THE FOREST COMMUNITIES OF THE LITTLE LOST MAN CREEK RESEARCH NATURAL AREA, REDWOOD NATIONAL PARK, CALIFORNIA

J.M. Lenihan 1983

ABSTRACT

This paper describes a forest classification study in the Little Lost Man Creek Redwood Research Natural Area, CA. Data from 80 sample plots were analyzed using cluster analysis, contingency analysis, discriminant analysis, and phytosociological table manipulation. Eight unions and three associations were described on the basis of floristic composition. These are the Sequoia-Blechnum, Sequoia-Mahonia, and Sequoia-Arbutus associations. The associations occur in moist, mesic, and xeric environments, respectively. An association map of the natural area was prepared using the grid method.

INTRODUCTION

This paper presents the results of a vegetation classification study in the Little Lost Man Creek Redwood Research Natural Area in Redwood National Park, CA. The 2,400 ac watershed was set aside by the National Park Service to preserve a representative unit of virgin upland redwood forest for research and educational purposes. The purpose of this study was to define forest community types in the research natural area (RNA) and to provide baseline documentation within each community type for future comparisons and additional scientific research.

There are few detailed accounts of the phytosociologic nature of redwood vegetation. Becking (1982) has differentiated two broad categories of redwood vegetation at the "alliance" level. Zinke (1977) discussed redwood vegetation in terms of prevalent species of conifers and hardwoods. On the basis of very few reconnaissance plots, Dyrness et al. (1972) recognized three community types in the redwood vegetation of Wheeler Creek RNA in southwestern Oregon. Waring and Major's (1964) gradient analysis of redwood vegetation has some applicability to this study. On a brief visit to Redwood National Park and nearby state parks, Daubenmire and Daubenmire (1975) noticed two ecologically distinct redwood forest-types and recommended that special effort be directed to define the ecological subsystems of the redwood forest.

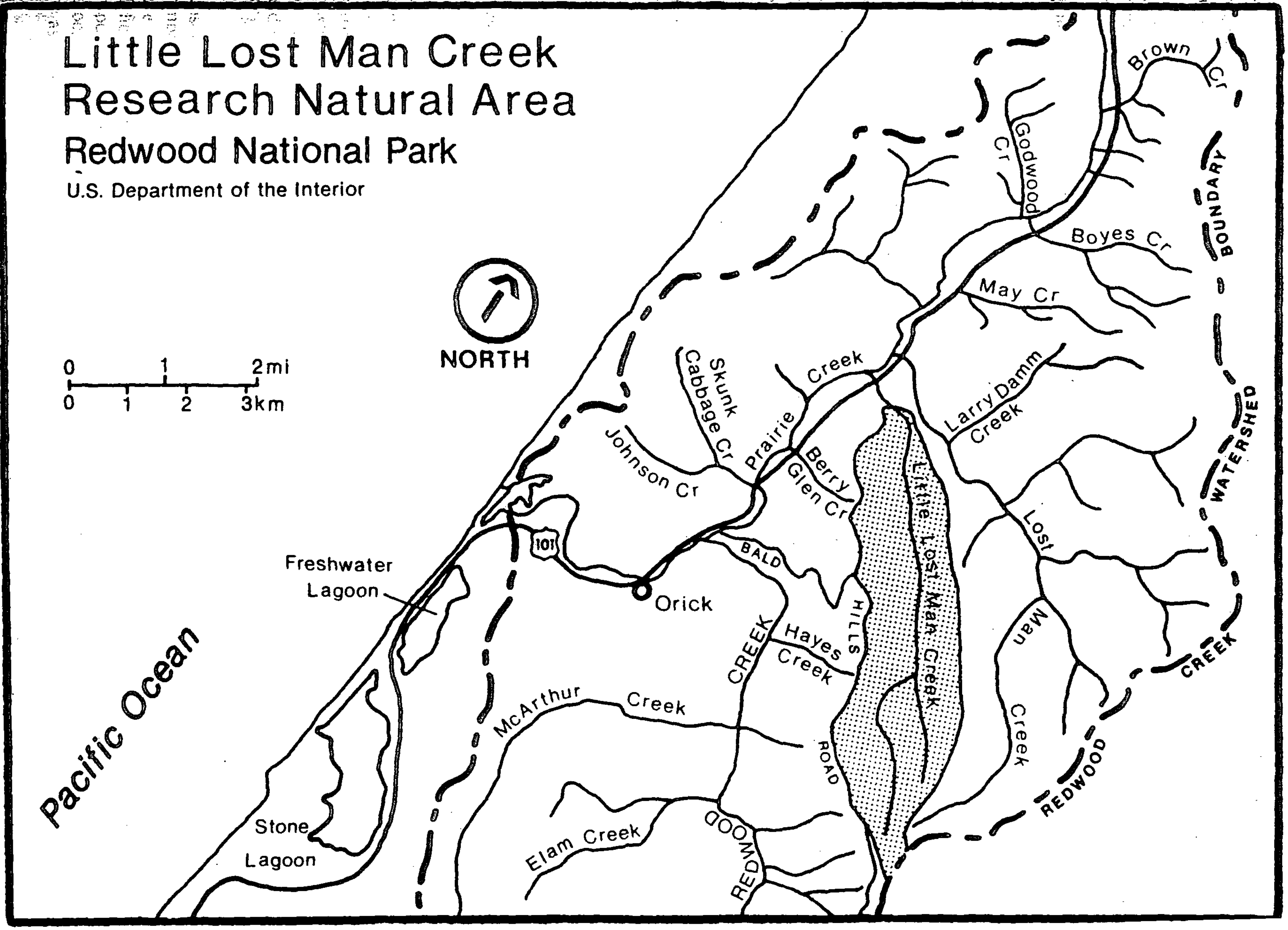
Much of the forest classification work in the Pacific Northwest is based on concepts advocated by Daubenmire (1952). The classification units in these studies are often the "union" and the "association". Unions are groups of species of similar life-form and local environmental amplitude. Associations are groups of unions superimposed on the same area. This two-level classification hierarchy was applied to the vegetation of Little Lost Man Creek watershed to facilitate the comparison of the results with other classification studies in the Pacific Northwest.

Multivariate techniques (Gauch 1982) were applied to the floristic and environmental data collected in 80 sample plots systematically distributed throughout the natural area. Eight unions and three associations were defined by cluster and contingency analysis. The results of discriminant analysis suggest that the associations are distributed along a moisture gradient defined by elevation, topography, slope position, soil texture, and soil development. A forest association map of the RNA was prepared using the grid method described by Goodall (1953) and others.

STUDY AREA

The Little Lost Man Creek Redwood Research Natural Area is located near Orick, Humboldt County, CA (Fig. 1). The RNA occupies virtually the entire drainage of Little Lost Man Creek and its boundaries, following the ridgeline of the watershed. The natural area has a moderate, maritime

Redwood National Park, P.O. Box SS, Arcata, CA 95521


Little Lost Man Creek
Research Natural Area
Redwood National Park
U.S. Department of the Interior
NORTH
0 1 2mi
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Pacific Ocean
Freshwater Lagoon
Stone Lagoon
Orick
101
Brown Cr
Godwood Cr
Boyes Cr
May Cr
Larry Damm Creek
Skunk Cabbage Cr
Prairie Creek
Johnson Cr
Berry Glen Cr
Little Lost Man Creek
Lost Man Creek
BALD HILLS ROAD
REDWOOD CREEK
Hayes Creek
McArthur Creek
Elam Creek
REDWOOD CREEK WATERSHED BOUNDARY

Figure 1

climate with cool, rainy winters and warm, nearly rainless summers. Heavy, wet fog produced by onshore movement of moist oceanic air is common in the summer months. Average annual precipitation is about 64 in. January is the coldest month with an average temperature of 45° F. August and September are the warmest months with average temperatures of 60° F. (U.S. Dept. of Commerce 1970-1980).

Little Lost Man Creek is a perennial stream flowing from southeast to northwest through a deeply-incised, two-branched canyon. Elevations range from 100 ft to 2,400 ft, and most of the drainage consists of moderate to steep slopes (20-60%). The principal rocks in the RNA are Franciscan graywacke sandstones and interbedded shales (Bailey et al. 1964). The soils belong to the Melbourne, Hugo, Mendocino, and Usal soil series (USDA Soil Conservation Service 1963). Melbourne and Melbourne/Hugo associations make up 95% of the natural area.

METHODS

Field Sampling

A grid system of 100 sample points was superimposed on a 7.5 ft topographic map of the RNA. Twenty points fell within the stream channel or in logged areas of the watershed. These points were eliminated from the sample. The remaining 80 sample stands were located along the east-west lines of the grid system by pacing with a compass, a topographic map, and a pocket altimeter. A 10x25 m sample plot was placed in a representative portion of each sample stand. The basal area of the canopy species was measured with an angle gauge from a central point in the plot. Every vascular plant species occurring within the plot boundaries was recorded under one of five different life-form categories (Mueller-Dombois and Ellenburg 1974). The cover of each species was estimated using a six-point cover scale (Daubenmire 1968). Several environmental factors were also measured or described. The aspect of the sample plot was recorded in degrees azimuth using a Silva range compass. The percent slope of the plot was measured with a clinometer. The plot elevation in feet was estimated using the topographic map and pocket altimeter. The topographic configuration of the plot was described as concave, even, or convex. Soil samples were collected at 4 in intervals down to 20 in. The sample plot was then photographed in black and white from a representative angle.

Data Analysis

Cover data in the five life-form categories were grouped into tree, tall shrub, and low shrub/herb categories. The data matrices for these three field layers were screened for species with less than 5% frequency. Species meeting this criteria were withdrawn from the analysis.

The first step in the analysis focused on the lower level of the classification hierarchy, the unions. Cluster analysis, a statistical method of partitioning populations into classes (Clifford and Stephenson 1975), was used to find groups of species with a similar distribution in each field layer. A distance matrix of the arccosines of the correlations between all pairs of species was calculated from the species cover data for each field layer. Polythetic, agglommerative clustering was applied to each distance matrix using the average linkage rule to determine the sequence of clustering. Dendrograms were then constructed to show the linkage of species at various levels of similarity. Species clusters were defined by the structure of the dendrograms and by reference to subjective concepts of the unions formed by field observation. Subsequent manipulation of phytosociological tables (Westhoff and van der Maarel 1978) improved the floristic definition of the unions.

The investigation then turned to the upper level of the classification hierarchy, the associations. A subset of union core plots was selected from the total set of sample plots to best represent the floristic composition of the unions. The coincidence of the unions from different field layers was then investigated by contingency analysis (Kershaw 1973). Contingency tables were assembled for each pair of field layers to show the joint frequency distribution of the core plots by their union membership. Inspection of the high frequency cells in the contingency tables led to the initial concept of the associations. Subsequent manipulation of a phytosociological table improved the floristic definition of the associations.

The next objective of the analysis was to investigate the relationship between the associations and 10 different physiographic factors. The plot elevation, slope, and topography were entered into the analysis as measured or described in the field. The azimuth of the plot was transformed into two directional vectors. The north-south vector equaled the cosine of the azimuth, and the east-west vector equaled the sine of the azimuth. A composite variable called the radiation index was based on the latitude, slope, and azimuth of the plot (Frank and Lee 1966). The slope position of the plot was described by four different variables: 1) the horizontal distance from the plot to the ridgeline, 2) the angle up the slope from horizontal, 3) the height of the plot above the creek, and 4) the plot elevation expressed as a fraction of the elevation of the ridgeline (Kercher and Goldstein 1977).

Discriminant analysis (Tatsuoka 1970) was used to investigate the relationship of the associations to these physiographic factors. Discriminant analysis is a method of distinguishing between groups (e.g. the associations) by forming linear combinations of discriminating variables (e.g. the physiographic factors) called discriminant functions that serve to maximize group separation. A set of discriminant functions was derived from the physiographic data for the association core plots. Changes in Wilks' lambda were used to test the significance of each function. An index of discriminating power described by Tatsuoka (1970) was calculated for the set of functions. This is a measure of the total variability of the functions attributable to physiographic differences among associations. The pooled within-group correlations between the functions and the discriminating variables were examined to identify environmental factors that best distinguish the associations.

Soils were described for the association core plots. The color, texture, and depth of the soil horizons were examined for similarities that would serve to characterize the associations edaphically. The soils were also compared to the Soil Survey series descriptions to evaluate the correspondence between the associations and the soil series within the RNA.

The final objective of the analysis was to classify non-core plots so that the association membership of all plots in the sample grid could be indicated on the topographic map of the RNA. A set of discriminant functions was derived from a new set of discriminating variables. These variales were characteristic species selected to represent the associations and physiographic factors shown to be effective discriminators in the previous step of the analysis. The discriminant scores for the association core plots and the pooled within-groups covariance matrix for the functions were used to derive a classification function for each association (Klecka 1975). Non-core plots were scored on each classification function and these scores were converted to probabilities of association membership. Non-core plots were assigned to the association in which the probability of membership was the highest. The classification functions were also used to reclassify the core plots. The percent correct reclassifications is a measure of the effectiveness of the classification functions.

The statistical analyses were accomplished using the BMDP (Dixon and Brown 1979) and the SPSS (Nie et al. 1975) program packages on the Cyber-170 computer at Humboldt State University. The variable clustering program in BMDP was used to cluster species. The CROSSTABS and DISCRIMINANT programs in SPSS were used for contingency analysis and discriminant analysis. A computer program written in Fortran V sequenced the species and plots in the phytosociological tables.

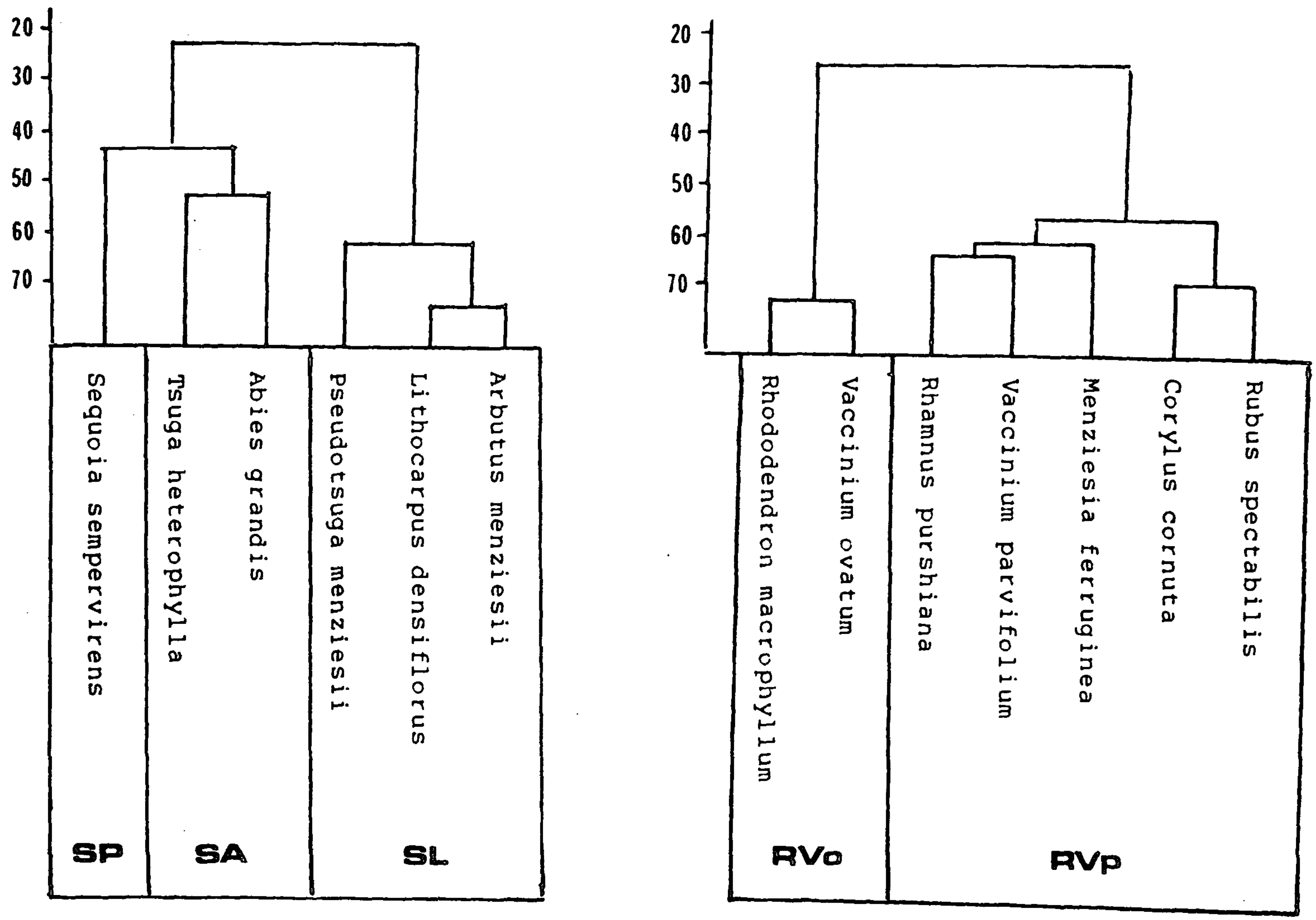
RESULTS

Eight unions in the three field layers were identified from the results of cluster analysis. The dendrograms in Figs. 2-4 show the species in the different field layers forming unions at the 50% to 60% similarity level.

Three associations were identified by inspection of the contingency tables (Tables 1-3) and by manipulation of the phytosociological table summarized in Table 4. This constancy table (Becking 1957) shows the within-association frequencies and modal cover ratings for species from all three field layers. Table 5 shows the mean basal area values by association for the overstory species. The final classification at both levels of the hierarchy is presented in Table 6.

Figures 2 and 3

Results of clustering in the tree and tall shrub layers. Vertical scale is the arcsine of the correlation recoded to a similarity measure between 0 and 100. Union symbols are as follows: SP = Sequoia-Picea, SA = Sequoia-Abies, SL = Sequoia-Lithocarpus, RVo = Rhododendron-Vaccinium, RVp = Rhamnus-Vaccinium.



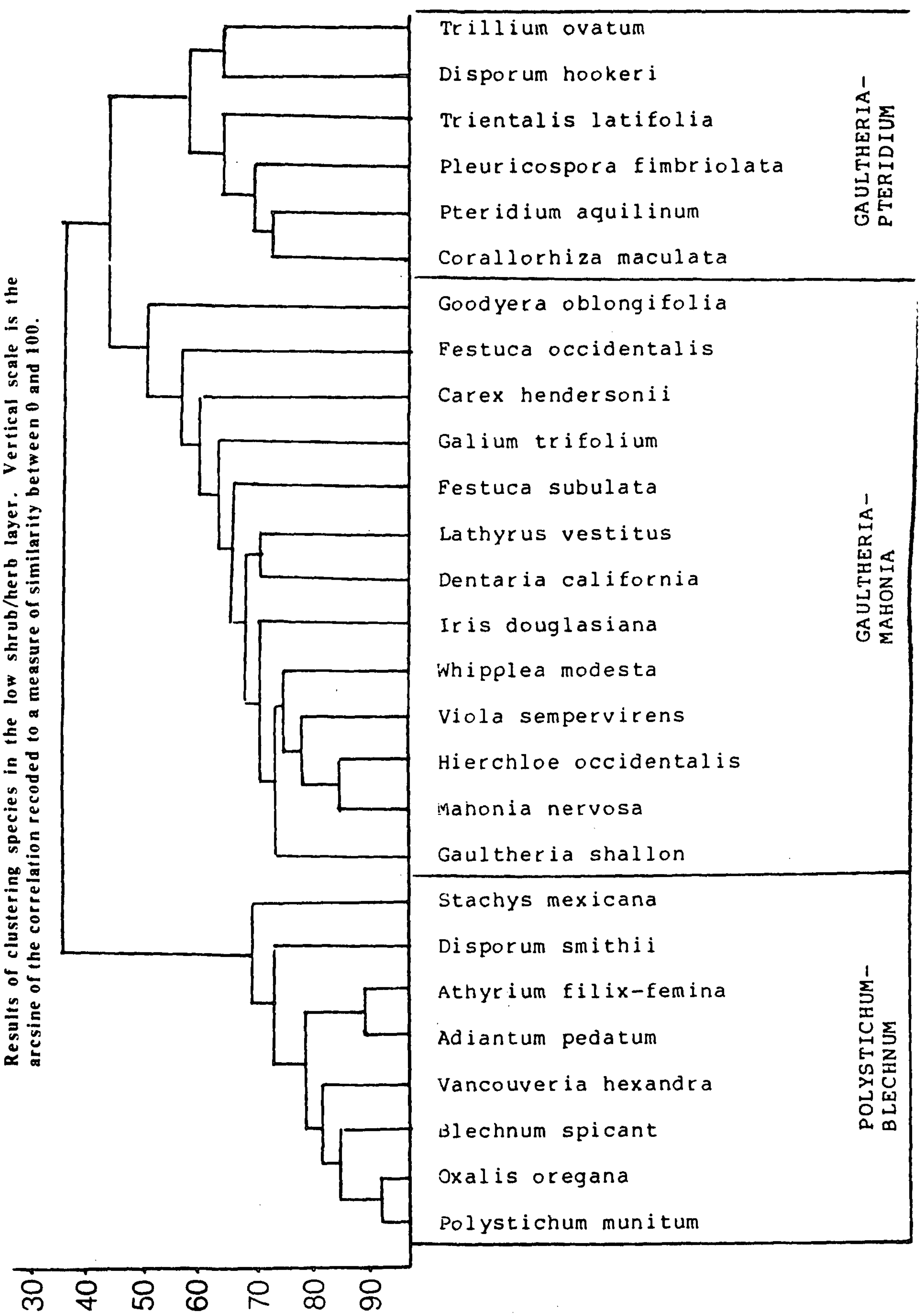


Figure 4

Results of clustering species in the low shrub/herb layer. Vertical scale is the arcsine of the correlation recoded to a measure of similarity between 0 and 100.

Table 1

Contingency Table Showing Joint Frequency Distribution of Union Core Plots in the Tree and Tall Shrub Unions

	Rhamnus-Vaccinium	*Rhododendron-Vaccinium*
Sequoia-Picea	9	0
Sequoia-Abies	2	15
Sequoia-Lithocarpus	0	11

Table 2

Contingency Table Showing Joint Frequency Distribution of Union Core Plots in the Tree and Low Shrub/Herb Unions

	Polystichum-Blechnum	*Gaultheria-Mahonia*	*Gaultheria-Pteridium*
Sequoia-Picea	8	0	0
Sequoia-Abies	1	23	0
Sequoia-Lithocarpus	0	1	11

Table 3

Contingency Table Showing the Joint Frequency Distribution of Union Core Plots in the Tall Shrub and Low Shrub/Herb Unions

	Polystichum-Blechnum	*Gaultheria-Mahonia*	*Gaultheria-Pteridium*
Rhamnus-Vaccinium	9	1	0
Rhododendron-Vaccinium	0	20	10

Table 4

Constancy Table for the Associations of Little Lost Man Creek RNA. Table Entries are Percent Frequencies/Modal Crown Cover Values. Cover Values are 1:1 to 5%, 2:6 to 25%, 3:26 to 50%, 4:51 to 75%, 5:76 to 100%.

	Sequoia-Blechnum	*Sequoia-Mahonia*	*Sequoia-Arbutus*
TREE LAYER			
(canopy species)			
Picea sitchensis	14/1		
Abies grandis		38/1	
Tsuga heterophylla	43/1	25/1	
Pseudotsuga menziesii	57/1	100/3	100/2
Sequoia sempervirens	100/4	100/3	92/2
(subcanopy species)			
Picea sitchensis	14/1		
Abies grandis		38/2	
Arbutus menziesii			75/2
Pseudotsuga menziesii		25/1	58/1
Tsuga heterophylla	71/1	56/3	33/3
Sequoia sempervirens	100/2	88/2	58/1
Lithocarpus densiflorus	57/3	100/4	100/4
TALL SHRUB LAYER			
Rubus spectabilis	29/1		
Menziesia ferruginea	43/1		
Corylus cornuta		57/2	
Rhamnus purshiana	57/1	19/1	
Vaccinium parvifolium	86/3	63/1	25/1
Rhododendron macrophyllum	29/1	81/2	83/3
Vaccinium ovatum	100/1	100/3	100/3
LOW SHRUB/HERB LAYER			
Blechnum spicant	100/2	06/1	
Mahonia nervosa	14/1	100/2	
Polystichum munitum	100/5	100/2	25/1
Gaultheria shallon	14/1	100/3	100/3
Stachys mexicana	29/1		
Adiantum pedatum	43/1		
Disporum smithii	57/1		
Athyrium filix-femina	71/1		
Vancouveria hexandra	57/1	19/1	
Oxalis oregana	100/3	56/2	
Galium triflorum	29/1	94/1	
Hierchloe occidentalis		94/1	
Festuca subulata		63/1	
Iris douglasiana		44/1	
Lathyrus vestitus		44/1	
Viola sempervirens		100/2	92/1
Whipplea modesta		69/1	17/1
Disporum hookeri		19/1	17/1
Festuca occidentalis		19/1	17/1
Trientalis latifolia		25/1	58/1
Dentaria californica		31/1	50/1
Goodyera oblongifolia		44/1	50/1
Pteridium aquilinum			67/1
Pleuricospora fimbriolata			50/1
Corallorhiza maculata			50/1
Boschniakia strobilacea			17/1
Pyrola picta			17/1
Lotus aboriginuum			17/1

Table 5

Mean Basal Area in Square Feet Per Acre for Canopy Species in Each Association

	Sequoia-Blechnum	*Sequoia-Mahonia*	*Sequoia-Arbutus*
Picea sitchensis	4	0	0
Abies grandis	0	39	0
Tsuga heterophylla	19	30	0
Pseudotsuga menziesii	25	227	140
Sequoia sempervirens	611	344	154
All canopy species	659	639	294

Table 6

Classification Hierarchy for the Little Lost Man Creek Research Natural Area

Association	Tree Union	Shrub Union	Herb Union
Sequoia-Blechnum	*Sequoia-Picea*	*Rhamnus-Vaccinium*	*Polystichum-Blechnum*
Sequoia-Mahonia	*Sequoia-Abies*	*Rhododendron-Vaccinium*	*Gaultheria-Mahonia*
Sequoia-Arbutus	*Sequoia-Lithocarpus*	*Rhododendron-Vaccinium*	*Gaultheria-Pteridium*

The physiographic separation among associations was adequately described by a single discrimina function statistically significant at the 0.001 level. About 92% of the total variability of this function attributable to physiographic differences among associations. The pooled within-group correlatio between the function and the discriminating variables are shown in Table 7. Elevation, topography, ar the fractional slope position are the variables that best distinguish the associations.

Table 7

Pooled-Within Group Correlations Between the Discriminant Function and the Physiographic Variables

Elevation	.58668
Topography	.25036
Slope Position	.21190
Slope	-.17949
Distance to Ridge	-.17880
Radiation Index	.14310
Angle on Slope	.13130
Height Above Stream	.12001
North-South	-.03749
East-West	.02073

The associations were not as well-differentiated by edaphic characters. The soils of the association core plots more or less fit the Melbourne series description. Surface horizons were brown to dark brown clay loams. Subsurface horizons were brown to yellowish-brown clay loams or gravelly clay loams. Some generalized differences in soils among associations are noted below.

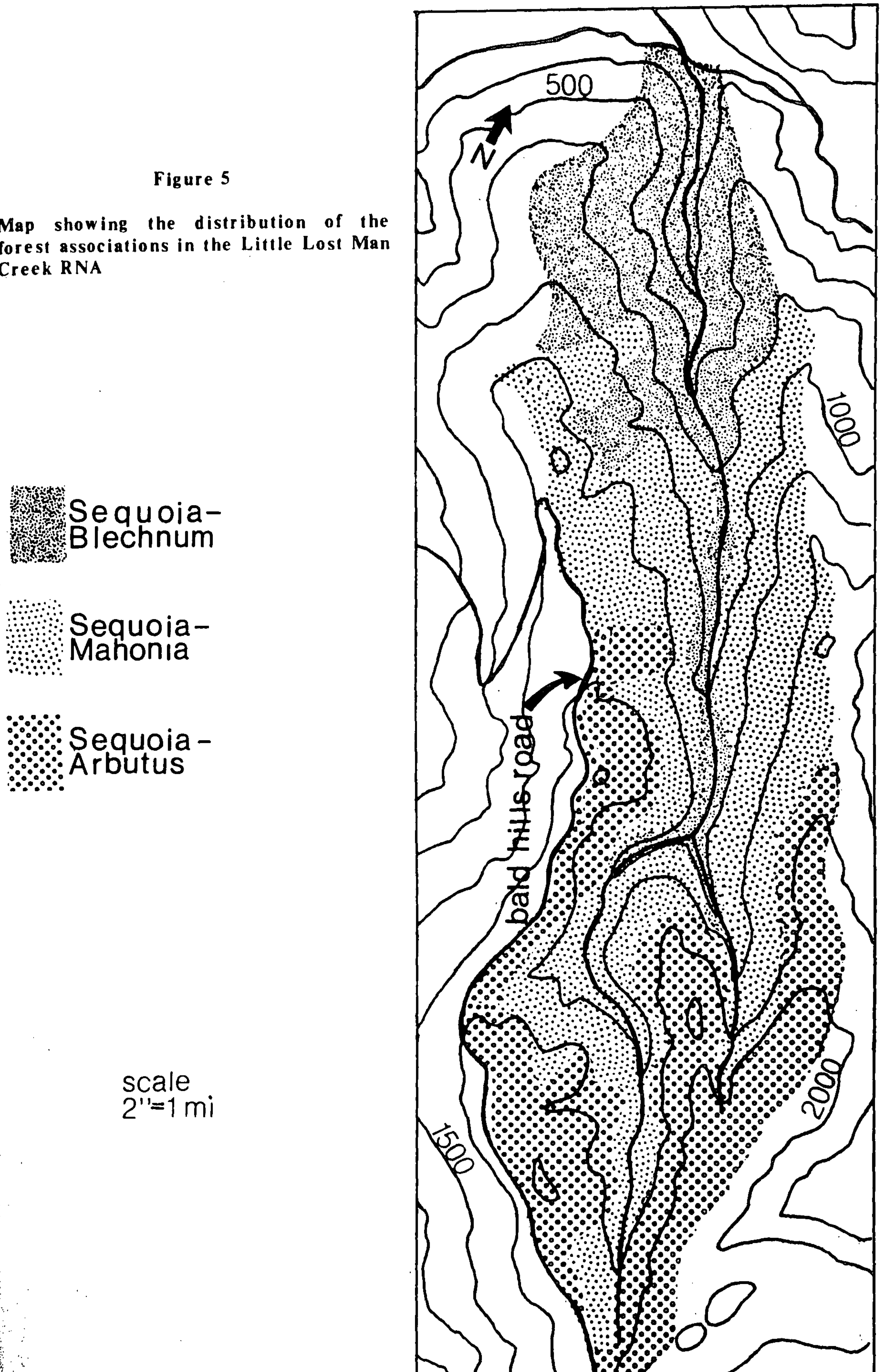
Two discriminant functions, both significant at the .001 level, were derived for mapping purposes. About 99% of the total variability of both functions is attributable to the floristic and environmental differences among associations. The classification functions derived from the discriminant functions correctly classified 100% of the association core plots. Non-core plots were assigned to the predicted association with the exception of six plots classified into the Sequoia/Arbutus association. These plots were considered to be poorly classified because they lack the character species and coincidence of unions typical of the xeric association, and because they are outside the lower elevation range of this association. These six plots were left unclassified. The association membership of the remaining plots in the sample grid was indicated on the topographic map of the RNA. Boundary lines were drawn around clusters of adjacent plots within the same association (Goodall 1953) to produce the forest association map of the natural area (Fig. 5).

The results are summarized in the following descriptions of the associations (nomenclature after Munz and Keck 1973).

The Sequoia/Blechnum association ranges from 200 to 1,250 ft in elevation and is best developed on lower concave slopes in the northern half of the RNA. At higher elevations this relatively moist type is restricted to slopes directly adjacent to Little Lost Man Creek and its tributaries. The soils of the association are usually moderately-developed clay loams with brown to dark brown surface horizons

Figure 5

Map showing the distribution of the forest associations in the Little Lost Man Creek RNA



and brown, somewhat mottled subsurface horizons. These are the most Melbourne-like soils in RNA.

The Sequoia-Picea union in the tree layer of the association is dominated by a dense canopy *Sequoia sempervirens. Picea sitchensis, Tsuga heterophylla,* and *Pseudotsuga menziesii* also occur the canopy but only as scattered individuals. The mean canopy cover is 70%. *Lithocarpus densifl* occasionally forms an open subcanopy up to 20 ft tall with a cover of 25 to 50%. The tree seedlings a saplings commonly found in this union (in decreasing order of importance) are *Sequoia, Tsu Lithocarpus,* and *Picea.*

The Rhamnus-Vaccinium union in the large shrub layer of the association is dominated *Vaccinium parvifolium.* Other species with significant cover are *Rhamnus purshiana, Menzie ferruginea,* and *Vaccinium ovatum. Corylus cornuta* var. *californica* co-dominates in the large shr layer on relatively open sites. The mean cover for the union is 30%.

The Polystichum-Blechnum union in the low shrub and herbaceous layers of the association dominated by *Polystichum munitum* and *Oxalis oregana.* Characteristic members of the union a *Blechnum spicant, Athyrium filix-femina* var. *sitchense, Disporum smithii, Adiantum pedatum* v *aleuticum,* and *Stachys mexicana.* Species frequently present as scattered individuals are *Vancouver hexandra* and *Galium triflorum.* The mean cover for the union is 90%.

The Sequoia/Mahonia association ranges from 1,000 to 1,750 ft in elevation throughout a lar portion of the RNA. This relatively mesic type is best developed at mid-range elevations on eve slopes. At lower elevations the association occupies the convex upper slopes and ridgetops. At high elevations the association is restricted to more sheltered topography. The soils of this association a usually moderately-developed clay loams to gravelly clay loams with brown surface horizons and brow to yellowish-brown subsurface horizons.

The Sequoia-Abies union in the tree layer of the association is dominated by a dense canopy *Sequoia* and *Pseudotsuga. Abies grandis* and *Tsuga heterophylla* are common components of th canopy and occasionally co-dominate with *Sequoia* and *Pseudotsuga.* The mean crown cover for th union is 60%. *Lithocarpus* usually forms an open to dense subcanopy up to 40 ft tall with a cover of 2 to 75%. The tree seedlings and saplings found in this union (in decreasing order of importance) ar *Sequoia, Tsuga, Lithocarpus, Abies,* and *Pseudotsuga.*

The Rhododendron-Vaccinium union in the large shrub layer of the association is co-dominate by *Rhododendron macrophyllum* and *Vaccinium ovatum. Vaccinium parvifolium* is present onl occasionally as scattered individuals. The mean cover for the union is 60%.

The Gaultheria-Mahonia union in the low shrub and herbaceous layer of the association is co dominated by *Gaultheria shallon, Mahonia nervosa,* and *Polystichum munitum* in the low shrub laye The herbaceous layer is dominated by *Viola sempervirens* or co-dominated by *Viola* and *Oxali oregana.* Characteristic members of the union are *Hierochloe occidentalis, Lathyrus vestitus* spp *bolanderi, Iris douglasiana,* and *Festuca subulata.* Species frequently present as scattered individual are *Vancouveria hexandra, Galium triflorum, Whipplea modesta, Goodyera oblongifolia, Dentari californica* var. *sinuata, Festuca occidentalis,* and *Disporum hookeri.* The mean cover for the union i 70%.

The Sequoia/Arbutus association is restricted to elevations above 1,500 ft in the southern half o the RNA. This relatively xeric type is best developed on convex upper slopes and ridgetops. The soils of this association are usually moderately to slightly-developed gravelly clay loams with brown surface horizons and yellowish-brown to pale brown subsurface horizons. Occasional rock outcrops occur in places. Although these soils generally fit the Melbourne series descriptions, they are the most Hugo-like soils in the RNA.

The Sequoia-Lithocarpus union in the tree layer of the association is dominated by an open canopy of *Sequoia* and *Pseudotsuga.* The mean canopy cover is 40%. *Lithocarpus* forms a dense subcanopy in this union. *Arbutus menziesii* and *Chrysolepis chrysophylla* are also present as scattered individuals in the subcanopy which often attains a height greater than 40 ft and a cover of 50-100%. The tree seedlings and saplings commonly found in this union (in decreasing order of importance) are *Lithocarpus, Pseudotsuga, Sequoia,* and *Arbutus. Tsuga* is also an important component of the understory on north facing slopes.

The large shrub layer is occupied by the Rhododendron-Vaccinium union already described for the mesic association. *Vaccinium parvifolium* is absent or infrequent in this association. The mean cover for the union in this association is 70%.

The Gaultheria-Pteridium union in the low shrub and herbaceous layer of the association is dominated by *Gaultheria shallon*. Characteristic members of the union are *Pteridium aquilinum* var. *pubescens, Pleuricospora fimbriolata, Boschniakia strobilacea, Corallorhiza maculata, Pyrola picta* var. *aphylla,* and *Lotus aboriginuum.* Species frequently present as scattered individuals are *Polystichum munitum, Viola sempervirens, Goodyear oblongifolia, Whipplea modesta, Disporum hookeri, Festuca occidentalis,* and *Dentaria californica* var. *sinuata.* The mean cover for the union is 40%.

DISCUSSION

The three forest associations are distributed within the RNA along a moisture gradient defined by elevation, topography, fractional slope position, soil texture, and soil development. The Sequoia/Blechnum association occupies the moist position on the gradient. The lower elevation sites occupied by this association have the highest incidence of fog during the otherwise dry summer months. The relative humidity stays at high levels throughout the summer (Freeman 1971), especially in the sheltered position of lower concave slopes. The relatively deep, organic clay loams that are generally characteristic of these sites are morphologically the soils with the highest moisture-holding capacity in the RNA. The favorable moisture status of sites occupied by the Sequoia/Blechnum association is indicated by the high basal area and high crown cover attained by Sequoia, the dominant species in the tree layer. Species in the understory of this association rate high on Waring and Major's (1964) moisture index, and together they indicate relatively moist conditions in redwood vegetation.

The xeric end of the moisture gradient is occupied by the Sequoia/Arbutus association. This association is restricted to elevations above 1,500 ft in the study area. A warm inversion layer forms at 1,500 ft during the summer months and restricts the incidence of fog above this elevation (Freeman 1971). The relative humidity in the upper reaches of the watershed is lower during the summer, especially on exposed ridgetops and convex upper slopes. The relatively shallow, gravelly loams that are generally characteristic of these sites are morphologically the driest soils in the RNA. The low moisture status of sites occupied by the Sequoia/Arbutus association is indicated by the low crown cover and low basal area of conifers in the tree layer. The dense subcanopy of sclerophyllous hardwoods under the open canopy of conifers is another indication of the xeric nature of sites occupied by this association. Species in the understory of the association rate low on Waring and Major's moisture index, and together they indicate relatively xeric conditions in redwood vegetation.

The mesic position on the moisture gradient is occupied by the Sequoia/Mahonia association. This association occurs throughout the watershed wherever a combination of physiographic and edaphic factors forms a mesic environment. The center of the association's distribution is at mid-elevations in the study area. Here the incidence of fog is variable, and the relative humidity is subject to fluctuation during the summer months. At lower elevations, where the incidence of fog is higher, the Sequoia/Mahonia association occupies exposed positions on ridgetops and convex upper slopes where soils are often more shallow and gravelly. At higher elevations, above the normal fog level, the association occupies lower slopes adjacent to the creek, especially where the topography is concave and soils tend to be deeper and less gravelly. The mesic status of the Sequoia/Mahonia association is indicated by the high crown cover, the high basal area, and the mixed species dominance of conifers in the tree layer. The co-dominance of *Polystichum* and *Gaultheria* in the low shrub layer and the co-dominance of *Oxalis* and *Viola* in the herb layer is another indication of the relatively mesic nature of this association. In both cases, a species common in more moist conditions co-dominates with a species common in drier conditions. The characteristic understory species of the association rate an intermediate score on Waring and Major's moisture index, and together they indicate mesic conditions in redwood vegetation.

The forest associations of the RNA are easily related to the redwood forest alliances described by Becking (1982). The Sequoia-Blechnum association is a member of Becking's Redwood-Oxalis alliance, and both the Sequoia-Mahonia and Sequoia-Arbutus associations are members of the Redwood-

Swordfern alliance. The range of species composition in the natural area is encompassed by th Sequoia-Abies and Sequoia-Pseudotsuga types discussed by Zinke (1977). The moist, mesic, and xeri community types in the Wheeler Creek RNA (Dyrness et al. 1972) resemble their counterparts in Littl Lost Man Creek. The understory unions of the Sequoia-Blechnum and Sequoia-Mahonia association share many species in common with the Western Hemlock/Swordfern-Oregon Oxalis and Wester Hemlock/Pacific Rhododendron/Oregongrape habitats described by Franklin and Dyrness (1973) fo coastal Oregon and Washington. The Pseudotsuga-hardwood forests in the North Coast Range o California (Sawyer et al. 1977) immediately east of the redwood belt resemble the Sequoia-Arbutu association in the natural area.

The primary objective of this study was to classify and map the vegetation of the RNA as : starting point for subsequent studies in the natural area. With some expansion the classification systen devised for Little Lost Man Creek could also be applied to the adjacent lower Redwood Creek basir which is the focus of the National Park Service vegetation management program in Redwood Nationa Park. Here the old-growth redwood types could be related to an existing classification system for earl) successional vegetation (Muldavin et al. 1981) and a classification of older, second growth redwooc forests in the lower basin (Lennox, pers. comm.). The old-growth forest-types, their associated sera types, and the collective area they occupy would define the redwood habitat-types *(sensu* Daubenmire 1952) of the lower basin. Habitat-types have proven to be a very useful framework for understanding the successional dynamics of forest vegetation (Pfister 1982, Jahn 1982). For example, Veirs (1982) has shown that age-class distributions, the incidence of fire, and the successional status of overstory species are markedly different in various types of old-growth redwood forests. An understanding of succession in redwood habitat-types is of fundamental importance if the Redwood National Park vegetation management program is to be founded upon an ecologic basis.