BIOPHYSICAL WILDLIFE HABITAT MAPPING OF THE SKAGIT VALLEY

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Surveys and Resource Mapping Branch provided the computer mapping support for the project. Boyd Porteous wrote the computer routines for the species models. Ron Muir conducted the computer mapping.

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1. INTRODUCTION

This project provides maps of wildlife habitat and interpretations for the Skagit River drainage of British Columbia. It was funded by the Skagit Environmental Endowment Commission and the British Columbia Ministry of Environment and Parks. The maps depict the present and potential quality of habitat for a variety of wildlife species. They can be used to predict habitat change over time and areas suitable for enhancement. The maps are stored on computer so that interpretations can be changed as new information becomes available. A wide range of wildlife species interpretations are possible, with those thought to be of immediate importance included in this report.

1.1 Products Available

The mapping was conducted at two map scales (Figure 1). The entire Skagit River drainage was mapped at a scale of 1:50,000. This provides a general habitat overview of the entire area. Interpretations of carrying capacity are done at this map scale.

Habitat mapping at 1:20,000 scale was done within the Skagit Recreation Area below about 1,220 m (4,000 ft). This elevation was chosen to include most important deer winter range, spring range and spotted owl habitat. This detailed scale provides more reliable interpretations of habitat importance and potential enhancement. This area was also included within the 1:50,000 scale mapping area for overview purposes.

A description of map products produced at each map scale are listed in Table 1 and are described in Chapter 3. Additional interpretations can be developed in the future. Proposals for additional interpretations should be addressed to the author. Existing maps will be reproduced on mylar with legends attached and are available on request from:

Maps B.C.
Surveys and Resource Mapping Branch
553 Superior Street
Victoria, B.C. V8V 1X5

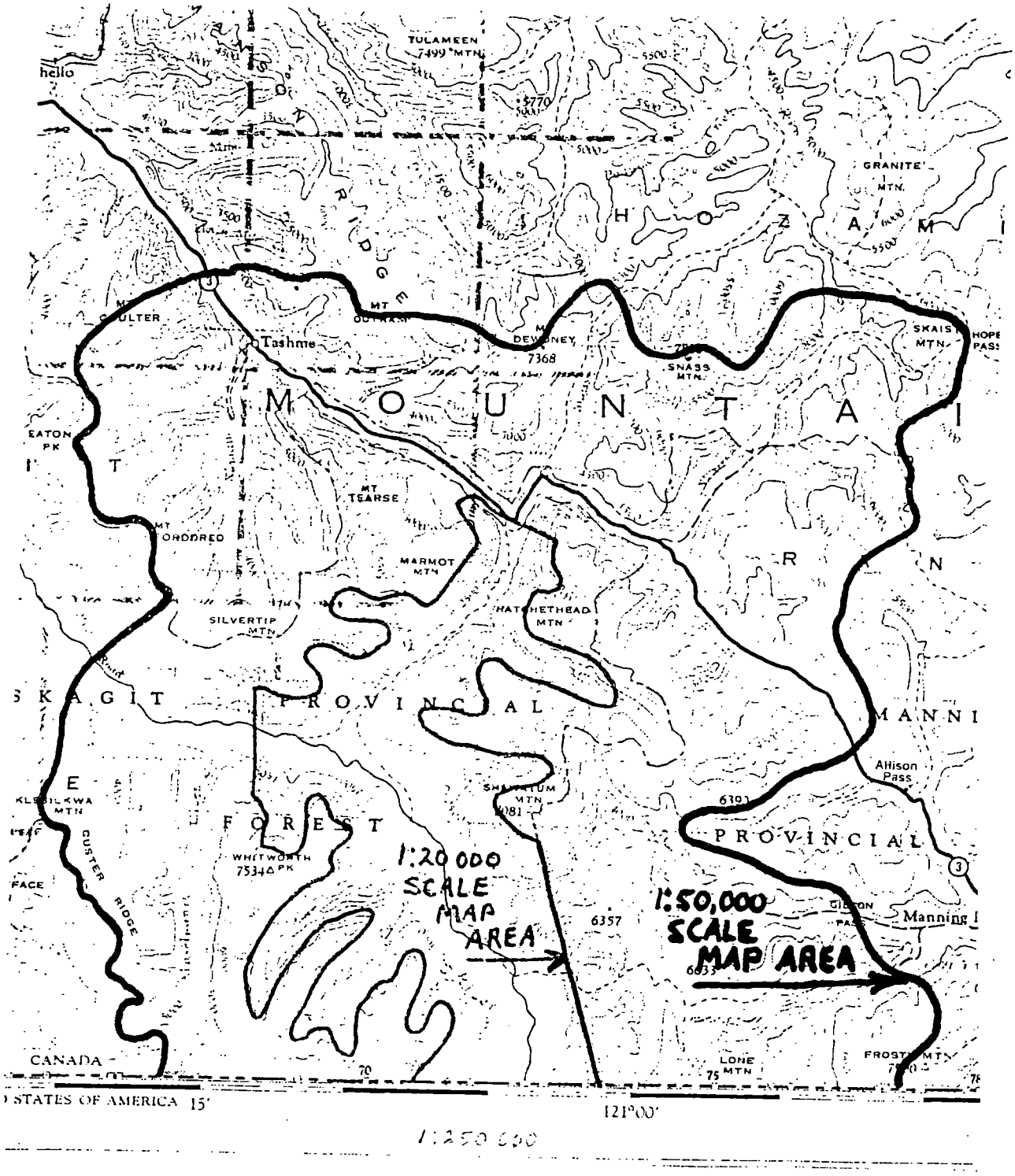

Figure 1. The Skagit study area and limits of mapping.

Table 1. Map products presently available for the Skagit area.

1:20,000 scale	1:50,000 scale
Deer[1] winter range suitability	Deer habitat suitability
Deer spring range suitability	Deer habitat capability
Deer spring range enhancement	Elk habitat suitability
Elk winter range suitability	Spotted owl habitat suitability
Spotted owl suitability	

[1]"Deer" used throughout this report refers to the two black-tailed deer subspecies Odocoileus hemionus columbianus, Odocoileus hemionus hemionus and their intergrades common the Skagit River drainage.

1.2 Previous Studies

The numerous wildlife studies that have been undertaken have recently been summarized in "Skagit Environmental Endowment Area: Status of Wildlife Data" (Ministry of Environment 1986). The largest wildlife study conducted was done by F.F. Slaney and Company Limited (1972, 1973) for the City of Seattle. "Wildlife habitat and vegetation units" (Slaney 1972) were prepared for the area below 915 m (3,000 ft.) from Silvertip Creek downstream to the British Columbia/Washington border. This was primarily a cover classification. It provides a good overview of the existing vegetation units, especially the spring range areas where much of their work was focussed. However, their map was derived largely from forest cover maps and does not have the ecological foundation to provide predictions of changes with seral progression or enhancement. The report (Slaney 1973) provides considerable information on deer population size and seasonal numbers, distribution, movement and the characteristics of seasonal ranges. This, and the information provided for other species was of particular usefulness during this project. Other studies provided some qualitative information, but information for the broader area of the Skagit River drainage was sparse. Significant wildlife habitat studies are included in the references.

2. METHODS

Previous studies were reviewed for relevant habitat descriptions and wildlife use information. I used this information to help determine the kinds of habitats that would be described and their importance for various species. Observations of snowpack from these studies and from "Snow Survey Measurements: Summary 1935-1985 (Ministry of Environment 1985) were helpful in determining the extent and quality of spring and winter deer range.

The "biophysical" method of habitat mapping (Demarchi in prep.) describes habitat in ecological terms. It integrates biological factors such as vegetation and wildlife with physical factors such as topography, landform and climate. An integrated classification of habitat is required since wildlife react to their whole environment, not just a part of it. For example, a habitat classification based only on forest cover is incomplete because it omits important factors such as slope, aspect, elevation and soil development. The biophysical method attempts to reduce ecological complexity by stratification, or describing the parts of the ecosystem. The strata used in this study are biogeoclimatic zonation, habitat unit (a climax community) and successional stage.

Surficial geology and topography are the primary delineators of the map units with some additional boundaries created by successional stages and biogeoclimatic zonation. Habitat units are often more general than surficial geology/landform units, although these may be used to refine habitat enhancement interpretations within a habitat unit. Biogeoclimatic zonation is the most general stratification. Each biogeoclimatic unit contains a separate group of habitat units, since each subzone is climatically distinct. This zonation is used to infer climatic change for the prediction of snow depth and potential plant communities. Biogeoclimatic zonation has been described in a general way by the Ministry of Forests (1985). The names and definitions of these subzones are used in this project however, the distribution of the subzones was refined because of the more detailed information available in this project.

Aerial photography of 1:50,000 and 1:20,000 scale were used to outline habitat units and surficial materials before field sampling. Field work was done during May and August 1986 (20 days total) with several other short trips during the spring and winter seasons. Reconnaissance plots done during this work were recorded using standard Ministry of Environment/Ministry of Forests methods (Walmsley et. al. 1980). These plots are stored in the Ministry of Environments' British Columbia Soil Information System (BCSIS). Copies or summaries of the site, vegetation and wildlife data forms are available. The original forms and additional field notes are held by the author. Copies of aircraft surveys (maps and notes) are available from me or the Wildlife Branch office in Surrey. Map units were interpreted on stereo orthophotos, allowing direct digitizing to computer map form without distortion of scale.

The maps and their associated biophysical information are stored on the Ministry of Environment and Parks' CAPAMP mapping system (Computer Aided Planning, Assessment and Map Production). Maps of wildlife species importance or habitat enhancement were produced using models of the biophysical data. Other interpretations such as areas for viewing wildlife or terrain hazards and constraints for road building can also be produced. The area of individual map units and area summaries can be produced. Maps can also be reduced in scale and presented in a more general format.

The biophysical data relating to the final map polygons was coded on forms, keypunched and corrected for errors. The models written by the author were programmed by the Development Unit of the Surveys and Resource Mapping Branch of the Ministry of Environment and Parks. Chapter 3 describes the models that have been written to date. These models can be changed if they are found to be inaccurate. Models for additional species can be written as necessary.

3. RESULTS

Separate map products have been produced for the 1:20,000 and 1:50,000 scale map areas. This is because the different scales of information are appropriate for different uses. The more detailed scale (1:20,000) is best used to identify suitable sites for enhancement and present use by various species. Its detailed scale has greater "on-the-ground" reliability. The 1:50,000 scale information provides an overview of the Skagit drainage. Carrying capacity for various species is estimated for present and potential successional stages. Terrain hazards and constraints can be done at both scales to indicate areas where roads or trails may be subject to hazard from flooding, avalanching or rapid mass movement.

3.1 1:20,000 Scale Map Products

The Skagit Recreation Area was mapped below about 1,220 m (4,000 ft) elevation to include the important deer spring range, winter range and spotted owl habitat.

This area is within the Interior Douglas-fir (IDF) and the Coastal Western Hemlock (CWH) biogeoclimatic zones. The three subzones of the area are, from drier to wetter, the IDFe, CWHc and CWHb (Figure 2), as described by Ministry of Forests (1985).

The IDFe has extensive Douglas-fir[1] forests and the mildest climate of the area. It is transitional between coastal and interior ecosystems having many plant species common to each area. It extends from Ross Lake north to the Klesilkwa/Skagit confluence along the valley bottom and on the warmer eastern side of the valley. Many plant and animal indicators of wetter zones in the area. This classification highlights the high diversity and abundance of plants and animals that make the Skagit Recreation Area a special place to the public.

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[1] see Appendix B for scientific names

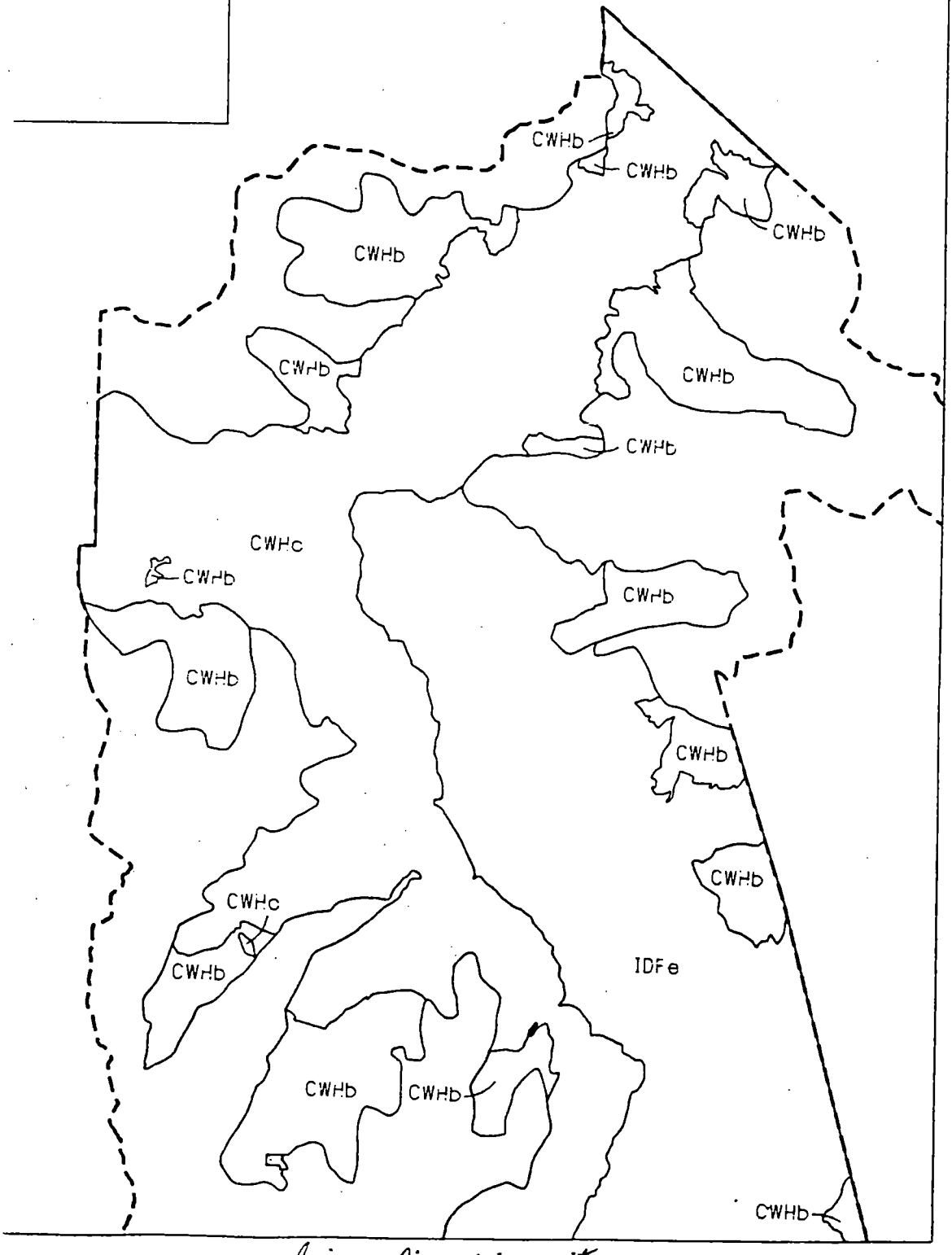

Figure 2. The ~~vegetation subzones~~ biogeoclimatic units of the 1:20,000 scale map area.

The CWHc has Douglas-fir forests on steep southerly aspects, but hemlock is common on other aspects. This reflects a wetter climate. The growing season is shorter than in the IDFe. The CWHc in the Recreation Area occurs along the valley bottoms and lower elevation slopes of the Skagit and Klesilkwa Rivers above their confluence, and in the area west of the lower Skagit River.

The CWHb has the wettest, coldest climate of the three subzones. Forests are predominantly hemlock with some Douglas-fir forest on steep, dry southerly apsects. This area has the highest snow depth and shortest growing season of the three subzones in the Skagit Recreation Area.

There are twenty-eight habitat units described in the three subzones. They are briefly described in Tables 2, 3 and 4 with a full description in Appendix A.

Forested habitat units were separated into seven successional stages: 1, sparsely vegetated (recent disturbance); 2, pioneer seral herb stage (< 20 years old); 3, pioneer seral shrub stage (< 20 years old); 4, young seral forest (20 - 100 years old); 5, mature seral forest (100 - 250 years old); 6, mature climax forest (100 - 250 years old); 7, old growth (> 250 years old).

The following are brief descriptions of the interpretations of the 1:20,000 scale map area data.

3.1.1 Deer Winter Range Suitability

Most deer winter range occurs on moderately to steeply sloping southerly aspects below 1,070 m (3,500 ft). Forests are mainly older aged Douglas fir. These characteristics are required because much of the Skagit River area receives a relatively high snow depth on much of the winter range. Some of the lowest elevations near Ross Lake may have low enough snow accumulation in most years that snow interception is less important than forage production. Such areas are the exception rather than the rule. The snowpack is sufficiently reduced under a mature conifer canopy to expose some rooted forage. This compaction and melting increases the density of the snow and deer the mobility of the deer. These factors have been documented by Bunnell

Table 2. Habitat units of the 1:20,000 scale map area, IDFe subzone.

Habitat Unit	Moisture[1]	Description
Rock-Douglas fir	vx	southerly aspect rock outcrops with an open forest cover, steep slopes
Talus slope	vx	rubbly colluvium, sparsely treed
Pine-kinnikinnick	x	stunted, open canopy lodgepole pine terraces
Douglas fir-saskatoon	sx-sm	steep Douglas fir forests with a closed canopy
Boxwood terrace	sx-sm	coarse textured terraces with abundant Oregon boxwood
Douglas fir - Oregon-grape	sm	gently sloping well-drained terraces
Douglas fir - clintonia	m	good tree growth, dense canopy
Cottonwood fluvial fan	shg	open cottonwood/coniferous forest
Grand fir floodplain	hg	floodplain of the lower Skagit River
Willow-twinberry honeysuckle	shd	backchannels of the lower Skagit River
Wetland	hd	untreed sedge fen
Vine maple avalanche chute	-	variable sites and moisture

[1]Ecological Moisture Regime (Walmsley et al. 1980):
vx - very xeric, x - xeric, sx - subxeric, sm - submesic, m - mesic, shg - subhygric, hg - hygric, shd - subhydric, hd - hydric.

Table 3. Habitat units of the 1:20,000 scale map area, CWHc subzone.

Habitat Unit	Moisture	Description
Rock	vx	sparsely vegetated bedrock
Rock - Douglas-fir	vx	southerly aspect rock outcrops with an open forest cover, steep slopes
Talus slope	x	rubbly colluvium, sparsely treed
Douglas fir - lichen	x-sm	steep southerly aspect Douglas fir forest with an open canopy and abundant arboreal lichen
Hemlock - boxwood	sx-sm	lower elevation terraces
Hemlock - moss	m	western hemlock forests on northerly aspects
Cedar - clintonia	m	red cedar forests on fluvial fans
Cottonwood - thimbleberry	shg	cottonwood/coniferous forests on moist sites
Red-osier dogwood floodplain	hg	open cottonwood forests
Willow backchannel	shg	backchannels of the upper Skagit drainage
Wetland	hd	untreed sedge fen
Vine maple avalanche chute	-	variable sites and moisture

Table 4. Habitat units of the 1:20,000 scale map area, CWHb subzone.

Habitat Unit	Moisture	Description
Rock - hemlock	vx-x	open hemlock forest on rock
Talus slope	x	rubbly colluvium, sparsely treed
Douglas fir - boxwood	sx-sm	steep southerly aspects with open forests
Hemlock moss	m	closed hemlock forests with a sparse understory
Cedar - oak fern	shg	moisture receiving areas with cedar forests
Vine maple avalanche chute	-	variable sites and moisture

et al. (1984) and the recent Integrated Wildlife Intensive Forestry Research (IWIFR) such as presented by McNay (1985). In addition to rooted forage made available by a modified snow cover, such sites often have a high arboreal lichen density. Slaney's (1973) observation that arboreal lichen was an important winter forage was confirmed by my own field work in February 1987.

Sites which are not strongly influenced by solar radiation or which do not have a mature forest cover of Douglas fir have deeper and softer snow with little or no suitability for winter range. However, the area of winter range and the kinds of sites used at a given time vary with snow condition. This description and mapping is intended to represent average winter conditions. During periods of low snow depth or very dense snow the area of winter range increases. Elevations to 1,400 m (4,500 ft) adjacent to main winter ranges are commonly used. These are usually the upper elevations of the Rock-Douglas fir, Douglas fir - saskatoon or Douglas fir - arboreal lichen habitat units. Level sites near the valley floor may also provide winter range at such times, especially the Boxwood - terrace habitat unit. Areas without snow modification by large Douglas fir trees have lower or no winter range suitability. Some areas near the Ross Reservoir may be an exception to this as snow depths are frequently low in this area. Areas with young seral Douglas fir forests on steep southerly aspects or at very low elevation near the reservoir have some winter use, but do not have the snow interception ability or arboreal lichen density of older stands.

The best quality and most extensive areas of winter range occur in the IDFe. The wetter CWHc has some winter range, but it is more restricted in elevation, slope, aspect and forest cover because of deeper snow. Most of the winter range in the CWHc is on the steep southerly aspects of the upper Skagit and Klesilkwa River, although extensive areas of steep bedrock make winter range discontinuous and of lower quality. There is no significant deer winter use of the CWHb because of deep snow.

Deer winter range quality in the Skagit Recreation Area (1:20,000 map area) was rated as high, medium, low, early and nil. Early winter range was mapped at high elevations and is more likely to be used during period of low snow depth or high snow density. The area of winter range is shown in Table 5. Many areas rated as low or moderate will increase their suitability with age

Table 5. Area of deer winter range in the Skagit Recreation Area (1:20,000)

Rating	Area (ha)
High	610
Moderate	2,140
Low	4,070
Early	2,830
Nil	10,940

due to improved snow interception ability and arboreal lichen density. Carrying capacity is estimated at the 1:50,000 map scale (Section 3.2.1). Habitat management is discussed in Chapter 4.

3.1.2 Deer Spring Range Enhancement

Deer spring range is an important component of their seasonal habitats. These areas exhibit the first spring growth of shrubs and grasses. Slaney (1973) provided a good description of spring range and documented its importance. Spring ranges occur in areas with sparse tree cover at lower elevations. Southerly aspects have earlier growth than level areas or northerly aspects. Spring range is presently provided by the two meadows on the lower Skagit River (locally named Ponderosa and Whitworth Meadows), forest openings, the Ross Lake drawdown area, the Skagit River floodplain and the southerly aspect cutovers near the Klesilkwa River (Slaney, 1973). Of these areas the meadows of the lower Skagit River appear to be preferred as they are heavily used (Figure 3).

Surficial material and soil moisture are important characteristics for determining the suitability of sites as spring range. Finer textured materials will have better production of herbs and shrubs than coarse textured materials. This is evident when comparing the more abundant spring forage production of Ponderosa Meadow with the sparser production of Whitworth Meadow. Ponderosa meadow occurs on the finer textured material of the Douglas-fir - Oregon-grape habitat unit while Whitworth Meadow occurs on the coarser textured Boxwood terrace habitat unit. Sites which are xeric and drier or subhygric or wetter will have lower potential suitability as spring range due to lower forage production. Wet sites rapidly grow a dense shrub cover such as the area west of Whitworth Meadow (the Willow - twinberry honeysuckle habitat unit). Dry sites such as the Boxwood terrace and Pine - kinnikinnik habitat units will have a lower herb and shrub production potential.

The Douglas-fir - clintonia habitat unit has optimum soil texture and moisture for potential spring range. However, southerly exposure is also very important for early spring growth, and other units may also provide potential spring range. The Douglas-fir - saskatoon, Boxwood terrace,

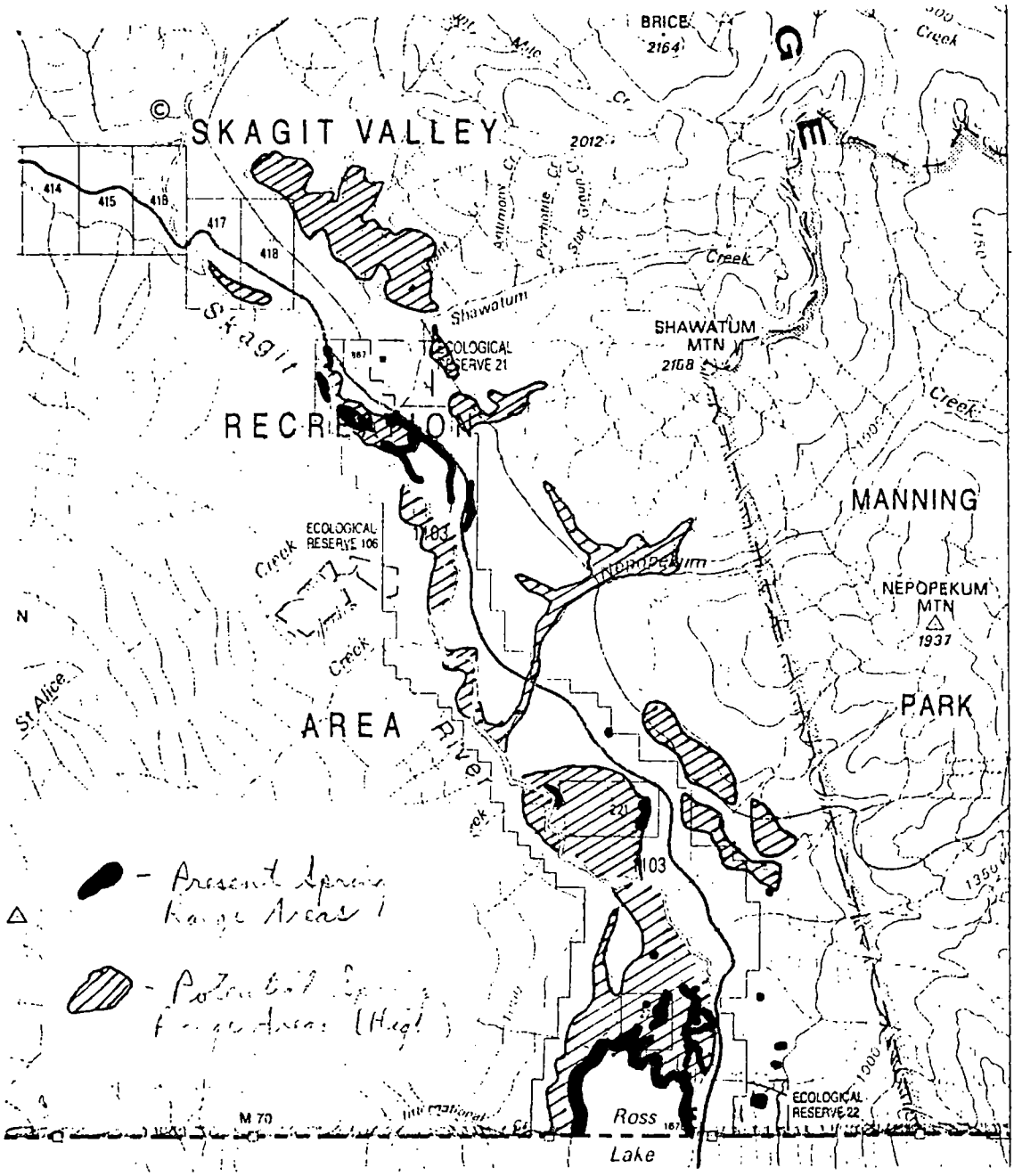

Figure 3. Existing deer spring range and potential enhancement sites for deer spring range in the IDFe.

Douglas-fir - Oregon-grape and Cottonwood fluvial fan habitat units all have good potential for spring range, especially on southern exposures. These habitat units are distinguished by their different soil texture, moisture and plant species. However, there are many sites with intermediate texture and moisture characteristics. These four habitat units are best thought of as a gradient from dry, coarse textured sites to wet, fine textured sites, using the habitat descriptions as benchmarks along this gradient (refer to Table 2).

Sites were mapped for their present and potential ability to provide spring range as high, medium, low and nil based on habitat unit, soil texture, slope, aspect and elevation. The areas of present and potential spring range appear in Table 6.

3.1.3 Elk Winter Range Suitability

Elk populations occur in Washingtion State in habitat similar to that found in the study area. Since the forage species, cover and snow conditions in the Skagit area are similiar to other areas where elk presently occur, it is reasonable to expect that capability for elk exists. Although elk have been occasionally sighted in the Skagit drainage (Barnard, 1986) it is unlikely that a population will become established in the near future without being introduced.

Suitability for elk was mapped using patterns of habitat use described by elk studies in similar ecosystems (Janz 1980, Brunt et al. 1984) and discussions with other biologists. Snow depth is potentially a limiting factor for elk winter range in the Skagit area, with the overall suitability of the area being moderate. Some good habitats do occur however, and will improve as coniferous stands increase their snow interception ability with age. Most potential winter range occurs in the IDFe, especially along the Skagit River floodplain and mature forests of the lower portion of the valley near Ross Lake. Since elk can tolerate greater snow depths than deer, elk winter use of some floodplain habitats (especially the Grand fir floodplain habitat unit) is expected. Some use of steep southerly aspect Douglas-fir forest will also likely occur during more severe snow conditions.

Table 6. Present and potential spring range for deer in the Skagit Recreation Area (1:20,000)

	Present (ha)	Potential (ha)
High	360	2,870
Medium	190	1,620
Low	270	700
Nil	14,390	14,390

Although a map for elk spring range suitability was not produced, it would be similar to the map for deer spring range, except that it would favour areas of wetter soil and sites with greater herb production potential. There would be some competition between elk and deer for spring range although elk prefer to graze while deer mainly browse on spring range (Slaney 1973).

The area of suitable elk winter range is summarized in Table 7.

3.1.4 Spotted Owl Habitat Suitability

Spotted owls have recently become the focus of study in southwestern British Columbia, having been nationally classified as endangered. Recent studies in the Skagit area (Forsman and Booth 1986) have shown some use of the area by spotted owls. A recent summary of literature has been produced by Campbell et al. (1984). Since spotted owls require large areas of old growth coastal forest with few openings, many stands in the Skagit Recreation area are too young to be suitable. The suitability of many of these areas will improve with time. Fire frequency has been low in the wetter CWHb where considerable old growth habitat presently exists. Much of the best habitat in the study area appears to be in this subzone.

Important habitat units for spotted owl have the potential for a continuous mature or old growth forest cover of Douglas-fir or hemlock, such as Douglas-fir - saskatoon, Douglas-fir - Oregon-grape or Hemlock - moss habitat units. Units which inherently have forest openings such as the Rock-Douglas fir or Grand fir floodplain habitat units have little importance for spotted owls. Old growth forests were given a high rating on the map, mature forests a low to moderate rating and younger forests no rating. It is not known if the parameters of slope, aspect or elevation are of importance, so they are not included in this model. The areas of spotted owl habitat mapped in the Skagit Recreation area are presented in Table 8.

Spotted owls are thought to require extensive areas of old growth forest for habitat. The size of this habitat is currently under debate, but is thought to be at least 1,000 ha (2,500 acres) for productive habitat in Oregon (Dunbar pers. com.). The habitat maps produced for spotted owl have not considered minimum habitat unit size since few areas of suitable habitat larger than 1,000 ha exist. Our understanding of spotted owl habitat use and

page break

Table 7. Area of elk winter range in the Skagit Recreation Area (1:20,000)

Rating	Area (ha)
High	460
Moderate	3,730
Low	3,310
Nil	12,880

Table 8. Area of spotted owl habitat in the Skagit Recreation Area (1:20,000)

Subzone	Rating	Area (ha)
IDFe	High	80
	Moderate	2,530
	Low	960
	Nil	3,180
CWHc	High	470
	Moderate	2,360
	Low	2,850
	Nil	3,040
CWHb	High	1,020
	Moderate	2,030
	Low	1,100
	Nil	700

importance is not adequate to make such interpretations.

3.2 1:50,000 Scale Map Products

The entire drainage of the Skagit River (1,043 sq. km.) was mapped at a scale of 1:50,000 to provide an overview of the present and potential value of habitat for wildlife.

Six biogeoclimatic units (Ministry of Forests 1985) occur in this area: the IDFe, CWHc and CWHb described in section 3.1 for the 1:20,000 scale map area; the Mountain Hemlock b subzone (MHb), the Engelmann Spruce - Subalpine fir f subzone (ESSFf) and the Alpine Tundra zone (AT). The distribution of this zonation appears in Figure 4. This distribution differs in some areas from that shown by the Ministry of Forests (1985) map because of our more detailed survey. The Mountain Hemlock "b" subzone (Mhb) occurs above the CWH in elevation and in the southwestern portion of the area. It reflects a strong coastal influence. Old growth mountain hemlock forests are common, but heavily forested areas are seldom extensive because of frequent steep bedrock outcrops and areas of stunted tree growth. Snow depths in the MHb are very high and the growing season is short.

The MHb is replaced by the Engelmann Spruce - Subalpine Fir f (ESSFf) subzone in subalpine areas of the northern and eastern portion of the map area. This reflects the climatic drying trend to the east. Climax forests in the ESSFf consist of Engelman spruce and subalpine fir. Mature forests are often dense lodgepole pine. Most areas have an extensive forest cover since the physiography is less mountainous. Subalpine meadows with an abundant herb cover are also common in this subzone.

The Alpine Tundra zone (AT) has not been mapped separately since it is difficult to distinquish because of extensive areas of unvegetated bedrock. True alpine (no trees present) is rare in the study area. For the purposes or mapping in this project it appears as a habitat unit within its adjacent subalpine zone. Snow and vegetation characteristics can be inferred from adjacent subalpine areas. In the western portion of the area the alpine is poorly vegetated with heather communities common. This reflects the deep and persistent snow common in alpine areas near the MHb. In the eastern portion of the area the alpine tundra is less common but better vegetated and with less snow. The alpine areas south of Lightning Lakes in Manning Park receive

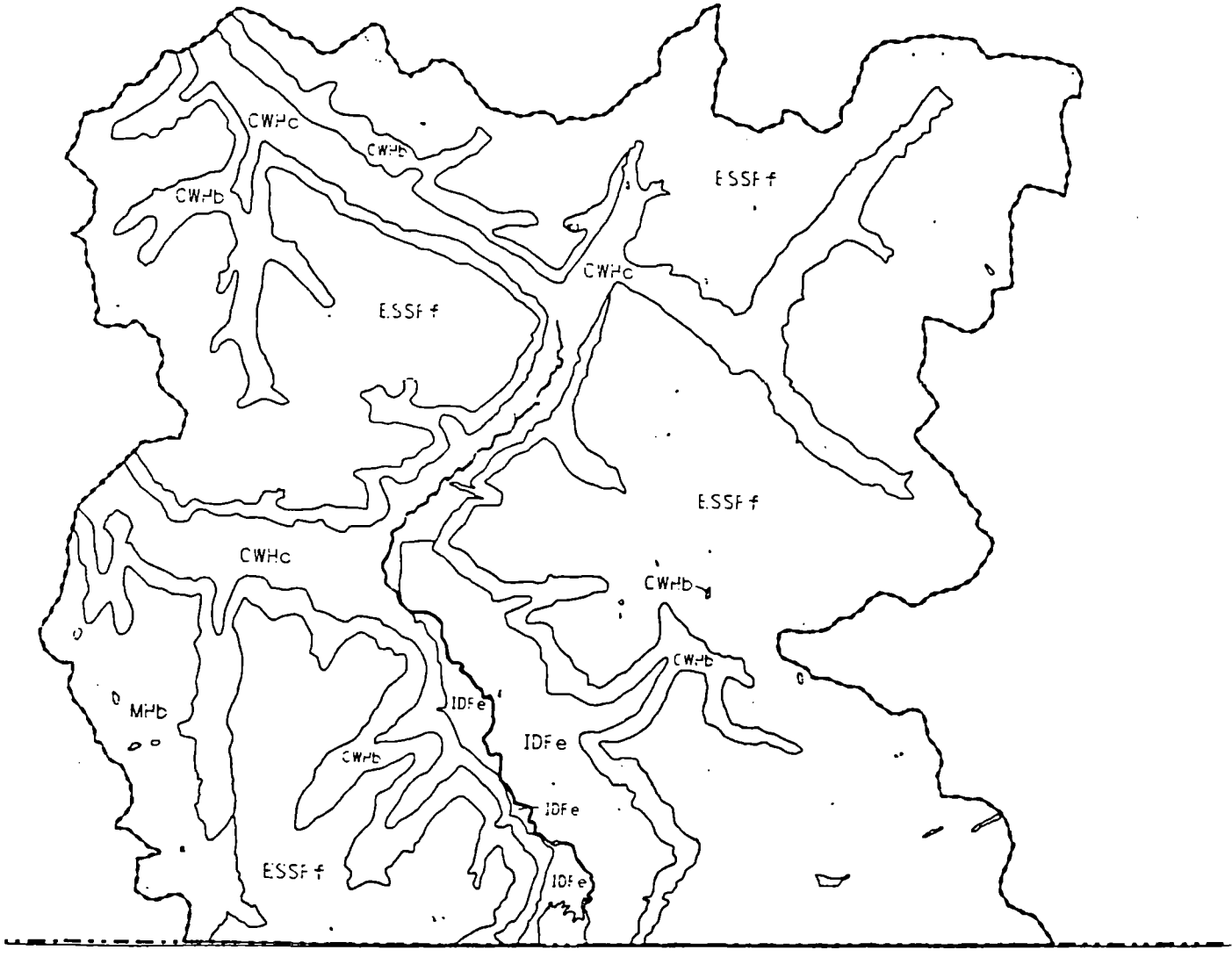

Figure 4. The ~~vegetation zonation~~ biogeoclimatic units of the 1:50,000 scale map area.

the least snow. The Alpine tundra habitat unit contains some subalpine parkland and krummholz because of the general map scale.

There are thirty-nine habitat units described in the six vegetation zones. The same seven successional stages were used as in the 1:20,000 scale map area. Some habitat units are the same as those described for the 1:20,000 scale map area. Other habitat units of the 1:20,000 scale map area that could not be shown at the smaller (1:50,000) map scale have been combined into more general units. A general description of the habitat units of each vegetation subzone of the 1:50,000 scale map area appears in Tables 9 to 13 with a full description in Appendix A.

The following are interpretations of the 1:50,000 scale map area data.

3.2.1 Present Habitat Suitability for Deer

The suitability of each habitat unit and successional stage was rated for its ability to support deer. The rating scale used is taken from "Wildlife Capabiltiy Classification for British Columbia: An Ecological (Biophysical) Approach for Ungulates" (Demarchi et al. 1983). These ratings (see Table 14) apply to mule deer. Although some Columbian black-tailed deer occur in the study area, most of the deer appear to be mule deer or hybrids with a large body size. The higher carrying capacity estimate ratings for Columbian black-tailed deer (Demarchi et. al. 1983) would likely result in an over-estimate of potential population.

Each habitat unit and successional stage was also given a season of use. These were simply separated into winter, the seasonal concentration of animals because of deep snow, and summer, the season of dispersal. Most spring ranges are too small to be mapped at this scale. Spring ranges occur on early snow-free areas at the lower elevations of winter ranges, as described for the 1:20,000 area.

Successional stage is very important for winter range suitability. The old growth successional stage received the highest winter ratings for deer (2W). This is because snow is the main limiting factor for deer, even in normal winter conditions. Snow interception and snow-pack modification by large

Table 9. Habitat units of the 1:50,000 scale map area, IDFe subzone.

Habitat Unit	Moisture[1]	Description
Rock - Douglas fir	vx	southerly aspect rock outcrops with an open forest cover, steep slopes
Boxwood terrace	x-sm	dry, coarse textured terraces, includes Boxwood terrace and Pine - kinnikinnick of 1:20,000 area
Slope - saskatoon	sx-sm	steep Douglas fir forests with a closed canopy
Douglas fir - Oregan grape	sm-m	dense Douglas fir forests, gentle slopes, includes Douglas fir - Oregon grape and Douglas fir - clintonia of 1:20,000 area.
Cottonwood - cedar	shg-hg	floodplain and fluvial fan units, includes Cottonwood fluvial fan and Grand fir floodplain of 1:20,000 area
Willow wetland	shd-hd	backchannels and wetlands, shrubbly and sparsely treed, includes Willow - twinberry honeysuckle and Wetland of 1:20,000 area
Avalanche chute	-	variable site and moisture

[1]Ecological Moisture Regime (Walmsley et. al. 1980)
vx - very xeric, x - xeric, sx subxeric, sm- submesic, m - meric, shg - subhygric, hg - hygric, shd - subhydric, hd - hydric

Table 10. Habitat units of the 1:50,000 scale map area, CWHc subzone.

Habitat Unit	Moisture[1]	Description
Rock - Douglas fir	vx	southerly aspect rock outcrops with an open forest cover; steep slopes
Talus slope	x	rubbly colluvium, sparsely treed
Douglas fir - lichen	x-sm	steep southerly aspect Douglas fir forest with an open canopy and abundant arboreal lichen
Hemlock - boxwood	x-sm	lower elevation terraces
Hemlock - moss	m	hemlock forests on northerly aspects includes Cedar - clintonia of 1:20,000 area
Cottonwood - red-osier dogwood	shg-hg	cottonwood floodplain and moist fluvial fans, includes Red-osier dogwood floodplain and Cottonwood-thimbleberry of 1:20,000 area
Red-osier dogwood wetland	shd-hd	shrub dominated wetlands adjacent to floodplains, includes Wetland and Willow backchannel of 1:20,000 area
Avalanche chute	-	variable sites and moisture

Table 11. Habitat units of the 1:50,000 scale map area, CWHb subzone.

Habitat Unit	Moisture[1]	Description
Rock - hemlock	vx-x	open hemlock forest on rock outcrops
Talus slope	x	rubbly colluvium, sparsely treed
Douglas-fir - boxwood	sx-sm	steep southerly aspects with open forests
Amabilis fir - moss	m	Amabilis fir and hemlock forests, closed canopy, includes Hemlock - moss of 1:20,000 area
Amabilis fir - oak fern	shg-hg	Amabilis fir forests on fluvial fans, lower slopes and floodplains, includes Cedar - oak fern of 1:20,000 area
Wetland	shg-hd	sparsely treed wetlands, low vegetative productivity
Avalanche chute	-	variable sites and moisture

Table 12. Habitat units of the 1:50,000 scale map area, MHb subzone.

Habitat Unit	Moisture[1]	Description
Mountain hemlock - moss	vx-sx	open mountain hemlock forest on rock outcrops and shallow soils
Talus slope	x	sparsely treed rubbly colluvium
Mountain hemlock - blueberry	sm-m	closed mountain hemlock forests on deep soils
Amabilis fir - devil's-club	shg-hg	closed forests on moist lower slopes and floodplains
Parkland - meadow	-	subalpine forest openings with heath and some herbaceous vegetation
Avalanche chute	-	upper elevations of avalanche chutes, often steep with exposed bedrock
Alpine tundra	-	mainly unvegetated rock and talus, includes some small parkland meadows and krummholz
Ice	-	permanent glaciers and snowfields

Table 13. Habitat units of the 1:50,000 scale map area, ESSFf subzone.

Habitat Unit	Moisture[1]	Description
Rock	vx-x	sparsely vegetated bedrock
Talus	x	sparsely treed rubbly colluvium
Subalpine fir - blueberry	sx-sm	open canopy, subalpine fir forests on dry, convex slopes, shallow soils
Subalpine fir - Sitka valerian	m	dense subalpine fir forests on deep soils
Engelmann spruce - horsetail	shg-hg	subalpine fir forests on moist lower slopes and floodplains, abundant herb cover
Wetland	shd-hd	sedge dominated wetlands
Parkland meadow	-	subalpine meadows with an abundant herbaceous cover
Avalanche chute	-	variable sites and drainage
Alpine tundra	-	mainly unvegetated rock and talus, includes some samll parkland meadows and krummholz

Table 14. Carrying capacity estimate classes for deer

Class	Carrying Capacity Estimate (Deer/square kilometer/year)
1	15.9-21.0
2	10.7-15.8
3	5.4-10.6
4	1.2- 5.3
5	< 1.1
6	0

trees, especially Douglas-fir, are important in normal years and essential in deep snow years. In addition, such trees often have an abundance of arboreal lichen which is an important winter forage. These observations were made by Slaney (1973) and confirmed by my winter field work. However the mature seral stages are more common than old growth in the study area. Mature Douglas fir forest on dry sites such as steep southerly aspects, rock outcrops or coarse textured materials may have a higher arboreal lichen density than faster growing stands. The snow interception ability and arboreal lichen production of these stands is good and will improve with time. These areas received deer winter range ratings equal to or one rating lower than that given to old growth. Younger seral stages are rated low or nil ratings for winter range because of high snow depth. For example in the lower Skagit valley during mid-February of 1987, the snow depth on a moderately sloping, southwest aspect opening dominated by willow and saskatoon was about one meter and had no deer use. Deer were using the adjacent mature Douglas fir forest having only 30 cm of hard snow, feeding on Oregon boxwood and arboreal lichen. Also, the snow pack was only 80-90% of normal at this time (Ministry of Environment and Parks Snow Survey Bulletin, March 1, 1987.) A small area of the winter range near Ross Lake has considerably less snowfall than elsewhere. Snow interception may be less important in this area.

It should be noted that normal or average snowpack may be a misleading indicator of winter range importance in coastal ecosystems. The frequency of severe winter conditions may be at least as important as average conditions, since high deer mortality can occur at these times. It appears from the limited snow survey measurements available that the Skagit area has had twice its normal March 1 snow depth seven times in the last 35 years. This was based on the closest available long term snow course data (Klesilkwa, No.3D03A, Ministry of Environment 1985). The effect of these deeper snow years on the deer population is not known, but it emphasizes the importance of snow interception cover, arboreal lichens and Douglas-fir litterfall.

Most deer winter range occurs in the IDFe on the southerly aspect slopes east of the Skagit River. This area was mapped as 3W (moderate winter range) for deer, limited by snow depth, by the Canada Land Inventory (Hazelwood 1971). However, some of the small, higher capability areas on steep southerly

aspects could not be shown because of the general mapping scale. In this project the best winter range areas were rated 2W (high). Very high capability winter range (1W) is not thought to occur because of high snow depth. Areas of less favourable habitat unit, slope, aspect or elevation were rated 3W (moderate) and marginal winter range as 4W (low). The best winter ranges occur on steep southerly aspects in the Slope - saskatoon and Rock - Douglas fir habitat units. Some winter range occurs on the Boxwood terrace and Douglas fir - Oregon-grape habitat units. These latter habitat units often lack a steep southerly aspect, but they occur at lower elevations and therefore have lower snow depths during some winter conditions. This is especially true near the reservoir where snow depths are particularly low.

Deer winter range also occurs in the CWHc subzone on the steep southerly aspect slopes of the Klesilkwa, upper Skagit and Sumallo River valleys. These areas have similar characteristics and ratings as the area described for the IDFe, but are more limited in extent. Steep bedrock outcrops and the higher elevation of the valley bottom combine to make this winter range area less extensive than that of the IDFe subzone. The important winter range habitat units of the CWHc subzone are Rock - Douglas-fir and Douglas-fir - arboreal lichen.

During the summer, deer are widespread throughout the study area. They use all habitat units to some extent, with the exception of Talus slope and some high Alpine tundra. Different habitat units and elevations will be preferred at different times of the year. Since deer are widespread and using habitat for a relatively short period, classes 3, 4 and 5 are used for summer range. A few areas of exceptionally high use may be class 2. Class 3 should be considered high use, 4 as moderate use and 5 as low use.

Successional stages affect the summer range ratings. Pioneer herb and shrub stages are the most productive for forage. Young seral forests are often dense with little shrub or herb understory. Mature seral and climax stages may provide thermal cover but not a great deal of forage. Old growth forests may provide both forage and cover. Mature and old growth stages can be particularly important when mixed with areas that have abundant forage.

Important summer ranges include young seral stages near winter range. Such areas often provide spring range at lower elevations or early winter range at

higher elevations. Good fall and early winter ranges are important for the maintenance of animal condition before the more stressful winter period.

Habitat units that do not change greatly over time and that have abundant forage are important summer range. Avalanche chutes occur throughout the study area on a variety of aspects. Their use by deer is often enhanced by close association with mature forest for thermal cover. The Parkland meadow habitat unit of the ESSFf subzone has abundant herbaceous forage. It is frequently used by deer and provides good summer viewing opportunities for recreationists.

Deer are concentrated on the relatively small area (Table 15) of winter range for a relatively long period. Only 6% (66.9 sq. km.) of the study area presently provides winter range. This allows a calculation of present carrying capacity to be made, using the carrying capacity estimates from Table 14 and the areas of winter ranges from Table 15. The length of time winter range is used is important because the carrying capacity estimates are in units of deer per square kilometer per year. For example a carrying capacity of 2 deer/sq. km./year is equal to 4 deer/sq. km./6 months. The period of winter range use, used for this calculation is six months, even though the actual period of high winter use is only about 4 months. This is because there is likely to be increased use of winter range in the late fall and spring as well as some use throughout the summer period. This "non-winter" use likely reduces the carrying capacity of the winter range by a small factor. A six month winter period is therefore thought to be a good estimate of the period of use of winter range.

This carrying capacity estimate (Table 16) is based on the present successional stages of the area. The potential of the area with optimal stages is presented in the next section (3.2.2) and a discussion of habitat enhancement is given in Section 4.2.

3.2.2 Capability for Deer

Capability for deer describes the potential of the area to produce deer if the area were in an optimal successional stage. Present seral stages are not considered. The capability population estimate can be compared to the

Table 15. The present area of summer and winter deer range in the Skagit River drainage (1:50,000).

Subzone	Summer		Winter	
	Class[1]	Area (sq km)	Class[1]	Area (sq km)
IDFe	3	10.3	2	19.0
	4	12.6	3	12.4
	5	0.4	4	3.0
	6	0		
CWHc	3	27.5	2	22.7
	4	23.5	3	0
	5	41.1	4	9.8
	6	0.2		
CWHb	3	17.3		
	4	47.0		
	5	85.5		
	6	4.0		
MHb	3	6.0		
	4	10.8		
	5	21.5		
	6	10.2		
ESSFf	3	87.3		
	4	85.6		
	5	298.2		
	6	155.9		
Total Area	3	148.4	2	41.4
	4	179.5	3	12.4
	5	361.2	4	12.8
	6	166.3		

[1]See Table 15 for the carrying capacity estimates of these classes. 166.3 sq km were rated class 6, no capability.

Table 16. A present deer carrying capacity estimate for the Skagit River Drainage (1:50,000).

Subzone	Class[1]	Carrying Capacity[1] (deer/sq km/year)	Area of[2] Winter Range	Number of Deer
IDFe	2	13.3	19.0	505
	3	8.0	12.4	198
	4	3.3	3.0	40
CWHc	2	13.3	22.7	604
	3	8.0	0	0
	4	3.3	9.8	65
Total			66.9	1,412

[1]average values from Table 15, to be doubled for a six month period
[2]from Table 16

present suitability population estimate (Section 3.2.1). The comparison of these two map themes provides an indication of the areas in which habitat improvement can occur.

The present carrying capacity estimate of 1,412 deer and the capability carrying capacity estimate of 1,790 deer seem high when compared to previous estimates. Slaney (1973) estimated about 400 deer use spring range on the proposed reservoir site. However the 1:50,000 map area of this study is a much larger area and includes some other important ranges. Also, winter range carrying capacity should have increased with seral progression over the 15 years since Slaney's work. The IDFe is more extensive than the area referred to by Slaney, and has a present carrying capacity estimate of 743 deer. The CWHc has some extensive winter ranges, contributing an additional 669 deer. If these carrying capacity estimates are too high then either the distribution of winter range is too extensive as shown and/or the classes are too high. Computer generated maps can also result in some overstimation because they do not consider factors such as the value of adjacent areas or topographic shading. However, this source of error is not large in this project.

The capability model is much the same as the suitability model (Section 3.2.1) without seral stage. Biogeoclimatic subzone, habitat unit, slope, aspect and elevation are the variables used. Table 17 show the potential area of winter range and the capability capacity estimate.

3.2.3 Present Habitat Suitability for Elk

This habitat model is similar to that described in Section 3.1.3 for the 1:20,000 area. As noted by Barnard (1986), little potential for elk winter range occurs outside of the Skagit Recreation area. The only other possible areas are the southerly aspects of the Klesilkwa River west of the Recreation area and northeast along the upper Skagit River to and including the Sumallo River deer wintering area. This latter area should be discounted as an elk wintering area because of its restricted size, higher snow depth and the small floodplain adjacent to a major highway.

page break

A number of suitable elk summer range areas appear on the map. Avalanche chutes provide good potential summer range in many areas of the CWHc, MHb and

Table 17. Capability for deer winter range and a potential carrying capacity estimate for the Skagit River drainage (1:50,000).

Subzone	Class[1]	Carrying Capacity[1] (deer/sq km/year)	Area of Winter Range	Number of Deer
IDFe	2	13.3	22.4	596
	3	8.0	22.7	363
	4	3.3	2.5	17
CWHc	2	13.3	28.0	745
	3	8.0	0	0
	4	3.3	10.5	69
Total			86.1	1,790

[1]average values from Table 15, to be doubled for a six month period.

ESSFf subzones. Mature and old growth forest often provide cover adjacent to the foraging areas provided by avalanche chutes. Recent cutovers can providegood elk summer range if adequate hiding and thermal cover remains. Some areas, such as Maselpanik Creek, lack such cover after extensive logging. The Parkland meadow and Avalanche chute habitat units of the ESSFf subzone potentially provide excellent potential summer range. Some elk use of these meadows in northern Manning Park has been reported. These elk are most likely from the Princeton population (an introduction in 1931) which appears to have been expanding its summer range in this area (Lincoln pers. com.). Table 18 illustrates that good quality potential summer range for elk is abundant.

Winter range was mapped but its quality is less certain. For this reason a present carrying capacity was not calculated. The winter carrying capacity for the Skagit River drainage is likely less than 100 elk by the author's estimation, but this is difficult to substantiate. The summer population could be considerably higher since winter ranges occur outside of study area.

3.2.4 Suitability for Spotted Owl

The habitat requirements of the spotted owl were described in Section 3.1.4. The most extensive area of suitable habitat outside of the Recreation Area occurs in the Nepopekum Creek drainage. One spotted owl was located here during 1986 (Forsman and Booth 1986). Spotted owl use east of this area is unlikely as spruce, subalpine fir and lodgepole pine forests become more common. Spotted owl occurrence in the ESSF zone is unlikely (Forsman pers. com.). Many of the more coastal habitat units outside of the Recreation Area have frequent bedrock outcrops and are on steep slopes. This results in an open forest cover with a lower potential for spotted owl habitat. Most coastal areas which have good potential for spotted owl habitat (ie. good forest sites) have been logged, such as Maselpanik Creek. Therefore most of the spotted owl habitat that is not in Manning Park occurs in the Skagit Recreation Area.

P.B.

As with the 1:20,000 scale map area, areas that have dense coastal old growth forests received a high rating. Areas of younger forest or more open

Table 18. The present area of summer and winter elk range in the Skagit River drainage (1:50,000)

Subzone	Summer		Winter	
	Class[1]	Area (sq km)	Class[1]	Area (sq km)
IDFe	3	1.1	3	35.0
	4	12.3	4	8.7
	5	0.4		
	6	0		
CWHb	3	13.5		
	4	50.8		
	5	84.5		
	6	4.0		
CWHc	3	22.5	3	27.6
	4	23.5	4	9.8
	5	41.1		
	6	0.2		
MHb	3	0.9		
	4	7.7		
	5	29.7		
	6	10.2		
ESSFf	3	87.5		
	4	85.4		
	5	325.2		
		155.9		
Total Area	3	125.5	3	62.6
	4	179.7	4	18.5
	5	480.9		
	6	170.3		

[1] Carrying capacity estimates for elk winter range were not calculated because of a present lack of knowledge of habitat importance.

stands received lower ratings. Old growth forests in the ESSF and MH received a low rating. The total area of spotted owl habitat appears in Table 19.

3.3 Additional Map Products

The CAPAMP stored habitat information allows the present species interpretations to be changed or other species interpretations to be done. These are dependent on the existing polygons and associated information. Changes to the polygons and their attributes can be done on a limited basis, for example to correct errors or to update the maps from recent disturbance such as logging or forest fire. Extensive changes would require re-entering of the polygon linework and their attributes. Other suggested themes include places to view wildlife and suitability for black bear and grizzly bear.

Maps of Geologic Hazard and Terrain Constraints could be produced from the surficial geology information. These would be of use for the planning of roads, trails or logging. Such maps predict areas where flooding, avalanching, rockfall, slope stability or excessive erosion would be likely to occur. Similar interpretations are commonly used to predict sedimentation of streams from road building or logging activity.

Mountain goats are common in the northern portion of the Skagit River drainage. Important winter ranges occur on the low elevation, southerly aspect, forested rock bluffs above the Klesilkwa River, the upper Skagit River and the Sumallo River. Summer range is more extensive and at higher elevations. Mountain goat habitat was not produced as a map theme for this project since computer mapping methods were considered unreliable for this purpose. This theme will be produced manually using this habitat information and airphoto interpretation. It will be produced along with other maps for the Chilliwack River area, a current project to the west of the Skagit River drainage. In addition, habitat mapping is underway for Manning Park and the recently established Cascade Recreation Area to the east of the Skagit River drainage. These areas will match the habitat units and interpretations shown in the 1:50,000 scale Skagit map area.

Table 19. Area of suitable spotted owl habitat in the Skagit River drainage

Subzone	Rating	Area (sq km)
IDFe	High	2.9
	Medium	0
	Low	31.3
	Nil	23.4
CWHc	High	8.4
	Medium	2.4
	Low	60.0
	Nil	53.9
CWHb	High	47.3
	Medium	152.9
	Low	49.1
	Nil	56.5
ESSFf	Low	202.4
	Nil	451.8
MHb	Low	20.0
	Nil	28.5

4. RECOMMENDATIONS

4.1 Deer Winter Range

Shelter from deep snow and high arboreal lichen production are important features of deer winter range in the Skagit River drainage. There are presently many areas of winter range that would have been less suitable twenty years ago because of younger stand ages. Some winter ranges, such as the Sumallo River area, may have only recently become good winter range. They will improve with time as larger trees intercept more snow and arboreal lichen production of the stand increases.

Commercial logging or forest fire on good winter range areas that results in an open forest canopy will reduce winter range suitability in most cases. Some logging of areas that do not have the potential for good winter range could benefit deer. Sites which do not have a southerly aspect and some of the level to gently sloping lower elevations of the IDFe are possible sites for logging. The Douglas fir - Oregon-grape habitat unit has many such areas and in addition is a good forest site. Openings should be small and discontinuous so that they do not block deer winter movements. Such openings would provide late spring and early summer range (they will not have early spring growth because of aspect) for deer. They would increase habitat diversity for wildlife species in general, but reduce the suitability of habitat for spotted owls. Logging near the reservoir where snow depths are least may improve deer habitat by increasing rooted forage. Snow interception is less important in this area. Such areas should be small and done on a test basis.

Some non-commercial thinning of good winter range areas could be attempted in the IDFe subzone. Removal of some subdominant trees could increase light penetration that would improve growth of rooted forage (mainly Oregon boxwood) and possibly also arboreal lichen production. Moderate slopes on southerly aspects with deep surficial materials and a mature Douglas fir forest cover are probably the best areas for such treatment. Most steep or rocky slopes presently have adequate light penetration and do not require thinning. Such thinning would be of low intensity so as to not reduce snow interception or create debris that would be a barrier to deer movement. This would best be done first as several small test areas to determine its

effectiveness. Personnel from the Integrated Wildlife Intensive Forestry Research Program (IWIFR) should assist, as they have the greatest experience in this area.

Some burning or logging of early winter range at high elevation would probably benefit deer by producing abundant forage. Such areas should be small to provide cover and allow easy movement to the main winter range when needed. Large cutovers such as those in Shawatum Creek should be avoided.

4.2 Deer Spring Range

Deer spring range is not abundant and is poorly distributed with respect to winter range in the IDFe subzone. The winter range of the CWHc subzone appears to have adequate spring range in most areas because of frequent bedrock outcrops, avalanche chutes and some logging. Figure 3 shows some potential enhancement areas which would provide a better distribution of spring range with respect to winter range. These are only some of many potential areas, and other areas or more areas could be selected if desired.

Detailed ground inspection of the proposed sites is necessary. The sites noted are near existing roads so as to minimize road construction and to permit viewing of deer and other wildlife species. Sites selected should have some southerly aspect to increase the rates of snowmelt and plant growth. Openings should be at least three tree heights in width to prevent shading of the site. Elongate shaped clearings would be preferred because of increased edge. Following tree removal the remaining debris should be piled and burned. Sites should be seeded with a grass mix to reduce tree regeneration, and of species that will be palatable for deer. Saskatoon, a preferred browse species, should be retained, if possible, during site treatment. Planting of saskatoon could be considered.

If dense tree and/or shrub regeneration reduces the effectiveness of sites for spring range, repeated or additional disturbance may be necessary. This could include scarification, discing and seeding of sites, or spring burning when the adjacent forest is wet enough to prevent fire spread. The intent of these methods is to discourage tree regeneration and develop a grass/shrub disclimax which will have a lasting effect. In any case, trials should be

conducted to determine the effectiveness of the methods used before large scale clearing is undertaken. One hectare openings would be an adequate testsize, with a final size of five to ten hectares. Slaney (1973) described the creation of a small meadow, but this site was not visited during this survey. The effectiveness of this treatment should be checked.

The present meadows should be maintained. They are important because many deer have developed a pattern of using these areas (Slaney 1973). Encroaching trees should be removed by cutting. The mature ponderosa pines of Ponderosa Meadow and some ponderosa pine regeneration should be retained for ecological interest. Although the area of Ponderosa Meadow could be enlarged, there is already considerable spring range in this area. The Ross Lake drawdown area and the active Skagit River floodplain all provide spring range. Whitworth meadow is considered to be a good spring range, but it is on a coarse textured, dry site with relatively poor herb production. Whitworth meadow should be maintained at its present size by removal of tree regeneration, but not enlarged. Better sites for spring range enhancement exist.

Prescribed fire on these meadows would have no obvious advantage over cutting and could reduce the shrub production of these areas. Saskatoon is a particularly important spring forage species and may have reduced productivity after burning. However, the effects of fire are difficult to predict. The high soil moisture of this area during the spring would likely protect shrub root systems from damage and not reduce productivity. Shrubs often grow vigourously after burning and are more attractive to ungulates. Regardless, burning should be conducted on small test areas before being applied to larger areas.

These meadows provide good opportunities to view deer from April until about the end of June. Deer concentrate on these openings, often feeding throughout the day and are more easily approached than at other times of the year. The creation of similar openings along the eastern side of the Skagit River Valley would make better quality spring range available to more deer and improve viewing opportunities.

Maintenance of wildlife diversity is a high priority with the Ministry of Environment and Parks. Habitat diversity of forested units is low in much of

the IDFe, since forest cover is mainly mature Douglas fir with few forest openings. If diversity is to be maintained or enhanced, more openings or younger seral stages should be considered. This would also benefit deer spring range.

4.3 Elk Potential

Sections 3.1.3 and 3.2.3 described the area of Skagit within the IDFe as having moderate potential for elk winter range. Little potential winter range occurs outside of this area (also see Barnard, 1986).

Two strategies exist to establish elk. One is to wait to see if dispersing elk will become established in the area. Elk have been occasionally sighted in the Skagit drainage since 1981 and perhaps as early as 1965 (Barnard, 1986). This timing roughly corresponds to the expansion of elk in Washington. Although elk range widely during the summer months, they are likely to return to their winter range. Elk winter ranges do not presently occur in Washington near the British Columbia portion of the Skagit River drainage. The usual small group size of summer dispersing elk and a poor (or no) sex ratio of these groups further limit the chance of establishment by dispersal.

Introduction is more likely to have success over the long term. The number of elk and the sex ratio can be controlled. An introduction has no guarantee of success, but it is more likely that a pattern of habitat use in the lower Skagit River valley can be established in this manner.

4.4 Spotted Owl Habitat

The habitat available to spotted owls is discussed in sections 3.1.4 and 3.2.4. There is a successional trend towards increasing habitat suitability in the Skagit Recreation Area and the coastal portion of Manning Park. This is particularly true in the Recreation Area where extensive mature seral Douglas fir stands occur. Most old growth habitat suitable for spotted owls in the Skagit River drainage outside of these two areas has been logged. The trend here is towards decreasing habitat.

Deer spring range enhancement would require some clearing in the Recreation Area. These areas would be very small and would have a negligible effect on spotted owl habitat. Enhancement of winter range that maintains snow interception would not effect the suitability of the habitat for spotted owls.

Logging in the Recreation Area would have a detrimental effect on the present and long-term habitat suitability for spotted owl. Most stands in the IDFe subzone of the Skagit Recreation Area are only just becoming old enough to be suitable for spotted owls. Although Forsman and Booth (1986) did not locate a spotted owl in this area, it is not known whether habitat suitability or competition from barred owls is responsible. Population trends of spotted and barred owls cannot be predicted as these forests change from a mature to old growth forest structure.

Management of the Skagit Recreation Area for spotted owls is in conflict with habitat diversity objectives for other species. Habitat diversity is necessary to maintain species diversity. Slaney (1973) noted the abundance and diversity of passerine birds using the Ponderosa Meadow area. Management of the entire area for uncertain benefit to the spotted owl would benefit few other species.

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APPENDIX A
Habitat Type Description

APPENDIX A: Table of Contents

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INTRODUCTION

This appendix provides a description of the site characteristics of each habitat unit and the vegetation commonly occurring at each successional stage. Successional stages which were not mapped in the study area but which could occur with disturbance or succession are shown in brackets eg. (3). A description of habitat importance to some wildlife species is included.

The habitat units of the 1:20,000 scale map area (Skagit Recreation Area) provide more detail than those of the 1:50,000 scale map area. Some of the former habitat units were grouped for mapping at the 1:50,000 scale. Their names have been altered to reflect this difference. If the habitat unit name is the same for both areas (eg. Rock - Douglas-fir), then their descriptions are similar. An example of altered habitat names is the lumping of Grand fir floodplain and Cottonwood fluvial fan of the 1:20,000 area into the Cottonwood-cedar habitat unit of the 1:50,000 area.

The seven successional stages used were: 1, sparsely vegetated (recent disturbance); 2, pioneer seral herb stage (< 20 years old); 3, pioneer seral shrub stage (< 20 years old; 4, young seral forest (20 - 100 years old); 5, mature seral forest (100 - 250 years old); 6, mature climax forest (100 - 250 years old); 7, old growth (> 250 years old). The ecological moisture regime classes of very xeric, xeric, subxeric, submesic, mesic, subhygric, hygric, subhydric and hydric are described in Walmsley et. al. (1980).

The following habitats are described by biogeoclimatic subzone and are arranged from driest to wettest moisture regime. A correlation of these habitats to other studies appears in Appendix C.

1. Habitats of the Skagit Recreation Area (1:20,000)[1]

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[1] Mapped only below about 1,220 m (4,000 ft.) to include important deer winter range and spotted owl habitat. The area above this elevation is mapped at 1:50,00 scale only.

1.1 Interior Douglas-Fir 'e' Subzone

1.1.1 Rock - Douglas-fir.

This habitat unit occurs on steep southerly aspect rock outcrops. It is common along the upper elevations of the study area east of the lower Skagit River. Later successional stages (5-7) provide good deer winter range because of the snow interception of large Douglas fir trees and the snow depth reduction by steep slope and southerly aspect. Rock outcrops create permanent openings that allow a variety of browse plants to be maintained. The slow tree growth and good light penetration on these areas results in abundant arboreal lichen production. This is an important component of ungulate winter forage. Younger seral stages have little winter use by deer because of deep snow. Spotted owl habitat was rated as low for mature seral stages and as moderate for old growth because of the frequent small openings in the forest canopy. Rate of succession is slow.

Successional Stages

1. Sparsely Vegetated. The dryness of these sites and their shallow soils result in slow succession after disturbance.

(2.) Pioneer Seral Herb. Moderate abundance of low shrubs such Oregon boxwood, saskatoon and Oregon-grape. Pine grass, pipsissewa and strawberry are common.

(3.) Pioneer Seral Shrub. Moderate abundance of low (see stage 2) and tall shrubs such as oceanspray, vine maple and willow. Douglas-fir regeneration may be clumped because of dry rocky soil.

4. Young Seral Forest. Shrubs may remain in rocky openings, but have low abundance in the dense young Douglas-fir forest. Lodgepole pine is a common seral tree species, especially after fire.

(5.) Mature Seral forest. Even aged mature Douglas-fir or lodgepole pine forest with relatively small trees and slow growth for their age because of the dry site. Arboreal lichen density may be high. Many forest openings remain.

6. Mature Climax Forest. Douglas fir remains dominant because of the edaphic nature of this site. Some western hemlock and western red cedar are present in the understory. Oregon boxwood and pipsissewa are common in the understory. Rocky openings are moss covered with a low to moderate shrub abundance. Arboreal lichen density is usually very high.

(7.) Old Growth Forest. Similar to 6 above, but with some mature western hemlock and western red cedar in the dominantly Douglas-fir forest.

1.1.2 Talus Slope. This habitat unit is not common in the IDFe because of the less mountainous nature of the terrain there. Talus slopes can be active and have very little vegetation (stage 1) or inactive (stage 3). Inactive areas are often moss covered with scattered shrubs such as saskatoon and oceanspray.

1.1.3 Pine - kinnikinnick. This uncommon habitat unit occurs only on the valley bottom in the northern portion of the IDFe. The open canopy of lodgepole pine (30% crown closure) and sparse understory result from the dryness of these gravelly terraces. Kinnikinnick, arboreal lichen and terrestrial lichens are common on these sites, but other shrubs and herbs are sparse. Pacific rhododendron occurs on these sites, but is more common in areas with more climatic moisture either in, or transitional to the CWHc Subzone. Succession is retarded because of dryness and low nutrient availability.

Only stage 4 (young seral forest) was mapped. Older stages would have an open canopy of stunted Douglas fir with some lodgepole pine remaining.

1.1.4 Douglas fir - saskatoon. This habitat unit occurs extensively along the steep southwest facing slopes of the eastern Skagit River valley. It has deeper soils and a more continuous forest canopy than the closely associated Rock - Douglas fir habitat unit. Shrubs and herbs are more abundant in pioneer seral stages, but may be sharply reduced under the shading of the denser canopies of young and mature forests. Crown closure is more open on steeper and more southerly aspects, while being denser on the more typical moderately sloping westerly aspects. These latter areas have more moisture available to plants. Rate of succession is moderate, being slightly faster where more soil moisture is available. This is an important habitat unit for deer winter range, since older closed canopy Douglas-fir forests have good snow interception and may produce abundant arboreal lichen. Oregon boxwood, an important winter forage for deer is abundant and partially available with normal snow conditions under the canopy of large Douglas fir trees. Old growth forests may have high suitability for spotted owls.

Successional Stages

(1.) Sparsely Vegetated. This stage would be of short duration following severe disturbance.

(2.) Pioneer Seral Herb. This stage would have a continuous herb cover, most likely composed of pine grass, peavine, heart-leaved arnica, chickweed, strawberry, and young shrubs. On southerly aspects at lower elevations this stage would provide good spring range, although it would be relatively short lived because trees will invade the site.

3. Pioneer Seral Shrub. Abundant shrub production can occur on these sites. Douglas fir, saskatoon, vine maple, oceanspray, bitter cherry, snowberry, rose, willow, Oregon-grape and Oregon boxwood are common. Snowbush ceanothus and redstem ceanothus may also occur, especially after fire. During the deeper snow period of the winter, these shrubs are usually unavailable to deer because of a lack of snow interception by large trees.

4. Young Seral Forest. Dense Douglas-fir forest restricts shrub and herb production except on steep slopes or following severe disturbance. Snow interception of the stand is moderate and arboreal lichen density is low.

5. Mature Seral Forest. Mature Douglas-fir trees of this stage provide good snow interception and may have abundant arboreal lichen, especially on steeper south aspects. Oregon boxwood and Oregon-grape are the main browse species under this closed canopy, except on steeper southerly aspects where a variety of shrubs (see 3) may remain.

6. Mature Climax Forest. This is similar to stage 5 except that western red cedar may occur in the tree layer and is more abundant in the understory.

7. Old Growth Forest. This seral stage provides the best mix of snow interception and forage production for deer winter range. Large old Douglas-fir trees have very good snow interception ability and have abundant arboreal lichen. Openings in the forest canopy allow some shrub production. Western red cedar is common and is heavily used by deer. Such forests provide good habitat for spotted owls and cavity nesting birds.

1.1.5 Boxwood terrace. This habitat unit occurs on dry inactive fluvial terraces along valley bottoms, mainly on the eastern

side of the Skagit River. Surficial material textures are often sandy and not as gravelly as in the Pine-kinnickinnick habitat unit. Forest cover usually consists of slow growing Douglas-fir. The dryness of these sites (often subxeric) limits tree growth and results in a more open canopy than occurs on moister areas. These factors favour an abundance of Oregon boxwood and arboreal lichen in later seral stages. During severe winters deer may not use these areas because of the deeper snow conditions resulting from the relatively open canopy and level topography.
Forest succession is slow.

Successional Stages

(1.) Sparsely Vegetated. Vegetation will become established slowly because of the dryness of the soil.

2. Pioneer Seral Herb. Herb production is low to moderate on these dry sites. "Whitworth Meadow" is in this successional stage, although it is at a disclimax (very slow succession) from repeated disturbance. Common plants include kinnikinnick, pine grass, strawberry, yarrow, lupine and some introduced grass species. These areas provide good deer spring range, but herb productivity is low because of soil dryness.

3. Pioneer Seral Shrub. Shrub production is low to moderate on these dry sites. Common species include Douglas-fir, saskatoon, Oregon boxwood and red huckleberry.

4. Young Seral Forest. These young Douglas-fir forests have a partially open or closed canopy. Lodgepole pine and western white pine may occur as minor species. Shrub production is often reduced, arboreal lichen density is low and snow interception is poor.

5. Mature Seral Forest. These mature Douglas-fir forests have moderate snow interception and a moderate to high

arboreal lichen density. Oregon boxwood is common in the understory. Tree growth is slow.

(6.) Mature Climax Forest. This stage would be similar to "5", but with western red cedar and western hemlock common in the main canopy and in the understory.

(7.) Old Growth Forest. This stage would have a forest of Douglas-fir, western red cedar and western hemlock. Douglas-fir trees have an irregular growth form, often with dead tops and a high arboreal lichen density. Oregon boxwood and western red cedar are common. Snow interception would be lower than stages 5 or 6 because of more mature hemlock and cedar trees.

1.1.6 Douglas fir - Oregon-grape. This habitat unit occurs extensively along the gently sloping terraces and lower slopes of the east side of the Skagit River valley. It often occurs in an intermediate slope position below the Douglas fir - saskatoon habitat unit and above the Boxwood terrace habitat unit. The moisture regime is usually wetter than the Boxwood terrace habitat unit because of a receiving moisture position and often a finer textured surficial material. These are good sites for tree growth, with most areas presently supporting even aged stands of mature Douglas-fir. Arboreal lichen density of these stands is low because of their rapid growth and close stocking. Shrub production is generally low under mature canopies. The Douglas-fir - Oregon-grape and the Boxwood terrace habitat units commonly intergrade since there are many areas of intermediate soil texture and moisture. Rate of succession increases with improved soil moisture.

Successional Stages

(1.) Sparsely Vegetated. This stage would be relatively short lived because of the rapid growth on this site.

(2.) Pioneer Seral Herb. This stage would have an abundant herb growth. Common species would include fireweed, pine grass, heart-leaved arnica and young shrubs.

3. Pioneer Seral Shrub. This stage can have dense shrub cover dominated by vine maple with oceanspray, saskatoon, California filbert, rose, and Oregon-grape. Douglas-fir regeneration may be dense.

4. Young Seral Forest. This stage often has dense Douglas-fir with a closed canopy and a sparse understory. Snow interception is poor.

5. Mature Seral Forest. This seral stage has an even aged mature Douglas fir forest with a closed canopy. The understory is sparse, with vine maple, Oregon-grape, pipsissewa and northern twinflower occurring commonly. Arboreal lichen density is usually low because of the high stand density and good tree growth. Snow interception is good, but deer forage availability is low.

6. Mature Climax Forest. This stage has some western red cedar and western hemlock in the main canopy and more in understory layers. Snow interception is less than seral stage 5.

7. Old Growth Forest. Western hemlock and western red cedar are common in the stand, with some Douglas-fir remaining. Snow interception is less than stage 5.

1.1.7 Douglas-fir - clintonia. This habitat unit is found on level or gently sloping areas of the lower Skagit River valley bottom. It occurs on silty or sandy fluvial terraces with a mesic ecological moisture regieme. Some areas may be rarely flooded. Most areas undergo rapid succession and have a high diversity and abundance of plant species. This is an important habitat unit for deer, and potentially for elk and

spotted owls in older seral stages. This habitat unit has the best potential for deer spring range enhancement.

Successional Stages

(1.) Sparsely Vegetated. This stage would be short lived because of rapid succession.

2. Pioneer Seral Herb. This stage has abundant and diverse herb growth. Ponderosa Meadows is at this stage although it is presently a disclimax from repeated disturbance. This stage will be of short duration without repeated or severe disturbance. Common species include grasses (especially blue grasses), rose, lupine, yarrow, strawberry, cinquefoil, and a variety of young shrubs.

3. Pioneer Seral Shrub. This stage can have a dense shrub cover, including Douglas-fir, grand fir, saskatoon, rose, snowberry, vine maple and thimbleberry.

4. Young Seral Forest. This stage may have a dense canopy of Douglas-fir and grand fir. The shrub understory (see 3) will be reduced.

5. Mature Seral Forest. This stage has a mature closed canopy of Douglas-fir, grand fir and western red cedar. Understory shrubs include Oregon-grape, Oregon boxwood, vine maple and thimbleberry. Snow interception of these forests is good and provide potential winter shelter for elk, especially as these areas are near the floodplain.

(6.) Mature Climax Forests. This stage would be similar to 5 above but with more abundant grand fir and western red cedar.

(7.) Old Growth Forest. This seral stage would be dominated by western red cedar and grand fir with a minor component of Douglas-fir. Since tree growth is good on this habitat unit, large trees with very good snow interception would be common.

1.1.8 Cottonwood Fluvial Fan. This habitat unit occurs where tributary streams reach the gently sloping Skagit River valley bottom. They usually have moist soils from flooding and groundwater movement. Old channels and diverse vegetation from stream course changes are common. Forest cover is usually mixed Douglas-fir, western red cedar and black cottonwood. Shrub and herb cover is diverse and abundant, providing good foraging for deer and (potentially elk). The forest cover has openings which reduce its potential for spotted owl habitat. Passerine diversity is high. Older cottonwood trees provide good habitat for cavity nesters. Succession is rapid but may be slowed by a high water table or stream activity. Some large areas of this unit are included in the Douglas fir Ecological Reserve (Number 21).

Successional Stages

(1.) Sparsely Vegetated. This stage would be short lived because of rapid succession.

(2.) Pioneer Seral Herb. This stage would have an abundant herb cover of vanilla leaf, wild rye grass, sweet cicely, sweet-scented bedstraw, stinging nettle and young shrubs.

3. Pioneer Seral Shrub. A dense shrub cover of vine maple, black cottonwood, western red cedar, Douglas-fir, red-osier dogwood, thimbleberry and red alder may occur.

Species may vary with material texture, soil moisture and disturbance.

4. Young Seral Forest. This stage may have dense clumps of Douglas-fir, western red cedar, black cottonwood and red alder. Shrub production will be low in these areas. Some openings remain, especially near stream channels. Snow interception is poor.

5. Mature Seral Forest. Mature seral forest may have extensive areas of Douglas-fir forest similar to the Douglas-fir - clintonia habitat unit. Tree growth is good. High shrub production remains near openings. Good snow interception under areas of dense Douglas-fir.

(6.) Mature Climax Forest. Similar to 5 above but with more western red cedar in the main canopy and in understory layers.

(7.) Old Growth Forest. Forest canopy dominated by western red cedar and western hemlock with some old Douglas-fir remaining.

1.1.9 Grand Fir Floodplain. This habitat unit occurs along the larger tributaries and floodplain of the Skagit River. Flooding frequency may be frequent or rare, depending on an area's elevation and position with respect to the main active river channel. This habitat unit has a heterogeneous vegetation pattern reflecting past flood occurrence and present water availability. Although usually mapped as having one or two successional stages, these areas often contain other stages. The habitat heterogeneity of these areas and the presence of free water make this an important area for many wildlife species. Shrub and herb diversity and production are high in young seral stages. Such young areas are often closely associated with coniferous forest, thereby increasing habitat heterogeneity. Floodplains have the highest diversity of plant and wildlife species in the area,

thereby enhancing their already high recreational value. The lower Skagit River has a very actively changing channel. Rate of succession is variable on floodplain units.

Successional Stages

1. Sparsely vegetated. This stage is common on very actively flooded portions of the river (gravel bars). They are very sparsely vegetated and remain so until less frequently flooded.

2. Pioneer Seral Herb. This area often has patchy herb cover on sandy soil. Common herbs include strawberry, pyrola, dandelion, cow-parsnip, horsetails, ferns and grasses. Seeding shrub and tree species may be common.

3. Young Seral Shrub. Shrub cover is dense unless near the active portion of the river. Commons shrubs include vine maple, red-osier dogwood, twinberry honeysuckle, hardhack, ninebark, rose, devils'-club and young tree species, especially black cottonwood. Red alder may also occur.

4. Young Seral Forest. This stage has clumped stands of black cottonwood with some regenerating conifer species. Similar shrub species (see 3) occur but may be reduced in abundance from shading. Snow interception is poor.

5. Mature Seral Forest. This forest is dominated by western red cedar and grand fir with some Douglas-fir and black cottonwood. Vine maple, devils'-club, thimbleberry and a variety of other shrubs are common, but not abundant. Snow interception is moderate to good.

(6.) Mature Climax Forest. This forest would be similar to 5 but with less cottonwood and Douglas-fir in the main canopy.

(7.) Old Growth Forest. This forest would have large grand fir and western red cedar trees combined with other age classes. Snow interception would be good and some browse available in forest openings. This forest stage existed on much of the lower Skagit River floodplain prior to the reservoir clearing of the 1940's.

1.1.10 Willow - twinberry honeysuckle. This habitat unit occurs on the wet soils common along the back channels of the Skagit River. Shrub cover is often dense and tree cover sparse. Forest succession occurs slowly as long as the water table remains high, with some areas remaining as a shrub disclimax for long periods. This is an important habitat unit for many wildlife species.

Successional Stages

(1.) Sparsely Vegetated. These areas would rapidly become vegetated because of the abundant soil moisture.

(2.) Pioneer Seral Herb. These areas would have a dense cover of grasses, horsetails and young shrubs.

3. Pioneer Seral Shrub. Most areas of this habitat unit are at this seral stage. Shrubs such as willows, twinberry honeysuckle, western trumpet honeysuckle and hardhack usually form a dense and long lasting shrub cover.

Older successional stages are not likely to occur.

1.1.11 Wetland. Wetlands are small and occur infrequently in this area. Only 2 seral stages are described and succession proceeds very slowly. Their importance to large mammals is poorly documented in this area, but passerine birds and waterfowl are common.

Successional Stages

2. Pioneer Seral Herb. These wetlands are dominated by sedges and contain free water for most of the year. Shrubs often occur around the wetland fringe.

3. Pioneer Seral Shrub. These wetlands are dominated by hardhack with sedges. Willows and twinberry honeysuckle may occur around the wetland fringe. These areas do not contain free water as long as 2 above.

1.1.12 Vine maple avalanche chute. This habitat unit is not common in the IDFe. These areas have variable surficial material unit and depth and variable soil moisture. Most upper elevations have extensive rock outcrop. Lower elevation areas often have deeper colluvial and morainal materials with greater soil moisture. The runout areas of the avalanche chutes often contain lush herbaceous meadows. Avalanche chutes at lower elevations on southerly aspects provide important spring range for deer and black bear. Higher elevations and other aspects become important foraging areas later in the summer. Most areas are in a disclimax condition because of repeated avalanching. Only 3 seral stages are described.

Successional Stages

1. Sparsely Vegetated. This is common in the upper portion of the avalanche chute where steep slopes, shallow soils and bedrock are common.

2. Pioneer Seral Herb. Small areas of this stage occur along stream edges and at the base of avalanche tracks. A lush herb cover of grasses, sedges, lady fern, cow-parsnip, stinging nettle and other herbs is typical.

3. Pioneer Seral Shrub. Most areas of avalanche track are presently in this stage. Vine maple is the most common shrub, with willow, Sitka mountain alder, thimbleberry, elderberry, devil's-club and currant occurring commonly. Many of the herbs mentioned in stage 2 also occur.

1.2 Coastal Western Hemlock 'c' Subzone

1.2.1 Rock - Douglas-fir. This can be considered the same as the Rock - Douglas-fir unit of the IDFe. The CWHc has more precipitation than the IDFe, but this effect is largely negated by a steep southern exposure and shallow soils. This unit is common at low elevation in the CWHc and only upper elevations of the IDFe. This habitat unit occurs extensively on the southerly aspects of the Skagit River from the western to eastern boundaries of the Skagit Recreation area. Some important deer winter ranges occur in this area. Stages 1 and 3 - 7 were mapped. See IDFe for these descriptions.

1.2.2 Talus slope - see IDFe.

1.2.3 Douglas-fir - lichen. This habitat unit occurs on steep southerly aspects with shallow soils. The dryness (xeric to submesic) of the soil and steep slope results in a continuous but relatively open forest cover (< 30% crown closure) of Douglas-fir. These areas are similar to the forested portions of Rock - Douglas-fir. This habitat unit is analagous to the Douglas-fir - saskatoon habitat unit of the IDFe, except that Douglas-fir - lichen commonly has steeper slopes and more southerly exposure. Arboreal lichen is abundant in later seral stages. These areas provide the most important deer winter ranges in the CWHc. Rate of succession is slow.

Successional Stages

1. Sparsely Vegetated. Plant establishment will be slow to moderate because of the dryness of the site.

2. Pioneer Seral Herb. This stage has a sparse to moderately abundant cover of herb species adapted to dry sites. These include fireweed, Indian paintbrush, stawberry, and young shrubs.

3. Pioneer Seral Shrub. This stage may have a variable shrub cover indlucing saskatoon, vine maple, California filbert, Oregon boxwood, snowbush ceanothus, redstem ceanothus and regenerating Douglas-fir. Stages 2 and 3 usually provide good spring deer range.

4. Young Seral Forest. This stage has a predominantly Douglas-fir forest with few openings. The shrub cover of stage 3 above is reduced by shading. Snow interception and arboreal lichen density are low to moderate.

5. Mature Seral Forest. This stage has an open canopy of Douglas-fir with a sparse to moderate shrub understory, including Oregon boxwood, vine maple, oceanspray, saskatoon and Oregon-grape. Arboreal lichen density is high and snow interception is moderate to high.

6. Mature Climax Forest. This stage is similar to 5 above but includes more western red cedar in the main canopy and understory. Some Douglas-fir regeneration occurs in openings. This stage is mapped extensively.

(7.) Old Growth Forest. This stage would include all-aged Douglas-fir with western red cedar. Snow interception would be reduced slightly from stages 5 and 6, but rooted forage and arboreal lichens would be more abundant.

1.2.4 Hemlock - boxwood. This habitat unit occurs on terraces near the valley floor. These terraces have a coarse soil texture and are sometimes bouldery. It is analagous to the Douglas fir - boxwood habitat unit of the IDFe, but hemlock has replaced Douglas fir because of the increased climatic moisture of the CWHc. Snow depths are higher than on the nearby areas of Douglas-fir - lichen or Rock - Douglas fir habitat units upslope. Topographic shading and cold air drainage often have a cooling influence on the Hemlock - boxwood habitat unit. Snow interception by hemlock forest is poor, except for old growth. Rate of succession is moderate to rapid. Only stages 4 and 5 were mapped.

Successional Stages

(1.) Sparsely Vegetated. This stage would be of short duration.

(2.) Pioneer Seral Herb. This seral stage would have a moderate cover of fireweed, strawberry, kinnikinnick, Canadian bunchberry and young shrubs.

(3.) Pioneer Seral Shrub. Common shrubs would include black huckleberry, vine maple, saskatoon and willow. Tree regeneration will include hemlock, Douglas-fir and western red cedar.

4. Young Seral Forest. This seral stage is usually dominated by hemlock. Douglas-fir or lodgepole pine may be dominant if the site is unusually dry or on a southern exposure. Shrub production is reduced and snow interception is low to moderate. Pacific rhododendron commonly occurs on these sites.

5. Mature Seral Forest. This forest cover is dominated by mature Douglas-fir, usually being on a southern exposure without topographic shading. Snow interception is moderate to high. Arboreal lichens may be abundant. The

shrub understory is sparse, but may include significant amounts of Oregon boxwood and Oregon-grape, providing good deer winter forage.

(6.) Mature Climax Forest. This forest cover is dominated by western hemlock and western red cedar. Snow interception and arboreal lichen density are low.

(7.) Old Growth Forest. These forests would have an uneven aged stand of western hemlock and western red cedar. Some Douglas-fir would remain on warmer sites. Snow interception and arboreal lichen density would be moderate to high.

1.2.5 Hemlock-moss. The Hemlock - moss habitat unit occurs extensively in the CWHc on a variety of surficial materials and sites. All of these areas have a cool, northerly aspect or are topographically shaded. Western hemlock forms dense stands on these sites and usually has a very sparse understory. Snow depths are usually high. Arboreal lichens are seldom abundant.

Successional Stages

(1.) Sparsely Vegetated. This stage would be short lived in most cases, but areas of steep slope or bedrock may remain unvegetated for long periods.

(2.) Pioneer Seral Herb. This stage would be dominated by fireweed, Canadian bunchberry and a low diversity of other herbs.

3. Pioneer Seral Shrub. This stage includes vine maple, black blueberry, and tree regeneration, mainly hemlock.

4. Young Seral Forest. Dense hemlock forest with a sparse understory is common. Douglas-fir may occur with hemlock on some sites.

5. Mature Seral Forest. This stage has a reduced tree density from stage 4 and a sparse understory. Western hemlock dominates and Douglas-fir is occasional in the main canopy.

6. Mature Climax Forest. This stage is similar to 5 above, but lacks Douglas-fir.

7. Old Growth Forest. These uneven aged stands of western hemlock and western red cedar have a sparse understory and a continuous ground cover of thick moss.

1.2.6 Cedar - clintonia. These forests occur on active fluvial fans of tributary streams along the valley bottom. Forest cover is usually dense and dominated by western red cedar and western hemlock. Some black cottonwood may occur along stream channels (stream channels not always present), but significant stands will likely be the closely associated Cottonwood - thimbleberry habitat unit (see 1.2.7). These are good areas for tree growth and some large trees can occur.

Successional Stages

(1.) Sparsely Vegetated. This stage would be short lived because of rapid succession on these moist sites.

(2.) Pioneer Seral Herb. This stage would have an abundant herb cover of fireweed, blue-bead clintonia, ferns and young shrubs. Southerly aspects may provide deer spring range.

3. Pioneer Seral Shrub. This stage has vine maple, devil's-club, black blueberry, black cottonwood, and regenerating conifers. Southerly aspects may provide deer spring range.

4. Young Seral Forest. Dense stands of western red cedar, western hemlock and Douglas-fir reduce shrub cover. Snow interception is poor.

5. Mature Seral Forest. Mature western red cedar, western hemlock and some Douglas-fir form the tree canopy. The sparse understory includes vine maple, devil's-club, black blueberry, Oregon boxwood, Oregon-grape and occasional Pacific rhododendron.

(6.) Mature Climax Forest. This stage was not mapped, but would include some old Douglas-fir trees.

7. Old Growth Forest. This forest is an uneven aged stand of western red cedar and western hemlock. Snow interception is moderate.

1.2.7 Cottonwood - thimbleberry. This habitat unit is closely associated with the somewhat drier Cedar - clintonia unit (1.2.6). Cottonwood - thimbleberry occurs on seepage areas near the base of fluvial fans and mountain slopes, adjacent to the floodplain. These areas often have a thick shrub cover, but snow interception is usually poor.

Successional Stages

1. Not Vegetated. This stage would be of short duration because of the good growing conditions of these sites.

(2.) Pioneer Seral Herb. This stage would have a lush herb cover of fireweed, grasses, ferns and shrub seedlings.

3. Pioneer Seral Shrub. This stage has an abundant shrub cover of vine maple, thimbleberry, devil's-club, red-osier dogwood, willow and black cottonwood.

4. Young Seral Forest. This forest is dominated by black cottonwood with some western red cedar. Shrub cover may be reduced from stage 3, but shrubs are still abundant.

5. Mature Seral Forest. Mature black cottonwood forests with a secondary canopy of western red cedar are common.

(6.) Mature Climax Forest. This forest has a dominant canopy of western red cedar and black cottonwood. Shrub abundance is reduced.

7. Old Growth Forest. This stage is an uneven aged stand of western red cedar with few black cottonwood remaining. The shrub layer is reduced, but shrubs are more abundant than in stage 6.

1.2.8 Red-osier floodplain. This habitat unit occurs along the floodplains of the Skagit and Klesilkwa Rivers in the CWHc subzone. This habitat is analagous to the Grand fir floodplain unit of the IDFe subzone, but occurs in the moister climate and deeper snow area of the CWHc. Many successional stages may occur in a small area. This is an important habitat unit for many wildlife species.

Successional Stages

1. Sparsely Vegetated. These areas are usually sparsely vegetated gravel bars.

(2.) Pioneer Seral Herb. These areas would usually have a sparse herb cover because of frequent flooding.

3. Pioneer Seral Shrub. These areas may have a dense and diverse shrub cover of black cottonwood, red alder, willow, western red cedar, black twinberry, red-osier dogwood, salmonberry and thimbleberry.

4. Young Seral Forest. These young forests may include black cottonwood, red alder and western red cedar in their tree layer, with a reduced understory of similar shrub species as described for 3. Snow interception is poor.

5. Mature Seral Forest. These forests have large black cottonwood trees often mixed with western red cedar, especially in lower tree layers. Red-osier dogwood and black twinberry are common shrubs but may be of low vigour. Snow interception is low to moderate.

(6.) Mature Climax Forest. These forests would be dominated by western red cedar with some black cottonwood and a sparse understory. Snow interception would be moderate.

(7.) Old Growth Forest. These forests would have an uneven aged stand of western red cedar with a sparse understory. Snow interception would be moderate.

1.2.9 Willow backchannel. This habitat unit occurs on river backchannels of the floodplain. The wet soils contribute to slow succession and a long lasting cover of shrubs. The dense shrub cover is similar to that described for the Red-osier floodplain habitat unit but is long lasting. Only stage 3 was mapped. Later successional stages would be unlikely to be densely forested but may have cottonwood and western red cedar. These areas are important for a large number of wildlife species. Snow depths are high.

1.2.10 Wetland. Wetlands are rare in the CWHc subzone, occurring mainly adjacent to the floodplain. Only stage 2 was mapped. These sedge dominated fens are often surrounded by a zone of

shrubs including hardhack, red-osier dogwood, willow and black twinberry.

1.2.11 Vine maple avalanche chute. See description in IDFe (1.1.12). Avalanche chutes in the CWHc subzone have more snowfall and occur more frequently than in the IDFe subzone. Runout areas frequently occur at low elevation near floodplain areas or adjacent to important deer winter ranges. These areas may provide good spring and early summer range for deer on southerly exposures. They may also be important for elk, moose, black bear and a wide variety of wildlife species.

1.3 Coastal Western Hemlock 'b' Subzone

1.3.1 Rock - Hemlock. These areas are often on steep slopes and have shallow soils with extensive bedrock outcrops. Bedrock openings in the forest cover are common. Snow depth is high and wildlife species diversity is low.

Succcessional Stages.

1. Sparsely Vegetated. Vegetation may be slow to become established because of the dry rocky site.

(2.) Pioneer Seral Herb. Patchy herb vegetation would occur.

3. Pioneer Seral Shrub. Shrub species include huckleberries, oceanspray, western hemlock and Pacific amabilis fir. Some Douglas fir may also be present.

4. Young Seral Forest. Hemlock forest with some shrubs remaining near openings.

5. Mature Seral Forest. Mature hemlock and Douglas-fir forest predominates. Some Douglas-fir and amabilis fir may be present.

6. Mature Climax Forest. Mature hemlock and amabilis fir predominate.

7. Old Growth Forest. These forest have uneven aged stands of western hemlock and amabilis fir. Forest openings are reduced but the forest canopy is still too discontinuous for good spotted owl habitat.

1.3.2 Talus slope. This habitat unit is sparsely vegetated and has deep snow. Only stages 1 and 3 were mapped. The pioneer seral shrub stage (3) has a very sparse cover of red huckleberry, oceanspray and conifer seedlings. Rate of succession is very slow.

1.3.3 Douglas-fir - boxwood. This habitat unit occurs on steep southerly aspects usually having shallow colluvial soils. Douglas-fir is the predominant tree species and is a long lasting seral species. Forest canopies are often open because of the dryness and active colluvial nature of the soils. Many plant species more common to the CWHc or IDFe subzones may occur in these areas. Snow depth is high, but these areas often provide important early winter and summer ranges for deer.

Successional Stages

(1.) Sparsely Vegetated. Plant establishment would be slow following severe disturbance.

2. Pioneer Seral Herb. A sparse to moderately dense herb cover of fireweed, strawberry, and young shrubs form the herb layer. Significant areas of bare mineral soil occur.

3. Pioneer Seral Shrub. A moderately abundant and diverse shrub cover of vine maple, Oregon boxwood, saskatoon, red huckleberry, currants, willow, oceanspray and Douglas-fir regeneration ocurs.

4. Young Seral Forest. These young Douglas-fir forests have an open canopy with shrub production remaining high in most areas.

5. Mature Seral Forest. These mature Douglas-fir forests are slow growing and may have a high arboreal lichen density. These lichens and the abundant Oregon boxwood of the understory provide important deer forage in early winter until deep snow forces deer down to lower elevations. These areas are shown as early winter range on the maps.

6. Mature Climax Forest. These forests are similar to '5' above, but have more western red cedar, western hemlock and amabilis fir in the main canopy.

7. Old Growth Forest. These forests are uneven aged stands of western hemlock, western red cedar and amabilis fir with some Douglas-fir remaining. Forest openings are reduced and shrub production is lower than in earlier seral stages.

1.3.4 Hemlock - moss. This habitat unit occurs on deep, well drained surficial material on northerly aspects. Forest canopies are continuous and shrub and herb layers are very sparse. Amabilis fir is more common in this subzone than in the Hemlock - moss habitat unit of the CWHc. Stages 1 and 3-7 were mapped. See successional stage descriptions in the CWHc (1.2.5). Most good spotted owl habitat is presently stage 7 of this unit.

1.3.5 Cedar - oak fern. This habitat type occurs on wet soils where seepage is present or on floodplains. Good tree growth with an abundant and diverse shrub and herb layer characterize the vegetation of these sites. These sites are important summer range for ungulates, black bear, mountain beaver and a variety of other wildlife species. Snow cover is deep and of long duration.

Successional Stages

1. Sparsely Vegetated. This stage would be of short duration, except on floodplain gravel bars. Floodplains are seldom large at these higher elevations.

(2.) Pioneer Seral Herb. This lush herb cover may include lady fern, fireweed, oak fern, unifoliate-leaved foam flower, Canadian bunchberry, blue-bead clintonia, cucumber-root twistedstalk, fairybells and young shrubs.

3. Pioneer Seral Shrub. This successional stage has an abundant cover of blueberry, devil's-club, currants, vine maple, red elderberry, with some conifer regeneration. Conifers may be slow to establish on these sites.

4. Young Seral Forest. The tree layer is composed of western red cedar, western hemlock and amabilis fir. There may be some Douglas-fir on sites with a southerly exposure. Openings in the forest cover with abundant shrub and herb cover are common.

5. Mature Seral Forest. This stage has some Douglas-fir in the canopy.

6. Mature Climax Forest. This stage lacks Douglas-fir. More densely forested areas have a sparse understory with some blueberry, devil's-club, and oak fern.

7. Old Growth Forest. These uneven aged forests of western red cedar, amabilis fir and western hemlock have some openings with good shrub and herb production, but otherwise have a reduced understory.

1.3.6 Vine maple avalanche chute. This habitat unit is common on the steeper slopes of the CWHb subzone. Snow cover is deep and persistent with a short growing season. Snow patches may remain on run-out areas through August. Such areas provide good summer range for ungulates and black bear. Stages 1-3 were mapped, and are described in section 1.1.12.

2. Habitats of the Skagit River Drainage (1:50,000)

2.1 Interior Douglas-Fir 'e' Subzone

2.1.1 Rock - Douglas-fir. Stages 1, 2, 4-7 were mapped, see 1.1.1.

2.1.2 Boxwood terrace. This includes the small Pine-kinnikinnick areas of the 1:20,000 scale map area. Stages 4 and 5 were mapped, see 1.1.5 and 1.1.3.

2.1.3 Slope saskatoon. Stages 1, 2, 4-7 were mapped, see 1.1.4.

2.1.4 Douglas-fir - Oregon-grape. This includes the closely related Douglas-fir - Oregon-grape and Douglas-fir - clintonia habitat units of the 1:20,000 scale map area. Stages 2, 3, 4 - 6 were mapped, see 1.1.6 and 1.1.7.

2.1.5 Cottonwood-cedar. This includes the closely related Cottonwood fluvial fan and Grand fir floodplain of the 1:20,000 scale map area. Stages 1-5 were mapped, see 1.1.8 and 1.1.9.

2.1.6 Willow Wetland. This includes the Willow - twinberry honeysuckle and Wetland of the 1:20,000 scale map area. Stage 2 was mapped, see 1.1.10 and 1.1.11.

2.1.7 Avalanche chute. Stages 1 and 2 were mapped, see 1.1.12.

2.2 Coastal Western Hemlock 'c' Subzone

2.2.1 Rock - Douglas-fir. All stages were mapped, see 1.2.1.

2.2.2 Talus slope. Stage 1 was mapped, see 1.2.2.

2.2.3 Douglas-fir - lichen. Stages 2-7 were mapped, see 1.2.3.

2.2.4 Hemlock boxwood. Stages 2, 4-6 were mapped, see 1.2.4.

2.2.5 Hemlock moss. This includes the Hemlock-moss and Cedar - clintonia units. Stages 1-7 were mapped see 1.2.5 and 1.2.6.

2.2.6 Cottonwood - red-osier dogwood. This includes the Red-osier floodplain and the small, closely related Cottonwood - thimbleberry habitat unit. Stages 1-7 were mapped, see 1.2.7 and 1.2.8.

2.2.7 Red-osier wetland. This includes the Willow - backchannel and Wetland of the 1:20,000 area. This is common along the Sumallo River. Stages 2 and 7 were mapped, see 1.2.9 and 1.2.10.

2.2.8 Avalanche chute. Stages 1 and 2 were mapped.

2.3 Coastal Western Hemlock 'b' Subzone.

2.3.1 Rock - hemlock. Stages 1-7 were mapped, see 1.3.1.

2.3.2 Talus slope. Stage 1 was mapped, see 1.3.2.

2.3.3 Douglas-fir - boxwood. Stages 1-7 were mapped, see 1.3.3.

2.3.4 Amabilis fir - moss. This is similar to the Hemlock - moss habitat unit of the 1:20,000 scale map area. The name change reflects a more extensive application of this unit in the more coastal and more interior transitional range of the 1:50,000 map area. Stages 2-7 were mapped, see 1.3.4.

2.3.5 Amabilis fir - oak fern. See not above in 2.3.4. Stages 2-4, 6 and 7 were mapped, see 1.3.5.

2.3.6 Wetland. Some small wetlands occur in the CWHb subzone of the 1:50,000 scale map area. They are sedge dominated and have a short growing season. Only stage 2 was mapped. Their importance for wildlife is uncertain.

2.3.7 Avalanche chute. Stages 1 and 2 were mapped, see 1.3.6.

2.4 Mountain Hemlock 'b' Subzone

2.4.1 Mountain hemlock - moss. This is an extensive habitat unit in coastal mountains. Much of this area is steep bedrock with an open forest of slowly growing mountain hemlock and amabilis fir. This area has a low wildlife diversity and abundance. Snow depths are very high.

Successional Stages

1. Sparsely Vegetated. These areas may be slow to become vegetated because of thin soils, a short growing season and steep slopes.

2. Pioneer Seral Herb. This stage is sparsely vegetated.

(3.) Pioneer Seral Shrub. Blueberry and mountain hemlock seedlings form patches of vegetation on better growing sites.

4. Young Seral Forest. These young hemlock forests have a sparse understory and frequent bedrock openings. These openings may have some Douglas fir or lodgepole pine.

(5.) Mature Seral Forest. This stage may have some mature Douglas fir or lodgepole pine in the tree layer.

(6.) Mature Climax Forest. This stage would have an even aged stand of mountain hemlock and Pacific silver fir with a sparse understory.

7. Old Growth Forest. This uneven aged mountain hemlock and Pacific silver fir forest has openings of reduced size.

2.4.2 Talus slope. These areas are unvegetated talus, with only stage 1 mapped.

2.4.3 Mountain hemlock - blueberry. These areas occur on deep soils that can support a continuous forest canopy. Rock outcrops occur infrequently. Snow cover is deep and persistent. These areas were poorly sampled.

Successional Stages

(1.) Sparsely Vegetated. These areas will have a moderate rate of vegetation establishment because of a short growing season.

2. Pioneer Seral Herb. This stage would have a continuous cover of fireweed, creeping raspberry, Sitka valerian and young shrubs.

(3.) Pioneer Seral Shrub. This continuous shrub cover would be composed of blueberries, Pacific menziesia and red elderberry.

4. Young Seral forest. These forests of mountain hemlock and Pacific silver fir may have a somewhat reduced shrub understory, but shrubs remain common.

(5.) Mature Seral forest. This stage would only be mapped if a seral tree species such as Douglas-fir was common in the stand.

(6.) Mature Climax forest. This stage would have mountain hemlock and Pacific silver fir with some tree regeneration and a moderately abundant shrub understory.

7. Old Growth Forest. This is an uneven aged stand of mountain hemlock and Pacific silver fir. Shrubs are abundant.

2.4.4 Amabilis fir - devil's-club. This habitat unit develops on moist soils such as seepage areas or floodplains. Only small areas occur, but they provide important summer range for deer and black bear.

Successional Stages

(1.) Sparsely Vegetated. Floodplain gravel bars would be included in this stage, but they are too small to be mapped. Other areas would be rapidly vegetated.

2. Pioneer Seral Herb. A rich herb cover of fireweed, Sitka valerian, false hellebore, sedges and young shrubs can occur here.

(3.) Pioneer Seral Shrub. Common shrubs would include blueberries, devil's-club, Pacific menziesia and regenerating Pacific silver fir.

4. Young Seral Forest. These forests of amabilis fir and mountain hemlock would have a reduced but moderately abundant shrub and herb layer.

(5.) Mature Seral Forest. This stage has mature forests with the same tree species.

(6.) Mature Climax Forest. Mature amabilis fir and mountain hemlock may result in a sparse understory in some areas. Abundant shrubs and herbs remain near forest openings.

7. Old Growth Forest. These uneven aged stands of amabilis fir and mountain hemlock may have an increased shrub and herb production because of a more open canopy.

2.4.5 Parkland meadow. This is a subalpine habitat unit. The forest canopy has frequent openings because of deep and persistent snow cover. These areas are described as a Mountain Hemlock Parkland subzone by the Ministry of Forests and Lands (1985). These complex areas are composed of moist meadows interspersed with clumps of mixed mountain hemlock, yellow cedar, amabilis fir and subalpine fir (especially in the eastern portions of the MHb). Forest openings are primarily heath vegetation with greater herb diversity near water courses and on lower slopes. Many of these areas have extensive bedrock outcrops, especially in the MHb. Tree growth and succession are very slow. Moist parkland meadows have a more abundant herb cover including sedges, false hellebore, Sitka valerian, cinquefoil, lupine and rushes. These areas may provide important summer range for deer, mountain goat and black bear. Only stage 7 was mapped, so other successional stages are not described here. They would have differences in tree cover and height.

2.4.6 Avalanche chute. These areas are usually very steep and rocky with few runout areas in the MHb subzone. Most runout

areas are at lower elevations in the CWHb or CWHc subzones. Stages 1 and 2 were mapped. Stage 1 (not vegetated) is mainly bedrock. Stage 2 (pioneer seral herb) has vegetation and wildlife use similar to that described for moist parkland meadows in 2.4.5 above.

2.5 Engelmann Spruce - Subalpine Fir 'f' Subzone.

2.5.1 Rock. Bedrock is mapped extensively in this subzone. Since it often has some sparse tree shrub and herb cover, it was assigned a successional stage. Rock is often mapped as a complex unit. Its successional stage usually matches the stage of the associated forested habitat type.

2.5.2 Talus. Only unvegetated talus (stage 1) was mapped.

2.5.3 Subalpine fir - blueberry. This forested habitat type occurs on dry sites, most often on convex, moisture shedding slope or on steep slopes with shallow colluvial soils. Forest cover usually has an open canopy of Engelmann spruce and subalpine fir with a moderate shrub understory. It is mapped extensively.

Successional Stages

1. Sparsely Vegetated. These areas may be slow to establish vegetation after severe disturbance.

2. Pioneer Seral Herb. The sparse herb layer may include grouseberry, heart-leaved arnica, fireweed, lupine and young shrubs.

3. Pioneer Seral Shrub. This stage has a moderately abundant shrub layer of black blueberry, birch-leaved spirea, Oregon boxwood, currants and conifer regeneration. These areas may provide good berry production for bears.

4. Young Seral Forest. Young forests may include lodgepole pine, Engelmann spruce and subalpine fir. The shrub and herb layer will be reduced in cover.

5. Mature Seral Forest. These forests include lodgeplole pine as a common tree species. This is more common on drier, southerly aspect sites.

6. Mature Climax Forest. These forests have a mature canopy of Engelmann spruce and subalpine fir. The shrub and herb understory may be sparse.

7. Old Growth Forest. These forests are uneven aged stands of Engelmann spruce and subalpine fir. The shrub and herb layer may have increased cover compared to stages 5 or 6.

2.5.4 Subalpine fir - Sitka valerian. This habitat unit occurs on middle slope positions with deep soils. It is intermediate in ecological moisture regime between the drier Subalpine fir - blueberry (2.5.4) and the wetter Engelmann spruce - horsetail habitat unit (2.5.6). Forest cover is usually dense.

Successional Stages

(1.) Sparsely vegetated. These areas would become vegetated soon after distrubance.

2. Pioneer Seral Herb. An abundant herb cover of fireweed. Sitka valerian, creeping raspberry, wild rye grass and heart-leaved arnica cover this site.

3. Pioneer Seral Shrub. An abundant shrub layer can include white-flowered rhododendron, black blueberry, currant, Oregon boxwood and coniferous tree regeneration, especially lodgepole pine.

4. Young Seral Forest. A dense forest cover of lodgepole pine, Engelmann spruce and subalpine fir may occur. The shrub and herb understory will be reduced in cover.

(5.) Mature Seral Forest. These even-aged mature forests have lodgepole pine commonly occurring.

6. Mature Climax Forest. These even-aged mature forest lack lodgepole pine and are composed of Engelmann spruce and subalpine fir.

7. Old Growth Forest. These uneven-aged climatic climax forests of Engelmann spruce and subalpine fir have an increase shrub cover of black blueberry and white-flowered rhododendron.

2.5.5 Engelmann spruce - horsetail. These moist areas occur where seepage is present at the base of slopes or on floodplains. These areas have an abundant herb and shrub cover because of the moist site and because forest openings commonly occur here. These areas provide important summer range for ungulates and bears.

Successional Stages

(1.) Not Vegetated. These areas would rapidly become vegetated.

2. Pioneer Seral Herb. These areas have an abundant herb cover of horsetail, cucumber-root twistedstalk, Sitka valerian, false hellebore and young shrubs.

3. Pioneer Seral Shrub. Common shrubs on these areas include white-flowered rhododendron, blueberry, twinberry honeysuckle, currents and conifer regeneration.

(4.) Young Seral Forest. These forests would have Engelmann spruce and subalpine fir as tree species. Lodgepole pine would be less common because of these moist soil conditions.

(5.) Mature Seral Forests. These mature forests would include the same tree species. No such areas were located.

6. Mature Climax Forest. These mature forests are even-aged. The shrub and herb understory would be reduced where crown closure is high, but forest openings are common.

7. Old Growth Forest. These uneven-aged stands occur commonly in the western portion of Manning Park. They are important not only because of their high forage production, but also because they provide thermal cover for large mammals during hot periods of the summer.

2.5.6 Wetland. Few wetlands occur in this subzone. Only stage 2 (pioneer seral herb) was mapped. These are primarily sedge fens. They can have a fringe of shrubs including willow, Sitka mountain alder and twinberry honeysuckle.

2.5.7 Parkland meadow. These areas are common in Manning Park near the Similkameen-Skagit height of land. They have a lush herb cover and provide important summer range for deer and bears. Rocky Mountain elk favour such areas as summer range and presently use some of these areas in the headwaters of the Tulameen River. Islands of subalpine fir occur throughout these meadows. Some of the diverse and abundant herbs present include lupine, fleabane, cinquefoil, rushes, sedges, Sitka valerian, yarrow, and grasses. Only stage 7 was described.

2.5.8 Avalanche chute. Avalanche chutes are less common in the ESSF because there is less steeply sloping terrain in this

area. Those that occur provide some important wildlife habitat, especially in the run-out areas. Stages 1 and 2 were mapped. Stage 2 may include many of the herb species found in parkland meadows (2.5.7). Shrubs occurring in these areas include vine maple and Sitka mountain alder.

2.6 Alpine Tundra Zone

The alpine tundra in the coastal portion of the area (associated with MHB) is predominantly steep bedrock with very little vegetation. It is difficult to separate from the MHb subzone for this reason, and its importance to wildlife is low. The alpine tundra in the interior portion of the area (associated with ESSFf) is better vegetated. Moist sites include many of the herb species found in subalpine parkland. Dry sites may include some grasses, expecially in the drier southeastern portion of the area. Some important mountain goat summer ranges occur in alpine areas associated with the ESSFf. Alpine tundra is mapped as a habitat unit in both subzones.

APPENDIX B

Scientific Names

Wildlife Species Cited

Common Names	Scientific Names
barred owl	Strix varia
black bear	Ursus americanus
deer	Odocoileus hemionus
elk	Cervus elaphus
moose	Alces alces
mountain goat	Oreamnos americanus
spotted owl	Strix occidentalis

Common Plant Species

Vascular Plants

Common Names	Scientific Names
Alaskan blueberry	Vaccinium alaskaense
alpine enchanter's-nightshade	Circaea alpina
alumroot	Heuchera sp.
amabilis fir	Abies amabilis
red elderberry	Sambucus racemosa
bigleaf maple	Acer macrophyllum
birch-leaved spirea	Spiraea betulifolia subsp. lucida
bitter cherry	Prunus emarginata
black blueberry	Vaccinium membranaceum
black cottonwood	Populus balsamifera subsp. trichocarpa
blue-eyed Mary	Collinsia parviflora
blue grass	Poa spp.
blue-bead clintonia	Clintonia uniflora
broad-leaved starflower	Trientalis latifolia
California filbert	Corylus cornuta var. californica
Canadian bunchberry	Cornus canadensis
cascara	Rhamnus purshiana
chickweed	Stellaria spp.
cinquefoil	Potentilla spp.
coast Douglas-fir	Pseudotsuga menziesii var. menziesii

common cow-parsnip	Heracleum sphondylium subsp. montanum
common lady fern	Athyrium filix-femina subsp. cyclosorum
common paper birch	Betula papyrifera
common pink pyrola	Pyrola asarifolia
common saskatoon	Amelanchier alnifolia
common western pipsissewa	Chimaphila umbellata
common yarrow	Achillea millefolium
creeping raspberry	Rubus pedatus
cucumber-root twistedstalk	Streptopus amplexifolius
dandelion	Taraxacum officinale
devil's-club	Oplopanax horridum
Douglas-fir	Pseudotsuga menziesii
dull Oregon-grape	Mahonia nervosa
fairybells	Disporum sp.
fairyslipper	Calypso bulbosa
Pacific menziesia	Menziesia ferruginea
false hellebore	Veratrum viride
false Solomon's-seal	Smilacina racemosa
fireweed	Epilobium angustifolium
fleabane	Erigeron spp.
grand fir	Abies grandis
grouseberry	Vaccinium scoparium
hardhack	Spiraea douglasii
heart-leaved arnica	Arnica cordifolia
horsetail	Equisetum spp.
Indian paintbrush	Castilleja sp.
kinnikinnick	Arctostaphylos uva-ursi
large-leaved rattlesnake orchid	Goodyera oblongifolia
lodgepole pine	Pinus contorta
lomatium	Lomatium sp.
luetkea	Luetkea pectinata
lupine	Lupinus sp.
mountain hemlock	Tsuga mertensiana
mountain sweetcicely	Osmohiza chilensis
ninebark	Physocarpus capitatus
northern twinflower	Linnaea borealis
oak fern	Gymnocarpium dryopteris

oceanspray	Holodiscus discolor subsp. discolor
Oregon boxwood	Paxistima myrsinites
Pacific bleeding-heart	Dicentra formosa subsp. formosa
Pacific rhododendron	Rhododendron macrophyllum
peavine	Lathyrus sp.
pine grass	Calamagrostis rubescens
ponderosa pine	Pinus ponderosa
red alder	Alnus rubra
red huckleberry	Vaccinium parvifolium
redstem ceanothus	Ceanothus sanguineus
red-flowering currant	Ribes sanguineum var. sanguineum
red mountain-heather	Phyllodoce empetriformis
red-osier dogwood	Cornus sericea
rose	Rosa spp.
sedge	Carex spp.
selaginella	Selaginella sp.
Sitka mountain alder	Alnus viridis subsp. sinuata
Sitka valerian	Valeriana sitchensis
snowberry	Symphoricarpos albus
snowbush ceanothus	Ceanothus velutinus
spiny shield fern	Dryopteris assimilis
star-flowered false Solomon's-seal	Smilacina stellata
stinging nettle	Urtica dioica
strawberry	Fragaria spp.
subalpine fir	Abies lasiocarpa
sweet-scented bedstraw	Galium triflorum
tall Oregon-grape	Mahonia aquifolium
trailplant	Adenocaulon bicolor
twinberry honeysuckle	Lonicera involucrata
unifoliate-leaved foamflower	Tiarella unifoliata
vanilla leaf	Achlys triphylla
vetch	Vicia sp.
vine maple	Acer circinatum
violet	Viola spp.
western bracken	Pteridium aquilinum

western hemlock	Tsuga heterophylla
western red cedar	Thuja plicata
western thimbleberry	Rubus parviflorus
western trumpet honeysuckle	Lonicera ciliosa
western white pine	Pinus monticola
western wild ginger	Asarum caudatum
white-flowered rhododendron	Rhododendron albiflorum
wild rye grass	Elymus sp.
willow	Salix spp.
wood-rush	Luzula spp.
yarrow	Achillea millifolium
yellow cedar	Chamaecyparus nootkatensis

Mosses and Lichens

Alectoria spp.
Cladina rangiferina
Cladonia spp.
Dicranum spp.
Hylocomium splendens
Mnium spp.
Pleurozium schreberi
Polytrichum sp.
Rhacomitrium spp.
Rhytidiadelphus loreus
Rhytidiadelphus triquetrus
Rhytidiopsis robusta
Stereocaulon sp.

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[1]Nomenclature for vascular plants is after Taylor and MacBryde (1977); lichens and mosses follow respectively Hale (1969) and Crum et al. (1979).

APPENDIX C. Correlation to Other Studies.

1. Vegetation and Fuel Mapping of North Cascades National Park Service Complex, by J.K. Agee and S.G. Pickford, 1985, University of Washington, Seattle.

   Vegetation Cover Units of the North Cascades, by J.K. Agee and Jane Kertis, 1986, University of Washington, Seattle.

   This is a cover classification at 1:100,000 scale generated from Landsat and topographic information. Since it is of general scale and lacks soil related inputs, there are fewer classes. Some classes do not occur in the Canadian Skagit River drainage.

North Cascades Vegetation	Skagit 1:20,000	Skagit 1:50,000
Douglas-fir (open canopy)	Rock - Douglas-fir	Rock-Douglas-fir
Douglas-fir (closed canopy)	Douglas-fir-saskatoon	Douglas-fir - Oregon-grape
	Douglas-fir - Oregan grape	Boxwood terrace
	Boxwood terrace	Slope-saskatoon
	Douglas-fir-clintonia	Douglas-fir-lichen
	Grand fir floodplain	Douglas-fir-boxwood
	Douglas-fir-lichen	
	Douglas-fir-boxwood	
Subalpine fir (open canopy)	none	Subalpine fir-blueberry
Subalpine fir (closed canopy)	none	Subalpine fir-Sitka valerian
		Engelmann spruce - horsetail
Whitebark pine/subalpine larch (open canopy)	none	none
Whitebark pine/subalpine larch (closed canopy)	none	none
Ponderosa pine	none	none
Tall shrub	Vine maple avalanche chute	Avalanche chute
	Wetland	Willow wetland
	Willow-twinberry honeysuckle	Red-osier wetland
	Willow backchannel	Wetland

APPENDIX C. Continued.

Lowland herb	Douglas-fir-clintonia (or similar), stage 2	Douglas-fir-Oregon-grape (or similar), stage 2
Rock	Rock	Rock
Mountain hemlock (open canopy)	none	Mountain hemlock-moss
Mountain hemlock (closed canopy)	none	Mountain hemlock-blueberry
Pacific silver fir (open canopy)	none	none
Pacific silver fir (closed canopy)	none	Amabilis fir-moss Amabilis fir-oak fern Amabilis fir - devil's-club
Western hemlock (open canopy)	Rock-hemlock	Rock-hemlock
Western hemlock (closed canopy)	Hemlock-boxwood Hemlock-moss Cedar-oak fern Cedar-clintonia	Hemlock-boxwood Hemlock-moss

2. Preliminary Plant Associations and Habitat Units of the Mt. Baker Ranger District, Mt. Baker-Snoqualmie National Forest, by J.A. Henderson and D. Peter, U.S.D.A. Forest Service, Olympia, Washington.

The Mount Baker District lies west of the Skagit drainage in a wetter climatic area. Slesse Creek and the western headwaters of the Chilliwack Lake border on this area. Only the wetter more coastal habitat units of the 1:50,000 scale area can be roughly correlated to these plant associations. This paper provides a good method of classifying forest vegetation. It was not intended for mapping and does not classify non-forested ecosystems.

Mt. Baker study	Skagit 1:50,000
MOUNTAIN HEMLOCK SERIES	MOUNTAIN HEMLOCK ZONE
Tsuga mertensiana/Oplopanax horridum	Amabilis fir-devil's-club
Tsuga mertensiana/Tiarella unifoliata-Streptopus roseus	Mountain hemlock-blueberry
Tsuga mertensiana/Rhododendron albiflorum - Vaccinium membranaceum	Mountain hemlock-blueberry
Tsuga mertensiana/Rododendron albiflorum - Phyllodoce empetriformis	Parkland meadow (MH)
Tsuga mertensiana/Phyllodoce empetriformis-Vaccinium deliciosum	Parkland meadow (MH)
Tsuga mertensiana/Vaccinium alaskense-Vaccinium membranaceum	Mountain hemlock-blueberry
Tsuga mertensiana/Vaccinium membranaceum	Mountain hemlock-blueberry Mountain hemlock-moss
Tsuga mertensiana/Vaccinium alaskaense	Mountain hemlock-blueberry
SILVER FIR SERIES	COASTAL WESTERN HEMLOCK 'B' SUBZONE
Abies amabilis/Vaccinium membranacium	Douglas-fir boxwood
Abies amabilis/Oplopanax horridum	Amabilis fir-oak fern
Abies amabilis/Rubus pedatus	Amabilis fir-moss
Abies amabilis/Vaccinium alaskaense	Amabilis fir-moss
Abies amabilis/Tiarella unifoliata	Amabilis fir moss
Abies amabilis/Polystichum munitum	none

Abies amabilis/Berberis nervosa	none
Abies amabilis/Depauperate	Rock-hemlock
Western hemlock series	Coastal western hemlock 'a' subzone (not in Skagit area)

3. Site Diagnosis, Tree Species Selection and Slash Burning Guidelines for the Vancouver Forest Region, by K. Klinka, R.N. Green, P.J. Courtin and F.C. Nuszdorfer, 1984, Ministry of Forests.

This paper provides brief descriptions of the various sites expected to occur along moisture and soil nutrient gradients in the area. Some of these site units were not recognized in the current Skagit studies because they were not extensive or were not of particular significance to wildlife.

Klinka et al., 1984	Skagit 1:20,000	Skagit 1:50,000
IDFe1 (Grid 4)	IDFe1	IDFe1
1	Pine-kinnickinnick	none
2	Rock-Douglas-fir	Rock-Douglas-fir
3	Boxwood terrace Douglas-fir saskatoon	Boxwood terrace Slope saskatoon
4	Douglas-fir-Oregon-grape	Douglas-fir-Oregon-grape
5	Douglas-fir-clintonia	none
6,7	Cottonwood fluvial fan Grand fir floodplain	Cottonwood-cedar
8,9	Wetland	Wetland
none	Talus slope Rock Vine maple avalanche chute	Talus slope Rock Avalanche chute
CWHc1 (Grid 16)	CWHc*	CWHc*
1	none	none
2	Rock-Douglas-fir	Rock-Douglas-fir
3,4	Douglas-fir lichen	Douglas-fir lichen
5	Hemlock-boxwood Hemlock-moss	Hemlock boxwood Hemlock moss
6	Cedar clintonia	none
7	Cottonwood-thimbleberry Red-osier floodplain	Cottonwood-red-osier
8	Wetland	none

* The CWHc was mapped more extensively than shown on the Ministry of Forests biogeoclimatic map (1985)

9	none	none
none	Willow backchannel Vine maple avalanche chute Talus slope	Red-osier wetland Avalanche chute
CWHb5 (Grid 15)	CWHb	CWHb
1	none	none
2,3	Douglas-fir-boxwood	Douglas-fir-boxwood
4,5	Douglas-fir-boxwood Hemlock-moss	Douglas-fir-boxwood Amabilis fir-moss
6,7,8	Cedar-oak fern	Amabilis fir-oak fern
9	Wetland	Wetland
10	none	none
none	Vine maple avalanche chute Talus slope	Avalanche chute Talus slope
MHb (Grid 2)	-	MHb
1		Mountain hemlock-moss
2,3,4		Mountain-hemlock blueberry
5,6		Amabilis fir-devil's-club
7,8		none
none (MHp)		Parkland meadow Avalanche chute
ESSFf (Grid 3)		ESSFf
1		none
2,3		Subalpine fir-blueberry
4,5		Subalpine fir-Sitka valerian

6,7,9		Engelmann spruce-horsetail
8		Wetland
none		Avalanche chute Talus Rock
none (ESSFfp)		Parkland meadow