

Lily Pad^{Lake} and Buck Hills Road ER # 5 and 6 -

Biological study (wildlife and Vegetation).

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INTRODUCTION

1977
ECOLOGICAL RESERVES COLLECTION
GOVERNMENT OF BRITISH COLUMBIA
VICTORIA, B.C.
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British Columbia Ecological Reserves were formed by the Government of the Province of B. C. as an outgrowth of the International Biological Program to set aside selected ecosystems for ecological study. These reserves were set up primarily for research and educational studies of ecosystems represented in British Columbia.

Two ecological reserves; No. 5 - Lily Pad Lake and No. 6 - Buck Hills Road, located in the East Okanagan Highlands, were the sites of a field study during the months of May through August, 1976. The purposes of this study were to compile annotated species lists of the flora and vertebrate fauna, describe possible plant communities, and to make a collection of representative plant species of the area. A limnological study of three regional lakes was carried out in conjunction with this study (Bayliss and Black, unpublished). The information obtained from these studies should be useful as baseline data for further ecological work.

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PHYSIOGRAPHY AND GEOLOGY

The East Okanagan Highlands are located east of the Okanagan valley and the Coast and Cascade Mountains. To the east of the Highlands lies the Columbian Mountain system including the Monashee Mountains. The Highlands are aligned in a northwest direction and run the length of the valley. These Highlands, consisting of rounded

mountains and ridges, are placed in the Interior Plateau System by Holland (1964) and represent a transition between the true plateau and the mountains. With summit elevations of 2135 m., the East Okanagan Highlands are about 760 m. above the valley floor.

Rowe (1959) describes the bedrock of this area as largely Paleozoic sediments, Tertiary extrusions and exposed granite cores. Jones (1959) found the bedrock to be Jurassic and Cretaceous coast intrusions consisting of granite and related rocks with some foliation present. The Highlands may also have isolated pockets of Triassic and Permian volcanics more characteristic of the plateau areas (OKBA 1974).

During the Pleistocene age the Cordilleran ice sheet, whose upper surface was in excess of 2450 m., covered the whole region (Holland 1964, Tisdale and McLean 1957). Glaciation rounded the ridges and summits causing the local relief to be moderate and rolling in nature. The retreat of the ice sheet left a mantle of glacial till over the area, forming the parent material of most of the soils of the region. Where there were no excessive erosion forces a fine textured boulder clay was left, in many cases yielding sandy to clay loams with varying amounts of stones. In areas with greater erosion sandy and gravelly soils are found (Kelley 1940). The gentle rolling nature of the uplands is not conducive to large scale erosion, but small scale erosion does occur in the movement of material from the hill tops into the troughs.

Within these shallow troughs are found some extensive swamps and many small lakes. Some are formed in rock basins and others are formed frequently by the damming of streams by small Pleistocene

moraines (Reinecke 1915, Brink and Farstad 1949). The numerous lakes and swamps have made the Highlands a valuable source of irrigation water for the Okanagan Valley (OKBA 1974).

CLIMATE

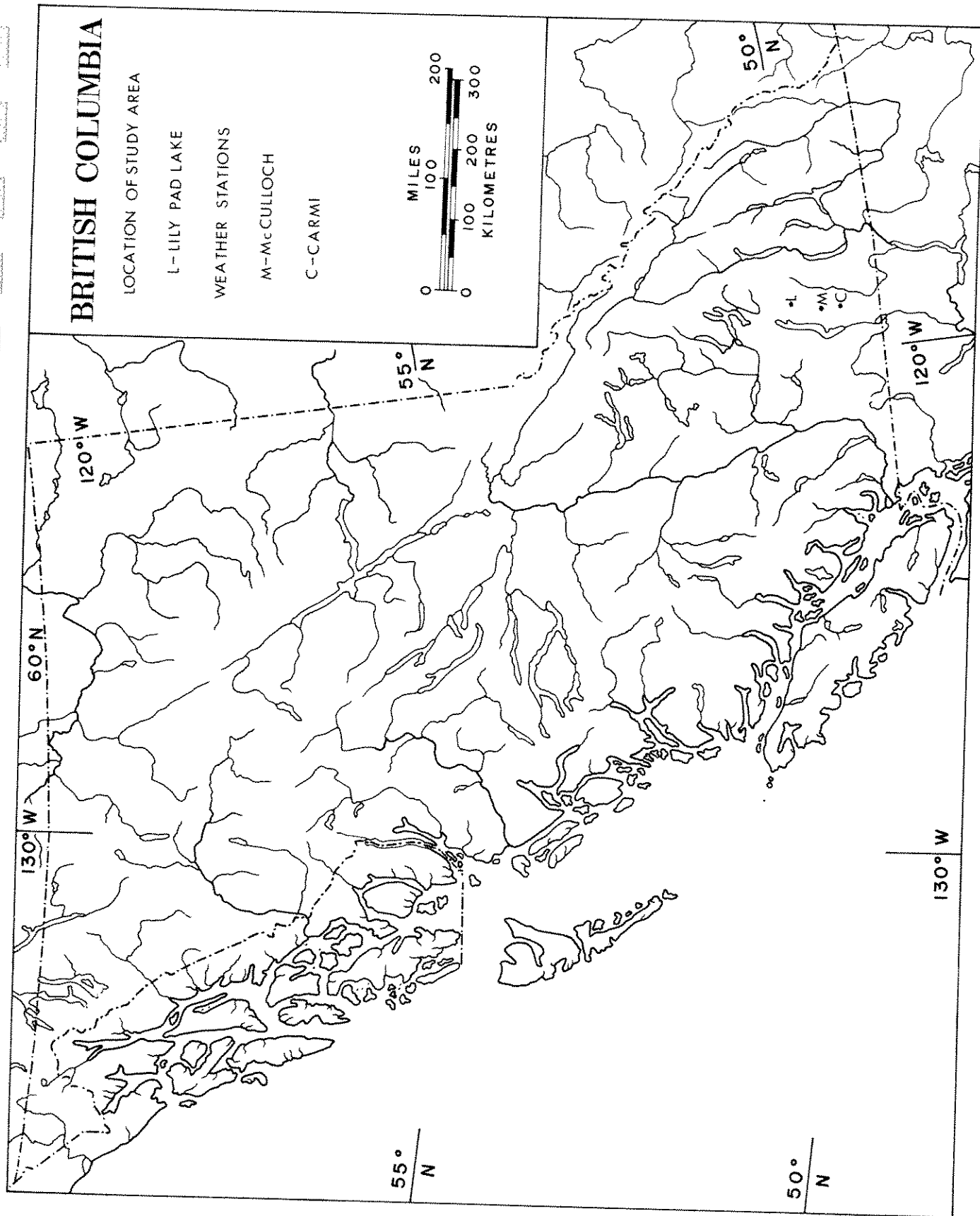
In winter the climate of the Okanagan Highlands is dominated by Polar Continental air moving down the valley from the northwest. The air produces cold, dry conditions and prevailing winds from the north and northwest. In summer, a Tropical Continental system extends northward from the desert-like basins and western plateaux of the United States, bringing hot, very dry air and prevailing southerly winds with it (Chapman 1952, Kendrew 1955, OKBA 1974).

The Highlands are partly in the rainshadow of the Cascade and Coast Mountains, which prevent moist maritime air from affecting the area. The drying effects of the air systems and the rainshadow are lessened by the presence of the Monashee Mountains to the east.

The climate for the region is classified as Continental Subarctic Type (Dfc)¹ in the Koppen system (Nesbitt 1965). However, there are no climatic stations in the area of the reserves and Nesbitt based her designation on readings from stations not in the immediate area. Two of these stations are McCulloch and Carmi located south of the reserves by .5° lat. and 1° lat. respectively (see figure 1). The recordings of these stations are examined in this paper because they are the only

¹ D climates - cold, snowy moist climates (humid mesothermal);
average temperature of coldest month less than 26.6°F
(-3°C) with average temperature of warmest month above
50°F (10°C).
f - no distinct dry season; driest summer month with more
than 1.2 inches (3 cm) of precipitation
c - cool short summer, about four months over 50°F (10°C)

Figure 1 Location of Main Study Area and Weather Stations



two stations reasonably close to the reserves, that are approximately at the same elevation; Lily Pad Lake 1390 m., McCulloch 1250 m., and Carmi 1245 m. However, McCulloch is an exposed station while Carmi is subject to unusual wind patterns (Chapman 1952). Therefore, the following information is only a general description of the climate of the Okanagan Highlands and not specifically for the area of the reserves. The climate data recorded for the reserves during the summer will be presented in the report on the limnological study of Lily Pad Lake, to be completed in the near future (Bayliss and Black unpublished).

The annual total precipitation for the Highlands averages 51 - 77 cm with the wettest months being June, December and January, averaging 6.5 cm each. The bulk of the winter precipitation is snow, averaging 330 cm yearly (OKBA 1974, see also Table 1).

Although the annual precipitation is light there are many cloudy periods throughout the year. The cloudiness would cause the climate to be milder and increase the number of frost-free days (Chapman 1952, Kendrew 1955). The number of frost-free days for McCulloch and Carmi (Table 1) indicates a wide range in the length of the frost-free period. Nesbitt (1965) estimates the number of frost-free days for the reserve area at 60 ± 20 days.

Table 1 shows the average temperature readings for the two stations. The mean annual temperature is approximately 2.8°C .; with 3 - 4 months averaging greater than 10°C and 5 months averaging less than 0°C . Nesbitt (1965) estimates the mean annual temperature as $3.9^{\circ} \pm .5^{\circ}\text{C}$, with a mean January temperature of $-8.3^{\circ} \pm .5^{\circ}\text{C}$ and a

TABLE 1 Summary of climatic data from two Okanagan Highland
 weather stations

MEAN DAILY TEMPERATURE (°C)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YR. YEAR
McCULLOCH	-9.3	-6.7	-3.5	2.2	7.1	10.2	13.4	12.4	9.2	4.1	-3.3	-6.6	+2.4
CARMI	-8.4	-5.6	-2.1	3.7	8.7	11.6	15.7	14.4	10.8	5.1	-2.4	-5.9	+3.7

MEAN TOTAL PRECIPITATION (mm.)

McCULLOCH	75.9	64.5	58.7	46.2	61.0	72.6	47.5	39.4	50.3	55.9	64.5	83.3	719.8
CARMI	63.0	51.1	38.9	36.3	50.0	61.2	36.3	36.3	33.8	45.2	49.0	58.9	560.1

FROST FREE DAYS LAST FROST FIRST FROST

McCULLOCH	19(55-0)	JULY 8	JULY 28
CARMI	98(144-43)	JUNE 6	SEPT 13

FIGURE 2 Climatogram for McCulloch, B. C. showing periods
of water surplus (dotted areas) and deficits (lined
areas)

McCULLOCH (EL.1250m.)

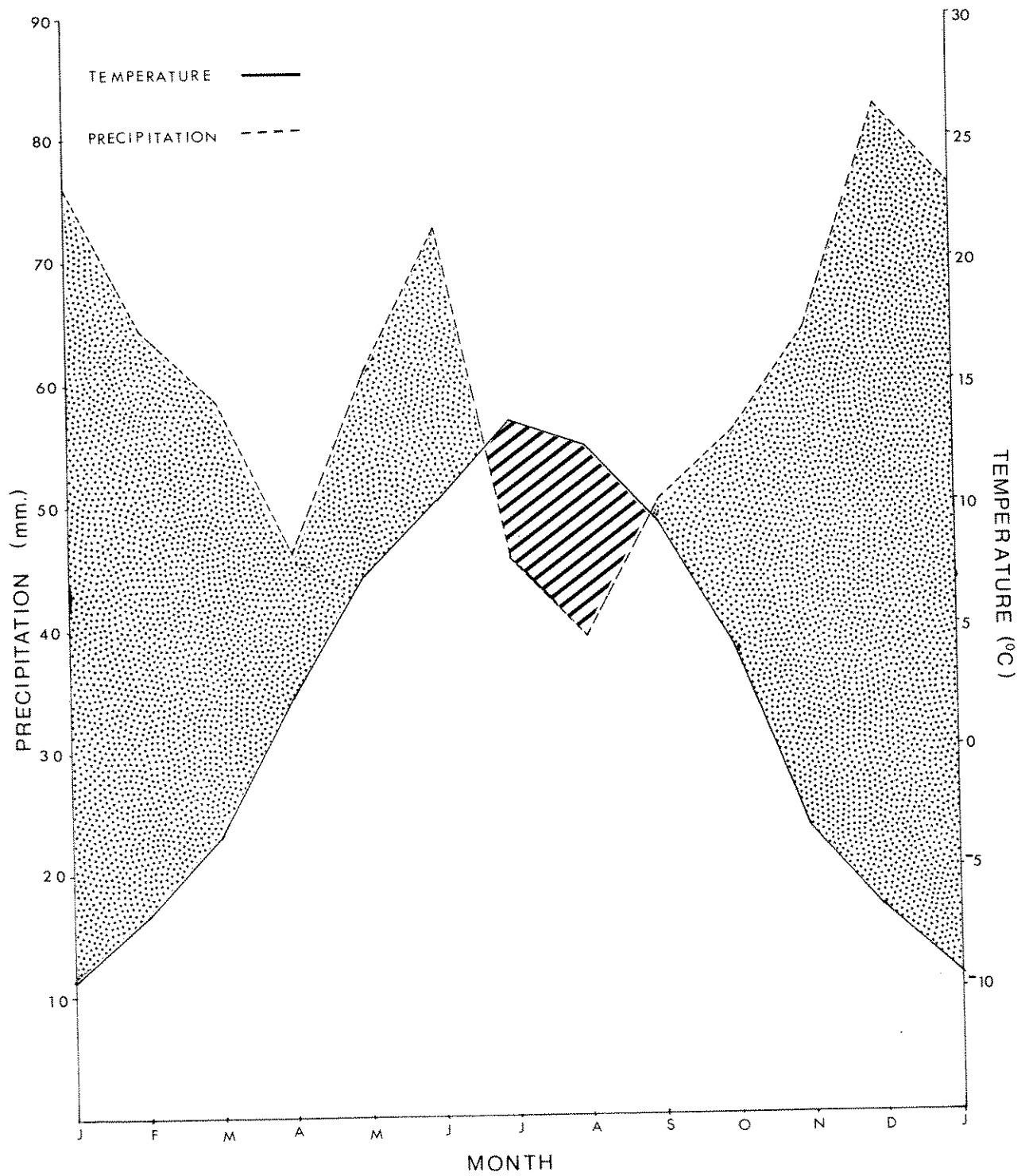


FIGURE 3 Climatogram for Carmi, B. C. showing periods of water surplus (dotted areas) and deficits (lined area)

CARMI (EL.1245 m.)

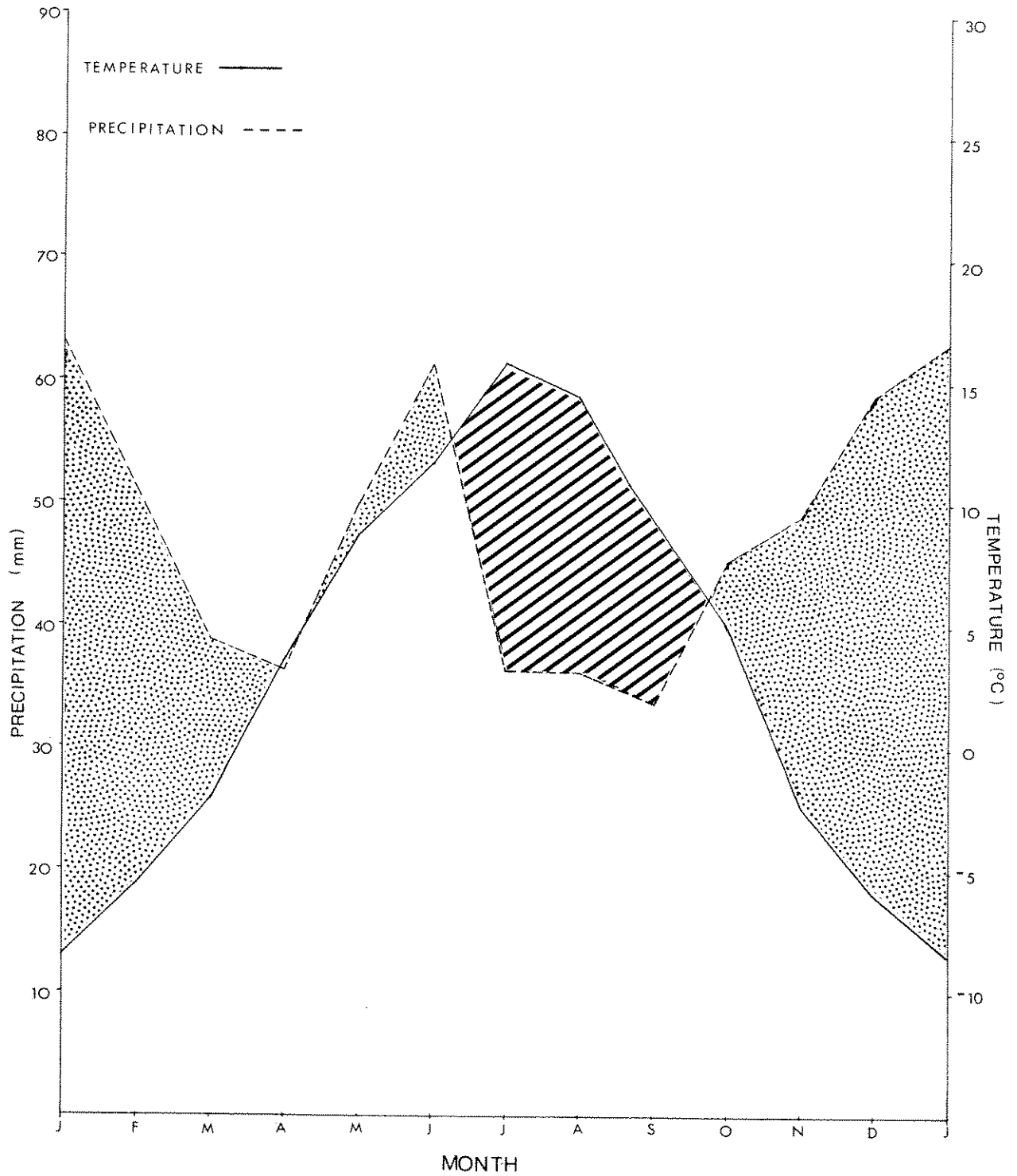
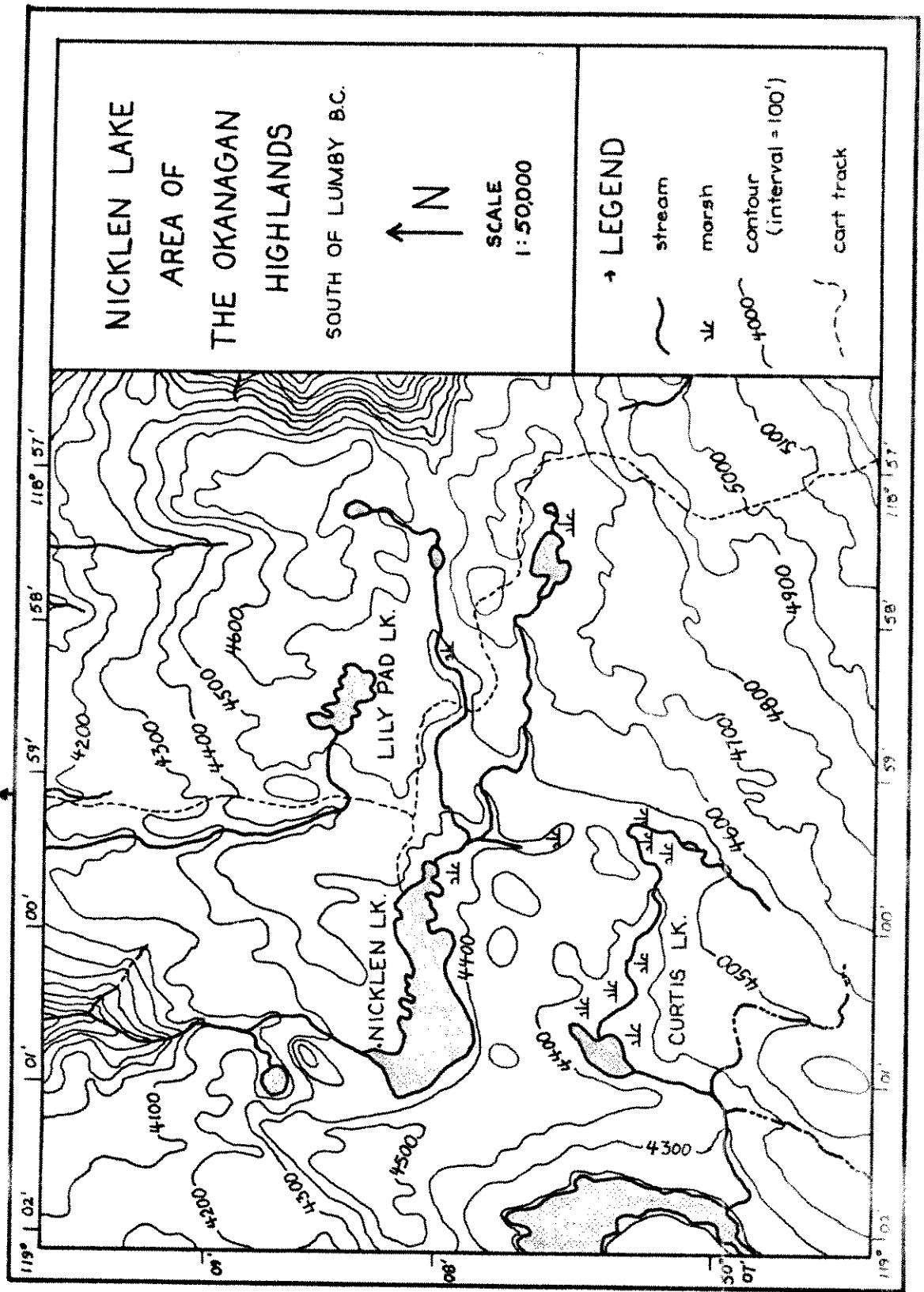


FIGURE 4 Location of reserves



BUCK HILL RD RESERVE

2.5 MILES



mean July temperature of $14.4^{\circ} \pm .5^{\circ}\text{C}$. Average January temperatures of -12.2°C - 6.7°C and average July temperatures of 12.8°C - 18.3°C are reported in the OKBA (1974) for the Okanagan Highlands.

DESCRIPTION OF STUDY AREA

The reserves are located on the East Okanagan Highlands about 25 km southeast of Lumby, B. C. Access to the reserve area is via Buck Hills Road which is in poor shape at lower elevations. It is recommended that four wheel drive vehicles be used as transportation to the reserves if further studies are to be made.

The Buck Hills Road reserve is, at an elevation of 1340 m., near the edge of the Highlands (Figure 4). A dirt road divides the reserve in half. On each side of the road are two large, basalt outcrops with scattered veteran Larix occidentalis trees on them. On the eastern side, a stream flows between the road and the rock outcrop.

About 3 km southwest of this reserve is the Lily Pad Lake reserve at an elevation of 1370 - 1400 m. Its boundaries encompass the drainage basin of Lily Pad Lake (unofficial name). The lake was originally two small, basin lakes which were enlarged into one by the damming of the outlet by beaver. The lake is fed by seepage, mainly from the east axis and has a temporary creek as its outlet to the west.

Because of the close proximity of the reserves and their similar vegetation, the two reserves are treated as one area unless obvious differences occur.

Additional information regarding surveyors, location and dimension of reserves can be obtained from Ecological Reserves in British Columbia (Krajina, Larkin, Foster and Pearson 1974).

TABLE 2 Modified Version of Braun-Blanquet Cover-abundance
Scale used During Sampling

	<u>Cover of total plot area</u>
5	76 - 100%
4	51 - 75%
3	26 - 50%
2	6 - 25% <u>or</u> very abundant with <6% cover
1	<5% abundant with very low cover, or less abundant with higher cover
+	<5% occasional
R	- one or few individuals

METHODS

A. Vegetation Field Work

Field sampling, carried out during May through August 1976, followed air photo interpretation of differences in overstory vegetation of the reserves. The first releves were situated in homogeneous stands of vegetation within these different areas. The decision whether or not a stand was homogeneous was based on apparent uniformity of species composition, landform and stand physiognomy.

Each releve was about 400 m² and comprised a list of vascular and abundant non-vascular plant species, both rated for cover-abundance. Table 2 outlines the modified version of the Braun-Blanquet cover-abundance scale used in sampling. Each releve also contained a brief habitat description which included notes on slope and exposure, ground surface features, moisture regime and drainage, landform and parent material, soil profiles, land disturbances, vertebrates in area, and total vegetation cover, by stratum.

Following the initial sampling, other releves were located in areas not readily seen in the air photos. These areas included isolated stands of Populus tremuloides, Alnus sinuata, and A. incana, along with areas having major differences in ground cover. The total number of releves located in the reserves was 48 and one releve was situated in a stand of Populus tremuloides, about two miles south of Lily Pad Lake.

Plant species were identified using the manuals listed on page 18. Some plant species were collected and voucher specimens are filed at the B. C. Provincial Museum, or in the University of Victoria herbarium. An annotated plant species list is provided in Appendix 1 and includes information as to whether or not the species was

collected and if so where the specimen is filed.

Soils were identified using the 1974 revised edition of the System of Soil Classification for Canada published by the Canada Department of Agriculture. Interpretation of colour was carried out using dried soil layer smears and Munsell Soil Colour Charts (1975 edition). It should be noted that only a very broad classification is used here because of authors' unfamiliarity with soil classification and soil data collecting.

Vascular Plant Manuals

- Clark, L. J. 1974. Field guides to wildflowers in the Pacific Northwest, Nos. 1 - 6, Gray's Publ. Ltd., Sidney, B. C.
- Hitchcock, C. L. and A. Cronquist. 1974. Flora of the Pacific Northwest, University of Washington Press, Seattle, U. S. A. 730 p.
- Hitchcock, C. L. et. al. 1969. Vascular plants of the Pacific Northwest, University of Washington Press, Seattle, U. S. A. pts. 1 - 5
- Hubbard, W. A. 1969. The grasses of British Columbia, Handbook No. 9, British Columbia Provincial Museum, Victoria, B. C. 205 p.
- Lyons, C. P. 1974. Tree, Shrubs and Flowers to know in British Columbia, J. M. Dent & Sons (Canada) Ltd., Vancouver, B. C. 194 p.
- Taylor, T. M. C. 1973. The Rose family of British Columbia, Handbook No. 30, British Columbia Provincial Museum, Victoria, B. C. 223 p.

B. Vegetation Data Analysis

The analysis is based on the method developed by the Braun-Blanquet or Zurich-Montpellier school, which describes groups of species which occur together. This floristic approach, based on species constancy, enables the researcher to characterize and/or differentiate between

community types. Species groups and community types are generally found through a simultaneous sorting of species (rows) and relevés (columns) in two-dimensional vegetation tables. This is comparable to R and Q analysis, where R analysis is independent grouping of attributes (i.e. species) according to similarity of species distribution in samples and Q analysis is independent grouping of samples (i.e. relevés) according to similarity in species composition (Harcombe, 1974).

Češka and Roemer (1971) developed a computerized version of the table sorting method, which was later updated by Češka (1976). The final updated version was applied to the data of this study. In the computer programme, five different sets of inside/outside percentage rules were used to define blocks of relevés and species. These were 25/10, 33/10, 40/20, 50/20, and 66/33, where the first number indicated the percentage of relevés in which a species must occur within the block and the second number the percentage of relevés above which the species could not be outside the block.

Only those species groups which appeared to accurately represent a meaningful classification for the vegetation of the reserves were used in the final sorting. Some manual rearrangement of species and releve order within the blocks was done to visually emphasize the community and vegetation types.

C. Animals

Vertebrates were located in the two reserves by random search. Reptiles were found basking on rock outcrops. The aquatic larvae of amphibians were captured with a dip net in late July and August. Adult amphibians were found on damp moss, roadways, in streams, and in Lily

TABLE 3 Species Groups used in Table VT and ST

A. Differential Species Groups

<u>Group</u>	<u>Rule</u>	<u>Species</u>
<u>Veronica americana</u> group	66/33	Veronica americana Epilobium glandulosum Geum macrophyllum Carex canadensis
<u>Equisetum arvense</u> group	50/20	Equisetum arvense Tiarella trifoliata Mitella pentandra Rubus pubescens Mitella nuda Petasites frigidus
<u>Rubus pedatus</u> group		Rubus pedatus Streptopus amplexifolius Alnus sinuata Clintonia uniflora
<u>Lupinus latifolius</u> group		Lupinus latifolius Spirea betulifolia Pachistima myrsinites Carex concinnoides
<u>Lilium columbianum</u> group		Lilium columbianum Lupinus polyphyllus var. burkeyi Aster conspicuus Antennaria racemosa

B. Regional Species Group

<u>Pinus contorta</u> group	Pinus contorta Fragaria virginiana Linnaea borealis Cornus canadensis Vaccinium scoparium Calamagrostis rubescens Pyrola secunda
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TABLE 4 Plant Associations and Species Groups

1. Veronica Marsh-edge community type
2. Picea-Abies Bottom community type
3. Alnus sinuata Gulley community type
4. Alnus Open forest community type
5. Pinus-Lupinus community type
 - A. Pinus-Lupinus Mid-slope vegetation type
 - B. Pinus-Lupinus-Lilium Ridge vegetation type
 - C. Pinus-Lupinus Ridge vegetation type

COMMUNITY TYPE	1	2	3	4	5a	5b	5c	
RELEVÉ NUMBER	4 2 3 2 0 0 6 4 9 8	4 4 4 1 0 7 3 5 5 6	1 2 7 4	1 0 0 0 3 7	0 3 3 1 3 1 5 9 2 4 0 2	4 2 2 2 1 1 3 0 2 2 3 4 2 1 2 7 1 6 3 6 4 3 0 3 9 8	1 3 3 1 3 4 1 3 0 4 4 8 1 8 9 5 8 1 7 2 6 4	0 0 2 4 1 9 5 2
SPECIES NUMBER	5 5 5 5 5 6 5 6 2 5	4 4 5 5 3 1 2 7 4 8	5 5 2 3	3 3 3 4 5 0	4 4 4 5 3 3 7 7 1 4 8 7	3 5 3 3 3 3 4 5 3 3 3 4 3 0 3 6 4 6 8 5 3 0 8 5 3 1	3 4 3 3 2 3 3 3 5 4 3 5 0 2 5 7 7 3 9 2 0 5	4 4 5 5 2 3 0 8
AVERAGE SPECIES No.	5.5	4.6	5.3		4.4	3.8	3.7	

SPECIES GROUP

PINUS contorta	1 3 3 3 R 2 1 2 1	2 5 3 4 4 3 3 4 3 5 5 3 4 4 4 5 4 3 2 3 5 5 3 5 4 5 4 4 4 3 4 2 R 3 3	+	2
Fragaria virginiana	1 + 2 2	1 1 2 2	2 1 + + 1 2 1 2 3 2 2 1 2 1 2 2 1 + 2 2 2 1 2 2 2 2 1 2 1 2 2 2 +	2 1 + 1
Linnaea borealis	1 + 2 3 1 1 2 2	1 2 1 2 2 2 2 3 4 3 3 + 2 2 3 3 2 2 1 4 3 2 1 1 2 2 2 3 2 2 3 3 2 3		3 1 1
Cornus canadensis	2 1 3 3 1 2 2 2 1 1 2 2 1 4 2 2 3 1 2 3 2 + 2 2 + 2 1 2 1	1 2 1 1 2 1 1 1 1 +	+ 1 1	+ + 1 2
Vaccinium scoparium	1 1 + 2	2 2 3 1	2 2 + 1 4 1 1 2 2 3 2 1 2 3 1 3 1 3 3 3 1 3 3 2 3 4 2 2 2 2 + 2 3 3 3	3 2 1
Calamagrostis rubescens	2 2 3	1 2 1 + 1 +	2 4 4 3 1 4 2 2 2 2 2 3 4 3 2 3 3 4 2 4 3 2 3 2 4 3 3 3 3 2 2	2 3 2
Pyrola secunda	1	1 1 + + 1 + 1 + 1 2 1 +	2 1 1 1 2 1 1 1 1 1 1 1 +	2 + 1 1 1 + 1 1 1 1 + + +
VERONICA americana	1 2 + 2 +			+
Epilobium glandulosum	2 1	2 1	+	
Geum macrophyllum	1 2 1 1 +			
Carex canadensis	1 + 1 1			
EQUISETUM arvense	2 5 3	++ 1 ++ + 1 1		
Tiarella trifoliata	1 + 1 2	+	3 1 + 1	2
Mitella pentandra	1 + 1 2	+ 1 2	+ 1	R
Rubus pubescens	2 1 2 1 R	+ + 1 2 1	2	
Mitella nuda	+ + R 1 1	1 1 1 1		
Petasites frigidus	1 1 + 1	1 1 1 1	2	
RUBUS pedatus	1 2	4	3 2 2 +	1 2 +
Streptopus amplexifolius	1 + + 2 1	+ + 2 + 1 R R	1 1 +	++
Ainus sinuata	3	1	2 1 3 5 3 2 1 4 3	
Clintonia uniflora	1 1	+	2	2 + + R 2 + + 2
LUPINUS latifolius				
Spirea betuifolia	+	+	+	
Pachistima myrsinites				
Carex concinnoides				
LILIUM columbianum	1	+	R	
Lupinus polyphyllus	2			
Aster conspicuus				
Antennaria racemosa	R +			

Pad Lake. Birds were observed throughout the study area. Mammals were observed through their droppings. Skulls on actual observation. Some rodents were trapped in Tomahawk live mouse traps (#101, 3" X 3" X 10", Tomahawk Live Traps, Tomahawk, Wisconsin) using peanut butter and hamburger drippings as bait. One species of rodent (Thomomys talpoides, the Pocket Gopher) was identified by its burrows.

Species names for the vertebrates were obtained from the following:

Herptiles - Stebbins, 1966

Birds - Peterson, 1961
Robbins, 1966

Mammals - Burt and Grossenheider, 1964
McTaggart-Cowan and Guiguet, 1965
Murie, 1954

RESULTS

Table 4 shows the community and vegetation types obtained in the final sorted version. Four relevés (01, 09, 25 and 42) were removed from the main body of the table because they were either a result of errors in sampling procedure or did not contain any of the defined differential species groups.

The differential species groups are listed in table 3 along with rules under which they were defined. In addition the Pinus contorta species group was extracted as representing the regional vegetation. This group has no value in differentiating between community and vegetation types but may be useful when comparing this region with others. The groups are named after the species which would be the most noticeable symbol for the group and differentiate the group from others.

In the following descriptions community and vegetation types are floristically characterized and differentiated from their related types. A constant species is defined as one which occurs in at least 80% of the relevés making up the type. General habitat and soil descriptions follow descriptions of types.

Veronica Marsh-edge Community Type

This type is characterized by the Veronica americana, Equisetum arvense and Rubus pedatus differential species groups (Table 3 and 4). The average number of species is 55 (52-56). Pinus contorta and Picea engelmannii dominate the tree layer. The trees are about 20 m high and the average total tree cover is 50% of photo. Alnus incana (more common in areas around Lily Pad Lake) and A. sinuata usually form a secondary layer of tall shrubs or small trees, ranging 1-10 m in height and with a coverage of 10-60% of plots. Discounting the Alnus, the dominance of the shrub layer is shared by Ribes lacustre and Rubus pubescens. Cornus canadensis and Equisetum arvense share dominance of the herb layer though in places the Equisetum is more abundant.

The Veronica americana species group is restricted to the areas along marshes and places with an abundance of standing water. This group occurs in semi-open to shaded areas on muck-type soils. Intrusion of other species groups is onto small tussocks or mounds giving the areas a pocked appearance.

Around Lily Pad Lake a number of the Alnus have been cut by beaver in the past and are now regenerating by suckers.

Picea-Abies Bottom Community Type

Two differential species groups, Equisetum arvense and Rubus pedatus are found in this type (Table 4). The average number of species is 46 (38-57). Generally a Picea engelmannii-Abies lasiocarpa mix dominates the tree stratum. Picea glauca may replace P. engelmannii in the area around Lily Pad Lake. The major tree stratum occurs at about 18 m., with some veterans between 25 and 30 m high, and a few small trees from 1 - 10 m in height. The Picea-Abies mixture limits light penetration, thereby excluding shade intolerant species. Picea engelmannii and Abies lasiocarpa are the climax species of the area and are shade tolerant, therefore their regeneration is not greatly affected by the light limitation. In sites where the total tree cover is reduced the number of species goes up (compare relevés 06 with 15 and 45).

The shrub cover ranges from 35 to 60% of plots and layer is dominated by small trees, Ribes lacustre and often Vaccinium scoparium as a co-dominant at less than a meter high. Rubus pubescens is a constant in the shrub layer. Brachythecium species dominate the moss layer. Cornus canadensis dominates the herb layer, with Fragaria virginiana and Linnaea borealis as constant species.

This community type is generally found in moist, shaded areas at the bottom of slopes along side Alnus stands. This could explain penetration into these Picea-Abies stands by the Rubus pedatus species group which more often occurs with the presence of Alnus species.

The soils of this type appear to be Grey Luvisols, Gleysols and possibly Gleyed Brunisols. The sites are moist and have a fair drainage. Texture is a sandy-loam with some clay in the B horizon. Smooth-edged rocks of 5-20 cm in diameter were encountered at depth of about 30 cm.

Alnus sinuata Gulley Community Type

This type consists of small stands of Alnus sinuata, found in moist gullies that have fair to poor drainage. Equisetum arvense, Rubus pedatus and Lupinus latifolius are the differential species groups which delineate this type. Alnus sinuata, ranging in height from 1 to 7 m., has a coverage estimated at 65% of plot. Pinus contorta forms the uppermost tree layer at about 20 m but coverage is limited to 25% or less of plot. There is some Picea engelmannii and Abies lasiocarpa regeneration as evidenced by a few small trees in the plots.

There is no dominant shrub in this type probably because of the presence of a large number of small Alnus. Vaccinium scoparium is a constant low shrub. No single species dominates the herb layer but Rubus pedatus and Cornus canadensis are the most abundant constants (Table 4).

The soils are moderately gleyed Brunisols and are a silty loam in texture. A water table was encountered at a depth of 20 cm and a number of dried-up puddles were found on these sites. This type is more open than the Picea-Abies bottom type and has a greater abundance of species (average 53 (52-53)). These Alnus stands are bounded by the Pinus-Lupinus community type.

Alnus Open-forest Community Type

The community is characterized by the Rubus pedatus and Lupinus latifolius differential species groups (Table 3). The average number of species is 33 (30-35). Pinus contorta dominates the tree layer at a height of about 15 m. Scattered Larix occidentalis veterans occur with a small number of seedlings in the open areas (note that the Larix only occurs around the Buck Hills Road reserve).

Alnus sinuata is a conspicuous member of the shrub layer, ranging in height from 1 to 3 meters. At the lower end of its height range Alnus is not as prominent due to the presence of the low shrubs, Vaccinium membranaceum, V. scoparium and Lonicera utahensis.

No one species dominates the herb layer but Calamagrostis rubescens, Cornus canadensis, Chimaphila umbellata and Linnaea borealis are all constants.

Though this group appears aligned beside the Alnus sinuata Gulley community type in the vegetation table, they do not occur in conjunction with one another. The Alnus Open-forest type occurs on mesic ridges in open areas caused by breaks in the tree canopy. The Alnus is restricted by sunlight and is rooted in small depressions where moisture may accumulate.

The soils are either degraded Eutric Brunisols or degraded Dystric Brunisols. The texture is loamy or sandy-loam in nature. Soil is fairly thin (10 - 15 cm to bedrock), except in the small depressions where depth may reach 30 cm before encountering bedrock.

It is probably the combination of the breaks in the tree canopy and the small depressions which allow these stands to exist. The absence of the Alnus stands on other partially open ridges may be due to a restriction in the number of depressions in which water may accumulate and past history of area e.g. past fire disturbance.

The Alnus Open-forest community type occurs in the vicinity of the Pinus-Lupinus community type.

Pinus-Lupinus Community Type

Two species groups characterize this type, namely the Pinus contorta and Lupinus latifolius groups (Table 3). This community is very prominent on the many small undulating ridges in the region. The total tree cover averages 40-60% of plots and the fairly dense herbaceous layer is dominated primarily by grasses. The majority of the sites are mesic to dry habitats.

Often a sharp distinction exists between this community type and the types characterizing moist sites. The differences are reflected in the structure and composition of both the shrub and herb layers. In the shrub layer the number of Ribes lacustre decreases while Shepherdia canadensis increases in abundance and cover. Lupine species are the most visible herbs of this community type with Lupinus latifolius being the most abundant, followed by L. polyphyllus var. burkeyi and L. wyethii (Table 4). Galium triflorum is virtually absent in the drier areas while Arctostaphylos uva-ursi appears almost exclusively in these areas. Calamagrostis rubescens increases in number and dominance on the ridges. Carex concinnoides is often present amongst the grass but is more noticable when in anthesis around late May. Hieracium albiflorum is a constant species in the herb layer.

This community type can be sub-divided into three vegetation types which seem to follow a moisture gradient. The Pinus-Lupinus Mid-slope type is found on some mesic to moist areas. On mesic ridges the Pinus-Lupinus-Lilium Ridge type predominates. The mesic to dry ridges are characterized by the Pinus-Lupinus Ridge type (Table 4).

Pinus-Lupinus Mid-slope Vegetation Type

This type is characterized by three differential species groups, the Rubus pedatus, the Lupinus latifolius, and the Lilium columbianum

(Tables 3 and 4). Pinus contorta dominates the tree layer at a height of 20 m, and the average total tree coverage is 60% of plot. The shrub layer, ranging in height from 1 to 5 meters, has an average coverage of 45% of plot. Alnus sinuata dominates in the moist areas while Shepherdia canadensis is dominant on more mesic sites. Lonicera utahensis is a shrub species as is Ribes lacustre. No single species dominates the herb layer but Linnaea borealis and Calamagrostis rubescens are fairly prominent. Festuca occidentalis and Osmorhiza chilensis are constant species in the herb layer.

This type occurs in the middle of slopes on generally flat to concave ground. The moisture regime runs from mesic to moist and the drainage is good.

The soil is a silty-loam in texture with a large number of small smooth-edged rocks ranging in size from 3-10 cm diameter, at a depth of about 20 cm. The soils would probably be classed as Grey Luvisols and Dystric Brunisols. All but one relevé were on south facing slopes (number 30 was facing NW), and had a slope angle of about 3 degrees. However not all south-facing slopes have this vegetation type and appears in part that this type is limited by moisture.

This type occurs between the Pinus-Lupinus community type of mesic ridges and the community types of the small moist gullies, e.g. the Alnus sinuata Gulley type and the Picea-Abies Bottom type. This vegetation type is not always present at the interface of the ridge vegetation types and the community types of the moist areas. Sometimes this interface is noticeably sharp, and this vegetation type does not occur. This type is probably a transition between the ridge community type and the ones of moist sites, in the sense that the physical

parameters e.g. moisture are intermediate between those found in the community types. Because of this the vegetation type has members of species groups characterizing the community types and the interface is not sharp.

Pinus-Lupinus-Lilium Ridge Vegetation Type

The Lupinus latifolius and Lilium columbianum differential species groups characterize this type. The average species number is 38 (30-53). Pinus contorta dominates the tree layer with an average height of 20 m, and the average total tree cover is 65% of plot. The tall shrub cover is sparse (10-15% of plot on the average), with a height range of .5-3 m. Shepherdia canadensis dominates this layer while Vaccinium scoparium is an abundant low shrub. The three Lupinus species form a layer between the shrub layers, and are prominent herbs. The herbs of the Pinus contorta species group are constants (Table 4) and the foliose lichen Peltigera canina is often found.

This type occurs on mesic, well-drained, slightly elevated ridges. Soil is a sandy-loam or loam textured material and are degraded Dystric Brunisols and possibly Brunisolic Gray Luvisols. Smooth edged rocks from 2-10 cm diameter are present throughout the soil profile and pieces of charcoal are often found in the top layers. Veteran trees and some stumps have fire scars and the presence of the Pinus-Lupinus community type in moist areas around the reserves is linked to disturbance by fire. There is a fair number of windfalls and deadfalls, mainly Pinus contorta in this vegetation type. Also in these areas pocket gophers (Thomomys talpoides) may form extensive tunnel systems. Browsing by cattle and deer is evident but is seldom heavy.

This vegetation type borders the Pinus-Lupinus Mid-slope type and the Pinus-Lupinus Ridge type. Though this type has a slightly higher total tree cover than the Mid-slope type, the coverage of the shrub layer is less and therefore the type is more open. It grades into the Mid-slope type if there is enough moisture to support the members of the Rubus pedatus species group. In drier areas the vegetation intergrades into the Pinus-Lupinus Ridge type.

Pinus-Lupinus Ridge Vegetation Type

This type is characterized solely by the Lupinus latifolius differential species group (Table 4). The tree layer has an average coverage of 55% of plot, and is dominated by Pinus contorta at a height of 20 m. Larix occidentalis occasionally occurs in the veteran layer in sites around the Buck Hills Road reserve. There is some regeneration of Picea engelmannii as evidenced by a number of small trees and the occasional seedling in most sites. The shrub layer has a low coverage value of less than 25% of plot, and is composed mainly of Shepherdia canadensis and small trees.

Lonicera utahensis and L. involucrata are constant shrub species. The tall herb, Lupinus latifolius form a colourful layer between the shrub and herb layers. The herb layer is dominated by grasses with Calamagrostis rubescens being the most abundant. The other herbs and small shrub of the Pinus contorta species group (Table 3) occur as constants along with Hieracium albiflorum. The lichens Peltigera canina and Cladonia gracilis can be seen in small numbers amongst the forbs.

The soil features are similar to those found under the Pinus-Lupinus-Lilium Ridge Vegetation type. They could be classed as degraded Dystric Brunisols and possibly Brunisolic Gray Luvisols. The texture is a silt

loam and has an average depth to bedrock of 20 cm. Rounded rocks of glacial till origin, averaging 2-10 cm in diameter, are found in all layers. This type has slightly more surface rock than the Lilium type. Drainage is very good and moisture regime is mesic to dry.

This vegetation type usually occurs in conjunction with the Lilium Ridge type. It is hard to distinguish between the two in the field unless a close inspection is made. For example, Lilium columbianum is absent in this type, and the amount of Cornus canadensis is reduced. Lupinus polyphyllus var. burkeyi, which prefers moist habitats, has a low abundance on these sites. Lonicera involucrata has a higher constancy in these areas than those of the Lilium Ridge type.

Vertebrate Results

The area adjacent to the lake and Lily Pad Lake itself contained the greatest number of resident species compared with the rest of the reserve.

Throughout the summer all stages of the amphibians noted were found in and around the lake. Egg masses were most abundant around the shore and the Carex-Sphagnum mats as were all larval stages. Adults were most commonly found at the lake edge with the exception of Bufo boreas. This species was abundant throughout the reserve. Only young garter snakes (Thamnophis) (snout-vent length averaging 170 mm) were found on the reserve.

Three resident species of birds were found at the lake. A pair of Common loons (Gavia immer) nested on a Carex-Sphagnum mat at the eastern side of the lake rearing two young. Several Tree swallows (Iridoprocne bicolor) nested in dead Pinus contorta in one of the lake's

southern inlets. The Myrtle Warbler (Dendroica coronata) also nested here. The remaining bird species were observed throughout the reserve in no constant localities and assumed to be non-resident.

Entomias amoenus, the Northwestern Chipmunk, Tamiasciurus hudsonicus, the Rice squirrel, Thomomys talpoides, the Northern pocket gopher and Microtus pennsylvanicus, the Meadow Vole were abundant in all areas of reserve. The houses of Castor canadensis and Ondatra zibethica were observed on the lake and individuals were seen throughout the summer. In the middle of June, range cattle appeared on the reserve in large numbers.

SPECIES LIST

Amphibians

Ambystoma macrodactylum Krausei (Peters)
Northern long-toed salamander
common

Bufo boreas boreas (Baird and Girard)
Western Toad
abundant

Hyla regilla (Baird and Girard)
Pacific treefrog
common

Rana pretiosa pretiosa (Baird and Girard)
Spotted frog
uncommon to common

Reptiles

Thamnophis elegans vagrans (Baird and Girard)
Wandering garter snake
uncommon

T. sirtalis fitchi (
Valley garter snake
common

Birds

Gavia immer Common loon
common, resident

Branta canadensis Canada Goose
uncommon

Anas platyrhynchos Mallard
uncommon

Aythya collaris Ring-necked duck
uncommon

Bucephala islandica Barrows goldensye
uncommon

Oxyura jamaicensis Ruddy duck
rare

Accipiter striatus Sharp-shinned hawk
common

Circus cyaneus Marsh hawk
common

Buteo jamaicensis Red tailed hawk
uncommon

Canachites canadensis Spruce grouse
uncommon to common

Ardea herodias Great blue heron
uncommon

Tringa solitaria Solitary sandpiper
uncommon

Actitis macularia Spotted sandpiper
common

Bubo virginianus Great horned owl
uncommon

Stellula calliope Calliope hummingbird
common

Selasphorus rufus Rufous hummingbird
uncommon

Colaptes cafer Red-shafted flicker
abundant

Sphyrapicus varius Yellow-bellied sapsucker
common

Dendrocopos villosus Hairy woodpecker
uncommon to common

✓ D. pubescens Downy woodpecker
uncommon

Picoides tridactylus Northern three-toed woodpecker
common

✓ Tyrannus tyrannus Eastern kingbird
common

Empidonax traillii Traill's flycatcher
uncommon

✓ E. difficilis Western flycatcher
uncommon

Contopus sordidulus Western wood pewee
uncommon

✓ Nuttallornis borealis Olive-sided flycatcher
common

✓ Iridoprocne bicolor Tree swallow
abundant near lake, resident

Perisoreus canadensis Gray jay
abundant

Nucifraga columbiana Clark's nutcracker
uncommon

Corvus corax Common raven
abundant

✓ C. brachyrhynchus Common crow
common

✓ Parus atricapillus Black-capped chickadee
uncommon

P. gambeli Mountain chickadee
common

✓ P. hudsonicus Boreal chickadee
common

Cinclus mexicanus Dipper
common near all streams

Sitta canadensis Red-breasted nuthatch
abundant

Certhia familiaris Brown creeper
common

Telmatodytes palustris Long-billed marsh wren
common

Turdus migratorius Robin
abundant

Ixoreus naevius Varied thrush
uncommon

Hylocichla ustulata Swainson's thrush
common

Regulus satrapa Golden-crowned kinglet
common

R. calendula Ruby-crowned kinglet
uncommon

Bombycilla garrula Bohemian waxwing
rare to uncommon

Vermivora ruficapilla Nashville warbler
common

Dendroica coronata Myrtle warbler
abundant

D. auduboni Audobon's warbler
common

D. townsendi Townsend's warbler
common to uncommon

Seiurus noveboracensis Northern waterthrush
uncommon

Oporornis tolmiei MacGillivray's warbler
uncommon to common

Wilsonia pusilla Wilson's warbler
uncommon

Agelaius phoeniceus Red-winged blackbird
uncommon

Euphagus carolinus Rusty blackbird
common

Molothrus ater Brown-headed cowbird
uncommon

✓ *Hesperiphona vespertina* Evening Grosbeak
common to uncommon

✓ *Pinicola enucleator* Pine grosbeak
abundant

Spinus pinus Pine siskin
common

✓ *Loxia curvirostra* Red crossbill
rare

Junco oreganus Oregon junco
abundant

✓ *Passerella iliaca* Fox sparrow
common

Melospiza lincolnii Lincoln's sparrow
common

Mammals

✓ *Sorex vagrans obscurus* (Merriam)
Wandering shrew
common

✓ *Myotis lucifugus alascensis* (Miller)
Little brown myotis
common

Lepus americanus columbiensis (Rhoads)
Snowshoe or Varying hare
common

✓ *Marmota flaviventris avara* (Bangs)
Yellow-bellied marmot
uncommon

✓ *Eutamias amoenus luteiventris* (Allen)
Northwestern chipmunk
abundant

✓ *Tamiasciurus hudsonicus streator* (Allen)
Red squirrel
abundant

Thomomys talpoides incensus (Goldman)
Northern pocket gopher
abundant

Castor canadensis leucodontus (Gray)
American beaver
common, resident on lake

Peromyscus maniculatus artemisiae (Rhoads)
White-footed or Deer mouse
abundant

✓ *Phenacomys intermedius intermedius* (Merriam)
Mountain heather vole
uncommon

Microtus pennsylvanicus drummondi (Audubon and Bachman)
Meadow Vole
abundant

Ondatra zibethica osoyoosensis (Lord)
Muskrat
common, resident on lake

Canis latrans lestes (Merriam)
Coyote
common

Ursus americanus cinnamomum (Audubon and Bachman)
American black bear
common

Ursus arctos horribilis (Ord)
Grizzly bear
uncommon

Martes americana abietinoides (Gray)
Marten
uncommon

M. pennanti columbiana (Goldman)
Fisher
uncommon

✓ *Mustela frenata nevadensis* (Hall)
Long-tailed weasel
common

✓ *Mephitis mephitis hudsonica* (Richardson)
Striped skunk
uncommon

Felis concolor missoulensis (Goldman)
Cougar
rare

Lynx rufus pallescens (Merriam)
Bay lynx or Bobcat
uncommon to rare

L. canadensis canadensis (Kerr)
Canada lynx
common

✓ Odocoileus hemionus hemionus (Rafinesque)
Mule deer
uncommon to rare

O. virginianus ochrourus (Bailey)
Whitetail deer
uncommon to common

✓ Alces alces andersoni (Peterson)
Moose
common around lake

Bos taurus
Cow
abundant

BUCK HILLS ROAD - ECOLOGICAL RESERVE NO. 6

B. boreas was the most abundant herptile throughout this reserve. The Northern alligator lizard (Gerrhonatus coeruleus) was abundant only on the rock outcrops adjacent to the road. Several species of birds were observed around these rock outcrops. Many were observed nesting in the Larix growing here including Bubo virginianus, Aegolius acadicus, Colaptes cafer and Sitta canadensis.

Mammal species found on this reserve did not differ markedly from those on the Lily Pad Lake reserve. A colony of Rocky Mountain pikas (Ochotona princeps) was observed in the rock outcrops adjacent to the road.

SPECIES LIST

Amphibians

Ambystoma macrodactylum krausii (Peters)
Northern long-toed salamander
common

Bufo boreas boreas (Baird and Girard)
Western toad
abundant

Hyla regilla (Baird and Girard)
Pacific tree frog
common

Reptiles

Gerrhonotus coeruleus principis (Baird and Girard)
Northern alligator lizard
common on rock outcrops, rare throughout the rest of the reserve

Charina bottae utahensis
Rocky Mountain rubber boa
rare

Thamnophis sirtalis fitchi
Valley garter snake
uncommon

Birds

Accipiter striatus Sharp-shinned hawk
common

Circus cyaneus Marsh hawk
common

Buteo jamaicensis Red-tailed hawk
uncommon

Canachites canadensis Spruce grouse
uncommon

Bubo virginianus Great horned owl
common

Aegolius acadicus Saw-whet owl
common

Glaucidium ghoma Pygmy owl
uncommon

Stellula calliope Calliope hummingbird
uncommon

Selasphorus rufus Rufous hummingbird
uncommon

Colaptes cafer Red-shafted flicker
abundant

✓ *Sphyrapicus varius* Yellow-bellied sapsucker
common

✓ *Dendrocopas villosus* Hairy woodpecker
common

D. pubescens Downy woodpecker
uncommon

Picoides tridactylus Northern tree-toed woodpecker
common

✓ *Empidonax hammondi* Hammond's flycatcher
uncommon

✓ *E. difficilis* Western flycatcher
uncommon

Nuttallornis borealis Olive-sided flycatcher
uncommon

Perisoreus canadensis Gray jay
abundant

Nucifraga columbiana Clark's nutcracker
uncommon

✓ *Corvus corax* Common raven
common

✓ *Parus atricapillus* Black-capped chickadee
uncommon

P. gambeli Mountain chickadee
common

P. hudsonicus boreal chickadee
common

Sitta canadensis Red-breasted nuthatch
abundant

Certhia familiaris Brown creeper
common

✓ *Turdus migratorius* Robin
common

Hylocichla ustulata Swainson's thrush
common

Regulus satrapa Golden-crowned kinglet
uncommon

R. calendula Ruby-crowned Kinglet
uncommon

✓ Bombycilla garrula Bohemian waxwing
uncommon

✓ Lanius excubitor Northern shrike
uncommon

✓ Oporornis tolmiei MacGillivary's warbler
common

✓ Hesperiphona vespertina Evening grosbeak
uncommon

✓ Pinicola enucleator Pine grosbeak
common

Spinus pinus Pine siskin
abundant to common

Loxia curvirostra Red crossbill
rare

Junco oreganus Oregon junco
abundant

Passerella iliaca Fox sparrow
common

✓ Melospiza lincolni Lincoln's sparrow
common to uncommon

Mammals

Sorex vagrans obscurus (Merriam)
Wandering shrew
common

Myotis lucifugus alascensis (Miller)
Little brown myotis
uncommon

✓ Ochotona princeps cuppes (Bangs)
Rocky mountain pika
abundant

✓ Lepus americanus columbiensis (Rhoads)
Snowshoe or Varying hare
common

✓ Eutamias amoenus luteiventris (Allen)
Northwestern chipmunk
abundant

✓ *Tamiasciurus hudsonicus streatori* (Allen)
Red squirrel
abundant

Glaucomys sabrinus columbiensis (Howell)
Northern flying squirrel
rare

Thomomys talpoides incensus (Goldman)
Northern pocket gopher
common

Peromyscus maniculatus artemisiae (Rhoads)
White-footed or Deer mouse
common

Clethrionomys gapperi saturatus (Rhoads)
Borral red-back vole
uncommon

✓ *Phenacomys intermedius intermedius* (Merriam)
Mountain heather vole
uncommon to common

Microtus pennsylvanicus drummondi (Audubon and Bachman)
Meadow vole
common

✓ *Erethizon dorsatum nigrescens* (Allen)
Porquippine
common

✓ *Canis latrans lestes* (Merriam)
Coyote
uncommon

Ursus americanus cinnamomum (Audubon and Bachman)
American black bear
uncommon

Martes americana abietinoides (Gray)
Marten
uncommon

✓ *Mustela frinata nevadensis* (Hall)
Long-tailed weasel
common to uncommon

Lynx rufus pallescens (Merriam)
Bobcat or Bay lynx
uncommon

L. canadensis canadensis (Ker)
Canada lynx
common

Odocoileus hemionus hemionus (Rafin esque)
Mule deer
uncommon to rare

✓ *O. virginianus ochrourus* (Bailey)
White-tail deer
uncommon

Bos taurus
Cow
abundant

DISCUSSION

Nature of Vegetation:

The main factors influencing the nature and distribution of the plant associations are fire and moisture regime. Fire has been the most common factor in disturbing the vegetation and some types in this area owe their existence to this disturbance. The rain shadow effect of the Coast and Cascade Mountains and the dry nature of the winter and summer air masses tend to limit moisture in this region. Without sustained climatic measurements it is very difficult to determine how much of an influence the Monashee Mountains have on the overall moisture regime of the study area. However, if the area of the reserves is comparable to McCulloch and Carmi, only a small water deficit would occur in the late summer months (figs. 2 & 3, pg. 10 & 12).

The plant associations for the most part can be arranged along a moisture gradient from moist to dry habitats (Table 5).

The Veronica Marsh-edge community type is found in areas having permanent standing water and muck-type soils. The presence of tussocks in this type may warrant further dividing the type into separate communities based on position on the tussocks. This would

✓ TABLE 5 Summary table showing distribution of Species
Groups with plant associations and selected
habitat features.

SPECIES GROUP	COMMUNITY TYPE	<u>VERONICA</u> MARSH-EDGE	<u>PICEA-ABIES</u> BOTTOM	<u>ALNUS SINUATA</u> GULLEY	<u>ALNUS</u> OPEN-FOREST	<u>PINUS-LUPINUS</u>		
						MID-SLOPE	<u>LILIUM</u> RIDGE	RIDGE
Regional species group <u>Pinus contorta</u> Differentiating species groups <u>Veronica americana</u> <u>Equisetum arvense</u> <u>Rubus pedatus</u> <u>Lupinus latifolius</u> <u>Lilium columbianum</u>								
SOIL MOISTURE		VERY WET	MOIST	MOIST	MESIC	MESIC-MOIST	MESIC	MESIC-DRY
DRAINAGE		VERY POOR	FAIR-POOR	FAIR-POOR	FAIR-GOOD	GOOD	VERY GOOD	VERY GOOD
SOIL TYPE		MUCK	GRAY LUVISOLS GLEYSOLS	GLEIED BRUNISOLS	DEGRADED EUTRIC AND DYSTRIC BRUNISOLS	GRAY LUVISOLS DYSTRIC BRUNISOLS	DEGRADED DYSTRIC BRUNISOLS (BRUNISOLIC GRAY LUVISOLS)	DEGRADED DYSTRIC BRUNISOLS (BRUNISOLIC GRAY LUVISOLS)

involve a more details study than the present one and no attempt has been made here to divide the community type further.

There exist outside the reserves some stands composed of a mixture of Alnus and Salix species. These stands may constitute a plant association in a broader study.

The Picea-Abies Bottom community type is associated with Gleysol, Grey Luvisol and possibly gleyed Brunisol soils. This type occurs in moist areas and has an usually high degree of tree regeneration especially the climax species Picea engelmannii and Abies lasiocarpa.

The Alnus sinuata Gulley community type can be found in the shallow gullies which have the water table close to the surface part of the year. The habitats are moist and the soils are moderately gleyed Brunisols. This type is present to a larger extent than the number of releves for the type would indicate. With further sampling this type as well as the Alnus Open-forest type would appear clearer when used in a vegetation table. Fire has had a minor influence on the Alnus sinuata Gulley type. Fire would keep these sites open for invasion by the Alnus. However, probably most of these sites already had Alnus in them since the main means of reproduction of these trees is by vegetative propagation from root suckers.

The Alnus Open-forest type partly owes its existence to fire. Fire would keep the small depressions on the ridges open to invasion by Alnus sinuata. At the time of sampling the conifers appear to be squeezing out the Alnus. Unless the areas remain open and the herbaceous cover thick, conifer seedlings will become established and eventually shade out the Alnus.

The greatest effect fire has had is in establishing the conditions that would allow the development of the Pinus-Lupinus community type. Pinus contorta is a seral species following fire disturbance as is Larix occidentalis. This latter species is generally restricted to the drier open areas around Buck Hills Road Reserve and is not very abundant.

This community type is the only one described for the study area that is comparable to other vegetation associations of areas studied for the southern interior. This type is comparable to the Pinus-Calamagrostis association described by Tisdale and McLean (1957). However, the Pinus-Lupinus type does not have vigorous reproduction of Pseudotsuga menziesii and Lathyrus ochroleucus is absent. This type has many features of the Subalpine zone outlined in the study by Spilsbury and Tisdale (1944). The absence of Pedicularis bracteosa distinguishes this type from their zone. The Pinus-Lupinus type corresponds very closely with the Abies lasiocarpa-Vaccinium scoparium habitat type, Calamagrostis rubescens phase described by McLean (1969) in his study of the Similkameen Valley. Differences between the two types lie in the presence or absence of a few non-abundant species.

In a small scale study it would probably be necessary to divide the Pinus-Lupinus community type into the three vegetation types described. In larger scale studies these types may be combined and might be a reason why comparable types from other regions are hard to find in the literature. However, the Pinus-Lupinus Mid-slope type is similar to the Abies lasiocarpa-Pachistima myrsinites habitat type, Cornus canadensis phase of McLean (1969), though the phase appears

wetter and differs in a number of species. Another differentiating feature is that the Cornus phase occurred on Podzols and wet Regosols while these soil types were not sampled in the reserve area.

Without a thorough soil study it is very difficult to say what edaphic features other than soil moisture are affecting the nature and distribution of the plan associations in the reserves. An in depth soil study could also allow for correlating these associations with the various soil types beyond the simple one given in this study.

None of the plant associations described in this report could be said to represent the climatic climax association for the reserve area. A 1972 survey by the Department of Forestry Inventory Division determined the age of the Pinus contorta and Picea engelmannii to be about 60 - 80 years. Though not confirmed, this is probably the time of the last major fire for the reserve area. This would mean that most of the vegetation has not had sufficient time to have developed into the climatic climax state. The presence of a number of small trees and seedlings of Picea engelmannii and Abies lasiocarpa throughout the area as compared to Pinus contorta seedlings suggest that these trees are the climax species. If not disturbed these trees will replace the Pinus contorta. McLean (1969) set the division between his Pseudotsuga zone and Abies zone at 1370 m, the same elevation as the reserves and the climax vegetation may thus consist of a mixture from these two zones. However, most the vegetation of the reserves is very similar to his Abies lasiocarpa-Vaccinium scoparium habitat type Calamagrostis rubescens phase. An Abies lasiocarpa association would probably be the climax vegetation for most of the area.

A regional vegetation study of the northern half of the East Okanagan Highlands must be made before an hierarchal classification of the reserve vegetation can be attempted. The study could also provide information regarding the dynamics of the vegetation so that the succession within the reserves can be postulated.

DISCUSSION

The absence or rarity of several vertebrate species was noted for both reserves. Waterfowl were rare at Lily Pad Lake and Grouse and deer were encountered in smaller numbers than what might be expected. There are three possible reasons that might explain these observations. The area surrounding the two reserves is hunted extensively. Also the large number of range cattle grazing in this area may have affected the deer population. Since this summer was wetter and cooler than most, several species expected to be in this area may have remained at lower altitudes.

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APPENDIX I

Annotated species list of vascular and abundant non-vascular plants

Abbreviations regarding collection:

P.M. - given to Provincial Museum

V.H. - given to University of Victoria Herbarium

N.C. - not collected

ANNOTATED SPECIES LIST

Non-vascular Plants

Peltigera canina (L.) Willd., plus other Peltigera species.

- Often in mosaic Pinus contorta stands of the Pinus-Lupinus community type, amongst grasses. (N.C.)

Cladonia gracilis (L.) Willd.

- common in mosaic Pinus woods, often with Peltigera spp. (N.C.)

Jungermannia species

- found in moist areas of Buck Hills Road reserve. Dioecious species forming small mats. (N.C.)

Marchantia species

- along streams and marshes where it may be abundant. (N.C.)

Brachythecium species B.S.G.

- widespread mosses dominating moss layer in moist Picea-Abies Bottom community type. (P.M.)

Bryum species Hedw.

- inconspicuous moss on pocket gopher tunnels or bare ground. (P.M.)

Dicranum species Hedw.

- mosses of litter and rotten wood, never in large abundance. (P.M.)

Pohlia species Hedw.

- in moist shaded areas, not abundant. (P.M.)

Polytrichum species Hedw.

- widespread mosses but most abundant in the Pinus-Lupinus community type. (N.C.)

Sphagnum species Dill.

- low abundance in marshy areas not far from Sphagnum mats in Lily Pad Lake. (N.C.)

Tetraplodon species B.S.G.

- found as small patches on old excrement of moose and cow in Lily Pad Lake reserve. (P.M.)

Vascular Plants

Lycopodiaceae

Lycopodium annotinum L.

- common in moist, semi-open areas; often trailing over other vegetation. (P.M. and V.H.)

L. complanatum L.

- low abundance in moist Picea-Abies stands. (N.C.)

Equisetaceae

Equisetum arvense L.

- in moist to wet areas along streams, lake edge and marshes. For associated species see Equisetum arvense species group. (N.C.)

E. Palustre L.

- not as common as E. arvense but same distribution. (N.C.)

Polypodiaceae

Dryopteris austriaca (Jacq.) Woynar

- common in moist or wet areas. (P.M.)

Gymnocarpium dryopteris (L.) Newm.

- very common in moist woods along with Rubus pedatus near streams and standing water. (P.M.)

Woodsia scopulina D.L. Eat.

- commonly rooted in rock crevices of outcrops in Buck Hills Road reserve. (P.M.)

Cupressaceae

Juniperus communis L.

- scattered low shrubs in semi-open areas, mainly in Pinus-Lupinus community type. (N.C.)

Thuja plicata Donn.

- small non-vigorous trees of moist areas like those of Alnus sinuata Gulley community type. (N.C.)

Pinaceae

Abies lasiocarpa (Hook.) Nutt.

- a climax species with Picea engelmannii but with lesser regeneration. More abundant at higher elevations. Mostly in moist areas e.g. see Picea-Abies Bottom community type. (N.C.)

Larix occidentalis Nutt.

- mainly large veterans restricted to area around Buck Hills Road reserve. A fire seral species with limited regeneration in open areas. (N.C.)

Picea engelmannii Parry

- a climatic climax species found with Abies lasiocarpa in moist areas. Shows much regeneration but trees still smaller than Pinus contorta. (N.C.)

P. glauca (Moench) Voss

- restricted to Lily Pad Lake area where it replaces P. engelmannii as a co-dominant with Abies lasiocarpa. (N.C.)

Pinus contorta Dougl. var. latifolia Engelm.

- a very abundant seral species following fire. Major tree except in moist areas. (N.C.)

Pseudotsuga menziesii (Mirbel) Franco.

- a few scattered trees but more abundant about 150-300 m below Buck Hills Road reserve. (N.C.)

Salicaceae

Populus tremuloides Michx.

- considered a seral species after fire, located stands of tall trees with good reproduction in moist areas. (N.C.)

P. trichocarpa T. & G.

- tall, isolated trees in moist areas around Nicklen Lake, 32 km south of reserves. Not found on reserves. (N.C.)

Salix bebbiana Sarg.

- only willow found flowering, and was in Buck Hills Road reserve. (P.M.)

Salix species L.

- scattered in moist open areas, sometimes moderately abundant in mixed stands with Alnus, outside reserves. Probably more than one species. (N.C.)

Betulaceae

Alnus incana (L.) Moench

- very common in moist or wet areas near lake and along streams. (P.M.)

A. sinuata (Regel) Rydb.

- more common than A. incana, in sites that are moist to mesic away from waters edge. (P.M.)

Betula glandulosa Michx.

- forms a narrow band along parts of Lily Pad Lake. (N.C.)

Urticaceae

Urtica dioica L.

- common in moist areas. Grazed by cattle. Often with Viola glabella. (P.M.)

Polygonaceae

Rumex acetosella L.

- common on an open thin-soiled site disturbed by cattle. Presence due to cattle. (P.M. and V.H.)

Caryophyllaceae

Arenaria lateriflora L.

- common in moist to wet Alnus-Carex meadows along with Equisetum arvense species group. (P.M.)

Cerastium arvense L.

- herb of low abundance in moist areas around Lily Pad Lake. (N.C.)

C. vulgatum L.

- common in moist areas visited by cattle. On dung outside normal distribution. (P.M.)

Stellaria calycantha (Ledeb.) Bong.

- common in open, moist conifer stands, mixed in with S. crispa. (P.M.)

S. crispa Cham. & Schlecht.

- same distribution as S. calycantha, also common. (P.M.)

S. longifolia Muhl.

- common in moist Carex meadows, near lake edge. Flowers late summer. (P.M. and V.H.)

Ranunculaceae

Aconitum columbianum Nutt. var. howellii (Nels. & MacBR.) Hitchc.

- few plants along stream in open moist site amongst stinging nettle. Grazed by cattle. (P.M.)

Actaea rubra (Ait.) Willd.

- non-abundant species in moist areas and rock crevices of outcrop in Buck Hills Road reserve. (P.M.)

Aquilegia formosa Fisch.

- common in moist areas. Sometimes in large patches but more often not in great numbers. (P.M.)

Clematis columbiana (Nutt.) T. & G. var. columbiana

- few vines found in Buck Hills Road reserve, more common in moist woods about 300 m lower. (V.H.)

Ranunculus flabellaris Raf.

- common aquatic plant in sheltered ponds often forming large mats. (V.H.)

R. uncinatus D. Don. var. parviflorus (Torr.) Benson

- common in moist, mosaic woods and shallow gullies. (P.M.)

Thalictrum occidentale Gray

- uncommon; restricted to moist open places similar to Alnus sinuata Gulley community type. Only pistillate flowers found (P.M.)

Berberidaceae

Berberis aquifolium Pursh.

- uncommon shrub of dry open ridges along with Antennaria species. (N.C.)

Cruciferae

Capsella bursa-Pastoris (L.) Medic.

- along road in Buck Hills Road reserve, probably from valley. (N.C.)

Cardamine pensylvanica Muhl.

- common in moist areas, especially around Lily Pad Lake, on dark brown soils. (P.M.)

Rorippa species Scop.

- occasionally found in moist Carex meadows. Maybe R. islandica (Oed.) Borbas. (N.C.)

Saxifragaceae

Chrysosplenium tetrandrum (Lund) Fries

- non-abundant, small plant along streams and moist meadows. (P.M.)

Mitella nuda L.

- similar distribution as M. pentandra but not as abundant. (P.M.)

Mitella pentandra Hook.

- most abundant of Mitella species, common in moist woods and shallow gullies. Member of Equisetum arvense species group.

M. stauiopetala Piper

- uncommon, in moist woods with Rubus pedatus and Fragaria virginiana. (P.M.)

M. Trifida Grah.

- uncommon, in moist woods. (N.C.)

Parnassia fimbriata Konig.

- wet areas, about 105 m above, but not in reserves. (N.C.)

Tellima grandiflora (Pursh.) Dougl.

- few plants found in moist, sandy area below beaver dam of lake. Not found in Buck Hills Road reserve. (P.M.)

Tiarella trifoliata L. var. unifoliata (Hook.) Kurtz.

- very common in moist areas often with Mitella species. (P.M.)

Grossulariaceae

Ribes lacustre (Pers.) Poir.

- widely distributed; common in moist areas but also on forested slopes with a lower abundance. (P.M. and V.H.)

Rosaceae

Amelanchier alnifolia Nutt. var. humptulipensis (Jones) Hitchc.

- few scattered bushes on open, south-facing outcrop of Buck Hills Road reserve. (P.M.)

Fragaria vesca L. var. bracteata (Heller) Davis

- common in moist conifer or Alnus stands often with Rubus pedatus. (P.M.)

F. virginiana Duchesne

- very common throughout but generally in drier areas than F. vesca. Includes both varieties (var. glauca and var. platypetala). (N.C.)

Geum macrophyllum Willd. var. perincisum (Rydb.) Raup

- often in small numbers on moist open sites usually near Alnus-Carex meadows. (P.M. and V.H.)

G. rivale L.

- late flowering; small numbers on open, wet sites. (P.M. and V.H.)

Physocarpus capitatus (Pursh.) Kuntze

- small shrub along stream banks of Buck Hills Road reserve. Sparse. (N.C.)

Potentilla palustris (L.) Scop.

- on Lily Pad Lake shore and on floating Sphagnum mats. Common. (N.C.)

Rosa acicularis Lindl.

- small isolated groups in mesic, mosaic conifer woods; not as common as R. nutkana (P.M.)

R. nutkana Presl.

- scattered isolated groups, often with R. acicularis. (P.M.)

Rubus idaeus L.

- small isolated pockets in moist woods, and on rock outcrops of Buck Hills Road reserve. (P.M.)

R. parviflorus Nutt.

- very common in moist woods of reserves and at higher elevations. (N.C.)

R. pubescens Raf.

- creeping shrub of moist woods, often along cow paths. Sparse. (N.C.)

Spiraea betulifolia Pall.

- shrub of semi-open conifer woods, common but not in great abundance. (N.C.)

Leguminosae

Lupinus latifolius Agardh var. latifolius

- very common, with many colour variants. Members of Lupinus latifolius species group. Often in Pinus contorta woods, on ridges. (P.M.)

L. polyphyllus Lindl. var. burkei (Wats.) Hitchc.

- non-abundant but noticeable plant of moist to mesic areas. Members of Lilium columbianum species group. (P.M.)

L. wyethii Wats.

- uncommon; amongst other Lupinus species in mosaic Pinus stands on mesic to dry sites. (P.M.)

Trifolium repens L.

- common on sandy disturbed areas such as road cuts. Probably from valley. (P.M.)

Celastraceae

Pachistima myrsinites (Pursh.) Raf.

- very common, as scattered clumps, in mosaic conifer stands on mesic sites, often with Spirea betulifolia and Lonicera utahensis. (P.M. and V.H.)

Violaceae

Viola adunca Sm. var. bellidifolia (Greene) Harr.

- most abundant on rock outcrop of Buck Hills Road reserve but few in moister areas. (P.M.)

V. glabella Nutt.

- common as small groups in moist areas. (P.M. and V.H.)

V. macloskeyi Lloyd var. macloskeyi

- common on Sphagnum mats, but not so in Carex meadows around Lily Pad Lake. (P.M.)

V. nephrophylla Greene var. nephrophylla

- often mixed in with V. orbiculata in small depressions under Pinus contorta. Very uncommon, not noted for reserves. (P.M.)

V. orbiculata Geyer

- very abundant in region. Early flowering species occupies many habitats. (P.M. and V.H.)

V. palustris L.

- inconspicuous herb of wet areas, occasionally on Sphagnum mats. Few. (N.C.)

V. renifolia Gray

- in mesic and moist areas but never in abundance. Usually open areas. (P.M.)

Elaeagnaceae

Shepherdia canadensis (L.) Nutt.

- very common in mosaic, mesic Pinus contorta woods, but reduced in numbers on wetter sites. (P.M.)

Onagraceae

Circaea alpina L.

- commonly found along streams and beaver dam of Lily Pad Lake. (P.M.)

Epilobium alpinum L. var. lactiflorum (Hausskn.) Hitchc.

- a few plants in moist to wet sites along streams and Carex meadows (P.M. and V.H.)

E. angustifolium L.

- in open areas frequented by cattle, and along roadsides. (N.C.)

E. glandulosum Lehm. var. glandulosum

- several solitary plants amongst Carex and Equisetum in wet areas. Members of Veronica americana species group. (P.M.)

E. palustre L.

- in small numbers along creek edges on wet silty soil. (P.M. and V.H.)

Umbelliferae

Heracleum lanatum Michx.

- common in moist open areas along streams. Heavily grazed by cattle. (P.M.)

Lomatium species Raf.

- found in one sandy area disturbed by cattle in Lily Pad Lake reserve. Probably from valley. (N.C.)

Osmorhiza chilensis H. & A.

- common in moist or mesic woods, often under Populus tremuloides. (P.M.)

O. depauperata Phil.

- uncommon, similar distribution as O. chilensis. (N.C.)

O. purpurea (Coult. & Rose) Suksd.

- uncommon, in semi-open moist gullies. (N.C.)

Cornaceae

Cornus canadensis L.

- common throughout but greater abundance in moist areas. (P.M.)

C. stolonifera Michx.

- tall shrubs along streambanks and lakeshore. Few. (N.C.)

Ericaceae

Artostaphylos uva-ursi (L.) Spreng.

- common shrub of mosaic Pinus contorta woods, in Pinus-Lupinus community type. (N.C.)

Chimaphila umbellata (L.) Bart.

- abundant in mesic conifer stands but absent in areas of standing water. (P.M.)

Ledum glandulosum Nutt.

- common in marshy areas, may form a thick underbrush. (N.C.)

Pterospora andromedea Nutt.

- common saprophyte in conifer stands. Often in bunches which flower late in summer. (P.M.)

✓ Pyrola asarifolia Michx. var. asarifolia

- in moist or shaded areas with variable abundance. May occur in Populus stands. (P.M.)

P. chlorantha SW.

- similar distribution as P. elliptica. Very few. (N.C.)

P. elliptica Nutt.

- common in Pinus woods often with Linnaea borealis and Chimaphila umbellata. May be confused with P. chlorantha. (P.M.)

P. picta Smith

- very few solitary plants restricted to conifer stands. Flowering late summer. (P.M.)

P. secunda L.

- common throughout but more abundant in mosaic conifer stands. (P.M. and V.H.)

P. uniflora L.

- often in small groups but uncommon, in semi-open, moist areas. (P.M.)

Vaccinium caespitosum Michx.

- may be confused with V. scoparium; few plants in open mesic sites. (P.M.)

V. membranaceum Dougl.

- common, scattered throughout. Often with Lonicera utahensis except in wet areas where Lonicera drops out. (P.M.)

V. scoparium Leiberg

- very common, may be dominant ground cover. Absent in very wet areas. (P.M.)

Gentianaceae

Gentiana amarella L.

- common in mesic, semi-open Pinus contorta stands. Hidden amongst grasses and sedges. (P.M.)

Scrophulariaceae

Castilleja miniata Dougl. var. miniata

- scattered clumps amongst Lupinus species in mosaic conifer stands. (P.M. and V.H.)

Veronica americana Schwein.

- very common on muck type soil near marshes. Member of Veronica americana species group. (P.M.)

Plantaginaceae

Plantago major L. var. major

- few plants in one area disturbed by cattle. Probably from valley. (P.M.)

Rubiaceae

Galium trifidum L.

- small numbers in moist-wet areas amongst Carex and Equisetum on muck-type soils. (P.M.)

G. triflorum Michx.

- in mesic or moist areas, more abundant than G. trifidum. (P.M.)

Caprifoliaceae

Linnaea borealis L.

- very common shrub throughout area. (N.C.)

Lonicera involucrata (Rich.) Banks var. involucrata

- common in mesic, semi-open Pinus contorta stands. (P.M.)

L. utahensis Wats.

- common throughout but more abundant in mosaic conifer stands. (P.M. and V.H.)

Sambucus racemosa L.

- a few bushes found on rock outcrops of Buck Hills Road Reserve. (P.M.)

Compositae

Achillea millefolium L.

- found occasionally in dry, open woods. (N.C.)

Anaphalis margaritacea (L.) B. & H.

- scattered in dry, open woods and along roads. (N.C.)

Antennaria microphylla Rydb.

- common as small groups in open, fairly dry conifer woods. (P.M.)

A. neglecta Greene var. attenuata (Fern.) Cronq.

- sparsely distributed in open, mesic to dry woods. (P.M.)

A. racemosa Hook.

- common as small groups in mosaic, mesic conifer stands. (P.M. and V.H.)

Arnica cordifolia Hook.

- common, variable distribution but mostly in partially moist areas. Heavily infested with insects. (P.M.)

A. mollis Hook.

- abundant on NE outcrop of Buck Hills Road reserve but more common at higher elevations amongst Lupinus spp. and Castilleja sp. (P.M. and V.H.)

Aster conspicuus Lindl.

- very common in mesic or moist Pinus contorta stands. Flowers late summer. (P.M.)

A. foliaceus Lindl.

- highly variable species with wide distribution but more often in moist areas. (P.M. and V.H.)

Cirsium hookerianum Nutt.

- rooted in dry sandy soil on rock outcrop of Buck Hills Road reserve. Few. (P.M. and V.H.)

Cirsium species Mill.

- uncommon, found along stream below beaver dam of Lily Pad Lake. (N.C.)

Erigeron acris L. var. debilis Gray

- common on rock outcrops of Buck Hills Road reserve, in open areas. (P.M.)

Hieracium albiflorum Hook.

- very common in mesic woods with some intrusions into moist areas. (P.M. and V.H.)

Petasites erigidus (L.) Fries var. palmaris (Ait.) Cronq.

- few to many on muck-type soils in moist or wet areas. (P.M.)

Senecio indecorus Greene

- very few, only found along creek in Buck Hills Road reserve. Flowers late summer. (P.M. and V.H.)

S. pseudoreus Rydb

- widespread but abundant in moist to wet areas. (P.M. and V.H.)

Taraxacum officinale Weber

- common in disturbed areas (by cattle). Grazed by cattle and chipmunks. (P.M.)

Juncaceae

Luzula hitchcockii Hamet-Ahti

- a few scattered plants in moist semi-open areas. (P.M. and V.H.)

Cyperaceae

Carex aurea Nutt.

- inconspicuous, sparse sedge in open, moist shallow gullies. (P.M.)

C. canescens Bailey

- few in moist to wet areas on dark brown soil. Member of Veronica americana species group. (P.M.)

C. concinnoides Mack.

- very common in mesic, mosaic Pinus contorta woods along with Calamagrostis canadensis. Flowers late spring. (P.M. and V.H.)

C. hoodii Boott.

- uncommon, on moist streambank with other Carex spp. and Equisetum arvense. (P.M.)

C. petasata Dewey

- few to many, on wet silty soil of open Pinus or Alnus stands. (P.M. and V.H.)

C. Rossii Boott.

- very few, amongst grasses near outcrops in Buck Hills Road reserve. (P.M.)

Graminaceae

Bromus vulgaris (Hook.) Shear

- many varieties; few scattered plants on mesic to moist sites. Grazed. (P.M.)

Calamagrostis canadensis (Michx.) Beauv.

- non-abundant, highly variable species on mesic to moist sites. (P.M. and V.H.)

C. rubescens Buckl.

- very abundant in mesic Pinus contorta woods; may form dominant ground cover. (P.M.)

Cinna latifolia (Trevir) Griseb.

- uncommon, small groups mainly in open conifer stands. (P.M.)

Elymus glaucus Buckl. var. glaucus

- occasionally on mesic to moist sites but with a low coverage. (P.M.)

Festuca occidentalis Hook.

- very common in mesic conifer stands but with low coverage. (P.M.)

Glyceria elata (Nash) Jones

- common in very moist areas along with Alnus species. (P.M. and V.H.)

G. striata (Lam.) Hitchc. var. stricta (Scribn.) Fern.

- few plants in semi-open, moist to wet areas. (P.M.)

Poa leptocoma Trin. var. paucispicula (Scribn. & Merr.) Hitchc.

- common on streambank on gravelly soil, amongst Viola orbiculata. (P.M.)

Trisetum cernuum Trin.

- low abundance, on mesic, open sites. (P.M.)

T. spicatum (L.) Richter

- highly variable species, in mesic, open conifer woods with a low coverage. Common. (P.M.)

Liliaceae

Clintonia uniflora (Schult.) Kunth.

- common in open Alnus or conifer stands on mesic to moist sites. (P.M.)

Fritillaria species L.

- uncommon, occasionally in mosaic Pinus contorta woods amongst grasses. (N.C.)

Lilium columbianum

- abundant in semi-open mesic conifer stands. Member of Lilium columbianum species group. (P.M.)

Smilacina racemosa (L.) Desf.

- a few scattered plants in open woods or moist areas. (P.M.)

Streptopus amplexifolius (L.) D.C. var. chalazatus Fassett

- common in moist open areas and rooting in rock crevices of outcrops in Buck Hills Road reserve. (P.M.)

Orchidaceae

Calypso bulbosa (L.) Oakes

- small sparse clumps in fairly moist open sites. Flowers late spring. (P.M.)

Corallorhiza maculata Raf.

- very few, restricted to mesic or dry conifer woods. Appears late summer. (P.M.)

C. trifida Chat.

- occasionally amongst grasses on sandy soil of mosaic conifer stands. Few. (P.M.)

Goodyera oblongifolia Raf.

- common in mesic areas amongst grasses. Flowers late summer. (N.C.)

Habenaria dilatata (Pursh.) Hook. var. leucostachys (Lindl.) Ames

- a few plants restricted to moist or wet areas. (P.M.)

H. obtusata (Banks) Richards

- non-abundant, in moist shady areas. (P.M.)

H. unalascensis (Spreng.) Wats.

- scarce, generally in open, mesic Pinus contorta stands. (P.M.)

Listera cordata (L.) R.Br.

- small isolated pockets amongst grasses (e.g. Calamagrostis rubescens) under mosaic Pinus contorta stands. (P.M.)