it intergrades with the S.-facing phase of canyon live oak woodland. The following species are typical of this association: *Salvia apiana, Yucca whipplei* ssp. *parishii, Penstemon centranthifolius, Stipa coronata, Galium angustifolium, Eriogonum fasciculatum, Mimulus longiflorus, Trichostema lanatum, Antirrhinum coulterianum, Bromus rubens, Castilleja foliolosa, Cordylanthus filifolius, Corethrogyne filaginifolia, Cryptantha muricata, C. simulans, Eriophyllum confertiflorum, Gilia diegensis, Lotus strigosus* var. *hirtellus,* and *Stipa speciosa.*

At the upper elevations there is a transition with canyon oak and mixed chaparral associations and several montane species such as *Leptodactylon pungens,* and *Lupinus excubitus* var. *austromontanus* occur along with such upper elevation chaparral species as *Arctostaphylos pringlei* var. *drupacea.*

• Transitional Mixed Conifer Forest (84230, 84140): 28 acres (11 ha). This forest occupies upper N.-to W.-facing slopes. It is an extension of the canyon live oak-bigcone Douglas-fir forest with the addition of sugar pine *(Pinus lambertiana),* Coulter pine, and white fir. Elevations are not high enough locally to provide conditions favorable for strong dominance by conifers and, at best, this forest is co-dominated by canyon live oak and a mixture of conifers. This association is analogous to the transitional southern California mixed evergreen forest of # 61. The canopy of conifers varies from Coulter pine on W.-facing slopes to a sparse mixture of BDF, sugar pine, and white fir on steep NW.-facing slopes, to a more dense mixture of white fir and sugar pine on N.-facing slopes.

The understory is usually sparse with scattered shrubs of *Arctostaphylos patula* ssp. *platyphylla, Cercocarpus ledifolius,* and the herbs *Heuchera parishii, Claytonia spathulata* var. *tenuifolia, Sarcodes sanguinea, Hieracium horridum, Allium monticola, Streptanthus bernardinus,* and *Pedicularis semibarbata.*

Occasional ridgetop openings in this association house a richer herbaceous flora including *Eriogonum wrightii, Lupinus excubitus* var. *austromontanus, Linanthus breviculus, Gayophytum* sp., *Poa* sp., *Penstemon grinnelli, Solidago californicum, Chrysothamnus nausiosus* ssp. *bernardinus, Chaenactis santolinoides, C. glabriscula* var. *curta,* and *Bromus marginatus.*

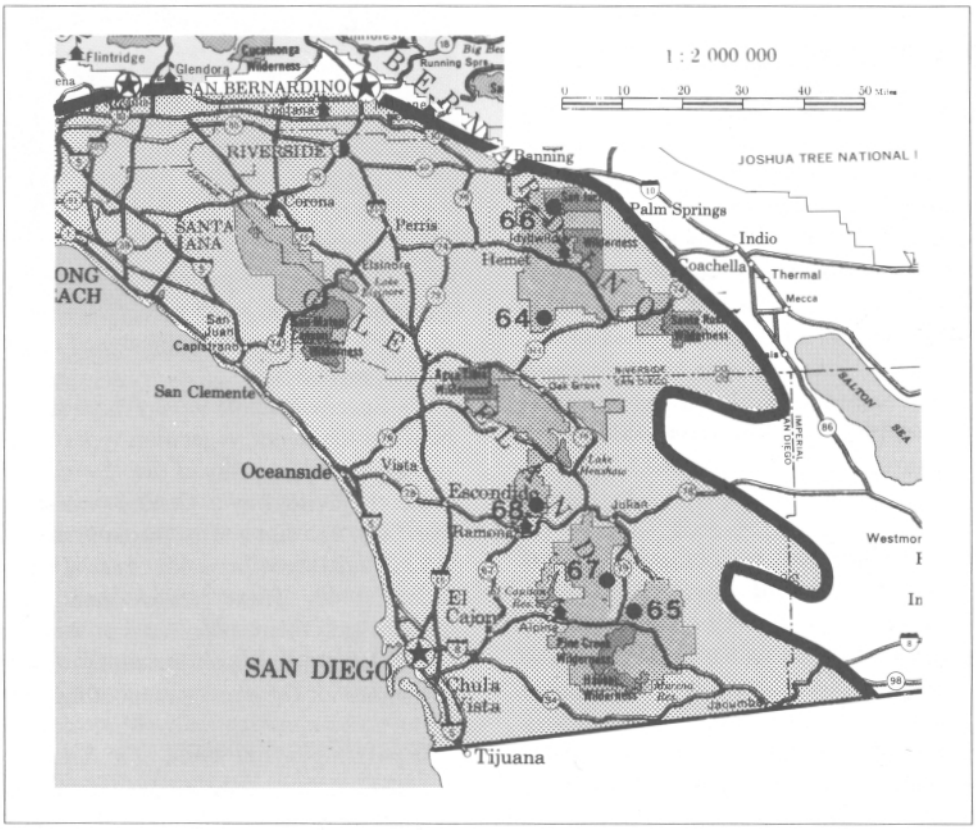
• Rock Outcrop (no Holland equivalent): Between the scattered small trees of canyon live oak and *Cercocarpus* spp., much of the steep escarpment at the N.-end of the area as well as other smaller outcrops is vegetated with a light cover of small rupicolous shrubs and herbs. These include *Dudleya abramsii, Selaginella bigelovii, Eriogonum saxatile, Haplopappus cuneatus,* and *Arabis sparsiflora* var. *arcuata.*

Plant Diversity

One hundred sixty-three taxa are listed.

Conflicting Impacts

Few exist. The area is within a 1984 addition to the San Gorgonio Wilderness, but rugged topography and dense vegetation preclude recreational interest. A short trail to Bear Wallow Spring is the only easy recreational entry route into the area, and it is not well-traveled.



X. PENINSULAR RANGES PROVINCE

64) Cahuilla Mountain
65) Guatay Mountain
66) Hall Canyon
67) King Creek
68) Organ Valley

PENINSULAR RANGES PROVINCE

64. CAHUILLA MOUNTAIN (Keeler-Wolf 1986d, 1989k)

Location

This established RNA is on the San Bernardino National Forest, Riverside County. It is ca. 11 miles (18 km) SW. of the town of Idyllwild. The area lies within portions of sects. 4, 8, 9, and 17 of T7S, R2E SBBM (33°35'N., 116°47'W.) USGS Cahuilla Mountain quad *(fig. 136).*

Target Elements

Coulter pine *(Pinus coulteri),* California black oak *(Quercus kelloggii)*

Distinctive Features

• Coulter Pine: Coulter pine woodland reaches its optimum development in the mountains of S. California (Holland 1986). This RNA contains diversely developed, well-defined stands of this vegetation showing a range from scattered old trees, to a large cohort of trees 50-60 years old, to a number of saplings and seedlings.

• California Black Oak: California black oak vegetation is widespread in California, but varies in its components and site characteristics. The stands of black oak at Cahuilla Mountain represent great variation in density, successional state, and associated species. They range from pure and relatively dense black oak, to open black oak savanna, to mixed woodlands of pine and oak.

• Native Grass- and Herblands: The openings dotting the summit of the area are dominated by native herbs, grasses and subshrubs that have often been swamped out by aggressive non-natives in such openings elsewhere in S. California. These openings have been free of livestock grazing for many years and are a mixture of coastal sage, Great Basin sagebrush, mid-montane, and valley grassland species *(fig. 137).* In some cases they occur as a melange, and in some cases as distinct units. The close association of so many different biogeographic elements, which are often separated by many miles, offers some unique research opportunities.

• Rare Plant: A population of *Delphinium hesperium* ssp. *cuyamacae* occurs in one of the grassy openings. It is a member of CNPS List 1b, and is threatened elsewhere in its range by development.

• Successional Trends: There is a dynamic relationship between the major vegetation types in the area based on the frequency and intensity of fire. Several forms of chaparral are presently giving way to Coulter pine and black oak vegetation *(fig. 138).* The date and extent of the last fire in the area is known (1928), and there is a record of aerial photos extending back to at least 1948. These baseline data coupled with analysis of growth and colonization rates of the principal species could provide many answers to questions regarding sound ecological guidelines for fire management of these vegetation types.

Physical Characteristics

The original study area covers 880 acres (356 ha). Final established boundaries include 929 acres (376 ha). Elevations range from 4360 ft (1329 m) at the NE. corner to 5635 ft (1718 m) atop the southern summit of Cahuilla Mountain. However, the majority of the area lies above 5200 ft (1585 m). The RNA encompasses the summit and upper slopes of the mesa-like mountain. All slope exposures are well represented.

The area is underlain by two rock types. The spectacular S. escarpment is composed of Cretaceous granitic rock (S. Califor-

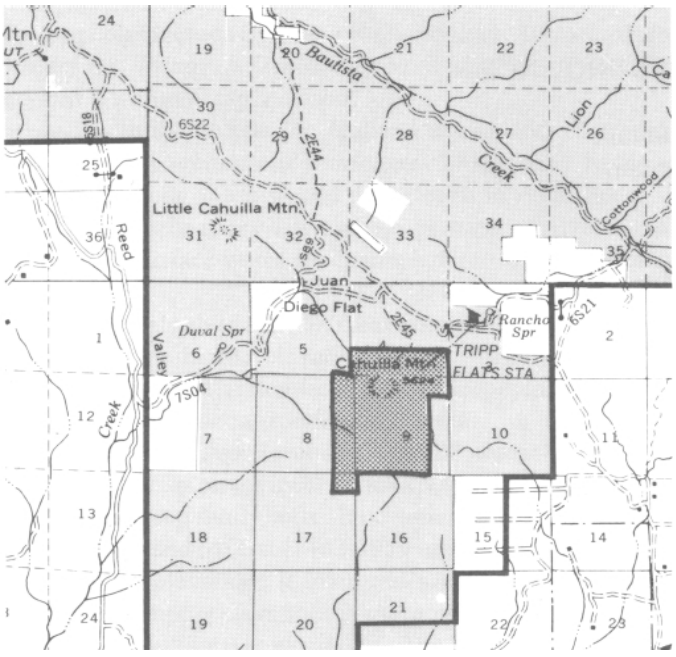


Figure 136--The Cahuilla Mountain RNA.

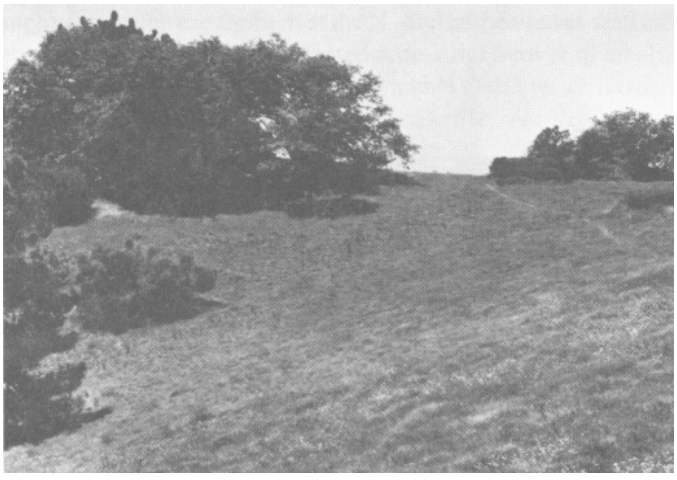


Figure 137--Cahuilla Mountain: Large SE.-facing native-dominated herbland with California black oak savanna on crest of hill.

Figure 138--Looking SW. toward summit of Cahuilla Mountain with intermixing of Coulter pine, California black oak, and manzanita chaparral dominated *by Arctostaphylos pringlei* var. *drupacea.*

nia Batholith); the remainder of the rocks are part of a series of older (as old as Carboniferous) intrusive and migmatic rocks (principally granitics and gneiss, with small areas of schist and marble). Soils have been divided into four map units: Morical and Wind River families complex 15-30 percent slopes; Trigo Family-Lithic Xerothents, Warm complex 50-75 percent slopes; Lithic Xerothents, Warm-Rock outcrop complex 50-100 percent slopes; and Rock Outcrop. Mean annual temperature for the mountain is ca. 53 °F (11.7 °C). Snow falls regularly in the winter. Average annual precipitation is estimated at 25 inches (635 mm).

Association Types

The vegetation of the black oak and Coulter pine forests and woodlands is sampled using the point-centered quarter technique (20 points). The remaining vegetation types are described qualitatively. The black oak savanna and Coulter pine-black oak vegetation is considered together in the survey, but is separated in the establishment record.

• *Arctostaphylos* Chaparral (37520): 220 acres (89 ha). There are two forms; both occur on the summit area on relatively gentle-to-moderate slopes. The first, the mixed *Arctostaphylos* chaparral, occurs on SE.-facing slopes and is dominated by *Arctostaphylos pringlei* var. *drupacea, A. glandulosa, Adenostoma fasciculatum,* and *Quercus wislizenii* var. *fructescens.* The second is the *Arctostaphylos parryi* var. *drupacea* type. It occurs on NE.-facing slopes on deeper soils than the former type. Both types are apparently successional to black oak woodland and Coulter pine forest. Invading Coulter pine in both types is ca. 20-30 years old and 20-26 ft (6-8 m) tall. Herb cover is sparse and restricted to small openings between the shrubs.

• Coulter Pine-Black Oak Woodland (84140,71120): 200 acres (81 ha). This association and the related black oak savanna form a complex in the RNA. The Coulter pine forest is the most variable of these two types with mixed composition pine-oak woodlands prevalent in the SW. part of the RNA and Coulter pine-chaparral more common in the NE. portion. These mixed woodlands consist of various stocking levels of Coulter pine and black oak, ranging from relatively large stands of robust specimens adjacent to grassland to early successional stands invading *Arctostaphylos* chaparral. Largest Coulter pines reach 4 ft (1.2 m) dbh and 75 ft (23 m) tall.

At eight points sampled in the mixed pine-oak phase, Coulter pine is twice as densely stocked as black oak, covers more than twice the basal area of oak, and occurs at all points versus 75 percent of points for black oak.

Mean density of trees throughout the entire complex is 160/ha with black oak averaging 9.6 m^2/ha and Coulter pine averaging 5.1 m^2/ha basal area (total basal area 14.8 m^2/ha). Coulter pine has seedlings associated with 35 percent, and black oak 15 percent, of the 20 points sampled.

Understory vegetation is made up of scattered shrubs of *Arctostaphylos pringlei* and *A. glandulosa* with many of the herbs and grasses also represented in the herbland-grassland. The most common include *Eriophyllum confertiflorum, Bromus carinatus, Galium angustifolium, Eriogonum wrightii, Castilleja martinii, Agoseris grandiflora, Vicia americana,* and *Koeleria macrantha.* Much of this vegetation in the SW. portion of the RNA appears to have recently invaded herbland-grassland.

• Interior Live Oak *(Quercus wislizenii)* Chaparral (37A00, 71150, 81330): 190 acres (77 ha). This type is divided in the ecological survey into woodland chaparral and escarpment chaparral, but is merged, following Holland's system in the establishment record. On steep, rocky NE.-facing slopes it is the most mesic of the local chaparrals, verging on a woodland or forest with some individuals of interior live oak and canyon live oak *(Quercus chrysolepis) up* to 16 ft (5 m) tall and 6 inches (15 cm) dbh. However, in most areas the oaks are shrubby. The relatively mesic and diverse understory consists of *Cercocarpus betuloides, Ceanothus integerrimus, Garrya veatchii, Fraxinus dipetala, Solanum xantii, Polystichum munitum, Dryopteris arguta, Monardella macrantha, Melica imperfecta,* and *Tauschia arguta.*

In contrast, the escarpment phase is the most open form of chaparral locally, with only scattered *Q. wislizenii* var. *fructescens,* shrubby canyon live oaks, and several understory plants characteristic of rock outcrops. These include *Mimulus longiflorus, Zauschneria californica* ssp. *latifolia, Haplopappus squarrosus, Lotus argophyllus, Eriogonum saxatile, E. davidsonii, Poa nevadensis,* and *Selaginella asprella.*

• Scrub Oak Chaparral (37900, 37110): 150 acres (61 ha). This is a diverse chaparral consisting of dense shrubs 6.5-13 ft (2-4 m) in height. It occurs on relatively open N.-facing exposures. Scrub oak *(Quercus dumosa)* dominates marginally over other shrubs including *Cercocarpus betuloides, Adenostoma sparsifolium, A. fasciculatum, Arctostaphylos glandulosa, Fraxinus dipetala, Quercus wislizenii* var. *fructescens, Keckiella antirrhinoides, Rhamnusi licifolia, Ribes malvaceum, Ceanothus cuneatus,* and *Haplopappus squarrosus* ssp. *grindeloides.*

• Herbland-Sage Vegetation (32500, 35210, 35400, 42110, 42200): 51 acres (21 ha). This association is divided into four subtypes. Although all have different dominants, there are a number of shared subdominants, and the environmental charac-

teristics of all subtypes are similar. They are described below:

-*Artemisia tridentata* dominates the *Artemisia*-herbland. It is restricted to a small 4-acre (1.6 ha) area on deep granitic soil with a gentle, mostly S.-facing aspect. The main body is dense sagebrush with few understory species, but marginal areas support a diversity (23 species listed) of herbs and subshrubs including *Vicia americana, Linanthus lemmonii, Lupinus excubitus* var. *austromontanus, Eriogonum wrightii, Eriophyllum confertiflorum, Frasera parryi,* and *Solidago californica.* This vegetation appears stable with little change from aerial photos taken in the 1940's.

-Open herbland occurs adjacent to *Artemisia*-herbland and in several other patches on W.- and SW.-facing slopes. All of the species associated with the *Artemisia tridentata* subtype also occur along with a number of others, including *Microseris linearíloba, Lotus strigosus, Camissonia bistorta, Lupinus bicolor, Penstemon centranthifolius, Eriastrum filifolium, Phacelia distans, Arabis sparsiflora* var. *californica* and *Gilia capitata.* Grasses are uncommon in this subtype.

-*Salvia* herbland is dominated by *Salvia apiana.* This subtype occurs in patches bordering open herbland and chaparral, on soils shallower than the open herbland, but deeper than chaparral. Diversity and density of plants are lower than in the previous open herbland subtype, but included are many of the same subdominants such as *Eriogonum wrightii, Galium angustifolium,* and *Penstemon centranthifolius.* The native grasses *Stipa coronata, Melica californica,* and *Koeleria macrantha* are conspicuous in some areas. Like the *Artemisia*-herbland, this subtype is relatively stable. It is similar to the sage scrub communities described by Holland (1986) and other authors.

-The herbland-grass subtype contains a significant mixture of grasses. These species vary from exposed xeric sites (with annual species such as *Bromus tectorum* and *Vulpia megalura*) through open W.-facing slopes with *Elymus condensatus, Koeleria macrantha, Sitanion longifolium,* and *Melica californica,* to relatively mesic depressions and swales dominated by *Muhlenbergia rigens.*

-A rather sparsely vegetated variant, the *Chrysothamnus*-herbland, occurs on loose granitic soil in one area in the W. portion of the RNA. *Chrysothamnus teretifolius* and *Eriogonum wrightii* co-dominate with scattered *Frasera parryi, Penstemon centranthifolius, Arenaria douglasii, Nemacladus ramosissimus, Viola purpurea* ssp. *xerophyta, Linanthus ciliatus, L. dianthiflorus, Trichostema lanceolatum,* and *Cryptantha micrantha.*

• Black Oak Savanna (71120, 81340): 41 acres (17 ha). This association is best developed in two patches adjacent to grassland in the NW. portion of the area where a savanna type or a forest type may occur. Individual black oaks may be over 3.3 ft (1 m) dbh (largest 5.3 ft, 1.6 m). The largest individuals are fire scarred. The understory of the oak savanna is dominated by herbs and grasses. This understory is taller and more lush (in spring) than adjacent open herbland. Dominant species include *Bromus diandrus, B. tectorum, B. carinatus, Collinsia heterophylla, Galium aparine, Solidago californica, Artemisia ludoviciana, Montia perfoliata, Delphinium parishii,* and *Madia gracilis.* These savannas grade into the Coulter pine-Black oak woodland on shallower soils. The few small areas of high density black oak have dense and mesic understories dominated by such species as *Symphoricarpos mollis* and *Thalictrum fendleri.*

One small seep (Holland 45400) is associated with a dense black oak forest. It has several hydrophilic herbs including *Aquilegia formosa, Juncus textilis, Carex fracta,* and *Stachys rigida.*

• Chamise Chaparral (37200): 31 acres (13 ha). This association occupies the steep xeric S.-facing slopes at the lowest elevations. It is dominated by *Adenostoma fasciculatum,* which often occurs in nearly pure stands. Other associated species are few and include *Yucca whipplei, Lotus scoparius,* and *Penstemon centranthifolius.* It is a low, dense chaparral with a very sparse understory.

Plant Diversity

One hundred fifty-eight taxa are listed in the establishment record.

Conflicting Impacts

The area will likely require prescribed burning to maintain the mixture of chaparral, Coulter pine, and black oak vegetation. The area receives moderate recreational use (principally day hiking), but there is little visible impact.

65. GUATAY MOUNTAIN (Gautier and Zedler 1980)

Location

This candidate RNA, dropped as of 1987, is on the Cleveland National Forest. It is approximately 3.5 miles (5.7 km) NNW. of Pine Valley and includes portions of sects. 21, 22, 27, and 29 T15S, R4E SBBM (32°50' N., 116°33' W.) USGS Descanso quad *(fig. 139).*

Target Element

Tecate Cypress *(Cupressus forbesii)*

Distinctive Features

• Tecate Cypress: Tecate cypress occurs only in scattered stands on several mountains in southern California and into Baja California. It is considered rare (List 1b CNPS) and is a candidate for California state listing as threatened. One large stand and many scattered individuals are represented in the study area *(fig. 140).* It is a major component of the unique local chaparral. The local population is remarkable for the great size and age of the individuals. Most are over 100 years old.

In California intense fires have reduced the numbers of Tecate cypress in recent years. Fire management is a crucial issue because of the conflicting needs of the vegetation and the local human population. Tecate cypress requires fire for reproduction. However, only certain types of fire affecting populations of cypress of certain ages are optimum for initiating release

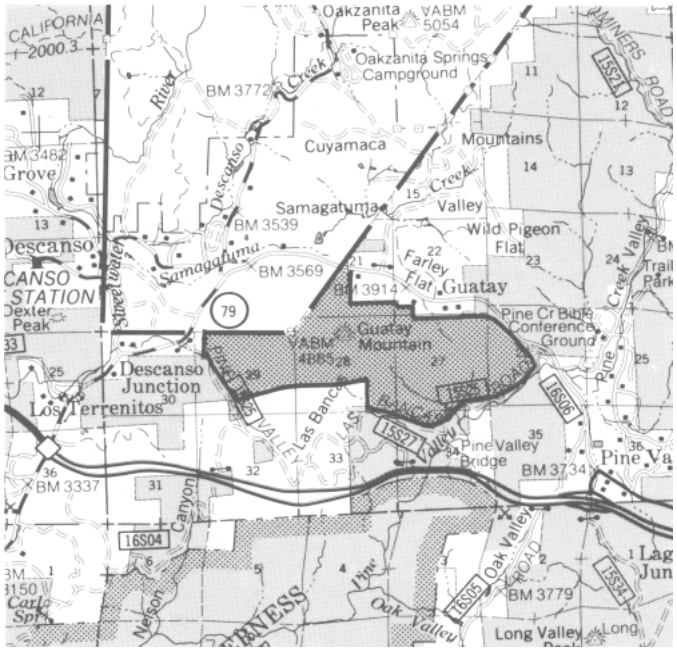


Figure 139--The Guatay Mountain study area.

of seeds from the serotinous cones. Stands younger than 40 years tend to produce relatively few seedlings when burned, perhaps because of the small number of cones present on young trees. Low intensity fire can kill the trees without opening the cones, and thus may do more harm than good. Crown fires every 50-100 years are best for high yields of seedlings.

Although the stands at Guatay Mountain are relatively old, their vigor is high, with few senescent individuals. However, without fire, the stand would have to be artificially reseeded, which would alter the natural dynamics of the ecosystem (through scraping of soil, etc.). A more detailed study of the population dynamics of Tecate cypress including the population at Guatay Mountain has been recently conducted by Dunn (1987).

• Gabbro Endemism: Guatay Mountain is underlain by the Guatay Mountain Gabbroic Pluton. A number of rare endemic plants are associated with gabbro, an ultramafic rock, in the Peninsular Ranges. Locally at least two species *(Calochortus dunnii* and *Calamagrostis densa)* are rare gabbro endemics. The first is considered a member of CNPS List 1b and is listed by the State of California as rare. The other is a member of CNPS List 4.

Figure 140--Guatay Mountain: View from inside main Tecate cypress stand (P. Zedler).

• Other Rare Plants: In addition to the cypress and the gabbro endemics, *Mimulus clevelandii* (CNPS List 4) is present along the ridges on the upper slopes of Guatay Mountain.

Physical Characteristics

This area is not well-defined in the survey. The vegetation types add up to ca. 2884 acres (1167 ha). Guatay Mtn. rises as an E.-W.-trending ridge with three high points averaging ca. 1000 ft (305 m) higher than the surrounding lowlands. The summit of the highest point is 4885 ft (1470 m). Slopes range from 10 to 70 percent. N.- and E.-facing slopes are steeper than S.-facing slopes.

The Guatay Mtn. Gabbroic pluton includes amphibole gabbro, gabbro, and olivine gabbro. The mountain is surrounded by tonalites (granitic rock) except for a small area of Julian Schist in the SE. of the area. The well-rounded conical shape of the mountain is characteristic of gabbro weathering. The soils are well-drained zonal soils with a high erosion hazard and are classified as Las Posas series. Temperatures are mild, and precipitation occurs primarily in the winter months. Estimated precipitation totals for the area are 25-37 inches (635-940 mm). Estimated highest and lowest temperatures are ca. 100 °F (38 °C) and -4 °F (-19 °C) with mean January and July temperatures of 39 °F (3.9 °C) and 70.1 °F (21.2 °C), respectively.

Association Types

No quantitative vegetation sampling is conducted in this survey.

• California Mixed Chaparral (37110): 2036 acres (824 ha). This association occurs on N.- and W.-facing slopes. Predominant shrub species include *Arctostaphylos glandulosa, Adenostoma fasciculatum, Ceanothus greggii, Quercus dumosa, Cercocarpus betuloides,* and *Yucca whipplei.* The understory is unusual in its relatively high cover of the prostrate shrub *Salvia sonomensis.*

On N. sides of the mountain canyon live oak *(Quercus chrysolepis)* forms dense island-like clumps 13-33 ft (4-10 m) tall in a sea of mixed chaparral. This suggests that with low fire frequencies canyon live oak forest could come to dominate this area.

Another subtype of mixed chaparral occurs on the highest S.-facing slopes of the mountain where *Haplopappus arborescens, Ceanothus foliosus,* and *Helianthemum scoparium* dominate.

• Southern Interior Oak Woodland (71160, 61310): 467 acres (189 ha). This association occurs in drainageways around the base of the mountain. These woodlands are dominated by coast live oak *(Quercus agrifolia).* Grasses are usually abundant in openings, with shrubs and herbaceous species predominating in shady areas. No additional information is available.

• Chamise Chaparral (37200): 335 acres (136 ha). This association, dominated by *Adenostoma fasciculatum,* occurs on

S.-facing slopes at lower elevations. *Arctostaphylos glandulosa* is scattered throughout the stand. Understory vegetation is virtually non-existent.

• Southern Interior Cypress Forest (83330): 47 acres (19 ha). This association is dominated by Tecate cypress which occurs on a N.-facing slope and consists of dense pockets of cypress interspersed with mixed chaparral. A large area in the middle of the stand is devoid of cypress, containing sparse cover of *Cercocarpus betuloides.* The dense pockets of cypress have poor understory development, but in open stands herbs such as *Sanicula crassicaulis, Bloomeria crocea,* and *Gutierrezia sarothrae* are common.

A total of 24 Tecate cypress individuals are cored. The mean age is 92 years (range 24-122). Trees at the bottom of the slope are younger (ca. 80 years) than those up-slope (ca. 100 years). A small number of trees are scattered throughout one of the main N. slope drainages to the E. of the main stand. These scattered trees are substantially younger than the main stand (mean 29 years).

Plant Diversity

Eighty-one taxa of vascular plants are listed.

Conflicting Impacts

There is much private land associated with the Guatay Mtn. cypress population. The area was reclassified as a Special Interest Area in 1987 largely because of the small amount of cypress on Forest Service land and its relatively small total population size.

66. HALL CANYON (Keeler-Wolf 1986e, 1988e)

Location

This established RNA is on the San Bernardino National Forest, Riverside County. It is ca. 5.3 miles (8.5 km) NW. of Idyllwild and lies in portions of sects. 15, 16, 21, and 22 T4S, R2E SBBM (33°48'N., 116°46'W.) USGS Lake Fulmor quad *(fig. 141).*

Target Element

Mixed conifer forest

Distinctive Features

• Research Precedent: The RNA lies adjacent to the small, but heavily used James Reserve, managed by the University of California, Riverside. This scientific reserve, part of the University of California Natural Lands Reserve System, has been in operation since 1966. A large number of research projects have taken place at least partially within the RNA. Virtually all of the visitors to the James Reserve (well over 1800 user-days annually) have made some use of the RNA, whether it be research, field trips, or casual observation. No other RNA in California except the Harvey Monroe Hall (# 56) has such a precedent of research use. Because of the excellent facilities (e.g., electricity, herbarium, refrigeration, computer access, etc.) at the James reserve there is great potential for further research. The present director of the James Reserve is operating a remote sensing station from the Black Mtn. lookout, which he is using to monitor many points within the RNA for phenological and successional change.

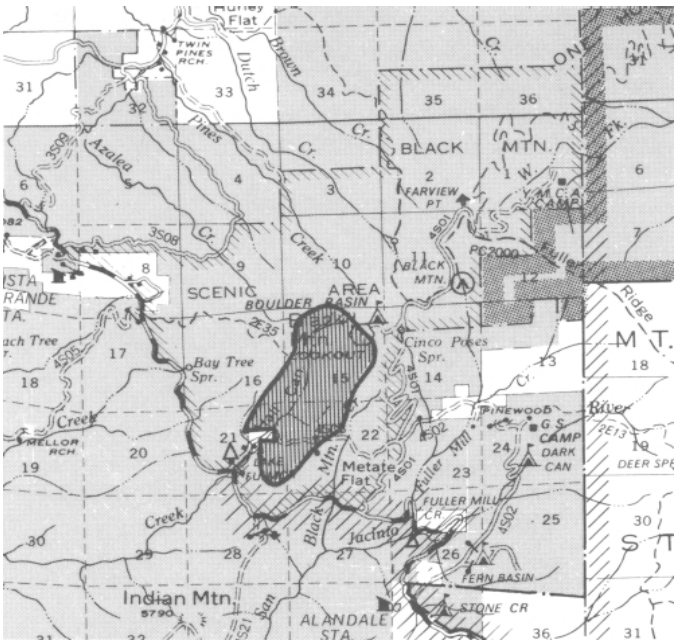


Figure 141--The Hall Canyon RNA.

• Mixed Conifer Forest: This is the only surveyed RNA representing the mixed conifer forest in S. California. A large elevation span assures the representation of a broad zone of mixed conifer and associated vegetation types from the chaparral up to the upper elevation mixed conifer forest. The area is representative of much of the mixed conifer forest of the Peninsular Range province.

• Fire History: The fire history over the RNA varies, and is indicative of the effects of fire and its importance in shaping the various plant associations in the area. Most of the area of mid- and upper-slopes below ca. 6500 ft (1981 m) were burned in an extensive fire ca. 1880. Most stems of conifers and resprouts of canyon live oak are younger than 108 years. The only survivors are in rocky areas or in the canyon bottom incense-cedar *(Calocedrus decurrens)* forest. At upper elevations fire intensity has been lower with many survivor stems of sugar pine *(Pinus lambertiana)* and white fir *(Abies concolor).* The recent fire of 1974 did not burn extensively into the upper elevation mixed conifer forest, probably largely as a result of the open nature of this forest dictated by the numerous rock outcrops.

• Rare Plants: One species, *Lilium parryi, is* a member of CNPS List 4. It is a characteristic component of the riparian scrub along Indian Creek.

Physical Characteristics

The area covers ca. 667 acres (270 ha) on the W. slopes of the San Jacinto Mountains. The RNA occupies the upper reaches of a SW.-trending drainage (Indian Creek) heading at

Black Mountain (7772 ft., 2369 m) and stretching to within 650 ft (200 m) of the small reservoir known as Lake Fulmor (ca. 5380 ft, 1640 m), for an elevation range of 2392 ft (729 m). SW.-facing slopes predominate with some S.-, W.-, N.-, SE.-, and E.-facing exposures. Slopes are steepest at the upper elevations and gentlest along two bench systems at the middle elevations.

Rocks are entirely late Cretaceous granitics from the San Jacinto Pluton. Numerous outcrops occur, particularly at the upper elevations. Soils have been mapped as five units. These are Wapi-Pacifico families/rock outcrop complex 50-75 percent slopes, Pacifico-Wapi families complex 30-50 percent slopes, Pacifico-Preston families complex 30-50 percent slopes, Green Bluff-Brader families association 15-50 percent slopes, and rock outcrop areas. Only the Green Bluff-Brader, which occurs in the flatter valley bottom areas, has relatively deep, sandy loam soil; the other types are typically shallow and rocky. The 50-year average annual precipitation from Idyllwild at 5397 ft (1645 m) is 25.3 inches (643 mm) although the estimated annual average atop Black Mtn. is 40 inches (1020 mm). Snow depth averages 10-25 inches (25-64 cm) on April 1 at the upper elevations. The mean annual temperature at Idyllwild is ca. 53 °F (11.7 °C).

Association Types

Ten 100-m^2 plots are sampled on the white fir-sugar pine *(Abies concolor-Pinus lambertiana)* forest, seven in canyon live oak *(Quercus chrysolepis)* forest, ten in ponderosa pine *(Pinus ponderosa)* forest, five in California black oak *(Quercus kelloggii)* forest, and eight in incense-cedar *(Calocedrus decurrens)* canyon bottom forest.

• White Fir-Sugar Pine Forest (84230, 85320): 245 acres (99 ha). This association is included under mixed conifer forest in the establishment record. It contains the most characteristic form of the mixed conifer series in the RNA. Canyon live oak is not as important a species as in lower-elevation forests (occurring only on xeric exposures), and the forest is clearly dominated by conifers. Typically, sugar pine dominates *(fig. 142)* on W.- and SW.- facing slopes at the upper elevations (> 6700 ft, 2042 m), while white fir dominates on more northerly-facing slopes.

Figure 142--Hall Canyon: Sugar pine-white fir forest on W.-facing upper slopes of Black Mountain.

This forest is open, averaging 780 trees/ha. A large portion of the ground is covered with massive outcrops, especially on the W.- and SW.-facing slopes. At such exposures sugar pine covers more than twice the basal area of white fir. However, white fir occurs in higher densities than sugar pine in many areas. This is particularly true on the small unburned area of NW. exposure. Here white fir is co-dominant with sugar pine, Jeffrey pine *(Pinus jeffreyi),* and incense-cedar *(Calocedrus decurrens)*. On W.- to SW.-facing slopes (where the plots are located) total basal area cover averages 102 m^2/ha. Sugar pine comprises 46 percent of the basal area, white fir only 19 percent. However, white fir averages 41 percent relative density, whereas sugar pine averages only 14 percent. Typical dominant sugar pines are relatively slow growing, between 330 and 400 years and 24-30 inches (61-76 cm) dbh. The largest trees in the sample area are ca. 46 inches (117 cm) dbh and may be 600 years old. The understory is sparse with occasional patches of *Chrysolepis sempervirens* at the upper elevations.

• Canyon Live Oak Forest (81320, 84140): 218 acres (88 ha). Canyon live oak is the most numerous tree in the RNA. There is a broad zone in the middle elevations of the area where this species is dominant in cover and density. Typically Coulter pine *(Pinus coulteri)* and sugar pine tower over the smaller oaks in a scattered, open canopy. Exposure is generally W. to SW.; slopes are steep, with rocky or boundary understory.

Most canyon live oak stems are resprouts (often 8-10 per clump) resulting from widespread fire ca. 1885. Stems of the oaks average <20 inches (51 cm) dbh and 40 ft (12 m) tall. Stem density is relatively high (1620/ha) with basal area cover averaging 85 m^2/ha. Canyon live oak makes up 56 percent of the stems and 42 percent of the basal area. Other species in descending importance value include sugar pine, Coulter pine, *Quercus* x *morehus, Arctostaphylos pringlei* var. *drupacea* (tree size), white fir, and interior live oak *(Quercus wislizenii)*. Herbs and shrubs are sparse, except at lower elevations where *Rhamnus californica* may be common.

• Ponderosa Pine Forest (84210): 93 acres (38 ha). This forest occurs at elevations below 6000 ft (1829 m). It dominates on deep alluvial soils of the valley bottom and also on N. and NW.-facing slopes. It co-occurs with Coulter pine, sugar pine, white fir, incense-cedar, California black oak, and canyon live oak. Basal dominance by ponderosa pine is more than 2 times greater than any other species (24 m^2/ha) with total basal area cover averaging 65 m^2/ha. Tree densities average 1140/ha. Canyon live oak comprises 46 percent of the stems. The understory is sparse with much duff. Three shrub and 19 herb species are listed on the sample plots, with *Galium angustifolium* the only species occurring on 50 percent or more of the plots. Trees grow relatively rapidly with ponderosa pine attaining diameters of 30-33 inches (76-84 cm) in slightly over 100 years.

• California Black Oak Forest (81340): 60 acres (24 ha). This deciduous forest occupies NW.- to W.-facing slopes between 5500 and 6150 ft (1676-1874 m). It occurs on relatively deep soils. Total basal area cover is 113 m^2/ha with California black oak comprising 57 percent of that value. Total tree density is 980/ha with black oak relative density 55 percent. Most California black oak are 15-25 inches dbh (38-61 cm), 17-22 m

tall, and 70-100 years old. Other subdominants in order of importance value include Coulter pine, incense-cedar, Jeffrey pine, sugar pine, and canyon live oak. Shrub and herb cover is relatively high with average ground cover estimated between 15 and 20 percent, representing 27 species. Among the most typical are *Galium angustifolium, Bromus marginatus, Bromus orcuttianus, Castilleja martinii, Thalictrum fendleri,* and *Angelica tomentosa.*

• Montane Chaparral (37520, 37530): 44 acres (18 ha). Two types are described: an early successional *Ceanothus* type dominated by either *C. leucodermis, C. integerrimus,* or hybrids between the two covering 34 acres (14 ha); and a more persistent manzanita type dominated by *Arctostaphylos glandulosa* or *A. pringlei* var. *drupacea,* covering 10 acres (4 ha). *Ceanothus* chaparral is most extensive where the 1974 fire occurred on the NW. side of the RNA. Manzanita chaparral occurs in small isolated remnant patches which may have resulted from fires more than 100 years ago. The understory of both types is typically sparse.

• Incense-cedar Canyon Bottom Forest (84230, 63500): 7+ acres (3 ha). This association is included in the discussions of mixed conifer forest and montane riparian scrub in the establishment record. Incense-cedar dominates in a narrow zone along the banks of Indian Creek near permanent moisture. Before the 1974 fire incense-cedar dominated this semi-riparian strip from the lowest reaches of the RNA up to ca. 6900 ft (2103 m). At present this type gives way to snags at ca. 6500 ft (1981 m).

Sample plots indicate a density of 1600 trees/ha and a total cover of 205 m^2/ha. Incense-cedar comprises 23 percent relative density and 63 percent relative cover. Other trees in descending order of importance value include white fir, canyon live oak, sugar pine, ponderosa pine, California bay *(Umbellularia californica),* Coulter pine, and black oak. The age of some of the incense-cedars is estimated at more than 500 years, and several measured more than 60 inches (1.52 m) dbh. The valley bottom location is relatively well-protected from fire. The dense forest tends to suffer major canopy damage if burned.

Herbs and shrubs are typically riparian hydrophilic species and may cover more than 50 percent in small sunny creekside openings. These include *Rhododendron occidentale, Euonymus occidentalis, Ribes nevadense, Pteridium aquilinum, Chimaphila menziesii, Woodwardia fimbriata,* and *Lilium parryi.* A similar group of species is associated with several seeps (Holland 45400) scattered throughout the area.

Plant Diversity

Two hundred forty-five taxa of vascular plants have been reported from the vicinity of the RNA; however, some are typical of lower elevation areas (e.g., locally only within the neighboring James Reserve).

Conflicting Impacts

The area is adjacent to the heavily used Lake Fulmor recreational site, although a chain-link fence forming the boundary of the James Reserve effectively prevents casual entry from the SW. A small area of the SE. side of the area was removed from the original RNA proposal because of impact by woodcutting and camping. A small area of the 1974 burn was revegetated with non-native giant sequoia *(Sequoiadendron giganteum).*

67. KING CREEK (CUYAMACA CYPRESS) (Reveal 1978)

Location

This soon-to-be-established RNA is on the Cleveland National Forest. It lies ca. 23 miles (37 km) NE. of El Cajon and occupies portions of sects. 24 and 25 T14S, R3E and sects. 19 and 30 T14S, R4E SBBM (32°56' N., 116°28' W.) USGS Cuyamaca Peak and Tule Springs quads *(fig. 143).*

Target Element

Cuyamaca cypress *(Cupressus arizonica* var. *stephensonii)*

Distinctive Features

• Cuyamaca Cypress: This is the rarest cypress in California, known only from seven small stands (one recently extinct) all on the SW. slopes of Cuyamaca Peak. It was originally described as a new species *(C. stephensonii)* in 1948, but is considered in this report a subspecies of the widespread C. *arizonica.* The total area occupied by this taxon is 43.5 acres (17.6 ha). Currently the taxon is known from four small and two much larger stands, five of which are on National Forest land. All of the stands burned in 1950 and several were burned again in 1970 *(fig. 144).* The more recent fire reduced one population of 20-year-old trees by about 75 percent because of premature burning before adequate numbers of cones could be produced.

This report stresses the regeneration strategy and taxonomy of this cypress and the potential impact on it from various management options. Several important points are brought out:

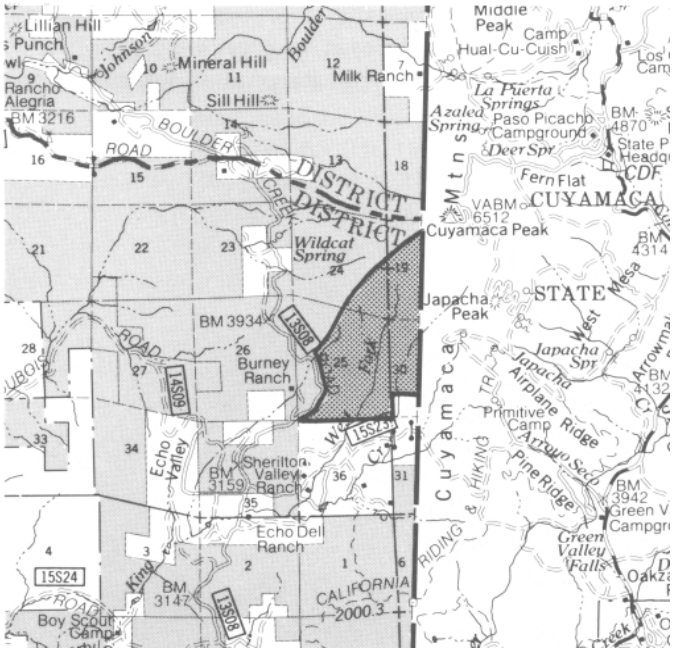


Figure 143--The King Creek study area.

Figure 144--King Creek: Cuyamaca cypress and Coulter pine emerging from mixed chaparral. All conifers germinated after the 1950 fire.

-Frequent fire is a great threat to the Cuyamaca cypress. Although the tree needs fire to open the serotinous cones, these fires cannot occur too early in the plant's life or the net result will be a decrease in population (see Guatay Mountain #65).

-Although the area and number of individuals are small, the surviving trees are healthy and show no sign of reduced vigor. This suggests that with proper fire management, the species would continue to thrive in this restricted area of gabbroic Las Posas soils.

-The demographics of each population vary. These are detailed in the report and underscore the potential for population extinction, increased representation or both in the future. In general, it is recommended that all populations must be protected from fire until the year 2000. Only trees older than 60 years were seen to have begun extensive cone production.

• Rare Plants: the Cuyamaca cypress is a member of CNPS List 1b. *Calamagrostis densa* and Engelmann oak *(Quercus engelmannii)* are members of List 4.

Physical Characteristics

The proposed RNA covers 750 acres (304 ha). Elevations range from 3700 to 5800 ft (1128-1768 m). The area occupies the SW.-facing slope of 6512 ft (1985 m) Cuyamaca Peak. The bulk of the cypress lines intermittent to dry upper drainages of the W. Fork and the main fork of King Creek which flow to the SW. and converge outside the area.

Geologically the area is divided at ca. the 4000 ft (1219 m) contour into an upper elevation area of Cuyamaca Gabbro and a lower elevation zone of Bonsal Tonalite (granitic). The cypresses are confined to the gabbro on which two soil series occur. The Las Posas and the Cohasset are both deep reddish-brown stony loams that retain water well. This quality has doubtless influenced the ability of cypress to survive continual drying of the environment since the Pleistocene. The cypress are restricted entirely to the Las Posas soils, which occur around the base of the mountain. Annual precipitation averages 30-35 inches (750-900 mm), with 80 percent falling between December and May. Snow falls regularly at the upper elevations, but melts quickly. January mean minimum is ca. 32 °F (0 °C). July maximum is ca. 90 °F (32 °C).

Association Types

No vegetation sampling is undertaken for this report. Acreage is given only for the cypress-dominated vegetation. An additional ecological survey of the entire area has been contracted in 1990.

• Chamise-Manzanita-Ceanothus Chaparral (37110): This association burned in 1950. Shrubs are dense, ca. 2.5-3.3 ft tall (0.75-1.0 m). The principal species are *Adenostoma fasciculatum, Arctostaphylos glandulosa,* and *Ceanothus greggii* var. *perplexans.* The soil surface is stony (up to 20 percent). The chaparral is vigorous and contains little dead material. *Salvia sonomensis* is an important ground cover in parts of this association.

• Riparian Vegetation (61310, 71181): This association lines the two main stream channels and several tributaries. It is dominated by coast live oak *(Quercus agrifolia),* which survived the 1950 fire *(fig. 145).* The understory is dense and is composed of a mixture of chaparral and mesophytic species. The best riparian vegetation occurs along a small tributary of the upper W. Fork of King Creek. It consists of an open grove of coast live oak broken by grassy openings and rock outcrops. Although not specifically discussed, Engelmann oak and several willows (*Salix* spp.) are listed as common in the riparian zone. Other characteristic species include *Rosa californica, Symphoricarpos mollis,* and *Toxicodendron diversilobum.* Two populations of the Cuyamaca cypress also occur in a riparian situation. One has two old individuals (50 and 90 years).

• Chamise-*Ceanothus*-Scrub Oak Chaparral (37110): This vegetation occurs at the lower elevations on islands of Las Posas soil surrounded by granitic rock. This chaparral, dominated by *Adenostoma fasciculatum, Ceanothus greggii* var. *perplexans,* and *Quercus dumosa, is* taller (up to 10 ft, 3 m) than its higher elevation counterpart, association 1. Cuyamaca cypress may have been a member of this association in the recent past.

• Dry Meadow (42110, 45400): This association occurs where ground water is near enough to the surface to support

Figure 145--King Creek: Closed riparian stand of coast live oak with *Symphoricarpos mollis* understory.

dense stands of the large tufted perennial grass *Muhlenbergia rigens.* Two cypress populations are associated with the edges of these meadows. Other species of the dry meadows include *Salix* spp., *Avena barbata, Elymus glaucus,* and *Juncus effusus.*

• Cypress Vegetation (83330): 44 acres (18 ha). Because populations of the cypress may occur in mesic riparian situations or in chaparral, this is a somewhat artificial association. The survey includes the cypress populations within other habitat types, not discussing them as separate associations. However, because of the high density of the cypress, the Holland treatment of southern interior cypress vegetation is adhered to here.

The largest population (22 acres, 8.9 ha) occurs in the chaparral. This stand suffered greatly from the 1970 fire with only 25 percent replenishment of the pre-fire population. Before the 1950 fire the second largest chaparral stand (19.5 acres, 8 ha) had fine specimens 49-53 ft (15-16 m) tall and 24-32 inches (60-80 cm) dbh. These mature trees had numerous cones which provided abundant seed for the large post-1950, pre-1970 population. This second largest population has 27-year-old trees in mesic areas up to 8 inches (20 cm) dbh and 16 ft (5 m) tall. Trees in thickets measure 2-4 inches (6-10 cm) dbh and are 16-26 ft (5-8 m) tall. In the main body of the chaparral cypress are suppressed by competition and are 0.75-2 inches (2-5 cm) in diameter at the base and only 5-8 ft (1.5-2.5 m) tall.

Plant Diversity

Only a partial list is given, including 36 taxa.

Conflicting Impacts

The majority of impacts are associated with fire management and have already been discussed. There may have been some cutting of trees in the past for fence posts and firewood. A dirt road comes close to one stand, and others are reachable by four-wheel-drive tracks. A portion of the Cuyamaca cypress stands lies on the adjacent Rancho Cuyamaca State Park. Both areas need to be cooperatively managed.

68. ORGAN VALLEY (Burke 1985)

Location

This soon-to-be-established RNA is on the Cleveland National Forest and is ca. 8 miles N. of Ramona in San Diego County. The site includes portions of sects. 6, 7, 8, and 18 T12N, R2E, SBBM (33°9' N., 116°40'W.) USGS Mesa Grande quad *(fig. 146).*

Target Elements

Engelmann oak *(Quercus engelmanii).*

Distinctive Features

• Rare Flora: Several rare plant species occur in the area. *Senecio ganderi* and *Horkelia truncata* are listed by the State of California as rare (CNPS List 1b) and occur on Las Posas soil along the Black Mtn. fuel break in the E. portion of the area. *Brodiaea orcuttii is* a member of CNPS List 1b and occurs as a

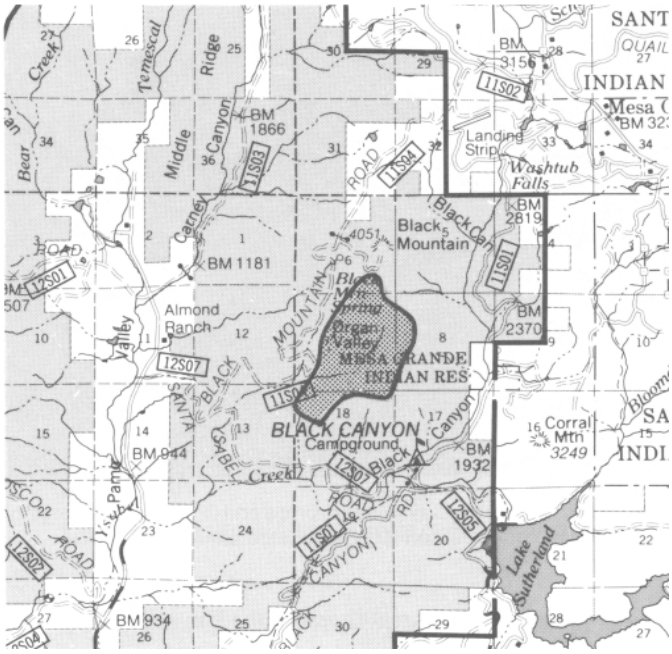


Figure 146-The Organ Valley RNA.

member of the savanna vegetation on the central mesa. *Calamagrostis densa, Diplacus (Mimulus) clevelandii,* and *Monardella hypoleuca* ssp. *lanata* are members of CNPS List 4 and also occur along the eastern boundary in Los Posas soil.

• Engelmann Oak: This species is an endemic to S. California, and the savanna subtype it forms in the central part of the area is considered an endangered plant association as a result of habitat alteration and destruction (Holland 1986). Engelmann oak is represented in four subtypes at Organ Valley and is reproducing well in all of them. Thus, the area has strategic importance as a reserve for this species.

Physical Characteristics

The area covers ca. 586 acres (237 ha) on the S. slope of Black Mountain. Elevations range from 2300 to 3900 ft (701-1189m). Slopes vary from 2 percent on the small mesa in the center of the area to 35 percent on the steep chamise-covered hillsides. The site is drained by two intermittent streams. Drainage is to the W. One spring occurs within the area and another just outside it.

Rocks are gabbroic (chiefly San Marcos and Cuyamaca gabbros) and granitic (primarily undivided quartz diorite of the S. California Batholith). Soils include four mapping units, the most extensive of which is the Las Posas stony fine sandy loam 30-65 percent slopes, followed by Acid igneous rock land, Reiff fine sandy loam 5-9 percent slope, and finally by Reiff fine sandy loam 0-2 percent slope. The last unit underlies the savanna in the center of the area. Average annual precipitation is estimated at between 20 and 25 inches (508-635 mm). Mean minimum temperatures are ca. 44 °F (6.7 °C) and mean maximum is ca. 77 °F (25 °C).

Association Types

No vegetation sampling is conducted in this survey.

• Chamise Chaparral (37200): 380 acres (154 ha). This chaparral is dominated by *Adenostoma fasciculatum.* It is best developed on S. and W.-facing slopes and ridges. *Yucca whipplei, Arctostaphylos glandulosa, Ceanothus leucodermis, Ceanothus foliosus, Eriogonum fasciculatum, Salvia apiana,* and *Quercus dumosa* are low-density associates.

On dry slopes with more N.-aspects, *Quercus dumosa* increases in relative cover. Also associated with this phase are *Garrya veatchii, Prunus ilicifolia, Rhus ovata,* and *Rhamnus ilicifolia.* This chamise-scrub oak vegetation covers 124 acres (50 ha).

On the E.- and S.-facing slopes overlying the acid igneous rock land soil series, a very dry phase of chamise chaparral occurs. About 20 percent of the cover is exposed granitic rock. Species composition is similar to the main phase of chamise chaparral, but the aspect is more xeric. All phases of chamise chaparral intergrade with both mixed chaparral and southern interior oak woodland.

• Southern Interior Oak Woodlands (71160, 71181, 71182, 81310, 42110, 32700): 124 acres (50 ha). This formation is represented by three subtypes locally. The first is the Engelmann oak savanna covering ca. 23 acres (9 ha). This type dominates on the central mesa where Engelmann oak occurs in relatively low stem density with an understory dominated by *Juncus* spp., *Stipa* spp., and *Muhlenbergia rigens (fig.147).* Many small annuals occur including *Silene multinerva, Vicia exigua, Arabis glauca, Sidalcea malvaefolium, Medicago polymorpha, Erodium cicutarium,* and *Stellaria media.*

The second subtype (38 acres, 15 ha) is characterized by an understory dominated by *Salvia apiana* and *Eriogonum fasciculatum* and other species characteristic of inland sage scrub including *Artemisia californica, Bromus mollis,* and *B. rubens.* Coast live oak *(Quercus agrifolia)* shares dominance with Engelmann oak in this type, which occurs on S.-facing slopes with slopes of ca. 8°.

The third subtype is a mixed-dominance closed canopy oak woodland covering ca. 48 acres (19 ha). Coast live oak and Engelmann oak share dominance. *Toxicodendron diversilobum* and *Heteromeles arbutifolia* are shrubby subdominants along *with Ceanothus leucodermis, Rhus ovata, Ribes indecorum,* and *Prunus ilicifolia.* This subtype occurs on relatively mesic, moderately sloping WSW.-facing slopes. This subtype may intergrade with chamise chaparral on W.-facing slopes where a sparse oak cover overlies an understory of *Adenostoma fasciculatum, Thalictrum polycarpum, Rhus ovata,* and *Heteromeles arbutifolia.* This transitional phase covers ca. 15 acres (6 ha).

Regeneration of Engelmann oak is excellent within all three main subtypes.

• Mixed Chaparral (37110, 37120): 56 acres (23 ha). This type covers W.-facing slopes. The principal woody species include *Arctostaphylos glandulosa, A. glauca, Quercus dumosa, Ceanothus leucodermis, C. oliganthus, C. integerrimus, C. tomentosus, Erigeron fasciculatum, Heteromeles arbutifolia, Rhus ovata, Rhus laurina, Clematis lasiantha,* and *Nolina parryi.* Both Engelmann and coast live oaks occur sporadically. Understory associates include *Symphoricarpos mollis, Cheilanthes clevelandii, Pellaea mucronata, Haplopappus squarrosus, Eriophyllum confertiflorum, Eriodictyon angustifolium, Antirrhinum nuttallianum, Thalictrum polycarpum,* and *Toxicodendron diversilobum.*

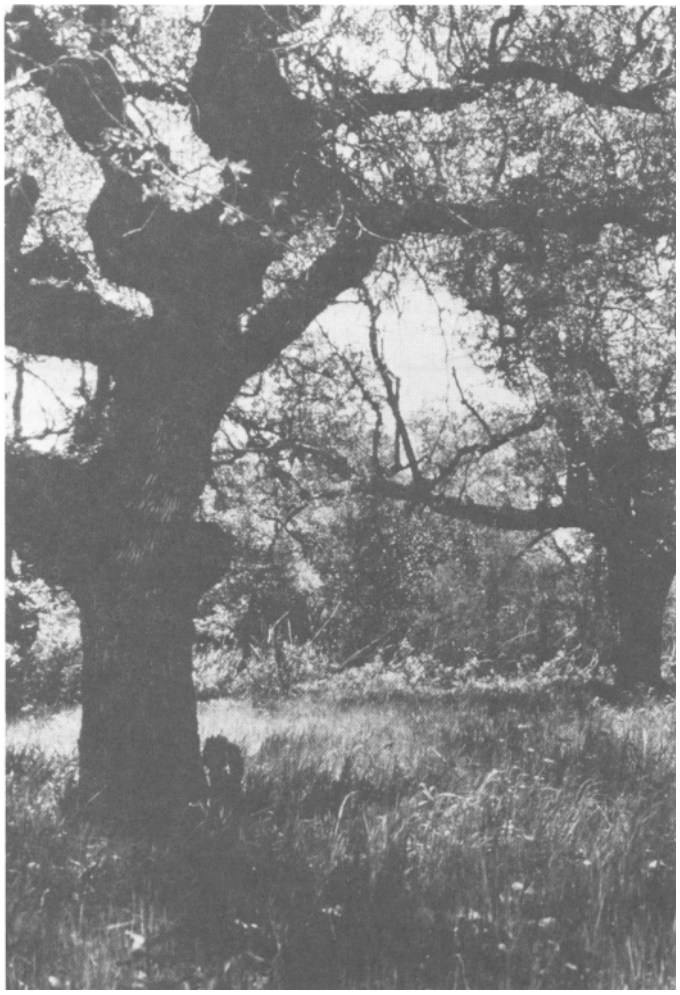


Figure 147–Organ Valley: Understory of main Engelmann oak savanna (M. Burke).

• Riparian Oak Woodland (61310): 48 acres (19 ha). This mesic association occurs along the two intermittent streams and scattered sandy washes. This woodland contains the following woody species: coast live oak, Engelmann oak (in low frequency), California sycamore *(Platanus racemosa), Salix lasiolepis,* and *Toxicodendron diversilobum.* A rich understory includes *Keckiella cordifolia, Dryopteris arguta, Woodwardia fimbriata, Iris missouriensis, Pycnanthemum californicum, Lonicera subspicata,* and *Anemopsis californica.*

Plant Diversity

One hundred eighty-two taxa are listed.

Conflicting Impacts

Grazing occurred in Organ Valley until 1981. Cattle grazing in oak woodlands contributed to poor reproduction by Engelmann and coast live oaks. Fuel breaks have been used by ORV's, and this has negative impacts on the sensitive plants of the N. boundary area. Three fires have occurred in portions of the area since 1913. The largest was the 1961 Black Mountain fire, which affected the N. portion of the area.

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GLOSSARY[1]

altern: an abrupt boundary between plant communities or associations

aplite: a granitic rock without biotite and related to pegmatites, with which it is often found

association table: a method of describing plant communities by summarizing results from a releve sample in matrix form, grouping species which tend to occur together into associations.

bajada: a type of plain in arid regions formed by deposition of debris in fan-shaped spreads at the base of mountains.

Botanical Areas: USDA Forest Service areas managed for their unique botanical values, a type of special interest area.

calcarious: rocks containing much calcium such as limestone, marble, and dolomite

charnockitic: containing chamockite, a coarse granular rock similar to granite which resulted from crystallization of magma at great depths or by ultra-metamorphism of basic igneous rock

climax: the end-product of a successional sequence, characterized by the lack of significant (directional) changes in species composition.

colluvium: weathered rocky material brought down by gravity from mountain slopes (including scree and talus)

congeliturbation: freeze-thaw sorting of soil into rings with coarser rocks and boulders surrounding sand and gravel

depauperate: poorly developed

dis-climax: an arrested climax, the result of some periodic environmental disturbance, such as fire, that prevents further succession

ecotone: a gradual boundary between plant communities or associations

edaphic: relating to soil

edaphic climax: an association of plants which has attained its highest possible successional state given its present soil conditions; e.g., mountain chaparral may be successional to mixed conifer forest on deep soils, but on dry rocky soils it may be an edaphic climax.

endemic: a taxon restricted to a certain area or habitat, may be divided into neo-endemics (evolutionarily recent) or

peleoendemics (relicts which may have once been more widespread)

ericaceous: referring to members of the heath family (Ericaceae)

establishment site-limited: limited to small favorable sites for germination within a community

even-aged stand: a forest stand composed of trees of all essentially the same age

gap regeneration species: tree species which tend to regenerate in openings in the forest are said to have this type of regeneration; also called gap-phase regeneration

graywacke: a type of sandstone characterized by rather angular and poorly sorted grains, thought to have originated from off-shore turbidity flows. It is widespread in the Franciscan Assemblage of the Coast Ranges.

hydrophilic: water-loving

hydrophyte: a plant of wet conditions

importance value: a synthesized measurement for rating the representation of a plant species in a stand of vegetation. It is based on a sum of other sampling values (e.g., relative density + relative frequency + relative cover). This value is given as a multiple of 100. Thus if three values are synthesized, the highest possible value is 300. If two values are added, the maximum would be 200.

line intercept method: a plotless vegetation sampling method counting all species touched by a line of predetermined length and determining their dominance by measuring the portion of the line that they cover.

liana: a woody vine such as California wild grape *(Vitis californica).*

lithosol: well drained, shallow, stony soils over bedrock

management indicator species: a type of plant or animal whose presence in a habitat or area is a fairly certain sign or symptom that particular environmental conditions are also present.

mass wasting: a type of gravity transport of rock and soil with sliding taking place either on a definite plane which may be related to the structure of the rock, or on a curved shear surface as in clay-rich soils.

mesic: moist, midway between xeric and hydric in moisture conditions

mesophyte: a plant of moderate (moist) moisture conditions

mesophilic: referring to species preferring moderate moisture conditions, typical of sheltered mid-slope to lower slope locations in California

oolitic limestones: limestones having numerous spherical rock particles which have grown by accretion around a nucleus

Paternoster lakes: glacially formed lakes arranged in a stepping-stone manner down a glacially carved valley

point-center(ed) quarter method: a plotless vegetation sampling technique in which points are chosen in a plant community. Each point represents the center of a four-cornered area. From each quadrant the nearest tree is sampled and calculations on density, frequency and cover can be made.

regosolic: having characteristics of regosols, typically poorly developed well-drained soils derived from deep recent volcanic ash deposits

releve: a sample quadrat (plot) used for vegetation analysis, the size of which is based on a minimal area in which the species of a community are adequately represented. On releves each species is recorded and several parameters are estimated (in size classes, not by absolute measurements), most typically including cover of each species, slope exposure, slope angle, and other environmental characteristics.

rupicolous: rock-inhabiting, rock-loving

sclerophyll: a plant characteristic of Mediterranean climates with a thickened cuticle on the leaves

seral: referring to vegetation which is changing, a transitory stage in an ecological succession

serpentine: The California state rock. More properly referred to as serpentinite, peridotite, dunite, etc. Serpentine is the lay person's generic term for these ultramafic rocks poor in calcium and high in magnesium, *which* create a harsh environment for vegetation. Most serpentine areas have unique floras with a high percentage of specially adapted, endemic taxa.

serotinous: late in opening, as in serotinous cones of closed-cone cypresses and pines

site class: a measure of productivity for forests, usually measured in cubic feet/acre/year. There are seven site classes with 1 the highest (225+ ft^3/ac/yr) and 7 the lowest (<20 ft^3/ac/yr).

site index: a measurement of tree growth potential for a given area based on the rate of growth of certain dominant tree species. Generally based on the length of time the dominant timber species takes to reach 100 ft (31 m) in height.

size classes: recognizable cohorts of trees in a forest representing different ages, e.g., saplings and seedlings, pole size, and mature trees.

solifluction lobes: saturated soil slumping in alpine zone

Special Interest Area: Areas established and managed by the USDA Forest Service for their unique special features. These include geological, historical, archaeological, botanical, and other noteworthy features.

vertisol: a clay-rich soil which usually has alternating wet and dry periods and tends to form large cracks in the dry season.

xeric: dry

xerophyte: a plant of dry conditions

xerophilic: dry-adapted (dry loving)

[1]This is a partial glossary of some of the more commonly used technical words in this report.

SYMBOLS AND ABBREVIATIONS

ca. circa (about, approximately)
cm centimeter
CNPS California Native Plant Society

dbh diameter breast height (4.5 ft., 1.4 m)
ft feet
E. east or easterly
ESE. east-southeast
ha hectare
HBM Humboldt Baseline and Meridian
IV importance value
km kilometers
m meters
m^2/ha square meters per hectare (the standard measurement for basal area cover of trees in this report) MDBM Mount Diablo Baseline and Meridian
mm millimeters
N. north or northerly
n sample size
NE. northeast
NNW. north-northwest
NW. northwest
R Range, as in Township and Range land divisions
S. south or southerly
SAF Society of American Foresters; used herein to designate a forest cover type classified in the SAF system (Eyre 1980)
SBBM San Bernardino Baseline and Meridian
SD standard deviation
SE. southeast
sect(s) section(s) within Township and Range land divisions
sp. an unidentified species (following a genus name)
spp. several species of a genus
ssp. subspecies
ssp. nov. undescribed subspecies
SSE. south-southeast
SSW. south-southwest
SW. southwest
T Township
var. variety of a species
W. west or westerly
WSW. west-southwest
x indicates a taxon of hybrid origin as in *Quercus x morehus*
< greater than
> less than
' minutes as in degrees and minutes of latitude or longitude
± more or less, or in conjunction with a number indicating confidence limits

APPENDIX 1

Holland (1986) community representation on 68 surveyed candidate and established RNAs in California.

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Scrub and Chaparral:										
Central Coastal Scrub (32200)	—	—	—	—	—	42 ±	—	—	—	—
Riversidian Sage Scrub (32700)	—	—	—	—	—	—	—	—	63	64, 68 ±
Great Basin Mixed Scrub (35100)	—	—	—	29 ±,	—	—	—	—	—	—
Big Sagebrush Scrub (35210)	—	—	—	29, 30, 31, 32	—	—	44, 48	—	—	64
Subalpine Sagbrush Scrub (35220)	—	—	—	31, 32, 33	—	—	—	—	—	—
Sagebrush Steppe (35300)	—	—	28	—	—	—	—	—	—	—
Rabbbrush Scrub (35400)	—	—	28	—	—	—	—	—	—	64 ±
Northern Mixed Chaparral (37110)	8 ±	24 ±	—	—	36, 37, 40	42	—	54, 55, 58	62, 63	64, 65, 67, 68
Southern Mixed Chaparral (37120)	—	—	—	—	—	—	—	—	—	64 ±, 65, 68 ±
Chamise Chaparral (37200)	—	—	—	—	36 ±, 37	42	—	58	62, 63,	64, 65, 68
Mixed Montane Chaparral (37510)	3, 5, 9, 10, 12, 13, 15, 19	22, 23, 25, 26, 27	—	—	—	—	44, 46, 47, 48, 49, 52	53, 60	—	—
Montane Manzanita Chaparral (37520)	15	26	—	—	—	—	47, 50 ±	54 ±	63	64, 66
Montane Ceanothus Chaparral (37530)	20	25	—	—	37	—	44	—	62	66

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Scrub and Chaparral:										
Shin Oak Brush (37541)	8	24 ±	—	—	35 ±, 38	—	—	—	—	—
Huckleberry Oak Chaparral (37542)	3, 13, 15	—	—	—	—	—	47, 49	53	—	—
Serpentine Chaparral (37600)	7 ±, 16	—	—	—	36	—	—	—	—	—
Buckbrush Chaparral (37810)	10, 16	24	—	—	—	—	—	54	—	—
Bluebush Chaparral (37820)	—	—	—	—	—	42	—	—	—	—
Scrub Oak Chaparral (37900)	—	24	—	—	34	—	—	—	—	64
Interior Live Oak Chaparral (37A00)	—	24	—	—	—	—	—	—	61, 62, 63	64
Upper Sonoran Manzanita Chaparral (37B00)	—	—	—	—	40	—	—	—	—	—
Mesic North Slope Chaparral (37E00)	—	—	—	—	36, 37	—	—	—	—	
Coastal Sage/Chaparral Scrub (37G00)	—	—	—	—	—	42	—	—	—	—
Grasslands, Vernal Pools, and Other Herb Communities:										
Coastal Terrace Prairie (41100)	—	—	—	—	—	42	—	—	—	—
Bald Hills Prairie (41200)	—	—	—	—	34 ±, 39 ±, 40 ±	—	—	—	—	—
Valley Needlegrass Grassland (42110)	—	24 ±	—	—	—	42 ±	—	—	62 ±	64 ±, 67, 68 ±
Non-native Grassland (42200)	—	24	—	—	34, 39, 40	42	—	58	—	64 ±
Northern Basalt Flow Vernal Pool (44131)	—	—	28 ±	—	—	—	—	—	—	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Grasslands, Vernal Pools, and Other Herb Communities:										
Montane Meadow (45100)	3, 5, 11, 12, 14, 16, 19	22, 23, 26, 27	—	—	35	—	45, 46, 47,	53, 56, 60	— 48, 49	—
Wet Subalpine/Alpine Meadow (45210)	11 ±, 19 ±	22 ±, 26	—	32, 33	—	—	45 ±, 47 ±	57, 59	—	—
Dry Subalpine/ Alpine Meadow (45220)	11 ±, 19 ±	22 ±, 26	—	32, 33	—	—	45 ±, 47 ±	57, 59	—	—
Freshwater Seep (45400)	2, 15, 16, 17	24, 27	—	—	35, 38, 40	—	51 ±	—	63	64, 66, 67
Bog and Marsh:										
Spahgnum Bog (51110)	19 ±	—	—	—	—	—	45, 47	—	—	—
Darlingtonia Bog (51120)	3, 7, 11, 14	—	—	—	—	—	—	—	—	—
Fen (51200)	19 ±	—	—	—	—	—	45, 47	—	—	—
Montane Freshwater Marsh (52430)	3, 16, 19	22	—	—	—	45, 46, 47, 48	53, 56	—	—	
Riparian and Bottomland Habitat:										
Red Alder Riparian Forest (61130)	17 ±, 20	—	—	—	41	—	—	—	—	—
Central Coast Cottonwood/Sycamore Riparian Forest (61210)	—	—	—	—	—	42 ±	—	—	—	—
Southern Coast Live Oak Riparian Forest (61310)	—	—	—	—	—	—	—	—	62 ±	65, 67, 68
Southern Cottonwood/ Willow Riparian Forest (61330)	—	—	—	—	—	—	—	—	61, 62 ±	—
White Alder Riparian Forest (61510)	1 ±, 2, 6, 8, 10, 13, 16, 17	24, 25	—	—	35, 40 ±	—	50	54	61±	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Riparian and Bottomland Habitat:										
Aspen Riparian Forest (61520)	—	—	—		—	—	45, 48, 49 ±	53	—	—
Montane Black Cottonwood Riparian Forest (61530)	—	25 ±, 27	—	—	—	—	—	53 ±	—	—
Montane Riparian Scrub (63500)	2, 5, 10, 13, 19	22, 25	—	—	35	—	45, 46, 47, 48,49	53, 57, 60	—	—
Woodland:										
Oregon Oak Woodland (71110)	8 ±, 10, 21 ±	—	—	—	38 ±,39, 40	—	—	—	—	—
Black Oak Woodland (71120)	8	24	—	—	34, 38	—	52	54	—	64
Blue Oak Woodland (71140)	—	24	—	—	34 ±	—	—	58	—	—
Interior Live Oak Woodland (71150)	—	24	—	—	—	—	—	—	62, 63	64 ±
Coast Live Oak Woodland (71160)	—	—	—	—	—	42	—	—	62 ±	65, 68 ±
Open Engelmann Oak Woodland (71181)	—	—	—	—	—	—	—	—	—	67 ±, 68
Dense Engelmann Oak Woodland (71182)	—	—	—	—	—	—	—	—	—	68
Open Digger Pine Woodland (71310)	—	—	—	—	—	—	—	58 ±	—	—
Serpentine Digger Pine/ Chaparral Woodland (71321)	—	—	—	—	36 ±	—	—	—	—	—
Non-Serpentine Digger Pine/Chaparral Woodland (71322)	—	24	—	—	36	—	—	55, 58	—	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Woodland:										
Digger Pine/Oak Woodland (71410)	—	24	—	—	39 ±, 40 ±	—	—	58	—	—
Mixed North Slope Cismontane Woodland (71420)	8 ±	—	—	—	40	—	—	—	—	—
Northern Juniper Woodland (72110)	—	—	28	—	—	—	—	—	—	—
Great Basin Pinyon/ Juniper Woodland (72121)	—	—	—	31	—	—	—	—	—	—
Great Basin Pinyon Woodland (72122)	—	—	—	31	—	—	—	—	—	—
Forest:										
Mixed Evergreen Forest (81100)	1, 2, 6, 8, 10, 13, 17, 20, 21	—	—	—	38 ±	42, 43	—	—	—	—
California Bay Forest (81200)	—	—	—	—	—	42	—	—	—	—
Coast Live Oak Forest (81310)	—	—	—	—	—	42	—	—	62 ±	68
Canyon Live Oak Forest (81320)	2, 8, 10, 13, 18, 21 ±	24	—	—	34, 35 ±	42, 43	50	54, 55, 58 ±	61, 62, 63	64, 66, 67±
Interior Live Oak Forest (81330)	—	24 ±	—	—	—	—	—	55 ±	62 ±, 63	64 ±
Black Oak Forest (81340)	7, 9 ±, 15 ±	24		—	35, 39	—	52	54		64, 66
Tanoak Forest (81400)	1, 2, 6 ±, 13 ±, 20	—	—	—	—	42 ±	—	—	—	—
Red Alder Forest (81A00)	20	—	—	—	41	—	—	—	—	—
Aspen Forest (81B00)	—	—	—	—	—	—	44	53, 57	—	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Forest:										
Western Hemlock Forest (82200)	20	—	—	—	—	—	—	—	—	—
Alluvial Redwood Forest (82310)	—	—	—	—	41 ±	42 ±	—	—	—	—
Upland Redwood Forest (82320)	—	—	—	—	41	42	—	—	—	—
Upland Douglas-fir Forest (82420)	2, 6, 7, 10, 13, 17, 18, 20, 21	—	—	—	—	—	—	—	—	—
Knobcone Pine Forest (83210)	2, 10, 13, 15 ±		—	—	—	36 ±, 37	—	—	—	—
Northern Interior Cypress Forest (83220)	—	—	—	—	36		48	—	—	—
Southern Interior Cypress Forest (83330)	—	—	—	—	—	—	—		—	65, 67
Coast Range Mixed Coniferous Forest (84110)	8, 10, 13, 15, 16		—	—	35, 37, 38	43 ±	—	—	—	—
Santa Lucia Fir Forest (84120)	—	—	—	—	—	42, 43	—	—	—	—
Upland Coast Range Ponderosa Pine Forest (84131)	8 ±, 10 ±	—	—	—	—	42 ±	—	—	—	—
Coulter Pine Forest (84140)	—	—	—	—	—	42 ±	—	—	63 ±	64, 66 ±
Bigcone Spruce/ Canyon Oak Forest (84150)	—	—	—	—	—	—	—	—	61, 62, 63	—
Ultramafic White Pine Forest (84160)	7 ±, 11	—	—	—	—	—	—	—	—	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Forest:										
Northern Ultramafic Jeffrey Pine Forest (84171)	7 ±, 16	—	—	—	—	—	—	—	—	—
Ultramafic Mixed Coniferous Forest (84180)	3, 14	—	—	—	—	—	—	—	—	—
Westside Ponderosa Pine Forest (84210)	19	27	—	—	—	—	50	54, 55	62	66
Eastside Ponderosa Pine Forest (84220)	—	25	—	—	—	—	—	—	—	—
Sierran Mixed Coniferous Forest (84230)	19	23, 25, 27	—	—	35, 38		48, 51, 52	55 ±	61 ±, 63 ±	66
Sierran White Fir Forest (84240)	2, 5, 10, 13, 19	23, 27	—	29	35, 38	—	44, 47, 48, 49, 51	53, 60 ±	—	—
Jeffrey Pine Forest (85100)	19	—	—	29, 30	—	—	—	53	—	—
Jeffrey Pine/Fir Forest (85210)	19		—	29	—	—	44 ±, 45	53	—	—
Washoe Pine/ Fir Forest (85220)	—	—	—	—	—	—	44	—	—	—
Red Fir Forest (85310)	3, 5, 9 ±, 12, 13 ±, 15 ±, 19	22, 23, 26	—	—	35 ±	—	44, 45, 46, 47, 48 ±, 49	53, 56, 60	—	—
Southern California White Fir Forest (85320)	—	—	—	—	—	—	—	—	—	67 ±
Siskiyou Enriched Conifer Forest (85410)	9 ±, 15 ±	—	—	—	—	—	—	—	—	—
Salmon–Scott Enriched Conifer Forest (85420)	3 ±, 19	—	—	—	—	—	—	—	—	—

Holland type (with code number)	Klamath Mountains	Cascade Range	Modoc Plateau	S Basin R Ranges	N Coast Ranges	S Coast Ranges	Sierra Nevada N	Sierra Nevada S	Transverse Ranges	Peninsular Ranges
Forest:										
Lodgepole Pine Forest (86100)	19 ±	—	—	29, 30	—	—	45, 47, 48 ±	53, 56, 57, 59, 60 ±	—	—
Whitebark Pine/ Mountain Hemlock Forest (86210)	3 ±, 4, 19	22, 26	—	—	—	—	—	57	—	—
Whitebark Pine/ Lodgepole Pine Forest (86220)	4 ±	—	—	—	—	—	57	—	—	—
Foxtail Pine Forest (86300)	4, 11, 19	—	—	—	—	—	—	58	—	—
Bristlecone Pine Forest (86400)	—	—	—	31, 33	—	—	—	—	—	—
Whitebark Pine Forest (86600)	4, 19	22 ±	—	—	—	—	—	57	—	—
Limber Pine Forest (86700)	—	—	—	30, 31, 33	—	—	—	59 ±	—	—
Alpine Habitats:										
Klamath/Cascades Fell-field (91110)	11	26	—	—	—	—	—	—	—	—
Sierra Nevada Fell-field (91120)	—	—	—	—	—	—		57	—	—
White Mountains Fell-field (91140)	—	—	—	32, 33	—	—	—	—	—	—
Alpine Talus and Scree Slope (91200)	3 ±, 11, 19 ±	22 ±, 26	—	33	—	—	47 ±, 49 ±	53 ±, 57	—	—
Alpine Snowbank Margin (91300)	19 ±	26 ±	—	33	—	—	—	57	—	—

[1]Numbers correspond to those of the RNAs as they are listed in this publication. The ± symbol indicates a community with partial representation, defined either by characteristics differing somewhat from the Holland description, or small area.

APPENDIX 2

List of California Native Plant Society (CNPS) Rare Plants on Surveyed RNAs[1]

Abies bracteata (4) Limekiln Creek (#42), South Fork Devil's Canyon(#43)
Abies lasiocarpa (2) Sugar Creek (#19)
Allium siskiyouensis (4) Crater Creek (#4)
Angelica arguta (4) L.E. Horton (#7), Sugar Creek (#19)
Antennaria suffructescens (4) L.E. Horton (#7)
Antirrhinum subcordatum (4) Frenzel Creek (#37)
Arabis aculeolata (2) L.E. Horton (#7)
Arabis macdonaldiana (1b) L.E. Horton (#7)
Arctostaphylos hooveri (4) South Fork Devil's Canyon (#43)
Arctostaphylos klamathensis (1b) Cedar Basin (#3)
Arnica spathulata (4) L.E. Horton (#7)
Arnica viscosa (4) Shasta Red Fir (#26)
Aster brickelloides (4) L.E. Horton (#7)
Aster paludicola (3) L.E. Horton (#7)
Astragalus clevelandii (4) Frenzel Creek (#37)
Astragalus kentrophyta ssp. *danaus (4)* White Mountain Summit (#33), White Mountain (#32), Harvey Monroe Hall (#56)
Astragalus pauperculus (4) Indian Creek (#24)
Bensoniella oregona (1b) Indian Creek Brewer Spruce (#9)
Botrychium pumicola (1a) historical occurrence in vicinity Shasta Red Fir (#26)
Boykinia rotundifolia (4) Falls Canyon (#61)
Brodiaea orcuttii (1b) Organ Valley (#68)
Calamagrostis crassiglumis (2) L.E. Horton (#7)
Calamagrostis densa (4) Guatay Mountain (#65), King Creek (#67), Organ Valley (#68)
Calochortus dunnii (1b) Guatay Mountain (#65)
Calycadenia fremontii (3) Indian Creek (#24)
Campanula scabrella (4) Mt. Eddy (#11)
Campanula wilkinsoniana (1b) known from adjacent areas Shasta Red Fir (#26)
Carex gigas (4) Cedar Basin (#3)
Carex halleana (2) Haypress Meadows (#5)
Castilleja elata (2) L.E. Horton (#7)
Collinsia linearis (4) Haypress Meadows (#5)
Cryptantha subretusa (2) Mt. Eddy (#11)
Cupressus arizonica ssp. *stephensonii* (1b) King Creek (#67)
Cupressus bakeri (4) Mud Lake-Wheeler Peak (#48)
Cupressus forbesii (1b) Guatay Mountain (#65)
Cypripedium californicum (4) Preacher Meadows (#14)
Cypripedium fasciculatum (4) Sugar Creek (#19), Sugar Pine Point (#52)
Darlingtonia californica (4) Cedar Basin (#3), L.E. Horton (#7), Preacher Meadows (#14), Mt. Eddy (#11)
Delphinium hesperium ssp. *cuyamacae* (1b) Cahuilla Mountain (#64)
Diplacus (Mimulus) clevelandii (4) Organ Valley (#68)
Draba aureola (1b) Mt. Eddy (#11)
Draba howellii (4) Sugar Creek (#19)
Epilobium oreganum (4) Haypress Meadows (#5)
Epilobium rigidum (4) L.E. Horton (#7)
Erigeron elegantulus (2) Devil's Garden (#28)
Eriogonum alpinum (1b) Mt. Eddy (#11)
Eriogonum pendulum (2) L.E. Horton (#7)
Eriogonum siskiyouense (4) Mt. Eddy (#11), Crater Creek (#4)
Eriogonum ternatum (4) L.E. Horton (#7)
Erythronium citrinum (list 4) Adorni (#1)
Eupatorium shastense (4) Hosselkus Limestone (#8)
Fritillaria eastwoodiae (3) Indian Creek (#24)
Galium californicum ssp. *luciense* (1b) South Fork Devil's Canyon (#43), Limekiln Creek (#42)
Galium clementis (4) Limekiln Creek (#42), South Fork Devil's Canyon (#43)
Gentiana affinis (4) L.E. Horton (#7)
Gentiana setigera (3) Haypress Meadows (#5), L.E. Horton (#7), N. Trinity Mtn. (#12)
Hackelia cusickii (2) Devil's Garden (#28)
Haplopappus ophitidus (1b) Smokey Creek (#16)
Haplopappus racemosus ssp. *congestus* (4) L.E. Horton (#7)
Heleanthus exilis (3) Smokey Creek (#16)
Hesperolinum drymarioides (1b) Frenzel Creek (#37)
Heuchera duranii (1b) White Mountain Summit (#32)
Heuchera elegans (4) Falls Canyon (#61)
Heuchera parishii (4) Millard Canyon (#63)
Horkelia sericata (4) L.E. Horton (#7)
Horkelia truncata (1b) Organ Valley (#68)
Iris innominata (4) L.E. Horton (#7)
Juglans hindsii (1b) Devil's Basin (#34)
Lathyrus delnorticus (4) L.E. Horton (#7)
Lewisia cotyledon var. *heckneri* (1b) Manzanita Creek (#10)
Lewisia pygmaea ssp. *longipetala* (1b) known from vicinity Sugar Pine Point (#52)
Lewisia serrata (1b) known from vicinity Sugar Pine Point (#52)
Lilium bolanderi (4) L.E. Horton (#7)
Lilium parryi (list 3) Hall Canyon (#66)
Lilium rubescens (4) Adorni (#1)
Lilium vollmeri (4) L.E. Horton (#7)
Lilium washingtonianum var. *purpurescens* (4) Cedar Basin (#3)
Lilium wigginsii (4) Haypress Meadows (#5)
Lomatium engelmannii (4) Crater Creek (#4), Sugar Creek (#19)
Lomatium foeniculaceum ssp. *inyoense* (4) White Mountain (#32), White Mountain Summit (#32)
Lomatium howellii (4) L.E. Horton (#7)
Lomatium tracyi (4) L.E. Horton (#7)
Lupinus cervinus (4) South Fork Devil's Canyon (#43)
Lupinus duranii (4) Indiana Summit (#29)
Lupinus lapidicola (4) Mt. Eddy (#11)
Lupinus tracyi (4) Haypress Meadows (#5)
Mimulus brachiatus (3) Frenzel Creek (#37)
Mimulus glaucescens (4) Frenzel Creek (#37), Indian Creek (#24)
Monardella hypoleuca ssp. *lanata* (4) Organ Valley (#68)
Monardella purpurescens (4) L.E. Horton (#7)
Navarretia subuligera (4) Indian Creek (#24)
Pedicularis howellii (4) Indian Creek Brewer Spruce (#9)
Penstemon cinereus (2) Devil's Garden (#28)
Penstemon neotericus (4) Mount Pleasant (#47)
Penstemon purpusii (4) Doll Basin (#35)
Phacelia cookei (1b) known from vicinity Shasta Red Fir (#26)
Phacelia stebbinsii (1b) known from vicinity Sugar Pine Point (#52)
Picea engelmannii (2) Sugar Creek (#19)
Pinguicula macroceras (2) L.E. Horton (#7)
Poa fibrata (3) Devil's Garden (#28)
Poa piperi (4) L.E. Horton (#7)
Poa rhizomata (4) Sugar Creek (#19)

Podistera nevadensis (4) Harvey Monroe Hall (#56)
Polygonum bidwelliae (4) Indian Creek (#24)
Polygonum polygonoides ssp. *esotericum* (1b) Devil's Garden (#28)
Polystichum lonchitis (3) Antelope Creek Lakes (#22), Cedar Basin (#3)
Quercus engelmannii (4) King Creek (#67), Organ Valley (#68)
Raillardella muirii (1b) Teakettle Creek (#60)
Rubus nivalis (3) Bridge Creek (#2)
Salix brachycarpa (2) Harvey Monroe Hall (#56)
Salix delnortensis (4) L.E. Horton (#7)
Salix reticulata ssp. *nivalis* (2) Harvey Monroe Hall (#56)
Salix tracyi (4) L.E. Horton (#7)
Sanicula peckiana (4) L.E. Horton (#7)
Sanicula tracyi (1b) Soldier (#39)
Scirpus clementis (4) Harvey Monroe Hall (#56)
Scirpus rollandii (2) White Mountain (#32)
Sedum laxum ssp. *flavidum* (4) L.E. Horton (#7)
Senecio clevelandii (4) Frenzel Creek (#37)
Senecio ganderi (1b) Organ Valley (#68)
Senecio macounii (2) L.E. Horton (#7)
Streptanthus bernardinus (1b) Millard Canyon (#63)
Streptanthus morrisonii (3) Frenzel Creek (#37)
Tauschia glauca (4) L.E. Horton (#7)
Thelypodium brachycarpum (4) Mt. Eddy (#11)
Trillium nivale (4) L.E. Horton (#7)
Vaccinium coccinum (3) Indian Creek Brewer Spruce (#9), Rock Creek Butte (#15)
Vancouveria chyrsantha (4) L.E. Horton (#7)
Veratrum insolitum (4) L.E. Horton (#7)
Veronica copelandii (4) Mt. Eddy (#11)
Veronica cusickii (4) Haypress Meadows (#5)

[1]This list includes all species on the four CNPS lists as defined in the introduction. Numbers following taxa indicate the CNPS list to which they are currently assigned (as of 1988); numbers following RNAs correspond to their numbers in this report.

APPENDIX 3

Trees Present on Surveyed RNAs[1]

KLAMATH MOUNTAINS PROVINCE

1) Adorni: *Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Chamaecyparis lawsoniana, Chrysolepis chrysophylla, Cornus nuttallii, Lithocarpus densiflorus, Pinus lambertiana, Pseudotsuga menziesii, Quercus chrysolepis, Taxus brevifolia, Umbellularia californica.*

2) Bridge Creek: *Abies concolor, Abies magnifica* var. *shastensis, Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Chrysolepis chrysophylla, Cornus nuttallii, Lithocarpus densiflorus, Picea breweriana, Pinus attenuata, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis*

3) Cedar Basin: *Abies concolor, Abies magnifica* var. *shastensis, Calocedrus decurrens, Chamaecyparis lawsoniana, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Pseudotsuga menziesii, Tsuga mertensiana*

4) Crater Creek: *Abies concolor, Abies magnifica* var. *shastensis, Juniperus occidentalis* ssp. *occidentalis, Pinus albicaulis, Pinus balfouriana, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus monticola, Tsuga mertensiana*

5) Haypress Meadows: *Abies concolor, Abies magnifica* var. *shastensis (Abies procera), Calocedrus decurrens, Chrysolepis chrysophylla, Picea breweriana, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Pinus ponderosa, Pseudotsuga menziesii, Taxus brevifolia, Tsuga mertensiana*

6) Hennessy Ridge: *Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Chrysolepis chrysophylla, Lithocarpus densiflorus, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii*

7) L.E. Horton: *Arbutus menziesii, Calocedrus decurrens, Calocedrus decurrens, Chamaecyparis lawsoniana, Lithocarpus densiflorus, Pinus contorta* ssp. nov., *Pinus attenuata, Pinus jeffreyi, Pinus monticola, Pseudotsuga menziesii, Quercus chrysolepis, Umbellularia californica*

8) Hosselkus Limestone: *Abies concolor, Acer macrophyllum, Aesculus californica, Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Cornus nuttallii, Fraxinus latifolia, Pinus lambertiana, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana* (including var. *breweri*), *Quercus kelloggii, Taxus brevifolia*

9) Indian Creek Brewer Spruce: *Abies concolor, Abies procera, Acer macrophyllum, Chamaecyparis lawsoniana, Chrysolepis chrysophylla, Cornus nuttallii, Picea breweriana, Pinus lambertiana, Pseudotsuga menziesii, Taxus brevifolia*

10) Manzanita Creek: *Abies concolor, Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Cornus nuttallii, Fraxinus latifolia, Pinus attenuata, Pinus lambertiana, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana, Quercus kelloggii, Taxus brevifolia*

11) Mount Eddy: *Abies concolor, Abies magnifica* var. *shastensis, Pinus albicaulis, Pinus balfouriana, Pinus contorta* ssp. *murrayana, Pinus monticola, Tsuga mertensiana*

12) North Trinity Mountain: *Abies concolor, Abies procera, Calocedrus decurrens, Pinus lambertiana, Pseudotsuga menziesii*

13) Pearch Creek: *Abies concolor, Abies procera, Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Chrysolepis chrysophylla, Cornus nuttallii, Fraxinus latifolia, Lithocarpus densiflorus, Picea breweriana, Pinus attenuata, Pinus lambertiana, Pinus monticola, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Taxus brevifolia*

14) Preacher Meadows: *Abies concolor, Abies magnifica* var. *shastensis, Calocedrus decurrens, Pinus lambertiana, Pinus jeffreyi, Pinus monticola, Pinus ponderosa, Pseudotsuga menziesii*

15) Rock Creek Butte: *Abies concolor, Abies procera, Calocedrus decurrens, Chamaecyparis lawsoniana, Cornus nuttallii, Picea breweriana, Pinus attenuata, Pinus lambertiana,*

Pinus monticola, Pinus ponderosa, Pseudotsuga menziesii, Taxus brevifolia

16) Smoky Creek: *Acer macrophyllum, Alnus rhombifolia, Calocedrus decurrens, Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii*

17) South Fork Mountain: *Abies concolor, Acer macrophyllum, Alnus oregona, Alnus rhombifolia, Arbutus menziesii, Chrysolepis chrysophylla, Cornus nuttallii, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii, Taxus brevifolia*

18) Specimen Creek: *Arbutus menziesii, Chrysolepis chrysophylla, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Taxus brevifolia*

19) Sugar Creek: *Abies concolor, Abies lasiocarpa, Abies magnifica* var. *shastensis, (Abies procera), Acer macrophyllum, Chrysolepis chrysophylla, Calocedrus decurrens, Picea breweriana, Picea engelmannii, Pinus albicaulis, Pinus balfouriana, Pinus contorta* ssp. *murrayana, Pinus lambertiana, Pinus monticola, Pinus jeffreyi, Pinus ponderosa, Populus tremuloides, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii, Taxus brevifolia, Tsuga mertensiana*

20) Upper Goose Creek: *Acer macrophyllum, Alnus oregona, Arbutus menziesii, Chamaecyparis lawsoniana, Chrysolepis chrysophylla, Cornus nuttallii, Lithocarpus densiflorus, Pinus attenuata, Pinus lambertiana, Pseudotsuga menziesii, Quercus chrysolepis, Sequoia sempervirens, Taxus brevifolia, Tsuga heterophylla*

21) Williams Point: *Acer macrophyllum, Arbutus menziesii, Lithocarpus densiflorus, Pinus lambertiana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana, Taxus brevifolia*

CASCADE RANGE

22) Antelope Creek Lakes: *Abies magnifca* var. *shastensis, Abies concolor, Pinus albicaulis, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus monticola, Tsuga mertensiana*

23) Cub Creek: *Abies concolor, Abies magnifica, Acer macrophyllum, Calocedrus decurrens, Cornus nuttallii, Pinus lambertiana, Pinus monticola, Pinus ponderosa, Pseudotsuga menziesii, Quercus kelloggii.*

24) Indian Creek: *Acer macrophyllum, Aesculus californica, Alnus rhombifolia, Calocedrus decurrens, Pinus ponderosa, Pinus sabiniana, Platanus racemosa, Populus fremontii, Quercus chrysolepis, Quercus douglasii, Quercus garryana* (including var. *breweri*), *Quercus kelloggii, Quercus lobata, Quercus wislizenii, Umbellularia californica*

25) Mt. Shasta Mudflow: *Abies concolor, Calocedrus decurrens, Pinus attenuata, Pinus lambertiana, Pinus ponderosa, Populus trichocarpa, Pseudotsuga menziesii, Quercus kelloggii*

26) Mt. Shasta Red Fir: *Abies concolor, Abies magnifica* var. *shastensis, Pinus albicaulis, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Tsuga mertensiana*

27) Soda Ridge: *Abies concolor, Abies magnifica, Calocedrus decurrens, Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Populus tremuloides, Populus trichocarpa, Pseudotsuga menziesii*

MODOC PLATEAU

28) Devil's Garden: *Juniperus occidentalis* ssp. *occidentalis, Pinus ponderosa*

SOUTHERN BASIN RANGES

29) Indiana Summit: *Abies concolor, Pinus contorta* ssp. *murrayana, Pinus jeffreyi*

30) Sentinel Meadow: *Juniperus occidentalis* ssp. *australis, Pinus albicaulis, Pinus flexilis, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus monticola, Populus tremuloides, Tsuga mertensiana* (*fide C.* Millar)

31) Whippoorwill Flat: *Juniperus osteosperma, Pinus flexilis, Pinus longaeva, Pinus monophylla*

32) White Mountain: *Pinus flexilis, Pinus longaeva, Populus tremuloides*

33) White Mountain Summit: none

NORTH COAST RANGES

34) Devil's Basin: *Aesculus californica, Juglans hindsii* may be introduced, *Pinus attenuata, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus douglasii, Quercus garryana, Quercus kelloggii, Umbellularia californica*

35) Doll Basin: *Abies concolor, Abies magnifca* var. *shastensis, Acer macrophyllum, Alnus rhombifolia, Calocedrus decurrens, Cornus nuttallii, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana* (including var. *breweri), Quercus kelloggii*

36) Frenzel Creek: *Alnus rhombifolia, Calocedrus decurrens, Cupressus macnabiana, Cupressus sargentii, Fraxinus latifolia, Pinus attenuata, Pinus ponderosa, Pinus sabiniana, Populus fremontii, Quercus chrysolepis, Umbellularia californica*

37) Hale Ridge: *Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Fraxinus latifolia, Pinus attenuata, Pinus ponderosa, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii*

38) Ruth: *Alnus rhombifolia, Acer macrophyllum, Arbutus menziesii, Calocedrus decurrens, Chrysolepis chrysophylla, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana* (including var. *breweri*), *Quercus kelloggii*

39) Soldier: *Arbutus menziesii, Pinus lambertiana, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus garryana, Quercus kelloggii*

40) Twin Rocks: *Aesculus californica, Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus douglasii, Quercus garryana, Quercus kelloggii, Quercus wislizenii*

41) Yurok: *Abies grandis, Acer macrophyllum, Alnus oregona, Chamaecyparis lawsoniana, Chrysolepis chrysophylla, Lithocarpus densiflorus, Pseudotsuga menziesii, Sequoia sempervirens, Tsuga heterophylla*

SOUTH COAST RANGES

42) Limekiln Creek: *Abies bracteata, Acer macrophyllum, Alnus rhombifolia, Arbutus menziesii, Calocedrus decurrens, Lithocarpus densiflorus, Pinus coulteri, Pinus lambertiana, Pinus ponderosa, Platanus racemosa, Pseudotsuga menziesii, Quercus agrifolia, Quercus chrysolepis, Quercus wislizenii, Sequoia sempervirens, Umbellularia californica*

43) South Fork Devil's Canyon: *Abies bracteata, Arbutus menziesii, Lithocarpus densiflorus, Pinus coulteri, Pinus lambertiana, Pinus ponderosa, Quercus chrysolepis, Quercus wislizenii, Umbellularia californica*

NORTHERN SIERRA NEVADA

44) Babbitt Peak: *Abies concolor, Abies magnifica, Juniperus occidentalis* ssp. *occidentalis, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus monticola, Pinus washoensis, Populus tremuloides*

45) Grass Lake: *Abies concolor, Abies magnifica, Pinus contorta* ssp. *murrayana,*

Pinus jeffreyi, Pinus monticola, Populus tremuloides, Tsuga mertensiana

46) Green Island Lake: *Abies concolor, Abies magnifica, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Populus tremuloides*

47) Mount Pleasant: *Abies concolor, Abies magnifica, Calocedrus decurrens, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Populus tremuloides, Tsuga mertensiana*

48) Mud Lake-Wheeler Peak: *Abies concolor, Abies magnifica, Calocedrus decurrens, Cupressus bakeri, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pseudotsuga menziesii, Populus tremuloides*

49) Onion Creek: *Abies concolor, Abies magnifica, Calocedrus decurrens, Juniperus occidentalis* ssp. *australis, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Populus tremuloides, Tsuga mertensiana*

50) Peavine Point: *Abies concolor, Acer macrophyllum, Alnus rhombifolia, Cornus nuttallii, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii, Taxus brevifolia, Torreya californica*

51) Station Creek: *Abies concolor, Calocedrus decurrens, Pinus lambertiana, Pseudotsuga menziesii*

52) Sugar Pine Point: *Abies concolor, Abies magnifica, Calocedrus decurrens, Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii*

SOUTHERN SIERRA NEVADA

53) Bell Meadow: *Abies concolor, Abies magnifica, Juniperus occidentalis* ssp. *australis, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Populus tremuloides, Populus trichocarpa*

54) Big Grizzly Mountain: *Alnus rhombifolia, Calocedrus decurrens, Pinus attenuata, Pinus ponderosa, Pseudotsuga menziesii, Quercus chrysolepis, Quercus kelloggii, Umbellularia californica*

55) Bishop Creek (South Fork Merced River): *Abies concolor, Aesculus californica, Alnus rhombifolia, Calocedrus decurrens, Cornus nuttallii, Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii, Quercus chrysolepis, Quercus Kelloggii, Quercus wislizenii, Umbellularia californica*

56) Bourland Meadow: *Abies concolor, Abies magnifica, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus monticola, Populus tremuloides, Quercus kelloggii*

57) Harvey Monroe Hall: *Pinus albicaulis, Pinus contorta* ssp. *murrayana, Tsuga mertensiana*

58) Jawbone Ridge: *Aesculus californica, Pinus ponderosa, Pinus sabiniana, Quercus chrysolepis, Quercus douglasii, Quercus wislizenii, Umbellularia californica*

59) Last Chance Meadow: *Pinus balfouriana, Pinus contorta* ssp. *murrayana, Pinus flexilis*

60) Teakettle Creek: *Abies concolor, Abies magnifica, Calocedrus decurrens, Pinus contorta* ssp. *murrayana, Pinus jeffreyi, Pinus lambertiana, Pinus monticola, Quercus kelloggii*

TRANSVERSE RANGES

61) Falls Canyon: *Acer macrophyllum, Alnus rhombifolia, Calocedrus decurrens, Pinus lambertiana, Pinus ponderosa, Platanus racemosa, Populus fremontii, Pseudotsuga macrocarpa, Quercus agrifolia, Quercus chrysolepis, Umbellularia californica*

62) Fern Canyon: *Abies concolor, Acer macrophyllum, Alnus rhombifolia, Pinus lambertiana, Pinus ponderosa, Pseudotsuga macrocarpa, Quercus agrifolia, Quercus chrysolepis, Quercus kelloggii, Quercus wislizenii, Umbellularia californica*

63) Millard Canyon: *Abies concolor, Acer macrophyllum, Calocedrus decurrens, Pinus coulteri, Pinus lambertiana, Platanus racemosa, Pseudotsuga macrocarpa, Quercus chrysolepis, Quercus wislizenii*

PENINSULAR RANGES

64) Cahuilla Mountain: *Pinus coulteri, Quercus chrysolepis, Quercus kelloggii, Quercus wislizenii*

65) Guatay Mountain: *Cupressus forbesii, Quercus agrifolia, Quercus chrysolepis*

66) Hall Canyon: *Abies concolor, Alnus rhombifolia, Calocedrus decurrens, Pinus coulteri, Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Quercus chrysolepis, Quercus kelloggii, Quercus wislizenii* (including var. *fructescens*), *Sequoiadendron giganteum* (introduced), *Umbellularia californica*

67) King Creek (Cuyamaca Cypress): *Cupressus arizonica* var. *stephensonii, Pinus coulteri, Quercus agrifolia, Quercus chrysolepis, Quercus engelmannii*

68) Organ Valley: *Platanus racemosa, Quercus agrifolia, Quercus engelmannii*

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[1]This includes all species noted in plant lists in the ecological surveys. Some locally rare or uncommon species may not be mentioned in the discussion of plant associations in the summary. Taxonomy follows Munz (1968).

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