AN ECOLOGICAL SURVEY

OF POTENTIAL NATURAL AREAS

IN THE NORTH CASCADES NATIONAL PARK COMPLEX

Prepared for

The Intercampus Educational

And Scientific Preserves Committee

by

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INTRODUCTION

The need for educational and research preserves (Natural Areas) has long been recognized by scientists and others. The establishment of such areas, however, has progressed at a relatively slow rate. This lack of Natural Area establishment is due to a number of factors ranging from outright opposition to general apathy by the persons or agencies involved. An argument put forward by some economists, and often quite justifiably, is that the area or resource in question is economically more desirable for an alternative use. Their arguments, however, have not, or have been unable to take into consideration the value of the resource to scientists and people of the future or its value as a baseline. Since the major objectives of Natural Area allocation are to provide relatively undisturbed ecosystems for the use of future generations as well as to provide baselines (which are essential in our understanding of ecosystem function); and since we do not, at this time, have adequate knowledge of future desires and needs, we arrive at a perplexing situation with regard to Natural Area establishment.

The policy of the National Park Service towards management and use of national parks is:

> . . . to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

These two aims have often proven to be incompatible. It is with this in mind that the National Park Service must recognize the need for land

use zoning within the national parks. Zoning in these parks should provide for: (1) the preservation of natural and historic objects and wildlife, (2) the preservation of partially modified ecosystems for man to use and enjoy, and (3) the preservation of ecosystems for baseline measurement and potential future use as Natural Areas.

In northwestern Washington a sizeable portion of the relatively undisturbed ecosystems remaining in the contiguous United States are found. Many of these are located within the North Cascades National Park Complex. During the summer of 1970 an ecological survey of 11 potential Natural Areas in the Complex was conducted and subsequently evaluated with regard to their potential as Natural Areas.

Two general categories or types of areas were surveyed. These consisted of: (1) valleys (mainly the bottomland and lower slope vegetation), and (2) mountains (subalpine and alpine vegetation). In each of the areas (Figure 1) the major plant communities were first studied by a reconnaissance of the area. Upon returning through the area a varying amount of quantitative and qualitative data was obtained, depending on the size, accessibility, and relative importance of the community. The quantitative data taken in the valleys consisted of coverage of all vascular plants, as well as density and DBH (diameter at breast height) of all tree species present in .2-acre circular sample plots. In the Subalpine and Alpine Zones*, where plant community size is much smaller, the coverage of the major vascular plants was estimated

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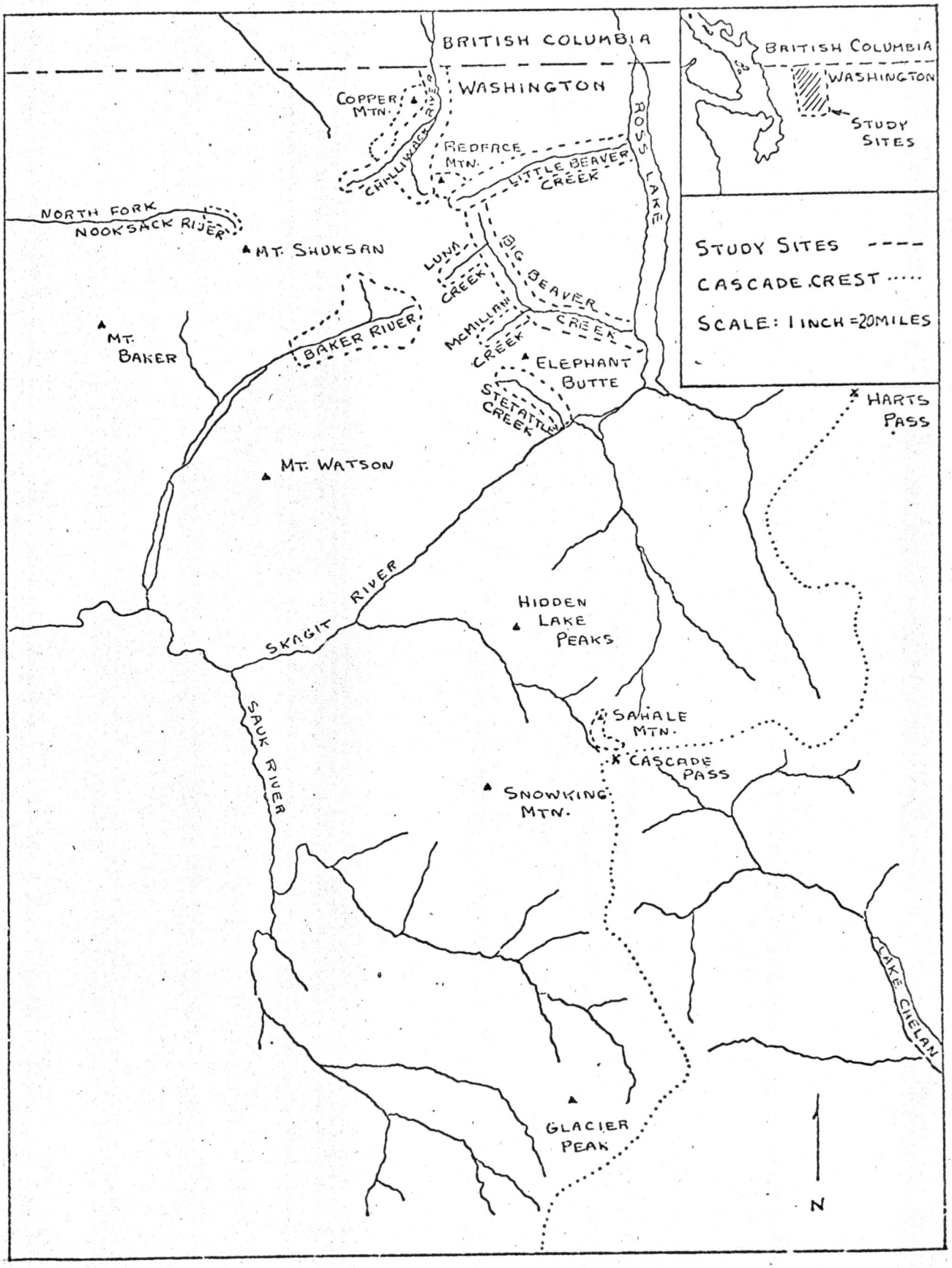
*The Subalpine Zone is defined in this report as that area above the continuous forest (forest-line) and below the upper limit of conifers as an upright tree form (tree-line), above this is the Alpine Zone (Douglas, 1969a, 1969b, 1970).

Figure 1. Map of the North Cascades.



for the entire community. Although a minimum number of plots was necessary the information obtained does provide a general picture of community structure and composition in the areas. Brief notes were also taken on the fauna, water resources and other factors that were of possible educational or research value.

The status of introduced or exotic plant species in each area has also been noted. Fortunately these exotics do not usually replace indigenous species unless the natural vegetation is disturbed by man (Baker, 1965). In the potential Natural Areas studied the introduced species are restricted to trails or campsites in the valleys and are presently not a threat to the natural communities.

Nomenclature of species appearing on the text follows Hitchcock, et al (1955, 1959, 1961, 1964, 1969), Lawton (1965), and Hale and Culberson (1970), for vascular plants, mosses and lichens, respectively. Only the binomial of the species has been used when just a single variant of the species occurs in the North Cascades.

U.S. Forest Service type maps have been included for each area surveyed. These type maps, however, have only been included to provide the reader with a rough idea of the extent of broad vegetation types (i.e., coniferous, deciduous, non-forested). The individual forest types designated by the maps were often found, when checked on the ground, to be erroneous or extremely misleading. In some instances the major tree species was incorrect, and more commonly, the stocking had been incorrectly estimated or important secondary tree species had been omitted. Thus the use of these maps for ecological purposes is usually quite limited.

VALLEY AREAS

The present geomorphology of the North Cascade Range is primarily due to the extensive glaciation by both continental and alpine glaciation during the Quaternary. This is reflected by the numerous steep-walled U-shaped valleys, the rounded tops of the lower mountains and the cirques, arêtes and jagged peaks of the higher mountains.

The glacial valleys examined during this study consist of two types: (1) valleys with the typical parabolic cross-section profile, and (2) valleys with a relatively more narrow and deep cross-section profile. The latter type is probably due to an increase in intensity during the process of valley glaciation (Graf, 1970). The first type of valley (Baker River, Little Beaver Creek, Big Beaver Creek, Chilliwack River and the North Fork of the Nooksack River) all contain substantial deposits of glacial till and have well developed bottomland vegetation types. This is in contrast to the relatively narrow and deep valleys (Stetattle Creek, Luna Creek and McMillan Creek) which have little or no deposits of glacial till and poorly developed bottomland vegetation types.

1. The Baker River Drainage

Description of the Area

The Baker River and its tributaries occur in portions of: T 38 N, R 10 E; T 38 N, R 11 E; T 39 N, R 10 E; and T 39 N, R 11 E (Figure 2). The river flows in a northeast to southwest direction and is about 10 miles in length; all but 2 miles being in the North Cascades

Figure 2. Topography map of the Baker River drainage.

National Park. The major tributaries, ranging from 3 to 5 miles in length are: Sulphide, Pass, Crystal, Mineral, Picket, Bald Eagle, Lonesome, and Scramble Creeks.

The valley of the Baker River ranges from 1/8 to 1/2 mile in width and has a rise of 1200 feet elevation from its mouth to its junction with Mineral and Picket Creeks, a slope of 3 percent over the 8 miles. The valley bottom is flat and consists of several river terraces of varying ages and origins. The mountain slopes along the river rise abruptly from the valley floor into precipitous cliffs and rock outcrops. The more level portions of the valley cover about 2500 acres while the entire drainage of the Baker encompasses approximately 58,000 acres.

Along the Baker River, especially on the north side, are numerous large ponds formed by beaver dams. These ponds are quite extensive and extend from just east of the National Park boundary to Pass Creek, a distance of about 7 miles (Figure 3).

Vegetation

General description

The main valley bottom of the Baker River consists of three general terraces. The first, the oldest and largest, probably dates back to the last valley glaciation. On this upper terrace, which upon closer examination may prove to be of more than one age or origin, occur the major coniferous plant communities of the valley. These communities are representative of the *Tsuga heterophylla* Zone or Forest Type described by Franklin and Dyrness (1969) and Douglas (1969a) for

Figure 3. Forest type map of the Baker River drainage.

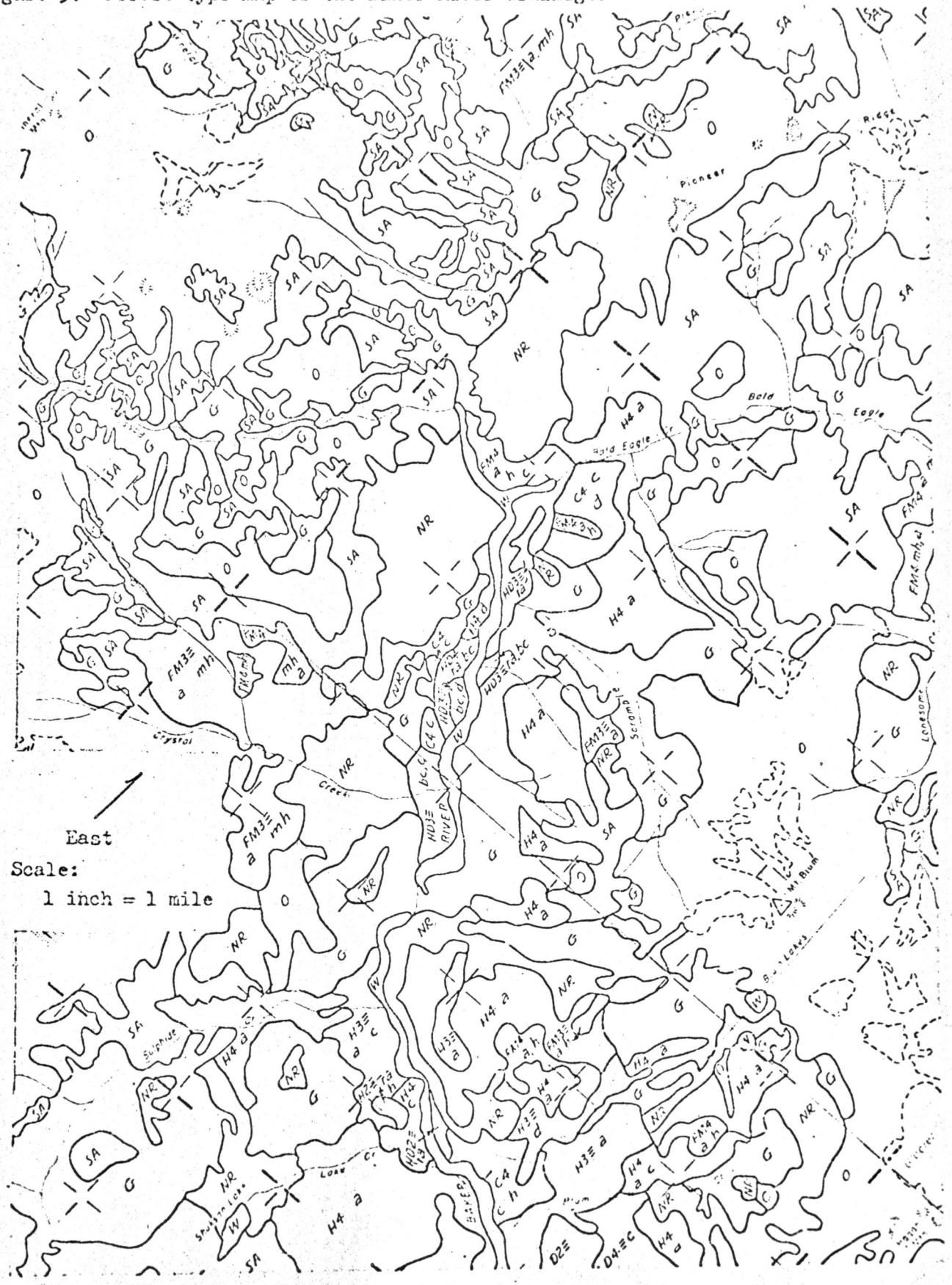


Figure 4. Legend for forest type maps.

Major Species

D	*Pseudotsuga menziesii*
H	*Tsuga heterophylla*
C	*Thuja plicata*
FM	*Abies* sp.-*Tsuga mertensiana*
LP	*Pinus contorta*
HD	Deciduous sp.

Associated Species

d	*Pseudotsuga menziesii*
es	*Picea engelmanni*
mh	*Tsuga mertensiana*
h	*Tsuga heterophylla*
yc	*Chamaecyparis nootkatensis*
c	*Thuja plicata*
lp	*Pinus contorta*
w	*Pinus monticola*
af	*Abies lasiocarpa*
a	*Abies amabilis*
wf	*Abies grandis*
bc	*Populus trichocarpa*
b	*Betula papyrifera*
m	*Acer macrophyllum*
ra	*Alnus rubra*

Noncommercial Forests and Nonforest Areas

SA	Subalpine
NR	Noncommercial rocky
G	Brush
O	Open
W	Water

Density of Stocking Symbols

	Nonstocked (less than 10 percent)
—	Poorly stocked (10-40 percent
=	Medium stocked (40-70 percent)
≡	Well stocked (70-100 percent)

Stand Size Class and Symbols

1	Seedlings and saplings (0-5" DBH)
2	Pole timber (5-11" DBH)
3	Small saw timber (11-21" DBH)
4	Large saw timber (21" DBH and larger)
5	Large old growth - *Pseudotsuga menziesii* (21" DBH and larger)

the North Cascades. *Tsuga heterophylla* is the major climax species while *Abies amabilis* is of lesser importance. The dominant tree layer of these forest stands consists of various mixtures of *Tsuga heterophylla* and *Thuja plicata*. Several large stands dominated by deciduous species such as *Acer macrophyllum*, *Alnus rubra*, and *Populus trichocarpa* also occur on the upper terraces.

On the upper slopes *Pseudotsuga menziesii*, which is infrequent on the lower slopes and in the valley bottom, is a common species along with *Tsuga heterophylla* and *Thuja plicata*. These slopes are extremely precipitous and difficult to climb thus none of these communities were examined except from a distance. At higher elevations *Abies amabilis* and *Tsuga mertensiana* are the dominant species in all tree layers.

The two lower terraces of the valley are of more recent origin and are the result of floods. The lowest consists of numerous age classes of trees and is dominated by the pioneer species, *Alnus rubra* or *Populus trichocarpa*. These sites are probably quite unstable with some of the communities being swept away during years of extremely heavy runoff. During these more extensive flood periods, a second and higher terrace has been formed. These older, and more stable communities have the same composition as on the lower terraces. The understory, however, because of better soil development, is relatively well developed.

Plant communities

1) *Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium* community.

Forest stands dominated by *Tsuga heterophylla* and varying amounts of *Abies amabilis* are common throughout the Baker valley. They

are most frequent on the upper river terrace or lower slopes.

The stand examined in detail (Table 1) is located west of Sulphide Creek on the north side of the river and covers approximately 140 acres. *Tsuga heterophylla* and *Abies amabilis* are the only species in the dominant and intermediate tree layers. These trees are also the major climax species. *Thuja plicata* seedlings, although rare, were also present in the understory. *Vaccinium ovalifolium* and *Acer circinatum* are important species in the tall shrub layer. Common herbs in the community are *Tiarella unifoliata* and *Dryopteris austriaca*.

The *Tsuga-Abies/Vaccinium* community is quite variable in the valley. The major differences occur in the composition and structure of the tree species. An example of this variability is illustrated in Table 2. This stand is almost identical to the previous one studied with the exception of the greater diversity of species in the dominant tree layer. The average size of the tree species is also greater on this more mesic site.

2) *Thuja plicata-Acer macrophyllum/Athyrium filix-femina* community.

This complex community occurs on the more hydric sites of the upper terrace. The tree species mixture is quite variable from stand to stand throughout the valley.

A representative stand (Table 3), located east of Lake Creek and covering about 125 acres, was examined. Although *Thuja plicata* was the most common species in the dominant tree layer *Acer macrophyllum*, *Tsuga heterophylla*, and *Abies amabilis* were also frequent. *Alnus rubra*, *Tsuga heterophylla*, *Abies amabilis*, and *Acer macrophyllum* dominate the intermediate tree layer. *Tsuga heterophylla*, although sparse, is the

Table 1. Composition and structure of a *Tsuga heterophylla-Abies amabilis/ Vaccinium ovalifolium* stand in the Baker River drainage.[a, b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	20	12-36	61	30	100
Abies amabilis	14	12-20	38	23	100
Intermediate trees:					
Abies amabilis	6	4-12	35	17	100
Tsuga heterophylla	8	4-12	37	15	100
Tall shrubs and saplings:					
Vaccinium ovalifolium				21	100
Acer circinatum				12	100
Sambucus racemosa var. *arborescens*				2	80
Rubus spectabilis				1	100
Oplopanax horridum				1	100
Tsuga heterophylla				1	100
Abies amabilis				1	100
Low shrubs and herbs					
Tiarella unifoliata				10	100
Dryopteris austriaca				3	100
Rubus pedatus				1	100
Clintonia uniflora				1	100
Athyrium filix-femina				1	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from five .2 acre plots.

TABLE 2. Composition and structure of tree species in a *Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium* community in the Baker River drainage.[a]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	24	16-48	77	49	100
Thuja plicata	48	36-72	22	24	100
Abies amabilis	16	16-18	3	2	67
Pseudotsuga menziesii	30	24-36	2	2	33
Intermediate trees:					
Tsuga heterophylla	12	4-14	48	29	100
Abies amabilis	7	4-14	32	21	100
Saplings:					
Tsuga heterophylla	1	0-2	10	1	67
Abies amabilis	1	0-2	10	1	67
Seedlings:					
Tsuga heterophylla				T	33
Abies amabilis				T	33

[a]Data for this community was compiled from three .2-acre plots.

TABLE 3. Composition and structure of a *Thuja plicata-Acer macrophyllum/Athyrium filix-femina* community in the Baker River drainage.[a, b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	48	16-96	10	14	100
Acer macrophyllum	17	12-26	6	9	60
Tsuga heterophylla	22	14-28	4	4	40
Abies amabilis	14	12-18	3	3	60
Intermediate trees:					
Alnus rubra	8	4-12	7	4	60
Acer macrophyllum	8	4-10	10	2	80
Tsuga heterophylla	8	6-10	7	2	60
Abies amabilis	7	4-10	4	4	40
Tall shrubs and saplings					
Sambucus racemosa var. *arborescens*				6	100
Oplopanax horridum				5	100
Acer circinatum				5	80
Rubus spectabilis				1	100
Ribes bracteosum				1	80
Low shrubs and herbs:					
Athyrium filix-femina				21	100
Tolmia menziesii				4	100
Circaea alpina				3	100
Dryopteris austriaca				2	100
Tiarella unifoliata				2	100
Galium sp.				1	100
Polystichum munitum				1	80

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from five 2-acre plots.

only important climax species. *Alnus rubra* and *Acer macrophyllum* occur sporadically in the tall shrub and sapling layer. In this layer *Sambucus racemosa* var. *arborescens*, *Oplopanax horridum*, and *Acer circinatum* are important species. The herb layer is dominated by *Athyrium filix-femina*. Other frequent associates are *Circaea alpina*, *Tolmia menziessii*, *Dryopteris austriaca*, and *Tiarella unifoliata*.

3) *Thuja plicata/Acer circinatum* community.

Stands of this community are common in the valley but are of small size. *Thuja plicata* reaches its greatest size in this community with an average DBH of 84 inches and some of the larger trees reaching. 132 inches DBH.

Thuja plicata is the sole species in all tree layers. *Acer circinatum* forms a dense tall shrub layer. The herb layer is dominated by *Polystichum munitum*, *Smilicina stellata*, and *Clintonia uniflora*.

4) *Acer macrophyllum/Rubus spectabilis/Polystichum munitum* community.

This community occurs on the well drained slopes above the upper terrace. The effects of the last major fire in the valley are most evident on these sites. *Thuja plicata* snags, up to 145 inches DBH, are common throughout the stands. Since the fire completely removed the forest cover on the mountain slopes above, runoff has apparently been rapid and has resulted in the removal of the upper soil horizons and the deposition of much coarse material.

The stand examined (Table 4) was about 100 acres in size and was located about 1/2 mile east of Sulphide Creek. The overstory consists mainly of *Acer macrophyllum* although *Alnus rubra* and *Tsuga heterophylla* are of some importance. *Thuja plicata* and *Pseudotsuga menziesii*

TABLE 4. Composition and structure of an *Acer macrophyllum/Rubus spectabilis/Polystichum munitum* community in the Baker River drainage.[a, b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant Trees:					
Acer macrophyllum	11	6-26	61	52	100
Alnus rubra	8	8-14	19	11	75
Tsuga heterophylla	14	8-22	5	6	25
Thuja plicata	16	16	1	1	25
Pseudotsuga menziesii	14	8-22	1	1	25
Intermediate trees:					
Tsuga heterophylla	4	4-8	14	1	75
Acer macrophyllum	5	4-6	6	1	50
Thuja plicata	6	6	2	1	25
Tall shrubs and saplings:					
Rubus spectabilis				10	100
Acer circinatum				6	100
Rubus parviflorus				1	100
Sambuscus racemosa var. *arborescens*				1	100
Thuja plicata				1	75
Tsuga heterophylla				1	50
Low shrubs and herbs:					
Polystichum munitum				8	100
Tolmia menziesii				5	100
Athyrium filix-femina				4	100
Circaea alpina				3	100
Tellmia grandiflorum				2	100
Vaccinium parviflorum				T	100
Adiantum pedatum				T	100
Galium sp.				T	100
Montia sibirica				T	100
Dicentra formosa				T	75

[a] Species with an average cover of one percent or a frequency of 75 percent, or more, are included in this table.

[b] Data for this community was compiled from four .2-acre plots.

are infrequent in the dominant tree layer. The sparse intermediate layer is composed of *Acer macrophyllum, Thuja plicata,* and *Tsuga heterophylla.* Reproduction is mainly *Tsuga heterophylla* and *Thuja plicata* with *Abies amabilis* occurring infrequently. Important tall shrubs are *Rubus spectabilis* and *Acer circinatum. Polystichum munitum, Tolmia menziesii, Athyrium filix-femina, Circaea alpina,* and *Tellmia grandiflora* are frequent herbs.

5) *Populus trichocarpa-Acer macrophyllum/Acer circinatum/Smilicina stellata* community.

This community occurs on moist sites of the second terrace. Stands representative of this community are most common in the lower part of the valley on both sides of the river.

Acer macrophyllum is the most important species in the dominant tree layer. *Thuja plicata,* a seral species, is infrequent in the overstory. *Acer macrophyllum, Tsuga heterophylla, Abies amabilis,* and less frequently, *Alnus rubra* occur in the intermediate tree layer. *Tsuga heterophylla, Abies amabilis,* and *Acer macrophyllum* are climax species in the community. Other important species in this layer are *Oplopanax horridum, Rhamnus purshiana,* and *Rubus spectabilis. Smilicina stellata, Clintonia uniflora,* and *Dryopteris austriaca* are common herbs.

6) *Alnus rubra/Rubus spectabilis* community.

On the more stable areas of the lower terraces (mainly on the second terrace where soil formation is more advanced) occur extensive stands of *Alnus rubra* dominated communities. The soils of these pioneer stands are usually quite moist and may be under water for short periods during spring floods.

Alnus rubra is often the sole species in all tree layers. *Rubus spectabilis* is the dominant tall shrub. Its main associates are *Acer circinatum* and *Sambucus racemosa* var. *arborescens*. The herb layer is dominated by *Gymnocarpium dryopteris, Viola glabella, Dicentra formosa, Smiliciana stellata, Athyrium filix-femina,* and *Tiarella unifoliata.*

7) *Alnus rubra-Populus trichocarpa* community.

Where both *Alnus rubra* and *Populus trichocarpa* have been the pioneer species on the lower flood terraces mixed deciduous communities are found. These, except for the addition of *P. trichocarpa,* closely resemble the *Alnus/Rubus* community previously described.

8) *Malus fusca-Acer circinatum* community.

In most instances, during the survey, time has not allowed a close study of small or minor communities in the continuous forests. The occurrence of *Malus fusca,* however, in a near pure stand of almost an acre in size deserves brief mention. This species is usually found as an isolated specimen on dry sites throughout the Cascades. The stand examined occurred near the banks of the Baker River on an old rockslide. *Malus fusca,* ranging in diameter from 6 to 12 inches, dominates this dense shrub or small tree community. *Acer circinatum* is also an important species. Other tall shrubs or small trees occurring are *Acer macrophyllum, A. glabrum* and *Rhamnus purshiana. Rubus spectabilis* dominates the understory shrub layer. *Viburnum edule, Amelanchier alnifolia* and *Sambuscus racemosa* are also found in this layer. Important herbs in the ground cover are *Streptopus roseus, Athyrium filix-femina, Smiliciana stellata,* and *Pteridium aquilinum.* This community

appears to be in a stable state since *Malus fusca* reproduction is abundant.

9) Avalanche Track communities.

These communities were not examined in detail thus only the major species will be mentioned. At lower elevations *Acer circinatum* is the dominant species. At upper elevations and on cool northerly aspects this species is replaced by *Alnus sinuata.*

10) Aquatic or Semi-aquatic communities.

These communities are restricted to the margins of the extensive and fairly recent beaver ponds. Common plants in these habitats are *Scirpus* sp., *Carex* sp. and *Juncus* sp.

Exotic species

The sides of almost the entire length of the Baker River trail is the habitat for numerous introduced species. As in most areas of the western North Cascades these plants are absent from the nearby natural plant communities. Some of the exotic species identified were *Plantago major, P. lanceolata, Trifolium repens, Rumex obtusifolius, R. acetosella, Taraxacum officinalis* and *Digitalis purpurea.* In addition, many of the grass species occurring along the trail may also be introductions.

Fauna

Very little deer sign was encountered in the Baker Valley. The possibility of a relatively small deer population in the main valley can be expected due to the mature forests and extremely steep slopes of

the valley. These forests and slopes present a rather unfavorable habitat for deer. Four bears were observed during the study. Two of them were females accompanied by twin cubs. The numerous bear sign indicates a good sized population. The extensive beaver ponds throughout the valley may support one of the largest beaver populations in the North Cascades. Recent activity was noted on the shores of several of the ponds.

2. The Little Beaver Creek Drainage

Description of the Area

The Little Beaver Creek drainage occurs in portions of: T 40 N, R 11 E; T 40 N, R 12 E; T 40 N, R 12 E; T 39 N, R 11 E; T 39 N, R 12 E; and T 39 N, R 13 E (Figure 5). Little Beaver Creek flows in a west to east direction with a length of about 13 miles; 11 1/2 miles in the North Cascades National Park and the remainder in the Ross Lake National Recreation Area. Pass, Redoubt, and Perry Creeks are major tributaries ranging from 2 1/2 to 6 miles in length.

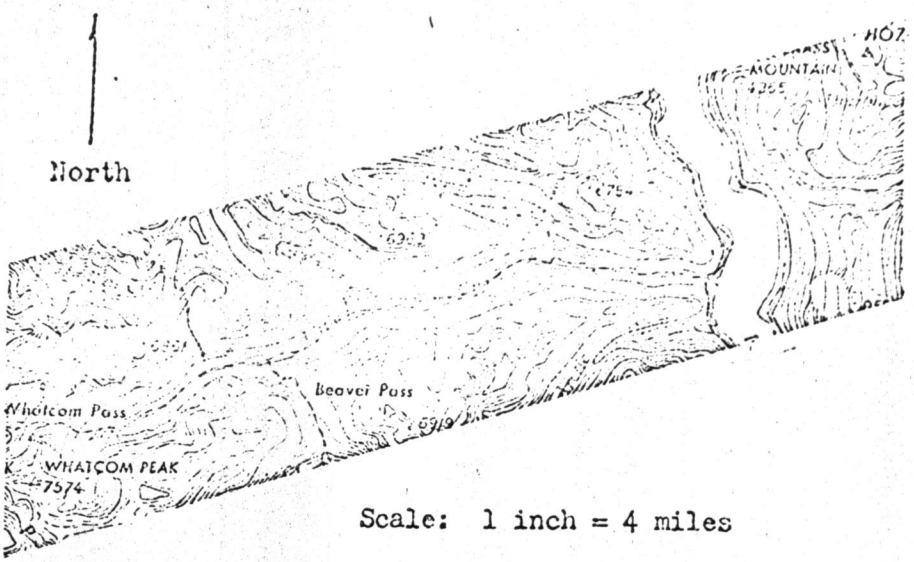
The valley of the Little Beaver ranges from only a few hundred feet wide (near the mouth) to almost 1/2 mile in width and has a low gradient, rising only 1300 feet in elevation over the first 13 miles. The valley bottom is fairly wide with extensive lower slopes. This area covers approximately 3500 acres. The entire area drained by Little Beaver Creek encompasses about 37,000 acres.

Vegetation

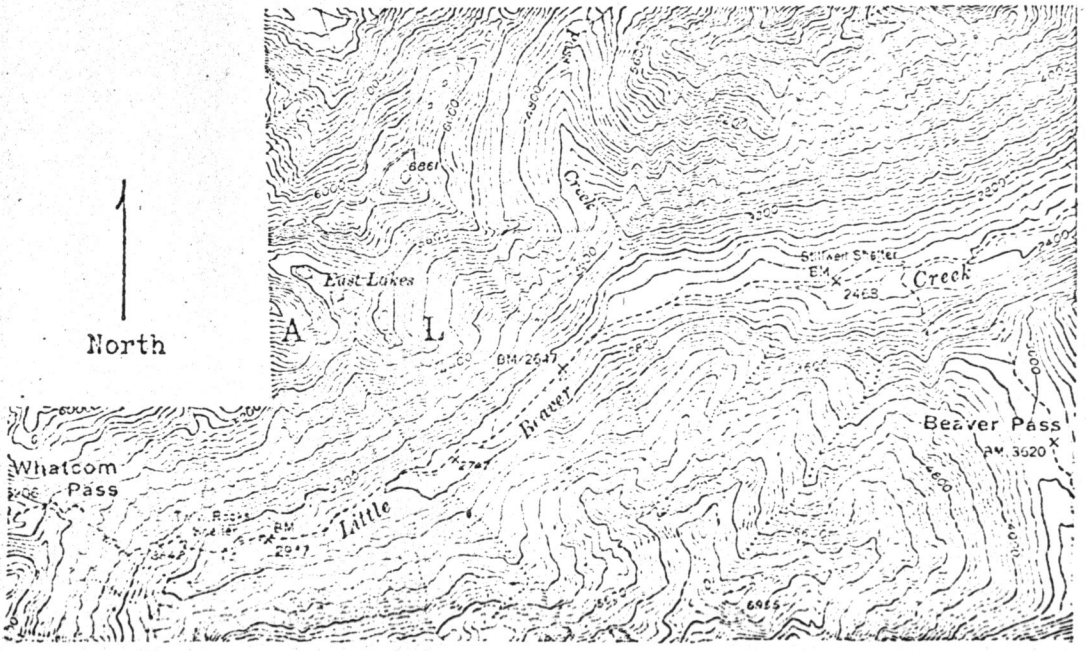
General description

The Little Beaver Creek drainage contains vegetation types that would be representative of both the eastern Washington forest zones (*Pinus contorta*, *Pseudotsuga menziesii*, *Abies grandis*, and *Tsuga heterophylla* Zones) and western Washington forest zones (*Tsuga heterophylla*, *Abies amabilis*, and *Tsuga mertensiana* Zones) described by Franklin and Dyrness (1969). The latter zone (*Tsuga mertensiana* Zone) has been designated as the Subalpine Zone by Douglas (1969a, 1969b, 1970)

Figure 5. Topography maps of the Little Beaver Creek drainage.



Scale: 1 inch = 4 miles



Scale: 1 inch = 1 mile

and is subsequently used in this report. This combination of vegetation types typical of both the east and west slopes of the Cascade Range in a single valley is indeed unusual. Until recently workers had recognized the Cascade Crest as the dividing line between east and west slope vegetation (Franklin, 1965; Douglas, 1969a). Thus the existence of lowland communities representative of both sides of the Cascade Range has been unknown. In a more recent subalpine study Douglas (1970) recognized the dividing line between west slope vegetation and east slope vegetation as existing somewhat west of Ross Lake and the Thunder Creek drainage in the North Cascades. This shift of the dividing line from the Cascade Crest to west of Ross Lake, a distance of about 20 miles, is due to the extreme width of the Cascade Range in the North Cascades and the subsequent decrease in precipitation as one proceeds east.

The climax species in the valley cover a wide spectrum. At the mouth of the creek and for several miles upstream *Pseudotsuga menziesii* is the sole climax species. In the remainder of the lower valley and in the middle valley *Tsuga heterophylla* predominates as the climax species. *Abies amabilis* becomes important as a climax in the upper valley and towards the headwaters is the major climax. Throughout the main part of the valley *Thuja plicata*, and to a lesser extent, *Abies grandis*, play varying minor roles in the climax vegetation.

Except for the extreme lower and upper parts of the valley, where *Pseudotsuga menziesii* predominates in the bottom lands or lower slopes, the forests may be generally described as consisting of *Thuja plicata* communities in the bottomlands and *Tsuga heterophylla* communities

on the lower and middle slopes (Figure 6). The plant communities of the valley, however, are extremely complex and a number of other tree species may be an important component (Table 5) or even the dominant in various communities. Most of the tree species occurring in the valley attain an impressive size. All of the important plant communities are described in the subsequent text. No attempt has been made to distinguish which of the *Tsuga heterophylla* communities are representative of which slope (west or east) of the Cascade Range although those occurring in the extreme eastern part of the valley probably are closely related to those of the east slope of the Cascade Range. Deciduous forest communities, although present in the valley, do not cover extensive areas, and occur mainly along the immediate banks of the Little Beaver and its tributaries. Several aquatic or semi-aquatic communities also occur in the valley.

Plant communities

1) Mixed Coniferous-Deciduous community.

This forest community consists of a number of tree species, none of which are dominant. Important species are *Populus trichocarpa, Thuja plicata, Abies grandis, Tsuga heterophylla, Picea engelmannii,* and *Abies amabilis.* Sites occupied by these stands are extremely moist and occur in the valley bottom.

The stand studied in detail (Table 6), about 1/2 mile east of Redoubt Creek, covered an area of about 50 acres and is probably the largest Mixed Coniferous-Deciduous community in the valley. The composition of both the pioneer (dominant) and seral (intermediate) tree

Figure 6. Forest type map of the Little Beaver Creek drainage.

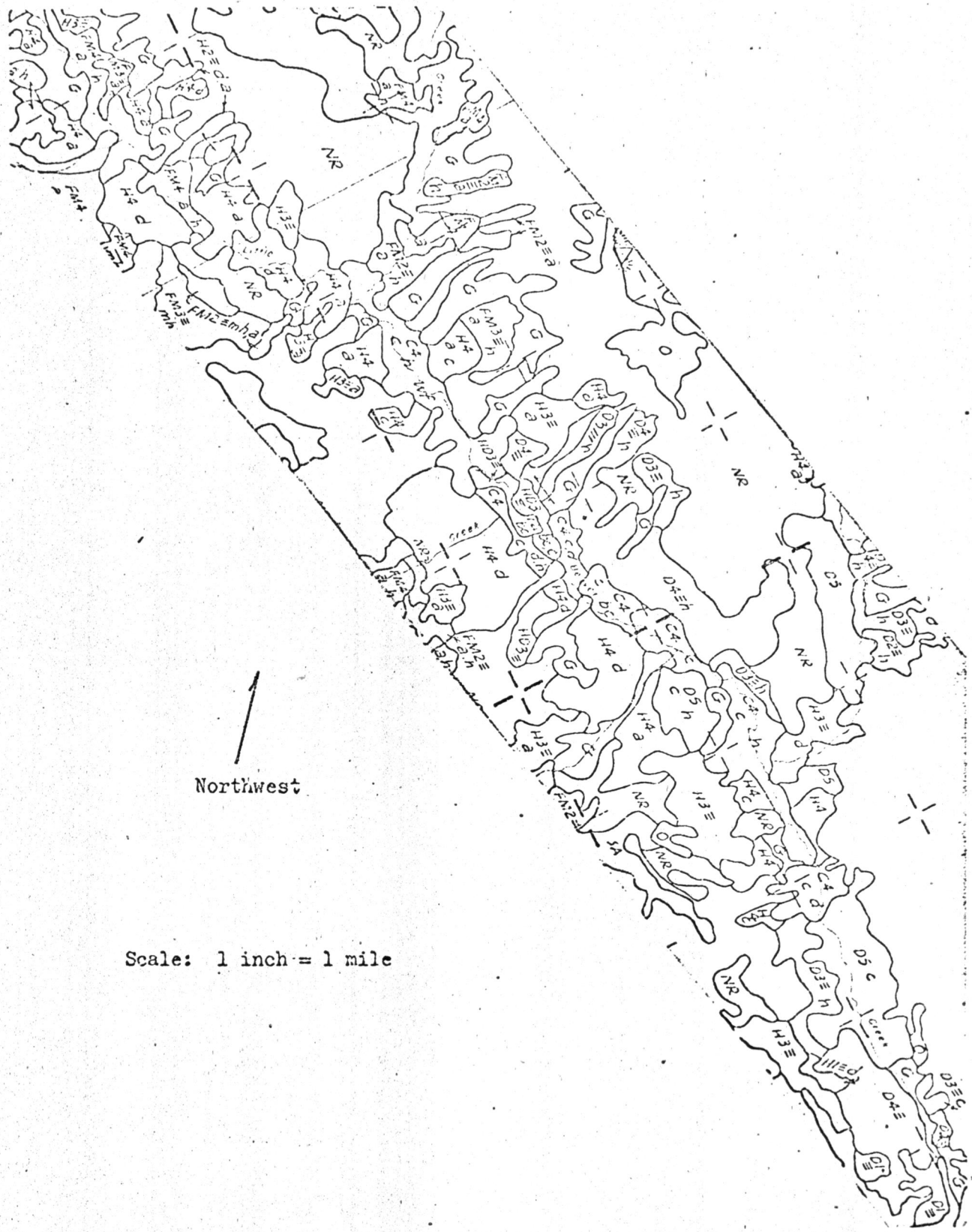


TABLE 5. Relative abundance of tree species in the Little Beaver Creek drainage.

Species	Abundance		
	Upper Valley (10-15 mi.)	Middle Valley (5-10 mi.)	Lower Valley (0-5 mi.)
Abies amabilis	High	Medium	Low
Abies grandis	Low	Medium	Low
Abies lasiocarpa	Low	Low	-
Acer macrophyllum	Low	Low	Low
Alnus rubra	Low	Medium	Medium
Betula papyrifera	-	-	Low
Chamaecyparis nootkatensis	Low	-	-
Picea engelmannii	Low	Medium	Low
Pinus contorta	-	-	Medium
Pinus monticola	Low	Low	Low
Populus trichocarpa	Low	Medium	Low
Prunus emarginata	-	Low	Low
Pseudotsuga menziesii	Low	Medium	High
Thuja plicata	Medium	High	Medium
Tsuga heterophylla	High	High	High
Tsuga mertensiana	High	-	-

TABLE 6. Composition and structure of a Mixed Deciduous-Coniferous community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees Per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Populus trichocarpa	28	24-32	12	11	100
Thuja plicata	43	26-56	8	9	67
Abies grandis	30	20-36	10	7	100
Tsuga heterophylla	20	16-26	8	7	67
Picea engelmannii	26	18-36	7	4	100
Abies amabilis	22	22	2	1	33
Intermediate trees:					
Tsuga heterophylla	12	6-14	18	7	100
Thuja plicata	14	14-16	7	4	100
Abies grandis	13	6-14	10	3	100
Abies amabilis	11	8-14	3	1	67
Populus trichocarpa	12	12	2	1	33
Picea engelmannii	12	12	2	1	33
Tall shrubs and saplings:					
Oplopanax horridum				53	100
Cornus stolonifera				2	100
Thuja plicata				1	100
Rubus spectabilis				1	100
Acer circinatum				T	67
Low shrubs and herbs:					
Streptopus roseus				18	100
Smilicina stellata				8	100
Gymnocarpium dryopteris				6	100
Athyrium filix-femina				7	100
Clintonia uniflora				4	100
Smilicina racemosa				1	100
Thuja plicata				T	67
Dicentra formosa				T	67

[a] Species with an average cover of one percent or a frequency of 67 percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

species is complex and would require further study to determine causal factors attributing to such a community. Reproduction is sparse and consists almost entirely of *Thuja plicata*. The tall shrub layer is dominated by *Oplopanax horridum*. Other frequent shrub species, but with low cover values, are *Cornus stolonifera* and *Rubus spectabilis*. *Streptopus roseus*, *Smilicina stellata*, *Gymnocarpium dryopteris*, *Athyrium filix-femina*, and *Clintonia uniflora* are important ground cover plants.

2) *Thuja plicata/Oplopanax horridum/Gymnocarpium dryopteris* community.

Wet bottomlands are the site of this community. Stands of this type occur along much of the lowlands of the Little Beaver Valley and are dominated by *Thuja plicata*.

The stand chosen for sampling (Table 7) was located just west of Redoubt Creek and covered about 300 acres on both sides of the creek. *Thuja plicata* was the major dominant with lesser amounts of *Tsuga heterophylla* and *Abies amabilis*. The latter two species were of more importance in the intermediate tree layer, with *Thuja plicata* being of minor importance in this layer. *Tsuga heterophylla* and *Abies amabilis* occur sparsely as climax species in the understory. *Oplopanax horridum* is the major tall shrub in the understory with *Acer circinatum* and *Cornus stolonifera* appearing less frequently. Common herbs in this community are *Gymnocarpium dryopteris*, *Athyrium filix-femina*, *Streptopus roseus*, and *Smilicina stellata*.

3) *Thuja plicata/Acer circinatum - Oplopanax horridum/Athyruim filix-femina* community.

A community quite similar to the *Thuja/Oplopanax/Gymnocarpium* community was observed in the valley several times. The sites occurred

TABLE 7. Composition and structure of a *Thuja plicata/Oplopanax horridum/Gymnocarpium dryopteris* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	40	20-66	19	27	100
Tsuga heterophylla	24	20-27	3	3	33
Abies amabilis	40	40	2	1	33
Intermediate trees:					
Tsuga heterophylla	11	8-14	5	4	67
Abies amabilis	7	6-12	9	3	67
Thuja plicata	11	10-12	3	1	33
Tall shrubs and saplings:					
Oplopanax horridum				40	100
Acer circinatum				4	67
Cornus stolonifera				2	67
Tsuga heterophylla				1	33
Abies amabilis				1	33
Low shrubs and herbs:					
Gymnocarpium dryopteris				23	100
Athyrium filix-femina				11	100
Streptopus roseus				6	100
Smilicina stellata				5	100
Tsuga heterophylla				1	67
Abies amabilis				1	67

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

on slight slopes but still appeared very moist, probably due to upslope runoff. The major differences were: (1) the increase in abundance and size (up to 120 inches DBH) of *Thuja plicata*, (2) the marked decrease in *Tsuga heterophylla* and *Abies amabilis* in all layers, (3) the change to a *Thuja plicata* climax, and (4) the increase of *Acer circinatum* and *Athyrium filix-femina* and the decrease of *Gymnocarpium dryopteris* in the understory.

4) *Thuja plicata/Alnus rubra-Cornus stolonifera/Lysichitum americanum-Smilicina stellata* community.

This community occurs on the wettest sites in the valley bottoms and occurs mainly from 2 to 8 miles upstream. Much of the area occupied by these stands is flooded during the spring runoff.

The area of the stand studied (Table i), although not currently flooded, had a water table just a few inches below the soil surface. This stand was located about 2 1/2 miles west of Perry Creek. Since the river was in flood it was not possible to determine the extent of the stand. *Thuja plicata* is the dominant tree species while *Picea engelmannii* is relatively sparse. The intermediate tree layer consists of *Thuja plicata* and depauperate specimens of *Alnus rubra*. Reproduction is fairly abundant and consisted entirely of *Thuja plicata*. *Alnus rubra* and *Cornus stolonifera* are the most common tall shrubs, with *Acer circinatum*, *Sambucus racemosa*, and *Salix* sp. being frequent but of lower cover. Important herbs are *Lysichitum americanum*, *Smilicina stellata* and *Athyrium filix-femina*.

5) *Thuja plicata-Tsuga heterophylla/Acer circinatum/Streptopus roseus* community.

TABLE 8. Coverage and frequency of important species in a *Thuja plicata/Alnus rubra-Cornus stolonifera/Lysichitum americanum-Smilicina stellata* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average Cover (%)	Frequency (%)
Dominant trees:		
Thuja plicata	50	100
Picea engelmannii	3	33
Intermediate trees:		
Thuja plicata	4	100
Alnus rubra	4	100
Tall shrubs and saplings:		
Alnus rubra	25	100
Cornus stolonifera	24	100
Acer circinatum	10	100
Salix sp.	10	100
Thuja plicata	5	100
Sambucus racemosa	4	100
Rubus spectabilis	2	100
Viburnum edule	2	67
Oplopanax horridum	1	100
Herbs:		
Lysichitum americanum	30	100
Smilicina stellata	30	100
Athyrium filix-femina	10	100
Viola glabella	5	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

The habitat in which this community occurs appears to be more mesic than any of the previous *Thuja*-dominated communities. This drier condition is indicated by the presence of the pioneer *Pseudotsuga menziesii* and *Pinus monticola* (Table 9). Several such stands were encountered on moist 20 to 30 percent slopes which were slightly concave. This community occurred mainly in the central portion of the valley.

Thuja plicata is the dominant pioneer tree species with *Pseudotsuga menziesii* occurring as an important secondary pioneer species. *Pinus monticola* although of less importance is scattered throughout the community. Some of the largest trees in the valley occur in this community. *Thuja plicata* reaches a DBH of 124 inches, *Pseudotsuga menziesii* a DBH of 72 inches, and *Pinus monticola* a DBH of 48 inches. In the intermediate tree layer *Tsuga heterophylla* is most common with lesser amounts of *Tsuga plicata* present. Reproduction, although not abundant, consists entirely of *Tsuga heterophylla*. *Acer circinatum* forms a dense upper shrub layer. *Oplopanax horridum* is alos common in the latter layer but has low cover values. *Streptopus roseus* and *Clintonia uniflora* dominate the herb layer.

6) *Tsuga heterophylla-Thuja plicata/Acer circinatum/Clintonia uniflora* community.

This is a common community on moist lower slopes of the middle valley. Although the name of this community resembles that of the previous community the composition and structure is actually quite different.

Tsuga heterophylla and *Thuja plicata* are the major tree species in the dominant layer (Table 10). *Pseudotsuga menziesii* is relatively

TABLE 9. Average cover and frequency of important species in a *Thuja plicata-Tsuga heterophylla/Acer circinatum/Streptopus roseous* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average Cover (%)	Frequency (%)
Dominant trees:		
Thuja plicata	40	100
Pseudotsuga menziesii	10	50
Pinus monticola	1	25
Intermediate trees:		
Tsuga heterophylla	30	100
Thuja plicata	10	50
Tall shrubs and saplings:		
Acer circinatum	70	100
Oplopanax horridum	3	50
Tsuga heterophylla	2	100
Herbs:		
Streptopus roseus	15	100
Clintonia uniflora	10	100
Tiarella unifoliata	2	75
Gymnocarpium dryopteris	1	75

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from four .2-acre plots.

TABLE 10. Average cover and frequency of important species in a *Tsuga heterophylla-Thuja plicata/Acer circinatum/Clintonia uniflora* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average Cover (%)	Frequency (%)
Dominant trees:		
Tsuga heterophylla	35	100
Thuja plicata	30	100
Pseudotsuga menziesii	1	33
Intermediate trees:		
Tsuga heterophylla	30	100
Abies amabilis	20	100
Tall shrubs and saplings:		
Acer circinatum	65	100
Tsuga heterophylla	5	67
Vaccinium ovalifolium	2	100
Oplopanax horridum	2	100
Abies amabilis	2	67
Low shrubs and herbs:		
Clintonia uniflora	15	100
Smilicina stellata	5	100
Streptopus roseus	2	100
Tsuga heterophylla	1	33
Abies amabilis	1	33

[a]Species with an average cover of one percent, or more, are included in this table.

[b]Data for this community was compiled from three .2-acre plots.

infrequent as a pioneer species. The intermediate tree layer is dominated by *Tsuga heterophylla* and *Abies amabilis*. These latter two species are also climax in the stands. The dense upper shrub layer consists mainly of *Acer circinatum* with lesser amounts of *Vaccinium ovalifolium* and *Oplopanax horridum*. *Clintonia uniflora* is the major herb while *Smilicina stellata* and *Streptopus roseus* are frequent associates.

7) *Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium* community.

In the upper valley and on the higher slopes of the middle valley this is one of the most frequent communities covering extensive areas. Many of the western hemlock (H) types of the Forest Type Map (Figure 5) consist of this community.

The stand examined in detail (Table 11) occurred on the gentle, lower mesic slopes about one mile east of Stillwell shelter. The most abundant tree in the dominant layer is *Tsuga heterophylla*. *Abies amabilis* and *Thuja plicata* are frequent associates. *Pseudotsuga menziesii* (on drier sites) and *Picea engelmannii* (on moister sites) are infrequent pioneer species. *Abies amabilis* and *Tsuga heterophylla* are important in the intermediate tree layer. *T. heterophylla* and *Abies amabilis* are climax species. *Vaccinium ovalifolium* and *Acer circinatum* contribute the major coverage in the tall shrub layer. The latter species, however, is less frequent than the former. *Clintonia uniflora* is the dominant herb. Other associates in this layer are *Smilicina stellata*, *Athyrium filix-femina* and *Gymnocarpium dryopteris*.

On northerly aspects and at higher elevations *Tsuga heterophylla* and *Abies amabilis* become the sole dominants. *Abies amabilis* also becomes the more important climax species on such sites.

TABLE 11. Composition and structure of a *Tsuga heterophylla-Abies amabilis/ Vaccinium ovalifolium* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	24	14-50	24	27	100
Abies amabilis	20	16-24	12	9	50
Thuja plicata	31	22-50	6	6	67
Pseudotsuga menziesii	42	38-48	2	2	33
Picea engelmannii	20	20	1	1	17
Intermediate trees:					
Abies amabilis	8	6-14	12	6	67
Tsuga heterophylla	10	6-14	6	4	67
Thuja plicata	13	12-14	2	1	33
Tall shrubs and saplings:					
Vaccinium ovalifolium				13	83
Acer circinatum				12	33
Abies amabilis				7	67
Tsuga heterophylla				4	67
Rubus spectabilis				1	33
Low shrubs and herbs:					
Clintonia uniflora				8	100
Smilicina stellata				6	17
Athyrium filix-femina				2	33
Gymnocarpium dryopteris				2	33

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from six .2-acre plots.

8) *Pseudotsuga menziesii-Tsuga heterophylla/Acer circinatum/Pachystima myrsinites* community.

Towards the lower end of the Little Beaver Valley, mainly on the southerly slopes, occur extensive *Pseudotsuga-Tsuga/Acer circinatum/Pachystima* communities. These communities are more xerophytic than any of the previous communities described.

The stand (Table 12) examined was located on a ep percent slope about 2 1/2 miles west of Perry Creek. *Pseudotsuga menziesii* is the major pioneer species, with *Tsuga heterophylla* a frequent associate. The latter species also dominate the intermediate tree layer. *T. heterophylla* and *Thuja plicata* are common in the lower strata. *Abies grandis* also occurs as a climax species but is relatively infrequent. In the tall shrub layer *Acer circinatum* is a conspicuous species while in the low shrub layer *Pachystima myrsinites* and *Linnaea borealis* are common. The only frequent herb in this community is *Clintonia uniflora*.

9) *Pseudotsuga menziesii-Tsuga heterophylla/Pachystima myrsinites* community.

This community occurs further east in the valley on slightly drier sites and is similar to the *Pseudotsuga-Tsuga/Acer/Pachystima* community. The *Pseudotsuga-Tsuga/Pachystima* community differs from the latter mainly in the infrequent occurrence of *Acer circinatum* in the tall shrub layer and the increase in diversity of the low shrub and herb layer. In this layer *Pachystima myrsinites* has increased in cover and in addition to *Clintonia uniflora* and *Linnaea borealis; Berberis nervosa, Vaccinium membranaceum* and *Chimaphila umbellata* are important components. *Pinus monticola* is infrequent in the cominant tree layer.

TABLE 12. Coverage and frequency of important species in a *Pseudotsuga menziesii-Tsuga heterophylla/Acer circinatum/Pachystima myrsinites* community in the Little Beaver Creek drainage.[a,b]

Species and Layer	Average Cover (%)	Frequency (%)
Dominant trees:		
Pseudotsuga menziesii	65	100
Tsuga heterophylla	10	100
Intermediate trees:		
Pseudotsuga menziesii	30	100
Tsuga heterophylla	20	100
Thuja plicata	2	33
Tall shrubs and saplings:		
Tsuga heterophylla	11	100
Thuja plicata	10	100
Acer circinatum	10	100
Low shrubs and herbs:		
Pachystima myrsinites	10	100
Clintonia uniflora	5	100
Tsuga heterophylla	2	67
Linnaea borealis	1	100
Thuja plicata	1	67
Abies grandis	1	33

[a] Species with an average cover of one percent, or more, are included in this table

[b] Data for this table was compiled from three .2-acre plots.

10) *Pseudotsuga menziesii/Acer circinatum/Berberis nervosa-Pachystima myrsinites* community.

In the eastern end of the valley, on the lower and middle slopes, mainly on south aspects, this is a common community. These stands encompass approximately 150 to 200 acres. The absence of *Tsuga heterophylla* indicate the extremely xeric conditions of these slopes.

The stand examined in detail (Table 13) was located on a steep (30%) southerly slope about two miles west of Ross Lake. *Pseudotsuga menziesii* is the major species in both the dominant and intermediate tree layer. *Thuja plicata* is of secondary importance in the overstory. *Betula papyrifera* is an infrequent species in the intermediate layer. The tall shrub and sapling layer is dominated by *Acer circinatum* and the climax *Pseudotsuga menziesii*. Other important species in this layer are *Acer glabrum*, *Corylus cornuta* and *Thuja plicata*. The low herb layer consists of a dense cover of *Berberis nervosa*. *Pachystima myrsinites* is also conspicuous in this layer.

11) *Pseudotsuga menziesii/Holodiscus discolor* community.

This community is found only on the south and south-east facing slopes above the mouth of Little Beaver Creek. The stand covers about 40 acres and consists almost entirely of various age classes of *Pseudotsuga menziesii*. A few depauperate specimens of *Acer macrophyllum* occur on the slopes. The understory is relatively sparse with only *Holodiscus discolor* being frequent but of low cover. Other species occurring sporadically in the tall shrub layer are *Corylus cornuta*, *Amelanchier alnifolia*, *Prunus emarginata*, and *Ceonothus sanguineous*. Infrequent ground cover species are *Fragaria virginiana*, *Arctostaphylos uva-ursi*, *Rosa* sp., and *Spiraea* sp.

TABLE 13. Composition and structure of a *Pseudotsuga menziesii/Acer circinatum/Berberis nervosa-Pachystima myrsinites* community in the Little Beaver Creek drainage.[a,b]

Species and Layers	Average DBH (inches)	DBH Range (inches)	Average Cover (%)	Frequency (%)
Dominant trees:				
Pseudotsuga menziesii	22	16-48	27	100
Thuja plicata	24	16-30	10	33
Intermediate trees:				
Pseudotsuga menziesii	10	6-14	57	100
Betula papyrifera	9	8-10	3	33
Thuja plicata	13	12-14	2	33
Tall shrubs and saplings:				
Acer circinatum			16	100
Pseudotsuga menziesii			13	100
Acer glabrum			8	100
Corylus cornuta			4	100
Thuja plicata			4	100
Prunus emarginata			3	100
Salix sp.			1	100
Rubus parviflorus			1	100
Amelanchier alnifolia			T	67
Low shrubs and herbs:				
Berberis nervosa			44	100
Pachystima myrsinites			17	100
Chimaphila umbellata			4	100
Trientalis latifolia			1	100
Rosa sp.			1	100

[a] Species with an average cover of one percent or a frequency of 67 percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

12) *Pseudotsuga menziesii-Pinus contorta/Arctostaphylos uva-ursi* community.

This community occurs on the lower slopes of both sides of the creek along Ross Lake and covers approximately 80 acres. The slopes are extremely dry with shallow soils. These stands date back to the major fire of 1926 which devastated many acres of forest in the upper Skagit Valley.

The pioneer and seral species are *Pseudotsuga menziesii* and *Pinus contorta*. *Pseudotsuga menziesii* is the major climax species with some *Pinus contorta* occurring. The ground cover is sparse with *Arctostaphylos uva-ursi* the most conspicuous plant. Other less frequent species are *Pachystima myrsinites*, *Chimaphila umbellata* and *Apocynum androsaemifolium*. In open areas (especially disturbed sites of the Little Beaver Creek Campground) the introduced species, *Bromus tectorum*, is quite abundant.

13) *Alnus rubra* community.

This community, although frequent throughout the valley, is restricted mainly to the immediate banks of Little Beaver Creek. Stands are also encountered on recent flood terraces near the stream.

Alnus rubra is the dominant trees species with *Picea engelmannii*, *Populus trichocarpa*, and *Thuja plicata* appearing infrequently. Common tall shrubs in the understory are *Oplopanax horridum*, *Rubus spectabilis*, *Ribes bracteosum*, *Sambucus racemosa*, *Cornus stolonifera*, and *Salix* sp. The low shrub and herb layer is dominated by *Athyrium filix-femina* and *Viola glabella*.

14) *Populus trichocarpa* community.

Populus trichocarpa is most commonly found throughout the Little Beaver Valley as a component of the Mixed Deciduous-Coniferous and *Alnus rubra* communities. Pure stands of *Populus trichocarpa* are limited both in size and abundance. They occur on recent flood plains where gravelly, sandy soils remain poorly developed. *Populus trichocarpa* is the dominant tree species although *Thuja plicata* and *Picea engelmannii* may be locally frequent. All pioneer species attain a large size in this community. *Populus trichocarpa* and *Picea engelmannii* average about 30 inches DBH (maximum 48 inches) and reach heights of almost 200 feet. *Thuja plicata* attains a DBH of up to 110 inches. The major understory species are *Cornus stolonifera, Oplopanax horridum, Rubus spectabilis* and *Sambucus racemosa* var. *arborescens.*

15) Avalanche Track communities.

At the eastern end of the valley the avalanche tracks are relatively xeric. On such sites a complex mixture of tall shrubs or depauperate trees are found. Important species are *Acer circinatum, A. glabrum, A. macrophyllum, Corylus cornuta, Prunus emarginata, Salix lasiandra* and *Salix* sp. In the remainder of the valley the sites are either more moist or show effects of cold air drainage. At lower elevations *Acer circinatum* is the most common species. *Acer glabrum* and *Salix* sp. are also conspicuous. Where cold air drainage occurs *Alnus sinuata* becomes important. This latter species is also the most common species at upper elevations or on north aspects of the valley.

16) Aquatic or Semi-aquatic communities.

Aerial photos reveal several aquatic or semi-aquatic communities

in the Little Beaver Creek drainage. The largest of these areas is approximately 25 acres in size. Since the Little Beaver was in flood during the period of this study the extent or the composition and structure of these communities could not be determined. The only area where these communities could be approached was a 1/4 mile stretch just west of Perry Creek. In these stands *Sphagnum* sp. appeared to be the major ground cover. Other conspicuous plants were *Lysichitum americanum*, *Carex* sp., *Salix* sp., *Spiraea* sp., and *Habenaria* sp. *Drosera rotundifolia*, an insectivorious plant, was also encountered here.

Exotic species

Exotic species in the Little Beaver Creek drainage are mainly restricted to shelters along the creek and in open disturbed areas of the campground at the mouth of the creek. Introduced species are relatively infrequent along most of the trail. Species encountered during the study were *Bromus tectorum*, *Plantago major*, *P. lanceolata*, *Rumex obtusifolia*, *R. acetosella*, *Taraxacum officinale* and *Trifolium repens*.

Fauna

Although only one bear was encountered during the study the numerous signs would indicate a high population. Deer sign was extremely light except in the headwaters of the valley. This numerous sign in the headwaters may be due to the extensive summer range (Subalpine Zone) existing on the northern slopes at the western end of the valley. Since the creek was in flood during the period of this study no evidence of beaver was observed. Photos taken from a helicopter (Appendix), however, show evidence of some beaver activity in the drainage.

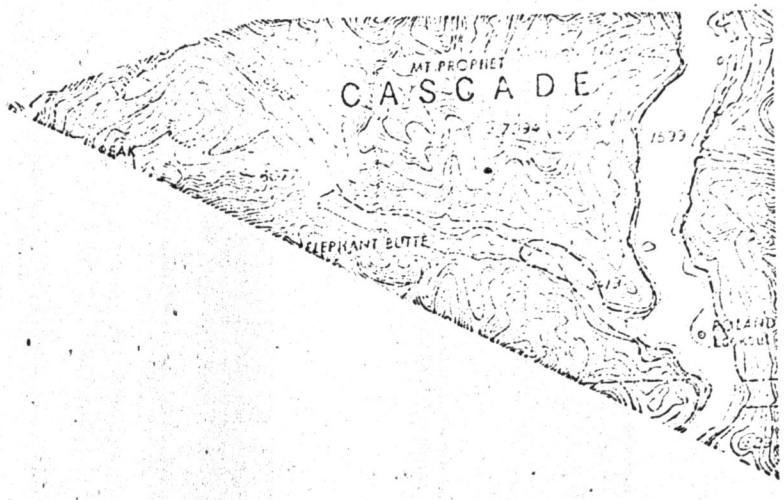
3. The Big Beaver Creek Drainage

Description of the Area

The Big Beaver Creek drainage occurs in portions of: T 39 N, R 12 E; T 39 N, R 13 E; T 38 N, R 12 E; and T 38 N, R 13 E (Figure 7). The upper segment (in the North Cascades National Park) of Big Beaver Creek flows in a northwest to southeast direction for six miles. The lower segment (most of which is in the Ross Lake National Recreation Area) of the creek flows east-southeast for six miles. Major tributaries, considered in subsequent sections of this study, are McMillan and Luna Creeks. Geomorphologically McMillan Creek is actually a continuation of the lower segment of Big Beaver Creek while the upper segment of Big Beaver Creek is a tributary of the latter two streams.

The valley of the Big Beaver ranges from less than 1/4 mile wide in the upper valley to approximately 3/4 mile in width in the lower valley. For the first six miles the gradient is extremely low, rising slightly more than 100 feet in elevation. In the upper valley the gradient is much greater with a rise of over 2000 feet. The wide valley bottom of the first six miles covers an area of about 2900 acres. The remaining six miles of the creek is relatively narrow with little bottomland vegetation. The entire area drained by Big Beaver Creek (exclusive of the McMillan and Luna Creek drainages) encompasses approximately 28,000 acres.

Figure 7. Topography map of the Big Beaver Creek drainage.



North

Scale: 1 inch = 4 miles

Vegetation

General description

As was found in the Little Beaver Creek drainage the Big Beaver Creek drainage contains vegetation types that would be representative of both the eastern Washington and western Washington Forest Zones described by Franklin and Dyrness (1969). These zones, however, are not as well represented or as distinct in the Big Beaver Creek drainage.

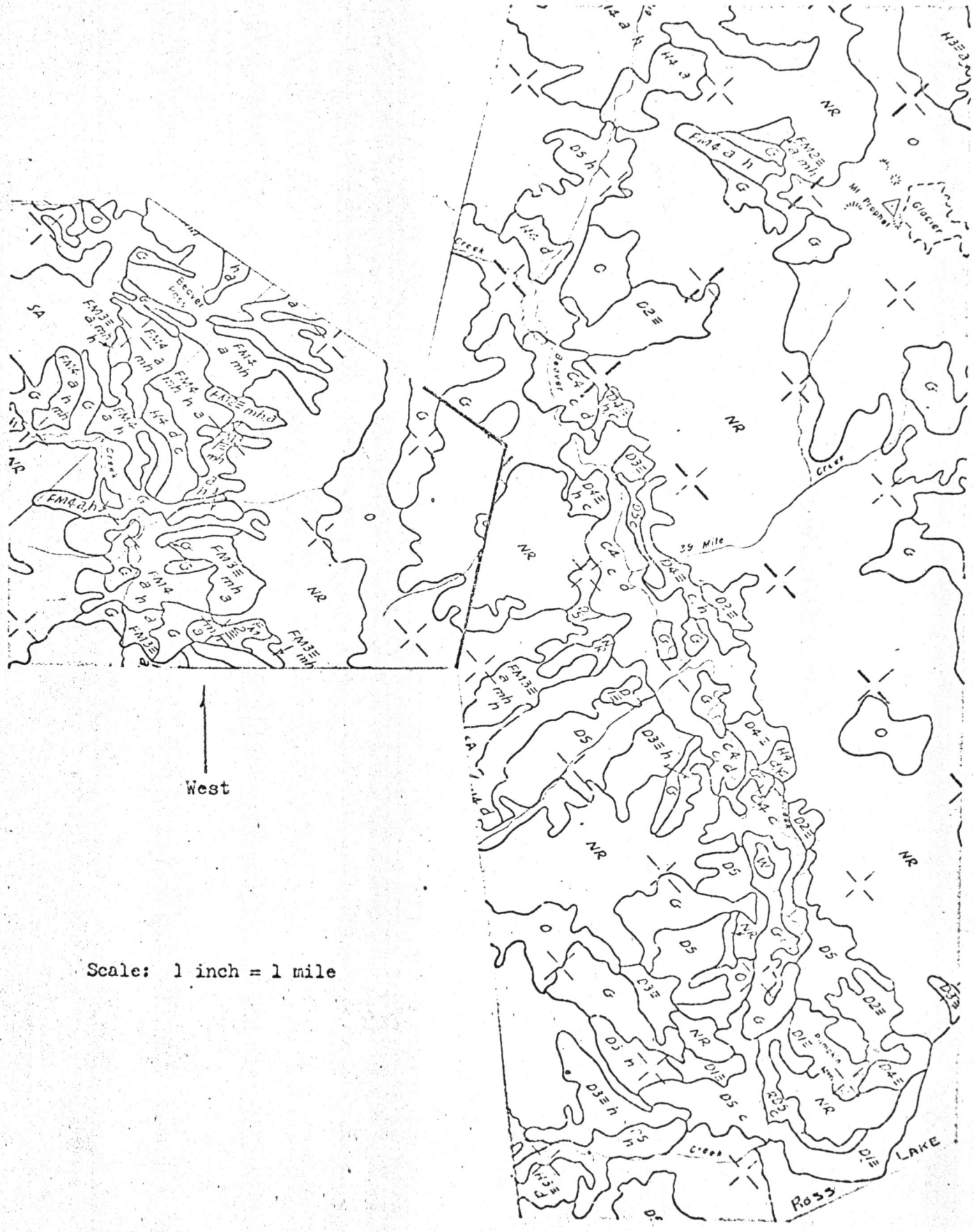
The major climax species in the lower valley is *Tsuga heterophylla* although *Pseudotsuga menziesii* and *Pinus contorta* are important climax species near the mouth of the creek. *Abies amabilis* becomes an important climax species along with *Tsuga heterophylla* (at middle elevations) in the upper valley. *Thuja plicata* and *Abies grandis* are climax species of minor importance in the lower valley.

The forests of the Big Beaver valley may generally be described as consisting of *Thuja plicata* communities in the bottomlands and *Tsuga heterophylla* and *Pseudotsuga menziesii* communities on the lower and middle slopes (Figure 8). At higher elevations *Abies amabilis* communities predominate. The composition and structure of these forest communities is extremely complex with a high tree species diversity (Table 14). Most of these species attain a large size in the valley. Deciduous communities, except for several stands near the main stream, cover a relatively limited area. Aquatic or semi-aquatic communities are common and several of them are quite extensive in size.

TABLE 14. Relative abundance of tree species in the Big Beaver Creek drainage.

Species	Abundance		
	Upper Valley (6-12 mi.)	Middle Valley (3-6 mi.)	Lower Valley (0-3 mi.)
Abies amabilis	High	Medium	Low
Abies grandis	-	Low	Low
Abies lasiocarpa	Low	-	-
Acer macrophyllum	-	Low	Low
Alnus rubra	-	Medium	Medium
Betula papyrifera	-	Low	Low
Chamaecyparis nootkatensis	Low	-	-
Picea engelmannii	-	Low	Low
Pinus contorta	-	-	Medium
Pinus monticola	-	Low	Low
Populus trichocarpa	-	Medium	Low
Prunus emarginata	-	Low	Low
Pseudotsuga menziesii	Low	Medium	High
Thuja plicata	Low	High	High
Tsuga heterophylla	High	High	High
Tsuga mertensiana	High	-	-

Figure 8. Forest type map of the Big Beaver Creek drainage.



Plant communities

1. *Tsuga heterophylla/Vaccinium ovalifolium* community.

This community occurs on many of the lower and middle slopes, especially in the upper reaches of the drainage. These sites are mesic and well-drained.

The stand examined (Table 15) was located about 1 mile northwest of McMillan Creek on a westerly slope and covered about 40 acres. *Tsuga heterophylla* is the dominant tree species with *Abies amabilis* and *Thuja plicata* of lesser importance. *Tsuga heterophylla* and *Abies amabilis* are the climax species. The tall shrub layer is dominated by *Vaccinium ovalifolium* while *Acer circinatum*, although common, has lower cover values. *Linnaea borealis* is the most important ground cover. Other frequent species in the low shrub and herb layer are *Clintonia uniflora*, *Cornus canadensis* and *Gymnocarpium dryopteris*.

2. *Tsuga heterophylla-Pseudotsuga menziesii/Abies amabilis-Vaccinium ovalifolium* community.

The habitat in which this community appears is more xeric than that of the previous community. These stands are typical of middle slopes in the central portion of the drainage.

The community examined in detail (Table 16) was about 1/2 mile northwest of McMillan Creek on a southwest facing slope. It encompassed an area of approximately 25 acres. *Tsuga heterophylla* and *Pseudotsuga menziesii* are both important in the dominant tree layer. Except for the abundance of *Abies amabilis* saplings other age classes of reproduction are quite sparse. *Vaccinium ovalifolium* is the only common tall shrub. Frequent understory species with low cover values are *Chimaphila umbellata*, *Clintonia uniflora*, *Linnaea borealis* and *Pyrola secunda*.

TABLE 15. Composition and structure of a *Tsuga heterophylla/Vaccinium ovalifolium* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	30	24-36	28	20	100
Abies amabilis	17	14-20	8	3	100
Thuja plicata	32	26-40	16	7	67
Intermediate trees:					
Abies amabilis	7	6-8	25	4	100
Tsuga heterophylla	8	6-10	13	3	100
Tall shrubs and saplings:					
Vaccinium ovalifolium				25	100
Abies amabilis				11	100
Acer circinatum				8	100
Tsuga heterophylla				8	100
Vaccinium membranaceum				1	67
Low shrubs and herbs:					
Linnaea borealis				11	100
Abies amabilis				4	100
Clintonia uniflora				2	100
Tsuga heterophylla				1	100
Cornus canadensis				1	100
Gymnocarpium dryopteris				1	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

TABLE 16. Composition and structure of a *Tsuga heterophylla-Pseudotsuga menziesii/Abies amabilis-Vaccinium ovalifolium* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	20	16-30	38	31	100
Pseudotsuga menziesii	32	24-40	21	19	100
Intermediate trees:					
Tsuga heterophylla	11	6-14	38	10	100
Abies amabilis	6	6	5	1	67
Thuja plicata	12	12	3	1	33
Tall shrubs and saplings:					
Abies amabilis				27	100
Vaccinium ovalifolium				23	100
Tsuga heterophylla				3	100
Vaccinium membranaceum				1	100
Thuja plicata				1	67
Low shrubs and herbs:					
Abies amabilis				3	100
Chimaphila umbellata				2	100
Clintonia uniflora				2	100
Linnaea borealis				1	100
Pyrola secunda				1	100
Tsuga heterophylla				1	67

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

3. *Tsuga heterophylla/Vaccinium ovalifolium-Thuja plicata* community.

This community is the most xeric of the *Tsuga heterophylla* -- dominated communities encountered in the Big Beaver valley. Only three such stands, all of a relatively small size, were observed.

The stand examined (Table 17) was about 1/4 mile north of McMillan Creek on a southerly slope. It covers an area of less than 10 acres. *Tsuga heterophylla* and *Thuja plicata*, the sole pioneer species, are of relatively small size (less than 22 inches DBH) and provide a sparse cover. The tall shrub and sapling layer is quite dense and is dominated by *Vaccinium ovalifolium* and *Thuja plicata*. A number of other species also contribute to this lush shrub layer (Table 17). Important low shrubs are *Gaultheria shallon* and *Pachystima mysinites*. Tree species reproduction is abundant and quite diverse with *Thuja plicata*, *Tsuga heterophylla*, *Abies amabilis* and *Pinus monticola* all occurring in the lower two strata.

4. *Thuja plicata/ Alnus rubra/Tiarella unifoliata* community.

This is the most hydric forested community encountered in the Big Beaver valley. The stand studied (Table 18) was relatively small, covering about 25 acres, but is typical of many of the *Thuja* communities occurring on the lower flood plain of the creek. The water table on sites such as these is often at or near the ground surface.

Thuja plicata, the sole dominant in the community, attains a relatively large size (up to 90 inches DBH). The intermediate tree layer, consisting of *Alnus rubra*, is well developed and contributes a dense cover. The lower strata are also extremely lush. Important tall shrubs are *Acer circinatum*, *Sambucus racemosa* var. *arborescens*, *Rubus parviflorus*,

TABLE 17. Composition and structure of a *Tsuga heterophylla/Vaccinium ovalifolium-Thuja plicata* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	15	14-16	5	11	100
Thuja plicata	21	20-22	2	2	67
Intermediate trees:					
Thuja plicata	10	8-12	3	2	100
Tsuga heterophylla	8	6-12	3	2	67
Tall shrubs and saplings:					
Vaccinium ovalifolium				25	100
Thuja plicata				16	100
Abies amabilis				7	100
Tsuga heterophylla				4	100
Vaccinium alaskaense				4	100
Vaccinium membranaceum				2	100
Vaccinium parvifolium				2	100
Menziesia ferruginea				2	100
Taxus brevifolia				2	100
Low shrubs and herbs:					
Gaultheria shallon				6	100
Thuja plicata				3	100
Abies amabilis				2	100
Pinus monticola				2	100
Pachystima myrsinites				2	100

[a]Species with an average cover of two percent, or more, are included in this table.

[b]Data for this community was compiled from three .2-acre plots.

TABLE 18. Composition and structure of a *Thuja plicata/Alnus rubra/Tiarella unifoliata* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	70	40-90	13	28	100
Intermediate trees:					
Alnus rubra	6	4-10	87	60	100
Tall shrubs and saplings:					
Acer circinatum				13	100
Alnus rubra				8	100
Sambucus racemosa var. *arborescens*				5	100
Rubus parviflorus				5	100
Oplopanax horridum				3	100
Thuja plicata				3	100
Tsuga heterophylla				3	100
Cornus stolonifera				2	100
Low shrubs and herbs:					
Tiarella unifoliata				23	100
Athyrium filex-femina				12	100
Circaea alpina				9	100
Dicentra formosa				4	100
Dryopteris austriaca				3	100
Streptopus roseus				3	100
Smilacina stellata				3	100
Clintonia uniflora				2	100

[a] Species with an average cover of two percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

Oplopanax horridum and *Cornus stolonifera*. Frequent tree species in this layer are *Thuja plicata*, *Tsuga heterophylla* and *Alnus rubra*. The latter is found only in occasional openings in the stand. *Tiarella unifoliata*, *Athyrium filex-femina* and *Circaea alpina* are the most abundant ground covers.

5. *Thuja plicata/Acer circinatum-Oplopanax horrifum/Tiarella unifoliata* community.

On bottomlands where drainage is slightly better a *Thuja* community with a much sparser understory develops. The community studied in detail (Table 19) was located in the lower valley and encompassed an area of over 100 acres.

The dominant and intermediate layers consisted mainly of *Thuja plicata*. *Acer circinatum* and *Oplopanax horridum* are common tall shrubs. *Tiarella unifoliata* is the major ground cover although *Clintonia uniflora*, *Asarum caudatum*, *Smilicina stellata* and *Streptopus roseus* are frequent but have low cover values. Tree species reproduction is virtually absent.

6. *Thuja plicata/Acer circinatum* community.

This community occurs on the lower slopes of the lower valley. These moist sites are frequent in the lower valley.

The stand examined (Table 20) is located just west of Ten Mile Shelter and covers about 100 acres. *Thuja plicata* is the dominant tree species but unlike the previous *Thuja* communities examined *Tsuga heterophylla* is also abundant in the upper layer. *T. heterophylla* and *Abies amabilis* are climax species in the stand. The tall shrub layer is dominated by *Acer circinatum* with some *Oplopanax horridum* present.

TABLE 19. Composition and structure of a *Thuja plicata/Acer circinatum-Oplopanax horridum/Tiarella unifoliata* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	62	50-76	16	40	100
Picea engelmannii	30	28-32	2	2	50
Intermediate trees:					
Thuja plicata	10	8-12	3	3	75
Tall shrubs and saplings:					
Acer circinatum				24	100
Oplopanax horridum				18	100
Rubus parviflorus				2	100
Alnus rubra				2	75
Low shrubs and herbs:					
Tiarella unifoliata				20	100
Clintonia uniflora				4	100
Asarum caudatum				3	100
Smilicina stellata				2	100
Streptopus roseus				2	75

[a] Species with an average cover of two percent, or more, are included in this table.

[b] The data for this community was compiled from four .2-acre plots.

TABLE 20. Composition and structure of a *Thuja plicata/Acer circinatum* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	50	40-80	21	55	100
Tsuga heterophylla	24	16-30	10	15	100
Intermediate trees:					
Tsuga heterophylla	6	6-8	12	4	67
Abies amabilis	6	6-8	5	2	67
Tall shrubs and saplings:					
Acer circinatum				25	100
Abies amabilis				17	100
Oplopanax horridum				3	100
Vaccinium ovalifolium				1	100
Rubus parviflorus				1	100
Tsuga heterophylla				5	67
Low shrubs and herbs:					
Clintonia uniflora				4	100
Streptopus roseus				4	100
Tiarella unifoliata				3	100
Cornus canadensis				3	100
Abies amabilis				2	100
Smilicina stellata				2	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

Important plants in the low shrub and herb layer are *Clintonia uniflora, Streptopus roseus, Tiarella unifoliata, Cornus canadensis* and *Smilicina stellata.*

7) *Pseudotsuga menziesii/Tsuga heterophylla - Abies amabilis/Acer circinatum* community.

On middle and lower slopes of the lower valley this is a common community. These slopes are moist and well-drained.

The stand studied in detail (Table 21) is located about 1 mile west of 10 Mile Shelter and covers an area of about 50 acres. *Pseudotsuga menziesii* is the major pioneer species with smaller amounts of *Thuja plicata.* Seral species in the stand are *Tsuga heterophylla, Abies amabilis* and *Thuja plicata. Abies amabilis* and *Tsuga heterophylla* are climax. The upper shrub layer is dominated by *Acer circinatum* and *Vaccinium ovalifolium.* The most conspicuous plants in the low shrub and herb layer are *Clintonia uniflora, Cornus canadensis* and *Linnaea borealis.*

8) *Pseudotsuga menziesii/Berberis nervosa* community.

This community occurs on dry southerly slopes in the eastern portion of the Big Beaver valley. These stands originated after the Skagit fire of 1926.

The stand examined (Table 22) was located about 1 1/2 miles west of Ross Lake and encompassed about 100 acres. *Pseudotsuga menziesii* is the sole pioneer species. The intermediate tree layer is dominated by *P. menziesii* with smaller amounts of *Tsuga heterophylla* and *Thuja plicata.* These three trees are also climax species, with *Thuja plicata* the least common. The only abundant tall shrub is *Acer circinatum. Berberis nervosa* and *Pachystima myrsinites* dominate the low shrub layer.

TABLE 21. Composition and structure of a *Pseudotsuga menziesii/Tsuga heterophylla-Abies amabilis/Acer circinatum* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	50	40-60	10	17	100
Thuja plicata	35	30-40	3	5	50
Intermediate trees:					
Tsuga heterophylla	11	8-14	24	15	100
Abies amabilis	9	6-14	22	14	100
Thuja plicata	12	6-14	5	6	75
Tall shrubs and saplings:					
Acer circinatum				28	100
Abies amabilis				12	100
Tsuga heterophylla				11	100
Vaccinium ovalifolium				11	100
Low shrubs and herbs:					
Clintonia uniflora				10	100
Abies amabilis				4	100
Cornus canadensis				4	100
Linnaea borealis				4	100
Tsuga heterophylla				3	100
Smilicina stellata				1	100
Pachystima myrsinites				1	75

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from four .2-acre plots.

TABLE 22. Composition and structure of a *Pseudotsuga menziesii/Berberis nervosa* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	24	20-27	1	5	100
Intermediate trees:					
Pseudotsuga menziesii	10	8-13	9	15	100
Tsuga heterophylla	7	6-8	2	3	100
Thuja plicata	10	9-12	1	2	75
Tall shrubs and saplings:					
Pseudotsuga menziesii				21	100
Tsuga heterophylla				19	100
Acer circinatum				10	100
Thuja plicata				2	100
Prunus emarginata				2	100
Acer macrophyllum				1	100
Low shrubs and herbs:					
Berberis nervosa				29	100
Pachystima myrsinites				14	100
Chimaphila umbellata				1	75

[a]Species with an average cover of one percent, or more, are included in this table.

[b]Data for this community was compiled from four .2-acre plots.

9) *Pseudotsuga menziesii/Salix lasiandra-Acer circinatum/Pachystima myrsinites-Berberis nervosa* community.

This community is the most xeric of the *Pseudotsuga* - dominated communities in the Big Beaver drainage. It is common (mainly on south slopes) at the eastern limits of the valley.

The stand examined in detail (Table 23) occupied about 40 acres. *Pseudotsuga menziesii* is the sole pioneer and seral species. The dominant climax tree species is also *P. menziesii* with some *Thuja plicata* also present. The upper shrub layer is dominated by *Salix lasiandra* (in openings) and *Acer circinatum*. Important low shrubs in the community are *Pachystima myrsinites* and *Berberis nervosa*.

10) *Pinus contorta/Arctostaphylos uva-ursi* community.

The *Pinus/Arctostaphylos* community is the most xeric in the valley. The habitat of these stands is found on the shallow soils near the mouth of the creek. These stands originated after the 1926 fire and occupy approximately 200 acres.

Pinus contorta is the major pioneer species in these open stands (Table 24). *Pseudotsuga menziesii* and *Pinus monticola* are also pioneers but of less importance. *Pseudotsuga menziesii*, along with some *Pinus contorta*, is the most common seral species. Reproduction, although relatively sparse, is quite diverse. *Pseudotsuga menziesii*, *Pinus contorta*, *P. monticola*, *Thuja plicata* and *Tsuga heterophylla* all appear in the understory. The low shrub and herb layer consists mainly of *Arctostaphylos uva-ursi* and smaller amounts of *Pteridium aquilinum*.

11) *Alnus rubra/Acer circinatum-Rubus spectabilis/Athyrium filix-femina* community.

Deciduous communities are limited in extent and occur mainly

TABLE 23. Composition and structure of a *Pseudotsuga menziesii/Salix lasiandra-Acer circinatum/Pachystima myrsinites-Berberis nervosa* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	25	20-29	3	12	100
Intermediate trees:					
Pseudotsuga menziesii	10	9-12	17	28	100
Tall shrubs and saplings:					
Pseudotsuga menziesii				20	100
Salix lasiandra				19	100
Acer circinatum				17	100
Thuja plicata				1	100
Phamnus purshiana				1	75
Low shrubs and herbs:					
Pachystima myrsinites				20	100
Berberis nervosa				17	100
Pteridium aquilinum				5	100
Chimaphila umbellata				1	100
Linnaea borealis				1	75

[a] Species with an average cover of 1 percent, or more, are included in this table.

[b] The data for this community was compiled from four .2-acre plots.

TABLE 24. Composition and structure of a *Pinus contorta/Arctostaphylos uva-ursi* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pinus contorta	7	6-8	78	22	100
Pseudotsuga menziesii	6	6	7	2	67
Pinus monticola	10	10	2	1	33
Intermediate trees:					
Pseudotsuga menziesii	4	4	5	1	33
Pinus contorta	4	4	20	4	100
Tall shrubs and saplings:					
Pseudotsuga menziesii				4	100
Pinus contorta				2	67
Thuja plicata				1	67
Tsuga heterophylla				1	67
Pinus monticola				1	33
Low shrubs and herbs:					
Arctostaphylos uva-ursi				14	100
Pteridium aquilinum				5	100
Pachystima myrsinites				2	100
Pseudotsuga menziesii				1	100
Pinus contorta				1	67
Thuja plicata				1	33

[a]Species with an average cover of one percent, or more, are included in this table.

[b]Data for this community was compiled from three .2-acre plots.

along the streambanks of the Big Beaver. These stands are dominated by *Alnus rubra* and occur on moist bottomland sites.

The stand examined (Table 25) is located at the eastern end of the valley about one mile west of Ross Lake. The pioneer species, which came in after the 1926 fire, are *Alnus rubra* and *Thuja plicata* with the former contributing a much higher cover than the latter. *Thuja plicata* is a common species in the intermediate tree layer. *Thuja plicata* and *Tsuga heterophylla* are infrequent as climax species. The dense upper shrub layer is dominated by *Acer circinatum* and *Rubus spectabilis*. *Athyrium filex-femina* is the most abundant ground cover in the stand. Concave sites, which may contain standing water, are frequented by *Cornus stolonifera* and *Lysichetum americanum*.

12) Avalanche track communities.

These communities are similar to those encountered in the Little Beaver with a moisture gradient ranging from mesic-hydric in the upper reaches to xeric near the eastern limits. *Acer circinatum, A. glabrum, Corylus cornuta* and *Prunus emarginata* are common species of the xeric sites while *Acer circinatum* (at lower elevations) and *Alnus sinuata* (at higher elevations) dominate on the moister sites.

13) Aquatic or semi-aquatic communities.

These communities are one of the most conspicuous features of the lower six miles of the Big Beaver Creek drainage. At least 15 large bogs, marshes and ponds occur in the valley. Their origin appears to be varied, being the result of beaver dams, ox-bow lakes created by the meandering stream, or pits left by the last alpine glacier. The entire spectrum of both size and successional stage is probably repre-

TABLE 25. Composition and structure of an *Alnus rubra/Acer circinatum-Rubus spectabilis/Athyrium filex-femina* community in the Big Beaver Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Alnus rubra	11	8-14	78	65	100
Thuja plicata	17	10-26	5	7	100
Intermediate trees:					
Thuja plicata	5	4-6	23	11	67
Tall shrubs and saplings:					
Acer circinatum				35	100
Rubus spectabilis				28	100
Cornus stolonifera				5	100
Thuja plicata				3	100
Tsuga heterophylla				1	67
Low shrubs and herbs:					
Athyrium filex-femina				33	100
Lysichetum americanum				12	100
Dryopteris austriaca				4	100
Viola glabella				2	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

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sented. Sizes range from about 5 to 75 acres. The communities may have extensive areas of open water or may be closed communities dominated by semi-aquatic species. Vegetation ranges from tall shrubs (*Salix scouleri, S. sitchensis, Cornus stolonifera* and *Spiraea douglasii*) to the *Sphagnum* sp. -- *Carex* sp. communities. Other conspicuous species of these habitats are *Potentilla palustris, Drosera rotundifolia* and *Menyanthes trifoliata*. Much more time would be necessary to adequately assess the composition and structure as well as the successional dynamics of these diverse communities.

Exotic species

Exotic plants in the Big Beaver Creek drainage are restricted mainly to the camping sites and trails of the lower valley. Species encountered during the study were *Plantago major, P. lanceolata, Rumex acetosella, Taraxacum officinale* and *Trifolium repens*.

Fauna

A sizeable bear population apparently exists in the valley. The numbers of deer, because of the lack of suitable habitat, are low. Active beaver colonies were noted in several of the aquatic communities.

4. The Chilliwack River Drainage

Description of the Area

The Chilliwack River Drainage occurs in portions of T 41 N, R 10 E; T 41 N. R 11 E; T 41 N, R 10 E; T 40 N, R 11 E; T 39 N, R 9 E; T 39 N, R 10 E; and T 39 N, R 11 E (Figure 9). The river is approximately 14 miles long and flows in a northeast to north direction. The first mile of the river is located in Canada with the remainder in the North Cascades National Park. Major tributories are the Little Chilliwack River, Bear Creek, Indian Creek and Brush Creek.

The valley of the Chilliwack ranges from 1/4 mile wide in the upper reaches to approximately one mile wide in the lower valley. For the first seven miles the gradient is moderate, rising only 300 feet, with the remainder of the river having a much steeper gradient. The valley bottom and lower slopes of the valley encompass about 3,800 acres while the entire drainage of the Chilliwack occupies approximately 49,000 acres.

Vegetation

General description

The Chilliwack River drainage contains vegetation types that are representative of the *Tsuga heterophylla* and *Abies amabilis* Zones or Forest Types described by Franklin and Dyrness (1969) and Douglas (1969a) for western Washington. *Tsuga heterophylla* is the major climax species in the lower valley with *Abies amabilis* becoming more important in the upper valley. The valley bottom is dominated by *Thuja plicata* in the lower valley and *Tsuga heterophylla* in the upper valley (Figure 10).

Figure 9. Topography map of the Chilliwack River drainage.

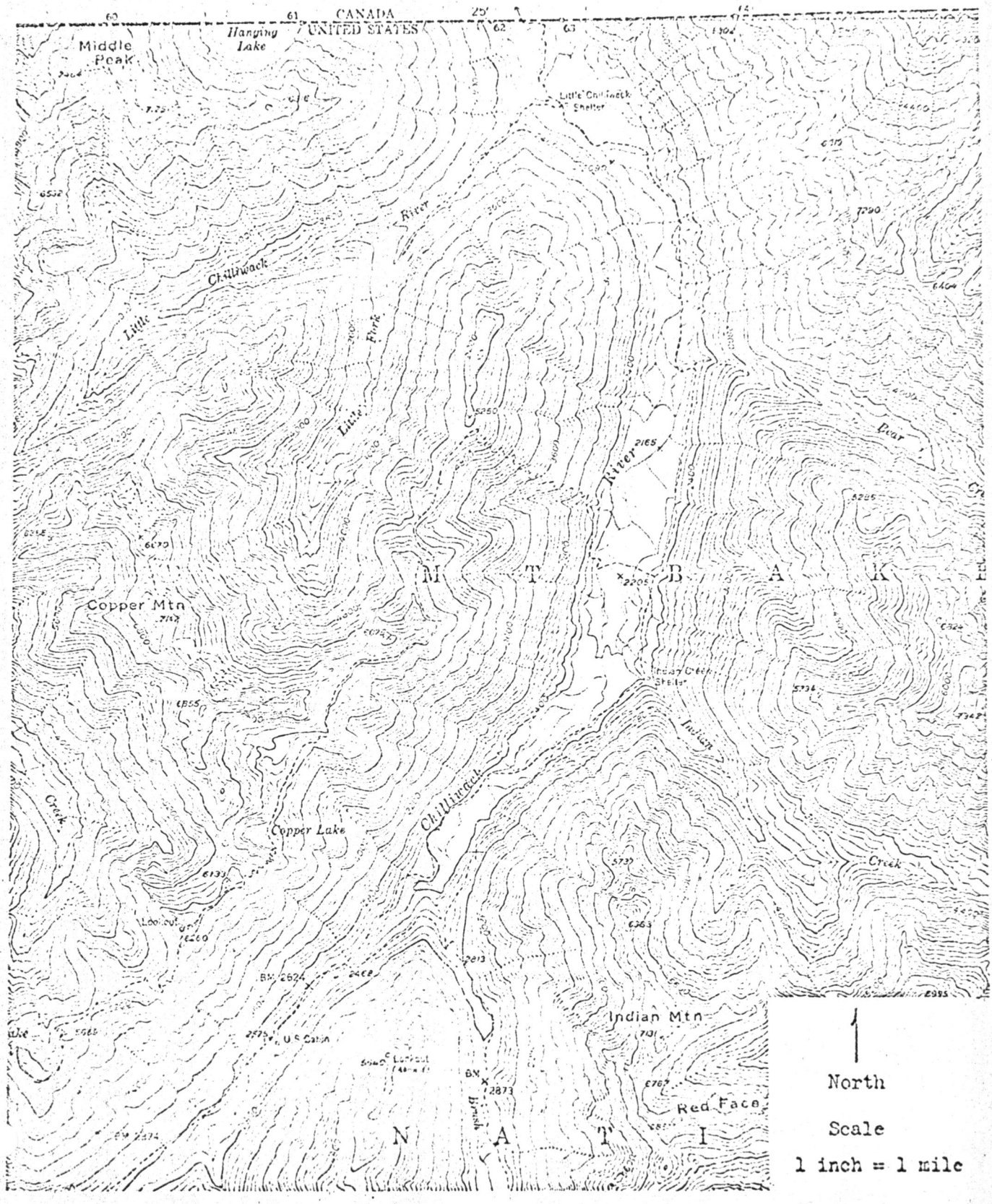
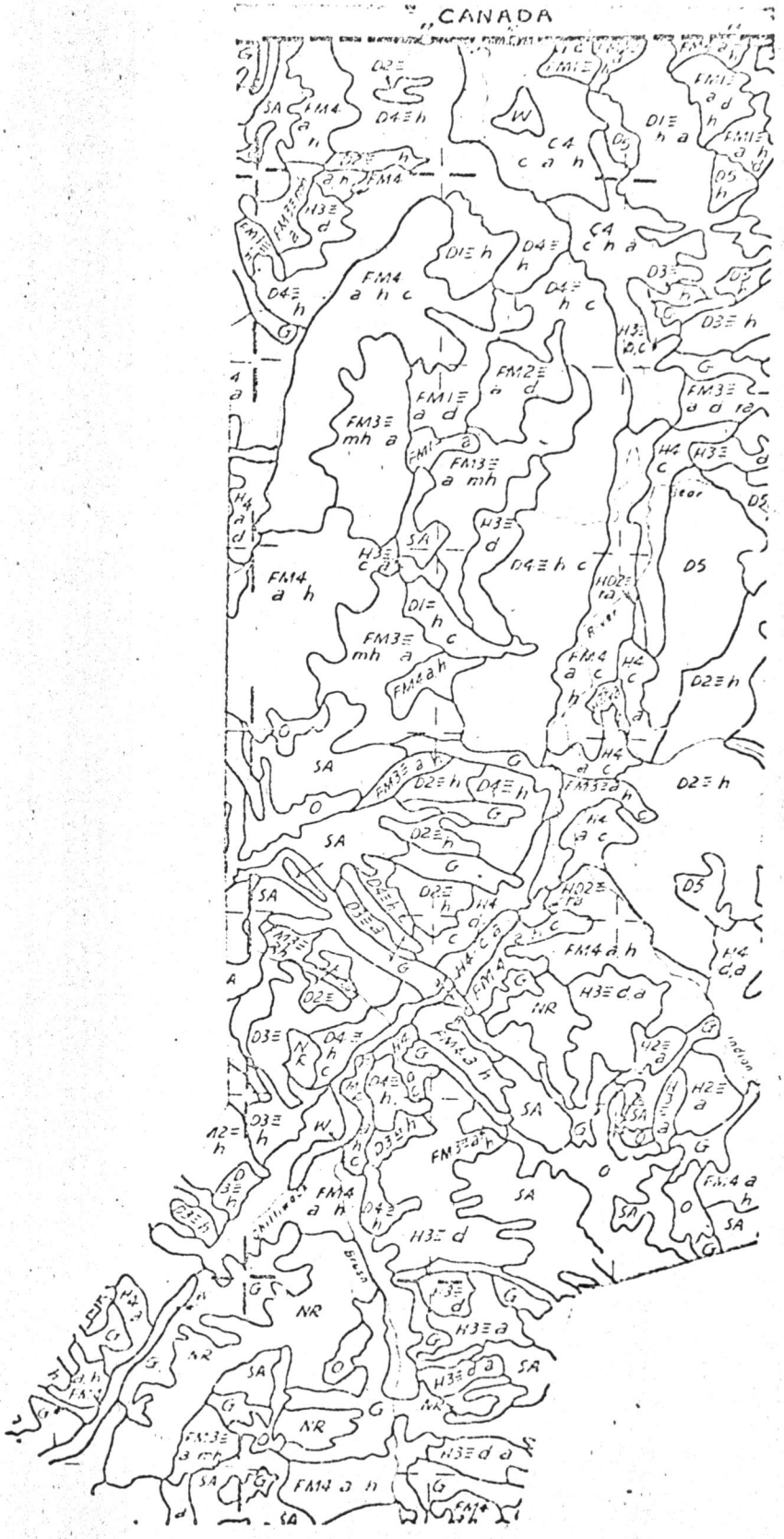


Figure 10. Forest type map of the Chilliwack River drainage.



Pseudotsuga menziesii is the major species on the lower and middle slopes of the lower valley. Most of the tree species attain a large size in the valley.* Deciduous communities are relatively limited in the valley. Several large aquatic communities occur on the eastern side of the river.

Plant communities

1) *Thuja plicata/Oplopanax horridum/Gymnocarpium dryopteris-Athyrium filex-femina* community.

Forest stands dominated by *Thuja plicata* are especially common in the lower three miles of the valley. They are most frequent on the bottom lands and lower slopes.

The *Thuja/Oplopanax/Gymnocarpium-Athyrium* stand examined in detail (Table 26) was located in the valley bottom about one mile south of the International Boundary. *Thuja plicata* is the dominant overstory species although some old-growth *Tsuga heterophylla* is also present. *T. heterophylla* and *Abies amabilis* are infrequent in the sparse intermediate tree layer. The sole climax species is *Tsuga heterophylla*. The dense tall shrub layer is dominated by *Oplopanax horridum*. *Gymnocarpium dryopteris* and *Athyrium filex-femina* are abundant species in the herb layer. Other important plants in this layer are *Tiarella unifoliata*, *Circaea alpina*, *Galium* sp., and *Asarum caudatum*.

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* The largest known specimen (25.6 feet in ~~diameter~~ circumference and 230 feet tall) of *Picea engelmannii* was discovered in the Chilliwack drainage during this study.

TABLE 26. Composition and structure of a *Thuja plicata/Oplopanax horridum/Gymnocarpium dryopteris-Athyrium filex-femina* community in the Chilliwack River drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	78	48-108	23	55	100
Tsuga heterophylla	25	18-36	16	9	67
Intermediate trees:					
Tsuga heterophylla	10	8-12	6	2	67
Abies amabilis	14	14	1	1	33
Tall shrubs and saplings:					
Oplopanax horridum				47	100
Tsuga heterophylla				2	100
Acer circinatum				7	67
Low shrubs and herbs:					
Gymnocarpium dryopteris				40	100
Athyrium filex-femina				20	100
Tiarella unifoliata				13	100
Circaea alpina				8	100
Galium sp.				5	100
Asarum caudatum				4	100
Smilicina stellata				1	100
Dicentra formosa				1	100

[a] Species with an average cover of 1 percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

2) *Thuja plicata/Acer circinatum* community.

On slightly better drained sites, especially on the lower slopes, the understory of the *Thuja* stands is markedly different both in species composition and total cover. The size of *T. plicata* is also smaller.

A *Thuja/Acer circinatum* community (Table 27) located about 1/4 mile south and upslope from the previous *Thuja* community was studied. *Thuja plicata* is the dominant pioneer species with lesser amounts of *Tsuga heterophylla*. In the intermediate tree layer and understory layers *T. heterophylla* and *Abies amabilis* are common. *Acer circinatum* is abundant in the tall shrub layer. In this layer *Vaccinium ovalfolium* is frequent but has lower cover values. The relatively sparse ground cover consists mainly of *Tiarella unifoliata* and *Cornus canadensis*.

3) *Pseudotsuga menziesii/Tsuga heterophylla/Chimaphila umbellata* community.

Stands dominated by old-growth *Pseudotsuga menziesii* are common on the well drained, lower slopes of the lower valley. These trees are approximately 850 years old (estimated from tree sections cut recently by trail crews) and are probably a good indication of the date of the last major disturbance in the valley.

A representative stand (Table 28), located just south of Bear Creek was examined. This community covered approximately 300 acres. *Pseudotsuga menziesii* is the major pioneer species reaching 84 inches DBH. *Tsuga heterophylla* is an important seral and climax species. A secondary climax species of lower cover is *Abies amabilis*. *Vaccinium ovalifolium* is the only common tall shrub in the stand while *Chimaphila umbellata* and *Linnaea borealis* are common in the low shrub layer.

TABLE 27. Composition and structure of a *Thuja plicata/Acer circinatum* community in the Chilliwack River drainage.[a,b]

Species and Layer	Average DBH (inches	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	52	41-94	18	50	100
Tsuga heterophylla	22	16-30	5	9	100
Intermediate trees:					
Tsuga heterophylla	8	6-12	13	4	100
Abies amabilis	7	6-8	6	2	67
Tall shrubs and saplings:					
Acer circinatum				24	100
Vaccinium ovalifolium				6	100
Tsuga heterophylla				3	100
Oplopanax horridum				1	100
Abies amabilis				1	100
Low shrubs and herbs:					
Tiarella unifoliata				11	100
Cornus canadensis				4	100
Smilicina stellata				1	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] The data for this community was compiled from three .2-acre plots.

TABLE 28. Composition and structure of a *Pseudotsuga menziesii/Tsuga heterophylla/Chimaphila umbellata* community in the Chilliwack River drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	64	47-73	18	25	100
Tsuga heterophylla	22	16-24	20	17	100
Thuja plicata	25	24-26	3	2	67
Intermediate trees:					
Tsuga heterophylla	12	10-14	21	11	100
Tall shrubs and saplings:					
Tsuga heterophylla				32	100
Abies amabilis				4	100
Vaccinium ovalifolium				4	100
Low shrubs and herbs:					
Chimaphila umbellata				14	100
Linnaea borealis				8	100
Tsuga heterophylla				3	100

[a] Species with an average cover of two percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

4) *Pseudotsuga menziesii/Tsuga heterophylla/Acer circinatum* community.

On slightly wetter sites, especially on easterly aspects, this *Pseudotsuga*-dominated community is common. The pioneer trees are generally smaller than in the previous community and *Abies amabilis* is more important as a climax species.

The stand studied in detail (Table 29) is located on the west side of the river, about one mile south of Bear Creek. The pioneer tree species is *Pseudotsuga menziesii*. *Tsuga heterophylla* and *Abies amabilis* are frequent seral and climax species. The tall shrub layer is dominated by *Acer circinatum* and smaller amounts of *Vaccinium ovalifolium*. *Cornus canadensis*, *Linnaea borealis* and *Gynocarpium dryopteris* are frequent plants in the sparse low shrub and herb layer.

5) *Tsuga heterophylla/Acer circinatum-Vaccinium ovalifolium* community.

The most common community in the Chilliwack River drainage are those dominated by *Tsuga heterophylla*. In the lower valley where such stands are relatively infrequent, *Thuja plicata* is important. From the middle to upper valley, where *Tsuga heterophylla*-dominated communities are common, *Abies amabilis* becomes increasingly important.

A typical stand (Table 30), located on the lower slopes southwest of the mouth of Brush Creek, was studied in detail. *Tsuga heterophylla* and *Abies amabilis* are important pioneer species in this community. The latter two trees are also abundant as seral and climax species. *Acer circinatum* and *Vaccinium ovalifolium* are common tall shrubs while *Tiarella unifoliata* and *Clintonia uniflora* are important ground cover species.

TABLE 29. Composition and structure of a *Pseudotsuga menziesii/Tsuga heterophylla/Acer circinatum* community in the Chilliwack River drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	48	36-64	15	26	100
Tsuga heterophylla	21	18-26	3	5	67
Intermediate trees:					
Tsuga heterophylla	8	6-10	10	3	100
Abies amabilis	6	6	6	2	100
Tall shrubs and saplings:					
Acer circinatum				26	100
Tsuga heterophylla				9	100
Vaccinium ovalifolium				4	100
Abies amabilis				2	100
Low shrubs and herbs:					
Abies amabilis				7	100
Cornus canadensis				4	100
Linnaea borealis				1	100
Gymnocarpium dryopteris				1	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

TABLE 30. Composition and structure of a *Tsuga heterophylla/Acer circinatum-Vaccinium ovalifolium* community in the Chilliwack River drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	19	14-32	60	34	100
Abies amabilis	16	14-20	24	15	100
Intermediate trees:					
Tsuga heterophylla	9	6-12	34	19	100
Abies amabilis	8	6-12	20	10	100
Tall shrubs and saplings:					
Acer circinatum				20	100
Vaccinium ovalifolium				18	100
Tsuga heterophylla				4	100
Abies amabilis				2	100
Tubus spectabilis				1	67
Low shrubs and herbs:					
Tiarella unifoliata				8	100
Clintonia uniflora				3	100
Cornus canadensis				1	100
Rubus pedatus				1	100
Athyrium filex-femina				1	67

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

6) Avalanche track communities.

As in all valleys of the North Cascades, avalanche track communities are common in the Chilliwack River drainage. At lower elevations *Acer circinatum* is the dominant species and on extremely wet sites, especially in the lower valley, *Cornus stolonifera* may be of importance. In the middle and upper valley *Alnus sinuata* becomes the most abundant species in such habitats.

7) Aquatic or semi-aquatic communities

There are several aquatic or semi-aquatic communities in the valley. Two of them, one in the lower valley and another in the middle valley, are of relatively large size (ca. 25 and 30 acres). These two areas are the result of beaver dams built a number of years ago. Plant succession has developed to the stage where floating mats of *Sphagnum* sp. , along with other typical associates (*Menyanthes trifoliata, Potentilla palustris, Carex* sp., etc.), are encroaching on the open water.

Exotic species

The Chilliwack River valley is relatively free of exotic species. They are abundant only around shelters. This lack of introduced plants may be due to the lack of horse travel in the lower valley and the sufficiently high elevation (where exotics do not thrive) of the upper valley where horse use is more common. Species encountered were *Plantage major, Rumex obtusifolius,* and *Trifolium repens.*

Fauna

Although no fresh deer sign was encountered, old sign was numerous. The valley probably serves as a winter range for the large deer

population that spend the summer in the Subalpine Zone on the upper mountain slopes of the valley. Bear sign was also abundant and a considerable food supply of spawning kokanee were noted in the river during late summer. No active beaver dams were encountered although some recent cuttings were found.

5. The North Fork Nooksack River Drainage.

Description of the Area

The North Fork Nooksack River drainage, within the North Cascades National Park, is located in portions of: T 39 N, R 9 E and T 39 N, R 10 E (Figure 11). The river flows in a northeasterly direction and is approximately 2 1/2 miles in length. The mountainsides of the valley rise abruptly from the 1/2 to 3/4 mile wide valley floor. The valley bottom covers an area of about 900 acres while the entire drainage encompasses approximately 7,700 acres.

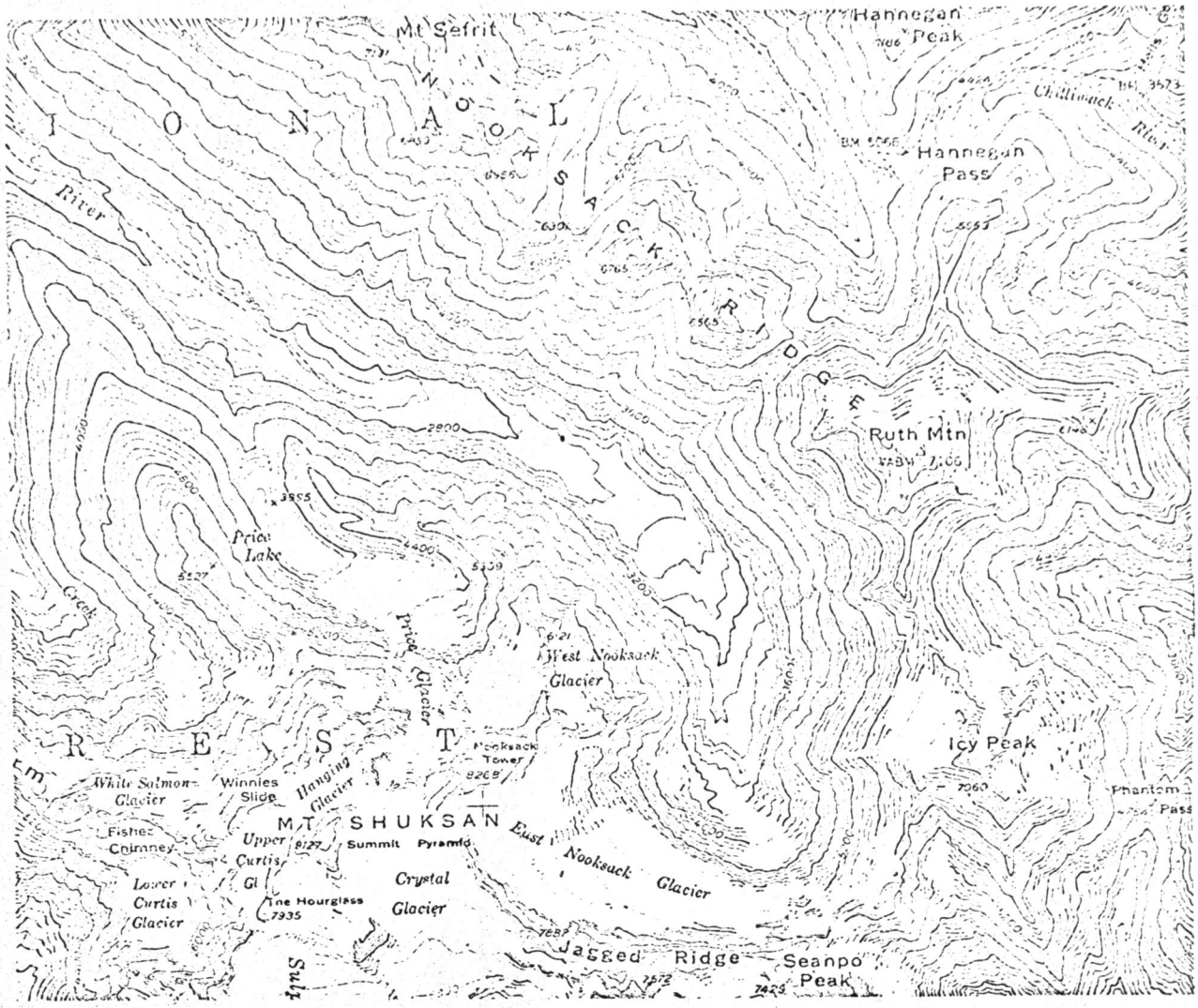
This valley is markedly different from most other low elevation drainages in the North Cascades in that the last alpine glacier to occupy the valley has just recently receded. In fact, a sizeable area of the upper headwaters is still occupied by the glacier. This recent glaciation has resulted in a very dramatic transition of vegetation and soils.

Vegetation

General description

Plant succession and soil development in the valley can be traced from the young barren moraines near the front of the glacier to the old-growth forests of the lower valley (Figure 12). There are presently five stages or stades that may be recognized: (1) the present stade (pioneer vegetation), (2) the *Alnus sinuata* stade, (3) the *Tsuga mertensiana-Alnus sinuata* stade, (4) the *Tsuga mertensiana* stade, and (5) the *Tsuga heterophylla-Thuja plicata* stade. Since a detailed vegetation or soils analysis was beyond the scope of this study only qualitative information was collected for the various stades.

Figure 11. Topograpy map of the North Fork Nooksack River drainage.



Scale: 1 inch = 1 mile

Figure 12. Forest type map of the North Fork Nooksack River drainage.

Scale: 1 inch = 1 mile

A number of avalanche track communities are also present along the sides of the valley. These communities, where avalanches are frequent, are dominated soley by *Alnus sinuata*. Where avalanches are less common *Tsuga mertensiana* may be found invading the communities.

Plant communities

1) The present stade.

This stade extends from the front of the glacier down the valley for about 1/3 mile. The ground surface near the glacier is unvegetated but as one goes further away a diverse, but sparse, pioneer vegetation of low shrubs and herbs is found. *Luetkea pectinata, Phyllodoce empetriformis, Juncus mertensianus, Cryotogramma acrostichoides, Cares spectabilis, Gramineae* sp. and *Sorbus sitchensis* var. *grayii* are frequent species with low cover values. Small seedlings of *Tsuga mertensiana* and *Abies amabilis* are infrequent. The only important moss, but of low cover and frequency, is *Rhacomitrium canescens* var. *ericoides*. In several small areas, which have silted in, the vegetative cover is higher (ca. 50% cover) and is dominated by *Juncus mertensianus* and several species of Gramineae.

2) The *Alnus sinuata* stade.

This stade covers about the same area as Stade 1. *Alnus sinuata* is a conspicuous invader forming numerous small clumps. In the vicinity of the clumps and in the intervening areas a number of low shrubs and herbs are established. These species, although of higher cover than in the previous stade, are still relatively sparse. Frequent plants encountered are *Luetkea pectinata, Phyllodoce empetriformis, Penstemon*

davidsonii, *Menziesia ferruginea*, *Vaccinium membranaceum*, *Athyrium americanum* var. *distentifolium*, *Lycopodium sitchense*, *Tsuga mertensiana*, *Abies amabilis*, *Anaphalis margaritacea*, and *Rhacomitrium canescens* var. *ericoides*. In this area the lichen *Rhizocarpum geographicum* is common. In the future, with the use of lichenometry, this plant may prove valuable in determining the age of this and other stades.

3) The *Tsuga mertensiana-Alnus sinuata* stade.

Stade 3 covers a slightly smaller area than the previous two stades. The *Alnus sinuata* clumps are slightly larger and are being invaded by *Tsuga mertensiana*. Occasional specimens of *Abies amabilis* are also found in the clumps. The low shrubs and herbs, which consist mainly of the species mentioned in the previous stade, have a slightly higher cover. The moss, *Rhacomitrium canescens* var. *ericoides*, has notably increased in cover.

4) The *Tsuga mertensiana* stade.

This stade covers approximately the same area as Stade 3. *Tsuga mertensiana*, averaging 20 feet in height, is now the dominant species and forms essentially closed stands. In openings between the stands *Rhacomitrium canescens* var. *ericoides* occurs as a continuous mat. *Lupinus latifolius* and *Anaphalis margaritacea* are common herbs in these openings.

5) The *Tsuga heterophylla-Thuja plicata* stade.

In the lower portion of the area studied a mature old-growth stand of *Tsuga heterophylla* and *Thuja plicata* is found. This community occurs on alluvium deposited by the river after glaciation. Whether this is the upper limit of such stands in the valley or whether the

Tsuga mertensiana stade will develop towards the *Tsuga heterophylla-Thuja plicata* stade is not known. These alluvium deposits and the numerous terraces near the river in the lower valley would indicate the occurrence of frequent floods. These floods are probably due to avalanches damming the river in the upper valley.

Soils

Soils in the valley range from the coarse gravels of Stade 1 through the well developed soils of Stade 5. The soils of Stades 2, 3 and 4, although exhibiting progressively greater development, are still relatively poorly developed. In the alluvium deposits of Stade 5 mature podzols have developed.

6. The Stetattle Creek Drainage

Description of the Area

Stetattle Creek is located in portions of: T 38 N, R 12 E; T 38 N, R 13 E; T 37 N, R 12 E; and T 37 N, R 13 E (Figure 13). The creek flows in a southeast direction and is about eight miles in length. The only sizeable tributary is Jay Creek which is three miles in length. Azure Lake, an 89 acre cirque lake, is located in the extreme headwaters at an elevation of 4200 feet.

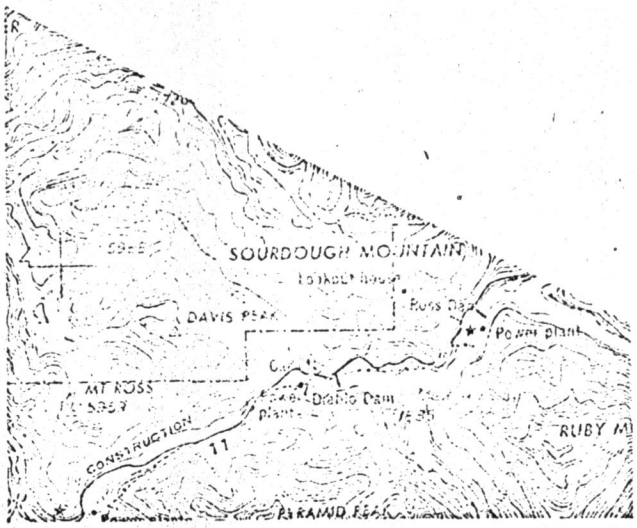
The mountain slopes along Stetattle Creek rise abruptly from the narrow valley. The creek rises about 2000 feet in elevation in the first seven miles, then another 1000 feet in the last mile. The entire drainage encompasses about 16,000 acres.

Vegetation

General description

In this drainage, as in all of the previous dranages examined, the continuous forest has consisted of a complex mosaic of vegetation types. This is due, in large part, to the frequent occurrence of relatively small fires over a long period of time. In the Stetattle Creek drainage this vegetation mosaic caused by fires is especially notable (Figure 14). In the central part of the valley, at low elevations, the *Pseudotsuga menziesii* and *Tsuga heterophylla* stands have remained undisturbed for approximately 800 years or more. In contrast the mountain slopes, especially on the east side of the creek have incurred numerous fires. The most recent fire, of appreciable size, occurred about 65 years ago. Occasionally these fires travel upslope

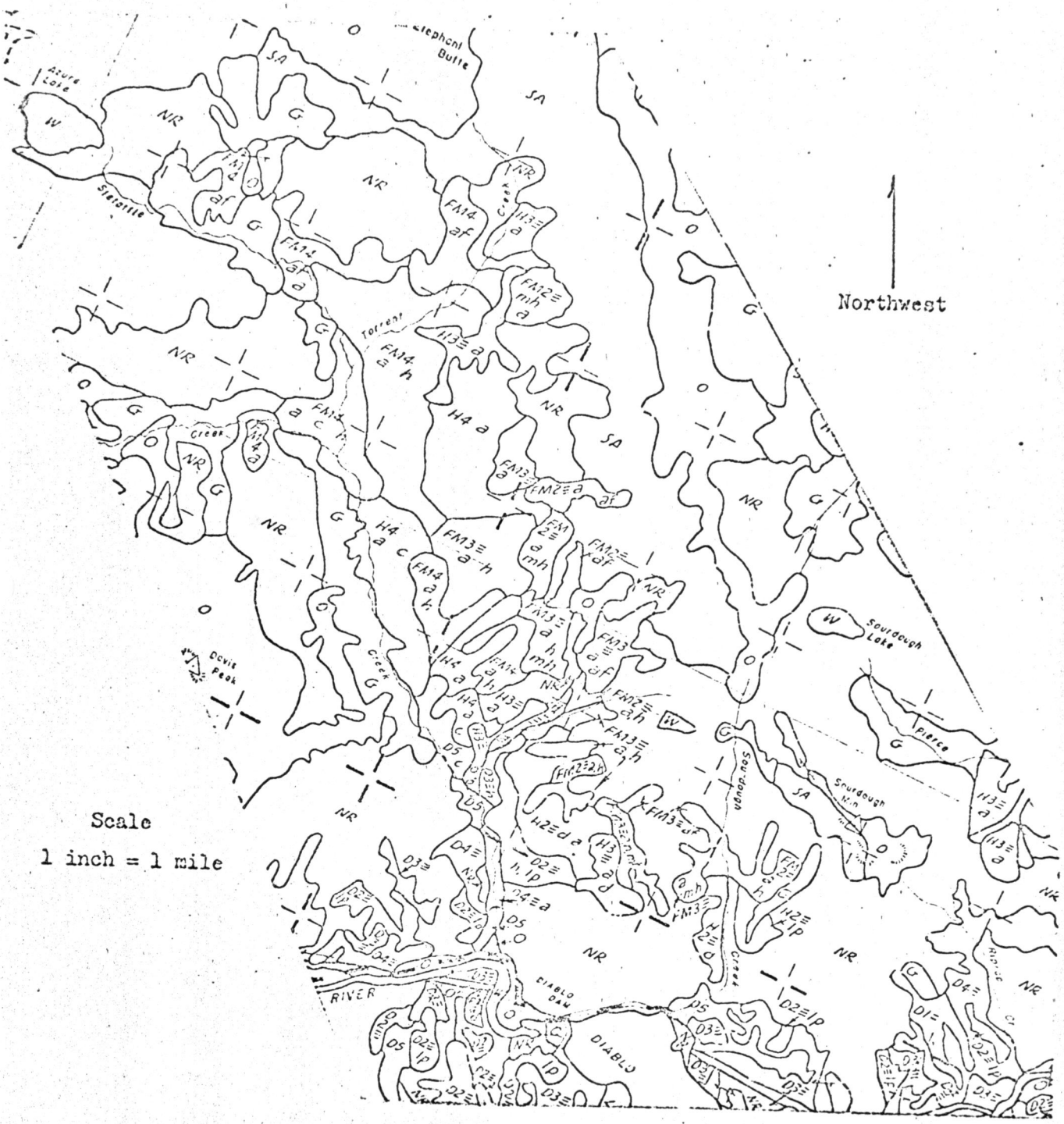
Figure 13. Topography map of the Stetattle Creek drainage.



North

Scale: 1 inch = 4 miles

Figure 14. Forest type map of the Stetattle Creek drainage.



and enter the Subalpine or Alpine Zones. Such a fire cut a swath about 1/4 mile wide extending from low elevation up to over 6000 feet elevation about 30 years ago (Douglas and Ballard, 1970).

The fire history of the valley has thus been extremely influential in governing the vegetation types occurring in the drainage. On the rather limited hydric to mesic sites along the creek, and on the several terraces, communities are dominated by either *Pseudotsuga menziesii* or *Tsuga heterophylla*. *Thuja plicata* and *Abies amabilis* are of secondary importance in these stands. At higher elevations *A. amabilis* and *Tsuga mertensiana* are more frequent. Deciduous communities, consisting mainly of *Alnus rubra*, are small and restricted to the immediate banks of the stream. On the more xeric slopes both *Pinus contorta* and *Pseudotsuga menziesii* are the dominant species. At higher elevations in the continuous forest the occurrence of *Abies lasiocarpa* and *Picea engelmannii* indicate the lower precipitation of the area and the gradual change toward eastern North Cascade vegetation types. The vegetation in the lower valley is representative of the Zones or Types described by Franklin and Dyrness (1969) and Douglas (1969a) for western Washington. Those of the middle and upper slope forests are similar to the eastern Washington zones of Franklin and Dyrness (1969).

Plant communities

1) *Tsuga heterophylla/Tiarella unifoliata* community.

Stands dominated by *Tsuga heterophylla* cover a relatively small area in the valley. Most of these stands occur on the mesic lower to middle slopes of the central portion of the drainage.

The community examined in detail (Table 31) is located about three miles from the mouth of the creek and covers approximately 150 acres. *Tsuga heterophylla* is the dominant overstory species. Scattered throughout the community are a number of large (up to 84 inches DBH) *Thuja plicata*. *Tsuga heterophylla* and *Abies amabilis* are important in the intermediate tree and understory layers. In the tall shrub layer *Vaccinium ovalifolium* is the only common plant. The floristically rich ground cover is dominated by *Tiarella unifoliata*.

2) *Pseudotsuga menziesii/Tsuga heterophylla/Berberis nervosa* community.

This community occurs on the well drained, southerly slopes of the lower valley. These stands are rather limited and are restricted to about two miles of the valley along the stream.

The stand (Table 32) examined in this survey is located about two miles from the mouth of the creek and encompasses about 75 acres. The overstory is dominated by *Pseudotsuga menziesii* with lesser amounts of *Thuja plicata* and *Tsuga heterophylla*. *Tsuga heterophylla* and *Pseudotsuga menziesii* are common components of the intermediate tree layer. The climax species in the community are *Thuja plicata* and *Tsuga heterophylla*. *Vaccinium ovalifolium* and *Acer circinatum* are frequent tall shrubs but have low average cover. *Berberis nervosa* is an important ground cover.

3) *Pseudotsuga menziesii/Gaultheria shallon* community.

On slightly drier sites a second *Pseudotsuga*-dominated community is encountered. These communities, although relatively small, are found on steep, southerly slopes in the lower valley.

TABLE 31. Composition and structure of a *Tsuga heterophylla/Tiarella unifoliata* community in the Stetattle Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Tsuga heterophylla	22	14-36	22	31	100
Thuja plicata	75	72-84	4	4	75
Abies amabilis	20	16-24	1	1	50
Intermediate trees:					
Tsuga heterophylla	8	6-10	17	6	100
Abies amabilis	8	6-10	7	2	75
Tall shrubs and saplings:					
Abies amabilis				12	100
Vaccinium ovalifolium				6	100
Tsuga heterophylla				3	75
Oplopanax horridum				1	100
Acer circinatum				1	75
Low shrubs and herbs:					
Tiarella unifoliata				14	100
Clintonia uniflora				3	100
Abies amabilis				2	100
Tsuga heterophylla				2	100
Smilicina stellata				2	100
Cornus canadensis				1	100
Blechnum spicant				1	100
Streptopus roseus				1	100
Rubus pedatus				1	75

[a] Species with an average cover of one percent or a frequency of 50 percent or more, are included in this table.

[b] Data for this community was compiled from four .2-acre plots.

TABLE 32. Composition and structure of *Pseudotsuga menziesii/Tsuga heterophylla/Berberis nervosa* community in the Stetattle Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pseudotsuga menziesii	20	14-36	44	54	100
Thuja plicata	22	16-28	4	5	50
Tsuga heterophylla	19	18-20	5	3	50
Intermediate trees:					
Tsuga heterophylla	8	6-10	38	21	100
Pseudotsuga menziesii	8	7-10	25	13	100
Tall shrubs and saplings:					
Thuja plicata				8	100
Tsuga heterophylla				7	100
Vaccinium ovalifolium				1	100
Acer circinatum				1	100
Low shrubs and herbs:					
Berberis nervosa				13	100
Gaultheria shallon				3	100
Thuja plicata				1	100
Linnaea borealis				1	100

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from four .2-acre plots.

Pseudotsuga menziesii is the sole pioneer and seral species present. The climax species, however, are more diverse with *P. menziesii*, *Tsuga heterophylla* and *Thuja plicata* occurring frequently. Several *Pinus monticola* are also reproducing. *Gaultheria shallon* is abundant in the understory. Other important plants in the ground cover are *Pachystima myrsinites*, *Pteridium aquilinum* and *Chimaphilla umbellata*.

4) *Pinus contorta-Pseudotsuga menziesii* community.

Large areas on the lower to middle slopes near the mouth of Stetattle Creek were burned about 65 years ago. Secondary succession in these areas consists of dense, stagnated stands of *Pinus contorta* and *Pseudotsuga menziesii*.

The stand studied in detail (Table 33) was located at about 2,000 feet elevation and approximately 1/2 mile northeast of the creek mouth. This community encompasses over 200 acres on the dry southwesterly slopes. *Pinus contorta* and *Pseudotsuga menziesii* are the dominant tree species. These trees are slow growing (75 feet tall and 65 years old) and have an extremely high density. Reproduction, consisting of the former two species, is infrequent. *Holodiscus discolor*, *Gaultheria shallon* and *Salix* sp. are the only frequent species in the sparse understory.

5) *Pinus contorta/Vaccinium parviflorum/Gaultheria shallon* community.

This community is similar to the previous community both in habitat and vegetation. This area, however, was swept by fire about 125 years ago.

The stand examined is located just east of the *Pinus-Pseudotsuga* community and covers approximately 50 acres. *Pinus contorta* and

TABLE 33. Composition and structure of a *Pinus contorta-Pseudotsuga menziesii* community in the Stetattle Creek drainage.[a,b,c]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Pinus contorta	6	4-14	418	60	100
Pseudotsuga menziesii	8	6-14	68	13	100
Tall shrubs and saplings:					
Holodiscus discolor				3	100
Salix sp.				1	100
Prunus emarginata				T	67
Low shrubs and herbs:					
Gaultheria shallon				2	100
Berberis nervosa				1	100
Trientalis latifolia				1	100
Spiraea sp.				T	100
Pachystima myrsinites				T	100
Habenaria unalascensis				T	67
Chimaphila menziesii				T	67
Rosa nutkana				T	67
Pteridium aquilinum				T	67

[a] Species with an average cover of one percent or a frequency of 67 percent, or more, are included in this table.

[b] Data for this table was compiled from three .2-acre plots.

[c] T(trace) indicates an average cover of less than 0.5 percent.

Pseudotsuga menziesii form a dense overstory. The understory is floristically richer in this community with *Vaccinium parviflorum*, *Salix* sp., *Gaultheria shallon* and *Linnaea borealis* occurring abundantly. *Pseudotsuga menziesii*, *Thuja plicata*, *Tsuga heterophylla* and *Pinus monticola* are climax species.

6) Avalanche track communities.

These communities are common on slopes of the west side of the lower valley as well as in the upper valley. The major species on these relatively cool, moist habitats is *Alnus sinuata*.

7) Subalpine and Alpine communities.

The highest slopes and ridges on the east side of Stetattle Creek include some of the most extensive subalpine and alpine plant communities in the western North Cascades. These communities, however, were not examined during this survey. It was felt that since time was limited, and since the vegetation had been studied previously by Douglas (1970) and Douglas and Ballard (1970), it would be more profitable to study other subalpine and alpine areas in the North Cascades National Park.

The vegetation on the upper slopes includes most of the subalpine units (*Saxifraga tolmiei*, *Carex nigricans*, *Phyllodoce empetriformis-Cassiope mertensiana*, *Vaccinium deliciosum*, *Vaccinium membranaceum-Rhododendron albiflorum*, *Tsuga mertensiana-Abies amabilis*, *Valeriana sitchensis-Veratrum viride*, and *Carex spectabilis* communities) described by Douglas (1970). The two major alpine communities (heath and krummholz) of the ridge were examined by Douglas and Ballard (1970). They also studied an area where these two communities had been disturbed by fire 30 years ago.

Exotic species

Exotic plants, except for the beginnings of both trails into the area, are infrequent in the drainage.

Fauna

Bear and deer sign were uncommon at lower elevations. In the upper forests and the Subalpine and Alpine Zones, however, both animals are abundant. The higher slopes and ridges also support very large marmot and pica populations.

7. The McMillan Creek drainage.

Description of the Area

The McMillan Creek drainage is located in portions of: T 38 N, R 11 E; T 38 N, R 12 E; and T 39 N, R 12 E (Figure 15) The creek is six miles in length and flows in an east-northeast direction. As stated previously, McMillan Creek is actually a continuation of the lower portion of Big Beaver Creek.

The valley ranges from 1/4 to 1/2 mile wide and is flanked by steep, sparsely vegetated mountain slopes. The stream gradient is moderate for the first four miles, rising about 1200 feet in elevation. The level portions of the drainage, mainly in the lower valley, cover about 800 acres. The entire drainage encompasses approximately 7700 acres.

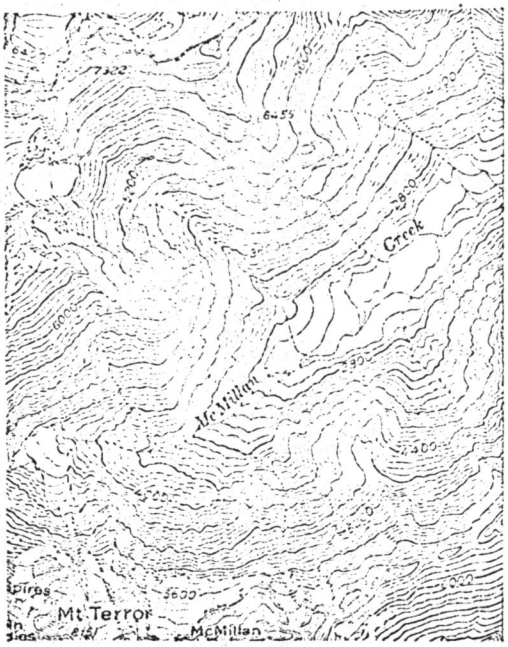
Vegetation

General description

The vegetation types found in the valley are representative of the *Tsuga heterophylla* and *Abies amabilis* Zones or Forest Types described by Franklin and Dyrness (1969) and Douglas (1965a). These two types are rather poorly represented with over 60 percent of the valley consisting of avalanche tracks, rock slides, or precipitous rocky slopes (Figure 16).

In the upper valley and on the higher slopes *Abies amabilis* and *Tsuga mertensiana* are the dominant species. The limited stands in the lower valley, although dominated by *T. heterophylla* and *Thuja plicata*, include a number of other species. *Pseudotsuga*

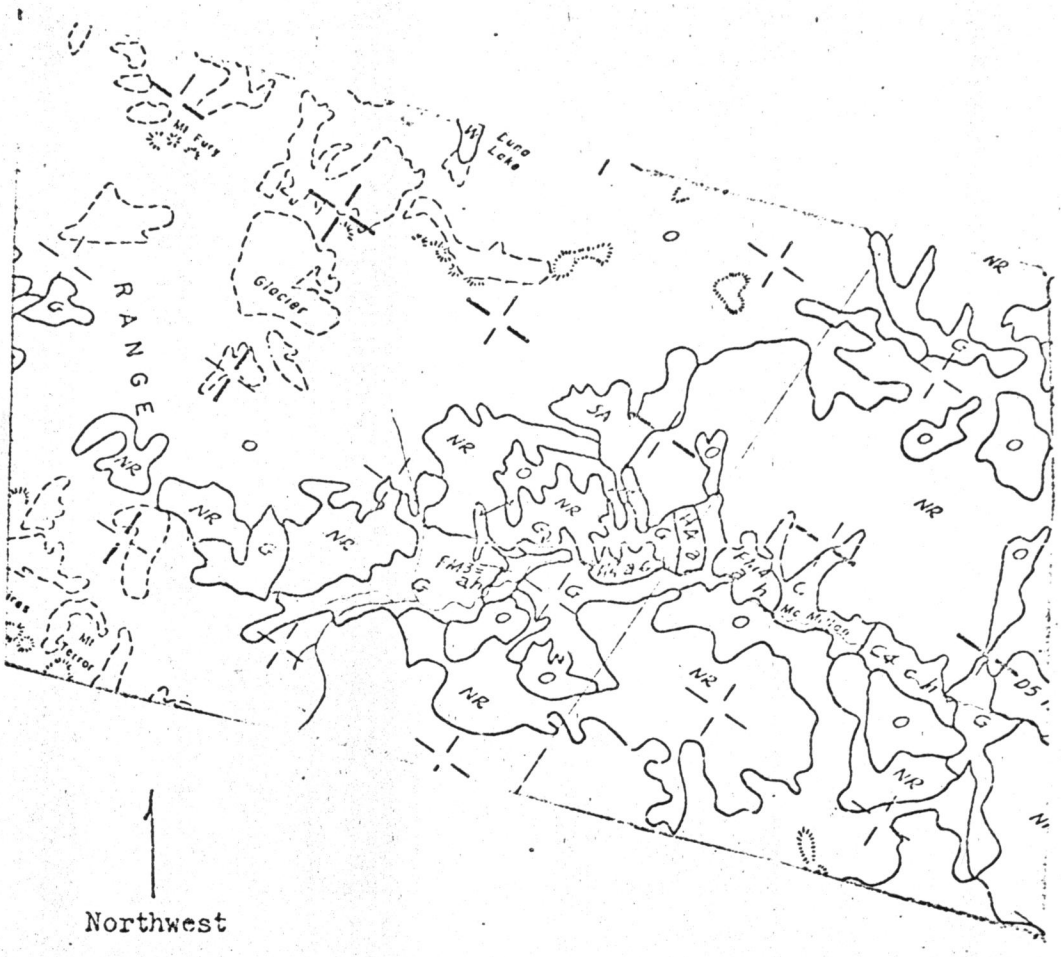
Figure 15. Topography map of the McMillan Creek drainage (upper three miles).



North

Scale: 1 inch = 1 mile

Figure 16. Forest type map of the McMillan Creek drainage.



Scale: 1 inch = 1 mile

menziesii is conspicuous on the southerly slopes near the mouth of the creek. Several small streamside stands of *Alnus rubra* also occur near the mouth. *Tsuga heterophylla* and *Abies amabilis*, in the lower and upper valleys, respectively, are the major climax species.

Plant communities

1) *Thuja plicata-Tsuga heterophylla/Acer circinatum/Clintonia uniflora* community.

The only *Thuja-Tsuga* stands of any size occur in the bottomlands of the lower valley. These communities cover about 100 acres.

These moist sites are dominated by *Thuja plicata* and *Tsuga heterophylla* with smaller amounts of *Abies amabilis*, *Picea engelmannii* and *Pseudotsuga menziesii* (Table 34). Important seral and climax species are *Tsuga heterophylla* and *Abies amabilis*. The dominant tall shrub is *Acer circinatum*. *Oplopanax horridum* and *Vaccinium ovalifolium* are also common in this layer. *Clintonia uniflora* and *Smilicina stellata* are abundant herbs in the groundcover.

2) *Alnus rubra/Rubus spectabilis* community.

A small stand dominated by *Alnus rubra* occurs on the bottomlands near the mouth of McMillan Creek. The stand encompasses approximately 20 acres.

Alnus rubra is the dominant overstory species. *trichocarpa*, *Thuja plicata* and *Tsuga heterophylla* are infrequent in the dominant tree layer. The latter, along with *Abies grandis*, also occurs sparsely as a climax species. *Rubus spectabilis*, *Oplopanax horridum* and *Sambucus racemosa* are common in the lush understory. Important

TABLE 34. Composition and structure of a *Thuja plicata-Tsuga heterophylla/Acer circinatum/Clintonia uniflora* community in the McMillan Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acre	Average Cover (%)	Frequency (%)
Dominant trees:					
Thuja plicata	40	36-46	15	16	100
Tsuga heterophylla	21	16-28	13	11	100
Abies amabilis	20	18-24	10	3	67
Picea engelmannii	20	20	3	1	67
Pseudotsuga menziesii	85	85	2	2	33
Intermediate trees:					
Abies amabilis	12	10-14	10	4	100
Tsuga heterophylla	10	8-12	10	3	67
Tall shrubs and saplings:					
Acer circinatum				26	100
Oplopanax horridum				5	100
Vaccinium ovalifolium				3	100
Abies amabilis				2	100
Tsuga heterophylla				1	67
Viburnum edule				1	67
Low shrubs and herbs:					
Clintonia uniflora				17	100
Smilicina stellata				9	100
Streptopus roseus				2	100
Abies amabilis				1	100
Cornus canadensis				1	100

[a]Species with frequency of one percent, or more, are included in this table.

[b]Data for this community was compiled from three .2-acre plots.

herbs are *Smilicina stellata, Dicentra formosa* and *Viola glabella.*

3) Avalanche track communities.

These communities are especially common in the drainage. They are dominated mainly by *Alnus sinuata* although at lower elevations near the mouth of the creek *Acer circinatum, A. glabrum, Salix* sp., *Cornus stolonifera* and *Viburnum edule* become important associates.

4) Aquatic or semi-aquatic communities.

Several aquatic or semi-aquatic communities are found in the upper part of the valley. These communities were not examined but from the air and from aerial photographs they appear to be the typical *Sphagnum-Carex* stands found in most drainages of the North Cascades.

Exotic species.

There are no introduced species in the valley since no trails enter the area.

Fauna

Large mammals are probably not abundant in the valley because of the vegetation types present. Beaver may occur in the upper valley but aerial examination did not verify this.

8. The Luna Creek Drainage

Description of the Area

The Luna Creek drainage occupies portions of: T 39 N, R 11 E and T 39 N, R 12 E (Figure 17). The creek is 2 1/2 miles long and flows in an east-northeast direction. Luna Lake, a 17-acre cirque lake, is located in the extreme headwaters at an elevation of 4900 feet.

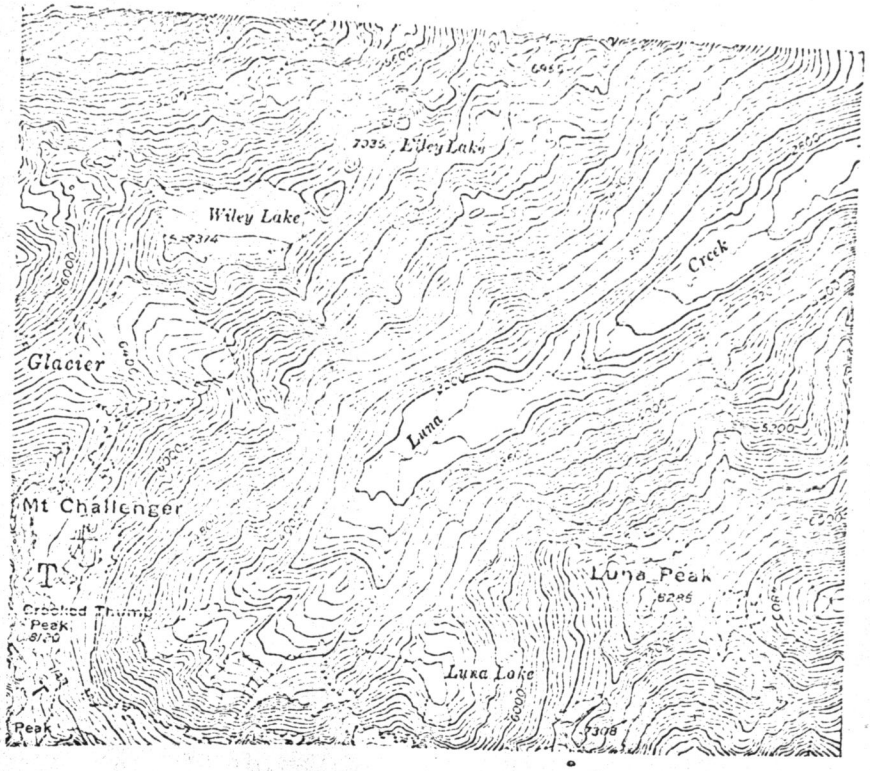
The mountain slopes of the drainage rise abruptly from the narrow valley. The stream gradient is steep, with a 100 feet rise per mile. The entire drainage of Luna Creek covers approximately 1500 acres.

Vegetation

General description

The vegetation of the valley is representative of the *Abies amabilis* Zone or Forest Type described by Franklin and Dyrness (1969) and Douglas (1969a). This vegetation type is discontinuous, however, since the major portion of the valley is occupied by avalanche tracks and rocky slopes. *Tsuga mertensiana* and *Abies amabilis* are the major pioneer species in the continuous forest. *Tsuga heterophylla* is of lesser importance near the mouth of the creek. *Abies amabilis* is the most common climax species throughout the drainage. Several small outlier stands of *Larix lyallii* occur near Luna Lake.

Figure 17. Topography map of the Luna Creek drainage.



North

Scale: 1 inch = 1 mile

Plant communities

1) *Abies amabilis-Tsuga heterophylla/Vaccinium ovalifolium* community.

In the lower valley and on some of the middle slopes communities dominated by *Abies amabilis* and *Tsuga heterophylla* occur. The composition of the overstory is quite variable while the understory may range from dense to sparsely covered.

A typical stand (Table 35), located on the lower slopes of the lower valley, was examined in detail. *Abies amabilis* is the dominant tree species, with smaller amounts of *Tsuga mertensiana*. The latter two species, in about the same proportion, are frequent in the intermediate tree layer. *Abies amabilis* is the major climax species. The relatively sparse understory is dominated by *Vaccinium ovalifolium*. Frequent ground cover plants are *Rubus pedatus* and *Clintonia uniflora*.

2) *Larix lyallii* communities.

Several small stands of *Larix lyallii*, occurring about 15 miles west of their main range are of notable interest. These stands however, when viewed from the air, are discontinuous and appear to be associated with the rock slides and rocky slopes of the area.

3) Avalanche track communities

These communities, in which *Alnus sinuata* is the major species, are common throughout the Luna Creek drainage.

Exotic species

No trails are found in the drainage thus exotic species have been excluded from the area.

TABLE 35. Composition and structure of an *Abies amabilis-Tsuga mertensiana/ Vaccinium ovalifolium* community in the Luna Creek drainage.[a,b]

Species and Layer	Average DBH (inches)	DBH Range (inches)	Trees per Acer	Average Cover (%)	Frequency (%)
Dominant trees:					
Abies amabilis	18	12-24	28	32	100
Tsuga mertensiana	14	12-20	10	6	100
Intermediate trees:					
Abies amabilis	7	6-10	13	5	100
Tsuga mertensiana	7	6-8	5	3	100
Tall shrubs and saplings:					
Vaccinium ovalifolium				12	100
Abies amabilis				5	100
Vaccinium alaskaense				2	100
Vaccinium membranaceum				1	100
Tsuga mertensiana				1	67
Low shrubs and herbs:					
Rubus pedatus				4	100
Clintonia uniflora				2	100
Streptopus roseus				1	67
Abies amabilis				1	67

[a] Species with an average cover of one percent, or more, are included in this table.

[b] Data for this community was compiled from three .2-acre plots.

Fauna

The lack of suitable habitat in the valley probably keeps the larger mammals, with the possible exception of goats, at a minimum population level.

MOUNTAIN AREAS

1. The Copper Mountain Area.

Description of the Area

The Subalpine and Alpine Zones of the Copper Mountain area occur in portions of: T 39 N, R 10 E and T 40 N, R 10 E (Figure 18). The area extends from the headwaters of Silesia Creek and the Chilliwack River north to the headwaters of the Little Chilliwack River. Two cirque lakes (Copper and Egg) occur within the area.

The topography of the ridges south of Copper Lake and north of Copper Mountain is relatively moderate. The area in the vicinity of Copper Mountain, however, is extremely precipitous with numerous small glaciers occupying the northeasterly slopes. The entire area encompasses approximately 2500 acres.

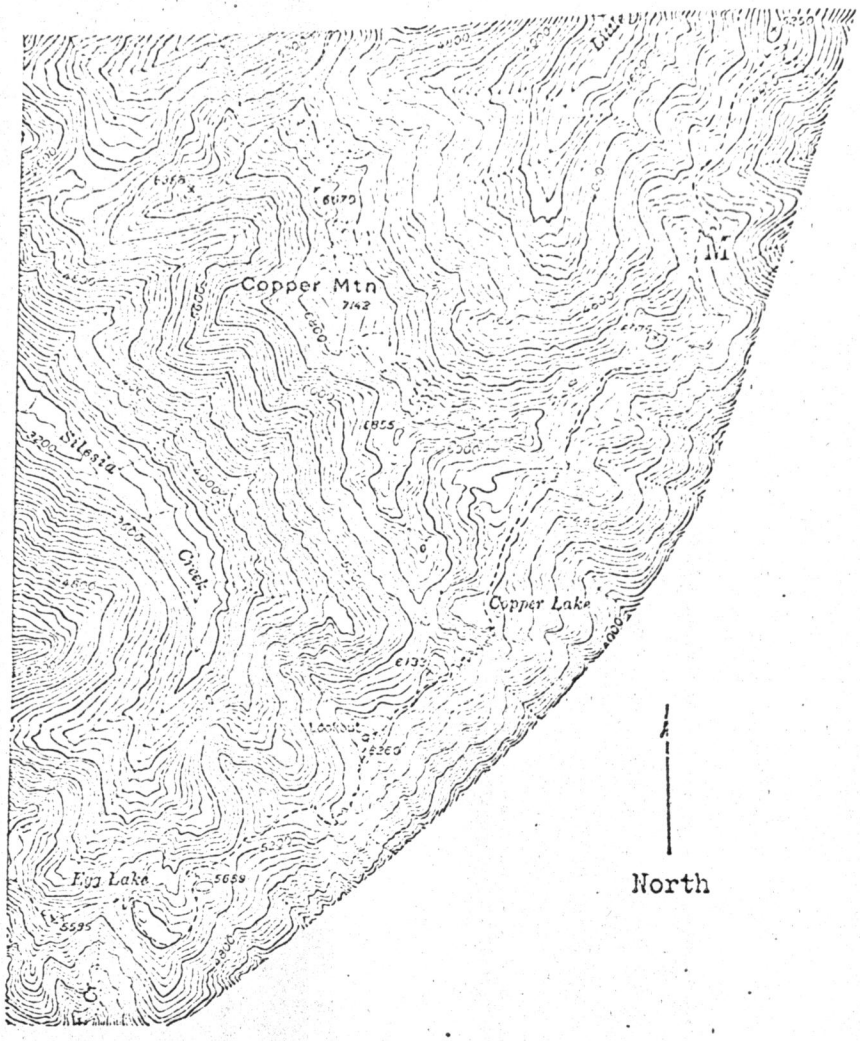
Vegetation

General description

Plant communities of the Copper Mountain area are representative of those described by Douglas (1969a, 1970) for the Subalpine and Alpine Zones of the western North Cascades. Most of the subalpine plant communities described by Douglas (1970) are present in the extensive meadows of the area. The most common of these are the tree clump and heath communities.

Alpine vegetation is restricted to the precipitous upper slopes and the small, relatively level top of Copper Mountain. The upper slopes are frequented by discontinuous rock outcrop and krummholz communities. The small area on top of the mountain is dominated mainly

Figure 18. Topography map of the Copper Mountain area.



Scale: 1 inch = 1 mile

by heath communities although several snowbed *(Carex nigricans)* communities are also present.

Plant communities

A. Subalpine Zone

1) *Carex nigricans* community.

This community occurs in depressions and level areas where late snowmelt and soil water from the slopes above maintain constantly moist soils. A number of these stand are found in the Copper Mountain area.

The communities examined (Table 36) were all characterized by a thick, continuous mat of *Carex nigricans*. *Luetkea pectinata, Deschampsia atropurpurea, Phyllodoce empetriformis, Cassiope mertensiana, Vaccinium deliciosum,* and *Juncus drummondii,* while often present, have low cover values.

2) *Luetkea pectinata* community.

In areas adjoining the *Carex nigricans* community, where drainage is slightly better, *Luetkea pectinata* is a dominant plant. These *Luetkea*-dominated communities are relatively infrequent in the area.

Luetkea pectinata, the major species, has a large number of associates. Some the more important in the Copper Mountain area are *Carex nigricans, Deschampsia atropurpurea, Phyllodoce empetriformis, Cassiope mertensiana, Vaccinium deliciosum* and *Juncus drummondii.*

3) *Phyllodoce empetriformis-Cassiope mertensiana* community.

This is the most common and widespread community in the area. These stands cover most of the better drained slopes and ridges in the Subalpine Zone.

TABLE 36. Relative abundance of important species in subalpine plant communities of the Copper Mountain area.

Species	*Carex nigricans*	*Luetkea pectinata*	*Phyllodoce-Cassiope*	*Vaccinium deliciosum*	*Dwarf Tsuga*	*Tsuga-Abies*	*Vaccinium-Rhododendron*	*Saxifraga tolmiei*
Community								
Carex nigricans	M	m	t	t	t	–	–	t
Luetkea pectinata	m	M	m	m	m	m	m	m
Deschampsia atropurpurea	m	m	m	m	m	–	m	m
Phyllodoce empetriformis	m	m	M	m	m	m	M	m
Cassiope mertensiana	m	m	M	m	m	–	m	–
Vaccinium deliciosum	m	m	M	M	m	–	m	–
Vaccinium membranaceum	–	–	–	–	m	m	M	–
Rhododendron albiflorum	–	–	–	–	–	m	m	–
Menziesia ferruginea	–	–	–	–	–	m	m	–
Tsuga mertensiana	–	–	–	–	M	M	m	–
Abies amabilis	–	–	–	–	–	m	m	–
Abies lasiocarpa	–	–	–	–	–	t	m	–
Saxifraga tolmiei	–	–	–	–	–	–	–	M
Luzula wahlenbergii	–	m	–	–	–	m	–	–
Juncus drummondii	m	m	–	–	–	–	–	–

[a]M indicates a species is a major component; m indicates a species of minor or secondary importance; and t (trace) indicates a species is infrequent or rare

Phyllodoce empetriformis and *Cassiope mertensiana* contribute the highest cover in the community. Another important and common heath is *Vaccinium deliciosum*. *Luetkea pectinata* and *Deschampsia atropurpurea* are frequent species but of secondary importance. *Dicranum fuscescens* is a conspicuous moss in the community.

4) *Vaccinium deliciosum* community..

In the immediate vicinity of tree clumps the *Vaccinium deliciosum* community commonly occurs. These stands are similar to the *Phyllodoce-Cassiope* stands and differ mainly in the increased cover and dominance of *Vaccinium deliciosum*.

Vaccinium deliciosum is the major species in the community. Common associates are *Phyllodoce empetriformis, Cassiope mertensiana, Luetkea pectinata* and *Deschampsia atropurpurea*. As in other heath communities, *Dicranum fuscescens* is an important moss.

5) Dwarf *Tsuga mertensiana* community.

Several of these communities, invading the heath communities of the upper subalpine slopes and ridges, were encountered. These trees ranged in age from 35 to 50 years old. This age class agrees with the work of Franklin, et al (in press) who suggested that meadow invasion in the Cascade Range was limited to a 20 - 30 year period in the first half of this century. Several factors (early snowmelt, long growing seasons and good seed crop) occurring over a short period of time probably attribute to the meadow invasion.

In the Copper Mountain area *Tsuga mertensiana* is the major species in these communities. Remnants such as *Phyllodoce empetriformis, Cassiope mertensiana, Vaccinium deliciousum* and *Luetkea pectinata* persist from the communities invaded.

6) *Tsuga mertensiana-Abies amabilis* community.

These tree clumps are a conspicuous feature of the subalpine vegetation in the area. They occur on the more mesic upper slopes and ridges and are amongst the first communities to become snowfree.

Tsuga mertensiana is the dominant species with *Abies amabilis* as a major associate. In several clumps *A. lasiocarpa* was also important. Frequent species in the ground cover are *Luetkea pectinata, Phyllodoce empetriformis* and *Luzula wahlenbergii*. When stands are more open taller shrubs such as *Vaccinium membranaceum, Rhododendron albiflorum* and *Menziesia ferruginea* commonly occur.

7) *Vaccinium membranaceum-Rhododendron albiflorum* community.

This community is found on the periphery of many of the *Tsuga-Abies* communities. The longer growing season and more favorable microenvironment in the vicinity of the tree clumps allows this community to become established.

Vaccinium membranaceum is usually the dominant species in the upper shrub layer although *Rhododendron albiflorum* and *Menziesia ferruginea* are often abundant. *Tsuga mertensiana, Abies amabilis* and *A. lasiocarpa* may be found invading these stands. Important species in the ground cover are *Luetkea pectinata, Phyllodoce empetriformis, Cassiope mertensiana* and *Vaccinium deliciosum*.

8) *Saxifraga tolmiei* community.

Rocky, northerly slopes are the site of this community. These habitats are amongst the last to become snowfree and remain moist throughout the growing season.

Plant cover and diversity are low because of the talus type rock cover. *Saxifraga tolmiei* is the dominant species with lesser amounts of *Luzula wahlenbergii* and *Juncus drummondii*. The mosses, *Gymnomitrium varians* and *Polytrichum norvegicum*, are often common associates.

B. Alpine Zone

1) *Carex nigricans* community.

This community occurs on snow accumulation sites. These snowbed communities are the last to become snowfree and resemble the *Carex nigricans* community of the Subalpine Zone. This alpine habitat is slightly drier, however, because of lower maximum snow depths and the lack of an upslope water supply.

Carex nigricans is the dominate species although *Luetkea pectinata*, *Erigeron peregrinus* sp. *callianthemus*, var. *scaposus*, *Antennaria lanata* and *Lepraria neglecta* are also common (Table 37). Minor species in the community are *Deschampsia atropurpurea* and *Juncus drummondii*.

2) *Cassiope mertensiana* community.

The continuous vegetation on the top of Copper Mountain consists mainly of heath communities. These exposed sites are more xeric than those occupied by subalpine heath communities.

In the three communities examined *Cassiope mertensiana* was the dominant plant. Important associates are *Phyllodoce glandulifiora*, *Luetkea pectinata* and *Lepraria neglecta*. *Carex nigricans*, *Deschampsia atropurpurea*, *Erigeron peregrinum* sp. *callianthemus* var. *scaposus* and *Antennaria lanata* are also present but have lower frequency and cover values.

TABLE 37. Relative abundance of important species in the alpine plant communities of the Copper Mountain area.[a]

Species	Community: *Carex nigricans*	*Cassiope mertensiana*	*Abies lasiocarpa*
Carex nigricans	M	m	-
Erigeron perigrinus ssp. *callianthemus* var. *scaposus*	M	m	-
Luetkea pectinata	M	M	t
Lepraria neglecta	M	M	-
Antennaria lanata	M	m	-
Deschampsia atropurpurea	m	m	t
Juncus drummondii	m	-	-
Cassiope mertensiana	t	M	t
Phyllodoce glanduliflora	t	M	-
Abies lasiocarpa	-	-	M
Tsuga mertensiana	-	-	m
Pinus albicaulis	-	-	m

[a] M indicates a species is a major component; m indicates a species of minor or secondary importance; and t(trace) indicates a species is infrequent or rare.

3) *Abies lasiocarpa* community.

Krummholz stands are common on the rocky, upper slopes of Copper Mountain. *Abies lasiocarpa* is the major species in these communities. Other species, occurring less frequently, are *Tsuga mertensiana* and *Pinus albicaulis*. These stands have a relatively sparse understory, due mainly to the rocky substrate upon which they are located.

Fauna

The extensive subalpine vegetation supports a fairly large deer population. On the more rugged slopes of Copper Mountain, especially on easterly aspects, goats are common. Numerous marmot and pica also occur in the area.

2. The Redface Mountain Area.

Description of the Area

The Subalpine and Alpine Zones of the Redface Mountain area are located in T 39 N, R 11 E (Figure 19). The area extends from the west end of Redface Mountain east to the peaks above East Lake. Ten cirque lakes occur along the southern slopes of the area.

The long, continuous south slopes, although quite steep, are carpeted by vegetation. Several large talus slopes also occur on this aspect. The north slopes of Redface Mountain are precipitous and unvegetated. The entire area covers approximately 1400 acres.

Vegetation

General description

The subalpine and alpine vegetation is typical of that described by Douglas (1969a, 1970). Both the Subalpine Zone, represented mainly by tree clump and heath communities, and the Alpine Zone, represented mainly by krummholz communities, cover an extensive area.

Plant communities

A. Subalpine Zone

1) *Carex nigricans* community.

This is a common community on sites that are filling in around many of the lakes. These habitats remain moist throughout the growing season.

Total vegetative cover is high with *Carex nigricans* being the dominant species (Table 38). Other species, with low cover values, are *Luetkea pectinata, Deschampsia atropurpurea* and *Epilobium alpinum*.

Figure 19. Topography map of the Redface Mountain area.

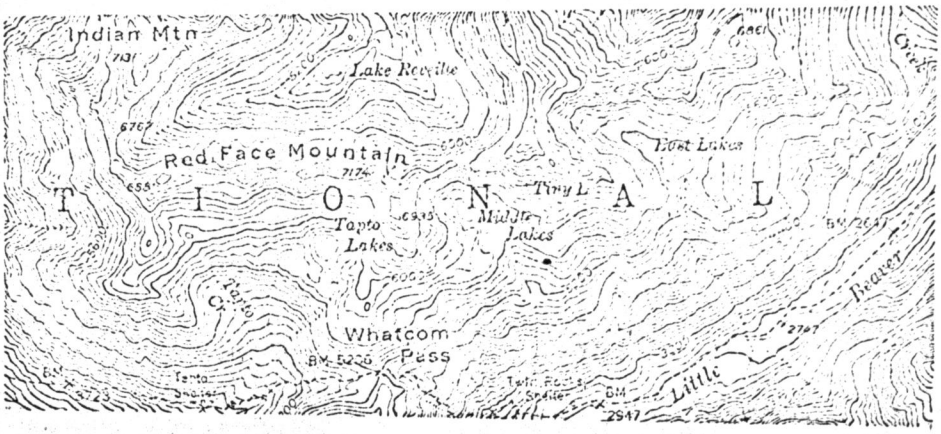


TABLE 38. Relative abundance of important species in plant communities in the Subalpine Zone of the Redface Mountain area.[a]

Species	*Carex nigricans*	*Luetkea pectinata*	*Phyllodoce-Cassiope*	*Vaccinium deliciosum*	*Tsuga-Abies*	*Vaccinium-Rhododendron*
Community						
Carex nigricans	M	m	t	–	–	–
Luetkea pectinata	m	M	m	m	t	t
Deschampsia atropurpurea	m	m	–	t	–	–
Epilobium alpinum	m	–	–	–	–	–
Castilleja parviflora	t	m	–	–	–	–
Phyllodoce empetriformis	t	t	M	m	m	m
Cassiope mertensiana	t	t	M	m	–	m
Lycopodium sitchense	–	–	m	–	–	–
Vaccinium deliciosum	–	–	m	M	m	m
Vaccinium membranaceum	–	–	–	–	–	M
Rhododendron albiflorum	–	–	–	–	–	m
Tsuga mertensiana	–	–	–	–	M	m
Abies amabilis	–	–	–	–	m	–

[a] M indicates a species is a major component; m indicates a species of minor or secondary importance; and t (trace) indicates a species is infrequent or rare.

2) *Luetkea pectinata* communities.

On slightly better drained sites the *Luetkea* community is a frequent unit. These communities on Red Mountain are usually of small size.

Luetkea pectinata is the major species in these stands. Frequent associates are *Carex nigricans, Deschampsia atropurpurea* and *Castilleja parviflora.*

3) *Phyllodoce empetriformis-Cassiope mertensiana* community.

In the Subalpine Zone this is the most conspicuous community. The stands occupy much of the southern slopes between 5000 and 6000 feet elevation.

The dominant species in the community are *Phyllodoce empetriformis* and *Cassiope mertensiana. Luetkea pectinata, Lycopodium sitchense* and *Vaccinium deliciosum* are frequent but less abundant. An important ground cover is the moss, *Dicranum fuscescens.*

4) *Vaccinium deliciosum* community.

On several of the ridges and in the immediate vicinity of tree clumps the *Vaccinium deliciosum* community occurs. These units are infrequent and of small size in the Red Mountain area.

The most important species is *Vaccinium deliciosum.* This community's close relationship to the *Phyllodoce-Cassiope* community is apparent by its major associates, *Phyllodoce empetriformis, Cassiope mertensiana,* and *Luetkea pectinata.*

5) *Tsuga mertensiana-Abies amabilis* community.

These tree clumps are common throughout the Subalpine Zone of the area. They occur mainly on slight ridges of the southern slopes.

At lower elevations both *Tsuga mertensiana* and *Abies amabilis* dominate the stands. At upper elevations the latter species is less frequent. Occasionally *Abies lasiocarpa* and *Pinus albicaulis* occur in the stands. Frequent species in the sparse understory are *Phyllodoce empetriformis* and *Vaccinium deliciosum*.

6) *Vaccinium membranaceum-Rhododendron albiflorum* community.

This vegetative unit occurs around many of the tree clumps at lower elevations. It is the only community in the Subalpine Zone where tall shrubs predominate.

Vaccinium membranaceum is the major species in the community. Common associates are *Rhododendron albiflorum, Menziesia ferruginea, Phyllodoce empetriformis* and *Vaccinium deliciosum*.

B. Alpine Zone.

1) *Abies lasiocarpa* community.

This krummholz community is common above 6000 feet in the area. These prostrate trees reflect the harsh environment of the alpine slopes.

Abies lasiocarpa is usually the sole tree species in these stands (Table 39). Common species beneath the tree cover are *Vaccinium deliciosum, Phyllodoce empetriformis,* and the moss, *Brachythecium starkei*.

2) *Tsuga mertensiana* community.

A second type of krummholz stand in the area, the *Tsuga* community, is almost identical to the previous community except for the composition of the overstory. *Tsuga mertensiana* is the dominant species although specimens of *Abies lasiocarpa, A. amabilis* and *Chamaecyparis*

TABLE 39. Relative abundance of important species in the alpine plant communities of the Redface Mountain area.[a]

Species	Community: *Abies lasiocarpa*	*Tsuga mertensiana*	*Phyllodoce empetriformis-Vaccinium deliciosum*	*Phyllodoce glanduliflora*	*Saxifraga tolmiei*
Abies lasiocarpa	M	m	-	-	-
Vaccinium deliciosum	M	m	M	t	-
Phyllodoce empetriformis	M	m	M	-	t
Brachythecium starkei	M	m	-	-	-
Cassiope mertensiana	m	m	m	-	-
Arnica latifolia var. *gracilis*	m	-	-	-	-
Luetkea pectinata	m	m	m	-	-
Tsuga mertensiana	-	M	-	-	-
Phyllodoce glanduliflora	-	-	m	M	-
Carex nigricans	-	-	m	-	-
Cetraria cubalpina	-	-	m	t	-
Polytrichum piliferum	-	-	m	-	-
Empetrum nigrum	-	-	-	M	-
Thamnolia vermicularis	-	-	t	m	-
Cetraria islandica	-	-	t	m	-
Cladina mitis	-	-	t	m	-
Saxifraga tolmie	-	-	-	-	M
Luzula wahlenbergi	-	-	t	-	M

[a] M indicates a species is a major component; m indicates a species of minor or secondary importance; and t (trace) indicates a species is infrequent or rare.

nootkatensis also occur infrequently. Major understory species are *Vaccinium deliciosum, Phyllodoce empetriformis, Cassiope mertensiana* and *Luetkea pectinata. Brachythecium starkei* is an important moss in the community.

3) *Phyllodoce empetriformis-Vaccinium deliciosum* community.

In the Alpine Zone of the western North Cascades the composition of the heath communities is extremely complex. At least six heath species may play varying major roles in different habitats. The difference in these habitats is usually subtle and, as yet, poorly known. Two different heath stands were examined on Redface Mountain.

The first, the *Phyllodoce empetriformis-Vaccinium deliciosum* community, is usually situated downslope from krummholz stands. Since these krummholz stands are the last units to become snowfree the vegetation downslope receives meltwater for an extended period each summer.

In this heath community *Phyllodoce empetriformis* and *Vaccinium deliciosum* are the most abundant species. Other important vascular plants are *Cassiope mertensiana, Luetkea pectinata, Phyllodoce glanduliflora* and *Carex nigricans. Cetraria subalpina* and *Polytrichum piliferum* are common cryptogams.

4) *Phyllodoce glanduliflora* community.

This heath community is found on the drier alpine slopes of the area. Unlike the previous community, soil moisture may become a limiting factor during the latter part of the growing season.

Phyllodoce glanduliflora is the major plant in the community. *Empetrum nigrum* may also be abundant. Important lichens, which were rare in the previous community, are *Thamnolia vermicularis, Cetraria islandica* and *Cladonia mitis.*

5) *Saxifraga tolmiei* community.

The alpine *Saxifraga* community is almost identical to the *Saxifraga* community in the Subalpine Zone. The aspect, however, is completely opposite with the alpine community occurring only on southerly slopes.

The only frequent plants, of low cover value, are *Saxifraga tolmiei* and *Luzula wahlenbergii*. Small patches of the moss, *Gymnomitrium varians*, occur sporadically in the stand.

Fauna

Deer sign, although not abundant, was noted throughout the area. The goat sign appeared to be old indicating that during the summer the goat population might move northward to the Bear Mountain-Mount Redoubt area where a more suitable summer habitat may be available. Marmots and picas did not appear to be as abundant as in other subalpine-alpine areas of the North Cascades.

3. The Sahale Mountain Area.

Description of the Area

The Subalpine and Alpine Zones of the Sahale Mountain area occur in portions of : T 35 N, R 13 E; and T 35 N, R 14 E (Figure 20). The area extends from east of Cascade Pass north to the upper slopes of Sahale Mountain.

The subalpine and alpine vegetation occurs on a wide, gentle ridge that extends for about two miles south from Sahale Mountain. The entire area encompasses about 400 acres.

Vegetation

General description

The plant communities of the Sahale Mountain area are representative of those described for the Subalpine and Alpine Zones of the western North Cascades by Douglas (1969a, 1970). Most of the major subalpine communities occur in the area. The alpine communities, while of low diversity, cover an extensive area.

Plant communities

A. Subalpine Zone

1) *Luetkea pectinata* community.

On moist, northerly or easterly sites the *Luetkea* community is encountered. These communities are limited in size and occur infrequently throughout the area.

The dominant species is *Luetkea pectinata* (Table 40). Of its many associates *Carex nigricans*, *Deschampsia atropurpurea*, and *Hieracium gracile* are the most common.

Figure 20. Topography map of the Sahale Mountain area.

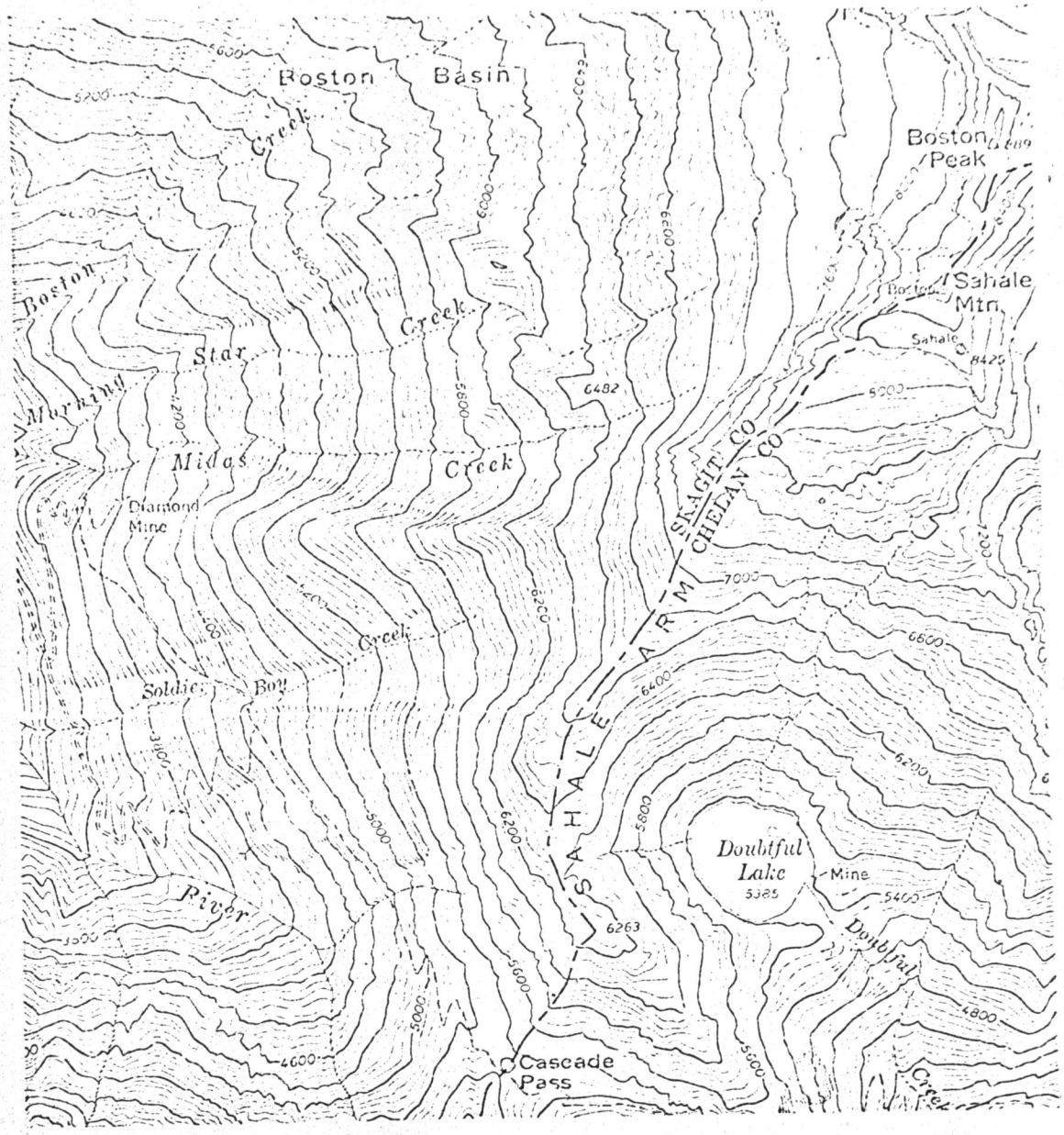


TABLE 40. Relative abundance of important species in the subalpine plant communities of the Sahale Mountain area.[a]

Community	*Luetkea pectinata*	*Phyllodoce-Cassiope*	*Tsuga-Abies*	*Vaccinium-Rhododendron*	*Valeriana-Veratrum*
Species					
Carex nigricans	m	t	-	-	-
Luetkea pectinata	M	m	m	m	-
Deschampsia atropurpurea	m	-	-	-	-
Hieracium gracile	m	-	-	-	-
Phyllodoce empetriformis	-	M	m	m	-
Cassiope mertensiana	-	M	-	m	-
Vaccinium deliciosum	t	M	m	m	-
Vaccinium membranaceum	-	-	m	M	-
Rhododendron albiflorum	-	-	-	m	-
Sorbus sitchensis var. *grayi*	-	-	-	m	-
Tsuga mertensiana	-	-	M	m	-
Abies amabilis	-	-	M	t	-
Valeriana sitchensis	-	-	t	-	M
Veratrum viride	-	-	-	-	M
Carex spectabilis	t	t	t	-	m
Lupinus latifolius var. *subalpinus*	-	-	-	-	m
Polygonum bistortoides	-	t	-	-	m
Arnica latifolia	-	t	-	-	m

[a] M indicates a species is a major component; m indicates a species of minor or secondary importance; and t (trace) indicates a species is infrequent or rare.

2) *Phyllodoce empetriformis-Cassiope mertensiana* community.

This is the most widespread community in the Subalpine Zone of the area. It is found on most of the well drained upper slopes and ridges.

Phyllodoce empetriformis, Cassiope mertensiana and *Vaccinium deliciosum* are all major components of the community. Of lesser importance is *Luetkea pectinata.*

3) *Tsuga mertensiana-Abies amabilis* community.

These tree clumps are a conspicuous feature of the area. They occur on many of the convex slopes and ridges at lower elevations.

Tsuga mertensiana and *Abies amabilis* are the sole dominants in the overstory. Important species beneath the tree canopy are *Luetkea pectinata, Phyllodoce empetriformis, Vaccinium deliciosum* and *V. membranaceum.*

4) *Vaccinium membranaceum-Rhododendron albiflorum* community.

The *Vaccinium-Rhododendron* community is common on the periphery of many of the *Tsuga-Abies* stands. These units occur mainly on the southerly slopes of the area.

Vaccinium membranaceum is the dominant species while *Rhododendron albiflorum* and *Sorbus sitchensis* var. *grayi* are frequent but of lower cover. Important lower shrubs and herbs are *Luetkea pectinata, Phyllodoce empetriformis, Cassiope mertensiana* and *Vaccinium deliciosum.*

5) *Valeriana sitchensis-Veratrum virides* community.

This lush herbaceous community occurs on the southerly slopes of the area at lower elevations. These extensive stands are maintained by continuous snow creep on the steep colluvial slopes.

The major species in the community are *Valeriana sitchensis* and *Veratrum viride*. *Carex spectabilis*, *Lupinus latifolius* var. *subalpinus*, *Polygonum bistortoides* and *Arnica latifolia* are also important.

B. Alpine Zone

1) *Abies lasiocarpa* community.

These krummholz stands are frequent at higher elevations on Sahale Mountain. They are usually associated with exposed, well drained sites.

The dominant tree species is *Abies lasiocarpa* (Table 41). *Tsuga mertensiana* and *Pinus albicaulis* are infrequent in the stands. The relatively sparse understory is dominated by *Vaccinium deliciosum*, *Cassiope mertensiana* and *Phyllodoce empetriformis*.

2) *Cassiope mertensiana-Vaccinium deliciosum-Phyllodoce glanduliflora* community.

As in other alpine areas of the western North Cascades the heath communities of the area are extremely variable. This vegetation unit covers extensive areas on the upper slopes of the mountain.

The largest stand examined was dominated by *Cassiope mertensiana*, *Vaccinium deliciosum* and *Phyllodoce glanduliflora*. Other important species in this diverse community are *Carex spectabilis*, *C. nigricans*, *Sibbaldia procumbens*, *Hieracium gracile*, *Polygonum bistortoides* and *Deschampsia atropurpurea*. *Cetraria subalpina* and *Cladonia gracilis* are frequent lichens in the stand.

TABLE 41. Relative abundance of important species in the alpine plant communities of the Sahale Mountain area.[a]

Species	*Abies lasiocarpa*	*Cassiope-Vaccinium deliciosum-Phyllodoce glandulifloa*	*Empetrum nigrum-Salix nivalis*
Abies lasiocarpa	M	-	-
Vaccinium deliciosum	m	M	-
Phyllodoce empetriformis	m	-	-
Cassiope mertensiana	m	M	-
Luetkea pectinata	t	M	-
Phyllodoce glanduliflora	-	M	-
Carex spectabilis	-	m	-
Carex nigricans	-	m	-
Sibbaldia procumbens	-	m	-
Hieracium gracile	-	m	-
Polygonum bistortoides	-	m	-
Deschampsia atropurpurea	-	m	-
Cetraria subalpina	-	m	-
Cladonia gracilis	-	m	-
Empetrum nigrum	-	-	M
Salix nivalis	-	-	M
Erigeron aureus	-	-	m

[a] M indicates a species is a major component; m indicates a species of minor or secondary importance; and t (trace) indicates a species is infrequent or rare.

3) *Empetrum nigrum-Salix nivalis* community.

In the Alpine Zone of the Sahale Mountain area the effects of downslope soil movement, a phenomena lacking in other areas examined in the North Cascades National Park Complex, were encountered. Numerous turf-banked terraces, turf-banked lobes and stone-banked terraces (Benedict, 1970) occur at elevations above 6600 feet. These landforms are probably similar to those in the Rocky Mountains where they were found to be caused by both frost creep and solifluction acting together (Benedict, 1970). Other frost phenomena such as frost boils and stone nets are also found in the Sahale Mountain area.

One of the communities examined (Table 41) consisted of shallow stone-banked terraces about six inches high. The major vegetative cover was located at the front of the terrace and just above the risers. *Empetrum nigrum* and *Salix nivalis* are the dominant plant species in the community. The only other conspicuous plant is *Erigeron aureus*.

Fauna

The goat and deer population in this area is relatively small. This may be due to the high recreation use of the area. Marmot and pica are common on most of the lower and middle slopes.

EVALUATION OF THE AREAS

This survey of potential natural areas in the North Cascades National Park Complex has dealt mainly with the vegetation since the collection of a comparable amount of data on the animal communities would have required a much greater length of time. In evaluating these areas it seems more appropriate to treat each community type separately rather than make repetitious comparisons for each of the areas. This approach will illustrate the complexities and difficulties encountered when attempting to make comparisons between entire ecosystems.

Tsuga heterophylla communities.

All drainages examined, with the exception of Luna Creek, McMillan Creek, and the North Fork of the Nooksack River, have extensive stands dominated by *Tsuga heterophylla*. These communities were largest in the Chilliwack River drainage. This is due mainly to the more moderate mountain slopes and the large size of the drainage.

Thuja plicata communities.

Sizeable communities of *Thuja plicata* occur in the Baker River, Little Beaver Creek, Big Beaver Creek, and Chilliwack River drainages. These stands are less extensive and smallest. with smaller (and probably younger) individual specimens, in the Baker River valley. The largest continuous *T. plicata* communities are those in the lower valley of the Chilliwack River. The Big Beaver drainage, has a slightly greater acreage of *T. plicata* stands than either the Chilliwack River or Little Beaver Creek drainages. Individual specimens reach a large size in all of the latter three valleys.

Pseudotsuga menziesii communities.

The only valleys surveyed that did not contain appreciable stands dominated by *Pseudotsuga* were the Luna Creek and North Fork of the Nooksack River drainages. The stands in the McMillan Creek and Baker River drainages are relatively small and occur mainly on the steep lower to middle slopes. The greatest range of size and age classes occurs in the Stetattle Creek drainage where fire has created a distinct community mosaic. *Pinus contorta* is often an important associate of *Pseudotsuga menziesii* on the drier slopes in the latter area. In the Little Beaver Creek, Big Beaver Creek, and Chilliwack River valleys extensive stands of mature *P. menziesii* are found. Individual specimens reach a large size in all three drainages. In most of the drainages of the western North Cascades *Tsuga heterophylla* is the major climax species. In the lower reaches of the Little Beaver and Big Beaver, however, *Pseudotsuga menziesii* is both the pioneer and climax species. This community type is best illustrated in the Little Beaver Creek valley.

Deciduous communities.

Except for the avalanche communities found in all of the valleys studied, the only other significant stands dominated by deciduous species (i.e., *Acer macrophyllum, Alnus rubra* and *Populus trichocarpa)* are located in the Baker River drainage. These bottomland and lower slope communities represent various stages of both primary and secondary succession.

Subalpine plant communities.

In the North Cascades National Park Complex subalpine vegetation, although often fragmentary, is a conspicuous feature on the landscape. The three areas studied during this survey, as well as a fourth (the upper easterly slopes of Stetattle Creek - Elephant Butte to Sourdough Mountain) for which previous information is available, are all extensive and include representative subalpine plant communities. The impact of recreational use is probably the only major difference between the four areas. The Sahale Mountain area is an intensive use area with the damage on the lower slopes (lower Sahale Arm) reflecting this high use. The Redface Mountain, the southern half of the Copper Mountain and the Sourdough Mountain areas receive light to moderate use. The northern half of the Copper Mountain and the northern-most slopes of the Stetattle Creek (Elephant Butte) areas are practically undisturbed and rarely visited by man.

Alpine plant communities.

With the exception of the Copper Mountain area, all the areas (Redface Mountain, Sahale Mountain, and Sourdough Mountain-Elephant Butte) examined have extensive alpine vegetation. Recreation use ranges from very low (Redface Mountain and Sourdough-Elephant Butte areas) to moderate (Sahale Mountain). Recreationalists have caused little damage in the Sahale Mountain area, however, restricting their travel to the main trail that passes through the area.

Another feature of noteable interest in the Sahale Mountain area is the alpine landforms due to downslope soil movement. This

phenomena is not evident in other alpine areas of the North Cascades National Park Complex.

Primary succession communities.

Although primary succession is encountered to some extent in all of the valleys studied it is due mainly to fluvial or colluvial processes. In the North Fork of the Nooksack River drainage glacial processes during recent years provide an excellent opportunity to study development of the climax ecosystem from an originally unvegetated surface. Five extensive communities (stades) in varying degrees of plant and soil development occur in the valley.

Transition (western Cascade-eastern Cascade) communities.

In the Cascade Range of Washington it is often common to encounter transitional subalpine or alpine plant communities on the higher mountains near the Cascade Crest. It is extremely unusual, however, for these communities to consist of lower elevation forest types. In the North Cascades this phenomena occurs in three valleys, all of which have east-west flowing drainages that cross the boundary or transition from the moist westside environment to the drier eastside environment. The two drainages surveyed (Big Beaver and Little Beaver Creeks) exhibit vegetation that ranges from the typical westside *Abies amabilis* and *Tsuga heterophylla* climax forest types to the typical eastside *Pseudotsuga menziesii* climax forest type. "Progress" in the third valley, the Skagit River valley, has created highways, power lines, and a series of dams thus obliterating most of the natural vegetation of the lower elevation transition area.

Aquatic or semi-aquatic communities.

Aquatic or semi-aquatic communities occur in most of the drainages surveyed. In the Baker River valley these communities occur on the periphery of large open bodies of water resulting from beaver dam construction. In the Little Beaver Creek, Big Beaver Creek, and Chilliwack River drainages *Sphagnum-Carex* communities are encroaching on, or have eliminated, the open water on the ponds or small lakes. These *Sphagnum-Carex* communities are best illustrated in the Big Beaver Creek valley where an excellent range of successional stages are represented.

In addition to the numerous lower elevation bogs and ponds, small cirque lakes occur at higher elevations in every area examined, with the exception of McMillan Creek.

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