INTERNAL REPORT 102

FOREST PLANT COMMUNITIES OF THE LOWER CEDAR RIVER WATERSHED

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INTRODUCTION

The Cedar River Watershed is one of two principal sites for the Western Coniferous Biome of the International Biological Program (IBP). Various physical and biological components of the watershed are being intensively studied as part of the Analysis of Ecosystems objectives of IBP.

The purpose of this report is to present the results of an initial reconnaissance-level study of the forest vegetation of the watershed. The tentative delineations and descriptions of this vegetation may be useful in the stratification of the watershed for intensive ecological research.

A proposal for an inventory of terrestrial ecosystems of the Cedar River drainage by Scott and Del Moral (1971) was not funded for 1972. However, a half-time graduate student salary for six months and some transportation were made available. This limited funding made possible the initiation of a survey of the forest communities of the watershed. The emphasis during this first field season was placed on the vegetation of the lower watershed. This decision was based on several factors, including the uncertainty of transportation to the upper watershed and the fact that some study of the upper watershed, specifically the Findley Lake Basin, had already been completed (Del Moral, unpublished).

DESCRIPTION OF THE LOWER WATERSHED

The lower watershed can be defined, for the purposes of this report, as that part of the Cedar River Watershed below 600 m in elevation. On this basis it represents approximately 14,000 ha or 40% of the total watershed.

The surficial geology of the lower watershed is typical of much of the Puget Sound Basin. The glacial history of this area has resulted in the build-up within the lower valley of glacial outwash and till--this material overlaying and forming terraces and drumlins. The topography is, with a few local exceptions, gentle. Cole and Gessel (1968) state that there has been little

topographical modification of the area since the Fraser Glaciation (10,000-18,000 years before present).

Most of the soils and weather data available come from the Thompson Research Site which is located at the extreme west end of the watershed. It is presumed that these data provide a reasonable approximation of conditions throughout most of the lower watershed.

There are two primary soil types on the Thompson Site (Cole and Gessel 1968). Everett soils dominate areas of outwash material and are characterized by excessive drainage. In contrast, the poorly drained Alderwood soil is found on the compacted basal till of drumlin areas. Cole and Gessel (1968) attribute the greater soil moisture and cation exchange capacity of the Alderwood soils to its higher silt and clay fraction.

The climate of the lower watershed is mild with January and July average temperatures at the Thompson Site of 3°C and 17°C, respectively. The average annual precipitation at the Thompson Site is approximately 130 cm, of which most falls as rain and over 70% of which falls between October and March. The lower watershed occurs entirely within the *Tsuga heterophylla* Zone as defined by Franklin and Dyrness (1969).

The original forest had been removed from nearly all of the lower watershed by 1924 (Winkenwerder and Thompson 1924). At least one seral stand, the product of a prelogging era fire, now contains *Pseudotsuga menziesii* approximately 150 years old. However, the majority of the forest cover represents planted or natural regeneration 35-40 years of age.

METHODS

The reconnaissance method of forest site classification described by Franklin, Dyrness and Moir (1970) was adopted for this study. This reconnaissance approach allows the description of vegetation units over large areas in a relatively short time. It is a particularly useful method for the investigator who must work without field assistance.

The technique entailed the location of study plots within what were considered to be homogeneous areas. Information measured or estimated on each 15-20 m circular plot included: (1) elevation, (2) slope and aspect, (3) topography and landform, (4) density of forest canopy, (5) basal area (estimated with a wedge prism), abundance and canopy coverage of mature trees by species (mature trees were defined as those thought to have reached sexual maturity, (6) height, DBH and age of the largest tree of each species, (7) abundance and coverage of tree reproduction by species, (8) projection of climax species, (9) abundance and coverage of each species of shrub, herb and moss.

Abundance and coverage were estimated without the aid of a plot frame. The estimates of cover presented here probably represent over-approximations. This is particularly true for the less abundant species as is made evident by the summation of the individual species estimates. Total coverage greater than 100% within a stratum is not unreasonable due to overlap of individuals of different heights. Totals as great as those reported here, however, are probably too high. This assumption is supported by the concurrent installation

of analytic plots in the same area as part of another study. Nevertheless, this source of error should not have a major effect on the conclusions derived from these data. The errors are assumed to be fairly uniform for the entire study and the differences between plots of a particular forest type will be small, relative to the differences between plots of dissimilar forest types.

Species diversity was calculated with Brillouin's formula:

$$H = \frac{1}{N} \log_2 \left(\frac{N!}{n_1!n_2!\ldots\ldots n_s!}\right) \qquad (1)$$

where N equals the total coverage of a particular sample, n_i equals the coverage of the ith species and s equals the total number of species. Coverage values were normalized as $cm^2/100\ m^2$ (Reiners et al 1970). Evenness was calculated as

$$J = H/\log_2 S.$$

RESULTS AND DISCUSSION

Three vegetation units, each of which is seral, were delineated from the vegetation of the lower watershed. They are, in the assumed order of increasing soil moisture and decreasing total area, *Pseudotsuga menziesii/ Gaultheria shallon, Pseudotsuga menziesii/Polystichum munitum* and *Alnus rubra/ Polystichum munitum*. The approximate location of each plot is indicated in Figure 1. Tables 1-4 summarize the environmental and floristic data for each plot of the three different forest communities. Data presented for each plot in Table 1 include total basal area for the trees, aspect, slope, stand age and elevation. Tables 2-4 represent coverage for each species on each plot; average cover values are given for each type.

The *Pseudotsuga/Gaultheria* community represents the most extensive vegetation type on the lower watershed. The data from the eleven reconnaissance plots established within this type are summarized in Tables 1 and 2. The ages of the stands sampled ranged from 34 to 73 years of age. This type, like the others, represents a pioneer stage of a *Tsuga heterophylla* sere. It is characteristically found, but not restricted to moderate slopes and the Everett soil series. Diversity, richness and evenness of this type are lower than either of the other two communities (Table 5).

The overstory tree layer of the *Pseudotsuga/Gaultheria* Community is dominated by *Pseudotsuga menziesii*, with over 75% cover. While *Tsuga heterophylla* occurs as a mature tree in over 50% of the stands sampled, it occurs in the understory in over 80% of these stands. The climax status of this species within the *Pseudotsuga/Gaultheria* community is apparent. *Thuja plicata* on the other hand seems to play a relatively minor role, both as an overstory species (less than 20% constancy) and as reproduction (less than 10% constancy). Basal area for this community averages only 9 m^2/ha--lower than the *Pseudotsuga Polystichum* community. It should be noted that this basal area results from a higher density of stems than is found in stands of the other types.

The tall shrub layer is poorly developed in each of the types. In the *Pseudotsuga/Gaultheria* community there are species which occur in over 40% of the stands but no species averages more than 4% cover. The most common species, *Vaccinium parviflorum*, has 91% constancy and only 3% average cover. *Acer circinatum* and *Holodiscus discolor* are the other two species which commonly occur in these stands (54% and 45% constancy, respectively). Diversity and richness of this stratum are low relative to the same stratum in the other two communities, a fact which may be symptomatic of the generally poor site quality of which the *Pseudotsuga/Gaultheria* community is found.

The low shrub layer is strongly developed in the *Pseudotsuga/Gaultheria* community. The understory of these stands is dominated by *Gaultheria shallon*. This species is ubiquitous within the type and averages over 50% cover. *Rubus ursinus* with 91% constance and *Berberis nervosa* with 75% constancy are common associates of *Gaultheria shallon*. However, both associates average only 3% cover. The total cover for this stratum is over 60%, compared to less than 20% for the same stratum in the other two forest types. When *Gaultheria shallon* is discounted, however, the total cover of this stratum is lowest for the *Pseudotsuga/Gaultheria* community. This discrepancy is probably due in part to the rather arbitrary delineation of strata, but also probably reflects the high concentration of dominance in *Gaultheria shallon* in the *Pseudotsuga/Gaultheria* community.

While fourteen species were found within the herb layer of this type, over 50% of the coverage is contributed by only two species, *Polystichum munitum* and *Pteridium aquilinum*. *Linnaea borealis* and *Viola sempervirens* were the only other species found in over 50% of the stands sampled, but their average cover is only 6% and 1%, respectively. Diversity of this stratum is comparable to that found in the other two types. This fact may reflect a high equibility component of diversity compensating for a relatively low richness component (Table 5).

The moss layer of the *Pseudotsuga Gaultheria* community is dominated by *Eurhynchium oreganum*. This species was found in every stand sampled and has an average cover of 44%. Three other species of moss were found in over 50% of the sampled stands, but each has less than 5% average cover; they are, in decreasing order of occurrence, *Rhytidiadelphus loreus, Mnium insigne* and *Hylocomium splendens*.

Data from the fifteen reconnaissance plots established within the *Pseudotsuga/Polystichum* community are summarized in Tables 1 and 3. The ages of the stands sampled range from 31 to 50 years. This type has the highest diversity and richness of the forest types found on the lower watershed. It is typically found on sites of moderate to steep slope, which may in part account for a more optimium soil moisture status for many species in this community than is found in the *Pseudotsuga/Gaultheria* community.

The overstory of the *Pseudotsuga/Polystichum* community is strongly dominated by *Pseudotsuga menziesii*, which has a 75% average cover for the stands sampled. *Tsuga heterophylla* has a more important role in the structure of these stands than in the *Pseudotsuga Gaultheria* community. Mature individuals of this climax species average over 10% cover and occur in nearly 90% of the plots. *Tsuga heterophylla* regeneration occurs in each of the stands sampled and averages 10% cover. *Thuja plicata* is slightly more common in this type than

in the *Pseudotsuga Gaultheria* community, both as mature trees and regeneration. The overstory tree layer of the *Pseudotsuga/Polystichum* community is the most diverse of any similar stratum in the other two forest types.

The tall shrub layer of the *Pseudotsuga/Polystichum* community is relatively well developed. It has a higher diversity and total average cover than the same stratum in either of the other two types. The layer is dominated by *Vaccinium parviflorum* and *Acer circinatum*, both of which occur in at least 80% of the stands sampled. No single species, however, has over 5% average cover.

The low shrub layer consists of three species, of which only *Berberis nervosa* has over 5% average cover. *Rubus ursinus* occurs in nearly every (93%) stand sampled, but has only 3% average cover. *Gaultheria shallon* occurs in only 67% of the stands sampled and has less than 5% average cover. This is in sharp contrast to the 100% occurrence and 56% cover for *Gaulteria shallon* in the *Pseudotsuga/Gaultheria* community.

The herb layer of the *Pseudotsuga/Polystichum* community has lower diversity and evenness indices than those for the same stratum of the other two types. This is in spite of the fact that its richness (25 species) is nearly equal to that for the herb layer of the *Alnus/Polystichum* community (26 species) and is 50% greater than that for the herb layer of the *Pseudotsuga/Gaultheria* community (14 species).

Dominance of this layer is strongly concentrated in a single species, *Polystichum munitum*. This species is found in every stand sampled, its average cover is 43%. Average cover for only one other species was found to be greater than 5%. *Linnaea borealis* has high coverage in a few of these stands, a fact which results in an average cover of 6%, but only 33% constancy. Besides *Polystichum munitum* only *Pteridium aquilinum* (80%) *Trillium ovatum* (87%) and *Galium triflorum* (53%) occur in over 50% of the sampled stands. Of these, *Trillium ovatum* *Galium triflorum* occur much more commonly in this type than they do in the *Pseudotsuga/ Gaultheria* community.

The moss layer of the *Pseudotsuga/Polystichum* community has a higher diversity than the same stratum for the other two forest communities. The layer is dominated by *Eurchynchium oreganum* with an average cover for the stands sampled of 22%. Two other species, *Mnium insigne* and *Rhytidiadelphus loreus*, were found to occur in at least 80% of these stands.

Twelve reconnaissance plots were established within the *Alnus Polystichum* community; these data are summarized in Tables 1 and 4. The sampled stands range in age from 30 to 50 years. Diversity of this type is intermediate in value relative to that found for the other two types (see Table 5). The *Alnus Polystichum* community is most commonly found on level sites of less than average drainage. Near the Thompson site it has been found to occur on the Alderwood soil series (Cole and Gessel, 1968). The *Alnus/Polystuchum* community probably is indicative of higher soil moisture than is found beneath either *Pseudotsuga* community.

The overstory of the *Alnus/Polystichum* community is strongly dominated by *Alnus rubra*. In the stands sampled this species has an average cover of 75%. While *Acer macrophyllum* and *Pseudotsuga menziessii* both occur in

at least 50% of the sampled stands, their average cover is only 8% and 3%, respectively. The contribution to the structure of these stands by *Tsuga heterophylla* is minor compared to its role in the other two types. This ewduction is true both for mature and immature trees. Since there can be little doubt as to eventual dominance of these sites by *Tsuga heterophylla*, its partial early exclusion from this community is noteworthy.

The tall shrub layer of the *Alnus/Polystichum* community is better developed than the same stratum in the other two forest communities. *Acer circinatum* occurs in over 80% of the sampled stands and contributes an average cover of 8%. Three additional species, *Rubus spectabilis*, *Vaccinium parviflorum* and *Sambucus racemosa*, occur in at least 50% of the sample stands, although all have less than 5% average cover. A total of nine species occur in at least one of the plots for this community.

The low shrub layer of the *Alnus/Polystichum* community is similar to that of the *Pseudotsuga/Polystichum* community. *Rubus ursinus* occurs in every stand and has an average cover of 11%, as opposed to only 3% in the *Pseudotsuga/Polystichum* community. *Gaultheria shallon* and *Berberis nervosa* occur with approximately the same constancy and average cover as they do in the *Pseudotsuga/Polystichum* community.

The *Alnus/Polystichum* community has the richest (26 species on the plots sampled) and most diverse herb layer of the three forest communities. The layer is dominated by *Polystichum munitum* with 58% average cover--15% more cover than this species contributes to the *Pseudotsuga/Polystichum* understory. While this stratum in the *Alnus/Polystichum* and *Pseudotsuga/Polystichum* communities is not dissimilar, there are interesting and perhaps significant differences. For example, on the basis of the stands sampled, of the 31 species found in the herb layer of either one community or the other, over 30% are not common to both. *Montia sibirica* occurs in 75% of the *Alnus/Polystichum* stands, but in less than 10% of the *Pseudotsuga/Polystichum* stands. Two other species occur in at least 50% of the *Alnus/Polystichum* stands, but only *Polystichum munitum* has over 10% average cover.

The moss layer of the *Alnus/Polystichum* community is similar in species composition to the *Pseudotsuga/Polystichum* community, though not so diverse. Of the seven species observed, only two were found in over 50% of the sampled stands. *Eurhynchium oreganum* dominates this stratum. It occurs in 92% of the plots with an average cover of 9%. *Mnium insigne* occurs in 75% of the plots with an average cover of only 1%.

SUMMARY AND CONCLUSIONS

A reconnaissance-level survey of the forest vegetation on the lower Cedar River watershed has resulted in the delineation of three seral forest communities. The lower watershed falls within the *Tsuga heterophylla* Zone and each of the described communities is considered to be a successional precusor of a *Tsuga heterophylla* climax. Distribution of the three communities within the watershed is believed to be controlled in large part by the availability of soil moisture. This supposition is not supported by environmental data, but is suggested by the species composition of the three types.

The validity of these delineations is suggested by their replication in other areas as studied by other investigators. Becking (1955) reports the occurrence of these particular dominate species groupings in his treatment of site classification for western Washington and Oregon. Corliss and Dyrness (1963) report three apparently similar communities in the Oregon Coast Range. Among eight forest associations found beneath *Pseudotsuga menziesii* on eastern Vancouver Island, Mueller-Dombois (1959) lists *Gaultheria shallon* and *Polystichum munitum*. Dyrness, Franklin and Moir (unpublished) describe a *Pseudotsuga menziesii/Acer circinatum/Gaultheria shallon* community in the central portion of the western Cascades of Oregon. A comparison of their data for this community with the data for the *Pseudotsuga/Gaultheria* community of the Cedar River Watershed indicates that there are differences in species occurrence and cover. However, these differences are relatively minor and may perhaps be explainable on the basis of slightly more xeric conditions found in the Oregon Cascades and increased stand age - 125 years for the Oregon stands as opposed to 40 years for the Cedar River study.

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Table 1. Environmental information for the forest communities of the lower Cedar River watershed

Plot No.	Aspect	Slope %	Stand age (Years)	Elevation (meters)	Basal Area (m^2/ha)
Pseudotsuga menziesii/Gaultheria shallon					
1	None	0	40	215	---
4	none	0	38	190	6.90
7	W	25	42	400	8.05
15	none	0	55	275	10.35
19	SE	5	44	285	8.05
48	none	0	40	215	5.75
55	none	0	40	305	9.20
56	E	5	40	275	8.05
57	none	0	73	210	13.80
58	none	0	35	200	9.20
59	none	0	40	210	10.35
Pseudotsuga menziesii/Polystichum munitum					
2	none	0	40	280	13.80
3	N	10	31	365	12.65
5	W	5	35	550	11.50
6	none	0	50	490	10.35
16	N	35	45	270	11.50
26	NW	5	40	240	9.20
49	N	5	45	225	10.35
51	SE	5	50	275	9.20
54	none	0	--	355	9.20
60	none	0	40	190	10.35
61	none	0	40	195	8.05
62	none	0	40	215	10.35
63	S	5	40	365	11.50
64	none	0	40	360	11.50
65	NE	5	40	355	5.75
Alnus rubra/Polystichum munitum					
9	N	10	47	285	3.45
17	none	0	39	275	11.50
18	S	15	50	490	8.05
25	NW	10	40	240	---
39	E	5	--	490	9.20
46	E	25	30	520	5.75
50	none	0	40	275	4.60
52	none	0	--	245	5.75
53	none	0	--	240	4.60
66	S	5	40	305	9.20
67	none	0	40	170	8.05
68	none	0	--	240	4.60

Table 2. *Pseudotsuga meniesii/Gaultheria shallon* community of the lower Cedar River watershed.

SPECIES	1	4	7	15	19	48	55	56	57	58	59	Ave. Cover %	Constancy %
OVERSTORY TREE LAYER													
Prunis emarginata	2											tr	9
Pseudotsuga menziesii	80	75	80	70	70	80	80	75	70	85	75	76	100
Thuja plicata			5	5								1	18
Tsuga heterophylla	tr		25	10	5			tr	15			5	54
Total	82	75	110	85	75	80	80	75	85	85	75	82	
SMALL TREE--TALL SHRUB LAYER													
Acer circinatum		14		tr		10	5	5	5			4	54
Cornus nuttallii		1										tr	9
Corylus cornuta var. californica		10					1					1	18
Holodiscus discolor		5	15						1	1	10	3	45
Thuja plicata			2									tr	9
Tsuga heterophylla	5	10	10	5	5		10		10	5	1	6	82
Vaccinium parviflorum	10	5	5	1	3	1	1	1		1	1	3	
Total	20	46	17	6	8	11	17	6	16	7	12	15	
LOW SHRUB LAYER													
Berberis nervosa	1	5				1	5	15	1	1	1	3	73
Gaultheria shallon	95	85	30	25	75	40	75	50	45	45	55	56	100
Menziesia ferruginea					1							tr	9
Rosa gymnocarpa					3							tr	9
Rubus ursinus	1	1	1		5	1	5	5	5	5	1	3	91
Total	97	91	31	25	84	42	85	70	51	51	57	62	
HERB LAYER													
Campanula scouleri											tr	tr	9
chimaphila menziesii			2	1			1	1				tr	36
Corallorhiza maculata				1								tr	9
Galium triflorum						1						tr	9
Goodyera oblongifolia			1									tr	9
Hypopitys monotropa				1								tr	9
Linnaea borealis	10			1		30	10		10	5	1	6	64
Luzula parviflora			1	1								tr	18
Polystichum munitum	5		5	1	3	10	5	5	1	1	5	4	91
Pteridium aquilinum	5	5		5	1	15	1	5	1	35	15	8	91
Streptopus amplexifolius						1							
Trientalis latifolia	1							1	1	1		tr	36
Trillium Ovatum			1					1		1		tr	27
Viola sempervirens	1	1	10	1	1		1	1				1	64
Total	22	6	20	12	5	56	18	15	14	43	21	21	
MOSS LAYER													
Eurhynchium oreganum	25	75	30	90	35	60	50	75	5	25	10	44	100
Hylocomium splendens			1	10	Tr	1		1	20			3	54
Mnium insigne	1			1	1				1	1	1	1	54
Mnium spinulosum				1					tr			tr	18
Oncophorus wahlenbergii				tr	1						1	tr	9
Polytrichum commune				1								tr	9
Rhytidiadelphus loreus	1		1		1	1	1	1		1		1	64
Rhytidiadelphus triquetrus						1						tr	9
Total	27	75	32	103	38	63	51	77	26	27	12	48	
TOTAL UNDERSTORY	166	218	100	146	135	172	171	168	107	128	102	147	
TOTAL ALL LAYERS	248	293	210	231	210	252	251	243	192	213	177	229	

Table 3. *Pseudotsuga menziesii/Polystichum munitum* Community of the Lower Cedar River Watershed

SPECIES	Plot No. 2	3	5	6	16	26	49	51	54	60	61	62	63	64	65	Ave. Cover %	Constancy %
OVERSTORY TREE LAYER																	
Acer macrophyllum					Tr							Tr				Tr	13
Alnus rubra		Tr		10												1	13
Prunus emarginata						5	5									1	13
Pseudotsuga menziesii	80	90	75	65	75	85	70	60	85	85	75	65	75	80	60	75	100
Thuja plicata		10	25					5								3	20
Tsuga heterophylla	5	5	50	25			15	10	5	5	5	5	5	5	30	11	87
Total	85	115	150	100	75	90	90	75	90	90	80	70	80	85	90	91	
SMALL TREE AND TALL SHRUB LAYER																	
Acer circinatum	10		Tr		1	1	5	1	10	1	1		1	5	1	2	80
Acer macrophyllum												5				Tr	7
Cornus nuttallii		1									10	1				1	20
Menziesia ferruginea															1	Tr	7
Oplopanax horridum			1	1			1	5					1		1	1	40
Sambucus racemosa		5					1	1								1	20
Rubus parviflorus					Tr											Tr	7
Rubus spectabilis	5	1	5										1		1	1	33
Thuja plicata		10	5	1				1		1	5		1		5	2	53
Tsuga heterophylla	25	5	20	10	10	10	10	1	5	10	5	5	10	5	10	10	100
Vaccinium membranaceum	2															Tr	7
Vaccinium parviflorum	10	5	5	1		5		1	1	5	5	5	1	1		3	87
Total	52	27	36	13	11	16	17	10	16	17	26	16	15	11	19	20	
LOW SHRUB LAYER																	
Berberis nervosa					75	1			1					10		6	27
Gaultheria shallon	10	5			5	1			5	1	1	5		10	5	3	67
Rubus ursinus	1		1	1	1	5	1	5	1	5	5	5	5	1	1	3	93
Total	11	5	1	1	81	7	1	5	7	6	6	10	5	21	6	12	

Table 3. (continued)

SPECIES	Plot No. 2	3	5	6	16	26	49	51	54	60	61	62	63	64	65	Ave. Cover %	Constancy %
HERB LAYER																	
Achlys triphylla						1										Tr	7
Actaea rubra			1	5					1			1				Tr	27
Asarum caudatum				1												Tr	7
Athyrium filix-femina			1				5	1				1			1	Tr	33
Blechnum spicant	5		3	7				1					Tr	1	1	1	47
Chimaphila menziesii									1							Tr	7
Circaea alpina			1	3												Tr	13
Corallorhiza maculata					1											Tr	7
Dryopteris austriaca				10												1	7
Festuca sp.				1												Tr	7
Galium triflorum	1		3	5	1	5		1					1	1		1	53
Goodyera oblongifolia				1												Tr	7
Hieracium albiflorum		1														Tr	7
Linnaea borealis						1				10	50	25	1			6	33
Luzula parviflora			1					1	1						1	Tr	27
Maianthemum unifolium dilatatum	5		1	5					1				5		1	1	40
Montia sibirica					1											Tr	7
Polystichum munitum	75	65	30	50	15	25	50	80	10	30	25	25	75	25	60	43	100
Pteridium aquilinum	1	5			1	1		1	5	1	1	1	1	5	5	2	80
Smilacina stellata			1	1									Tr			Tr	20
Tiarella trifoliata				5				1					1			Tr	20
Tiarella unifoliata	1															Tr	7
Trientalis latifolia					1			1		1	1	1		1		Tr	40
Trillium ovatum	1	1	1	1	1	1	1	1	1	1	1	1	1	Tr		1	87
Viola sempervirens		1	5	10	1								5	1		2	40
Total	84	73	48	105	22	34	56	88	20	43	78	55	90	33	69	60	

Table 3. (continued)

SPECIES	Plot No. 2	3	5	6	16	26	49	51	54	60	61	62	63	64	65	Ave. Cover %	Constancy %
MOSS LAYER																	
Eurhynchium oreganum	25	30	50	25	5		5	5	5	50	50	35	15	5	25	22	93
Hylocomium splendens					3	75	Tr	1		5	10	5			5	7	53
Mnium insigne	1		2	5	1	1	1	1	1	1	1	1	1		1	1	87
Mnium spinulosum												1	Tr	1		Tr	20
Oncophorus wahlenbergii					5						1					Tr	13
Polytrichum commune					1											Tr	7
Rhytidiadelphus loreus	1	1		Tr		1	1	1	1	Tr		1	1	1	1	1	80
Rhytidiadelphus triquetrus							1					1			1	Tr	20
Total	27	31	52	30	15	77	8	8	7	56	62	44	17	7	33	32	
TOTAL UNDERSTORY	89	136	137	149	129	134	82	111	50	122	172	125	127	72	127	109	
TOTAL ALL LAYERS	174	251	287	249	204	224	172	186	140	212	252	195	207	157	217	208	

Table 4. *Alnus rubra/Polystichum munigum* Community of the Lower Cedar River Watershed

SPECIES	Plot No. 9	17	18	25	39	46	50	52	53	66	67	68	Ave. Cover %	Constancy %
OVERSTORY TREE LAYER														
Acer macrophyllum	25	25	10	15		Tr	5				15		8	58
Alnus rubra	40	75	75	85	90	85	80	80	75	75	60	75	75	100
Prunus emarginata		5						5					1	17
Pseudotsuga menziesii	Tr	10	15	10							Tr	5	3	50
Thuja plicata							5			10			1	17
Tsuga heterophylla										5			Tr	8
Total	65	115	100	100	90	85	90	85	75	90	75	80	88	
SMALL TREE AND TALL SHRUB LAYER														
Abies grandis						5							Tr	8
Acer circinatum	10		25	10	30		1	5	1	5	1	5	8	83
Alnus rubra									1				Tr	8
Cornus nuttallii								5					Tr	8
Corylus cornuta var. californica											1		Tr	8
Oplopanax horridum	2				5					5	1		1	33
Prunus emarginata					5								Tr	8
Rubus parviflorus						Tr							Tr	8
Rubus spectabilis	1				1	15	5	1		1			2	50
Sambucus racemosa		1			1	1	1			1	1		1	50
Symphoricarpos albus											5		Tr	8
Thuja plicata										5			Tr	8
Tsuga heterophylla			2	5	1	5		5	5	5	5	5	3	75
Vaccinium parviflorum	1	1		1			1	1	1	1	1	5	1	75
Total	14	2	27	16	43	26	8	17	8	23	15	15	18	
LOW SHRUBS														
Berberis nervosa			15	15		5		10					4	33
Gaultheria shallon	1			1				5	1		5	10	2	50
Rubus ursinus	15	25	5	5	1	10	30	10	10	1	10	5	11	100
Total	16	25	20	21	1	15	30	25	11	1	15	15	16	
HERB LAYER														
Achlys triphylla		1		5		1							1	25
Actae rubra									1				Tr	8
Asarum caudatum					1								Tr	8
Athyrium filix-femina				1	5	1		1		1			1	42
Blechnum spicant				1	1	Tr			1				Tr	33
Campanula scouleri									1				Tr	8
Circaea alpina	1												Tr	8
Dicenta formosa		3			1	1					1		1	33
Digitalis purpurea									1				Tr	8
Equisetum arvense					Tr									
Festuca sp.	1											1	Tr	17

Table 4 (continued)

SPECIES	Plot No. 9	17	18	25	39	46	50	52	53	66	67	68	Ave. Cover %	Constancy %
Galium triflorum	1		5		1			1	1		1		1	50
Grasses		15	5	Tr	1						5		2	42
Linnaea borealis												1	Tr	8
Luzula parviflora			1			1	1	1				1	Tr	42
Maianthemum unifolium dilatatum	1							1		5			1	25
Montia sibirica		5	20	5	Tr	1	15		1	1			4	75
Polystichum munitum	85	50	75	85	10	75	50	75	45	50	50	50	58	100
Pteridium aquilinum				5	1		5	25	45		5	15	8	58
Smilacina stellata										1			Tr	8
Tiarella trifoliata											1		Tr	8
Tiarella unifoliata		5				1							1	17
Tolmiea menziesii					15	1							1	17
Trientalis latifolia									1				Tr	8
Trillium ovatum										1			Tr	8
Viola sempervirens									1				Tr	8
Total	89	79	106	102	36	82	71	104	98	59	63	68	80	
MOSS LAYER														
Eurhynchium oreganum	5	5	5	1		1	5	15	15	25	10	25	9	92
Hylocomium splendens	1			15		1							1	25
Mnium insigne		1	1	Tr	1		1	1	1	1		1	1	75
Oncophorus wahlenbergii				1		1					1		Tr	25
Rhytidiadelphus loreus		1		1	1			1				1	Tr	42
Rhytidiadelphus triquetrus					1	1		1	1			1	Tr	42
Total	6	7	7	3	3	5	6	18	17	26	11	28	11	
TOTAL UNDERSTORY	125	113	160	142	83	128	115	164	134	109	104	126	125	
TOTAL ALL LAYERS	190	228	260	242	173	213	205	249	209	199	174	206	213	

Table 5. Species Diversity (H), Richness (R) and Evenness (J) within the strata of these communities

	PSME/GASH	*PSME/POMU*	*ALRU/POMU*
OVERSTUDY TREE LAYER	H = 0.427 J = 0.213 R = 4	H = 0.905 J = 0.350 R = 6	H = 0.826 J = 0.319 R = 6
SMALL TREE AND TALL SHRUB LAYER	H = 2.157 J = 0.768 R = 7	H = 2.413 J = 0.673 R = 12	H = 2.128 J = 0.559 R = 14
LOW SHRUB LAYER	H = 0.560 J = 0.241 R = 5	H = 1.500 J = 0.946 R = 3	H = 1.261 J = 0.795 R = 13
HERB LAYER	H = 1.803 J = 0.474 R = 14	H = 1.629 J = 0.351 R = 26	H = 1.856 J = 0.400 R = 26
MOSS LAYER	H = 0.626 J = 0.209 R = 8	H = 1.171 J = 0.390 R = 8	H = 0.904 J = 0.322 R = 6
TOTAL ALL LAYERS	H = 2.843 J = 0.542 R = 38	H = 3.328 J = 0.578 R = 54	H = 3.107 J = 0.537 R = 55