

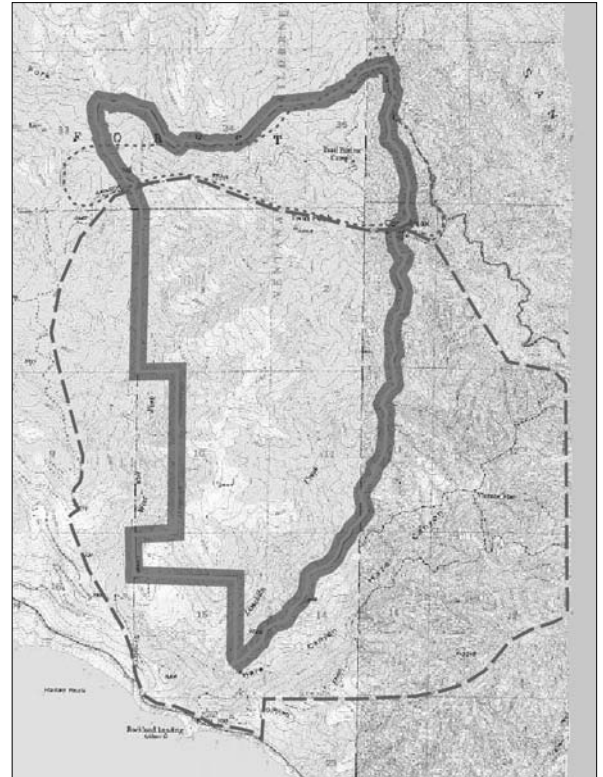
## 19. Cone Peak Gradient (Limekiln Creek, South Fork of Devil's Canyon)

### Location

This established RNA is on the Los Padres National Forest, near Lucia about 23 miles (37 km) SE. of the town of Big Sur, in Monterey County. It incorporates two ecological surveys, Limekiln Creek and South Fork of Devil's Canyon. The RNA includes portions of sects. 33, 34, and 35 T21S, R4E and all or portions of sects. 1, 2, 3, 10, 11, 12, 13, 14, 15, 22, and 23 T22S, R4E MDBM (36°01'N., 121°29'W.), USGS Cone Peak and Lopez Point quads (fig. 38). Ecological subsection – North Coastal Santa Lucia Range (261Aj).

### Target Elements

This area falls in part under the category of unique ecosystem, 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. The area also has been selected to represent the canyon live oak (*Quercus chrysolepis*) woodland, mixed evergreen forest, California coast live oak (*Quercus agrifolia*) woodland, redwood (*Sequoia sempervirens*), and chaparral target elements for the Central California Coast Ranges ecological section.



**Figure 38—Cone Peak Gradient RNA**

Dashed line = Limekiln Creek ecological study area  
 Solid gray line = RNA Boundary  
 Dotted line = South Fork of Devil's Canyon ecological study area

### A. Limekiln Creek (Keeler-Wolf and Keeler-Wolf 1977, Borchert 1987)

#### 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, coast live oak, and canyon live oak woodlands may provide answers to questions concerning the tolerance and requirements of the individual species comprising these associations.

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 represents whole associations. For example, the local coast redwood forest contains several

characteristic plants such as *Oxalis oregana*, *Viola sempervirens*, *Whipplea modesta*, and *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 at the upper elevations of the RNA is characteristic montane California plants and may be more than 100 miles (161 km) from the nearest known populations. These include such species as sugar pine (*Pinus 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; the RNA is a meeting ground for the northern *Batrachoseps pacificus* and the southern *B. nigriventris*. 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 (rock groups) 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 N. Cascades, a major thrust fault (the Sur-Nacimiento Fault), and the only charnockitic terrain described W. 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. They include Santa Lucia fir (*Abies bracteata*, CNPS List 4), *Galium californicum* ssp. *lucienne* (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 about 3.25 miles (5.2 km) from Cone Peak (the lowest 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 more than 75 percent of the area. These rocks include limestone, quartzite, granofelses, and gneisses 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 annual precipitation at the lower elevations about 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 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 about 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 was conducted for the ecological survey. Description and acreages of the types were based on the ecological survey.

**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*), bigleaf 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*, and *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; it 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 bigleaf maple, California wax myrtle (*Myrica californica*), *Petasites palmatus*, *Boykinia elata*, *Aralia californica*, *Adiantum pedatum* var. *aleuticum*, and *Woodwardia fimbriata* (fig. 39).

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 patchier, nondiverse, 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



**Figure 39—Cone Peak Gradient / Limekiln Creek, *Adiantum pedatum*, *Oxalis oregana*, and *Vaccinium ovatum* of the redwood riparian forest along W. Fork Limekiln Creek. (1976)**

subdominants. Occasionally, Santa Lucia fir (*Abies bracteata*) occurs in redwood groves in 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 N. 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 about 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, 37G00):** 550 acres (223 ha). This association occurs on S.-facing slopes away from the immediate coast between 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.

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 frequently may 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 1950s. 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 it 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 shrubs, are widely spaced with a sparse herb cover 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 of this association indicate past fire. This association is transitional between lower elevation, broad-leaved sclerophyll forests and the higher, more mesic conifer 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. 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) that 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). Closely associated with the coastal scrub and sage scrub, this scrub association is dominated by bluebush (*Ceanothus thyrsiflorus*) or the similar *Ceanothus griseus* (at lower elevations) or *C. soledadensis* (at higher elevations). This type of scrub is taller than coastal scrub and generally found on steeper, rockier slopes than the two related scrub associations. Holland considers it a form of chaparral.



**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*, *Eucrypta 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.

**Figure 40—Cone Peak Gradient, South Fork of Devil's Canyon,** the sugar pine dominated pine/oak woodland on the north slope of Twin Peak in South Fork of Devil's Canyon. (J. R. Griffin 1976)

## B. South Fork of Devil's Canyon (Griffin 1976, Borchert 1987)

### Distinctive Features

**Disjunct and Unusual Vegetation:** The Devil's Canyon vegetation encompasses a combination of plants in an unusual topographic setting including extensive groves of the Santa Lucia Mountains' endemic bristlecone fir, impressive disjunct old-growth sugar pine stands (fig. 40), interesting S. and N. 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. *lucianum* (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 survey area covers 542 acres (219 ha). Elevations range from about 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.-facing slope aspects predominating, but all 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-xerotherms, 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) across most of the area to 90 inches (2286 mm) on the E. flank of Cone Peak.

### **Association Types**

Twelve 300-m<sup>2</sup> plots were sampled in the sugar pine/tanoak-canyon live oak/*Toxicodendron* forest. Twelve 250-m<sup>2</sup> plots were sampled in the sugar pine/tanoak-canyon live oak-madrone/*Toxicodendron* forest. Twelve 500-m<sup>2</sup> plots were sampled in pine/oak woodland. Descriptions and acreages are based on the ecological survey.

**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 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 sugar pines (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<sup>2</sup>/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), and 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; it 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 first phase with few older hardwood stems.

Maximum dbh for tanoak and madrone sprouts is about 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). Trees also may be younger and shorter on average than sugar pines in 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<sup>2</sup>/ha), respectively, are given after the following species: 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), and 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 also is broken 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 presence of sugar pine. Tanoak is the most important species, with canyon live oak and Pacific madrone locally dominant. Interior live oaks (*Quercus wislizenii*) are scattered, but unimportant. 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.

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; 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). It is characterized by very steep (average 96 percent) rocky slopes with tree and shrub cover less than 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 of 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. *lucienae*, *G. clementis*, *Holodiscus microphyllus*, *Lotus argophyllus* var. *fremontii*, *Penstemon corymbosus*, *Stipa coronata*, and *Streptanthus tortuosus*.

The other two types are the transition phase, which occurs below the summits. One type is the steep (average 84 percent) rocky slopes without cliffs or sudden breaks in slope, with average tree cover of 40 percent and shrub cover of 25 percent. The other type is the ravine phase, with an average slope of 70 percent and tree cover of greater than 50 percent. These types are mapped together and are estimated to cover about 27 acres (11 ha).

**Pine/Oak Woodland (no Holland equivalent):** 51 acres (21 ha). Between the ridge crest at Twin Peak (4843 ft, 1476 m) and about 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

pinus 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<sup>2</sup>/ha), respectively, are given after the species name 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), and 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

More than 380 taxa of vascular plants have been identified from the RNA (Borchert 1987). The number listed in Limkilt Creek is 288; in South Fork of Devil's Canyon, 107.

### Conflicting Impacts

The greatest recent influence in the area has been the 1985 Rat Fire, which burned virtually the entire RNA. 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 prior amount of vegetation sampling will provide important baseline information for the monitoring of succession over the ensuing decades.

The area lies within the Federally-designated Ventana Wilderness. However, recreational use has traditionally been light.

Grazing, browsing (deer and cattle), and cattle wallowing within the coast live oak woodland appear to have affected the relatively poor 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.

## 20. Craig's Creek (Imper 1991a)

### Location

This recommended RNA is on the Six Rivers National Forest, Del Norte County. It is about 10 miles (16 km) E. of Crescent City and 13 miles (21 km) S. of the Oregon border, near the confluence of the Main and S. Forks of the Smith River. The area is included in portions of sects. 1, 2, 3, 10, 11, 12 T16N, R1E HBM (41°48'N., 124°03'W.), USGS Hiouchi quad (fig. 41). Ecological subsections – Western Jurassic (M261Aa) and Gasquet Mountain Ultramafics (M261Ab).

### Target Element

Knobcone Pine (*Pinus attenuata*) Forest

### Distinctive Features

**Knobcone Pine:** Knobcone pine occurs both in pure stands and mixed with Douglas-fir (*Pseudotsuga menziesii*) and hardwoods at Craig's Creek. These forests provide an interesting gradient in moisture availability, soil chemistry, and competitive abilities of the species present. They are representative of the Klamath Mountains ecological section.

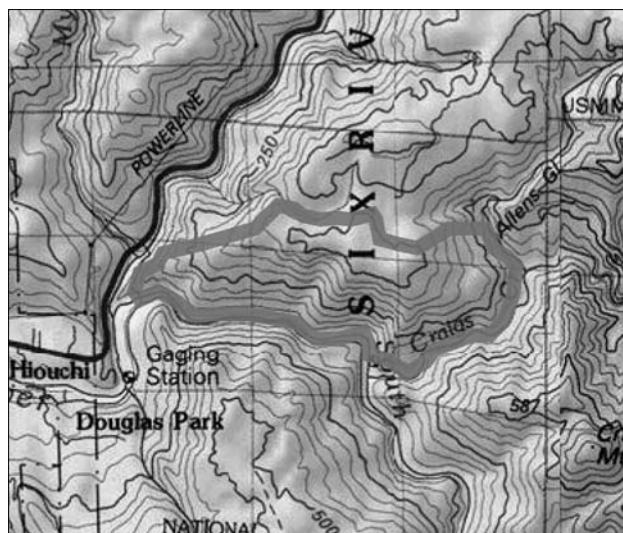


Figure 41—Craig's Creek rRNA

**Habitat and Floral Diversity:** Habitat diversity at the rRNA is impressive due to the broad range of soils, abundant water, and topographic/microsite variability. Species richness is characteristic of the Klamath Mountains, in part a function of its large endemic component and relictual status.

**Rare Plants:** *Arctostaphylos hispidula* and *Erigeron delicatus* (*E. cervinus* in Hickman [1993]) on CNPS List 4 are present in the rRNA.

**Plant Species of Special Interest:** Many species present are endemic to the Klamath Mountains. Local endemics include *Holodiscus discolor* var. *delnortensis* and *Arctostaphylos hispidula*. *Juniperus communis* var. *jackii*, *Galium ambiguum* var. *siskiyouense*, *Stenanthium occidentale*, *Tofieldia glutinosa*, *Tauschia glauca*, and *Lomatium howellii* are all endemic to the region. The carnivorous *Pinguicula vulgaris* grows on rock outcrops adjacent to the S. Fork.

### Physical Characteristics

The survey area covers about 950 acres (385 ha), but the acreage proposed in the forest plan is 1150 acres (465 ha). The study area occupies the entire S.-facing slope of one continuous ridge, extending for about 2.25 miles (4.0 km) E. of the S. Fork Bridge. Elevation ranges from about 140 ft (43 m) at the S. boundary to 1750 ft (533 m) at the ridgetop. Aspects tend to be S., with slopes ranging from 50 to 100 percent.

The area is underlain by gabbro and related rocks with a complex of dike rocks intruding into the W. half. An area of Wimer formation is mapped on the ridgetop at the S. boundary. Soils are Hugo family, moderately deep-Maymen family complex 50-70 percent in the W. portion, and Maymen family-Rock outcrop, metaigneous complex 70-90 percent in the E. portion. Soils of the Clallam-Skalan-Goldridge families occur in the far E. portion and along Craig's Creek.

Due to proximity to the coast and the Siskiyou Mountains to the E., weather in the area is relatively mild year-round. A small portion of the abundant precipitation occurs in summer. Mean annual precipitation averages 80-90 inches (2036-2290 mm), although nearby locations occasionally receive more than 200 inches (5080 mm). Fog or low clouds are common. Snowfall is infrequent and light. The January mean minimum temperature is about 16 °F (-9 °C) and July's mean maximum is about 70 °F (21 °C). The average frost-free period extends from about April 1 to November 15.

**Figure 42—Craig's Creek,** looking southwest from lateral ridge (ca. 700 ft [213 m]) at west end of Craig's Creek rRNA, toward South Fork Bridge. The knobcone-tanoak forest is almost impenetrable, characterized by dense, stunted tanoak, and dense shrub layer of *Vaccinium ovatum*, *Arctostaphylos columbianum*, *Toxicodendron diversiloba*, *Rhododendron macrophyllum*, and *Gaultheria shallon*. (1990)



### Association Types

Twenty-two 0.1-acre circular plots were sampled within representative stands for each of the vegetation types present. An additional three plots were sampled in a 4-acre area that burned in 1978.

**Knobcone Pine Forest (83210):** 151 acres (61 ha). The stunted vegetation, the presence of indicator species such as tanoak (*Lithocarpus densiflorus* var. *echinoides*) and *Juniperus communis* var. *jackii*, and the absence of species common to the other vegetation types are all due to the ultramafic nature of the parent material. The even-aged stands of knobcone pine approach pygmy stature

in this forest, with most individuals less than 4-5 inches (10-13 cm) dbh and 25 ft (8 m) tall at 50-65 years. Both Douglas-fir and sugar pine (*Pinus lambertiana*)

are present, and the Douglas-fir is often stunted in appearance. Other species restricted to this vegetation type include *Lotus crassifolius* and *Castilleja applegatei*. *Rhododendron macrophyllum*, *Vaccinium ovatum*, and *Arctostaphylos columbiana* are among the few species able to make the transition in soils from the other forest types. *Xerophyllum tenax*, as usual, is most common on the ultramafics but also occurs on adjacent soils. Additional species typical of the knobcone pine forest are *Gaultheria shallon*, *Chrysolepis chrysophylla*, *Quercus vaccinifolia*, and *Pteridium aquilinum*. No sign of disease or fire is obvious, and no regeneration of knobcone is occurring in this fire-suppressed forest.

**Knobcone-Tanoak Forest (83210):** 256 acres (104 ha). This entire forest dates to a fire in the 1920s and appears to be transitional between the knobcone pine forest and tanoak forest (fig. 42). Here, knobcone pine competes well and attains sizes somewhat larger and taller than in the knobcone pine forest. In some cases the type approaches chaparral in appearance, with only scattered knobcone pine and Douglas-fir. This forest mostly occurs on ridgetops and relatively steep slopes, on poor, rocky soils that are shallow and coarse.

Vegetation composition and structure distinguish this forest from the mixed evergreen forest. Canopies are more open, tree basal area is lower, and understory more diverse. Tanoak is almost invariably scrubby, normally less than 6 inches (15 cm) in diameter. The forest shares several species with the canyon live oak (*Quercus chrysolepis*) forest, including *Arctostaphylos columbianum*, *Mimulus aurantiacus*, *Whipplea modesta*, and others. *Rhododendron macrophyllum* is present in moister areas or sites exhibiting a stronger ultramafic influence. Occasional canyon live oak, madrone (*Arbutus menziesii*), and chinquapin (*Chrysolepis chrysophylla*) occur in this type. Other associated species are *Vaccinium ovatum*, *Gaultheria shallon*, poison oak (*Toxicodendron diversilobum*), *Eriodictyon californicum*, *Lonicera hispidula*, *Rubus vitifolius*, *Pteridium aquilinum*, *Trientalis latifolia*, and *Polystichum munitum* var. *imbricans*.

On a 4-acre patch in the W. portion of the forest, the 1978 fire burned sufficiently hot to stimulate knobcone pine regeneration. The lower portion and peripheral areas on either side of the core area burned only at the ground surface and suffered minimal dieback. Only an occasional knobcone pine seedling is seen in the marginal area compared to dense reproduction in the 4-acre core. Poor regeneration in these lightly burned areas is probably due to retention of much of the overstory and the thick litter layer. Vegetation composition in the core burn area differs significantly from that in the adjacent unburned area. It includes *Happlopappus arborescens*, *Ceanothus thrysiflorus*, *Baccharis pilularis*, and *Arctostaphylos hispidula*. Some level of fire-adaptation is implied in species found here but not encountered elsewhere in the rRNA.

**Mixed Evergreen Forest (81100):** 233 acres (94 ha). The mixed evergreen forest is characterized by a consistently dense overstory canopy of mostly tall tanoak and madrone. Here, the tanoak is much smaller in stature than in the knobcone-tanoak forest. Soils are deeper and moister, with a higher clay content. Douglas-fir is normally present in various size classes and ages (up to 400+ years), some dating to the 1920s fire. Occasional knobcone pines, up to 16 inches (41 cm) or more in diameter, occur close to the river, but most of the forest at lower elevations contains little or no knobcone pine. This forest in general tends to be dark, with a poorly developed understory. The drier-site forest may include *Vaccinium ovatum*, *Rhododendron macrophyllum*, *Gaultheria shallon*, *Toxicodendron diversilobum*, and *Pteridium aquilinum*. More open, moist stands support a diverse understory. The forest in the protected Craig's Creek canyon is quite lush and equivalent to Douglas-fir forest but with little or no Douglas-fir. Added species may include *Alnus rubra*, *Corylus cornuta* var. *californica*, *Polystichum munitum*, *Oxalis oregano*, and most of the species listed below for Douglas-fir forest.

**Canyon Live Oak Forest (81320):** 220 acres (89 ha). This type occurs in the rockiest, driest portion of the area (except actual rock outcrops). Soils are more closely related to the knobcone-tanoak forest than the better soils of the mixed evergreen forest. Canyon live oak forest is commonly associated with the upper headwalls of small watersheds and other sites probably associated with massive soil failure in the past. The largest contiguous area lies just above the S. Fork of the Smith River, near the sharp river bend, where surface exposure of gravel and cobbles is high. Except for the steep slopes (75-100 percent) and frequent poison oak, this forest is easier to walk through than either the knobcone pine forest or knobcone-tanoak forest. The tree layer is characterized by high cover of canyon live oak and dense shrubby tanoak, variable amounts of madrone, and scattered Douglas-fir. This is the only forest in the rRNA in which rhododendron is consistently absent. The moderately dense shrub layer is dominated by *Vaccinium ovatum*, *Arctostaphylos columbiana*, *A. canescens*, and, occasionally, *Quercus vaccinifolia*. *Gaultheria shallon*, *Garrya buxifolia*, *Lonicera hispidula*, and *Mimulus aurantiacus* are also present. The herbaceous layer is sparse and closely related to the rock outcrop community. It includes *Polystichum munitum* var. *imbricans*, *Polypodium californicum*, *Whipplea modesta*, *Trientalis latifolia*, *Eriophyllum lanatum*, *Galium ambiguum* var. *siskiyouense*, *Achillea borealis*, *Pteridium aquilinum*, *Hieracium albiflorum*, and *Maianthemum dilitatum*. Knobcone pine occurs only sporadically, probably due to moisture limitations.

**Douglas-Fir Forest (82400):** 16 acres (6 ha). Although it occupies only about 2 percent of the area, Douglas-fir forest is exceptionally well represented in old-growth stage and contributes significantly to the diversity of the rRNA. Little evidence of fire is present, and the stand appears to represent climax Douglas-fir forest. It is best developed on the low stream terrace and adjacent toeslope near the junction of Craig's Creek and the S. Fork of the Smith River. Douglas-fir ranges to 500+ years old, 6 ft (183 cm) dbh, and more than 200 ft (61 m) tall, although most trees are smaller than 4 ft (122 cm) dbh. Tanoak is the only hardwood generally present, in relatively low cover. Well-decayed logs are scattered throughout. The dense shrub and herb layers cover as much as 98 percent of the log and ground surface. In addition to the most common shrubs of the other forest types, the following occur here: *Corylus cornuta* var. *californica*, *Toxicodendron diversilobum*, *Rubus spectabilis*, *R. parviflorus*, *Aralia californica*, *Berberis nervosa*, *Rhamnus purshiana*, *Rosa gymnocarpa*, and *Acer circinatum*. Common herbs are *Polystichum munitum*, *Oxalis oregana*, *Rubus vitifolius*, *Trillium ovatum*, *Pteridium aquilinum*, *Hierochloe occidentalis*, *Achlys triphylla*, *Maianthemum racemosum*, and *Vancouveria planipetala*.

**Redwood Forest (82320):** 74 acres (30 ha). All of this type occurs adjacent to the S. Fork of the Smith River and along some of the drainages at lower elevation, on moderate slopes and several high benches. Redwoods (*Sequoia sempervirens*) vary in size, but range up to 7 ft (213 cm) dbh or more. Douglas-fir and Port Orford-cedar (*Chamaecyparis lawsoniana*) are subdominants; tanoak, occasional madrone, and, rarely, California bay (*Umbellularia californica*) form a hardwood mid-story. Patches of pure Douglas-fir forest are interspersed within the area. The understory is usually dark, rather sparse, and includes the following species: *Vaccinium ovatum*, *Rhododendron macrophyllum*, *Gaultheria shallon*, *Myrica californica*, *Rubus parviflorus*, *Corylus cornuta* var. *californica*, *Rubus vitifolius*, *Rosa gymnocarpa*, *Polystichum munitum*, *Trientalis latifolia*, *Viola sempervirens*, *Pteridium aquilinum*, and *Festuca subuliflora*. There is abundant evidence of fire in this forest, ranging from char to large fire scars.

**Riparian Zone (Red Alder Forest, 81A00):** No acreage available. Lush riparian corridors follow each of the numerous creeks that flow across the lower slope of the area. Hardwoods grow somewhat larger in these corridors than in adjacent forest. Understories are dark and include a diverse complement of shade-tolerant

species. The greatest diversity occurs along streams and seeps in the E. portion of the area, above Craig's Creek. Plants of the riparian corridor include *Alnus rubra*, *Rhamnus purshiana*, *Lithocarpus densiflorus*, *Acer macrophyllum*, *Umbellularia californica*, *Chamaecyparis lawsoniana*, *Sequoia sempervirens*, *Arbutus menziesii*, *Rhododendron macrophyllum*, *Berberis nervosa*, *Adiantum pedatum*, *Rubus parviflorus*, *Vaccinium ovatum*, *Polystichum munitum*, *Aralia californica*, *Aquilegia formosa*, and a host of herbaceous species. The riparian corridors along the S. Fork of the Smith River and Craig's Creek are well developed and contain unique elements. Dense vegetation is interspersed with rock outcrops with their own unique assemblage of plants. Some of the species generally restricted to or more common in those areas include *Cornus nuttallii*, *Stenanthium occidentale*, *Trifolium longipes*, *Petasites palmatus*, *Mimulus cardinalis*, *Juncus orthophyllus*, *Ligusticum apiifolium*, *Acer circinatum*, *Philadelphus lewisii*, and *Physocarpus capitatus*.

**Rock Outcrops:** No acreage available. Rock outcrops are commonly surrounded by canyon live oak forest, but they are floristically distinct. Exposed rocks are usually fine grained, and some are nearly covered by *Quercus vaccinifolia*. Most support open communities, including species such as *Garrya buxifolia*, *Mimulus aurantiacus*, *Selaginella oregana*, *Luina hypoleuca*, *Calochortus tolmiei*, *Eriodictyon californicum*, *Whipplea modesta*, *Sedum spathulifolium*, *Holodiscus discolor* var. *delnortensis*, *Madia minima*, *Calystegia polymorpha*, *Lonicera hispidula*, *Achillea borealis*, *Arctostaphylos canescens*, *A. columbiana*, and *Pinguicula vulgaris*.

### Plant Diversity

One hundred seventy-three taxa are listed.

### Conflicting Impacts

Recreational use may increase now that the National Recreation Area is established. Presence of the fatal *Phytophthora lateralis* root rot in stands of Port Orford-cedar may continue to affect the structural diversity of the forests in the lower portion of the area, but not where knobcone pine is present. Vegetation management by fire may be important in the near future in many of the vegetation types.

## 21. Crater Creek (Keeler-Wolf 1987b)

### Location

This candidate RNA is on the Klamath National Forest, Siskiyou County. It is about 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. 43). Ecological subsection – Upper Scott Mountains (M261Aj).

### 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., Sugar Creek candidate RNA and Whippoorwill Flat RNA). These may be the most productive subalpine forests in the State. Trees are typically not only dense but also relatively tall and well-formed. In addition, these subalpine forests may be the most diverse in the State, with seven regularly occurring tree

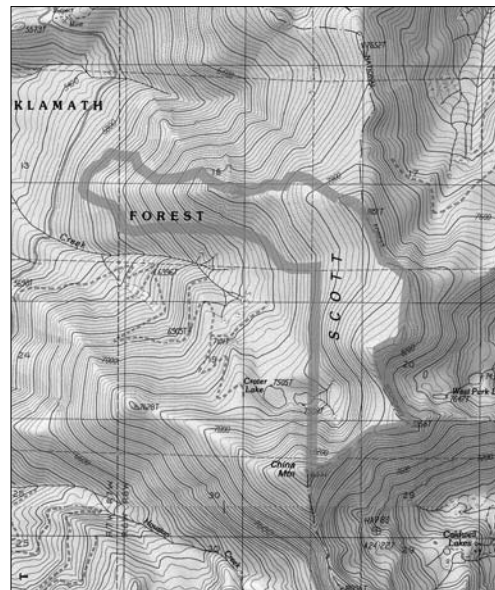


Figure 43—Crater Creek cRNA

species. These forests contain mixtures of all the important subalpine trees of E. Klamath Mountains. The codominance of foxtail pine (*Pinus balfouriana*), whitebark pine (*P. albicaulis*), and mountain hemlock (*Tsuga mertensiana*) in certain stands is unique.

**Curl-Leaf Mountain Mahogany Vegetation:** This area displays an excellent array of curl-leaf mountain mahogany (further known as, simply, mountain mahogany) vegetation types with respect to variations in slope exposure, steepness, parent material, and elevation. Although mountain mahogany associations are widespread in the W. 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 survey (late May), several other rare species known from the vicinity may have been overlooked.

### Physical Characteristics

The study area covers about 550 acres (223 ha). Elevations within the area surveyed 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 W. side of a portion of the main crest itself, stretching for about 1.5 miles (2.4 km) N. 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 W. portion of the area underlain by serpentized 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 40-60 inches (1016-1525 mm) annually, with estimated mean January minima of -10 °F (-23 °C) at the upper elevations and mean July maxima about 90 °F (32 °C) at the lowest elevations.

### Association Types

Ten 100-m<sup>2</sup> plots each were sampled in the mountain mahogany and 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 identifiable.

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 numbers of mountain mahogany, red fir, and lodgepole, western white, and whitebark pines. 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

**Figure 44—Crater Creek,** dense mixed subalpine forest with foxtail pine, whitebark pine and mountain hemlock. (1986)



pinus are not particularly old. Five trees 27-35 inches (69-89 cm) dbh were between 370 and 435 years old. 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 on mostly W.-facing exposures above the previous subtype. It is denser than subtype 1, 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. 44).

Subtype 3. The mountain hemlock subalpine forest (117 acres, 47 ha) occurs at higher elevations and on more NW.-facing slopes than the previous subtypes. 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 semikrummholz 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<sup>2</sup>/ha, density 660/ha, frequency 90 percent), followed by foxtail pine (basal area cover 32 m<sup>2</sup>/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 about 80 m<sup>2</sup>/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 woodland on deeper gabbroic soil with scattered trees of several species of conifers at high elevations.

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. Average shrub density on two 100-m<sup>2</sup> plots is 900/ha, and average shrub cover is 27 percent. Density of mountain mahogany saplings and seedlings averages 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 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 four 100-m<sup>2</sup> plots, the stem cover for mountain mahogany averages 9 m<sup>2</sup>/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 they 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<sup>2</sup> 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/ha). Some mountain mahogonies 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, although it does not appear to have affected any of the major vegetation types within the proposed boundaries.

## **22. Cub Creek (Lassen National Forest 1981, Taylor and Randall 1978)**

### **Location**

This established RNA is on the Lassen National Forest. It lies about 12 miles (19 km) S. 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, R5E MDBM (40°10'N., 121°9'W.), USGS Butte Meadows and Jonesville 15' quads (*fig. 45*). Ecological subsections – Lassen-Almanor (M261Dm) and Shingletown-Paradise (M261D1).

### **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 (*fig. 46*). 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.

### Physical Characteristics

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 W. slope of the S. Cascades. Elevations range from 3725 to 6703 ft (1136-2044 m). Gross topography is moderately steep (25-40°). However, because of many small cliffs less than 66 ft (20 m) high, the microtopography is more rugged than indicated on topographic maps. The stream runs in a NW. 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 annual precipitation at Mineral averaging 51.5 inches (1309 mm). 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 were sampled in the mixed conifer forest and four in the red fir zone.

***Arctostaphylos patula-Quercus vaccinifolia* (37510):** 974 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-Libocedrus decurrens*) (84230):** 901 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<sup>2</sup>/ha, and density ranges from 808 to 1050 trees/ha. Shrubs are not indicated on the samples. 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):** 481 acres (191 ha). This association occupies rocky or shallow soil sites at the highest elevations within

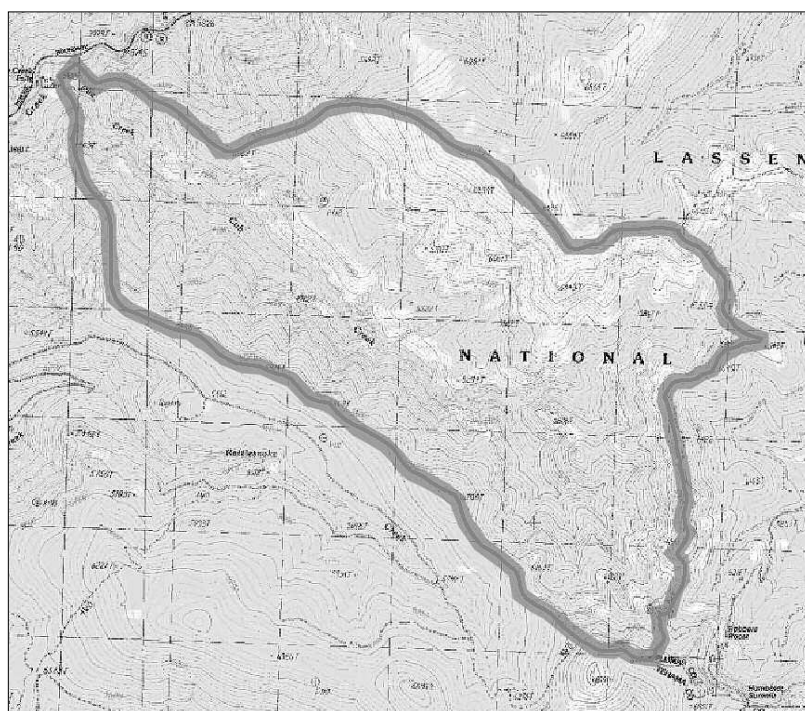


Figure 45—Cub Creek RNA

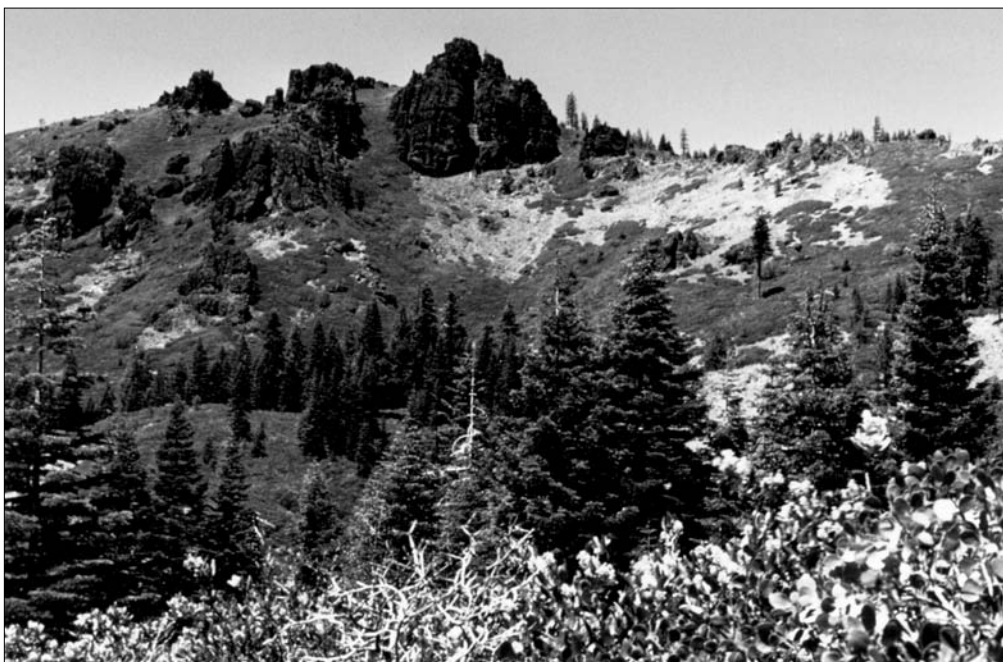
the Cub Creek basin. These sites are dry and well-drained with little snow cover in winter because of wind exposure. The vegetation is composed of cold-desert type species. Other species beside the two definitives include *Penstemon laetus*, *Phacelia frigida* ssp. *dasyphylla*, *Calyptridium umbellatum*, *Eriophyllum lanatum* ssp. *integrifolium*, *Artemisia arbuscula*, *Leptodactylon pungens* ssp. *hookeri*, *Calochortus leichtlinii*, *Sanicula tuberosa*, *Phlox diffusa*, *Pteryxia terebinthina* var. *californica*, *Allium plauticaule*, *Galium hypotrachium*, *Eriogonum microthecum*, *Penstemon deustus*, *Collomia tinctoria*, and *Eriogonum ursinum*.

**Red Fir (*Abies magnifica*)-White Fir-Western White Pine (*Pinus monticola*) (84240, 85310):** 1366 acres (552 ha). The four plots yield basal area cover of 56-123 m<sup>2</sup>/ha, with white fir, red fir, and western white pine dominating the canopy. Densities range from 301 to 1902 trees/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 viscosum* ssp. *hallii*, *Chrysoopsis breweri*, *Acer glabrum*, *Pyrola picta*, and *Chimaphila menziesii*.

**Douglas-Fir-Pacific Dogwood (*Cornus nuttallii*) (84110):** 160 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 bigleaf 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):** 40 acres (16 ha). Meadows are few in number and small. 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*.

**Figure 46—Cub Creek, view of the southwest-facing slopes at the head of Cub Creek.** Montane chaparral alternates with patches of *Abies concolor-Abies magnifica* reproduction. *Arctostaphylos patula* and *Ceanothus integerrimus* dominate the chaparral. Cliffs are formed from resistant volcanic rocks. Barren areas within the chaparral are vegetated by the *Sitanion hystrix-Chrysothamnus nauseosus* association. (1976)



### Plant Diversity

Two hundred thirty-one plant taxa are listed.

### Conflicting Impacts

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

## 23. Devil's Basin (Martin 1995, Newton 1987)

### Location

This established RNA is on the Mendocino National Forest and is located about 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. 47). Ecological subsection – Eastern Franciscan (M261Ba).

### 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*) provides 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.

### Physical Characteristics

The area covers 671 acres (272 ha). Elevations range from 1400 to 3660 ft (427-1116 m). Topography is rugged, with steep N.- to NE.-facing slopes predominating (fig. 48). The area 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 rock-land and colluvial soils. Climate is mild, with estimated mean annual precipitation of 30+ inches (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 relevés are not given.

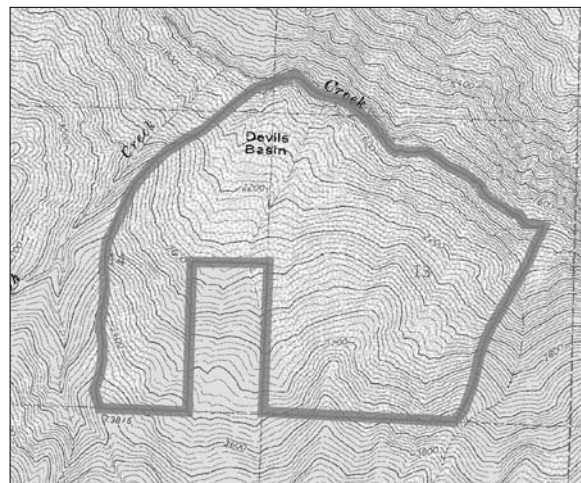


Figure 47—Devil's Basin RNA

**California Black Oak/*Festuca californica* (71120):** The California black oak-dominated forest at the site is composed of both persistent subclimax stands and 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<sup>2</sup>/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 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 to 82.6 m<sup>2</sup>/ha, and trees range from 70 to 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). It 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) and dominated by Douglas-fir, with smaller amounts of ponderosa and knobcone pine (*Pinus attenuata*). The subcanopy averages 70 percent cover; it is 50-70 ft (15-21 m) tall and dominated by California black oak. Reproduction of both major trees is low. Basal area averages 50.5 m<sup>2</sup>/ha, with trees averaging 150-200 years old. 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):** This blue oak savanna has an open canopy (5 percent cover) dominated by blue oak about 50 ft (15 m) tall and 100 years old, with some Oregon white oak (*Quercus garryana*) interspersed. Basal cover averages about 9.2 m<sup>2</sup>/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 caryophylla*, *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); it 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)

**Figure 48—Devil's Basin,** view east down Thomes Creek gorge, canyon live oak forest in middleground, mixed California black oak and buckeye brush in foreground. (1986)



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 (37110):** This brushy woodland type has a very low canopy cover (<5 percent). Canopy species include sparse foothill pine (*Pinus sabiniana*) up to 50 ft (15 m) tall 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.

## 24. Devil's Garden (Keeler-Wolf 1984a)

### 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. 49). Ecological subsection – Devil's Garden (M261Gb).

### 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 in NE. California. The RNA is positioned within the most extensive single stand of western juniper anywhere, and it is within its zone of optimal development (fig. 50).

**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 Babbitt Peak, Cahuilla Mountain, Indiana Summit, McAfee, Mud Lake, Sentinel Meadow, Whippoorwill Flat, and White Mountain), but it 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

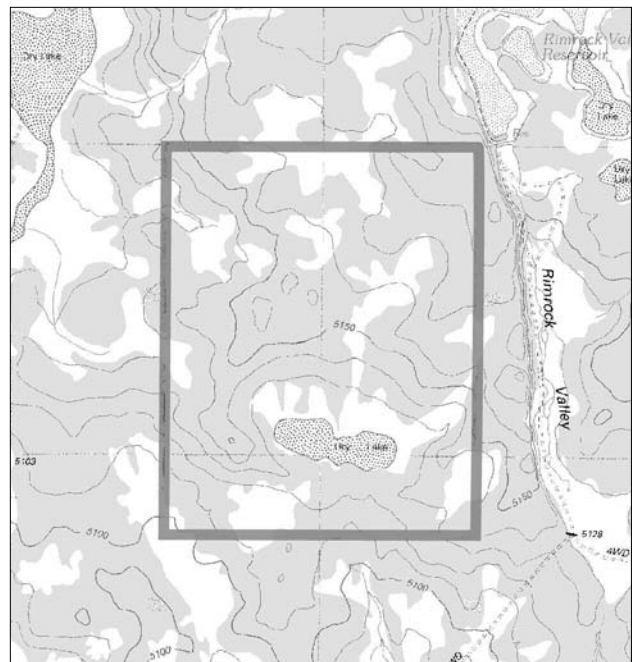


Figure 49—Devil's Garden RNA

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.

**Succession on the 1959 Burn:** Little is known about succession in western juniper woodland. Twenty-four years after a fire in the SE. 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 burn 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 NE. California examples are among the lowest elevation of any known in the state. The cold, dry, continental climate of the area and the predominantly heavy clay soil, subject to much expansion and contraction during freezing and thawing, may be responsible for their presence.

**Rare Flora:** *Erigeron elegantulus* (List 4), *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, vernaly flooded depression located in the S.-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 and 20 inches (380-500 mm). It is mostly snow, which is often blown clear over large areas. Temperatures range from January minima of about 14 °F (-10 °C) to July maxima of about 86 °F (30 °C).

### Association Types

Two 0.1-ha plots were 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); this phase 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



**Figure 50—Devil's Garden,** open western juniper woodland looking west from northeast corner of Devil's Garden RNA. (1983)

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 about 80 acres (32 ha) that burned in 1959. Although this association type is 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 here than on typical undisturbed open woodland (about 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):** 208 acres (84 ha). This association generally occurs on less rocky and more poorly drained sites than the juniper woodland. It may also be divided into three phases: rocky scabland, upland, and closed basin.

The rocky scabland type covers 5 acres (2 ha) and 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 160 acres (65 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 flooded briefly 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 vernal 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* (43 acres, 17 ha). Grasses are substantially less important than in other *A. arbuscula* types. Diversity is low with *Lomatium leptocarpum*, *Polygonum 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**

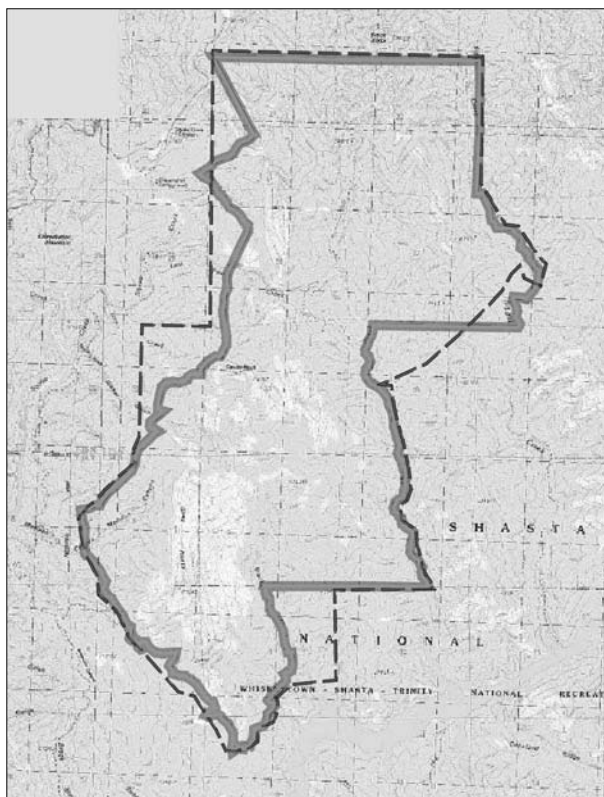
One hundred and four taxa are listed.

### **Conflicting Impacts**

Cattle grazing has some impact, particularly on the NE. corner and E.-central part of the RNA. The size of the RNA has been reduced 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.

**Note: for Devil's Rock, see Devil's Rock-Hosselkus, #25**

## 25. Devil's Rock-Hosselkus (Devil's Rock, Hosselkus Limestone) (Keeler-Wolf and Keeler-Wolf 1975, Keeler-Wolf 1989h, Cheng 1997b)



**Figure 51—Devil's Rock-Hosselkus RNA**

Dashed line = Ecological study area;  
Solid gray line = RNA Boundary

### Location

This established RNA 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. 51). Ecological subsection – Eastern Klamath Mountains (M261Ai).

### Target Elements

Limestone Ecosystem (unique element), California Black Oak (*Quercus kelloggii*), and 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. 52). 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 (Shasta sideband snail [*Monodenia troglodytes*], a category 2

candidate for listing by the U.S. Fish and Wildlife Service, which means existing information indicates taxa may warrant listing, but substantial biological information necessary to support a proposed rule is lacking), a localized endemic salamander (Shasta salamander [*Hydromantes shastae*], a State-listed threatened species), a rich assemblage of Triassic invertebrate fossils (including ammonites, brachiopods, corals, in all more than 200 species of invertebrates), the best representation of N. American Triassic marine reptiles (including five species and three genera of ichthyosaurs and the only known remains of the order Thalatosauria in the W. 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 Mountains ecological section. The 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 can be found on the other RNAs currently designated for this target element in California (fig. 53). The variety of successional states, including Douglas-fir (*Pseudotsuga menziesii*) invasion on mesic exposures and ponderosa pine (*Pinus ponderosa*) and foothill 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 Mountains and Great Valley ecological sections, 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 N. 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. Species such as black salamander (*Aniades flavipunctatus*), tailed frog (*Ascaphus truei*), and Pacific giant salamander (*Dicamptodon ensatus*) are near their most inland locations in California.

**Archeological Values:** This RNA is adjacent to a significant multilevel cultural deposit dating back at least 6500 years. Although no excavations or thorough searches for artifacts have been conducted in the RNA, sites occupied by American Indians have been discovered in caves in the S. of the area.

**Rare Plants:** The endemic *Eupatorium shastensis* is considered a member of List 4 by CNPS. Shasta snowwreath (*Neviusia cliftonii*), CNPS List 1B, is a species discovered in 1992. This species is thought to be relict from the Arcto-tertiary period; its closest relative occurs in SE. United States.

**Rare Animals:** The Shasta salamander (*Hyromantes shastae*) is listed by California State as threatened, and it is considered sensitive species by the Shasta-Trinity National Forests. The land snail (*Monodenia troglodytes*) is a candidate for State listing.

### Physical Characteristics

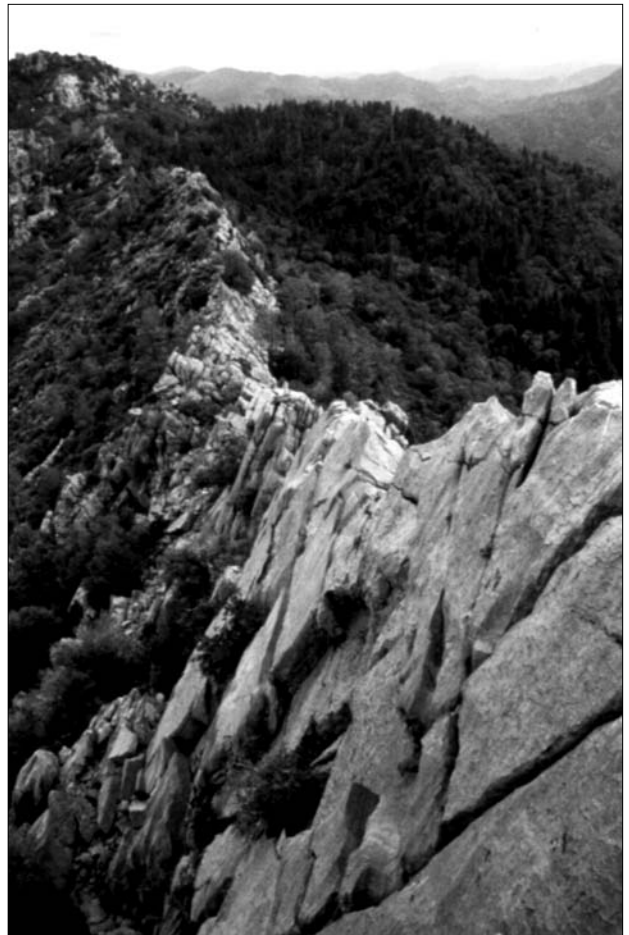
The survey area covers 6439 acres (2608 ha) with elevations from 1100 to 3272 ft (335 to 997 m). The established RNA is 5550 acres (2246 ha). This area occupies the upper Brock Mountain peninsula between the Squaw Creek and Pit River arms of Lake Shasta. It is bisected by a prominent N.-S. trending ridge of rugged, resistant gray limestone, which stretches for about 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 E. of the limestone is gentler topography, dominated by the valleys of S.-flowing Flat and Ripgut creeks. Slopes of all aspects are well represented.

Rocks include the previously discussed Hosselkus Limestone, 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 was 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.



**Figure 52—Devil's Rock-Hosselkus Limestone, sharp-edged outcrop of Hosselkus limestone at Gray Rocks, looking north. (1988)**



**Figure 53—Devil's Rock-Hosselkus Limestone, open ridgetop stand of California black oak in Devil's Rock – Hosselkus RNA. (1988)**

Typical-ly, 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 age is 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*, and *Aristolochia californica*, among others. There may be saplings of

ponderosa pine and Douglas-fir. Some of the larger black oaks 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 high elevations on E. side of RNA. This is a spindly woodland with black oak 15-51 cm dbh and an understory of *Styrax officinalis* var. *californica*, *Melica californica*, *Carex multicaulis*, *Toxicodendron diversilobum*, and reproduction by Douglas-fir and foothill 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 bigleaf 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 co-dominant 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 dbh of more than 3 ft (1 m) and heights above 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 foothill pine. The most mesic N.-facing cliffs have a scattering of canyon live oak and such characteristic species as *Eupatorium shastensis*. The primary factor determining the distribution of limestone scrub is the substrate, whether on limestone or shale, this vegetation type occurs generally on the poorest rocky slopes and outcrops.

**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 bears a resemblance to the coastal mesic Douglas-fir-mixed evergreen forests, and the other is more similar to xeric ponderosa pine-Douglas-fir type (Society of American Foresters [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 5-6 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, bigleaf 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 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 sugar pines (*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 Riggut creeks. Dominant trees and shrubs include white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), bigleaf 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 shade and water availability. Typical species include *Woodwardia fimbriata*, *Aralia californica*, *Peltiphyllum peltatum*, *Mimulus guttatus*, and *Luzula divaricata*.

### Plant Diversity

A total of two hundred fifty-seven 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, this RNA 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. A jeep road enters Low Pass Canyon, traversing the limestone in a sensitive area (containing caves, associated flora and fauna, and fossil deposits).

## 26. Doll Basin (Keeler-Wolf 1986b, 1990g)

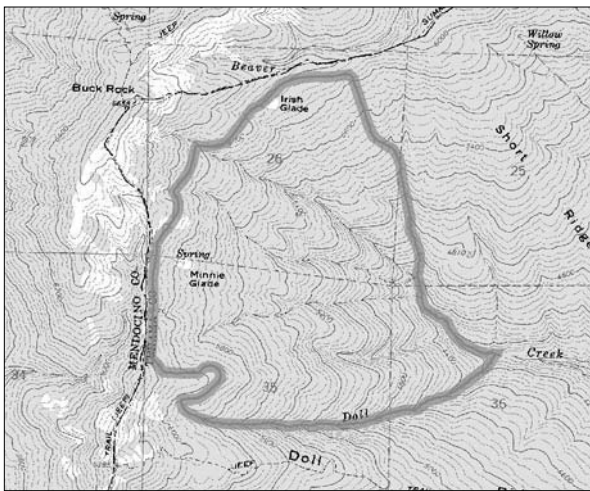


Figure 54—Doll Basin RNA

### Location

This established RNA is on the Mendocino National Forest. It is about 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. 54). Ecological subsection – Eastern Franciscan (M261Ba).

### Target Elements

Mixed Conifer Forest

### Distinctive Features

**Mixed Conifer Forest:** Doll Basin was selected for its excellent representation of Sierran mixed conifer forest. This forest is extensive and economically important in California. This and Ruth RNA are the only two RNAs in the N. Coast Ranges (Northern California Coast Ranges ecological

section) having this vegetation. The Doll Basin mixed conifer forest is similar to many areas of this vegetation type throughout N. California; it exhibits the standard distribution of dominants and subdominants over such an elevational gradient as the Doll Basin RNA. 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*), both listed as California species of special concern, have been sighted within the area, as has the Federally-listed endangered peregrine falcon (*Falco peregrinus*). Many other large vertebrates such as black bear (*Ursus americanus*), blue grouse (*Dendragapus obscurus*), black-tailed deer (*Odocoileus hemionus columbianus*), and pileated woodpecker (*Dryocopus piliatus*) have been seen in the area. These vertebrates include 8 of the 12 species listed in the Mendocino National Forest's management plan (Mendocino National Forest 1987) as management indicator species.

**Archeological Value:** Two of the meadows in the white fir zone, Minnie and Irish glades, are significant archeological sites. These sites are important, particularly as windows on past climate. Because of continuous use of these and

nearby sites for more than 8,000 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 about 3.5 ft (1 m) have been unearthed by stream erosion.

**Transition Forests:** With an elevational span of more than 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 transition is important in the understanding of the mixed conifer type in relation to adjacent forest types; it 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 895 acres (403 ha) on the E. side of the inner N. Coast Ranges crest. Elevations range from 4100 to 6200 ft (1250-1890 m). Topography is relatively rugged. The area is dissected by six small drainageways that converge into Doll Creek on the E. 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 E. portion of the area and 65 inches (1651 mm) near the summit area along the W. 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<sup>2</sup> plots were sampled in the area.

**The Sierran Mixed Coniferous Forest (84230):** 485 acres (196 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 [*Libocedrus decurrens*]) may dominate individual stands. Of the eleven 100-m<sup>2</sup> 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 is 160 m<sup>2</sup>/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 stems (40 percent).

Fire history of Doll Basin mixed conifer forest has changed dramatically in the past 100 years. Analyses of cut stems adjacent to the RNA indicate fire frequencies before 1900 of 9-53 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.

**Figure 55—Doll Basin,** north-facing white fir forest at ca. 6100 ft (1859 m) with significant admixture of several age classes of red fir. (1985)



Densities of saplings are highest on the SE. slopes where occasional overly 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 S. 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):** 320 acres (130 ha). At elevations over about 5800 ft (1768 m) on E.-facing slopes and about 5600 ft (1707 m) on N.-facing slopes tree diversity decreases. Ponderosa pine, California black oak, and Douglas-fir become uniformly scarce and incense-cedar becomes more localized along drainage channels. On eight 100-m<sup>2</sup> plots white fir is the uniform dominant of the tree (relative cover 72 percent, basal area cover 92 m<sup>2</sup>/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 young and small (80-100 yr, 45-65 ft [14-20 m] tall). This is a result of a major crown fire about 100 years ago. Shasta red fir (*Abies magnifica* var. *shastensis*) occurs on sheltered N.-facing slopes at the higher elevations (approaching Holland 85310) (fig. 55). 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 is 128 m<sup>2</sup>/ha. Understory vegetation is very sparse because of shade and duff accumulation.

**Douglas-Fir Canyon Bottom Forest (84110):** 155 acres (63 ha). This forest occurs in the lower reaches of the RNA on relatively mesic, N.-facing slopes. It is dominated by Douglas-fir (70 percent relative cover, basal area cover of 167 m<sup>2</sup>/ha, and importance value of 122 on ten 100-m<sup>2</sup> plots). White fir, sugar pine, ponderosa pine, Pacific dogwood (*Cornus nuttallii*), canyon live oak (*Quercus chrysolepis*), incense-cedar, and bigleaf maple (*Acer macrophyllum*) also occur in this type. Total basal area cover for trees is very high (241 m<sup>2</sup>/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 4 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):** 12 acres (5 ha). This association is scattered along the main branches of Doll Creek below about 4600 ft (1402 m). It is a simple community dominated by white alder (*Alnus rhombifolia*), with very few other indicator species, except occasional individuals of *Salix scouleriana* and *Epilobium adenocaulon* var. *holosericeum*. This type is best developed along the branch of Doll Creek forming the E. boundary. The stream has a relatively sunny S. exposure and is characterized in summer by intermittently flowing water and pools interspersed with large outcrops, log jams, and dry cobble beds. The S. branch of Doll Creek is a shadier stream in a narrow gulch, with low cover of alder and higher cover of such species as bigleaf maple and *Aralia californica*.

**Meadow-Riparian (45100, 45400, 63500):** 14 acres (6 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 for 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):** 9 acres (4 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 S.-facing phase of the Sierran mixed conifer 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. Some areas contain 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.

**Openings (no Holland equivalent):** 5 acres (2 ha). Small open areas between stands of white fir occur on relatively steep E.- and SE.-facing exposures throughout the upper elevations of the survey area. On Yolla Bolly rocky loam, these areas 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 may be considered shin oak brush (Holland 37541). Successionally, these openings are enigmatic; some appear very stable while others are being slowly colonized by white fir.

### **Plant Diversity**

One hundred ninety taxa are listed.

### **Conflicting Impacts**

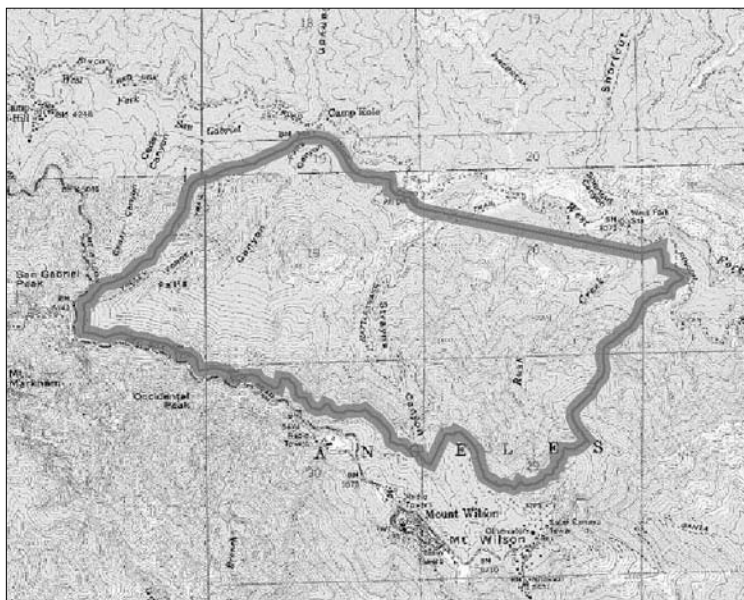
Cattle grazing has had heavy impact on some of the meadows, particularly Irish Glade. Portions of Irish Glade are eroding at unnaturally fast rates. The patches of dense conifer reproduction in the mixed conifer and Douglas-fir-dominated forests may require prescription burns. There may be some increased gullying within the area as a result of the construction (around 1975) of road 24N02 up-slope from the W. boundary.

**Note: for Eagle Crag, see Agua Tibia, #2**

## 27. Falls Canyon (Phillips 1998b, Sproul 1981)

### Location

This 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°04'N., 118°06'W.), USGS Mt. Wilson quad (*fig. 56*). Ecological subsection – San Gabriel Mountains (M262Bd).



**Figure 56—Falls Canyon RNA**

### Target Elements

Bigcone Douglas-Fir (*Pseudotsuga macrocarpa*) and 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 modern fires. Although the species is known to resprout and to have thick, fire-resistant bark, it cannot survive extremely hot fires. 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.

**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). Canyon live oak occurs in typical fashion for the region in Falls Canyon, dominating on several slope exposures and codominating 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 RNA covers 1165 acres (472 ha). Falls Canyon is a tributary of the West Fork of the San Gabriel River. Strayns Canyon and Rush Creek are also tributaries of the West 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 Mount Wilson-San Gabriel Peak Ridge, significant areas of W. and E. exposures also occur. Elevations range from 3200 to 5440 ft (975-1658 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 average annual precipitation of 30+ inches (762+ mm).

### Association Types

Accurate estimates of acreages for each association type were not given. Point-centered quarter samples were taken in three stands of BDF.

**Southern California Mixed Evergreen Forest (61510, 84150, 61330, 81320):** 885 acres (359 ha). A mixed forest of canyon live oak (*Quercus chrysolepis*) and BDF covers 80–87 percent of the three boundary proposals discussed. This type is described following Thorne (1976). However, the BDF stands are treated separately in the vegetation analysis. All 21 major species listed by Thorne for the southern California 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 (*Libocedrus decurrens*) and sugar pine (*Pinus lambertiana*).



**Figure 57—Falls Canyon,** southern California mixed evergreen forest dominated by big-cone Douglas-fir in Strayns Canyon.

The southern California mixed evergreen forest grades into a riparian community along the major streams of the area. Here, such hydrophilic species as bigleaf 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*), coast live oak (*Quercus agrifolia*), and the other previously mentioned species.

In the Mount Disappointment and Valley Forge campgrounds area (20 sample points), BDF averages 16 m<sup>2</sup>/ha (all species 21 m<sup>2</sup>/ha) basal area, 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 oaks are multi-stemmed, reflecting 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. 57). At these sites, BDF represents 48 percent of all trees. Mean BDF density is 131/ha (total trees: 272/ha), while mean basal area cover is 34.4 m<sup>2</sup>/ha (total average: 31.0 m<sup>2</sup>/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 were taken from BDF. In general, there is great variation in growth rates, with some approximately 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 old and 40 inches (102 cm) dbh. The largest of any measured trees 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 in the dense phases. Whether this indicates an expansion of young trees in the former phase is unclear 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, openings, stabilized road cuts, and slides. This diversity of regeneration sites suggests perpetuity of BDF.

Regeneration following two major fires around 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 trunks and larger branches, or they were passed over completely by the fires.

**Transitional or High-Altitude Southern California Mixed Evergreen Forest (84230):** 100 acres (40 ha). Above about 5500 ft (1676 m), near the summit of Mount 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 codominant with canyon live oak.

**Mountain Talus (no Holland equivalent):** 105 acres (42 ha). This type has also been described as "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 (37510):** 175 acres (71 ha). The chaparral at Falls Canyon is described as mixed chaparral; however, there are small monospecific stands of *Arctostaphylos glauca*, *Cercocarpus betuloides*, *Quercus wislizenii* var. *frutescens*, 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 N. and S. peripheries. However, the uniqueness of the BDF stands is not easily duplicated, and it 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.