VEGETATION AND UNGULATE HABITAT IN THE GLADYS LAKE ECOLOGICAL RESERVE, NORTHERN BRITISH COLUMBIA

by

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ABSTRACT

A rapid reconnaissance technique was used to sample subalpine and alpine vegetation in the Gladys Lake Ecological Reserve, upper Stikine River drainage, northern British Columbia. Twenty major subalpine community types and their habitats were described from 193 sample stands. Picea glauca and Abies lasiocarpa dominate the open forest and woodland that covers most of the lower subalpine elevations. Betula glandulosa and several species of Salix dominate the abundant shrub cover in the subalpine forests and as well form an extensive, medium-tall scrub that prevails higher in the subalpine zone. Festuca altaica steppe is the most common of the subalpine herb community types.

Thirteen major alpine community types and their habitats were described from 132 sample stands. A. lasiocarpa krummholz and a low scrub dominated by B. glandulosa and species of Salix are common at lower alpine elevations, but the majority of the alpine vegetation is tundra. F. altaica and Dryas integrifolia dominate relatively dry habitats with shallow snow cover. Cassiope tetragona, Dryas integrifolia, Salix polaris, and S. reticulata dominate or codominate mesic habitats with average to deep snow cover. S. polaris, S. reticulata, Cyperaceae, and mosses dominate wet, seepage/snowbed habitats, and lichen-dominated fellfield occurs at the highest, most exposed elevations.

One field season's data were sufficient to sample and describe the major types of vegetation and, in combination with previous and concurrent wildlife studies, qualitatively assess the importance of the vegetation types for ungulates. Of the total thirty-three plant community types described in the reserve, approximately 7, 7, 10, and 18 appear to be of major importance for mountain goats, mountain sheep, moose, and woodland caribou, respectively. This order reflects both a decline in feeding specialization from sheep to caribou, and an increasing trend in the quality and extent of physical habitat and vegetation suitable for the different ungulate species.

Most of the subalpine and alpine community types are closely related to those elsewhere in northern British Columbia and the southern Yukon, more so than to those in southern British Columbia and the southern Canadian Rocky Mountains. Vegetation - ungulate relationships of the reserve are typical for the interior plateaus and mountains of northern British Columbia and adjacent Yukon Territory.

Key Words: subalpine, alpine, vegetation, environment, ungulates, British Columbia.

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TABLE OF CONTENTS

APPENDICES

TABLES

FIGURE

INTRODUCTION

The upper Stikine River drainage of northern British Columbia is a remote, mountainous region long renowned for its big game populations (Patterson 1966; Walker 1976). However, until recently the vegetation of the region has been virtually unstudied. Szczawinski (1959) collected plants and briefly surveyed the vegetation while on a biological survey of the Spatsizi Plateau by the British Columbia Provincial Museum. In the 1960's, V. Geist studied the behaviour of mountain sheep and goats at Gladys Lake, and accounts of his life and research there may be found in Geist (1971, 1975). Welsh and Rigby (1971) report on a botanical and physiographic reconnaissance of the region. Pertinent studies in nearby areas include Cathey (1974) to the west, Fenger (1982) to the north, and several unpublished, reconnaissance - level, vegetation and wildlife studies sponsored by B.C. Hydro (downstream) and mining companies (to the east).

The present study reports on fieldwork done by the author and assistant R. Carswell from June 19 to September 1, 1975, in the vicinity of Gladys Lake, upper Stikine River drainage (Fig. 1). The study was done to help select and describe a proposed ecological reserve in the area. The Gladys Lake Ecological Reserve was subsequently established in late 1975 (Krajina et al. 1978), as was the surrounding Spatsizi Plateau Wilderness Park (Fig. 1). Some controversy soon arose about trophy hunting in the park (hunting is not permitted in the ecological reserve). Concern over this problem and over various proposed hydroelectric and mining developments peripheral to the park has sparked several valuable wildlife studies in the area, mainly involving woodland caribou and the wolf - caribou - moose system (Bergerud and Butler 1978; Haber 1979; Hatler 1983; Boonstra and Sinclair 1984).

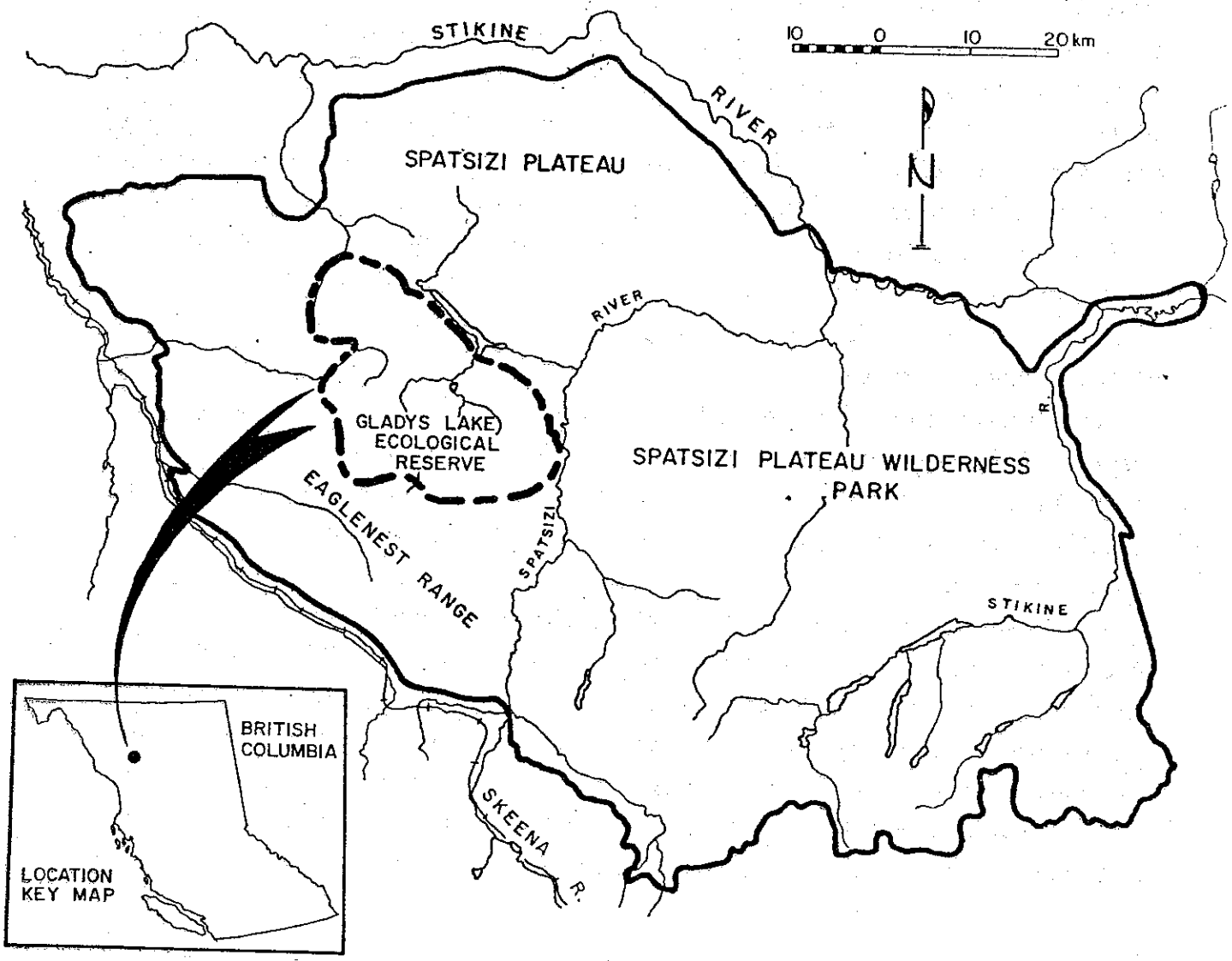

Figure 1. Gladys Lake Ecological Reserve and Spatsizi Plateau Wilderness Park, northern British Columbia.

STUDY AREA

The Gladys Lake Ecological Reserve is a 48,560 ha area in the upper Stikine region of north central British Columbia. Gladys Lake itself lies at 1275 m in the heart of the rugged Eaglenest Range, and is surrounded by peaks rising to 2100 - 2500 m. The ecological reserve is entirely above 1200 m elevation.

The Eaglenest Range is part of the Skeena Mountains (Holland 1976). In the Gladys Lake area, these mountains have been carved in folded Triassic and Jurassic volcanic and sedimentary rocks. In the western part of the reserve these are partly in fault contact with siltstones, graywackes, and conglomerates of the Upper Jurassic-Lower Cretaceous Bowser assemblage (Geol. Surv. Can. Map 9-1957; Welsh & Rigby 1971; Holland 1976; Eisbacher 1974; Souther et al. 1979). For the most part, the peaks and high ridges are jagged and serrated due to alpine glaciation, and cirques are common on their north and east faces. However, there are areas of gently sloping uplands indicating that here at their northern boundary the Skeena Mountains pass by transition into the Spatsizi Plateau (Holland 1976). The transition is striking between the Eaglenest Range of the Gladys Lake area and the Spatsizi Plateau to the north, with the broad valley of Cold Fish Lake separating the two realms.

The entire region was covered by glacial ice to a height of about 2100 m (Holland 1976). Upland surfaces were eroded and a veneer of drift deposited over most of the country. Late-stage cirque glaciation sculptured the higher peaks and ridges. There is a concentration of remnant ice around Mount Will.

The Gladys Lake area has a moist, cold, continental climate. Summers are cool and moist, with frequent cloud cover. Moist Pacific air from the west frequently causes sudden, often violent, local storms during summer. Winters are long, cold, and cloudy, and Gladys Lake remains frozen for almost eight months of the year (Geist 1971). A more stable air mass usually prevails in the winter, but cold spells may be broken by chinook winds. Snow and freezing temperatures can occur at any time.

There are no long-term meteorological data for the study area. The closest comparable long-term climate station is at Cassiar, 150 km to the

northwest. Based on 30-year (1951-1980) normals (Environment Canada 1980), Cassiar has a mean annual temperature of -3.2°C. Temperature averages above 10°C for just one month, below 0°C for seven months of the year. Total annual precipitation averages 700 mm, with 395 cm or 56% falling as snow.

Soil development in the Gladys Lake reserve is generally not far advanced, because of recent glaciation, cold climate, and periglacial processes. The processes of frost shattering, solifluction, nivation, and cryoturbation, as well as colluviation and snow avalanching, are all active, especially in the alpine zone. Permafrost is scattered and uncommon, but does occur in the alpine, especially beneath wet tundra and organic soils on northern and eastern slopes.

Soils have developed in glacial till, and in colluvial, fluvial, and glaciofluvial materials. Parent material may be basic or acidic, but sola are generally acid with pH increasing with depth. Lithology is variable, with basalt, shales, sandstone, siltstone, mudstone, and conglomerate all present (Alley and Young 1978; Souther et al. 1979).

Prevailing subalpine soils are Humo-Ferric Podzols and Dystric Brunisols. Gleyed Regosols, Humic Gleysols, and shallow Organics are found in subalpine wetlands, while fluvial soils are usually Regosols. Eutric or Melanic Brunisols are fairly common on steep, grassy, south-facing slopes. Regosols (Orthic and Humic) and Dystric Brunisols predominate in the alpine zone. Wet alpine habitats may have Humic Regosols, Humic Gleysols, or Organic soils, and Turbic Cryosols and Organic Cryosols also occur (Young and Alley 1978).

METHODS

3.1 Vegetation

A rapid reconnaissance technique similar to that of Douglas (1974) was used. The Gladys Lake reserve encompasses a large area of extremely rugged, mountainous terrain that made adequate sampling coverage difficult. The reconnaissance approach was especially valuable in that a larger number of stands were quantitatively sampled and a greater range of variability included than would have been possible using other, less subjective methods.

Sample stands were selected that had relatively homogeneous populations of various combinations of species throughout the reserve. The term "stand" in this report refers to a specific example of vegetation that was sampled, a "community type" to a grouping of similar stands. The names of the community types were derived from the dominant species in one or more strata. Sampling was limited (as few as 4 stands) in rare community types, but was greater (as many as 26 stands) in widespread and variable types. A total of 325 stands was sampled.

Quantitative data were collected in each stand using a circular plot. Plot size was 15 m in diameter for forest stands, 7 m for shrub stands and most alpine tundra communities and 3 or even 1 m for tundra stands of small extent. Crown cover, using the methods and cover classes (0-5, 5-25, 25-50, 50-75, 75-95, 95-100%) of Daubenmire (1959, 1968) was estimated for overstory and intermediate trees, saplings, shrubs, all other vascular plants and terricolous lichens, mosses, and liverworts. The corresponding vegetation layers or strata were defined as: (A2) Main tree canopy, usually over 10 m high; (A3).Secondary tree canopy forming a definite layer below the main canopy; (B1) Tall shrubs and tree saplings, usually between 2 m and 8 m high; (B2) Low shrubs and tree regeneration, less than 2 m high; (C) All herbaceous plants and dwarf shrubs; (D) Cryptogams - lichens, mosses, and liverworts.

Midpoints of the six cover classes were used to calculate average per cent coverage of the taxa tallied within each plot. Similarly, average per cent frequency was calculated for all plant species. Saxicolous and corticolous lichens, mosses, and liverworts were recorded in each plot using a broad abundance scale (rare, frequent, abundant). Additional rare species, that occurred outside the plots but within the stand, were also tallied. The aspect, percentage slope, elevation, landform, and other site characteristics of each plot were also recorded.

Prominence values were calculated by multiplying cover by the square root of the frequency of each species of each community type. This index is considered to be a good estimate of the prominence of a species in a particular community type (Douglas 1974).

3.2 Taxonomic Considerations

For the most part, nomenclature, authorities, and taxonomy follow Taylor and MacBryde (1977, 1978) for vascular plants, Hale and Culberson (1970) for lichens, Ireland et al. (1980) for mosses, and Stotler and Crandall-Stotler (1977) for liverworts. Hulten (1968), Argus (1973), Welsh (1974), and several other more specialized treatments were consulted in vascular plant identification.

A complete set of voucher specimens of vascular plants, mosses, and liverworts has been deposited in the Herbarium of the British Columbia Provincial Museum, and a complete set of lichen specimens is in the Herbarium of the University of British Columbia.

3.3 Soils

In each of the major plant community types, one or more soil pits were established and the soil profile briefly described. Soil nomenclature is according to the Canadian System of Soil Classification (Canada Soil Survey Committee 1978).

3.4 Wildlife

Most of the ecological reserve was traversed on foot by the two-man study team. They recorded all animal sightings and included notes on ungulate behaviour, descriptions of mineral licks and game trails, and type and density of big game "sign" (see Carswell 1975). Observations relating to feeding were emphasized. The occurrence and intensity of browsing and grazing, and the occurrence and density of scats were noted in each stand. Ungulate taxonomy follows Banfield (1974).

4 RESULTS

The vegetation of the Gladys Lake Ecological Reserve falls within subalpine and alpine zones, or the subalpine Spruce - Willow - Birch (SWB) and Alpine Tundra (AT) biogeoclimatic zones of Krajina (1969, 1975). In the upper Stikine River region, lower elevations up to 950 - 1150 m are covered by

essentially continuous, white spruce (Picea glauca) - dominated forests that form a montane zone (cf. Douglas 1974) equivalent to the Boreal White and Black Spruce Zone (BWBS) of Krajina (1965, 1969). The study area is entirely above 1200 m, and has no true montane or boreal forest.

Within the ecological reserve, the SWB zone occupies the lower valleys and slopes and is dominated by open white spruce and subalpine fir (Abies lasiocarpa) forests, and (especially in the upper subalpine) by dense thickets of medium to tall (1 to 4 m high) deciduous shrubs, mainly Betula glandulosa and Salix spp. There are also frequent aspen (Populus tremuloides) stands, grasslands, wetlands, and other shrub and herb communities within the SWB.

The upper limit of the SWB ranges from 1450 to 1600 m and above this is the alpine zone or AT. Lower alpine elevations are dominated by low (up to 1 m) Betula - Salix shrubfields, herbaceous meadows, and krummholz. The upper AT has dwarf shrub, heath, grassland, seepage, snowbed, and fellfield community types, together commonly referred to as alpine tundra.

4.1 SUBALPINE VEGETATION OF THE GLADYS LAKE ECOLOGICAL RESERVE

4.1.1 Forest community types

Eight forest community types can be distinguished in the Gladys Lake area. There are six coniferous types, one dominated by lodgepole pine (Pinus contorta var. latifolia), two by white spruce, and three by subalpine fir. Trembling aspen and balsam poplar (Populus balsamifera) each dominate a deciduous forest type. Table 1 summarizes the species composition of these community types, while Table 2 presents selected environmental and community characteristics.

The subalpine fir types generally occur at higher elevations than the others, which represent primarily valley bottom and lower slope communities. A pattern apparent in the lower subalpine valleys of the ecological reserve and also in the upper Stikine region in general is of intermittent to closed forest cover of spruce, aspen, and pine on the valley bottom and lower slopes. Higher on the slopes subalpine fir dominates, especially on northern and estern exposures,

TABLE 1. Composition of plant community types in the subalpine zone of the Gladys Lake Ecological Reserve. Data are for prominence value indices[a]

Strata and species	PCB[b] (12)[c]	PTR (16)	PBA (4)	PHY (9)	PGB (6)	PSB (10)	AHY (8)	ABE (8)	SCA (19)	SAS (7)	SAL (7)	SGB (12)	SBE (6)	BEF (9)	JUA (13)	POG (9)	FES (17)	FEL (12)	HER (5)	CAR (4)
Overstory trees																				
Pinus contorta var. latifolia	510								T											
Picea glauca	10			620	317	331		1	52											
Populus tremuloides		553	T																	
Salix scouleriana		6	11																	
Populus balsamifera			472																	
Abies lasiocarpa							481	309												
Understory trees																				
Picea glauca	100	2		150	183	93			21											
Pinus contorta	17								T											
Abies lasiocarpa	6			20	3	6	179	197												
Populus tremuloides		180		2																
Salix scouleriana		20	4			16														
Populus balsamifera			145																	
Tree saplings/seedlings																				
Picea glauca	43	1		160	28	26			29	2	7	T	T							
Pinus contorta	9								2											
Abies lasiocarpa	6			47	15	11	372	365	T					1						
Populus tremuloides		152	3												4					
Populus balsamifera			203							1	1				T					
Tall shrubs																				
Salix scouleriana	7	18	16	1	2	25				684			17							
Salix glauca	2	2	3	16	8	44	T		7	4		83	49							
Betula glandulosa	T										40									
Salix alaxensis											30	5								
Salix barclayi											1	67								
Salix planifolia																				
Low shrubs																				
Betula glandulosa	216	3	3		532	184	25	317	105	100		8	459	841	5					
Salix glauca	59	1		25	67	178	1	31	37	93	1	254	408	28	1					
Ledum groenlandicum	T			5	5	6	1	1	42	9		T	17							
Shepherdia canadensis	31	16	1							24	1				12		T			
Rosa acicularis ssp. sayi		28	31	1						4					19	21				
Viburnum edule		10	16							7					T					
Ribes oxyacanthoides		4													1					
Salix scouleriana		1	3	1		T				15			5							
Potentilla fruticosa				1					20	1	4	44		1	28	7	1			

TABLE 1. Continued

Strata and species	PCB	PTR	PBA	PHY	PGB	PSB	AHY	ABE	SCA	SAS	SAL	SGB	SBE	BEF	JUA	POG	FES	FEL	HER	CAR
Salix barclayi				1	5			1	211		98	215								
Ribes glanculosum							20													
Salix barrattiana									40			55		8						
Salix alaxensis											190									
Salix planifolia									20		7	11								
Dwarf shrubs/herbs																				
Empetrum nigrum ssp. hermaphroditum	107	1		22	64	76	67	161	48	25		T	23	5						
Festuca altaica	100	238	43	17	79	116	16	18	2	118	4	179	161	140	141	14	602	355	62	
Vaccinium vitis-idaea ssp. minus	80	5		18	38	37	8	20	12	7			14	3	3	1	T			
Lupinus arcticus	73	86	117	29	61	102	16	20		63	38	T	42	27	3	1	29	57		
Vaccinium caespitosum	44	4		1	5	11	3	16		1			5	5			13	49		
Linnaea borealis	28	82	31	100	24	46	20	13		204		2	42	10	7					
Cornus canadensis	24	2		61	2	14	62	13		7		T	8							
Epilobium angustifolium	16	177	376	14	8	24	9	5	1	186	3	47	79	11	22	9	54	99	95	
Juniperus communis ssp. alpina	7	154	43		2	4				86			5		302	3	T			
Mertensia paniculata	7	54	87	42	24	45	13	9	1	53	1	40	46	14	1	6	20	23	18	
Pedicularis labradorica	7	10			17	18		13	6	1			2	6			T			
Achillea millefolium	5	25	25	2	14	14		1	T	19	30	58	8	7	17	22	10	8	25	
Arnica cordifolia	3	63	75	56	5	4	1	5		59	1	3	8	1	3			T		
Stellaria longipes var. altocaulis	3	T		1	2	2	1		T			16	2	5	T	14	10	11		
Arctostaphylos uva-ursi	2	63	3	1		23		1		14	1	T	2		365	42	4			
Galium boreale	T	4	60									3	5	1	T	1	7	1	11	
Fragaria virginiana		48	75	4						27	1	6	2		21	13	42	T		
Delphinium glaucum		29	75	2		4		1	T	29		30	40	T		13	34	13	90	
Saxifraga tricuspidata		15								1	1				93	75				
Gentianella propinqua		14	16			2				15	7	5	5		14	14	3	T	2	
Pyrola asarifolia		7	21		2		1	1	T	4			5	1						
Koeleria macrantha		6								1					43	47	4			
Solidago multiradiata var. scopulorum		6	6	1	2	4				7	7	8	2	3	14	4	31	T		
Poa glauca		5													60	410	28			
Agropyron trachycaulum s. lat		4									7	11			3	84	5		13	
Draba aurea		3										1	2		12	5	4	T		
Festuca saximontana		2									4	14		3	10	25	15			
Thalictrum occidentale		2	53								T						1	1	76	
Aconitum delphiniifolium		1	8							4	1	49	2	10		1	46	132	6	
Anemone multifida		1								1					10	9	T			

TABLE 1. Continued

Strata and species	PCB	PTR	PBA	PHY	PGB	PSB	AHY	ABE	SCA	SAS	SAL	SGB	SBE	BEF	JUA	POG	FES	FEL	HER	CAR
Androsace septentrionalis		T													4	18	1			
Castilleja unalaschensis		T				2				51	1				T		4	43	31	
Aquilegia formosa		T	31							1	T									
Trisetum spicatum s. lat.		T						1			10	7			10	41	10	3		
Heracleum sphondylium ssp. montanum			91								28							13	670	
Bromus richardsonii			71																13	
Geranium richardsonii			53							1								3	22	
Equisetum arvense			8	26		4		1	53		150	13	2					1	13	
Artemisia arctica			1		8	4	15	9		1		8	2	17		1	94	177		
Calamagrostis canadensis			1					1	4		8	2		28			1	10	66	6
Equisetum scirpoides				10	5	6	1	3	6			T	2					T		
Arctostaphylos rubra				7		14		11	29	1		2	2	4						
Astragalus alpinus				1							114	16					T			
Poa leptocoma				1				1			7	42					1	1		
Polemonium caeruleum ssp. villosum				1		2	6	1	4	1		28	2	7			11	19	23	
Rubus arcticus ssp. acaulis				1					11		1	58	5	1			T	28		
Petasites palmatus				1				1	11		7	52						3		
Salix myrtillifolia						T			89			14								
Carex media						T		1	3		1	18								
Luzula parviflora								3	2		30	27	2	5			20	106	6	
Carex aquatilis									188		13	6								180
Rubus chamaemorus									27											
Carex disperma									24											
Vaccinium microcarpum									17											
Carex vaginata									15											
Equisetum sylvaticum									10				2							
Arctagrostis latifolia var. arundinacea									8		57	10								
Sanguisorba canadensis ssp. latifolia									7		1	17					2	22	12	
Bistorta vivipara									5		1	22						1		
Equisetum variegatum									1		61									
Valeriana dioica ssp. sylvatica									1	1		11					T	3		
Senecio triangularis									1		1	T						82	49	
Ranunculus occidentalis									T								T	31		
Epilobium latifolium											161									
Artemisia tilesii s. lat.											107	2			1					
Poa alpina											53	23		1	T	1	5	3		

TABLE 1. Continued

Strata and species	PCB	PTR	PBA	PHY	PGB	PSB	AHY	ABE	SCA	SAS	SAL	SGB	SBE	BEF	JUA	POG	FES	FEL	HER	CAR
Juncus arcticus ssp. ater											44									
Parnassia kotzebuei											38	2								
Agrostis scabra											30	2			1					
Erigeron acris ssp. debilis											18	5			1		2	T		
Oxytropis campestris s. lat.											18	T			10	102	T			
Phleum alpinum var. commutatum											15	8					14	68	25	
Cerastium beeringianum											4	T			T	42	9	1		
Myosotis asiatica											1				T	61	7	72		
Veronica wormskjoldii											1	14					4	24		
Carex macloviana											1	7					15	3	6	
Senecio pauciflorus												25		T			2	3		
Potentilla diversifolia												9			T	7	57	43		
Rumex acetosa ssp. arifolius												T				1	9	87	11	
Carex podocarpa														1	T		27	120		
Artemisia campestris ssp. borealis															12	88	2			
Carex supina ssp. spaniocarpa															10	350	1			
Potentilla nivea															8	54				
Artemisia michauxiana															2	44				
Potentilla pensylvanica															T	69	2			
Poa cusickii s. lat.															T		41	13		
Penstemon procerus																10	T			
Valeriana sitchensis																		58	13	
Cirsium edule																			13	
Lupinus nootkatensis																			13	
Carex rostrata																				530
Carex saxatilis ssp. laxa																				28
Bryophytes																				
Pleurozium schreberi	183	12	2	128	100	110	102	63	5	24	1	7	57	64	2		4	2		
Dicranum fuscescens	110	5	2	70	25	35	46	30		3		6		2						
Polytrichum juniperinum	77	4		45	12	10	10						5	9			11	6		
Hylocomium splendens	74	6		216	80	106	331	93	15	50		31	125	101			T	5	T	
Ptilium crista-castrensis	6	2		11	7	T	5	2		1			10	3						
Pogonatum alpinum	4			13	10		10	2												
Dicranum acutifolium	2	2		15	15	5		35	T				7	19			4			
Hypnum revolutum		32	2							6										
Thuidium abietinum		12	1							15			2		1		20			
Tortula ruralis		8	4			1				3					8	17	7			
Drepanocladus uncinatus		7	7	12						7	15	25	1					2	T	

TABLE 1. Continued

Strata and species	PCB	PTR	PBA	PHY	PGB	PSB	AHY	ABE	SCA	SAS	SAL	SGB	SBE	BEF	JUA	POG	FES	FEL	HER	CAR
Dicranum scoparium	6			8			20													
Tomenthypnum nitens				1		1		4	136		14	7					2	4		
Barbilophozia lycopodioides				T			12	1												
Aulacomnium palustre				T					125		8	56		5				27		
Sphagnum spp.[a]									138			3								
Drepanocladus exannulatus									44											150
Plagiomnium ellipticum									20			2						3		
Paludella squarrosa									18		2	5								
Polytrichum strictum									14		1	10								
Calliergon cordifolium									12			2								
Calliergon giganteum									10											12
Campylium stellatum									10											
Hypnum lindbergii											23	T								
Lichens																				
Cladina mitis	183	4		36	91	85	12	83	15	11		15	33	45	T		15	1		
Cladina rangiferina	137	1		1	52	57	10	65	3	2			22	34			2			
Peltigera aphthosa	120	4		122	91	110	95	74	20	39	6	35	97	83	1		6	6		
Cladina alpestris	63			3	35	31	4	41		3		T	20	24						
Cladonia uncialis	56				23	11	2	1				T	7	3			T			
Peltigera malacea	51	7		37	77	48	28	22		3			22	3	2		2	T		
Cladonia gracilis	45	11		3	18	22	15	14	2	2		4	13	16				T		
Cladonia ecmocyna	35			2	25	15	25	57	8			10	11	14						
Cladonia cornuta	33	1		11	15	16	16	18	5	2		4	10	8	T		T			
Cladonia gonecha	30				10	4	6	13	6	T		1	5	2						
Cetraria islandica	23	1		1		6	2	T	T			3	1	7	3	T	3	T		
Nephroma arcticum	21			1	23	5	5	23	T				8	1			T			
Cetraria nivalis	18	T		3	2	8		1	T			T	1	2	5	T				
Cetraria cucullata	14	T		4	15	18	T	4		T		3	5	10	4	7	T			
Cladonia chlorophaea s. lat.	14	1	1	2	6	4	12	13	4	8		8	4	5	T	1	T			
Cladonia pyxidata	12	13	1		2	3	T	3		7	3	3	1	1	11	3	2			
Stereocaulon alpinum	7		T	3	6	12	1					7								
Cladonia deformis	T			T	5	T	10	13	1			2	1	1						
Cladonia pleurota	T	T		2	T	4	T	13	T			4	3				T			
Lobaria linita	T			3	2	4	T	10	T			5		7			4	1		
Peltigera canina s. lat.	T	28			1	1				18	22	8	3	T	17	7	3			
Peltigera scabrosa		T	1	58		26	17	13	7			12	22				1	3		
Stereocaulon paschale					1	8		5			12		1	4	1		3	T		

TABLE 1. Concluded

Strata and species	PCB	PTR	PBA	PHY	PGB	PSB	AHY	ABE	SCA	SAS	SAL	SGB	SBE	BEF	JUA	POG	FES	FEL	HER	CAR
Average cover (%)																				
Overstory trees	53	56	49	70	32	33	50	31	7											
Intermediate trees	13	20	18	13	18	14	21	20	3											
Tall shrubs and tree saplings	4	7	21	6	4	9	12	14	4	67	11	22	10							
Low shrubs	22	12	6	9	61	36	29	39	48	31	30	64	84	88						
Dwarf shrubs and herbs	45	87	97	26	28	34	21	28	54	71	56	51	28	37	91	89	105	113	135	82
Bryophytes and lichens	85	11	3	79	68	68	82	76	65	20	18	33	54	51	7	7	16	12	T	11
Bare ground	T	1			T	T				T	25				8	9	1			

[a]Only those species with a prominence value of 10 or more in at least one community type are listed; T (trace) indicates a prominence value of less than 0.5.

[b]Community type abbreviations: PCB, Pinus contorta - Betula glandulosa - Pleurozium schreberi; PTR, Populus tremuloides - Juniperus communis - Festuca altaica; PBA, Populus balsamifera - Epilobium angustifolium; PHY, Picea glauca - Hylocomium splendens; PGB, Picea glauca - Betula glandulosa - Salix glauca, Betula phase; PSB, Picea glauca - Betula glandulosa - Salix glauca, Salix phase; AHY, Abies lasiocarpa - Hylocomium splendens - Pleurozium schreberi; ABE, Abies lasiocarpa - Betula glandulosa - Empetrum nigrum; SCA, Salix barclayi - Betula glandulosa - Carex aquatilis - Aulacomnium palustre; SAS, Salix scouleriana; SAL, Salix alaxensis - Epilobium latifolium; SGB, Salix (glauca, barclayi) - Petasites palmatus; SBE, Salix glauca - Betula glandulosa - Festuca altaica; BEF, Betula glandulosa - Festuca altaica - Hylocomium splendens; JUA, Juniperus communis - Arctostaphylos uva-ursi; POG, Poa glauca - Carex supina; FES, Festuca altaica; FEL, Festuca altaica - Luzula parviflora; HER, Heracleum sphondylium; CAR, Carex rostrata - C. aquatilis.

[c]Number of stands sampled appears in parentheses.

[d]Sphagnum nemoreum, S. rubellum, S. fallax, S. fuscum, S. warnstorfii.

TABLE 2. Summary of environmental and community characteristics for subalpine plant community types, Gladys Lake Ecological Reserve

Community type	Relative abundance in reserve	Elevation range (m)	Slope (%) range and (mean)	Aspect	Snow release	Drainage	Moisture regime	Soil classification	Total no. species	Mean no. species	Mean cover (dominants[a]) (%)	Mean frequency (dominants[a]) (%)	Mean total plant cover (%)
Pinus contorta - *Betula glandulosa* - *Pleurozium schreberi*	X	1220-1250	0 - 10 (4)	Flat	Medium	Good - rapid	Subxeric -submesic	Humo-Ferric Podzols, Dystric Brunisols	58	30	31	100	222
Populus tremuloides *Juniperus communis* - *Festuca altaica*	XX	1220-1500	8 - 65 (30)	S, SW	Early	Moderate-rapid	Subxeric -mesic	Eutric & Melanic Brunisols, Regosols, Luvisols	82	26	42	94	193
Populus balsamifera - *Epilobium angustifolium*	X	1300-1500	15 - 50 (27)	S, SW	Early	Moderate - good	Mesic	Brunisols	45	24	62	100	194
Picea glauca - *Hylocomium splendens*	X	1220 1370	0 - 20 (6)	All	Medium - late	Moderate-imperfect	Mesic - subhygric	Podzols, Luvisols Regosols, Brunisols	65	27	55	100	203
Picea glauca - *Betula glandulosa* - *Salix glauca*, *Betula* phase	XXX	1220-1400	0 - 40 (18)	E, NE	Medium - late	Moderate - good	Mesic	Gray Luvisols, Dystric Brunisols, Humo-Ferric Podzols	56	31	38	100	211
Picea glauca - *Betula glandulosa* - *Salix glauca*, *Salix* phase	XXX	1220-1310	0 - 35 (15)	All	Medium	Moderate-good	Mesic - submesic	Gray Luvisols, Dystric Brunisols	83	35	30	90	194
Abies lasiocarpa - *Hylocomium splendens*	XX	1400-1550	3 - 55 (25)	N, NE	Very late	Moderate	Mesic	Humo-Ferric Podzols, Dystric Brunisols	61	23	43	100	215
Abies lasiocarpa - *Betula glandulosa* - *Empetrum nigrum*	XXX	1370-1575	0 - 3 (0)	N, E NW	Late	Moderate imperfect	Mesic - subhygric	Podzols, Gleysols	77	34	40	100	208
Salix barclayi - *Betula glandulosa* - *Carex aquatilis* - *Aulacomnium palustre*	XX	1220-1370	0 (0)	Flat	Medium	Very poor	Hygric - hydric	Organic, Humic Gleysols, Regosols	108	33	17	86	181

TABLE 2. Continued

Community type	Relative abundance in reserve	Elevation range (m)	Slope (%) range and (mean)	Aspect	Snow release	Drainage	Moisture regime	Soil classification	Total no. species	Mean no. species	Mean cover (dominants[a]) (%)	Mean frequency (dominants[a]) (%)	Mean total plant cover (%)
Salix scouleriana	XX	1300 1460	8 - 50 (32)	W, SW	Early	Moderate-good	Submesic - mesic	Brunisols	65	29	70	100	189
Salix alaxensis - Epilobium latifolium	X	1220-1500	0 - 25 (3)	Flat	Early	Imperfect	Hygric	Cumulic & Gleyed Regosols	108	30	22	100	115
Salix (glauca, barclayi) - Petasites palmatus	XXX	1220-1430	0 - 5 (1)	Flat (All)	Medium	Imperfect - poor	Subhygric - hygric	Rego & Humic Gleysols	127	42	22	86	170
Salix glauca - Betula glandulosa - Festuca altaica	XXX	1300-1450	0 - 50 (23)	All	Medium	Moderate	Mesic	Brunisols, Humo-Ferric Podzols	68	27	37	100	177
Betula glandulosa - Festuca altaica - Hylocomium splendens	XXX	1300-1675	0 - 45 (12)	N, E, W	Late	Moderate - good	Mesic	Humo-Ferric Podzols, Dystric Brunisols	65	24	40	100	176
Juniperus communis - Arctostaphylos uva-ursi	X	1250-1630	15 - 60 (48)	S	Very early	Good - rapid	Xeric - subxeric	Brunisols, Regosols	85	27	34	95	98
Poa glauca - Carex supina	X	1495-1700	35 - 70 (51)	S	Snow-free	Good - rapid	Xeric - subxeric	Eutric & Melanic Brunisols	74	27	38	100	96
Festuca altaica	XX	1220-1700	0 - 70 (32)	S, W	Early-medium	Moderate - good	Submesic - mesic	Melanic & Sombric Brunisols	127	28	60	100	121
Festuca altaica - Luzula parviflora	X	1220-1675	0 - 25 (8)	E, N, SE	Late	Moderate -imperfect	Mesic - subhygric	Gleyed Brunisols, Humic Gleysols	93	26	24	96	125
Heracleum sphondylium	X	1400-1585	5 - 40 (13)	S, W	Late	Imperfect - poor	Subhygric - hygric	Gleyed Regosols & Rego Humic Gleysols	47	19	67	100	135
Carex rostrata - - C. aquatilis	X	1220-1370	0	Flat	Medium	Very poor	Subhygric - hydric	Organics, Humic Gleysols	30	8	44	67	93

[a] The one-few species used to name community type.

where it often forms pure stands. Higher in the subalpine zone, in passes and wide valleys subject to cold air drainage and ponding, valley bottoms are typically treeless and occupied by a mosaic of shrubfields, marshes, fens, and grassland. A skirt of forest occurs on lower and middle slopes, and shrubs and krummholz dominate above the intermediate forested belt.

(a) Pinus contorta - Betula glandulosa - Pleurozium schreberi.

Lodgepole pine forest occurs only in the northeastern corner of the ecological reserve, near the outlet of Cold Fish Lake. This community type has developed on Humo-Ferric Podzols and Dystric Brunisols over coarse textured, rapidly drained glaciofluvial outwash and alluvial terraces.

The pine stands are relatively open (total mean canopy cover of 62%), with trees occasionally reaching 18 m in height. The presence of charcoal in the soil profiles, and frequent spruce in the canopy, subcanopy, and as saplings and seedlings, indicate the seral nature of this forest type.

The shrub stratum is moderately to poorly developed, with a total mean cover of 20%. Betula glandulosa dominates, and Salix glauca, S. scouleriana, and Shepherdia canadensis are fairly frequent.

Prominent in the moderately developed dwarf shrub/herb stratum are Empetrum nigrum , Vaccinium vitis-idaea, V. caespitosum, Festuca altaica, and Lupinus arcticus.

The cryptogamic ground cover is well-developed. Prominent mosses are Pleurozium schreberi and Dicranum fuscescens; Hylocomium splendens and Polytrichum juniperinum are frequent. Lichens are common and abundant, especially Cladina mitis, C. rangiferina, C. alpestris, other Cladoniae (Cladonia gracilis, C. ecmocyna, C. uncialis, C. gonecha, C. chlorophaea), and Peltigera aphthosa and P. malacea.

Epiphytes are moderately abundant. Typical species, for pine forests as well as most other types within the reserve, are Alectoria

americana, Cetraria pinastri, Hypogymnia austerodes, H. physodes, Parmelia sulcata, Parmeliopsis ambigua, and P. hyperopta.

Lodgepole pine forests are fairly common in the SWB of the upper Stikine region, but are much more frequent and widespread at lower elevations in the BWBS, presumably because of greater frequency and extent of wildfires. Similar subalpine forests have been briefly described by Anderson (1970) in the Atlin area of northwestern British Columbia, by Luckhurst (1973) in the Rocky Mountain foothills of northeastern B.C., and by Geist et al. (1974) in the south central Yukon.

(b) Populus tremuloides - Juniperus communis - Festuca altaica.

Stands of trembling aspen occur frequently within the reserve on convex, south slopes of valley bottom moraines and glaciofluvial deposits, and on steep, colluvial, generally south-facing, lower mountain slopes. The aspen community type has two physiognomic phases, forest and scrub. Open forest with erect aspen trees to 15 m tall is rare in the Gladys Lake area, occurring on valley-bottom moraines, kames, and eskers in the northeast corner of the reserve. These few subalpine forest stands are related to those that occur commonly in the montane zone, but are grouped here with the subalpine scrub that is much more common in the SWB and is very similar in species composition. In the open forest phase, shrubs are uncommon, the herb layer is well-developed, and the cryptogamic layer sparse. Soils are shallow to moderately deep Brunisols with dark surface (Ah) horizons. Anderson (1970), Cathey (1974), Douglas (1974), Viereck (1975), and Orloci and Stanek (1979) have described similar aspen forests in the Atlin, Mt. Edziza, southwest Yukon, interior Alaska, and southern Yukon areas, respectively.

Tall scrub or "pygmy forest" of aspen occurs to 1500 m on steep, dry, south- or southwest-facing lower colluvial slopes in the Gladys Lake study area. The pygmy forest consists of fairly dense stands of

stunted, gnarled, young aspen with pole-sized trunks. "Tree" height is 2-7 m, DBH averages 7 cm, and tree age is apparently less than 50 years -- although older stands with thicker trees do occur. In the pygmy forest, the shrub and herb strata are both moderately developed, and the cryptogamic layer sparse. The shallow, dark-coloured soils are skeletal Brunisols or Chernozem-like, colluvial Regosols. Annas (1974) in the southern Yukon, Lord and Luckhurst (1974) in the northern Rocky Mountain foothills, and Viereck et al. (1983) in interior Alaska have described similar aspen communities.

Characteristic shrub species of both forest and scrub are Salix scouleriana (which occasionally reaches the canopy or subcanopy), Shepherdia canadensis, Rosa acicularis, and Viburnum edule. Juniperus communis, Arctostaphylos uva-ursi, and Linnaea borealis are common dwarf or prostrate woody species. Festuca altaica, Epilobium angustifolium, Lupinus arcticus, Mertensia paniculata, Arnica cordifolia, Fragaria virginiana, Achillea millefolium, Delphinium glaucum, and Poa interior and P. glauca are prominent in the herb stratum.

Hypnum revolutum, a moss that clothes the bases of aspen trunks, and Peltigera canina are the only prominent cryptogams. Thuidium abietinum and Drepanocladus uncinatus are also frequent tree-base mosses. Tortula ruralis, Pleurozium schreberi, Brachythecium salebrosum, and Cladonia pyxidata are common in some stands.

Epiphytes are sparse to frequent, with greater coverage in more open stands. Leptogium saturninum, Parmelia subaurifera, and Physcia spp. are typical in addition to the species listed under (a).

The aspen forest has a fire history. Seral stands on more mesic sites have white spruce slowly coming up underneath, but the pygmy forest has very little spruce invasion and appears to be a pyroedaphic climax type.

Snow cover beneath aspen is probably moderate to heavy, with

drift accumulation. But melt-off is early, especially from the pygmy forest (cf. Geist et al. 1974; Lord and Luckhurst 1974).

(c) Populus balsamifera - Epilobium angustifolium.

Balsam poplar "pygmy forest" occurs up to 1500 m on steep, colluvial, generally south-facing, mountain slopes. It is an uncommon community type within the ecological reserve and often occurs with aspen pygmy forest, but there are very few mixed stands. Balsam poplar occupies moister sites than does aspen, and in several stands some downslope seepage was evident. Balsam poplar stands are often found on slightly concave slopes, and snowpack is probably heavier and longer-lasting then beneath aspen. Douglas (1974) and Birks (1977) recognized somewhat similar balsam poplar community types, but Lord and Luckhurst (1974) and Hoefs et al. (1975) grouped aspen and poplar stands together in one community type.

The shrub stratum is poorly developed, with Shepherdia canadensis, Rosa acicularis, and Viburnum edule the common species. The herb layer is lush and dominated by broad-leaved forbs. Epilobium angustifolium, Arnica cordifolia, Delphinium glaucum, Fragaria virginiana, Mertensia paniculata, Heracleum sphondylium, Thalictrum occidentale, Geranium richardsonii, and Lupinus arcticus are prominent forbs. Bromus richardsonii is the only common grass. The cryptogamic layer is poorly developed or even lacking, and epiphytes are sparse.

In the upper Stikine region, well-developed alluvial balsam poplar or poplar - spruce forest types occur only in the montane or BWBS zone, on floodplain terraces of the Stikine and lower Klappan rivers.

(d) Picea glauca - Hylocomium splendens.

Closed white spruce forest is present within the reserve on some north- and east-facing lower slopes, and on a few older alluvial

terraces along major creeks. Soils are cold, moist, and generally deep, till-derived Podzols and Luvisols, or gleyed alluvial Regosols and Brunisols. Such forest types are widespread and represent climatic climax vegetation in the montane zone of the upper Stikine region, but occur only in pockets in the subalpine zone. Roughly similar community types have been reported by Anderson (1970), Kojima (1972), Cathey (1974), Douglas (1974), Geist et al. (1974), Lord and Luckhurst (1974), Viereck (1975), Orloci and Stanek (1979), and Viereck et al. (1983).

The alluvial phase of this community type, which is rare in the reserve, is common in the surrounding region in the lower major river valleys. It is found on poorly to moderately drained, alluvial flood plains with silty or fine sandy parent material, and resembles the Picea glauca - Ribes triste - Equisetum pratense - Drepanocladus uncinatus association of Kojima (1972).

The P. glauca - Hylocomium splendens forest has a closed canopy (mean cover of 70%) and is moderately to densely stocked. Trees attain their best growth in the reserve in this type, with heights averaging 17-20 m and occasionally reaching 25 m. White spruce is the dominant tree species, and is reproducing in most of the stands of this climax type. Subalpine fir is frequently found in the overstory and as a sapling and seedling, especially in north-slope stands.

The shrub stratum is sparse or lacking. The dwarf shrub/herb stratum is sparse to moderately developed and typically includes Linnaea borealis, Cornus canadensis, Arnica cordifolia, and Mertensia paniculata. In the alluvial phase of this community type, Equisetum spp. (E. arvense, E. pratense, E. scirpoides, E. sylvaticum) are more frequent, along with Petasites palmatus.

The cryptogamic layer is very well-developed and carpet-like. The feather mosses Hylocomium splendens, Pleurozium schreberi, and (to a much lesser extent) Ptilium crista-castrensis form extensive

wefts, and tufts of Dicranum fuscescens, D. scoparium, Polytrichum juniperinum, and Pogonatum alpinum are common. Drepanocladus uncinatus is more abundant in the alluvial phase. Barbilophozia lycopodioides is a frequent liverwort. Peltigera aphthosa and P. scabrosa are common lichens.

Epiphytes are frequent to abundant, more so than in the open forest types. Common species include all those listed under (a). Usnea glabrescens is frequent only in the P. glauca - H. splendens community type.

(e) Picea glauca - Betula glandulosa - Salix glauca.

Open forest and woodland[1] with abundant shrub cover is general on uplands throughout the reserve on valley bottoms and lower slopes up to about 1400 m. It is also one of the dominant vegetation types in the subalpine zone of the entire upper Stikine region. Krajina (1975) has termed the subalpine zone of northern British Columbia, the Yukon, and the Mackenzie District the Spruce - Willow - Birch zone, in recognition of the zonal (climatic climax) dominance of this general type of community. Similar communities have been described by Anderson (1970), Luckhurst (1973), Douglas (1974), Viereck (1975, 1979), and Viereck et al. (1983).

The Gladys Lake P. glauca - B. glandulosa - S. glauca stands have an open canopy (mean cover of 33%), with widely spaced trees usually less than 17 m tall. Mature spruce have a greater DBH and are shorter than in the P. glauca - Hylocomium splendens closed forest type. White spruce regeneration was present in nearly all of the stands sampled. All stands have evidence of past fire. Soils are Gray Luvisols, Dystric Brunisols, and Humo-Ferric Podzols.

The shrub layer is moderately to well-developed. Betula

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[1]Woodland: scattered trees, canopy coverage 10-25% (Fosberg 1967).

glandulosa and Salix glauca are the prominent species. Both are abundant in most stands, but B. glandulosa predominates on colder, moister, northern slopes, while S. glauca does so on drier sites with southern aspects. In the former situation, the plant cover can be characterized as a Picea - Betula phase. Douglas (1974) gave this phase community type status in the Alsek Valley. However, in the Gladys Lake area, it appears to be merely an extreme phase linked by intermediate stands to a Picea - Salix phase, all within the P. glauca - B. glandulosa - S. glauca community type.

The sparse to moderately abundant dwarf shrub/herb layer typically includes Empetrum nigrum, Vaccinium vitis-idaea, Linnaea borealis, Festuca altaica, Lupinus arcticus, Mertensia paniculata, Epilobium angustifolium, and Pedicularis labradorica.

The cryptogamic stratum is well-developed. Prominent mosses are Pleurozium schreberi, Hylocomium splendens, Dicranum fuscescens, and Polytrichum juniperinum. Cladina mitis, C. rangiferina, C. ecmocyna, Cladonia gracilis, C. cornuta, C. deformis, C. gonecha, C. uncialis, Stereocaulon alpinum, and Peltigera aphthosa, P. canina, P. malacea, and P. scabrosa are common. Many of the open-grown spruce have very dense foliage "tents" that cast a litter shadow beneath them, the ground being densely covered with needles, but with very few cryptogams.

(f) Abies lasiocarpa - Hylocomium splendens - Pleurozium schreberi.

Closed forest of subalpine fir is local within the reserve, with best development on a few northern mid-slopes. This community type is more widespread in the southwestern section of the wilderness park, where there seems to be a moister climate with greater snowfall. The relatively deep, podzolic or brunisolic soils are cold and moist, but without permafrost. Geist et al. (1974) briefly described similar, nearly pure subalpine fir stands in the south central Yukon.

Subalpine fir forms stands with patchy, incompletely closed canopies (mean total cover of 50%) and moderately dense stocking. Tree growth is poor, with an average height of 15 m. Abies reproduction is extensive, both by layering and seedlings, in these climax stands.

The poorly developed shrub stratum has no prominent species other than reproducing subalpine fir. Betula glandulosa and Ribes glandulosum occur fairly frequently. Empetrum nigrum and Cornus canadensis are the only prominent species in the generally sparse dwarf shrub/herb stratum, but Linnaea borealis, Mertensia paniculata, Vaccinium vitis-idaea, and Festuca altaica may frequently be found.

The cryptogamic layer is very well-developed, with a mean total cover of 80%. The feather mosses Hylocomium splendens and Pleurozium schreberi are prominent, along with Dicranum fuscescens. Additional common bryophytes are Barbilophozia lycopodioides, Dicranum scoparium, Brachythecium spp., Drepanocladus uncinatus, Polytrichum juniperinum, and Pogonatum alpinum. Common lichens include Peltigera aphthosa, P. scabrosa, P. malacea, Cladonia cornuta, C. gracilis, C. ecmocyna, C. deformis, and C. gonecha.

Epiphytes are usually frequent to abundant and typically are Cetraria pinastri, Hypogymnia austerodes, and Parmeliopsis ambigua.

(g) Abies lasiocarpa - Betula glandulosa - Empetrum nigrum.

Open subalpine fir forest and woodland are common on steep, moist midslopes, with best development on northern exposures. Soils are moist to wet, cold, Podzols and Gleysols. As Picea - Betula - Salix is the dominant forest community type at lower elevations in the subalpine zone, so Abies - Betula - Empetrum is in the higher subalpine. The open forest and woodland grade into dwarfed clumps and eventually krummholz or "shintangle" on upper slopes. The treeline is thus gradual. The krummholz belt generally occurs at alpine elevations (1600+ m) and is included in the AT zone.

Luckhurst (1973), Cathey (1974), and Geist et al. (1974) have described similar Abies - Betula - Empetrum communities.

The trees are widely spaced and very poorly growing (10 m or less in height). Subalpine fir reproduction is common, but mainly by layering. In the progression towards krummholz, the trees become stunted and assume the "flag" form, in which there is a dense, shrub-like thicket at the tree base, followed by a main stem snow-blasted and wind-desiccated free of foliage and most branches for a half meter or so. This bare "pole" is then topped by a sparse crown or "flag" of foliage. The height of the basal thicket indicates the prevailing winter snow depth on the site, which in the Gladys Lake area is about 1-1.5 m in this community type.

The shrub layer is moderately abundant to dense. Betula glandulosa is the prominent species, but Salix glauca and Ledum groenlandicum are abundant on wetter sites with gleyed soils.

Prominent in the dwarf shrub/herb stratum are Empetrum nigrum and Vaccinium vitis-idaea. Artemisia arctica, Cornus canadensis, Linnaea borealis, Lupinus arcticus, Mertensia paniculata, Pedicularis labradorica, and Festuca altaica also occur, and Arctostaphylos rubra may be abundant on wetter sites.

The cryptogamic layer is well-developed (mean total cover of 75%) and diverse. Lichens are more prominent here than in the Abies - Hylocomium - Pleurozium community type. Important species include Cladina alpestris, C. mitis, C. rangiferina; Cladonia cornuta, C. gracilis, C. ecmocyna, C. chlorophaea, C. cenotea, C. coccifera, C. deformis, C. gonecha, C. crispata, and C. uncialis; Peltigera aphthosa, P. scabrosa, P. malacea; Nephroma arcticum, Lobaria linita, and Dactylina arctica. Hylocomium splendens, Pleurozium schreberi, and Dicranum spp. are the prominent mosses.

Epiphytes are sparse to frequent, generally less abundant than in Abies - Hylocomium - Pleurozium forests.

4.1.2 Shrub Community Types

There are seven shrub-dominated community types in the Gladys Lake reserve. Most of these appear to be climax or subclimax types. They range from swamps and shrub fens to dry colluvial scrub (Tables 1 and 2).

(a) Salix barclayi - Betula glandulosa - Carex aquatilis - Aulacomnium palustre.

Subalpine shrubby wetlands occur commonly in the reserve in the valley bottoms in poorly drained, abandoned channels and old oxbows within the meander plains of the major creeks. Swamps and fens have also developed in potholes in moraine fields, pitted outwash, and kame terraces, and as backswamps between mountain bases and natural levees along the streams. As well, wetlands occur along lake margins and in areas swamped by beaver ponds. Shrub and forest swamps are common in the park (primarily in the montane zone), and are exceptionally well-developed along the lower Spatsizi River. This wetland type may be termed a moderately rich (weakly minerotrophic) soligenous/topogenous shrubby swamp or fen, following the classification of Sjörs (1963), Heinselman (1963, 1970), Zoltai et al. (1975), and Tarnocai (1980). That is to say, the wetland waters appear to be moderately rich in basic ions (and thus do not have low pH's), and the nutrients are fed in by water flowing from surrounding mineral soil and/or seepage down from higher ground. Soils are organics, Humic Gleysols, and gleyed Regosols. Anderson (1970), Kojima (1972), Cathey (1974), and Douglas (1974) have reported somewhat similar wetlands. There are no true bogs in the ecological reserve.

Trees are often lacking; if present, they are widely scattered, stunted, and slow-growing. White spruce (most frequent) and lodgepole pine are the only tree species present in the Gladys Lake fens, and this appears to be the case in most of the wetlands of the

upper Stikine drainage. However, black spruce (Picea mariana) occurs in some swamps and bogs in the region, especially at lower elevations and in lower nutrient regimes.

The shrub stratum is moderately to well-developed. Salix barclayi, Betula glandulosa, Salix barrattiana, S. glauca, S. planifolia, and Potentilla fruticosa are prominent species.

A moderate to dense dwarf shrub/herb stratum is always present. Carex aquatilis is the most prominent species, followed by Salix myrtillifolia and Empetrum nigrum. Important associates are Ledum groenlandicum, Arctostaphylos rubra, Vaccinium microcarpum, Rubus chamaemorus, Rubus arcticus, Equisetum arvense, Carex disperma, C. vaginata, C. media, and Arctagrostis latifolia.

The cryptogamic layer (mainly mosses) is usually well-developed and markedly hummocky. Prominent species are Aulacomnium palustre, Tomenthypnum nitens, Paludella squarrosa, Drepanocladus exannulatus, Sphagnum capillaceum, S. recurvum, Plagiomnium ellipticum, Calliergon cordifolium, and Polytrichum strictum. Also common are Calliergon giganteum, Campylium stellatum, Cinclidium stygium, Plagiomnium medium, Dicranum undulatum, Drepanocladus revolvens, Sphagnum fuscum, S. warnstorfii, Bryum pallescens, and Hylocomium splendens. Peltigera aphthosa, P. scabrosa, Cladina mitis, Cladonia gonecha, C. deformis, C. chlorophaea, C. cyanipes, C. carneola, and Icmadophila ericetorum are frequent lichens.

(b) Salix scouleriana.

Salix scouleriana forms a tall willow scrub on moderately to steeply sloping, mesic to dry, well-drained colluvial or till slopes with brunisolic soils. It is best developed on southern exposures, and in the reserve ascends such slopes to 1460 m. It occurs fairly commonly on burned-over sites throughout the region, and is often associated with pygmy stands of aspen and balsam poplar. Like the two Populus types, the Salix scouleriana scrub probably has a

moderate to heavy snowcover that melts off early in spring. Douglas (1974) described a similar community type in the Alsek region.

Clumps of Salix scouleriana to 7 m tall form a well-developed tall shrub stratum. Lower shrubs are moderately abundant, with Salix glauca prominent, and Betula glandulosa and Shepherdia canadensis frequent associates. White spruce and balsam poplar invasion is infrequent.

The dwarf shrub/herb stratum is usually well-developed. Prominent species are Linnaea borealis, Epilobium angustifolium, and Festuca altaica. Important associates are Juniperus communis, Lupinus arcticus, Arnica cordifolia, and Mertensia paniculata.

The cryptogamic layer is sparse to moderately abundant. Common species include Thuidium abietinum, Pleurozium schreberi, Hylocomium splendens, Drepanocladus uncinatus, Hypnum revolutum, Peltigera canina, P. aphthosa, and Cladonia chlorophaea.

Cetraria pinastri, Parmeliopsis ambigua, and Leptogium saturninum are the most common epiphytes.

(c) Salix alaxensis - Epilobium latifolium.

Riparian willow thickets develop on fresh alluvium on active floodplains of low gradient streams and ascend for short distances on rubble along steep mountain creeks. The alluvial deposits are heterogeneous in size and texture and are well-drained, although they are flooded in early summer, and the water table is high for most of the growing season. Soils are Cumulic and Gleyed Regosols. The vegetation is in different seral stages on such sites, depending on the age and stability of the substrate. Early stages have low or seedling shrubs, a moderately developed herb layer, sparse to moderate cryptogamic cover, and some bare ground. The most advanced stages have dense thickets or even small-tree-sized stands of willows with white spruce seedlings and saplings, a moderately developed herb stratum, and a sparse to moderate cryptogamic layer.

Prominent shrubs are Salix alaxensis, S. barclayi, and S. planifolia. Epilobium latifolium, Artemisia tilesii, Astragalus alpinus, Equisetum arvense, E. variegatum, Parnassia kotzebuei, Lupinus arcticus, Arctogrostis latifolia, Poa alpina, and Juncus arcticus are prominent in the herb stratum. Other characteristic herbs are Minuartia dawsonensis, Barbarea orthoceras, Erigeron acris ssp. debilis, Oxytropis campestris, Carex aurea, Deschampsia cespitosa, Agrostis scabra, and Phleum alpinum. Typical cryptogams include Drepanocladus uncinatus, Hypnum lindbergii, Isopterygium pulchellum, Ceratodon purpureus, Bryum caespiticium, Distichium capillaceum, Rhacomitrium canescens, Preissia quadrata, Stereocaulon tomentosum, Cladonia pyxidata, C. chlorophaea, and Peltigera canina.

This community type is similar to the Salix alaxensis - Calamagrostis canadensis - Drepanocladus uncinatus association of Kojima (1973).

Interestingly, there are no pioneer Dryas drummondii communities in the Gladys Lake reserve. This type colonizes recent gravel outwash fans and stream terraces and is locally common in the nearby Cassiar area of British Columbia, and in the southern Yukon (Douglas 1974; Orloci and Stanek 1979).

(d) Salix (glauca, barclayi) - Petasites palmatus.

Medium-tall (1.5-3 m) willow thickets are common on wet sites in the valley bottoms on alluvial fans, meander plains, lakesides, and depressions in till plains. Typical soils are Rego and Rego Humic Gleysols.

The shrub stratum is well-developed, but variable in that tall shrubs may be lacking or abundant. Salix glauca, S. barclayi, and S. planifolia are the prominent willows, and S. barrattiana and Potentilla fruticosa are common. Betula glandulosa is generally not an important species in this community type.

The dwarf shrub/herb layer is rich in species and moderate to abundant in cover. Prominent species include Festuca altaica, Luzula parviflora, Poa leptocoma, Petasites palmatus, Rubus arcticus, Epilobium angustifolium, Achillea millefolium, Aconitum delphiniifolium, Mertensia paniculata, Polemonium caeruleum, Stellaria longipes var. altocaulis, and Senecio pauciflorus.

The moss layer is moderately developed and characteristically hummocky. Prominent species are Aulacomnium palustre, Hylocomium splendens, and Peltigera aphthosa. Important associates are Polytrichum strictum, Drepanocladus uncinatus, Plagiomnium venustum, and Peltigera scabrosa. Other locally common cryptogams are Brachythecium salebrosum, Climacium dendroides, Bryum pallescens, Tomenthypnum nitens, Blepharostoma trichophyllum, Cladonia cyanipes, and C. gonecha.

(e) Salix glauca - Betula glandulosa - Festuca altaica.

The most extensive cover of the subalpine zone of the Gladys Lake reserve is a dense scrub of Betula glandulosa and Salix spp. 1 to 2.5 m high. At lower elevations, it is mixed with Picea - Betula - Salix open forest and woodland, but at middle and upper subalpine elevations the shrub cover becomes increasingly dominant, especially on mesic to dry, well-drained sites. This scrub is climax vegetation over much of the upper

Stikine region. Except in the lower subalpine, tree reproduction beneath the shrub cover is rare. As well, the shrub communities appear to be encroaching on the subalpine grassland throughout the region. Krajina (1975) suggests that the deciduous shrubs thrive in part because, even under cloudless skies, frost does not occur during the short summer nights. Similar shrub communities are common throughout northern British Columbia and the southern Yukon, and several have been described by Kojima (1973), Luckhurst (1973), Cathey (1974), Douglas (1974), Krajina (1975), Birks (1977),

and Orloci and Stanek (1979).

Salix - Betula scrub is widespread on mesic to dry, well-drained sites in valley bottoms and on lower slopes. It occurs generally except on cold, moist, northern slopes. The brunisolic to podzolic soils have developed on well-drained till, colluvium, or alluvium.

The shrub stratum is very well-developed and generally 1-2 (3) m tall. Salix glauca and Betula glandulosa are co-dominants, and Salix scouleriana is a frequent associate. The herb stratum is sparse to moderately developed. Festuca altaica is the prominent species. Important associates are Epilobium angustifolium, Mertensia paniculata, Linnaea borealis, and Lupinus arcticus.

The moss layer is moderately to well-developed. Hylocomium splendens and Pleurozium schreberi are prominent mosses and Dicranum acutifolium is frequent. Peltigera aphthosa is the only prominent lichen, although other Peltigeras and various Cladoniae are frequent.

Epiphytes are generally sparse in the deciduous scrub. However, Cetraria pinastri, Parmeliopsis ambigua, P. hyperopta, and Parmelia exasperatula are fairly constant in both this and the following community type.

(f) Betula glandulosa - Festuca altaica - Hylocomium splendens.

Betula glandulosa forms extensive thickets throughout the subalpine zone, but dominates most on mesic to moist, northern, middle and upper slopes. This Betula scrub (commonly called "buckbrush" by locals) is widespread throughout the upper Stikine region, and northern British Columbia and the southern Yukon in general (cf. Kojima 1973; Cathey 1974; Douglas 1974; Lord and Luckhurst 1974; Krajina 1975). Typical soils are shallow, coarse textured Podzols over moderately drained colluvium and till.

The shrub stratum is well-developed, often covering 100%. It is overwhelmingly dominated by Betula glandulosa, usually 0.8-2 m tall. Salix glauca is a frequent associate, but never dominates in this community type.

The herb stratum is usually fairly sparse, probably because of the dense Betula cover. Festuca altaica is the only prominent species. Empetrum nigrum, Artemisia arctica, Lupinus arcticus, Mertensia paniculata, Vaccinium vitis-idaea, Linnaea borealis, and Stellaria longipes var. altocaulis are common.

The cryptogamic layer is well-developed. Prominent mosses are Hylocomium splendens, Pleurozium schreberi, and Dicranum acutifolium. Important lichens include Peltigera aphthosa, Cladina mitis, C. rangiferina, C. alpestris, Cladonia gracilis, and C. ecmocyna. Cetraria cucullata, C. islandica, Cladonia cornuta, C. gonecha, C. deformis, C. coccifera, Peltigera malacea, Nephroma arcticum, and Lobaria linita are fairly common.

On drier sites, the bryophytes tend to cluster around the bases of the B. glandulosa clumps, while the lichens and Festuca altaica abound in patches in the open between the clumps. On moister sites, B. glandulosa forms a closer canopy and the mosses form thick carpets beneath it. The Peltigeras and Nephroma increase in abundance on the moss carpets.

(g) Juniperus communis - Arctostaphylos uva-ursi.

Juniperus communis - Arctostaphylos uva-ursi dwarf scrub is fairly common on dry, lower to middle elevation, colluvial slopes, stabilized talus, rocky ridge-crests, and kame and esker faces. It is generally found on steep south slopes, at elevations up to 1630 m. J. communis - A. uva-ursi appears to be invading adjacent subalpine grassland, and at these elevations is itself succeeded (often very slowly) by aspen or balsam poplar pygmy forests, or by Salix - Betula scrub. Douglas (1974) described a similar community type in the southwestern Yukon.

The well-developed dwarf shrub/herb stratum is dominated by Juniperus communis, Arctostaphylos uva-ursi, and Festuca altaica. Stunted Rosa acicularis and Potentilla fruticosa are frequent shrubby

associates. Other important herbaceous species include Poa glauca, Koeleria macrantha, Saxifraga tricuspidata, Epilobium angustifolium, Achillea millefolium, Draba aurea, Gentianella propinqua, Sedum lanceolatum, and Anemone multifida.

The cryptogamic layer is usually sparse. Ceratodon purpureus, Tortula ruralis, Orthotrichum laevigatum, Peltigera canina, and Cladonia pyxidata are fairly frequent, and all are typically xerophytic species.

Snow cover in this type is probably light and discontinuous, and periodically lacking. Soils are shallow Brunisols over coarse, well-drained colluvium or glaciofluvial materials.

4.1.3 Herb community types

Five subalpine herb communities are described in the Gladys Lake reserve. They all appear to be pioneer or seral or topoedaphic climax types and are generally local in distribution. They occur on a variety of parent materials and range from dry steppe to sedge fens.

(a) Poa glauca - Carex supina.

This subalpine steppe is restricted to very steep (ca 30°), dry, south-facing colluvial slopes, between about 1490 and 1770 m in the study area. The Eutric and Melanic Brunisols have well-developed, dark Ah horizons but otherwise are shallow over colluvium, and this grassland type is largely snow-free in winter. Annas (1974) and Douglas (1974) have described similar steppe community types.

The well-developed herb layer is dominated by grasses and sedges, most notably Poa glauca and Carex supina ssp. spaniocarpa. Agropyron trachycaulum, Koeleria macrantha, Festuca altaica, F. saximontana, Trisetum spicatum, Carex petasata, and C. obtusata are additional important grasses and sedges. Prominent forbs are Potentilla pensylvanica, Artemisia campestris ssp. borealis, and Oxytropis campestris. Common associates are Potentilla nivea, Artemisia michauxiana, Cerastium beeringianum, Myosotis asiatica,

Saxifraga tricuspidata, and Androsace septentrionalis.

The cryptogamic stratum is sparse. Tortula ruralis is the most prominent species, while Peltigera canina, Parmelia separata, and Physconia muscigena are fairly frequent.

On some sites this grassland type appears to be a topoedaphic climax, but other sites are being invaded by shrubs such as Rosa acicularis, Arctostaphylos uva-ursi, Potentilla fruticosa, and Juniperus communis.

(b) Festuca altaica.

Festuca altaica steppe is widely distributed in the subalpine zone, usually below 1625 m, but occasionally ascending to 1850 m on south slopes. In the Gladys Lake reserve it occurs on mesic to dry sites on glaciofluvial and fluvial landforms, in the bottom of rapidly drained frost-pocket depressions in moraine fields, and on south-facing, lower and middle colluvial slopes. F. altaica steppe is of patchy occurrence in the reserve, but occasionally forms extensive cover in larger areas of glaciofluvial deposits. In the upper Stikine region, much more extensive steppe occurs in wide, drift-filled valleys subject to cold air ponding. Throughout the region, some areas of steppe appear to form topoedaphic climax vegetation, whereas other grasslands are being invaded by shrubs.

This grassland type is conspicuously dominated by Festuca altaica, the widespread bunchgrass of the subalpine steppe of the region (Pojar 1982). The well-developed herb stratum contains numerous species of other grasses and forbs. Prominent among them are Festuca saximontana, Poa glauca, P. cusickii, Artemisia arctica, and Potentilla diversifolia. Additional common herb species are Aconitum delphiniifolium, Delphinium glaucum, Epilobium angustifolium, Fragaria virginiana, Lupinus arcticus, Solidago multiradiata, Trisetum spicatum, Luzula parviflora, Carex podocarpa, and C. macloviana.

The cryptogamic stratum is generally poorly developed. Thuidium abietinum is the only common species. On drier sites, the herb stratum thins out a bit, and moss and lichen cover increase. Polytrichum juniperinum, Dicranum acutifolium, Tortula ruralis, Cladina mitis, Cetraria cucullata, C. islandica, Peltigera canina, P. aphthosa, Cladonia chlorophaea, and C. furcata may be locally common.

Soils are dark, well-drained, and range from shallow, marginal Chernozems to deep, loamy Sombric and Melanic Brunisols. Snow accumulation is variable. Snow cover is probably light and discontinuous or lacking on steep, south-facing slopes, whereas moderate, continuous snow cover is probable in the broad upper valleys and frost pocket areas.

(c) Festuca altaica - Luzula parviflora.

Lush grass-forb subalpine meadows are uncommon in the reserve. They are restricted to sites moister than those of the previous community type, and reach best development on gentle, often north- or east-facing lower slopes along broad ridges or the sides of wide valleys. Soils are deep and moderately to poorly drained (Gleyed Brunisols and Humic Gleysols). These meadows appear to be seral or edaphic subclimax vegetation, slowly being succeeded by moist Salix thickets and Betula glandulosa scrub.

The herb stratum is very well-developed, and consists of a lush and diverse mixture of grasses and forbs. Prominent species include Festuca altaica, Luzula parviflora, Carex podocarpa, Phleum alpinum, Artemisia arctica, Aconitum delphiniifolium, Rumex acetosa, Senecio triangularis, Rubus arcticus, Vaccinium caespitosum, Myosotis asiatica, Epilobium angustifolium, and Polemonium caeruleum. Common associates are Castilleja unalaschcensis, Lupinus arcticus, Mertensia paniculata, Agoseris aurantiaca, Valeriana sitchensis, Veronica wormskjoldii, and Sanguisorba canadensis ssp. latifolia. Ranunculus occidentalis and Erigeron peregrinus may be locally common.

The cryptogamic layer is generally sparse, but Aulacomnium palustre and Peltigera aphthosa are important on some sites.

Moist F. altaica - forb subalpine meadows are much more common in the moister southwestern part of the upper Stikine region. This is a common community type in the mountains further to the west. A coastal influence is indicated even in the study area by the occurrence in these meadows of such species as Fritillaria camschatcensis, Castilleja parviflora, Ranunculus occidentalis, and Viola langsdorfii. The F. altaica - forb subalpine meadows are related to the forb-rich timberline meadows of central and southern British Columbia, but have major floristic differences (cf. Hamet-Ahti 1978).

(d) Heracleum sphondylium.

Lush Heracleum sphondylium meadows are uncommon and of small extent in the Gladys Lake reserve. They develop over coarse alluvium on convex, sloping, fluvial fans at the bases of steep mountain creeks, and in concave lower slope seepage and snow accumulation areas. Soils are Gleyed Regosols and Rego Humic Gleysols, fed by continuous downslope seepage through these hygric sites.

The herb stratum is extremely well-developed, but with fewer species than any of the previous community types. It is dominated by Heracleum sphondylium (usually with cover values greater than 50%) and other broad-leaved forbs. Prominent forbs include Epilobium angustifolium, Thalictrum occidentale, Delphinium glaucum, Achillea millefolium, Mertensia paniculata, and Polemonium caeruleum. Phleum alpinum, Calamagrostis canadensis, and Festuca altaica are important grasses.

The cryptogamic layer is sparse or lacking. Species of Bryum, Mniaceae, and Drepanocladus are occasional.

As with the F. altaica - forb meadows, H. spondylium meadows have some coastal affinities and increase in abundance toward the

southwest of the region. Cirsium edule, Epilobium luteum, and Lupinus nootkatensis are three typically coastal species collected only in H. sphondylium communities in the reserve.

(e) Carex (rostrata, aquatilis).

Carex-dominated wetlands are not common in the reserve. They have developed in poorly drained depressions in till fields, and are encroaching on kettlehole lakes, oxbows, backwaters, and beaver sloughs. Soils are organics, Humic Gleysols, and Rego Humic Gleysols. Carex marshes and fens are pioneer and seral vegetation types, succeeded by shrub and forest fen types. Carex wetlands are very well-developed on the meander plain of the lower Spatsizi River, especially its stretches along the eastern boundary of the Gladys Lake reserve. They are fairly common throughout the region, but generally not very extensive.

The herb stratum is sparse to moderately developed in the marshes, but better developed with more continuous cover in the fen type. Prominent sedges include Carex aquatilis, C. rostrata, and C. saxatilis. Carex canescens, C. limosa, C. paupercula, and Eriophorum angustifolium, E. callitrix, and E. vaginatum are frequent associates. Epilobium palustre, Chrysosplenium tetrandrum, Potentilla palustris, Callitriche verna, Hippuris vulgaris, Ranunculus hyperboreus, Calamagrostis canadensis, Arctagrostis latifolia, and Sparganium minimum may be locally abundant.

The moss layer is generally poorly developed. Drepanocladus exannulatus and Calliergon giganteum are the only prominent species. Cinclidium stygium, Drepanocladus revolvens, Calliergon cordifolium, Plagiomnium venustum, and Bryum pallescens may also occur.

4.1.4 Talus - lichen - moss terrain unit

The only cryptogam-dominated vegetation in the subalpine zone of the Gladys Lake reserve might be characterized as the (Dryopteris

fragrans) - lichen - moss community type. However, this nowhere forms continuous, homogeneous cover, and the vegetation is actually a complex of several, very small-scale, cryptogamic communities that would require different sampling methods to define. This terrain unit (as it is more properly termed) is uncommon and occurs below 1450 m. It comprises pioneer vegetation on partially stabilized, south-facing talus and rubble slopes. It appears to be transitional to Juniperus communis - Arctostaphylos uva-ursi communities. Similar communities have been described on recent lava in the nearby Mt. Edziza area by Cathey (1974).

There is a preponderance of exposed rock, with little or no soil (organic matter slowly accumulates on ledges and flat boulders and in crevices). Xeric conditions predominate, but moist, shaded microhabitats honeycomb the talus.

The herb stratum is sparse. There are no prominent species, but Dryopteris fragrans , Cystopteris fragilis, Festuca saximontana, Saxifraga tricuspidata, Poa glauca, and Koeleria macrantha are fairly frequent.

The cryptogamic stratum is moderately to very well-developed, with clumps of mosses and fruticose lichens, and numerous crustose lichens. Its composition is difficult to quantify because of the complex of microenvironments. However, important species include Rhacomitrium lanuginosum, Cladina alpestris, C. mitis, Cetraria nivalis, Stereocaulon tomentosum, S. saxatile, S. paschale, Cladonia uncialis, Rhizocarpon geographicum agg., Rhizocarpon eupetraeum, Parmelia stygia, P. taractica, Lecidea spp., Actinogyra muehlenbergii, Umbilicaria hyperborea, and U. proboscidea. The cryptogamic flora is diverse. Additional common species are Andreaea rupestris, Dicranum acutifolium, D. fragilifolium, Polytrichum piliferum, Pohlia cruda, Tortula ruralis, Rhacomitrium canescens, Thuidium abietinum, Chandonanthus setiformis, Barbilophozia hatcheri, Ptilidium ciliare, Cladina rangiferina, Cladonia amaurocraea, C. coccifera, C. gracilis, C. pyxidata, C. crispata, Cetraria cucullata,

Alectoria ochroleuca, Sphaerophorus fragilis, Thamnolia subuliformis, Dactylina arctica, Parmelia omphalodes, P. infumata, P. saxatilis, Physconia muscigena, Umbilicaria vellea, Xanthoria elegans, Lepraria chlorina, Lecidea macrocarpa, Haemotomma lapponicum, and Lecanora spp.

4.2 Alpine Vegetation of the Gladys Lake Ecological Reserve

4.2.1 Shrub Community Types

Shrub types are common at low to middle elevations (roughly 1600-1800 m) of the alpine zone of the Gladys Lake reserve. There are three basic types (see Tables 3 and 4).

(a) Abies lasiocarpa - Cassiope mertensiana.

Subalpine fir tree clump and krummholz communities are local within the reserve, occurring on some upper valley bottoms and middle slopes, usually on colluvial materials. Such communities are much more common in the southwestern part of the region (cf. Welsh and Rigby 1971), an area of heavier snowfall. The A. lasiocarpa - C. mertensiana community type is very common and characteristic in the leeward coastal mountains of British Columbia. Subalpine fir forms dense, stunted clumps in the tree clump-heath complex at lower alpine elevations, and krummholz on mid-slopes to 1700 m. Reproduction by layering and seedlings is abundant. Soils are shallow and podzolic

The shrub stratum is sparse in the forest clumps, but dense in krummholz. Stunted or regenerating Abies is dominant in this stratum. Vaccinium membranaceum is the only other common species, although Sorbus sitchensis and Ribes glandulosum may also be found.

The dwarf shrub/herb layer is well-developed and dominated by woody mats of Cassiope mertensiana and Empetrum nigrum. Rubus pedatus, Linnaea borealis, Phyllodoce empetriformis, Luetkea pectinata, and Vaccinium caespitosum are also common woody species. Additional characteristic

TABLE 3. Composition of plant community types in the alpine zone of the Gladys Lake Ecological Reserve. Data are for prominence value indices[a].

Strata and species	ALC[b] (5)[c]	BEH (7)	SAB (6)	OME (5)	CDI (18)	FEA (14)	PRU (13)	KOM (12)	SCM (26)	DRY (6)	SCA (6)	STO (11)	AFF (9)
Shrubs													
Abies lasiocarpa	850												
Vaccinium membranaceum	52												
Betula glandulosa	8	868	9		T								
Salix glauca		11	T										
Salix planifolia ssp. pulchra		9	10			1			T		17		
Salix barrattiana		8	912			T					5		
Salix commutata			10										
Dwarf shrubs/herbs													
Cassiope mertensiana	410			625									
Empetrum nigrum ssp. hermaphroditum	34	73		13	T								
Phyllodoce empetriformis	32			79									
Luetkea pectinata	20			98									
Lycopodium alpinum	15			18	T	15							
Juncus drummondii	12			31								2	
Hieracium gracile	10			18									
Artemisia arctica	8	70	48	85	6	153	6	T	6			32	
Sibbaldia procumbens	7	1		50		2					2	4	
Lupinus arcticus	5	24	5	4	27	9	T	14	T	100			
Luzula parviflora	3	1	13	18		T					5	10	
Aconitum delphiniifolium	2	1	5		T	1	21	T	T		11	15	
Gentiana glauca	2			12	T	11	T	T	T	T		T	
Vaccinium vitis-idaea ssp. minus	1	11		T	10	13	2	4		2	2		
Carex podocarpa	T		9	9	45	8	10		19		10	106	
Mertensia paniculata	T	11	67		T		22					T	
Poa arctica	T			2	11	14	2	7	16			10	
Stellaria longipes var. altocaulis	T	7	5		17	5	34	16	11	6		5	
Pyrola grandiflora	T				10				T				
Festuca altaica		80	49	18	23	408	30	4	25	12	6	4	
Epilobium angustifolium		13	2				9						
Vaccinium uliginosum		4		T	61	T		T		23	2		
Polemonium caeruleum ssp. villosum		1	66		3	1	T		T		2	15	
Salix reticulata		1	48		180	1	T	22	69	79	170	83	
Rubus arcticus ssp. acaulis		1	46								17	4	
Delphinium glaucum		1	38										
Senecio lugens		1	26		3		3	T	1		8	5	
Veronica wormskjoldii		1	13						T		2	8	
Bistorta vivipara		1	13	2	17	13	8	47	46	30	25	8	

TABLE 3. Continued

Strata and species	ALC[b]	BEH	SAB	CME	CDI	FEA	PRU	KOM	SCM	DRY	SCA	STO	AFF
Cassiope tetragona		1		2	210	T							
Campanula lasiocarpa		1			3	18	3	9	8	2			
Poa alpina		T	10		6	T	14	13	3	6	2	31	
Equisetum arvense			77	2							8	4	
Petasites nivalis			76								5	34	
Senecio triangularis			30								6	7	
Carex aquatilis			25								277		
Anemone richardsonii			18		T							5	
Anemone parviflora			17		13	1			2		5	35	
Sanguisorba canadensis ssp. latifolia			17								23	23	
Pedicularis sudetica			13									2	
Claytonia sarmentosa			5		T		3					57	
Epilobium anagallidifolium			5								2	10	
Equisetum variegatum			5								25	16	
Saxifraga lyallii			5		T							19	
Ranunculus eschscholtzii			2	9							2	71	
Epilobium latifolium			2	9								10	
Myosotis asiatica			2				14	2	T	2		T	
Pedicularis capitata			2		45			T	1	2	2	T	
Potentilla diversifolia			2			7	27				2	T	
Trisetum spicatum			2		T	1	59		T				
Salix polaris				22	77	25	6	55	197	22	2	117	7
Carex pyrenaica				14									
Dryas integrifolia					244	3	7	24	6	182	5	T	
Carex microchaeta					46	69	3	51	179	40		15	10
Silene acaulis					15	11	4	32	16	50			16
Antennaria monocephala					6	15	3	8	36	2		4	
Luzula confusa					5	7	3	7	10				
Kobresia myosuroides					5	T	19	380	2	113			
Saxifraga tricuspidata					2	3	10	10	3	6			12
Hierochloe alpina					T	40	60	58	29	18			
Calamagrostis lapponica					T	T			4		11	24	
Ranunculus nivalis					T				T		2	15	
Tofieldia pusilla					T						24		
Festuca brachyphylla					T	2	15	11	12	19			7
Carex scirpoidea					T		T				8	10	
Oxytropis nigrescens					T		T	20	T	62			2
Luzula spicata						22	6	14	9	6		T	
Potentilla hyparctica						3	7	7	12	8		T	8
Carex albonigra						1	43	14					

TABLE 3. Continued

Strata and species	ALC[b]	BEH	SAB	CME	CDI	FEA	PRU	KOM	SCM	DRY	SCA	STO	AFF
Draba nivalis						T	3	24	3	18			1
Potentilla uniflora						T	28	21	T	79			2
Carex bipartita						T	T		T		2	16	
Agropyron violaceum						T	53						
Poa rupicola							212	26	T	2			
Carex supina ssp. spaniocarpa							86	4					
Potentilla nivea							70	11	6				
Carex obtusata							17						
Calamagrostis purpurascens							16	4	16				
Potentilla hookerana							15						
Artemisia tilesii s. lat.							12					4	
Festuca saximontana							10						
Minuartia rubella							T	7	12				
Cardamine bellidifolia							T	T	1			5	10
Campanula uniflora								3	T	12			
Saxifraga cespitosa								T	T	3			13
Trichophorum cespitosum											55		
Eriophorum callitrix											28		
Eriophorum angustifolium											11		
Caltha leptosepala											7	67	
Parnassia fimbriata												22	
Bryophytes													
Hylocomium splendens	180	221	64		150	3	5		7		8	23	
Barbilophozia hatcheri	98	23		240	25		3		5				
Brachythecium spp.	33		12								18	40	
Barbilophozia floerkei	25			150								38	
Dicranum acutifolium	15	68	2	50	60	6	20	11	11	2		8	
Pleurozium schreberi	12	100		T	T								
Polytrichum juniperinum	12	39		8	8	36							
Dicranum fuscescens	12			25									
Drepanocladus uncinatus	12											55	
Blepharostoma trichophyllum	10			80	75		8						
Dicranum scoparium	5	15		100									
Ptilidium ciliare	2				2				3			3	10
Ptilium crista-castrensis	T	23											
Distichium capillaceum	T			58	165		20	2	5				
Bryum angustirete	T					49	3	44	45	12			
Rhytidium rugosum		19			97	12	17	14	33	38	8	17	
Aulacomnium palustre		4	24		8						180	72	