ECOLOGICAL RECONNAISSANCE OF RELICT CONIFERS IN THE KLAMATH REGION[1]

by

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February 20, 1969

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THE SIGNIFICANCE OF THE KLAMATH REGION

An ecological and phytogeographic understanding of the vegetation and flora of the Klamath Region is critical to the understanding of the vegetation and flora of the western United States because of its central nature to the other western forest regions. There are two striking characters of the Klamath Region; the highly complex vegetation patterns, and an exceedingly rich flora for its latitude.

There are several reasons for the vegetational complexity and floristic diversity. These are well presented in two papers by Whittaker (1960, 1961). The following briefly summarizes his points. The region is centrally located and hence an area of meeting and mixing of the northwestern and California species. The region is also characterized by many endemics and relict populations of widespread species of other western forest regions. The diversity is also due to the long vegetational history of the area including the shrinkage of the Arcto-Tertiary Forests and the expansion and differentiation of the Madro-Tertiary communities into the area. Further diversity is the result of climatic and parent material diversity due to the complex nature of the regions physiography and geology.

Whittaker summarizes (1961, p. 17):

> "The central relation of the Klamath Region is regarded primarily not as one of a center of origin for forests of other parts of the West, but as a center toward which mesophytic forests of the past have shrunk, and as a center of accumulation of species of varied evolutionary history in the diverse habitats of ancient land surfaces."

PROPOSED RESEARCH

The application for COOP-AID proposed the following objectives for the 1968 field season. The primary objectives were to determine the environmental conditions under which Brewer spruce, silver fir, Engelmann spruce and foxtail pine grow and to determine the population status of each species in the Klamath

*Financial support: COOP-AID, U. S. Forest Service, Pacific Southwest Forest and Range Experiment Station

Region. Obvious environmental factors were to be determined such as: elevation, slope, aspect, topographic position, soil and parent material. The population status of each species was to be determined by analysis of population size, age structure and vitality. The 1968 field season was considered to be exploratory.

These original objectives have been met, but in the process data on two other relict species, subalpine fir and Alaska yellow cedar, have been gathered. Also information about the vegetation patterns in the Klamath Region was collected. This report discusses the vegetation patterns of the Klamath Region as a framework into which the individual relict conifers are placed.

Our interest has centered on the problems presented by the presence of local populations of relict conifers in the Klamath Region. The primary objective of research during the summer of 1968 was to locate and study the ecology of the following species:

Abies amabilis (Dougl.) Forbes	Pacific Silver Fir
Abies lasiocarpa (Hook.) Nutt.	Subalpine Fir
Chamaecyparis nootkatenses (D. Don.) Spach.	Alaska Yellow-Cedar
Picea breweriana Wats.	Brewer Spruce
Picea engelmannii Parry ex Engel.	Engelmann Spruce
Pinus balfouriana Grev. & Balf. ex A. Murr.	Foxtail Pine

Very little is known about the distribution of these species and less is known about their ecology in the Klamath Region. With an understanding of the ecology of these relicts vegetational and floristic interpretations will become easier and more reliable.

PROCEDURE

PERSONNEL

Principal Investigators: John O. Sawyer, Jr.
Assistant Professor of Botany

Dale A. Thornburgh
Assistant Professor of Forestry

Student Assistants: Timothy E. Paysen, Forestry Senior
C. Hal Doran, Forestry Senior
Bill Bowman, Biology Graduate
Carl Young, Wildlife Senior

Study Areas: Salmon Mountain - Paysen and Doran
Salmon-Scott Divide - Bowman
Upper Bridge Creek - Young

FIELD SEASON

The principal investigators were engaged in reconnaissance and gathering data for the study through the summer and fall of 1968. An average of four days a week was spent in the field during one-half of June, all of July and one-half of September. After the start of classes at Humboldt State College, occasional field trips were made until the onset of snow in the study area.

Mr. William Bowman spent about two weeks during the summer of 1968 reconnoitering and gathering stand data in the Salmon-Scott Divide Area.

Mr. Paysen and Mr. Doran gathered information of the Salmon Mountain Area on two separate four-day excursions into the area during September, 1968.

Mr. Young gathered information on the Brewer spruce stands in the Upper Bridge Creek Area while working for the U.S.F.S.

METHODS

At the start of the study the following locations of the four study species were known:

SPECIES	LOCATION	SOURCE
Silver fir	English Peak	P. G. Haddock For. Sci. 1961
	Ukonom Lake	P. G. Haddock For. Sci. 1961
	Joe Creek	p.c. Jim Griffin
Engelmann spruce	Blake's Fork	p.c. Jim Griffin
	Sugar Creek	p.c. Jim Griffin
Foxtail pine	Throughout the Eastern Klamath Region	Ron Mastroguiosepi
Brewer spruce	Throughout the Klamath Region	Dick Waring

Methods of gathering data varied depending upon time available at each area. In many areas it was decided that only general information on forest composition and site conditions could be obtained. We have termed this "general reconnaissance." For these study areas tree, shrub and known herb composition was recorded using scales of relative cover/abundance. Environmental conditions were described. In other areas deemed to be important enough to take the time

for more complete inventory sampling plots recording tree density, size and height, and a more complete inventory of understory plants were employed. These areas included stands of those species of principle interest. The following account of procedures used in the Blake's Fork drainage will illustrate the methods used. From such procedures the Stand Structure Tables presented below were derived.

Engelmann spruce in the Blake's Fork Area was selected as the first species to study. The first step was to stop at the local U.S.F.S. district ranger station and inquire about route approaches and locally known locations of the species. The district ranger, Bob Devlin, and the siviculturist, Don Osterhouse, at the Sawyers Bar Ranger Station were very interested and furnished us with valuable maps and several new locations of Brewer spruce and Engelmann spruce. After hiking into the area, one full day was spent in general reconnaissance. The next day was spent in taking detailed sample plots of several stands in the drainage. At each sample plot all the trees were tallied by diameter at breast height and species in a strip 10 meters wide and 100 meters long. The seedlings less than breast high were tallied in a strip down the middle of the larger strip. The cover/abundance class of each of the understory species in the vicinity of the sample was estimated and recorded. A specimen of each species recorded in the drainage was collected and brought back for vouchers. These collections have been placed in the Humboldt State College Herbarium. Obvious environmental factors were recorded at each plot; elevation, aspect, slope, parent material, soil and humus depth. Representative trees were measured for height and age at each plot. All study areas are shown in Fig. 1.

A small plane was hired so that we could take oblique colored photographs of selected study areas to assay the feasibility of such procedures in determining species composition of the stands. Due to weather and flying conditions the photographs did not show the desired detail needed to differentiate species of conifers in the very mixed stands of interest to us.

RESULTS AND DISCUSSION

VEGETATION PATTERNS

The results of the field work follow a somewhat different outline than

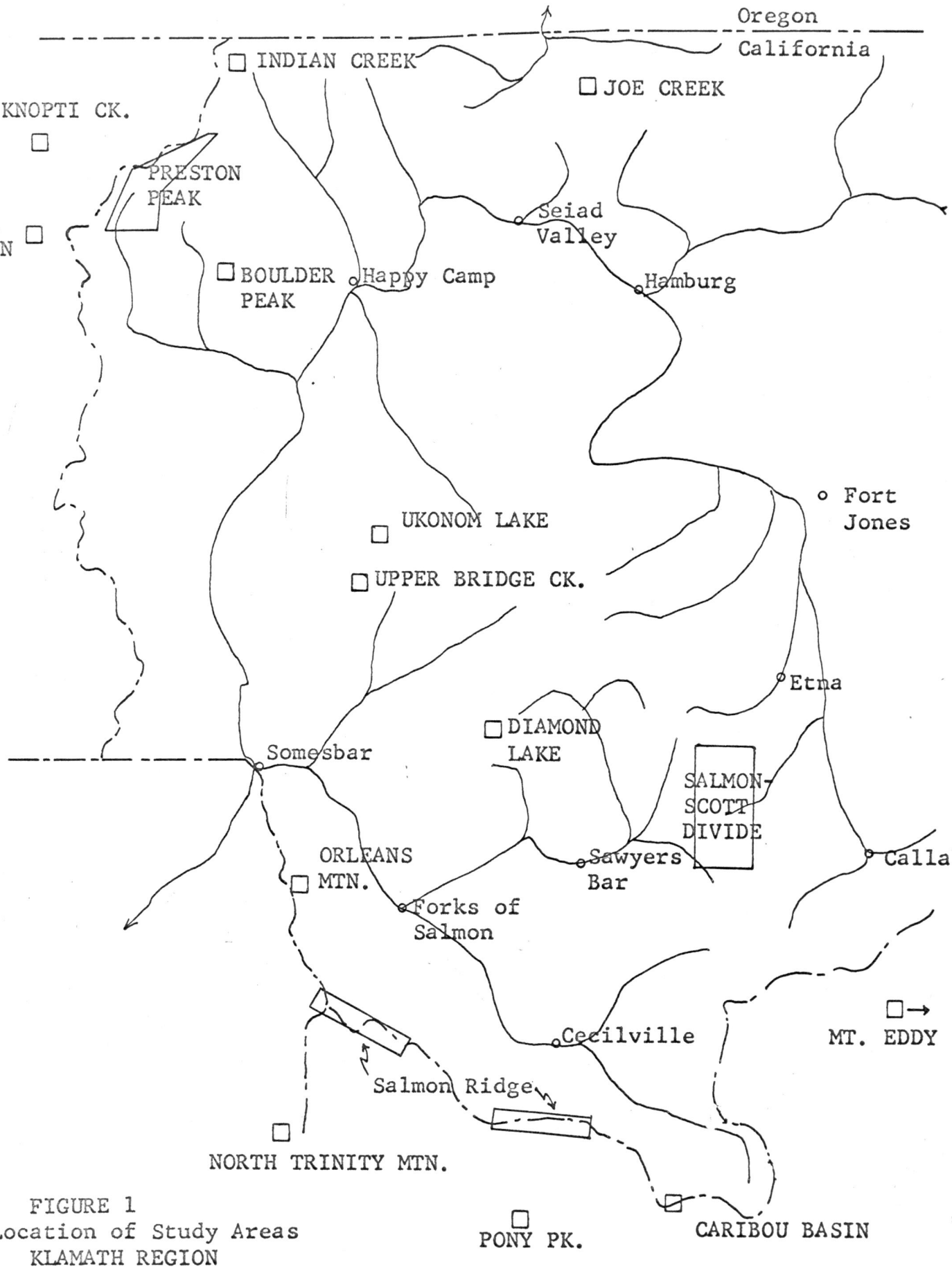

FIGURE 1
Location of Study Areas
KLAMATH REGION

□ = study area

made in the original proposal. The original concept was to study the ecology of the relic conifers listed above, but in the process we feel that insight has been gained about general vegetation patterns in the Klamath Region so we include such a discussion.

The lower elevations were not studied. In California, as well as in Oregon, these elevations are characterized by a mosaic of types collective named Mixed Evergreen Forests by Whittaker (1960) or California Mixed Evergreen by Munz (1959) and Kuchler (1964). At the lower elevations Douglas fir (Pseudotsuga menziesii) is mixed with the following evergreen, sclerophyllous trees; Lithocarpus densiflora, Quercus chrysolepis, Arbutus menziesii and Castanopsis chrysophylla. With increasing elevation Douglas fir becomes more important. Further elevational increase results in a gradual transition into the Mixed Conifer type, here rather dominated by Douglas fir.

The Mixed Conifer, typical of the mid-elevation Sierra Nevada, has five component trees, white fir (Abies concolor), incense cedar (Libocedrus decurrens), sugar pine (Pinus lambertiana), ponderosa pine (Pinus ponderosa) and Douglas fir. If we continue to apply Sierran zonation patterns to this region, the Red Fir and Subalpine forests form the two zones above the Mixed Conifer. The Red Fir forest is characterized by shasta fir (Abies magnifica var. shastensis) in this region. Whitebark pine (Pinus albicaulis), lodgepole pine (Pinus contorta var. murrayana) and mountain hemlock (Tsuga mertensiana) characterize the Subalpine forests as defined by Munz and Kuchler.

If one insists, the Sierran zonation patterns for middle and high elevations can be made to apply here, but little observation is needed to realize that these categories are forced and new ones should be defined. Observation also indicates that two ecologically distinct patterns of vegetation change with elevation are seen in the Klamath Region. To describe this fact two subregions have been recognized: the wetter, western subregion and the drier, eastern subregion. Even though the overlap in species and even species dominants are very great, the two subregions are apparently ecologically distinctive. The differences between the two subregions are readily seen in Fig. 2 which illustrates the geographic affinities of the conifers in the Preston Peak-Little Grayback area in western Siskiyou County and the Salmon-Scott Divide area in central Siskiyou County. The following tentative and incomplete classification of the vegetation types in each subregion is presented

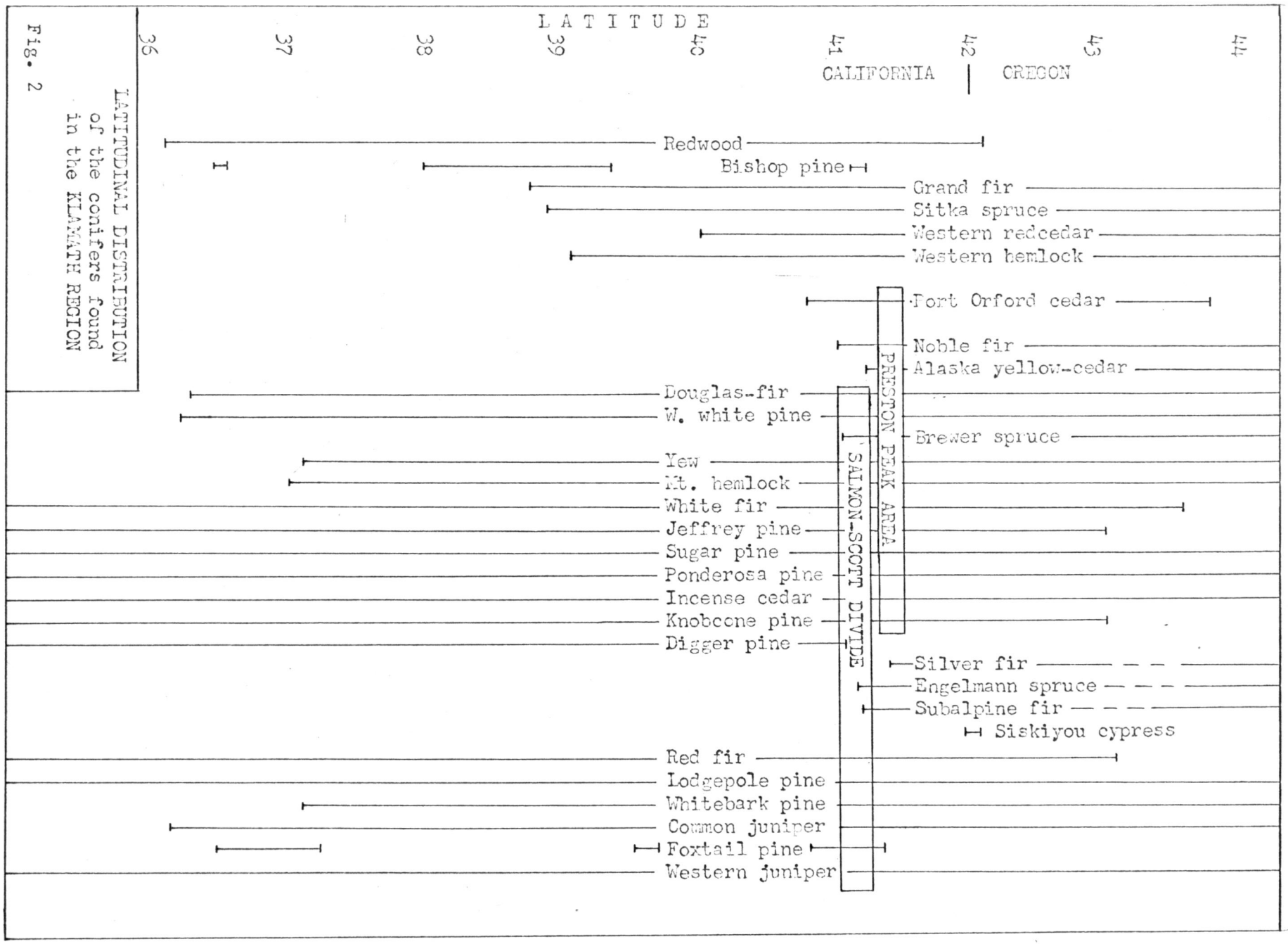

Fig. 2 LATITUDINAL DISTRIBUTION of the conifers found in the KLAMATH REGION

here to form a convenient framework for later discussions of the ecology of the relict conifers.

WESTERN SUBREGION

The Preston Peak-Little Grayback forests include trees of mainly affinities. Bear Basin Butte, North Trinity Mountain, Boulder Peak, Orleans Mountain, Indian Creek, Diamond Lake, Joe Creek, Ukonom Lake stands are also representatives of the western subregion.

A tentative classification of the forest types examined in the western subregion is possible, at least for the middle and high elevation forests. This classification was developed for the vegetation of the Preston Peak area; the other types are added to it:

Vegetation of the Klamath Region, Western Subregion	Study Areas
High Elevation Forests	
Mixed Forest	Preston Peak
	Ukonom Lake
	Upper Bridge Creek
Silver fir forest	Diamond Lake
	Joe Creek
Jeffrey Pine Woodland	Preston Peak
Montane Chaparral	Little Grayback
	Preston Peak
Middle Elevation Forests	
Creek Bottom Forests	Clear Creek
Slope Forests	
Open Forests	Preston Peak
	Indian Creek
	Orleans Mtn.
	Boulder Creek
Closed Forests	Clear Creek
	Poker Flat
	Bear Basin Butte
	Knopki Creek
Montane Chaparral	Preston Peak
	Orleans Mtn.
Jeffrey Pine Woodland	Preston Peak

The High Mixed Forest varies in composition but usually includes noble fir, Brewer spruce and mountain hemlock. Mountain hemlock was not found near Preston Peak, however, it occurs on Bear Basin Butte to the southwest and near Granite Creek in the northeast. In the Marble Mountain Wilderness (Ukonom

Lake) mountain hemlock is common along with noble fir. Porbably the silver fir forests of Joe Creek and Diamond Lake should be considered as variations of the High Elevation Mixed Forest category.

In the more open phases of the High Elevation Forest Brewer spruce or Jeffrey pine dominate locally. Other open stands are quite mixed. The open phases usually have more tree species present than do the closed stands (Table 1). High Montane Chaparral is not very different in species composition from the Middle Elevational Chaparral described below. Quercus sadleriana is present only in the western subregion, and might be used as a plant indicator to separate the regions. Holodiscus discolor var. delnortensis is also common in the west, while Holodiscus microphyllus is found in the east.

The High Elevation Forests grade gradually into the Middle Elevation forests in the western subregion. Creek Bottom forests have the mixed conifer species plus Port Orford cedar as an important component. Douglas-fir plays a rather important role in these forests.

Slope forests, if closed, are typically dominated by Douglas-fir or white fir. The more open stands are mixed, with dominance less extensive. Both slope forest phases are rich in coniferous species with nine seen in closed forests and ten in the open stands.

In the open phase Brewer spruce dominates local areas at middle elevations as described at Boulder Peak, Orleans Mtn., Bear Basin Butte, and Knopki Creek. Jeffrey pine woodland is local in the Preston Peak area. Middle elevation Montane Chaparral is rather uniform over this subregion, the common shrubs being Amelanchier pallida, Arctostaphylos nevadensis, A. patula, Holodiscus discolor var. delnortensis, Quercus sadleriana and Q. vaccinifolia.

THE PRESTON PEAK TO LITTLE GRAYBACK AREA, SISKIYOU MTNS.

A general reconnaissance was made of the Siskiyou Mountains in the area between Preston Peak and Little Grayback (Fig. 3). More of the reconnaissance time was spent in the Preston Peak area.

The High Forests are above roughly 5600'. Most of the area above this elevation supports only open forest or woodland and montane chaparral. Occasionally site conditions will be favorable enough to support a closed forest.

On Little Grayback the zone is represented only by Holodiscus discolor dominated chaparral. White fir and incense cedar occur as shrubs to the top

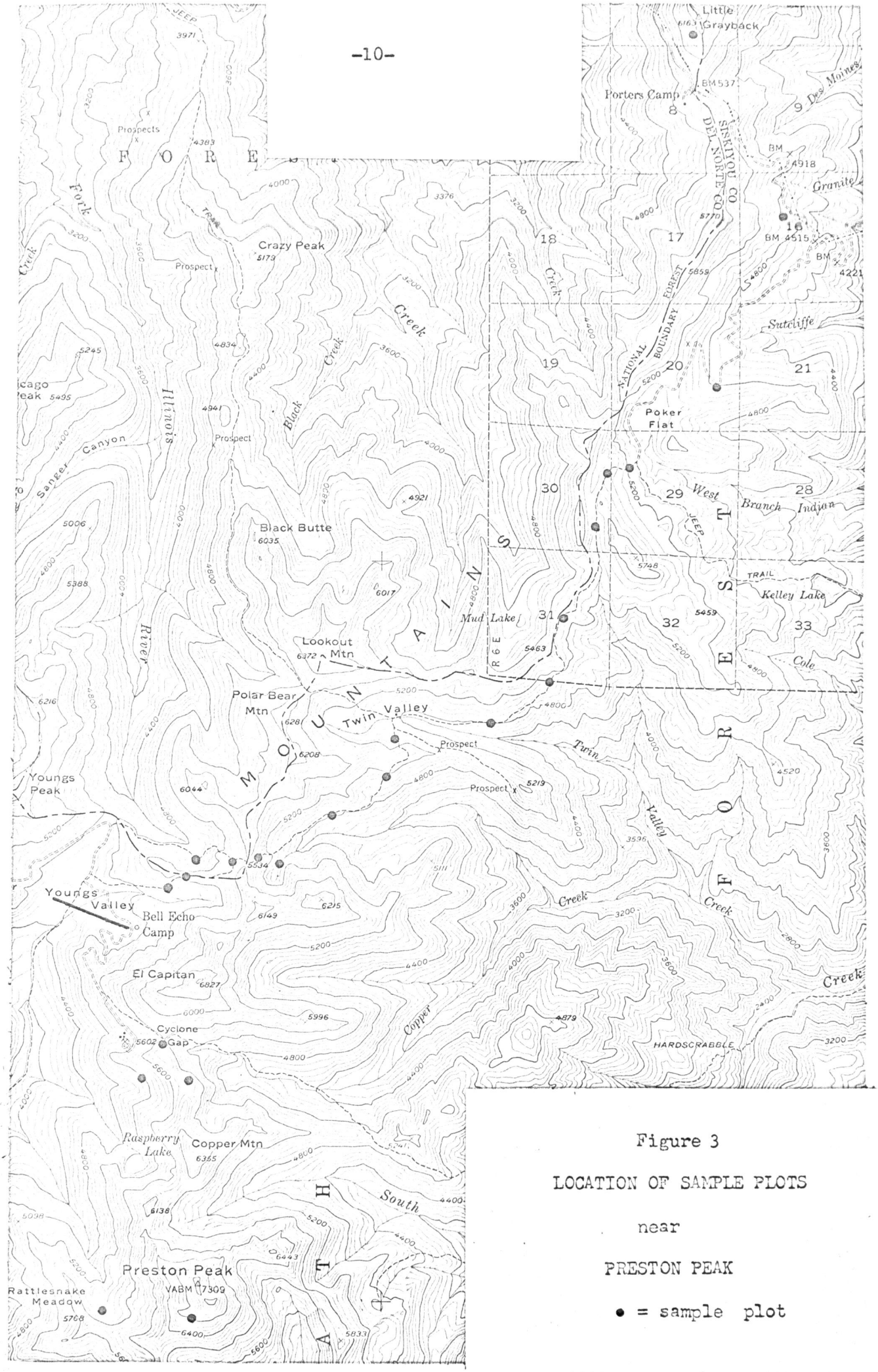

Figure 3

LOCATION OF SAMPLE PLOTS

near

PRESTON PEAK

• = sample plot

of the peak.

This High Elevation Forest Zone is more extensive on the higher and more massive Preston Peak. Most of the Mixed Forest is open rather than closed (Table 1). Species composition is basically the same regardless of the openness of the forest. One closed stand south of Cyclone Gap is dominated by noble fir (Table 2). Brewer spruce and white fir were important; western white pine and Alaska yellow-cedar were occasional (Table 3). The understory is dominated by Vaccinium membranaceum.

A nearby forest of open character had the same tree species with additional Douglas-fir, incense cedar and Jeffrey pine for a total of eight conifers. Arctostaphylos nevadensis, Vaccinium membranaceum, Quercus sadleriana and Q. vacciniolia characterize the shrubs between the clumps of trees. In this area Alaska yellow-cedar forms shrubby mats.

On the ridges and south slopes Jeffrey pine dominates open stands. Usually western white pine, Brewer spruce and noble fir are secondary associates. Near the top of Preston Peak are shrubby noble fir, Brewer spruce, western white pine and Alaska yellow-cedar. Taxus brevifolia is found on the south side near the top. Ceanothus velutinus, Quercus sadleriana and Q. vaccinifolia are common shrubs near the peak.

The middle elevations are better vegetated, although montane chaparral contributes significantly to the vegetation. Creek bottom forests as shown by Clear Creek data (Table 4), are variable, but usually have a mixture of species and are characterized by the presence of Port Orford cedar. Port Orford cedar is not, though, restricted to creek bottoms, and in this region can occur on rather dry sites. The forest is typically closed and dense, so the shrub layer is little developed except in openings (Table 3). Typical forest herbs are found on the ground (Table 5).

Slope forests range from tall, dense forests to montane chaparral with scattered trees. In the Preston Peak area the following pattern exists. Eleven conifers were recorded on slope forests. The closed forests on the better soil sites may be mixed but usually there are dominated by a single species like white fir or Douglas fir.

On the drier sites with shallow soils the forest is open with montane chaparral species forming a continuous layer. The scattered trees in these

open forests vary considerably (Table 3). On very dry ridges the vegetation becomes simpler, and is dominated by Jeffrey pine.

On the trail from Young's Valley to Poker Flat this pattern remains basically unchanged until the region of metavolcanic rocks is reached near Poker Flat. Dense forests are found here because of the better quality of this substrate in contrast to the serpentine and tonalitic substrates of the Preston Peak area. Mountain hemlock is present at 4800' here, (at the headwaters of Granite Creek) while none was seen near Preston Peak. Douglas-fir and white fir dominate extensive stands in this northern area.

LITTLE GRAYBACK STUDY AREA

Little Grayback (Elev. 6163') is one of the taller peaks northwest of Happy Camp. Brewer spruce occurs on the southeast slopes, the Indian Creek Stand. The slopes are generally forested except near the peak where shrubs dominate. The western slope forest is one of white fir with Douglas fir and incense cedar as secondary associates. On the northeast slopes noble fir forms pure stands. On the peak itself an unusual chaparral occurs; the regional dominants, Quercus vaccinifolia and Arctostaphylos nevadensis are missing. Instead Holodiscus discolor var. delnortensis, Amelanchier pallida, Quercus garryana var. breweri and Prunus emarginata occur (Table 3).

INDIAN CREEK BREWER SPRUCE AREA

A unique stand was found between Indian Creek and Louse Creek on the Happy Camp-O'Brien road. This stand is on the east slopes of Little Grayback. At 5100' in elevation the forest is dominated by large Brewer spruce. Associated species are shasta fir and white fir (Table 6). In the upper part of the stand the Brewer spruce is reproducing in a sadler oak chaparral and apparently is enlarging its area of dominance (Tables 7, 8). A clearcut block adjoins the stand to the south. Apparently Brewer spruce occurred in the cut, so the original stand was more extensive.

The stand is unique by the extensiveness of the Brewer spruce dominance, and by the quality of the site on which the Brewer spruce is growing. This is a moderate slope with deep soil, not the typical rocky ridge or slope. The trees here are large and reproduction is extensive in the open brush.

THE BEAR BASIN BUTTE AREA, SISKIYOU MOUNTAINS

The Bear Basin Butte area initiated our active interest in the Klamath Region relicts when first visited in the early fall of 1967. When talking to local people who know Brewer spruce invariably the Bear Basin area is mentioned. When we arrived we found the Brewer spruce, but of exceptional interest was the mixture of coniferous species and the mosaic of vegetational types which occur in this small area. We have recognized the following types there:

Noble fir–mountain hemlock forest
Mixed forest
Knobcone pine–montane chaparral
Brewer spruce
White fir–Douglas fir forest

The noble fir–mountain hemlock forest occurs on the steep north slopes of Bear Basin Butte. This is an unusually low elevation stand of mountain hemlock, especially when it is noted that no mountain hemlock occurs in the Preston Peak area.

The mixed forest is here dominated by Douglas fir, but including white fir, Port Orford cedar, sugar pine, western white pine, mountain hemlock, Brewer spruce, noble fir and western yew. The canopy is dominated by Douglas fir, the mixed nature is mainly shown by the smaller trees and reproduction (Table 9). The stand structure table is misleading in that not all tree species were sampled in its limited extent.

Knobcone pine occurs in close proximity to the proceeding stand. The scattered trees are mixed with montane chaparral, including Quercus vaccinifolia, Q. sadleriana, Amelanchier pallida, Ceanothus velutinus, Prunus emarginata and Holodiscus discolor var. delnortensis. White fir, Brewer spruce, incense cedar and western white pine are young and scattered in the montane chaparral. These chaparral areas are obviously early successional, rapidly changing from brush to forest.

Local populations of Brewer spruce occur on open ridges along the road to Doe Flat. A stand of nearly pure Brewer spruce was recently located (11/68) on the steep north slopes east of Bear Basin Butte. Its extent is not yet known.

Stands dominated by white fir and Douglas fir are found near the mixed forest. Noble fir occurs as a secondary species in some of these stands.

KNOPTI CREEK BREWER SPRUCE STAND, SISKIYOU MOUNTAINS

An unusually low elevation stand (3300') of Brewer spruce was found on the Knopti Creek Road to Sanger Lake. The northwestern slopes on which it occurred were moderately steep. The stand is open and dominated by Douglas fir. Brewer spruce, Port Orford cedar and sugar pine are the secondary conifers along with tan oak and madrone. The understory shrubs are typical of the area and elevation (Table 10) except possibly Vaccinium scoparium.

BOULDER PEAK BREWER SPRUCE AREA, SISKIYOU MTNS.

In the Boulder Peak area Brewer spruce is a rather common member of the forest stands on ridges and north facing slopes, from 5200 to 5600 feet in elevation. In closed forests noble fir or Douglas-fir dominate with Brewer spruce a secondary species. In one dense stand on a north facing slope Brewer spruce is the major reproductive species along with noble fir. In the species rich open forests (Table 11), Brewer spruce is typically important and can be the dominant. One such stand on a very steep northwest facing slope has seven species. The understory includes the common montane chaparral shrubs of the region (Table 11).

The forests in this area are fairly typical for Brewer spruce. The heavy Brewer spruce reproduction under the dense forest canopy that was observed in the area indicates that Brewer spruce has the potential of being the major dominant in the climax stand.

ORLEANS MOUNTAIN BREWER SPRUCE AREA

Open stands of Brewer spruce characterize the east ridge and slopes of Orleans Mountain from 5200' to 5600'. Brewer spruce is most common on the ridge top and north facing slopes. Here it occurs with only four other tree species (Table 12). It is occasionally seen on the south slopes reproducing in the montane chaparral thickets which cloth these slopes. The chaparral is dominated by Arctostaphylos patula, Quercus vaccinifolia, Q. sadleriana and Amelanchier pallida.

This stand is rather typical of the ridge and steep slope sites of Brewer spruce dominance. The stand is not unusually large or small, and if different, it is by its rather impoverished flora, compared to other areas examined (Table 13).

NORTH TRINITY MOUNTAIN NOBLE FIR STUDY AREA

The area surrounding North Trinity Mountain (Elev. 6262') and toward Red Cap Prairie to the north is characterized by a beautiful parkland mosaic of wet meadows, dry meadows, open and closed forests. The closed forests are dominated by noble fir. The noble fir stands are young, healthy and in many areas nearly pure. This may possibly be considered the southern limit of the species, though some Forest Service personnel mention noble fir on South Fork mountain further to the south. On the rocky points and summits the tree component becomes mixed including with noble fir, white fir, incense cedar and western white pine. Vaccinium occidentale is found in the wet meadows. Typical dry site charapparl shrubs are found in the open forests (Table 14).

JOE CREEK SILVER FIR FOREST, SISKIYOU MTNS.

At the headwaters of Joe Creek between Copper Butte and White Mountain is the largest known stand of Pacific silver fir in California. The stand, about 300 acres in extent, lies between 5600' and 5900' in elevation on moderate to steep north-facing upper slopes. It is entirely in the Rogue River National Forest.

The stand is floristically simple. Silver fir dominates; in some areas mountain hemlock shares dominance. Noble fir and western white pine are secondary species. One Brewer spruce was seen in a clearcut adjacent to the stand.

The understory is strikingly underdeveloped, and in some areas is almost nonexistant. Only in windfall openings do the shrubs and herbs listed in Table 15 become abundant. Under the dense forest only occasional Vaccinium, Pyrola and Chimaphila are typical. The major understory component are seedlings of silver fir and occasionally a mountain hemlock (Tables 16, 17, 18).

Also typical of this stand is a litter layer of compacted needles, possibly a contributing factor to the sparseness of undergrowth. The most striking aspect of this stand is the success of the silver fir seedlings.

DIAMOND LAKE SILVER FIR FOREST, SALMON MOUNTAINS

Above Diamond Lake and from there down to the southern shore of Hancock Lake is a silver fir forest. The stand occurs between 6350 and 6960 feet. The soil is moderately deep to shallow silt derived from granodiorite. The general aspect is north with some slopes facing northeast and northwest.

Three species comprise the stand, silver fir, mountain hemlock and shasta fir. The tree species occur in various combinations; each may dominate local areas (Tables 19, 20, 21). On the north and east facing slopes the forest is dense and continuous. The understory is little developed as in the Joe Creek stand, and the compacted litter layer is also seen under this closed forest. Vaccinium, Pyrola are the typical understory plants (Table 22).

Around Diamond Lake and near Hancock Lake are wet meadows and dry rocky sites. Most of the shrubs and herbs listed in Table 22 come from these areas as indicated. The woodland found on the dry rocky ridges and slopes includes silver fir, shasta fir, mountain hemlock and in addition western white pine and Brewer spruce. These individual trees are scattered among the shrubs of Vaccinium and Arctostaphylos. Notable of the meadows is Kalmia polifolia and Phyllodoce empetriformis.

UKONOM LAKE BREWER SPRUCE STAND, MARBLE MTNS.

Pacific silver fir was reported to occur just north of Ukonom Lake in the Marble Mountain Wilderness Area. We could not find the reported stand, only shasta fir and white fir formed the rather extensive and closed forest north of the lake.

On the north side of the 6540' peak north of Ukonom Lake Brewer spruce is locally abundant on the steep granitic slopes and ridges. The stand is the very open type typical of this site. Shasta fir is usually the most abundant species in the open as well as the closed forest. Brewer spruce is second in importance followed by the distinctly less important white fir, mountain hemlock and western white pine.

This is another area where Brewer spruce was seen successfully reproducing under a closed forest of shasta fir. Canopy trees are rare in comparison to the seedlings and saplings, which are obviously tolerant of rather deep shade.

UPPER BRIDGE CREEK, MARBLE MTN. WILDERNESS

Carl Young, a Humboldt State College senior, surveyed the Brewer spruce stands in the southern Marble Mountain Wilderness during the summer of 1968. The results (Fig. 4) map seven localities of varying size. The typical associates are white fir and shasta fir. He noted that these stands typically occur between 5600 and 6000' in this area, and that the Brewer spruce have a tendency

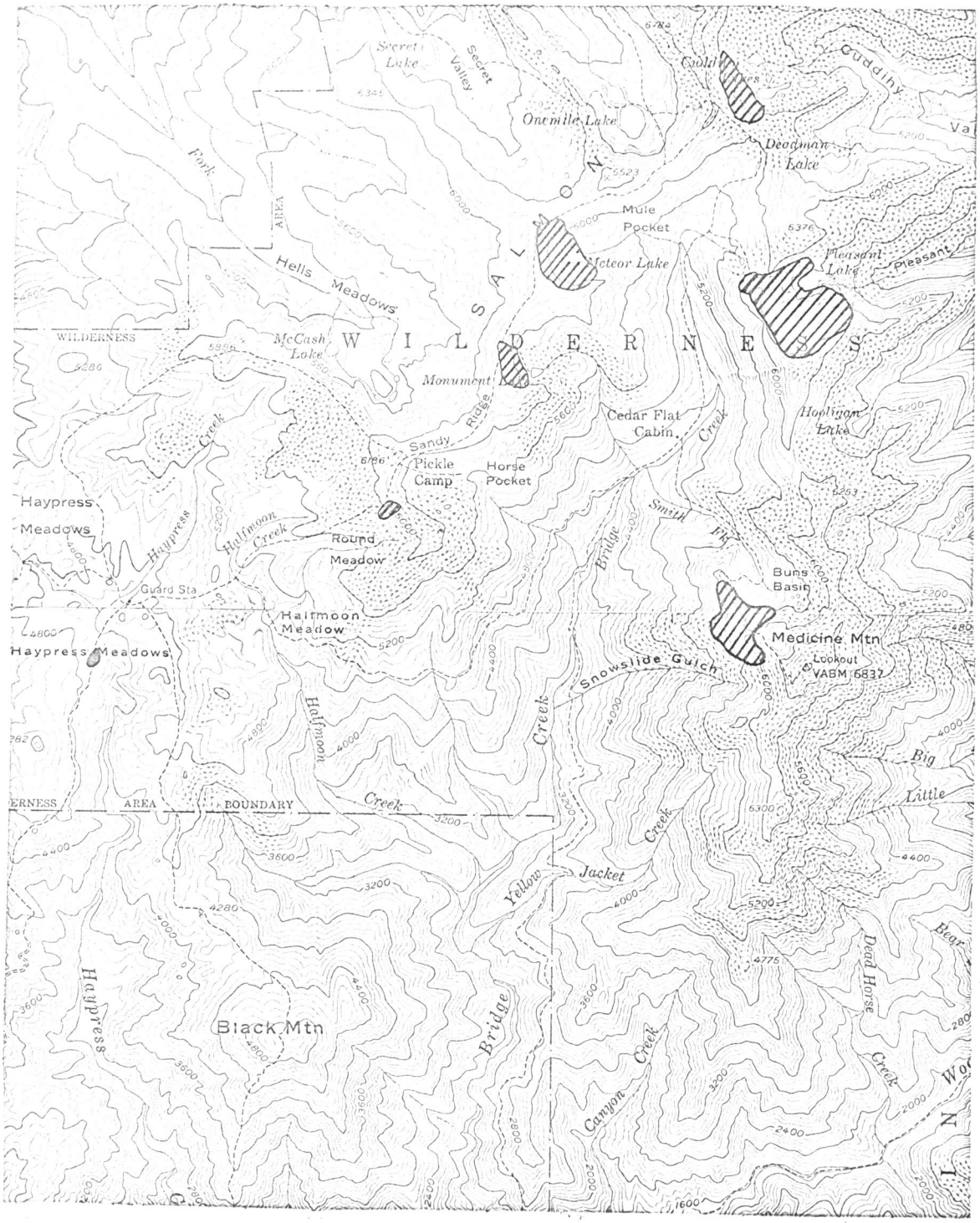

Figure 4

TENATIVE LOCATION
of
BREWER SPRUCE
in the
UPPER BRIDGE CREEK AREA

to be found on either dry ridges or cool, northeast slopes. He was puzzled by the single Brewer spruce that occurs along the trail in Haypress Meadows miles from the other stands.

EASTERN SUBREGION

The eastern subregion was most intensively sampled in the Salmon-Scott Divide area. Other samples in this subregion are Pony Peak, Packer's Peak, Mt. Eddy and Salmon Mtn. Ridge. In general they fit into the zonation pattern shown in the Salmon-Scott Divide study area.

Vegetation of the Salmon-Scott Divide area shows more Californian and Western Interior affinity than do the trees of the Preston Peak-Little Grayback area (Fig. 2).

Zonation is strikingly different than at Preston Peak with four middle and high elevation zones evident. The following classification resulting from study in the Scott-Salmon Divide area should be considered tentative for the subregion.

Whitebark pine zone (above 7000')
- Whitebark pine-mountain hemlock-shasta fir
- Foxtail pine

Shasta fir zone (6400-7000')
- Shasta fir-western white pine-mountain hemlock
- Jeffrey pine-montane chaparral
- Brewer spruce-montane chaparral
- Subalpine fir

Mixed Conifer-Shasta fir zone (5300-6400')
- Enriched mixed conifer
- Engelmann spruce-Subalpine fir
- Engelmann spruce
- Jeffrey pine-montane chaparral
- Brewer spruce-montane chaparral

Mixed conifer zone (below 5300')*
- Mixed conifer (white fir-Douglas-fir-ponderosa pine-sugar pine-incense cedar)
- Ponderosa pine-incense cedar
- Engelmann spruce

Species distribution according to zones is shown in Fig. 5.

In the Salmon-Scott Divide several drainages were studied in varying detail as indicated below (Fig. 6), with the more intensively surveyed drainages

*Elevations are averages, zones vary in elevation with drainage.

Figure 5

ELEVATIONAL DISTRIBUTION OF THE CONIFERS OF THE SALMON MOUNTAINS

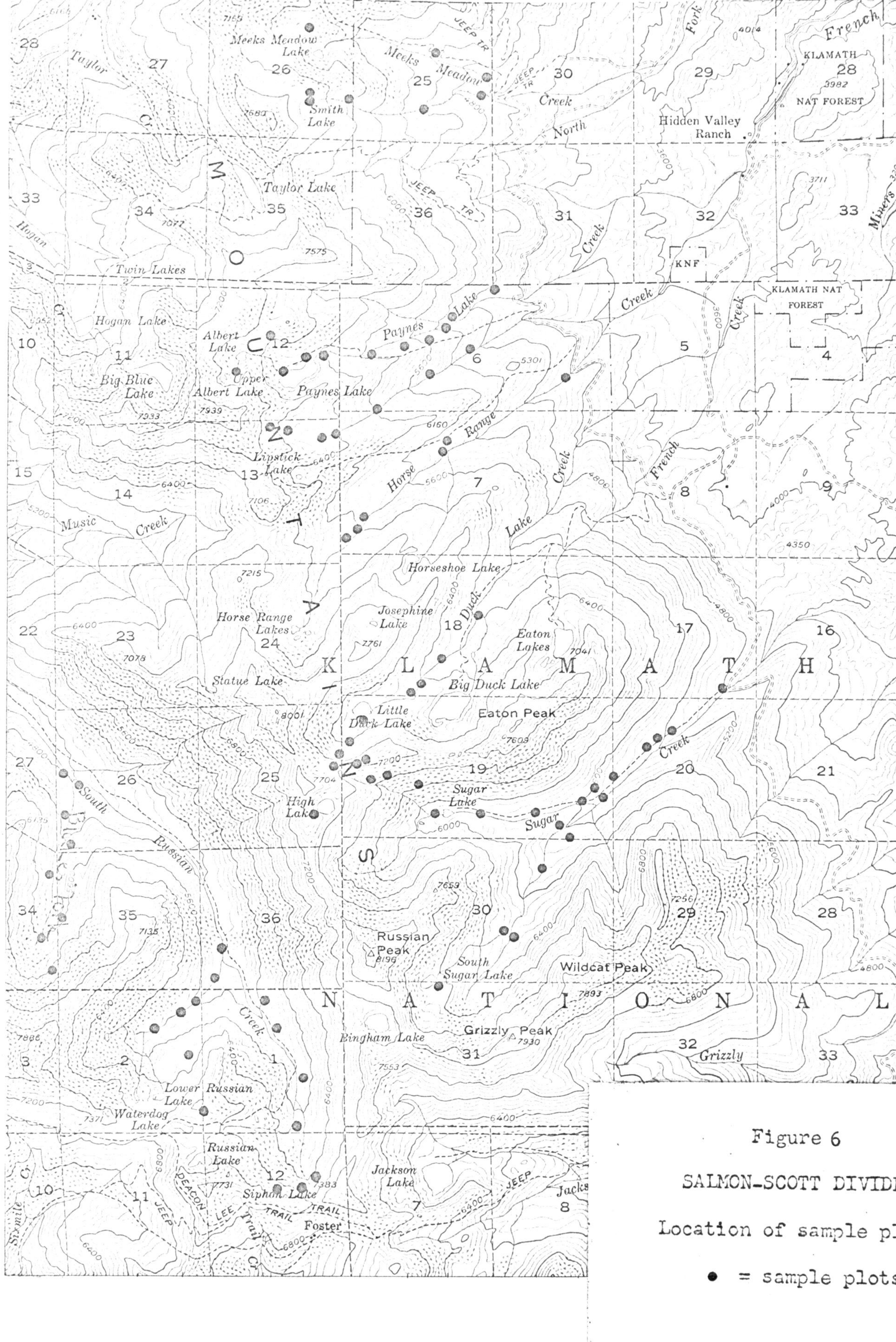

Figure 6

SALMON-SCOTT DIVIDE

Location of sample plots

● = sample plots

starred:

Meeks Meadow Creek
Paynes Lake Creek
**Horse Range Creek including the north fork
**Duck Lake Creek
**Sugar Creek including South Sugar Creek
South Russian Creek
**Blake's Fork

SALMON-SCOTT DIVIDE, MEEKS MEADOW CREEK DRAINAGE

Meeks Meadow Creek at the north end of the study area lacks the floristic richness of the rest of the area. Neither Brewer spruce or Engelmann spruce occur there. The South Fork of Meeks Meadow Creek is bordered by steep expanses of sheer granodiorite. Both forks were surveyed.

Shasta fir zone: Around much of Smith Lake is a dense shasta fir forest. Mountain hemlock and western white pine are also present in the more open forests of the area as found at the east end of Smith Lake.

Mixed conifer/Shasta fir zone: The Meek's Meadow area had an incomplete complement of conifer species for this zone (Table 23). Shasta fir, and white fir dominate in the forests of the area. The grouping is a typical mixture of high elevation and middle elevation species which is typical of this zone, but deleations are notable (compare to Fig. 5). At lower elevations (5200') other mid-elevation species (sugar pine and Douglas-fir) are found. In the South Fork white fir dominates up into this zone, and surprisingly shasta fir decends to 5100'.

Mixed conifer: Below 5000' the typical mixed conifer forest (Table 23) is found. On drier sites ponderosa pine dominated forest was surveyed.

SALMON-SCOTT DIVIDE, PAYNE'S LAKE CREEK DRAINAGE

Payne's Lake Creek also lacks Engelmann spruce. Along most of its upper extent the creek is bounded by sheer clifts as high as 30 feet, and lacks the moist stream bottom site that appears to be essential for Engelmann spruce.

Whitebark pine zone: Mountain hemlock dominated forest with shasta fir occurs between Albert Lake and Upper Albert Lake. Whitebark pine occurs on the 7933' peak obove Upper Albert Lake.

Shasta fir zone: Shasta fir dominantes in a mixed forest with mountain hemlock and western white pine near Payne's Lake. Brewer spruce was recorded

on the west side of Payne's Lake.

Mixed conifer/Shasta fir zone: At 6200' a mixed stand with Brewer spruce dominating was recorded. Other stands in this zone have six, seven and even nine conifer species with sugar pine and ponderosa pine only present toward the lower elevation boundaries of the zone (Table 23).

Mixed conifer zone: Stands in the zone are dominated by white fir. Incense cedar was not seen here.

SALMON-SCOTT DIVIDE, HORSE RANGE CREEK DRAINAGE

Whitebark pine zone: Two forests were surveyed in this drainage, the typical open forest of whitebark pine, mountain hemlock and shasta fir, on the west side of the ridge at the headwaters of Horse Range Creek. Eastern facing slopes have pure stands of mountain hemlock.

Shasta fir zone: Two major forests were seen in this zone (Tables 24, 25). The steep slopes behind Horse Range Lake have a rather closed forest of shasta fir, western white pine and mountain hemlock. To the north and east the open slopes have a forest including white fir, lodgepole pine and Brewer spruce mixed with the three typical species mentioned above (Table 26). Dominant shrubs are Arctostaphylos spp., Castanopsis sempervirens and Holodiscus microphyllus.

Mixed conifer-Shasta fir zone: This area in Horse Range Creek has some of the richest coniferous stands sampled (Table 27). Only Sugar Creek drainage exceeds this drainage by the presence of subalpine fir. Three forests were sampled here: The Brewer spruce-montane chaparral on the steep tallus slopes, the enriched mixed conifer on the mesic lower slopes and high alluvial terraces, and the Engelmann spruce forests on the wetter alluvial terraces (Tables 24, 25). Eleven conifer species were seen in this zone, ten in one sample of less than two acres. The Engelmann spruce forest adjacent to the enriched mixed conifer has nine species, missing only incense cedar and ponderosa pine and adding mountain hemlock (Tables 28, 29). This outstanding forest is in Section 7; the one owned by International Paper.

Mixed conifer zone: The Engelmann spruce dominated forest along Horse Range Creek continues down into the Mixed conifer zone with six conifer species, the five mixed conifer species plus Engelmann spruce. In this zone Engelmann spruce is very restricted to the creek-side location.

SALMON-SCOTT DIVIDE, DUCK LAKE CREEK DRAINAGE

This drainage was rather incompletely sampled. It assumes importance since the area southwest of Little Duck Lake was the area of the initial sighting of subalpine fir in California. The stand, surrounding a wet sedge meadow, is dominated by subalpine fir with three other associated conifers (Tables 30, 31). Subalpine fir occurs on the Southwest shores of Little Duck Lake as well. East of the lake is an extensive lodgepole stand. The location of Engelmann spruce and subalpine fir in this area is shown in Fig. 7.

Mixed conifer/Shasta fir zone: A rather mixed forest is seen on mesic sites including Engelmann spruce. The highest Engelmann spruce was at 6500'. The Enriched mixed conifer includes western white pine, lodgepole pine, Engelmann spruce, mountain hemlock, Douglas-fir, white fir, shasta fir and incense cedar.

SALMON-SCOTT DIVIDE, HIGH LAKE AREA AND SUGAR CREEK DRAINAGE

The Sugar Creek drainage has the richest and most diverse forests of the Salmon Mountains, as far as we know in the world. Seventeen conifers including extensive stands of subalpine fir in South Sugar Creek occur in this drainage.

Whitebark pine zone: The whitebark pine/shasta fir/mountain hemlock forest typical of this zone occurs above High Lake either as an open, mixed forest or a pure forest of mountain hemlock. East of High Lake on the ridge between Sugar Creek and Duck Lake Creek at 7200' is a foxtail pine stand. This open forest contains eight conifers species plus Juniperus communis (Tables 32, 33, 34, 35). This is a highly unusual site for foxtail pine as it is rarely seen in the Klamath region on granitic substrates.

Shasta fir zone: Shasta fir occurs as dense stands on the better sites above Sugar Lake. More extensive are open stands of shasta fir, western white pine, and mountain hemlock. On dry south-facing slopes these open forests are typically Jeffrey pine, western white pine, Lodgepole pine and montane chaparral. South Sugar Lake has around it mountain hemlock and shasta fir with a long subalpine fir gracing the south end of the lake. In the wet sedge meadows south of South Sugar Lake subalpine fir becomes common. It occurs on these sites and along the streams in this zone.

Mixed conifer/shasta fir zone: The Enriched mixed conifer, Engelmann spruce, Engelmann spruce/Subalpine fir forests were sampled in this zone (Tables 23, 31, 36, 37, 38, 39). In South Sugar Creek the Engelmann spruce

FIGURE 7
TENTATIVE LOCATION
of
= ENGELMANN SPRUCE
and
= SUBALPINE FIR
in the
SALMON-DIVIDE AREA

goes up to 6400', and the subalpine fir descends to 5800'. Between these elevations, a distance of over one mile, both species grow together on the creek alluvium. Subalpine fir dominates at the higher elevations. Below 5800' Engelmann spruce alone dominates on the wet terraces with a mixture of other speices.

The moist upper terraces and gentle lower slopes are sites for the Enriched Mixed Conifer forest. Up to ten species can be found in a single stand. Eleven species of conifers were found on this site, in this zone. The understory of these stands is similar to the drier phases of the Engelmann spruce forests: Amelanchier florida, Berberis nervosa, Castanopsis charysophlla, Leucothoe davisiae, Rosa gymnocarpa, Symphoricarpos hesperius and Vaccinium. Taxus brevifolia dominates areas of understory in the Engelmann spruce forests. Many herbs are present in much of the forest (Table 33).

On the steep dry slopes single trees of Sugar pine, white fir, Brewer spruce and Jeffrey pine occur mixed with montane chaparral: Amelanchier pallida, Arctostaphylos patula, Castanopsis sempervirens, Quercus vaccinifolia, and Symphoricarpos hesperius.

Mixed conifer zone: Below 5000' the forest on alluvial terraces again is simplified to the typical mixed conifer species plus Engelmann spruce. Lower slope forests have the typical five species with Ponderosa pine common. Engelmann spruce occurs only along the stream banks in this zone.

SALMON-SCOTT DIVIDE, SOUTH RUSSIAN CREEK DRAINAGE INCLUDING BLAKE'S FORK

The upper elevations of South Russian Creek do not have Engelmann spruce. Blake's Fork has an extensive forest of Engelmann spruce. It continues down South Russian Creek below the Blake's Fork confluence.

Whitebark pine zone: At 7200' at the headwaters of South Russian Creek an open stand of whitebark pine, mountain hemlock, shasta fir, western white pine and white fir occurs. On the 7300' peak overlooking Waterdog Lake whitebark pine, mountain hemlock and shasta fir are joined by a few western white pine, Jeffrey pine and Brewer spruce.

Shasta fir zone: Open shasta fir, mountain hemlock and western white pine forests with Brewer spruce occur below the Whitebark pine zone on these peaks at the headwaters of South Russian Creek. Mountain hemlock is the most

common tree on the steep slopes at the headwaters of Blake's Fork.

Mixed conifer/Shasta fir zone: Nine conifer species occur in this zone and drainage. The Enriched conifer sites average only five or six species, though. Lodgepole pine forms extensive stands in some areas (Table 23).

In Blake's Fork the steep, boulder strewn slopes support Brewer spruce in a montane chaparral of Amelanchier pallida and Quercus vaccinifolia. These steep slopes abruptly meet the alluvium covered by a dense Engelmann spruce, white fir forest. Taxus brevifolia dominates the understory extensively (Tables 40, 41, 42).

Engelmann spruce also was found relatively high on the hillsides in areas of seepage. One tree with a diameter of 72" was measured in such a seepage area.

Mixed conifer zone: At Blake's Fork the Engelmann spruce forest continues into the Mixed conifer zone (Tables 43,44). It is restricted to alluvial terraces along South Russian Creek, below the Blake's Fork confluence. At this elevation Engelmann spruce is less common in the type. The shrubs and herbs are essentially like those of the high elevation Engelmann spruce forests (Table 45).

PACKERS PEAK FOXTAIL PINE, TRINITY ALPS PRIMITIVE AREA

General reconnaissance was made of the foxtail pine stands on Packer's Peak. Very open to rather closed stands are rather extensive on the southeast and southwest ridges of the peak. Foxtail pine begins at about 7000' forming open stands and mixed with several species. At 7500' on the southeast ridge shasta fir dominates a closed stand containing some foxtail pine. Ridges at this elevation have open stands of Jeffrey pine. Near the peak (7800') foxtail pine dominates in a rather closed stand. Mountain hemlock and shasta fir are secondary associates. Typical montane chaparral species form the shrub layer in the open forests except for the endemic Penstemon tracyi. Local areas of Cercocarpus ledifolius occur on ridge crests (Table 46).

MT. EDDY FOXTAIL PINE STUDY AREA

General reconnaissance was made of the Whitebark pine zone on Mt. Eddy including the slopes and ridges in the Deadfall Lakes area. A forest of foxtail pine is found on the ultrabasic "serpentine." Also forests on granite are described (Table 47).

Between Middle and Upper Deadfall Lakes the open forest is dominated by western white pine, white fir and lodgepole pine. Only an occasional whitebark pine is seen at 7300'. Above Upper Deadfall Lake foxtail pine and whitebark pine dominate an open forest. On the southern side of the ridge above upper Deadfall Lake is a rather extensive, nearly pure stand of foxtail pine. Whitebark pine, a secondary associate, becomes more important toward the summit of Mt. Eddy. Near the summit the open krummholz is whitebark pine.

The ridge and slope west of Middle Deadfall Lake is granitic. On the steep northeast slopes the forest is dominated by shasta fir and mountain hemlock. Whitebark pine becomes more important on the ridges (Table 47).

Another interesting plant in this area is Darlingtonia californica, the cobra lily. This California endemic is not unusually rare in the Klamath region, but this locality is the highest elevation at which it is known to occur.

SALMON MOUNTAIN RIDGE STUDY AREA

A reconnaissance was conducted of the tree species in two areas along the Salmon Mountain Ridge. This reconnaissance was run by two forestry students from Humboldt State College, Timothy E. Paysen and C. Hal Doran. Brewer spruce had been located on Orleans Mountain and in Caribou Basin which lie at the west and east end of the Salmon Mountain Ridge. It was logical to assume that it occurred between these areas along the ridge. The objective of this reconnaissance was to investigate this possibility and to check out rumors of some odd species occurring at some of the lakes along the ridge. The reconnaissance was conducted in two areas, between Indian Rocks and Knownothing Lake southwest of forks of the Salmon and between Election Camp and Cold Spring south of Cecilville.

At higher elevation along this ridge the forest tree composition was dominated by Shasta red fir with white fir in moist sites and north facing slopes. Sugar pine, ponderosa pine and incense cedar were found on the drier south aspects. Douglas fir and western white pine also occurred in minor amounts. None of the rare species found throughout the Klamath region were found along the ridge.

PONY PEAK STUDY AREA, TRINITY ALPS PRIMITIVE AREA

At the headwaters of Cabin Creek north of Pony Peak Shasta Fir Zone forests occur above 5900'. Much of the area at this elevation is steep and rocky with shallow soils. Montane chaparral dominates the landscape. On the better sites below 5900' shasta fir-white fir forests dominate. Also common in this area are extensive knobecone pine forests, especially on south facing slopes.

The montane chaparral is dominated by Quercus vaccinifolia. Arctostaphylos patula and Ceanothus velutinus are also important. Scattered trees invading the chaparral include shasta fir, Douglas fir, white fir, knobecone pine, western white pine, Jeffrey pine and incense cedar. Above Cabin Creek Lake the open forests is that typical of the Shasta Fir Zone: shasta fir, mountain hemlock and western white pine. Trees occur in groups mixed with montane chaparral species, Quercus vaccinifolia, Prunus emarginata and Arctostaphylos nevadensis. Taxus brevifolia follows the drainages (Table 48).

AUTECOLOGY OF ABIES AMABILIS

Pacific silver fir has been previously reported at three locations in the Klamath Mountain area of Northern California. All three of these areas were visited to determine the extent and condition of the Pacific silver fir stands. One of these reported stands, near Ukonom Lake, was not found. One day was spent traversing the section in which the Pacific silver fir stand was reported. It was concluded that the stand was incorrectly located in our information or else the species was confused with Abies concolor by the original discoverers. The other two stands were located and investigated.

The Joe Creek silver fir stand lies in the upper headwaters of Joe Creek, a tributary of Elliot Creek which runs into the Applegate River. The general topographic position is that of moderately steep upper slopes, indicating good drainage. There was very little sign of excess moisture throughout the area other than the normal creek in a small draw. Some of the slopes which had a few silver fir appeared to be rather dry.

The silver fir is primarily mixed with Tsuga mertensiana with about equal numbers in the larger size classes (Tables 16, 17, 18). A few noble fir and western white pine are also mixed in the stand. The stand is very dense with very little understory and with a thick, matty humus layer. Almost all the

reproduction under 2.5 cm in diameter was silver fir. Silver fir appears as the dominant reproducing species and can be considered as the climax species on this site. Mountain hemlock appears to be successional to silver fir here. The same situation occurs in the stands of silver fir in the main portion of its range. The large numbers of large sized mountain hemlock either became established when the stand was more open or else the stand as a whole came in after a fire. A small portion of the stand had been logged approximately 6 years ago. Silver fir was reproducing fairly well in the logged area along with one Brewer spruce and large numbers of mountain hemlock, western white pine, noble fir, Douglas fir and white fir.

Forty-one miles to the south of the Joe Creek stand is located the other known stand of silver fir at Diamond Lake on the north side of English Peak in the southern part of the Marble Mountain Wilderness area. This stand is similar to the Joe Creek stand with mountain hemlock as a codominant with silver fir and a few western white pine and shasta fir (Tables 19, 20, 21). The reproduction is also similar, being almost entirely silver fir. The following data were obtained for representative trees in the stand:

FIGURE 8

AGE DIAMETER RELATIONSHIPS OF TREES AT DIAMOND LAKE AREA

Silver Fir			Mt. Hemlock		
Height (meters)	DBH (cm)	Age (years)	Height (meters)	DBH (cm)	Age (years)
25.8	63.3	150	22.0	51.1	170
14.4	23.1	125	11.7	20.0	137
18.8	33.4	169	4.2	7.7	112
4.1	7.9	132	22.0	35.7	
2.4	5.7	110	20.0	29.2	
0.5	---	62	26.0	51.9	
27.0	39.1				
			Shasta fir		
			28.5	55.0	

Within the accuracy of the increment cores that were used for the age determination it can be concluded that this is an even aged stand approximately 170 years of age. Any tree that reproduce under this dense stand grow at an exceedingly slow rate as indicated by the ½ meter tall silver fir seedling that

was 62 years old. This slow growth rate is indicative of the very tolerant nature of both silver fir and mountain hemlock. The small amount of reproduction of mountain hemlock is probably due to the inability of seedlings to survive through the first year.

In both of the stands silver fir is reproducing well and is in no danger of disappearing. The reasons why silver fir is restricted to these two relative small stands was not apparent.

AUTECOLOGY OF ABIES LASIOCARPA

Subalpine fir was officially recorded for the first time in California with the location of the two stands in the Salmon-Scott Divide Area. The stands are located near Little Duck Lake and near South Sugar Lake.

The stand at Little Duck Lake is the smallest of the two occupying an estimated 40 acres. This stand extends from the wet meadows near the lake to steep well-drained north facing slopes. The elevation of the stand extends from 6,500 feet to approximately 6,800 feet. The soil in most of the stand is very rocky and generally shallow. The soil parent material is granodiorite. The stand structure (Table 31) indicates that subalpine fir is the dominant species in the stand with mountain hemlock a major component. The stand appears to be all-aged with subalpine fir reproducing in large number and with a limited amount of mountain hemlock reproduction. Although this stand is restricted in size it appears to be slowly enlarging. Reproduction is slowly moving out into a wet sedge meadow both by layering and from seed. Several small subalpine fir were found below the lake coming in under an older Engelmann spruce stand. It is also moving out onto the relatively drier slopes under the mixed stands of Shasta fir, mountain hemlock, Brewer spruce and western white pine.

The largest stand of subalpine fir is located along south Sugar Creek. The stand extends from above the lake to about a mile along the creek, Fig. 7, between 6,900 and 5800 feed in elevation. Subalpine fir occurs on the alluvial flats along the streams and extends up the lower side slopes onto well drained soils. It occurs mixed with Shasta fir, mountain hemlock, western white pine, lodgepole pine, Engelmann spruce and willow. On the lower slopes it appears that lodgepole pine had initially invaded wet meadows and now is being followed

by subalpine fir and Engelmann spruce.

In this area subalpine fir appears to be more restricted in its location than either mountain hemlock or Engelmann spruce. In the mountains of northern Idaho (Daubenmire, 1968) mountain hemlock and subalpine fir are the major climax species, however, mountain hemlock is limited and restricted to certain slopes. Engelmann spruce on most sites is seral to the other two tree species. Throughout the northern Rocky Mountains and the Cascade Mountains subalpine fir can be found in drier warmer sites than mountain hemlock. However, in the study area the reverse is true. It may be that subalpine fir had been restricted by other factors and has the ability to move into the areas that are not dominated by mountain hemlock and Engelmann spruce.

AUTECOLOGY OF CHAMAECYPARIS NOOTKATENSIS

Previous to this study Alaska yellow-cedar was reported in the literature at two locations in California, on the north side of Little Grayback two miles south of the Oregon border at an elevation of 6,000 feed and on Preston Peak. The Little Grayback stand was not visited during this study. While looking for stands of Brewer spruce near Preston Peak in the western Siskiyou Mountains several new locations of Alaska yellow-cedar were found. On the ridge south of Cyclone Gap, which lies above Youngs Valley, a small shrubby patch of Alaska yellow-cedar was located. It occurred on a steep north-facing slope with very thin rocky soil at 5700 feet. Further south along the same ridge occurred a larger clump of Alaska yellow-cedar. Several stems up to 8 inches in diameter were growing on a steep north-facing slope at an elevation of 5750 mixed with Brewer spruce, noble fir and western white pine.

Alaska yellow-cedar, along with Brewer spruce, was observed growing on the vertical north face of Preston Peak above the 7,000 foot level. The yellow-cedar grew as a mat in large cracks in the rock. It has also been reported to occur in a similar matter in the Devils Punchbowl, several miles southwest of Preston Peak, apparently the southern range limit of the species.

The observed patches of Alaska yellow-cedar were occupying very precarious positions. They were all on steep well-drained north facing slopes at high elevations. At the time of observation in September, the soil at these locations appeared fairly dry, although these areas are probably sites in which the

snow pack stays well into the summer, providing moisture through the growing season. Further study of the ecology of this species in California is greatly needed.

AUTECOLOGY OF PICEA BREWERIANA

Brewer spruce is ubiquitous in the Klamath Region in the sense that it is not restricted to any one area or zone. In the eastern subregion it generally occurs above 5000'; in the western subregion it has been seen as low as 3300' (Knopti Creek). Generally, though, it is common above 4500'. Even though it is regionally spread, it occurs on local, disjunct areas either as one to a few trees (Joe Creek), or as a common associate in mixed stands (Horse Range Creek enriched mixed conifer stands), or as locally abundant populations (Bear Basin Butte, Indian Creek).

Brewer spruce is typically seen as individual trees or local populations on steep slopes or on ridges and open slopes (ex.Blakes Fork, Orleans Mtn.). Rarely does it form but a secondary species in these open stands. The dominant associates vary with region and elevation. The common site for the species is one with shallow, dry soils. There is a tendency to "prefer" north-facing slopes.

Brewer spruce, though, can grow successfully on the better sites, even dominating the stand. The Indian Creek stand (Tables 7, 8) is unique for this reason. Here Brewer spruce,white fir and noble fir are rapidly replacing sadler oak chaparral. The chaparral is obviously seral on this site.

Brewer spruce has also been observed as reproduction under closed mountain hemlock-shasta fir forests (Ukonom Lake), or Douglas fir-noble fir (Boulder Peak), and Douglas fir (Bear Basin Butte mixed forest). These stands are on cool, north-facing slopes. But it also reproduces under Quercus vaccinifolia-Arctostaphylos patula chaparral on dry, south-facing slopes at Orleans Mtn.

Brewer spruce seems capable of tolerating most environmental conditions, yet it does not occur everywhere. It has been seen on a variety of substrates. It tolerates hot, dry sites, and it successfully competes with other species on moist sites. It is shade tolerant. Apparently flooding is a restricting factor; it was never seen on terrace or meadow locations where waterlogging might occur. Its commonness on rocky, open areas or on north-facing slopes suggests that fire may play a role in restricting populations to local areas.

Needless to say, its ecology is not yet understood.

AUTECOLOGY OF PICEA ENGELMANNII

Engelmann spruce stands were studied between the elevations of 3300 and 6400 feet in elevation in three drainages in the Salmon-Scott Divide Area, Blake's Fork, Horse Range Creek and Sugar Creek. It was also seen in Duck Lake Creek drainage and has been said to occur in the Grizzley Creek area. Other stands are known such as the stand in Shasta County.

Engelmann spruce is typically found on alluvial terraces in the valley bottoms of these northeast-running stream valleys. Alluvial soils in this area are relatively sandy, since they are derived from granodiorite. Soils are moderately deep, but shallow alluvium over boulders will support Engelmann spruce. Trees do not require good drainage; some were seen on poorly drained soils around the wet meadows.

Even though the restriction to alluvial soils is common, trees were seen in several areas growing on moist lower tallus slopes where soils were fairly deep. Such slope conditions are relatively rare in these drainages, especially Blake's Fork. The steep, dry tallus slopes descend to the valley bottoms, so the gradient from dry to moist conditions is very steep. Moderate moisture throughout the growing season appears to be the controlling factor, since large trees were also seen around hillside seeps.

Engelmann spruce is reproducing well on fresh alluvium, on rotton logs and in duff, especially on the moist lower slope sites (Tables 28, 41). In the dense stands white fir, shasta fir and mountain hemlock seedlings are denser suggesting a more mixed canopy in the future in these areas (Tables 21, 31, 36). Stand composition is generally mixed, though white fir and/or shasta fir depending on elevation are usually more abundant than Engelmann spruce. In many areas the canopy is dominated by Engelmann spruce.

At lower elevations, in the Mixed Conifer Zone Engelmann spruce becomes more restricted to the moist, streamside locations. Here it is mixed with common species of the elevational type. One tree was observed, much to our surprise, at 3300' along Sugar Creek.

Restriction seems to be the result of suitability of moist sites in these drainages. Topography is immature so that the slopes are steep, with dry rocky tallus. Engelmann spruce's area in these drainages is increasing,

especially on sites with median soil moisture characterized by Enriched Mixed Conifer Forests. Its abundance on stream terraces may decline, except at middle and lower elevations. More study of this species is needed.

AUTECOLOGY OF PINUS BALFOURIANA

Three stands of foxtail pine were studied, two well known stands (Packer's Peak and Mount Eddy), and one new location (High Lake, Salmon-Scott Divide). All stands are at or above 7000 feet. The parent materials are schist, serpentine and granodiorite respectively. On Packer's Peak the foxtail pine forms extensive open to moderately closed stands on dry ridges and warm south-facing slopes. Mountain hemlock and shasta fir are associates there. Reproduction is notable, but not abundant. On Mt. Eddy the foxtail pine is mixed with lodgepole pine and whitebark pine in very open stands around Upper Deadfall Lake at about 7300 feet. It forms an extensive stand on south-facing slopes above Upper Deadfall Lake. This is in the headwaters of the North Fork of the Sacramento River.

At High Lake the foxtail pine is found in a mixed forest occurring on a dry ridge. Nine conifers were found in this stand, including Jeffrey pine and Juniperus communis not shown in Tables 34 and 35.

Foxtail pine dominated the mature tree sizes, but with less dominance in the reproductive sizes. Here shasta fir and mountain hemlock show high numbers indicating probable change in forest composition toward increasing importance of these species. The other six species occur sparingly in the stand.

High, dry ridges and dry, hot slopes characterize the typical site for this species. It is reproducing in the areas studied, but not densly. The shallow soils, hot and dry conditions keep competition to a minimum to maintain the pine stands.

RECOMMENDATIONS

FOR FUTURE RESEARCH

Last summer's work initiated some very interesting studies whose findings are critical to an understanding of the ecology and phytogeography of California montane vegetation. Continuing vegetational and ecological research is needed here while much of the Klamath Region is in the natural state. We

propose the following objectives for future research:

1. Continuing study of the vegetational patterns of the montane zones towards a description and evaluation of the forest patterns of the Klamath Region;
2. Continuing study of the relict conifers in the region hopefully towards an understanding of the reasons for their restrictions to specific locations.

We feel that it is of no coincidence and is of great significance that the floristically diverse forests and the relict species occur in the same areas. This means, furthermore, that we can work towards both objectives in one study.

We propose the following more immediate objectives for the 1969 field season, continued study of one or both of the following critical areas: The Salmon-Scott Divide area and the Preston Peak area. These areas are central to the understanding of the Klamath Region's vegetation patterns. By restricting our studies to these areas detailed reconnaissance can be made, including a more complete inventory of the vascular plants of the areas, since collections throughout the season are needed. Also by concentrating on these areas, the distribution of vegetation types and the populations of the relict conifers can be studied.

We see the possibility of the following information being obtained by the end of an active field season:

1. A rather complete inventory of the vascular plant flora of the study areas.
2. Definitions and descriptions of the vegetation types of the areas.
3. Locations and extent of the relict conifers in the study areas, as well as further information about the ecology of these species.

The extent of activity during the next field season will depend on the degree of financial support and previous commitments which we made. The field season will be generally from late June to about the first of October. The field season is further restricted for us due to the International Botanical Congress in late August in which we plan to participate. Analysis of the field data and report preparation is a major job after the field season is completed.

We propose the following arrangements. If money is available we propose an active field season involving us and four graduate students collecting information in the Salmon-Scott Divide area and in the Preston Peak-Clear Creek area. We would be available full time except for a part of August. By then

the graduate students would be capable of working alone with the routine collecting, describing and mapping. If such a degree of support is not available for a crew of that size, we propose that the study be restricted to the Salmon-Scott Divide Area utilizing only two graduate students.

During the Fall Quarter, and possibly the Winter Quarter, we propose to take a part-time leave from our academic duties, so that we can fully evaluate the summer's work. This would require financial support for us and two graduate assistants. Since both areas are being considered for wilderness classification some cooperative arrangements with the Klamath National Forest and the Experiment Station might be possible.

FOR NATURAL AREAS OR OTHER DESIGNATIONS

1. We have proposed to Mr. Robert Allison, Supervisor of the Six Rivers National Forest, the establishment of a Natural Area near Bear Basin Butte. The proposal is in Appendix 1. He suggested a "less permanent status" be given to it in the form of an ecological area in the revised management plan. He has designated a small spot in the revised management plan for the Siskiyou Study Area, recently published (Multiple Use Plan Review, Siskiyou Study Area, Preliminary Report, Area S-GF-3). This area is much too small to serve the desired purpose, since it includes only one of the various forest types discussed in the proposal. It fails to meet the objectives of setting the area aside; i.e., its educational values and unique research potential. The importance of the area is not that it has Brewer spruce, but that it has a significant mosaic of vegetation types and a variety of tree species. We stress the need for at least a larger "special use" area. The area should be considered as a possible Natural Area.

2. We propose the designation of the Joe Creek silver fir stand as a Natural Area. It is the largest silver fir stand in California and occurs there under a variety of site conditions. The Diamond Lake stand is effectively protected in the Marble Mountain Wilderness, and is less accessible. No contact with the personnel of the Rouge River National Forest has been made.

3. The Indian Creek Brewer spruce stand should be considered as a possible Natural Area. Its location on a site of relatively high quality, and its easy accessibility supports the area's research potential. Studies of the

stand development under such conditions as the trees replace the chaparral will be very instructive. Very few areas have such extensive populations of Brewer spruce.

4. The Mt. Eddy area might be considered as a Natural Area for foxtail pine. More study of the species in the Klamath Region is needed before we can evaluate the desirability of it over other areas. Another interesting fact about the Mt. Eddy area is the presence of Darlingtonia californica below Lower Deadfall Lake in a rather extensive slope bog. This elevation, about 7000', is extremely high for Darlingtonia. Also the bog is becoming disturbed by jeep trails through it, and should be protected from such disturbance. At least a rerouting of the jeep trails, if not a special designation of the area as botanically significant should be done.

5. A significantly large area in the Salmon-Scott Divide area should be removed from the allowable cut to preserve its botanical uniqueness due to the richness of the flora, especially the conifers, and the presence of relict species. The type of designation and the extent of the area requires much more information about the area, especially in light of the area's consideration as a possible wilderness.

6. A significantly large area in the Preston Peak-Clear Creek region should be removed from the allowable cut. It is of equal importance ecologically and botanically to the Salmon-Scott Divide Area. And it is different. A large area is needed to preserve the vegetation mosaic of the western subregion. Clear Creek offers an undisturbed watershed for scientific study. Leaving it intact will allow future comparisons to other watersheds in the area where cutting has occurred. Successional studies, without the complication of logging influences can then be conducted. It offers a relatively large watershed to study which does not contain significant stands of commercial timber. Inclusion of some commercial stands are needed, though, so that their role in the regional ecology can be evaluated. Much more study of this area is needed before more specific proposals can be made. The apparent need for an immediate decision as to wilderness designation is unfortunate since so little is known about it. Possibly a large Natural Area would be equally desirable to wilderness.

7. We have discussed the possibility of a noble fir Natural Area in the vicinity of North Trinity Mtn. with the local District Rangers. A tentative proposal is included in the appendix. This area should receive more consideration.

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TABLE 1

STAND STRUCTURE, CYCLONE GAP HIGH MIXED FOREST, PRESTON PEAK AREA

SAMPLE 1 elev. 5700'

Reprod.[1]	DF	BS	Ld	WP	WF	CN	NF	JP
X								
1- 15 cm	5	50		10	5			
16- 30		35	5	10	25		5	
31- 60		105		40	20		5	
61- 90	5	25		40	35		5	
91-120					15			
121-150								
151-180								
Trees[2]								
2.5- 9 cm	20	120	20	5	85	10	60	
10- 19	15	45		30	15			
20- 29	15	75		45	5			
30- 39	25	55		20				5
40- 49	5	5		5	5			
50- 59					5			
60- 69	5							
70- 79								
80- 89								
90- 99								
100-109								
110-119								
120+								
Stand density[3]		720						
Stand basal area[3]		23.4						

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2000 m^2
Tree sample 2000 m^2

TABLE 2

STAND STRUCTURE, CYCLONE GAP HIGH MIXED FOREST, PRESTON PEAK AREA

SAMPLE 2 elev. 5750'

Reprod.[1]	NF	BS	WP	DF	WF
X					
1- 15 cm	300	300			
16- 30	100	100			
31- 60		300			
61- 90	100				
91-120		100			
121-150					
151-180					
Trees[2]					
2.5- 9 cm	310	480	20	20	20
10- 19	390	110	50		
20- 29	240	130	80		
30- 39	260	120	60		
40- 49	100	30			
50- 59					
60- 69					
70- 79					
80- 89					
90- 99					
100-109					
110-119					
120+					
Stand density[3]	2420				
Stand basal area[3]	92.7				

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 1000 m^2

TABLE 3

TREES AND SHRUBS OF THE SISKIYOU MTNS.,
PRESTON PEAK TO LITTLE GRAYBACK

	MIDDLE ELEVATION FORESTS					HIGH FORESTS	
	Creek bottom forests	Slope for's. Closed f. Poker Flat	Clear Creek	Open forest	Mont. chaparral	Jeffrey pine woodland	Mixed forest	Jeffrey pine woodland
TREES								
Abies concolor	x	x	x	x		x	x	
Abies procera	x	x	x	x			x	x
Chamaecyparis lawsoniana	x	x	x	x		x	x	
Chamaecyparis nootkatensis							x	x
Libocedrus decurrens	x	x	x	x		x	x	
Picea breweriana	x	x	x	x			x	x
Pinus attenuata			x					
Pinus jeffreyi				x		x	x	x
Pinus lambertiana	x	x	x	x		x		
Pinus monticola	x	x		x		x	x	x
Pinus ponderosa	x		x	x				
Pseudotsuga menziesii	x	x	x	x		x	x	
Tsuga mertensiana		x						
SHRUBS								
Acer circinatum		x		x*				
Acer glabrum var. torreyi			x					
Alnus sinuata	x*			x*			x*	
Amelanchier pallida	x		x	x	x	x	x	
Arctostaphylos nevadensis			x		x	x	x	
Arctostaphylos patula	x		x		x	x	x	
Berberis pumila			x				x	
Castanopsis chrysophylla			x					
Ceanothus velutinus			x	x	x		x	x
Cornus nuttallii		x	x					
Cornus stolonifera			x					
Corylus cornuta var. californica		x	x					
Carrya fremontii			x	x	x			
Gaultheria ovatifolia			x					

	MIDDLE ELEVATION FORESTS							HIGH FORESTS	
	Creek Bottom Forests	Slope for's. Closed f. Poker Flat	Clear Creek	Open forest	Mont.,chaparral	Jeffrey pine woodland	Mixed forest	Jeffrey pine woodland
Holodiscus discolor var. delnortensis			x	x	x		x	
Linnaea borealis ssp. longiflora			x					
Lonicera conjugialis					x			
Paxistema myrsinites			x					
Physocarpus capitatus	x		x					
Prunus emarginata					x		x	
Prunus virginiana					x**			
Quercus garryana var. breweri					x**			
Quercus sadleriana	x	x	x		x		x	x
Quercus vaccinifolia	x			x	x	x	x	x
Rhamnus californica		x		x				
Rhododendron occidentale	x			x				
Ribes sanguineum			x					
Rosa gymnocarpa	x							
Rubus parviflorus		x	x					
Salix sp.	x							
Sorbus californica			x		x			
Spiraea densiflora	x							
Spiraea douglasii				x*				
Symphoricarpos hesperius			x					
Taxus brevifolia				x*				
Umbellularia californica				x	x			
Vaccinium membranaceum			x				x	
Whipplea modesta				x				

*In wetter areas
**Only on Little Grayback

TABLE 4

STAND STRUCTURE, YOUNGS VALLEY CREEK BOTTOM FOREST, PRESTON PK.

Elevation 4500 Feet

Reproduction[1]

Trees[2]	CL	WF	LD	WP	SP	NF	DF	PP
2.5- 9 cm								
10- 19	12	48					12	
20- 29	18	12		6		6		
30- 39	12	60	6	6		6	6	
40- 49	30	36						
50- 59	18	6		12	6			
60- 69		6						
70- 79	6	24	6		18			
80- 89	18	6	6			6		
90- 99		6						
100-109	12	6						
110-119	6		6					
120+	6		18				18	6

Stand density[3]	498
Stand basal area[3]	121.9

1. Reproductive layer was not quantatively sampled.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

*Trees were sampled using the Quarter method.

TABLE 5

IDENTIFIED HERBS AT SELECTED STANDS NEAR PRESTON PEAK

	MIDDLE ELEVATION FORESTS Creek bottom f.	HIGH FORESTS Mixed forest
Achyls triphylla	x	
Anemone deltoidea	x	
Castilleja miniata		x
Chimaphila umbellata var. occidentalis	x	x
Cryptogramma acrostichoides		x
Disporum hookeri	x	
Erigonum umbellatum ssp. polyanthum	x	
Galium sp.	x	
Lewecia cotyledon		x
Pedicularis racemosa	x	
Penstemon nemorosus		x
Penstemon newberryi ssp. berryi		x
Perideridia gairdneri	x	
Phlox diffusa		x
Polygonium spergulariaeformae	x	
Pteridium aquilinum var. lanuginosum	x	
Pyrola picta	x	x*
Pyrola secunda	x	x*
Sedum obtusatum ssp. boreale		x
Smilacina stellata	x	
Tiarella unifoliata	x	
Trientalis latifolia	x	
Trillium ovatum	x	

*Only under a dense forest

TABLE 6

IDENTIFIED FLORA AT INDIAN CREEK, SISKIYOU MTNS.

TREES

Abies concolor
Abies procera
Picea breweriana

SHRUBS

Acer glabrum var. *torreyi*
Amelanchier florida
Paxistema myrsinites
Quercus sadleriana
Ribes sanguineum
Salix sp.
Symphoricarpos acutus
Vaccinium membranaceum

HERBS

Achyls triphylla
Anemone deltoidea
Chimaphila menziesii
Chimphila umbellata var. *occidentalis*
Clintonia uniflora
Goodyera oblongifolia
Penstemon nemorosus
Polystichum lonchites
Pyrola picta
Pyrola secunda
Rubus lasiococcus
Trillium ovatum

TABLE 7

STAND STRUCTURE, INDIAN CREEK BREWER SPRUCE AREA, SISKIYOU MTNS.

SAMPLE 1 elev. 5100'

Reprod.[1]	WF	BS	DF	NF	SP
X				5400	
1- 15 cm	5500	3200		200	
16- 30	500	200		100	
31- 60	1100	100		400	
61- 90	1500	200		100	
91-120	1500	100			
121-150					
151-180					
Trees[2]					
2.5- 9 cm	880	220	120		
10- 19	30	90	40		
20- 29		10	25		
30- 39		5			
40- 49		5			
50- 59					
60- 69		5			
70- 79		5			
80- 89		5			
90- 99					
100-109					
110-119			5		
120+				5	
Stand density[3]	1715				
Stand basal area[3]	35.3				

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 8

STAND STRUCTURE, INDIAN CREEK BREWER SPRUCE AREA, SISKIYOU MOUNTAINS

SAMPLE 2 elev. 5100'

Reprod.[1]	SP	NF	DF	WF	BS
X					
1- 15 cm					
16- 30			100	100	
31- 60		100			100
61- 90				100	
91-120		100	100	400	
121-150				200	
151-180					
Trees[2]					
2.5- 9 cm		150	20	485	345
10- 19		45		70	155
20- 29		10		10	85
30- 39		5	5	10	25
40- 49					15
50- 59					20
60- 69				5	10
70- 79					5
80- 89					
90- 99					
100-109					
110-119					5
120+	10		5		
Stand density[3]	1495				
Stand basal area[3]	53.6				

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 9

STAND STRUCTURE, BEAR BASIN BUTTE MIXED FOREST, SISKIYOU MOUNTAINS

elev. 4400'

Reprod.[1]	WF	TB	BS	DF	MH	SP
X						
1- 15 cm	2600	1600	200	100	100	100
16- 30	3700	900	100			
31- 60	2300	700	100			
61- 90	1000	100				
91-120	400					
121-150						
151-180						
Trees[2]						
2.5- 9 cm	290	20	15			
10- 19	10	10	20		5	
20- 29						
30- 39						
40- 49	5					
50- 59				5		
60- 69				10		
70- 79	5					
80- 89				5		
90- 99				25		
100-109				10		
110-119				10		
120+				5		
Stand density[3]	450					
Stand basal area[3]	54.8					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 10

KNOPTI CREEK BREWER SPRUCE STAND, SISKIYOU MOUNTAINS

Trees

Arbutus menziesii
Chamaecyparis lawsoniana
Lithocarpus densiflora
Picea breweriana
Pinus lambertiana
Pseudotsuga menziesii

Shrubs

Amelanchier pallida
Castanopsis chrysophylla
Linnaea borealis ssp. *longiflora*
Quercus vaccinifolia
Rhododendron macrophyllum
Vaccinium scoparium

TABLE 11

TREES AND SHRUBS OF THE BOULDER PEAK AREA, SISKIYOU MTNS.

TREES

Abies concolor
Abies procera
Chamaecyparis lawsoniana
Libocedrus decurrens
Picea breweriana
Pinus lambertiana
Pinus monticola
Pinus ponderosa
Pseudotsuga menziesii

SHRUBS

Acer glabrum var. *torreyi*
Amelanchier pallida
Arctostaphylos nevadensis
Arctostaphylos patula
Ceanothus velutinus
Cornus stolonifera
Quercus sadleriana
Quercus vaccinifolia
Rhododendron occidentale
Spiraea douglasii
Taxus brevifolia

TABLE 12

IDENTIFIED FLORA OF THE ORLEANS MOUNTAIN AREA

TREES

Abies concolor
Abies procera
Picea breweriana
Pinus lambertiana
Pseudostuga menziesii

SHRUBS

Amelanchier pallida
Arctostaphylos nevadensis
Garrya fremontii
Quercus sadleriana
Quercus vaccinifolia
Ribes lobbii
Rosa gymnocarpa
Symphoricarpos hesperius
Taxus brevifolia
Vaccinium membranaceum

HERBS

Achlys triphylla
Anemone deltoidea
Chimaphila menziesii
Chimaphila umbellata var. *occidentalis*
Goodyera oblongifolia
Penstemon nemorosus
Pyrola picta
Pyrola secunda

TABLE 13

STAND STRUCTURE, ORLEANS MOUNTAIN BREWER SPRUCE STAND

Elevation 5200 to 5600 Feet

Reprod.[1]	WB	BS	WF	NF
X				
1- 15 cm	1200	300		
16- 30	1300	300		1500
31- 60	900	300		
61- 90	100			
91- 120				
121-150				
151-180				
Trees[2]				
2.5- 9 cm	55	70	425	160
10- 19	5	25	80	40
20- 29	10	35	40	25
30- 39		15	15	20
40- 49	15	20	5	20
50- 59	5	20	15	
60- 69		10	20	
70- 79				
80- 89				
90- 99	5	5		
100-109				
110-119				
120+				
Stand density[3]	1160			
Stand basal area[3]	48.1			

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 14

IDENTIFIED TREES AND SHRUBS OF THE NORTH TRINITY MTN. AREA

TREES

Abies concolor
Abies procera
Libocedrus decurrens
Pinus monticola

SHRUBS

Acer glabrum var. *torreyi*
Arctostaphylos nevadensis
Ceanothus velutinus
Holodiscus microphyllus
Penstemon newberryi ssp. *berryi*
Prunus emarginata
Quercus sadleriana
Salix sp.
Vaccinium occidentale

TABLE 15

IDENTIFIED FLORA OF THE JOE CREEK SILVER FIR FOREST, SISKIYOU MTNS.

TREES

Abies amabilis
Abies procera
*Picea breweriana**
Pinus monticola
Tsuga mertensiana

SHRUBS

Ribes menziesii
*Quercus sadleriana**
Vaccinium membranaceum

HERBS

Anemone deltoidea
Anemone quiquefolia var. *minor*
Arenaria macrophylla
Arnica sp.
Chimaphila umbellata var. *occidentalis*
Clintonia uniflora
Goodyera oblongifolia
Listera convallarioides
Luzula sp.
Myosotis sp.
Osmorhiza chilensis
Pyrola picta
Rubus lasiococcus
Smilacina racemosa var. *amplexicaulis*
Trillium ovatum
Valeriana sitchensis
Viola glabella

*In clearcut

TABLE 16

STAND STRUCTURE, JOE CREEK SILVER FIR FOREST, SISKIYOU MOUNTAINS

SAMPLE 1 elev. 5900'

Reprod.[1]	MH	SF	NF
X		400	
1- 15 cm		8300	
16- 30	200	2300	
31- 60		3000	
61- 90		1100	
91-120		1100	
121-150		400	
151-180		200	
Trees [2]			
2.5- 9 cm	15	300	
10- 19	35	170	
20- 29	30	135	
30- 39	30	125	
40- 49	10	40	
50- 59		5	
60- 69	15	25	
70- 79		15	
80- 89		15	
90- 99			
100-109	5		
110-119			
120+	10	5	10
Stand density[3]	695		
Stand basal area[3]	90.8		

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 17

STAND STRUCTURE, JOE CREEK SILVER FIR FOREST, SISKIYOU MOUNTAINS

SAMPLE 2 elev. 5700'

Reprod.[1]	SF	NF	WP	MH
X	600			
1- 15 cm	2200			
16- 30	800			
31- 60	600			
61- 90	600			
91-120	400			
121-150				200
151-180	200			
Trees[2]				
2.5- 9 cm				
10- 19	433	8		183
20- 29	225			208
30- 39	117	8	8	150
40- 49	75		8	117
50- 59	42		17	25
60- 69				17
70- 79	25			17
80- 89				
90- 99				
100-109				
110-119				
120+				
Stand density[3]	1683			
Stand basal area[3]	68.8			

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 50 m^2
Tree sample: 1200 m^2

TABLE 18

STAND STRUCTURE, JOE CREEK SILVER FIR FOREST, SISKIYOU MOUNTAINS

SAMPLE 3 elev. 5600'

Reprod. [1]	SF	MH
x	100	
1- 15 cm	666	
16- 30	150	
31- 60	33	
61- 90	17	
91-120	17	
121-150	17	
151-180	17	
Trees [2]		
2.5- 9 cm	242	42
10- 19	25	42
20- 29	42	33
30- 39	33	33
40- 49	33	25
50- 59	25	
60- 69	25	17
70- 79	8	42
80- 89	17	8
90- 99		
100-109		
110-119		
120+		
Stand density [3]	692	
Stand basal area [3]	77.6	

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 60 m^2
Tree sample: 1200 m^2

TABLE 19

STAND STRUCTURE, DIAMOND LAKE SILVER FIR FOREST, SALMON MTNS.

SAMPLE 1 elev. 6600'

Reprod.[1]	SF	MH	WP	ShF
X	333			167
1- 15 cm	7664	167		666
16- 30	333			
31- 60	500	167		167
61- 90		167		
91-120		333		
121-150				
151-180				
Trees[2]				
2.5- 9 cm	142	117		8
10- 19	67	83	8	
20- 29	83	83		
30- 39	75	67		
40- 49	33	8		
50- 59	8	8		
60- 69		8		
70- 79		8		8
80- 89		16		
90- 99				
100-109				
110-119				
120+				
Stand density[3]	826			
Stand basal area[3]	53.6			

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 60 m^2
Tree sample: 1200 m^2

TABLE 20

STAND STRUCTURE, DIAMOND LAKE SILVER FIR FOREST, SALMON MTNS.

SAMPLE 2 elev. 6600'

Reprod.[1]	MH	SF	ShF
X		1000	
1- 15 cm	100	32400	
16- 30	100	1000	
31- 60	100	1600	
61- 90	100	900	
91-120	100	800	
121-150			
151-180			
Trees[2]			
2.5- 9 cm	235	410	
10- 19	215	140	
20- 29	70	120	
30- 39	65	110	
40- 49	10	70	
50- 59	15	25	
60- 69	5	20	
70- 79	10	5	
80- 89	10		
90- 99	5		5
100-109	5		5
110-119			
120+			
Stand density[3]	1555		
Stand basal area[3]	81.7		

1. Reproduction given in height, dm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 21

STAND STRUCTURE, DIAMOND LAKE SILVER FIR FOREST, SALMON MOUNTAINS

SAMPLE 3 elev. 6800'

Reprod.[1]	SF	MH	ShF
X			
1- 15 cm	5497		
16- 30	333		
31- 60			
61- 90	167		
91-120			
121-150			
151-180	5998		
Trees[2]			
2.5- 9 cm	42	17	
10- 19		108	
20- 29		133	8
30- 39	8	267	
40- 49	8	125	17
50- 59	8	8	17
60- 69	8		17
70- 79			
80- 89			
90- 99			
100-109			
110-119			
120+			
Stand density[3]	791		
Stand basal area[3]	69.3		

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 60 m^2
Tree sample: 1200 m^2

TABLE 22

IDENTIFIED FLORA OF THE DIAMOND LAKE AREA, SALMON MOUNTAINS

	Silver fir forest	Mixed woodland	
		Wet meadow	Dry rocks
TREES			
Abies amabilis	x		
Abies magnifica var. shastensis	x	x	
Picea breweriana		x	
Pinus monticola	x	x	
Tsuga mertensiana	x	x	
SHRUBS			
Amelanchier pallida			x
Arctostaphylos nevadensis			x
Kalmia polifolia var. microphylla		x	
Leucothoe davisiae		x	
Lonicera conjugialis		x	
Phyllodoce empetriformis		x	
Ribes sanguineum			x
Salix commutata		x	
Sorbus californica		x	
Vaccinium arbuscula		x	
Vaccinium membranaceum	x		
Vaccinium scoparium		x	
HERBS			
Arenaria congesta			x
Aster alpigenus ssp. andersonii		x	
Caltha howellii		x	
Carex sp.		x	
Lewesia leana			x
Luetkea pectinata			x
Monotropa hypopithys	x		
Pedicularis racemosa	x		
Penstemon newberryi ssp. berryi			x
Phlox diffusa			x
Pyrola picta	x		
Pyrola secunda	x		
Rumex californicus			x
Sedum obtusatum ssp. boreale			x
Tofieldia glutinosa ssp. occidentalis		x	

TABLE 23

DISTRIBUTION OF TREES ACCORDING TO THE DRAINAGE
SALMON-SCOTT DIVIDE

	Meeks Meadow Creek	Paynes Lake Creek	Horse Range Creek	Duck Lake Creek	Sugar Creek	South Russian Creek
WHITEBARK PINE ZONE						
Brewer spruce						x
Douglas fir					x	
Foxtail pine					x	
Jeffrey pine						
Lodgepole pine					x	
Mountain hemlock		x	x	x	x	x
Shasta fir		x	x	x	x	x
Western white pine					x	x
Whitebark pine			x	x	x	x
White fir					x	x
SHASTA FIR ZONE						
Brewer spruce			x	x		x
Engelmann spruce			x	x		
Jeffrey pine					x	
Lodgepole pine			x	x	x	
Mountain hemlock	x	x	x	x	x	x
Shasta fir	x	x	x	x	x	x
Subalpine fir				x		
Western white pine	x	x	x	x	x	x
White fir		x	x	x		x
MIXED CONIFER/ SHASTA FIR ZONE						
Brewer spruce		x	x		x	x
Douglas fir	x	x	x	x	x	x
Engelmann spruce			x	x	x	x
Incense cedar	x	x	x		x	x
Lodgepole pine			x	x	x	x
Mountain hemlock	x		x	x	x	x
Ponderosa pine		x	x		x	
Shasta fir	x	x	x	x	x	x
Subalpine fir					x	
Sugar pine	x	x	x		x	x
Western white pine	x	x	x	x	x	x
White fir	x	x	x	x	x	x
MIXED CONIFER ZONE						
Douglas fir	x	x	x		x	x
Engelmann spruce			x		x	x
Incense cedar	x	x	x		x	x
Ponderosa pine	x	x	x		x	x
Sugar pine		x	x		x	x
White fir	x	x	x		x	x

TABLE 24

TREES AND SHRUBS OF HORSE RANGE CREEK DRAINAGE

	SHASTA FIR ZONE		MIXED CONIFER/ SHASTA FIR Z.			MIXED CONIFER ZONE
	Brewer sp./ mont. chap.	Shasta fir/ w. wh. pine/ mt. hemlock	Engelmann spruce	Brewer sp./ mont.chap.	Enriched mix. con.	Engelmann spruce
TREES						
Abies concolor	x		x	x	x	x
Abies magnifica var. shastensis	x	x	x	x	x	
Libocedrus decurrens					x	x
Picea breweriana	x	x	x	x	x	
Picea engelmannii			x		x	x
Pinus contorta var. murrayana	x		x		x	
Pinus lambertiana			x	x	x	x
Pinus monticola	x	x	x	x	x	
Pinus ponderosa					x	x
Pseudotsuga menziesii			x		x	x
Tsuga mertensiana	x	x	x	x		
SHRUBS						
Alnus sinuata		x*	x			
Alnus tenuifolia		x*	x			
Amelanchier pallida			x	x	x	
Arctostaphylos nevadensis	x			x	x	
Arctostaphylos patula	x					
Berberis nervosa					x	
Castanopsis sempervirens	x		x	x	x	
Holodiscus microphyllus	x					
Kalmia polifolia var. microphylla			x			
Ledum glandulosum var. californicum		x*				
Leucothoe davisiae		x*	x			
Linnaea borealis ssp. longiflora			x		x	
Lonicera conjugialis		x*	x			
Paxistima myrsinites			x		x	
Penstemon newberryi ssp. berryi	x					

	SHASTA FIR ZONE		MIXED CONIFER/ SHASTA FIR Z.			MIXED CONIFER ZONE
	Brewer sp./ mont. chap.	Shasta fir/ w. wh. pine/ mt. hemlock	Engelmann spruce	Brewer sp./ mont. chap.	Enriched mix. con.	Engelmann spruce
Phyllodoce empetriformis		x*	x			
Quercus vaccinifolia				x	x	
Ribes cereum		x*				
Ribes lacustre		x*	x			
Rosa gymnocarpa					x	
Rubus parviflorus			x			
Sorbus californica				x		
Spiraea douglasii		x*				
Symphoricarpos hesperius			x			
Taxus brevifolia			x			x
Vaccinium membranaceum	x					
Vaccinium scoparium		x*	x	x		

*Near creek and/or Horse Range Lake

TABLE 25

IDENTIFIED HERBS, HORSE RANGE CREEK DRAINAGE

	SHASTA FIR ZONE	MIXED CONIFER/ SHASTA FIR ZONE	
	Brewer sp./ mont. chap.	Engelmann spruce	Enriched mix. con.
Adenocaulon bicolor		x	
Anemone deltoidea		x	x
Apocynum sp.	x		x
Arenaria congesta	x		x
Caltha howellii		x	
Castilleja pruinosa	x		
Chimaphila umbellata var. occidentalis		x	x
Clintonia uniflora		x	x
Corallorhiza mertensiana			x
Cypripedium montanum		x	
Disporum hookeri		x	x
Dodecatheon jeffreyi		x	
Habenaria sparsiflora		x	
Mitella pentandra		x	
Pteridium aquilinum var. lanuginosum	x	x	x
Pyrola picta		x	x
Pyrola secunda		x	x
Sedum obtusatum ssp. boreale	x		
Smilacina stellata var. sessifolia		x	
Streptopus amplexifolius var. denticulatus		x	
Trillium ovatum		x	
Viola glabella		x	

TABLE 26

STAND STRUCTURE, HORSE RANGE CREEK BREWER SPRUCE-MONTANE CHAPARRAL

elev. 6600'

Reprod.[1]	ShF	WF	MH	WP	BS	LP
X						
1- 15 cm	28		2		2	
16- 30	64		17		4	
31- 60	68		32	8	4	
61- 90	52	4	11	17	6	
91-120	32	2	13	4	11	2
121-150	15		4	4		
151-180	4		4			
180+	2					
Trees[2]						
2.5- 9 cm	87	12	59	13	11	2
10- 19	85	2	51	8	11	2
20- 29	34	6	8	11	4	
30- 39	21	2	11	4	2	2
40- 49	17		11	4	13	2
50- 59	11		4	11	4	2
60- 69	21				2	
70- 79	2			6	2	
80- 89						
90- 99					2	
100-109	2					
110-119						
120+	2					
Stand density[3]	570					
Stand basal area[3]	46.2					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 4700 m^2
Tree sample: 4700 m^2

TABLE 27

STAND STRUCTURE, HORSE RANGE CREEK ENRICHED MIXED CONIFER FOREST

elev. 5400'

Reprod.[1]	DF	PP	WF	BS	WP	LP	SP	ES	ShF
X									
1- 15 cm	5		50	20					
16- 30	10		35	5	15				10
31- 60	5		85	20	5				40
61- 90	10		50	15	5				15
91-120			25	10	15				5
121-150			20	15	15				10
151-180			10	15					15
181-210				5					
Trees[2]									
2.5- 9 cm	5		415	35	40				80
10- 19			250	10					20
20- 29			85	10					5
30- 39			35	25					5
40- 49			25	10	5			5	
50- 59			20	15	10	5			
60- 69			5	5					
70- 79	5			10	5				
80- 89	5			5	5				
90- 99									
100-109							5		
110-119									
120+		5							

Stand density[3]	1170
Stand basal area[3]	64.3

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal areas are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2000 m^2
Tree sample: 2000 m^2

TABLE 28

STAND STRUCTURE, HORSE RANGE CREEK ENGELMANN SPRUCE FOREST

SAMPLE 1 elev. 6000'

Reprod.[1]	WF	WP	ShF	ES	MH	DF
X						
1- 15 cm	450	20		125		
16- 30	45	5		5		
31- 60	35		30			
61- 90	45	5	10	5		
91-120	15	5	15	10		
121-150	5	5	10	5	10	
151-180		5		5		
180+		5				
Trees[2]						
2.5- 9 cm	80	35	20	10		
10- 19	15		5	5		
20- 29	45			5	5	
30- 39	50			5		5
40- 49	30			20	5	
50- 59	30			20		
60- 69	5			5		
70- 79						
80- 89				5		
90- 99	5					5
100-109			5	5		
110-119						
120+						
Stand density[3]	445					
Stand basal area[3]	57.2					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2000 m^2
Tree sample: 2000 m^2

** 2/3 of seedlings on rotten logs

TABLE 29

STAND STRUCTURE, HORSE RANGE CREEK ENGELMANN SPRUCE FOREST

SAMPLE 2 elev. 5400'

Reprod.[1]	MH	ShF	ES	WF	LP	WP	LD
X							
1- 15 cm							
16- 30	21	12					
31- 60	83	62		29		4	4
61- 90	100	79	12	67		8	
91-120	71	71	21	21	4	17	
121-150	37	25	12		8		
151-180	8	12	4		4		
Trees [2]							
2.5- 9 cm	358	195	92	92	33	21	
10- 19	133	71	33	37	4	8	
20- 29	42	29	8	4	24	12	
30- 39	21	12	4		4		
40- 49	42	25	54	4			
50- 59	8	12	25		4	8	
60- 69	4		21		8	4	
70- 79	4	4	4				
80- 89			8				
90- 99			4				
100-109							
110-119							
120+							
Stand density[3]	1468						
Stand basal area[3]	68.4						

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2400 m^2
Tree sample: 2400 m^2

TABLE 30

IDENTIFIED FLORA OF THE SUBALPINE FIR FOREST
WEST OF LITTLE DUCK LAKE

TREES	
Abies lasiocarpa	*Pinus monticola*
Abies magnifica var. *shastensis*	*Tsuga mertensiana*
SHRUBS	
Gaultheria humifusa	*Ribes lacustre*
Kalmia poliofolia var. *microphylla**	*Salix* sp.*
Leucothoe davisiae	*Vaccinium membranaceum*
*Phyllodoce empetriformis**	*Vaccinium scoparium**
HERBS	
*Caltha howellii**	*Pyrola picta*
Clintonia uniflora	*Saxifraga ferruginea**
Corallorhiza mertensiana	*Senicio triangularis**
*Dodecathoen jeffreyi**	*Tofieldia glutinosa* ssp. *occidentalis**
Luetkea pectinata	
*Potentilla flabellifolia**	*Veratrum californicum**

*Plants of adjoining sedge meadow

TABLE 31

STAND STRUCTURE, LITTLE DUCK LAKE SUBALPINE FIR FOREST, SALMON-SCOTT DIVIDE elev. 6400'

Reprod.[1] X	SAF	MH	WP	ShF
1- 15 cm	8			
16- 30	309	8		
31- 60	198			
61- 90	214	32		
91-120	16	32		
121-150	143	24		
151-180	24	8		
Trees[2]				
2.5- 9 cm	503	328	8	4
10- 19	225	145	4	
20- 29	125	67		
30- 39	116	42		
40- 49	83	33		4
50- 59	12			4
60- 69		4		
70- 79				
80- 89				
90- 99				
100-109				
110-119				
120+				
Stand density[3]	1710			
Stand basal area[3]	53.8			

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare respectively.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 1260 m^2
Tree sample: 2400 m^2

TABLE 32

TREES OF THE HIGH LAKE AREA AND SUGAR CREEK DRAINAGE

	Whitebark pine zone		Shasta fir zone		Mixed conifer/ shasta F.	Mixed conifer zone	
	Foxtail pine	Whitebark p./ shasta fir/ mt. hemlock	Subalpine fir	Shasta fir/ w. wh. pine/ mt. hemlock	Engelmann sp./ subalpine fir	Engelmann spruce	Engelmann spruce
Abies concolor	x					x	x
Abies lasiocarpa			x		x		
Abies magnifica var. shastensis	x	x		x	x	x	x
Libocedrus decurrens						x	x
Picea breweriana						x	
Picea engelmannii					x	x	
Pinus albicaulis	x	x					
Pinus balfouriana	x						
Pinus contorta var. murrayana	x				x	x	x
Pinus jeffreyi	x						
Pinus lambertiana							x
Pinus monticola	x		x	x	x	x	
Pinus ponderosa							x
Pseudotsuga menziesii						x	x
Tsuga mertensiana	x	x	x	x	x		
Salix scouleriana						x	

TABLE 33

IDENTIFIED SHRUBS AND HERBS,
HIGH LAKE AREA AND SUGAR CREEK DRAINAGE

	Foxtail pine forest	Engelmann spruce forests	
	Whitebark pine zone	Mixed conifer/ shasta fir zone	Mixed conifer zone
SHRUBS			
Alnus sinuata		x	
Alnus tenuifolia		x	
Amelanchier florida		x	x
Amelanchier pallida	x		x*
Arctostaphylos nevadensis	x		
Arctostaphylos patula	x		
Berberis nervosa		x	x
Castanopsis chrysophylla		x	
Castanopsis sempervirens			x
Cornus stolonifera		x	
Cornus nuttallii		x	
Holodiscus microphyllus	x	x	
Juniperus communis var. saxatilis	x		
Linnaea borealis var. longiflora		x	x
Lonicera conjugialis		x	
Leucothoe davisiae		x	
Quercus vaccinifolia	x		x*
Ribes lacustre		x	x
Rosa gymnocarpa		x	x
Rubus parviflorus		x	
Salix caudata var. bryantiana		x	
Sorbus cascadensis		x	
Spiraea douglasii		x	
Symphoricarpos hesperius		x	x
Taxus brevifolia		x	
Vaccinium membranaceum		x	
Vaccinium scoparium		x	
HERBS			
Achellea lanulosa	x		
Aconitum columbianum			x
Adenocaulon bicolor		x	x

	Foxtail pine forest	Engelmann spruce forests	
	Whitebark pine zone	Mixed conifer/ shasta fir zone	Mixed conifer zone
Anemone deltoidea		x	x
Anemone quiquefolia var. minor		x	
Arenaria congesta	x		
Caltha howellii		x	
Calyptredium umbellatum	x		
Chimaphila menziesii		x	x
Chimaphila umbellata var. occidentalis		x	x
Clintonia uniflora		x	x
Corallorhiza mertensiana		x	
Dicentra formosa		x	
Disporum hookeri			x
Galium sp.		x	x
Goodyera oblongifolia		x	x
Habenaria sparsiflora		x	x
Listera convallarioides		x	x
Lotus oblongifolius			x
Mimilus sp.		x	
Mitella pentandra		x	x
Montia sibirica		x	
Osmorhiza purpurea		x	
Penstemon nerberryi ssp. berryi	x		
Phlox diffusa	x		
Pteridium aquilinum var. lanuginosum		x	x
Pyrola picta		x	x
Pyrola secunda		x	x
Rumex californicus	x		
Sedum obtusatum ssp. borcale	x		
Senicio triangularis		x	x
Smilacina racemosa var. amplexicaulis		x	x
Smilacina stellata var. sessifolia		x	x
Streptanthus tortuosus	x		
Trillium ovatum		x	x
Vicia americana			x
Viola glabella		x	

*In dry openings

TABLE 34

STAND STRUCTURE, HIGH LAKE FOXTAIL PINE FOREST, SALMON-SCOTT DIVIDE

SAMPLE 1 elev. 7200'

Reprod.[1]	MH	FP	LP	WP	WBP	ShF	WF
X						8	
1- 15 cm	75	25				233	
16- 30	67	17	8			200	
31- 60	158	17			8	192	8
61- 90	50					83	
91-120	42					50	
121-150	50	8				33	
151-180							
Trees[2]							
2.5- 9 cm	192	8			8	83	
10- 19	83	25	8		8	33	
20- 29	58	25	17			17	
30- 39	17	17		17		17	
40- 49		17	8			8	
50- 59							
60- 69							
70- 79							
80- 89							
90- 99							
100-109							
110-119							
120+							

Stand density[3]	658
Stand basal area[3]	19.0

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 1200 m^2
Tree sample: 1200 m^2

TABLE 35

STAND STRUCTURE, HIGH LAKE FOXTAIL PINE FOREST, SALMON-SCOTT DIVIDE

SAMPLE 2 elev. 7200'

Reprod.[1]	MH	FP	WF	LP	ShF	WP
X						
1- 15 cm					5	
16- 30		5			15	
31- 60		10		5	40	
61- 90					5	
91-120	5			5	20	
121-150					5	5
151-180						
Trees[2]						
2.5- 9 cm	10	5	20	10	65	
10- 19		10		20	10	
20- 29		10			5	5
30- 39		5		10		
40- 49		15		15		5
50- 59		5			5	5
60- 69		5				
70- 79		5				
80- 89						
90- 99		10				
100-109						
110-119						
120+		5				
Stand density[3]		260				
Stand basal area[3]		29.3				

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X = first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2000 m^2
Tree sample: 2000 m^2

TABLE 36

STAND STRUCTURE, SUGAR CREEK ENGELMANN SPRUCE FOREST

SAMPLE 1 elev. 5900'

Reprod.[1]	WF	WP	ES	LP	MH	ShF
X	115					65
1- 15 cm	110				5	225
16- 30	90					60
31- 60	55				5	40
61- 90	25					20
91-120	40					30
121-150						
151-180						
Trees[2]						
2.5- 9 cm	445	10	10	10	15	220
10- 19	230	5	10	20	5	100
20- 29	55		5	50		10
30- 39	15	5	20	85	5	
40- 49	10	10		60	5	5
50- 59	5			35		10
60- 69	5			5		
70- 79			5	15		
80- 89	5					
90- 99	5					
100-109						
110-119			5			
120+						
Stand density[3]	1515					
Stand basal area[3]	71.8					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2000 m^2
Tree sampel: 2000 m^2

TABLE 37

STAND STRUCTURE, SUGAR CREEK ENGELMANN SPRUCE FOREST

SAMPLE 2 elev. 5700'

Reprod.[1]	WF	LP	ES	DF	MH	WP	LD	SHF	SALIX
X	100			100					
1- 15 cm	1400		100			100		100	
16- 30	300								
31- 60	200		100						
61- 90	500		100						
91-120	300								
121-150	100		100						
151-180									
Trees[2]									
2.5- 9 cm	570	10	470	120	20	20	10	80	10
10- 19	160	80	350	80				50	
20- 29	120	40	170					10	
30- 39	10	110	40	10					
40- 49		40	20			10			
50- 59			10						
60- 69									
70- 79	10								
80- 89									
90- 99	10								
100-109									
110-119									
120+									
Stand density[3]	2640								
Stand basal area[3]	64.5								

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 1000 m^2

TABLE 38

STAND STRUCTURE, SUGAR CREEK ENGELMANN SPRUCE FOREST

SAMPLE 3 elev. 5600'

Reprod.[1]	WF	MH	ES	DF	LP	ShF
X	200					
1- 15 cm	3400	500				
16- 30						
31- 60	100					
61- 90						
91-120						
121-150						
151-180						
Trees[2]						
2.5- 9 cm	315	25	100	5		30
10- 19	155	30	135		10	
20- 29	90	10	60	10	5	
30- 39	20	5	45	15	10	5
40- 49	20	5	35			
50- 59	15	5	30		5	10
60- 69	10		15	5		
70- 79	5		10			
80- 89	5		10			
90- 99	15					
100-109						5
110-119						
120+						
Stand density[3]	1285					
Stand basal area[3]	57.2					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 39

STAND STRUCTURE, SUGAR CREEK ENGELMANN SPRUCE FOREST

SAMPLE 4 elev. 5300'

Reprod.[1]	WF	ES	DF	PP	LD	LP	SP	ShF	SALIX
X									
1- 15 cm	1900	100							
16- 30	300		200						
31- 60	200	200	200		100				
61- 90		300					100		
91-120	100	100					100		
121-150									
151-180									
Trees[2]									
2.5- 9 cm	695	270	100		15	15	10	60	5
10- 19	195	20	35		5			15	
20- 29	60	25							
30- 39	20	10	5		5				
40- 49	5	10	5	5	15				
50- 59		5		5	5				
60- 69		10	10		5			25	
70- 79		5		5					
80- 89			5	5					
90- 99			5	10					
100-109			5	10					
110-119			5						
120+				15					
Stand density[3]	1975								
Stand basal area[3]	98.9								

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 100 m^2
Tree sample: 2000 m^2

TABLE 40

TREES AND SHRUBS OF BLAKE'S FORK DRAINAGE

	SHASTA FIR ZONE	MIXED CONIFER/ SHASTA FIR Z.		MIXED CONIFER ZONE
	Shasta fir/ w. wh. pine/ mt. hemlock	Engelmann spruce	Brewer sp./ mont. chap.	Engelmann spruce
TREES				
Abies concolor	x	x	x	x
Abies magnifica var. shastensis	x	x	x	x
Libocedrus decurrens		x	x	x
Picea breweriana	x		x	
Picea engelmannii		x		x
Pinus contorta var. murrayana		x		
Pinus lambertiana			x	x
Pinus monticola	x		x	
Pinus ponderosa				x
Pseudotsuga menziesii				x
Tsuga mertensiana	x	x	x	x
Populus tremuloides			x	
Salix scouleriana				x
SHRUBS				
Acer glabrum var. torreyi		x	x	
Alnus sinuata		x	x	x
Alnus tenuifolia		x		
Amelanchier pallida	x	x*	x	x
Arctostaphylos nevadensis	x			
Arctostaphylos patula			x	
Berberis nervosa		x		x
Castanopsis chrysophylla				x
Castanopsis sempervirens		x		
Cornus stolonifera				x
Corylus cornuta var. californica		x	x	x
Holodiscus microphyllus	x			
Leucothoe davisiae		x		
Linnaea borealis ssp. longiflora		x		x

	SHASTA FIR ZONE	MIXED CONIFER/ SHASTA FIR Z.		MIXED CONIFER ZONE
	Shasta fir/ w. wh. pine/ mt. hemlock	Engelmann spruce	Brewer sp./ mont. chap.	Engelmann spruce
Lonicera conjugialis			x	
Paxistema myrsinites		x		x
Phyllodoce empetriformis	x			
Prunus emarginata			x	
Prunus virginiana var. melanocarpa			x	
Quercus vaccinifolia		x*	x	
Ribes cereum		x*	x	
Ribes lacustre		x	x	
Ribes sanguineum	x	x	x	
Rosa pisocarpa				x
Rosa sp.		x		
Rubus parviflorus		x		x
Salix sp.		x	x	
Sambucus microbotrys	x			
Sorbus californica			x	
Sorbus cascadensis				x
Spiraea douglasii		x		
Symphoricarpos hesperius		x		x
Taxus brevifolia		x		x
Vaccinium membranaceum	x	x	x	x

*On drier sites only

TABLE 41

STAND STRUCTURE, BLAKES FORK ENGELMANN SPRUCE FOREST

SAMPLE 3 elev. 5700'

Reprod.[1]	WF	ES	LP	MH	LD	SALIX
X						
1- 15 cm	137	20			13	
16- 30		3				
31- 60	10	23			57	
61- 90	13	17		3	69	
91-120					47	
121-150	3	7			23	
151-180					3	
Trees[2]						
2.5- 9 cm	7	13			7	
10- 19	33	10	3	3		3
20- 29	27	20				
30- 39	13	33			3	
40- 49	7	37				
50- 59	10	3				
60- 69	13	23				
70- 79	10	27				
80- 89	10	10				
90- 99	3	3				
100-109						
110-119						
120+	7					
Stand density[3]	343					
Stand basal area[3]	74.8					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 3000 m^2
Tree sample: 3000 m^2

** $\frac{1}{2}$ of seedlings on rotton logs

TABLE 42

STAND STRUCTURE, BLAKES FORK ENGELMANN SPRUCE FOREST

SAMPLE 4 elev. 6400'

Reprod.[1]	WF	ES	LD	MH	SP	SALIX
X	**					
1- 15 cm	198					
16- 30	52				5	
31- 60	72	5	5			
61- 90	29	5				
91-120	24	5				
121-150	19	5				
151-180	14	5		5		
Trees[2]						
2.5- 9 cm	109	14	5			5
10- 19	71	48				10
20- 29	19	29				
30- 39	23	38				
40- 49	10	14				
50- 59	5	14				
60- 69	5	33				
70- 79		19				
80- 89	5	14				
90- 99	5	24				
100-109	5	14				
110- 119	5					
120+						
Stand density[3]	543					
Stand basal area[3]	85.8					

1. Reproduction given in height, cm. Any individual less than 2.5 cm in diameter was considered part of the reproductive layer. Values given per hectare. X= first year seedlings.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Reproduction sample: 2100 m^2
Tree sample: 2100 m^2

** 25 seedlings on rotten log.

TABLE 43

STAND STRUCTURE, FLAKES FORK ENGELMANN SPRUCE FOREST

SAMPLE 1 elev. 4700'

Reprod. [1]

Trees [2]	WF	LD	ShF	SP	ES	SALIX
2.5- 9 cm	20					
10- 19	140					
20- 29	80		20			20
30- 39	40	20				
40- 49	20					
50- 59		20				
60- 69					20	
70- 79	20					
80- 89						
90- 99						
100-109						
110-119						
120+				20		

Stand density [3]	440
Stand basal area [3]	53.7

1. Reproduction insufficiently sampled.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm. Values given in number of trees per hectare and square meters per hectare respectively.

* Tree sample: 500 m^2

TABLE 44

STAND STRUCTURE, BLAKES FORK ENGELMANN SPRUCE FOREST

SAMPLE 2 elev. 4800'

Reprod.[1]

Trees[2]	WF	SP	DF	ES	BF
2.5- 9 cm	44				
10- 19	56				
20- 29	67		11	11	
30- 39	78		11		
40- 49	11				
50- 59				22	
60- 69	11		22		11
70- 79					
80- 89			11	11	
90- 99+					
100-109					
110-119		11			
120+					

Stand density[3]	389
Stand basal area[3]	48.9

1. Reproduction not sufficiently sampled.

2. Size classes represent diameters at breast height, cm. Individuals greater than 2.5 cm are included here. Values given per hectare.

3. Stand density and stand basal area are based on a lower limit of 2.5 cm dbh. Values given in number of trees per hectare and square meters per hectare respectively.

* Tree sample: 900 m^2

TABLE 45

HERBS IDENTIFIED IN THE ENGELMANN SPRUCE FORESTS, BLAKE'S FORK DRAINAGE

	Engelmann spruce in the Mixed Conifer/Shasta fir zone	Engelmann spruce in the Mixed Conifer zone
Actaea rubra ssp. arguta	x	
Adenocaulon bicolor	x	x
Anemone deltoidea	x	x
Arnica latifolia	x	x
Calypso bulbosa		x
Chimaphila menziesii	x	
Chimaphila umbellata var. occidentalis	x	x
Clintonia uniflora	x	x
Cypripedium fasciculatum	x	
Cypripedium montanum	x	
Dicentra formosa	x	x
Disporum hookerii	x	x
Dodecatheon jeffreyi	x	
Fragaria californica	x	
Galium sp.	x	x
Goodyera oblongifolia		x
Habenaria sparsiflora	x	
Listera convallarioides		x
Mitella pentandra	x	x
Mitella trifida	x	
Montia sibirica	x	
Pteridium aquilinum var. lanuginosum	x	x
Pyrola asarifolia var. purpurea		x
Pyrola picta	x	x
Pyrola secunda	x	x
Smilacina racemosa var. amplixicaulis		x
Smilacina stellata var. sessifolia	x	x
Streptopus amplexifolius var. denticulatus		x
Trientalis latifolia	x	x
Trillium ovatum	x	x
Viola glabella	x	x
Viola macloskeyi	x	

TABLE 46

TREES AND SHRUBS OF PACKERS PEAK, TRINITY ALPS PRIMITIVE AREA

Trees	6700o'	7000'	7500'	7800'
Abies concolor	x	x	x	
Abies magnifica var. shastensis	x	x	x	x
Libocedrus decurrens	x	x		
Pinus balfouriana		x	x	x
Pinus jeffreyi		x	x	
Pinus lambertiana	x			
Pinus monticola		x*		
Pseudotsuga menziesii	x			
Tsuga mertensiana		x*		x
Shrubs				
Acer glabrum var. torreyi	x			
Arctostaphylos nevadensis		x	x	x
Arctostaphylos patula	x	x		
Berberis nervosa	x			
Ceanothus velutinus		x	x	
Cercocarpus ledifolius		x		x
Holodiscus microphyllus		x		x
Monardella odoratissima		x	x	x
Penstemon newberryi ssp. berryi		x		
Penstemon tracyi		x		
Quercus vaccinifolia		x		
Ribes cereum			x	

*on north slope only, without foxtail pine

TABLE 47

TREES OF THE WHITEBARK PINE ZONE, MT. EDDY

	Forests on serpentine			Forests on granite
	7300'	8000'	9000'	7800'
Abies concolor	x			
Abies magnifica var. shastensis				x
Pinus albicaulis	x	x	x*	x
Pinus balfouriana		x		
Pinus contorta var. murrayana	x	x		
Pinus jeffreyi	x			
Pinus monticola	x	x		x
Tsuga mertensiana				x

*Open krummholz

TABLE 48

TREES AND SHRUBS OF THE PONY PEAK AREA,
TRINITY ALPS PRIMITIVE AREA

	SHASTA FIR ZONE	
	Shasta fir/western white pine/mt. hemlock	Montane chaparral
TREES		
Abies concolor		x
Abies magnifica var. *shastensis*	x	x
Libocedrus decurrens		x
Pinus attenuata		x
Pinus jeffreyi		x
Pinus monticola	x	x
Pseudotsuga menziesii		x
Tsuga mertensiana	x	x
SHRUBS		
Acer glabrum var. *torreyi*	x	
Alnus sinuata	x	
Amelanchier florida		x
Arctostaphylos nevadensis	x	
Arctostaphylos patula		x
Castanopsis chrysophylla		x
Ceanothus prostratus		x
Ceanothus velutinus		x
Cornus stolonifera	x	
Garrya fremontii		x
Holodiscus microphyllus	x	x
Paxistema myrsinites	x	x
Prunus emarginata	x	x
Quercus vaccinifolia	x	x
Ribes sanguineum	x	
Rubus parviflorus	x	
Sorbus californica	x	
Taxus brevifolia	x	

APPENDIX: NATURAL AREA PROPOSALS

Proposal: The Establishment of the Bear Basin Butte Natural Area.

Location: Gasquet District, Six Rivers National Forest, California. The proposed natural area is located in eastern Del Norte County as shown by the enclosed map. The total suggested acreage is about 2,000 acres.

Vegetation Types of the Natural Area: This area is very unique because of its rich mosaic of vegetation types and numerous coniferous species that are found together in a restricted area. This group of stands is unique in the Six Rivers National Forest in that it is the only area that contains a mixture of montane California tree species and montane tree species from the Pacific Northwest along with the local endemic weeping spruce. The following vegetation types are readily accessible from the forest road which transverses the area.

1. Noble Fir-Mountain Hemlock Forest occurs on the steep north slopes of Bear Basin Butte. This is an unusually low elevation stand of Mountain Hemlock.

2. Mixed Forest dominated by Douglas fir but including white fir, Port Orford cedar, sugar pine, western white pine, mountain hemlock, weeping spruce, noble fir and western yew. Such a large number of species is not normally found together.

3. Knobcone pine occurs in close proximity to the preceeding stand. These trees are mixed with montane chaparral, including Quercus vaccinifolia, Q. sadleriana, Amelanchier alnifolia, Ceanothus velutinus, Prunus emarginata and Holodiscus discolor var. delnortensis. In other areas white fir, weeping spruce, incense cedar and western white pine occur scattered in the montane chaparral, and represent an early successional change from brush to forest.

4. Weeping spruce. Local populations of weeping spruce occur on open ridges where the montane chaparral shrub species form the understory. This woodland also includes ponderosa pine, Jeffrey pine, incense cedar, noble fir and white fir. Characteristic sites for weeping spruce, ridges and rocky slopes, are included in the proposed area.

5. White Fir-Douglas Fir. Stands dominated by white fir and Douglas fir are included. It is important that such stands be included since they are typical of the surrounding region and can be used as a control for studies made in the adjacent managed areas. Noble fir occurs as a secondary species in some stands.

6. The meadows in Bear Basin would be included. No description of them is now available.

Justifications for Natural Area Classification:

Educational. The rich mosaic of vegetation types and soils, and the topographic and geologic complexity of this area makes it very useful for field instruction in the areas of biology and forestry. A variety of different age classes are available for some types, not only obvious early and mid-successional stages, but more significantly, late succesional and near climax stands. The close proximity to Humboldt State College and the area's accessibility by car and bus has allowed it to already be used by classes in general ecology, plant geography and plant taxonomy. Classes in forest ecology and silvics plan to use it in the future. It will also provide areas for independent study for undergraduate biology and forestry students. This area could also be used for graduate research (master's theses) in biology and forestry.

Unique Research Potential of this Area:

In addition to the general research uses provided by any natural area (see appended sheets) the proposed Bear Basin Butte Natural Area offers some unique research opportunities. Primarily the area would act as a control in contrast to adjacent managed areas. Late successional development of stands in several types could be studied on a continuing basis. Continuing studies of tree growth characteristics of all species, especially the common tree species would be possible. Studies of low elevation growth of the subalpine mountain hemlock (typically found in California above 7,000 feet) and the noble fir in its southern range are needed.

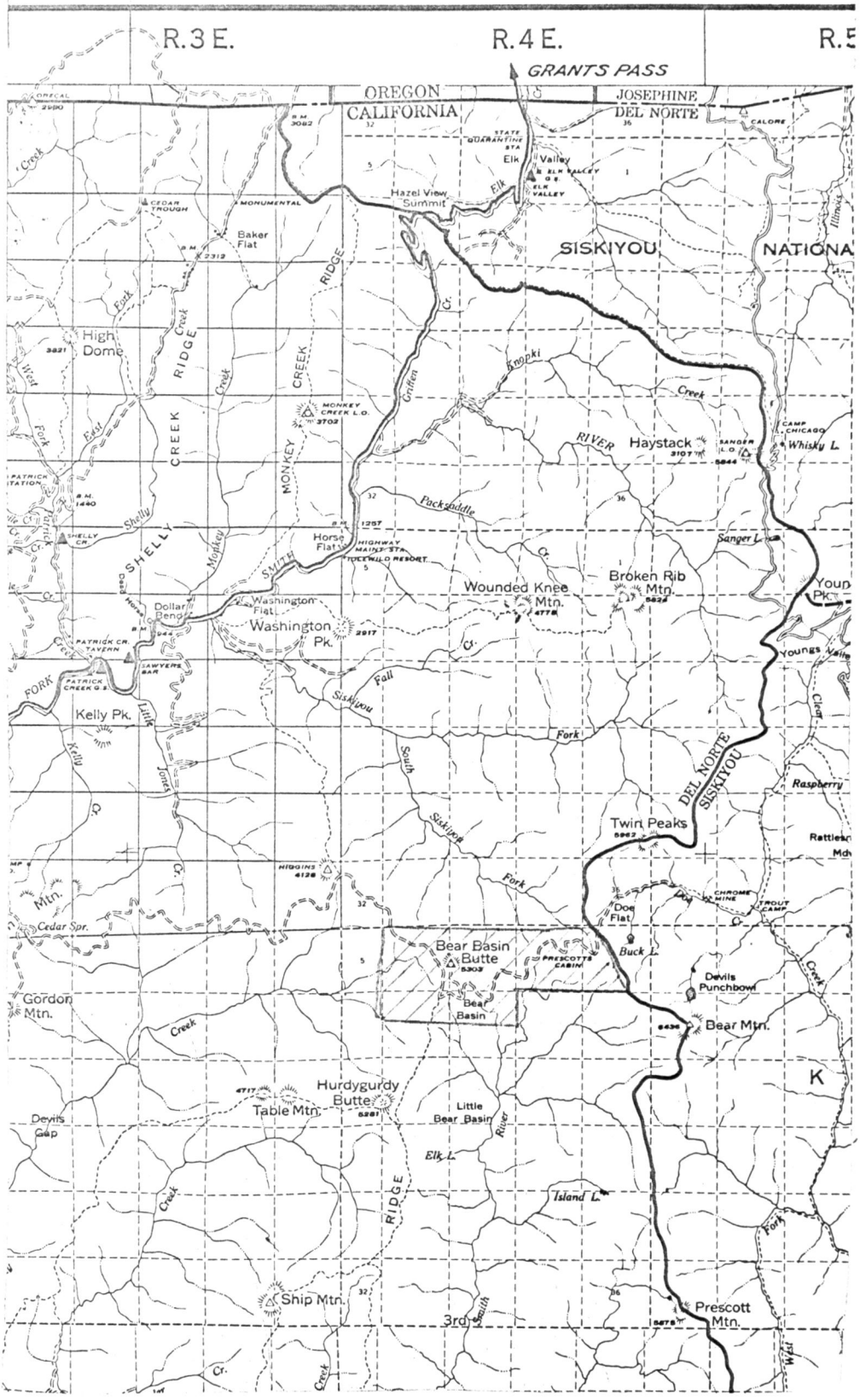
A study of the ecology of the weeping spruce, a Klamath Region endemic, is one more reason for Natural Area designation. Such a designation would preserve stands of weeping spruce probably near its western range boundary. Also this stand of mountain hemlock is at, or near, its southwestern boundary.

Summary:

The mosaic of vegetation types and the variety of tree species, some at, or near, range boundaries, give this area outstanding educational and research potential. It is proposed that this area be set aside as a Research Natural Area.

CONIFER TREE SPECIES FOUND IN THE PROPOSED
BEAR BASIN BUTTE NATURAL AREA

Abies concolor - white fir
Abies procera - noble fir
Pinus lambertiana - sugar pine
Pinus monticola - western white pine
Pinus ponderosa - ponderosa pine
Pinus jeffreyi - Jeffrey pine
Pinus attenuata - knobcone pine
Picea breweriana - weeping spruce
Tsuga mertensiana - mountain hemlock
Pseudotsuga menziesii - Douglas fir
Libocedrus decurrens - incense cedar
Chamaecyparis lawsoniana - Port Orford cedar
Taxus brevifolia - western yew



AREA PROPOSED FOR INCLUSION IN THE BEAR BASIN BUTTE RESEARCH NATURAL AREA

Proposal: The establishment of the North Trinity Mountain Research Natural Area.

Location: Lower Trinity District, Six Rivers National Forest, California.

The proposed area includes Sections 27, 34, T.9 N. R. 6E, and Sections 2, 3, T.8 N. R. 6E. (2,560 acres). The area is accessible by a four-wheel drive road connecting with Big Hill Road which begins at Hoopa.

Vegetation Types: The area includes a mosaic of high elevation forest and prairies.

1. Noble Fir Forest. Apparently, this is the only nearly pure stand of Noble Fir in California. This stand is also distinctive in being south and east of the Klamath River. The California range of this species is nearly completely north and west of the Klamath River, in Humboldt and Del Norte Counties, where it is typically mixed with other species.
2. Prairies. These meadows, as yet undescribed, include stands of Vaccinium caespitosum. About half of the proposed area consists of prairies, which at the present time are heavily grazed.

Justifications:

Educational Potential. This area has the closest stands of pure noble fir to Humboldt State College. Its potential use would be for summer undergraduate independent studies, and graduate research (Master's thesis). Summer use for ecology and plant taxonomy classes is also probable.

Unique Research Potential.

1. Study the ecology of the noble fir forest at or near its southern range limits.
2. Study of prairie invasion rates by noble fir.
3. Study the ecology of these high elevation prairies.
4. Preservation of this population will add to the total gene reservoir of noble fir.

A relatively isolated population like this one will have a slightly different genetic composition than noble fir in Oregon and Washington, an important factor for future plant breeding work. This is probably the most important factor in setting this area aside as a Research Natural Area.