AN ABSTRACT OF THE THESIS OF

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Title: DESCRIPTION AND CLASSIFICATION OF THE FORESTS OF THE UPPER ILLINOIS RIVER DRAINAGE OF SOUTHWESTERN OREGON

Abstract approved: Redacted for privacy

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The purpose of this study was to develope a plant community classification within the Siskiyou mountains, a small range within the Klamath geological province well known for its geologic and floristic diversity.

Forest land managers have expressed the need for identification of basic land classes that will aid in the assessment of the applicability of research results, aid the assessment of the results of management practices, and aid in the prediction of management techniques needed to produce specific results. Because of the extreme diversity, such a classification must be developed locally by intensive sampling and rigorous analytical techniques.

Thus cluster analysis, discriminant analysis and canonical analysis were used in combination with a classification table to classify and analyze 250 plotes taken in 100,000 acres the Upper Illinois River drainage.

Seventeen communities based on the dominant climax species were subdivided from six major vegetation groups. The six vegetation groups, the _Abies magnifica shastensis_, the _Abies concolor_, the _Chamaecyparis lawsoniana_, the _Pseudotsuga menziesii_, the _Lithocarpus densiflora_, and the _Pinus jefferyi_ were separated on the basis of the dominate tree in both the understory tree layer and overstory tree layer. A description of each community, the basic classification unit, is given. The descriptions include: the results of the classification techniques and their meaning, the relative environment of each community, species relationships for the more common species in each community, estimates on their relative productivity, their successional status, and keys for mapping the communities and identifying stands.

The geologic and floristic history of the Klamath province is complex, but it provides a basis for understanding today's flora. The affects of the Applegate, Galice and Nevadan episodes which were later modified by the ice advances and the Xerothermic period are presented. The affects of the major Tertiary plant migrations are also presented.

Description and Classification of the Forests of the Upper Illinois River Drainage of Southwestern Oregon

by

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DESCRIPTION AND CLASSIFICATION OF THE FORESTS OF THE UPPER ILLINOIS RIVER DRAINAGE OF SOUTHWESTERN OREGON

INTRODUCTION

As the competition for land use grows keener, the land available for primary production will steadily decrease, while at the same time the demand for primary production will steadily increase. Thus, there is intense pressure on the land manager to optimize production mix and maximize production.

In the realm of forest resources this intensifying trend is only in its infancy. The needs for water, recreation, forage, and wood will continue to grow at an increasing rate. To meet future production demands the forest land manager must abandon generalized, regional rule of thumb style of management for a highly localized, site specific approach.

There are various approaches which provide the practitioner with site specific information. Gradient techniques for example, have been successfully used to explain vegetation-site relationships in the Siskiyous, but because they are difficult to apply, practitioners have resisted their use. However, land managers commonly use and understand classification systems. And, in areas where vegetation classifications have been provided they have been accepted and successfully applied. But, because of the complexity of the Siskiyou vegetation, classification is extremely difficult and only a few specialized studies have been done in the area. Therefore, the purpose of this work is to attempt a classification of extremely complicated vegetation using the most powerful classification tools available. The upper Illinois River Drainage was chosen because of its known complexity (Whittaker, 1960).

The classification is intended for use as basic land management stratification, therefore, parameters familiar to most practitioners were used as classification criteria. In addition, vegetation classification should provide understanding of the vegetation association, successional patterns, and a basis for predicting change resulting from man's activities.

Vegetation classification is based on the widely accepted premise that vegetation, with its co-extensive environment, changes in an orderly and somewhat predictable fashion toward a predictable end, and that similar vegetation classes will react similarly to perturbations. Thus, spatial diversity resulting from differences in on site environment is the major concern. However, recent perturbations have made temporal diversity an additional concern. Many stands are still recovering from past fires and stable climax representatives are uncommon. Thus, stand structure and age class data were essential in separating temporal variation. Therefore, the reader is presented with inferred climax communities believed to be representative of potential vegetation.

The field work was completed in the summers of 1977 and 1978 within the upper Illinois River Drainage in the Klamath Mountains straddling the Oregon California border. Data on environment, soils, and all plant species were gathered on uniform sites selected using a combination of photography and ground reconnaissance. The data were subsequently analyzed with PRESENSE and REFORM, basic data cleaning and manipulation tools, ORDER, a computerized classification table, SIMILARITY INDEX, a program using Sorenson's index of similarity, CLUSTER ANALYSIS, a program with options designed to cluster the similarity matrix, and DISCRIMINANT and CANONICAL CORRELATION ANALYSIS, both multivariate classification tools.

The geologic and floristic history of the area is given in some detail because of its importance as a basis for understanding the study area.

The vegetation was separated into six major groups based primarily on understory and overstory vegetation. The groups are named for the dominant understory and overstory tree whether or not it is considered the climax dominant. This change greatly simplified the field key. The groups were broken into seventeen community types producing a hierarchical key for the study area. Environmental characteristics, species distributions and successional patterns are given for the vegetation groups and communities.

Because a great number of species were used in this analysis a simplified method of their presentation was used. The common name followed by scientific name is used when a species is first presented. Thereafter only the common name is used. Code names were used on Figures. Codes, scientific names and common names are given in Appendix V.

THE STUDY AREA

Geology

Introduction

The Klamath geological province is found in the southwest corner of Oregon and the northwest corner of California and can be distinguished from the surrounding formations by its advanced age. It forms an elongate north, south arch with the majority of the area in California, (Cater and Wells, 1954). The Siskiyou Mountains are within the Klamath province. They occupy the area south of the Applegate Valley and lie between the Cascade and Coast Ranges. To the south they are more or less continuous with the Trinity Alps, but the California border is usually considered to be their southern extent. The study area (Figure 1) located in the upper Illinois River Drainage, the east half of the Illinois Valley Ranger District, and is positioned toward the west end of the Siskiyou Mountains. Topographically, the area is deeply dissected and mountainous with no particular orientation of the valleys and ridges. The elevation ranges from approximately 1600 feet at Waldo to 6300 feet at Althouse Mountain.

The Klamath province has an extremely complex geologic history. Scientists have had difficulty interpreting the seemingly jumbled arrangement of parent material. Mckee (1972) in "Cascadia" introduces the Klamath geologic section with "Here is a genuine geologic nightmare". However, understanding the history, or chronological sequence, provides an excellent basis for understanding the existing formations. Consequently, I will use a chronological sequence to describe the geology of the study area.

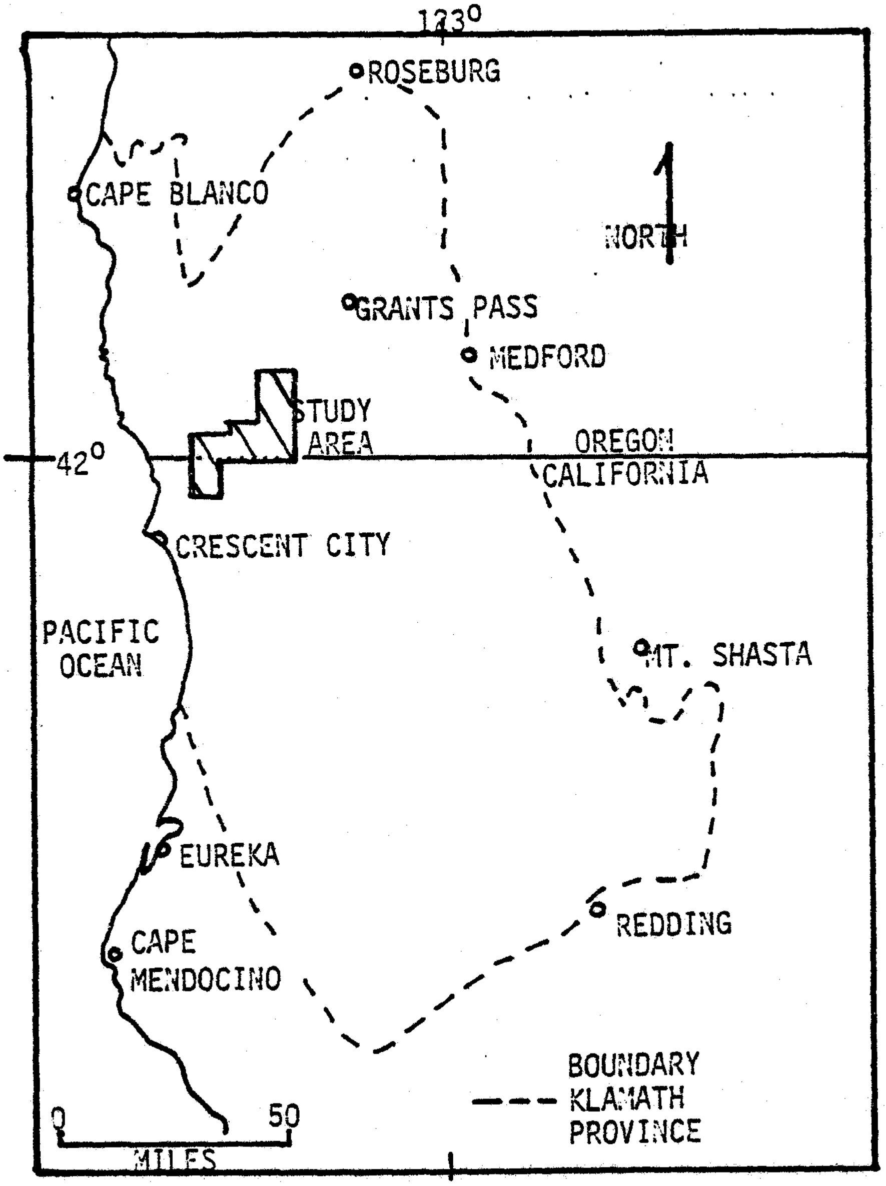


Figure 1 Map of the klamath geological province showing the location of the study area.

The Paleozoic Era

During the late paleozoic most of the Pacific Northwest was submerged. There were a few outlying islands above sea level west of the continental edge (Kay, 1955). The Salmon hornblend schist complex described by Irwin (1960) which presently lies along the California border in the Eastern Siskiyous was one of these masses and represents the birth of the Siskiyous. Its formation may be attributed to faulting created by pressure from an ancestral Pacific Plate, (Figure 2). Palmer (1968) reported that an ancestral East Pacific rise was several hundred miles west of the drifting North American Plate and was actively producing sea floor. It was closest to the continent at approximately 43° N. latitude which roughly corresponds to the area where the first island arch land masses appeared. The arch configuration is typical of areas where sea floor is being subducted at a continental margin (Menard, 1969) - an activity which produces energy for volcanism and faulting. On this setting, basaltic and sedimentary layers were implaced. This sea floor sequence was the basement for the Siskiyous, but was later scrambled by tectonic activities brought about by the Ancestral Pacific Plate.

The Triassic Period

The two major events in the Triassic period were erosion and uplift. Heavy rains and high temperatures common to a warm sea environment quickly weathered the parent rock. A profusion of material was transported by an extensive stream system and spilled into the offshore basin between the island arch and the continent. Both were sources of sediment. Even as

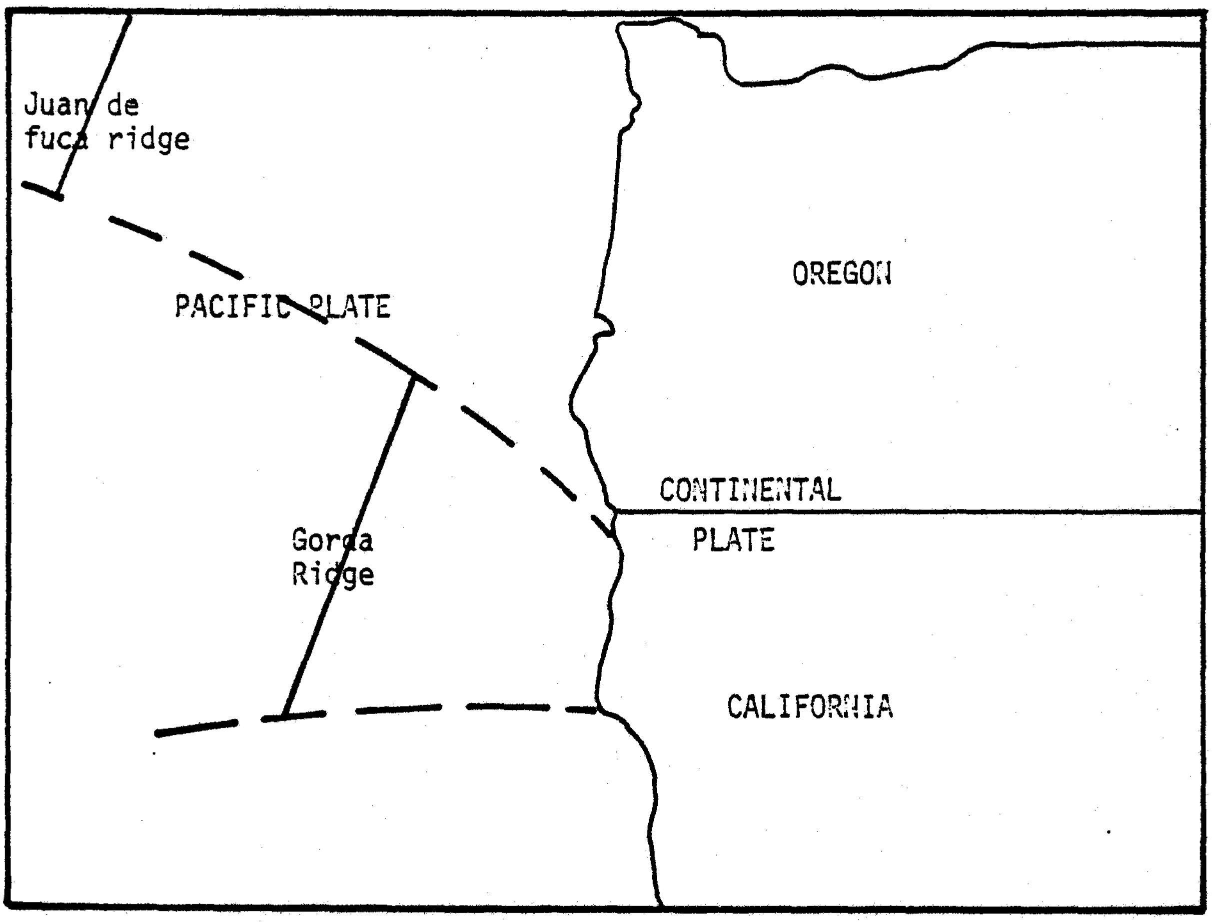


Figure 2 Tectonic setting of the Oregon California coast as it now exists (after Dott, 1965).

the sediments were accumulating on the oceanic crust, they were being propelled by the Ancestral Pacific Plate toward the continental plate. Eventually the interaction between the two plates resulted in the oceanic crust being thrust upon the continental margin (Dott, 1971). In the process it was variably metamorphosed into what is now known as the Applegate Group, (Wells, Holtz, Cater, 1949).

It is probable that a slowing of the rate of spread was responsible for some deformation of the island arch and the production of the Applegate group. By the end of the Triassic period the Applegate group, now well above sea level but with little relief, was available for plant and animal colonization.

The Jurassic Period

The Jurassic was similar to the Triassic; erosion and uplift were the dominant forces. However, the period ended with the Nevadan orogeny, an event that changed the west coast of North America.

At the beginning of the period, a slightly deformed volcanic arch continued to exude basic material into the synclinal basin between the island arch and the continent. Erosion material, the majority produced from weathered sediments, was also deposited. The intense pressure between the plates produced fissures into which ultrabasic material was intruded. Before the Nevadan orogeny, the entire structure was thrust upon the continental margin producing the Oregon (Vail, 1977) and Josephine (Dick, 1976) ophiolites [1/] and the Galice Formation.

The Galice Formation was positioned adjacent to the Applegate Group on the west. Its mudstone, siltstone and fine-grained sediment differ from the more coarse grained sandstones and metamorphosed basalts and pyroclastics of the Applegate Group produced in the Triassic. Later in the Jurassic period, the Nevadan episode emplaced the Sierra Nevada batholites, the Idaho batholith, the coast mountains of British Columbia, the North Cascades and a few other minor intrusions. Locally they folded and overturned the Applegate, Galice, and ophiolitic formations. All were metamorphosed, repositioned, and intruded with ultrabasic dikes and extensive acidic plutons ranging from diorite to granite. The cause of this cataclysmic upheaval was attributed to the collision of the ancestral East Pacific Rise with the continental margin (Palmer, 1968) rather than a decreased spread rate of the oceanic crust.

1/ "In areas of crustual spreading along oceanic ridges, one can envisage spreading crust with basaltic magma rising to fill the gap. At depth, intrusions of gabbro and residual melts of peridotite are emplaced, and at the surface extensive flows of submarine basalt are extruded. As the crustal material drifts away from the rise, flows of basalt generated by waning volcanism become interbedded with and overlain by deepsea sediments. This assemblage of rocks eventually may be thrust against the continent and exposed by erosion. Such rocks are termed "ophiolites" to emphasize their deepsea origin and largescale displacement," (Allen and Beaulieu, 1976).

At the end of the Jurassic, structural relationships were extremely confused, a variety of igneous and sedimentary rocks had become folded, faulted, and metamorphosed and their original postions were drastically changed. Therefore, reconstruction of the exact chronology of geologic events is at best tentative.

The Cretaceous Period

By the end of the Cretaceous, the North American Plate was practically in its present position (Palmer, 1968). It had been moving, and continues to move west away from Europe and Africa, and slightly north.

Plate movements alone have not been a factor in plant selection. The rate of movement is extremely slow when compared to plant migration and evolution. Fluctuation in climate brought about by global changes in plate position is hardly a driving force for selection of the best adapted species. Most selective pressure has occured as a result of more intensive short term fluctuations in climate. Generally plants have been able to migrate or evolve faster than the indirect changes resulting from plate movement would affect them. And extinction is most often a result of competition with better adapted species. These temporal relationships are mentioned here to help resolve the magnitude of the rates of change in geologic processes.

The Tertiary Period

Compared to the massive upheavals of the Triassic, the Teritary was a relatively quiet period for the Siskiyous. Yet the building of the Cascades and coast ranges were not without their effect. The uplift of the continental plate that raised the coastal sedimentary formations above sea level to form the south coast range, also gently lifted the Siskyous, (Baldwin, 1959; McKee, 1972). The Cascades on the other hand were built by igneous eruptions through fissures produced by crustal pressure. Originally, liquid andesite flowed thru the fissures and produced the extensive, thin layers of the "Old Cascades" and gradually pushed the coastline westward from the Blue Mountains. Later in the Tertiary period the viscosity and composition of the eruptions changed. Although a few acidic plutions were intruded, viscous basaltic eruptions that produced the older composite cones of the Southern Cascade predominated (Dott, 1971). (This change coincides with the crossing of the East Pacific Rise under the continental plate in the Southwestern part of North America). Mt. Thielsen and Mt. Howlock with their scored sides exemplify the older cones that were dormant during the Quarternary but survived the ravages of glaciation (Purdon, 1969; Weissenborn, 1969). The viscous flows and cones gave the Cascades significant relief.

The Quarternary Period

The ice of the Pleistocene had only local effects on the Siskiyous. Alpine glaciation created cirques on the north side of the higher peaks and glacial till material can be found in many of the high elevation draws. Bolen, Tannen, Rabbit, and Bigelow lakes are examples of cirques produced in the study area. Althouse Mountain, above Bolen Lake, hosted the most extensive glaciers. All but its south side have characteristic "U" shaped drainages. Later in the period erosion deepened the drainages and further dissected the "Klamath Peneplain", (Wells *et al*, 1949).

In the Cascades, some of the composite cones continued to build during the ice advances. For example, Mt. Mazama shows glacial scars, covered by younger flows. Mt. McLoughlin, however, was at the southern extent of the glacial sheet that covered the high Cascades and was not as greatly affected as its northern counterparts. The Coast Range continued to rise throughout the period.

Soils

Soil formation is a function of parent material, climate, vegetation, topography, and time (Jenny, 1941). Any factor or combination of factors may dominate the developmental process, as the domination of serpentine parent material is never masked by the other factors, or all factors may interact. In the study area, parent material seems to be the most dominant in the developmental process.

The combination of parent materials available in the study (Figure 3) were provided by four major geologic episodes: The Applegate formation, the Galice formation, the Nevadan orogeny, and the Wisconsin glacial advance (Wells, *et al*. 1949). Most soils were developed from the Applegate group which consists of metamorphosed lava flows and volcanic ash beds of andesitic and basaltic composition. Imposed within these metavolcanics are metamorphosed sandstone, mudstone and some limestone. Intruded within the Applegate group are the granitoid batholiths of the Nevadan orogeny which are generally thought of as highly erosive (Wells *et al*. 1949). Additional variation is provided by periodtite masses of ophiolitic origin (Vail, 1977), some of which have been altered to serpentine during the Nevadan episode. The Galice formation provided extremely hard shale and siltstone which is less metamorphosed than the

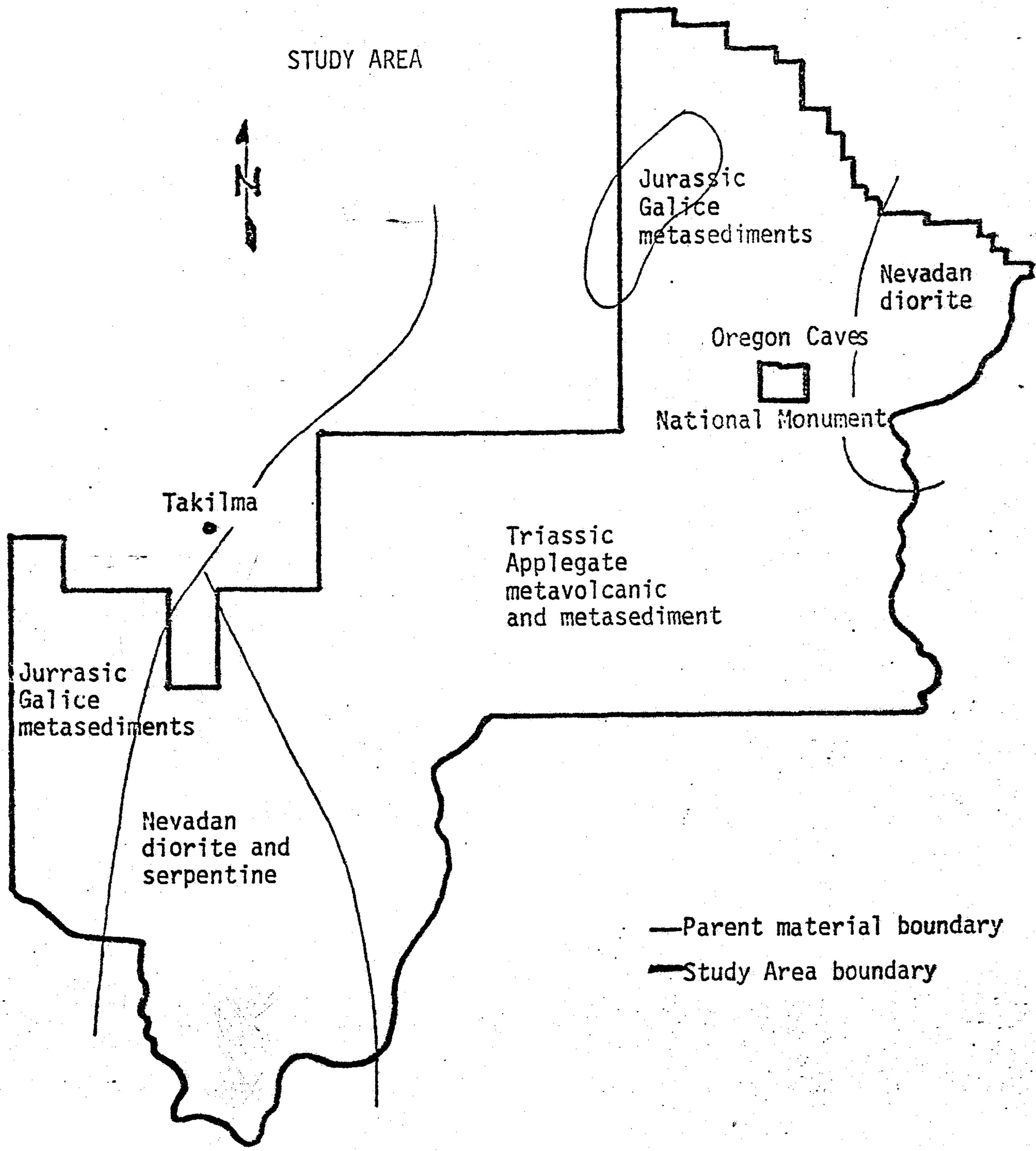


Figure 3 The occurrence of major parent material types within the study area.

Applegate group and is somewhat acidic. Lastly, alpine glaciation during the late Pleistocene deposited unsorted till of variable composition within many of the high elevation valleys (Wells et al. 1949).

All of these parent materials, except glacial till, have been exposed to physical and chemical weathering since the Nevadan disturbance subsided approximately 136 million years ago. Soil development was under a hot, wet tropical climate. But the erosion during the glacial advance removed much of the weathered regolith developed earlier. Thus, today's soils have developed under a more temperate climate and have no evidence of tropical influence. Their physical properties are characteristic of the parent material from which they were developed. The coarse textured igneous materials have produced coarse textured soil and the fine grained sediments have produced fine textured soils.

The descriptions of the forest soils in Josephine County are now being correlated by the Soil Conservation Service. However, some series have been established for some time. Table 1 shows the relationship between the major soil classifications and the geologic parent material (Power and Simonson 1968). Most of the soils are composed of the Applegate metamorphic material and as such are mostly Alfisols or Inceptisols. The Galice formation hosts some Ultisols in the lower slope positions, and the intrusives have formed Inceptisols. All of the soils are xeric. Soils with a xeric moisture regime must be dry in the upper 4-12 inches for at least 45 consequtive days during the summer. All soils listed except those derived on serpentine are in the typic subgroups. The soils derived from serpentine must be classified as lithic because they do not meet the depth requirements typical of their class (USDA, 1975). All of the soils except Bigelow, are low in organic coloration and resemble the colors of their weathered parent material.

Table 1 Soil taxonomic classes and related geologic formations.

GEOLOGIC FORMATION SOIL SUB GROUP	SOIL FAMILY	SERIES	STATUS
Applegate formation			
Typic haploxeralfs	loamy-skeletal, mixed, mesic	Voorhies	Tenative
Typic xerochrepts	fine-loamy, mixed, mesic	Colestine	Tenative
Dystric xerochrepts	loamy-skeletal mixed, frigid	Althouse	Tenative
Entic cryumbrepts	loamy-skeletal, mixed	Bigelow	Tentative
Galice formation			
Typic haploxerults	fine-loamy, mixed,mesic	Josephine	Established
Nevadan intrusions			
Typic xerochrepts	coarse loamy, mixed, mesic	Siskiyou	Established
Serpentine			
Lithic xerochrepts	clayey, serpentinitic mesic	Pearsoll	Tentative

Climate

Introduction

The Siskiyous lie at the northern border of the 30° latitude high pressure area, and as such are subject to warm marine storms and cold polar storms. This combination of warm, wet and cold, wet influence, together with the existing xeric climate gives the Siskyous an unusual climatic blend. Northern California is consistently warmer and dryer, and Oregon north of the Klamath mountains, is consistently wetter and colder. In addition, an east-west orientation provides the area with a temperature and moisture gradient westward from the Pacific Ocean that is slightly modified by topography.

Generally the climatic stations (Table 2) are arranged from west to east representing low elevations except the Oregon Caves station which is at 4,000 feet. Rain decreases eastward and snow generally increases. A significant increase in both rain and snow is found with increasing elevation as witnessed by the Oregon Caves station. Also, increases in ranges of temperature appear from west to east providing the Western Siskiyous with a more equable climate than the variable continental climate of the Eastern Siskiyous. The difference between mean January and July temperatures is slightly less at the Oregon Caves station indicating that the midslopes provide less extremes than the valley positions. However, the midslopes are generally cooler.

Table 2 Regional climate showing east-west climatic gradient.

LOCATION	Crescent City	Waldo	Oregon Caves	Ashland
DISTANCE FROM THE COAST	0 Miles	46	58	78
PRECIPITATION	79 Inches	49	69	20
SNOW	0 Inches	15	172	20
MEAN ANNUAL TEMPERATURE	52.3 ^{o} F	50.0	46	52.5
MEAN JANUARY TEMPERATURE	45.8 ^{o} F	36.3	34	39.7
MEAN JULY TEMPERATURE	59.4 ^{o} F	68.0	64	69.5
ELEVATION	Sea level	1,500feet	4,000	1,895

Four sources for local weather information were available: precipitation stations, Low Divide and Althouse, maintained by the Weather Bureau, fire weather records from the Siskiyou Smokejumper Base, near Waldo, and weather records kept by the National Park Service at Oregon Caves National Monument (Figure 4).

The precipitation stations were neither frequently nor regularly visited. Consequently monthly distribution, particularly during the growing season, cannot be resolved. (Figure 7). Nevertheless, they provide some important comparative material. Weather data taken at the Jumper Base was complete and faithfully kept, but only through the fire season. The Caves records were complete, faithfully kept all year, and typify the study area. However, all records are short term. The Weather Bureau, Jumper Base and Caves stations recorded for only 12 years, 5 years and 7 years respectively. A description of each station is given in Figure 4.

Precipitation Within The Study Area

Figure 5 gives comparative figures for the precipitation stations across the study area. Although increased rainfall correlates with high elevation, precipitation does not follow a strict topographic gradient, perhaps related to the funneling of storms by certain drainages. Cave Creek seems to capture storms most effectively followed by Grayback, Sucker and Althouse Creeks. Precipitation at the Caves station averages 69 inches per year. The Althouse station, which is 500 feet higher, receives only 56 inches per year followed by Low Divide, 900 feet lower, which receives 50 inches per year. The stations on the valley floor, the Smokejumper Base and Waldo, average 47 and 49 inches respectively.

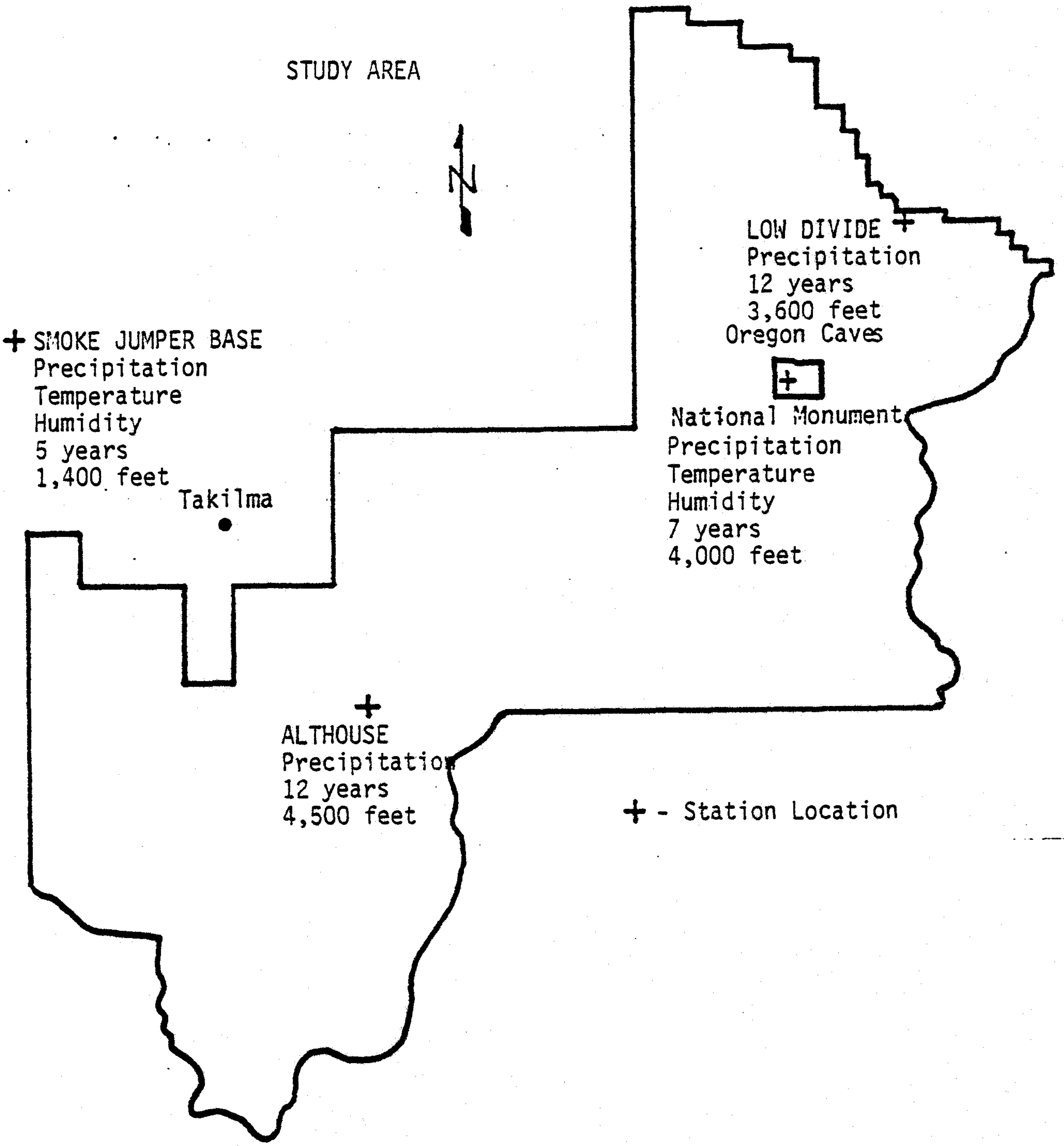


Figure 4 Description and location of weather stations.

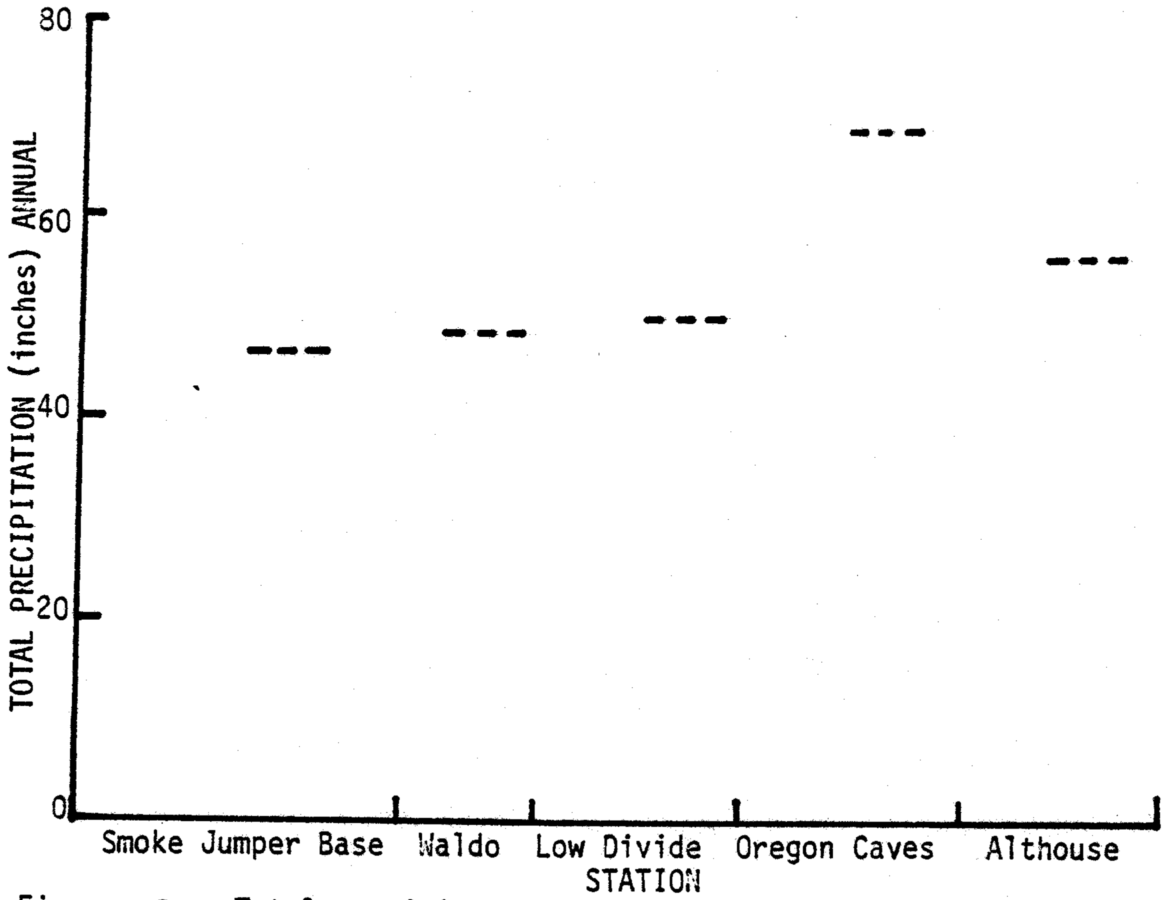


Figure 5 Total precipitation for precipitation stations within the study area.

Figure 6 shows the monthly average precipitation at the Caves station which is most typical of the study area. During the average year rain falls every month. The July average is one third of an inch.

In Figure 7 the higher elevation stations are shown as receiving more Summer precipitation than the Jumper Base station in the valley. Also, the difference in precipitation between the Althouse and Caves stations illustrates the extreme climatic variation within the study area.

Temperature

The average yearly maximum temperature at the Caves station is 55° F and less than two percent of the days reach 90° F or above (Figure 8). The minimum average yearly temperature is 38° F. Records show that July and August are frost free. June has a greater than 50 percent probability of frost occurring some time during the month and September has a less than 15 percent chance of frost occurring during the month. The average maximum temperature during the growing season is 70° F. Comparatively, the maximum temperature on the valley floor averages 10° F higher than the Caves, but the average minimum is very similar. Generally the range of temperatures at the mid elevations is subdued when compared with the valley floor.

Figure 9 shows the average number of clear days at the Smoke Jumper Base during the growing season. Over half of the days have some degree of cloudiness. Cloud cover may be even greater at the mid elevations. Because cloud cover reduces temperature, increases humidity and lowers transpirational demand, it is an important climatic modifier in the study area.

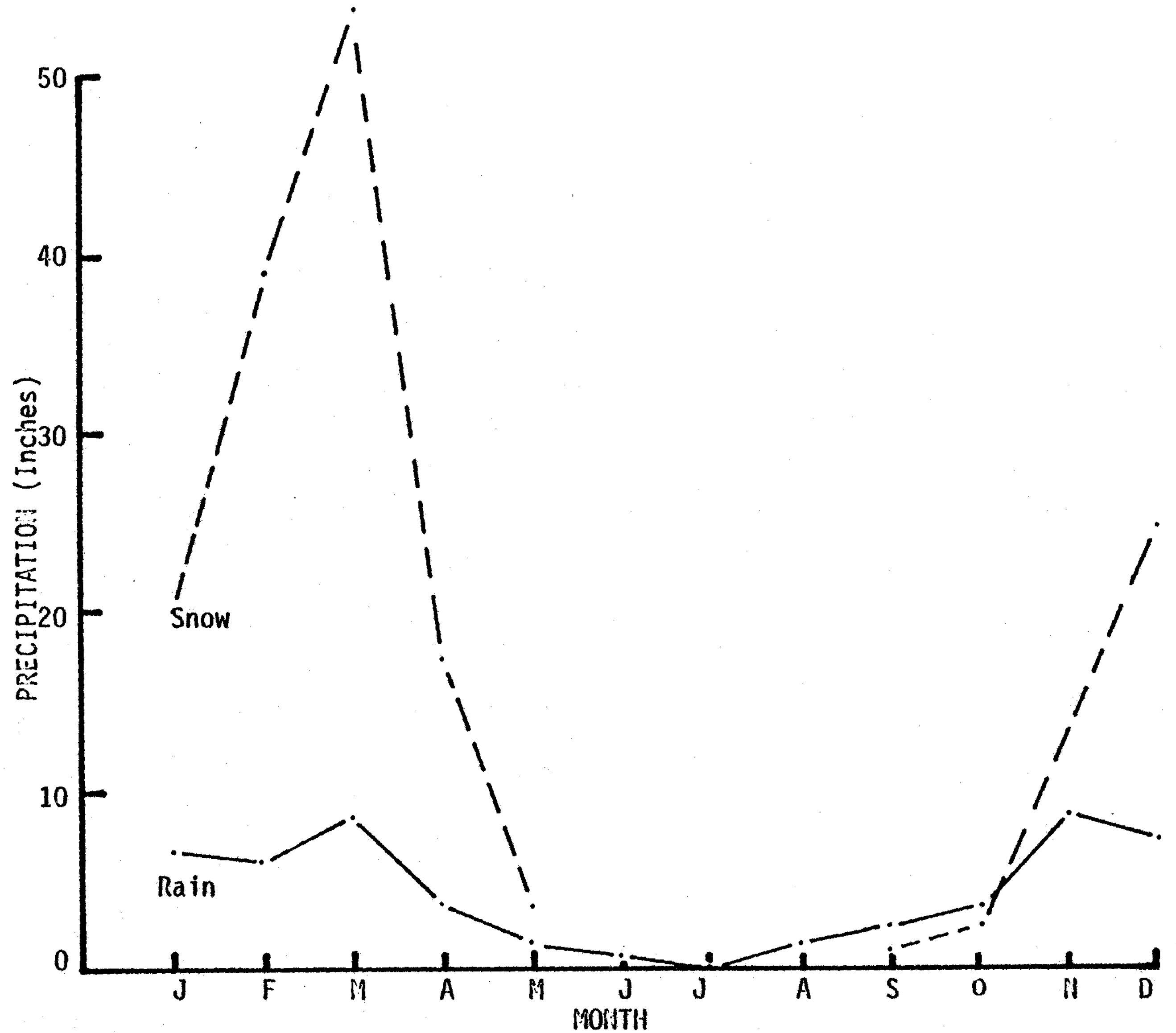


Figure 6 Average monthly precipitation at Oregon Caves National Monument for the period of 1971-1977.

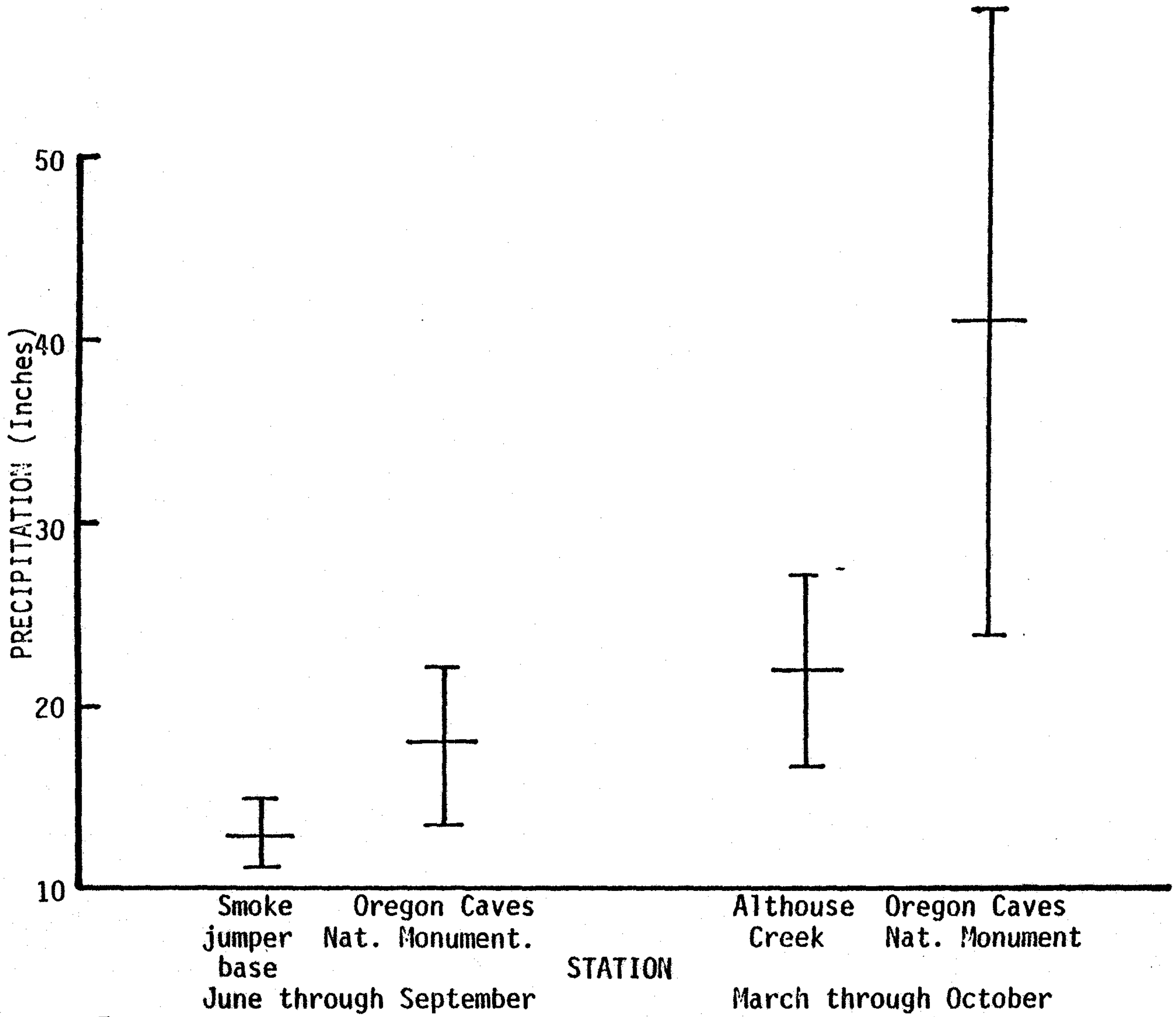


Figure 7 Mean and standard deviation for precipitation stations.

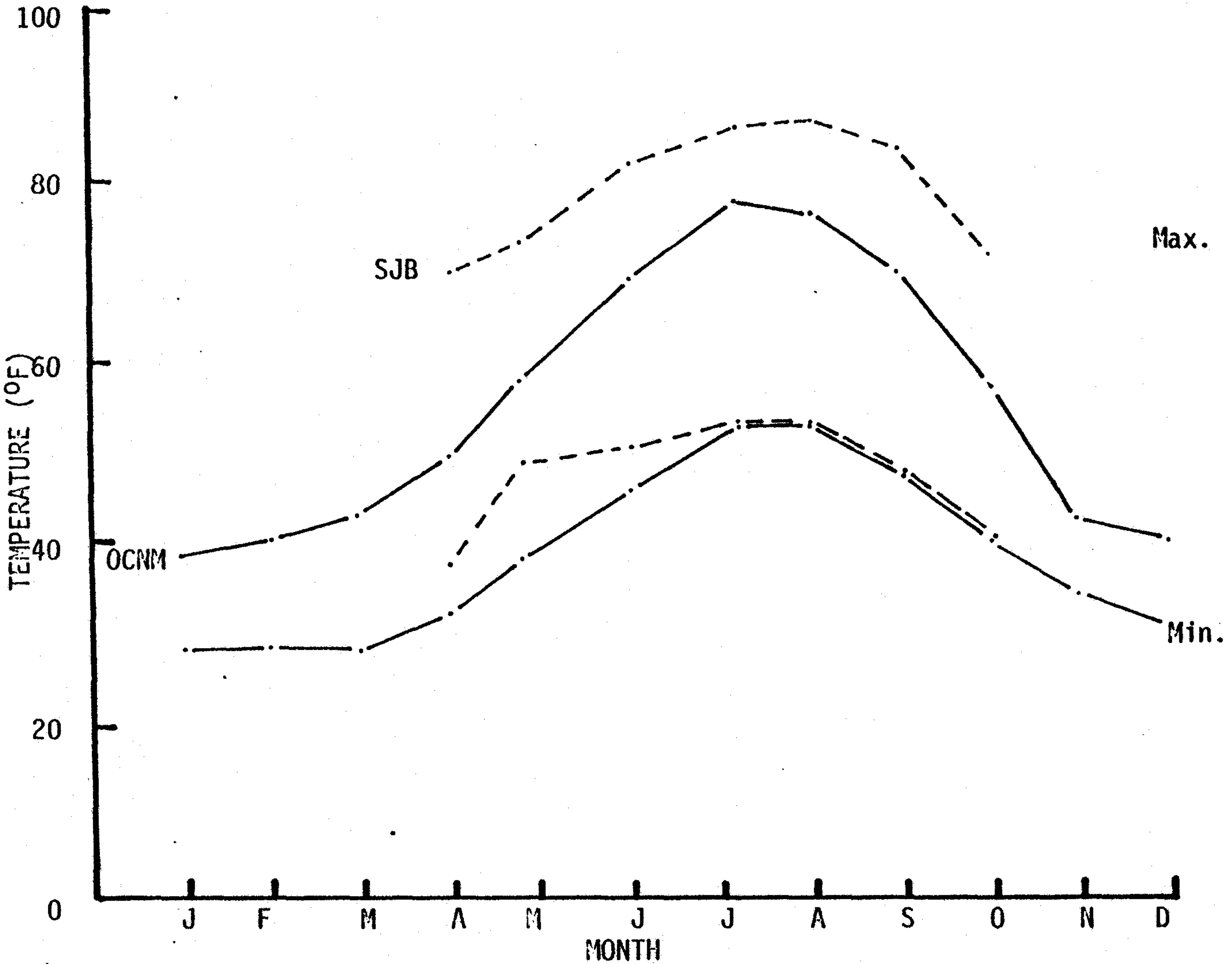


Figure 8 Average monthly maximum and minimum temperature for the Smoke Jumper Base (SJB) and Oregon Caves National Monument (OCNM) over a 5 year period.

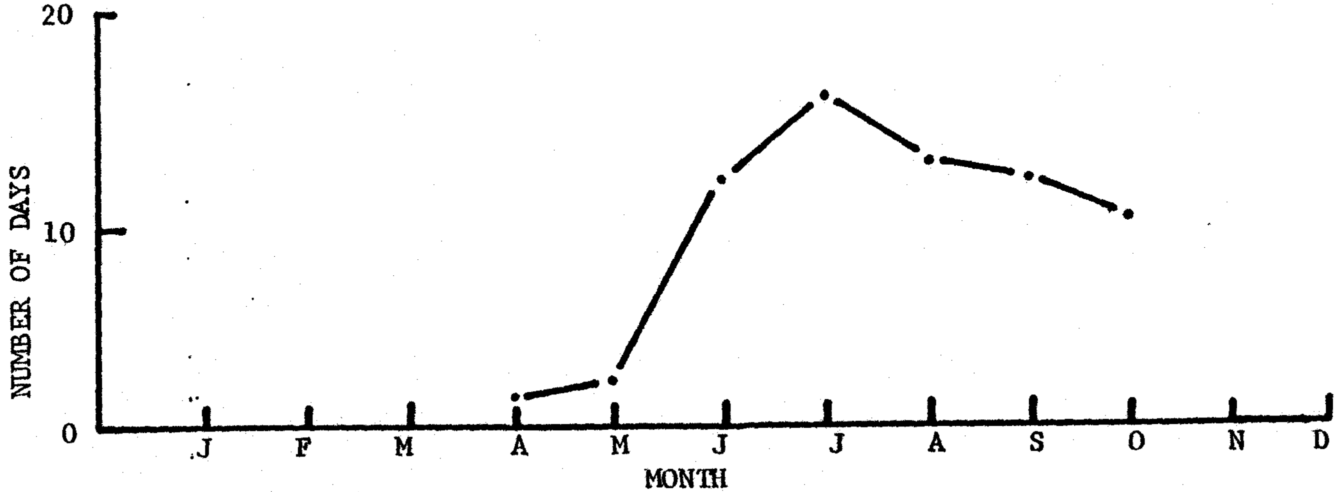


Figure 9 Average numger of clear days per month at the Jumper Base

Humidity

The humidity at the Caves seldom falls below 40 percent, which is quite high. However, the station is within the Cave Creek drainage where a somewhat higher humidity would be expected than on hillsides or ridgetops. In contrast, the Jumper Base at the valley floor averages 18 percent dryer during the day, but is similar to the Caves at night (Figure 10). Therefore, the mid elevations are more moist with less of a range in humidity than the valley floor.

The fog patterns observed from Bolen Lookout (Dueker, 1977) show the base of Cave Creek almost always had morning fog which lingered longer than most other places where it occured (Figure 11).

FLORA - PAST AND PRESENT

Introduction

The Siskiyous with their great variety of environments have produced a rich and unique flora. The geology, climate, and soils have interacted over time to select adapted genotypes.

The Mesozoic Era

During the Triassic period the Siskiyous were surrounded by warm seas on all sides except the east, and were commonly engulfed in fog. Ferns were the dominant vegetation type. By the end of the Jurassic, greater relief resulted in the beginning of a differentiation of climate relative to elevation and distance from the sea. The higher elevations provided a cooler environment and the east-west trending relief lessened

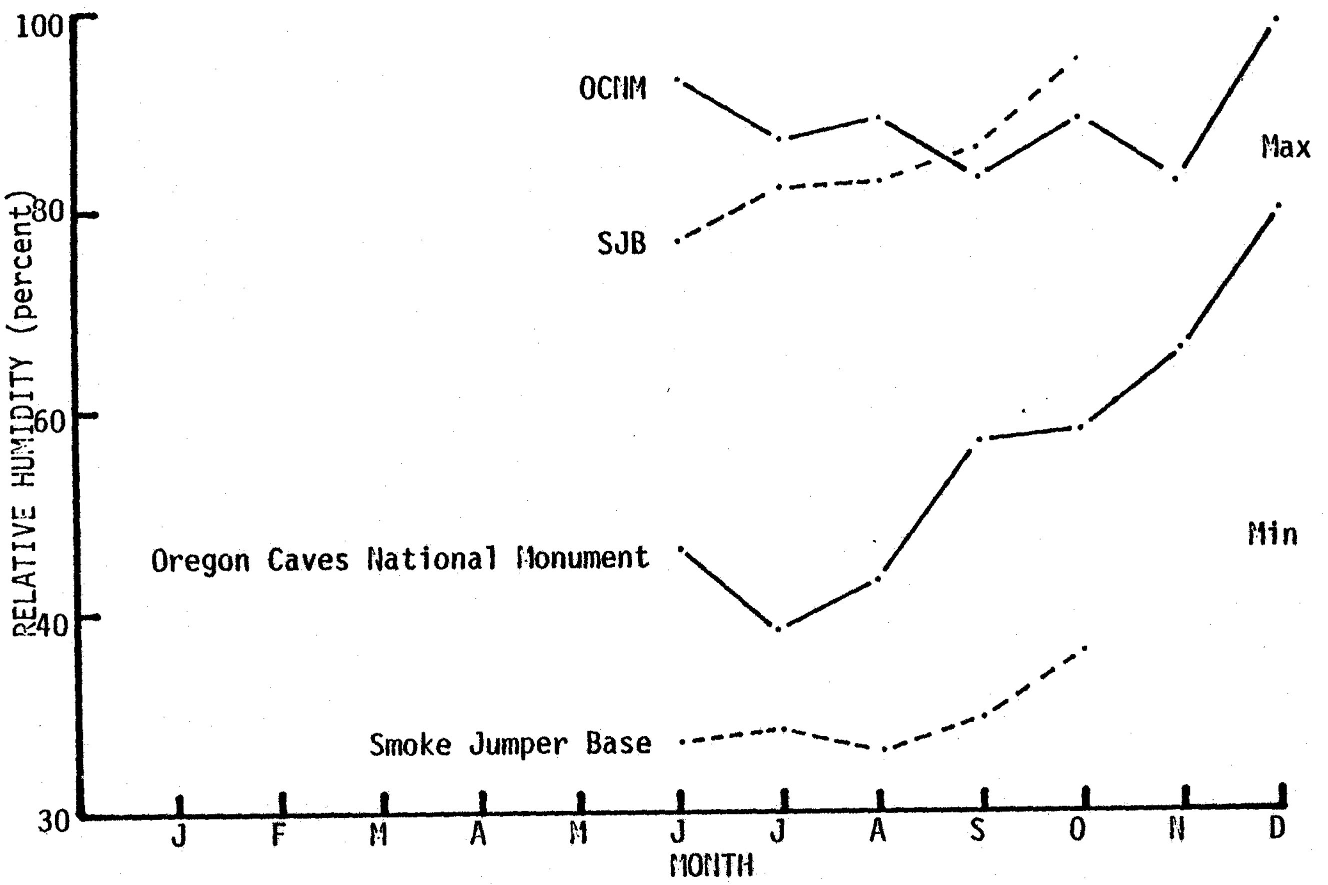


Figure 10 Maximum and minimum relative humidity at the Oregon Caves National Monument and the Siskiyou Smoke Jumper Base.

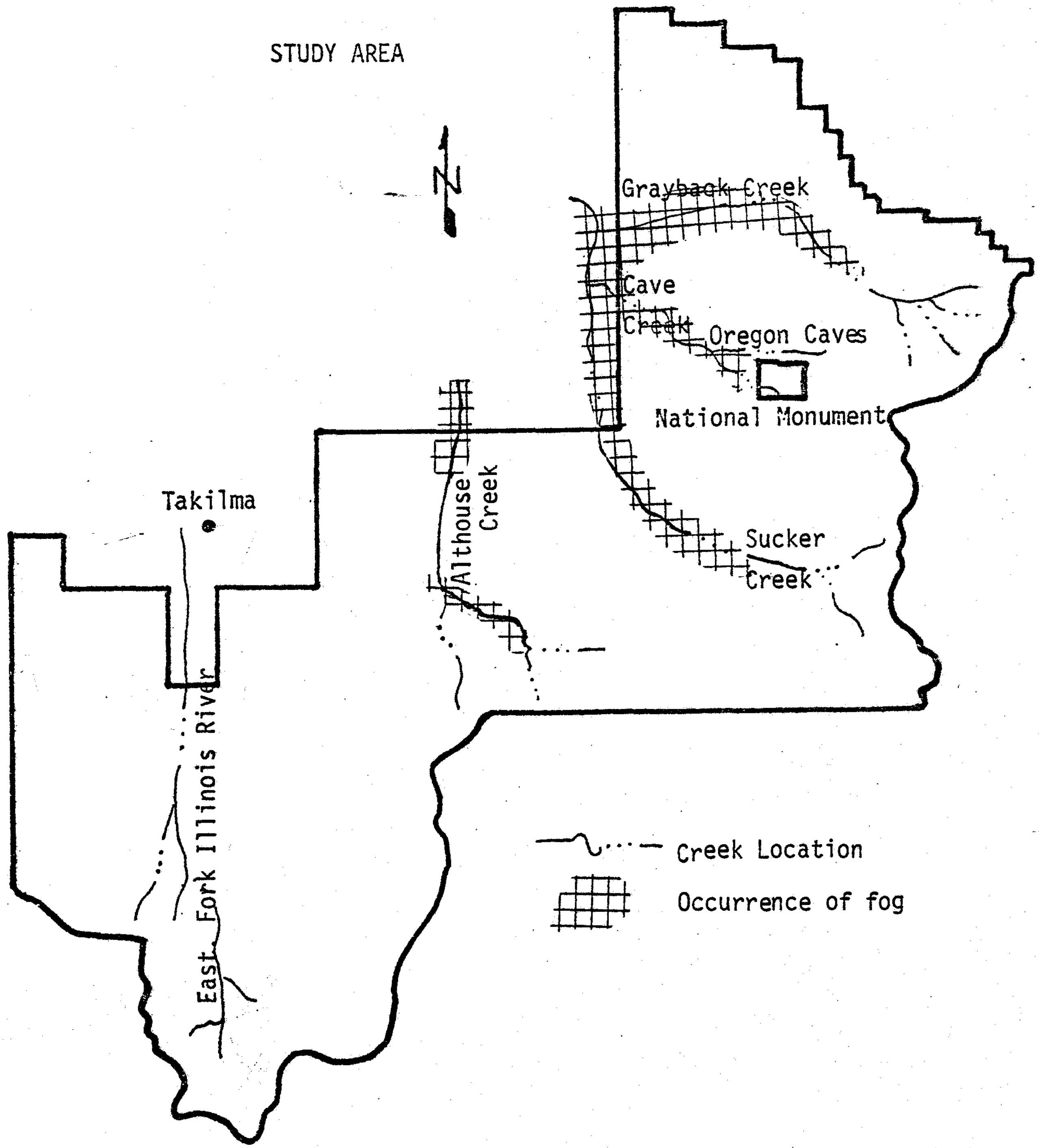


Figure 11 Major drainages within the study area and occurrence of fog.

inland rainfall. This change produced a variety of environments and the dominance of the ferns was broken by the Ginkgos and Cycads, which are now confined to the tropics (Axlerod, 1959).

During the Cretaceous period atmospheric moisture became less abundant, and ancestral conifers come into prominence. They reached the climax of their evolution by the end of the era and were followed by the more adaptive angiosperms.

The Cenozoic Era

During the early Tertiary, the climate along the Pacific Coast had very little gradient from Mexico to Canada and it was still warm and wet. The angiosperms were competing in most areas, but were especially successful on the lower slopes. From sea level to the mid elevations a mixture of temperate angiosperms and gymnosperms could be found with the prototype of the fir subalpine forests dominating the higher elevations, (Axlerod, 1976).

Climatic changes triggered the migrations of the Madro-Tertiary Geoflora and the Arcto-Tertiary Geoflora. The Madro-Tertiary Geoflora spread north from the Sierras as the drying climate allowed them to compete at higher latitudes. The Arcto-Tertiary Geoflora spread south from the Canadian border into Southern Oregon in response to the cooling trend.

During the mid Cenozoic the high elevations were dominated by the true fir and other temperate species, when they begin to receive competition from the migrants of the Geofloras. The Madro-Tertiary Geoflora was limited in its northern extension by cold temperatures. The Arcto-Tertiary Geoflora had reached the California border and started down the Sierra range but was stopped by the drying climate. As a result of these migrations, the Siskiyous now contained elements of three origins; the Arcto-Tertiary Geoflora, the Madro-Tertiary Geoflora, and the warm temperate indigenous flora.

Later in the era, the Western Siskiyous were still under oceanic influence and retained much of the temperate flora. But all floras were pushed south, as much as 200 miles (Axlerod, 1976). Northern conifers were pushed south into the study area and as the glaciers receded they remained in cool, moist niches much like their original habitat. Among them were Alaska-cedar (*Chamaecyparis alaskensis*), Brewer spruce (*Picea breweriana*), silver fir (*Abies amabilis*), and noble fir (*Abies procera*) which now occur here in disjunct populations. Some of the species of the Madro-Tertiary Geoflora that adapted to the Siskiyous were pushed south out of the area by the glaciers. However, during the inter-glacial and post glacial periods the trend was reversed and Ceanothus, pines, manzanitas, and firs again advanced northward.

Remnants of the Arcto-Tertiary Geoflora have been gradually separated from the Madro-Tertiary Geoflora by elevation. The Arcto species are limited by drought and high temperature from going down slopes and the Madro elements are limited by cold from the higher elevations. However, in the mid elevations the two floras mixed with the temperate flora that originally occupied the area.

Present Flora

Franklin and Dyrness (1973) recognized four zones within the study area named after the climax dominant. In order of desending elevation they are: the mountain hemlock zone (*Tsuga mertensiana*), the Shasta red fir zone (*Abies magnifica shastensis*), the white fir zone (*Abies concolor*), and the mixed evergreen zone.

The mountain hemlock and Shasta red fir zones host several representatives of the Arcto-Tertiary Geoflora. Western white pine (*Pinus monticola*), mountain hemlock and the Huckleberries are examples. The influence of the Madro-Tertiary Geoflora is seen in all zones. Madrone (*Arbutus menziesii*), Shasta red fir, incense-cedar (*Calocedrus decrrens*), Jeffery pine (*Pinus jefferyi*) and the manzanitas represent the Madro influence. Representatives of the temperate species occur mostly in the mid elevations where the climate lacks the extremes found at the high and low elevations. The large leafed evergreens, such as tanoak (*Lithocarpus densiflora*) and rhododendron, and the conifers, such as Pacific yew (*Taxus brevifolia*), are examples of these temperate species.

The mountain hemlock zone is narrow and discontinuous. It is confined to the northerly facing cirques that are common on the higher peaks. Mountain hemlock is usually found associated with Shasta red fir, white fir and western white pine. At times it may be found with small amounts of incense-cedar and Douglas-fir (*Pseudotsuga menziesii*).

The Shasta red fir zone is narrow but continuous. Its associates are the same as those of the mountain hemlock zone, but it is often dominated by Douglas-fir where fire was a recent influence.

The white fir zone has the largest elevational range of the four zones. It is bordered by the Shasta red fir zone at its upper limit and the mixed evergreen zone from below. Every coniferous species that occurs in the area can be found assiocated with white fir. But its most common associate is Douglas-fir which is dominant in the overstory when fire has been a part of the stand history.

There are two special vegetation types in the white fir zone. The Port-Orford cedar (*Chamaecyparis lawsoniana*) type and the Jeffery pine type. The Jeffery pine type is an edaphic climax within the study area occurring almost entirely on soils formed from ultrabasic rocks. The Port-Orford cedar type is a topographic climax only occuring in concave, protected sites.

The mixed evergreen zone is dominated by either Douglas-fir or tanoak. Both groups are associated with many of the same species. Madrone, canyon live oak (Quercus crysolepis), sugar pine (Pinus lambertiana), ponderosa pine (Pinus ponderosa), Pacific yew (Taxus brevifolia), and white fir are a few of the zone's common associates. Tanoak seems to be the climax in the more mesic sites and has a wider area of influence. Douglas-fir is climax only on the shallower soils and dryer sites.

Fire History

Introduction

Following the recession of the last glacier, fire has been an important modifier of species composition, age structure, and successional status of forests in the Western Siskiyous. Evidence of fire has been found in many stands. Several even-aged stands reflect the widespread burning by the early settlers and the recent change in species composition reflects the period of fire control that followed.

Recent History

Before 1828, the year the Hudson Bay Company explored the area, indians and lightning were the sole ignition source. However, there are no records of fire occurrence for that era. By 1851 the Waldo and Althouse Creek areas had been heavily settled by gold miners who used fire indiscriminantly. Most fires were set to eliminate the vegetative obstacle, to improve grazing conditions for their stock, or to kill wood ticks and other pests. Fires were also set for fun and excitement. Although there are no records of fires during this period, it seems likely the yearly average was raised by the settlers.

The Siskiyou National Forest, although established in 1907, had little or no fire suppression capability until about 1914, when concern for the resource and available manpower coincided to reduce the incidence and extent of both natural and man caused fires. Forest officers evangelized on the ills of unrestrained burning and mobilized to suppress all fires. Law enforcement against arson was also effectively intensified. Thus, the era of complete elimination of fire began.

After the depression three additional factors combined to make fire suppression even more effective; the Civilian Conservation Corps provided additional manpower specifically for fire suppression and pre-suppression activities, radio communication made the dispatch and use of the manpower more efficient, and law enforcement activities against arson and other man caused fires were again greatly intensified.

By the end of World War II, an efficient suppression team, stationed at Cave Junction, had improved forest access, improved equipment, and improved communications. Since that time fires have been immediately manned and suppressed.

METHODS

Approach

Where continuum approaches focus on the total range of variation, classification forces the variation into smaller, similar packages. If the idea that similar vegetation responds similarly is true, both approaches are valid as explanations of plant behavior, but classification is more easily applied and understood (Greig-Smith, 1964). Classes are commonly used by the land manager to allocate monies and evaluate input and output alternatives. Because forest practitioners have been conditioned to think in terms of classes, they feel comfortable with such systems. Therefore, if a discrete system can approximate reality, it is more likely to be used. Whittaker (1960) and Waring (1969) applied gradient techniques to explain plant distribution in the Siskiyous. Both present excellent explanations, but their use has been limited by practitioners.

Classification of vegetation into discrete units has been successfully applied in Eastern Oregon where vegetational boundaries are often distinct or even abrupt (Daubenmire, 1968; Hall, 1973; Volland, 1976). However, in areas of high diversity where vegetational boundaries are often obscure, a continuum approach has been favored (Whittaker, 1960).

Classification requires a degree of subjectivity in placement of class divisions and some information may be obscured in the process. Lumping averages a wide range of conditions and obscures reality. Splitting may ultimately result in a continuum and create confusion. Thus, a compromise between precision and applicability was sought in this study to classify the vegetation into an optimum number of practical, workable units.

Sample Size

The study area is over 100,000 acres and is well known for its diversity (Whittaker, 1960). Therefore, a large number of samples were necessary for its characterization. Because a completely systematized grid would require an extremely dense network of samples to insure that important variation was not overlooked, it was felt a partially subjective sampling scheme would be more efficient. Thus, satellite imagery, aerial photos and ground checks were used to subjectively prestratify and locate sample plots. After 130 plots were taken, the coefficient of variation for species composition and cover was examined and used to adjust the total number of plots required for the study. An additional 120 plots were needed; thus 250 plots were taken.

Plot Selection

Plots were taken in homogenous areas to assure that within plot variation was not related to differences in environmental conditions nor differences in stand succession. Thus, the vegetation within a sample was assumed to represent a point in time related to a particular set of environmental conditions.

When possible, plots were taken in climax stands or where the vegetational composition was relatively stable to reduce temporal variation and reflect site potential. However, the remaining plots were taken in areas that were recovering from disturbances. Thus it was necessary that natural potential vegetation be determined by an inferential system proposed by Decker (1959).

Plot centers were referenced to a tree chosen at random within the stand, and were placed seven feet upslope from the reference tree. A running tally of aspect, elevation, slope, and parent material was kept to assure adequate representation of the environmental variables.

Parameters

Parameters which have been used to evaluate environmental relationships and are believed to have ecological meaning (Daubenmire, 1974; Volland, 1976; Dyrness, et al. 1974) were also used in this study. Table 3 summarizes the variables and their codes. All are secondary environmental factors, rather than primary as indicated by Major (1951), but they can be quickly and cheaply measured - an attribute necessary for their acceptance in practical application.

Coding of the parameters was designed to accomplish quantification, scaling and weighting (Walker, 1974). When possible, parameters were scaled by their hypothesized influence on plant productivity. For example microtopography was broken into three classes: convex, flat, and concave, which were assigned the values 1, 2, and 3 respectively. On the theory that concave slopes are the most productive, they were assigned the highest value. Other variables, such as elevation, had to be weighted. Elevation given in thousands of feet was decreased in magnitude by ten. Without such weighting, some programs would automatically treat elevation as 100 times more "important" than soil depth, which is measured in tens.

Slope, taken in percent, was left unchanged. Total basal area, litter, moss, bare ground and rock were also left unchanged. The latter

Table 3 Summary of the parameters and their codes.

PARAMETER	CODE	
Elevation	Thousands of feet divided by ten	
Slope	Percent	
Total Basal Area	Square feet per acre	
Litter	Percent of ground cover	
Moss	Percent of ground cover	
Bare Ground	Percent of ground cover	
Rock	Percent of ground cover	
Pavement	Percent of ground cover	
Rooting Depth	Inches	
Total Soil Depth	Inches	
Landform		
Alpine	1	
Mountain Meadow	2	
Mountainous	3	
Foothills	4	
Valley Floor	5	
Macrotopography		
Major ridge	1	
Secondary ridge	2	
Rolling	3	
Flat	4	
Microtopography		
Convex	1	
Flat	2	
Concave	3	
Position on Slope		
Ridge Top	1	
Upper third	2	
Midslope	3	
Lower third	4	
Bottom	5	
Bedrock Fracturing		
Uncracked	1	
Poorly Cracked	2	
Moderately Cracked	3	
Well Cracked	4	
Rotten	5	
Soil Texture		
Sand	1	
Sandy Loam	2	
Loam	3	
Silt Loam	4	
Clay loam	5	
Clay	6	
Soil Consistence(Wet)		
	A Horizon	B Horizon
Non Sticky	21	11
Slightly Sticky	22	12
Sticky	24	14
Very Sticky	23	13

Table 3 (Continued)

PARAMETER	CODE
Aspect (Degrees)	
10-35	40
36-55	37
56-80	33
81-100	31
101-120	29
121-145	27
146-165	23
166-190	21
191-215	20
216-235	22
236-255	24
256-280	28
281-305	30
306-330	32
331-350	34
351-9	38
Geology	
Serpentine	1
Peridotite	2
Gabbro	3
Breccia	4
Pumice	4
Ash	5
Granodiorite	7
Hornblende	9
Andesite	9
Basalt	7
Chert	4
Schist	5
Metavolcanic	5
Metasediment	6
Limestone	6
Cover (Percent)	Vertical projection of plant outline
Trace	1
2-5	2
6-10	3
11-30	4
31-70	5
71-90	6
90 +	7
Dominance	Degree the species occupies the site
Dominant	5
Codominant	4
Common	3
Hard to find	2
Searched for	1
Frequency	By percent in increments of five

four were recorded as percent of ground covered. Rooting depth and soil depth were recorded in inches. Landform, macrotopography, microtopography, position on slope, bedrock fracturing, soil texture, soil consistence, geology and aspect were all scaled according to their suspected influence on productivity. Because of its general classification, moss was grouped with the environmental factors.

Vegetative parameters were recorded with standard classes (Daubenmire, 1968). Cover, the vertical projection of the crown area, and dominance, the degree to which the species occupies the site, were estimated for all layers of vegetation. Frequency was measured for shrubs and herbs only. The three measures were used to provide a comparative evaluation of their effectiveness as classifiers.

Vegetative cover and trees per acre were estimated by breaking the fifth acre plot into quarters. A crown densiometer was used to estimate overstory cover. Ten frequency plots were taken on the contour on each side of plot center. A one foot square plot was used the first year and a two square foot plot was used the second year. Dominance was estimated for each species in the overstory, tree understory, shrub and herb layers. Understory refers to trees under the general canopy. Diameter, density, age and fire history by species were also recorded on each plot. The resulting stand table was used to evaluate the successional status of the stand.

Near the center of each plot a soil pit was dug to the C or R horizon. Texture, wet consistence and depth were recorded for each horizon. Total depth and rooting depth were also measured. Bedrock fracturing was estimated from material from the pit bottom or from a nearby road cut.

Three photos were taken at each plot. A general view of the stand from the right of plot center, a view of the ground cover two paces upslope

Data Analysis

A cyclic interchange between objective and subjective techniques was used to analyze the data (Bradfield and Orloci, 1975). A schematic representation of this strategy is given in Figure 12.

Presence Program

The presence program lists each species by its occurence. If for example, 250 plots were taken and a species occurred on 125 of them, its percent occurrance would be 50 percent. If a species is miscoded it appears as incorrect and the program lists the location of the error within the data file. Codes used are from Garrison, et al (1976). Thus the presence program was used to clean the data of misspelled alphameric species names and to determine which species occurred frequently enough to be reformatted for further analysis.

All species with greater than three percent presence were reformatted. See Appendix III.

Order Program

The order program (Omeg and Volland, 1977) is a computerized classification table where columns and rows can be manipulated without the traditional cutting and pasting (Braun Blanquet, 1972). Plots can be listed as suggested by the results of the cluster analysis (see Cluster analysis section below) or manipulated subjectively by the investigator. Plot order also can be listed by increasing elevation, slope, aspect, soil depth, productivity or even species cover. Limits of species and their environmental relationships are clearified clear with such order listings.

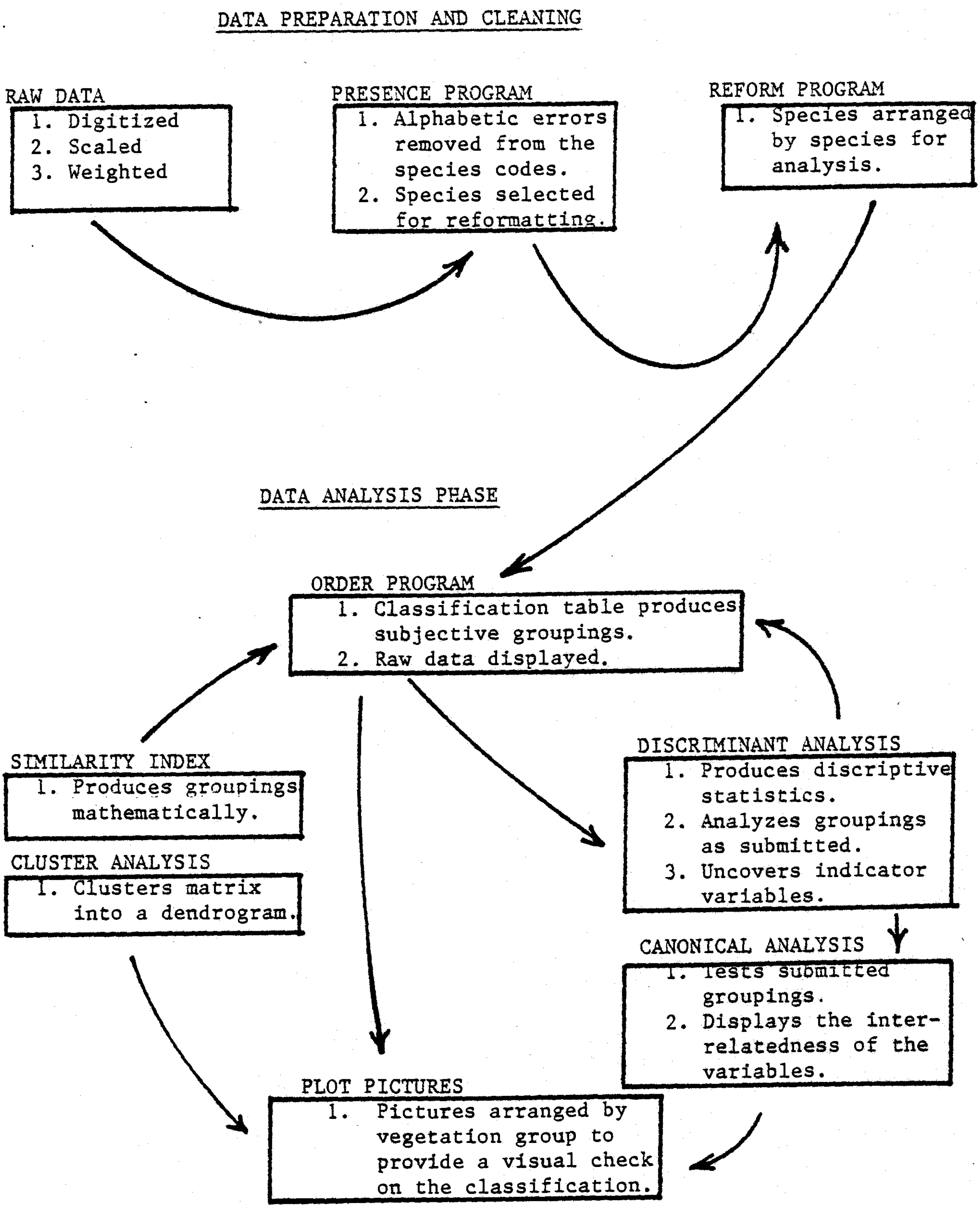


Figure 12 Diagram of the interchange between programs used in the analysis

The table also may be modified by the results of a discriminant analysis (DA) and/or canonical analysis (CA). Objective groups from the cluster analysis, or subjective groups arranged by the investigator or both, can be submitted to DA and CA for testing of the groups (DA and CA will be covered below in detail) and the results may be used to modify the Order Table. However, the table is an important final product because its unadulterated data is a close link with reality.

The table for this study (250 plots with 494 variables each) was manipulated both subjectively and mathematically. The first 23 variables were environmental (see parameter section) and were followed by 157 species variables each with a value for cover, dominance and frequency. The table is only partially listed in appendix IV because of it size.

Discriminant Analysis

Discriminant analysis (DA) was used both as a heuristic tool and a comparison tool but it is not strictly inferential (Del Moral and Long, 1977). It provides statistical information and an assessment of group homogeniety. Groupings determined by cluster and/or order and submitted by DA may not be properly grouped according to DA output (Table 4). The investigator may adjust group membership by reassigning plots until all plots are "correctly" classified according to their given probability of group membership. The "correct" groupings may then be rerun through order for subjective consideration by the investigator. Parameters submitted to a particular run also can be controlled and non-significant discriminators may be successively deleted until a satisfactory reduced model is formed. Thus, key discriminators are uncovered for use in key building or predictive work (Table 5).

Averages, standard deviations, correlation and covariance matrices are given for each group and each parameter, followed by the step-wise discrimination process which ends by summarizing the importance of each variable as a discriminator. (Table 5).

Canonical Analysis

The canonical analysis (CA) attached to the DA tests the validity of the classification as submitted, and presents a graphical representation of the groups, plotted on the first two canonical axis (Figure 13) a very illustrative visual technique (Cooley and Lohnes, 1971; Volland, 1978). Although the third axis may sometimes help to separate groups, it was most often found to be insignificant. The meaning of the coordinates can be evaluated with the factor coefficients which are the relative weights of the original variables on the axis. Confidence limits can be applied to the group centroids as a visual test of their exclusivity between groups and affinity within groups (Seal, 1964). See Figure 13.

Similarity Index and Cluster Analysis

Sorenson's index 2W/A+B was used to measure similarity between plots. It is widely accepted as a similarity measure (Muller-Dombois, and Ellenberg, 1974) and takes relative values as well as presence and absence into account. It's processing produces a lower triangular similarity matrix which was submitted to an average linkage clustering routine (Lance and Williams, 1967). The average linkage routine was chosen because it has been shown to result in few misclassifications (Pyott, 1971; Kuiper and Fisher, 1975) and its tendency to chain or

Table 4 Example of probability table from discriminant analysis.

1/ Case nine or plot 166 has been misassigned to the PIJE group. The probability is .873 that it belongs to the LIDE3 group. ~~Plot 180 is also misassigned. It belongs to the REST (ABGO) group.~~

2/ The probability column indicates that all other plots are correctly assigned with the probability of one.

GROUP PIJE CASE			TABR		ABMAS		CHLA		REST		LIDE3		PIJE	
1	137	PIJE	277.314	.000,	303.417	.000,	286.525	.000,	244.935	.000,	222.917	.000,	138.208	1.000, 2/
2	19	PIJE	239.688	.000,	242.830	.000,	220.182	.000,	179.365	.000,	180.210	.000,	45.671	1.000,
3	149	PIJE	230.938	.000,	266.501	.000,	214.632	.000,	202.214	.000,	193.026	.000,	41.155	1.000,
4	150	PIJE	229.053	.000,	265.364	.000,	211.862	.000,	198.203	.000,	190.487	.000,	48.193	1.000,
5	158	PIJE	205.382	.000,	225.052	.000,	202.652	.000,	170.209	.000,	168.686	.000,	98.985	1.000,
6	159	PIJE	156.554	.000,	189.522	.000,	151.784	.000,	124.402	.000,	117.125	.000,	24.541	1.000,
7	160	PIJE	197.104	.000,	228.929	.000,	162.476	.000,	166.044	.000,	160.764	.000,	60.984	1.000,
8	161	PIJE	233.371	.000,	285.928	.000,	195.573	.000,	233.204	.000,	237.005	.000,	143.331	1.000,
9	166	LIDE3 1/	104.237	.000,	135.919	.000,	120.027	.000,	78.299	.126,	74.421	.873,	87.594	.001,
10	178	PIJE	223.881	.000,	250.365	.000,	243.590	.000,	200.557	.000,	189.341	.000,	53.316	1.000,
11	179	PIJE	175.617	.000,	187.374	.000,	165.518	.000,	141.310	.000,	145.601	.000,	41.086	1.000,
12	180	REST	75.510	.000,	89.473	.000,	84.070	.000,	29.448	.997,	41.079	.003,	81.674	.000,
13	208	PIJE	316.490	.000,	341.322	.000,	300.833	.000,	288.776	.000,	287.140	.000,	146.921	1.000,
14	209	PIJE	240.012	.000,	267.349	.000,	250.059	.000,	210.812	.000,	211.845	.000,	85.910	1.000,
15	210	PIJE	234.563	.000,	265.381	.000,	232.953	.000,	205.666	.000,	213.338	.000,	81.259	1.000,
16	212	PIJE	259.158	.000,	280.242	.000,	275.691	.000,	234.797	.000,	238.724	.000,	93.837	1.000,

NUMBER OF CASES CLASSIFIED INTO GROUP -

GROUP	TABR	ABMAS	CHLA	REST	LIDE3	PIJE
TABR	22	0	0	2	0	0
ABMAS	0	60	0	1	0	0
CHLA	0	0	42	0	0	0
REST	0	0	0	69	4	0
LIDE3	0	0	0	4	40	0
PIJE	0	0	0	1	1	14

Table 5 Example of the summary table from the discriminant analysis.

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	
1	[illegible] 2/	40.5300	1	.2701	
2	43	5.4726	2	.1942	Significantly discriminatory variables 1/
3	61	3.0095	3	.15[illegible]	Non significant variables
4	31	4.0311	4	.1177	(Critical value is 4.45)
5	62	1.9535	5	.0999	
6	22	1.0538	6	.0903	
7	59	2.2556	7	.0722	
8	4	2.3132	8	.0534	
9	60	2.8081	9	.0363	
10	21	1.9058	10	.0289	

1/ An F test can be applied to determine which variables are not significantly contributing to the classification. In this case(the PIJE group) only two variables were required to separate the communities of the group.

2/ The variables are listed in order of their discriminatory power.

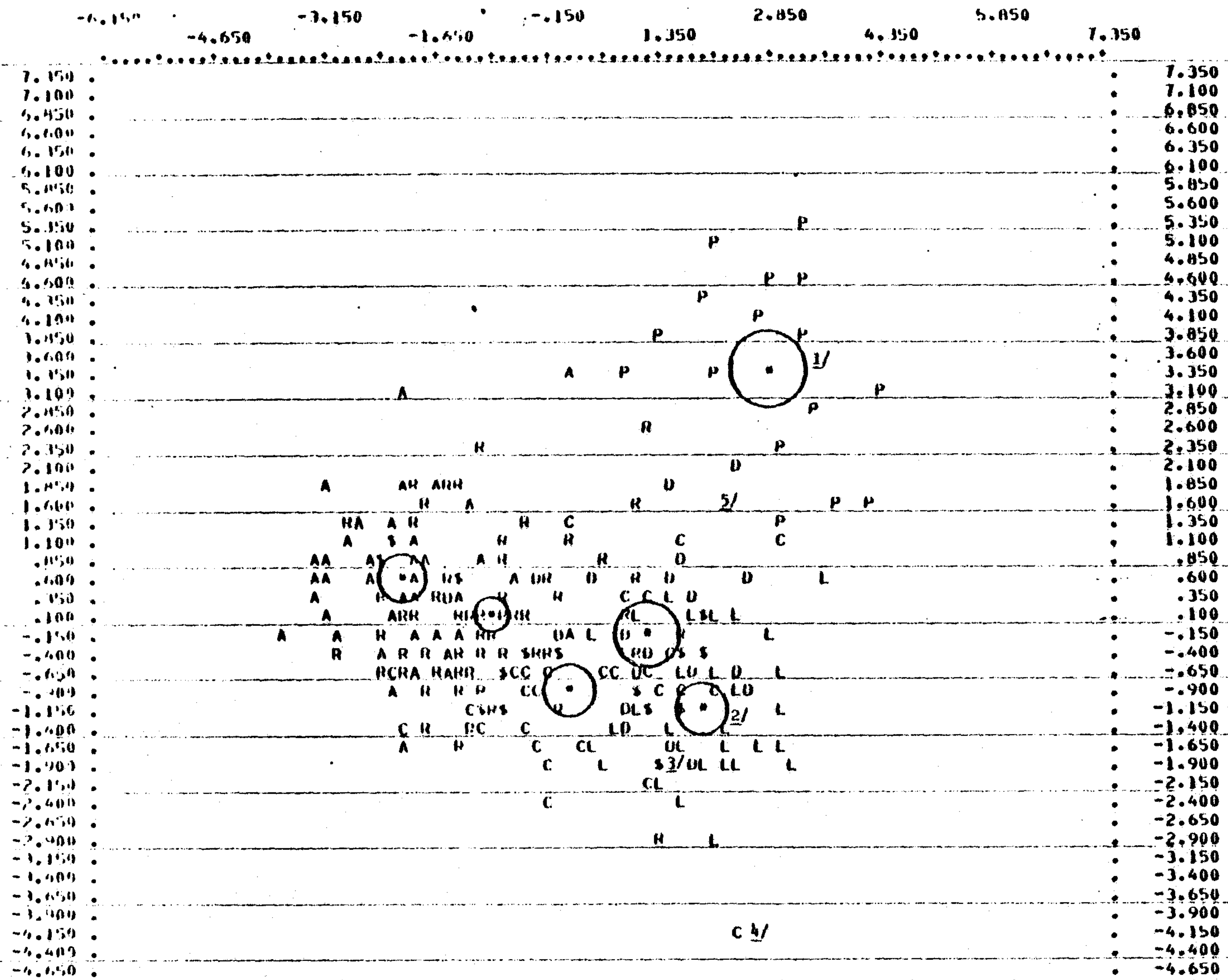


Figure 13 Canonical graph of the six vegetation groups using the 23 environmental variables as discriminators.

1/ The circles are the confidence limits around the group's centroid.

2/ Proximity of centroids indicates the affinity between groups.

3/ $ indicates overlaping of plots of different groups.

4/ Each letter represents a plot location in canonical space

5/ The separation of the confidence limits indicate the groups can be separated by environment.

overcluster is slight. Table 16 (page 125) shows a dendogram, the output from cluster analysis. The number of groups split is entirely the subjective judgement of the investigator (he may choose to split groups at any similarity level) but the affinity between plots and groups is a mathematical reality. Thus cluster analysis can serve to group plots (Classify vegetation) on a purely mathematical basis, and provide insight on plot affinities.

In summary the three programs give unique views of the same data set but are interfaced for compaison and evaluation, and contribution to the total classification.

RESULTS AND DISCUSSION

Group Classification

The results of this study are presented in two phases; (1) an overall classification of the vegetation into groups and (2) the division of the groups into community types.

Six major plant groups were identified and subsequently divided into 17 community types. The classification was developed after analysis of over 30 cycles between the order classification table and the discriminant and canonical analysis. Interaction between cluster analysis and the other programs was much less intense. Only four runs of the cluster analysis were made. Only the final products are presented. The order of presentation of the results is repetitive throughout the community subsections.

Four letter species codes are used as abbreviations of the species scientific name in tables and figures in the results. Scientific names, common names, codes and authorship of all species used in the analysis are given in Appendix V.

Species Presence

The presence results (presence is the number of plots in which a species occurred divided by the total number of plots sampled) show 326 species were found in the overstory, tree understory, shrub and herb layers combined (Appendix III). Many of the overstory species are repeated in the understory and some plants were not identified to species. For example, Ponderosa pine occurred both in the overstory and tree understory and some sedges and lupines could not be identified. Thus, 285 different known species were found and 157 were reformatted for analysis. These are given in Appendix V with their code, author and common name. Thus, 494 variables were used in the analysis; cover, dominance and frequency values for 157 species plus 23 environmental variables.

Order: The Classification Table

The order table is arranged by vegetation layer (Appendix IV). Overstory, understory, shrubs and herbaceous species respectively are in rows with the most frequently occuring species ordered from the top. The first 23 variables are environmental. Their codes are given in the methods section. However, the complete table is seven feet by twelve feet and could not be completely reproduced here. Appendix IV lists the environmental variables with part of the understory for all 250 plots. The remainder of the table is available through the author.

Seven vegetative climax zones became evident from the manipulation of the classifcation table. (Again, data presented in this table are unchanged from the field record. Only the order of presentation of the plots and variables has been changed.) In order of decreasing average elevation they are: (1) the mountain hemlock zone, (2) the red fir zone, (3) the white fir zone, (4) the Port-Orford cedar zone, (5) the Jeffery pine zone, (6) the Douglas-fir zone, and the (7) tanoak zone.

The table (appendix IV) is divided by zone (heavy vertical line), by community (light vertical line) and by group (double vertical lines). The arrangement of the table is generally from high elevation, cold, wet to low elevation, hot, dry. Thus, the red fir, white fir and Port-Orford cedar groups are presented in order followed by the tanoak, Douglas-fir and Jeffery pine groups.

Zone is used in this study to refer to all areas with the same major climax tree species, while group is used to refer to those areas separated by the analysis herein.

Number of Plots per Group

The number of plots per zone seemed to vary directly with its extent. All zones were well represented except the mountain hemlock zone which is represented by only nine plots. Except for tentative recognition, it was considered in this work to be a part of the red fir group. The white fir group was by far the most extensive, with 76 plots, followed by the red fir group with 48. The Port-Orford cedar and tanoak groups had 42 each, while the Douglas-fir and Jeffery pine groups had 25 and 17 respectively.

Species Pattern

For classification purposes the understory proved to be the most patterned and therefore, the most useful. Presence versus absence was the most obvious pattern used for grouping. However, plots grouped by presence/absence were later repositioned by assessing cover, dominance or frequency values.

The overstory had little variation and was usually dominated by Douglas-fir. The shrubs were patterned somewhat and were useful in developing community classes. Subjective discrimination by herbs was almost impossible; there seemed to be little recognizable pattern in the herbaceous layer.

Qualitiative ecological relationships, such as the lack of tanoak on granitic parent materials, can be uncovered using the table. However, such relationships are clearified by quantitatively treatment.

Canonical Analysis

As explained in the methods section, canonical analysis may be used to test the validity of a classification. That is, do statistically separate groups exist? Figure 14, the canonical graph, shows that the vegetation can be statistically separated into the six groups formed with the order table. The Jeffery pine group is the most distinct. There is no overlap among plots from other groups, and the fact that the group is separated from the others, is an indication of its distinctness. Also note that the size of its circular confidence limits is larger than limits for the other groups indicating the group lacks sample plots.

The red fir group is also very distinct. The white fir, Douglas-fir, tanoak and Port-Orford cedar groups, however, are more closely associated. Although they are statistically significant groups and may be thought of as separate entities, (see confidence limits around the centroid) some plots overlap in canonical space. But, by removing the Jeffery pine, red fir and Port-Orford cedar groups from the analysis the relationship between the Douglas-fir, white fir, and tanoak groups can be more closely examined. (Figure 15).

Figure 15 shows the relationship of the white fir, Douglas-fir, tanoak groups with the variation associated with the more distinct groups removed. Again, statistical separation is evident, but in this analysis it is more clearly shown. Thus, the classification table as submitted to canonical analysis is objectively or statistically valid.

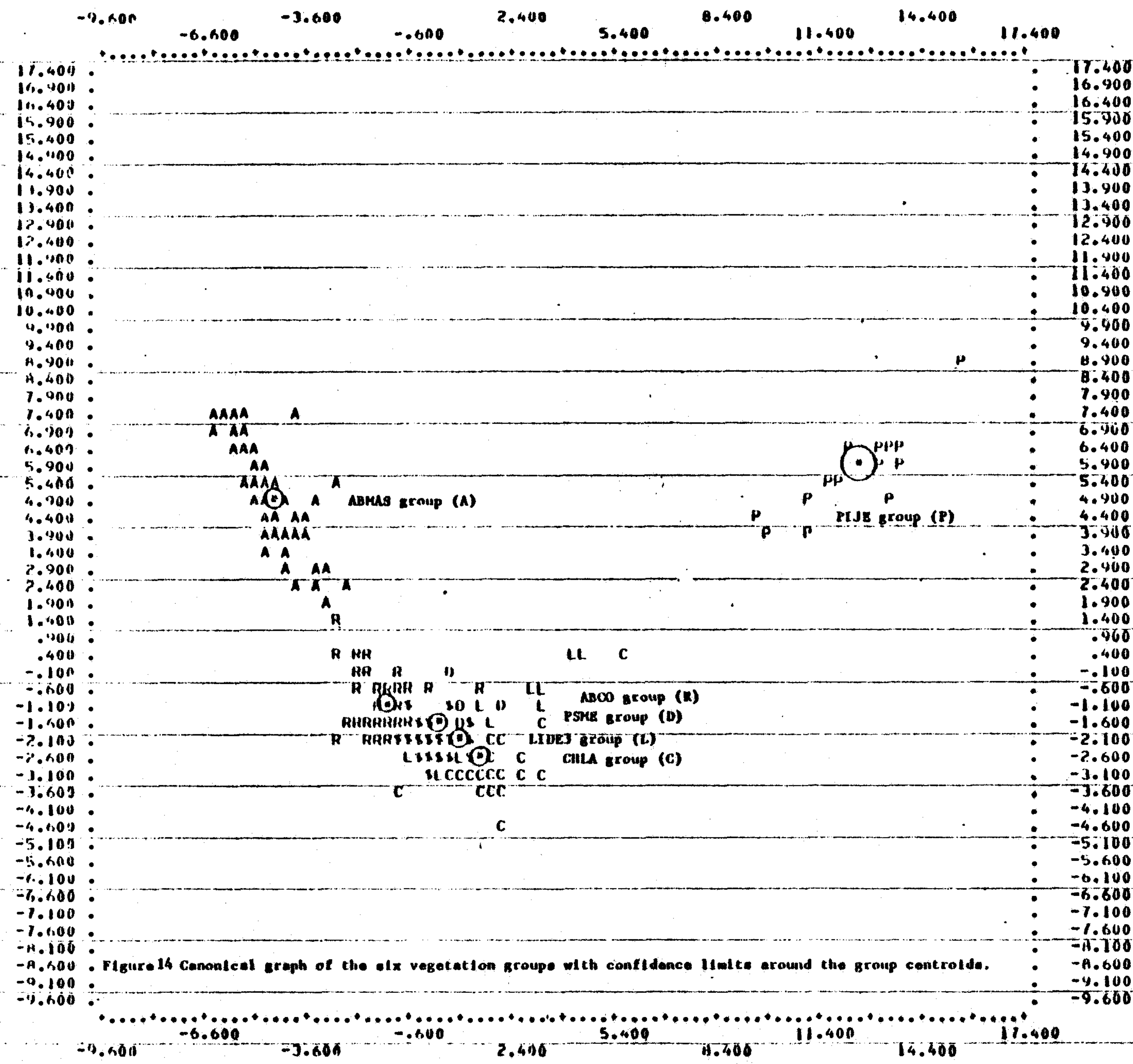


Figure 14 Canonical graph of the six vegetation groups with confidence limits around the group centroids.

Another indication of the soundness of the classification is the probability table of the discriminant analysis. See Table 5 of the methods section. [2/] In this classification, only 4 of the 250 plots were shown to be misclassified.

In addition, canonical analysis uncovered relationships between variables and vegetation groups by interpretation of the canonical axis. In Figure 15, for example, the abscissa, which accounts for 81 percent of the variation, is represented by the variable landform and less so by the distribution of wet site swordfern (*Polystichum munitum munitum*. Since landform is essentially a measure of elevation, the axis can be loosely interpreted as elevation. The white fir group would have the highest average elevation and the Douglas-fir and tanoak groups would be closely related, with tanoak having the lower average elevation.

Figure 14 is much more difficult to interpret: three axis are needed to explain the variation, four species variables are equally represented on the axis, and little is known about the species. With Jeffery pine, hairy honeysuckle (*Lonicera hispidula*) and slender toothwart (*Cardamine pulcherrima pulcherrima*) loading heavy on the abscissa, a loose interpretation is that the groups are separated on the basis of ultrabasic parent material. Thus Port-Orford cedar (C on the graph), the closest group to Jeffery pine (P on the graph), may have more affinity to ultrabasic parent material than the other groups.

2/ A cluster analysis of the entire classification could not be run. The matrix size exceeded the limits of the program.

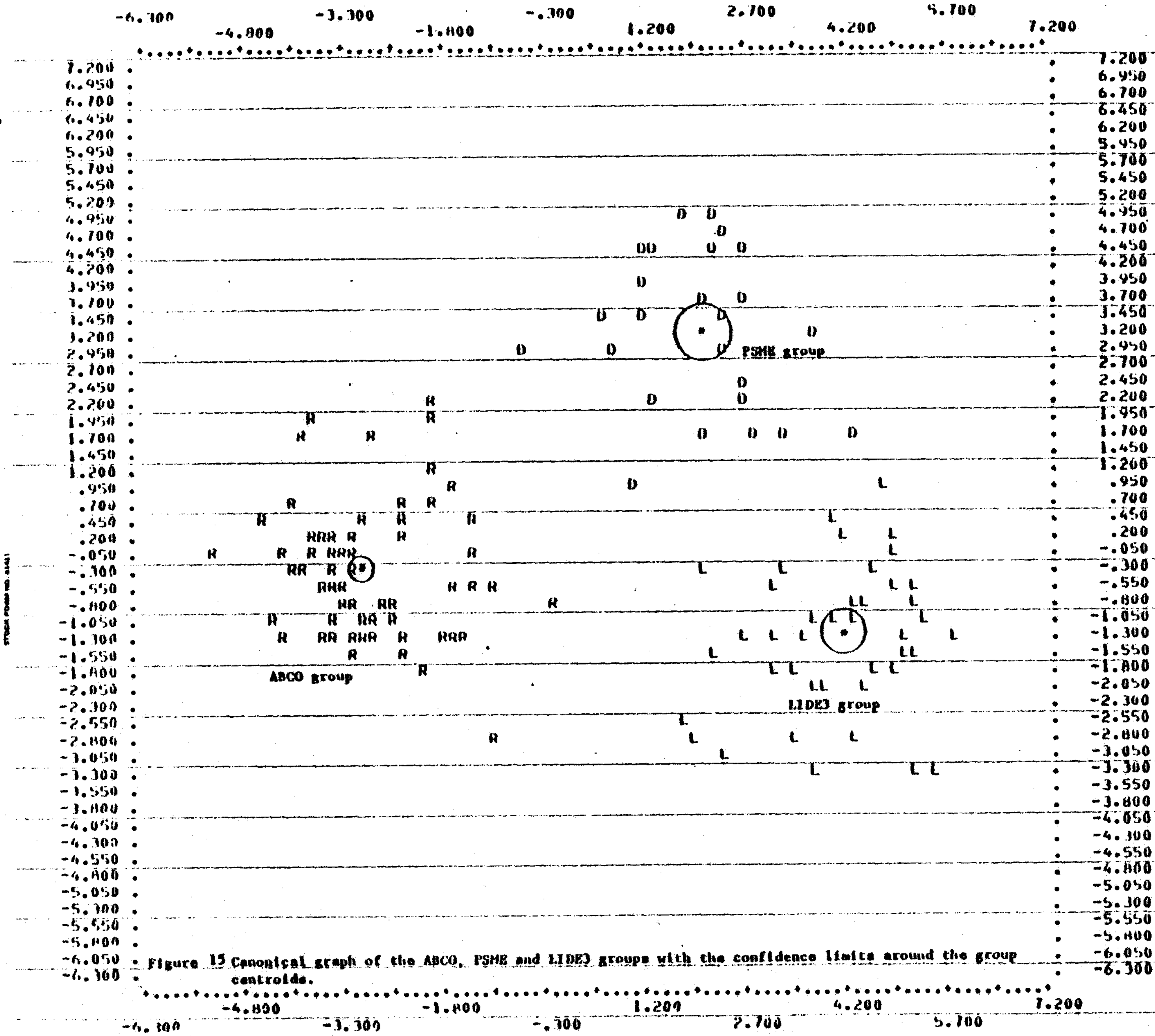


Figure 15 Canonical graph of the ABCO, PSME and LIDE3 groups with the confidence limits around the group centroids.

Thus, the Siskiyous support a diversity of vegetation with wide cotonal boundaries. However, they can be discretely classified.

Discriminant Analysis

The 494 variables were screened in groups of 64 or less to determine their power as discriminators and check for concomitance. The final run contained the most promising discriminators (Table 6). In the final run only 32 of the 64 variables submitted contributed significantly as class discriminators. They are listed in Table 7 in order of their importance as discriminators. The F value relates how well they account for between group and within group variation.

The environmental variables were not powerful discriminators. Only 8 of the 23 survived the screening and only five were significant discriminators. The first of those, moss, was entered at step thirteen. The others in order of importance are range, consistence of the B horizon, elevation and geology (parent material). The first ten discriminators were ninty percent efficient. They classified 225 of the 250 plots. Six of the first 10 most significant discriminators were understory tree species. The shrub layer was represented by two species and the overstory and herb layer each contributed one discriminator. Dominance was the most important discriminatory parameter followed by cover and frequency.

Table 8 shows the average per vegetation group for the 23 environmental variables. Averages and standard deviations (Table 8) are computed for all variables during the discriminant run and are the basis for plotting environmental relationships and species distributions.

Table 6 Variables used in the final discriminate run.[1/]

VARIABLE Number	Name	VARIABLE Number	Name
1	Range	33	LOHI D
2	Elevation	34	LOHI F
3	Aspect	35	GOOB D
4	Slope	36	TRLA2 C
5	Geology	37	ACTR C
6	Landform	38	LIBOL F
7	Moss	39	TROV C
8	Consistence of B Horizon	40	POMUM C
9	ABMAS OS C	41	POMUM D
10	ABMAS OS D	42	POMUM F
11	CHLA OS C	43	PYSE C
12	CHLA OS S	44	ASHA F
13	CACH OS D	45	FRVEB D
14	CACH OS F	46	POMUI F
15	ABCO US D	47	COST2 C
16	PSME US D	48	COST2 D
17	CACH US C	49	APAN C
18	CHLA US C	50	APAN D
19	ABMAS US C	51	LIWA F
20	TABR US C	52	XETE D
21	TABR US D	53	CAPR3 C
22	QUCH US D	54	MOSI C
23	CONU US F	55	CIAL C
24	PIJE US C	56	PEAN D
25	ALRU US C	57	ACRU D
26	BENE F	58	TITRU D
27	RUUR D	59	CAPUP C
28	LIDE3 D	60	CAPUP D
29	ACCI D	61	CAPUP F
30	ARNE F	62	ASDE C
31	BEPU F	63	FERU F
32	RILA D	64	PHSP D

1/ All variables listed were found to be significant discriminators in earlier subruns. OS= Overstory US=Understory C=Cover D=Dominance F=Frequency Species codes are given in Appendix V

Table 7 Summary of variables that significantly contributed to the classification, listed in order of their importance as discriminators.

STEP ENTERED	VARIABLE NUMBER	VARIABLE NAME	F VALUE	PERCENT PRESENCE
1	10	ABMAS OS D 1/	255.2	20
2	18	CHLA US C	156.8	21
3	24	PIJE US C	74.7	4
4	15	ABCO US D	52.9	72
5	33	LOHI D	23.6	4
6	61	CAPUP F	26.1	7
7	16	PSME US D	16.2	55
8	22	QUCH US D	14.6	18
9	34	LOHI F	12.8	4
10	19	ABMAS US C	9.3	20
11	9	ABMAS OS C	9.8	20
12	12	CHLA OS D	8.4	14
13	13	Moss	7.3	
14	1	Range	6.9	
15	8	Consistence of B	7.0	
16	63	FERU F	8.2	7
17	28	LIDE3 D	5.9	11
18	32	RILA D	4.2	6
19	2	Elevation	3.6	
20	59	CAPUP C	3.5	7
21	41	POMUM D	3.4	11
22	11	CHLA OS C	4.2	14
23	5	Geology	3.2	
24	55	CIAL C	3.0	3
25	49	APAN C	3.0	10
26	60	CAPUP D	2.9	7
27	31	BEPU F	2.3	4
28	51	LIWA F	3.9	4
29	6	TRLA2 C	2.5	53
30	37	ACTR C	3.2	61
31	40	POMUM C	2.3	21
32	62	ASDE C	2.1	18

1/ OS=Overstory US=Understory C=Cover D=Dominance F=Frequency

Correlation Matrix

The within group correlation matrix can aid in assessing the concomitance of variables in the discriminant analysis. When two highly correlated variables are used in the same run, one often masks the discrimating abilities of the other. Such variables are said to be concommitant. When masking occurs it is often necessary to drop one of the variables in order to "unmask" the discriminatory power of the other. Therefore, after the first run, if discriminating variables were found to be highly correlated with other "non discriminators" the discriminators were dropped from the succeeding run in order to assess the power of the masked variables. The matrix can also be used to assess the relationship between the variables. By comparing species with species and species with environment, ecological amplitudes may be assessed and substitutes for difficult to use key characters may be found. Table 9 lists the significantly related variables found in the correlation matrix of the discriminant analysis. The relationships shown are not surprizing; one often mentally formulates such associations subjectively. The correlation matrix, however, objectively quantifies such qualitative notions.

Ecological Relationships

Elevation. Plots range in elevation from 1,880 feet to 6,150 feet. The highest point within the study area is Althouse Mountain at 6,326 feet. The lowest point is 1,600 feet. The average elevation for all plots is 4,118 feet which is approximately the average elevation of Oregon Caves National Monument.

Table 8 Averages and standard deviations for the 23 environmental variables by vegetation group.

VARIABLE	VEGETATION GROUP					
	ABMAS	ABCO	CHLA	LIDE3	PSME	PIJE
COMPARTMENT	4142±74	3991±817	4192±93	3907±1097	4164±63	4239±51
TWNSP	387±73	391±78	409±32	409±10	410±8	415±13
RANGE	64±10	63±12	64±12	72±7	72±9	69±10
ELEVATION	518±49	441±91	394±70	315±48	342±46	363±73
ASPECT	31±5	28±8	31±5	37±36	30±5	28±5
SLOPE	35±14	39±17	35±17	43±19	48±15	33±14
GEOLOGY	6±1	5±2	6±2	5±.9	5±2	2±1
LNDFRM	3±0	3±.5	3±0	3±0	3±0	3±0
MACROTOP	1±.3	1±.4	2±.5	1±.5	1±.5	1±.5
MICROTOP	2±.9	2±.9	2±1	1±.7	2±1	1±.7
POSITION	2±.7	2±1	3±1	3±.7	3±1	2±.8
T BASAL A	328±85	358±149	389±141	331±123	321±127	215±125
LITTER	47±43	45±44	34±38	17±33	62±36	4±15
MOSS	2±4	5±16	18±21	33±26	12±16	7±13
BRGRD	1±3	2±9	2±5	3±6	3±7	13±15
PVMT						
ROCK	9±12	10±15	16±23	12±19	15±20	31±26
SOIL	31±10	33±11	35±11	38±13	40±10	34±14
CONST A	21±3	21±4	21±4	22±4	22±2	20±8
CONST B	11±2	12±3	12±2	12±2	12±2	11±5
BDRKFRCT	3±.9	3±1	4±1	4±1	4±.8	3±1
ROOTDPT	38±18	35±17	33±13	34±14	29±9	21±14
TOTDPT	39±18	36±17	34±12	35±15	31±8	22±14

Table 9 Significantly related variables taken from the within group correlation matrix of the final group run.[1/]

CORRELATED VARIABLES	VALUE	CORRELATED VARIABLES	VALUE
Soil Texture Soil Const.	.58	ACTR ANDE	.49
Elevation Landform	.58	ACTR ADBI	.50
Landform B Consistence	.48	ACTR VAHE	.48
Microrelief A Const.	.45	DIHOO ANDE	.47
Rooting Dpth. Tot. Dpth.	.98	DIHOO VAHE	.50
ARME QUCH	.43	HIAL CASC2	.41
PIMO PIBR	.49	GAAP VAHE	.41
TABR POMUM	.41	GAAP ADBI	.43
LOHI PIJE	.50	GAAP CASC2	.45
LOHI BEPI	.47	ANDE VAHE	.54
ARNE BEPU	.43	ADBI CASC2	.50
ARNE LIWA	.75	ADBI VAHE	.67
MOSI CIAL	.55	ARMA3 CASC2	.50
MOSI ACRU	.57	FRVEB VIGL	.54
ROGY BENE	.41	SYRE VIOR2	.52
RHDI LOHI	.43	SYRE FESU	.42
CEVE SALIX	.75	MESU MOSI	.59
CEVE SOSI	.53	CIAL AQFO	.58
CEVE LOCO	.48	ACRU ASCA3	.63
LOCO RIBI	.41	ACRU MOSI	.57
LOCO RULA	.41	ACRU PHCO3	.59
SALIX SOSI	.56	CAREX PHSP	.51
TRLA2 ACTR	.42	MOSI CYGR	.55
TRLA2 VAHE	.42	CAPUP CYGR	.50
TRLA2 GAAP	.48	ASDE PHSP	.60
TRLA2 ANDE	.41	FERU GAAM	.55

1/ Critical value at the 0.05 alpha level is 0.35. Critical value at the alpha 0.01 level is 0.48

Figure 16 shows the distribution of the vegetation groups with respect to elevation. In order of decreasing elevation, they are the red fir, white fir, Port-Orford cedar, Jeffery pine, Douglas-fir and tanoak groups. The Douglas-fir group, averaging 3,420 feet, has the narrowest range of elevation with a standard deviation of 460 feet. The tanoak and red fir groups have a similar range with a standard deviation of 480 and 490 feet, respectively. They average 3,150 feet and 5,190 feet. The white fir group, the widest, averages 4,410 feet with a standard deviation of 910 feet. the Port-Orford cedar and Jeffery pine groups 3,940 feet and 3,634 feet, occur under a relatively wide range of elevations. Their standard deviations are 701 feet and 726 feet respectively.

Aspect. Aspect in Figure 17 is displayed as coded. Thirty and above are northerly aspects and are considered to be more productive than the southerly aspects which are coded from 20 to 30. The tanoak group occupies the most favorable aspects followed by the red fir and Port-Orford cedar groups. All occupy northerly aspects. The white fir and Jeffery pine groups occupy the most southerly aspects and the Douglas-fir group is neutual.

Moss. Percent moss cover was the most discriminatory "environmental" variable, although it was number 13 overall (Table 7), in the classification of the groups. Its average with one standard deviation is given by group in Figure 18. Its an extremely variable parameter and differences between groups are slight. However, the tanoak and Port-Orford cedar groups are recognizably different from the red fir group with respect to moss cover.

Soils

Introduction. The average slope in the study area is 39 percent. With such steep terrain, erosion potential is high and down-slope soil

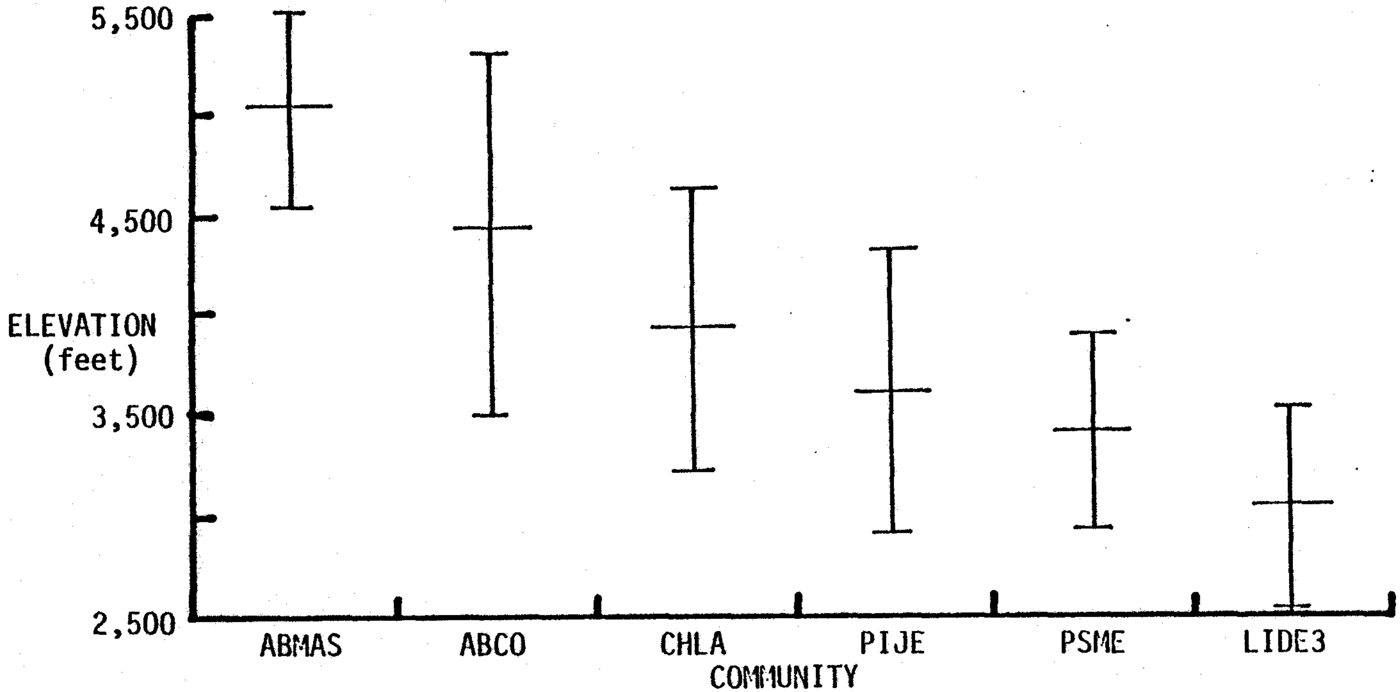


Figure 16 Mean and standard deviation for the elevation of the vegetation groups.

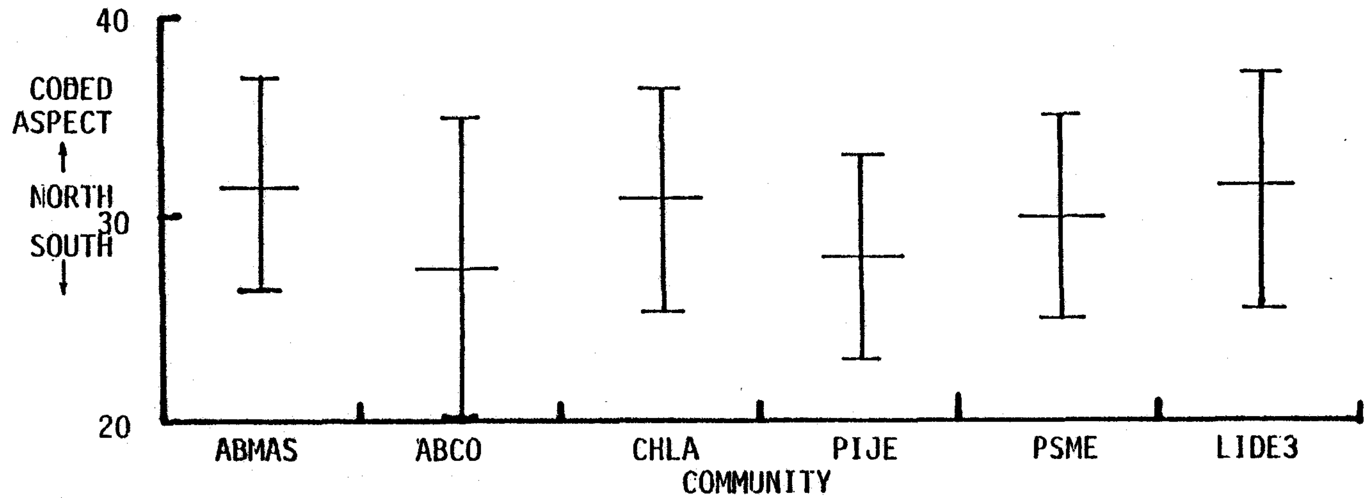


Figure 17 Mean and standard deviation for coded aspect for the six vegetation groups.

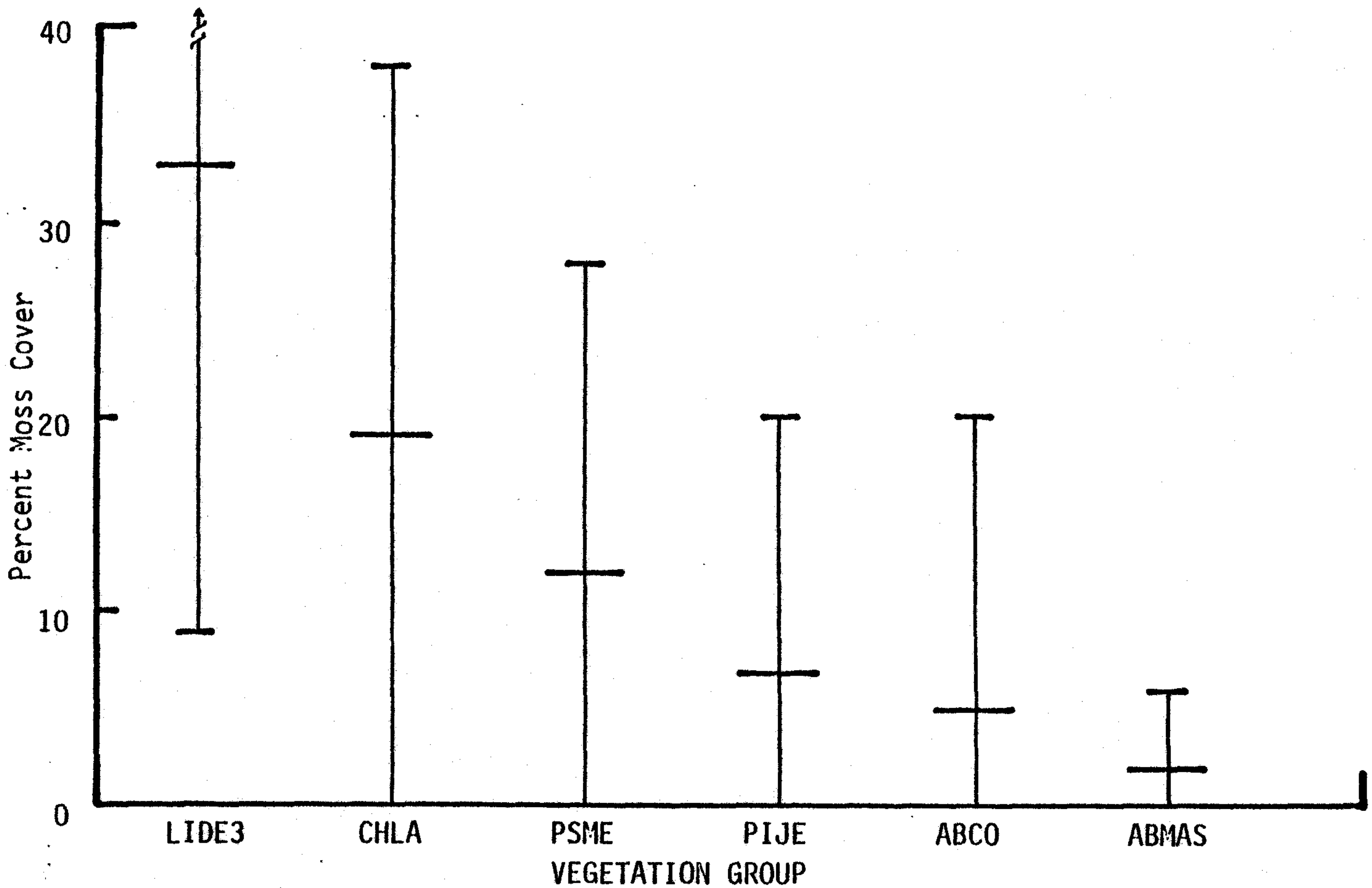


Figure 18 Percent moss cover by vegetation group. Average with one standard deviation.

movement is common. Meyer (1978) reported many soils are derived from colluvium. In fact, it is sometimes difficult to identify the parent material of a sample because "floaters" and other material from upslope have thoroughly mixed with the residual material. However, plots were located where identification was possible, in order to separate and identify the characteristics of each parent material. Location of plots relative to parent material is given in Table 10.

Parent Material and Depth. Within each parent material there is a continuous range of hardness. For example, the intrusives that were emplaced during the Nevadan episode ranged from granodorite to gabbro and from very hard to rotten. The highly erosive rock at Grants Pass is typical of the dioritic material that occupies the lower positions because it eroded faster than the surrounding rock types. However, most of the material of associated origin within the study area is much more resistant and occupies the high positions. Black Butte, Grayback and Lake mountains are examples.

Soil depth is highly related to hardness, or the degree of bedrock fracturing, of the parent material. Figure 19 illustrates this relationship. Glacial till was not defined for fracturing because it is an unconsolidated deposit of various materials lain over existing rock. Another problem was the classification of the Galice metasediments which break quite well along the striations, but have extremely hard core material. These sediments are categorized as well cracked parent material, but their internal hardness prevents rapid weathering into soils. As a group they produce a clayey textured, shallow soil (Figure 19).

Table 10 The percent occurrence of parent material and the number of samples taken in each.

FORMATION Parent Meterial	Percent occurrance of meterial in study area	Number of plots taken	Percent of total	General Description
APPLEGATE GROUP	67	170	68	Coarse textured metamorphosed sediments and volcanics including large bodies of ultrabasics of ophiolitic origin.
Peridotite and serpentine	20	29	12	
Metasediments	5	28	11	
Metavolcanics	42	113	45	
GALICE FORMATION	7	12	5	Fine textured Metamorphosed sediments.
Metasediments	7	12	5	
NEVADAN METERIALS	23	60	24	Granitoid and more basic intrusive meterial.
Diorite	22	52	21	
Gabbro	1	8	3	
GLACIAL TILL	1	7	3	Compacted and unsorted till of variable composition.

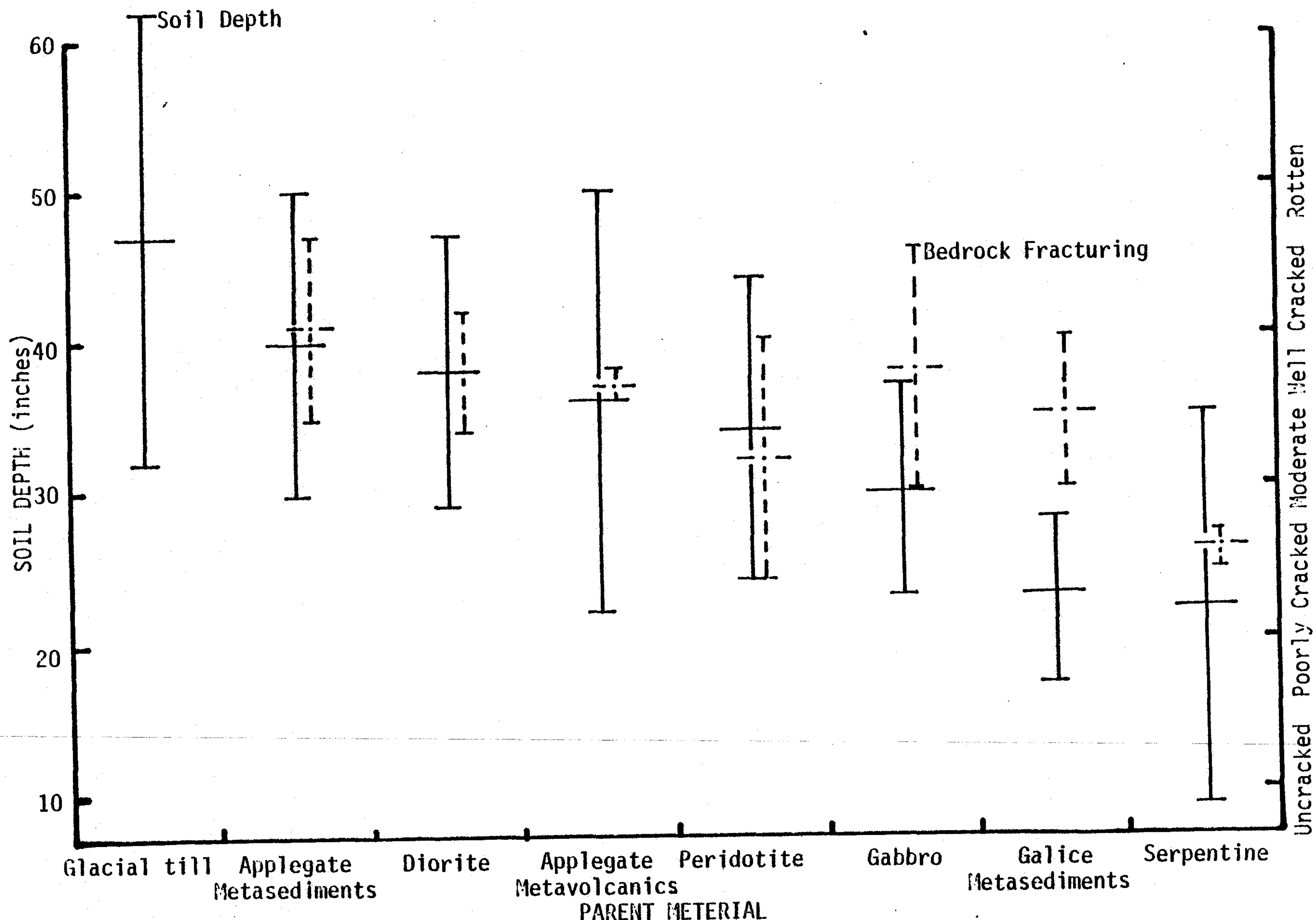


Figure 19 Mean and standard deviation for soil depth and bedrock fracturing for the parent material found in the study area.

The Applegate metasediments are softer, coarser in texture, produced deeper soils and are more productive than the Galice metasediments. The total basal area production on the Applegate parent material is about 20 percent greater, although some of the difference may be caused by other sources of variation. Gabbroic and dioritic parent materials were equal in average hardness, but gabbro produced shallower soils. The difference in depth may be related to their relative fertility. Vegetation on diorite may help to speed soil development.

An outstanding example of the effect of parent material is the serpentine syndrome. Its most striking feature is its sparse vegetative cover. The ecology of serpentine sites has been investigated by a number of scientists. The following factors have been reported as critical to the development of vegetation on serpentine: low levels of nitrogen, phosphorus, and potassium and sometimes low exhangeable calcium (Dhanpat Rai, Simonson, and Youngberg, 1970); unfavorable physical characteristics and shallowness, hiegh pH and resultant restriction of mineral uptake, (White, 1971); low occurrence of soil micro-organisms and high levels of nickel and chromimum (Walker, 1954; Birrel, 1945). However, there is a wide range of variation in characteristics which produce a wide range of vegetative variation.

Soil Depth by Vegetation Group. The red fir group has the deepest soils (Figure 20). It occurs on all parent materials except serpentine and Galice metasediments. Its absence from serpentine is likely a matter of tolerance, but its absence from the metasediments reflects elevational differences. The Galice metasediemnts average 2,940 feet

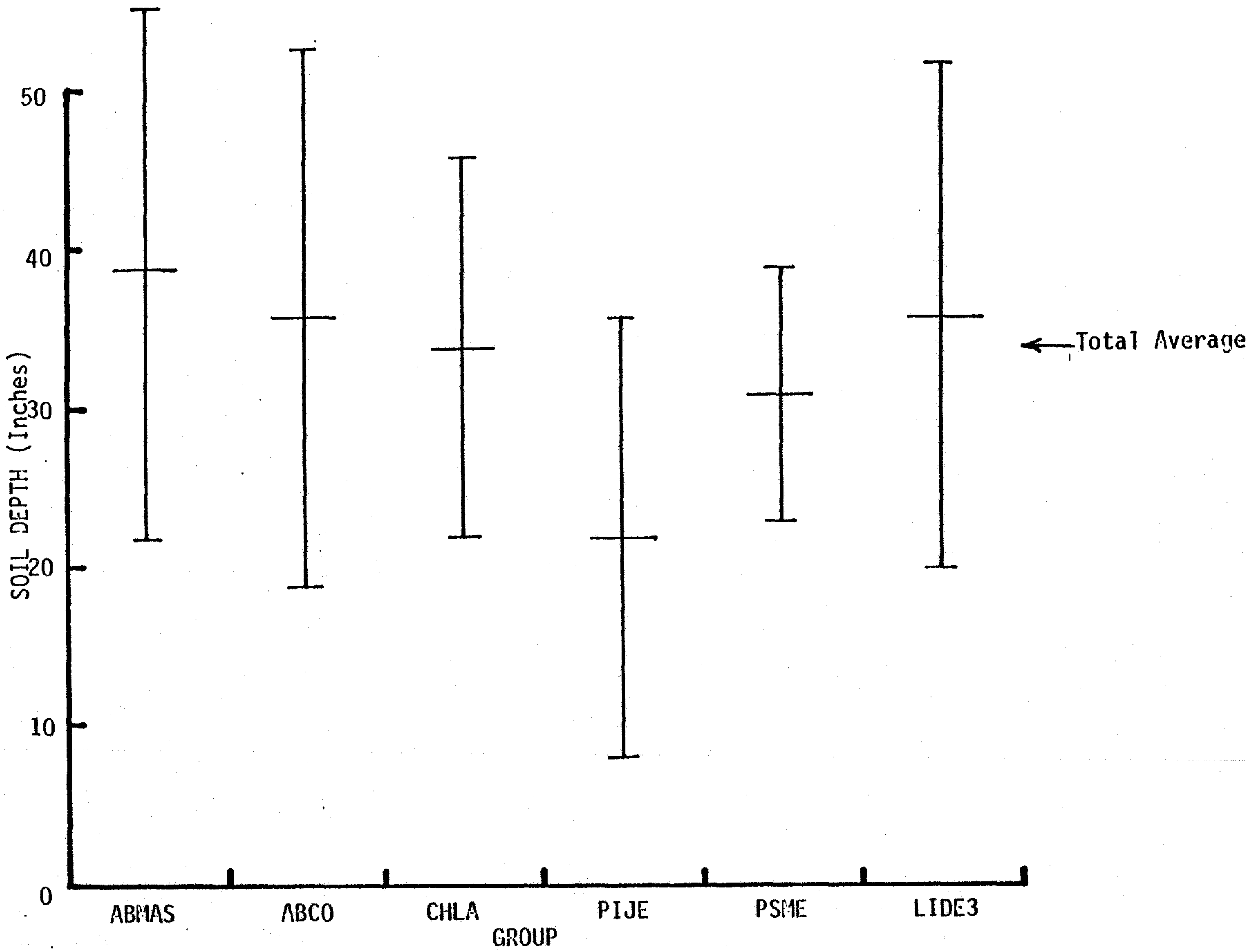


Figure 20 Mean and standard deviation of soil depth for vegetation groups.

in elevation with a high of 3,440 feet. The red fir communities average 5,180 feet with the lowest plot occuring at 3,800 feet. Although glacial till is associated with high elevations, as is red fir, only two red fir plots were found on glacial till. Most of the red fir group occurred on diorite and Applegate metavolcanics.

The tanoak and white fir groups occur on soils of similar depth. Both averaged 35 inches. While white fir was found on all parent material, tanoak was rarely found on serpentine and diorite. White (1971) on the other hand, reported tanoak as a serpentine species. But, within the study, it achieved its maximum dominance on metamorphosed material and was severely stunted on diorite or serpentine. Moreover, it most often occurred on northerly aspects where soils are commonly deeper.

The Jeffery pine group, with the lowest average soil depth of 21 inches, was restricted to ultrabasic soils by its competitors.

The Douglas-fir group tends to occur on Galice metasediments. The average soil depth for the group is 30 inches. Although Douglas-fir occurs universally within the area, it is climax only on the shallow soils where it seems better able to compete with other understory species.

The Port-Orford cedar group occurs on soils that average 34 inches in depth. The group occurs in concave, protected positions on all types of parent material. Glacial till and Port-Orford cedar were found associated with major drainages.

Correlations Between Soil Variables. Table 11 presents some of the stronger correlations from the within group correlation matrix. With such correlations coefficients and 250 plot sample size, the critical value is approximately .35 at the 0.05 alpha level. Values greater than

Table 11 Soil correlations.

WITHIN GROUP SOIL CORRELATIONS

CORRELATED VARIABLES	CORRELATED VALUE
Consistence of the A Horizon with Consistence of the B Horizon	.85 1/ 2/
Rooting depth with Total depth	.98
Texture of the A & B Horizon with Consistence of the B Horizon	.58
Landform with consistence	.45
Consistence with Bedrock fracturing	.42
Bedrock fracturing with soil depth	.45

1/ Values are from the correlation matrix of the discriminant analysis.

2/ Critical value at alpha 0.01 is 0.48.

the critical suggest the strength of a relationship but may or may not reflect a casual relationship. In addition, the matrix may be used heuristically.

Consistence of the A horizon with consistence of the B horizon, soil depth with rooting depth and bedrock fracturing with soil depth are all expected correlations. Texture and consistence are related; the very sticky soils are usually high in clay. These variables were related at r=0.58. Landform is related to soil consistence at 0.45 suggesting that the finer textured soils are on the foothill and valley positions and the coarse textured soils are at the higher mountainous positions. It is true that diorite parent material was found at a higher average elevation than other materials and that the Galice metasediments were found in the lowest landform positions. Consistence correlated with bedrock fracturing at 0.42. Accordingly, the softer bedrocks produced the more clayey soils.

Soil Texture and Wet Consistence. Parent material type by consistence and texture is given in Figure 21. Generally, the deeper soils are more coarse textured and the shallower soils have more clay. The coarse grained intrusive rocks and glacial till which produce a deep but coarse textured soil are at the higher elevations. The Galice metasediments occur at a lower average elevation and produce a shallow fine textured soil.

Figure 22 shows Jeffery pine communities occuring on fine textured clays and Douglas-fir communities occurring on coarser, well drained loams. The other groups are similar to each other and intermediate in texture between the Jeffery pine and Douglas-fir groups. The clay content in the Jeffery pine group approaches the range where water is tightly held and root penetration is slightly restricted.

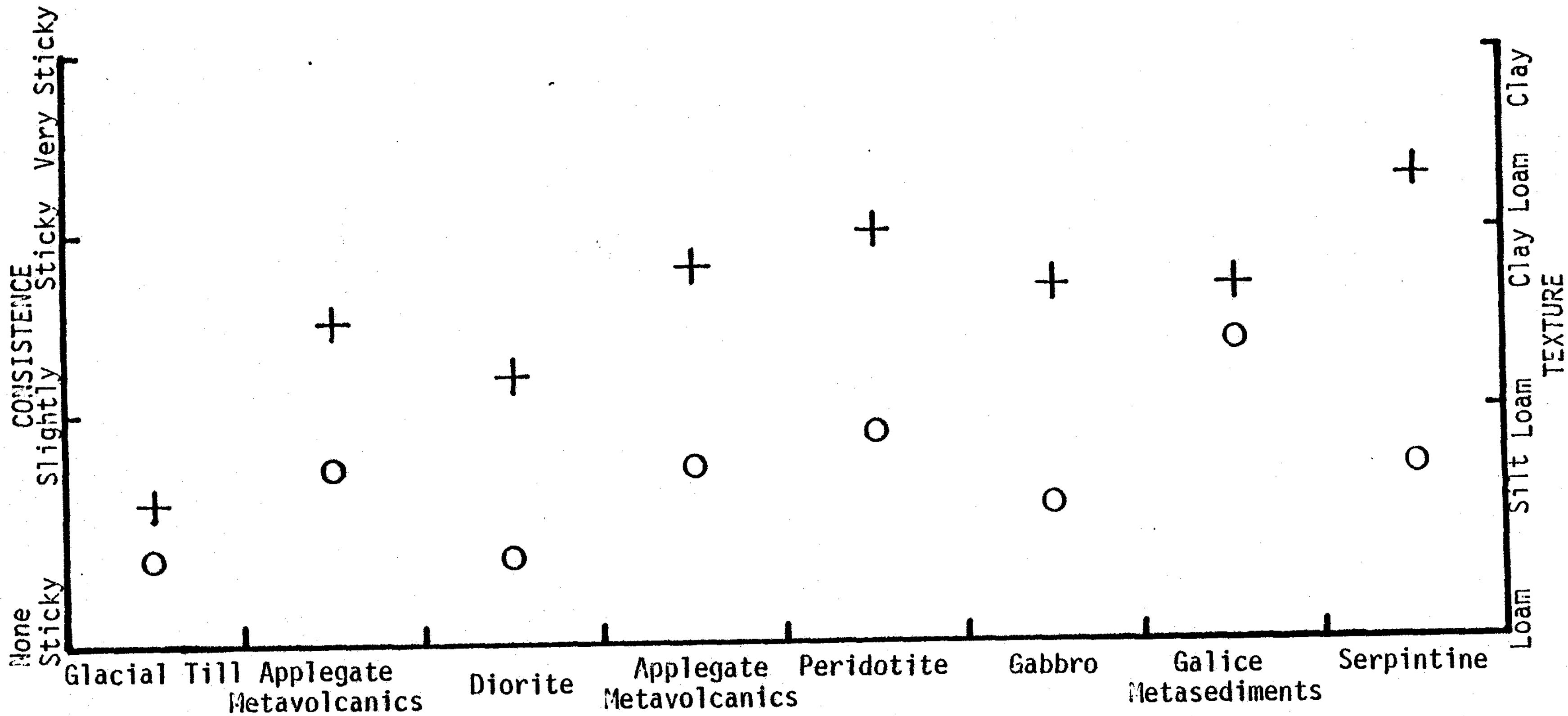


Figure 21 Average texture(O) and wet consistence(+) by parent material.

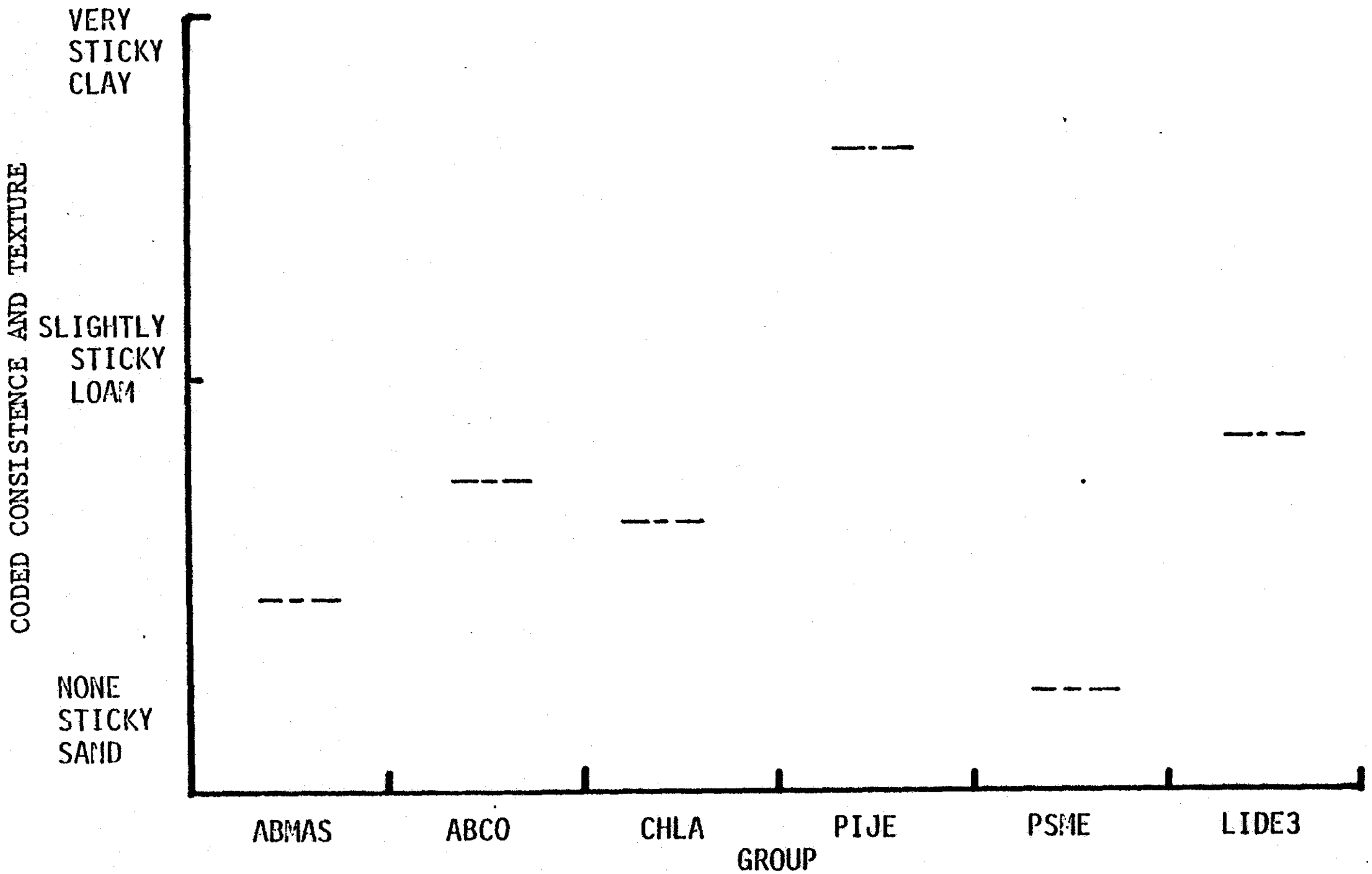


Figure 22 Combined texture and consistence for vegetation groups.

The texture of the tanoak group is in the range that is usually associated with good water holding capacity and high water availability. The white fir group is slightly less favorable than the tanoak group followed by the Port-Orford cedar and red fir groups.

Total Basal Area.

Total basal area (TBA) is used here as a crude approximation of the productivity of the tree layer. Average basal area for the groups is presented in Figure 23. TBA for the study area averaged 340 square feet per acre which is more productive than the adjacent Eastern Siskiyous. Waring (1967) reported that the Eastern Siskiyous have a higher evaporative demand with less total rainfall and that lack of moisture often limits productivity. Eighty eight plots taken in the Eastern Siskiyous (Atzet, 1975) averaged 242 TBA which is significantly different than the Western Siskiyou figure. Certainly moisture differences are a major cause. A majority of the Eastern Siskiyous lie upon the Ashland granitic batholith which does not provide highly productive soil nor high water holding capacity.

The most productive group is the Port-Orford cedar group which averages 389 square feet of TBA. It is often found in sheltered, warm, wet concavities, is shade tolerant, and produces tight stands with most of the biomass in the tree layer. Hawk (1977) reported an average of 391 square feet in similar stands within the mixed evergreen zone. The Jeffery pine group produces the lowest average TBA with 213 square feet. Soil chemical are the limiting factors in this case (Rai, Simonson, and Youngberg, 1970; Walker, 1954). The red fir group, which averages 328 square feet, is probably limited by temperature and the length of the

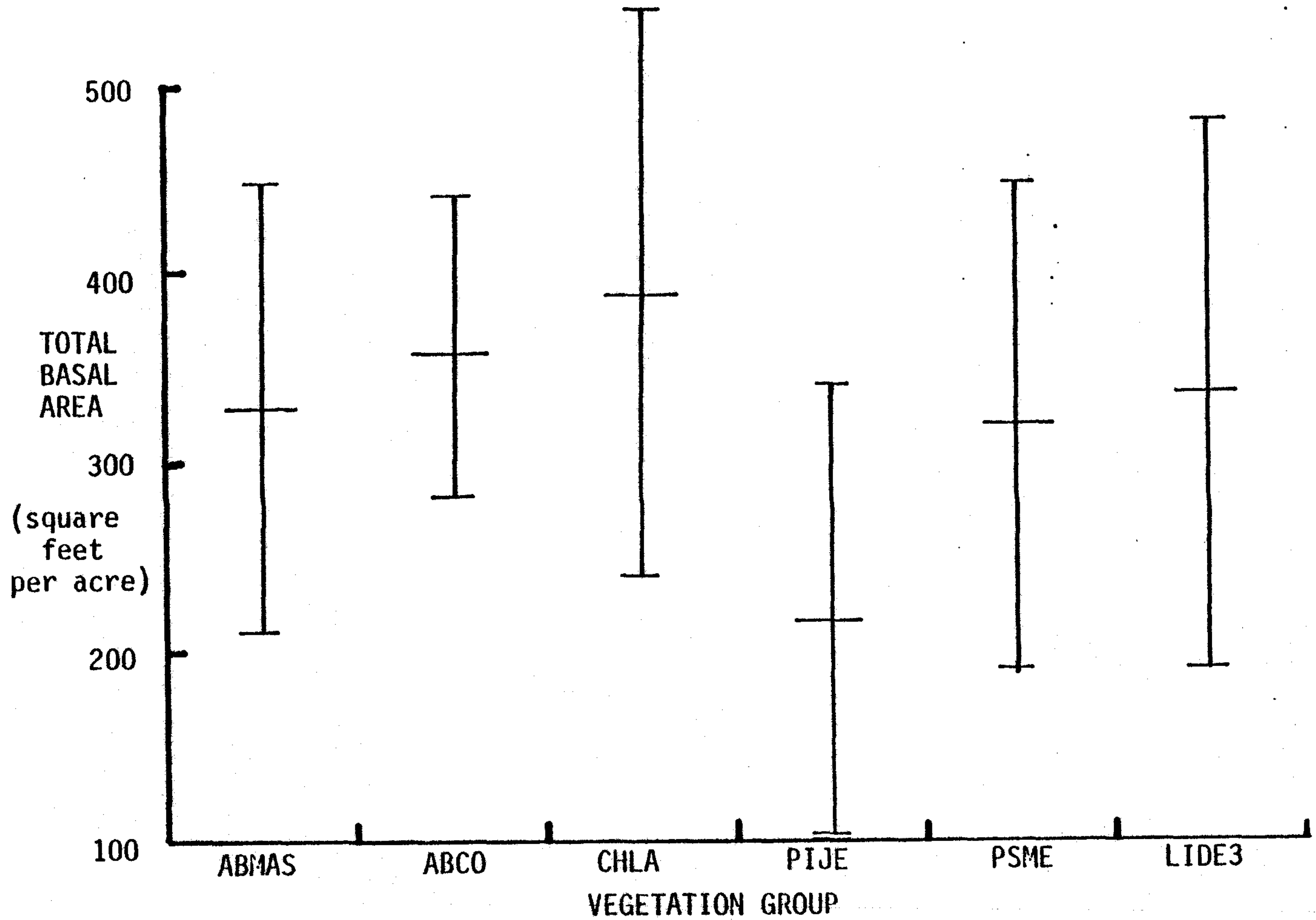


Figure 23 Mean and standard deviation for total basal area per acre for the six vegetation groups

growing season (Cleary and Waring, 1969). It is probable suspect only the highest white fir communities (358 TBA) are also temperature limited. Douglas-fir communities average 321 TBA and tanoak communities average 331 TBA. Douglas-fir occurs on shallow, well drained soils in a hot, dry environment. Tanoak communities occur in low elevations but on the deeper soils and the cooler aspects. Thus, production in Douglas-fir communities is likely to be limited by moisture. In tanoak communities, as in the majority of the white fir communities, no single limiting factor is outstanding.

Fire

Introduction. Fire scarred trees and the occurrance of charcoal in the soil were used as indicators of fire occurance. Eighty six of the 250 sample plots, 34 percent, displayed evidence of fires. Most often one or more scars were present on the upper slope side of the bole. Fewer plots had charcoal in the profile or fire killed boles, suggesting that most fires were not highly intensive. Because small, light fires leave little lasting evidence which is often overlooked, the 34 percent figure is considered conservative. Nevertheless, these small fires are not without effect (Hall, 1974).

Number of Fires. Records for the total study area (Cooper, 1940) show that lightning caused an average of four fires per year between 1914 and 1940 (Figure 24). However, Cooper indicated that small lightning fires were often left to burn themselves out, particularly when rain was forecasted, and were not entered in the records. These records, like the field observations, also give a conservative estimate. More recent records indicate that lightning causes an average of 12 fires per year in the study area (one per 10,000 acres) (Bender, 1978).

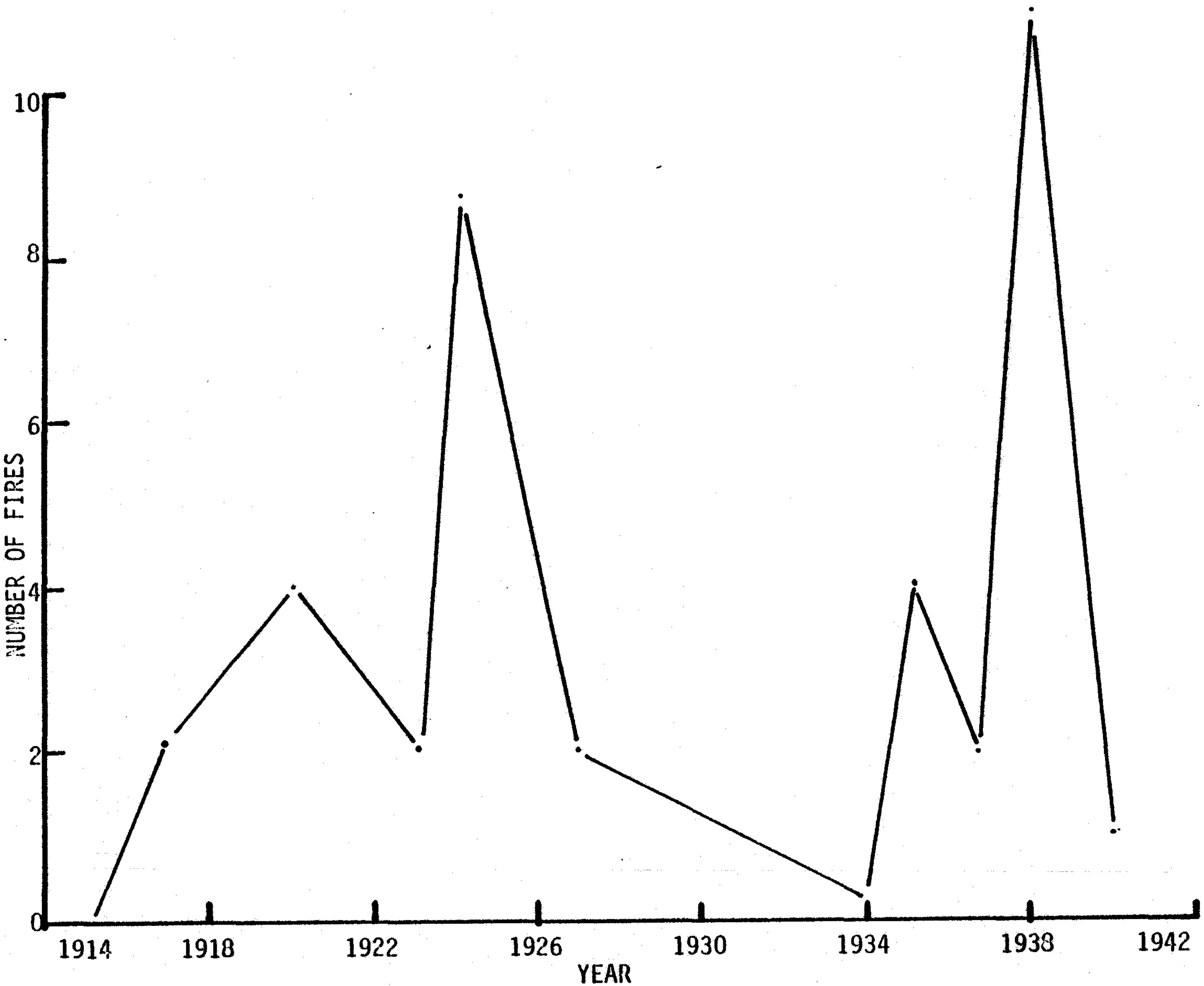


Figure 24 Number of lightning caused fires by year for the total area.

When ignitions by white settlers are added, the average number of fires per year in the 26 year period increases to 28 (Figure 25). Simon McKee, a compulsive arson, was responsible for a large number of these fires. His incendiary drives were at their peak in 1916 and 1917 when he was thought to be responsible for over 200 fires. He was convicted of incendiarism in 1919 after which the yearly average dropped to 17 per year (Figure 26). Nevertheless, over 60 percent of the fires were man caused a figure much higher than the 5.3 average found by Fahnestock (1974) in the Pasayton Wilderness where 88 percent of the fires were caused by lightning.

Fire Periodicity. The periodicity of fire is basically dependent on fuel accumulation and weather. The time required to accumulate a combustable parcel depends on the productivity of the stand and the amount of litter dropped on the forest floor. Both Port-Orford cedar and Douglas-fir are good producers but shadeintolerant Douglas-fir drops much more material and has a tendency to increase the fire periodicity where it occurs. The weather drys and heats the accumulated fuels, readies them for ignition, and in extreme cases may cause stress which usually increase needle fall.

Each plant community has a unique productive potential, structure and environment and in turn a unique fire regime. For example, open canopied Douglas-fir communities allow more light penetration, which increases the rate of drying and possibly increases the production of volatile understory species.

Periods between fires in the Pacific Northwest vary. Hall (1976) reported the period to vary from 9 to 15 years (ten is the average) in northeastern Oregon. Periods from 6 to 47 years have been reported in

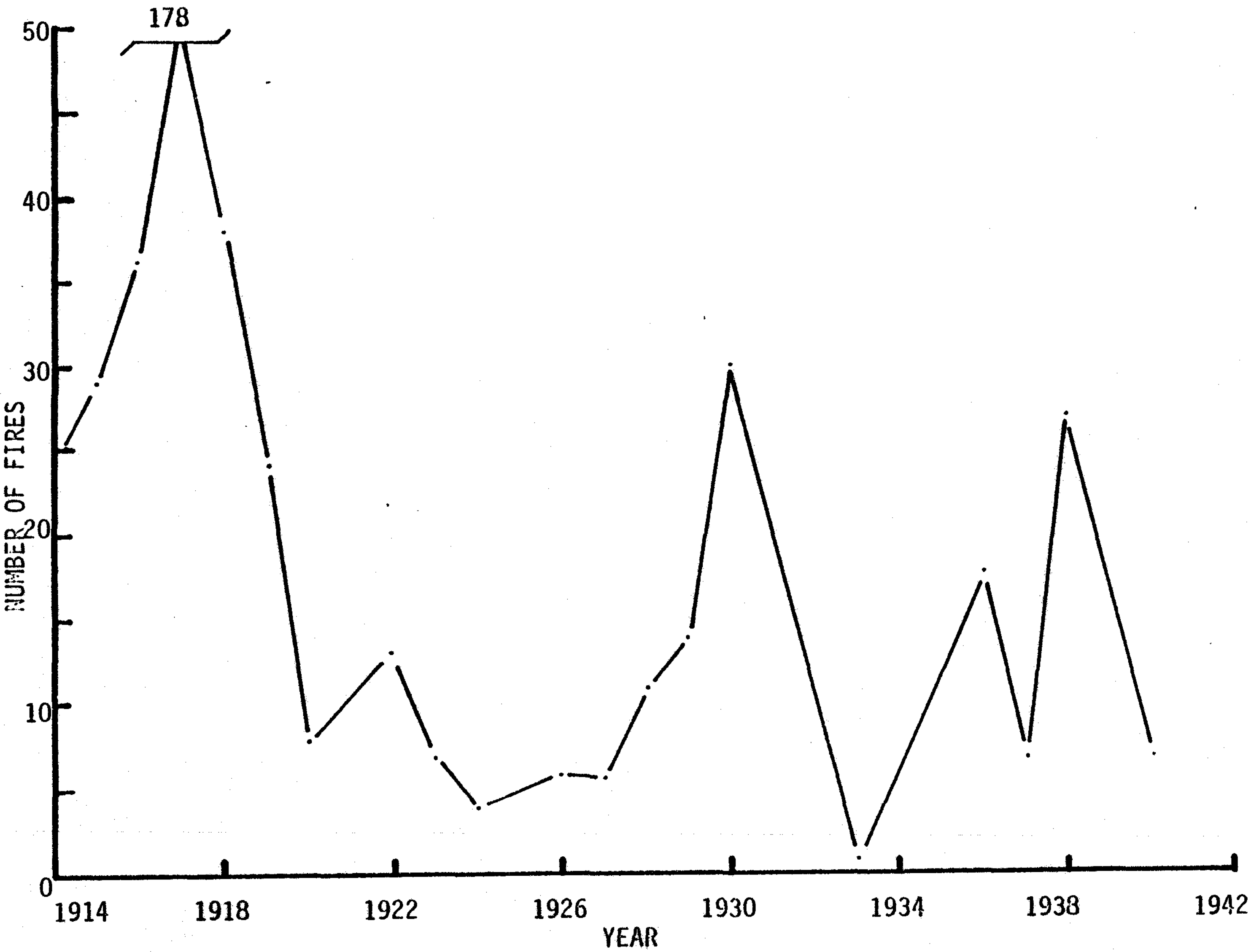


Figure 25 Total number of fires by year (Fire History data).

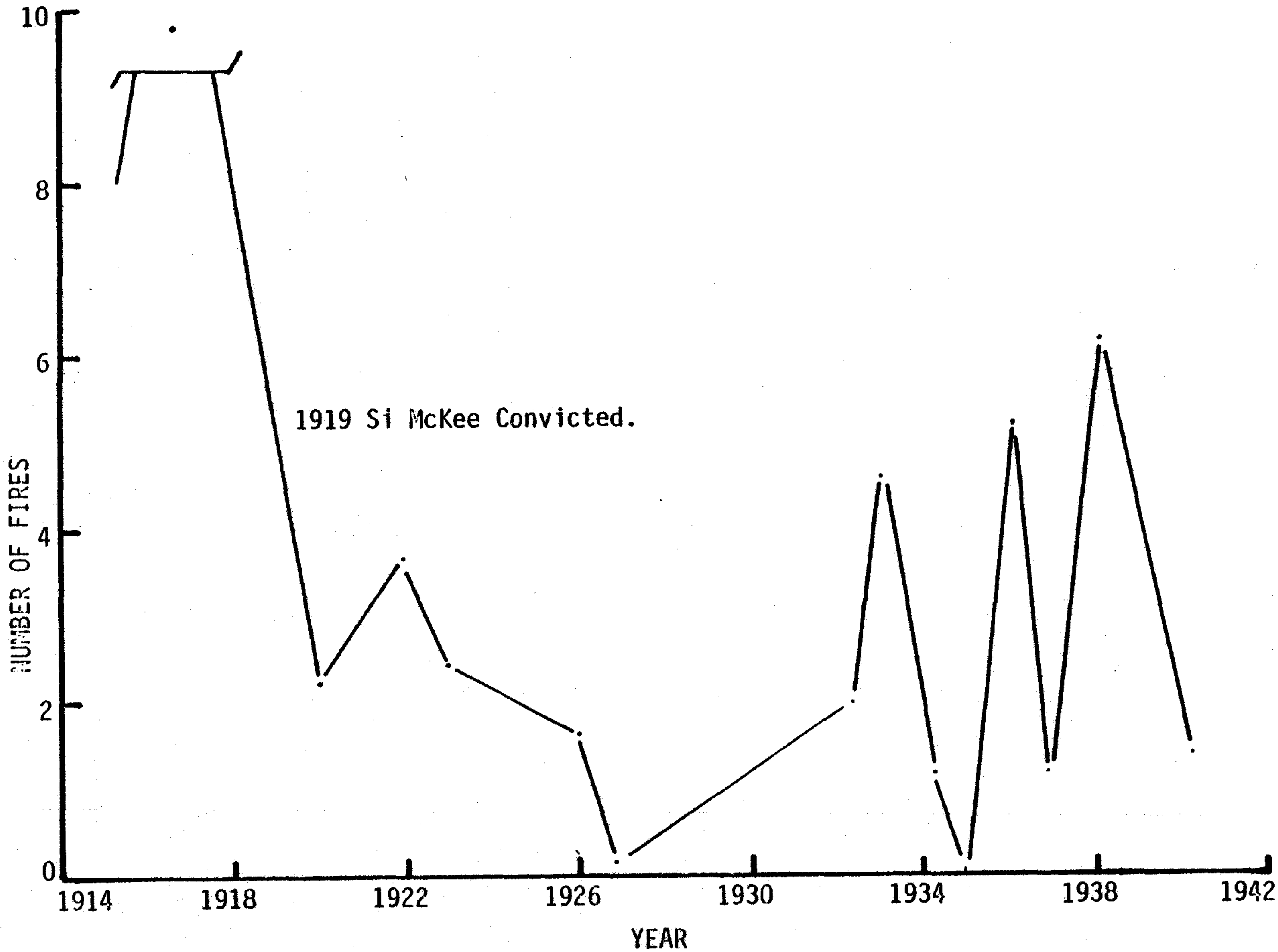
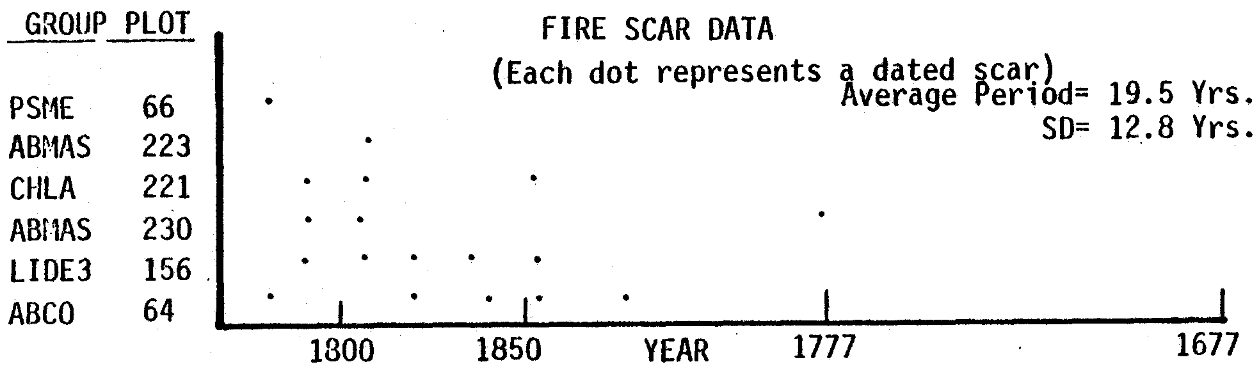


Figure 26 Number of man caused fires by year (Fire History Data).



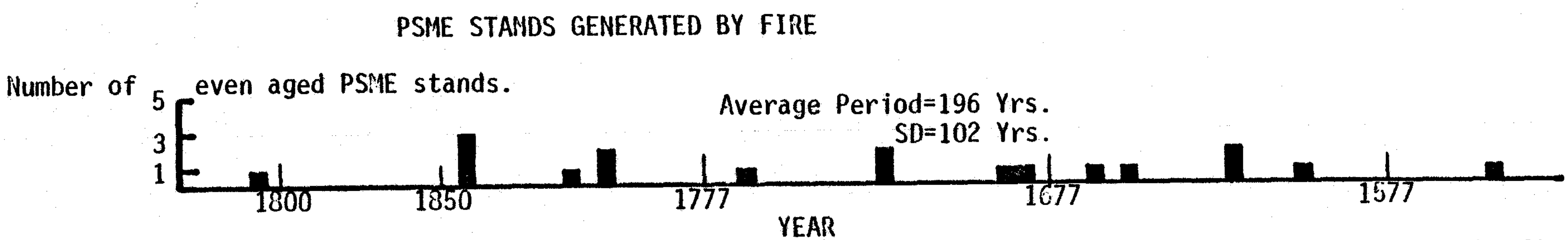


Figure 27 Fire scar data by plot(Plots have had several fires),and even aged PSME stands generated by fire.

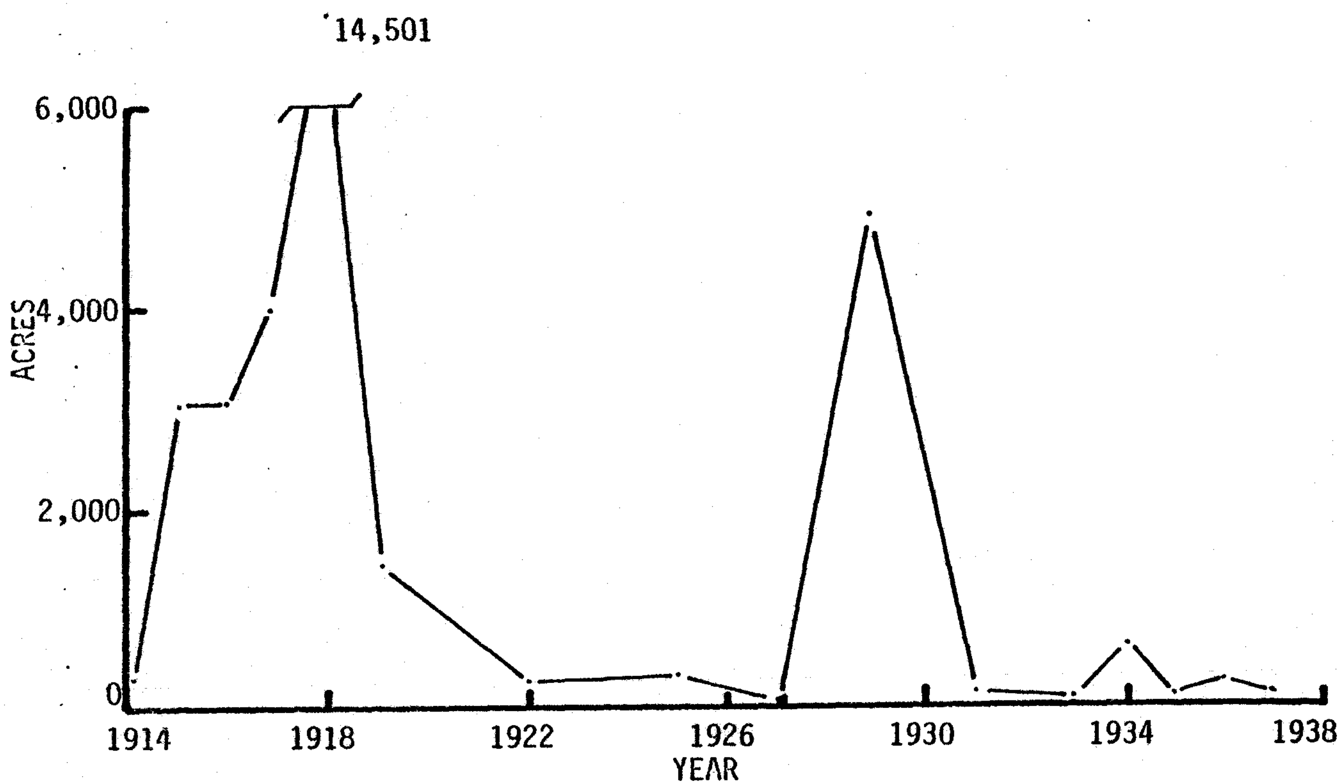


Figure 28 Number of acres burned (Fire History Data).

eastern Oregon (Martin, Robinson, and Schaeffer, 1974). Evidence of recent periodicity collected in the study area indicates a highly variable 20 year period. Crosby, (1961) and Capell (1976) reported similar periods in the southern pine forests and coastal Douglas-fir forests respectively. Another indication of fire periodicity is the occurrence of even-aged pioneer stands. Such stands are usually produced by intensive fires. Windthrow and disease may also stimulate reproduction, but, even aged stands are not usually produced. Figure 27 shows few even aged stands occurred in the area, indicating some evidence of intensive fire. But because the total number of fires is much greater than the number of even aged stands, it is likely that the majority of fires were of insufficient intensity to create even-aged stands.

Additional information, the record of acres burned by year from 1914 to 1940, shows a loose 12 year period between extensive burnings (Figure 28). Although size class records are not given and it is impossible to determine the size of individual fires, it is interesting to note that the relation between the number of fires and acres burned has an r value of .27. One could conclude that no matter how many points were ignited, only the communities that are "ripe" will burn, and ripeness requires time for fuel to accumulate.

Location of Fires. If fire occurence is dependent on the relation between biomass production, fuel accumulation and incidence of solar radiation, communities producing large amounts of fuel on the hot dry aspects should have the greatest number of fires. Figure 30 shows this is generally the case. For example, red fir communities produce average basal area, but occur in cold, moist, high elevations. They are less subject to drying than other communities and therefore, have a low

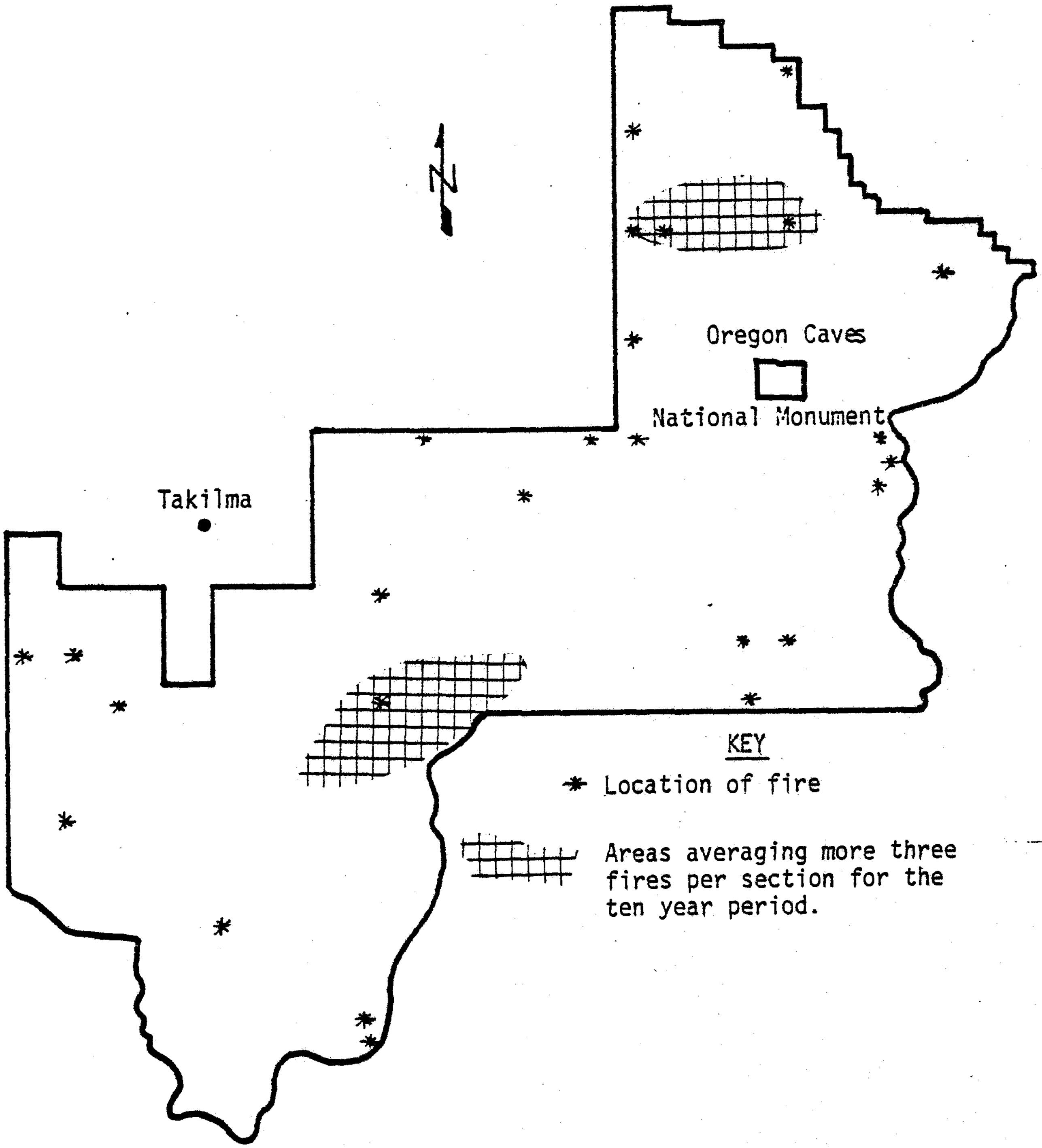


Figure 29 Occurrence of lightning caused fires between 1959 and 1969.

number of fires even though they are subjected to high intensities of lightning (Figure 31). Red fir is also somewhat shade tolerant and does not produce much litter. Jeffery pine communities occur on hot, dry slopes, produce by far the least basal area, and have a low fire occurrance. White fir communities which are similar environmentally to Jeffery pine but produce twice the basal area and litter, have twice the number of fires.

A model for predicting fire occurrence can be made by combining the rating of four environmental factors measured in the study. Litter accumulation and total basal area together approximate fuel accumulation. Aspect and elevation combined approximate drying. When these four factors are rated as to the likelihood of fire occurence and added together, the total approximates the actual natural fire occurence pattern found in the area (Figure 32).

Fire Intensity. The intensity of wild fire is dependent on fuel, weather and topographic variables. The weather and topography of the Siskiyous often provide opportunities for large intensive fires. But, evidence suggests that under natural conditions, the many small low intensity fires maintain a low level of fuel, and break fuel continutity. Recently man has altered this natural fire pattern by allowing fuels to build-up to levels that bring about more intensive and destructive fires rather than the numerous light sanitizing fires that subtly change plant communities.

Fire Effects. The effects of a fire are dependent on its intensity and frequency. Intense fires create conditions favoring the establishment of even-age stands of pioneer species. Light fires may only weaken

Parameter							
Litter	1	5	2	3	6	4	Fuel Load Rating
Total Basal A.	1	3	4	6	2	5	
Aspect	4	2	6	3	5	2	Fuel Drying Rating
Elevation	5	1	1	3	4	6	
	11	11	13	15	17	17	Total Likelyhood

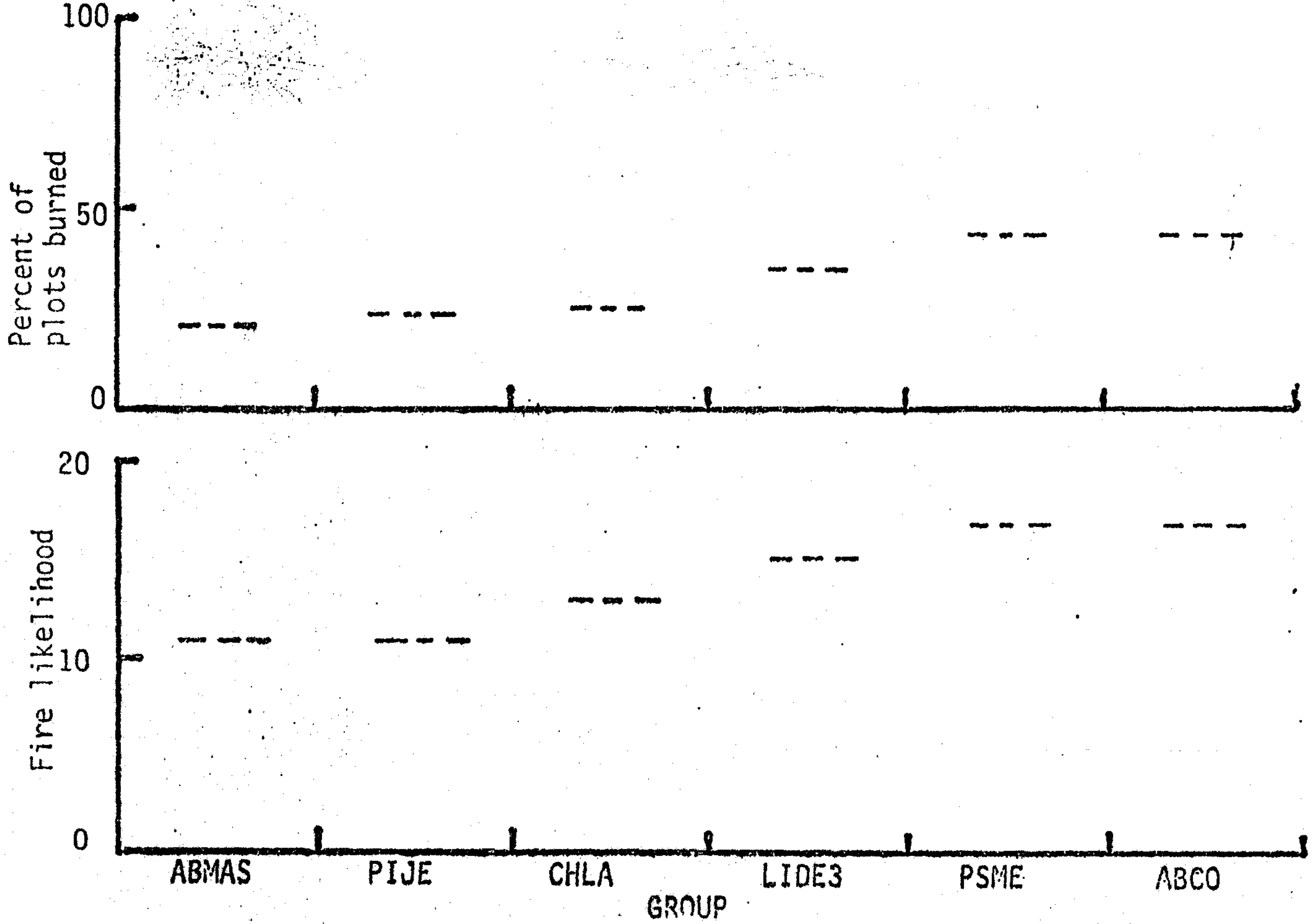


Figure 30 Actual observed fire occurrence (top) by vegetation group and likelihood of fire rating (bottom).

or kill suseptable species and give the non suseptable species a competitive advantage. The environment, species compostion, and stand structure are subtly modified as succession is set back. Although a majority of the fires in the study area are in the light category, some even aged stands of Douglas-fir were found (Figure 27). However, most were small in area (except for the 1929 and 1945 fires that were 5,000 and 6,000 acres respectively) suggesting the fires that generated them were less than catastrophic.

The environmental changes brought about by understory fires are well known. Loss of understory vegetation increases the amount of radiation reaching the soil surface, daytime temperatures, and evaporation rate, decreases relative humidity, and night time tempertures and increases diurnal extremes both in the soil and atmosphere. The insolation and protective properties of the litter are not usually destroyed. Some elements may be released and/or volatilized and others leached if infiltration is increased. Detrimental fungus may be killed by fire such as brown spot disease in the south or damping off fungus in the redwoods. Germination of plants such as Ceanothus, knobcone pine and rizina root rot may be stimulated by fire. Repeated small fires also maintain habitat diversity and forage production for the animal component of the forest system (Kozlowski and Ahlgren, 1974).

Flamability, sprouting ability and life history strategy of a species determines its reaction to fire. Annual species are often killed but quickly invade from adjacent areas. Many shrubs, including manzanita and Ceanothus, resprout if the root collar is not unduly damaged. Tree resistance is a function of bark thickness which varies with species and age. Capell (1976), reported that most western conifers were not usually harmed during underburning if they were greater than 9 inches in diameter. If weakened, however, they may experience a secondary attack and eventually add to the fuel build-up setting the stage for another cycle of fire.

The most obvious result of fire in the Siskiyous is the occasional stand of knobcome pine. These stands are associated with the more intense fires as a great deal of heat is needed to induce germination. There are three such stands in the study area; all were rotting at about age fifty and were succumbing successional to white fir. Madrone is known for its sprouting ability after fire and is somewhat dependent on fire for reproduction. It is associated with the tanoak group which is now replacing it as the dominant species in these stands. Tanoak is more easily killed by fire than madrone, nevertheless, it will resprout if not severely damaged. Because fire has been eliminated from the area for about the past 60 years, tanoak is gaining dominance in the lower moist sites, where it is potentially the climax dominant. Similarly, white fir is regaining dominance over Douglas-fir and red fir. Many stands in the Siskiyous are dominated by Douglas-fir or red fir in the overstory but are dominated by white fir in the understory which until recently has been eliminated by fire. Port-Orford cedar is easily killed by fire, but, it occurs in concavities where fire is less frequent and less intense. As a result, the composition and structure of these communities is reasonably stable. Jeffery pine communities are also not often visited by fire. Fuel levels are low, and the few fires that do occur, change stand structure very little.

Species Distribution

Cover values by vegetation group were used to present distributions of selected species in all figures and tables in this section. The series of tables and figures are broken down by overstory, tree understory, shrub and herb layer. The general arrangement from top to bottom and left to right is from cold, wet to hot, dry.

Overstory. The red fir zone is rich in species; all of the major coniferous species, except Jeffery pine, occur within the zone (Table 12). It is similar to the red fir zone described by Franklin and Dyrness (1973) and Sawyer and Thornberg (1977) white fir, mountain hemlock, and red fir are the most important species within the zone. Mountain hemlock and white fir are climax species on the upper and lower ends of the zone and red fir is the climax species within. There are instances, however, where mountain hemlock and red fir seem to be co-climax. Port-Orford cedar which occurs in a narrow environmental range (it can tolerate neither cold nor dry conditions) is rarely found within the zone. The occurence of Brewer spruce, western white pine, incense cedar, sugar pine ponderosa pine and Douglas-fir is more common. (Figures 32 and 33).

The white fir zone has sugar pine, ponderosa pine, Douglas-fir and incense cedar as its common inhabitants. Western white pine, Port-Orford cedar and red fir are rarely found and Brewer spruce and mountain hemlock are absent from the zone. Douglas-fir is often found as the overstory dominant but is not common in the understory. Ponderosa pine is generally not common in the study area and occurs in the white fir zone as an occasional dominant. Plot 64 had one such dominant over 700 years and

Table 12 Percent of total cover of selected overstory species by species and vegetation zone.

	VEGETATION ZONE					
SPECIES	ABMAS	ABCO	CHLA	LIDE3	PSME	PIJE
TSME	100					
ABMAS	96	4				
ABCO	43	37	16	2	3	
PIBR	16		84			
CHLA	1	1	86			12
PIMO	14	2	28			55
PILA	5	23	8	33	30	2
PSME	8	18	20	23	20	11
CADE	13	13	8	5	12	49
PIPO	4	30	2	37	13	12
PIJE						100

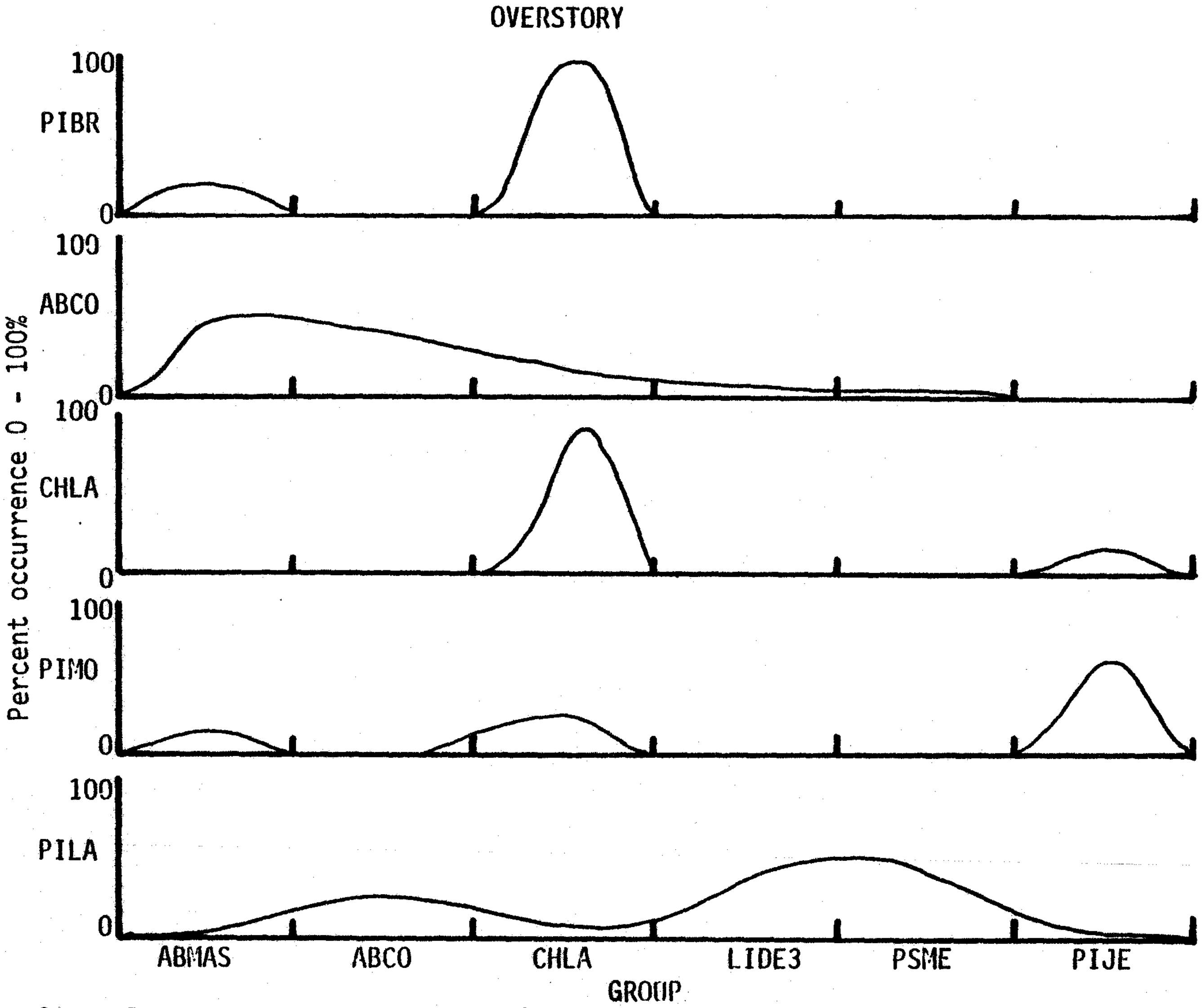


Figure 31 Percent occurrence of species by vegetation group.

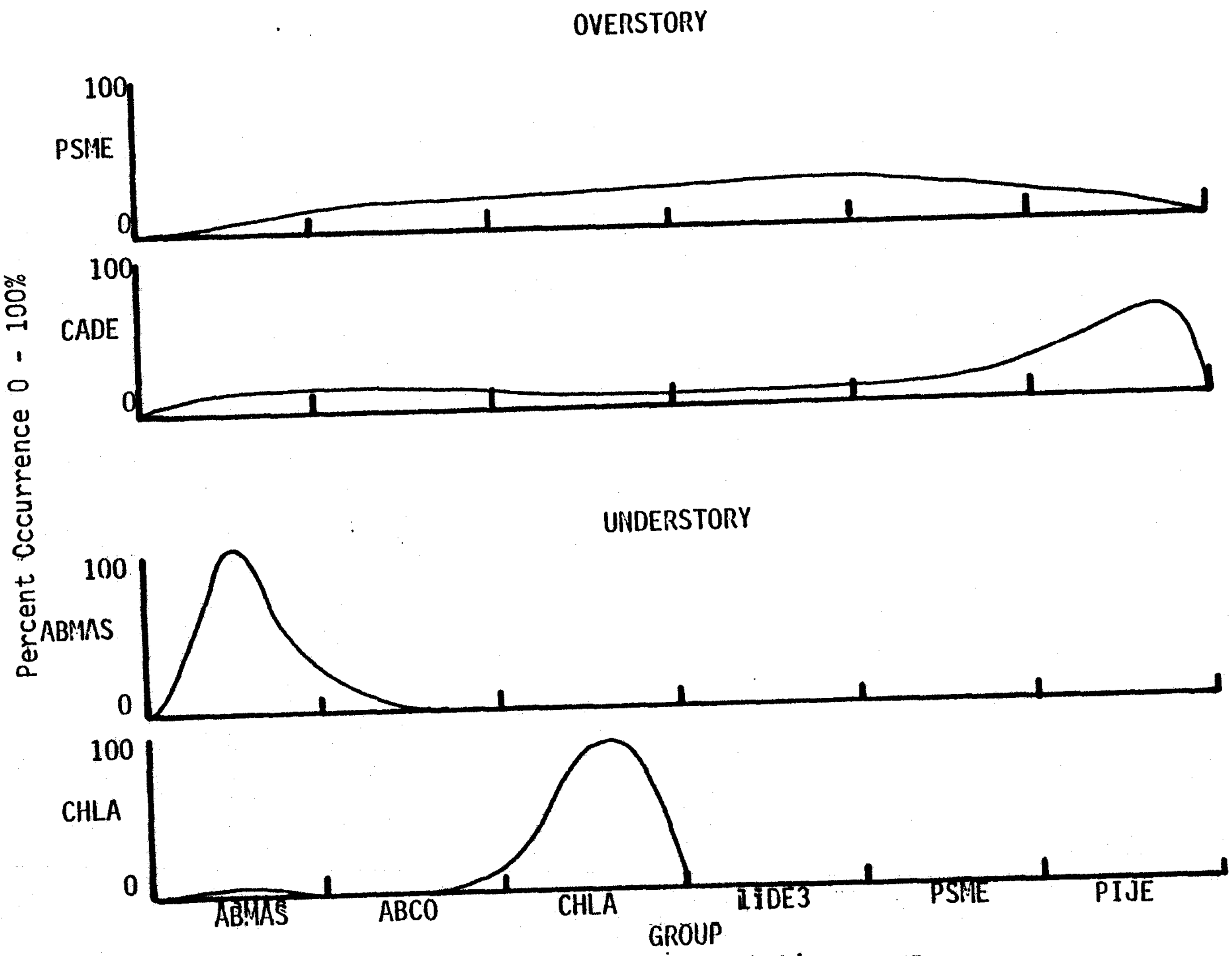


Figure 32 Percent occurrence of species by vegetation group.

that survived five fires in the last 150 years (Figure 27). With fire control ponderosa pine and Douglas-fir are becoming less important in unmanaged stands. The Port-Orford cedar zone seems to be cool yet moist. It lacks mountain hemlock and red fir which are associated with cold, and has little ponderosa pine, sugar pine and incense cedar which are often associated with hot, dry environments. It is within this zone that Brewer spruce was most often found. Western white pine was often found, but is extremely scattered. Douglas-fir and white fir are often a significant part of the overstory with Douglas-fir assuming a dominant position and white fir acting as a common associate.

The Douglas-fir and tanoak zones are quite similar. Both lack species which require a cool, moist environment - mountain hemlock, red fir, Brewer spruce, Port-Orford cedar and western white pine. In addition, white fir is rarely present in the overstory. Sugar pine, Douglas-fir, incense cedar, and ponderosa pine are quite common and are considered typical conifers of the mixed conferous zone (Franklin and Dryness, 1973).

The Jeffery pine zone has little absolute cover and is always associated with ultrabasic soils. Port-Orford cedar, ponderosa pine, and incense cedar are tolerent of ultrabasic soils and are often found associated with Jeffery pine, Ponderosa pine, Douglas-fir and sugar pine are only found within the zone where the ultrabasic condition is at its minumum.

Whittaker's (1960) work is helpful in relating species distribution to environment, but by limiting his study to specific parent materials, much of the variation was overlooked. In addition, he chose to describe the vegetation in continuous terms; thus, plant communities or zones can only be subjectively inferred from his results.

Understory. The understory species reflect more recent environmental trends of which the lack of fire is most significant (Table 13) (Figures 33, 34 and 35). The relative proportions of white fir, Port-Orford cedar and tanoak have increased while Douglas-fir, ponderosa pine, madrone, incense cedar and canyon live oak have decreased. Mmany other species have been affected but the change in composition is not as apparent. The red fir zone has been least affected and has a full complement of conifers within the zone in the understory; red fir and white fir are the most common. Both are tolerant of cold and the short growing season. None of the temperate hardwoods are found within the zone. They developed during the mid Cenozoic and were confined to the lower slopes as they are now.

The white fir zone is rich in understory species. It has a wide physical range which provides environmental diversity and allows the temperate hardwoods bigleaf maple (*Acer macrophyllum*), Pacific dogwood (*Cornus nuttalli*), tanoak, madrone and canyon live oak, to reach the upper elevational extreme of their range.

The Port-Orford cedar zone is indeed dominated by Port-Orford cedar in the understory. White fir and Pacific yew are prevalent associates. All of the temperate hardwoods except canyon live oak are present. Of the conifers, only mountain hemlock and ponderosa pine which represent opposite environmemtal extremes, are absent. Red fir, sugar pine,

Table 13 Percent of total cover of selected understory species by species and vegetation zone.

	VEGETATION ZONE					
SPECIES	ABMAS	ABCO	CHLA	LIDE3	PSME	PIJE
ABMAS	92	6	1		1	
CHLA	6	2	80			13
ABCO	28	30	24	9	6	3
CACH	1	11	19	35	35	
PILA	4	11	5	32	43	4
PSME	6	10	12	16	37	19
PIMO	3	1	14	9	15	59
CADE	9	12	8	7	14	50
TABR		10	33	15	30	11
ACMA		9	18	46	26	
CONU		11	11	49	23	6
LIDE3		3	12	68	9	7
ARME		7	3	42	38	11
QUCH		7		53	21	18
PIJE						100

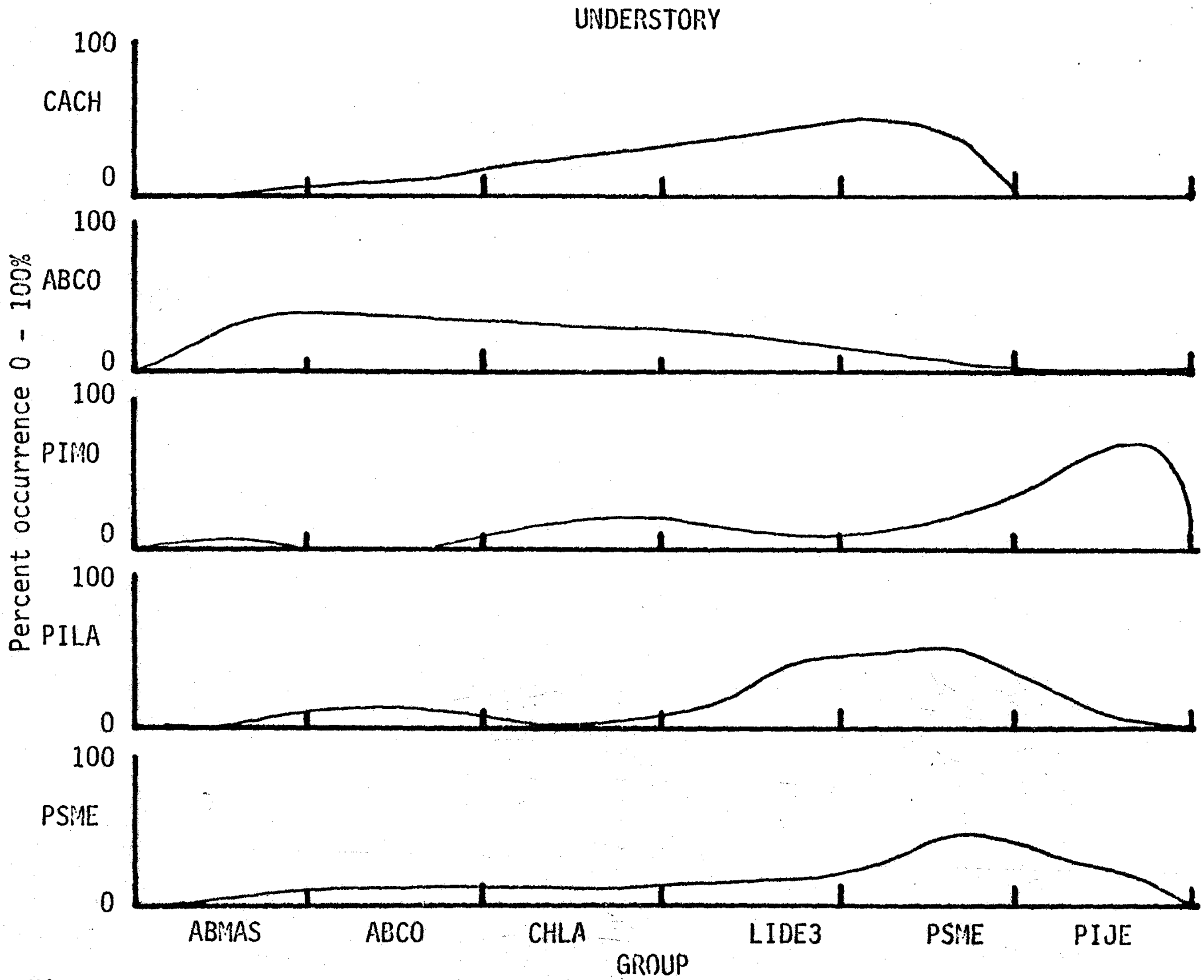


Figure 33 Percent occurrence of species by vegetation group.

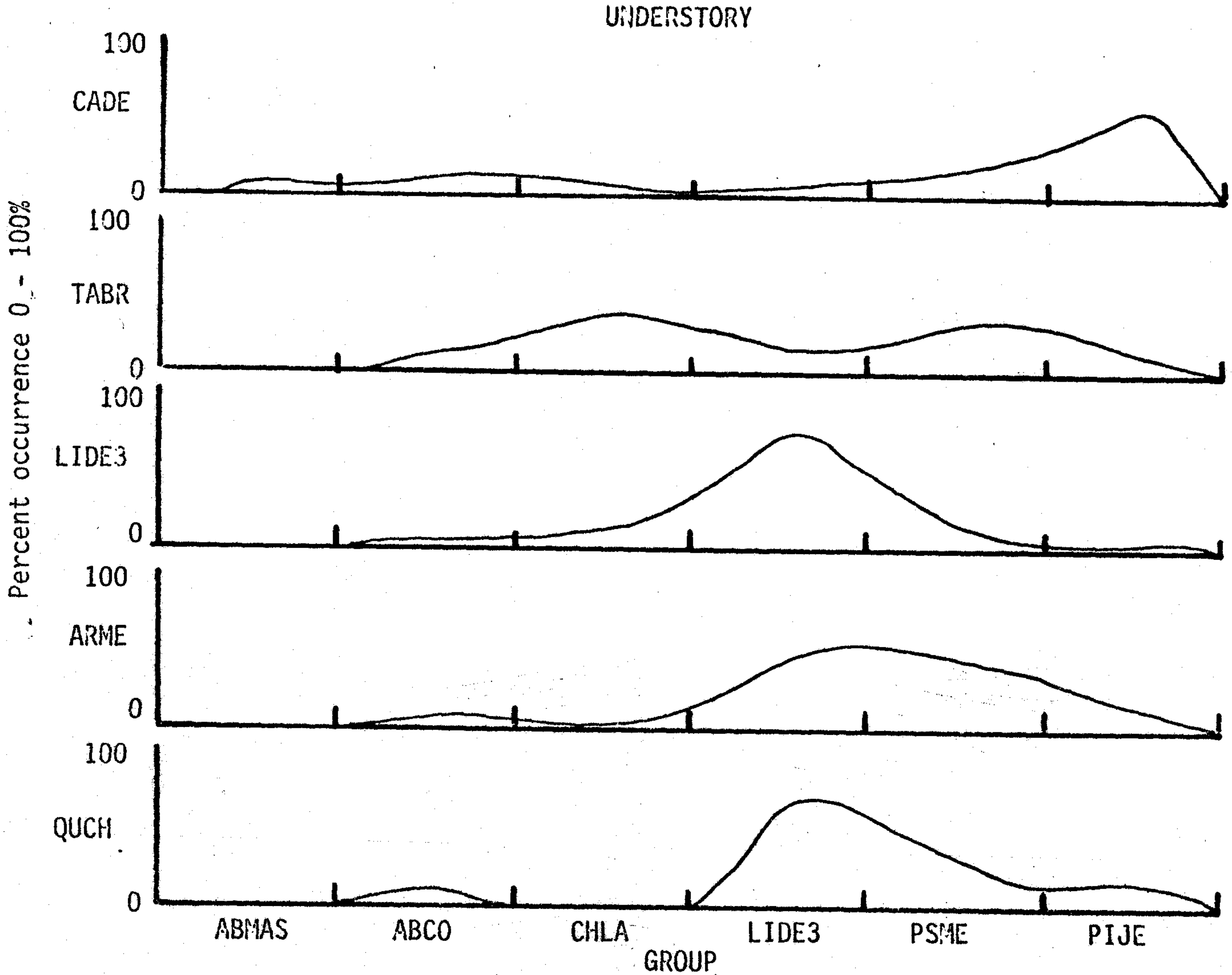


Figure 34 Percent occurrence of species by vegetation group..

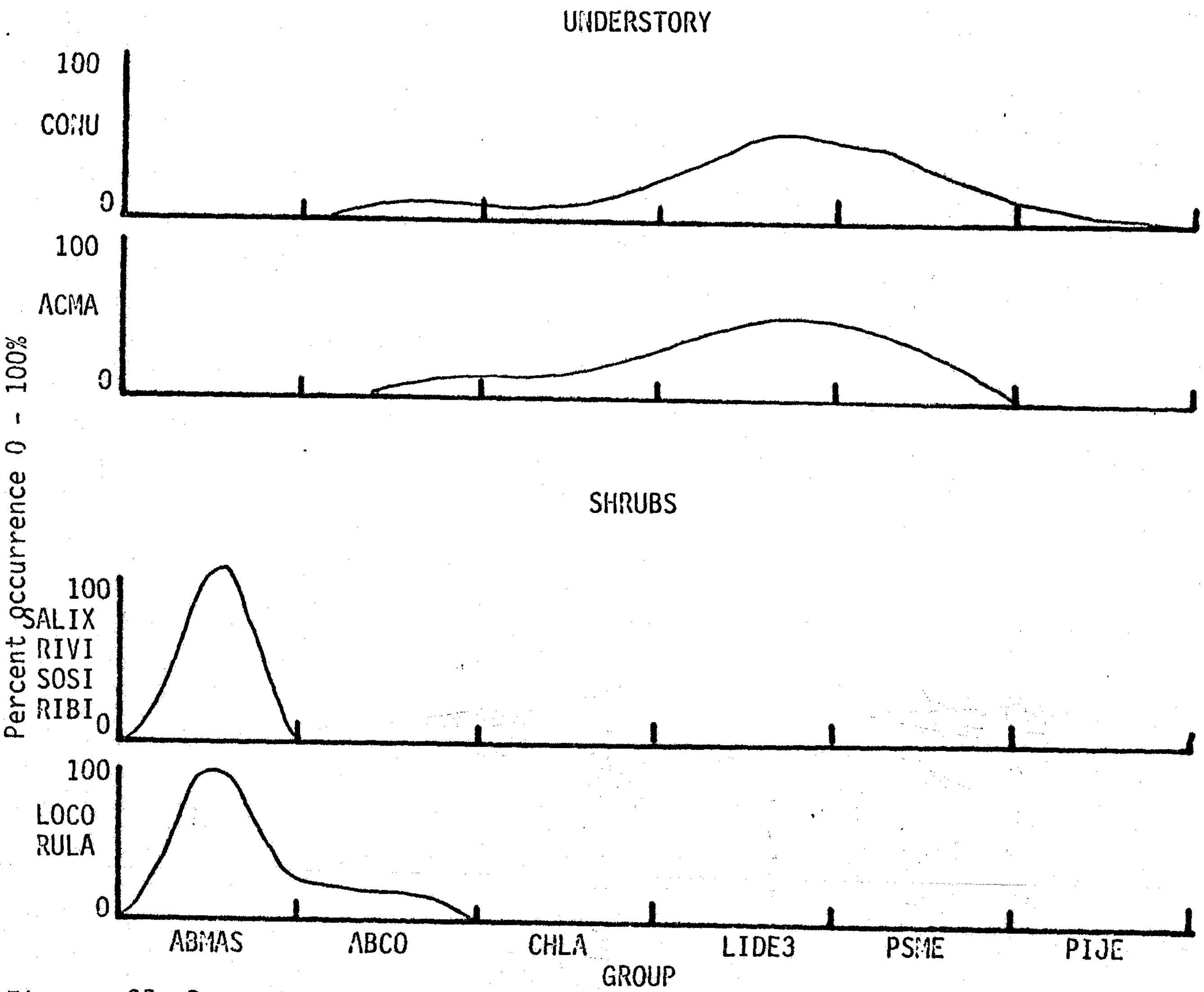


Figure 35 Percent occurrence of species by vegetation group.

Douglas-fir, western white pine, incense cedar, and Brewer spruce are found, but are not common. Hawk's (1977) work on the *Chamaecyparis* genus recognized the zone in the Illinois Valley area and described it as occuring along stream drainages and northerly aspects. This description is in full agreement with the findings herein. Franklin and Dyrness (1973) did not give the species zonal status.

In the tanoak zone, the temperate hardwoods reach their peak development. They evolved during the warm, moist mid Cenozoic and are said to inhabit such areas today (Axlerod, 1976). Atmospheric moisture is common in this zone. It is the lowest of the zones and often experiences summer fog. Sugar pine, Douglas-fir and Pacific yew are common; incense cedar, western white pine and white fir are not. Franklin and Dyrness (1973) refer to this area as the mixed evergreen zone. However, with the exclusion of fire, the role of tanoak is becoming more apparent and it can be considered the major climax dominant of the mixed evergreen zone.

Emmingham (1973) described tanoak dominated sites in his description of the vegetation of the lower Illinois River Basin. The soils are shallow (10" average) and atmospheric moisture is important. Most of his communities are considered part of the mixed evergreen forest although Douglas-fir is the climax dominant in some.

The Douglas-fir zone is characterized by shallow soils on steep slopes where moisture is a major environmental constraint. Together with the Port-Orford cedar and Jeffery pine zones, it can not be considered a climatic climax. It has gained acceptance in the Northwest as a topoeudaphic and pyric climax. Sugar pine and incense cedar, are its major understory coniferous associates; Pacific yew is less often found. All the temperate hardwoods are present, but madrone and golden chinkapin (*Castanopsis chrysophylla*) are by far the most abundant.

Jeffery pine was found only on ultrabasic parent material where it achieves climax status. Most understory species, both conifer and hardwood, occur within the zone but in extremely limited abundance. However, bigleaf maple, golden chinkapin, red fir and mountain hemlock were not found within the zone.

Shrubs. In terms of absolute cover Sadler oak (*Quercus sadleriana*), is the most abundant shrub in the red fir zone. Cascade hollygrape (*Berberis nervosa*), and big whortleberry (*Vaccinium membranaceum*), also occur abundantly in much of the zone, but on a percentage basis, Sitka mountain-ash (*Sorbus sitchensis*), Siskiyou gooseberry (*Ribes binominatom*), sticky currant (*Ribes viscosissimum*), Lobbs gooseberry (*Ribes lobbii*), and willow species are almost exclusive associates (Table 14).

The purple flower honeysuckle (*Lonicera conjugalis*), prickly currant (*Ribes lacustre*), Douglas maple (*Acer glabrum*), and big whortleberry group are most common in the red fir zone and are indicative of warmer down slope conditions than the species associated with Sitka mountain ash (Figures 36, 37, 38, 39 and 40). The zone has a small percentage of species that are associated with warm wet conditions. Myrtle pachistma (*Pachistima myrsinites*), and Pacifc rhododendron (*Rhododendron macrophyllum*), occur at nine and five percent respectively. There is even less representation by canyon live oak and pineniat manzanita (*Arctostaphylos nevadensis*), which occur on hot sites with shallow soils.

The white fir zone lacks the cold, wet species of the red fir zone and the hot, dry species of lower zones. It contains a full complement of intermediate species. Myrtle pachistina and Pacific rhododendron are most

Table 14 Percent of total cover of selected shrub species by species and vegetation group.

	VEGETATION GROUP					
SPECIES	ABMAS	ABCO	CHLA	LIDE3	PSME	PIJE
SOSI	100					
RIBI	100					
RIVI	100					
SALIX	100					
RILO	99	1				
RULA	86	14				
LOCO	84	16				
RILA	91	3	6			
ACGL	70	30				
VAME	70	12	18			
QUSA	60	17	8	1	14	
RUPA	47	29	5	2	16	
PAMY	9	76	1	5	9	
ACCI	27	17	9	40	20	
CEVE	20	11		69		
RHMA	5	57	2		36	
RUUR	9	29	30	7	25	
VAPA	16	4	33	20	17	10
GASH			62	38		
SYMO	21	34	15	16	12	2
BENE	13	23	20	31	13	1
ROGY	18	29	20	20	13	
COCOC		40	12	18	31	
AMPA		40	1	1	1	57
ARNE	3	2	5	91		
QUCH	1	20	9	17	52	1
HODI	6	31	21	7	34	1
GABU		39			61	
LOHI		1	2	21	17	60
RHDI				23	67	10
BEPU			39			61
BEPI				6	22	72

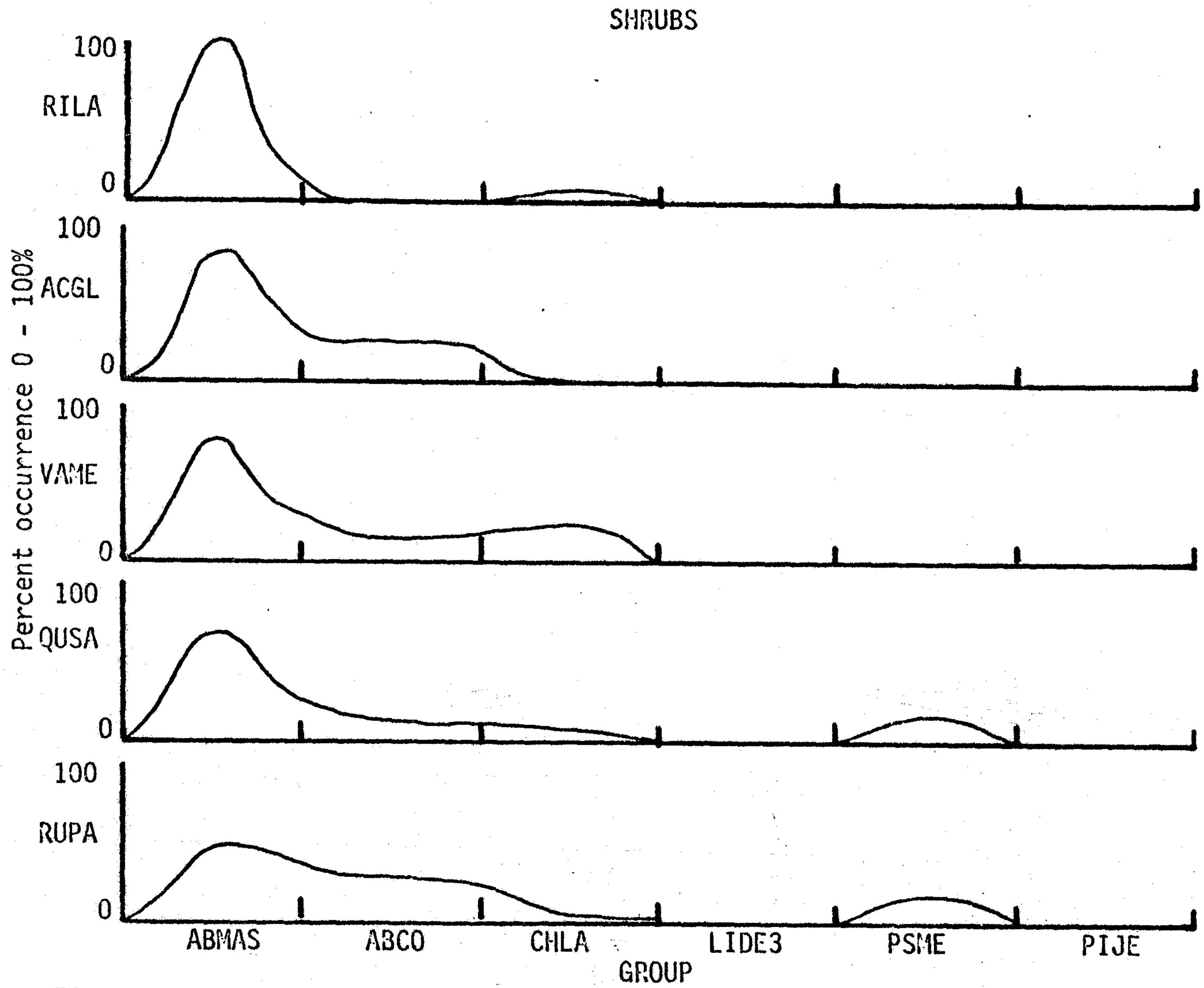


Figure 36 Percent occurrence of species by vegetation group.

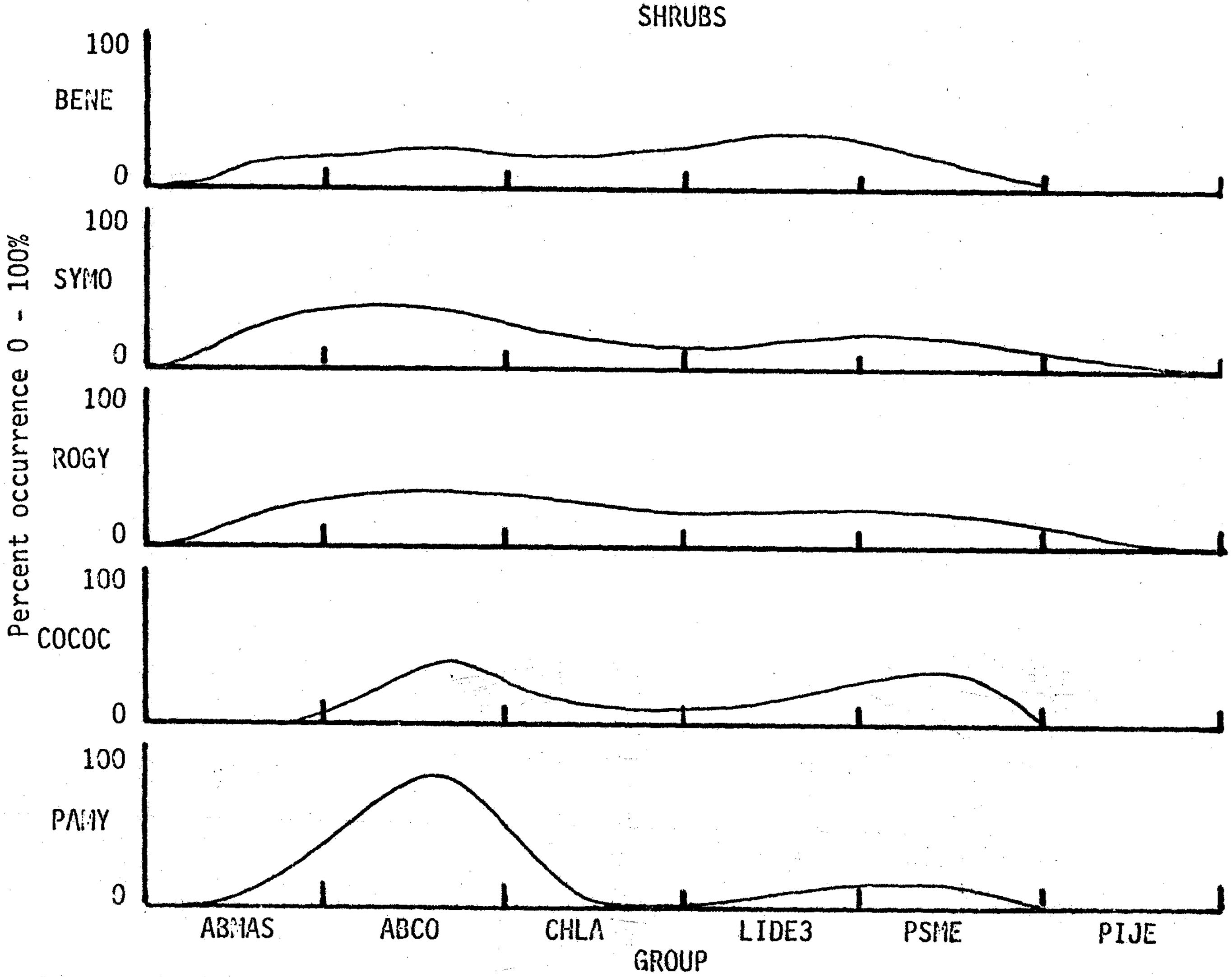


Figure 37 Percent occurrence of species by vegetation group.

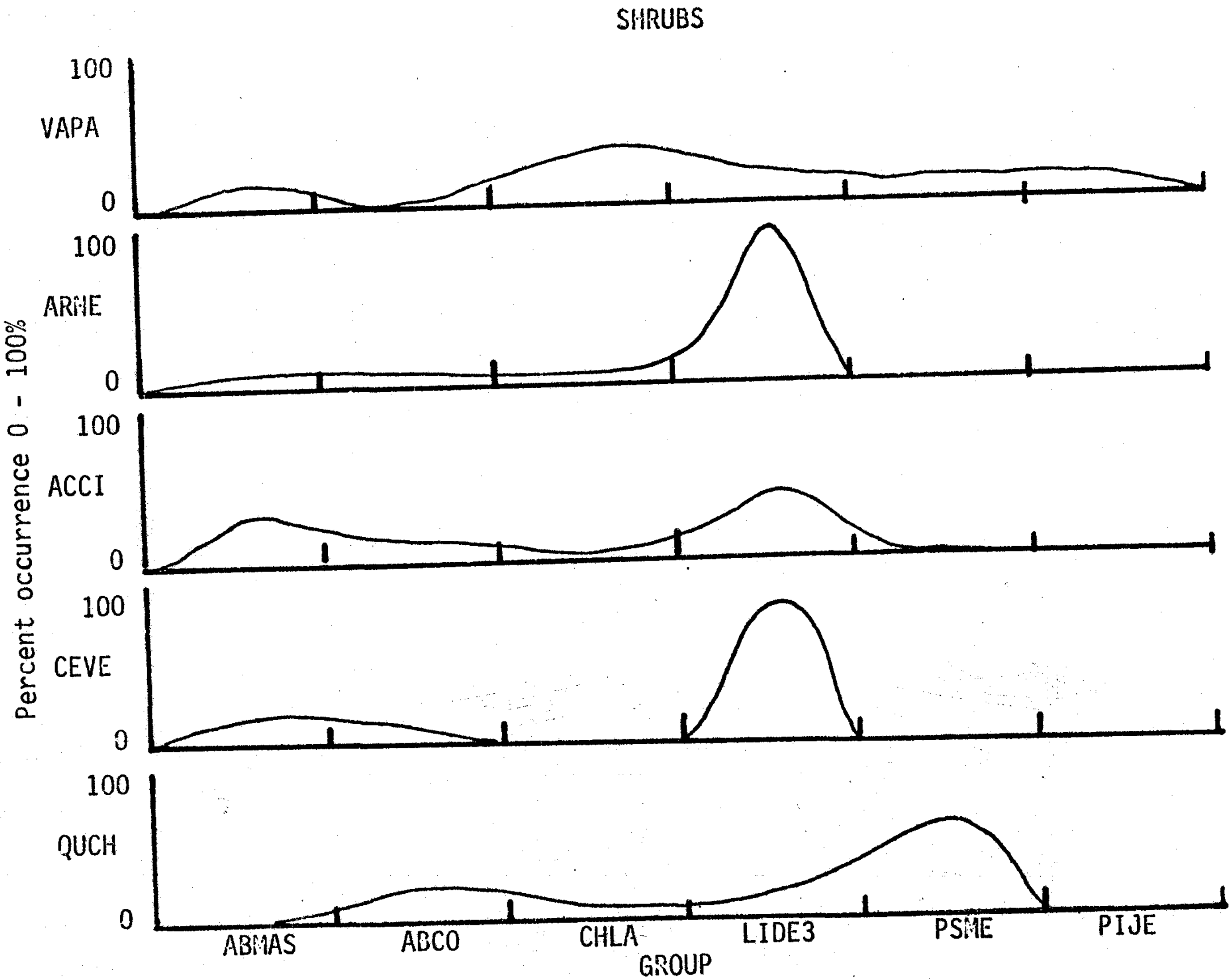


Figure 38 Percent occurrence of species by vegetation group..

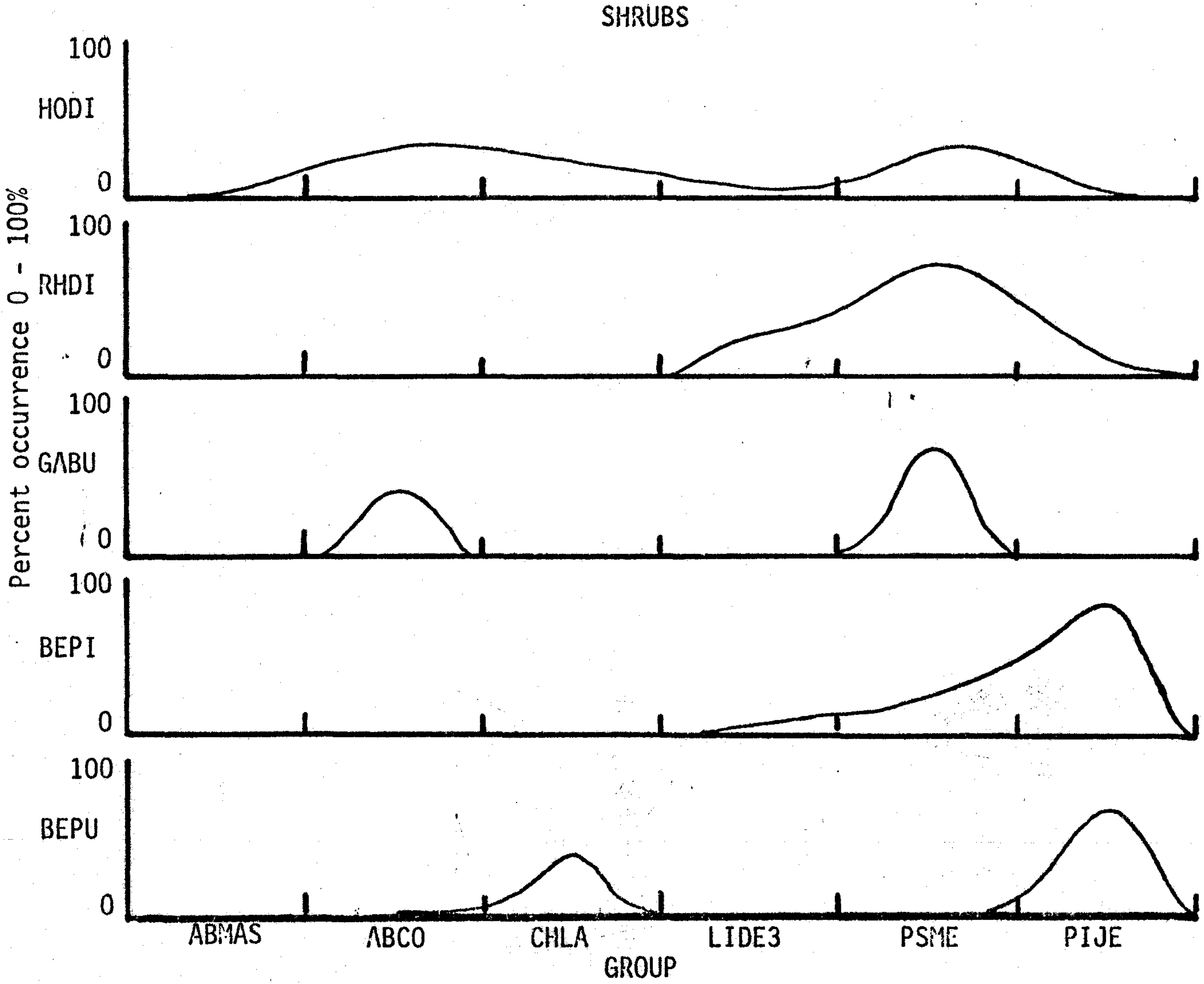


Figure 39 Percent occurrence of species by vegetation group.

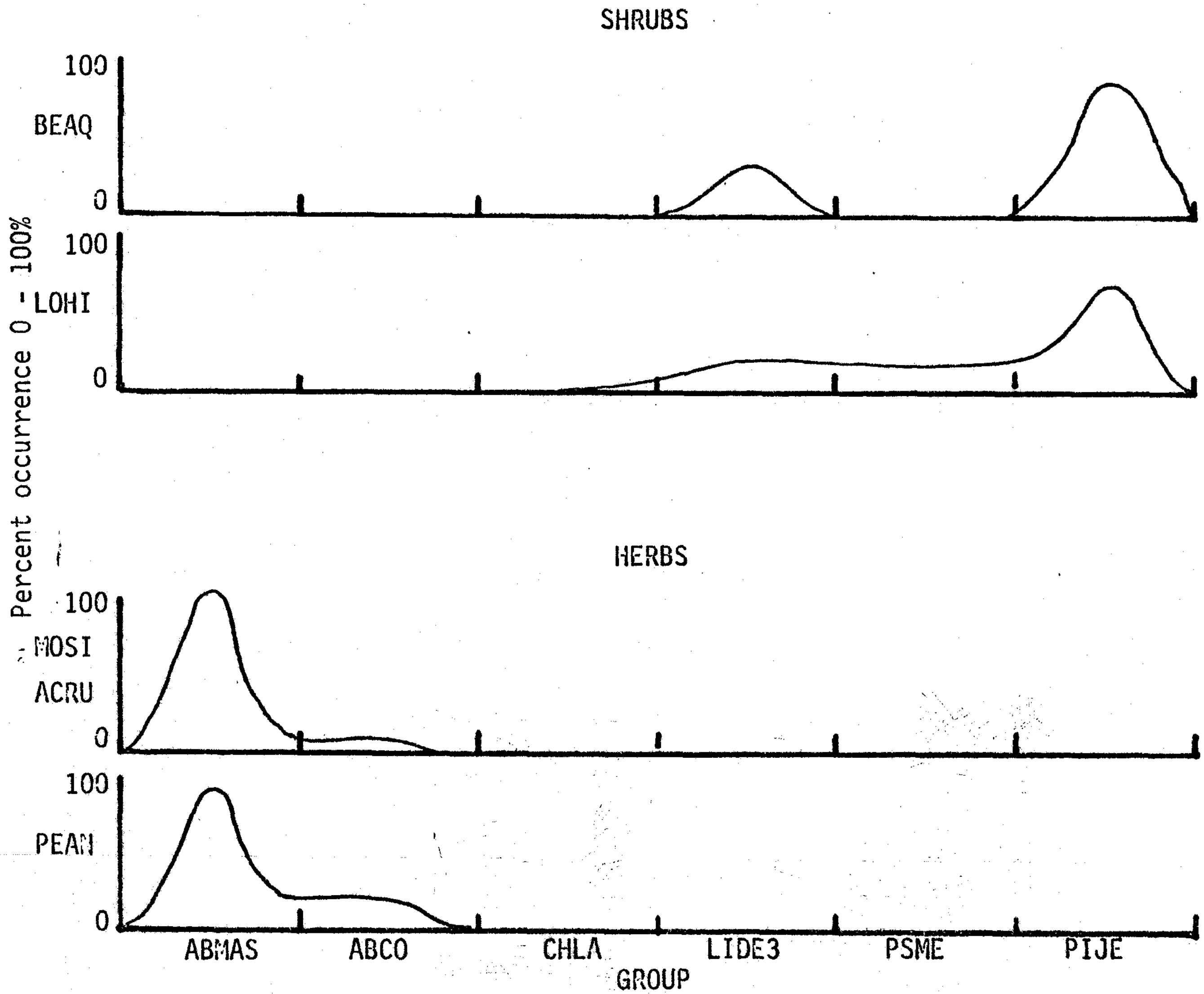


Figure 40 Percent occurrence of species by vegetation group.

common in the zone and reflect the cool, moist environment, characteristic of the zone. Snowberry (Symphoricarpos mollis), little wood rose (Rosa gymnocarpa), and Cascade hollyberry are common in this zone. In fact, they are the most common shrubs within the study area. California hazel (Corylus cornuta california), California dewberry (Rubus ursinus), pale serviceberry (Amelanchier pallida), oceanspray (Holodiscus discolor), boxed-leaved ganya (Garrya buxifolia), are also common in the zone. Species characteristic of hot, dry environments, such as canyon live oak and oceanspray, are present bu not common.

The Port-Orford cedar zone is both warm and wet. Species such as oceanspray and canyon live oak attest to its potential warmness, although they occur infrequently. Red whortleberry (Vaccinium parvifolium), salal (Gaultheria shallon), indicate its relative wetness. Red whortleberry salal, and Piper's hollygrape (Berberis pumila), are the most common shrubs within the zone. Piper's hollygrape is common on serpentine soils and may indicate the ability of Port-Orford cedar to tolerate such soils.

The tanoak zone, although lowest in average elevation, is not the hotest, dryest zone. Varnish-leaved ceanothus (Ceanothus velutinus), is often present and associated with vinemaple (Acer circinatum), salal, Cascade hollygrape, and pinemat manzanita. Poison oak (Rhus diversiloba) and hairy honeysuckle often occur on the dryer tanoak communities. The combination of species suggests that the zone is warm, moist rather than hot, dry as the Douglas-fir zone.

The Douglas-fir zone has the greatest number and abundance of species associated with hot, dry environments. Poison oak, canyon live oak, box-leaved garrya and oceanspray are such species. The zone also has representatives of moister environments such as Pacific rhododendron and myrtle pachistima. Such combinations may be attributed to both the genetic plasticity of the species involved and the variety of environments within the particular zone. Cascade hollygrape, California dewberry, canyon live oak and poison oak are the most common species within the zone. Pale serviceberry occurs rarely. It is most commonly associated with the Jeffery pine zone. _Ceanothus_ and _Arctostaphylos_ species are well as pale serviceberry and poison oak are part of a hot, dry valley flora that migrated north into the area during the Xerothermic period.

The Jeffery pine zone has a great variety of species, however, few of the species common to the other zones occur on serpentine. Thus, Table 14 does not reflect the variety of species found in this zone. Hairy honeysuckle, Piper's hollygrape, huckleberry oak (_Quercus vaccinifolia_), and pale serviceberry are the dominant shrubs of the zone. Pale serviceberry is seemingly confined to the white fir and Jeffery pine zones. It has a high tolerance to ultrabasic soils, but does not do well in the hot, dry environment. Its occurrence in the PIJE zone is confined to the higher elevations. Hairy honeysuckle and Piper's holly grape on the other hand have both tolerance for ultrabasic soils and hot, dry environments.

Herbs. Sixty six percent of the herbaceous species occur in less than three percent of the plots. Thus, only 74 herbs of the 215 found were reformatted for classification and analysis. Only a few of those reformatted were of significant value for classification purposes. Those plus selected commonly occurring herbs are presented in Table 15. Figures 41, 42, 43, and 44 illustrate their distribution.

Table 15 Percent of total cover of selected herbaceous species by species and vegetation group.

	VEGETATION GROUP					
SPECIES	ABMAS	ABCO	CHLA	LIDE3	PSME	PIJE
MOSIS	92	8				
ACRU	91	9				
PEAN	87	13				
CIAL	71	8	21			
TITRU	30	9	61			
PYSE	59	18	20	3		
COST2	23	27	7	5	37	
FERU	32	44	12	3	5	4
TROV	33	14	38	5	10	
ACTR	23	27	15	18	18	
LIBOL	4	10	31	24	31	
ASHA	8	30		54	8	
APAN	1	21		13	65	
TRLA2	13	22	26	14	18	7
GOOB	10	16	21	28	18	7
POMUM	4	7	19	28	23	19
CAPR3	4	31	11		27	27
CAPUP	3	4		18	10	66
POMUI			7	67	23	
XETE		1	30	5	31	33
LIWA						100
PHSP						100
ASDE						100

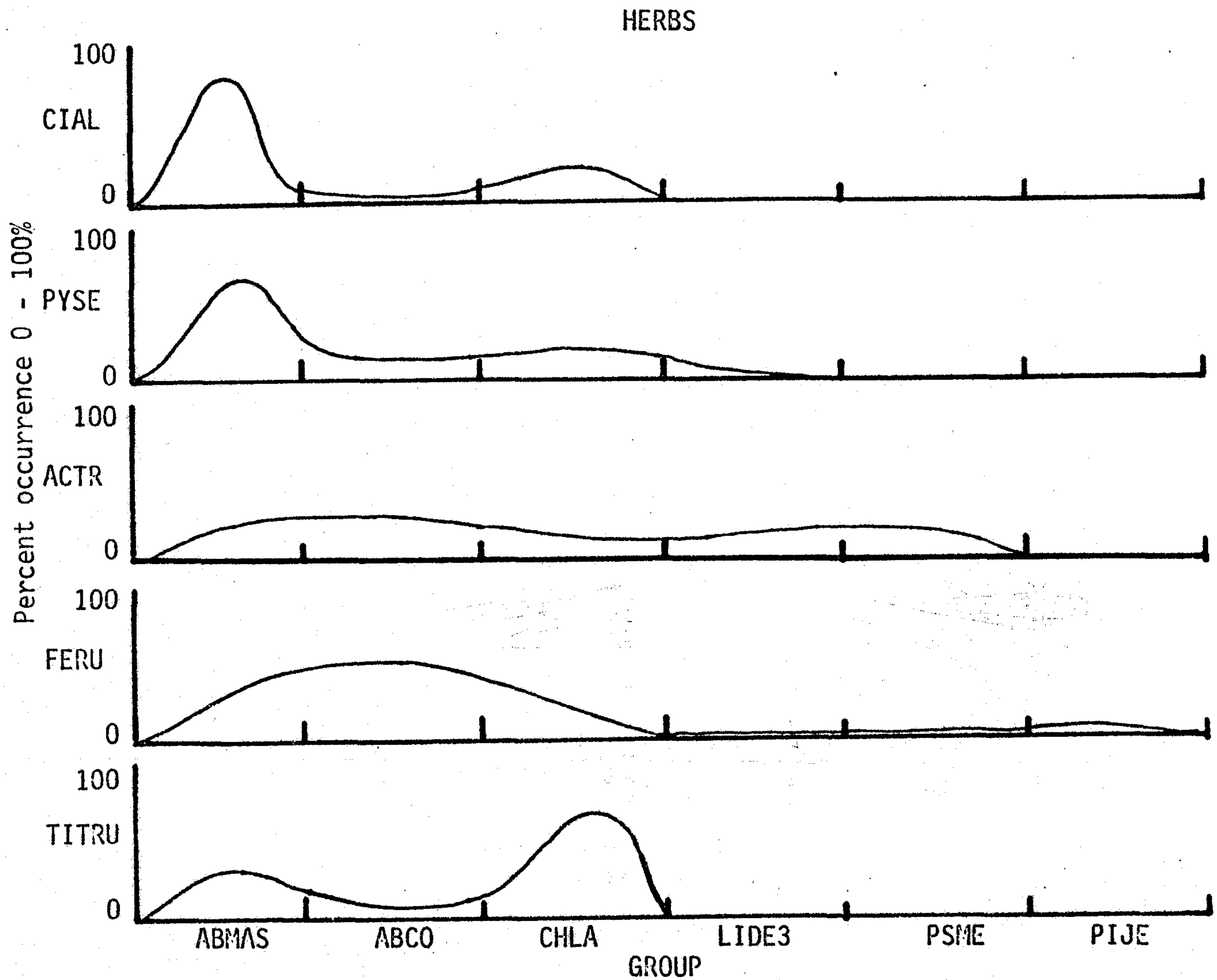


Figure 41 Percent occurrence of species by vegetation group.

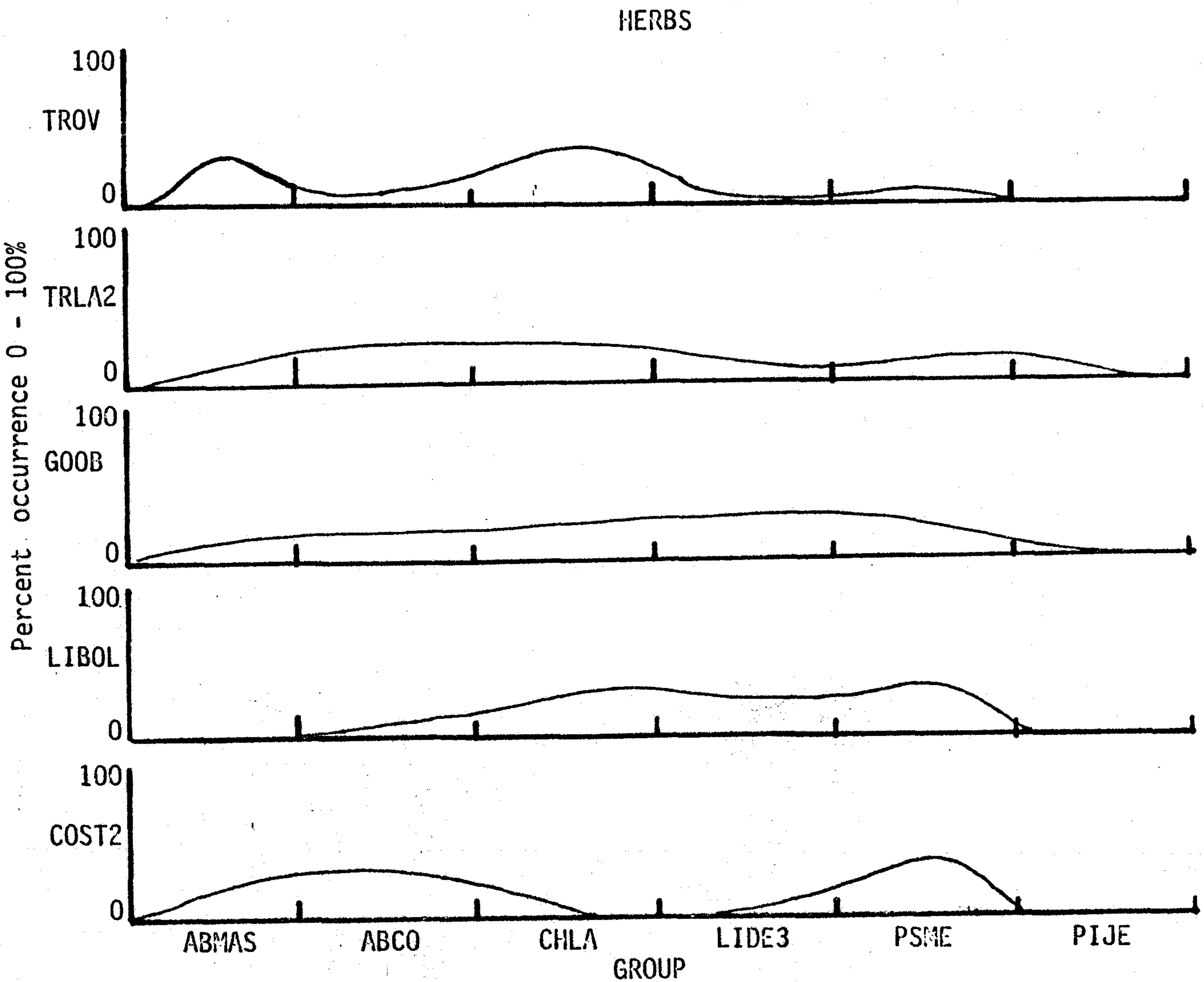


Figure 42 Percent occurrence of species by vegetation group.

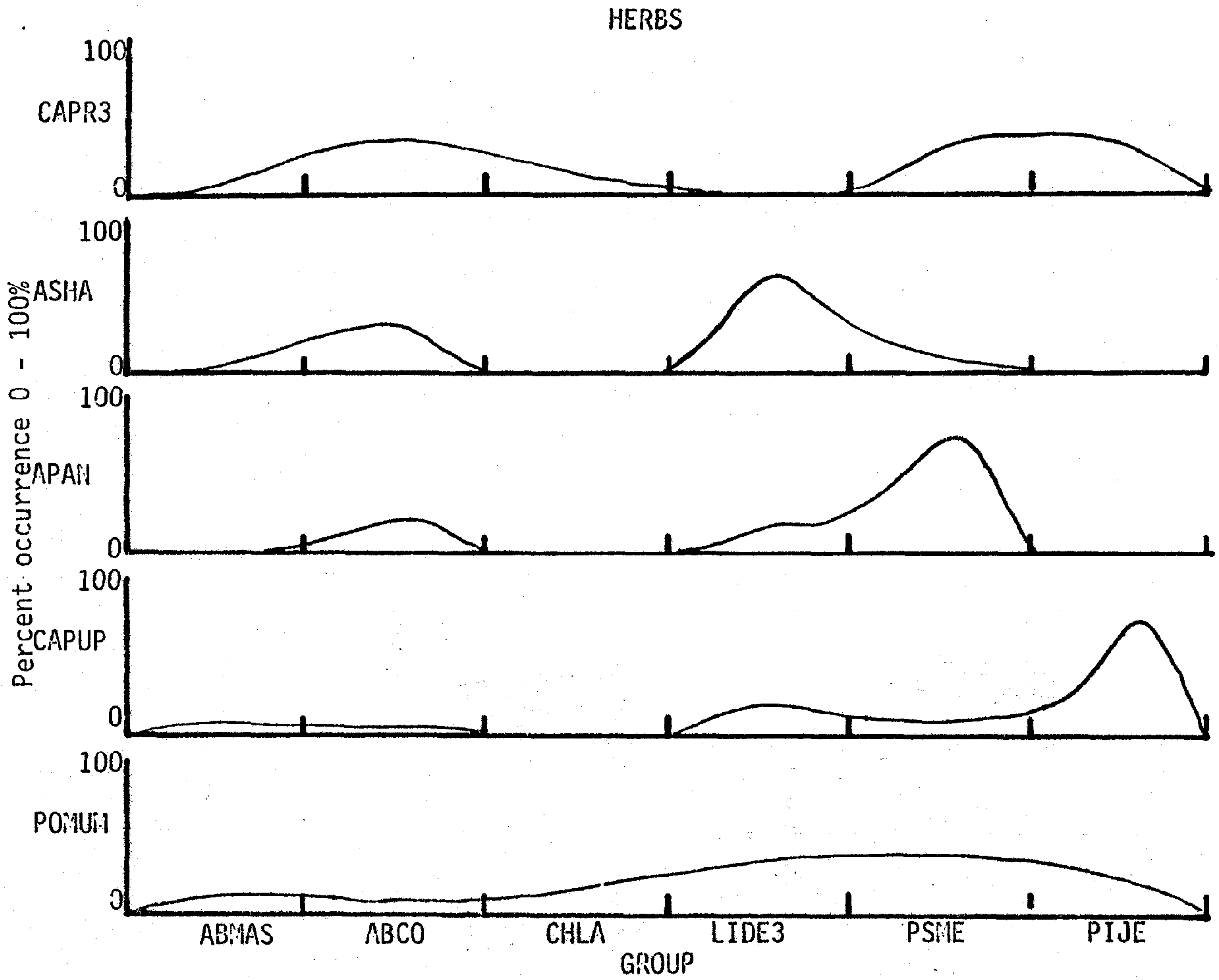


Figure 43 Percent occurrence of species by vegetation gorup.

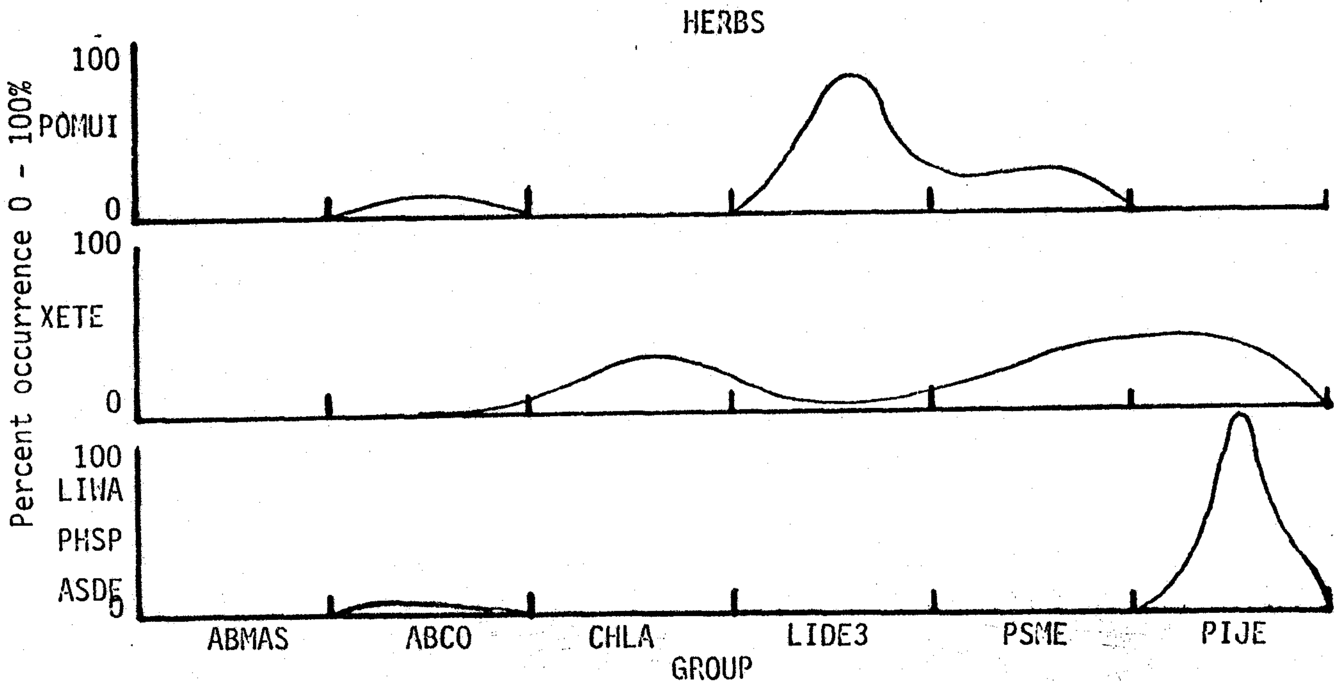


Figure 44 Percent occurrence of species by vegetation group.

Plantain (Goodyera oblongifolia), and vanilla leaf (Achlys triphylla), are the most commonly occuring herbs. Plantain, however, grows single stemed and provides less cover than a spreading species such as twinflower (Linnaea borealis longiflora), which occurs less often but carpets the forest floor.

The red fir zone is expectedly dominated by species adapted to high elevation such as baneberry (Actaea rubra), and Circaea alpina, (Whittaker 1960). Miners lettuce (Montia siberica siberica), and Penstemon anguineus, are common, twinflowers plantain, dogbane (Apocynum androsaemifolium), mottleleaf ginger (Asarum hartwegi), more commonly associate with dryer environments and are not often found in the red fir zone.

The white fir zone has a large variety of herbs. The most dominant are those of cool, moist environments such as baneberry, red fescue (Festuca rubra), mottleleaf ginger and California bellflower (Campanula prenanthoides). Species of the cold, wet environments, such as miners lettuce and baneberry, and hot, dry environments such as dry site swordfern (Polystichum munitum imbricans), and beargrass (Xerophyllum tenax), are rare within the zone.

The Port-Orford cedar zone is characterized by coolwart (Tiarella trifoliata unifoliata), Pacific trillium (Trillium ovatum), and twinflower of cool, wet environments. Circaea, vanilla leaf, starflower (Trientalis latifolia), one sided pyrola (Pyrola secunda), and wet site swordfern are all common inhabitants of the cool, wet midslope concavities. Beargrass, more characteristic of dry, cold sites often occurs within the Port-Orford cedar zone. Its presence, however, is related to its association with Port-Orford cedar on the more ultrabasic sites of the zone.

Twinflower is the most common species of the tanoak zone and mottleleaf ginger and dry site swordfern are indicative of the zone's warm, moist character. Species characteristic of the red fir zone, miner's lettuce and baneberry, are absent. Species of hot environments, beargrass and slender toothwart, are present but lacking in abundance. Mottleleaf ginger, although not found in great abundance within the study area, reaches its maximum development here.

The Douglas-fir zone, the hottest, dryest zone, lacks both cold and wet species of the red fir and Port-Orford cedar zones. Dogbane, California bellflower, beargrass, twinflower and spotted coralroot (*Corallorhiza maculata*), are common and characterize the zone. Red fescue trillium, vanilla lead and mottleleaf ginger are of minor importance here. Plantain is common within the zone, however, it is common within all zones and has little value as an indicator.

The Jeffery pine zone is characterized by red fescue in the high elevations and slender toothwart, beargrass Washington lily (*Lillium washingtoniaum*), showy phlox (*Phlox speciosa*), and podfern (*Aspidotis densa*), which commonly occur within the zone. Very few of the species common to the other zones occur in the Jeffery pine zone because of the soil inbalance.

Key. The key (Figure 45) was constructed with the aid of the order and discriminant analysis programs. The discriminatory variables in the summary table were used to arrange the key. Thus, most often the understory variables were used. In addition to being discriminators they are easily identified by practitioners. The sixty four most discriminating herbs did not separate the groups well. Figure 46 shows the overlap and

1. PIJE present, sparse stand with grass ____________ PIJE GROUP

1. PIJE absent ____________ 2

2. Understory dominated by LIDE3. QUCH & ARME are often present. ____________ LIDE3 GROUP

2. LIDE3 absent or not dominant in the understory ____________ 3

3. CHLA usually present in the overstory and dominant in the understory ____________ CHLA GROUP

3. CHLA either absent or not dominant in the understory ____________ 4

4. PSME dominant in the overstory and the understory ____________ PSME GROUP

4. Overstory dominated by ABMAS, or ABCO present ____________ 5

5. ABMAS present in the overstory and the understory ____________ ABMAS GROUP

5. ABMAS not present ____________ ABCO GROUP

Figure 45 Key to the vegetation groups of the Upper Illinois Valley Drainage.

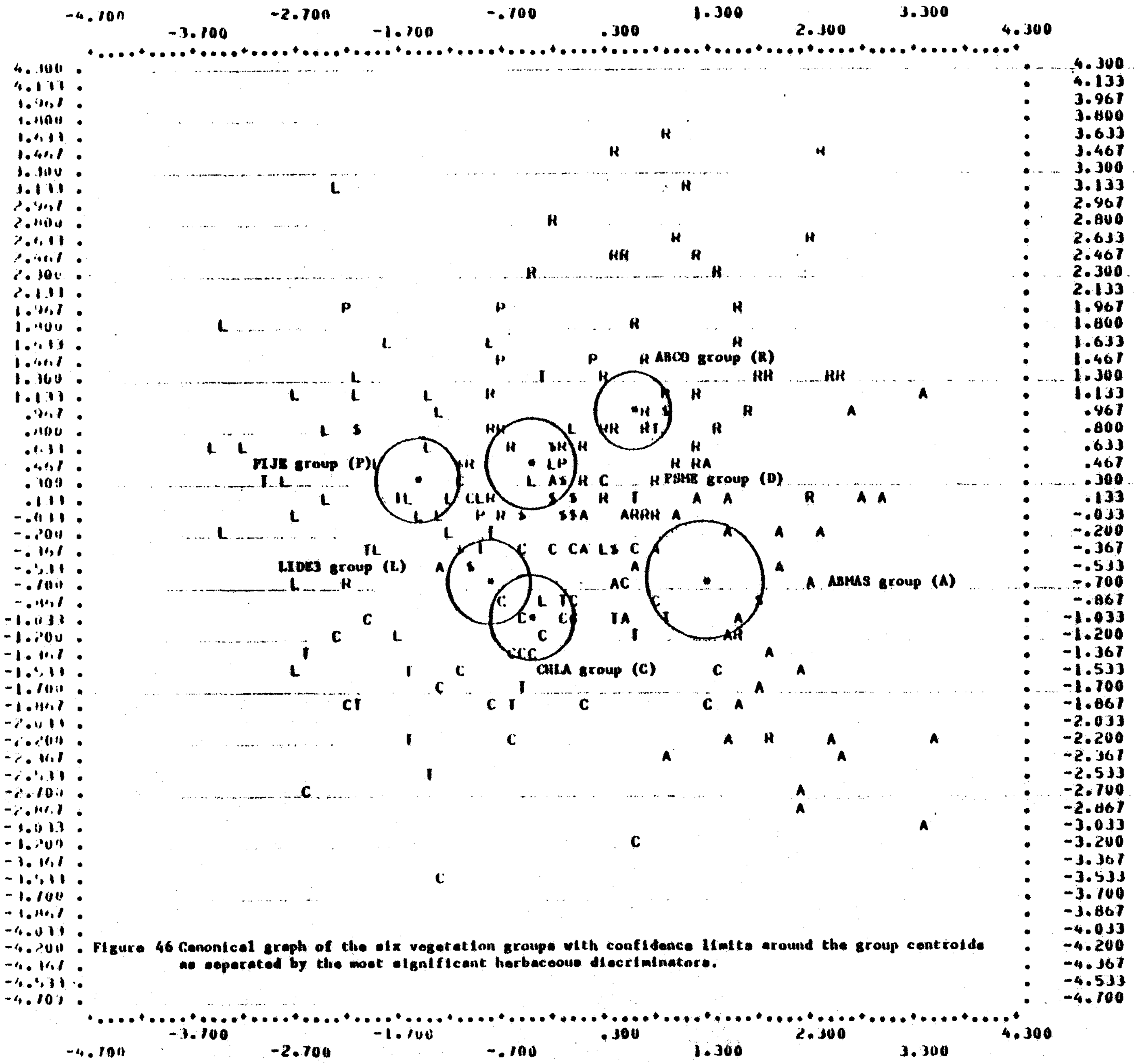


Figure 46 Canonical graph of the six vegetation groups with confidence limits around the group centroids as separated by the most significant herbaceous discriminators.

"shotgun" dispersion of the plots and the circular confidence limit around the centroid. Only 60 percent of the plots could be classified on the basis of the herbs alone.

According to the summary table of the discriminant analysis (Table 7) cover and dominance were similar in their discriminatory power. Eleven of the 32 variables were dominance values. The correlation matrix gave their average relatedness as extremely high (r=0.97). Thus, either cover or dominance could be dropped as a variable without losing discriminatory power. Frequency variables were less often discriminatory. Only five of the 32 discriminators were frequency values. However, two of the five were the sixth and ninth most discriminatory variables. But, because the size of the frequency plot (2' X 2') was inadequate for sampling local spacial diversity, no conclusions about its relative usefulness can be made.

Presence and absence were used where possible and dominance was used in all other cases. Dominance was considered a less desirable key character because judgement is required to assess dominance.

The key was tested with the order table which arrays all the variables as seen in the fieldand was found to be 200 percent effective for the sample population.

Community Classification

The Jeffery pine Group

The Jeffery pine group occurs exclusively on ultrabasic soils within the study area. Thus, it is a eudaphic climax. Both Franklin and Dyrness (1963) and Whittaker (1960) give the group special status.

Order Table. Appendix IV arrays the plots of the Jeffery pine group. The group can be broken into two communities with nine and eight plots each. The first nine plots are lower in elevation and have less pattern than the last eight plots. The first community (nine plots is dominated by Jeffery pine in the overstory and understory with few shrubs, and red fescue is the dominant species of the herbaceous layer. Thus, it is referred to as the PIJE/FERU community. (To decrease repetition, the species codes in appendix V are used for naming the communities). The last 8 plots, are higher in elevation, dominated by Jeffery pine in the overstory and understory, with incense cedar of major importance. Huckleberry oak dominates the shrub layer and red fescue dominates the herb layer. It is the PIJE/QUVA/FERU community. In some cases incense cedar is the dominant regenerating species in the understory of the PIJE/QUVA/FERU community and codominant in most other plots. Thus, it is possible that incense cedar will be a co-climax component in the Jeffery pine group. However, incense cedar was found in the codominant position only once in the overstory within the group, and not found at all in the PIJE/QUVA/FERU communities.

Canonical Analysis. The canonical analysis confirms statistical separation of the PIJE/FERU and PIJE/QUVA/FERU communities (Figure 47). The confidence limits are non overlapping and the plot dispersion, represented by letter symbols A and B, is relatively close to the group, or community, centroid. On the basis of the variables submitted, the PIJE/FERU (A) community type is the more uniform of the two. The Order Table verifies its uniform pattern (Appendix IV).

Only one axis is needed to significantly separate the communities. Thus, interpretation of the variation that separates the communities is focused on the x axis factor loadings, which array elevation as the most

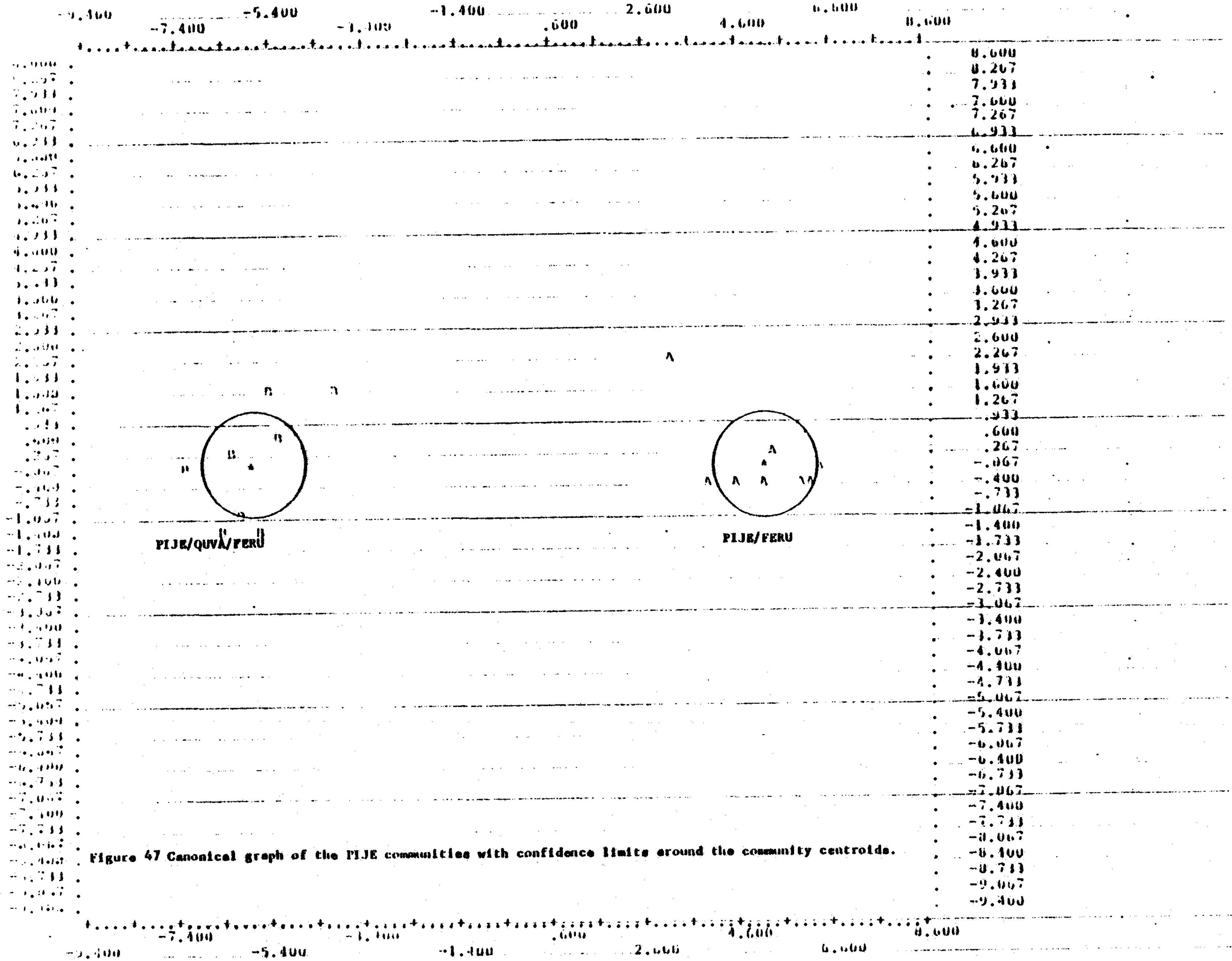


Figure 47 Canonical graph of the PIJE communities with confidence limits around the community centroids.

influential variable. Thus, the PIJE/QUVA/FERU and PIJE/FERU communities are separable by elevation.

Cluster Analysis. Generally the cluster analyses by group were similar to the canonical output and will be presented only where they contribute to the understanding of the classification.

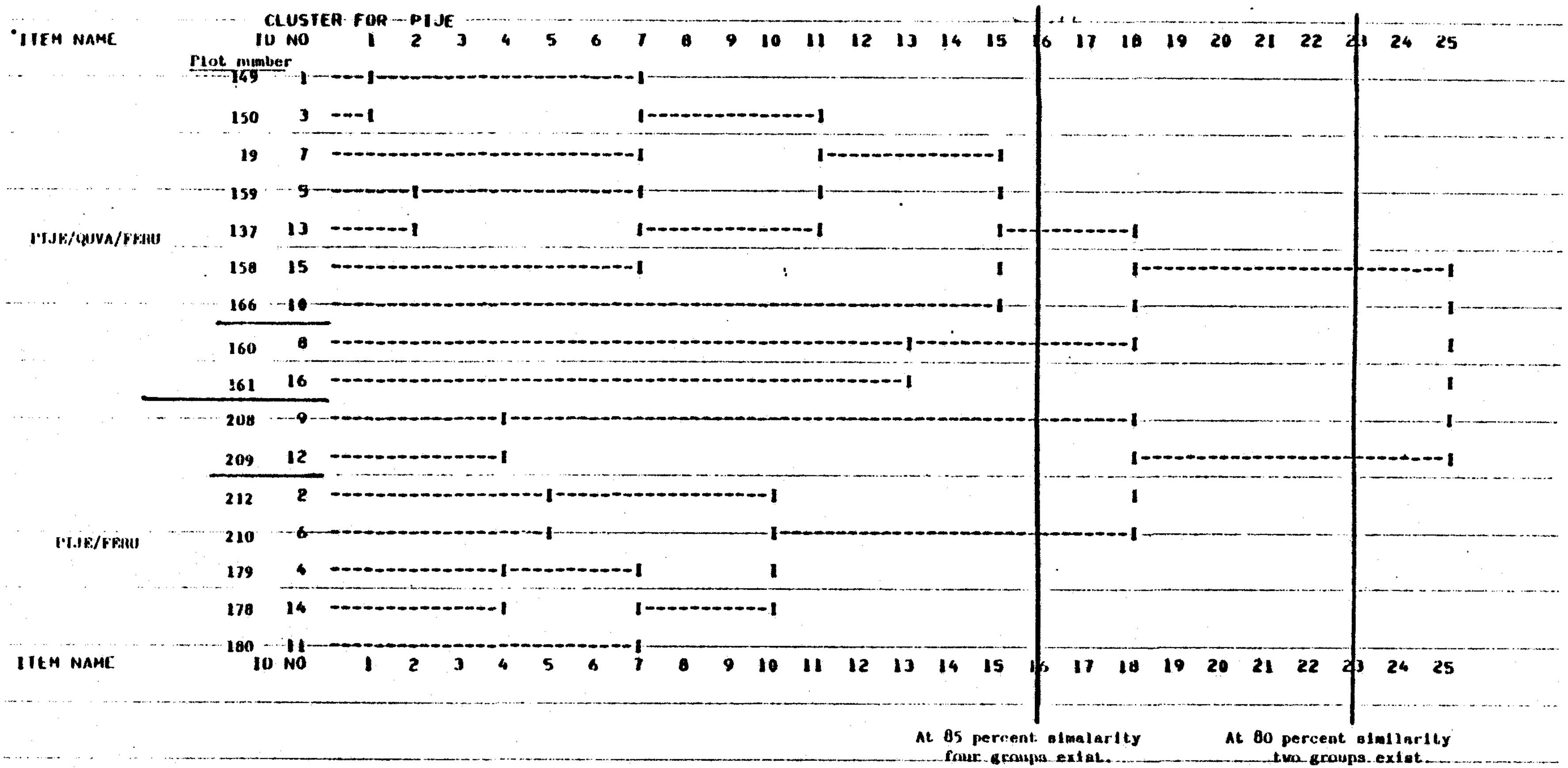
The dendrogram from the cluster analysis (Table 16) shows the same grouping for the communties as the canonical graph at an .84 similarity. Thus, on a strict mathematical evaluation, the group can be separated into two distinct communities.

Discriminant Analysis. Only two variables were significant discriminators. Elevation alone could classify 16 of the 17 plots of the PIJE group. Cascade hollygrape the second discriminantory variable, classified the remainder. The probability table showed all the plots correctly classified. Thus, the most efficient key variable is elevation.

Correlation Matrix. The correlation matrix provided only one significantly related pair of variables: the co-occurrence of Cascade hollygrape and twinflower at 0.91. However, both species occur only on one plot within the group. Therefore, the meaning of the correlation lacks substance.

Ecological Relationships. The nutritional imbalance of ultabasic soils is extremely influential on plant expression. However, environmental changes brought about by elevational differences are significant enough to divide the Jeffery pine group itself. Figure 48 gives the average elevation and one standard deviation for each Jeffery pine community.

Table 16 Dendrogram for the PIJE group.



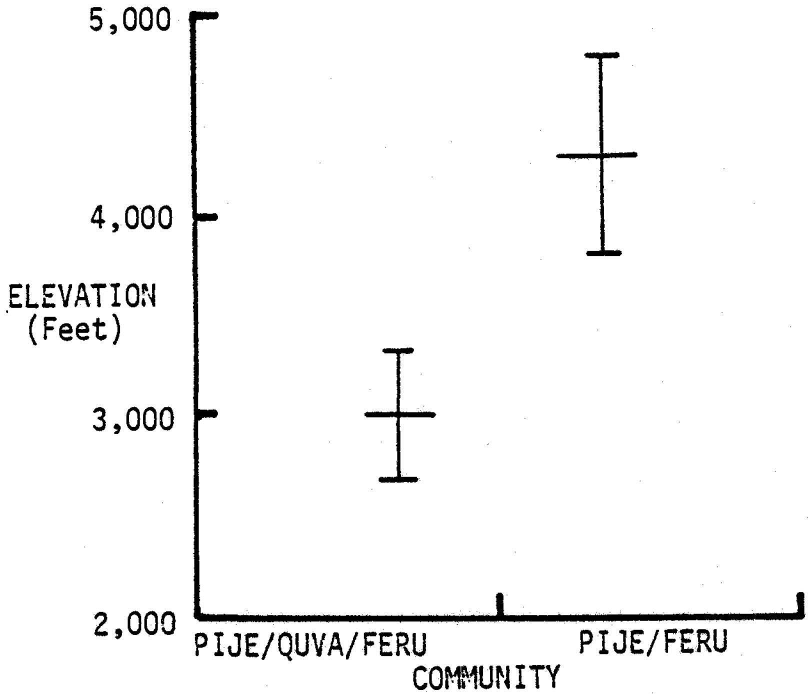


Figure 48 Mean and standard deviation for elevation in the PIJE communities.

The average elevation for the PIJE/FERU community is 3,060 feet. The PIJE/QUVA/FERU community averages 4,270 feet. Average temperature and length of the growing season are expected to be quite different between the communities.

The PIJE/QUVA/FERU community averages 175 square feet of basal area per acre, while the PIJE/FERU community averages 251 square feet. The higher elevation and colder temperatures of the PIJE/QUVA/FERU community may limit production. However, the species distributions give additional insights.

Species Distribution. Pacific yew, Pacific dogwood and tanoak commonly occur in the PIJE/FERU community but are absent from the PIJE/QUVA/FERU community. Such a combination of species indicate available moisture. On the other hand, Washington lily, beargrass, and pinemat manzanita are exclusive inhabitants of the PIJE/QUVA/FERU community in the PIJE group. These species are indicators of moisture stress. In addition slender toothwart, and showy phlox which occur in both communities are more abundant in the PIJE/QUVA/FERU community. Thus, the PIJE/QUVA/FERU community is cooler and dryer than the PIJE/FERU community. Thus, cold and lack of moisture may explain the lower basal area production of the PIJE/QUVA/FERU community.

The abundance of incense cedar in the understory of the PIJE/QUVA/FERU community suggests the possibility of incense cedar communities. However, neither White (1971) nor Whittaker (1960) suggest the possibility and Emmingham (1973) describes a PIJE/QUVA community, that is similar in composition to the PIJE/QUVA/FERU community, as a stable climax community. Thus, without additional information, one must conclude that incense cedar does not attain climax status within the Jeffery pine group.

The PIJE/FERU community represents a clearer successional trend. The community is stable and regenerating itself. This community is similar to Emmingham's PIJE/GRASS community of the Lower Illinois River Valley.

Port-Orford cedar often occurs in the Jeffery pine zone. Its presence suggests a tolerance for ultrabasic soils. Hawk (1977) found such a relationship in his CHLA/POMUM communities. This relationship will be detailed in the Port-Orford cedar community descriptions.

Key. An extremely simple key to the PIJE communities was constructed on the basis of the results of the order and discriminant analysis program. The discriminant analysis indicates that elevation is most discriminatory and the order table gives 3,500 feet as the critical elevation for separating the two communities. The key is given as Figure 49.

The Tanoak Group

The tanoak group occurs within Franklin and Dyrness's (1973) mixed evergreen zone on the lower slope position, above the valley floor. The species itself is a mid Cenozoic angiosperm and is recognized as a climax dominant in the Redwood Region (Stone et al. 1972). It is both tolerant as an understory species and extremely competitive as a pioneer in disturbed sites. It ranges along the coastal northwest and also competes well inland. It is associated with moist, warmer climates but can tolerate, cool temperatures. It is an extremely adaptive species but like many of the angiosperms, summer moisture is vital for its survival.

1. Above 3,500 feet in elevation ....PIJE/QUVA/FERU

1. Below 3,500 feet in elevation ....PIJE/FERU

Figure 49 Key to the communities of the PIJE group of the Upper Illinois Valley Drainage.

Order Table. Without exception Douglas-fir is the dominant overstory species (Appendix IV). Sugar pine is more common in this group than others, but it is still rare on most sites. The most striking row in table IV shows the overwhelming dominance and cover of tanoak in the understory. Madrone and canyon live oak are the most common understory associates but they show little pattern. Within the group the shrubs discriminate the community types. Salal and rhododendron are common associates as are poison oak and hairy honeysuckle. Vine maple is quite common in many of the plots and Cascade hollygrape is present in most. In the herb layer baneberry, twinflower and common princespine (*Chimaphila umbellata*), dominate.

Four tanoak communities may be separated: the LIDE3/GASH/ACTR with five plots, the LIDE3/ACCI/ACTR with 10 plots, the LIDE3/BENE/LIBOL with 10 plots, and LIDE3/BENE-RHDI/CHUM with 17 plots. None of the communities resemble those discribed by Emmingham (1973). In fact, Emmingham suggests that in the Lower Illinois Valley Drainage, tanoak does not achieve climax status.

Canonical Analysis. The communities grouped with the classification table were submitted to canonical analysis. The results are presented in Figure 50. The communities are statistically discrete and plot dispersion around the centroid is loose but non overlapping between community types. There seems to be, however, a continuous dispersion of plots parallel to the Y axis. The Y axis is related to the variation in the distribution and abundance of Pacific yew and slender toothwart. Pacific yew shows twice the loading of toothwart and is opposite in sign. Pacific yew is associated with cool, moist environments and

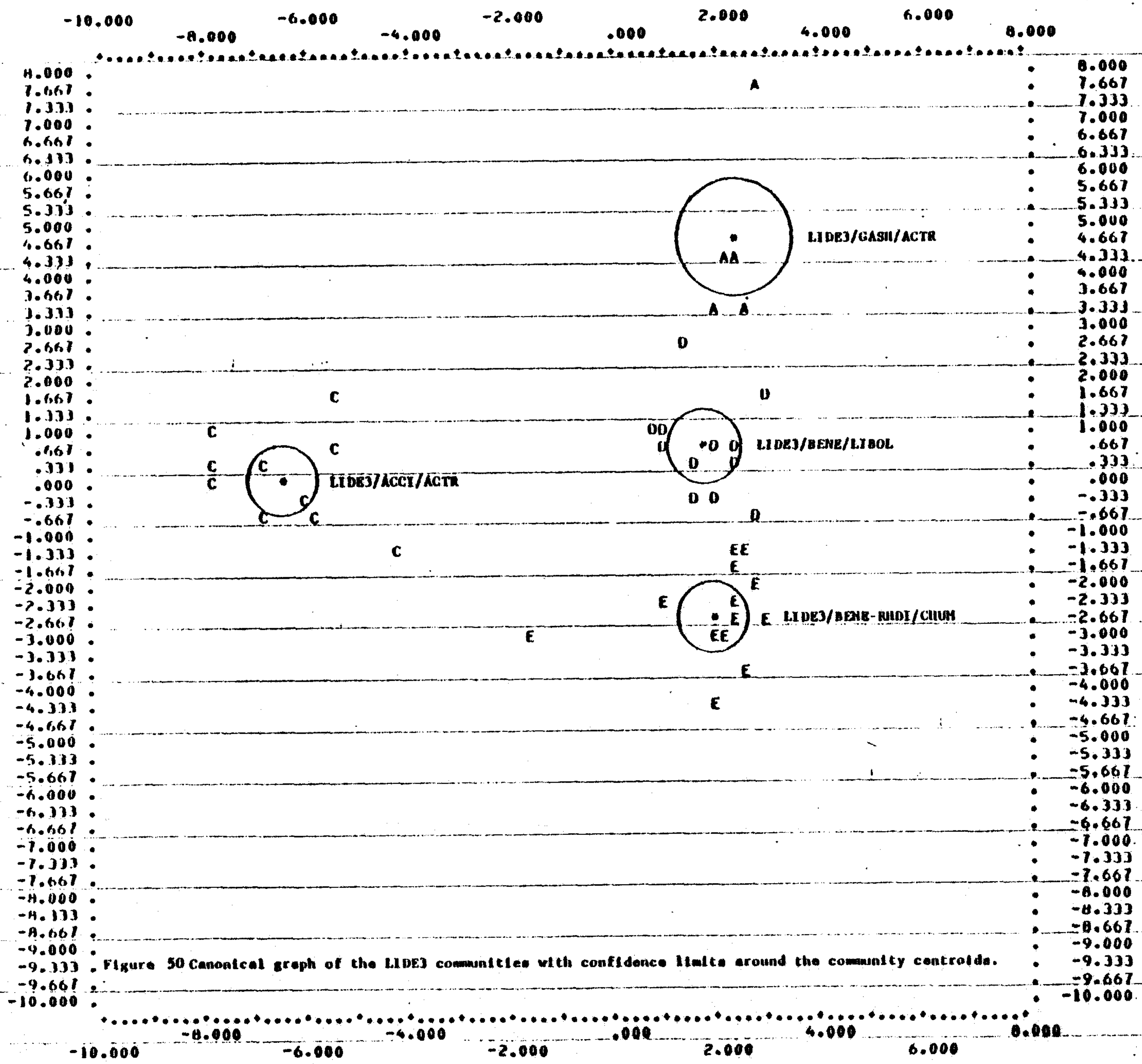


Figure 50 Canonical graph of the LIDE3 communities with confidence limits around the community centroids.

toothwart is associated with hot, dry environments. Thus, if Pacific yew strongly represents the upper axis and toothwart the lower negative portion, the axis can be loosly interpreted as a gradient from hot, dry to cool, moist conditions. Thus, the LIDE3/BENE-RHDI/CHUM community is the hotest and dryest followed by the LIDE3/BENE/LIBOL and the LIDE3/GASH/ACTR which is the most mesic of the three. The X axis relates to the distribution of vine maple which has a high negative coefficient. Thus, LIDE3/ACCI/ACTR community is separated from the others on the basis of the occurence of vine maple.

Discriminant Analysis. Seven significant discriminators were needed to classify the 42 plots into 4 communities. The variables in order of importance were: vine maple, slope, aspect, white fir, Pacific yew, range and wet site swordfern. According to the probability table, all plots were correctly classified.

Correlation Matrix. Table 17 displays variables from the correlation matrix that were significantly correlated. Canyon live oak and wet site swordfern are negatively correlated at 0.56. The critical value at the one percent level is o.48. Thus, canyon live oak and swordfern are from significantly different distributions.

Canyon live oak is considered an inhabitant of hot, dry environments and wet site swordfern of warm, moist environments. The distribution of Cascade hollygrape and baneberry are also significantly related. In this case, however, they inhabit similar sites. The abundance of strawberry (*Fragaria vesca bracteata*), is positively related to aspect. Thus, the more northerly the aspect the greater the abundance of strawberry. Vine

Table 17 Significantly related variables within the LIDE3 group.

CORRELATED VARIABLES	CORRELATED VALUE
PYSE COST	.52
LIDE3 PYSE	.56
QUCH POMUM	-.57
CONU FRVEB	.48
BENE ACTR	.58
Aspect FRVEB	.68
Aspect ACCI	-.60 1/

1/ Critical value at alpha 0.01 is 0.48.

maple and aspect, on the other hand, are negatively related at -0.60. Vine maple, however, only grows on northerly slopes within the zone and the relationship must be interpreted as an indication that vine maple avoids the more directnortherly aspects and favors the north easterly or northwesterly aspects.

Ecological Relationships. Averages and standard deviations of elevation, aspect and slope were extracted from the final discriminant run. Figure 51 displays the information graphically. Elevation distinguishes the LIDE3/ACCI/ ACTR community from the others. With the highest average elevation it is likely to be coolest. Aspect, the third most discriminatory variable in the discriminant analysis, clearly separates the LIDE3/GASH/ACTR community from the others as being closely associated with the northerly aspects. The LIDE3/BENE/ LIBOL community inhabits the greatest variety of aspects. Slope, the second most discriminatory variable, seems to display greater differences between the communities. The LIDE3/GASH/ACTR community averages about 20 percent slope while the LIDE3/BENE-RHDI/CHUM community averages 58 percent slope. Again the LIDE3/BENE/LIBOL community is most variable.

The combined affects of elevation, aspect and slope indicates the relative environment of the communities. For example, the LIDE3/GASH/ACTR community occupies low elevations and is, therefore, relatively warm. It occurs on the northerly cool, moist aspects and occupies gentle slopes. Thus, the combined effects would produce a warm, mesic environment. On the other hand, the LIDE3/BENE-RHDI/CHUM community with its low elevation, more southerly aspects and steep slope is expected to be the hottest, dryest of the tanoak communities. The LIDE3/ACCI/ACTR community

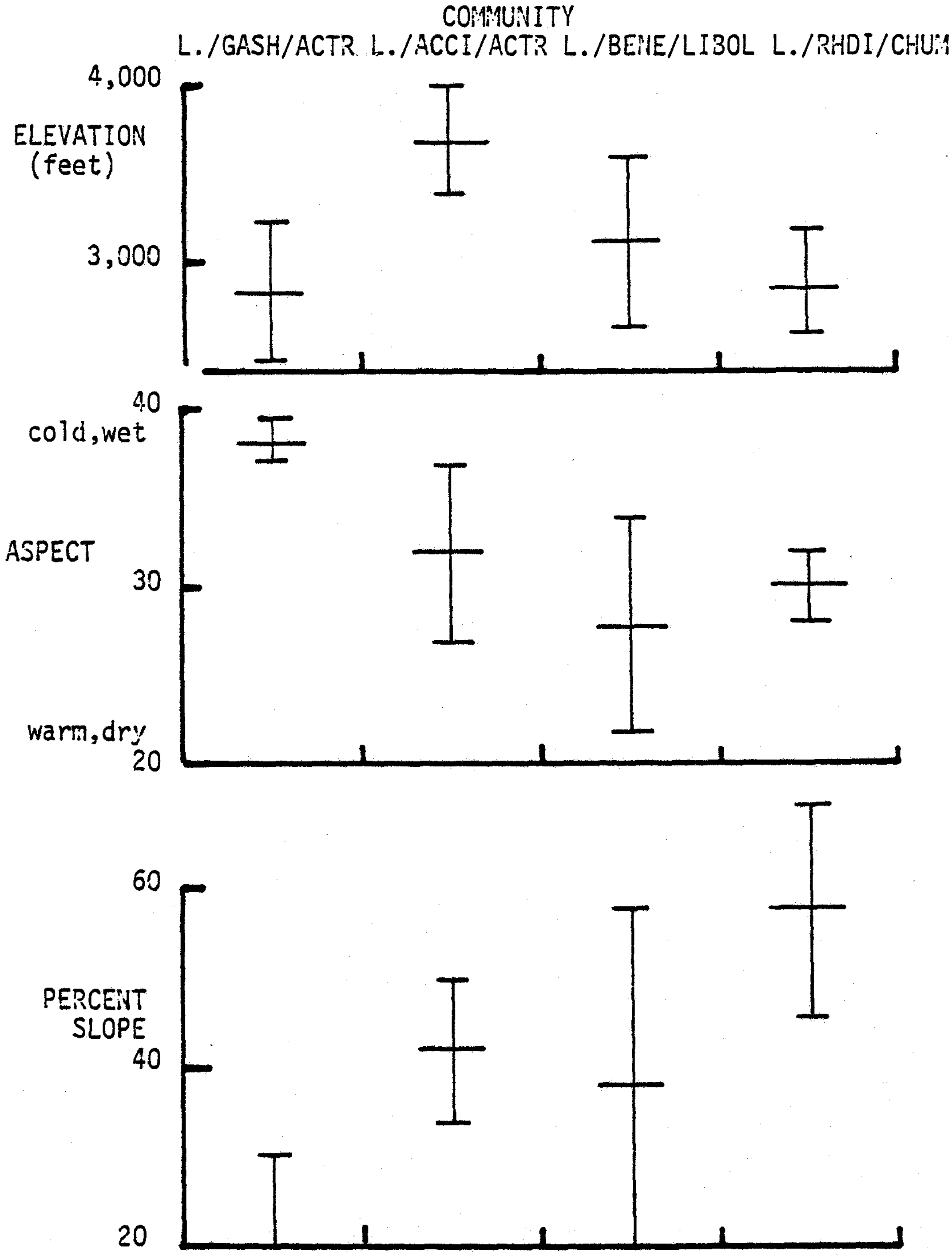


Figure 51 Mean and standard deviation for elevation aspect and slope for the LIDE3 communities.

is the coldest of the tanoak group, but is still somewhat mesic. The LIDE3/BENE/LIBOL community is the most variable of the group and intermediate between the LIDE3/ACCI/ACTR and LIDE3/BENE-RHDI/ACTR. Their relative environmental positions agree with the interpretations of the canonical graph (Figure 50).

The total average basal area production for the communities varies slightly: the LIDE3/BENE/LIBOL community produces 375 square feet, the LIDE3/GASH/ACTR community produces 360 square feet, the LIDE3/ACCI/ACTR community produces 332 square feet, and the LIDE3/BENE-RHDI/CHUM community produces 298 square feet. Thus, the warmest of LIDE3 communities produces the lowest basal area. The intermediate LIDE3/BENE/LIBOL community is the most productive.

The elimination of fire in the beginning of the century has been an important factor in the recent development of the tanoak zone. The lack of fire has allowed the fire susceptible tanoak seedlings and saplings to become well established in the understory. Although Douglas-fir is now dominant in the overstory, it is not replacing itself. Thus, tanoak is becoming the overwhelming understory dominant with tolerance enough to supplant Douglas-fir. Similar to the Redwoods (Sequoia sempervirens), (Stone et al, 1972), without fire, tanoak will eventually dominant the zone.

Disease was also observed to have an impact on the composition of the tanoak zone. Numerous small western white pine seedlings were found in the understory that were observed to be dying of rust. Only a few resistent individuals developed to maturity.

Species Distribution. Species common to the group are given in Appendix IV and Tables 12, 13, 14 and 15. However, there are some important differences in the occurence of species amoung the communities. The LIDE3/BENE-RHDI/CHUM is the only community which supports dogbaneand not Pacific trillium, a combination indicative of warm sites.

Its absence is consistent with the presentation of hairy honeysuckle as an indicator of hot, dry environments, and the LIDE3/ACCI/ACTR community as cool. Of the species common to all four communities the abundance of starflower and Pacific yew in the LIDE3/GASH/ACTR community collaborates its wetness as does significantly lesser amounts of canyon live oak in that community. Thus, the differences in species distribution seems to be consistent with the environmental interpretation of the communites.

Key. Variables used to construct the group key were taken from the discriminatory variables of the summary table and selected from the classification table (Figure 52). Vine maple (from the summary table) salal and poison oak were key variables, and on the basis of presence and absence were effective in keying all the plots in the tanoak group.

The Red fir Group

The red fir zone is common in high elevations throughout the Klamath Mountains (Sawyer and Thornberg, 1977). The zone is narrow and with decreasing elevation is confined to northerly slopes.

The zone consists of one community type but other communities have been included in the group for the ease of keying. The group separated well on the basis of presence of red firin both the overstory and understory.

1. GASH present..................................LIDE3/GASH/ACTR

1. GASH absent 2

2. ACCI present..................................LIDE3/ACCI/ACTR

2. ACCI absent...3

3. RHDI present LIDE3/BENE-RHDI/CHUM

3. RHDI absent LIDE3/BENE/LIBOL

Figure 52 Key to the communities of the LIDE3 group of the Upper Illinois Valley Drainage.

Order Table. The table is divided into four groups with 9, 14, 14, and 11 plots sucessively from left to right (Appendix IV). The first nine represent the ABMAS/QUSA/PYSE community. Within this community, there are three plots that are possible mountain hemlock climax TSME/QUSA/PYSE. This community is included in the key so that it may be recognized by practitioners. However, three sample plots are inadequate to characterize a community. Thus, it is treated as variation within the ABMAS/QUSA/PYSE community.

The ABCO/ROGY/ACTR community is represented by the next 14 plots. Here red fir continues to be present and abundant in both the overstory and understory but white fir is clearly the climax dominant. The average elevation is slightly lower than the ABMAS/QUSA/ACTR community and is herb rich. The adjacent 14 plot group is the ABCO/BENE/ACTR community. Two major differences from the ABCO/ROGY/ACTR community are apparent: one is the universal occurrence of Douglas-fir in the overstory and the dominance of Cascade hollygrape in the shrub layer. Red fir is still a major species in both the overstory and understory but, white fir dominates the sites. The last eleven plots are the ABCO/QUSA/CHUM community. It is dominated by Douglas-fir in the overstory with white fir and red fir commonly occurring in the overstory. Brewer spruce, western white pine, Ponderosa pine, and Port-orford cedar occur sporatically. Again white fir dominates the understory but red fir is consistently an important part of the stand.

Canonical Analysis. Figure 53 is canonical output for the group. Here again the communities can be considered discrete entities. However, the plots are widely dispersed and overlap between the ABMAS/QUSA/PYSE (A)

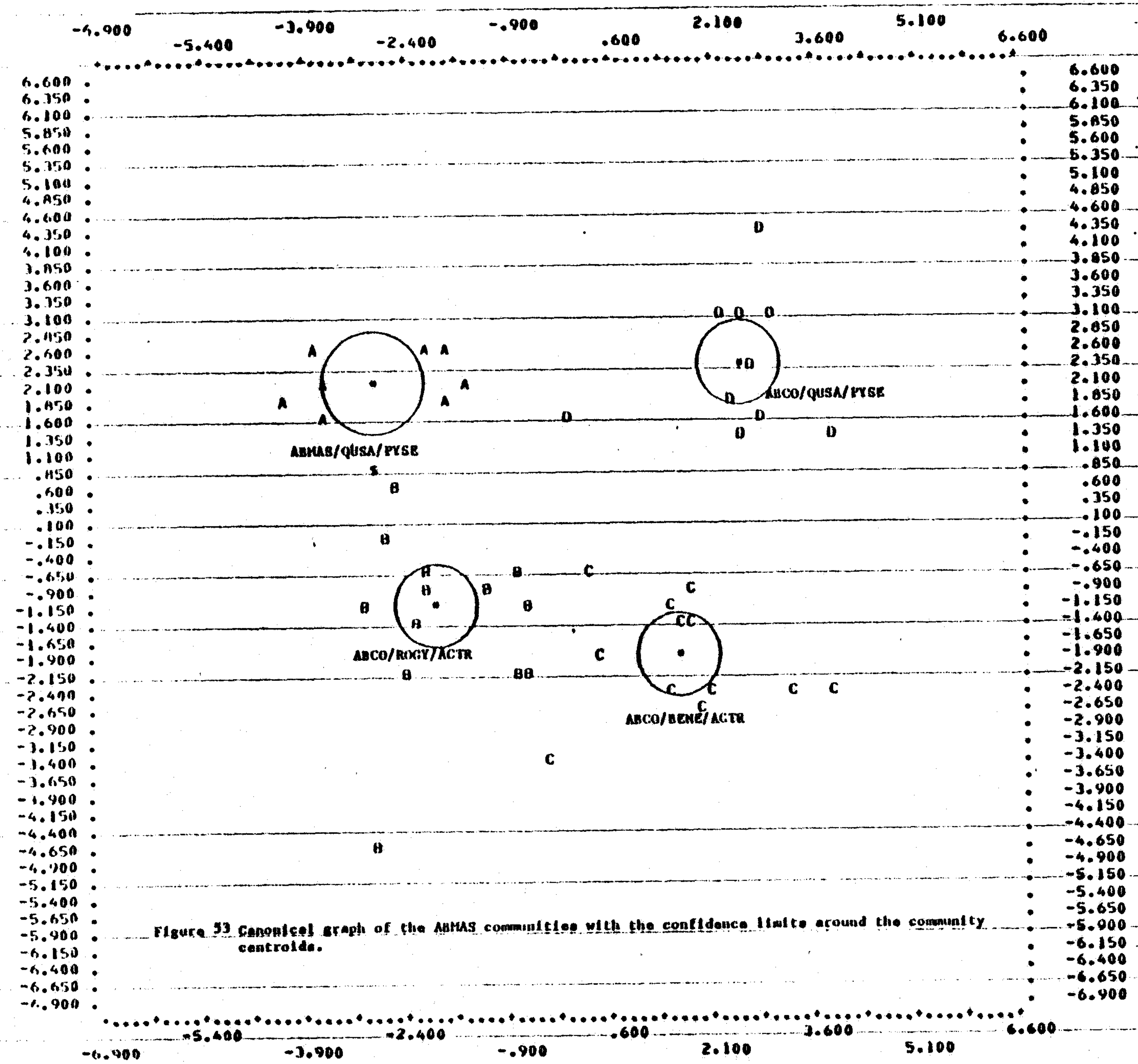


Figure 53 Canonical graph of the ABMAS communities with the confidence limits around the community centroids.

community and the ABCO/ROGY/ACTR community (B). The dispersion suggests that the grouping of plots into communities is somewhat artifical and that naturally a continuum exists. However, it is accepted that classification is artificially devised for pragmatic purposes. More important is the fact that a continuous complex such as the Siskiyous can be treated discretely.

Both the X and Y axis are significant. Together they account for 92 percent of the variation among the plots. Three species are of major importance on the X axis: dogbane, Circaea and California bellflower. Thus, they are of major importance in positioning of the centroid but no environmental interpretation of the axis can be made. The distribution of Port-Orford cedar is of major importance on the Y axis. The axis may represent a temperature continuum separating the Sadler oak communities from the others.

Cluster Analysis. The dendrogram only vaguely reflected the communities of the group. On inspection of the similarity matrix, the basis for clustering, the values were extremely high and selection of associated plots was often based on a tenth of one percent difference. Ninety percent of the clustering was completed above the 92 percent similarity rating. Such subtle differences may have been responsible for lack of more definite classes in the red fir cluster. Such results agree with the dispersion and overlap found in the canonical analysis.

Discriminant Analysis. Because the differences between the plots and communities were so slight, the discriminant run required 14 variables to achieve a 96 percent classification. The nine significant variables only classified 87 percent of the plots. In order of importance they are: elevation, baneberry, aspect, red fir, starflower, twinflower, circea, penstemon and parent material. Elevation alone classified 44 percent of the plots.

The probability table showed all plots correctly classified on the basis of 62 variables. However, such a classification has little practical value. In addition, two plots within the group had split probabilities. Plot number 236 of the ABCO/ROGY/ACTR community had a 32 percent probability of belonging to the ABMAS/QUSA/PYSE group. Plot 236 is the same plot that overlapped with the ABMAS/QUSA/PYSE community in the canonical graph. Plot 61 of the ABCO/BENE/ACTR community showed a similar tendency to belong to the ABCO/ROGY/ACTR community. Thus, separation in the ABMAS group is not as clean as the other groups.

Correlation Matrix. Four pairs of variables were significantly correlated. Aspect was positively correlated with vanilla leaf at 0.56 indicating that vanilla leaf is associated with the cooler aspects. Moss correlated with California dewberry and plantain at 0.61 and 0.50 respectively. These relationships are interpreted as warm, moist associations. Finally, elevation was negatively related to the occurence of penstemon at -0.51. The indication is that penstemon is more abundant at the lower elevations within the zone.

Ecological Relationships. Elevation and aspect were the primary environmental variates in the red fir group (Figure 54). The ABMAS/QUSA/PYSE and ABCO/ROGY/ACTR communities were approximately equal in average elevation at 5,500 feet. The ABCO/BENE/ACTR and ABCO/QUSA/CHUM communities averaged below 5,000 feet.

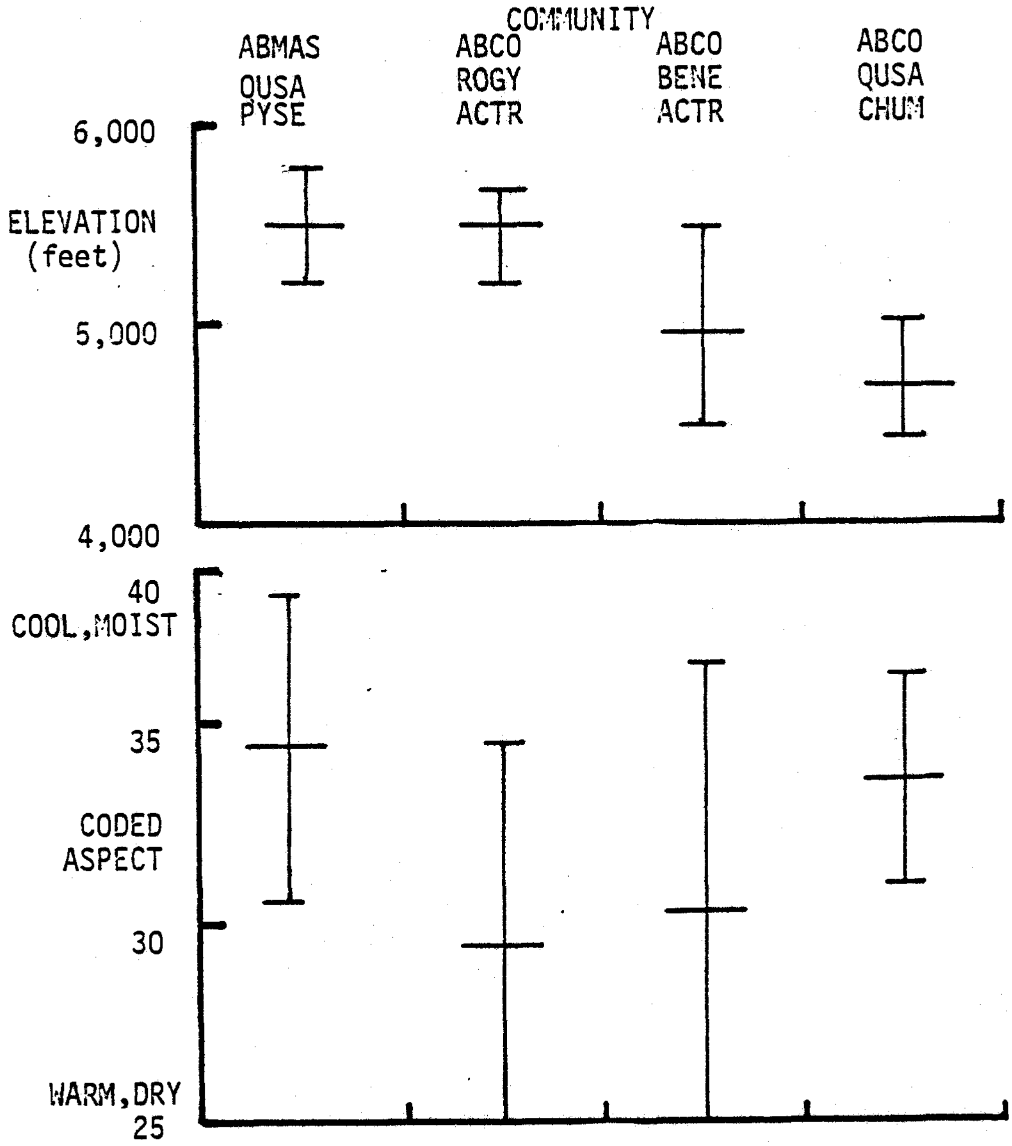


Figure 54 Mean and standard deviation for elevation and slope for the ABMAS communities

Aspect paired the "QUSA" communities which occur primarily on northerly cool sites. The ABCO/ROGY/ACTR and ABCO/BENE/ACTR had only a slight preference for northerly aspects. Thus, the coolest community is the ABMAS/QUSA/PYSE community that occurs higher in elevation on the most northerly slopes. The warmest community of the red fir group is the ABCO/BENE/ACTR community that combines relatively low elevation with intermediate aspects. The ABCO/ROGY/ACTR and the ABCO/QUSA/CHUM communities combine extremes of elevation and aspect and are considered intermediate relative to the other communities.

There is no significant difference between the basal area production in the red fir group, although the averages of the lower elevation communities are slightly lower. The ABMAS/QUVA/PYSE, ABCO/ROGY/ACTR, ABCO/BENE/ACTR, and the ABCO/QUSA/CHUM communities average 323, 317, 317, and 352 square feet of basal area per acre respectively.

The occurence of fire in the red fir community is relaitvely low. Many of the stands have been undisturbed and exhibit a stable age distribution. Thus, the ABMAS/QUSA/PYSE community is considered typically climax.

As previously mentioned, the TSME/QUSA/PYSE component could be broken out into a community type. However, there are very few occurences of this type and statistical substantiation would be difficult.

<u>Species Distribution</u>. Many of the high elevation species given in Table 15 are common to all communities within the red fir group. Plantain, starflower, vanilla leaf, Pacific trillium, coolwart, and one sided pyrola are the most common. There are some notable differences between communities. The ABCO/BENE/ACTR community is the only community of the

group that supports twinflower, mottleleaf ginger, dogbane, and slender toothwart. All are species of warm, dry environments. Similarly the ABCO/QUSA/CHUM community supports vine maple and pinemat manzanita and the ABCO/ROGY/ACTR community solely supports golden chinkapin and California bellflower. The latter two communities have intermediate environmental requirements.

Key. The key classifies 94 percent of the plots in the zone. Four additional species variables would have been necessary to classify the remaining three plots with complete surity. It was felt that the added complexity was not warrented. (Figure 55).

The Port-Orford cedar Group

The Port-Orford cedar group is an inland extension of coastal communities, modified by continental influence. All inland communities occur in drainage concavities where atmospheric and soil moisture are plentiful. There are some communities tolerant of serpentine, but there seems to be no preferred soil type. Hawk (1977) found Port-Orford cedar in eight communities of three zones in the Pacific Northwest and some of the plots were taken in the study area.

Order Table. The Port-Orford cedar group, as the red fir group, was separated on the basis of the occurence of the species in both the understory and overstory. Thus, one community within the Port-Orford cedar group is a member of the white fir zone. The remaining three groups are Port-Orford cedar climax.

1. PSME present and common, LIBOL usually present.
   - A. Three of the following spreies usually present: CLUN, OSPU,VAHE, ANDE or GAAP.......ABCO/BENE/ACTR
   - B. The above combination absent.................ABCO/QUSA/CHUM

1. PSME absent or rare, LIBOL absent.
   - A. TSME present in both the overstory and understory..................................TSME/QUSA/PYSE
   - B. TSME absent in one or both layers
     - a. ABMAS dominant understory specie ACRU present...........................ABMAS/QUSA/PYSE
     - b. ABCO the dominant understory specie ....ABCO/ROGY/ACTR

Figure 55 Key to the communities of the ABMAS group of the Upper Illinois Valley Drainage.

Appendix IV shows four communities with the group identified as the ABCO/BENE/CHUM, the CHLA/BENE/CHUM, the CHLA/QUVA/CHUM, and the CHLA/GASH/LIBOL with 9, 18, 5, and 10 plots respectively. Again Douglas-fir is the dominant in the overstory and white fir is quite common in both the layers. However, Port-Orford cedar is almost always part of the overstory and is often codominant with Douglas-fir. Incense cedar and Western white pine are scattered throughout the group but Brewer spruce and Western white pine are associated only with the CHLA/QUVA/CHUM community.

Port-Orford cedar is the dominant understory species with most other species showing little pattern. Pacific yew is the exception; it is more commonly associated with the CHLA/GASH/LIBOL community.

Canonical Analysis. The communities of the Port-Orford cedar group can be statistically separated (Figure 56). The circular confidence limits are large, however, partly because of group diversity and partly because of the small number of plots representing the communities. The CHLA/QUVA/CHUM community for example is represented by five plots and plot dispersion is mixed with the ABCO/BENE/CHUM community. Generally plot dispersion is loose and the CHLA/GASH/LIBOL community is the only community quite apart from the others.

Once again there is no obvious environmental interpretation of the canonical axis. Port-Orford cedar dominance of the understory loads the highest and negative on the X axis, followed by geology which is positive and less important. Possibly Port-Orford cedar dominance increases toward the positive end of the axis along with the poorer parent materials. In the Y axis the dominance of Port-Orford cedar is all important.

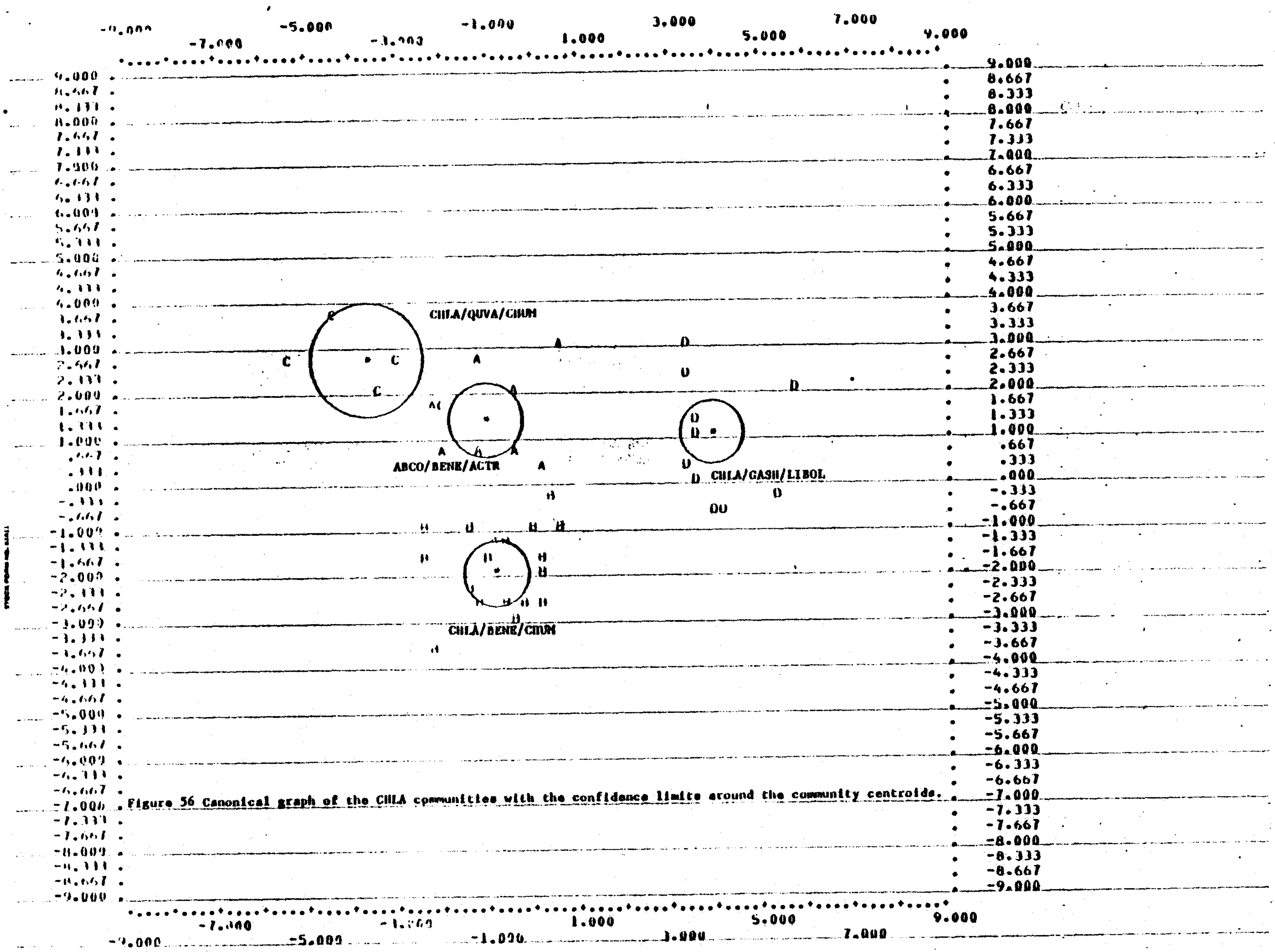


Figure 56 Canonical graph of the CHLA communities with the confidence limits around the community centroids.

<u>Cluster Analysis</u>. The cluster analysis gave the same groupings except for two plots from the CHLA/BENE/CHUM community that were placed in the CHLA/QUVA/CHUM community.

<u>Discriminant Analysis</u>. All 42 plots were classified with seven variables. Elevation classified 43 percent of the plots. Moss classified an additional 20 percent. Twinflower, Cascade hollygrape, Port-Orford cedar and geology classified the remaining fifteen. The ABCO/BENE/ACTR community held together with probabilities above 0.90 while the CHLA/BENE/CHUM community hosted plot 203 which had only a 0.65 probility of belonging to its community as assigned.

The variables of the summary table were efficient key characters and were used for key construction.

<u>Correlation Matrix</u>. Table 18 gives the significant correlations from the correlation matrix of the discriminant analysis. Elevation is negatively correlated with moss cover, vine maple is negatively correlated with moss cover and Port-Orford cedar is positively correlated with moss cover. Thus, moss cover would be expected to decrease with increasing elevation and increasing vine maple cover, but increase with increasing Port-Orford cedar cover. Therefore, within the Port-Orford cedar group, vine maple represents the higher elevations and cooler sites. In addition Port-Orford cedar and moss may be interpreted as prefering the warmer sites within the Port-Orford cedar group.

White fir and twinflower are negatively correlated while Cascade hollygrape and twinflower, and Port-Orford cedar and twinflower are positively correlated. Therefore, both Cascade hollygrape and twinflower are associated with Port-Orford cedar on the warmer sites as opposed to white fir which is in the upper, colder extremes of the group.

Table 18 Significantly related variables within the CHLA group.

CORRELATED VARIABLES	CORRELATED VALUE
Elevation Moss	-.59
Moss CHLA	.48
Moss ACCI	-.50
ABCO LIBOL	-.48
BENE LIBOL	.54
CHLA BENE	.58 1/

1/ Critical value at alpha 0.01 is 0.48.

<u>Ecological Relationships</u>. The two discriminatory environmental variables are displayed in Figure 57. The CHLA/QUVA/CHUM community has the highest average moss cover. But, the average is calculated from five plots with extreme variability and may not be representitive of the population. The other communities are less variable and all average under 20 percent moss cover.

The average elevation 2,880 feet, of the CHLA/GASH/LIBOL community is significantly lower than the other communities which average slightly above 4,200 feet.

Disregarding the CHLA/QUVA/CHUM community, the community with the highest moss cover is the lowest in elevation and inversely, the community with the highest elevation has the lowest moss cover.

The CHLA/BENE/CHUM community produces the highest average basal area with 437 square feet per acre. The CHLA/QUVA/CHUM community produces the lowest average with 336 square feet. The ABCO/BENE/CHUM and the CHLA/GASH/LIBOL produce 373 and 344 square feet respectively.

Fire occurred often enough within the Port-Orford cedar group to have eliminated much of the Port-Orford cedar and white fir regeneration. Douglas-fir, less suseptable to fire, has gained dominance in the overstory, but will eventially lose its position to the more tolerant Port-Orford cedar.

<u>Species Distribution</u>. Pacific yew, California dewberry, plantain, starflower, vanilla leaf, trillium, and common princespine are common and abundant in all of the communities in the Port-Orford cedar group. Pacific yew's distribution is skewed toward the CHLA/GASH/LIBOL community - an indication of its wetness. This wet community is also the only

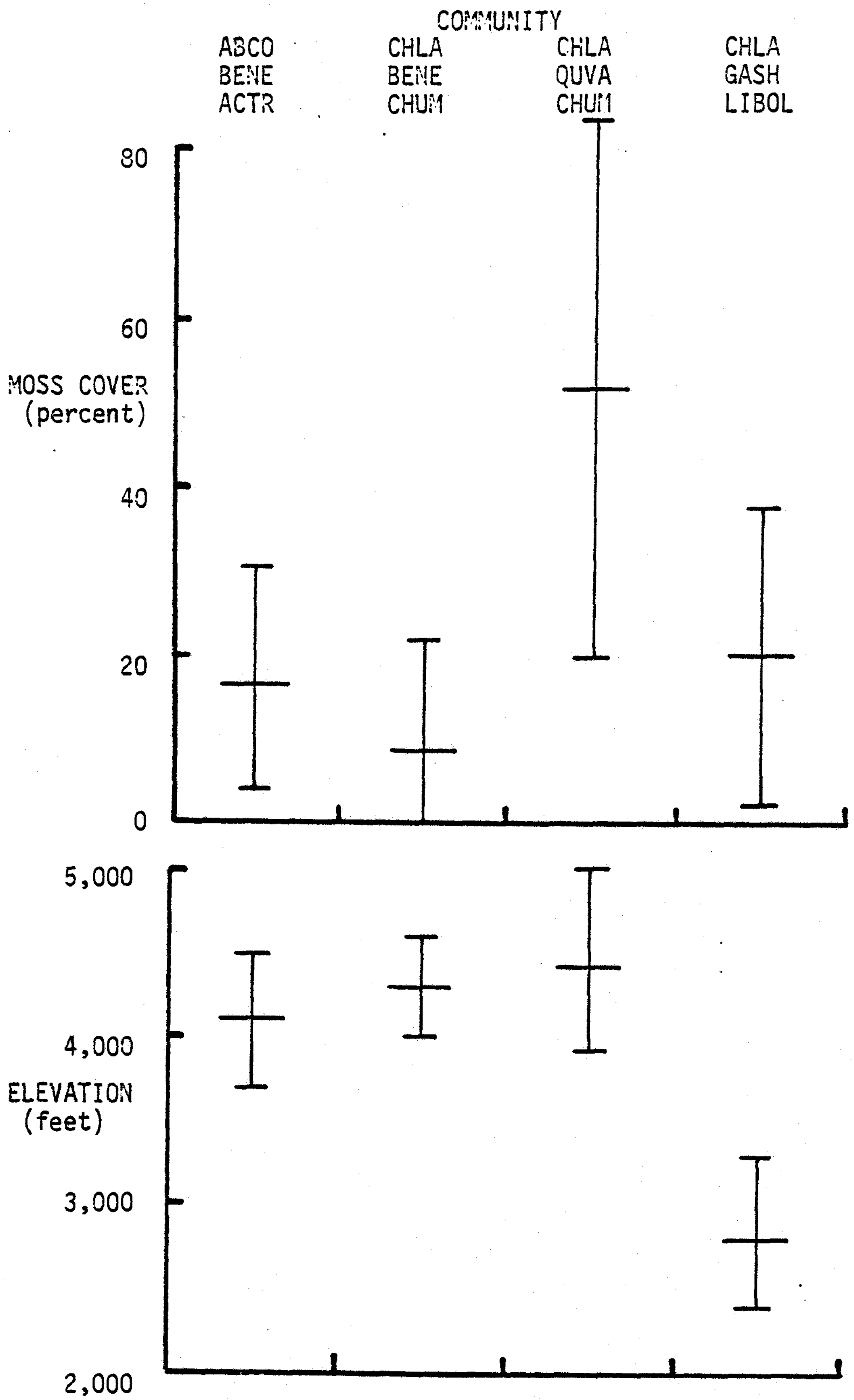


Figure 57 Mean moss cover and mean elevation with one standard deviation for the CHLA communities

community of the Port-Orford cedar group that supports red alder (Alnus rubra). The CHLA/QUVA/CHUM community supports red fir and pinemat manzanita. Red fir and pinemat manzanita are indicative of cold, high elevations and Piper's hollygrape is usually assocaited with ultrabasic soils as is huckleberry oak. Thus, the CHLA/GASH/LIBOL community is considered wet, the CHLA/ QUVA/CHUM community is considered cold with the other communiteis intermediate for the group.

The ABCO/BENE/CHUM community is not completely dominated by white fir. Some question remains as to the role of Port-Orford cedar in the successional pattern. Possibly, some sites may have a duel climax. The stand structure and species composition is very similar to the ABCO/CHLA/herb community reported by Hawk (1977). He feels that in most cases the climax species will be white fir. Thus, there is agreement between the studies.

Key. The key (Figure 58) was effective in keying all the plots in the group. It was constructed from the variables taken from the discriminant analysis.

The Douglas-fir Group

The seral status of Douglas-fir on most sites is widely recognized. The widespread occurence of fire has kept it in the dominant position in many stands where most sueseptable species succumb. However, under particular conditions it is sufficiently tolerant to reproduce and maintain climax status. Three such communities were found in the Upper Illinois Valley.

Order Table. The group is divided into three Douglas-fir communities: the PSME/BENE/WHMO, the PSME/LIDE3/LIBOL, and the PSME/RHDI/WHMO. Douglas-fir

1. Elevation 3,500 feet and above........................2

1'. Elevation 3,500 feet and below............CHLA/GASH/LIBOL

2. Over 30 percent moss cover.................CHLA/QUVA/CHUM

2. Less than 30 percent moss ground cover..................3

3. LIBOL common or the dominant herb..........ABCO/BENE/CHUM

3. LIBOL not the dominant herb and CHLA dominant in the understory.................CHLA/BENE/CHUM

Figure 58 Key to the communities of the CHLA group of the Upper Illinois Valley Drainage.

is the dominant tree in the overstory and understory (Appendix IV). Sugar pine is common in about half of the stands but no other conifer is present in the overstory in significant numbers. White fir is common in the understory of the PSME/BENE/WHMO community only and is present in slightly over half of the stands. Madrone is the most abundant hardwood in the stand. It is always part of the understory and was most often found to be senescent. Golden chinkapin is an important understory species in the PSME/LIDE3/LIBOL community and occurs in the PSME/BENE/WHMO community less often. Canyon live oak is associated with the PSME/RHDI/WHMO community and is common there. Tanoak occurs only in the shrub form in the zone. Tanoak over 50 years old are commonly less than six feet in height and are associated with the PSME/LIDE3/LIBOL community.

Canonical Analysis. The separation of the communities of the Douglas-fir group by the canonical analysis is quite distinct (Figure 59). Although the sample size is small, (PSME/LIDE3/LIBOL, seven plots, PSME/RHDI/WHMO, eight plots PSME/BENE/WHMO, nine plots) and the confidence limits are large, there is statistical separation. The dispersion of the plots around their centroid is also relatively tight with no overlapping plots.

Only the X axis is significant in separation of the plots. Pacific yew is highly representative of the positive side of the axis and wet site swordfern is representative of the negative side of the axis. Thus, the separation of the Douglas-fir communities is based primarily on wet site swordfern and Pacific yew distributions.

Cluster Analysis. The cluster analysis separated the plots into the same groups except plots 155 and 226. The canonical placed plot 155

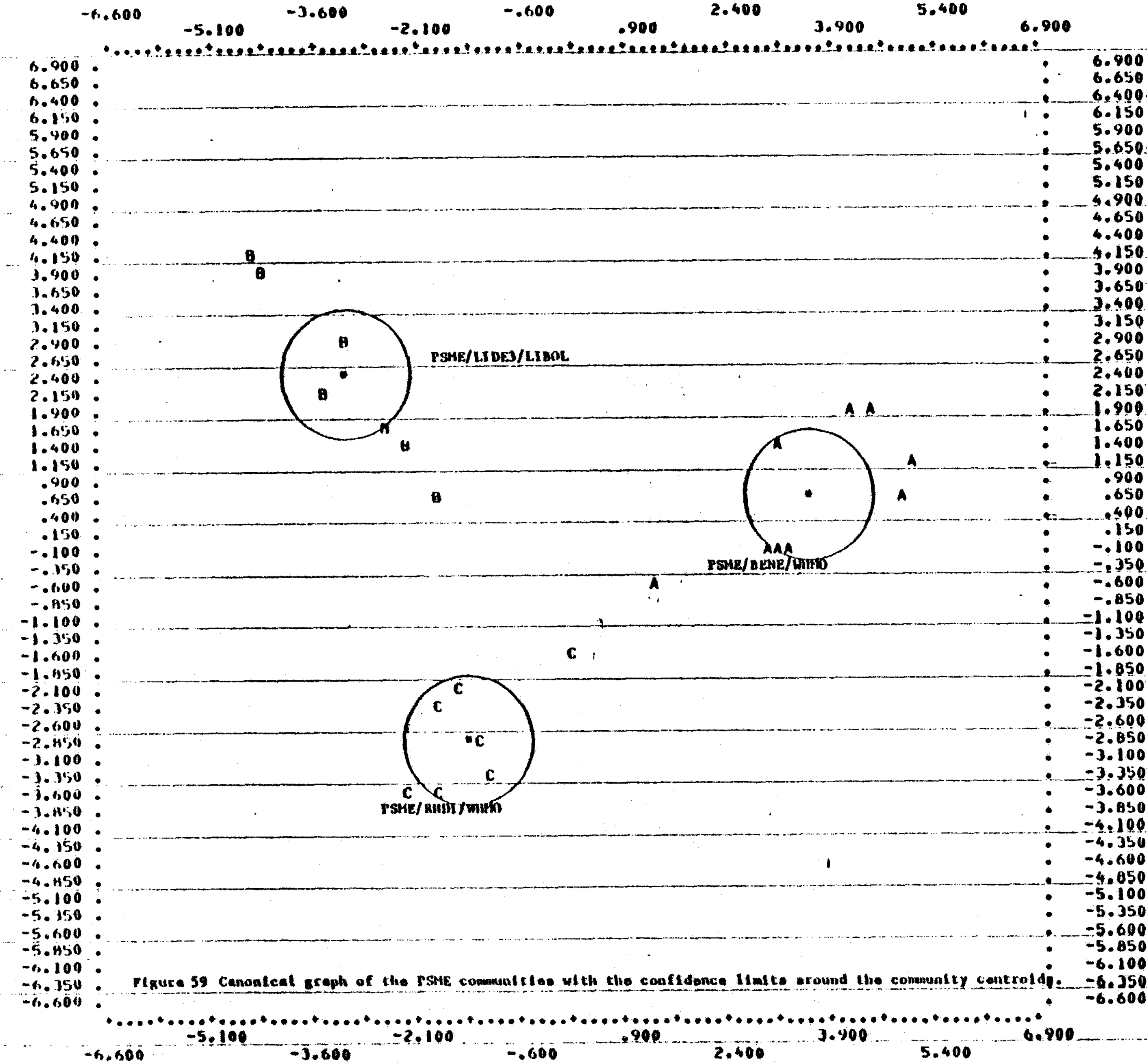


Figure 59 Canonical graph of the PSME communities with the confidence limits around the community centroids.

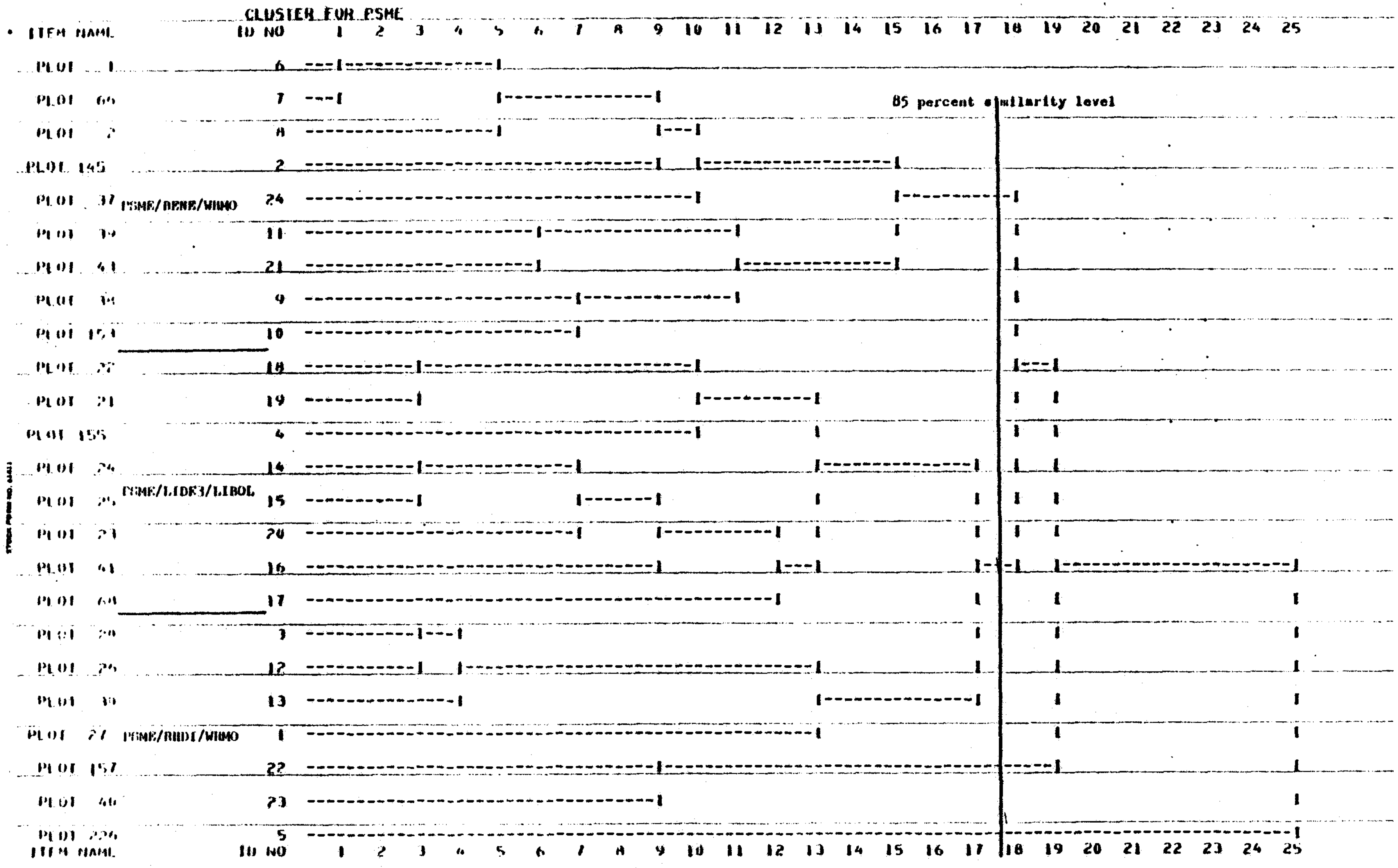


Figure 60 Dendrogram for the PSME group.

in the PSME/RHDI/WHMO community with the probability of 1.0. The cluster placed the plot in the PSME/LIDE3/LIBOL community (Figure 60). Plot 226 was loosely associated with the group in general and is slightly tied to the PSME/RHDI/WHMO community.

Discriminant Analysis. Twinflower, slope, range, and wet site swordfern cover classified all of the plots. Twinflower alone classified 81 percent and would be expected to be an efficient key variable. Range is an unusual discriminatory variable, however, it is based on the location of the Galice metasediments. They occur on the Western edge of the study area and are associated with the PSME/LIDE3/LIBOL and PSME/RHDI/WHMO communitites.

The probability table gives 1.0 probability of correct assignment of all but three plots within the group. One plot within each community was given a less than one probability of membership, the least of which was 0.96. Thus, one can conclude that such a classification is sound.

Correlation Matrix. Table 19 displays the significantly correlated pairs of variables from the correlation matrix. Pacific yew, California dewberry, wet site swordfern, and starflower are all linked as species of common environment which is interpreted as warm with atmospheric moisture and a lack of soil moisture. The canyon live oak-beargrass pair are usually associated with hot, dry environments. The moss-vanilla leaf pair are negatively associated. Thus, decreasing moss cover is associated with increasing vanilla leaf cover. This association is as expected since vanilla leaf occurs in the cooler environments and moss in the warmer. Geology is negatively correlated with the occurence of golden chinkapin. Thus, within the range of the parent materials within the Douglas-fir group, chinkapin is associated with the least productive.

Table 19 Significantly related variables within the PSME group.

CORRELATED VARIABLES	CORRELATED VALUE
Geology CACH	-.52
Moss ACTR	-.52
TABR RUUR	.58
TABR TRLA2	.63
TABR POMUM	.76
QUCH XETE	.56
RUUR POMUM	.50
TRLA2 POMUM	.69 1/

1/ Critical value at alpha 0.01 is 0.48.

Ecological Relationships. Slope, the only discriminatory variable is graphed in Figure 61. Here again, as in the tanoak zone, the poison oak communities occur on the steep, well drained slopes with surface colluvial rock. Parent material differences are not as distinct as those of slope, but there is a tendency for the PSME/LIDE3/LIBOL and PSME/RHDI/WHMO communities to occur on the shallow, fine textured soils of the Galice metasedimants. The Galice metasediments are hard, produce shallow soils and are low in productivity compared to soils from the other metamorphosed material in the study area. The PSME/BENE/WHMO plots occur on metavolcanics 87 percent of the time and do not occur on Galice metasediments at all. Productivity among the communities does not vary significantly. The PSME/BENE/WHMO, the PSME/LIDE3/LIBOL, and the PSME/RHDI/WHMO average 336,291 and 324 square feet of basal area respectively. In this group, as in other groups, there was a recognizable but nonsignificant difference between the productivity of the Galice and Applegate materials. Specifically, TBA productivity was 285 feet for the Galice and 360 for the Applegate parent materials.

The species composition of the group is now fairly stable. The most significant change will be the loss of madrone. It is being suppressed and excluded because of the lack of fires. Tanoak is expected to continue its shrub habit and maintain a subordinate position as reported by Emmingham (1973).

Species Distribution. Differences in species occurence among the communities seems to indicate relative environmental differences. The occurence of red fir in the PSME/BENE/LIBOL community suggests its relative coolness. While canyon live oak is absent from the PSME/LIDE3/WHMO

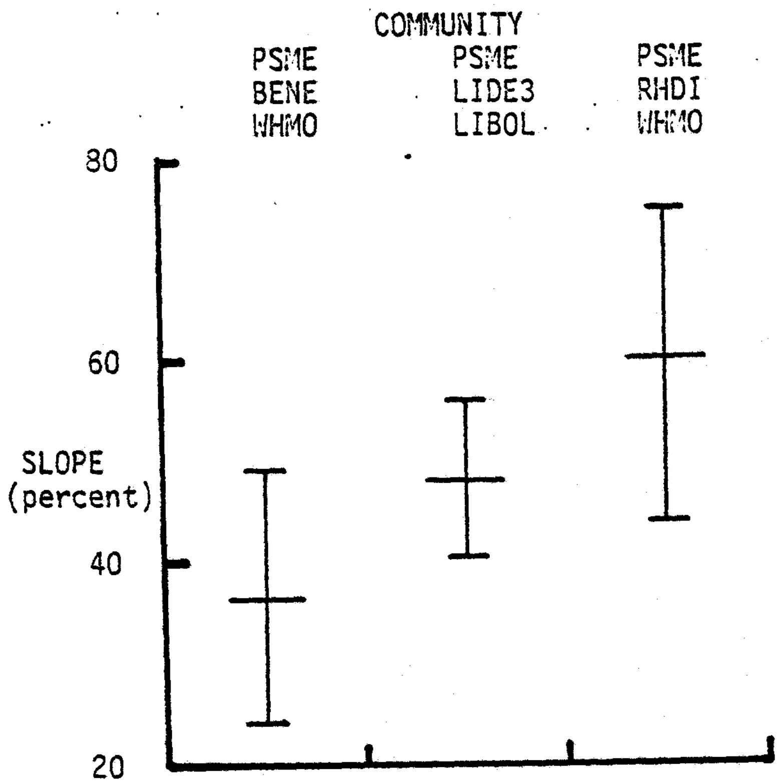


Figure 61 Mean and one standard deviation for slope on the PSME communities

community, red alder and trillium are present. The combination indicates moistness. The PSME/RHDI/WHMO community is the only community that supports canyon live oak, mottleleaf ginger, California bellflower, and slender toothwart which are all indicators of hot dry environments.

Key. The key for the Douglas-fir group is simple but efficient (Figure 62). Two variables (twinflower and slope) were needed to classify all the plots. These variables were taken from the discriminant analysis.

The White fir Group

The white fir zone is the most extensive zone in the study area. It is definately a climatic climax in the Western Siskiyous and is usually the sole climax dominant of the stand.

Order Table. There are two apparent communities within the white fir group: the ABCO/BENE/ACTR, and the ABCO/QUSA/CHUM communities (Appendix IV). The former group was further subdivided on the basis of the occurrence of Douglas-fir in the understory. Although such a subdivision is important in forest management, it is not greatly important here and, therefore it will be treated lightly. The ABCO/QUSA/CHUM community is represented by seven plots within the white fir group. The ABCO/BENE/ACTR community is represented by 70 plots and is broken into groups with 37, 9, 12 and 12 plots each.

Douglas-fir is the dominant species in the overstory with white fir often in the codominant position. Sugar pine is the only other species common in the overstory and it only occurs on 39 percent of the plots in the group. White fir is uncontested as the understory dominant. Douglas-fir is the next most commonly occuring species and achieves a common status

1. LIBOL the dominant herb, LIDE3 abundant PSME/LIDE3/LIBOL

1. Not as above..2

2. Slope greater than 45 percent ....PSME/RHDI/WHMO

2. Slope less than 45 percent ....PSME/BENE/WHMO

Figure 62 Key to the communities of the PSME group of the Upper Illinois Valley Drainage.

in 16 percent of the plots of the ABCO/BENE/ACTR community. Chinkapin is associated with the higher occurences of Douglas-fir but is not commonly found within the group. Incense cedar as usual, is randomly scattered but may be slightly related to increasing dominance of Douglas-fir. Red fir is only found in the ABCO/QUSA/CHUM community. Cascade hollygrape, rose, snowberry, and California dewberry are ubiquitus within the zone. Cascade hollygrape usually achieves the highest cover followed by snowberry, rose, and California dewberry. Hazel is also common in the zone but much less so than the four shrubs mentioned above.

Canonical Analysis. Figure 63 shows significant separation of the communities and phases. The series of phases in the ABCO/BENE/ACTR community are based on the dominance of Douglas-fir: in the first, Douglas-fir is absent; in the second, it is always found but must be searched for; in the third, it is always found but it is less than common; and in the last phase it is common and sometimes co-dominant. Generally the dispersion of the plots about the centroids is extremely tight. For example in the "Douglas-fir absent" phase of the ABCO/BENE/ACTR community (represented by B) 36 plots are within the confidence limits around the centroid represented by a single B location (Figure 63). The 37th plot is above and to the left of the centroid and is plot 13.

The two canonical axis are significant in separating the groups. The X axis is represented by the distribution of red fir and Douglas-fir From left to right the occurence of both red fir and Douglas-fir decrease. The Y axis is also represented by the occurrence of red fir and Douglas-fir. Douglas-fir decreases from bottom to top. Environmentally the

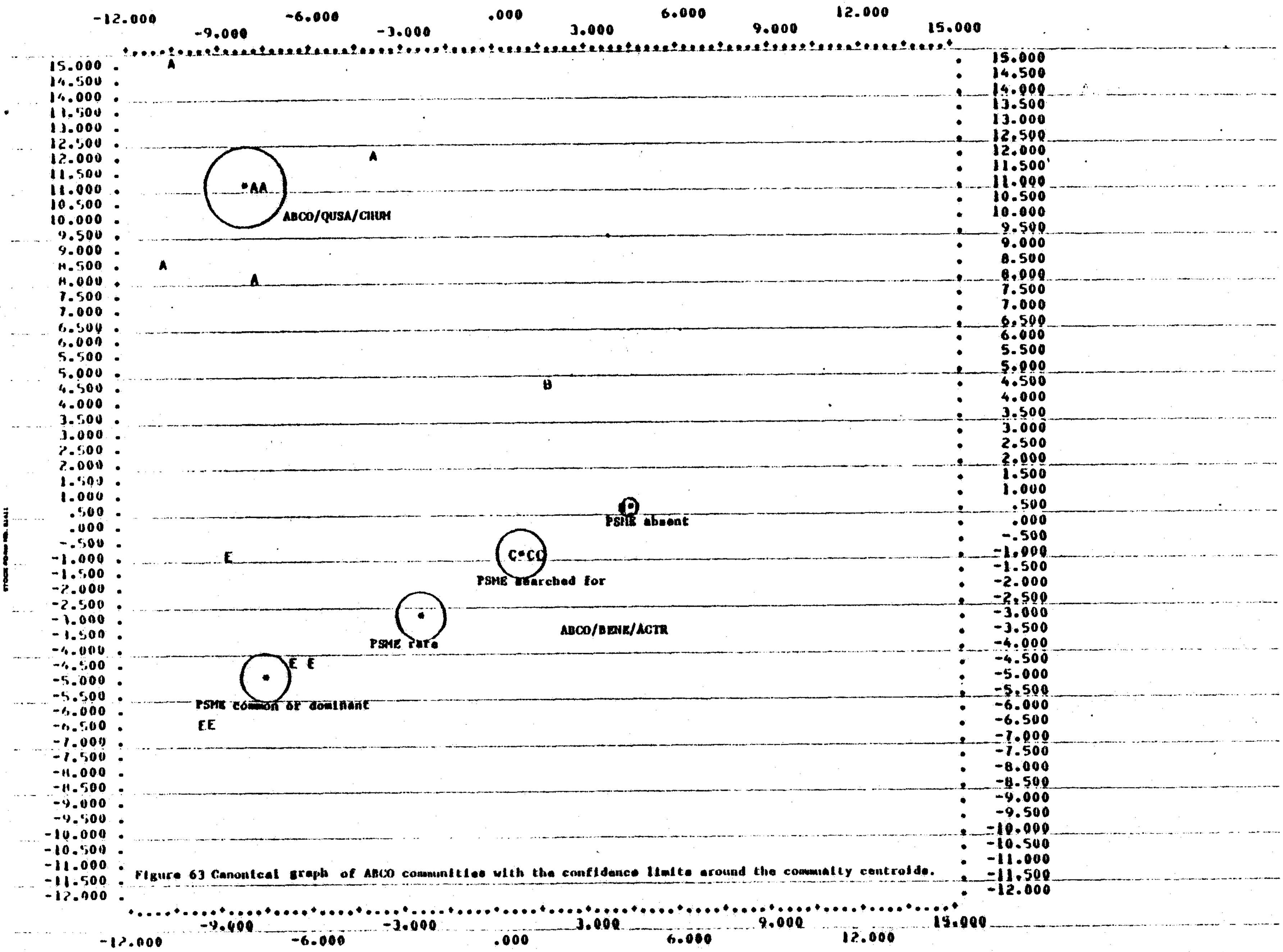


Figure 63 Canonical graph of ABCO communities with the confidence limits around the community centroids.

axis may be interpreted as increasing moisture and cold, from right to left.

Cluster Analysis. The cluster analysis separates the communities but not the phases. Most similarities are in the nineties and some in the eighties for the ABCO/BENE/ACTR community. Thus, it is a very similar group of plots. Similarity values for the ABCO/QUSA/CHUM community are much lower.

Discriminant Analysis. Only three variables significantly contributed as discriminators in the discriminant run. In order of importance they are: Douglas-fir dominance in the understory, red fir dominance in the overstory, and red fir dominance in the understory. The three variables classified all of the 77 plots, while the first entered, Douglas-fir, classified 91 percent of the plots. Membership probability was at or near 1 in every case. Thus, only one variable was needed for use in the key for the white fir group.

Correlation Matrix. Correlated variable pairs are given in Table 20. Elevation and white fir are correlated. Thus, as one increases in elevation, the abundnace of white fir increases. The mutual occurrence of moss and hairy honeysuckle is also indicated. The mutual occurrence of Pacific yew and vine mapple, and Cascade hollygrape and twinflower are expected. The wet site swordfern-slender toothwart pair, however, seems contradictory. Swordfern is usually associated with moist sites and slender toothwart is usually associated with dry sites. A closer look at this association within the white fir group is needed. The

Table 20 Significantly related variables within the ABCO group.

CORRELATED VARIABLES	CORRELATED VALUE
Elevation ABCO	.54
Moss LOHI	.67
ABMAS(overstory) ABMAS(understory)	-.87
TABR ACCI	.52
BENE LIBOL	.59
POMUM CAPUP	.90[1/]

1/ Critical value at alpha 0.01 is 0.48.

negative correlation of the red fir understory cover with red fir overstory cover attests to that species' lack of climax status within the zone. Where red fir overstory cover is high, red fir lacks in the understory and is not replacing itself. Red fir cover is low in the older stands and the additional light allows some regeneration.

Ecological Relationships. Elevation was the only environmental variable with noticeable differences between the communities (Figure 64). The ABCO/QUSA/CHUM community averages approximately 5,000 feet and the ABCO/BENE/ACTR community averages 700 feet lower. It would be expected that the former is a much cooler community environmentally.

The productivity for the ABCO/QUSA/CHUM community is below the average for the group at 346 feet and is limited by low temperature. The phases of the ABCO/BENE/ACTR community produce an average of 388, 378, 350 and 324 square feet of basal area per acre. As the cover of Douglas-fir increases, the productivity of the community decreases.

The ABCO/QUSA/CHUM community is now dominated by white fir in the overstory and the understory. The community is now quite stable. The ABCO/BENE/ACTR community is dominated by Douglas-fir in the overstory and will be gradually replaced by white fir as long as fire continues to be excluded.

Species Distribution. There is very little difference between the two communities floristically. Beargrass and red fescue are associated with the ABCO/BENE/ACTR community only. They are associated with the highest occurrence of Douglas-fir. Similarly miner's lettuce, circaea, and baneberry are unique to the ABCO/BENE/ACTR community but are associated

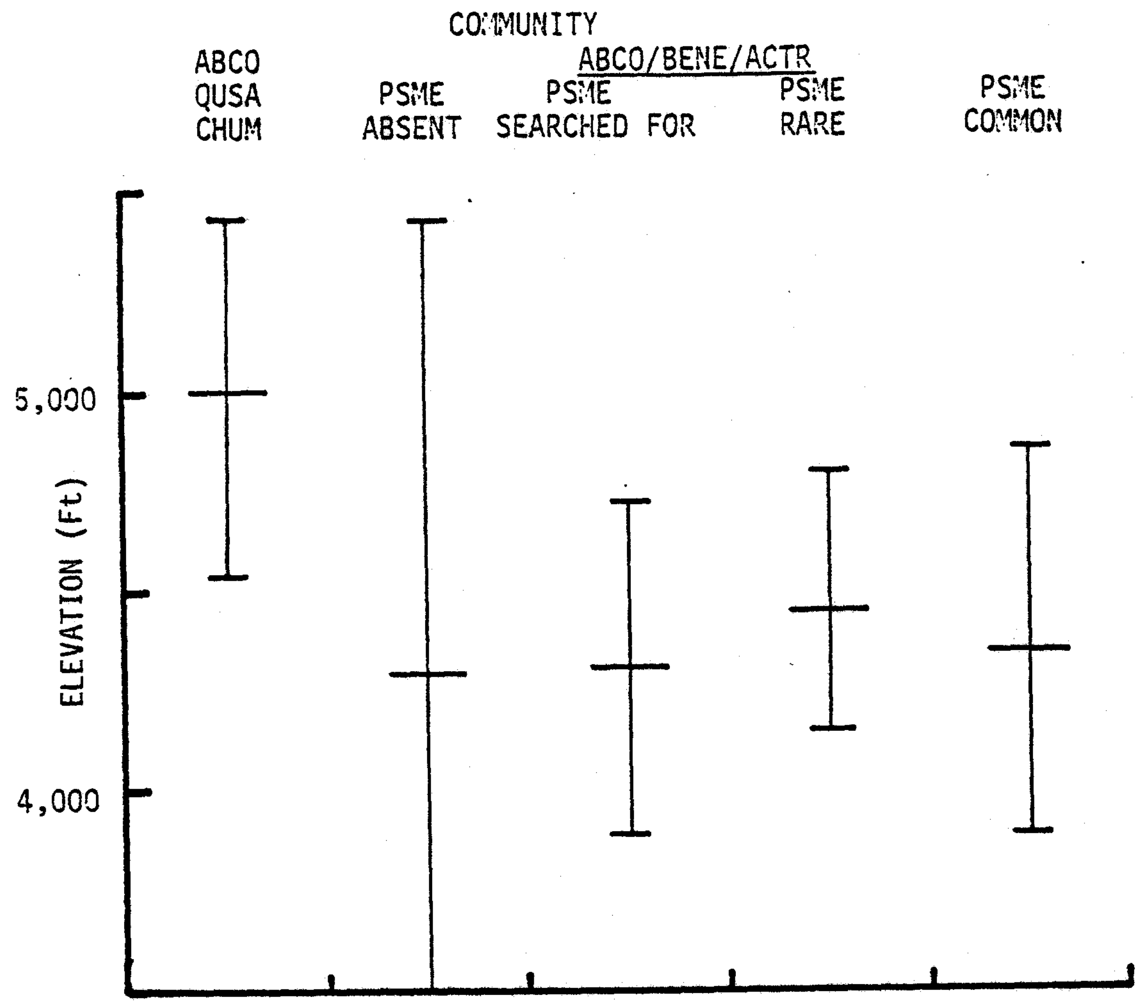


Figure 64 One standard deviation and mean for elevation of the ABCO communities

with the Douglas-fir absent phase. Thus, as Douglas-fir becomes more plentyful in the understory, mesic species are lost and xeric species are gained.

Key. The key to the white fir group is simple. Only one dicotomy and one variable is needed to separate two communitites (Figure 65).

1. QUSA the dominant shrub ....ABCO/QUSA/CHUM

2. BENE the dominant shrub ....ABCO/BENE/ACTR

Figure 65 Key to the communities of the ABCO group of the Upper Illinois Valley Drainage.

SUMMARY AND CONCLUSIONS

The purpose of this study was to classify the complex vegetative continuum of the Upper Illinois River drainage of the Siskiyou Mountains for adaptation and use as a practical tool in resource management.

Geologically the study area consists primarily of metavolcanics of the Applegate group, less extensive areas of acidic and ultrabasic intrusives, and Galice metasediments. Glacially deposited materials are minor. The ultrabasics produced the most striking vegetation pattern. Sparse, stunted stands with a large variety of herbaceous species characterized these areas of mineral imbalance. But, over the rest of the study area, the parent materials produced relatively deep soils of over 34 inches which supported commercially productive forests.

Climatologically the area has undergone a gradual transition from subtropical to warm temperate and finally to cool temperate as a result of global cooling and drying trends. More recently the ice ages and the Xerothermic Period produced major deviations in global trends which greatly affected local species distribution. Presently the climate has been described as being somewhat reminiscent of the late Tertiary climate.

The flora evolved from three sources: the temperate flora, that evolved in the area, and the Madro and Arcto Tertiary Geofloras, which invaded during climatic changes. Many of the Tertiary species have been forced to extinction by subsequent climatic changes, but others, such as Brewer spruce, remained as endemic in niches resembling the mid Tertiary climate. Indeed, the unique combination of climate and geology produces a variety of niches that has accomoidated species from many origins.

Before man inhabited the area, fire was a frequent occurrence. With man, especially the miners and ranchers post 1850, fire became increasingly common as a forest clearing tool. But since the early 1900's wildfire has been virtually eliminated from the area and the effects are still being realized. Since elimination of fire, white fir, tanoak, and mistletoe have been steadily increasing in occurrence and abundance at the expense of Douglas-fir which gained dominance when fires were frequent.

Although the comparison of cover, frequency and dominance as classification parameters was not completely valid, (the size of the frequency plot was not large enough to sample the spacial variation) I favor the frequency measure because of its objectivity. However, a very large plot, possibly greater than four feet square, would be necessary to adequately sample non tree vegetation. Therefore, a large investment in time and effort would be necessary to measure and record 20 subplots per plot. Thus, the parameter is not practical for field practitioners. Since cover can be used to adequately classify the vegetation and is a simple and quick measure, it is a more realistic, practical tool.

The use of the mathematical and statistical methods should not be used without some reference to reality. Some of the initial runs on the total classification seemed reasonable, until compared with the classification table that was developed concurrently. Since the values on the classification table are essentially unaltered field data, they served as reality during the analysis. On the other hand, the classification table alone is not sufficient. It does not provide the quantitative treatment necessary for a full understanding and detailed description of the flora and its environment.

The cluster analysis is a good hypothesis forming tool, particularly when there seems to be no starting points. The program mathematically provides a graphic dendrogram that will act as a catalyst for continued analysis. However, the dendrogram is a three dementional model (similar to a mobil) and is very difficult to interpret in two dimensional space. One must envision the rotation of many axies to fully assess its meaning.

Variables, whether taken in the field or contrived, such as transformed variables, must be continually evaluated for their reflection of ecological utility. Some variables used in other studies and used here, were of no value. For example, erosion pavement, an important variable in the eastern part of the state, was looked for, but never found in the study area. Another example is the use of both cover and dominance. They were found to be correlated at 0.98 and therefore, measure essentially the same thing. Thus, one should be dropped in favor of the other.

Soil variables such as texture, consistence, depth and parent material were expected to be more discriminatory. Soil is an important factor influencing the development and composition of the vegetation. However, parent material and consistence of the B horizon were the only soil variables of value and they were low on the list of discriminators. Other soil parameters not used in this study may be more useful.

Six vegetation groups were established. These groups, red fir, white fir, Port-Orford cedar, Jeffery pine, tanoak and Douglas-fir were subdivided into 17 plant communities (Figure 66) which are named after the dominant climax species in each layer. A summary graph (Figure 67) of the groups and their relative environmental position is presented in this section because it is considered a conclusion, not a result, based on the author's subjective hypothesis. More precise environmental measurements are needed to subtantiate their relative position.

The range of the climax species of the groups are to a degree limited by competition. However, at times, the most limiting factor relative to their distribution is environmental. For example, the red fir zone is cold and wet and is limited in elevation by temperature. Low growing season temperatures are common during the short growing season, and soil temperatures are extremely low in the Spring even when atmospheric temperatures are high. Red fir, however, is a plastic species and occurs quite low in elevation, but the efficiency of white fir limits its desent.

The white fir zone has the widest environmental range within the study area and is considered a zonal climatic climax. At the upper limits of its range it is limited by temperature and red fir competition. At the lower end, a combination of high temperature, moisture and competition by tanoak gradually usurps its influence.

In the late 1800's fire eliminated much of the white fir regeneration. But, recently lack of fire has favored the tolerant species and white fir stands 50 to 60 years old are now commonly replacing Douglas-fir dominated stands.

KEY TO ILLINOIS VALLEY DISTRICT COMMUNITIES

1.	PIJE present, stand usually sparce with grass	PIJE GROUP
	A. Elevation greater than 3,500 feet	PIJE/QUVA/FERU
	B. Elevation less than 3,500 feet	PIJE/FERU
1.	PIJE absent	2
2.	Understory dominated by LIDE3 (QUCH & ARME often present) .	LIDE3 GROUP
	A. GASH present	LIDE3/GASH/ACTR
	A. GASH absent	B
	B. ACCI present	LIDE3/ACCI/ACTR
	B. ACCI absent	C
	C. RHDI present	LIDE3/BENE-RHDI/CHUM
	C. RHDI absent	LIDE3/BENE/LIBOL
2.	LIDE3 absent in the understory or not dominant.	3
3.	CHLA usually present in the overstory and dominant in the understory	CHLA GRUOP
	A. Below 3,500 feet in elevation	CHLA/GASH/LIBOL
	A. Above 3,500 feet in elevation	B
	B. Over 30% moss cover on the ground	CHLA/QUVA/CHUM
	B. Less than 30% moss ground cover	C
	C. LIBOL common or dominant herb	ABCO/BENE/CHUM
	C. LIBOL not dominant, CHLA dominant in the understory	CHLA/BENE/CHUM
3.	CHLA either absent or not dominant in the understory	4
4.	Overstory dominanted by ABMAS, ABCO usually present in the understory	5
4.	Overstory and understory dominanted by PSME	PSME GROUP
	A. LIBOL is the dominant herb, LIDE3 abundant . . .	PSME/LIDE3/LIBOL
	A. Herb layer not dominated by LIBOL	B
	B. Slope greater than 45%	PSME/RHDI/WHMO
	B. Slope less than 45%	PSME/BENE/WHMO
5.	ABMAS present in overstory and understory	ABMAS GROUP
	A. PSME present and common, LIBOL usually present	
	1a. Three of the following species usually present: CLUN, OSPU, VAHE, ANDE or GAAP . .	ABCO/BENE/ACTR
	1b. The above combination absent	ABCO/QUSA/CHUM
	B. PSME absent or rare, LIBOL absent.	
	1a. TSME present in both the overstory and understory	TSME/QUSA/PYSE
	2b. TSME absent in one or both layers	
	1aa. ABMAS dominant understory species ACRU present	ABMAS/QUSA/PYSE
	2bb. ABCO the dominant understory species . .	ABCO/ROGY/ACTR
5.	ABMAS not present	ABCO GROUP
	A. QUSA dominant shrub	ABCO/QUSA/CHUM
	A. BENE dominant shrub	ABCO/BENE/CHUM

Figure 66 Key to Vegetation Groups and Communities

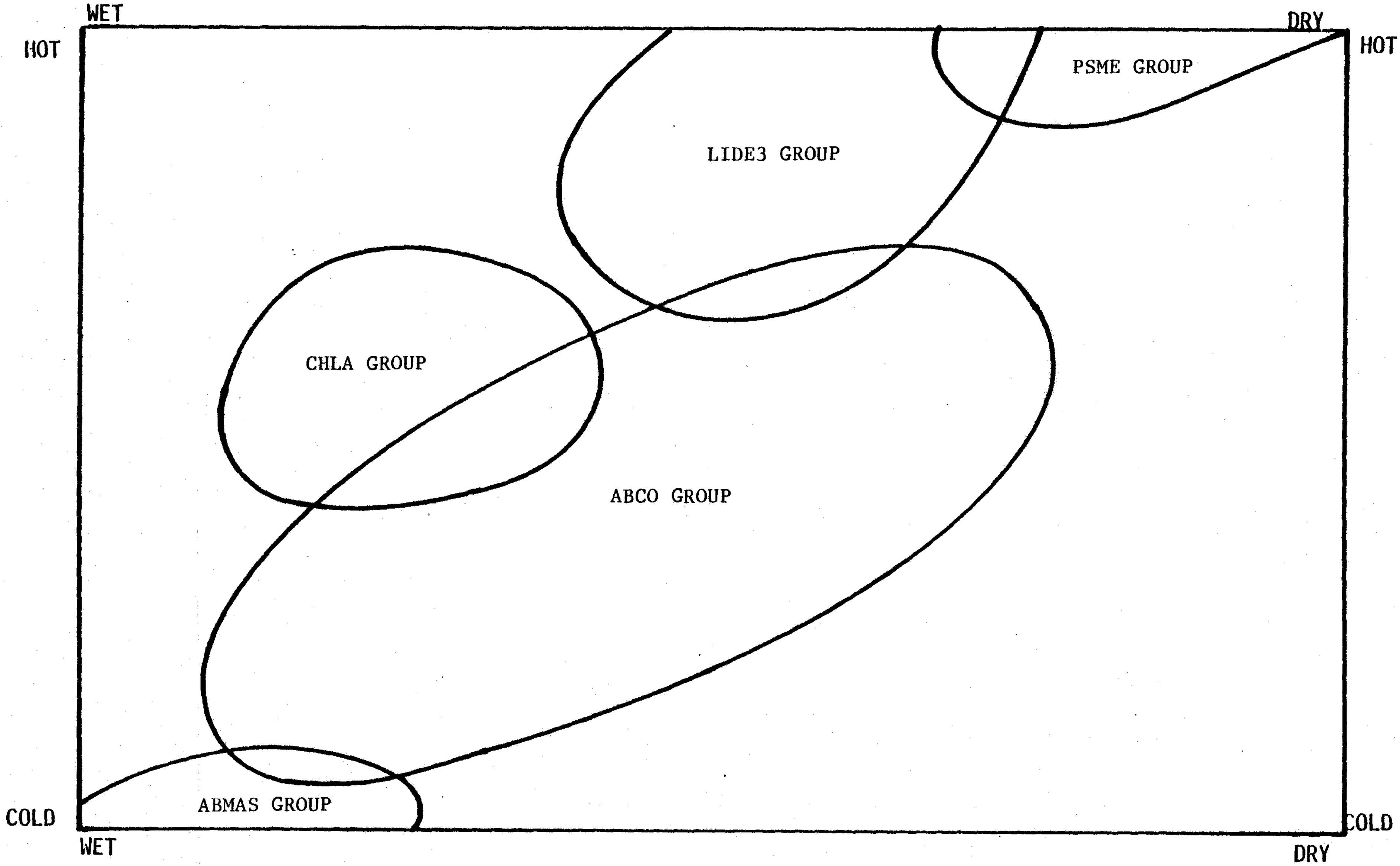


Figure 67 Relative environmental position of the vegetation groups.

The Port-Orford cedar zone is the least extensive zone. It follows stream drainages and occurs on a few sites with northeasterly aspects between 3,800 and 4,200 feet in elevation. Its requirement for moisture limits its distribution to concavities that collect soil water and atmospheric moisture, and its requirements for moderate temperatures limits it to the unexposed mid elevations. Its topographic position dampens the occurrence and effects of fire and many stands are dominated by Port-Orford cedar or codominant with Douglas-fir.

The tanoak zone is characterized by a warm, moist environment. It is the second most extensive zone within the study area. The spread of tanoak is limited by moisture on shallow soils and by low temperature in the higher elevations. It has a similar relationship to fire as does white fir.

The Douglas-fir zone is one of the smallest in the area but Douglas-fir itself occurs as the overstory dominant in 60 percent of the stands sampled. Douglas-fir is competitive in a great variety of sites as witnessed by its dominance in the overstory. However, it is dependent on fire to eliminate its competitors where the overstory limits light penetration. It is a climax dominant in its own niche, which is hot, dry and produces thin canopied stands which allow light penetration.

The Jeffery pine zone is restricted to ultrabasic soils. It was found from 2,600 feet in elevation to 4,800 feet. Jeffery pine has been found on lower and higher elevations off the study area and was still found in association with ultrabasic soils. It can tolerate a wide range of temperatures, but apparently can not compete with other species off serpentine.

The zone is high in plant diversity. Apparently, both species adapted to serpentine and those common on nearby soils have mixed. The resultant variation is interesting and diverse.

Recognition of local communities is only the first step in dealing with the land resource. Plant communities are a basic stratification for information storage and retrieval, extraplolation of previous studies, compartmentalizing variation for further studies and predicting the outcome of management activities. More quantitative information on the primary environment within community types is needed to realize the full use of this classification.

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APPENDIX

APPENDIX I

FORM OF THE RAW DATA

```
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APPENDIX II

FORM OF THE REFORMATTED DATA

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000003      000     1C
000004      000     1D          04  05  05  02  02  00  01  02  00  01  02  00
000005      000     1E
000006      000     1F                                                                          05
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000008      000     1H
000009      000     1I
000010      000     1J
000011      000     1K
000012      000     1L
000013      000     1M          01  02  00  01  02  00  03  05  30  02  03  00  02  03  10  01  02
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000017      000     1Q
000018      000     1R
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000020      000     1T
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000024      000     1X
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000030      000     2D          02  03  20              01  02  00  02  02  00  03  05  00
000031      000     2E
000032      000     2F                                                                          02
000033      000     2G  05  30                                                  01  02  00  02  03
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000035      000     2I
000036      000     2J
000037      000     2K
000038      000     2L
000039      000     2M                      01  02  00  01  02  00              03  05  00  01  02
000040      000     2N  00  01  02  15  01  02  00                                      01  02  00
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000043      000     2Q
000044      000     2R
000045      000     2S
000046      000     2T
000047      000     2U
000048      000     2V
000049      000     2W
000050      000     2X
000051      000     2Y
000052      000     2Z
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```

APPENDIX III

FINAL PRESENSE RUN ALL DATA

```
  THIS IS THE FINAL RUN OF PRES PLOTS 1 THRU 250
A    6   (6(A5,6X))
B    6   (6(A5,6X))
C    6   (6(A5,6X))
D    6   (6(A5,6X))
```

NO. OF PLOTS = 250

SPECIES GROUP A

SPECIES	COUNT	PRES. %	PLOT NO. BY OCCURRENCE 1ST	2ND	3RD
1 PSME	217	86	1	2	3
2 PILA	83	33	2	3	8
3 CACH	9	3	3	4	33
4 ABCO	128	51	4	5	6
5 ACMA	2	0	5	45	0
6 ABMAS	52	20	6	10	12
7 CHLA	36	14	7	9	67
8 LIDE3	2	0	8	81	0
9 CADE	41	16	9	10	13
10 PIMO	14	5	9	17	61
11 PIPO	19	7	14	64	65
12 ARME	7	2	14	43	54
13 PIBR	6	2	17	186	187
14 PIJE	16	6	19	137	149
15 PIAT	3	1	57	65	228
16 QUCH	1	0	66	0	0
17 TSME	4	1	72	94	238
18 ABGR	1	0	151	0	0

SPECIES GROUP B

SPECIES	COUNT	PRES. %	PLOT NO. BY OCCURRENCE 1ST	2ND	3RD
1 PSME	138	55	1	2	3
2 PIMO	14	5	1	17	18
3 ABCO	182	72	1	2	3
4 ARME	64	25	1	2	8
5 CACH	69	27	2	3	7
6 CADE	68	27	3	4	9
7 TABR	43	17	4	21	22
8 ABMAS	50	20	6	12	13
9 LIDE3	68	27	7	8	14

APPENDIX III CONTINUED

12 QUCH	45	18	8	20	30
13 ACMA	19	7	8	31	34
14 ACGL	1	0	9	0	0
15 PILA	38	15	13	14	21
16 QUKE	3	1	14	27	137
17 PIBR	10	4	18	186	187
18 PIJE	12	4	19	149	150
19 ALRU	6	2	41	45	110
20 PIAT	1	0	57	0	0
21 PIPO	3	1	65	198	205
22 TSME	10	4	72	73	94
23 SALIX	1	0	80	0	0
24 ABGR	3	1	151	152	155
25 UMCA	2	0	160	161	0
26 QUGA	1	0	179	0	0
27 PREM	1	0	228	0	0
28 RUPU	1	0	233	0	0
29 RHPU	1	0	246	0	0

SPECIES GROUP C

SPECIES	COUNT	PRES. %	PLOT NO. BY OCCURRENCE 1ST	2ND	3RD
1 QUCH	44	17	1	2	7
2 AMPA	50	20	1	9	19
3 ARNE	13	5	1	15	186
4 SYMO	128	51	1	4	5
5 HODI	65	26	1	5	34
6 RUUR	108	43	1	2	3
7 BENE	157	62	2	3	4
8 ROGY	180	72	2	3	4
9 VAPA	56	22	3	7	9
10 COCOC	69	27	5	8	14
11 QUSA	59	23	6	12	17
12 VAME	28	11	6	17	18
13 GASH	18	7	7	28	29
14 ACCI	24	9	7	10	23
15 PHDI	26	10	8	14	20
16 RUPA	44	17	8	32	33
17 LOCI	24	9	8	14	20
18 BEPU	11	4	9	13	25
19 RILA	16	6	10	30	48
20 ACGL	21	8	16	17	51
21 RISA	10	4	16	56	82
22 CACH	17	6	17	18	21
23 CEPR	5	2	19	208	209
24 ARVI	4	1	19	149	150
25 CECU	6	2	19	149	150
26 RHMA	15	6	21	28	39
27 LIDE3	28	11	21	22	23
28 PAMY	40	16	32	33	36
29 PREM	6	2	32	90	91

APPENDIX III CONTINUED

32 HEPI	19	7	43	47	66
33 PHLE2	1	0	45	0	0
34 GAFR	1	0	51	0	0
35 SALIX	5	2	51	60	230
36 RIVI	12	4	56	70	72
37 GABU	7	2	57	65	66
38 SOSI	8	3	61	74	232
39 RIHI	7	2	61	86	97
40 ARPA	8	3	65	78	158
41 CEIN	1	0	65	0	0
42 SARAA	2	0	67	120	0
43 VAOV2	5	2	68	69	136
44 RICR	5	2	70	72	74
45 LONIC	6	2	73	74	91
46 DUKE	1	0	78	0	0
47 ROSA	1	0	83	0	0
48 RIBES	7	2	89	92	93
49 LOCO	8	3	92	236	238
50 RILO	12	4	95	96	213
51 BEAQ	11	4	102	145	152
52 VASC	3	1	105	115	207
53 RUBUS	2	0	105	106	0
54 GAOV	4	1	113	115	121
55 SYAL	5	2	133	136	143
56 LOHI	10	4	137	158	161
57 CEHE2	3	1	150	178	179
58 CEVE	6	2	152	231	233
59 RHCA	1	0	159	0	0
60 OUVA	15	6	160	178	186
61 RUNI	5	2	199	200	221
62 VACI	1	0	222	0	0
63 RIMA	6	2	229	238	239
64 RULA	11	4	230	231	232

SPECIES GROUP D

SPECIES	COUNT	PRES. %	PLOT NO. BY OCCURRENCE 1ST	2ND	3RD
1 SESP	4	1	1	19	19
2 GAAP	97	38	1	5	9
3 COMA3	36	14	1	2	13
4 WHMO	113	45	1	2	3
5 POMUI	41	16	1	7	8
6 CHUM	149	59	1	2	3
7 CAPUI	4	1	1	15	16
8 GOOB	166	66	1	2	3
9 CHME	143	57	1	2	4
10 HIAL	105	42	1	2	13
11 COHE	10	4	1	25	30
12 TRLA2	134	53	1	3	4
13 ABLA	24	9	1	17	18
14 MOPA	2	0	1	45	0
15 COST2	33	13	2	3	4

APPENDIX III CONTINUED

17	PYPI	102	40	2	3	4
18	LIBOL	91	36	2	3	4
19	SASA2	9	3	2	3	12
20	IRCH	54	21	2	13	18
21	ACTR	154	61	2	3	4
22	PIAQ	57	22	2	3	4
23	ANDE	90	36	3	4	5
24	ASHA	54	21	3	5	8
25	PYSE	68	27	3	10	13
26	VIGL	38	15	3	4	10
27	CLUN	57	22	3	4	6
28	PHAD	84	33	3	5	38
29	ADBI	90	36	4	5	10
30	VAHE	86	34	4	5	10
31	IROV	78	31	4	5	6
32	FRVEB	50	20	4	5	14
33	GAUR	2	0	4	5	0
34	DIEU	6	2	5	125	126
35	POMUM	53	21	5	10	20
36	TEGR	4	1	5	45	123
37	SETR	3	1	6	126	127
38	SMST	76	30	6	8	34
39	SAME3	1	0	6	0	0
40	LICA3	2	0	6	249	0
41	EBAU	8	3	7	29	33
42	APAN	27	10	8	15	20
43	PYDE	12	4	8	25	26
44	HOST2	7	2	8	14	43
45	LIWA	11	4	9	18	49
46	SMRA	39	15	9	15	20
47	OSPU	40	16	10	35	45
48	ARCO	20	8	13	48	49
49	VIOLA	45	18	15	18	21
50	CASC2	87	34	15	16	20
51	ARMA3	60	24	16	20	25
52	VECA	18	7	17	18	50
53	ANLY2	32	12	18	23	48
54	COGR	6	2	19	95	95
55	RADC	2	0	19	179	0
56	BRCA	2	0	19	95	0
57	SCAL	1	0	19	0	0
58	ERAL	21	8	19	86	90
59	CATO	1	0	19	0	0
60	EPMI	7	2	19	70	178
61	XETE	18	7	21	22	24
62	PYASP	11	4	21	39	41
63	MESU	23	9	23	56	74
64	VISA	2	0	23	30	0
65	FEID	1	0	26	0	0
66	POCAH	3	1	28	153	240
67	CAPR3	20	8	30	50	51
68	AREL	2	0	30	99	0
69	MOPED	1	0	30	0	0
70	LICO3	27	10	35	36	41
71	MITR2	20	8	36	52	55

APPENDIX III CONTINUED

74 POHE2	7	2	40	132	134
75 HAUN	4	1	41	65	66
76 FEOC	7	2	41	58	59
77 MOSI	16	6	45	83	86
78 CIAL	9	3	45	86	88
79 HECU	2	0	47	117	0
80 BROMU	15	6	48	51	52
81 OSCH	11	4	48	55	229
82 AQFU	8	3	48	67	93
83 SYRE	50	20	50	51	52
84 MEBE	1	0	50	0	0
85 PERA	8	3	51	93	94
86 PEAN	11	4	56	231	233
87 VIAMV	15	6	65	82	86
88 ACMI	15	6	65	82	90
89 LATHY	11	4	65	82	83
90 PTAN	1	0	65	0	0
91 PYAP	9	3	67	76	88
92 ADPE	1	0	67	0	0
93 ERAS	1	0	70	0	0
94 DELPH	12	4	70	75	78
95 ARPL	1	0	70	0	0
96 NONE	2	0	70	72	0
97 RULA	12	4	72	92	94
98 POCAS	3	1	72	123	125
99 CAREX	15	6	73	97	115
100 MOOD	4	1	74	78	90
101 PHHEP	5	2	74	75	78
102 ACHU	18	7	74	86	88
103 SICAG	1	0	78	0	0
104 PENST	5	2	78	94	201
105 PEDE	2	0	78	243	0
106 BRID	1	0	78	0	0
107 COPA	3	1	78	123	178
108 SEIN	1	0	78	0	0
109 ERNU	1	0	78	0	0
110 HYDRO	3	1	80	95	97
111 ASCA3	11	4	80	86	92
112 HYCAC	2	0	86	93	0
113 LUAL2	2	0	90	91	0
114 ERLA	6	2	90	91	159
115 AGUR	5	2	90	95	119
116 GIAG	2	0	90	91	0
117 ORIM	1	0	90	0	0
118 ERUMS	1	0	90	0	0
119 EPPA	1	0	90	0	0
120 CAJO	2	0	90	91	0
121 ARLU	2	0	90	92	0
122 LIAP	1	0	90	0	0
123 LIPEL	1	0	90	0	0
124 ARGL	1	0	90	0	0
125 HADI2	3	1	90	91	153
126 ELGL	3	1	90	91	99
127 STOCM	2	0	90	91	0
128 POPA	1	0	90	0	0

APPENDIX III CONTINUED

131	MOSIS	5	2	92	123	160
132	PHCO3	8	3	92	93	95
133	CYOC	3	1	92	96	231
134	NEHE	2	0	93	95	0
135	STACH	1	0	95	0	0
136	ANAPH	1	0	95	0	0
137	POA	4	1	99	101	135
138	LOTUS	11	4	100	100	102
139	FESTU	10	4	100	101	104
140	VICIA	2	0	100	104	0
141	SCBO	1	0	103	0	0
142	MITEL	5	2	104	105	106
143	BRSU	1	0	104	0	0
144	ASBRG	11	4	105	106	108
145	ASCA2	1	0	107	0	0
146	POMO3	2	0	109	123	0
147	COSU	1	0	109	0	0
148	TITRU	15	6	110	112	114
149	TITRT	1	0	113	0	0
150	SENEC	1	0	119	0	0
151	ERIGE	1	0	119	0	0
152	POPH	2	0	119	127	0
153	ELYMU	1	0	119	0	0
154	VISE	1	0	120	0	0
155	PHHA	1	0	123	0	0
156	HOPU	1	0	123	0	0
157	ANAR2	1	0	123	0	0
158	SEOR2	2	0	123	125	0
159	HYOC	6	2	125	229	238
160	GERAN	2	0	125	126	0
161	HYFEA	2	0	126	127	0
162	VIOR2	27	10	132	135	136
163	MOPE	3	1	133	166	217
164	VIAM	18	7	137	153	172
165	CAPUP	18	7	137	143	152
166	ALVI	1	0	138	0	0
167	CAHU2	28	11	140	143	152
168	ERHO2	2	0	146	157	0
169	ARUB	4	1	149	178	179
170	ASDE	8	3	149	152	159
171	RAUCO	4	1	149	150	159
172	FERU	18	7	150	159	160
173	FECA	3	1	150	152	156
174	LILY	2	0	150	194	0
175	CYGR	6	2	154	166	182
176	ERIOG	4	1	159	179	210
177	PHSP	7	2	159	178	179
178	VICU	5	2	159	178	180
179	UMBEL	1	0	159	0	0
180	PHPR	1	0	159	0	0
181	GAAM	17	6	159	160	169
182	ALLIU	2	0	159	178	0
183	ERHE2	5	2	160	161	169
184	ARPLH	1	0	160	0	0
185	ANFIF	1	0	161	0	0

APPENDIX III CONTINUED

188	SELAL	1	0	166	0	0
189	GRASS	1	0	166	0	0
190	IOIE	1	0	166	0	0
191	FESU	37	14	169	175	181
192	COMA2	1	0	177	0	0
193	LOIR	1	0	178	0	0
194	ALSI3	2	0	179	210	0
195	COPO	1	0	179	0	0
196	CRPL	2	0	179	208	0
197	MAMA	5	2	179	193	208
198	CAHA2	1	0	185	0	0
199	LABO	6	2	193	221	222
200	ERGR	1	0	197	0	0
201	TRRI	4	1	201	208	209
202	SEDUM	1	0	210	0	0
203	ALFA	1	0	212	0	0
204	LOCI	1	0	226	0	0
205	SADO	1	0	227	0	0
206	MODI3	1	0	229	0	0
207	PHHE	2	0	231	243	0
208	SAXIF	2	0	232	238	0
209	LAPA	1	0	232	0	0
210	COME	6	2	232	237	239
211	PEHU	3	1	235	238	243
212	LUPIN	1	0	241	0	0
213	EPAN	1	0	244	0	0
214	LOAP	1	0	244	0	0
215	PICA	2	0	245	248	0

APPENDIX IV

	ABMAS 94	238	72	243	237	235	118	119	241	236	73	240	244	70	74	92	242	93	95	126	124	233	125	71
1 COMPT	4104	4108	4106	4107	4108	4107	4103	4103	4107	4108	4106	4107	4205	4106	4106	4104	4205	4104	4104	4103	4104	4108	4103	4106
2 TWNSP	403	413	404	412	413	412	402	402	412	413	403	412	412	404	403	403	412	403	402	402	402	412	402	404
3 RANGE	65	63	64	71	63	62	66	65	71	63	65	61	71	64	65	64	76	64	65	65	65	63	65	64
4 ELEV	542	570	574	615	585	550	516	500	566	585	584	566	572	584	580	546	546	536	540	502	506	510	504	576
5 ASPCT	37	36	38	29	30	38	32	40	31	26	28	28	26	28	30	30	22	32	24	40	30	31	38	21
6 SLOPE	40	50	42	40	30	38	32	38	25	20	17	35	40	05	47	0	5	52	50	50	35	55	12	55
7 GEOL	7	5	7	5	5	5	7	7	8	5	5	5	5	7	5	5	6	7	7	5	3	7	5	7
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9 MACRO	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10 MICRO	1	1	3	1	1	1	3	3	1	1	1	1	1	3	1	2	3	1	1	3	1	1	1	1
11 POSIT	2	2	2	2	2	2	3	3	2	2	1	2	3	1	2	1	3	2	3	2	2	2	1	2
12 TRA	240	320	320	100	300	400	520	360	320	400	400	400	406	160	280	320	320	240	240	240	400	240	320	200
13 LITTER	70		90					90						95	70			70	90	95	95		95	70
14 MOSS	0	5	5	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	0
15 ARGRD	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5	0	0	5	0	0	5	0
16 PVMT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 ROCK	30	5	5	0	5	15	0	10	9	5	0	25	5	5	25	0	5	25	10	0	5	0	0	30
18 SOIL	22	44	33	22	33	33	22	22	33	34	22	32	34	32	33	22		22	32	33	33	22	32	32
19 CONST	21	22	21	21	21	21	22	22	21	21	21	21	22	21	21	21		21	21	21	22	21	21	21
20 CONST	11	12	11	11	12	12	11	12	11	14	11	11	13	11	11	11		11	11	11	12	11	11	11
21 BORKF	2	4	3	2	3	4	3	3	3	3	4	4	4	5	4	3	3	2	3	3	4	5	4	2
22 HTOPT	27	68	34	30	54	72	25	35	50	56	30	72	94	36	34	40		31	30	37	32	90	26	20
23 TOOPT	32	60	30	30	54	72	25	35	50	56	34	72	94	30	34	40		31	30	37	32	90	26	22
24 [redacted]																								
25 [redacted]																								
26 [redacted]																								
	TSME/QUSA/PYSE			ABMAS/QUSA/PYSE						ABCO/ROGY/ACTR														
27 PSMEC	2							1			1													4
28 PSMED	2						4	2			2													3
29 PSMEF	0						0	0			0													
30 ABCOC	4	3	5			2	2	5	1	1	5	5	2	4	3	4	5	5	5	6	6	5	4	5
31 ABCOD	3	3	3			2	3	5	2	1	5	5	3	3	2	5	5	5	5	5	5	5	5	5
32 ABCOF	0	0	0			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
33 PILAC																								
34 PILAD																								
35 PILAF																								
36 ABMAS	4	1	5	5	6	5	5	4	6	7	5	3	5	5	6	4	4	4	4	2	2	3	1	2
37 ABMAS	3	2	5	5	5	5	5	4	5	5	4	3	5	5	5	4	3	3	4	3	3	3	2	2
38 ABMAS	0	0	0	0	0	0	0	0	10		0	0	0	0	0	0	0	0	0	0	0	0	0	
39 CADEC											1			1	1				2	1		2		
40 CADED											2			2	1				2	2		2		
41 CADEF											0			0	0				0	0		0		
42 CHLAC																								
43 CHLAD																								
44 CHLAF																								
45 PIPOC																								
46 PIPOD																								
47 PIPOF																								
	TSME ZONE			ABMAS ZONE						ABCO ZONE														
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC	1																							
52 PIMOD	2																							
53 PIMOF	0																							
54 CACHC																								
55 CACHD																								
56 CACHF																								
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								
60 TSMEC	5	5	2	2																				
61 TSMED	5	5	3	3																				
62 TSMEF	0	0	0	0																				
															ABMAS GROUP									
63 ABCOC	3	1	4			2	3	3	2	1	2	3	3	3	3	3	2	3	3	3	2	3	3	1
64 ABCOD	3	2	3			3	5	5	3	1	5	4	5	5	4	5	3	5	5	5	3	5	5	5
65 ABCOF	0	0	0			0	20	0	0		0	5	10	0	0	0	0	0	0	5	10	0	20	
66 PSMEC										1										1	4			
67 PSMED										1										2	5			
68 PSMEF																				0	0			
69 CACHC																							1	
70 CACHD																							1	
71 CACHF																							0	
72 CADEC																	1		2			2		
73 CADED																	1		2			2		
74 CADEF																	0		0			0		
75 LIDE3C																								
76 LIDE3D																								
77 LIDE3F																								
78 ARMEC																								
79 ARMED																								
80 ARMEF																								
81 CHLAC																								
82 CHLAD																								
83 CHLAF																								
84 ABMASC	2	1	5	4	3	3	2	3	4	3	2	3	3	2	4	2	3	2			2	1	1	1
85 ABMASD	3	2	5	5	5	5	3	4	5	5	4	4	4	3	4	3	5	3			2	1	2	3
86 ABMASF	0	0	5	10	0	30	0	0	0		0	0	0	0	0	0	0	0			5	0	0	
87 TABRC																								
88 TABRD																								
89 TABRF																								
90 QUCHC																								
91 QUCHD																								
92 QUCHF																								
93 PILAC																								
94 PILAD																								
95 PILAF																								
96 CONUC																								
97 CONUD																								
98 CONUF																								
99 ACMAC																								
100 ACMAD																								
101 ACMAF																								
102 PIMOC																								

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APPENDIX IV

	47	81	91	236	44	108	158	98	86	63	294	6	127	48	204	211	17	12	248	117	249	103	10	18
1 COMPT	4108	4107	4106	4108	4106	4103	4103	4104	4106	4106	4305	4101	4103	4106	4307	4306	4306	4306	4205	4103	4205	4103	4306	4306
2 THHSP	406	412	403	412	406	402	402	402	404	403	423	0342	402	406	235	434	0144	0435	413	402	413	40	0435	0143
3 RANGE	64	61	64	64	64	66	66	65	64	63	72	0063	65	64	56	54	0056	0082	74	66	74	6	0083	0056
4 ELEV	531	552	536	520	546	446	464	512	508	480	496	0480	380	528	485	478	0450	0480	485	494	490	496	0420	0430
5 ASPCT	24	28	21	34	46	28	31	24	33	32	40	038	35	40	33	34	037	031	32	33	34*	30	032	034
6 SLOPE	13	36	30	25	55	40	40	37	50	22	46	45	40	35	45	45	30	55	50	45	5	45	40	30
7 GEOL	5	5	7	8	5	7	7	7	6	5		0005	7	5	7	6	0007	0007	5	7	6	7	0007	0007
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	0003	3	3	3	3	0003	0003	3	3	3	3	0003	0003
9 MACRO	1	2	1	1	1	1	2	1	2	1	1	0001	1	1	1	1	0001	0001	1	2	1	2	0001	0001
10 MICRO	1	1	1	1	1	3	3	1	1	1	1	0001	3	1	1	3	0001	0001	1	3	2	1	0001	0003
11 POSIT	1	4	2	2	3	2	4	3	2	2	2	0002	2	2	2	2	0002	0002	2	3	1	2	0004	0001
12 TRA	360	244	240	200	360	360	400	440	400	200	320	0280	320	320	200	440	0280	0440	320	440	400	400	0400	0240
13 LITER	95	95	75		95	90	94			95		90	85	95			65	90		58		45	70	90
14 MOSS	0	0	0	0	0	10	5	0	0	5	15	10	0	0	0	0	05	00	0	5	0	5	20	05
15 ARGRO	0	0	20	0	0	0	0	0	0	0	0	00	5	0	0	5	00	00	0	0	0	0	00	00
16 PUMI	0	0	3	0	0	0	0	0	0	0	0	00	0	0	0	0	00	00	0	0	0	0	00	00
17 ROCK	5	5	5	0	5	0	5	0	0	0	20	00	10	5	5	20	30	10	0	45	0	50	10	05
18 SOIL	44	42	22	35	44	32	32	22	33	44	44	0044	22	44	32	25	0055	0023	33	1	43	22	0033	0033
19 CONST	21	22	21	21	21	21	22	21	21	24	21	22	22	21	22	22	22	21	21	21	22	21	21	21
20 CONST	12		11	13	12	11	12	11	12	14	11	12	11	11	12	14	12	11	12	11	12	11	11	11
21 HORMF	3	4	3	5	4	3	4	3	5	4	3	004	3	4	4	5	003	004	2	2	3	5	003	003
22 RTDPT	27	[illegible]	36	72	36	30	36	38	45	28	48	024	43	46	35	50	029	032	36	25	20	31	029	020
23 TODPT	27	[illegible]	36	72	36	30	30	38	45	28	48	024	43	46	35	50	033	036	36	25	20	31	034	022
24 [illegible]																								
25 [illegible]																								
26 [illegible]																								
	ABCO/BENE/ACTR													ABCO/QUSA/CHUM										
27 PSMEC	2	2	2	3	[illegible]	3	3	3	1	3	4	03	1	2	3	4	04	04	5	5	5	6	05	04
28 PSMED	3	2	3	3	4	4	4	2	2	4	3	02	2	5	5	5	05	05	5	5	5	5	05	05
29 PSMEF	0	0	0	0	0	0	0	0	0	0	0	00	0	0	0	0	00	00	10	0	0	0	00	00
30 ABCOC	5	4	2	4	6	3	4	5	5	4	4	03	6	5	3	4	04	05	3	1	4		03	04
31 ABCOD	5	5	3	5	5	3	5	3	5	5	5	04	5	4	3	3	04	04	3	2	4		03	04
32 ABCOF	0	0	0	0	0	0	0	0	0	0	0	00	0	0	0	0	00	00	0	0	0		00	00
33 PILAC															2	3		03	1		1			
34 PILAD															3	4		03	2		1			
35 PILAF															0	0		05	0		0			
36 ABMAS	5	2	3	1	3	3	2	4	4	3	3	05	2	4	2	2	03	02	4	1		1	01	04
37 ABMAS	4	3	3	2	4	3	3	5	3	4	3	05	3	2	3	2	03	02	3	2		2	02	04
38 ABMAS	0	0	0	0	0	0	0	0	0	0	0	00	0	0	0	0	00	00	0	0		0	00	00
39 CADEC			4					2			4												.02	
40 CADED			5					2			3												03	
41 CADEF			0					0			0												00	
42 CHLAC															2									
43 CHLAD															3									
44 CHLAF															0									
45 PIPOC															2									
46 PIPOD															2									
47 PIPOF															0									
	ABCO ZONE																							
48 PIJEC																								
49 PIJEC																								
50 PIJEF																								
51 PIMOC		2													2		01							
52 PIMOD		1													3		01							
53 PIMOF		.													0		00							
54 CACHC																								
55 CACHD																								
56 CACHF																								
57 PIMRC															2		01							
58 PIMRD															3		02							
59 PIMRF															0		00							
60 TSHEC																								
61 TSHED	ABMAS GROUP																							
62 TSHEF																								
63 ABCOC	3	2		5	2	5	3	4	3	5	4	04	2	3	3	4	03	06	3	2	3	0	04	03
64 ABCOD	3	3		5	2	4	4	5	4	5	5	03	5	5	5	5	04	05	3	4	3	0	05	04
65 ABCOF	[illegible]	4		15	0	0	5	10	0	15	0	10	5	10	0	0	00	00	10	0	5	10	05	25
66 PSMEC				3						3	2				2			02	1			3	01	
67 PSMED				3						3	2				2			02	1			5	01	
68 PSMEF				6						0	0				0			05	0			0	00	
69 CACHC																								
70 CACHD																								
71 CACHF																								
72 CADEC			3					2		3	2												02	
73 CADED			5					2		3	2												03	
74 CADEF			0					0		0	0												00	
75 LIDE3C																								
76 LIDE3D																								
77 LIDE3F																								
78 ARMEC																								
79 ARMED																								
80 ARMEF																								
81 CHLAC						2	1								1	2							02	01
82 CHLAD						3	2								2	2							03	01
83 CHLAF						0	0								0	0							00	00
84 ABMASC		4	2	2		4	3	3	3		3	05	2	2	2	3	03	02	4	2	4			03
85 ABMASD		5	3	2		4	4	3	5		3	05	3	4	3	3	04	02	5	4	5			05
86 ABMASF		0	0	0		0	0	0	0		10	15	3	0	0	0	00	00	15	0	20			00
87 TABRC																								
88 TABRD																								
89 TABRF																								
90 QUCHC																								
91 QUCHD																								
92 QUCHF																								
93 PILAC				1											2									
94 PILAD				1											2									
95 PILAF				9											0									
96 CONUC																								
97 CONUD																								
98 CONUF																								
99 ACMAC																								
100 ACMAD																								
101 ACMAF																								
102 PIMOC																	01							00

3003

APPENDIX IV

RFST	77	239	234	99	250	209	50	75	13	217	78	90	89	129	79	80	46	100	245	81	123	87	88	97
1 COMPT	4106	4108	4108	4104	4205	4307	4106	4106	4306	4204	4106	4106	4105	4102	4106	4106	4108	4104	4205	4106	4103	4105	4105	4102
2 TWNSP	404	413	412	401	196	435	405	404	0435	422	404	403	403	401	404	404	406	402	413	403	402	403	403	401
3 RANGE	64	63	63	64	63	66	63	65	0083	62	64	64	62	65	64	64	64	65	74	64	65	62	62	65
4 ELEV	554	575	515	494	488	480	432	582	0476	492	556	542	466	460	520	524	522	496	487	492	496	474	460	694
5 ASPCT	23	27	31	24	21	24	37	23	030	23	21	28	30	32	27	28	21	28	28	27	33	24	39	30
6 SLOPE	47	23	55	25	25	45	50	43	40	45	33	35	45	45	30	15	45	42	50	53	52	15	32	0
7 GEOL	7	7	5	2	6	7	5	5	0007	6	7	7	7	5	5	5	5	6	5	5	5	6	6	5
8 LOFRM	3	3	3	3	3	3	3	3	0003	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9 MACRO	1	1	1	1	1	2	1	1	0001	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10 MICRO	1	1	1	3	1	1	1	1	0001	1	1	3	3	1	3	1	1	3	1	3	1	1	3	1
11 POSIT	2	2	2	2	2	1	2	2	0003	2	2	2	2	2	2	1	2	2	2	4	2	1	2	1
12 TRA	240	480	160	520	480	360	240	480	0680	640	40	0	400	400	160	160	320	480	680	280	480	200	360	280
13 LITER				90			95	80	85		50	30	95	95		95	95	50		95	70	95		
14 MOSS	0	0	0	5	0	0	0	0	00	0	0	0	5	0	0	0	0	5	0	0	0	0	0	0
15 BRGRD	0	0	0	0	0	20	0	0	00	0	0	70	0	0	0	0	0	0	0	0	10	0	0	0
16 PVMT	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 ROCK	0	0	0	5	0	75	5	20	15	5	50	0	0	5	0	5	5	15	0	5	20	5	0	0
18 SOIL	33	44	33	34	33	22	55	33	0034	34	00	22		45	45	44	34	45	34	34	34	45	45	44
19 CONST	21	22	21	21	21	22	22	21	22	24	21	21	22	22	22	22	22	22	21	22	22	24	24	22
20 CONST	11	12	11	12	12	11	14	11	12	12	11	11	14	14	14	12	12	14	14	12	14	14	14	14
21 WORKF	4	5	2	3	2	4	3	4	004	4	2	3	3	4	4	4	4	4	5	4	2	3	3	4
22 RTDPT	31	70	63	24	22	21	42	22	056	53	12	33	29	29	34	29	34	32	110	30	30	27	28	40
23 TODPT	33	70	63	24	22	21	42	22	056	53	12	33	30	29	34	29	34	32	110	30	30	27	29	40
24 [redacted]																								
25 [redacted]																								
26 [redacted]	ABCO/QUSA/CHUM												ABCO/BENE/ACTR											
27 PSMEC			2		5	3	2		05	7	3		6	6	2		6	6	4	5		6	5	3
28 PSMED			2		5	5	3		05	5	3		5	5	2		5	5	3	5		5	4	3
29 PSMEF			0	0	0	0	0		05	5	5		0	0	0		0	0	0	0		0	0	
30 ABCOC	6	5	5		3		5	6			4		4	2	6	7	5		6	3	1	2	5	6
31 ABCOD	5	5	5		3		5	5			5		3	3	5	5	4		5	3	2	2	4	5
32 ABCOF	0	0	0	0	0		0	0			0		0	0	0	0	0		0	0	0	0	0	
33 PILAC			3		1	3					3									3		2		
34 PILAD			2		3	3					3									3		2		
35 PILAF			0		0	0					0									0		0		
36 ABMAS	2	3	3	1			2																	
37 ABMAS	2	2	2	1			2																	
38 ABMAS	0	0	0	0			0																	
39 CADEC			2						01	1	3	2									6			2
40 CADED			2						04	2	3	5									5			2
41 CADEF			0						00	0	0	0									0			
42 CHLAC																								
43 CHLAD																								
44 CHLAF																								
45 PIPOC						2					3				3									
46 PIPOD						2					3				3									
47 PIPOF						0 ABCO		ZONE			0				0									
48 PIJEC																								
49 PIJEC																								
50 PIJEF																								
51 PIMOC						1																		
52 PIMOD						1																		
53 PIMOF						0																		
54 CACHC																								
55 CACHD																								
56 CACHF																								
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								
60 TSMEC																								
61 TSMED										ABCO GROUP														
62 TSMEF																								
63 ABCOC	2	3	3	2	4	3	3	1	04	3	4	1	1	4	2	3	2	4	2	2	3	3	3	3
64 ABCOD	5	5	5	5	5	5	5	5	05	5	5	2	5	5	5	5	3	5	5	5	4	5	5	5
65 ABCOF	0	0	0	0	30	5	0	0	00	0	15	0	15	0	0	0	0	5	0	0	15	0	0	15
66 PSMEC				1		1				0														
67 PSMED				1		2				0														
68 PSMEF				0		0				5														
69 CACHC							3																	
70 CACHD							3																	
71 CACHF							5																	
72 CADEC			1			1				1		4				1					3			
73 CADED			2			1				3		5				1					4			
74 CADEF			0			0				0		0				0					0			
75 LIDE3C																				1				
76 LIDE3D																				3				
77 LIDE3F																				0				
78 ARMEC																								
79 ARMED																								
80 ARMEF																								
81 CHLAC														1										
82 CHLAD														1										
83 CHLAF														0										
84 ARMASC		1		1	3	3		0	02															
85 ARMASD		1		1	3	3		0	01															
86 ARMASF		3		5	0	0		5	00															
87 TABRC																								
88 TABRD																								
89 TABRF																								
90 QUCHC																								
91 QUCHD																								
92 QUCHF																								
93 PILAC					1	2			01															
94 PILAD					1	3			01															
95 PILAF					0	0			00															
96 CONUC																								
97 CONUD																								
98 CONUF																								
99 ACMAC																								
100 ACMAD																								
101 ACMAF																								
102 PIMUC						1																		

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APPENDIX IV

	REST 214	222	34	4	182	169	247	5	59	16	63	32	62	181	185	173	192	44	98	11	163	35	15	224
1 COMPT	4306	4304	4108	4101	4204	4307		4101	4107	4306	4106	4108	4106	4204	4204	4204	4305	4107			4202	4108	4306	4204
2 TWNSP	433	431	412	0393	411	434	196	0393	406	0184	404	412	404	411	411	411	432	405			405	411	0434	432
3 RANGE	55	62	65	0062	71	61	75	0062	62	0056	65	65	65	71	71	71	61	62			73	65	0083	62
4 ELEV	500	420	426	0420	400	412	416	0440	440	0440	436	442	440	405	392	384	302	298			350	416	0440	445
5 ASPCT	40	30	20	020	30	22	20	030	32	033	24	24	22	0	20	38	32	33			30	22	030	23
6 SLOPE	40	45	25	15	50	25	55	55	60	50	50	45	55	0	20	25	70	47			45	25	60	40
7 GEOL	5	6	7	0005	6	7	6	0005	5	0007	7	7	7	6	6	5	5	5			5	7	0007	6
8 LDFRM	3	3	3	0003	3	3	3	0003	3	0003	3	3	3	3	3	3	3	3			3	3	0003	3
9 MACRO	1	2	1	0002	1	1	1	0002	1	0001	2	1	2	1	2	2	1	1			1	1	0001	1
10 MICRO	3	1	1	0003	1	1	1	0001	1	0003	3	1	1	2	1	1	1	1			3	3	0001	1
11 POSIT	2	3	3	0005	2	4	3	0002	2	0001	4	3	4	1	1	1	4	4			2	4	0003	2
12 TBA	480	360	280	0440	680	480	520	0280	240	0300	360	320	440	300	320	440	260	360			440	320	0320	320
13 LITER				95				95	95	65		95						85				95	90	
14 MOSS	0	0	0	05	0	0	5	00	0	05	0	0	0	0	10	25	95	5			55	0	05	0
15 BRGRD	0	0	0	00	10	0	10	00	0	05	0	0	0	0	0		0	5				0	00	0
16 PVNT	0	0	0	00	0	0	0	00	0	00	0	0	0	0	0		0	0				0	00	0
17 ROCK	70	0	0	05	20	10	15	05	5	25	0	5	0	0	10	10		5			30	5	05	0
18 SOIL	35	33	34	0034	34	22	33	0034	35	0033	33	45	33	34	33	35	33	45				45	0055	33
19 CONST	22	22	21	24	21	21	22	24	21	21	21	21	21	22	21	21	21	24				22	22	21
20 CONST	14	14	12	14	12	11	12	14	14	12	11	12	11	12	12	12	11	13				14	12	14
21 HORKF	5	5	4	4	3	3	3	004	4	004	4	4	4	3	2	3	3	3				4	003	4
22 RTOPT	50	42	24	27	21	48	34	025	28	048	38	30	38	24	15	26	29	27				30	014	41
23 TODPT	50	42	24	27	21	40	34	025	28	040	45	30	38	24	15	26	29	35				30	030	41
24 [redacted]																								
25 [redacted]																								
26 [redacted]																								

ABCO/BENE/ACTR

	REST 214	222	34	4	182	169	247	5	59	16	63	32	62	181	185	173	192	44	98	11	163	35	15	224
27 PSMEC	3	7	3	05	6	7	6	05	5	05	5	3	5	6	7	4	4	5			5	4	05	5
28 PSMED	3	5	4	05	5	5	5	05	5	04	4	3	5	5	5	5	5	5			5	4	05	5
29 PSMEF	0	0	0	00	0	0	0	00	0	00	0	0	0	5	0	0	0	0			0	0		0
30 ABCOC	5		5	04	2		3	06	4	05	5	6	5	3		2					1	5	04	3
31 ABCOD	5		5	03	3		3	04	4	04	4	5	3	3		1					1	4	04	3
32 ABCOF	5		0	00	0		0	00	0	00	0	0	0	0		0					0	0		0
33 PILAC			3			3			2				2		1	2	1	3			3	2	01	
34 PILAD			4			3			3				2		1	3	1	4			3	2	02	
35 PILAF			0			0			0				0		0	0	0	0			0	0		
36 ABMAS																								
37 ABMAS																								
38 ABMAS																								
39 CADEC			2																					
40 CADED			3																					
41 CADEF			0																					
42 CHLAC																								
43 CHLAD																								
44 CHLAF																								
45 PIPUC																								
46 PIPUD																								
47 PIPUF																								

ABCO ZONE

	REST 214	222	34	4	182	169	247	5	59	16	63	32	62	181	185	173	192	44	98	11	163	35	15	224
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC																								
52 PIMOD																								
53 PIMOF																								
54 CACHC				03																		2		
55 CACHD				03																		2		
56 CACHF				00																		0		
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								

ABCO GROUP

	REST 214	222	34	4	182	169	247	5	59	16	63	32	62	181	185	173	192	44	98	11	163	35	15	224
60 TSMEC																								
61 TSMED																								
62 TSMEF																								
63 ABCOC	2	4	3	04	3	3	3	02	2	03	1	2	1	4	4	4	1	1			4	4	04	4
64 ABCOD	5	5	5	05	5	5	5	02	5	05	5	5	1	5	5	5	1	1			5	5	05	5
65 ABCOF	0	10	10	10	0	0	0	05	0	00	0	0	0	10	10	0	0	0			5	0	10	0
66 PSMEC																					1	1	01	1
67 PSMED																					1	1	01	1
68 PSMEF																					0	0		0
69 CACHC		1							1				1		1	2		4						
70 CACHD		2							1				1		2	3		4						
71 CACHF		0							0				0		0	0		0						
72 CADEC				02		1												1						1
73 CADED				02		2												1						2
74 CADEF				00		0												0						0
75 LIDE3C			2												4	4					5			
76 LIDE3D			3												4	3					3			
77 LIDE3F			0												35	25					50			
78 ARMEC						2								2	1		3	4			2			
79 ARMED						3								3	1		3	4			3			
80 ARMEF						0								0	0		0	0			0			
81 CHLAC																1								
82 CHLAD																1								
83 CHLAF																0								
84 ARMASC																								
85 ARMASD																								
86 ARMASF																								
87 TABRC		3		02												1								
88 TABRD		3		32												1								
89 TABRF		0		00												0								
90 QUCHC					1									3	1		6				3			
91 QUCHD					2									3	2		5				3			
92 QUCHF					0									25	0		25				20			
93 PILAC	1						1														1			
94 PILAD	1						1														1			
95 PILAF	0						0														0			
96 CONUC									2													2		
97 CONUD									3													3		
98 CONUF									0													30		
99 ACMAC			2		1																			
100 ACMAD			2		2																			
101 ACMAF			0		0																			
102 PIMOC																								

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APPENDIX IV

REST	33	53	52	216	231	54	101	223	116	232	246	64	58	198	3	55	82	213	169	104	190	60	228	56
1 COMPT	4108	4106	4106	4204	4108	4106	4104	4204	4103	4109	4205	4106	4107	4204	4101	4106	4106	4307	4204	4103	4307	4107	4305	4107
2 TWNSP	412	406	406	423	412	405	401	432	402	412	413	405	406	412	0393	404	403	433	411	401	434	411	423	411
3 RANGE	65	65	64	62	63	65	63	62	66	63	75	65	62	71	0062	65	64	55	71	51	66	61	72	61
4 ELEV	434	448	422	485	568	488	439	448	486	495	468	442	422	430	0430	486	502	501	325	420	395	428	480	516
5 ASPCT	23	33	30	30	32	29	21	27	30	35	28	31	33	21	029	30	23	29	33	28	32	40	22	28
6 SLOPE	70	60	67	35	55	60	26	0	40	45	45	57	52	10	25	60	42	45	35	50	40	55	20	57
7 GEOL	7	5	5	7	7	5	5	5	7	7	6	7	5	1	0005	5	5	5	1	7	6	5	6	5
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0003	3	3	3	3	3	3	3	3	3
9 MACRO	1	1	1	1	1	1	1	1	2	1	1	2	1	2	0002	1	1	1	1	1	1	1	1	1
10 MICRO	3	1	3	1	1	1	1	2	1	1	1	3	3	1	0001	1	3	1	1	3	3	1	1	1
11 POSIT	3	3	2	2	2	4	2	1	3	2	4	3	2	1	0004	4	3	2	4	4	3	3	3	2
12 TBA	240	440	360	480	520	440	480	400	320	480	440	440	360	220	0480	440	360	520	200	360	600	320	320	280
13 LITER	95	95	85			95	90		90			95	90		90	90	95			95		80		50
14 MOSS	0	0	5	0	0	0	5	0	5	25	0	0	5	0	10	5	0	10	85	5	5	5	0	0
15 WRGRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00	0	0	0		0	0	0	0	0
16 PVMT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00	0	0	0		0	0	0	0	0
17 ROCK	5	5	10	0	5	5	5	0	5	25	0	5	5	0	10	5	5	15		0	50	15	5	50
18 SOIL	22	34	33	33	33	32	44	33	32	22	33	33	45	46	0034	32	35	34	44	32	33	34	45	33
19 CONSY	21	21	21	21	21	21	22	21	21	21	21	21	22	22	24	21	21	22	22	21	21	21	22	22
20 CONST	11	12	12	12	11	12	14	12	11	11	12	12	14	14	14	11	14	14	12	12	11	12	14	12
21 BORKF	4	3	3	4	4	3	3	2	3	4	3	4	4	5	004	3	4	3	4	5	5	4	3	2
22 WTOPT	38	37	37	48	92	42	21	30	39	58	43	38	35	48	027	60	32	48	40	43	65	41	19	37
23 TOOPT	38	37	37	48	92	50	21	30	39	50	43	38	35	48	027	60	32	48	48	43	65	42	19	37
24 [illegible]																								
25 [illegible]																								
26 [illegible]																								

ABCQ/BENE/ACTR

REST	33	53	52	216	231	54	101	223	116	232	246	64	58	198	3	55	82	213	169	104	190	60	228	56
27 PSMEC	5	5	4	6	1	5	5	5	4	2	6	4	5	5	05	5	4	5	5	5	7	6	5	4
28 PSMED	4	4	4	5	2	4	5	5	5	2	3	4	5	5	05	4	3	5	5	5	5	5	5	5
29 PSMEF		0	0	5	0	0	0	0	0	0	0	0	0	0	00	0	0	0	0		0	0	0	0
30 ABCOC	5	5	5	3	5	6	2	4	4	5	4	5	4	3		5	4	4		4		4	3	4
31 ABCOD	4	4	5	3	5	5	3	3	3	5	5	5	3	3		4	5	3		3		4	3	4
32 ABCOF		0	0	0	0	0	0	0	0	0	5	0	0	0		0	0	5				0	0	0
33 PILAC	3	3				1						3	4		03	2		4	1					
34 PILAD	4	3				2						4	3		04	2		3	1					
35 PILAF		0				0						0	0		00	0		0	0					
36 ABMAS																								
37 ABMAS																								
38 ABMAS																								
39 CADEC					3												2							
40 CADED					3												3							
41 CADEF					0												0							
42 CHLAC									1															
43 CHLAD									2															
44 CHLAF									0															
45 PIPOC							1					3		2									3	
46 PIPOD							2					3		3									3	

ABCO ZONE

REST	33	53	52	216	231	54	101	223	116	232	246	64	58	198	3	55	82	213	169	104	190	60	228	56
47 PIPOF							0					0		0									0	
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC									1															
52 PIMOD									2															
53 PIMOF									0															
54 CACHC	2											3			04									
55 CACHD	3											3			03									
56 CACHF												0			00									
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								
60 TSMEC																								

ABCO GROUP

REST	33	53	52	216	231	54	101	223	116	232	246	64	58	198	3	55	82	213	169	104	190	60	228	56
61 TSMED																								
62 TSMEF																								
63 ABCOC	3	4	2	7	4	2	3	4	3	3	3	2	3	3	04	3	3	4	1	3	3	3	5	4
64 ABCOD	5	5	3	5	5	5	3	5	5	5	5	5	5	5	05	5	5	5	4	5	5	5	5	5
65 ABCOF		0	0	0	0	0	0	0	5	0	0	0	0	0	00	0	0	5	0	15	0	0	5	5
66 PSMEC	1	1	1	1	1	1	1	2	1	1	1	2	2	2	02	2	2	3	2	2	3	2	3	3
67 PSMED	1	1	1	1	1	2	2	2	2	2	2	2	2	2	02	2	2	3	3	3	3	3	3	3
68 PSMEF		0	0	5	0	5	5	0	0	0	0	0	0	0	00	0	0	0	0		0	0	0	0
69 CACHC		2	2			1		1		1			1		02	2		2						
70 CACHD		3	2			3		1		2			2		03	3		3						
71 CACHF		9	0			0		0		0			0		00	0		0						
72 CADEC	1					1	2			1	1	2		1	01		2		2		2			
73 CADED	1					2	2			2	2	2		2	02		3		3		2			
74 CADEF						0	0			0	0	0		0	00		10		0		0			
75 LIDE3C																								
76 LIDE3D																								
77 LIDE3F																								
78 ARMEC														2					2		1			
79 ARMED														2					3		2			
80 ARMEF														0					0		0			
81 CHLAC		1																		1				
82 CHLAD		2																		2				
83 CHLAF		9																						
84 ABMASC																		1						
85 ABMASD																		1						
86 ABMASF																		0						
87 TABRC										1									3				1	
88 TABRD										1									4				1	
89 TABRF										0									5				6	
90 QUCHC																							4	
91 QUCHD																							3	
92 QUCHF																							20	
93 PILAC																		3						
94 PILAD																		3						
95 PILAF																		0						
96 CONUC		1	3													3								
97 CONUD		1	5													3								
98 CONUF		0	10													0								
99 ACMAC																1								
100 ACMAD																1								
101 ACMAF																0								
102 PIMOC																								

APPENDIX IV

	RFST 57	36	65	51	
1 COMPT	4107	4108	4106	4106	
2 TWNSP	406	411	404	405	
3 RANGE	62	64	64	63	
4 ELEV	420	402	434	432	
5 ASPCT	31	22	31	40	
6 SLOPE	45	25	55	55	
7 GEOL	5	8	3	5	
8 LDFRM	3	3	3	3	
9 MACRO	1	1	2	1	
10 MICRO	1	1	1	1	
11 POSIT	2	4	4	2	
12 TRA	120	440	280	280	
13 LITER	86	95	85	80	
14 MOSS	5	0	0	10	
15 BRGRD	0	0	0	0	
16 PVMT	0	0	0	0	
17 ROCK	15	5	15	10	
18 SOIL	35	33	34	33	
19 CONST	21	21	22	21	
20 CONST	14	11	14	12	
21 BORKF	4	3	2	3	
22 RTDPT	26	18	19	48	
23 TODPT	24	18	22	48	
24 [redacted]					
25 [redacted]					
26 [redacted]					ABCO/BENE/ACTR
27 PSMEC	5	4	4	3	
28 PSMED	5	5	5	4	
29 PSMEF	0	-3	0	0	
30 ABCOC		4		4	
31 ABCOD		4		5	
32 ABCOF		9		0	
33 PILAC	3	1	1	2	
34 PILAD	3	2	2	2	
35 PILAF	5	0	0	0	
36 ARMAS					
37 ARMAS					
38 ARMAS					
39 CADEC		2	3		
40 CADED		3	3		
41 CADEF		0	0		
42 CHLAC					
43 CHLAD					
44 CHLAF					
45 PIPOC			4		
46 PIPOD			4		
47 PIPOF			0		ABCO ZONE
48 PIJEC					
49 PIJEC					
50 PIJEF					
51 PIMOC					
52 PIMOD					
53 PIMOF					
54 CACHC				2	
55 CACHD				3	
56 CACHF				0	
57 PIBRC					
58 PIBRD					
59 PIBRF					
60 TSMEC					
61 TSMED					ABCO GROUP
62 TSMEF					
63 ABCOC	3	4	4	4	
64 ABCOD	3	5	5	4	
65 ABCOF	5	0	0	5	
66 PSMEC	3	2	4	4	
67 PSMED	3	4	4	4	
68 PSMEF	10	5	0	0	
69 CACHC	4	3	1		
70 CACHD	5	3	2		
71 CACHF	25	9	0		
72 CADEC	1	2	2		
73 CADED	1	3	3		
74 CADEF	0	0	0		
75 LIDE3C	0				
76 LIDE3D	0				
77 LIDE3F	5				
78 ARMEC	2				
79 ARMED	3				
80 ARMEF	0				
81 CHLAC					
82 CHLAD					
83 CHLAF					
84 ABMASC					
85 ABMASD					
86 ABMASF					
87 TABRC		1		1	
88 TABRD		2		1	
89 TABRF		0		0	
90 QUCHC					
91 QUCHD					
92 QUCHF					
93 PILAC		1	1		
94 PILAD		1	1		
95 PILAF		0	0		
96 CONUC		4			
97 CONUD		3			
98 CONUF		5			
99 ACMAC		1			
100 ACMAD		2			
101 ACMAF		0			
102 PIMOC					

APPENDIX IV

	LIDE3 197	136	141	139	142	133	42	76	132	85	215	160	14	8	94	143	191	193
1 COMPY	4304	4202	4202	4202	4202	4202	4107	0000		4104	4303	4204	4101	0000	4104	4202	4305	4305
2 TWNSP	431	405	405	405	405	406	406	401	401	401	431	406	0393	0393	401	405	433	432
3 RANGE	61	74	74	74	75	74	62	76	76	61	54	71	0061	0076	61	75	61	66
4 ELEV	350	260	260	260	325	312	326	278	246	262	278	323	0270	0240	262	330	320	320
5 ASPCT	21	28	24	28	22	27	31	30	29	32	37	33	027	032	34	32	28	30
6 SLOPC	29	45	25	45	55	70	55	50	52	60	50	70	60	90	55	55	50	45
7 GEOL	6	2	5	5	5	5	5	6	3	5	5	5	0005	0005	5	5	3	6
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	3	0003	0003	3	3	3	3
9 MACRO	2	2	1	2	1	1	1	1	2	1	1	1	0002	0002	1	1	1	1
10 MICRO	1	1	1	3	1	1	1	3	1	1	1	1	0001	0001	3	1	1	1
11 POSIT	1	2	3	3	3	3	3	3	3	3	4	3	0003	0004	3	3	4	3
12 TBA	360	220	320	360	160	280	280	440		280	300	400	0400	0200	120	340	360	400
13 LITER								95		40			90	50	45			
14 MOSS	0	45	30	10	15	0	0	5	40	55	50	55	10	30	50	90	55	15
15 HRGRD	0	0	0	0	20	0	0	0	0	0	0		00	10	0	0	5	0
16 PVMT	0	0	0	0		0	0	0	0	0	0		00	00	0		0	0
17 ROCK	0	20	0	0	5	0	0	0	0	5	50	20	00	10	5	75	50	20
18 SOIL	64	33	33	23	33	23	45	55	53	55	33	33	0035	0020	44	33	35	33
19 CONST	24	21	21	22	22	21	24	23	22	24	22	21	22	22	24	21	21	21
20 CONST	14	12	12	14	14	14	13	13	14	14	12	12	12	12	14	12	12	12
21 BORKF	5	4	4	4	3	4	3	4	5	4	3	4	002	004	4	5	2	4
22 RTOPT	32	45	35	27	34	43	29	30	20	20	27	45	021	015	30	38	31	40
23 TOOPT	32	45	40	28	36	43	33	30	24	29	27	45	027	015	30	52	31	45
24 [illegible]																		
25 [illegible]																		
26 [illegible]	LIDE3/BENE/				LIBOL ←					LIDE3/BENE-RHDI/CHUM →								
27 PSMEC	5	4	5	6	4	6	6	6	6	4	6	6	05	04	5	5	5	6
28 PSMED	5	5	5	5	5	5	5	5	5	5	5	5	05	05	5	5	5	5
29 PSMEF	0	0	10	0	0	0	5	0	0	5	0	0	00	00	0	0	0	5
30 ARCOC																		
31 ARCOD																		
32 ABCOF																		
33 PILAC			1	1	4		2	1	1	2	4	1	03	01		3	2	2
34 PILAD			2	1	4		2	1	2	2	3	2	03	02		3	3	2
35 PILAF			0	0	0		0	0	0	0	0	0	00	00		0	0	0
36 ABMAS																		
37 ABMAS																		
38 ABMAS																		
39 CADEC	4																	
40 CADED	4																	
41 CADEF	5																	
42 CHLAC																		
43 CHLAD																		
44 CHLAF																		
45 PIPOC	1				3								03					
46 PIPOD	2				3								03					
47 PIPOF	0				0			LIDE3 ZONE →					00					
48 PIJEC																		
49 PIJED																		
50 PIJEF																		
51 PIMUC																		
52 PIMUD																		
53 PIMUF																		
54 CACHC																		
55 CACHD																		
56 CACHF																		
57 PIBRC																		
58 PIBRD																		
59 PIBRF																		
60 TSMEC																		
61 TSMED										LIDE3 GROUP →								
62 TSMEF																		
63 ABCOC	1		3		1										1	1		
64 ABCOD	2		3		1										1	2		
65 ABCOF	0		0												0	0		
66 PSMEC	2	1		1	3	3	2	2	1			2	02		3		1	2
67 PSMED	3	1		2	3	3	2	3	2			2	03		3		1	3
68 PSMEF	0	10		0		0	0	0	5			0	00		10		0	5
69 CACHC		4	2		4		2	3		2	2				3	4		
70 CACHD		3	2		4		3	3		3	2				3	3		
71 CACHF		30	0				0	0		0	0				0	0		
72 CADEC	2	1											01					
73 CADED	4	1											02					
74 CADEF	5	0											00					
75 LIDE3C	3	4	4	5	5	4	3	6	6	5	5	4	04	05	5	5	5	4
76 LIDE3D	5	5	3	5	3	3	3	5	5	5	5	5	04	05	5	4	5	4
77 LIDE3F	10	35	50	20	55	15	10	0	10	40	75	15	30	30	15	45	80	10
78 ARMEC		4	5	3	3	3	4	2			3	2		03	3		3	3
79 ARMED		3	5	3	4	3	5	2			3	2		03	3		3	3
80 ARMEF		9	0	0		0	0	0			0	0		10	0		0	0
81 CHLAC																		
82 CHLAD																		
83 CHLAF																		
84 ARMASC																		
85 ARMASD																		
86 ABMASF																		
87 TABRC										1								
88 TABRD										2								
89 TABRF										0								
90 QUCHC		3	5	3	4	4				2	3	3		06		4	4	4
91 QUCHD		3	4	4	5	5				2	3	3		03		4	3	4
92 QUCHF		10	10	0	25	5				5	20	5		40		20	25	35
93 PILAC		1	1	1	1			2	1		1		01		2	1		
94 PILAD		1	2	2	2			1	2		2		02		2	2		
95 PILAF		0	0	0				0	0		0		00		0	5		
96 CONUC							2		2	1	2	2	02	02		2		
97 CONUD							3		2	2	3	2	02	02		2		
98 CONUF							0		0	5	0	0	05	00		0		
99 ACMAC												3		02				
100 ACMAD												3		02				
101 ACMAF												0		00				
102 PIMUC																		

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APPENDIX IV

	CHLA 47	105	115	221	146	172	113	208	202	184	219	229	201	203	218	107	114	130	131	180	128	199	122	144
1 COMPT	4103	4103	4103	4304	4202	4204	4103	4204	4307	4204	4304	4304	4307	4307	4304	4103	4103	4102	4102	4307	4102	4204	4103	4105
2 TWNSP	402	402	402	431	404	411	401	422	436	412	432	432	436	235	432	402	402	401	401	435	401	422	402	405
3 RANGE	51	51	51	62	76	71	66	71	56	71	61	61	66	56	61	66	66	65	65	61	65	71	66	76
4 ELEV	438	438	423	430	400	383	320	410	458	385	485	468	466	472	450	454	450	420	410	430	422	412	416	400
5 ASPCT	28	28	37	37	40	32	33	34	33	34	24	27	37	31	28	30	34	31	31	28	38	30	40	31
6 SLOPE	30	30	15	15	34	40	23	15	50	30	20	25	20	20	10	40	45	45	50	50	55	40	20	15
7 GEOL	7	7	7	7	5	1	7	6	7	5	7	7	7	7	7	7	7	5	5	7	5	5	7	3
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9 MACRO	1	1	1	1	1	2	2	2	1	1	1	1	1	2	1	2	1	2	2	1	2	2	1	1
10 MICRO	3	3	1	3	1	1	3	3	3	3	1	1	3	3	3	3	3	1	3	1	3	3	3	3
11 POSIT	3	3	4	3	2	2	4	2	2	2	3	3	2	1	3	4	3	4	4	4	4	1	4	2
12 TBA	360	360	240	600	400	220	360	560	260	300	320	600	360	200	440	440	560	600	360	480	400	400	400	320
13 LITTER	75	75	50				60									90	85	95			95		65	95
14 MOSS	20	20	30	5	5	30	40	5	0	20	5	0	0	0	25	5	5	0	0	0	0	0	15	10
15 BRGRD	0	0	0	0	20		0	0	0	5	0	0	0	0	0	0	0	0	0	0	5	0	5	5
16 PVNT	0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
17 ROCK	5	5	20	0			0	10	5	15	15	0	0	0	5	5	10	5	0	40	0	45	15	
18 SOIL	32	32	22	34	35	55	32	33	22	45	34	33	44	22	36	32	22	22	34	23	45	56	22	35
19 CONST	21	21	22	21	22	24	22	21	21	24	22	21	21	21	24	22	22	22	21	21	22	23	21	24
20 CONST	12	12	11	14	14	14	12	11	11	14	14	12	11	11	13	11	12	12	12	12	14	13	11	13
21 BDRKF	5	5	3	5	5	4		5	4	3	5	5	4	4	5	3	4	4	4	3	4	4	3	3
22 RTDPT	28	28	24	29	51	27	23	30	48	32	50	56	40	15	23	30	29	38	32	70	38	47	24	52
23 TODPT	28	28	34	33	51	27	23	30	36	32	40	46	32	15	23	30	29	38	32	70	38	47	34	52
24 [illegible]																								
25 [illegible]																								
26 [illegible]	ABCO/BENE/CHUM									CHLA/BENE/CHUM														
27 PSMEC	5	5	5	6	5	6	4	4	4	5	7	5	4	1	5	4	1	7	6	5	6	5	2	6
28 PSMED	5	5	5	5	5	5	3	4	5	4	5	5	5	2	5	5	2	5	5	5	5	5	3	5
29 PSMEF	0	0	0	0	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 ABCOC	3	3						3	4	3		4		3	3	2	3			4	2	2	1	
31 ABCOD	3	3						3	3	4		3		3	3	3	4			4	3	2	2	
32 ABCOF	0	0						0	0	0		0		10	0	0	0			0	0	5	0	
33 PILAC					1	1									2									
34 PILAD					2	1									2									
35 PILAF					0										0									
36 ARMAS																								
37 ARMAS																								
38 ARMAS																								
39 CADEC												1	3											
40 CADED												1	3											
41 CADEF												0	0											
42 CHLAC	5	5	4		1		5	4		5			1	5	4	1	5		3	4	3	3	4	5
43 CHLAD	4	4	4		1		5	4		4			2	5	3	2	5		3	4	4	3	5	4
44 CHLAF	0	0	0		0		0	20		0			0	0	0	0	0		0	0	0	0	0	0
45 PIPOC																								
46 PIPOD																								
47 PIPOF	ABCO ZONE									CHLA ZONE														
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC														2										
52 PIMOD														3										
53 PIMOF														0										
54 CACHC																								
55 CACHD																								
56 CACHF																								
57 PIBNC																								
58 PIBND																								
59 PIBNF																								
60 TSMEC																								
61 TSMED										CHLA GROUP														
62 TSMEF																								
63 ABCOC	3	3		4	2	4	2	4	2	1	5	4	4	4	2	2	2	2		1	2	4	3	2
64 ABCOD	4	4		5	5	5	4	5	3	2	5	5	5	5	3	3	3	3		3	3	5	4	2
65 ABCOF	0	0		5	5		10	0	0	0	5	0	20	10	0	0	5	0		0	0	5	0	5
66 PSMEC			5			2	2		1			1	1	1	1	2						1	2	1
67 PSMED			5			2	3		2			1	1	2	1	3						2	3	1
68 PSMEF			0				0		0			0	0	0	0	0						0	0	5
69 CACHC					2	2	2	1			1						2					2	1	2
70 CACHD					3	2	3	2			1						3					2	2	2
71 CACHF					5		5	0			0						5					5	0	0
72 CADEC											3	1	2											
73 CADED											3	1	3											
74 CADEF											0	0	0											
75 LIDE3C					3	4		1														4		
76 LIDE3D					3	3		2														4		
77 LIDE3F					0	5		5														0		
78 ARMEC					2	2																		
79 ARMED					2	3																		
80 ARMEF					5																			
81 CHLAC	3	3	2	2	2	2	2	3	3	3	4	2	2	3	3	3	3	4	3	2	3	3	4	5
82 CHLAD	4	4	3	2	2	3	3	3	5	5	3	2	2	3	5	5	5	5	5	5	5	3	5	5
83 CHLAF	0	0	0	0	0		0	20	0	5	0	0	0	0	5	0	0	0	0	0	0	0	5	15
84 ARMASC																								
85 ARMASD																								
86 ARMASF																								
87 TABRC					1	0	1			1								1					1	
88 TABRD					1	0	2			2								2					2	
89 TABRF					0	5	0			0								0					0	
90 QUCHC					0																			
91 QUCHD					0																			
92 QUCHF					10																			
93 PILAC					2																			
94 PILAD					2																			
95 PILAF					0																			
96 CONUC																								
97 CONUD																								
98 CONUF																								
99 ACMAC																								
100 ACMAD																								
101 ACMAF																								
102 PIMUC																								

APPENDIX IV

	CHLA 227	186	175	207	9	187	194	206	171	112	69	7	111	109	110	67	121	120
1 COMPT	4304	4307	4204	4307	4306	4307	4304	4307	4204	4103	4105	4101	4102	4102	4102	4105	4102	4101
2 TWNSP	426	435	411	435	0441	435	431	435	406	401	404	0394	396	396	396	404	396	395
3 RANGE	71	66	71	55	0082	6	61	55	72	66	76	0063	65	65	55	76	65	61
4 ELEV	429	435	375	465	0510	422	372	452	330	330	304	0306	280	282	276	302	284	188
5 ASPCT	30	30	32	33	022	33	28	28	21	33	37	021	22	38	21	31	40	21
6 SLOPE	5	55	55	40	50	50	10	50	45	25	42	40	60	60	55	75	10	15
7 GEOL	9	7	6	7	0007	7	5	7	5	7	5	0006	5	2	5	5	5	7
8 LDFRM	3	3	3	3	0003	3	3	3	3	3	3	0003	3	3	3	3	3	3
9 MACRO	1	1	2	1	0002	1	1	1	2	2	2	0002	2	2	2	2	2	2
10 MICRO	2	1	3	1	0001	1	3	1	3	3	1	0003	1	1	3	3	1	3
11 POSIT	1	2	3	3	0004	2	3	3	3	4	4	0004	4	3	4	5	4	5
12 TRA	320	400	320	320	0400	160	400	400	560	240	240	0560	320	240	280	200	280	520
13 LITER					80					90	70	55	75	50	60	40	70	35
14 MOSS	0	45	30	80	05	75	70	30		10	15	30	0	10	30	20	25	60
15 ARGRO	0	5	25	0	00	0	0	0	5	0	0	05	0	0	0	0	0	0
16 PVNT	0	0		0	00	0	0	0		0	0	00	0	0	0	0	0	0
17 ROCK	0	90	35	80	15	75	0	40		0	15	10	5	40	10	40	5	5
18 SOIL	55	33	55	32	0021	33	11	22	33	34	55	0045	34	35	45	55	40	46
19 CONST	23	22	22	21	21	22		21	22	22	24	22	22	22	22	23	21	24
20 CONGT	13	12	12	11	11	12		11	14	12	13	12	12	14	14	12	11	13
21 RORKF	4	3	4	4	004	3		4	2	4	4	004	3	3	3	4	4	4
22 RTOPT	56	38	28	34	030	36		44	29	34	23	020	26	30	21	26	22	54
23 TOOPT	56	38	30	40	039	36		44	29	34	26	020	26	30	29	26	22	54
24 [redacted]				CHUM														
25 [redacted]																		
26 [redacted]	C./BENE/				CHIOA/QUVA/~~CHUM~~						CHLA/GASH/LIBOL							
27 PSMEC	7	4	9			3	2	5	6	5	5	05	5	3	5	4	4	4
28 PSMED	5	5	5	4	03	3	3	5	5	5	5	04	5	4	5	4	3	3
29 PSMEF	0	0	0	0	00	0	0	0	0	0	0	00	0	0	0	0	0	0
30 ABCOC		3		3	06	3	3										1	
31 ABCOD		4		3	05	2	3										3	
32 ABCOF		0		5	00	5	0										0	
33 PILAC		4		2				1			1					1		
34 PILAD		3		2				2			1					1		
35 PILAF		0		0				0			5					0		
36 ABMAS																		
37 ABMAS																		
38 ABMAS																		
39 CADEC	1				03			2										
40 CADED	2				03			3										
41 CADEF	0				00			0										
42 CHLAC		3	3	4	02	3	6			3	2	05	3	5	3	4	5	6
43 CHLAD		4	4	5	03	3	5			4	1	04	3	5	3	5	5	5
44 CHLAF		0	0	0	00	0	10			0	0	00	0	0	0	0	0	0
45 PIPOC								1										
46 PIPOD								1										
47 PIPOF								0				CHLA ZONE						
48 PIJEC																		
49 PIJEC																		
50 PIJEF																		
51 PIMOC				3	02	3												
52 PIMOD				3	02	2												
53 PIMOF				5	00	0												
54 CACHC																	4	
55 CACHD																	3	
56 CACHF																	0	
57 PIBRC		3		3		4		3										
58 PIBRD		4		3		5		3										
59 PIBRF		0		0		5		0										
60 TSHEC																		
61 TSHED																		
62 TSHEF												CHLA GROUP						
63 ABCOC	4	2		2	04	2	2	3	2	2			2	2	2		3	1
64 ABCOD	5	3		4	05	4	3	5	2	3			3	3	3		5	2
65 ABCOF	5	0		5	05	5	0	0	0	5			0	0	0		10	0
66 PSMEC	1			1		2	2	1			1	01	2	3	2		3	3
67 PSMED	2			3		4	2	2			2	01	3	4	3		3	3
68 PSMEF	0			0		0	0	0			0	00	10	15	0		0	0
69 CACHC	2									3	6	02	2		2		2	
70 CACHD	2									4	5	02	4		3		3	
71 CACHF	0									5	20	00	0		0		25	
72 CADEC		2			03			2	1									
73 CADED		3			02			3	2									
74 CADEF		0			00			0	0									
75 LIDE3C	2						2		7		5	04					0	2
76 LIDE3D	3						2		5		3	04					0	3
77 LIDE3F	0						40		55		35	05					5	10
78 ARMEC													1					
79 ARMED													2					
80 ARMEF													0					
81 CHLAC	3	3	3	2		2	3	1	2	1	3	03	2	4	2	2	3	4
82 CHLAD	3	4	3	4		4	5	2	3	2	3	05	4	5	4	2	3	5
83 CHLAF	0	0	5	0		0	10	0	0	0	5	35	15	10	0	0	0	5
84 ABMASC				1														
85 ABMASD				1														
86 ABMASF				0														
87 TABRC	1		3	2		1				2			2	2	2	3	1	
88 TABRD	2		5	2		2				3			3	3	3	5	1	
89 TABRF	0		0	0		0				0			0	0	0	5	10	
90 QUCHC																		
91 QUCHD																		
92 QUCHF																		
93 PILAC								1										
94 PILAD								1										
95 PILAF								0										
96 CONUC									2			01			2	3		
97 CONUD									3			02			3	3		
98 CONUF									0			00			0	0		
99 ACMAC															1	3		2
100 ACMAD															2	3		3
101 ACMAF															0	0		0
102 [illegible]				2		1												

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APPENDIX IV

LIDE3	28	31	147	29	167	177	151	165	162	170	152	164	176	174	183	148	136	135	140	225	154	156	134	175
1 COMPT	4203	4203	4202	4203	4201	4204	4201	4201	4202	4204	4201	4202	4204	4204	4204	4202	4202	4202	4202	4305	4201	4201	4202	4304
2 TWNSP	413	412	404	413	404	406	404	405	404	411	404	405	411	411	412	404	405	406	405	422	404	405	406	431
3 RANGE	82	82	75	82	72	72	72	72	73	71	71	73	72	71	86	75	74	74	74	71	72	72	74	61
4 ELEV	250	254	340	266	310	355	330	375	344	370	325	370	365	375	455	325	312	389	260	395	325	330	307	360
5 ASPCT	30	37	38	40	38	30	40	32	33	32	40	27	30	31	260	34	23	40	40	26	20	30	31	33
6 SLOPE	27		25	10	30	50	50	40	60	50	40	30	40	40	30	35	18	45	60	45	15	45	80	5
7 GEOL	6	6	5	6	6	5	6	6	5	6	5	6	6	6	5	5	5	5	5	6	5	5	5	5
8 LDFRM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9 MACRO	1	2	1	1	2	2	2	1	1	2	2	1	2	2	1	1	3	1	1	1	2	1	1	2
10 MICRO	3	3	1	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
11 POSIT	3	3	3	3	3	3	2	2	2	3	2	2	2	2	3	3	3	3	3	3	2	3	3	1
12 TBA	300	200	400	280	400	400	180	520	320	440	360	320	180	360	400	320	150	500	360	400	560	520	240	360
13 LITER	75	80		80														90	95					
14 MOSS	20	20	25	20	70	35	80		20	30	60		40	45	10	75	60	45	90	15	5		35	15
15 MRGRO	0	0		0		0	25				5		0		5		0	10	0	5			20	0
16 PVWT	3	0		0		0							0		0		0	0	0	0			0	0
17 ROCK	5	9		0	5	5	40	5			60		25		20		0	30	5	20			30	0
18 SOIL	56	55	55	33		33	45	34	22	34	35	25	34	55	55	35	35	35	25	22	64	33	33	36
19 CONST	24	22	24	21		22	22	21	22	21	22	24	22	22	22	22	22	21	24	21	24	21	22	24
20 CONST	13	12	14	11		12	13	12	12	12	14	14	12	12	14	12	14	14	13	11	14	11	12	13
21 WORKF	4	3	3	3	3	3	5	4		3	3	4	5	4	3	3	5	5	5	2	5	4	5	3
22 RTOPT	18	25	45	28		37	68	68		25	43	59	67	31	24	38	34	48	33	41	50	31	44	33
23 TOOPT	18	20	45	28		37	72	68		31	43	68	67	36	24	39	35	40	33	41	50	35	44	33
24 [illegible]																								
25 [illegible]																								
26 [illegible]	L./GASH/ACTR							LIDE3/ACCI/ACTR										LIDE3/BENE/LIBOL						
27 PSMEC	5	5	5	6	5	6	5	6	4	6	5	7	5	6	6	5	6	4	5	5	7	6	4	6
28 PSMED	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5
29 PSMEF	0	0	0	0		0	0	0	0	0	0	0	0	5	0		0	10	5	15	5	0		0
30 ARCOC												1								4				1
31 ARCOD												2								3				1
32 ARCOF												0								0				0
33 PILAC	1		5	1				2	3		3		3	1	1		2	2	1				4	
34 PILAD	2		4	3				3	3		2		3	2	1		2	3	1				4	
35 PILAF	0		0	0				0	0		0		0	0	0		5	0	0					
36 ABMAS																								
37 ABMAS																								
38 ABMAS																								
39 CADEC											3													
40 CADED											2													
41 CADEF											0													
42 CHLAC																								
43 CHLAD																								
44 CHLAF																								
45 PIPOC															1						2	2		2
46 PIPOD															1						2	2		2
47 PIPOF											LIDE3 ZONE				4						0	0		0
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC																								
52 PIMOD																								
53 PIMOF																								
54 CACHC																								
55 CACHD																								
56 CACHF																								
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								
60 TSHEC																								
61 TSHED																								
62 TSHEF									LIDE3 GROUP															
63 ABCOC								3		1		4	3	3	3	1	2		3	4				2
64 ABCOD								3		1		3	3	3	3	2	3		3	3				3
65 ABCOF								0		0		30	0	5	0		0		0	5				0
66 PSMEC	2	4	3	3	2	1			1				2	0	2	1	1			3		3	1	2
67 PSMED	3	4	3	4	3	2			1				2	0	2	1	2			3		3	3	2
68 PSMEF	10	0	0	0		0			0				0	5	0		0			5		5	0	0
69 CACHC	3		6	5		2			1			2		2		5	4	2	3				1	
70 CACHD	4		5	4		3			1			3		2		5	4	2	4				2	
71 CACHF	0		0	5		0			5			0		0		10	5	0	5				0	
72 CADEC					1	1	4								1									1
73 CADED					1	1	2								2									1
74 CADEF						0	0								0									0
75 LIDE3C	2	4	4	4	5	5	2	5	7	7	5	6	4	5	3	4	5	6	5	4	4	3	3	4
76 LIDE3D	3	4	3	4	5	5	4	5	5	5	5	5	5	5	4	3	5	5	5	5	5	5	4	3
77 LIDE3F	25	5	25	25	25	75	55	55	90	60	5	40	20	55	20	25	25	20	25	25	5	10	10	25
78 ARMEC	2		1		1	2			2	1	3	2	2		3		4	2		1	2	2	3	2
79 ARMED	4		1		2	3			3	2	2	3	3		3		4	2		2	2	2	5	3
80 ARMEF	0		0		15	0			0	0	0	5	0		0		0	0		0	0		0	0
81 CHLAC																								
82 CHLAD																								
83 CHLAF																								
84 ABMASC																								
85 ABMASD																								
86 ABMASF																								
87 TABRC			1	2	1										1	1			2	1			1	
88 TABRD			1	3	2										2	1			2	2			1	
89 TABRF			0	0											0				0	0			0	
90 QUCHC					1		1	2		1	2	2	2	2	4		2	3		2		2	3	1
91 QUCHD					1		2	3		1	2	3	3	3	4		2	3		3		3	4	2
92 QUCHF							0	5		0	0	0	35	10	10		0	15		5			5	0
93 PILAC	2	2						1	1					1										
94 PILAD	3	2						1	1					1										
95 PILAF	0	0						0	0					0										
96 CONUC	3	2	1	4		2	3						1			3	2							
97 CONUD	4	3	1	4		3	3						1			3	3							
98 CONUF	0	0	0	0		0	0						0				0							
99 ACMAC		3				2		1		2	2													
100 ACMAD		4				3		1		2	2													
101 ACMAF		3				0		0		0	0													
102 PIMOC																1					1	1		

APPENDIX IV

	PSME 38	1	145	43	2	37	39	66	153	25	41	23	24	22	21	68	20	155	30	27	226	40	157	26
1 COMPT	4108	4101	4105	4107	4101	4108	4108	4106	4201	4203	4107	4203	4203	4203	4203	4105	4302	4201	4203	4203	4305	4107	4201	4203
2 TWNSP	411	0394	404	406	0394	411	414	405	404	413	411	426	413	414	0414	404	0426	405	413	413	422	411	404	413
3 RANGE	63	0061	76	62	0061	64	61	63	72	83	62	81	82	83	0083	76	0081	72	82	81	71	63	73	83
4 ELEV	334	0388	410	318	0390	370	312	384	320	320	322	332	314	344	0345	306	0310	350	294	250	410	325	325	324
5 ASPCT	22	032	28	33	027	28	32	21	20	31	38	34	33	31	030	37	030	32	30	28	28	38	34	32
6 SLOPE	17	60	30	40	30	27	45	57	30	45	55	50	50	55	50	35	70	50	80	45	80	55	45	67
7 GEOL		0005	5	5	0005	5		5	5	6	5	6	6	6	0007	5	0006	6	6	6	5	5	5	6
8 LDFRM	3	0003	3	3	0003	3	3	3	3	3	3	3	3	3	0003	3	0003	3	3	3	3	3	3	3
9 MACRO	1	0002	1	1	0002	1	1	1	2	1	1	2	1	2	0002	2	0002	1	1	1	1	1	1	1
10 MICRO	3	3003	1	1	0001	1	3	1	1	3	1	3	1	1	0001	1	0003	3	1	3	1	3	3	3
11 POSIT	4	0002	2	4	0001	4	4	4	2	2	4	2	3	2	0002	4	0003	3	2	2	2	4	2	2
12 FMA	240	0240	440	240	0400	360	360	220	560	360	160	320	320	280	0280	320	0320	320	200	160	360	120	400	320
13 LITER	95	30		90	97	90	85	95		80	75	95	75	70	85	50	85		60	85		35		75
14 MOSS	5	05	15	5	01	5	5	0		5	5	0	5	20	10	40	05	10	0	10	40	15	70	10
15 HRGRD	0	15		0	01	0	0	0		0	5	0	0	0	00	0	00	25	20	0	15	0	0	0
16 PVMT	3	00		0	00	0	0	0		0	0	0	0	0	00	0	00		0	0	0	0	0	0
17 ROCK	0	50	5	5	01	5	10	5		15	15	5	20	10	00	10	10		20	5	75	50	50	15
18 SOIL	55	0043	33	55	0043	55	33	33	45	55	35	35	56	33	0022	55	0033	34	35	46	22	33	44	35
19 CONST	22	21	24	24	21	22	21	21	24	22	21	22	24	22	22	23	21	21	22	22	21	21	22	22
20 CONST	14	11	16	14	11	12	12	11	14	14	14	14	13	12	12	13	11	12	12	13	11	11	14	14
21 BORKF	4	004	5	3	004	3	4	2	5	4	3	4	4	4	005	4	003	4	3	4	4	3	3	2
22 HTOPT	32	029	38	27	012	28	26	17	27	38	38	32	19	27	036	24	033	36	36	24	54	30	30	24
23 TOOPT	34	020	38	27	018	36	26	17	27	40	38	32	19	27	036	36	033	36	36	24	54	30	30	24
24 [redacted]																								
25 [redacted]	PSME/BENE/WHMO									PSME/LIDE3/LIBOL							PSME/RHDI/WHMO							
26 [redacted]																								
27 PSMEC	5	05	7	5	05	2	5		3	5	5	5	3	5	04	5	06	6	5	4	6	5	5	4
28 PSMED	5	35	5	4	05	3	5		4	5	5	5	5	5	05	5	05	5	5	5	5	3	5	3
29 PSMEF	0	00	0	0	00	0	0		0	0	0	0	0	0	00	0	00	0	10	0	0	0	5	0
30 ABCOC						3																3		
31 ABCOD						3																4		
32 ABCOF						0																0		
33 PILAC	2				04	4	1		3	3			2		03	2			1	2		3		
34 PILAD	2				04	5	3		4	3			4		04	3			2	4		4		
35 PILAF	0				00	0	0		0	0			0		00	0			0	0		0		
36 ARMAS																								
37 ARMAS																								
38 ABMAS																								
39 CADEC	3								4														2	
40 CADED	3								4														2	
41 CADEF	0								0														0	
42 CHLAC																								
43 CHLAD																								
44 CHLAF																								
45 PIPOC									3															
46 PIPOD									4															
47 PIPOF									0			PSME ZONE												
48 PIJEC																								
49 PIJED																								
50 PIJEF																								
51 PIMOC																								
52 PIMOD																								
53 PIMOF																								
54 CACHC				2		2																		
55 CACHD				3		3																		
56 CACHF				0		0																		
57 PIBRC																								
58 PIBRD																								
59 PIBRF																								
60 TSMEC																								
61 TSMED												PSME GROUP												
62 TSMEF																								
63 ABCOC		01	3	1	01	5					2												1	
64 ABCOD		02	4	2	02	4					3												2	
65 ABCOF		30		0	00	35					0												0	
66 PSMEC	4	C4	3	4	02	5	3	3	1	3	4	4	3	2	02	1	04	4	3	4	3	3	3	3
67 PSMED	5	05	4	5	03	4	4	5	1	5	4	4	4	4	03	2	05	5	5	5	5	5	3	5
68 PSMEF	10	05	5	5	20	5	10	0	5	15	20	5	15	0	00	5	00	5	10	25	0	0	5	5
69 CACHC	2			3	03		4		2	3	5	2	3	3	03	5								
70 CACHD	2			3	05		4		2	3	5	3	4	5	05	5								
71 CACHF	C			5	00		15		0	0	5	0	5	20	00	0								
72 CADEC	2					2			6													2	2	
73 CADED	3					3			5													2	3	
74 CADEF	0					0			55													0	0	
75 LIDE3C			2														03	3		4	1		2	
76 LIDE3D			2														03	3		4	2		3	
77 LIDE3F																	10	5		30	0		0	
78 ARMEC	2	01	2		02	2	3		3	2	1			2		5	02	4	2	2		2	2	1
79 ARMED	2	32	2		02	2	4		3	3	2			4		3	03	3	2	3		3	3	1
80 ARMEF	0	38			00	0	0		0	0	0			0		0	00	0	5	0		0	0	5
81 CHLAC																								
82 CHLAD																								
83 CHLAF																								
84 ARMASC			1																					
85 ARMASD			1																					
86 ABMASF																								
87 TABRC				1		1						3		1	01							3	3	
88 TABRD				1		1						4		1	01							3	5	
89 TABRF				0		0						5		0	00							0	0	
90 QUCHC			3	2													03	2	2		3		2	
91 QUCHD			3	3													03	3	2		3		3	
92 QUCHF				5													00	5	5		30		30	
93 PILAC				1		2		1		2			2		02	1			2	2				
94 PILAD				1		2		1		3			3		03	1			2	3				
95 PILAF				0		0		0		0			0		00	0			0	5				
96 CONUC						3	2					2		1	01			1						
97 CONUD						3	3					3		2	01			2						
98 CONUF						0	0					0		0	00			0						
99 ACMAC						1					1							1				2		
100 ACMAD						1					2							2				3		
101 ACMAF						0					0							0				0		
102 PIMUC		42																1						

APPENDIX IV

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		PSME 102	
1	COMPT	4184	
2	TWNSP	401	
3	RANGE	64	
4	ELEV	476	
5	ASPCT	21	
6	SLOPE	40	
7	GEOL	5	
8	LOFRM	3	
9	MACRO	1	
10	MICRO	3	
11	POSIT	2	
12	THA	720	
13	LITER	95	
14	MOSS	0	
15	BRRRD	0	
16	PVNT	0	
17	ROCK	5	
18	SOIL	32	
19	CONST	21	
20	CONST	11	
21	BORKF	4	
22	RTOPT	26	
23	TOOPT	26	
24	[illegible]		
25	[illegible]		
26	[illegible]		← PSME/RHDI/WHMO
27	PSMEC	6	
28	PSMED	5	
29	PSMEF	9	
30	ABCOC		
31	ABCOD		
32	ABCOF		
33	PILAC		
34	PILAD		
35	PILAF		
36	ARMAS		
37	ARMAS		
38	ARMAS		
39	CADEC		
40	CADED		
41	CADEF		
42	CHLAC		
43	CHLAD		
44	CHLAF		
45	PIPOC		
46	PIPOD		
47	PIPOF		← PSME ZONE
48	PIJEC		
49	PIJEC		
50	PIJEF		
51	PIMOC		
52	PIMOD		
53	PIMOF		
54	CACHC		
55	CACHD		
56	CACHF		
57	PIBRC		
58	PIBRD		
59	PIBRF		
60	TSMEC		
61	TSMED		← PSME GROUP
62	TSMEF		
63	ABCOC	9	
64	ABCOD	0	
65	ABCOF	5	
66	PSMEC	3	
67	PSMED	4	
68	PSMEF	0	
69	CACHC		
70	CACHD		
71	CACHF		
72	CADEC		
73	CADED		
74	CADEF		
75	LIDE3C		
76	LIDE3D		
77	LIDE3F		
78	ARMEC		
79	ARMED		
80	ARMEF		
81	CHLAC		
82	CHLAD		
83	CHLAF		
84	ARMASC		
85	ARMASD		
86	ARMASF		
87	TABRC		
88	TABRD		
89	TABRF		
90	QUCHC		
91	QUCHD		
92	QUCHF		
93	PILAC		
94	PILAD		
95	PILAF		
96	CONUC		
97	CONUD		
98	CONUF		
99	ACMAC		
100	ACMAD		
101	ACMAF		
102	PIMOC		

APPENDIX IV

	PIJE 149	150	19	159	137	158	166	160	161	200	209	212	210	179	178	180	196
1 COMPT	4201	4201	4303	4202	4202	4202	4201	4202	4202	4307	4307	4306	4307	4204	4204	4204	4304
2 TWNSP	404	404	0426	404	405	405	404	404	404	435	435	434	435	411	411	411	431
3 RANGE	72	72	0082	73	74	73	72	73	73	55	54	54	54	86	71	71	61
4 ELEV	320	320	0350	285	280	260	335	300	302	480	483	430	480	390	400	395	360
5 ASPCT	20	22	028	27	28	20	32	40	31	33	33	24	28	28	22	33	30
6 SLOPE	15	35	45	44	49	35	45	55	50	20	5	30	30	35	10	45	20
7 GEOL	1	1	0001	1	2	5	2	1	1	2	1	1	1	1	1	1	5
8 LDFRM	3	3	0003	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9 MACRO	2	2	0001	1	2	1	2	1	1	1	1	1	1	1	1	1	2
10 MICRO	1	1	0003	1	1	1	1	1	3	1	2	1	1	1	1	1	1
11 POSIT	2	2	0002	2	1	3	4	2	2	1	1	1	2	2	1	2	1
12 TBA	140	300	0120	160	320	140	290	520	360	80	80	80	80	320	200	240	320
13 LITER			60														
14 MOSS			00	15	0	10	10	20	50	0	0	0	0	0	0	0	15
15 HRGRO	15	10	10	25	0	20			5	0	0	55	25	35	5	10	0
16 PVNT			00		0	0				0	0	0	0	0	0	0	0
17 ROCK	15		30	30	0	65		5	40	45	45	65	65	65	50	0	5
18 SOIL	34	45	0000	45	33	34	30	44		44	45	33	45	35	33	33	45
19 CONST	21	25		23	22	23	21	24		24	24	22	24	21	22	22	22
20 CONST	11	14		13	14	13		13		14	14	14	14	12	12	12	12
21 RORKF	2	3		3	4	2		3	3	3	4	2	4	2	2	2	5
22 RTDPT	28	31		37	24	33		42		32	18	14	19	28	9	12	36
23 TODPT	29	36		37	24	33		42		32	18	14	19	25	9	12	36
24 [redacted]																	
25 [redacted]																	
26 [redacted]	PIJE/FERU									PIJE/QUVA/FERU							
27 PSMEC		2			5	4	5	4	3	3	1			2	2	4	6
28 PSMED		3			5	5	5	4	3	3	2			3	3	5	5
29 PSMEF		0			0	0	0	0	0	5	0			0	0	5	0
30 ARCOC																	
31 ARCOD																	
32 ARCOF																	
33 PILAC						1											
34 PILAD						1											
35 PILAF						0											
36 ABMAS																	
37 ABMAS																	
38 ABMAS																	
39 CADEC				2			3	4		3	3	3	3	1		3	
40 CADED				3			3	4		3	3	3	3	2		3	
41 CADEF							5	0		5	25	0	5	0		0	
42 CHLAC								1	6								
43 CHLAD								2	5								
44 CHLAF								0	0								
45 HIPUC																	2
46 PIPOD																	3
47 PIPOF											PIJE ZONE						[illegible]
48 PIJEC	5	4	03	3	2	1	2	3	[illegible]	[illegible]	[illegible]	[illegible]	3	3	4	3	
49 PIJED	5	5	05	5	2	2	2	3	1	5	3	5	5	5	5	3	
50 PIJEF	0	0	30		0	0	5	0	0	0	5	0	0	0	0	0	
51 PIMUC										3	3		1			1	
52 PIMUD										3	5		1			1	
53 PIMUF										5	15		0			0	
54 CACHC																	
55 CACHD																	
56 CACHF																	
57 PIBRC																	
58 PIBRD																	
59 PIBRF																	
60 TSMEC																	
61 TSMED						PIJE GROUP											
62 TSMEF																	
63 AMCUC										1	1					1	2
64 AMCUD										1	1					1	3
65 AMCUF										0	0					0	0
66 PSMEC		4			3	3	2	3		3	2	1	1	1	2	1	3
67 PSMED		2			3	5	5	5		3	3	2	1	2	2	2	4
68 PSMEF		9			0	0	0	5		5	0	0	0	0	0	0	0
69 CACHC																	
70 CACHD																	
71 CACHF																	
72 CADEC	2	2	02	3	3	1		2		3	3	2	3	3	3	2	
73 CADED	3	2	03	5	3	1		3		4	4	3	4	5	4	5	
74 CADEF	0	0	00	5	5	0		5		5	25	0	5	0	0	0	
75 LIDE3C					3				2								3
76 LIDE3D					3				2								4
77 LIDE3F					0				0								0
78 ARMEC					4			2	2								
79 ARMED					4			2	3								
80 ARMEF					0			0	10								
81 CHLAC								1	4	2							
82 CHLAD								2	5	2							
83 CHLAF								0	10	0							
84 ARMASC																	
85 ARMASD																	
86 ARMASF																	
87 TABRC								1	2								
88 TABRD								2	3								
89 TABRF								0	0								
90 QUCHC					5	0			2						3		
91 QUCHD					5	0			3						3		
92 QUCHF					40	20			10						25		
93 PILAC						1											
94 PILAD						1											
95 PILAF						0											
96 CONUC									2								
97 CONUD									3								
98 CONUF									15								
99 ACMAC																	
100 ACMAD																	
101 ACMAF																	
102 PIMUC										4	3		1				

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APPENDIX V

Overstory

Code	Scientific Name	Author	Common Name
ABCO	ABIES CONCOLOR	(Gord. & Glend.)	white fir
ABMAS	ABIES MAGNIFICA SHASTENSIS	Lemm.	Shasta red fir
CACH	CASTANOPSIS CHRYSOPHYLLA	(Dougl.) A. DC.	golden chinkapin
CADE	CALOCEDRUS DECURRENS	(Torr.)	incense cedar
CHLA	CHAMAECYPARIS LAWSONIANA	Parl.	Port-Orford-cedar
PIBR	PICEA BREWERIANA	Wats.	Brewer spruce
PIJE	PINUS JEFFERYI	Grev. & Balf.	Jeffery pine
PILA	PINUS LAMBERTIANA	Dougl.	sugar pine
PIMO	PINUS MONTICOLA	Dougl. Ex D. Don	western white pine
PIPO	PINUS PONDEROSA	Dougl. Ex Loud.	Ponderosa pine
PSME	PSEUDOTSUGA MENZIESII	(Mirbel) Franco	Douglas-fir
TSME	TSUGA MERTENSIANA	(Bong.) Carr	mountain hemlock

Understory

Code	Scientific Name	Author	Common Name
ACMA	ACER MACROPHYLLUM	Pursh	bigleaf maple
ALRU	ALNUS RUBRA	Bong.	red alder
ARME	ARBUTUS MENZIESII	Prush	Pacific madrone
CONU	CORNUS NUTTALLII	Aud. ex T. & G.	Pacific dogwood
LIDE3	LITHOCARPUS DENSIFLORA	(H. & A.) Rend.	tanoak
QUCH	QUERCUS CHRYSOLEPIS	Liebm.	canyon live oak
TABR	TAXUS BREVIFOLIA	Nutt.	Pacific yew

Shrubs

Code	Scientific Name	Author	Common Name
ACCI	ACER CIRCINATUM	Pursh	vine maple
ACGL	ACER GLABRUM	Torr.	Douglas maple
AMPA	AMELANCHIER PALLIDA	Greene	pale serviceberry
ARNE	ARCTOSTAPHYLOS NEVADENSIS	Gray	pinemat manzanita
ARPA	ARCTOSTAPHYLOS PATULA	Greene	greenleaf manzanita
BEAQ	BERBERIS AQUIFOLIUM	Pursh	Oregon hollygrape
BENE	BERBERIS NERVOSA	Pursh	Cascade hollygrape
BEPI	BERBERIS PIPERIANA	(Abrams) McMinn	Piper's hollygrape
COCOC	CORYLUS CORNUTA CALIFORNICA	(DC.) Sharp	California hazel
GABU	GARRYA BUXIFOLIA	Gray	Box-leaved garrya
GASH	GAULTHERIA SHALLON	Pursh	salal
HODI	HOLODISCUS DISCOLOR	(Pursh) Maxim.	oceanspray
LOCI	LONICERA CILIOSA	(Pursh) DC.	western trumpet honeysuckle
LOCO	LONICERA CONJUGALIS	Kell.	purpleflower honeysuckle
LOHI	LONICERA HISPIDULA	(Lind.) Dougl.	hairy honeysuckle
PAMY	PACHISTIMA MYRSINITES	(Pursh) Raf.	myrtle pachistima
QUSA	QUERCUS SADLERIANA	R. BR.	Sadler oak
QUVA	QUERCUS VACCINIFOLIA	Kell.	huckleberry oak
RHDI	RHUS DIVERSILOBA	T. & G	poison oak
RHMA	RHODODENDRON MACROPHYLLUM	G. Don	Pacific rhododendron
RIBI	RIBES BINOMINATUM	Hel.	Siskiyou gooseberry
RILA	RIBES LACUSTRE	(Pursh) Foir.	prickly currant
RILO	RIBES LOBBII	Gray	Lobbs gooseberry

Shrubs (Cont'd)

Code	Scientific Name	Author	Common Name
RIVI	RIBES VISCOSISSIMUM	Pursh	sticky currant
ROGY	ROSA GYMNOCARPA	Nutt.	Little wood rose
RULA	RUBUS LASIOCOCCUS	Gray	dwarf bramble
RUPA	RUBUS PARVIFLORUS	Nutt.	western thimbleberry
RUUR	RUBUS URSINUS	Cham. & Schlecht.	California dewberry
SOSI	SORBUS SITCHENSIS	Roemer	Sitka mountain-ash
SYMO	SYMPHORICARPOS MOLLIS	Nutt.	Snowberry
VAME	VACCINIUM MEMBRANACEUM	Dougl. Ex Hook.	big whortleberry
VAPA	VACCINIUM PARVIFOLIUM	Smith	red whortleberry

Herbs

Code	Scientific Name	Author	Common Name
ACMI	ACHILLEA MILLEFOLIUM	L.	-
ACRU	ACTAEA RUBRA	(Nutt.) Hult.	baneberry
ACTR	ACHLYS TRIPHYLLA	(Smith) DC.	vanilla leaf
ADBI	ADENOCAULON BICOLOR	Hook.	trail plant
ANDE	ANEMONE DELTOIDEA	Hook.	three leaf anemone
ANLY2	ANEMONE LYALLII	Britt.	Lyall anemone
APAN	APOCYNUM ANDROSAEMIFOLIUM	Gray	dogbane
AQFO	AQUILEGIA FORMOSA	Fisch.	Sitka columbine
ARCO	ARNICA CORDIFOLIA	Hook.	hartleaf arnica
ARLA	ARNICA LATIFOLIA	Bong.	broadleaf arnica
ARMA3	ARENARIA MACROPHYLLA	Hook.	-
ASBRG	ASTER BRICKELLIOIDES GLABRATUS	Greene	-
ASCA3	ASARUM CAUDATUM	Lindl.	wild ginger
ASDE	ASPIDOTIS DENSA	(Brackenr.) Lellinger.	podfern
ASHA	ASARUM HARTWEGI	Wats.	mottleleaf ginger
BROMU	BROMUS	L.	brome
CABU2	CALYPSO BULBOSA	(L.) Oakes	calypso
CAPUP	CARDAMINE PULCHERRIMA PULCHERRIMA	Greene	slender toothwart
CAPR3	CAMPANULA PRENANTHOIDES	Dur.	California bellflower
CAREX	CAREX	L.	sedge
CASC2	CAMPANULA SCOULERI	Hook. Ex A. DC.	-
CIAL	CIRCAEA ALPINA	L.	alpine circaea

Herbs (Cont'd)

Code	Scientific Name	Author	Common Name
CHME	CHIMAPHILA MENZIESII	(R. Br.) Spreng.	little princes-pine
CHUM	CHIMPAPHILA UMBELLATA	(L.) Bart.	common princes-pine
CLUN	CLINTONIA UNIFLORA	(Schult.) Kunth	queencup beadlily
COHE	COLLOMIA HETEROPHYLLA	Hook.	-
COMA3	CORALLORHIZA MACULATA	Raf.	spotted coralroot
COME	CORALLORHIZA MERTENSIANA	Bong.	Pacific coralroot
COST2	CORALLORHIZA STRIATA	Lindl.	hooded coralroot
CYGR	CYNOGLOSSUM GRANDE	Dougl. Ex Lehm	Pacific houndstongue
DELPH	DELPHINIUM	L.	larkspur
DIHOO	DISPORUM HOOKERII	(Torr.)	-
EPMI	EPILOBIUM MINUTUM	Lindl. Ex Hook.	-
ERAL	ERIGERON ALICEAE	Howell	fleabane
FEOC	FESTUCA OCCIDENTALIS	Walt.	western fescue
FERU	FESTUCA RUBRA	L.	red fescue
FESU	FESTUCA SUBULATA	Trin.	bearded fescue
FESU2	FESTUCA SUBULIFLORA	Scribn.	-
FESTU	FESTUCA	L.	fescue
FRVEB	FRAGARIA VESCA BRACTEATA	(Heller) Davis	strawberry
GAAM	GALIUM AMBIGUM	Wight	obscure bedstraw
GAAP	GALIUM APARINE	L.	catchweed bedstraw
GOOB	GOODYERA OBLONGIFOLIA	Raf.	plantain
HIAL	HIERACIUM ALBIFLORUM	Hook.	white hackweed
IRCH	IRIS CHRYSOPHYLLA	Howell	white iris

Herbs (Cont'd)

Code	Scientific Name	Author	Common Name
LATHY	LATHYRUS	L.	peavine
LIBOL	LINNAEA BOREALIS LONGIFLORA	Torr.	twinflower
LICO3	LISTERA CORDATA	(L.) R. Er.	northern listera
LIWA	LILIUM WASHINGTONIANUM	Kell.	Washington lily
LOTUS	LOTUS	L.	vetch
MESU	MELICA SUBULATA	(Griseb.) Schribn.	oniongrass
MITR2	MITELLA TRIFIDA	Grah.	-
MOSIS	MONTIA SIBERICA SIBERICA	(L.) How.	miners lettuce
OSCH	OSMORHIZA CHILENSIS	H. & A.	-
OSPU	OSMORHIZA PURPUREA	(Coult. & Rose) Suksd.	-
PEAN	PENSTEMON ANGUINEUS	Eastw.	-
PERA	PEDICULARIS RACEMOSA	Dobl. Ex Hook	sickletop pedicularis
PHAD	PHLOX ADSURGENS	Torr. Ex Gray	periwinkle phlox
PHCO3	PHACELIA CORYMBOSA	Jep.	-
PHSP	PHLOX SPECIOSA	Pursh.	showy phlox
POHE2	POLYPODIUM HESPERIUM	Maxon	licorice fern
POMUI	POLYSTICHUM MINITUM IMBRICANS	(D.C. Eat.) Maxon	dry site swordfern
POMUM	POLYSTICHUM MUNITUM MUNITUM	(D.C. Eat.) Maxon	wet site swordfern
PTAQ	PTERIDIUM AQULINUM	(L.) Kuhn in Von Der Decken	-
PYAP	PYROLA APHYLLA	Smith	leafless pyrola

Herbs (Cont'd)

Code	Scientific Name	Author	Common Name
PYASP	PYROLA ASARIFOLIA PURPUREA	(Bunge) Fern.	-
PYDE	PYROLA DENTATA	Smith	toothleaf pyrola
PYPI	PYROLA PICTA	Smith	white vein pyrola
PYSE	PYROLA SECUNDA	L.	one sided pyrola
SASA2	SARCODES SANQUINEA	Torr.	snow plant
SMRA	SMILACINA RACEMOSA	(L.) Desf.	solomon plume
SMST	SMILACINA STELLATA	(L.) Desf.	starry solomon plume
SYRE	SYNTHYRIS RENIFORMIS	(Dougl.) Benth.	snow queens
TITRU	TIARELLA TRIFOLIATA UNIFOLIATA	(Hook.) Kurtz.	coolwart
TRLA2	TRIENTALIS LATIFOLIA	Hook.	starflower
TROV	TRILLIUM OVATUM	Pursh	Pacific trillium
VAHE	VANCOUVERIA HEXANDRA	(Hook.) Norr. & Dec.	insideout flower
VECA	VERATRUM CALIFORNICUM	Durand	false hellebore
VIAM	VICIA AMERICANA	Muhl. Ex Willd.	American vetch
VIAMV	VICIA AMERICANA VILLOSA	(Kell.) Hermann	bitleaf vetch
VIGL	VIOLA GLABELLA	Nutt.	pioneer violet
VIOLA	VIOLA	L.	violet
VIOR2	VIOLA ORBICULATA	Gey. Ex Hook	-
WHMO	WHIPPLEA MODESTA	Torr.	whipplevine
XETE	XEROPHYLLUM TENAX	(Pursh) Nutt.	beargrass