Vegetation and Wildlife Findings for Three Ecological Reserves in the Skagit River Valley

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Summary

Ecological reserves are areas of land which have been protected from consumptive resource use under the Ecological Reserves Act. Three of the Skagit Valley's ecological reserves were studied during this project. Vegetation, soil, topographic, habitat and wildlife data was collected in the Skagit River Cottonwoods reserve, the Ross Lake reserve and the Skagit River Forest reserve. This inventory was done to find out what animals may be using the reserves, what vegetation presently exists in the reserves, and what vegetation may exist in the reserves in the future.

The reason that the three reserves were established was also considered. The Skagit River Cottonwoods reserve was established to protect the black cottonwoods growing on the floodplain of the Skagit River. The Ross Lake reserve was established to protect a stand of ponderosa pines. The Skagit River Forest was established to protect a piece of land within a transitional zone. The Skagit Valley has a climatic regime that is transitional between that of the coast and the interior of B.C.

The purpose of the Ross Lake reserve and the Skagit River Forest reserve are clearly being met. In order to determine whether the purpose of the Skagit River Cottonwoods reserve is being met, further studies are required.

The data which was collected revealed that the habitat in the reserves was being used by a variety of animals such as bears, deer, coyotes, racoons and many forest birds. The plant communities were diverse and several site associations, or potential vegetation communities, were identified for each reserve.

It is recommended that further wildlife and vegetation studies be conducted in these reserves, as well as in the Skagit River Rhododendron reserve. Due to time limitations the survey crew was unable to do any studies in this fourth reserve, the Skagit River Rhododendrons. Since the vegetation in the Skagit Valley lies in a transitional climatic zone, the findings in the vegetation inventory did not match well with the expected vegetation listed in BC's classification systems. It is recommended that further vegetation studies be done in order to refine the sections for transitional zones in the Vancouver Forest Guide.

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1.0 INTRODUCTION

1.1 Ecological Reserves

There are 134 ecological reserves in B.C. These reserves have been established under the Ecological Reserves Act of 1971. By designating an area as an ecological reserve it is protected from consumptive resource uses such as logging, hunting, fishing, and camping.

Ecological reserves may be established to preserve:

- areas suitable for scientific research and educational purposes,
- areas that are representative examples of natural ecosystems,
- areas that serve as examples of ecosystems that have been modified by man and that offer an opportunity to study the recovery of the natural ecosystem,
- areas in which rare or endangered native plants or animals live in their natural habitat,
- areas that contain unique and rare examples of botanical, zoological or geological phenomena.

In this study three ecological reserves in the Skagit River Valley were studied.

Ecological Reserve #21	Skagit River Forest
Ecological Reserve #22	Ross Lake Reserve
Ecological Reserve #89	Skagit River Cottonwoods

The Skagit River Forest Reserve, was established to preserve an area whose climate is transitional between that of the coastal and interior regions of B.C. Certain coastal plant species reach their eastern distribution limit in the Skagit Valley, while some interior plant species reach their western distribution limit.

The Ross Lake Reserve was established to preserve a small population of ponderosa pines. The reserve was also established to preserve a piece of the transitional zone between coastal and interior climates.

The Skagit River Cottonwoods Reserve was set up to help preserve the genetic pool of the black cottonwoods found on the floodplain of the Skagit River.

In this study data was collected to:

- obtain information on vegetation, soil, topography and habitat characteristics in each of the reserves, and
- evaluate how well the reserves' characteristics corresponded with the stated purposes of each reserve.

1.2 The Skagit Valley

The three ecological reserves studied are located in the Skagit Valley which lies between Coast mountain ranges. The Skagit Valley, situated west of Manning Park, is a U-shaped valley which was carved by glaciers. The location of the Skagit Valley is shown in Figure 1 and the locations of the ecological reserves within the valley are shown in Figure 2.

The Skagit River flows northeast to southwest from Manning Provincial Park to where it joins the Sumallo River and begins to flow southeast to the Ross Lake Reservoir at the Canadian-US border.

The main road into the area is the Silver-Skagit road which enters the valley at the north end and runs alongside the Skagit River up to Ross Lake. The Silver-Skagit road and its many small offshoot roads were built in the 1940's and 1950's when portions of the valley were being logged (Perry, 1981).

The southern end of the Skagit Valley lies in a rainshadow. For this reason the climate is warm and dry compared to coastal regions, but not as dry as regions in the interior of the province. The climate in the Skagit Valley has been termed transitional between the climates of the coast and the interior.

Since the climate is transitional there is an overlap between some coastal and interior plant species in the valley. Some interior plant species, such as the ponderosa pine, reach their western distribution limit in the Skagit Valley. Similarly some coastal species, such as devil's club and vine maple, reach their eastern distribution limit in the valley. The red rhododendrons found in the Skagit Valley are rare in other parts of the province.

Plant species that are common in the valley include Douglas-fir, western red cedar, western hemlock, vine maple, black cottonwood and Oregon grape. Other plant species present include ponderosa pine, trembling aspen, falsebox, devil's club, prince's pine and Pacific yew.

In addition to the forested areas of the valley floor and valley sides, there are meadows, wetlands, and riparian zones in the Skagit Valley. The diversity in habitats and the transitional climate in the Skagit Valley probably promote wildlife diversity.

In this Skagit Valley study data was collected that would permit vegetation types and wildlife use to be analyzed for each of the reserves. The vegetation was considered on the basis of what vegetation is present now and what vegetation may be present in the future. Comments were then made about the boundaries of the reserves. Finally recommendations were made for each reserve on the basis of the data collected.

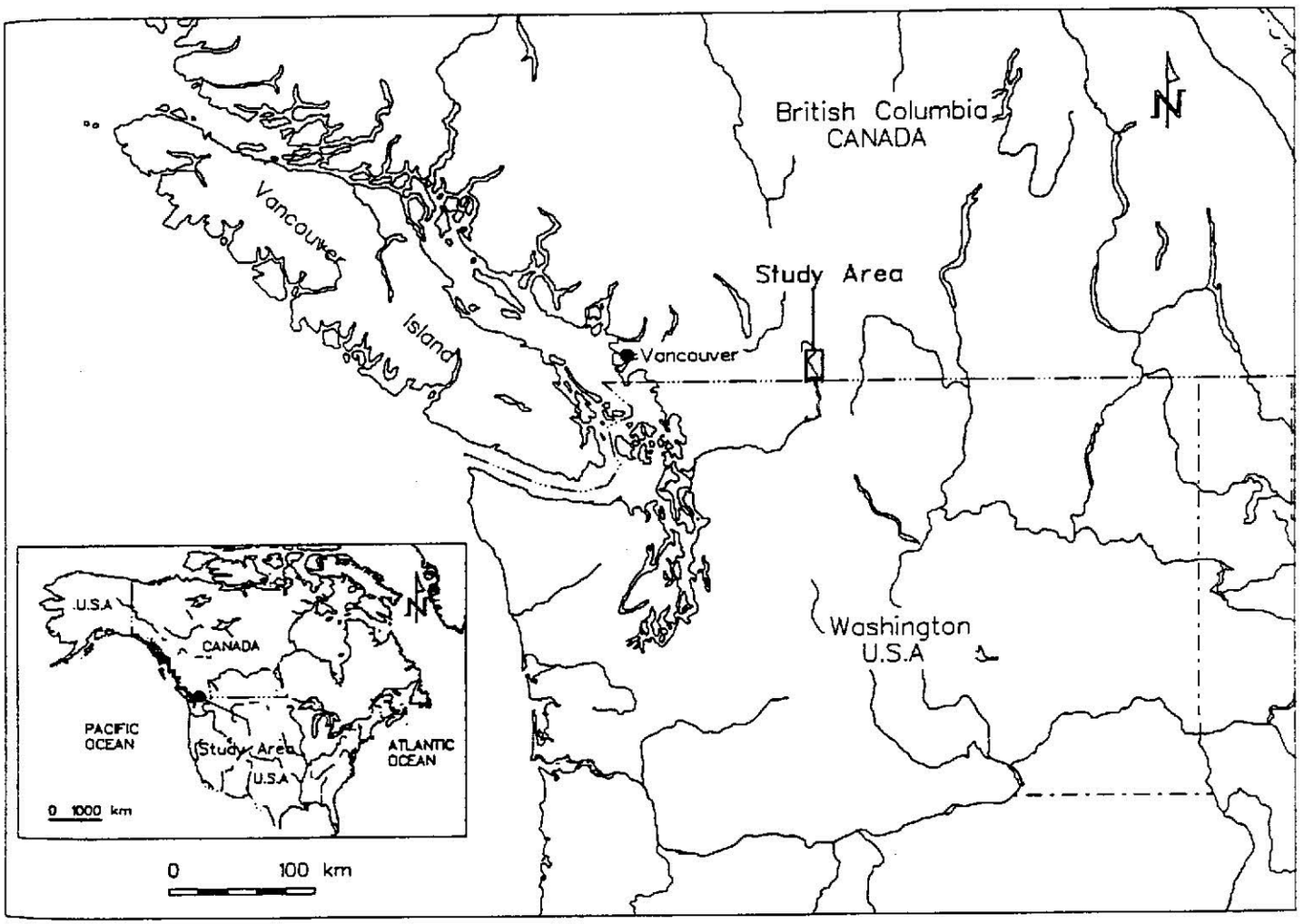


Figure 1: Ecological Reserve Study Area

2.0 MATERIALS AND METHODS

The following are lists of materials and methods used to conduct surveys in the Skagit River Forest, Ross Lake, and Skagit River Cottonwoods Ecological Reserves between May 10th and June 17th 1993.

The materials used for the surveys included:

- an increment borer (16"),
- aerial photos of the study area,
- a diameter tape,
- a 50m chain,
- a Suunto clinometer (degrees and percentage),
- an azimuth compass (Silva Ranger),
- Vancouver Forest Guide Site Diagnosis Sheets,
- Harvey Method Vegetation Sheets,
- a Canon AE-1 35mm camera,
- a shovel,
- field guides on wildlife and on identification of scat and tracks,
- a pair of 7 X 35 binoculars,
- a 9X - 30X zoom spotting scope,
- a micro-cassette recorder,
- various bird field guides, and
- some B.C. Parks Ecological Reserve signs.

Methods used in the field to determine the **vegetation** types within each plot included:

1) typing out different vegetation types on aerial photos according to texture, tone, and shading,

2) planning out plots for each vegetation type with an appropriate transect connecting the plots,

3) chaining in to the designated plots using aerial photos and an azimuth compass in the field and marking out 20m x 20m plots,

4) recording all species of trees, shrubs, herbs, and mosses within each plot,

5) recording the percent cover for each plant species on Site Diagnosis Forms from the Vancouver Forest Guide

6) evaluating height classes and distribution of the trees, shrubs, and herbs as according to the Harvey Method vegetation sheets,

7) determining the heights, diameters, and ages of two representative trees within each plot using:
   - the 50m chain and clinometer for heights,
   - the diameter tape for diameters, and
   - the increment borer for tree ages as illustrated in Figure 3.

8) recording dead and down woody material (Figure 4) percent cover and classifing this material according to diameter, length and extent of decay,

9) taking photographs from the centre of the plot to the north, east, south, and west directions.

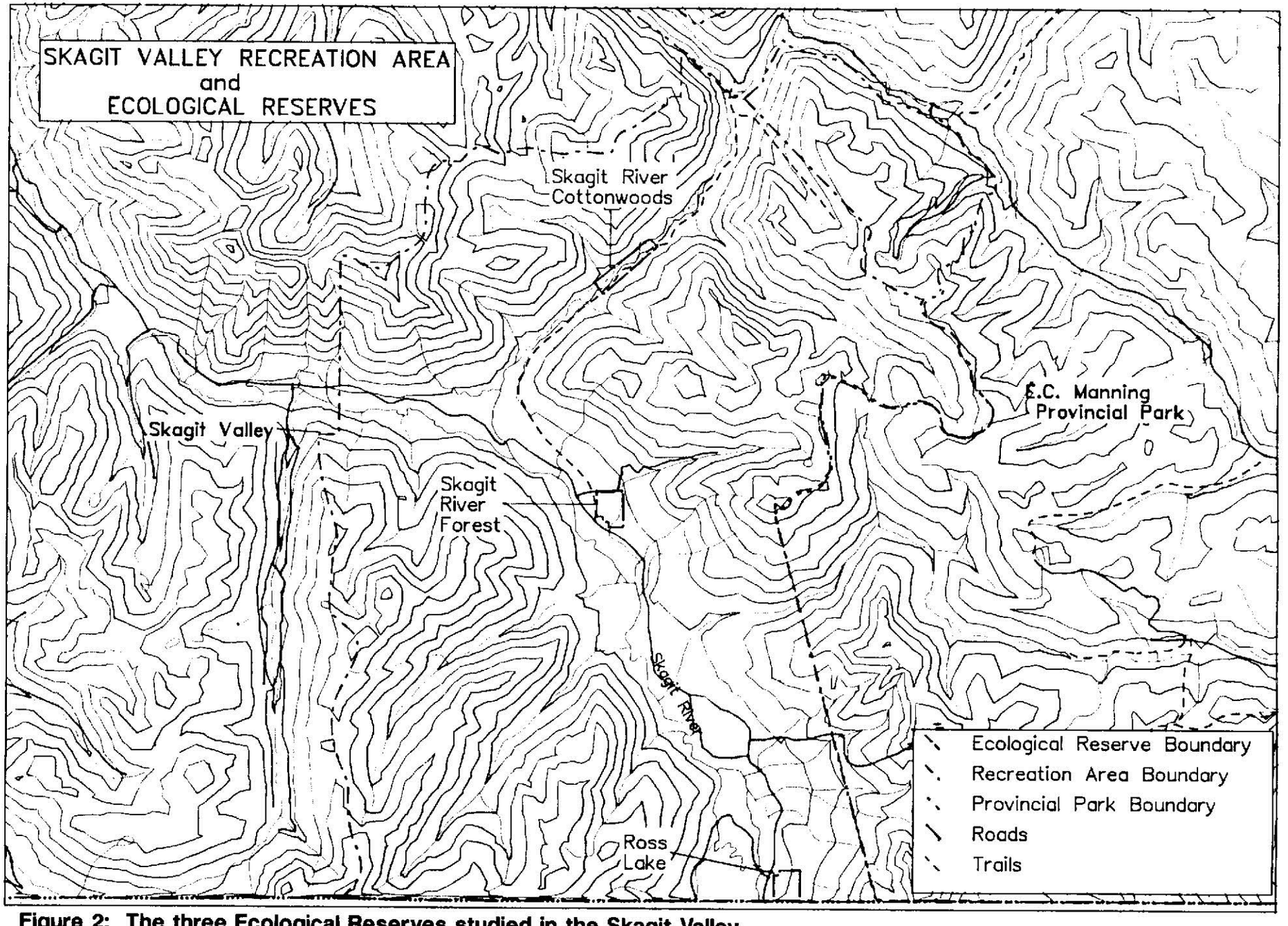


Figure 2: The three Ecological Reserves studied in the Skagit Valley

Figure 3: Use of the increment bore to estimate a tree's age

Figure 4: Dead and down woody debris in the Ross Lake Reserve

Methods used in the field to determine the **soil** type within each plot included:

1) digging 0.5m X 0.5m soil pits with varying depths according to the soil depth in the plot,

2) measuring the different layers and horizons using the diameter tape,

3) determining texture and wetness using hand texturing methods, while visual analysis was used to attain the rest of the recorded information,

4) evaluating the humus form layer within each pit following the Soil Features section of the Vancouver Forest Guide's Site Diagnosis Form,

5) evaluating the mineral layers again according to the Site Diagnosis Form, and

6) taking photographs of the soil pits.

Methods used in the field to determine the local **topography** within each plot included:

1) filling in the Site Diagnosis Form with the information that could be determined visually,

2) determining the slope gradient using the clinometer, and

3) determining the slope aspect using the compass.

"A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region" (Green et al., 1993) was used to analyze topographic, soil and vegetation data to determine site associations.

Methods used in the field to determine a sampling of **wildlife** usage within each reserve included:

1) recording sightings of wildlife inside the vegetation plots or along the transect,

2) recording indications of wildlife use such as scat (Figure 5), tracks (Figure 6), squirrel tables (piles of cone scales as shown in Figure 7), or burrowed holes in the plots and along the transect.

Figure 5: Deer skat found along a transect in the Ross Lake Ecological Reserve

Figure 6: Wolf track found along the trail leading into the Skagit River Cottonwoods Ecological Reserve

Methods used in the field to attain a sampling of the **birds** found within each reserve included:

1) walking along our transect and recorded any birds that could be identified by sight or sound,

2) walking to the vegetation plots just after dawn and siting silently for ten minutes recording any birds entering the plot,

3) recording any sightings of nests, as shown in Figure 8, inside the plots or along the transect,

4) noting any other indications of bird use such as feather piles or wildlife trees with woodpecker holes in them, as shown in Figure 9.

Methods used in the field to determine the location of the **boundaries** of each reserve included:

1) determining the boundary on aerial photos and laying out the best locations to find the boundaries on the ground,

2) walking in to the boundaries using the chain and the azimuth compass,

3) putting up signs at locations where public access would be probable,

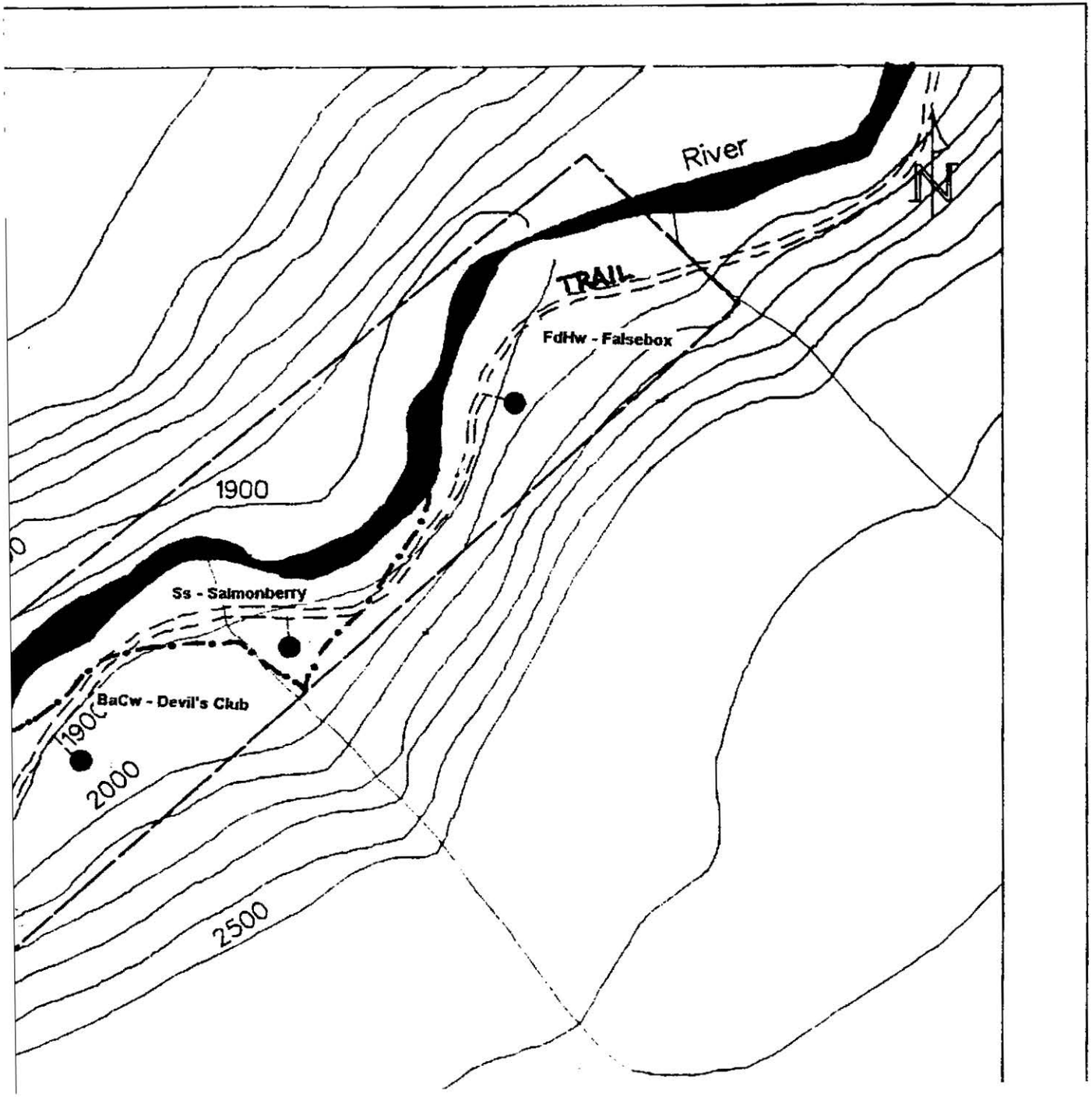
4) determining whether old B.C. Parks signs were in proper locations and in good condition. If they were misplaced or in poor condition they were replaced.

Figure 7: A "squirrel table" or pile of cone scales found in the Ross Lake Ecological Reserve

Figure 8: A bird nest found in the Ross Lake Ecological Reserve

Figure 9: A wildlife tree with many woodpecker holes

FIGURE 10: Vegetation Types and Plot Locations



Legend

- Vegetation Type Line
- Plot Location
- Transect
- Reserve Boundary

3.0 COMMENTS ON VEGETATION ANALYSIS AND SITE ASSOCIATION

The same plant communities can occur in areas with different climatic regimes. This happens when other site factors, such as soil porosity, act to compensate for differences between areas in such things as precipitation levels.

A plant community that could be found in sites throughout different climatic zones is called a site association. Site associations indicate what type of vegetation could potentially be found on a site if the existing vegetation community were to proceed, uninterupted, through to the end of its sucessional sequence.

Charts to assess nutrient and moisture regimes can be used for each plot. By using these nutrient and moisture values the site association can be determined for each plot.

In the vegetation component of this study, each reserve was considered on the basis of the existing vegetation and the potential vegetation.

Common plant names have been used throughout this report. the latin equivalents of these common names are listed in Appendix 1. The book called "Vascular Plants of British Columbia" (Taylor and MacBryde, 1977) was used as a guide to latin names. The vegetation codes such as height codes, distribution codes and tree abbreviations used in this study are defined in Appendix 2.

4.0 THE SKAGIT RIVER COTTONWOODS ECOLOGICAL RESERVE

In the Skagit River Cottonwoods Ecological Reserve, shown on Figure 2, five plots were established in order to study the vegetation in the area. The location of these plots is shown in Figure 10. Appendix 3 provides all the vegetation, soil, and topographic data that was collected for the plots in the Cottonwoods Ecological Reserve.

The Cottonwoods Ecological Reserve is considered a submaritime forest in the Coastal Western Hemlock biogeoclimatic zone. In these forests common coastal plant species, such as salal, tend to be scarce while interior plant species, such as red-stemmed feathermoss and queen's cup, tend to be present (Meidigger & Pojar, 1991). The common tree species in this type of forest are Douglas-fir, western hemlock, and western red cedar. The understory tends to contain Vaccinium sp., and false azalea. Other plant species common in the understory include rattlesnake plantain, twinflower, bunchberry, and one-sided wintergreen (Meidinger & Pojar, 1991). The humus forms tend to be mors.

4.1 Existing Vegetation in Plots 1 to 5

4.1.1 Plot 1 (Skagit River Cottonwoods Ecological Reserve)

This plot was located on an active floodplain of the Skagit River. There was no distinguishable humus form as the H and F layers were absent. A thin litter layer of leaves and needles sat on top of a deep mineral soil profile which consisted of alternating layers of coarse and fine sand.

The area was flat and would be considered a high-bench site due to the presence of its black cottonwood, western red cedar, and grand fir trees. In this stand the western red cedars were most common and were considered dominant trees as were the black cottonwoods. The grand firs were shorter and considered main trees. The western red cedars were over 65 years old and had heights around 40 m.

The shrub layer consisted mainly of grand fir shrubs, western red cedar shrubs, vine maple, thimbleberry and red-osier dogwood. Other shrubs, in fewer numbers, included devil's club, salmonberry, black gooseberry, and high-bush cranberry. The shrub layer consisted of shrubs up to 2 m high and shrubs from 2 m to 10 m high.

In the herb layer enchanter's nightshade, starflowered solomon's seal, meadow rue, broad-leaved starflower, sweet-scented bedstraw, and Siberian miner's lettuce were present. Some of these herbs, such as the meadow rue, and ferns, such as the spiny shield fern, stood above 30 cm in height. Overall though, the percentage of ground covered in herbs was much lower than that covered by shrubs in this plot.

About 15% of the ground in the plot was covered by dead and down woody debris. Seventy percent of these woody debris pieces had a diameter less than 10 cm. There were some large pieces, 20 - 40 cm in diameter, and above 40 cm in diameter, in this plot.

4.1.2 Plot 2 (Skagit River Cottonwoods Ecological Reserve)

This plot was located in a mid-slope position on a steep talus slope elevationally above the floodplain of the Skagit River. The slope gradient in this plot was 30 degrees. There was an organic layer on top of the talus but no distinguishable mineral soil. The humus form was a 4 cm thick mor.

The stand in this plot was made up primarily of Douglas-fir trees with some western hemlock trees. The Douglas-firs were approximately 40 years old and their heights were estimated to be between 35 to 40 m. The understory was made up almost entirely of shrubs which included falsebox, Oregon grape, Douglas maple, vine maple, oceanspray, and salmonberry. Other shrubs included Douglas-fir shrubs, western hemlock shrubs, western red cedar shrubs, thimbleberry, twinberry, and Pacific yew shrubs.

Although most of the shrubs in this plot were low shrubs, below 2 m high, there were some taller shrubs, from 2 to 10 m high. The only herb in the understory was prince's pine. Sword ferns were present as were several mosses. The mosses included stepmoss, electrified cat tail moss, and feather moss.

Only 5% of the ground in the plot was covered with dead and down woody debris. Of this 5%, half of the woody pieces had a diameter less than 10 cm and half had a diameter from 10 - 20 cm.

4.1.3 Plot 3 (Skagit River Cottonwoods Ecological Reserve)

This plot was located in a middle slope position on a steep (36 degree slope gradient) talus slope. This talus slope sits above the floodplain of the Skagit River. The organic layer on top of the talus slope is a 4 cm thick mor.

The stand was made up mainly of Douglas-fir with some western red cedar trees. The crown closure was low with Douglas-fir trees having 20% crown closure and cedar having 3% crown closure. A core sample was taken from one Douglas-fir tree and the tree was estimated to be 210 years old.

The understory in this plot was a dense shrub layer made up mainly of vine maple, dull Oregon grape, and falsebox. Other shrubs included western hemlock shrubs, western red cedar shrubs, Vaccinium sp., twinflower, and Scouler's willow. The shrub layer was made up mainly of shrubs less than 2 m tall. There were very few herbs in this plot. One-sided wintergreen, white-flowered hawkweed, rattlesnake plantain, and broad-leaved starflower each made up less than 1% of the ground cover in the plot.

Although sword fern, licorice fern, and electrified cat tail moss were present, these plants were not abundant. Step moss was abundant and covered 70% of the plot.

Dead and down woody debris covered only 2% of the ground in the plot. Seventy-five percent of this 2% was made up of woody debris with a diameter of less than 10 cm. The other 25% was made up by a single 5 m long log with a diameter of 19 cm.

4.1.4 Plot 4 (Skagit River Cottonwoods Ecological Reserve)

This plot was located on a middle slope elevationally above the floodplain of the Skagit River. The talus slope was steep with a 40 degree slope gradient and a northwestern aspect. There was a 4.5 cm thick mor humus form sitting on top of the talus, but mineral soil was not distinguishable.

Figure 11 shows the stand in this plot. The crown closure was high in this stand. Western red cedar had a 45% crown cover and Douglas-fir had a 33% crown cover. The number of trees in the plot was high. There were 18 Douglas-firs and 13 western red cedar. The Douglas-firs were considered dominant trees while the western red cedars were main trees. One western red cedar on the plot was estimated to be 103 years old while a Douglas-fir was estimated to be 80 years old.

The shrub layer in this plot was made up mainly of falsebox, vine maple, and western red cedar shrubs. Other shrubs present but with low percent cover were dull Oregon grape, Vaccinium sp., western hemlock shrubs, black gooseberry, saskatoon, red-osier dogwood, and twinflower. All of the shrubs were less than 2 m high creating a low shrub layer.

The herb layer was sparse and less than 30 cm tall. Sweet-scented bedstraw and rattlesnake plantain were present but each made up less than 1% ground cover. Sword fern, licorice fern, feather moss, electrified cat tail moss, and pipecleaner moss were present but had low percent cover. Step moss was abundant with a 70% ground cover.

Thirty-five percent of the plot's ground was covered in woody debris. Most of this woody debris had a diameter of 10 - 20 cm or 20 - 40 cm.

Figure 11: Vegetation in Plot 4 of the Skagit River Cottonwoods Ecological Reserve

4.1.5 Plot 5 (Skagit River Cottonwoods Ecological Reserve)

This plot was in a depression and it was far enough away from the Skagit River that it did not show evidence of flooding. The soil was very shallow, between 0.25 - 0.50 m deep, and was loamy. The soil had a 2 cm thick Ah layer and a 3 cm thick mull humus form.

The main trees in the plot were western red cedars with a percent cover of 60% and a western hemlock with a percent cover of 10%. There was one dominant Douglas-fir with a percent cover of 3%. The hemlock was 95 years old with a height of 54 m.

The shrub layer did not have a high percent cover in general. The shrubs present were almost all below 2 m high and included wine maple, devil's club, western red cedar shrubs, western hemlock shrubs, Pacific yew shrubs, and rose sp.

The herb layer had a high percent cover and consisted mainly of one-leaved foamflower and enchanter's nightshade. Other herbs that were present included sweet-scented bedstraw, twisted stalk, western trillium, queen's cup, and Siberian miner's lettuce. There was a high percent cover of ferns in this plot. Oak fern, spiny shield fern, and lady fern were abundant. Maiden hair ferns were also present in small patches. Pointed leafy moss was the most abundant moss followed by round leafy moss and then electrified cat tail moss.

Dead and down woody debris covered about 7% of the area of the plot. Most of this was woody debris with a diameter less than 10 cm or a diameter from 20 - 40 cm.

4.2 Potential Vegetation in the Skagit River Cottonwoods Reserve

By determining the moisture and nutrient regimes for each plot, site associations could be assigned.

- Plot 1 fit into the Ss-Salmonberry site association.
- Plot 2, 3, and 4 fit into the FdHw-Falsebox site association.
- Plot 5 fit into the BaCw-Devil's Club site association.

These type lines are illustrated in Figure 10 and follow the topography of the area. There seems to be three main areas on the southeastern side of the Skagit River.

There is the floodplain area where Plot 1 was located. Then there is a long talus slope area in which Plots 2, 3, and 4 were located. Near the northeastern edge of the reserve is an area in which Plot 5 was located. This area is higher than the floodplain area of Plot 1, but does not have the talus slopes or steep inclines as in the area where Plots 2, 3, and 4 were located. There is a small depression within the area where Plot 5 is located.

4.2.1 Ss-Salmonberry Site Association

This site association is found in the CWHms subzone on nutrient rich to very rich high bench floodplain sites.

Plot 1 was on a moist site and did have a rich to very rich soil nutrient regime. Since it is fairly close to the Skagit River, water and nutrients may be delivered to the site through the watertable and periodic flooding. The soil profile showed evidence of repeated floods and sediment deposition which might suggest the area was a low or medium bench site. However, the presence of nine western red cedar trees and two grand fir trees suggest that the plot may be a high bench site with only the edge closest to the Skagit River being flooded frequently.

High bench sites generally have western red cedar present with some red osier dogwood in the shrub layer. Over time the site association predicts that main trees should be sitka spruce with salmonberry in the understory.

4.2.2 FdHw-Falsebox Site Association

This site association is found in areas of the CWHms subzone which have very poor to medium soil nutrient regimes and moderately dry soil moisture regimes.

Plots 2, 3, and 4 were located on talus slopes. Moisture in these sites probably drains away rapidly through the angular talus leaving the area moderately dry. Since nutrients tend to be carried by water, these drier sites tend to be lower in nutrients.

In this site association Douglas-fir and western hemlock should be the main trees in the stand with falsebox in the understory, once the successional climax is reached. Plots 2, 3, and 4 all have a significant Douglas-fir component to the stand. Plot 2 also has western hemlock and falsebox. Plot 2 is probably at or very near the end of its successional sequence. The stand in Plots 3 and 4 will probably have their western red cedar components replaced with western hemlock over time.

4.2.3 BaCw-Devil's Club Site Association

This site association occurs in the CWHms subzone on sites with rich to very rich soil nutrient regimes and moist to very moist soil moisture regimes.

Plot 5 was a depression where water and nutrients could collect giving the site the required characteristics to be in the BaCw-Devil's Club site association. Although there is no amabalis fir on the site at present there is 60% cover in western red cedar. There is devil's club present but its percent cover is only 1%. Over time this site, if allowed to reach its successional climax, will have mainly western red cedar and amabalis fir present with an understory dominated by devil's club.

4.3 Wildlife in the Skagit River Cottonwoods Reserve

Various indications of wildlife use in the Skagit River Cottonwoods ecological reserve were discovered. The animals found to be using the habitat in the reserve were bears, wolves and small mammals. No evidence of deer use was found.

These sightings and indications of wildlife have been laid out in map form in Figure 12. Unfortunately, due to a lack of time and equipment no surveys of reptiles or amphibians were done.

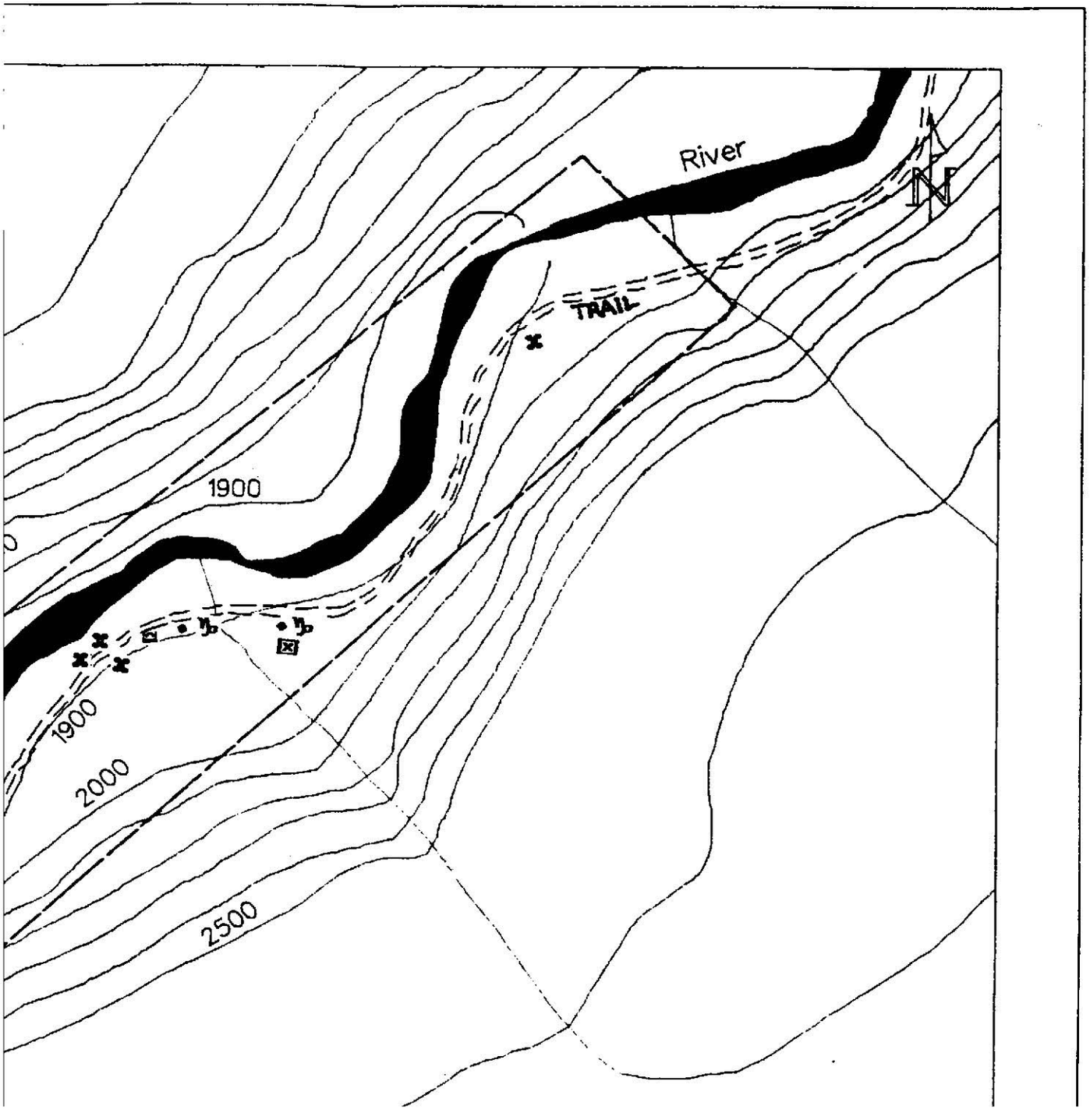
Indications of animal use found outside the reserve boundaries were also noted. Wolf (*Canis lupus*) tracks, as shown in Figure 6, were found along the Skagit River Trail before the trail met the reserve boundary. At our camping area, located approximately 500 metres outside the reserve, various small mammals including Douglas squirrels (*Tamiasciurus douglasii*), deer mice (*Peromyscus maniculatus*), chipmunks (*Eutamias sp.*), and shrews (*Sorex sp.*) were spotted.

Inside the reserve at vegetation plot 1 a cedar tree had bark stripped off of it's southwestern side from 1 metre to 3 metres above ground level. This bark was probably stripped off by an adult black bear (*Ursus americanus*).

Indications of small mammal use included burrows and small piles of collected leaves. These leaf mounds were first spotted in plot 1 and each was approximately 3 cm high and 10cm in diameter and spaced evenly 15cm from one another. The mounds were spotted again along the Skagit River Trail 15m from plot 1, but not anywhere else in the reserve. Between the trail and plot 3, burrows were spotted under dense moss cover on a talus slope. The burrows were between six and eight centimetres in diameter.

This information confirms that the reserve is an active habitat for wildlife species. More extensive wildlife inventories would provide more detailed information about the animal populations in the reserve.

FIGURE 12: Wildlife Indications and Sightings



Legend

- Indications of small mammals
- Sightings of small mammals
- Indications of Deer
- Sightings of Deer
- Indications of birds
- Sightings of birds
- Indications of Bears

4.4 Birds in the Skagit River Cottonwoods Reserve

Bird surveys were not conducted in this reserve due to the lack of time that was available. However, birds that were seen along the Skagit River Trail, transects, and in the plots were recorded. Indications of bird habitat such as nests and wildlife trees were also noted. Indications or sightings of birds outside the reserve were noted also if there was potential for the birds to enter the reserve.

There were a number of indications of birds outside the reserve. These included:

- a female harlequin duck (*Histrionicus histrionicus*) 500m NE of reserve boundary,
- a red-breasted sapsucker (*Sphyrapicus varius*) 500m NE of reserve boundary,
- numerous ravens (*Corvus corax*) along the Skagit River Trail,
- two robin's (*Turdus migratorius*) nests along side the Skagit River Trail, and
- numerous wildlife trees along the Skagit River Trail.

Inside the reserve sightings of birds included:

- three common mergansers (*Mergus merganser*) at Skagit River (near Plot4),
- two varied thrushes (*Ixoreus naevius*) were heard near plot 1,
- one red-breasted sapsucker (*Sphyrapicus varius*) at plot 3,
- one western tanager (*Piranga Iudoviciana*) near plot 4, and
- one winter wren (*Troglodytes troglodytes*) at plot 5.

Indications of bird use inside the reserve included:

- a bird nest 1.5 metres high in a cedar tree 2 metres outside plot 1, and
- trees with woodpecker holes along the Skagit River Trail between plots 1 and 4.

All of these sightings and indications of bird use are shown in map form in Figure 12.

The data collected indicates that the reserve is an active habitat for birds. Further bird surveys would provide more insight into the productiveness of the reserve as a bird habitat.

4.5 Boundary Observations for the Skagit River Cottonwoods Ecological Reserve

The locations of the Ecological Reserve signs along the Skagit River Trail were reasonably accurate according to the boundary shown on the aerial photographs. The old signs had been vandalized, so they were replaced with new ones.

The purpose of this reserve is to protect the cottonwoods stand reserved for the maintenance of the tree's natural gene pools (Krajina et al). The cottonwoods in this reserve are reportedly the best cottonwoods in the Pacific west (Krajina et al). Because of the description of the reserves purpose, it was expected that there would have been a dense stand of black cottonwoods somewhere within the reserve. This stand was not found. There were a number of cottonwoods within the reserve, but they were no more densely scattered than in a normal floodplain forest.

In order to assess the quality of the cottonwoods, further studies would have to be undertaken by someone more knowledgeable about cottonwood characteristics. The survey crew was not able to cross the river to the northwest side of the reserve where dense stand of cottonwoods potentially could be located. Consequently, the reserve boundaries are considered adequate as they currently stand.

4.6 Recommendations for the Skagit River Cottonwoods Reserve

Along the Skagit River Trail running through the Cottonwoods Ecological Reserve three culturally modified trees were noted. One of these trees is shown in Figure 13. There were large pieces of bark stripped off these trees. There were no carvings or burned in drawings visible. It is difficult to say whether these trees have been modified recently or a long time ago by native people. The survey crew was unable to obtain an accurate core sample. It is recommended that these trees be noted.

Figure 13: A culturally modified tree found along the Skagit River Trail in the Cottonwoods Reserve

This survey of the Cottonwoods Ecological Reserve did not include the portion of the reserve on the northwest side of the Skagit River. A future survey should be conducted there, so more can be learned about the reserve's ecological qualities. An interpretive program should be considered for the southeast side of the reserve as the Skagit River Trail runs directly through it. An interpretive program would increase public awareness of the purpose of ecological reserves and the need to protect areas for the future.

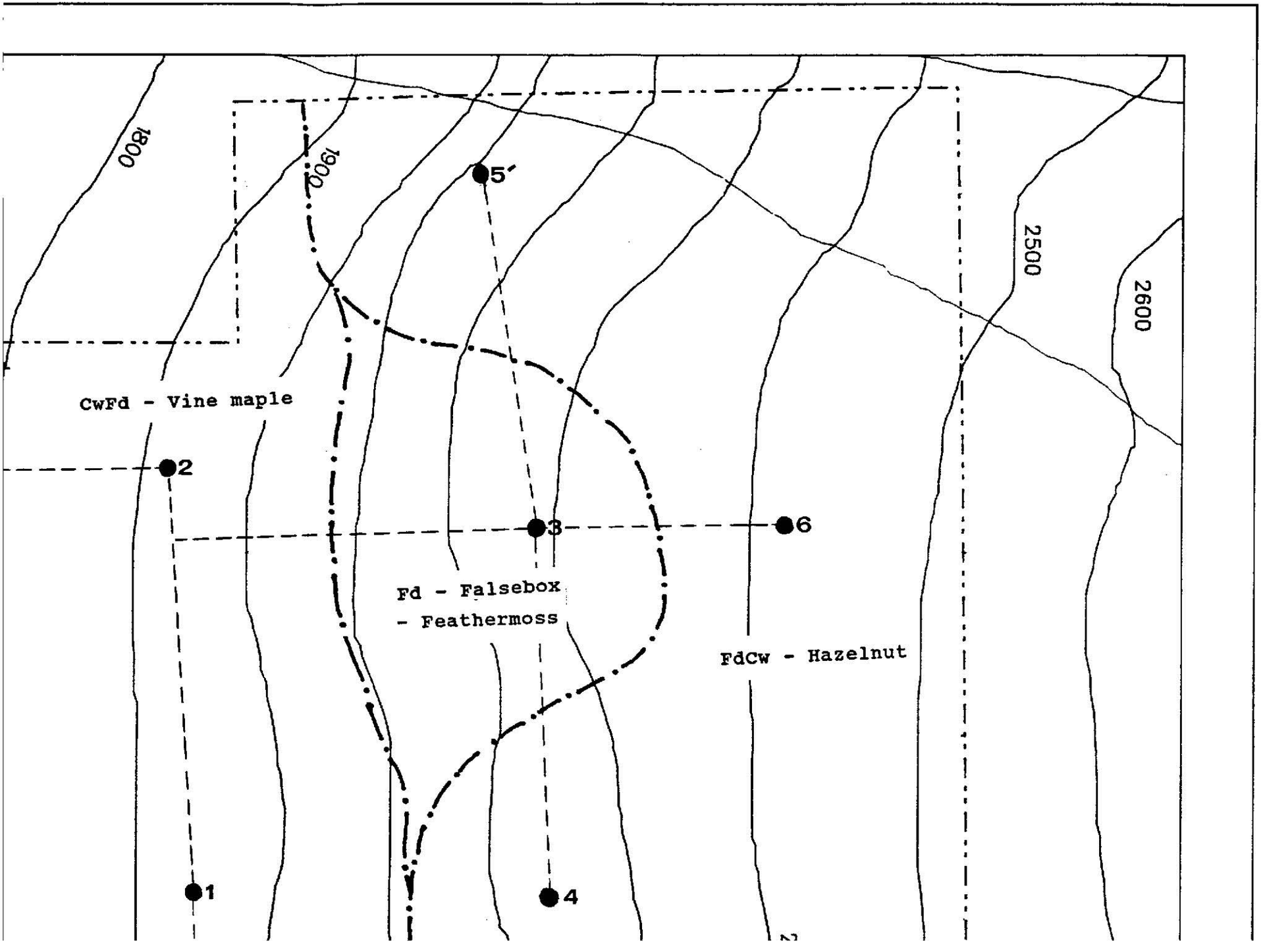
Many species of plants were found growing more vigorously and reaching larger sizes on the Skagit River floodplain within the reserve than in other areas in the Skagit Valley. The area's highly productive nature could be listed as another reason for preserving the area.

5.0 THE ROSS LAKE ECOLOGICAL RESERVE

The position of the six plots placed in the Ross Lake Ecological Reserve are shown in Figure 14. Appendix 4 contains the vegetation, soil, and topographic data that was collected for the plots in the Ross Lake Ecological Reserve.

The Ross Lake Ecological Reserve lies within the Interior Douglas-Fir zone in a "wet warm" subzone termed IDFww. Douglas-fir is the common tree in the IDF zone and may be found in mixed or pure stands. These stands may be open or closed. Western red cedar and paper birch may be found in this zone on wetter sites, while Ponderosa pine may be found on dry sites. Lodgepole pine and trembling aspen are common successional species in this zone.

Some common plants found in the understory of the IDFww subzone include vine maple, saskatoon, falsebox, twinflower, dull Oregon grape and prince's pine.


1800
1900
2500
2600
5'
CwFd - Vine maple
2
3
6
Fd - Falsebox
- Feathermoss
FdCw - Hazelnut
1
4

5.1 Existing Vegetation in Plots 1 to 6

5.1.1 Plot 1 (Ross Lake Ecological Reserve)

This plot was located on a lower slope with a western aspect and a slope gradient of 14 degrees. The soil was a very shallow, 0.25 - 0.50 m deep loam with high coarse fragment content. There was an Ah horizon and a 10 cm thick humus form.

There was 70% cover in western red cedar, 7% cover in paper birch, and 12% cover in Douglas-fir. The cedars and the Douglas-firs were dominant trees while the birches were main trees.

The shrub layer was sparse and consisted mainly of western red cedar shrubs. There were several species of herbs but none of them covered more than 1% of the plot's ground. The herbs present were western trillium, broad-leaved starflower, twisted stalk, one-leaved foamflower, wild ginger, and rattlesnake plantain. Sword fern and spiny shield fern were present but each covered less than 1% of the plot's ground. Step moss and pointed leafy moss were also present, each covering 1% of the plot's ground.

The understory was low to the ground since most of the herbs were less than 30 cm high and the shrubs were all less than 2 m high. In general the understory vegetation was sparce in this area.

Dead and down woody debris covered 30% of the plot's ground. Of this, 45% was woody debris with a diameter less than 10 cm. Twenty percent of the woody debris had a diameter between 10 - 20 cm. The remaining 35% was made up of 20 - 40 cm diameter debris.

Figure 15: Vegetation in Plot 1 of the Ross Lake Reserve

5.1.2 Plot 2 (Ross Lake Ecological Reserve)

This lower-slope plot was located on a terrace with an eight degree slope gradient and a western aspect. The sandy soil was very shallow, only 0.25 - 0.50 m deep, with a high coarse fragment content. There was an Ae layer and a 9 cm thick mor humus form. Western red cedar, western hemlock, and paper birch trees were common on this site and produced a high crown closure.

The shrub layer was dense and made up mainly of western red cedar shrubs, western hemlock, Douglas-fir shrubs, and dull Oregon grape. The herb layer was not very well developed but did included prince's pine, broad-leaved starflower, queen's cup, and starflowered solomon's seal. Step moss covered 15% of the ground while feather moss covered 6%.

Dead and down woody debris covered 15% of the plots ground. There was about equal amounts of woody debris with less than 10 cm diameter, 10 - 20 cm diameter, and 20 - 40 cm diameter.

5.1.3 Plot 3 (Ross Lake Ecological Reserve)

This mid-slope plot was located on a rock outcrop with a western aspect and a 28 degree slope gradient. The silty soil was extremely shallow, less than 0.25 - 0.50 m deep, with greater than 70% coarse fragment content. There was an Ah layer and a 6.5 cm thick Mull humus form.

Ten Douglas-fir trees made up a 20% cover while one ponderosa pine made up 1% cover on the plot. Although the percent cover in ponderosa pine was not high in our plot there were many ponderosa pine in the surrounding area, as shown in Figure 16. Regeneration of ponderosa pine was also observed outside the plot and an example of this is shown in Figure 17.

The shrub layer in the plot was made up mainly of falsebox with some saskatoon, kinnikinnick, and dull Oregon grape. The shrubs were all low shrubs, less than 2 m tall.

The herb layer had a low percent cover and consisted of yarrow, wooly sunflower, lobe-leaved indian paintbrush, small-flowered blue-eyed mary, small-flowered alumroot, and prince's pine. Parsley fern and the lichens, Cladonia and Cladina spp., were present. There was a 30% cover in pinegrass. Step moss and feather moss, among other mosses, covered a high percentage of the rock outcrop.

Only 1% of the plot was covered in woody debris and almost all of that was debris with a diameter of less than 10 cm.

Figure 16: A ponderosa pine near Plot 3 in the Ross Lake Ecological Reserve

Figure 17: Ponderosa pine regeneration in the Ross Lake Reserve

5.1.4 Plot 4 (Ross Lake Ecological Reserve)

This plot was located on a middle slope position with a slope gradient of 25 degrees and a western aspect. The sandy soil was very shallow, from 0.25 - 0.50 m deep, and contained a high percentage of coarse fragments. An Ae horizon was present and the 6 cm humus form was a mor.

The stand on this plot was made up mostly of Douglas-fir trees, with 45% cover. There was also western red cedar, with 20% cover, and western hemlock, with 5% cover. Some Douglas-firs were considered dominant trees, while the others were main trees.

The shrub layer was low and consisted mainly of vine maple, dull Oregon grape, western red cedar shrubs, western hemlock shrubs, and falsebox. The herb layer was not well developed and included prince's pine and green wintergreen. Feather moss and pipecleaner moss were the main mosses present with some pointed leafy moss mixed in.

Thirty-five percent of the ground of the plot was covered in dead and down woody debris. Most of this was either less than 10 cm diameter pieces or 10 - 20 cm diameter pieces.

5.1.5 Plot 5 (Ross Lake Ecological Reserve)

This mid-slope plot had a western aspect and slope gradient of seven degrees. The sandy soil was shallow, from 0.5 to 1.0 m deep, and had a Ah horizon. The humus form was a 5 cm thick mor.

This plot had a pure stand of dominant Douglas-fir trees which had a cover of 70%. Although western red cedar and western hemlock shrubs were present, they were less than 2 m tall and had a low percent cover.

The shrub layer was made up mainly of dull Oregon grape, orange honeysuckle, falsebox, and Douglas maple. The herb layer was sparse and consisted only of broad-leaved starflower, rattlesnake plantain, and prince's pine. Step moss and electrified cat tail moss were present each with a ground cover of about 5%.

Five percent of the plot's ground was covered in dead and down woody debris. Of this, 30% was debris with a diameter less than 10 cm, and 40% was debris with a diameter of 10 - 20 cm. Twenty percent of the woody debris had a diameter from 20 - 40 cm and 10% had a diameter over 40 cm.

5.1.6 Plot 6 (Ross Lake Ecological Reserve)

This plot was located in a middle slope position with a 27 degree slope gradient and a western aspect. The sandy soil was shallow, 0.5 to 1.0 m deep, with an Ah horizon and a 6 cm thick mor humus form.

The stand on this plot was composed mainly of western hemlock and western red cedar, each with a 30% cover. Douglas-fir trees were also present and produced a 6% cover. The shrub layer was fairly dense but low in height. The main shrubs were dull Oregon grape, falsebox, vine maple, soopalalie, and western red cedar shrubs.

The herb layer was sparse and consisted of western trillium, twinflower, rattlesnake plantain, and prince's pine. Bracken, step moss, and electrified cat tail moss were all present in small amounts.

Thirty percent of the plot was covered in dead and down woody debris. Most of this debris was made up of pieces with a diameter from 20 - 40 cm or over 40 cm.

5.2 Potential Vegetation in the Ross Lake Reserve

After determining the nutrient and moisture regimes for each plot, site associations were assigned.

- Plot 1 and 2 fit into the CwFd-Vine Maple site association.
- Plot 3 fit into the Fd-Falsebox-Feathermoss site association.
- Plot 4, 5, and 6 fit into the FdCw-Hazelnut site association.

These type lines are illustrated in Figure 14 and seem to follow the topography of the area. Plots 1 and 2 are situated on a lower slope. As one ascends from these lower slopes toward the upper edge of the reserve there seems to be a series of terraces which may have resulted from glacial activity. In the center of the reserve there is a rocky outcrop where Plot 3 was located. It is on this rocky outcrop that the ponderosa pines, for which the reserve was created, are found. Plots 4 and 5 were located on either side of the rocky outcrop and Plot 6 was located above the rocky outcrop.

5.2.1 CwFd-Vine Maple Site Association

This site association is found on sites in the IDFww subzone which have a soil nutrient regime from rich to very rich and a soil moisture regime termed "slightly dry".

If a plant community in the CwFd-Vine maple site association is allowed to progress to its final stage of succession, the stand should consist of western red cedar and Douglas-fir trees with vine maple in the understory.

Plots 1 and 2 were found on the lower slope where moisture and its dissolved nutrients may collect from upslope. Plots 1 and 2 both had a high percent cover in western red cedar, and a low percent cover in vine maple. Douglas-fir trees made up a component of the stand in Plot 1, but were only found in the understory in Plot 2.

It appears that the plant community that was sampled in Plot 1 is at or near its successional climax. The plant community of Plot 2 may still be moving through its successional sequence towards its climax community.

5.2.2 Fd-Falsebox-Feathermoss Site Association

This site association is found on sites in the IDFww subzone which have a soil nutrient regime from very poor to medium and a soil moisture regime termed "very dry".

The rocky nature and steep slope of the outcrop where Plot 3 was located must result in water being shed from the site. This might explain why the site was classed as very dry and medium in nutrient levels. Plot 3 did have Douglas-fir, falsebox, and feather moss present. This area may be close to or at its successional climax.

5.2.3 FdCw-Hazelnut Site Association

This site association will tend to occur in the IDFww subzone in areas that have moderately dry soil moisture regimes and very poor to medium soil nutrient regimes. Areas with this site association in this subzone are termed zonal.

Plots 4, 5, and 6 all fit into this site association. Douglas-fir and falsebox were present on all three of these plots. Western red cedar trees were present on Plots 4 and 6. In Plot 5 Douglas-fir made up the stand of trees but western red cedar shrubs were present in the understory. Hazelnut trees were not found in these three plots but a few of these plants were found in the area surrounding the plots and along the transects. These three plots are probably approaching their successional climax.

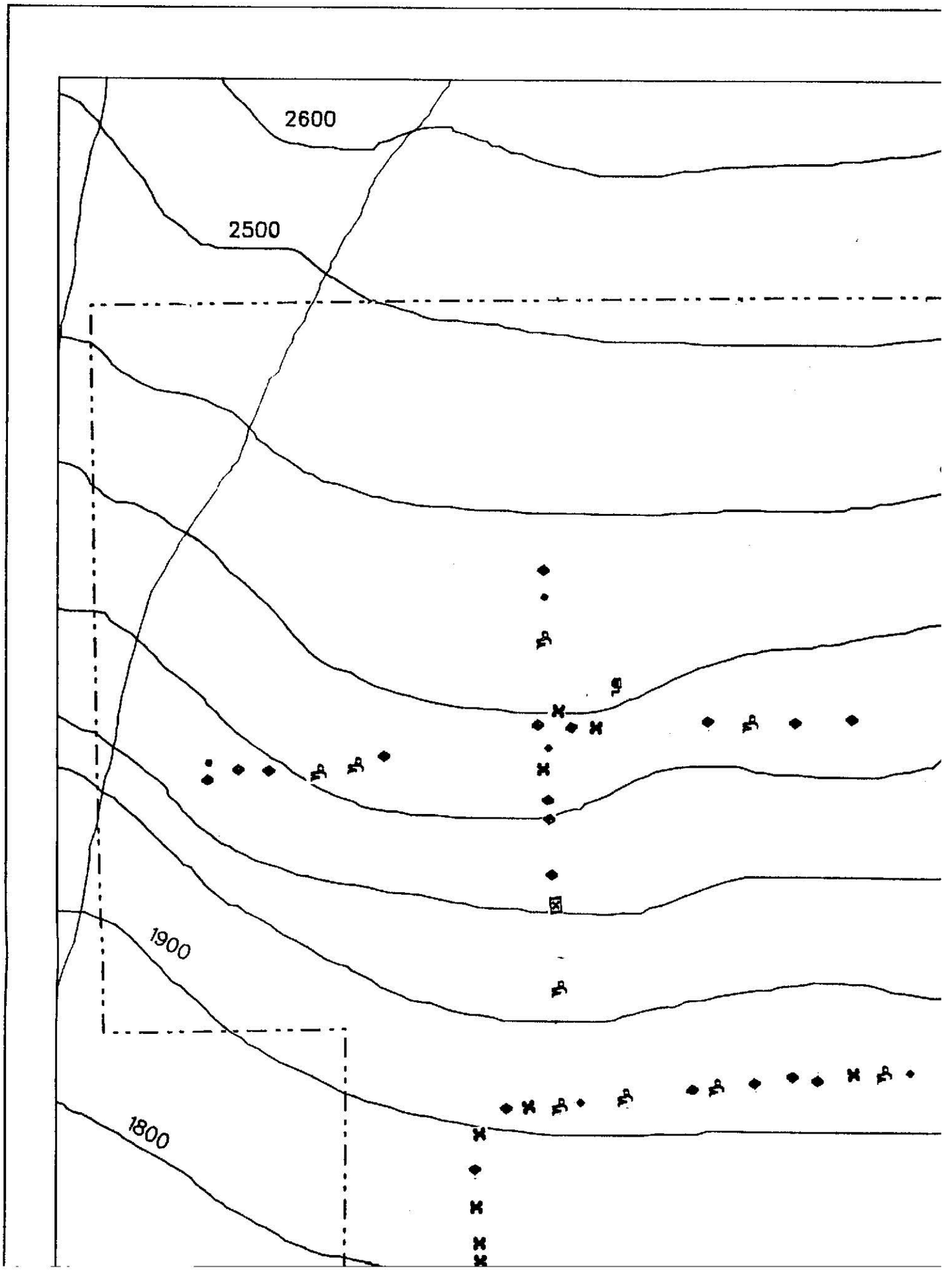
5.3 Wildlife in the Ross Lake Reserve

This reserve had a number of indications of wildlife use. The indicators were basically those of bears (*Ursus sp.*), deer (*Odocoileus sp.*), and small mammals. These indications and sightings are laid out in map form in Figure 18.

Indications of deer included tracks and scat. Deer tracks were spotted frequently throughout the reserve and were especially dense between plots 1 and 2. "Deer trails" or pathways where deer frequently walk were discovered winding through the reserve. These deer trails were quite common in and around plot 5. Scat also was found throughout the reserve, but more commonly on the rocky outcrops near plot 3. It may be that the deer use this rocky outcrop to warm themselves in the sunshine.

During the time of the survey a black bear (*Ursus americanus*) was spotted near the Ross Lake campground. However, the only indication of bear use in the reserve was a set of tracks spotted between plots 2 and 3.

A Douglas squirrel (*Tamiasciurus douglasii*) was spotted near plot 3 in the stand of Ponderosa pines. There were other indications of small mammal use, such as burrows and piles of cone scales. The piles of cone scales, as shown in Figure 7, were most often found on downed logs or stumps located throughout the reserve. Most of the burrows were found in the western part of the reserve.


2600
2500
1900
1800

5.4 Birds in the Ross Lake Reserve

One bird survey was done in this reserve with the help of B.C. Parks employee Al Grass, an experienced bird watcher. Mr. Grass was able to identify birds not only by sight but also by sound. Because the walk into the reserve did not begin until mid-morning, most of the birds identified were located before plot 2. This is because birds tend to sing less often in the middle of the day. The birds and the indications of their presence in the reserve are laid out in map form in Figure 19.

Sightings outside the reserve included:

- one male red-eyed vireo (*Vireo olivaceus*),
- four Swainson's thrushes (*Catharus ustulatus*)*,
- one Townsend's warbler (*Dendroica townsendi*)*,
- one winter wren (*Troglodytes troglodytes*)*,
- numerous robins (*Turdus migratorius*)*,
- one Hammond's flycatcher (*Empidonax hammondii*)*, and
- three mourning doves (*Zenaida macroura*).

(* denotes birds identified by their song)

Sightings inside the reserve included:

- one red-breasted nuthatch (*Sitta canadensis*)* at plot 2,
- one Pacific slope flycatcher* at plot 2.
- one common nighthawk (*Chordeiles minor*) in plot 3,
- one Accipiter* (Northern Goshawk, Cooper's Hawk, or Sharp-shinned Hawk) near plot 3, and
- three Dark-eyed Juncos (*Junco hyemalis*)* near plot 5.

(* denotes birds identified by their song)

Along with sightings (or "hearings") there were various other indications of bird use inside the reserve. The main indicators were feathers and wildlife trees with woodpecker or sapsucker holes. Wildlife trees with woodpecker holes were found in plots 1 and 4 and along the transect between plots 3 and 4. Also, a small pile of flicker feathers were spotted between plots 3 and 5; probably the result of predation by an Accipiter (forest hawk).

The recorded bird sightings and indications are useful only as a sampling of the birds found within this reserve. The collected information only tells us that the reserve seems to be an active habitat for various bird species. Further inventory studies could be more accurate in determining the numbers and health of the bird species populations.

5.5 Boundary Observations in the Ross Lake Reserve

The southern boundary of this reserve is at the Canada - United States border. Therefore, by using the line that runs parallel with the border (a 5 - 10 metre wide cleared line through the forest), the reserves southern boundary was not difficult to find. During the hike to the reserves southwest corner an ecological reserve sign was posted approximately 250 metres west of the reserves actual corner. The sign was left where it was because it was located on a trail that may enter the reserve.

The purpose of this reserve is to protect a stand of ponderosa pines and associated plants that are located on a sloping rock outcrop. According to aerial photos of the reserve this stand is found in the centre of the reserve and the survey verified this location on the ground. Therefore, the boundaries are in the proper location to protect the pine stand. The possibility of other stands of Ponderosa pines outside the reserve was not investigated.

5.6 Recommendations for the Ross Lake Reserve

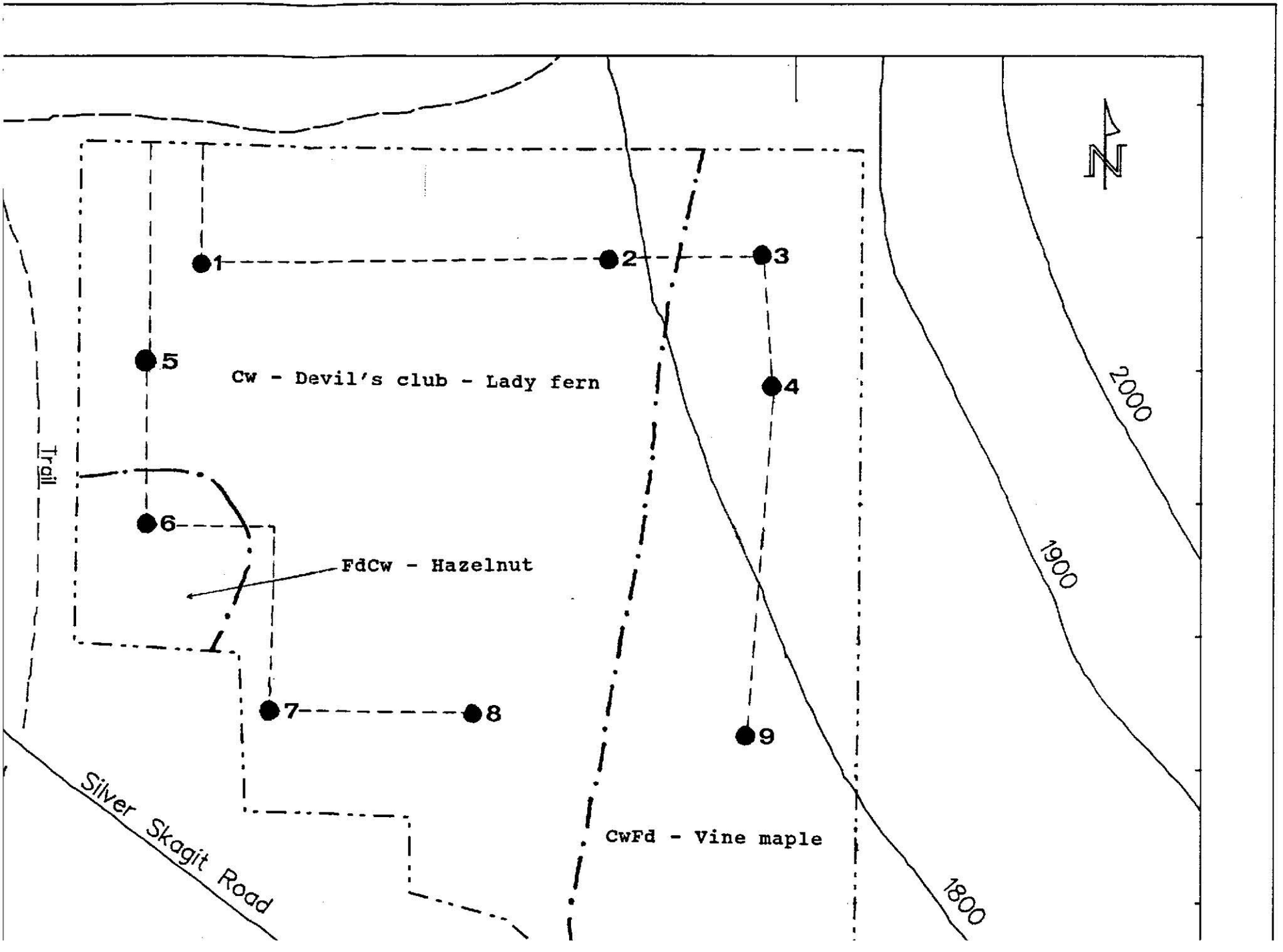
The purpose of this reserve is currently being served. However, the view from the opening at the Ponderosa Pine stand in the centre of the reserve was very scenic. This rock outcrop may become a popular spot for hikers if the Skagit Valley Recreation Area becomes a Provincial Park. Before a trail forms by accident, a more environmentally sensitive trail could be considered to best protect the purpose of the reserve. Since this ponderosa stand is so rare, interpretive signs should also be used along an established trail.

Further vegetation and wildlife studies should be conducted to learn about the progression of the reserves populations over time.

6.0 THE SKAGIT RIVER FOREST ECOLOGICAL RESERVE

The location of the nine plots placed in the Skagit River Forest Ecological Reserve are shown in Figure 19. Appendix 5 contains the vegetation, soil, and topographic data that was collected for the plots in this reserve.

The Skagit River Forest Ecological Reserve lies in the Interior Douglas-Fir zone in the "wet warm" subzone termed IDFww. Douglas-fir is the common tree species in this zone. Western red cedar and paper birch may occur on the wet sites while ponderosa pine may occur on dry sites. Trembling aspen and lodgepole pine are common seral species. Understory plants in this IDFww subzone include saskatoon, falsebox, twinflower, and prince's pine.


1
2
3
4
5
6
7
8
9
Cw - Devil's club - Lady fern
FdCw - Hazelnut
CwFd - Vine maple
Trail
Silver Skagit Road
2000
1900
1800
N

6.1 Existing Vegetation in Plots 1 to 9

6.1.1 Plot 1 (Skagit River Forest Ecological Reserve)

This plot was located in a flat area with deep loamy soil. There was an Ah layer present and an 8 cm thick mor humus form.

Douglas-fir, western red cedar, and black cottonwood were present in the plot. The western red cedar trees were main trees and had the highest percent cover. The Douglas-fir and black cottonwood trees were dominant trees.

The shrub layer consisted mainly of vine maple, devil's club, western red cedar shrubs, and coastal red elder. The herb layer was sparse and consisted mainly of vanilla leaf and queen's cup. Lady fern, spiny shield fern, step moss, and pointed leafy moss were all present in small amounts.

Most of the dead and down woody debris in this site was made up of pieces with 20 - 40 cm diameters or over 40 cm diameters.

Figure 20: Vegetation in Plot 1 of the Skagit River Forest Ecological Reserve

6.1.2 Plot 2 (Skagit River Forest Ecological Reserve)

This plot was on a flat site with deep sandy soil. There was an Ah horizon and a 7 cm thick moder humus form.

The stand was made up primarily of Douglas-fir with some western red cedar. The Douglas-firs in the plot were both main and dominant. The cedars were all dominant trees.

The shrub layer was sparse and consisted of vine maple and western red cedar shrubs. The herb layer varied in height with some herbs less than 30 cm tall and some 30 - 60 cm tall. The herb layer consisted mainly of vanilla leaf, one-leaved foamflower, starflowered solomon's seal, and stream violas. There was some queen's cup, broad-leaved starflower, sweet-scented bedstraw, and western trillium present in small amounts.

The ferns present had a low percent cover. They included sword fern, and spiny shield fern. Step moss was the only moss seen in this plot.

Twenty percent of the plot's ground was covered by dead and down woody debris. Of this total, 80% of the woody debris had a diameter less than 20 cm.

Figure 21: Vegetation in Plot 2 of the Skagit River Forest Ecological Reserve

6.1.3 Plot 3 (Skagit River Forest Ecological Reserve)

This lower slope plot had a slope gradient of one degree and a southwestern aspect. Its sandy soil was shallow, 0.5 - 1.0 m deep, with an Ah horizon and a 7 cm thick moder humus form.

The trees making up this mixed stand were western hemlock, western red cedar, Douglas-fir, and black cottonwood. The cottonwoods were the dominant trees in this stand with all other tree species being the main trees.

The main shrubs in this thick understory included Pacific yew shrubs, coastal red elder, vine maple, and thimbleberry.

The herb layer was not very dense and was made up mainly of starflowered solomon's seal, western trillium, and wild ginger. Pointed leafy moss covered 30% of the plot's ground.

Dead and down woody debris covered 15% of the plot's area and most of these woody pieces had a diameter less than 20 cm.

Figure 22: Vegetation in Plot 3 in the Skagit River Forest Ecological Reserve

6.1.4 Plot 4 (Skagit River Forest Ecological Reserve)

This lower slope plot had a three degree slope gradient with a southwestern aspect. The sandy soil was very shallow, 0.25 - 0.50 m deep, with a high coarse fragment content and a Ah horizon. The humus form was a 5 cm thick mor.

The main trees were western hemlock and western red cedar. Douglas-firs in this plot were dominant trees. The western hemlock and the Douglas-firs had the highest percent covers, each around 50%.

The shrub layer consisted of vine maple, baldhip rose, thimbleberry, and black gooseberry. The herb layer included starflowered solomon's seal, wild ginger, stream violas, broad-leaved starflower, and queen's cup. Lady fern, step moss, and pointed leafy moss were present.

Fifty-five percent of the plot's ground was covered by woody debris. Of this total, about half of the pieces had diameters less than 20 cm and half had diameters over 20 cm.

6.1.5. Plot 5 (Skagit River Forest Ecological Reserve)

This plot was on a flat site with deep silty soil. An Ah horizon and an 8 cm thick moder humus form characterized this soil profile.

The stand in the plot consisted predominantly of western red cedar trees which played dominant and main tree roles. The Douglas-fir trees in the stand were considered main trees.

The shrub layer was made up predominantly of western hemlock shrubs, western red cedar shrubs, devil's club, vine maple, and coastal red elder. The herb layer was composed of vanilla leaf, one-leaved foamflower, starflowered solomon's seal, and queen's cup. Lady fern and spiny shield fern were abundant as was pointed leafy moss and rounded leafy moss.

Woody debris covered 10% of the plot's ground and consisted mainly of pieces with a diameter below 10 cm.

Figure 23: Vegetation in Plot 5 in the Skagit River Forest Ecological Reserve

6.1.6 Plot 6 (Skagit River Forest Ecological Reserve)

This plot was located in a lower slope position on a flat site. The loamy soil was shallow, 0.5 - 1.0 m deep, with an Ah horizon and a 10 cm thick mor humus form.

The stand was made up purely of western hemlock. These hemlocks were main trees with 70% cover. The shrub layer was dense and consisted mainly of western hemlock shrubs, western red cedar shrubs, dull Oregon grape, and red rhododendron.

The herb layer contained prince's pine, bunchberry, queen's cup, and starflowered solomon's seal. Feather moss, pipecleaner moss, and step moss were present.

Forty percent of the plot's ground was covered in dead and down woody debris, most of which had a diameter between 20 - 40 cm.

6.1.7 Plot 7 (Skagit River Forest Ecological Reserve)

This plot was located on a flat site with deep loamy soil characterized by an Ah horizon. The humus form was a 5 cm thick mor.

The main and most abundant trees were western hemlocks and western red cedars, with the Douglas-fir acting as a less abundant, but dominant tree.

The shrub layer consisted mainly of vine maple, western red cedar shrubs, western hemlock shrubs, thimbleberry, dull Oregon grape, and twinflower.

The herb layer was sparse and included prince's pine, one-leaved foamflower, queen's cup, bunchberry, and false solomon's seal. Bracken and step moss were present.

Thirty-five percent of the ground was covered in dead and down woody debris. Of this total, most woody pieces had a diameter between 20 - 40 cm.

6.1.8 Plot 8 (Skagit River Forest Ecological Reserve)

This flat site had a two degree slope gradient and a southwestern aspect. Its silty soil was deep with an Ah horizon. The humus form was a 8 cm thick mor.

The stand consisted predominantly of Douglas-fir trees which were dominant trees in this plot. Western red cedar and western hemlock had lower percent cover and were considered main trees.

The shrub layer was made up mainly of western red cedar shrubs, vine maple, devil's club, and twinflower. The shrub layer was less than 2 m tall.

The herb layer was dense with some herbs less than 30 cm tall and some between 30 - 60 cm tall. The primary herbs were vanilla leaf and one-leaved foamflower. Other herbs included wild ginger and queen's cup. Spiny shield fern and lady fern were abundant. The mosses present were pointed leafy moss and step moss.

Twenty-five percent of the plot's ground was covered in dead and down woody debris, most of which had diameters between 20 - 40 cm.

6.1.9 Plot 9 (Skagit River Forest Ecological Reserve)

This plot was flat with extremely shallow sandy soil, less than 0.25 m deep, and characterized by an Ah horizon. The humus form was a 2.5 cm thick mull.

The stand was pure trembling aspen with a percent cover of 40%. The main shrub was thimbleberry with a 50% cover. The sparse herb layer contained many different herb species, each with a low percent cover. The herbs in this plot included cow parsnip, sweetscented bedstraw, pearly everlasting, tansy, and starflowered solomon's seal. There were no ferns noted. Pointed leafy moss was present but not abundant.

Only 5% of the plot's ground was covered in dead and down woody debris. Of this total, half of the woody pieces had a diameter of less than 10 cm and half had a diameter from 10 - 20 cm.

Figure 24: Vegetation in Plot 9 in the Skagit River Forest Ecological Reserve

6.2 Potential Vegetation in the Skagit River Forest Reserve

Site associations were determined for each plot on the basis of each plots nutrient and moisture regimes.

- Plot 1, 2, 5, 7 and 8 fit into the Cw-Devil's Club-Lady Fern site association,
- Plot 3, 4 and 9 fit into the CwFd-Vine Maple site association, and
- Plot 6 fits into the FdCw-Hazelnut site association.

These type lines are shown in Figure 19. The reserve slopes up slightly from its northwestern and southwestern edges towards the northeastern corner. Shawatum Creek runs from the northeast corner of the reserve down to the southern edge of the reserve and can be seen in Figure 2. Plots 1, 2, 5, 6 and 8 were west of Shawatum Creek and below the 1800 ft contour. Plot 9 was on the east side of the creek and below the 1800 ft contour. Plots 3 and 4 were east of Shawatum Creek and above the 1800 ft contour.

6.2.1 Cw-Devil's Club-Lady Fern Site Association

This site association is found on sites in the IDFww subzone which have a soil nutrient regime from rich to very rich and a soil moisture regime termed "fresh".

Plots 1, 2, 5, 7 and 8 all seemed to be on moist, rich sites. These sites may collect water as a result of their position. These plots were all on relatively flat ground at the base of the lower slope. Where water collects, nutrients also tend to collect.

Once a plant community designated as a Cw-Devil's club-Lady fern site association reaches its successional climax it should have significant amounts of western red cedar, devil's club, and lady fern.

Plots 1, 2, 5, 7 and 8 all had western red cedar in the stand and in the understory. Devil's club and lady fern were present in Plots 1, 5, 7 and 8. In Plot 2 lady fern was present, and devil's club was seen just beyond the plot edges. The plant communities represented in these plots appear to be at or very near their successional climax.

Plots 2 and 7 presented problems when site associations were being identified. The site associations determined through soil moisture and nutrient analysis, and through vegetation analysis did not match.

Plot 2 had a drier soil moisture regime than what would be found in a Cw-Devil's Club-Lady Fern site association. The moisture regime indicated the site should be in the Fd-Douglas Maple-Fairybells site association. The vegetation present, however, did not match well with what would be expected for a Fd-Douglas Maple-Fairybells site association. The Cw-Devil's Club-Lady Fern site associaton was chosen since the plot's vegetation corresponded well with that listed in the Vegetation Table (Green et al., 1993) under IDFww/06.

The vegetation in Plot 7 corresponded well with that described for a Cw-Devil's Club-Lady Fern site association. The soil nutrient and moisture regimes suggested a FdCw-Hazelnut site association. It is likely that the plant community, in which Plot 7 was located, is borderline between the Cw-Devil's Club-Lady Fern site association and the FdCw-Hazelnut site association found at Plot 6.

6.2.2 CwFd-Vine Maple Site Association

This site association tends to occur in the IDFww subzone in areas that have "slightly dry" soil moisture regimes and rich to very rich soil nutrient regimes.

Plot 3, 4 and 9 fit into the CwFd-Vine Maple site association. These plots had a higher elevation than the other plots in this reserve. The soils in Plot 3, 4 and 9 were shallower than in the other plots. These factors probably contribute to the "slightly dry" soil moisture regime characteristic of areas in the CwFd-Vine Maple site association. Nutrients may be delivered to these plots from upslope. Plots 3 and 4 were located fairly close to Shawatum Creek which may supply some moisture and nutrients to the sites.

An area assigned to the CwFd-Vine Maple site association should have, upon reaching its successional climax, a stand composed mainly of western red cedar and Douglas-fir trees, with vine maple in the understory and lower canopy.

Plot 3 and 4 had Douglas-fir, western red cedar, and vine maple present. The plant communities in the areas where these two plots were located are probably at or near their successional climax.

The stand on Plot 9 was made up entirely of trembling aspen. The understory did include some vine maple, but was made up mainly of thimbleberry. No coniferous seedlings were noticed in the understory. It is expected that over time the aspen will be replaced by western red cedar and Douglas-fir.

6.2.3 FdCw-Hazelnut Site Association

This site association tends to occur in the IDFww subzone in areas that have "moderately dry" soil moisture regimes and very poor to medium soil nutrient regimes.

In the FdCw-Hazelnut site association the plant community at its successional climax should have Douglas-fir, western red cedar and hazelnut trees present.

The stand in Plot 6 was made up of western hemlock trees with some young western red cedar and western hemlock trees in the understory. There was no hazelnut found in this plot. The site on which the plot was located is probably still approaching its successional climax.

6.3 Wildlife in the Skagit River Forest Reserve

This reserve appeared to be an excellent area for wildlife, as the number of wildlife sightings and indications was high. The primary wildlife users were mule deer (*Odocoileus hemionus*), black bears (*Ursus americanus*), and small mammals. Indications that raccoons (*Procyon lotor*) and coyotes (*Canis latrans*) use the area were also found. These sightings and indicators are laid out in map form in Figure 26. Sightings or indicators found beyond the reserve boundaries were also noted if they represented what might occur inside the reserve.

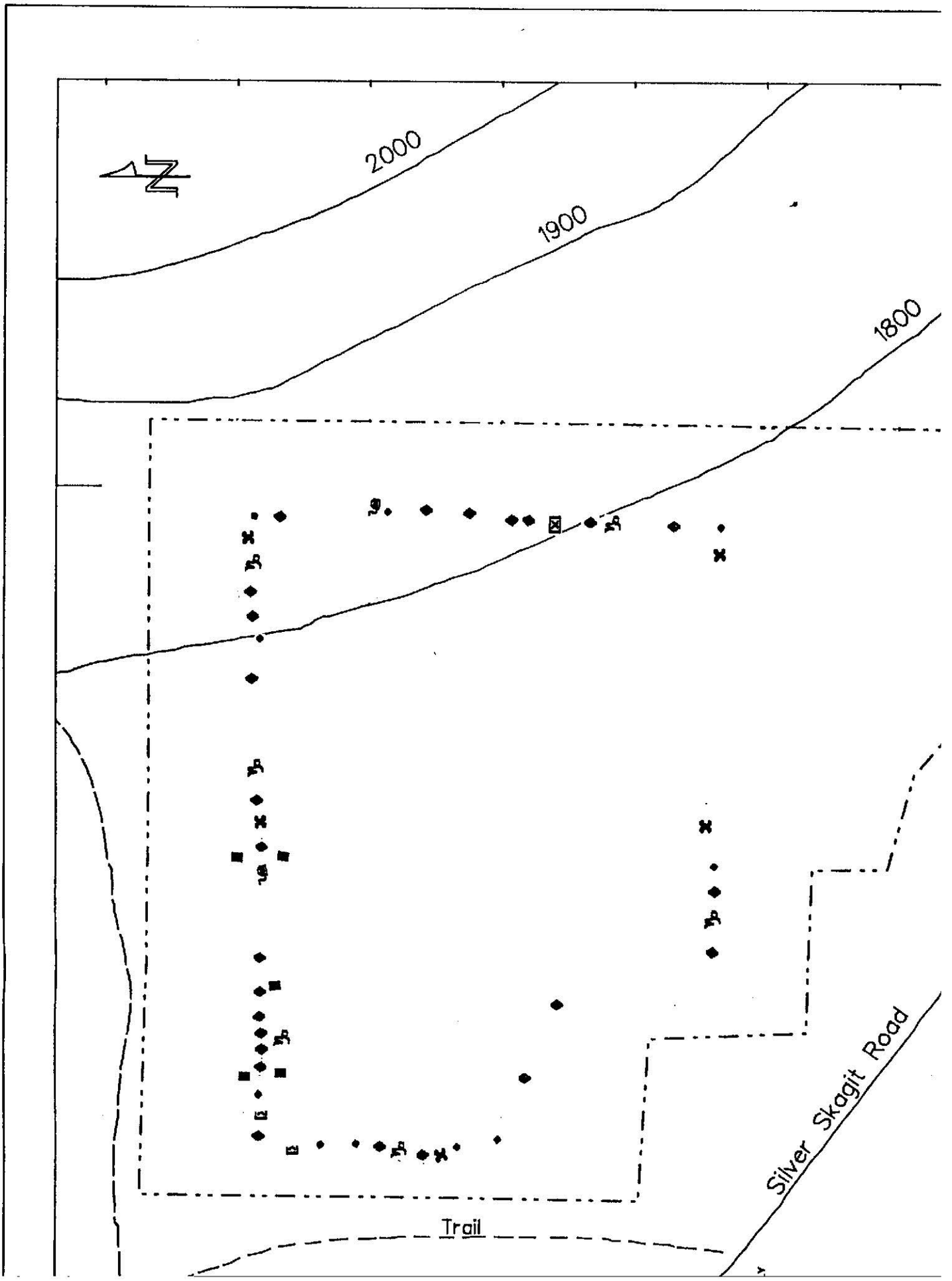
Indications and sightings of wildlife use outside the reserve included:

- deer (*Odocoileus sp.*) tracks along the logging road at the north boundary of the reserve,
- two sightings of black bears (*Ursus americanus*) along the Silver Skagit Road near the reserve,
- three to five sightings of mule deer (*Odocoileus hemionus*) along the Silver Skagit Road near the reserve, and
- numerous sightings of Douglas Squirrels (*Tamiasciurus douglasii*) and chipmunks (*Eutamias sp.*) along the Silver Skagit Road and the logging road leading up to the reserve boundary.

Inside the reserve indications and sightings of deer were abundant. The main indicators were of course tracks and scat (feces). These were found to be the most dense in the west side of the reserve, though they were found throughout. Another noted indicator was evidence of grazing and browsing on the leaves of herbs and shrubs. These bites out of leaves were again found to be more frequent in the west side of the reserve. Sightings of Mule Deer were restricted to in and around plots 1 and 2. The deer would enter the plots as singles or in groups of two or three. It also was noted that the deer showed no signs of being afraid of humans.

The only indication of bears in the reserve were tracks found on the transect between plots 4 and 9. It would still be reasonable to conclude that this reserve is an active black bear (*Ursus americanus*) habitat due to the number of bear sightings just outside the reserve.

Indications of other large mammals were limited to single sightings of both coyote (*Canis latrans*) tracks and raccoon (*Procyon lotor*) tracks.


2000
1900
1800
Trail
Silver Skagit Road

The main indicators of small animals were piles of Douglas-fir and western hemlock cone scales and burrowed holes. Burrows were found in plots 4, 5, 6, and 8. The most dense area of burrowed holes was in plot 4, where a small vole-like mammal was spotted at a distance. Plot 4 also had a great number of the cone scale piles throughout. No clear pattern showed up in the locations of small mammal indicators.

The reserve seems to have very suitable habitat characteristics for wildlife and especially deer. Further inventory studies could provide more detailed information on the populations of species within the reserve.

6.4 Birds in the Skagit River Forest Reserve

A number of bird surveys occurred in this reserve, but the findings were not extensive. Due to a lack of experience in identifying bird songs and the inability to see the birds in the dense tree canopies, the team recorded a limited sampling of birds. During the actual bird surveys in the early morning (4:00 am) all of the birds were above visible range and out of the range of the micro-cassette recorder. Therefore, all of the sightings of birds were done while walking the transect or doing vegetation plots. All of the data collected on birds identified or indications of their presence is in map form in Figure 26.

The birds that were identified include:

- one ruffed grouse (*Bonasa umbellus*) heard drumming while in plot 4,
- one varied thrush (*Ixoreus naevius*) heard in plot 5,
- one Stellar's jay (*Cyanocitta stelleri*) seen in plot 4,
- one Stellar's jay seen in plot 9,
- one red-tailed hawk (*Buteo jamaicensis*) heard in plot 9,
- one western wood pewee (*Contopus sordidulus*) seen in plot 9,
- one western tanager (*Piranga ludoviciana*) seen on the logging road outside the reserve,
- one Rufous hummingbird (*Selasphorus rufus*) seen on the logging road just outside the reserve, and
- two ruffed grouse heard drumming between plots 4 and 9.

The only other indications of bird use were woodpecker holes in wildlife trees as no nests or feathers were spotted.

Though not many species of birds were recorded during this survey, it would be reasonable to assume that there is quite a diverse community of bird species within the reserve. While doing the surveys in the early morning many different bird songs were heard, but they were not identified. Future bird surveys within the reserve could probably verify the health of the populations and their diversity.

6.5 Boundary Observations for the Skagit River Forest Reserve

The northwest corner of the reserve was the simplest to find using the old logging road as part of the border. The old ecological reserve signs were located 50 metres outside the reserve but were not removed as they still serve the purpose of informing the public that it is a sensitive area. However, a new sign was put up at the actual northwest corner.

The purpose of this reserve is to protect a representative portion of forest that is a transitional area between coastal and interior climates. The presence of a mixture of interior and coastal plant species would be the best evidence to verify that the reserve is in a transitional zone.

Coastal plant species such as western hemlock, Oregon grape, and sword fern were mixed together with interior species such as trembling aspen, and rhododendrons. This reserve does have a mixture of interior and coastal plant species. The reserve seems to be meeting its purpose within the boundaries as they currently stand.

6.6 Recommendations for the Skagit River Forest Reserve

This reserve seems to be excellent habitat for mule deer (*Odocoileus hemionus*) and other wildlife species, therefore public access should definitely not be encouraged. This reserve would probably serve best as a representative habitat for use by people interested only in the study of the transitional zone, wildlife species, or forest ecology. To protect the uniqueness of this area, hiking trails should be diverted around the reserve. Also in order to gain a better inventory of wildlife including birds, reptiles, and amphibians, further studies should be conducted.

7.0 GENERAL RECOMMENDATIONS

Table 1 shows the site associations determined for plots in the three ecological reserves in the Skagit Valley.

Table 1: Site associations identified for each of the ecological reserves studied

Site Association	Skagit River Forest	Ross Lake	Skagit River Cottonwoods
FdHw-Falsebox			///
BaCw-Devil's club			///
Ss-Salmonberry			///
Cw-Devil's club-Lady fern	///		
FdCw-Hazelnut	///	///	
CwFd-Vine maple	///	///	
Fd-Falsebox-Feathermoss		///	

When vegetation, soil and topography were being analyzed for each of the plots of the Ross Lake and the Skagit River Forest reserves in order to determine site associations, some problems were encountered.

The vegetation listed for each site association in the IDFww Vegetation Table of the Vancouver Forest Region guide did not include many of the plant species found in the field. Some of these plants included twinflower, queen's cup, wild ginger, black gooseberry, yarrow, western trillium and sweet-scented bedstraw.

Some of the site association names assigned to study sites include plants which were not seen in the field. The Skagit River Cottonwoods reserve contains a site association called "Ss - salmonberry". The survey crew did not find any Sitka spruce in this reserve. Although it is possible for these trees to be in the Skagit Valley they are near their eastern distribution limit. Sitka spruce is likely to be rare in this area compared to areas closer to the coast.

Another site association in the Cottonwoods Ecological Reserve was "BaCw - Devil's club". Amabilis fir was present in this reserve, but it was not abundant. Amabilis fir is also near its eastern distribution limit in the Skagit Valley. For this reason its occurrance in the Skagit Valley may be rare compared to areas closer to the coast.

The trembling aspen stand in Plot 9 of the Skagit River Forest Ecological Reserve was distinctly different from the coniferous stands of Plots 3 and 4. Plot 3, 4 and 9 all fit into the CwFd-Vine Maple site association though. In the guide for site identification in the Kamloops Forest Region (Lloyd et al.,1990) there is an EpAt-Thimbleberry-Falsebox site association. In this site association trembling aspen and paper birch are the climax species. Further research could be done in the trembling aspen stand of the Skagit River Forest Reserve to determine whether this plant community is really a step in the successional sequence or whether it is indeed the climax community.

It appears that the vegetation in the Skagit Valley is unique and although the subzones used take in transitional zones, this transitional zone seems slightly different. It is recommended that further vegetation inventories be done throughout the valley in order to build a database that could be used to refine the variants and site associations for transitional zones.

Problems were also encountered with one of the inventory methods, the Harvey method (Harvey, 1993), which was developed for BC Parks. In the soil section Harvey suggests measuring features of the humus layer, but these features do not seem to change between plots. Many of the descriptions on what to measure in the field were vague. The manual explains that certain observations should be recorded on the forms, but these forms do not have specific places for many of the observations to be filled in. The Harvey method would be easier to use if the forms where made up in "check list" form, as is done in the "Site Diagnosis" form in the Vancouver Forest Region guide. Then all of the terms used in Harvey's rating scales on the forms should be clearly defined in the manual.

In closing, it is recommended that studies be done on amphibians and small mammals in the ecological reserves of the Skagit Valley. Bird surveys carried out regularly throughout the year could provide a better list of the resident and migratory bird species using the reserves. A vegetation inventory in the fourth reserve, the Skagit River Rhododendrons, should also be undertaken.

9.0 LITERATURE CITED

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Appendix 1: List of Plant Species
Common names and botanical equivalents

Common Name	Latin Name
alder, mountain	*Alnus incana*
alumroot, small-flowered	*Heuchera micrantha*
bedstraw, sweet-scented	*Galium triflorum*
black cottonwood	*Populus balsamifera*
blue-eyed mary, sm.-flwd.	*Collinsia parviflora*
bracken	*Pteridium aquilinum*
bunchberry	*Cornus canadensis*
lichens	*Cladonia & Cladina sp.*
cow parsnip	*Heracleum sphondylium*
cranberry, high-bush	*Viburnum edule*
devil's club	*Oplopanax horridus*
dogwood, red-osier	*Cornus sericea*
Douglas-fir	*Pseudotsuga menziesii*
elder, coastal red	*Sambucus racemosa var. arbores*
electrified cat tail moss	*Rhytidiadelphus triquetrus*
enchanter's nightshade	*Circaea alpina*
fairyslipper	*Calypso bulbosa*
falsebox	*Paxistima myrsinites*
feather moss	*Kindbergia sp.*
horsetail, common	*Equisetum arvense*
fireweed	*Epilobium angustifolium*
foamflower, one-leaved	*Tiarella unifoliata*
goat's beard	*Aruncus dioicus*
gooseberry, black	*Ribes lacustre*
grand fir	*Abies grandis*
hawkweed, white-flowered	*Hieracium albiflorum*
honeysuckle, orange	*Lonicera ciliosa*
indian paintbrush, lobed	*Castilleja angustifolia*
kinnikinnick	*Arctostaphylos uva-ursi*
lady fern	*Athyrium filix-femina*
licorice fern	*Polypodium glycyrrhiza*
maidenhair fern	*Adiantum pedatum*
maple, Douglas	*Acer glabrum var. douglasii*
maple, vine	*Acer circinatum*
meadow rue	*Thalictrum occidentale*
oak fern	*Gymnocarpium dryopteris*
oceanspray	*Holodiscus discolor*
Oregon grape, dull	*Mahonia nervosa*
Pacific yew	*Taxus brevifolia*
parsley fern	*Cryptogramma crispa*
pearly everlasting	*Anaphalis margaritacea*
pinegrass	*Calamagrostis rubescens*
pipecleaner moss	*Rhytidiopsis robusta*
pointed leafy moss	*Plagiomnium insigne*
ponderosa pine	*Pinus ponderosa*

Common names and botanical equivalents

Common Name	Latin Name
prince's pine	*Chimaphila umbellata*
queen's cup	*Clintonia uniflora*
rattlesnake plantain	*Goodyera oblongifolia*
rhododendron, red	*Rhododendron macrophyllum*
rose sp.	*Rosa sp.*
rose, baldhip	*Rosa gymnocarpa*
round leafy moss	*Rhizomnium glabrescens*
salmonberry	*Rubus spectabilis*
saskatoon	*Amelanchier alnifolia*
Siberian miner's lettuce	*Claytonia sibirica*
fairybells, hooker's	*Disporum hookeri*
solomon's seal, false	*Smilacina rasamosa*
solomon's seal, starflwd.	*Smilacina stellata*
soopolallie	*Shepherdia canadensis*
spiny shield fern	*Dryopteris assimilis*
starflower, broad-leaved	*Trentalis latifolia*
step moss	*Hylocomium splendens*
strawberry sp.	*Fragaria sp.*
sword fern	*Polystichum munitum*
tansy	*Tanacetum vulgare*
thimbleberry	*Rubus parviflorus*
thistle sp.	*Cirsium sp.*
trembling aspen	*Populus tremuloides*
trillium, western	*Trillium ovatum*
twinflower	*Linnaea borealis*
twisted stalk	*Streptopus amplexifolius*
vanilla leaf	*Achlys triphylla*
viola, stream	*Viola glabella*
wall lettuce	*Mycelis muralis*
western hemlock	*Tsuga heterophylla*
western red cedar	*Thuja plicata*
paper birch	*Betula papyrifera*
wild ginger	*Asarum caudatum*
willow, Scouler's	*Salix scouleriana*
wintergreen, green	*Pyrola chlorantha*
wintergreen, one-sided	*Orthilia secunda*
wintergreen, pink	*Pyrola asarifolia*
wooly sunflower	*Eriophyllum lanatum*
yarrow	*Achillea millefolium*
	Rubus sp.
	Vaccinium sp.

Appendix 2: Explanation of the Vegetation Codes Used in the Harvey Method and in this Study

Terms Defined According to the Harvey Method (1993):

Veteran trees = significantly older and taller trees

Dominant trees = the tallest trees in the main canopy

Main trees = trees that make up the main canopy

Tall shrubs = shrubs, or young or stunted trees that are 2 to 10 m tall

Low shrubs = shrubs and young trees less than 2 m tall

Distribution Codes for Trees and Shrubs (Harvey, 1993):

1 - 1 or 2 individuals per strip
2 - 3 to 20 individuals scattered
3 - many individuals widely scattered
4 - many individuals densely scattered
5 - 1 or 2 patches of individuals
6 - over 2 patches of individuals

Distribution Codes for Herbaceous Plants, Ferns and Mosses (Harvey, 1993):

1 - 1 individual in the plot
2 - 2 to 5 individuals, scattered
3 - many individuals widely scattered
4 - many individuals densely distributed
5 - 1 or 2 small patches (each <.25 of the plot area)
6 - 2 to 5 patches (each <.25 of the plot)
7 - many patches of individuals

Tree Abbreviations Defined:

At = trembling aspen
Ba = amabilis fir
Cw = western red cedar
Ep = paper birch
Fd = Douglas-fir
Hw = western hemlock
Ss = Sitka spruce
Sxw = white spruce hybrid

Appendix 3: Vegetation, Soil and Topographic Data For the Cottonwoods Ecological Reserve

Table 2: Percent Cover of Tree Species in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Percent Cover				
Species present / Plot:	1	2	3	4	5
Trees:					
black cottonwood	5				
Douglas-fir		70	20	33	3
grand fir	15				
western hemlock		3			10
western red cedar	40		3	45	60

Table 3: Percent Cover of Shrub Species in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Percent Cover				
Species present / **Plot:**	**1**	**2**	**3**	**4**	**5**
Shrubs:					
Douglas-fir		15	<1		
grand fir	8				
Pacific yew	1	5			<1
western hemlock		4	5	<1	3
western red cedar	3	11	7	5	1
cranberry, high-bush	<1				
devil's club	1				1
dogwood, red-osier	16			<1	
falsebox		40	50	12	
goat's beard	<1				
gooseberry, black	<1		<1	1	
maple, Douglas		15			
maple, vine	30	13	30	10	2
oceanspray		6			
Oregon grape, dull		10	15	<1	
Rose sp.			<1		<1
salmonberry	2	<1			
saskatoon			<1	<1	
thimbleberry	12	1			
twinflower		4	7	<1	
Vaccinium sp.		<1	5	<1	
willow, Scouler's			1		

Table 4: Number of Live Trees Per Plot in Plots 1 to 5 in the Cottonwoods Ecologicial Reserve

	Number of Live Trees/Plot				
Species present / Plot:	1	2	3	4	5
Trees:					
black cottonwood	1				
Douglas-fir		25	8	18	1
grand fir	2				
western hemlock		1			1
western red cedar	9		1	13	13

Table 5: Number of Dead Trees Per Plot in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Number of Dead Trees/Plot				
Species present / Plot:	1	2	3	4	5
Trees:					
black cottonwood					
Douglas-fir		1		2	
grand fir					
western hemlock					
western red cedar					1

Table 6: Number of Shrubs Per Plot in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Number of Live Shrubs/Plot				
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**
Shrubs:					
Douglas-fir		10	5		
grand fir	3				
Pacific yew	1	2			2
western hemlock		4	5	1	5
western red cedar	8	6	10	15	2
cranberry, high-bush	10				
devil's club	12				9
dogwood, red-osier	26			2	
falsebox		300	500	80	
goat's beard	3				
gooseberry, black	14		6	45	
maple, Douglas		16			
maple, vine	19	5	40	15	9
oceanspray		8			
Oregon grape, dull		270	100	10	
rose sp.			6		1
salmonberry	30	2			
saskatoon			1	5	
thimbleberry	100	20			
twinflower		250	180	30	
Vaccinium sp.		6	25	4	
willow, Scouler's			3		

Table 7: Classification of Tree Species Present in the Plots According to whether they were Veteran, Dominant or Main Trees

	Veteran, Dominant or Main Trees				
Species present / Plot:	1	2	3	4	5
Trees:					
black cottonwood	D				
Douglas-fir		M	D	D	D
grand fir	M				
western hemlock		M			M
western red cedar	D		M	M	M

Table 8: Classification of Tree Species on the basis of Distribution within each Plot

	Distribution Code				
Species present / Plot:	1	2	3	4	5
Trees:					
black cottonwood	1				
Douglas-fir		3	2	2	1
grand fir	5				
western hemlock		1			1
western red cedar	2		1	2	2

Table 9: Height Classifications for Shrubs in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Low (< 2 m) or Tall (2 - 10 m) Shrubs				
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**
Shrubs:					
Douglas-fir		T,L	L		
grand fir	T,L				
Pacific yew	T	L			L
western hemlock		T,L	T,L	L	L,T
western red cedar	L	T	T,L	L	L
cranberry, high-bush	L				
devil's club	L				L
dogwood, red-osier	T			L	
falsebox		L	L	L	
goat's beard	L				
gooseberry, black	L		L	L	
maple, Douglas		T,L			
maple, vine	T,L	L	L	L	L,T
oceanspray		L			
Oregon grape, dull		L	L	L	
rose sp.			L		L
salmonberry	L	L			
saskatoon			L	L	
thimbleberry	L	L			
twinflower		L	L	L	
Vaccinium sp.		L	L	L	
willow, Scouler's			L		

Table 10: Classification of Shrub Species on the basis of Distribution within each Plot

	Distribution Codes				
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**
Shrubs:					
Douglas-fir		2	2		
grand fir	2				
Pacific yew	1	6			1
western hemlock		6	6	1	6
western red cedar	5	6	6	5	1
cranberry, high-bush	2				
devil's club					6
dogwood, red-osier	5			1	
falsebox		4	4	6	
goat's beard	5				
gooseberry, black	6		5	6	
maple, Douglas		6			
maple, vine	6	6	6	5	5
oceanspray		6			
Oregon grape, dull		6	6	5	
rose sp.			2		1
salmonberry	5	2			
saskatoon			1	5	
thimbleberry	5	2			
twinflower		3	3	2	
Vaccinium sp.	6	2	6	5	
willow, Scouler's			5		

Table 11: Percent Cover of Herb, Fern, Moss and Horsetail Species in Plots 1 to 5 in the Cottonwoods Ecological Reserve

	Percent Cover				
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**
Herbs:					
bedstraw, sweet-scented	<1			<1	<1
enchanter's nightshade	1				25
fairybells, Hooker's					<1
foamflower, one-leaved					10
hawkweed, white-flowered			<1		
meadow rue	<1				
prince's pine		<1	<1		
queen's cup					1
rattlesnake plantain			<1	<1	
Siberian miner's lettuce	<1				<1
solomon's seal, starflwd.	18				
starflower, broad-leaved	<1		<1		
trillium, western					<1
twisted stalk					<1
wall lettuce	<1				
wintergreen, one-sided			<1		
wintergreen, pink			<1		
Ferns, Horsetails and Mosses:					
lady fern	<1				30
licorice fern			<1	<1	
maidenhair fern					1
oak fern	1				20
spiny shield fern	<1				30
sword fern		1	1	1	
horsetail, common	<1				
electrified cat tail moss		40	1	2	1
feather moss		5		2	
pipecleaner moss				<1	
pointed leafy moss					10
rounded leafy moss					4
step moss		40	70	70	

Table 12: Height Classification of Herbs, Ferns and Horsetails of the Cottonwoods Ecological Reserve

	Low (<30 cm), Medium (30 - 60 cm) or High (>60 cm) Plants				
Species present / **Plot:**	**1**	**2**	**3**	**4**	**5**
Herbs:					
bedstraw, sweet-scented	L			L	L
enchanter's nightshade	L				L
fairybells, Hooker's					M
foamflower, one-leaved					L
hawkweed, white-flowered			L		
meadow rue	M				
prince's pine		L	L		
queen's cup					L
rattlesnake plantain			L	L	
Siberian miner's lettuce	L				L
solomon's seal, starflwd.	L,M				
starflower, broad-leaved	L		L		
trillium, western					L
twisted stalk					L
wall lettuce	L				
wintergreen, one-sided			L		
wintergreen, pink			L		
Ferns and Horsetails					
lady fern	L,M				L,M
licorice fern			L	L	
maidenhair fern					M
oak fern	L				L
spiny shield fern	M				L,M
sword fern		M	L,M	L,M	
horsetail, common	M				

Table 13: Classification of Herbs, Ferns, Horsetails and Mosses on the Basis of Distribution within each Plot

	Distribution Codes				
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**
Herbs:					
bedstraw, sweet-scented	6			2	2
enchanter's nightshade	3				4
fairybells, Hooker's					2
foamflower, one-leaved					4
hawkweed, white-flowered			2		
meadow rue	2				
prince's pine		3	3		
queen's cup					3
rattlesnake plantain			5	5	
Siberian miner's lettuce	6				2
solomon's seal, starflwd.	6				
starflower, broad-leaved	1		2		
trillium, western					2
twisted stalk					2
wall lettuce	6				
wintergreen, one-sided			6		
wintergreen, pink			6		
Ferns, Horsetails and Mosses:					
lady fern	6				4
licorice fern			2	5	
maidenhair fern					5
oak fern	6				7
spiny shield fern	2				4
sword fern		6	5	5	
horsetail, common	5				
electrified cat tail moss		7	3	7	7
feather moss		7		6	
pipecleaner moss				6	
pointed leafy moss					7
rounded leafy moss					7
step moss		7	4	4	

Table 14: Percent of Ground Covered by Dead and Down Woody Debris in in the Skagit River Cottonwoods Ecological Reserve Plots

	Total Percent Ground Cover in Woody Debris	% of the Total with a Diameter of:			
		< 10cm	10 - 20cm	20 - 40cm	> 40cm
Plot 1	15	70	3	20	7
Plot 2	50	50	50	0	0
Plot 3	2	75	25	0	0
Plot 4	35	17	45	38	0
Plot 5	7	40	7	53	0

Table 15: Number of Pieces, Average Length and Extent of Decay of Dead and Down Woody Debris in the Plots of the Skagit River Cottonwoods Ecological Reserve

Dead and Down Woody Debris:	20 - 40 cm diameter			Over 40 cm diameter		
	number of pieces	average length (m)	extent of decay	number of pieces	average length (m)	extent of decay
Plot 1	5	3	moderate	1	15	moderate
Plot 2	0			0		
Plot 3	0			0		
Plot 4	27	5 - 10	moderate to high	0		
Plot 5	5	6 - 10	moderate	0		

Table 16: Tree Ages, Heights and Diameters Measured in the Plots of the Skagit River Cottonwoods Ecological Reserve

	Species	Age (years)	Height (m)	Diameter at Breast Height (cm)
Plot 1				
Tree 1	w. red cedar	>65	38	65
Tree 2	w. red cedar	>65	43	63
Tree 3	bl cottonwood			145
Plot 2				
Tree 1	Douglas-fir	32	35	16
Tree 2	Douglas-fir	50	40	27
Plot 3				
Tree 1	Douglas-fir	210	45	52
Plot 4				
Tree 1	Douglas-fir	80	25	28
Tree 2	w. red cedar	103	30	29
Plot 5				
Tree 1	w. hemlock	95	54	57

Table 17: Soil Features For Plots 1 to 5 in the Skagit River Cottonwoods Ecological Reserve

Soil Feature	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth	deep (>1m)	extremely shallow (<.25m)	extremely shallow (<.25m)	extremely shallow (<.25m)	very shallow (.25-.5m)
Texture	sandy	no mineral soil	no mineral soil	no mineral soil	loamy
Coarse Fragment Content	<10%	>70%	>70%	>70%	<10%
Seepage or groundwater table	no	no	no	no	no
Gleyed horizons	no	no	no	no	no
Flooding	yes	no	no	no	no
Soil color	dark	no mineral soil	no mineral soil	no mineral soil	medium
A horizon	could not distinguish	no mineral soil	no mineral soil	no mineral soil	2cm thick Ah
Soil porosity	high	(talus) high	(talus) high	(talus) high	moderate
Humus form thickness	(litter only) 1.0cm	4.0cm	4.0cm	4.5cm	3.0cm
Humus form classification	-	Mor	Mor	Mor	Mull

Table 18: General Features of Plot 1 to 5 in the Skagit River Cottonwoods Ecological Reserve

Feature	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Elevation (feet ASL)	1940	2100	2050	1940	1940
Slope gradient	1 degree	30 degrees	36 degrees	40 degrees	2 degrees
Slope aspect	northwest	northwest	northwest	northwest	northwest
Slope position	flat	middle	middle	middle	depression
Slope shape	straight	straight	convex	straight	concave

Appendix 4: Vegetation, Soil and Topographic Data for the Ross Lake Ecological Reserve

Table 19: Percent Cover of Tree Species in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Percent Cover					
Species present / Plot:	1	2	3	4	5	6
Trees:						
Douglas-fir	12		20	45	70	6
paper birch	7	10				
ponderosa pine			1			
western hemlock		30		5		30
western red cedar	70	40		20		30

Table 20: Percent Cover of Shrub Species in Plots 1 to 6 of the Ross Lake Ecological Reserve

	Percent Cover					
Species present / Plot:	1	2	3	4	5	6
Shrubs:						
Douglas-fir		3			1	
Pacific yew						<1
western hemlock	<1	10		3	1	1
western red cedar	10	10		7	1	3
alder, mountain					1	3
devil's club	<1					
falsebox			20	4	2	12
honeysuckle, orange					22	<1
kinnikinnick			2			
maple, Douglas					7	
maple, vine	<1	<1		15		6
oceanspray					1	<1
Oregon grape, dull	<1	40	<1	30	80	35
paper birch				<1		
rose sp.		2		<1	<1	1
saskatoon			3		1	<1
soopolallie						4
twinflower		1		<1	1	1
Vaccinium sp.		<1			<1	<1

Table 21: Number of Live Trees per Plot in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Number of Live Trees/Plot					
Species present / Plot:	1	2	3	4	5	6
Trees:						
Douglas-fir	7		10	26	23	6
paper birch	3	8				
ponderosa pine			1			
western hemlock		9		3		5
western red cedar	15	16		9		10

Table 22: Number of Dead Trees Per Plot in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Number of Dead Trees/Plot					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Trees:						
Douglas-fir			1	4	2	1
paper birch		1				
ponderosa pine						
western hemlock				1		2
western red cedar	1					

Table 23: Number of Shrubs Per Plot in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Number of Live Shrubs/Plot					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Shrubs:						
Douglas-fir		7			3	
Pacific yew						1
western hemlock	1	27		2	2	3
western red cedar	20	22		16	2	8
alder, mountain					1	4
devil's club	5					
falsebox			600	28	200	170
honeysuckle, orange					200	5
kinnikinnick			110			
maple, Douglas					4	
maple, vine	2	4		40		25
oceanspray					20	3
Oregon grape, dull	25	800	3	900	2000	350
paper birch				1		
rose sp.		18		7	25	40
saskatoon			34		6	25
soopolallie						50
twinflower		90		20	300	30
Vaccinium sp.		2			1	3

Table 24: Classification of the Tree Species Present in the Plots According to whether they were Veteran, Dominant or Main Trees

	Veteran, Dominant or Main Trees					
Species present / Plot:	1	2	3	4	5	6
Trees:						
Douglas-fir	D,V		D	M,D	D	M,D
paper birch	M	M				
ponderosa pine			D			M,D
western hemlock		M		M		
western red cedar	D	M,D		M		M

Table 25: Classification of Tree Species on the basis of Distribution within each Plot

	Distribution Code					
Species present / Plot:	1	2	3	4	5	6
Trees:						
Douglas-fir	2		5	2	3	6
paper birch	5	5				
ponderosa pine			1			
western hemlock		2		2		2
western red cedar	2	2		2		2

Table 26: Height Classification for Shrubs in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Low (< 2 m) or Tall (2 - 10 m) Shrubs					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Shrubs:						
Douglas-fir		L			L	
Pacific yew						L
western hemlock	L	L,T		L,T	L	L
western red cedar	L	L,T		L	L	L
alder, mountain					L	L
devil's club	L					
falsebox			L	L	L	L
honeysuckle, orange					L	L
kinnikinnick			L			
maple, Douglas					L,T	
maple, vine	L	L		L		L
oceanspray					L	L
Oregon grape, dull	L	L	L	L	L	L
paper birch				L		
rose sp.		L		L		L
saskatoon			L		L	L
soopolallie						L
twinflower		L		L	L	L
Vaccinium sp.		L			L	L

Table 27: Classification of Shrub Species on the basis of Distribution within each Plot

	Distribution Code					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Shrubs:						
Douglas-fir		5			2	
Pacific yew						1
western hemlock	1	6		1	1	2
western red cedar	2	6		2	1	6
alder, mountain					1	5
devil's club	5					
falsebox			5	5	3	6
honeysuckle, orange					3	5
kinnikinnick			6			
maple, Douglas					2	
maple, vine	1	5		6		6
oceanspray					5	5
Oregon grape, dull	6	4	5	4	4	4
paper birch				1		
rose sp.		5		2	3	2
saskatoon			6		6	2
soopolallie						5
twinflower		3		5	6	3
Vaccinium sp.		1			1	2

Table 28: Percent Cover of Herb, Fern, Moss, Grass and Lichen Species in Plots 1 to 6 in the Ross Lake Ecological Reserve

	Percent Cover					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Herbs:						
alumroot, small flowered			<1			
blue-eyed mary, sm.-flwd			<1			
foamflower, one-leaved	<1					
indian paintbrush, lobed			<1			
prince's pine		2	<1	<1	6	<1
queen's cup		<1				
rattlesnake plantain	<1				<1	<1
solomon's seal, false		<1				
starflower, broad-leaved	<1	<1			<1	
strawberry sp.			1			
trillium, western	<1					<1
twisted stalk	<1					
wild ginger	<1					
wintergreen, green				1		
wooly sunflower			<1			
yarrow			2			
Grasses, Ferns, Lichens and Mosses:						
pinegrass			30			
Cladonia & Cladina sp.			5			
bracken						<1
parsley fern			1			
spiny shield fern	<1					
sword fern	<1					
electrified cat tail moss		<1			4	1
feather moss		6		3		
pipecleaner moss				3		
pointed leafy moss	10			<1		
step moss	1	15			5	3

Table 29: Height Classification of Herbs, Ferns and Grasses of the Ross Lake Ecological Reserve

	Low (<30 cm), Medium (30 - 60 cm) or High (>60 cm) Plants					
Species present / **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Herbs:						
alumroot, small flowered			M			
blue-eyed mary, sm.-flwd			L			
foamflower, one-leaved	L					
indian paintbrush, lobed			L			
prince's pine		L	L	L	L	L
queen's cup		L				
rattlesnake plantain	L				L	L
solomon's seal, false		L				
starflower, broad-leaved	L	L			L	
strawberry sp.			L			
trillium, western	L,M					L
twisted stalk	L					
wild ginger	L					
wintergreen, green				L		
wooly sunflower			M			
yarrow			L,M			
Ferns and Grasses:						
pinegrass			L,M			
bracken						H
parsley fern			L			
spiny shield fern	L					
sword fern	L					

Table 30: Classification of Herbs, Ferns, Grasses, Mosses and Lichens on the basis of Distribution within each Plot

	Distribution Codes					
Species present **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**
Herbs:						
alumroot, small flowered			5			
blue-eyed mary, sm.-flwd			2			
foamflower, one-leaved	2					
indian paintbrush, lobed			2			
prince's pine		3	2	5	3	3
queen's cup		5				
rattlesnake plantain	1				6	5
solomon's seal, false		5				
starflower, broad-leaved	5	2			3	
strawberry sp.			3			
trillium, western	5					1
twisted stalk	5					
wild ginger	6					
wintergreen, green				3		
wooly sunflower			2			
yarrow			3			
Grasses, Ferns, Lichens and Mosses:						
pinegrass			4			
Cladonia & Cladina sp.			7			
bracken						5
parsley fern			3			
spiny shield fern	5					
sword fern	6					
electrified cat tail moss		5			7	7
feather moss		5		6		
pipecleaner moss				6		
pointed leafy moss	7			6		
step moss	7	6			7	7

Table 31: Percent of Ground Covered by Dead and Down Woody Debris in the Ross Lake Ecological Reserve Plots

	Total Percent Ground Cover in Woody Debris	% of the Total with a Diameter of:			
		< 10cm	10 - 20cm	20 - 40cm	> 40cm
Plot 1	30	45	20	35	0
Plot 2	15	35	30	35	0
Plot 3	1	70	25	5	0
Plot 4	35	35	40	25	0
Plot 5	5	30	40	20	10
Plot 6	30	10	15	55	20

Table 32: Number of Pieces, Average Length and Extent of Decay of Large Diameter Woody Debris in the Plots of the Ross Lake Ecological Reserve

Dead and Down Woody Debris:	20 - 40 cm diameter			Over 40 cm diameter		
	number of pieces	average length (m)	extent of decay	number of pieces	average length (m)	extent of decay
Plot 1	6	5	high	0		
Plot 2	17	5	low - high	0		
Plot 3	1	6	low	0		
Plot 4	14	5	moderate - high	0		
Plot 5	12	6	moderate	5	7	high
Plot 6	16	10	moderate - high	4	4 -7	moderate - high

Table 33: Representative Ages, Heights and Diameters for Tree Species in the Ross Lake Ecological Reserve Plots

	Species	Age (years)	Height (m)	Diameter at Breast Height (cm)
Plot 1				
Tree 1	w. red cedar		43	63
Tree 2	w. red cedar		34	54
Plot 2				
Tree 1	paper birch	104	22	32
Tree 2	western hemlock	43	32	42
Plot 3				
Tree 1	Douglas-fir	90	24	43
Tree 2	ponderosa pine	75	27	41
Plot 6				
Tree 1	Douglas-fir		39	53
Tree 2	western hemlock	67	14	20
Tree 3	w. red cedar		24	38

Table 34: Soil Features for Plots 1 to 6 in the Ross Lake Ecological Reserve

Soil Feature	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Depth	very shallow (.25-.5m)	very shallow (.25-.5m)	extremely shallow (<.25m)	very shallow (.25-.5m)	shallow (.5-1m)	shallow (.5-1m)
Texture	loamy	sandy	silty	sandy	sandy	sandy
Coarse Fragment Content	35-70%	35-70%	>70%	35-70%	10-35%	10-35%
Seepage or groundwater table	no	no	no	no	no	no
Gleyed horizons	no	no	no	no	no	no
Flooding	no	no	no	no	no	no
Soil color	dark	light	dark	medium	medium	medium
A horizon	Ah	(2.5cm) Ae	(0.5cm) Ah	(4.0cm) Ae	(2.0cm) Ah	(2.0cm) Ah
Soil porosity	moderate	high	high	moderate	moderate	moderate
Humus form thickness	10.0 cm	9.0 cm	6.5 cm	6.0 cm	5.0 cm	6.0 cm
Humus form classification	Mor	Mor	Mull	Mor	Mor	Mor

Table 35: General Features of Plots 1 to 6 in the Ross Lake Ecological Reserve

Feature	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Elevation (feet ASL)	1950	1930	2280	2230	2110	2420
Slope gradient	14 degrees	8 degrees	28 degrees	25 degrees	7 degrees	27 degrees
Slope aspect	west	west	west	west	west	west
Slope position	lower	(terrace) lower	middle	middle	middle	middle
Slope shape	straight	straight	straight	straight	straight	convex

Appendix 5: Vegetation, Soil and Topographic Data for the Skagit River Forest Ecological Reserve

Table 36: Percent Cover of Tree Species in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Percent Cover								
Species present / **Plot:**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Trees:									
black cottonwood	20		20						
Douglas-fir	35	60	50	50	30		5	50	
trembling aspen									40
western hemlock	<1		10	60		70	45	5	
western red cedar	60	30	30	15	60		20	20	

Table 37: Percent Cover of Shrub Species in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Percent Cover								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Shrubs:									
grand fir							<1		
Pacific yew			20		<1	<1			
western hemlock					4	50	5		
western red cedar	15	4	1		2	20	20	5	
devil's club	10				20		1	7	<1
elder, coastal red	10		1		5				<1
gooseberry, black			1	5					<1
maple, Douglas									<1
maple, vine	30	3	20	15	1	1	50	4	1
Oregon grape, dull				<1	<1	25	5	<1	<1
rhododendron, red						4			
rose, baldhip				2	<1	2	2	<1	
Rubus sp.								<1	
saskatoon			<1						
thimbleberry			30	5			6		50
twinflower							7	5	
Vaccinium sp.						4			

Table 38: Number of Live Trees per Plot in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Number of Live Trees/Plot								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Trees:									
black cottonwood	4		4						
Douglas-fir	8	10	40	3	2		1	13	
trembling aspen									27
western hemlock			2	17		50	20	1	
western red cedar	12	10	9	3	7		6	13	

Table 39: Number of Dead Trees per Plot in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Number of Dead Trees/Plot								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Trees:									
black cottonwood	1								
Douglas-fir		1	30		1			1	
trembling aspen									8
western hemlock	1			8		5	1	1	
western red cedar									

Table 40: Number of Shrubs per Plot in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Number of Shrubs/Plot								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Shrubs:									
grand fir							3		
Pacific yew			6		3	3			
western hemlock					5	100	17		
western red cedar	4	18	1		7	25	19	12	
devil's club	20				100		10	50	2
elder, coastal red	3		2		8				3
gooseberry, black			9	25					6
maple, Douglas									3
maple, vine	12	6	6	5	2	5	50	12	12
Oregon grape, dull				3	2	170	55	4	1
rhododendron, red						10			
rose, baldhip				10	3	30	24	2	
Rubus sp.								4	
saskatoon			2						
thimbleberry			50	10			40		950
twinflower							80	60	
Vaccinium sp.						15			

Table 41: Classification of the Tree Species Present in the Plots According to whether they were Veteran, Dominant or Main Trees

	Veteran, Dominant or Main Trees								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Trees:									
black cottonwood	D		D						
Douglas-fir	D	D	M	D	M		D	D	
trembling aspen									D
western hemlock			M	M		M	M	M	
western red cedar	M	D,M	M	M	D,M		M	M	

Table 42: Classification of Tree Species on the basis of Distribution within each Plot

	Distribution Codes								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Trees:									
black cottonwood	2		2						
Douglas-fir	2	2	4	5	1		1	2	
trembling aspen									3
western hemlock	1		1	2		3	2	1	
western red cedar	2	2	2	2	2		2	2	

Table 43: Height Classification for Shrubs in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

	Low (< 2 m) or Tall (2 - 10 m) Shrubs								
Species present Plot:	1	2	3	4	5	6	7	8	9
Shrubs:									
grand fir							L		
Pacific yew			T		L	L			
western hemlock					T	L,T	L,T		
western red cedar	T	L,T	L		L,T	L,T	T	L	
devil's club	L				L		L	L	L
elder, coastal red	L		L		L				L
gooseberry, black			L	L					L
maple, Douglas									L
maple, vine	T	L,T	T	T	L,T	L	T	L	L
Oregon grape, dull				L	L	L	L	L	L
rhododendron, red						L			
rose, baldhip				L	L	L	L	L	
Rubus sp.								L	
saskatoon			L						
thimbleberry			L	L			L		L
twinflower							L	L	
Vaccinium sp.						L			

Table 44: Classification of Shrub Species on the basis of Distribution within each Plot

	Distribution Codes								
Species present / Plot:	1	2	3	4	5	6	7	8	9
Shrubs:									
grand fir							5		
Pacific yew			5		5	2			
western hemlock					5	3	2		
western red cedar	2	5	1		2	3	2	2	
devil's club	5				3		5	4	1
elder, coastal red	5		5		5				2
gooseberry, black			5	6					6
maple, Douglas									5
maple, vine	6	5	6	5	5	5	6	6	6
Oregon grape, dull				5	1	3	6	5	1
rhododendron, red						5			
rose, baldhip				5	2	2	6	1	
Rubus sp.								5	
saskatoon			1						
thimbleberry			5	5			5		4
twinflower							3	6	
Vaccinium sp.						6			

Table 45: Percent Cover of Herb, Fern and Moss Species in Plots 1 to 9 in the Skagit River Forest Ecological Reserve

Species present / Plot:	Percent Cover								
	1	2	3	4	5	6	7	8	9
Herbs:									
bedstraw, sweet-scented	<1	<1	<1	<1	<1		<1	<1	<1
bunchberry						3	2		
cow parsnip									4
fairyslipper						<1			
fireweed			<1						
foamflower, one-leaved		3			60		2	60	
meadow rue									<1
pearly everlasting									<1
prince's pine						25	2		
queen's cup	3	<1	<1	4	4	3	2	2	
rattlesnake plantain								<1	
Siberian miner's lettuce					<1				
solomon's seal, false							<1	<1	
solomon's seal, starflwd.	<1	2	20	3	6	1		<1	1
starflower, broad-leaved		<1	<1	4	<1		<1	<1	<1
strawberry sp.			<1						1
tansy									<1
thistle sp.									<1
trillium, western	<1	<1	3	<1	<1		<1	<1	
vanilla leaf	15	15		<1	4	<1	<1	20	
viola, stream	<1	2	<1	4					
wild ginger			2	5				2	
wintergreen, green						<1			
Ferns and Mosses:									
bracken							1		
lady fern	4	<1		2	15		<1	20	
spiny shield fern	2	<1			10		<1	17	
sword fern	<1	<1	<1					<1	
electrified cat tail moss			<1		<1				
feather moss						10			
pipecleaner moss						4			
pointed leafy moss	<1		30	20	20			3	<1
round leafy moss					5				
step moss	<1	3		2	<1	30	10	3	

Table 46: Height Classification of Herbs and Ferns of the Skagit River Forest Ecological Reserve

	Low (<30cm), Medium (30-60cm) or High (>60cm) Plants								
Species present Plot:	1	2	3	4	5	6	7	8	9
Herbs:									
bedstraw, sweet-scented	L	L	L	L,M	L		L	L	L
bunchberry						L	L		
cow parsnip									M,H
fairyslipper						L			
fireweed			M						
foamflower, one-leaved		L			L		L	L	
meadow rue									L
pearly everlasting									L,M
prince's pine						L	L		
queen's cup	L	L	L	L	L	L	L	L	
rattlesnake plantain								L	
Siberian miner's lettuce					L				
solomon's seal, false							L,M	M	
solomon's seal, starflwd.	L,M	L,M	L,M	L	L,M	M		M	L
starflower, broad-leaved		L	L	L	L		L	L	L
strawberry sp.			L						L
tansy									M
thistle sp.									L,M
trillium, western	L,M	L,M	M	M	L		L	L	
vanilla leaf	L,M	L,M		L	M	L	L,M	L,M	
viola, stream	L	L	L	L					
wild ginger			L	L				L	
wintergreen, green						L			
Ferns:									
bracken							H		
lady fern	L,M	M		M	L,M		L	M	
spiny shield fern	L,M	M			L,M		L	L,M	
sword fern	L,M	M	M					M	

* Distribution codes were not assigned to herbs, ferns and mosses in the Skagit River Forest Ecological Reserve

Table 47: Percent of Ground Covered by Dead and Down Woody Debris in the Skagit River Forest Ecological Reserve Plots

	Total Percent Ground Cover in Woody Debris	% of the Total with a Diameter of:			
		< 10cm	10 - 20cm	20 - 40cm	> 40cm
Plot 1	35	15	15	20	50
Plot 2	20	40	40	10	10
Plot 3	15	30	30	30	10
Plot 4	55	20	20	40	20
Plot 5	10	60	20	20	0
Plot 6	40	15	15	70	0
Plot 7	35	5	5	70	20
Plot 8	25	10	20	60	10
Plot 9	5	50	50	0	0

Table 48: Number of Pieces, Average Length and Extent of Decay of Large Diameter Woody Debris in the Plots of the Skagit River Forest Ecological Reserve

Dead and Down Woody Debris:	20 - 40 cm diameter			Over 40 cm diameter		
	number of pieces	average length (m)	extent of decay	number of pieces	average length (m)	extent of decay
Plot 1	3	7	moderate	5	4 - 25	low - high
Plot 2	20	7	moderate	0		
Plot 3	6	*	moderate	2	*	low
Plot 4	6	6	moderate - high	1	*	moderate
Plot 5	5	5 - 20	high	0		
Plot 6	*	13	moderate	0		
Plot 7	*	*	moderate - high	1	8	high
Plot 8	*	*	moderate	3	3 - 25	moderate
Plot 9	0			0		

* No measurement was taken

Table 49: Representative Ages, Heights and Diameters for Tree Species in the Skagit River Forest Ecological Reserve Plots

	Species	Age (years)	Height (m)	Diameter at Breast Height (cm)
Plot 1				
Tree 1	Douglas-fir	116	47	50
Tree 2	w. red cedar	55	30	53
Plot 2				
Tree 1	Douglas-fir	> 111	62	86
Tree 2	w. red cedar	76	23	32
Plot 3				
Tree 1	Douglas-fir	24	17	19
Tree 2	Douglas-fir	24	18	19
Plot 4				
Tree 1	western hemlock	20	14	17
Tree 2	Douglas-fir	70	29	51
Plot 5				
Tree 1	w. red cedar	*	45	94
Tree 2	Douglas-fir	*	57	120
Plot 6				
Tree 1	western hemlock	*	20	23
Tree 2	western hemlock	*	22	27
Plot 9				
Tree 1	trembling aspen	*	32	27
Tree 2	trembling aspen	*	29	25

Table 50: Soil Features for Plots 1 to 4 in the Skagit River Forest Ecological Reserve

Soil Feature	Plot 1	Plot 2	Plot 3	Plot 4
Depth	deep (> 1m)	deep (> 1m)	shallow (.5-1m)	very shallow (.25-.5m)
Texture	loamy	sandy	sandy	sandy
Coarse Fragment Content	<10%	<10%	10-35%	35-70%
Seepage or groundwater table	no	no	no	no
Gleyed horizons	no	no	no	no
Flooding	no	no	no	no
Soil color	medium	medium	medium	dark
A horizon	Ah	(6.0cm) Ah	Ah	(6.0cm) Ah
Soil porosity	moderate	moderate	moderate	high
Humus form thickness	8.0 cm	7.0 cm	7.0 cm	5.0 cm
Humus form classification	Mor	Moder	Moder	Mor

Table 51: Soil Features for Plots 5 to 9 in the Skagit River Forest Ecological Reserve

Soil Feature	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Depth	deep (> 1m)	shallow (.5-1m)	deep (> 1m)	deep (> 1m)	extremely shallow (<.25)
Texture	silty	loamy	loamy	silty	sandy
Coarse Fragment Content	<10%	<10%	<10%	<10%	35-70%
Seepage or groundwater table	no	no	no	no	no
Gleyed horizons	no	no	no	no	no
Flooding	no	no	no	no	no
Soil color	medium	medium	medium	medium	light
A horizon	Ah	Ah	Ah	(6.0cm) Ah	(3.0cm) Ah
Soil porosity	moderate	moderate	moderate	moderate	high
Humus form thickness	8.0 cm	10.0 cm	5.0 cm	8.0 cm	2.5 cm
Humus form classification	Moder	Mor	Mor	Mor	Mull

Table 52: General Features of Plots 1 to 4 in the Skagit River Forest Ecological Reserve

Feature	Plot 1	Plot 2	Plot 3	Plot 4
Elevation (feet ASL)	< 1800	< 1800	1850	1850
Slope gradient	1 degree	5 degrees	1 degree	3 degrees
Slope aspect	southwest	southwest	southwest	southwest
Slope position	flat	flat	lower	lower
Slope shape	straight	straight	straight	straight

Table 53: General Features of Plots 5 to 9 in the Skagit River Forest Ecological Reserve

Feature	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Elevation (feet ASL)	< 1800	< 1800	< 1800	< 1800	< 1800
Slope gradient	0 degrees	0 degrees	0 degrees	2 degrees	1 degree
Slope aspect	southwest	southwest	southwest	southwest	southwest
Slope position	flat	flat	flat	flat	flat
Slope shape	straight	straight	straight	straight	straight