NATURAL AND HUMAN HISTORY

INTERPRETIVE THEME DOCUMENT

for

MANNING PROVINCIAL PARK

Prepared for:

South Coast Region

BC Ministry of Parks

Prepared by:

David F. Fraser, Daniel R. Farr, L.R. Ramsay
and Nancy J. Turner

Arenaria Reserach and Interpretation
58'36 Old West Saanich Rd.
RR #7 victoria, B.C.
V8X 3X3

March 30, 1989

PREFACE

This publication is one of a series of documents and reports which outline the natural history, cultural history and recreational themes for the major Provincial Parks located in the southwestern portion of British Columbia.

The "Lower Mainland Area" of B.C. is one of vast geographical and biological diversity ranging fro glacier-covered mountains to the bottom of the world's largest ocean,.and B.C.'s Provincial Parks reflect that incredible spectrum.

With such a wealth of resources available to interpret, it is necessary to ensure the major attributes of each specific park are presented to the 'public in an organized, non-repetitive fashion throughout the region.

To achieve this objective an interpretation and information plan was developed for the parks in the region and the major themes/stories of regional significant to be told in each park were identified. A visitor travelling through the provincial parks in the regions should, through our interpretation efforts, appreciate the significant of each one, and collectively build on his or her knowledge of the value and importance overall.

This document therefore achieves several important objectives:

1. It outlines the most important natural and cultural history themes Manning'Provincial Park to guide interpretive programs offered to the public.

2. It provides site-specific locations of the park's most important features for use by interpretive planners and master planners.

3. It brings together additional park-specific natural and cultural history information gleaned from a review of past records, files, projects and reports.

4. It identifies information gaps requiring further research,

By reviewing the information contained in the 'followingpages, the reader should be able to grasp the essence of Manning Park's natural and cultural history which is an important step in appreciating what makes British Columbia's Provincial Park System so special.

Jim Cuthbert, R.P.Bio.
Visitor Programs Officer
South Coast Region

ACKNOWLEDGEMENTS:

Chris Kissinger, Bill Merilees, Rik Simmons and Wayne Stetski from the Parks Branch provided much assistance and access to their files. Faye Mogensen and Rhonda Korol reviewed portions of the manuscript. Katherine Farr typed part of the manuscript including inputting some of the species lists. Del Meidenger provided the vernacular name species list for British Columbia in disc form, saving hours of typing time. Chris Guppy of the Royal B.C. Museum provided some additional references on insects. Dave Suttill provided much of the information on the Cascades Wilderness Area.

We are indebted to the legions of interpreters that'bothered to put some of their observations down on paper - and those that thought to save them. Gail Ross left a specially well organised paper trail.

TABLE OF CONTENTS

NATURAL HISTORY OF MANNING PROVINCIAL PARK

II. TERRESTRIAL ECOSYSTEMS

HUMAN HISTORY OF MANNING PROVINCIAL PARK

TABLES

LIST OF FIGURES

APPENDICES

INTRODUCTION

This document outlines some of the characteristics of the human and natural history of Manning Provincial Park. Manning Park is perhaps the best known of our Provincial Parks; it is within an easy drive of Vancouver. The park was the first to have a naturalists program, and over the years scores of amateur naturalists, writers, professional scientists and interpreters have explored Manning Park. Some of these left a legacy of written material - this report summarizes the information that we found on Manning Park and outlines some of the interpretive stories that can be told about Manning Provincial Park.

It is by no means complete' - indeed it may not even be accurate in places. Time constraints prevented us from going back to original sources to check'details, species identifications and historical recollections. In compiling this document we have tried to cite the references used so that a future worker can check the details.

The choice of subject matter was dictated by several criteria - the format of the document, the availability of information, and to a certain extent the personal biases and experiences of the writers. We have tried to present enough information on important topics that the interpreter that reads this document will have a basic understanding some of the important interpretive themes of Manning Park. Another document of equal size could easily be produced on the natural and human history of this park, with little overlap.

Despite the size of the feference list at the back of this document, most of what we know about Manning Park comes from a relatively few individuals. Future Park employees and visitors should be encouraged to continue to add to the store of knowledge about Manning Park. Historical information quickly disappears, species distributions change, and new information is brought to light frequently - all of which should be documented.

Manning is one of the most visited parks in the .system - we hope that the information contained in this document will help interpreters prepare programs that will encourage the public to keep coming back.

I. LANDFORMS AND PROCESSES

A. Geology

1. Bedrock 'Significance

An understanding of the geology of the Park .requires some knowledge of the geologic history of the surrounding area. Manninq Park and the Cascades Wilderness are within the Cascades Mountain Range, which extends from southern British Columbia to northern California (McKee 1972). The Cascades are in turn part of the Cordillera, which includes the entire western mountainous area of North America, from Alaska to Mexico. For reference a geologic time scale is found in Table 1.

Little is known of this area's history during the Precambrian Era (prior to 650 million years ago). Rocks that formed during this time are now buried under such thick layers that none are now exposed at the surface. Precambrian Rocks can be seen elsewhere in the Cordillera, notably in the northern Rockies and Columbia Mountains. McKee (1972) suggested that it is possible . that the oldest rocks in the North Cascades (i.e. Manning Park area) may be of Precambrian age. The shists and gneisses at the bottom of some particularly old rock sequences may, in fact, be Precambrian; they are definitely older than Devonian (McKee 1972).

During the Paleozoic Era (650 to 225 million years B.P.), and into the Mesozoic Era (225 to 65 million years B.P.), a huge submarine trough was situated off the western coast of North America. Called the Cordilleran Geosyncline, this trough was the birthplace of a large proportion of the rock formations seen in Manning Park today. Its method of formation is interesting. Molten rock, or magma, from the earth's interior had forced its way up to the surface at underwater ridges formed between the huge plates that make up the floor of the Pacific Ocean. As the newly formed rock cooled, it was forced away from the ridge by magma from below, and the result was the continuous movement of the ocean floor, or crust, away from the underwater ridges toward the western coast of North America. This process, known as sea floor spreading, still occurs today. Because rocks that make up ocean floors are heavier than those that comprise the continents, the ocean crust that was pushed against the coast of North America was forced, or subducted, beneath the continent. The Cordilleran Geosyncline was the result of such a process. As the ocean's crust sank, a trough was created along the length of the coast. This process is behind much of the mountain-building episodes described in later sections.

As the forces of wind and water eroded the North American land mass during the Paleozoic and Mesozoic Eras, rivers carried the resulting sediments westward into the ocean. The sediments

Table 1. Geologic Time Scale.

PERIOD	APPROXIMATE DURATION in millions of years	ERA
Modern	6--70	Cenozoic
	70 million years ago	
Cretaceous	60-70	Mesozoic
Jurassic	40-50	
Triassic	40-50	
	225 million years ago	
Permian	45-55	Paleozoic
Carboniferous	60-80	
Devonian	50-60	
Silurian	20-40	
Ordovician	60-75	
Cambrian	100	
	600 million years ago	
		Precambrian
	5 billion years ago	

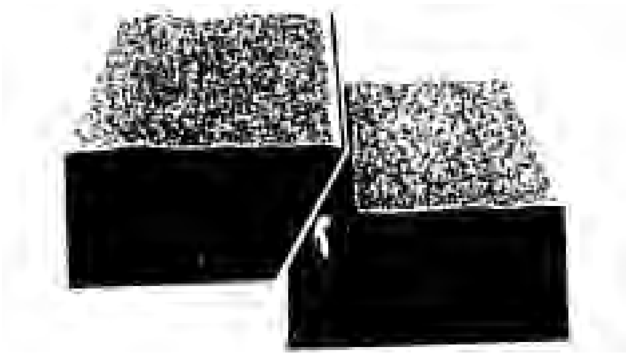
were deposited in the Cordilleran Geosyncline, but did not fill it, as its bottom sank at a rate similar to the rate of deposition. The result was the formation of layers of sandstone, shale, and other sedimentary rocks that were in some places up to 8 miles thick. It is these layers, when forced upwards and onto the continents during montain-building episodes, that form much of the bedrock seen in Manning Park today.

The actual location of the ocean shoreline during .the Mesozoic Era varied with changes in sea level, and with the degree to which the Cordilleran Geosyncline was uplifted by forces below. This is significant because of the differences in rock types formed in different depositional environments (e.g. ocean depth and distance offshore).' Coates (1974) suggested that in the Middle Jurassic (around 160 million years B.P.), the shoreline in what is now Manning Park was approximately northwest-southeast, extending along a line from the present Blackwall Peak past Hampton Campground. By 20 million years later (Late Jurassic), the shoreline may have moved west to the vicinity of Allison Pass (Coates 1974). Kleinspehn (1980), however, suggested that no such shoreline existed in the park at the time; and that it was actually much further east, near the present Rocky Mountains. Further study is required to clarify this question. Finally, as the region became uplifted during the late Mesozoic (see below), the sea left the area for the last time, and all subsequent rock sequences were deposited in fresh water environments.

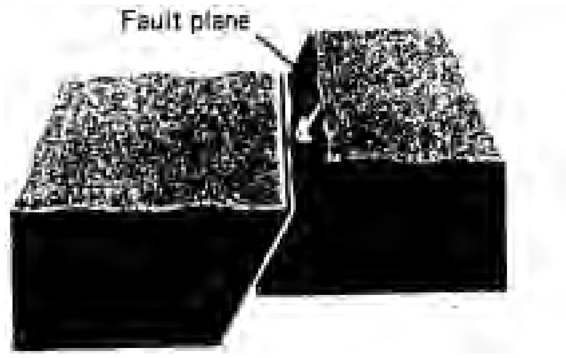
During the middle of the Cretaceous Period, the Cordilleran Geosyncline was destroyed by intense forces from within the earth. The entire western coast of North America underwent an orogeny, an intense period of uplift, faulting, and folding of the rock formations created in the Cordilleran Geosyncline. Two of the most important processes were strike-slip faulting, and downdropping of entire rock sequences. These processes profoundly affected.the character of the bedrock sequences. found in the Manning Park area.

Two major fault lines were formed during the late Mesozoic orogeny: the Hozameen Fault and the Pasayten Fault. These fault lines are not obvious to the casual observer, but closer inspection reveals that the rock sequences on the western side of each fault are very different from those on the east side.

The Hozameen Fault passes northwestward .through Manning Park just west of Rhododendron Flats (Ross 19.81). It was caused by the .northward movement of a huge section (plate) of the earth's crust past an adjacent section to the east (Kleinspehn 1980). So extensive was this movement that the land.to the west Manning Park may once have been at the latitude of Baja California, several hundred miles to the south (Kleinspehn 1980). The process, which is known as strike slip faulting, probably occurred for 40 to 50 million years (Kleinspehn 1980).



Strike Strip Faulting



Downdropping

Figure 1. Schematic diagram showing strike-slip faulting and downdropping.

The Pasayten Fault, situated along the eastern border of Manning Park, was formed by a process similar to that described for the Hozameen Fault. Again, the section of the earth's crust west of the fault slipped northward past the section to the east. In this case, the land currently west of the fault at Manning Park was probably once at the latititude of northern California (Kleinspehn 1980).

The Methow Trough, or Methow Graben (after the German word "graben, meaning "down") lies between the Hozameen fault to the west, and the Pasayten Fault to the east. It is a "downdropped" block that trends northwest from the Columbia River in Washington to about 100 miles (63 km) north of the international border (McKee 1972). Manning Park essentially lies completely within the Methow Graben. Kleinspehn (1980) described the formation of the graben as resulting from downward movements created by irregularities in the fault lines. These irregularities caused intense pressure along certain portions of each fault, pulling each one apart, allowing entire sections in between to "drop" down to a lower level (Kleinspehn 1980).

An important feature of the Methow Graben is that it contains Mesozoic rock formations that are largely absent in the bedrock immediately to the west and east of the Park., This is because the lower elevation of the trough "protected" the area from the degree of erosion experienced by the adjacent regions. The forces of wind and water generally are strongest at higher elevations, and the Mesozoic formations seen in Manning Park have been largely eroded from the areas to the east and west. Manning Park therefore provides us with a "window into the past".

The final phase of the late Mesozoic - early Cenozoic orogeny was general uplift of the entire region, resulting in long chains of mountains. By around 40 million year ago, uplifting forces had produced mountain chains similar to those seen today (Kleinspehn 1980). These are not, however, the same mountains that we see today. These "pre-Cordilleran" mountains were eroded down to nearly sea level', resulting in a flat "peneplain" across western B.C. during the Miocene epoch (after 25 million years B.P.) (Kleinspehn 1980). The most recent period of uplift, around 10 million years B.P., produced the Coastal and Cascade mountain chains that exist today (Kleinspehn 1980). In fact, the Cascades are among the youngest mountains on earth (Ross 1981).

While uplifting and faulting modified the landscape of the late Mesozoic - early Cenozoic, other forces modified the very nature of the rock sequences themselves. Heat and pressure caused metamorphosis of existing sedimentary rocks into metamorphic rocks. In addition, new material was added from below; the intrusion'of magma resulted in the addition of huge granitic formations.

All of the processes and events discussed above have resulted in a complex mosaic of bedrock formations within Manning Park. These are briefly described below; consult the enclosed map for the locations of each Group. Further descriptions of each may be found in Coates (1974), Kleinspehn (1980) and Ross (1981). Table 2. shows typical banding sequences and relative thicknesses of the groups in Manning Provincial Park.

Hozameen Group: This rock sequence is carboniferous (Anon. n.d. g) 'or at least late Paleozoic (McKee 1972:321), and is visible only at the westernmost boundary of the Park. The sequence was deposited in a deep marine environment, and typical rock types include chert, green andesite and limestone (Anon. n.d. g).

Ladner Group: The Ladner Group is present in a band between Rhododendron Flats and Lone Goat Mountain, and was formed around 160 million years B.P. Because deposition occurred at a range of distances offshore, this group contains a range of rock types. For convenience, they have been divided into a "near-shore" section deposited in shallow water (exposed in roadcuts below Lookout and Blackwall Peak; Ross 1981), and an "offshore" section deposited in deeper water that now comprises the western* portion of Skagit Bluffs (Ross 1981).

Jackass Mountain Group: Following the deposition of the Ladner Group, the Jackass Mountain Group was formed. Most of the bedrock covering Manning Park today belongs to this formation, which was deposited in shallow water from 135 to 120 million years B.P. (Ross 1981).

The conglomerate rocks visible on Windy Joe Mountain, at the Big Burn 2 miles west of Allison Pass, in the cliff across from the Nature House, and on the second switchback of the road to the Lookout all belona to this formation. Conglomerates are formed when pebbles and stones are cemented together by a a matrix of fine particles. If the conslomerate formed in a current. the direction of the current is preserved in the form of tilting of the pebbles orcobbles on a uniform direction. This is visible in the outcrop on the Heather Trail past Big Buck Mountain (Klepenspehn 1980).

Pasayten Group: Following the deposition of the Jackass Group, the Cordilleran Geosyncline was uplifted, and was therefore no longer covered by the sea. A relatively thin layer of non-marine sediments was deposited during the middle to late Cretaceous, forming the Pasayten Group (McKee 1972; Ross 1981).

Table 2. Typical banding sequences and relative thicknesses of bedrock groups in Manning Provincial Park. From Coates 1972.

ERA	PERIOD	EPOCH	GROUP OR FORMATION	MAP-UNIT	LITHOLOGY
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT			Stream deposits, glaciofluvial deposits and till
			UNCONFORMITY		
	TERTIARY	EOCENE	CASTLE PEAK STOCK	18	Granodiorite and tonalite
			UNCONFORMITY		
MESOZOIC	CRETACEOUS	UPPER CRETACEOUS	Stocks on SNASS CREEK and SILVERDAISY MOUNTAIN	17	Tonalite
			UNCONFORMITY?		
		UPPER CRETACEOUS	EAGLE TONALITE (in part)	14	Tonalite and granodiorite
			UNCONFORMITY?		
		ALBIAN OR YOUNGER	PASAYTEN GROUP	13	Non-marine lithic sandstone and conglomerate
				12	Non-marine redbeds, conglomerate, arkose and siltstone
		MIDDLE TO UPPER ALBIAN		11	Non-marine conglomerate, arkose, sandstone and siltstone
		LOWER TO UPPER ALBIAN	JACKASS MOUNTAIN GROUP	10	Marine sandstone, shale, siltstone and conglomerate
		LOWER ALBIAN		9	Polymict conglomerate, sandstone and argillite
		BARREMIAN - LOWER ALBIAN		8	Sandstone, argillite and minor conglomerate
		HAUTERIVIAN TO LOWER BARREMIAN		7	Marine sandstone
		NEOCOMIAN (LOWER CRETACEOUS)	COPPER CREEK ASSEMBLAGE	6	Volcanic sandstone, conglomerate and red argillite
				5	Hornblende andesite, breccia, tuff and flows
			PITYOPHYLLUM BEDS	4	Non-marine volcanic and polymict sandstone, conglomerate and argillite
			UNCONFORMITY		
	UPPER JURASSIC TO CRETACEOUS?		EAGLE GRANODIORITE (in part)	14	Tonalite and granodiorite, gneissic to foliated
	JURASSIC	UPPER JURASSIC	DEWDNEY CREEK GROUP	3	Volcanic sandstone, conglomerate and argillite
			UNCONFORMITY		
		TOARCIAN TO BAJOCIAN	LADNER GROUP	2	Volcanic sandstone, argillite, conglomerate, tuff, breccia, flows
			UNCONFORMITY		
MES &/OR PAL	MIDDLE TRIASSIC AND/OR PERMIAN (?)		HOZAMEEN GROUP	1	Greenstone, chert, argillite and limestone

GSC

2. Paleontology

Fossils are formed when living animals or plants die and become buried in the surrounding substrate. Usually only organisms with hard structures such as shells are preserved; soft bodies are decomposed. Fossils usually contain none of the original material, as it is usually replaced by minerals from the surrounding substrate. Plant fossils often are in the form of blackish impressions of leaves or wood in the rock. This occurs when a plant is buried and compressed by the overlying sediment, and most of the plant decays away, leaving a thin dark film of carbon. Sometimes the impression contains exquisite details of leaf venation or bark surface structure.

The best fossil-forming environments are under water; hence, most fossils are .ofaquatic organisms or 'organisms that have washed into the water from the land. The marine environment that was Manning Park millions of years ago was home to a diverse community of invertebrates, from thumbnail-sized pectens to huge predatory ammonites whose coiled shells were sometimes 'over a metre long. These animals,, plus the.terrestrial plants that washed into, the sea, formed fossils that are. now visible. in roadcuts, natural outcrops, and talus slopes throughout the park.

Fossils are widespread in Manning Park, occurring in around 175 different locations (Thorne 1978). Coates (1974) provides a Fossil Locality Map (see map pouch), plus numerous tables of known fossils in the Park. The following is an annotated list of species whose fossilized remains have been found, based largely upon Coates (1974). Selected localities are also provided, but readers should consult Coates (1974) and also Jeletzky (1970) for more specific details.

PLANTS

True Ferns (Devonian to Recent)

Ferns are rather primitive plants that reproduce by spores rather than seeds, and usually grow in moist habitats. Although the ferns we see today axe usually less than a metre tall,. extinct tree-ferns of 300 million years ago often reached heights of over 14 m (45 feet), with trunks over half a metre (2 feet) in diameter. The compound leaf of most ferns is often preserved as a carbon film in many sedimentary rocks..

In Manning Park, ferns are among the most common plant fossils, occurring in many locations including the Lookout Road.

Horsetails (Devonian to Recent)

Horsetails are a once dominant group of plants that, like the true ferns, are represented today by diminutive descendants, such as the horsetail rush (Equisetum). Extinct species of horsetails often grew in the form of trees over 15 m (48 feet) high. Their leaves or branches were attached to the trunk in the form of whorls at separate nodes.

In Manning Park, the fossil horsetails that have so far been located belong to the same genus as the only living genus (Equisetum). One of the three localities for this group is in a roadcut along the Monument 83 Trail

Seed Ferns (Mississippian to Jurassic)

As their name suggests, seed ferns reproduce by seeds, that are fertilized by wind-borne pollen. This is a considerable advance beyond their ancestors the true ferns, allowing them to inhabit drier environments. Seed ferns, which are similar in appearance to true ferns, have been extinct for many millions of years. They may be the ancestors of modern flowering plants.

Seed fern fossils are relatively uncommon within the park, and have been found in roadcuts along Highway 3, and along the Monument 83 Trail.

Cycads (Permian to Recent)

Cycads, which still occur today in warm tropical regions, are squat relatives of the seed ferns, from which they probably descended. They were once very common, and many argue that the Mesozoic Era should have been called the "Age of the Cycads" instead of the "Age of the Dinosaurs".

Fossilized impressions of the compound leaves of cycads are found in a variety of locations within the park, including roadcuts along Highway 3.

Ginkgos (Permian to Recent)

Like cycads, ginkgos were also common during the Mesozoic Era; only a single species remains today. They have broad, fan-shaped leaves, which were sometimes divided into lobes. In Manning Park, fossilized ginkgo leaves have been found on the Lookout Road.

Conifers (Pennsylvanian to Recent)

The conifer trees of today are an old group, with ancestors going back to over 300 million years. A common fossil conifer in this area is Sequoia, a cousin of the great California redwoods. Others include relatives of today's spruces and larches.

The leaves, cones, and wood of conifer trees are found in outcrops in many parts of the park, including along the Lookout Road, along the Monument 83 Trail, and on the bank of the Similkameen River.

Angiosperms (Cretaceous to Recent)

The angiosperms, or flowering plants, are by far the most dominant group of plants in many parts of the world today, with well over 200,00 species. Their main advantage is a food-filled seed that is covered with a protective outer coat. They can often remain dormant for long periods, and can often colonize environments too severe for other plants. Flowering plants are a relatively young group, having appeared less than 100 million. years ago. Fossils of this group found within Manning Park are mostly trees, and include extinct relatives of sycamores, magnolias, and figs.

Fossilized leaves and wood of these plants are found in numerous locations throughout the park, including the Lookout Road, and a roadcut below Blackwall Peak.

ANIMALS

Corals (Precambrian to Recent)

These tiny relatives of the jellyfishes and sea anemones produce a hard outer skeleton usually made of calcite. Most corals are communal, and their colonies often produce magnificent underwater marine landscapes such as'reefs.. Because of their mineralized skeleton, they are frequently found as fossils.

In Manning Park, fossil corals have been found in a roadcut below Blackwall Peak (Ross 1981), and numerous other areas.

Mollusks (Cambrian to Recent)

Snails (Cambrian to Recent)

Snails, or gastropods, are among the most familiar mollusks. Their hard outer shell grows into an often beautiful spiral or whorl, out of which the soft body of the snail itself pushes its single "foot".

In Manning Park, fossil snails are relatively common, and have been found along the Lookout Road and elsewhere.

Bivalves (Cambrian to Recent)

Bivalve molluscs, such as the familiar clams, cockles, mussels, oysters and scallops, all have the common characteristic of a shell with two parts. Strong muscles,' usually two in number, keep the shell closed. An elastic ligament pulls the shell open when these muscles relax. Bivalves filter tiny food particles from the water, which they receive by way of an incurrent siphon, or tube. An outcurrent siphon "exhales" this water after it has passed over the gill-like feeding structures. Many bivalves have changed little since their first appearance on

. the floor of the oceans over 600 million years ago.

In Manning Park, fossilized bivalves are common. Pectens (scallops and their relatives), such as the thumbnail-sized Svnclonema, have been found on the Lookout Road, on the first hairpin curve going uphill (Thorne 1978), and other bivalves, including the clam-like Trigonia, are found in a variety of other locations. One of the most common fossilized "clams" in the park is Buchia, sp.

Cephalopods (Cambrian to Recent)

The most familiar fossil cephalopods are the ammonites and belemnoids, both close relatives of today's octopus, squid and cuttlefish. Ammonites, which went extinct long ago, were very similar to the living Nautilus of warm tropical waters. Like the Nautilus, the coiled shells of most ammonite's heavy, calcified shell is divided by partitions into chambers, which are all connected by holes through the middle of each partition. The animals, which was very similar in form to today s squid, lived only in the outermost chamber. By secreting gases into the other chambers, it could control its buoyancy to an exquisite degree, allowing it to hover motionless in the water at any desired depth. Most ammonites were capable predators, aided by their keen eyesight and strong tentacles.

In Manning Park, ammonites have been found in outcrops along the Lookout Road (Ross 1981), and many other areas.

Belemnoids are extinct squid-like animals that possessed a calcareous internal support composed of two sections. A solid, heavy rostrum, or guard, probably served as ballast, and a hollow chambered section, or phragmocone, fit into a hollow in the front of the guard. Today's squid possess a structure similar to the phragmocone, but the guard is absent. Fossil belemnites are represented .almost exclusively by their guards, which appear as elongated cone-like structures.

Belemnoids are also common in Manning Park, having been found on the Lookout Road, and other areas.

Annelid worms (Precambrian to Recent)

Worm-like animals that burrowed in the soft ooze of the prehistoric ocean floor frequently left trace fossils. These are not the animals themselves, but rather their sediment-filled burrows. Many kinds of extinct worms are known only by the characteristic shape of their burrow.

In Manning Park, worm burrows occur in many outcrops, including just north of Allison Pass, on the north side of Highway 3 (Kleinspehn 1980).

Brachiopods (Cambrian to Recent)

Braclhiopods look superficially similar to bivalves such as clams, but the two groups are only distantly related. Brachiopods typically inhabit deep marine environments. Most extinct forms lived in the bottom mud, but living brachiopods usually attach themselves to rocks via a fleshy stalk.

Braclhipods have been found in scattered locations in Manning Park.

B. Geomorphology

1. Glaciation

Glaciation has profoundly influenced the topography of the Manning Park area. After the final mountain-building episode, periodic "Ice Ages" have caused the spreading of huge ice sheets southward across North America. Several cycles of advance and retreat of these continental glaciers have occurred starting around one million years ago (Kleinspehn 1980), but since each glacier all but obliterated any evidence of the previous one, only the most recent glaciation is documented in the topography of Manning Park today. This period, the Wisconsin Glaciation, ended around 18,000 years B.P.

During the Wisconsin Glaciation, two "lobes" of ice are thought to have extended through the Manning Park area: the Hozameen Ice Sheet, and the Thompson Plateau Ice Sheet (Coates 1974). The two glaciers were probably around 7000 feet thick, and virtually covered the surface of the Park. Only the highest mountain peaks, above 2130 m (7000 feet), were not covered by ice (Coates 1974). These unglaciated peaks are called nunataks (Ross 1981).

The great weight of the overlying ice, combined with the scouring action caused by their movement, cawed the bedrock into many of the shapes we see today. The tops of some mountains, such as those east of the Viewpoint Trail, have been rounded and smoothed (Coates 1974). Valleys such as that of the Lightning Lakes chain have been made deeper and wider, partly due to the scouring action of the ice itself, and partly due to erosion by major glacial rivers carrying water from the melting ice (Mathews 1968). Small glacial lakes, or tarns, were also formed in some areas; Nicomen Lake on the Heather Trail is a surviving example of such a lake (Geology Reference 2).

The Lightning Lake area contains many excellent examples of glacial formations. These are described in detail in Mathews (1968).

As the great ice sheets had retreated, local glaciers remained, sometimes cawing out cirques in the upper parts of mountains, such as on the front side of Mount Frosty (Ross 1981).

Other large-scale glacial 'features include aretes (jagged ridges), and horns (e.g. Mount Hozameen).

The grinding action of glacial ice and water fractured and removed huge quantities of the underlying bedrock. Perhaps the most important legacy of the Ice Age is the creation of a thick layer of loose rock material over much of the Manning Park area. This layer is usually from .75 to 2 m (2-6') feet deep, but is often 30 to 40 feet deep or more (Anon, n.d. g). The result is specific glacial features of various forms that are visible in many locations.

Glacial till (unsorted sediment) can be seen along the north side of the Canyon Nature Trail (Ross 1981). Erratics, in the form of large boulders, are visible on the south side of the Canyon Nature Trail (Ross 1981). These particular boulders, unlike the surrounding sedimentary bedrock, are made of granite, illustrating the power of glaciers to move objects large distances (Ross 1981). Other' erratics are visible on Windy Joe Mountain, particularly near the fire lookout (Geology Reference 2). These are conglomerates; again, very different from the surrounding rock. A glacial moraine has been transected by Highway 3 west of Mule Deer Campsite (Ross 1981). A final example of glacial deposits are the mountain terraces visible above Thunder Lake (Ross 1981). These are possibly the remains of deltas formed at the mouths of rivers that once emptied into a glacial lake that filled much of the valley (Coates 1974). Large kame terraces of sand and gravel sepostied along the valley sides by rivers swollen with glacial meltwater can be seen along the roadcut at the western approaches to the park.

2. Vulcanism

Although no active volcanoes presently occur within the park, the importance of volcanic action is evident in many rock formations. During the Late Mesozoic era, vulcanism became at least as important as erosion as a source of material for the newly formed rocks within the Cordilleran Geosyncline. Many rock formations in the park of Late Mesozoic age contain pyroclastics (chunks of hardened lava), and volcanic ash. The volcanoes themselves may have been on land, or they may have formed volcanic islands (Coates 1974). Blackwall Peak is likely one such island formed approximately 160 million years B.P. (Coates 1974).

3. Fluvial and Lacustrine Features

For ancient fluvial and lacustrine features refer to the section on glaciation.

Fluvial Features

Postglacial drainage patterns in the Manning Park region are divided into two river systems: one system' flows west, and includes the Sumallo and Skagit Rivers, and the other system' flows east,, and includes the Similkameen River. The relatively young age of most of the rivers and creeks in the area is reflected in the typically "V" shape of most river valleys. "U"-shaped valleys reflect the former presence of, large glacial rivers.

Lacustrine Features

The only major lacustrine system in:the park is the Lightning 'Lakes Chain, including Lightning, Flash, Strike, and Thunder Lakes. This system is thought to have once drained east, but "extensive downcutting through a pass just west of Thunder Lake may have reversed the drainage" (Coates 1974: p. 7). Presently, Lightning Lake is situated across a divide, and drains both east and west (Ross 1981).

4. Shoreline

Due to the paucity of large water bodies within Manning Park, shoreline processes are of little importance in shaping the terrain.

C. Important Locations for Interpretation of Landforms and Processes

A number of locations within Manning Park hold potential for use in interpretation of geologic and geomorphologic features. These are Highway 3, the Lookout Road, and the Skyline Trail. Other areas also contain interesting formations; these are briefly described at the end of this section.

1. Highway 3

The construction of Highway 3 has been a boon to those interested in the underlying structures of the Manning Park area. Roadcuts have exposed formations of various aqes, and permitted the direct observation of formations that would otherwise be hidden under overlying rock, soil and vegetation. The many natural outcrops along the route also contain interpretive stories. The following is a selection of features that may be viewed from the side of the highway, starting near the west gate.

1) An outcrop containing rippling and trace fossils of marine worms occurs about 4.8 km (3 miles) northwest of Allison Pass, near a pulloff on the north side of the highway. The fossils are of the mud burrows of soft-bodied marine worms, which became filled by sediment, now visible as vertical lines through the layers of rock. This outcrop also contains examples of "graded bedding". These are visible as sharply defined layers of sedimentary rock that are "graded", with the larqest particles (e.g. sand) at the bottom of the layer, and the finest particles (e.g. silt) at the top.. The bottom part of each layer is also

lighter in colour than the upper part. These beds are formed by pulses of sediment that suddenly wash into a body of water, such that the largest (heaviest) particles sink to the bottom first, followed by the lighter particles, which are held in suspension for longer periods of time (all from Kleinspehn 1980).

2) Just east of the Lookout Road, a good exposure of sedimentary rocks of the Dewdney Group may be seen, which contains a number of fossils (Westerborg 1965).

3) The hill west of the Canyon Nature Trail (?) contains sand and gravel sorted by a river when its channel was about 100 feet above the present river nearby (Underhill 1970).

4) East of Hampton Campsite, several outcrops of the Pasayten Group are exposed. An outcrop of primarily grano-diorite in the Castle Creek area contains some of the youngest rocks in Manning Park. It has been dated at 98 million year old (all from Westerborg 1965).

5) A large white outcrop exposed along the highway just west of Mule Deer Campground contains excellent examples of cross bed formations, formed between 70 and 90 million years ago. They appear as groups of parallel lines in the rock that are oriented in many different directions, often cutting off one another. Cross beds are formed by current action in 'near shore environments. Particles that are transported by the current become piled up on one another, forming ripples by a process that is not well understood. Each ripple contains parallel layers of particles, oriented in the direction of the prevailing current. At the time in which these particular crossbeds were formed, the current was probably flowing from the southwest. With time, successive generations of ripples become layered one on top of another. When viewed in cross section, they appear as distinct sets of parallel lines, or cross beds. (All from Kleinspehn 1980.)

6) Located in (or near) the outcrop described in 1) are whitish beds of chemical precipitate forming thin wavy lines above a section of black shale. These were probably formed by calcareous algae that formed mats in a near-shore marine environment. This identification is tentative, and should be verified. (All from Kleinspehn 1980.)

2. Lookout Road

The road to the Cascade Lookout contains many geologic and geomorphologic features that are readily accessible to the casual observer on foot or in a vehicle (but get out to get a closer look!). Underhill (1970) described a "Rock Reading Tour to the Lookout", which features conglomerates, glacial till, various types of sedimentary and metamorphic rocks, tilted sedimentary sequences, and fossils. It is reproduced, in modified form, below. The original description also includes diagrams of selected features. Distances are in km, those in brackets are miles, from the gate at the bottom of the Lookout Road.

0-0.8 (0.0 - 0.5) Look carefully at the cliffs rising behind the service station. These are made of conglomerate, a sort of natural concrete. Here, there was once a tumbling water that rounded boulders and pebbles then buried them, deep in silt and mud. Heat and pressure hardened the mixture, then weather removed the overlying material.

1.9(1.2) Just above the road are heaps of unsorted glacial till. A river would be expected to have left this more or less sorted by size and the pebbles more rounded.

2.2(1.4) At the upper side of the sharp curve there is sandstone stained bright orange where water seeping through it has left small amounts of iron. The orange color shows that the iron has turned to rust.

4.0(2.5) About here you begin to see siltstone and shale, finer in texture than sandstone, and the commonest rocks along this road. Here they are much broken and very dark; freshly broken surfaces are dark green or dark bluish grey. Elsewhere you may see them in firmer slabs and in varying shades of lighter grey or brown. Much of this rock was originally volcanic ash and other volcanic material. It is part of the Ladner or Dewdney Creek Groups, and was deposited in a deep marine environment (500 to 4,000 feet) many millions of years ago. They are interesting because they indicate that the major source of sedimentary material at that time was volcanoes, possibly volcanic islands, not continental mountains as in later formations (Kleinspehn 1980).

5.0(3.1) Leaving the hairpin bend look on your left for the line of division or "contact" between the older shale and the more recently formed conglomerate. This line must once have been more or less horizontal.

7.2(4.5) Fossil vegetation may be seen in an outcrop on the side of the road here.

7.5(4.7) Watch carefully, and in several places above you will see rock faces bearing distinct ripple marks. Waves left these on the shore of a shallow sea millions of years ago, just as similar marks are left on the beaches of today.

9.3(5.8) Stop on the switchback and observe that hills nearby are rounded, while those farther south are more rugged. Hills near you are of soft sedimentary rock, while southward some peaks are partly of younger and harder granite. The large peak directly south is Mount Frosty [2400 m (7900 feet)], the highest peak in Manning Park. Its peak has been gouged by a glacier that once flowed from there; the resulting rounded hollow is called a cirque. From this location along the Road you can also see

Lightning Lake to the southwest.

10.2(6.4) Look at the tilted layers of shale and sandstone. Each of these was once a flat layer of sand or mud on the sea bed', each being the product of a single flood, flood season, or volcanic disturbance. Count the layers in about five feet then estimate how many years' deposits are in sight here.

11.2(7.0) Here the rock layers are 'not only tilted, but also are twisted and contorted in curious shapes.

12.6(7.9) Now you should be at the Lookout. In the bend of the road is another good example of tilted sedimentary rock layers.

13.0-13.1(8.1-8.2) At the far end of the curve, just opposite the sign pointing towards the alpine meadows, are black fossil remains of tree trunks and limbs. In general, the Lookout Road is the best place in the park to view fossils. Many kinds of marine invertebrates and terrestrial plants are found in rock outcrops and roadcuts, both on the rock faces themselves, and in the talus slopes below. Fossilized wood and leaves occur in abundance in certain outcrops on the lower part of Lookout Road (Kleinspehn 1980).

13.3(8.3) More ripple marks are visible here.

3. Skyline Trail

1) The ridge visible along the Skyline Trail is a good example a surface feature caused by granitic intrusions. These intrusions, along with the surrounding metamorphosed rock, are resistant to erosion, thus forming a ridge. They take the form of sills (intrusions of molten rock parallel to existing layers in the surrounding rock) and dykes (intrusions cutting across existing layers). These intrusions were formed when molten rock, or magma, was forced upwards through a cracks or fissures in the surrounding bedrock, probably deep beneath the surface. In addition to forming granitic intrusions, the hot magma metamorphosed the surrounding sedimentary rock, forming shales and siltstones that are also resistant to erosion. The intrusions also caused the formation of economically important ores, and there is some evidence of early prospecting along this trail. (All from Kleinspehn 1980.)

2) On the trail approaching the first peak above Lightning Lake, at an elevation of about 6100 feet, an area of bedrock underfoot contains a series of undulating ripple marks. This is a side view of a vertical cut through white sandstone that was deposited in a deep water marine environment (all from Kleinspehn 1980).

4. Others

The three above areas are by no means the only areas in which to view geologic and geomorphic features. Two others include the Canyon Nature Trail, and the Heather Trail, Along the former route may be found granite boulders, erratics that were transported by glaciers (Underhill 1970), and glacial till along its north side (Ross 1981). Along the south side of the Heather Trail, a huge outcrop of white sandstone occurs as the trail passes through a gully just northwest of Big Buck Mountain (around 6800 feet elevation). The rock here was probably formed in a near-shore marine environment. The outcrop also contains excellent examples of conglomerates, in the form of cobbles and huge boulders (mainly granitic) embedded .in the surrounding matrix. Many of the cobbles indicate the direction of the water current at the time of their incorporation into conglomerate rock. Elongate cobbles are tilted in such a way that their upper ends are pointing downcurrent (all from Kleinspehn 1980).

II. TERRESTRIAL ECOSYSTEMS

A. Communities.

Manning Park and the Cascades Wilderness Area contain representative areas of five of the Biogeoclimatic Regions of British Columbia. Moving from west to east in the park, one passes through many of these zones. Well before Westgate one enters the Coastal Western Hemlock Zone. At higher elevations on the wetter slopes of the Cascade Wilderness Area is the Mountain Hemlock Zone. At Westgate one enters the park and travels through the Coastal Western Hemlock Zone until reaching Rhododendron Flats where edaphic conditions modify the vegetation to one similar to the Coastal Douglas-fir Zone. Before Allison Pass you move to the "interior" of the park and one encounters the Engelmann Spruce-Subalpine Fir Zone. Further east at low elevations is the dry Interior Douglas-fir Zone, while at highest elevations one finds the Alpine Tundra Zone. Moderate elevations at the east end of Manning Park are included in the Montane Spruce Zone. See Figure 2 for a map of the Biogeoclimatic zones of Manning Provincial Park. A summary of the characteristics of each zone is presented in Table 3.

1. Coastal Western Hemlock Zone (CWH)

For the visitor approaching Manning Park from the west 'the first zone encountered is the Coastal Western Hemlock Zone. The tongue of CWH that enters Manning Park represent the easternmost extension of this vegetation type in B.C. The precipitation in this zone is over.175 cm annually and most of it is in the form of rain rather than snow.

This high rainfall leads to soil leaching of nutrients, especially nitrogen, and acidification resulting in podzolized soils. Plant species richness is low, with a high proportion of plants in the Ericaceae - a family of plants that are characteristically able to exploit ammonia as a nitrogen source (Table 4). Ammonia tends to be the only form of nitrogen available in acidic growth conditions. For a more detailed explanation of nitrogen metabolism in ericaceous plants see Section II D 1. Plant Adaptations to Acidic Soils.

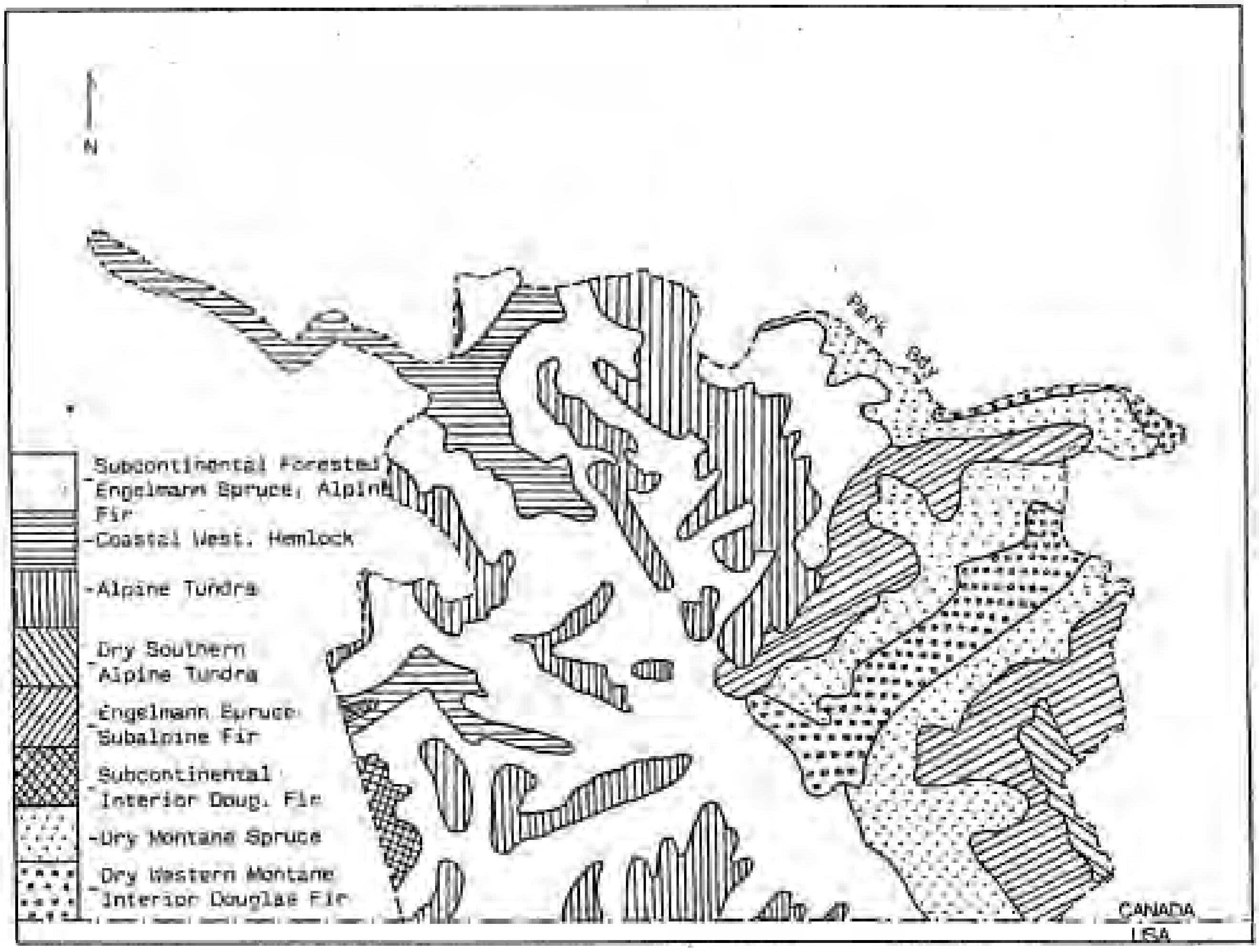


Figure 2. Map of the Biogeoclimatic **Zones of Manning Provincial Park (from Ross, 1982).**

Table 3. Summary of **Biogeoclimatic** Zones **of** Manning Provincial Park and the Cascades **Wilderness** Area.

	Alpine Tundra (AT)	Coastal **Western** Hemlock (CWH)		Mountain Hemlock, **(MH)**		**Interior** Dougias-fir (IDF)		Englemann Spruce-Subalpine **Fir**
CLIMATE		Dry	Wet	Forest	Parkland	**Pinegrass**	F. Boxwood	
Annual **Precip.** (mm)	2743	1651-2794	2794-6604	2210-4310		305-483	508-559	406-1825
Annual **Snowfall** (mm)	10558	127-7493		2794-20320		762-1778		1753-10160
% **Snowfall/Precip.**	72-74	1-38		20-70		21-35		43-72
Mean Annual Temp. (°C)	0	5-9		5	4	4-9		1-4
Mean January **Temp.** (°C)	-9	-4-5		-9--1		-12--3		-18--7
Mean July Temp. (°C)	7	13-19		12	10	17-21		12-16
Number of Months: 10°C	0	4-6		2-4		5-6		2-4
0°C	7	0-3		1-6		2-4		5-6
No. of **Frost-free** Days	25	120-150		100	110	75-200		?
ALTITUDE (m)	Southwest: **windward** 1525 leeward **1830**	**South: windward** 0-915 leeward 460-1070		South: windward 915-1525 leeward 1070-1830		**Southwest:** 610-1220		**Southwest: ?**
VEGETATION								
Climatic Climax	**Phyllodoce-Cassiope mertensiana** (P-Cm)	**Tsuga hetero-**phylla **(Th)**	**Abies-Tsuga heterophylla (A-Th)**	**Abies-Tsuga mertensiana** (A-Tm)	Tsuga- **Vaccinium membrana-**ceum (T-Vm)	**Pseudotsuga Arctostaphylos uva-ursi** (P-Au)	**Pseudotsuga Pachystima myrsintes** (P-Pm)	**Abies-Picea** Rhododendron
SOIL								
Prevailing **Pedogenic** Process	**Skeletal disintigration, gleization, podzolization**	mor **formation, podzoli-zation gleization**		strong mor formallon strong **gleization** strong podzdization		**thin** mor lormallon **podzolization**		strong **podzolization** mor formation
Zonal **Soil**	alpine **dystic brunisols** to mini **podzols**	**humo** ferric Io lerro **humic** podzds	**humic podzols**	subalpine **humic podzols**		orthlc brown wooded	mini **podzol**	subalpine humic

Table 4. The differentiating combinations of species for the Coastal Western Hemlock Biogeoclimatic Zone.

western hemlock	variable moss
Alaskan blueberry	flat moss
deer fern	lanky moss
bunchberry	Scapania bolanderi
three-leaved foamflower'	

The Skagit & Sumallo Rivers Junction

The junction of the Skagit and Sumallo Rivers is the most accessible representative site in the Coastal Western Hemlock Biogeoclimatic Zone in Manning Provincial Park. Much of the following discussion is adapted from Anon. (n.d. j.).

Here representative species of the CWH zone include .western hemlock, western red cedar, Douglas-fir, devil's club, queen's cup, bleeding heart, western trillium, and wild ginger. It is the only known location in the park where wild,ginger grows, and one of the few for'westerntrillium and stinging nettle.

There are two different community types seen at the Skagit Sumallo junction. The first is the semi-mature western red cedar-western hemlock-coastal Douglas-fir forest. This the most accessible stand of very large timber in the park, and one of the few locations where the public can see a stand of Coastal Western hemlock in which many of the canopy trees are more than 200 years old (Hill 1987). The second community type is the riparian deciduous shrub strip that grows along the river edges. Willows, salmonberry, red osier dogwood, alders, thimbleberry, red huckleberry, and stinging nettle. These moisture tolerant species are important in stabilizing the river banks, especially during peak runoff periods.

Some important interpretive themes that can be addressed at this site include semi-mature CWH zone, effects 'of shade and soil acidity, succession, growth and decay and the forest type, relative low animals species richness of this forest type.

This is one of the best locations in the park to see the dark, lowland race of Townsend's Chipmunk (see Appendix 6) and Douglas's Squirrel. Species such as red-legged frog, rough-skinned newt and shrew-mole should also be sought here - all species that are at or near the eastern edge of their range. The area is one of the best for viewing some of the coastal forest bird species - see Table 5.

Table 5. A partial checklist to the birds of the Skagit-Sumallo Rivers Junction Area, Manning Provincial Park - compiled from Anon (n.d.j.), Fraser (pers. obs.).

Mallard	Red-breasted Nuthatch
Harlequin Duck	Brown Creeper
Common Merganser	Winter Wren
Cooper's Hawk	American Dipper
Blue Grouse	Golden-crowned Kinglet
Ruffed Grouse	Swainson's Thrush
Band-tailed Pigeon	American Robin,
Spotted Owl	Varied Thrush
Black Swift	Cedar Waxwing
Vaux's Swift	Yellow Warbler
Rufous Hummingbird	Yellow-rumped Warbler
Red-breasted Sapsucker	MacGillivray's Warbler
Downy Woodpecker	Common Yellowthroat'
Hairy Woodpecker	Wilson's Warbler
Northern Flicker	Western Tanager
Pileated Woodpecker	Black-headed Grosbeak
Olive-sided Flycatcher	Song Sparrow
Willow Flycatcher	Dark-eyed Junco
Pacific Slope Flycatcher	Purple Finch
Violet-green Swallow	Red Crossbill
Steller's Jay	Pine Siskin
Common Raven	
Chestnut-backed Chickadee	

Rhododendron Flats

Rhododendron Flats is a roadside attraction area located 2.0 miles west of the Lodge. Much of the following information is adapted from Wareing (1982d), Mogensen (1982f) and Ross (1986, n.d.)

Rhododendron Flats is in the CWH zone, however the stand contains many species that are typical of the coastal Douglas-fir zone. Presumably edaphic conditions here have moderated the growing conditions so that species ordinarily found in the slightly. drier Coastal Douglas-fir zone can grow here.

The most important feature found at Rhododendron Flats is, of course, the impressive stand of pacific rhododendron (also called red rhododendron, California rhododendron, big-leaved rhododendron, California rosebay). This is one of only two large stands of pacific rhododendron found in British Columbia - the other is nearby in the Skagit Valley. Smaller stands are scattered in a few other locations in B.C. (Chilliwack, Hope and south of Parksville on Vancouver Island are mentioned in Szczawinski 1962). Of these stands, this is the only one readily accessible to the public. A June trip to see the blooms is an annual ritual for many British Columbian families.

A characteristic of Rhododendron Flats is a heavy moss cover and relatively poor vascular plant cover. Those plants that do grow here are highly noticeable, and the entire area has high aesthetic appeal.. As well as pacific rhododendron, other ericaceous plants are common here, including highly specialized saprophytes such as pinesap, indian pipe, gnomeplant and candystick. A list of plants that are found at Rhododendron Flats can be found in Table 6.

Pacific rhododendron is arguably the most beautiful shrub in British Columbia. Certainly it is as attractive as 'many of the species and varieties of rhododendrons in cultivation today. Why is it so rare in British Columbia?

It is believed that pacific rhododendron, along with western flowering dogwood and arbutus are "California relics" - remnants of a time when a warmer climate prevailed in British Columbia. Poor growth and sparse germination of rhododendron sees at Rhododendron Flats lend credence to this explanation (Ross n.d.). The alternate explanation of a recent northward expanding population appears less likely..

Some of the animals that can 'be found at Rhododendron Flats include Townsend's Warbler, Steller's Jay, Red-breasted Sapsucker and Chickaree Squirrel.

:e 6. Some of the conspicuous plants of Rhododendron Flats, ıing Provincial Park. List is from Mogensen (1982f), Wareing 32d), Fraser (pers. obs.), Ross (n.d., 1986) and Ross and Grass 31).

ses	Ericaceous Plants
step moss	false azalea
pipe cleaner moss	western tea-berry
curly heron's-bill moss	black huckleberry
broom moss	oval-leaved huckleberry.
Oregon beaked moss	prince's pine
red-stemmed feather moss	pink wintergreen
juniper hair cap moss	.one-sidedwintergreen
lanky moss	white-veined wintergre'en
pipe cleaner moss	pinesap
	indian pipe
lens	candystick
dog lichen	pacific rhododendron
reindeer lichen	kinnikinnick
tomentose stereocaulin	gnomeplant
Alectoria sp.	
ifers	
Douglas-fir	
western hemlock	
mountain hemlock (rare)	
lodgepole pine	Others
western white pine	queens cup
grand fir	vine maple
subalpine fir	utah honeysuckle
western red cedar	falsebox
amabalis fir	bunchberry
Engelmann spruce	sitka alder
western yew	twinflower
common .juniper	bracken
	baldhip rose
hids	sitka mountain ash
broad-leaved twayblade	willow'sp.
heart-leaved twayblade	birch-leaved spiraea
rattlesnake plantain	thimbleberry
	saskatpon
	dull Oregon-grape

Big Burn Area

In the transition zone between the CWH Zone and the Engelmann Spruce - Subalpine Fir Zone lies an area of sun-bleached snags and young growth known as the "Big Burn Area". Opened up by a fire in 1945, the area today has a cover of young conifers and blueberries and huckleberries. There is very little information on the biology of the Big Burn Area, despite its identification as one of the important areas for it's interpretive value. Much of the information presented here is from Ross and Grass (1981) and Fraser and Ramsay (pers. obs.).

On good berry crop years this is a good area for sighting black bears in the late summer and fall. Large quantities of fallen logs attract courting Blue and Spruce Grouse and the area is a good one for looking for raptors such as Red-tail Hawk and Northern Pygmy Owl. The high density of snags probably increases the available nest sites for cavity nesting species such as Common Flicker, Chestnut-backed and Black-capped Chickadee, and Vaux's Swift.

2. Mountain Hemlock Zone (MH)

This biogeoclimatic zone is not found within Manning Park proper, however is found in the adjacent Cascade Wilderness area, as a midelevation zone (1200-1650 m) in the wettest areas of the Recreation Area. See Table 7 for differentiating combination of species.

Table 7. The differentiating combination of species for the Mountain Hemlock Biogeoclimatic Zone.

amabalis fir	five-leaved bramble
yellow cedar	Barbilophozia floerkei
mountain hemlock	Dicranum pallidisetum
false azalea	pipecleaner moss
black huckleberry	
oval-leaved huckleberry	

3. Engelmann Spruce-Subalpine Fir Zone (ESSF)

Much of the low elevation areas of Manning Provincial Park are within this zone. Along the highway the zone starts at Allison Pass and extends along the valley bottom to east of the lodge. Much of the lower elevation areas of the park are in this Biogeoclimatic Zone. See Table 8 for differentiating combinations of species.

Table 8. The Differentiating Combination of. Species for the Engelmann Spruce-Subalpine Fir Zone (Courtin et al. 1981).

subalpine fir	one-sided wintergreen
Engelmann spruce	globeflower
white-flowered rhododendron	sitka valerian
black ,huckleberry	Barbilophoiia lycopodioides.
mountain arnica	Roellia roellia
Brewer's mitrewort	

As the name of this zone suggests the dominant climax species in this zone are Engelmann Spruce and subalpine fir. Seral species in this zone such as lodgepole pine are common in some areas of the park. Soils in this zone tend to be Podzols in wetter locations. Drier sites have brunisolic soils.

The Enqelmann Spruce-Subalpine Fir Zone of Manning Park can be divided into two areas, The Engelmann Spruce-Subalpine Fir Upper Alpine Parkland and the Engelmann Spruce Lower Subalpine Forest.

3a. The ESSF Upper Subalpine Parklands

The open subalpine meadows of this zone are situated at elevations between 1829 m and 2134 m ASL. Here the growing season is short, between 8 and 16 weeks. Snow usually leaves in late Junes and returns by late September, Frost is common by late August. Peak spring bloom runs form late June to early July and peak summer bloom runs from late July to early August. Soils here are classified as podzols (alpine podzols or cryohumods). This subzone can be further subdivided into Forbe Meadow Communities and Heath Communities.

Spring bloom in Forbe Meadow Communities in late June and early July includes species such as western anemone, spring beauty, avalanche lily. Later summer blooming species in the forbe community include several Arnicas, common red paintbrush, subalpine daisy, cow parsnip, several lupine species, wood betony, tall brook ragwort, mountain valerian, and false hellebore. This zone is the home of a plant called silvercrown (also called sivercrown luina). It is extremely rare in British Columbia, known from only two collections, both in Manning Park (see Douglas 1982).

Heath Communities, found in the lower slopes and in flat areas where snow collects contains a variety of ericaceous low shrubs such as kinnikinnick, white moss heather, red mountain heather, yellow mountain heather, a variety of huckleberries including grouseberry and black huckleberry and partridgefoot.

In moisture collecting areas and seepage sites attractive species such as marsh marigold, false saxifrage, coltsfoot, snow buttercup, globeflower, red monkey-flower, and alpine yellow monkey-flower can be found. For a list of the more conspicuous species found in this zone, as well as an identification guide see Underhill (1965).

Subalpine Meadows of Blackwall Peak Area

For many park visitors, it is this area that forms their "alpine meadow" experience. Much of the following description is based on Wareing (1982e).

The subalpine parkland that surrounds Blackwall peak was probably once covered by a subalpine forest. Presumably a large fire cleared the forest. Although not all subalpine meadows are caused by forest fires, there are several pieces of evidence indicating that the Blackwall Peak Parkland was formed this way.

Firstly, the most widespread community in this area is the Blueleaf Huckleberry-Red Mountain Heather.' This vegetation contains white mountain heather, and broad-leaved lupine and partridgefoot.' This vegetation type has been described by Franklin and Dryness (1973) as being a fire induced vegetation type. It can either be succeeded by a climax subalpine forest or form an edaphic climax.

Secondly, fire scars and bleached wood are found in the' Blackwall Peak area, especially near Buckhorn Camp. The fire that burned in the Blackwall Peak area probably burned before some of the surrounding areas have, with stumps and logs having largely decomposed. Pocket gopher mound on Blackwall meadows occasionally contained charred wood fragments (Fraser pers. obs.).
eskers

Finally the subalpine parkland around Blackwall Peak contains many Lodgepole pine and a few whitebark pine trees. Eventually one could expect a forest of Engelmann Spruce, Subalpine Fir and whitebark pine on drier ridgetops.

Table 9. A list of some of the conspicuous plants of the Blackwall Mountain Area, Manning Provincial Park. List adapted from an unpublished list on file at Manning Provincial Park by McGrenere and Wilson (1985), and also from Fraser (pers. obs.).

parsley fern
fragile fern
common juniper
lodgepole pine
western white.pine
whitebark pine
alpine larch
subalpine fir
mountain hemlock
Engelmann spruce
Piper's woodrush
green-leaved fescue
showy sedge
indian hellebore
glacier lily
alp lily
tiger lily
fragrant white rein orchid
slender rein orchid
sulfur buckwheat
sandwort
Macoun's campion
spring beauty
western pasqueflower
western meadowrue
white marsh marigold
buttercups
globeflower
red columbine
Montana larkspur
draba
rockcress
lance-leaved stonecrop
worm-leaved stonecrop
spreading stonecrop
grass of parnassis
mitrewort
alumroot
Alaska saxifrage
spotted saxifrage
brook saxifrage
partridgefoot
fan-leaf potentilla
lupines
round-leaved violet
early blue violet
desert-parsley
caw parsnip
grouseberry
black huckleberry
one-sided wintergreen.
kinnikinnick
four angled mountain heather
pink mountain heather
yellow mountain heather
white-flowered rhododendron
gentian
showy jacob's ladder
spreading phlox
Fendler's waterleaf
Menzies penstemon
small-flowered penstemon
alpine speedwell
small-flowered paintbrush
common indian paintbrush.
bracted lousewort
elephant's head
sickletop lousewort
sitka valerian
aster spp.
golden fleabane
fleabane spp.
yarrow
wooly groundsel
wooly pussytoes
pussytoes spp.
pearly everlasting
orange agoseris
Agoseris spp.
fireweed

Dry Ridge Trail

Strictly speaking the Dry Ridge Trail is within the ESSF Upper Parklands Zone, with the entrance to the trail starting near the Cascades Lookout.

The Dry Ridge Trail offers breathtaking scenery "and a paradoxical delight for the botanist" (Mogensen 1982a). It is one of the first high elevation areas to bloom in the park and is an excellent place to conduct interpretive walks early in the season. Named because it is situated along an extremely dry, southfacing slope, it is exposed to high solar radiation and wind. This ridge has an unusual floristic combination of plant more characteristic of the alpine tundra and the lowlands of the dry interior. Plants typical of the transition zones between these two vegetation types are virtually absent, creating a botanical puzzle.

Edaphic and climatic forces working together are responsible for the unusual species composition. The rockiness of the ridge contributes to the kind of microhabitiats available to plants. Only about half the ridge is vegetated. High winds further harshen the conditions, and reduce the rate of soil accumulation. Round-leaved alumroot and cushion buckwheat are two of the species that are found on Dry Ridge are more typical of the Ponderosa Pine-Bunchgrass Zone. Spreading phlox, alp lily and western springbeauty are other common plants on Dry Ridge - these more typical of the Alpine Tundra Zone.

Typical of plants living in the Alpine Tundra Zone, most of the plants of Dry Ridge are perennials, many reproducing effectively by vegetative means. Of special interest along Dry Ridge is a _Dicentra_ called steer's head. This tiny and rare plant is found along the trail in some heavily disturbed portions.

Trees found below the ridge and to the south of the crest of Dry Ridge are lodgepole pine and Douglas-fir. Some of them krumholz by wind and drought. On the north facing slope where snow lingers longer, moister conditions prevail allowing conifers like lodgepole pine and spruce to grow, as well as moisture loving species such as pink mountain heather and mountain valerian.

About 100 m below the upper entrance to the Dry Ridge Trail and across the road, there is a small seepage area. Here, Rein Orchids, Grass of Parnassis, Pink Elephant's Head, Common red paintbrush, and mountainbells grow out of the mossy knolls. The unusual species composition likely arises from the combination of a nutrient-rich calcareous deposits in the soil along with the ample moisture supply. A complete floristic list for the area needs to be compiled, a preliminary one was compiled by Goward (1985) see table 9.

Table 10. A list of some of the conspicuous plants of the Dry Ridge Trail, Manning Provincial Park. Compiled by Goward (1985).

cut-leaved.fleabane	grouseberry
spreading phlox	Lyall's rockcress
.thread-leaved sandwort	swale desert-parsley
sulphur buckwheat	Geyer's desert-parsley
fan-leaved cinquefoil	Douglas-fir
spreading stonecrop	lodgepole pine
falsebox	heart-leaved arnica
wooly groundsel	Utah honeysuckle
lance-leaved stonecrop	wild strawberry
jacob's ladder	sickletop lousewort
'spotted saxifrage	birch-leaved spiraea
kinnikinnick	arctic lupine
small-flowered.penstemon'	common juniper
Rosy pussytoes	glacier lily
harsh paintbrush	steer's head
Sitka mountain-ash.	Bebb's willow
	pinegrass
	field pussytoes

Wildlife seen along the Dry Ridge Trail includes Clark's Nutcracker, common raven, gray jay, dark-eyed Junco, chipping and white-crowned sparrows and red-tailed hawks. Pika are found in the rock slopes opposite the lower areas and red squirrels and yellow-pine chipmunks are common.

3b. The ESSF Lower Subalpine Forest

Found at the lower elevations of this biogeoclimatic zone this is the major subzone found throughout the park. Characteristic species are engelmann spruce, subalpine fir and mountain hemlock. Shrubs found in this vegetation type include white rhododendrons, sitka mountain-ash, black huckleberry, oval-leaved huckleberry, grouseberry, dwarf huckleberry. Herbs found in forests of this type characteristically include queen's cup, bunchberry, rattlesnake plantain, twinflower, heart-leaved twayblade and several species of clubmoss.

A common seral stage in this zone are fire induced even-aged stands of lodgepole pine. For more information of this type of forest see sections on sections on succession, mountain pine beetle infestations.

Rein Orchid Trail

The Rein Orchid Trail, is located in the Engelmann Spruce-Subalpine Fir one. The Rein Orchid Trail is located on a silted-in beaver pond and the area experiences moist edaphic conditions.

The plant community here is made of species of moisture loving plants. The upper story here is dominated by subalpine fir and Engelmann spruce. The ground layer contains bunchberry, Queen's Cup, several pyrola and green and white rein orchid species, and twinflower. Middle story species include lush growth of white rhododendrons and trapper tea.

The diverse flora of the area around the Rein Orchid Trail suggests a rich soil; The area may still be used by beaver, with fresh scent mounds and runways 'being built in 1982 (Mogensen 1982c). Animals that can be found at the Rein Orchid Trail include western spotted frog, garter snake, marten, black bear, Northern Three-toed woodpecker, red-naped sapsucker,' Townsend's Warbler and Swainson's Thrush.

Strawberry Flats

Strawberry Flats is a unique area within the park as it contains floristic elements of coastal, interior and alpine habitats. Much of the following discussion is based on Mogensen (1982e). The charred, decaying logs and the few fire scarred trees that remain and abundance of Huckleberry and Lodgepole Pine are evidence of a fire that burned the area in the 1930's or 1940's.

Most of Strawberry Flats is covered in a single aged stand of lodgepole pine. This stand is quite dense and has a sparse middle story of Engelmann Spruce and Subalpine Fir. The lower story is composed of shade tolerant shrubs and herbs such as false box, grouseberry, kinnikinnick, and lupines.

This stand of lodgepole pine is interrupted by two meadow areas. These two depressional meadow areas have many species that are more typical of high elevation areas. Strawberry Flats has been called an "upside-down mountain" because of this vegetation pattern.

The reasons for this distribution of alpine plants are unclear, but a number of possibilities have been suggested.

Cold ponding is a phenomena of mountainous terrain where cold air, by merit of it's denser nature, drains down hill, occasionally collecting in depression areas. In some areas this has resulted in a double tree line - one at high elevations, one at valley bottom. This may be the case in Strawberry Flats, were cold air ponding could allow subalpine and alpine species to become established. For a more detailed explanation of cold air drainage and its effect on vegetation patterning see Arno (1984).

Another explanation for these open meadows of high floristic diversity lies in the wet nature of the meadow- after years of heavy snowfall an area of standing water can appear in the first meadow (Mogensen 1982e). There are several species of plants typical of wet areas present in the meadows of Strawberry Flats such as willow, mountain monkshood, mountain forget-me-not. This may have resulted'in a heavy turf layer and a high water table limiting the establishment of conifer seedlings.

Still another explanation could be the element .of chance involved in the establishment of the post-fire vegetation on the Flats. The wide variety' of species there could still be competing for space, light and nutrients. In the future competition and successional processes could lead to a much lower species richness..

Whatever the cause, Strawberry Flats contains at least 148 species of vascular plants - over one fifth of the species that are known to occur in the park, Some of the conspicuous plant species of the Strawberry Flats area are listed in Table 11. This results in a spectacular display of flowers during the summer months, especially July. In turn, this display attracts a wide array of pollinating insects - especially beetles and butterflies.

As one continues to walk westward along the trail at Strawberry Flats through the second meadow a area of heavy timber forms the western border - here forest species more typical of coastal forests can be found including amabalis fir, western hemlock, western red cedar, and western yew. Thus in a space of a 6 km stroll on even ground the park visitor can experience much of the flora of this rugged provincial park.

The area has been used for a variety of interpretive purposes and some of the suggested topics have included -fire ecology, butterfly watching, naming of plants, wet to dry microclimates, berry tasting, seed dispersal mechanisms (Mogensen 1982e).

Some of the mammals that may be visible at Strawberry Flats are black bear, lynx, coyote, yellow pine chipmunk, red squirrel, Cascades mantled ground-squirrel, .northern pocket-gopher, mule deer, pika, varying hare. Some of the birds that have been seen at Strawberry Flats are listed in Table 12. Besides its daytime attractiveness it is one of the best areas in the park to take groups owling (Fraser pers. obs.).

Table 11. Some Plants of the Strawberry Flats Area, Manning Provincial Park. From the list compiled by Goward and Chuang 1974, and modified with information from Fraser (pers. obs.) and Mogensen (1982e).

Nonvascular Plants
- Brachythecium sp.
- Bryum sp.
- Ceratodon purpureus
- Dicranum sp.
- juniper haircap moss
- Rhacomitrium lamiginosum

Ferns
- northern grape-fern

Conifers
- subalpine fir
- common juniper
- Engelmann spruce
- lodgepole pine
- western white pine
- Douglas-fir
- western hemlock

Grasses
- bentgrass sp
- alaska brome
- mountain hairgrass
- blue wildrye
- western fescue
- perennial ryegrass
- timothy
- spike trisetum

Sedges
- Hood's sedge
- small-winged sedge
- russet sedge
- Ross' sedge
- common spike-rush
- field woodrush
- queen's cup
- chocolate lily
- tiger lily
- false Solomon's-seal

Orchids
- Alaska rein-orchid
- northern twayblade

Willows & Cottonwoods
- black cottonwood
- Barclay's willow
- Scouler's willow

Buckwheats & Knotweeds
- sulphur buckwheat
- Douglas' knotweed
- broadleaved knotweed
- sour weed

Plantains
- ribwort plantain
- common plantain

Pinks
- thread-leaved sandwort
- big-leaf sandwort
- red sandspurry
- field chickweed

Buttercup Family
- mountain monkshood
- red columbine
- Lyall's anemone
- Menzies' larkspur
- little buttercup
- western meadowrue

Barberry Family
- creeping Oregon-grape

Mustard Family
- spreadingpod rockcress
- Drummond's rockcress
- littleleaf rockcress
- little western bittercress
- western tansymustard

Stonecrop Family
- spreading stonecrop
- lance-leaved stonecrop

Saxifrage Family
- five-stamened mitrewort
- three-toothed mitrewort
- brook saxifrage
- tall fringecup

Currants
- black gooseberry
- sticky currant

Rose Family
- saskatoon
- goatsbeard
- wild strawberry
- sticky cinquefoil
- graceful cinquefoil

continued next page...

Table 11. Some plants of the Strawberry Flats Area, Manning Provincial Park (continued).

Alders
- sitka alder

Pea Family
- broadleaf lupine

Stafftree Family
- Falsebox

Violets
- early blue violet
- roundleaf violet

Oleaster Family
- buffalo berry

Evening Primrose Family
- fireweed
- alpine willowherb
- smooth willowherb
- broad-leaved willowherb
- yellow willowherb
- Watson's willowherb

Parsley Family
- sharptooth angelica
- cow parsnip
- Brandegee's lomatium
- mountain sweet-cicely
- western sweet-cicely

Heath Family
- kinnikinnick
- prince's pine
- pink mountain-heather
- one-sided wintergreen
- dwarf blueberry
- black huckleberry
- grouseberry

Gentians
- northern gentian

Phlox Family
- pink twink
- scarlet gilia
- spreading phlox

Waterleaf Family
- bullhead waterleaf
- Fendler's waterleaf
- silverleaf phacelia

Borage Family
- many flowered stickseed
- small-flowered forget-me-not
- mountain forget-me-not

- bitter cherry
- birch-leaved spiraea
- nootka rose
- Sitka mountain-ash

Figwort Family
- harsh paintbrush
- common red paintbrush
- palish indian paintbrush
- small-flowered blue-eyed mary
- sickle-top lousewort
- wood betony
- small-flowered penstemon
- chelan penstemon
- thyme-leaved speedwell
- pink monkey-flower

Honeysuckle Fam'ily
- twinberry
- Utah honeysuckle
- red elderberry
- common snowberry
- twinflower

Valerians
- Sitka valerian

Bluebell Family
- common harebell

Daisy Family
- yarrow
- pearly everlasting'
- orange agoseris
- pale agoseris
- leafy aster
- Douglas' aster
- Parry's arnica
- mountain arnica
- heart-leaved .arnica
- Engelmann's aster
- racemose pussytoes
- Nuttall's pussytoes
- Michaux' mugwort
- edible thistle
- thread-leaved fleabane
- wooly 'eriophyllum
- white cudweed
- western hawkweed
- alpine meadow butterweed
- rayless mountain butterweed
- rayless alpine butterweed
- arrowleaved groundsel
- common dandelion

Table 12. A partial checklist to the Birds of Strawberry .Flats, Manning Provincial Park. Modified from Mogensen (1982e) and Fraser (pers. obs.).

Cooper's Hawk	Mountain Chickadee
Northern Goshawk	Boreal Chickadee
Red-tailed Hawk	Red-breasted Nuthatch
Golden Eagle	Brown Creeper
American Kestrel	Winter Wren
Merlin	Golden-crowned Kinglet
Spruce Grouse	Ruby-crowned Kinglet
Blue Grouse	Townsend's Solitaire
Spotted Sandpiper	Swainson's Thrush
Great Horned Owl	American Robin
Barred Owl	Varied Thrush
Northern Saw-whet Owl	Cedar Waxwing
Black Swift	Solitary Vireo
Calliope Humminqbird	Yellow-rumped Warbler
Rufous Hummingbird	Townsend's Warbler
Red-naped Sapsucker	MacGillivray's Warbler
Hairy Woodpecker	Chipping Sparrow
Three-toed Woodpecker	Western Tanager
Northerh Flicker	White-crowned Sparrow
Pileated Woodpecker	Dark-eyed Junco
Olive-sided Flycatcher	Pine Grosbeak
Western Wood-Pewee	Cassin's Finch
Willow Flycatcher	Red Crossbill
Tree Swallow	White-winqed Crossbill
Gray Jay	Pine Siskin
Steller's Jay	
American Crow	
Common Raven	

4. Interior Douglas Fir Zone-IDF Zone

In Manning Park this zone is found in the rain shadow of the Cascades, east of Allison Pass near Eastgate, north up along the lower portion of the Copper Creek drainage and also east of Whitworth Peak along the drainage of the Skagit River (Courtin et al. 1981 see Figure 3). For most park visitors only the portion along the highway near the Similkameen River is accessible. This zone is typified by having Douglas-fir as the climax species on mesic sites. At the east end of the park at low elevations there is an area contains some of the IDF zone indicator species such as False Box, Western Waxberry and Dwarf Juniper. This zone is typically dry, with between 35.9 and 56.5 cm of precipitation falling annually - 24-51% of this falling as snow.

Both open and closed forests characterize this zone. Ponderosa pine is a common seral species and Douglas-fir forms the climax species on mesic sites. In general it is believed that fire promotes grassland communities in this zone (Valentine et al. (1978).

In the park, the commonest soils of this zone are tend to be brunisols.

Table 13. The differentiating combination of species for. the Interior Douglas-fir Zone (Courtin et al. 1981).

dwarf juniper	nodding onion
interior Douglas-fir	showy aster
saskatoon	pinegrass
tall oregon grape	wolf lichen.
buffalo-berry	
birch-leaved-Spiraea	

In Manning Park the IDF is represented by two biogeoclimatic subzones - the Dry Western Montane Interior Douglas-fir Subzone (IDFd) along the Similkameen and the Subcontinental Interior Douglas-fir (IDFe) along the Skagit (Courtin et al. 1981).

McDiarmid Meadows

McDiarmid Meadows, at the eastern end of the park contains a plant community unlike any other in the park. Low levels of rain and snow fall prevent many species with high moisture requirements from growing there. Much of the following discussion is adapted from Mogensen (1982d).

It is likely that McDiarmid Meadow is partially natural, partially man made. The history of McDiarmid Meadows is outlined in Human History, Section D. 5. Homesteading.

Ground cover at McDiarmid meadows consists mainly of grasses and dry-adapted herbaceous plants such as lance-leaved sedum, pussytoes and meadow salsify. Along the edge of the Similkameen River regular flooding creates sites that are moist enough for willows, black cottonwood, columbian monkshood, sweet-cicely, and ladies tresses. It is one of the best areas in the park for the later species.

McDiarmid Meadows is a good area for viewing small rodents, deer and coyotes. The juxtaposition of riparian thicket and an open meadow creates a productive area for birders, with species like American Dipper; white-crowned and chipping sparrows; yellow, orange-crowned and McGillivray's, common nighthawks and swifts.

5. Alpine Tundra Zone (AT)

The biogeoclimatic zone at the highest elevations in the park is the Alpine Tundra Zone. The AT zone consists of treeless meadows, slopes, and windswept ridges at an elevation of 2250 m and above (Valentine et al. 1978). Increasing elevation roughly approximates increasing latitude in terms of climate and vegetation. Alpine and arctic vegetation tend to be very similar.

The Alpine Tundra Zone is a cold, windy, snowy environment with a very short growing season. Desiccating wind containing abrasive ice crystals which breaks and erodes plant tissue. Occasional krummholzed trees are found in protected areas above treeline. For more information on adaptations of plants for living in this environment see Section II D 1.

Table 14. The differentiating combination of species for the Alpine Tundra Zone (Courtin et al. 1981).

white mountain-heather	Drummond's rush
pink mountain-heather'	Parry's rush
yellow mountain-heather	alpine clubmoss
alpine pussytoes	spreading phlox
black alpine sedge	diverse-leaved cinquefoil
dunhead sedge	moss campion
slender hawkweed	

Much of the following discussion here is based on Wareing (1982a). There are two areas in Manning Provincial Park where true alpine tundra may be found: the top of the First Brother, and near the summit of Mount Frosty. Climatic and edaphic conditions in the Alpine Tundra are extremely harsh. Mean monthly temperatures are below 0 for 7-11 months of the year. Mean temperature of the warmest month is above 0 and below 10 C. These are only between 25 and 105 frost free days per year. Average precipitation in the alpine tundra zone is 280 cm per year - with 72-74% in snowfall.

In comparison to the much more widely distributed subalpine meadows in the park, alpine tundra has on average, twice the wind and half as long a growing season (Wareing 1982a).

The Alpine Tundra of Mt. Frosty and First Brother.

The soils of the tundra were originally parts of large rocks, boulders or the bedrock. Through mechanical weathering the rocks break down and eventually become a gravel called tolus. Fellfields form on flatter areas where the rocks have stabilized over a period of time. Fellfields (from Gaelic "fell" meaning stone) are just fields of stone with a little rudimentary soil.

Plants growing under these conditions must have the ability to withstand drought, high winds, intense solar radiation and extreme cold.

Floristically rich alpine meadows form on more protected level slopes. If enough soil can build up, and conditions are not too harsh, sedges, grasses and flowering plants gradually invade the meadows.

Alpine "meadows" occur under moister conditions on .flat or gently sloping topography where snow cover lasts the longest. Conspicuous species such as indian paintbrush, lupines, sitka valerian and anemones and arnicas.

Alpine heath communities, composed of mountain-heathers and crowberry are very common and occupy extensive areas.

Under the harshest conditions, in very windy conditions, at the highest elevations; or in areas where only bedrock, occurs only mosses and lichens can survive.

6. Montane Spruce Zone (MS)

The Montane Spruce Zone in Manning Park is restricted to small areas at mid-elevations (1300 -1950 m) on'the extreme east side of Manning Provincial Park. Engelmann Spruce is the climax species. Table 15 shows some of the species that characterizes the Montane Spruce Zone.

Table 15. Differentiating Combination of Species for the Montane Spruce Zone.

Engelmann spruce	heart-leaved arnica
lodgepole pine	pinegrass
trapper's tea	wood strawberry
Utah honeysuckle	twinflower
black gooseberry	arctic lupine
grouseberry	red-stemmed feathermoss

The Montane Spruce Biogeoclimatic Zone in Manning Park is represented by the Very Dry Montane Spruce subzone (MSc).

B. Energy Transfer, Cycles and Processes

1. Climate

The climate of Manning Park is strongly influenced by the Pacific Ocean. In general, the section west of the Cascade Divide is moist, and that east of the divide is drier. This basic pattern is modified by'altitude, aspect and slope., to produce the diverse array of conditions within the park. While this section describes each of these climatic factors (longitude, altitude, aspect, and slope) separately, it must be emphasized that the climate at a particular location results from the interaction of all of these factors, and others. For further details, consult Barry (1981), Chilton (1981), Hare and Thomas (1974) and Kendrew and Kerr (1951).

The east-west transition

Weather information for Manning Park is available only for Allison Pass, and actual east-west weather comparisons within the park are not possible. In this section, the basic trend is illustrated using four locations that roughly transect the Cascade range at the latitude of Manning Park. These locations are Vancouver, Hope, Allison Pass, and Princeton.

When warm Pacific air first reaches the west coast, it deposits much of its precipitation, and produces one of the mildest climates in Canada. The Pacific Ocean, with its warm Japan Current, is a strong moderating influence, largely because the ocean water temperature fluctuates little compared to that on the adjacent land. This produces the relatively mild temperatures in Vancouver during both summer and winter (Table 16). These winds are especially persistent in winter, when they push moist air onto the land, where most of the moisture falls as rain (Hare and Thomas 1974).

As the westerly air masses move inland, temperatures become slightly more extreme; Hope has warmer summers and cooler winters than Vancouver (Table 17). Hope's position at the base of the Cascade Range also produces greater amounts of precipitation.

Table 16. Temperature and precipitation statistics for Vancouver (UBC: 49 degrees 15' N, 123 degrees 15' W; 87 m) after Environment Canada (1982a).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Temperature (degrees C)													
Daily Max.	5	8	9	12	15	18	21	20	18	13	9	6	13
Daily Min.	1	3	3	5	8	11	13	13	11	8	4	2	7
Daily	3	5	6	9	12	15	17	17	14	10	6	4	10
Precipitation (mm)													
Rainfall	152	127	112	69	60	43	37	53	72	133	158	187	1203
Snowfall	21	6	4	0	0	0	0	0	0	0	3	21	55
Total	173	133	116	69	60	43	37	53	7.2	133	162	208	1258

Table 17. Temperature and precipitation statistics for Hope (49 degrees 22' N, 121 degrees 29' W; 39 m) after Environment Canada (1982a).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Temperature (degrees C)													
Daily Max.	3	7	10	15	19	21	24	34	21.	15	8	4	14
Daily Min.	-3	0	1	4	7	11	13	13	10	6	2	-1	5
Daily	0	3	6	9	13	16	19	18	16	10	5	2	10
Precipitation (mm)													
Rainfall	185	165	131	103	72	65	37	50	103	172	209	249	1540
Snowfall	82	31	16	1	0	0	0	0	0	0	17	46	193
Total	257	196	147	104	72	65	37	50	103	172	224	289	1716

It is the Cascade Mountains that produce the most dramatic climatic effects in the Manning Park region. Wet air masses shed much precipitation on the western slopes, resulting in the luxurious growth characteristic of the Coastal Western Hemlock Biogeoclimatic Zone (Table 3). Parts of this zone in Manning Park may receive more than double the annual precipitation of Hope; over '6 metres (19.7 feet) of precipitation per year .have. been recorded (Table 3).

At Allison Pass, at the crest of the Cascade range, the climate is still wet, but temperatures in both summer and winter are cooler (Table 18). Most af the precipitation at this location falls ,assnow.

Table 18. Temperature and precipitation statistics for Allison Pass (49 degrees 8' N, 120 degrees 50' W; 1341 m) after Environment Canada (1982a).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Temperature (degrees C)													
Daily Max.	-4	-1	2	6	11	15	20	19	15	8	0	-3	7
Daily Min.	-12	-10	-9	-5	-2	2	4	4	2	-2	-7	-10	-4
Daily	-8	-5	-4	1	5	8	12	12	8	3	-3	-7	2
Precipitation (mm)													
Rainfall	28	24	10	17	45	74	30	46	61	62	44	33	473
Snowfall	227	201	98	215	24	0	0	0	3	358	121	183	1431
Total	263	175	144	86	74	74	30	46	64	103	189	278	1525

The eastern side of the Cascade Range experiences a pronounced rainshadow effect. Less than one quarter of the precipitation that falls at Allison Pass .falls here, and temperatures are higher, particularly during the summer (Table 19).

Table 19. Temperature and precipitation statistics for Princeton (49 degrees 28' N, 120 degrees 31' W; 700 m) after Environment Canada (1982a).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Temperature (degrees C)													
Daily Max.	-4	2	7	14	19'	22	27	26	21	13	3	-2.	12
Daily Min.	-12	-8	-5	-1	3	7	9	8	5'	0	-5	-9	-1
Daily	-8	-3	1	7	11	15	18	17	13	7	-1	-6	6
Precipitation (mm)													
Rainfall	8	8	7	11	20	27	23	26	18	20	17	13	197
Snowfall	55	25	13	4	0	0	0	0	0	3	23	.45	168
Total	55	.30	19	15	21	27	23	26	18	23	38	53	355

Altitudinal Transition

It is difficult to separate the climatic 'effects of longitude from those caused by altitude, and the east-west transition described above is often disrupted by elevation. The main reason for altitudinal transitions in climate is the decrease in atmospheric pressure that occurs with increased elevation. As an example, a given volume of the atmosphere at the top of Mount Frosty (2,400 m) contains only about three-quarters of the air present in the same volume of the atmosphere at sea level (cf. Armstrong and Williams 1986). The fewer gas molecules 'are capable of holding less heat energy, and rising air cools at a rate of 1 degrees C for every 100 m increase in elevation. Because cool air can hold less moisture than warm air, precipitation usually results as moist air climbs in elevation. Barry (1981) provides a detailed description of the effects of mountains on weather and climate.

Table 20 illustrates the profound influence of altitude on the duration of the frost-free period each year. Frost-free period is a measure of the time available each year for active plant growth, and is an important factor limiting the distribution of many species of both plants and animals. It must be emphasized that altitude is not the only factor responsible for the differences evident in Table 5.

Table 20. Frost-free period information for Vancouver, Hope, Allison Pass and Princeton, from Environment Canada (1982b; 1983c).

	Vancouver (UBC)	Hope	Allison Pass	Princeton
Elevation (m)	87	39	1341	700
Average Frost-free Period (Days)	244	199	32	104
Longest Frost-free Period (Days.)	290	259	56	144
Shortest Frost-free Period (Days)	200	163	8	54
Degree-days > 0°C Per Year	3619	3559	1553	2767

Altitudinal transitions are evident throughout Manning Park. These are in part reflected in the vegetation of different Biogeoclimatic Zones outlined in Table 3.

Aspect and Slope

Aspect is the direction in which a particular hillside faces; slope is the angle of declination at which that hillside is tilted. Both of these factors combine to determine the amount of solar radiation that reaches the surface. Heat energy input from the sun strongly influences local climatic conditions. In general, south facing slopes receive the most solar radiation, and this input is maximal when the slope equals the sun's angle from the zenith point (Smith 1980). The zenith point is the highest position reached by the sun during its "travel" across the daytime sky. The result is that, at a latitude of 50 degrees N, a south facing slope tilted at a slope of 45 degrees received five times the solar radiation input per year than an equally tilted slope that faces north (Buffo et al. 1972). A south facing hillside tilted at an angle higher or lower than 45 degrees would receive slightly less solar energy input annually.

The influence of aspect and slope can be best seen in vegetation patterns. Examples are found in many of the park's river valleys. For instance.,the dry Ponderosa pine - bunchgrass communities of the south facing slope of the Sumallo River Valley near Skagit Bluffs contrast strongly with the wetter Douglas-fir community of the north facing slope opposite it. Because south-facing slopes are exposed to greater amounts of solar radiation, evaporation rates are higher. Therefore, while precipitation may not differ, the higher ground temperatures and higher evaporation rates on south facing slopes typically produces more mesic habitats. At higher elevations, an additional effect of aspect is visible in the position of the treeline: it is usually lower on north-facing slopes than on south-facing slopes.

It is possible to actually estimate the difference in solar energy input received by a particular location within the park, with the assistance of tables prepared by Buffo et al. (1972). This can be extremely valuable when interpreting the often striking differences in natural communities between two adjacent hillsides. Aspect can be measured with a compass, and slope can be roughly estimated by eye. (Error in slope determination is less critical than in aspect.) Then, consult Table 21 or Table 22 (whichever date is closest), and extrapolate the amount of direct solar radiation received. These tables also illustrate the strong seasonal differences in solar radiation.

Table 21. Daily values of direct solar radiation computed for selected slopes and aspects at 50 degrees north latitude, for December 22 (from Buffo et al. 1972). Units are Calories / cm / day.

	Aspect								
Slope (Degrees)	N	NNE NNW	NE NW	ENE WNW	E W	ESE WSW	SE SW	SSE SSW	S
0	105	105	105	105	105	105	105	105	105
15	3	12	34	67	104	145	179	203	211
30	0	0	5	44	105	175	241	287	303
45	0	0	1	35	106	195	286	351	373
60	0	0	0	30	102	204	311	391	419
75	0	0	0	25	95	200	316	404	436
90	0	0	0	19	84	181	299	390	423

Table 22.' Daily values of direct solar radiation computed for selected slopes and aspects at 50 degrees north latitude, for June 22 (from Buffo et al. 1972). Units are Calories / cm / day.

	Aspect.								
Slope (Degrees)	N	NNE NNW	NE NW	ENE WNW	E W	ESE WSW	SE SW	SSE SSW	S
0	830	830	830	830	830	830	830	830	830
15	762	765	773	788	807	824	835	842	845
30	642	648	666	712	758	792	807	809	807
45	470	487	536	626	695	733	742	733	726
60	282	304	427	539	617	649	643	614	599
75	156	214	341	453	524	544	518	468	441
90	109	160	268	364	419	422	376	301	262

Avalanches

The accumulation of precipitation in the form of snow is one of the most striking effects of Manning Park's climate. Snow' serves as an insulator, protecting many plant and animal species from extremes of temperature, and as a water storage unit, resulting in spring freshets and runoff cycles. It is also a highly complex material, taking on a variety of forms and properties. Under certain conditions, instability and movement of huge quantities of snow can occur, and soms parts of Manning Park are particularly prone to avalanches. The following is a brief description of the conditions that promote avalanches, based on Armstrong and Williams (1986), Barry (1981), Fraser (1978), U.S. Forest Service (1961) and UNESCO (1981).

When snow falls to the ground, it is subject to a number of changes. The first is compression: the weight of overlying snow compresses the snow underneath, increasing its density and compactness. Compact snow is strong, and therefore stable. However, within a layer of snow, a temperature gradient usually is created: the air trapped between snow particles closest to the ground is often much warmer than that at the surface. Just as warm air rises within the atmosphere, with its water vapour condensing to form clouds., so too does the warm air at the bottom of the snow pack rise. The water vapour within this rising air also condenses, forming ice crystals around the colder snow particles near the surface. This type of snow is called depth hoar, or sugar snow, and is one of the major causes of avalanches. This is because of the weak connections between snow particles, resulting in very low strength. In the absence of a temperature gradient, no such process occurs, and the resulting snow pack is often very cohesive.

Avalanches usually occur when a cohesive snow layer forms overtop of a weak layer. Usually slopes of between 30 and 50 degrees are optimum. Higher slopes do not allow sufficient snow layers to form; lower ones do not provide a sufficient gravitational pull to to start a slide. The weight of snow on a slope creates downward force or tension, often deforming it much as snow on a rooftop "slumps" to overhang the eaves. If this tension is suddenly released, a vertical break through the snow occurs, the weaker lower layer gives way, and an avalanche begins. Slab avalanches occur when the break spreads more or less horizontally across a slope; point avalanches begin at a single point, spreading out as the snow slides downwards. The former type usually involves much greater quantities of snow than the latter, and is usually more dangerous. The speed and weight of avalanching snow is one of nature's most destructive forces.

Avalanches are most common on slopes that face north, northeast, and east, because they usually have deeper, colder snow packs. They are also common on south to southeast facing slopes when fresh snow is exposed to strong morning sun, weakening the snow, causing it to creep downhill, and increasing tension; Such conditions may be behind the "avalanche hazard" designation given to the steep south facing slopes of the Lightning Creek Valley (Ministry of Environment Map 1988).

Many other factors influence the likelihood of an avalanche occurring. These include vegetation and other surface features, wind, rain, the rate of snowfall, and the depth of snow. See the above references for further details.

An important effect of avalanches on natural communities is on vegetation. In areas with infrequent avalanches, broken off treetops may testify to the force of such events.' In other areas, where avalanches are frequent, a characteristic community of avalanche-resistant species may take hold. Near the top of the avalanche chute, where prolonged snowmelt results in moist soils, species such as Indian hellebore, mountain vallerian, desert parsely, and various sedge species predominate. Avalanche lilies are also common. Closer to the bottom, flexible-stemmed woody plants such as alders, red-osier dogwood, and white-flowered rhododendron can thrive, as they are not easily broken off by cascading snow.

2. Physical, Chemical and Biological Cycles

Water cycles

The previous sections have described the amount and timing of precipitation within Manning Park. Of equal importance, however, is the movement of water once it falls as precipitation. While detailed investigations of the hydrologic cycles in Manning's major terrestrial communities have not been done, familiarity with certain basic processes should help in understanding water's flow through the system. The following brief discussion is based largely on Barbour et al. (1980) and Smith (1980).

Terrestrial vegetation actually prevents much of the water that falls as rain from reaching the soil. For example, mature coniferous forests may intercept as much as 20 percent of the summer rainfall; much of this is last back to the atmosphere through evaporation. The remainder runs down the trunks, or drips off the leaves, eventually reaching the ground. Once there, it may evaporate, but also soaks into the ground. Most of the soils of Manning Park have high infiltration rates., and water easily moves into the ground. But in times of high rainfall or rapid snowmelt, or in areas with thin, easily saturated soils, surface runoff can occur, and the water may be quickly lost to streams (see Section III B 1. for a description of water cycles within aquatic ecosystems). Surface runoff is particularly common on west-facing slopes in the Coastal Western Hemlock Zone, and on the thin soils of the Alpine Tundra.

Once water is in the ground, it moves downward via capillary action and gravity; gravity is also responsible for subsurface flow of groundwater towards nearby streams. Some of the soil water is intercepted by the roots of plants, and is carried upwards into the vegetation. Here, some of it is used for essential metabolic functions, including photosynthesis. Photosynthesis occurs in the leaves, and involves the exchange of atmospheric gases through tiny leaf pores (stomata). The loss of gaseous water through leaves is called evapotranspiration, and is one of the major inputs of water back into the atmosphere. Evapotranspiration rates are particularly high on hot days and under low relative humidity. This, combined with evaporation from the previously mentioned sources and from aquatic ecosystems, returns water to the atmosphere where it can once again fall as precipitation.

Nutrient cycles

Nitrogen: The cycling of nitrogen in most of Manning Park's terrestrial communities is relatively rapid, due to high rainfall and acidic soils. Nitrogen frequently becomes in short supply, therefore, and becomes a limiting factor for plant growth and species composition.

In its gaseous form, nitrogen is ubiquitous: almost 80 percent of our atmosphere is composed of .nitrogen(Smith 1980). But neither plants nor animals can use nitrogen in this form. Nitrogen is required for amino acids, which make up proteins and enzymes essential for life, and in order to use it, nitrogen must be in the form of ammonia or nitrate.

In terrestrial ecosystems, only certain types of bacteria are capable of converting nitrogen into its useable form. Some, like Clostridium, live freely in the soil, while others live in association with the roots of certain plants, most notably legumes, and a few other species of plants such as the alders, redstem ceanothus and and snowbrush, soopolalie and mountain avens. The gaseous nitrogen dissolved in water becomes fixed into ammonia or nitrate, and is then taken up by the roots of plants, and incorporated into their tissue. It then cycles through the food chain (see section 3. below). If soils are excessively acidic, as they are in coniferous forests because of the high acidity of the litter, nitrogen-fixing soil bacteria are unable to survive, and a nitrogen shortage may occur (see section 11 D 1.).

When dead organisms are broken down by decomposers such as fungi and bacteria, nitrogen contained in their tissues again becomes available in the soil for uptake by plants. Alternatively, it may pass into the aquatic ecosystem dissolved in groundwater or in surface runoff (see section III B 2. for the fate of nitrogen in the aquatic ecosystem). Thus in the Coastal Western Hemlock Zone, soils are low in nitrogen, as the high rainfall leaches much of this particulate nitrogen away.

Phosphorus: Phosphorus is also an essential nutrient, and is a much rarer element than nitrogen. The main reservoir of the earth's phosphorous is bedrock and other deposits; leaching by rainfall frees the phosphorus, making it available to natural ecosystems. It is usually present in the soil as phosphate, and in Manning Park's terrestrial ecosystems, it is probably not in short supply. It essentially cycles through the food chain (see section 3. below), and some of it enters the aquatic ecosystem (see section III B 2.).

Other: Other nutrients that cycle within terrestrial ecosystems include sulfur, sodium, calcium, and heavy metals such as iron and manganese. Consult Smith (1980) and others for further details on their particular roles.

In general, nutrients in coniferous forests cycle relatively slowly; this is largely because much of the nutrient supply is "tied up" in the trees. Usually very low levels are contained in understory vegetation, and fallen branches and needles comprise an important source of nutrients for other organisms.

Energy

Plants, Animals and Ecological Food Webs: The diverse terrestrial communities of Manning Park support an even more diverse web of interrelationships, and all organisms are somehow connected to each other via a complex food web. Space does not permit elaboration on even a few of these here; instead, a brief description of each of the major trophic levels (producer, herbivore, carnivore and decomposer) are summarized below.

In Manning Park's forested ecosystems, trees are by far the most important primary producers, and as with nutrients, most of the system's energy is held within them. Trees support a limited variety of grazers, however, and they tie up much of the available energy within their tissues. Although seedlings are grazed by some species such mule deer, mountain beaver and a large number of insects, it is primarily through litter fall (needles, leaves, branches), and when these trees die, that their energy becomes available for other organisms. Important exceptions are the seeds and fruit produced by many coniferous and deciduous tree species. Cones, berries, and nuts are essential resources for many'animals.

Woody shrubs and herbaceous perennial and annual species support a greater variety of herbivores than do, trees.. They support an array of species, from grizzly bears to ptarmigans to caterpillars. Recently burned areas, through the release of nutrients and the profusion of ground cover, provide an important .resource for many herbivores;' particularly large ungulates such as moose.

Other animals harvest plant resources of many kinds. Some of the more conspicuous herbivores of Manning Park, in addition to those mentioned above, include porcupines; pikas, squirrels and chipmunks, beavers, granivorous birds such as sparrows and finches, bees, butterflies, Mountain Pine Beetles, and a diverse array of other herbivorous insects and arthropods. Note that many of these species are not solely herbivorous; they also consume varying amounts of animal material. This is often a seasonal life history phenomenon: the nestlings of many granivorous birds, for example, eat primarily insects. Animals that regularly eat both plant and animal material are termed omnivores (e.g. black bears, deer mice).

The uppermost links in the ecological food web are the carnivores (or predators), and although they are less numerous (see below), they are often some of the most conspicuous members of Manning Park's natural communities. Examples include coyotes, weasels, shrews, bats, hawks, owls, warblers, snakes, lizards, adult frogs, salamanders, wasps, spiders and many other carnivorous insects and arthropods. Parasites such as wood ticks are special types of carnivores; they eat only part of their prey (which are called hosts in this type of interaction), and are analogous to grazers that eat only part of a plant.

Each of the above organisms is eventually consumed by scavengers and decomposers. Bacteria and fungi (e.g. mushrooms) are the most numerous of the decomposers, and are 'largely responsible for maintaining the soil layer in a form that is suitable for plant growth. Many organisms scavenge dead plant and animal matter; arthropods are probably the most important of these.

A central concept in ecological food webs is that as one progresses "up" from one trophic level to the next (e.g. when herbivores are eaten by carnivores) not all of the energy acquired by the lower level is recovered by the higher one. This is because energy is lost to the environment, primarily as heat, when organisms metabolize (e.g. when herbivores digest their food, excrete feces, and run away from predators). The end result is that only a fraction of the original energy harvested by plants in a community eventually is obtained by carnivores. Thus carnivores are usually the least abundant organisms, followed by herbivores and then producers. See Smith (1980) and other texts for further details on this subject.

C. Succession

1. Post-glacial Su'ccession

There is little record of the initial stages of succession immediately following the retreat of continental ice sheeets from the Manning Park area between 12,000 and 18,000 years ago. Pioneer species like lichens and mosses probably arrived first, and through time, sufficient dead organic material built up to allow colonization by rooted plants. Roots are important in the development of soil, as they penetrate the substrate, allowing water to seep through cracks. Freeze-thaw cycles are a major soil-producing process. With the further buildup of organic material, a more diverse community of plants (and also animals) became established. As climate warmed,. vegetation became established at lower elevations first, and then climbed in elevation.

The pattern of community succession within the past 12,000 years is closely tied to climatic changes. Evidence for such changes has been obtained from analysis of sediments for the presence of pollen. Pollen analysis is an extremely important and widely used tool for understanding vegetational and climatic succession. Assuming that a species' climatic tolerance has not changed recently, scientists can extrapolate past climatic conditions in a particular reqion, based on the presence of different types of pollen found in sediments there. Techniques such as radiocarbon dating are used to determine the time of deposition of particular pollen grains. For further information refer to Birks (1981), Clague (1981), Hansen (1955), Mathewes (1985) and references in Andrews (1985), Harington and Rice (1984), and Hills and Sangster (1980). Although the Manning Park area has. yet to be examined in any detail, the pattern for southern British Columbia is at least partly understood. The following summary is based largely on Mathewes (1985).

Around 12,000 years ago (possibly later east of the Cascade Divide), the effects of the last glaciation were still being felt in Manning Park. Forests dominated by lodgepole pine probably covered the lower elevations, but pioneer species such as balsam fir, spruce, alder, soopolalie and various ferns were present in some areas. From around 12,000 to 10,500 years ago, climate was probably cool and moist; mountain hemlock was a common species during this time, and subalpine to alpine conditions may have existed at even moderate elevations.

An abrupt climatic warming occurred at around 10,500 to 10,000 years ago, and Douglas-fir rapidly gained dominance on the coastal side of the Cascades; a dominance that has continued until today. Western hemlock and bracken also became established at this time, and the climate throughout southern B.C. was warmer and drier than it is today. East of the Divide, open meadow areas such as that in the Three Brothers area may have been more extensive than they are now.

Subsequent cooling and increased precipitation around 7,000 years ago probably allowed the expansion of species such as western hemlock and western red cedar. By around 4,500 to 3,000 years ago, climate and vegetation were probably much like they are today.

2. Forest Succession

Forest succession in Manning Park takes many different paths and takes place at a variety of rates. Section II outlines the major Biogeoclimatic Zones of the park. These Biogeoclimatic Zones are based on the expected climax species on a mesic (average) site. The Coastal Western Hemlock Zone therefore reflects an area of the park where Western Hemlock is expected to be the climax species in that area. A climax species is a species that is capable of reproduction in its own shade, and will eventually form the dominant tree species in all age classes. By knowing which zone you are in you can predict, at least on sites with average moisture, soil and aspect, the species that will eventually grow there given enough time.

For many areas of the park it is unlikely that they will ever succeed to the climax vegetation - edaphic conditions, fire, disturbance and animal activity all slow or alter expected successional trends.

In the ESSF Zone, for example, two vegetation types that tend to persist for a long period of time are the open subalpine meadows and dense "dog's hair" lodgepole pine - both of these are successional stages leading toward an Engelmann Spruce and Subalpine Fir stand. In both of these cases fire causes the stand to establish (see next section).

Successional patterns in Manning Park are complicated. Juxtaposition of many Biogeoclimatic Zones, complicated climate soil and bedrock patterns make generalizations difficult. More detailed descriptions of successional patterns in the forest types found in Manning Park can be found in Nuszdorfer and Klinka (in prep.) - Biogeoclimatic Units in the Vancouver Forest Region - Differentiating and Accessory Characteristics.

3. Fire Succession

Fires are an integral part of the natural history of Manning Park. Numerous fires have been recorded in the park (see Section III D 8 . and many of the plants that are found in the drier portions of the park have evolved strategies for coping with fires (see Section II D). Fires are important in slowing successional trends in Manning Park, opening areas up, increasing wildlife browse and visibility. As importantly, the floristic diversity of the park is dependant on fire in order to maintain open habitats. Several of the most important areas of the park for wildflower displays are in old burn areas (e.g. see descriptions on Dry Ridge Trail, Strawberry Flats, Blackwall Peak in section II A).

In many areas of the park there are only small areas of climax forest typical of the Biogeoclimatic Zone - early successional stages cover more area. In most of these cases, these are old burn areas, undergoing successional development. The areas of lodgepole pine in the valley floor are good example, many of these stands, under normal conditions would burn again before the stand matured to a Engelmann Spruce - Subalpine Forest (see the next section on the interaction of Eire, mountain pine beetle and lodgepole pine).

Early colonizers after fire vary from Biogeoclimatic Zone to Biogeoclimatic Zone, but some typical species and their post fire reproductive strategies are discussed in section II D 1. In the ESSF Zone, lodgepole pine is a common early successional species, in the IDF zone, ponderosa pine and aspen are common early post-fire species. Douglas-fir, red alder and western white pine are often found in the CWH zone after a fire.

Some edaphic conditions encourage frequent fires, dry ridge tops, south facing slopes, areas with sandy soil and the drier areas in the park are more prone to fire.

4. Mountain Pine Beetle Infestations

Life History.

The mountain pine beetle is the most serious enemy of mature pines in western Canada with estimates of 1.3 million cubic ft. of lumber killed annually in B.C. for the past 20 years by this beetle. As it is found in Manning Park it is important to understand the beetle and some of its implications. Much of the following description here is based on Safranyik et al. (1974) and Wood (1989).

The mountain pine beetle is native to western North America, occurring in western Canada throughout the range of ponderosa pine and in the southern most range of lodgepole pine. Mountain pine beetles have a one year life cycle. In the midsummer the female beetles core through the bark of suitable trees and construct egg galleries in the phloem. While the galleries are being established, chemical attractants are released by the female beetles. These chemicals attract other beetles causing an aggregation at the tree. A male will enter, mate with the female and then usually leave. The female continues gallery construction while starting to lay about 2 eggs/cm to a total of 60-80 eggs in the niches along the sides of the gallery. These eggs will hatch into larvae after 2 weeks, living on the cambium of the tree throughout the winter, completing four instars during this time. In the spring of the following year the mature larvae construct an oval chamber in which they pupate. About mid-July the mature beetles bore through the bark to the outside and fly to attack living trees. Thus the cycle continues.

Susceptible Trees and Situations

Lodgepole pine, western white pine and ponderosa pine are the major hosts of the mountain pine beetle. These will be the preferred hosts in a mixed conifer stand. During an outbreak any acceptable host may be attacked including Douglas-fir and spruce, although in these trees a brood rarely develops. Whitebark pine is rarely, if ever attacked.

The aqe of the pine stand is a reliable indication of susceptibility. Mountain pine beetles prefer trees 80+ years old for several reasons. These larger trees have thicker phloems, therefore are able to maintain or increase a beetle outbreak (Amman and Safranyik 1984). Older trees have a decreased ability to produce pitch while under attack from the beetles, unlike younger trees which will produce copious quantities of pitch aiding in resistance (Shrimpton 1978).

As would be expected, tree diameter is also an indicator of susceptibility. A general guide for lodgepole stands in Canada is that at 25 cm or greater average stand diameter, the stand is capable of supporting a progressively increasing epidemic, that is, the trees can support as many or more beetles that it takes to kill it (Shrimpton and Thompson 1983).

The elevation of a stand may influence susceptibility. Lower elevations have a more suitable climate for beetles resulting in the above factors more strongly influencing populations while at higher elevations the climate may be more.important.'to beetle population dynamics (Wood 1989).

There are weather conditions that tend to favour maximum survival of mountain pine beetles - and therefore maximum likelihood of an outbreak of the beetles. A moderately warm fall, a mild winter (> - 17.8 degrees C), moderate weather in the next spring and early summer followed by a hot, dry July and August are ideal weather conditions for the beetle (Reid 1963). Too warm a spring and summer (>43 degrees C) kills the beetles, too cool slows development.

Detection

The most noticeable damage usually shows up in May or June of the year following an attack. The foliage, starting at the crown, goes from green to yellow to yellow-brown to red-brown needles that will eventually drop off. These red-brown needles may stay on the tree for up to 3 years post-attack. In order to detect an attack earlier than the next year and to be certain whether or not it is beetle damage a ground survey done in late August and September is necessary. Boring dust or pitch tubes are indicative of beetle attack. Boring dust is red-brown and in bark crevices at the base of a tree. A pitch tube will form at a beetle entry hole, be 1/4 .to 1 inch in diameter and may be mixed with bar and wood borings. Infestations may be readily found if woodpeckers have removed bark in search of insects (Safranyck et al. 1974). Death of a tree is the usual result of an attack.

How Mountain Pine Beetles Kill Trees

The mountain pine beetle is a vector of a fungus which is more often than not the actual cause of tree mortality. Four types of fungi are consistently associated with the beetle - two of which will grow in the phloem and two mainly n the sapwood, the latter being the blue stain fungi (Robinson 1982). The fungi are dispersed and carried by the beetles through their galleries. The blue stain fungi will penetrate living cells in the phloem and sapwood, spreading vertically and radially throughout the tree. If successful in colonizing, the tree will be killed.

Mountain Pine Beetle in Manning Park

A large proportion of Manning Park is forested in older age class lodgepole pine forests that are mountain pine beetle susceptible. Fire suppression has led to an increase in the average age class of pine stands in British Columbia. Under natural conditions a fire would interrupt a lodgepole pine ecosystem at an average interval of less than 75 years (Horton 1953, Day 1972, Loope and Gruell 1973, Gabriel 1976, Tande 1979).

Most of the lodgepole pine in Manning Park are growing in mixed stands with Engelmann spruce and subalpine fir or with Douglas-fir, thereby reducing the risk of a serious outbreak (Wood 1989). Old age class pine stands are the major forest type along the Similkameen corridor between Eastgate and Allison Pass and along the Chuwanteen and Monument Creek drainages to the US border (Wood 1989).

As of winter 1988-1989, 300 trees were infested in the park area. This is a controllable number, placing the risk of an outbreak in the park as moderate.

Effect of an Outbreak

The visual importance of healthy trees has been the subject of several studies, all of which indicate that park visitors place a high value on trees for outdoor recreation. A survey by Walsh and Olienyk (1981) showed that with only 15% of the trees discoloured in a Colorado park, willingness to participate in recreational activities decreased by an average of 34.6%. During a beetle outbreak 90% of trees can be discoloured.

Dead and downed trees can directly inhibit the enjoyment of recreational areas by blocking trails and roads. Dead trees that are deemed hazardous have to be removed from campgrounds, picnic areas, parking lots and high usetrails, decreasing their aesthetic appeal.

Indirectly, a mountain pine beetle outbreak greatly increases the fire hazard by providing large quantities of fuel on the ground and snags that will ignite more readily than living trees if hit by lightning.

This is important to the park as a threat to visual and recreational values as well as from an economic viewpoint, as a threat to facilities. As the park is more intensely used the risk of fire increases, with a large fuel source from a beetle infestation the risk would be even greater. Given this scenario, forest closures would probably be invoked during the high-use summer season. The high-use areas in the park are in the pine forests of the Similkameen corridor.

A high intensity fire will favour forest regeneration to a lodgepole pine stand as the cones of lodgepole pine are serotinous (Lotan 1976). They also require mineral soil for germination and survival. Without a fire a lodgepole pine stand will succeed to a mixed-age Douglas-fir or Engelmann spruce - subalpine fir stand. This would virtually eliminate the chance of a mountain pine beetle infestation.

Management Strategies

The selection and deployment of a strategy to manage the possibility of mountain pine beetle outbreaks has to take into consideration the goals and policies of B.C. Parks and in this case, Manning Park. Wood (1989) outlines the options for control of mountain pine beetle in Manning Park.

Briefly, strategies include:

i. Direct control methods to suppress infestations. This means removinq or destroying live populations in order to protect remaining healthy trees.

ii. Conduct a study'to determine the feasibility of thinning the parks mature lodgepole pine stands, thereby decreasing the chance of beetle attack.

iii. If #ii is feasible, thin the stands with continued spot control.

iv. 'Cooperate with the Merritt Forest District to develop a "buffer zone" to commercial pine stands adjacent to Manning Park in the Merritt District.

D. Adaptations

1. Plant Adaptations

The following section covers a handful of the environmental conditions that terrestrial plants encounter in Manning Park.

Much of Manning Park is located in areas that are prone to forest fires. Fires can be regarded as a natural part of the ecosystems in the park. There are a number of strategies that plants can use to survive or recolonize an area after a fire.

a) Resistance: A number of plant species found in Manning Park survive Eire by simply being hard to ignite. Two of these are trees - Douglas-fir and Ponderosa pine both have thick heavy corky bark that is difficult to ignite. Mature trees often survive ground fires - often standing to produce a crop of seedlings that will recolonize the area quickly.

b) Survive underground: Fire often kills the top portion of many of the plants found in Manning Park, however they are able to survive moderate fires by having buds underground capable of regenerating after the fire. Aspen is one of the best examples of this type of fire strategy. Clones of aspen often get burnt, but manage to sprout up from the roots. It has been estimated that some of the aspen stands in the western part of the United States may have had their original seedling establishment as long ago as the Pleistocene - and that some clones in British Columbia may have been established shortly after the last ice age. Fire rejuvenates the stand - and may even be beneficial in reducing insect pests, stem and leaf diseases and removing fungal pests.

Other species that use this strategy are blueberries and grouseberry, roses, salmonberry, thimbleberry and many herbaceous plants.

c) Burn quickly: Some plants survive fires by burning quickly, letting the fire pass over the plant and leaving dormant buds n the unburnt stems; big sage is a good example of this type of adaptation.

d) Survive as Seeds: A number of Manning plant species survive fire by lying dormant in the ground as seeds. The most widely known example of this is Lodgepole pine, which, in some populations, has serotinous cones,

These cones open slowly over a long period of time unless they experience intense heat - such as that experienced during a forest fire. Under these conditions the cone opens in a matter of minutes (or even seconds) releasing seeds that can germinate and reestablish the species on the newly burned landscape. This is easily demonstrated in an interpretive program in a campfire or with a torch.

Other species, such as some of the Ceanothus species have seeds which can sit dormant in the forest litter for decades, waiting until intense heat weakens the seed coat and allows water to enter the seed stimulating seedling development and subsequent germination.

d) Colonize after the fire: Some species rely on long range seed dispersal to colonize an area after a fire. Species such as fireweed, willows, poplars and alders are characteristic of early successional stages in burn areas in some areas of Manning Park. Light, easily wind dispersed seeds allow these species to send seeds large distances - those fortunate enough to land in an area soon after a burn are those that colonize the area. These species tend to be shade intolerant - flourishing only where fire or some other disturbance has reduced competition for light, nutrients and water.

Adaptations to Acidic Soils

Much of Manning Park contains soils with characteristically low pH's. These acidic conditions are caused by high rainfall or at least high amounts of precipitation in relation to the amount of evaporation. Typically, podzols, a soil type found under coniferous and heather vegetation are very acidic with pH values of 3.6 - 5.2 They are typical of the Coastal Western Hemlock Zone, Interior Western Hemlock Zone, Engelmann Spruce-Subalpine Fir Zone and parts of the Alpine Tundra Zone.

Acidification is achieved in a number of ways; by removal of the bases through leaching, by withdrawal from solution of exchangeable cations, by the release of organic acid, which accumulates in the soil as a product of respiration and fermentation. Depending on the parent rock and the degree of saturation of adsorption complexes with cations, the soil is buffered to within a certain pH range (Larcher 1975).

The effect of pH on the availability of nutrients varies from nutrient to nutrient (see Figure 3). Under acidic conditions nitrogen, phosphorous, potassium, calcium, magnesium and sulfur are less soluble - and therefore less available for plant growth. Iron, and a few other nutrients, are more available under acidic conditions.

Members of the Ericaceae, the heather family, have long been known to form a variety of mycorrhizal associations. In these, there is penetration into the cells and tissues of the higher plants by the fungi, and also a considerable development of fungal filaments on the surface of the roots and in the nearby soil. Apparently, the mycorrhizal species of fungi that are associated with Ericaceae cannot tolerate alkaline conditions (Raven and Curtis 1970). Plants of this family, such as rhododendrons, huckleberries, blueberries, mountain-heathers, and wintergreens are almost exclusively found on acid soils.

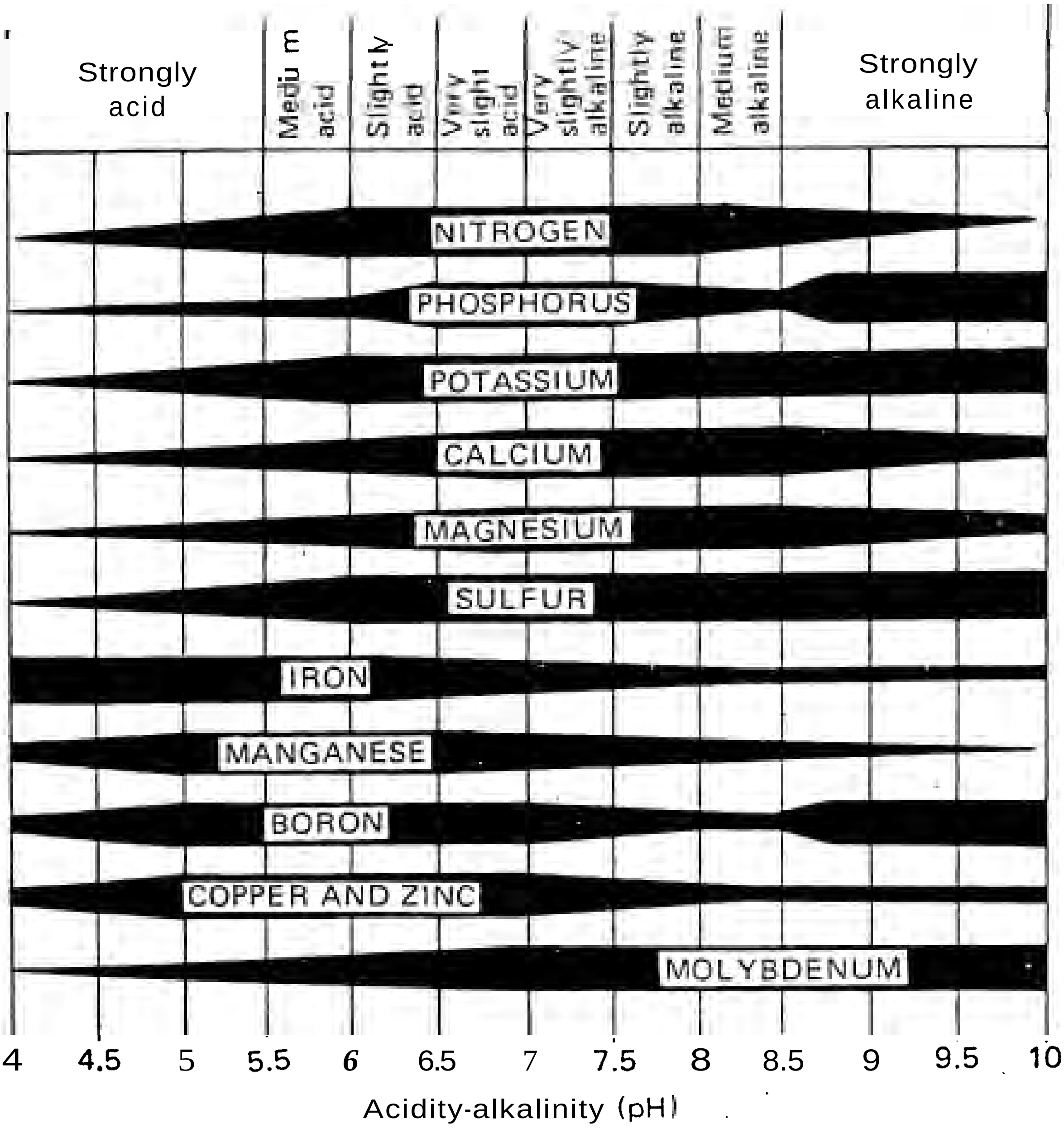


Figure 3. The effect of soil pH on nutrient availablity **(from** Bidwell **1979).**

Adaptations for Alpine Environments

The subalpine and alpine environments tend to experience high solar radiation; short, cold growing seasons; poor soil and high winds. High winds desiccate plants, remove nutrient rich detritus and soil fines, and carries abrasive grit and ice crystals. 'A readable discussion of the alpine environment can be found in Zwinger and Willard (1972).

These environmental characteristics have shaped the evolutionary pressures on high elevation plants, many taxa have responded in similar ways to these pressures so that some growth forms can be considered characteristic of alpine plants. Not all species exhibit all of these, but in general they tend to typify alpine plants. In comparison to lower elevation individuals of the same or closely related species, alpine plants tend to be:

- shorter
- slenderer
- less branched
- fewer flowering stems
- fewer and smaller leaved
- fewer flowered, but flower size remains the same.
- hairy, especially with clear or black hairs (or a mixture of the two).
- longer lived

Vegetative Reproduction:

Most high elevation species reproduce by both sexual and vegetative means. Alpine and subalpin'e environments are so harsh that successful flowering, pollination, seed set, dispersal and subsequent germination is a relatively rare event. Vegetative reproduction becomes an important means of sustaining and rejuvenating high elevation plants. Individuals at the highest elevations are likely to have started by an unusual seeding event that allowed establishment, subsequent survival has depended on vegetative reproduction. Annuals, (plants that overwinter as seeds), are rare to virtually absent in alpine environments, (Jackson 1985).

Multiple Year Flower Production

For many plants working at the highest elevations the process of initiating flower buds, cell division leading to a fully developed bud and subsequent flowering may be a long process. In most low elevation plants this process takes place in a single year or less. At high elevations however, this process may take one, two, three or even more years to complete (e.g. species of high elevation buttercups). Some plants may not even become free of snow cover each year. Favourable summers are few and far between and this is one of the adaptations that lets plants take advantage of them when they do come along.

Poor soil conditions and short growing seasons often mean that the age to first flowering can be 10-15 .years. It takes this long for enough food reserves to be present before flower bud initiation can take place.

Physiology:

One characteristic of high elevation environments is high solar radiation. Part of the radiation received on earth is ultraviolet. At low elevations most ultraviolet light is absorbed by th interbening atmosphere. On cloudless days, the intensity of direct ultraviolet light above treeline is about twice that at sealevel. Chlorophyll at high elevations can be damaged by these high ultraviolet levels. Natural filtration by epidermal pigmanets, such as the red and purple anthocyanin pigments can protect chlorophyll from break down.

This is why many alpine plants are reddish, especially in the early spring and the fall, when the red colour is not masked by the green chlorophyll pigments. (Chlorophyll production requires light, so newly emerged shoots often have very low levels of chlorophyll. In the fall chlorophyll production is shut down, again the red pigment shows through).

Hairs can serve in a similar way. Clear hairs block UV light and turn some light wavelengths into heat energy. In some plants a mixture of wooly white (clear) hairs are interspersed with black hairs that can store this heat.

Pollination Biology: Alpine plants have yet another hardship to face in that the harsh conditions in which they live. This environment is also harsh for pollinating insects. For same species, such as anemones, mountain avens and some buttercups, their parabolic shaped flowers turn to face the sun as it moves - by doing this they can keep the inside of their flowers - as well as their pollinators a full 10 degrees C warmer than the outside air. Warm pollinators are more active - much more capable of moving pollen from plant to plant.

Once a pollinator has left a flower, it must find another flower of the same species before the pollen load that it carries can be effective. This need for pollinators to be able to find flowers very quickly at high elevations has been suggested as the reason for alpine plants to maintain large blooms - even though the environment in which they live has dictated small stature in all other above ground portions of the plant.

On the few good days of each year where pollinating insects can move easily there is intense competition for pollinators - again a pressure favouring large and visible flowers.

2. Animal Adaptations

Animal Adaptations to Seasonal Environments

Many of the animals that live in Manning Park are subject to ,the rigours of snow, high winds, cold and fluctuating temperatures. This section will outline some of the ways that animals survive these conditions.

Hibernation in Mammals

Hibernation can be considered one of the ultimate forms of energy conservation for an organism. High body temperatures, characteristic of mammals are energetically expensive. During the winter months the resources are often not available to meet the high energy costs of maintaining body temperatures. This is especially true for animals that feed on seasonally available resources such as herbaceous forbs, berries, fruits and insects. In the fall hibernators will store large energy reserves in the form of fat deposits. Much of this discussion is adapted from Hainsworth (1981), Forsyth (1985), and Prosser (1973). A list of higher vertebrates that are found in Manning Park is presented in Table 23.

In order to make the most of these stored reserves significant changes occur in metabolism. Heart rate can decrease drastically: For example, an active jumping mouse will have a heart rate of 500-600 beats/minute but in deep hibernation the rate will be 30 beats/minute. Oxygen consumption will decrease to 5% of the amount required when active.

The decreased demand for oxygen uptake and delivery accompanies drastically reduced body temperatures. The big brown bat reduces its body temperature from 37 C to 5 C and its heart rate from 700 beats/minute to 10 beats/minute. The enzymes and hormones of these animals will adjust to function at lower temperatures.

Other changes in physiology take place. In some studies at least, kidney function changes - operating at a reduced rate. Often hibernators urinate very soon after arousal, indicating that periodic arousal may be necessary for waste elimination. Bears can go without urinating for at least 100 days. Apparently some hormones cause the urea in th urine to be reabsorbed and converted back into protein for the maintenance of muscle and other tissue.

Arousal from torpor requires alot of energy. It is important that the benefits of awakening exceed the costs. Small hibernators may arouse more often as they are not able to store as much energy internally relative to their rates of expenditures. These periodic arousals occur more often in the fall and spring when more food is available.

Table 23. Some Higher Vertebrates of Manning Provincial Park that Hibernate.

Long-toed Salamander	Northwestern Garter Snake
Tailed Frog	Silver-haired Bat
Western Toad	Big Brown Bat
Pacific Tree Frog	Yellow-bellied Marmot
Spotted Frog	Hoary Marmot
Red-legged Frog	Golden-mantled Ground Squirrel
Painted Turtle	Columbia Ground-squirrel
Rubber Boa	Grizzly Bear
Alligator Lizard	Black Bear
Western Terrestrial Garter Snake	Striped Skunk (partial dormancy)

There is some question whether or not bears actually hibernate. They will enter prolonged state of dormancy with a reduced metabolism. The heartbeat will drop from 40 to 10 beats/minute, oxygen consumption will cut to about half but body temperature will decrease only a few degrees. As a result a bear is much closer to an "active state" at all times. As a large animal, the bear is able to store more energy internally relative to their energy use. The energy requirement to raise the temperature of an animal the size of a bear after a period of torpor would be phenomenal. If a bear's temperature was decreased to 5 C (an average hibernating temperature) some 11,116,800 calories would be required for arousal!

Many hibernating mammals have increased deposits of fat cells called brown fat. This fat is particularly efficient in "non-shivering" heat production. The fat itself is at a higher temperature; and during arousal the vein that carries blood from the brown fat deposits dilate to carry larger quantities of the warmed blood to the heart.

Shivering also plays a part in "warming up", the energy. expended in shivering is partially used to provide heat.

A number of Manning's small mammals utilize the insulating properties of snow - living a subnivean existence through the winter months. This includes many of the voles, shrews and pocket gophers. Many of these are too small to efficiently hibernate - that is their body surface to mass ratio is too great for efficient hibernation. These small mammals are important in providing a food source to non hibernating carnivores (e.g. owls, weasels, marten, fisher, and coyotes).

Water during the winter months is an important consideration for these animals. Often the only source available is in the form of snow. Ice cold snow needs to be melted inside the 'body before it can be used, this is energetically inefficient. To offset this loss species such as the red-backed vole concentrates urine to conserve water, which in turn conserves heat, as warm urine carries heat away from the body as it is excreted.

Still another strategy that many mammals and a few species of birds use to survive the winter months 'is the hoarding of food. Some of the animals that use this strategy are listed in Table 24.

Other .Adaptations to Winter conditions

Migration: Many animals avoid winter conditions. in Manning Provincial Park by leaving the park. Long distance migrations are common in some bats (van Zyll de Jong 1985) and many birds (see Appendix 5). Elk migrate out of the high elevation summer areas to low elevation wintering areas outside the park. Many species of birds, and some other mammals, also migrate altitudinal, moving down during the winter months or during adverse weather conditions.

Adaptations for Snow: Deep snow presents another challenge to animals which remain active during the winter months. Animals like grouse, ptarmigan, snowshoe hare, lynx and wolverine have large surface areas to their feet. This provides a low mass to bearing surface ratio. The ungulates of Manning Park have high mass to bearing surface ratios, and in condition of heavy snow, animals, such as moose, will turn and face predators rather than trying to outrun them . Mule deer yard, packing the snow in areas where they concentrate, and along trails.

Ptarmigan, snowshoe hares, and weasels, change colour during the winter months, turning.white to match a snowy background. A few species, like fisher and some of the shrews turn darker during the winter months, presumably to take advantage of the heat absorptive properties of dark'colours.

Fur also can change in density during the winter months. Mammals get a thicker coat, for example the snowshoe hare's winter coat is 27% more insulative in winter than in summer. Partially this increased density is due to animals losing weight, with skins shrinking. A shrew can increase the density of hair by 31% due to this factor alone.

Table 24. List of birds and mammals occurring in Manning Park that are known to hoard food for use during the winter. The right-hand column contains foods that are typically stored for winter use, plus additional notes. Based largely on Ehrlich et al. (1988) and Forsyth (1985).

Species	Food Types and Caching Notes
Great Horned Owl	Mammals, birds (may sit on food, as if incubating, to thaw it prior to swallowing)
Boreal Owl	Mammals, birds
Northern Saw-whet Owl	Mammals, birds
Lewis' Woodpecker	Seeds (husks acorns prior to storage; defends stores in wintering areas, migrates out of Manning Prov. Park).
Hairy Woodpecker	Insects
Gray Jay	Seeds, meats and fats scavenged from winter kills, forms a bolus in throat and attaches wad to conifer branches -stored food permits early breeding season.
Steller's Jay	Pine and other seeds (on the ground or in elevated hollows)
Clark's Nutcracker	Pine seeds (see Section II D 2.) large throat pouches allow carrying quantities.
Black-billed Magpie	Seeds, insects, carrion
Common Raven	Carrion (often bury cache)
Chickadees	Conifer seed, insects, fat scraps.
Pika	Grasses (cut on adjacent meadows and dried on rocks in territory prior to underground storage; must defend hay piles from theft by other pikas)
Mountain Beaver	Grasses and other vegetation (may accumulate over a bushel of dried vegetation in underground chambers (see Appendix 7)
yellow-pine Chipmunk	Seeds (stores in a short underground burrow).

...cont.

Table 24. cont. Birds and Mammals that Hoard Food in Manning Pa'rk.

Townsend's Chipmunk	Seeds and other vegetation
Red Squirrel	Conifer cones (stores in a huge underground midden that may contain several bushels of cones; also stores seeds in tree hollows and dries fungi on branches prior to storage)
Douglas' Squirrel	Conifer cones, other seeds, fungi
.NorthernFlying Squirrel	Seeds, nuts (stores above ground in tree hollows)
Northern Pocket Gopher	Roots (store in extensive burrow systems; roots store well and are higher in carbo-hydrates than their summer diet of legumes and grasses)
Beaver	Tree bark, twigs (store underwater in tightly woven bundles)
Deer Mouse	Seeds - may store up to a gallon of small seeds (e.g. ragweed, conifer seeds., grasses)
Bushy-tailed Woodrat	Twigs and. other vegetation (dries in piles much like pikas; stores in large underground nests)
Heather vole	Woody vegetation, seeds
Meadow vole	Seeds and other vegetation
Weasels	Small stomach size (less than one ounce) means weasels must cache food items in order to eat every few hours.

Coevolution: Clark's Nutcracker and Whitebark Pine

When two species interact with each other, and evolve particular structure or behaviours because of the presence of the other species, coevolution is occurring. For example, predators evolve ways of capturing prey at the same time as prey evolve ways of avoiding being caught.

While many examples of this process can be found in Manning Park, a particularly striking one is the close-knit relationship between Clark's Nutcracker and Whitebark Pine. This interdependence is so strong that it is thought that Whitebark Pine may not be able to survive without Clark's Nutcrackers. the following discussion is based partly n Ehrlich et al. (1988); see Hutchins and Lanner (1982), Tomback (1980) and Vander Wall and Balda (1981) for further details.

Clark's Nutcrackers hoard seeds as a strategy for early. reproduction. By storing seeds in the fall, they are able to begin reproduction at their high-altitude breeding sites as early as February. (Gray Jays exhibit a similar strategy..) Nutcrackers have developed long, strong bills for prying pine seeds from their cones, and also have a special pouch under their tongue for storage during transport.

For their part, Whitebark Pines have developed seeds and cones of suitable shape and size, which they produce prior to the nutcracker's migration to lower elevations for the winter. The sticky seeds of the pine's cones may be difficult for squirrels to harvest, thus dissuading use by these mammalian seed predators. Another "anti-squirrel" adaptation may be the year-to-year variation in the number of cones produced. Trees in one area may have many cones in one year, then very few the next; squirrels are less mobile than nutcrackers and are not as able to depend on Whitebark Pine seeds year after year.

The seeds of Whitebark Pine are particularly large and nutritious - providing added incentive for the Clark's Nutcrackers. It is unlikely, however, that these seeds can be dispersed by wind and gravity, due to their weight.

A single nutcracker may store many thousand pine seeds in the fall, usually in shallow ground caches of up to several seeds each. Upon their return to the breeding grounds in late winter, they locate their caches by memory, using local landmarks such as rocks and trees. Not all caches are recovered, however, and those that are not raided by voles may result in new Whitebark Pine seedlings. While many other birds eat and even cache the seeds of their species, only Clark's Nutcrackers cache them in locations with conditions suitable for germination and growth. The loss of seeds eaten by nutcrackers is thus far outweighed by this species' assistance in the tree's reproduction.

The Lookout Area is an excellent area to view Clark's Nutcrackers.

Animals and Rockslides

Rockslide habitats are common in Manning Park, and are easily viewed along the trail to Nepopekum Falls, the Cascade Lookout, Blackwall Peak, the Cambie Creek Trail and at numerous areas along the roadsides.

These rockslide talus slopes are often in the form of colluvial fans at the bottom of unstable cliff faces, or are man made along roadcuts. They are often popular stopping spots because of the diurnal mammal fauna associated with them: pikas, Cascades mantled ground-squirrel, yellow-pine chipmunk and bushy tailed woodrat (packrat) are characteristic mammals. At the highest elevations of the park, talus slopes are the favourite nesting spots for Rosy-finches. Clark's Nutcrackers often cache seeds (and sandwiches) in rockslide areas. Some of the animals that are characteristic of these sites are outlined in the species accounts in Appendix 7.

3. The Cascades and Speciation - a Barrier and a Highway?

For many species of plants and animals the Cascade Mountain chain that forms the backbone of Manninq Provincial Park, acts as a barrier preventing the free flow of individuals (and therefore genes). Since the mountains themselves create very different ecological conditions this barrier also creates a different set of conditions that each population evolves in. In Manning the change from the moist mild coastal climate found in the western part of the park changes to the relatively cold climate in the central portion of the park and then changes again to the cold dry eastern section of the park.

Many plants and animals reach their western or eastern edge of their range in Manning Park, a few of these are listed in Table 25 and 26.

Table 25. Some Coastal Species Reaching the Eastern Edge of their Range in Manning Provincial Park.

Pacific Rhododendron	Pacific Jumping Mouse
Red-legged Frog	
Northwestern Garter Snake	
Red-breasted Sapsucker	
Mountain Beaver	
Townsend's Chipmunk	
Tailed Frog	
Shrew-mole	

Table 26. Some Interior Species Reaching the Western Edge of their Range in Manning Provincial Park.

Big Sage	Western Jumping Mouse
Ponderosa Pine	
Williamson's Sapsucker	
Red-naped Sapsuckers	
American Restart	
Columbia Ground Squirrel	
Yellow-pine Chipmunk	
Moose	

For many species of 'organisms, these different climates have led to enough evolutionary changes that separate species evolved on each side of the Cascades. Table 27 gives some examples of these species pairs.

In other cases, the changes between these populations are not enough to warrant the designation of different species, however, they are regarded as different, races, or subspecies. Some of the organisms that exhibit this taxonomic pattern are listed in Table 28. For more details o these subspecific diff rences see Hitchcock and Cronquist (1973) for plants, Carl et al. (1952) and Appendix 6 for mammals, Godfrey (1986) for birds.

Table 27. Some species pairs that have adjacent ranges in Manning Provincial Park.

Coastal Species,	Interior Species
Douglas' Squirrel	Red Squirrel
Townsend's Chipmunk	Yellow-pine Chipmunk
Red-breasted Sapsucker.	Red-naped Sapsucker
Pacific Jumping Mouse	Western Jumping Mouse

e

Table 28. Some of the species that have a coastal and an interior subspecies in Manning Provincial Park.

Douglas-fir	orange-crowned Warbler
Blue Grouse	Wilson's Warbler.
Ruffed Grouse	White-crowned Sparrow
Northern Pygmy-Owl	Red Crossbill
Northern,Flicker	Masked Shrew
Steller's Jay	Dusky Shrew
Black-capped Chickadee	Pika
Brown Creeper	Ermine
Golden-crowned Kinglet	Striped Skunk
American Robin	Bobcat.
Varied Thrush	Mule Deer

The Cascades Barrier has been recently overcome by some species however, and species such as yellow-bellied marmot, Columbia ground-squirrel, milkweed and gaillardia have moved across the Cascades into, or through' Manning Park within historical times. These species have been able to do this with the help of a manmade strip of open "interior-type" habitat afforded by the highway meridian. Yellow-bellied Marmot has used this route to colonize the park (moving up along the lookout road into the subalpine meadows) and eventually right through until it now reaches into North Vancouver. Milkweed is spreading as well, and can be seen along the highway and the road up to the lookout.

The Cascades also provide different habitats by merit of their elevation, and some species of animals have different ecotypes dependant on their elevation. Plants especially, have different genetically determined growth forms dependant on elevation. Some species of animals, such as Yellow-pine and Townsend's Chipmunk have high elevation and low elevation subspecies in Manning Park (see Appendix 5). Genetic differences exist in high and low elevation populations of ground-squirrels in some parts of North America, Columbia Ground-squirrels at high elevations have smaller litters than those at low elevations (Forsyth 1985). Given the short period of time that Columbia Ground-squirrels have been in Manning Park (Appendix 6.) it would be interesting to see if these differences have exhibited themselves here as well.

An detailed inventory of subspecies differences i n Manning Park would be a useful tool for interpretive programs.

The Cascades also have served as a highway for high elevation .species colonizing the park. From the south mountain loving species,such has Tweedy's Lewisia, silvercrown, dwarf mountain butterweed, Elmer's Butterweed, Indira swallowtail and.Cascade golden-mantled ground squirrel have moved north into British Columbia. Tweedy's Lewisia and silvercrown are known from British Columbia only by their Manning Provincial Park locations..

From the north, the high elevation habitats provided by the Cascades have allowed alpine and arctic species to move south and species like water pipit,' (grey-crowned) rosy-finch, northern hawk-owl, hoary marmot, and numerous alpine and arctic plant species follow the Cascades south into the United States through Manning Park.

III. FRESHWATER ECOSYSTEMS

A. Communities

The freshwater ecosystems of Manning Park are less well known than the terrestrial ecosystems, and information specific tp. the,park is sparse. The following discussion summarizes what is known, and includes more general information, extracted from the following sources: Cole (1983), Dymond (1932), Smith (1980), Stream Enhancement Research ,Committee (1980), Thompson (1984), 'Toews and Brownlee (1981), Weller (1981), Wetzel (1975), Whitton (1975), Wydosky and Whitney (1.979) and Zwinger and Willard (1972).

1. Lakes

Low Elevation Lakes

The only lakes of any size in Manning Park occupy mountain valleys, and include the Lightning Lakes Chain (including Lightning, Flash, Strike, and Thunder Lakes). Some of these lakes, particularly the first two, are heavily used by park visitors for picnics, swimming, camping, sport fishing, and other recreational activities. Surprisingly little, however, is known about the natural communities within this system. The following discussion summarizes what is known, supplemented by mare general information on the natural history of lakes in mountain valleys. The community of Twenty Minute Lake, just east of Lightning Lake is probably similar to those in the Lightning Lakes.

The morphology of the Lightning Creek Valley exerts a strong effect on the freshwater communities that occur there. The valley is "V"-shaped in cross-section, with steep walls (see Section I B 3 for further information on the geomorphology of this valley). A thick layer of sediments on the bottom of the valley (transported there by past glaciers and present tributary streams) has produced some areas of relatively shallow water that support marsh-like assemblages. Much of this has been destroyed by the damming of Lightning Lake in 1968 (see Human History). Overall, these lakes are still relatively shallow: L. Harris (1984) reported a depth of 9 metres (30 feet) for Flash Lake. The elevation is moderate, ranging from 1200 metres at Thunder Lake to 1250 metres at Lightning Lake proper.

The pH and nutrient conditions of these waters are virtually unknown. However, the clear, cold water probably contains relatively low levels of dissolved organic particles. This, combined with a rather depauperate plant component, likely contribute to somewhat low productivity. In a survey of the Lightning Lakes, Carl et al. (1952:126) reported that "Judging by plankton samples taken from two of these bodies of water they are not rich in production though fishing at times is good."

Some characteristic plant species of this lake system include partially submerged aquatics such as sedges, and submerged aquatics such as bladderwort and pondweed, and limnetic species such as duckweed.

Of the variety of animal species that occur in this system, the most apparent to the casual observer is the rainbow trout (see Information Sheet in Appendix 7). In the evening, 'the surface of Lightning Lake in particular is alive with the ripples of trout capturing insects.

The rainbow trout (also called Kamloops trout) is the only species of fish that occurs in these lakes. The population here is naturally occurring, and official records indicate that artificial stocking has not been done, although it is possible that some stocking occurred long age. Although the species is found in all five of the Lightning Lakes, angling success is .greatest in Lightning and Strike Lakes. Whether this is due to lower population sizes in Flash and Thunder Lakes is unknown.

Creel censuses have been conducted in the area, primarily in Lightning Lake proper, in an attempt to monitor changes in the number, size, and ago of trout captured by anglers. The most recent census (Sather 1982) reported that 287 rainbow trout captured in Lightning Lake in July 1982 ranged from 11 to 30 cm (4.5 to 12 in) in length, with a mean length of 21 cm (8.5 in). This is relatively small, compared to rainbow trout captured i most other areas. It has been suggested that the small size of trout (which has been noticed for at least 50 years) is caused by heavy fishing pressure, combined with high population density and limited food supply. It is likely that the small volume of relatively cold water in the lake results in low productivity; whether the trout are actually suffering a food shortage is unknown.

Not only are the rainbow trout in Lightning Lake small, but they appear to be relatively short lived. The creel census of Sather (1982) showed that of 49 fish captured in Lightning and Flash Lakes who age was determined, only 2 were over four years old (Table 29). Most of the fish captured were three years old, by which time they had reached a length of around 260 mm (10.3 in).

Table 29. Results of a creel census of rainbow trout conducted in July 1982 in Lightning and Flash Lakes by Sather (1982). The results are based on a sample of 49 fish.

Age Class (years)	Percentage of Fish	Mean Length of Fish (mm)
I+	5.7	127
II+	39.8	193
III+	53.7	262
IV+	0.8	305

The results of this census are biased, in that many anglers released fish that were less than 200 mm (8 in) in length (Sather 1982). Nonetheless, Sather felt that angling pressure prevented fish from living longer lives. It seems, however, that natural reproduction is sufficient to maintain the population at a fairly high level.

Other vertebrates that are commonly observed in the Lightning Lakes Chain include ducks (e.g. Mallard, Barrow's Goldeneye, Common Merganser), and semi-aquatic mammals such as mink and otter.

The aquatic invertebrate fauna of these lakes is relatively poor, possibly because of high predation levels by trout. Insects such as the larvae of damselflies and dragonflies, plus aquatic beetles and bugs may be captured in dip nets or by turning over submerged rocks and logs. Other invertebrates such as snails, leeches, and the occasional freshwater clam may also be found.

High Elevation Lakes

Several small, high elevation lakes occur within Manning Park, not all of which have been named. All of them occur at higher elevations, usually at the headwaters of mountain streams. Their community structure is therefore probably quite distinct from the Lightning Lakes discussed above. They are not accessable by road, and very little has been recorded concerning their natural history.

Poland Lake (1750 m) at the end of the Poland Lake Trail, and Nicomen Lake (1800 m) along the Grainger Creek Trail in the northern part of the park are excellent examples of high elevation lakes. An unnamed lake on Fourth Brother Mountain (1800 m), plus several other small mountain lakes at the headwaters of creeks, are probably similar. Some general characteristics of high elevation lakes may be found in Chamberlain and Karanka (1976) and Zwinger and Willard (1973).

Productivity is low, but can vary depending on the availability of nutrients in the, surrounding area.

Poland Lake was stocked with rainbow trout prior to 1956, but the population likely did not persist due to lack of suitable spawning areas (Spalding 1956). The size of approximately 35 fish sampled from this lake ranged from 9-29 cm (4.5 to 11.75 inches) in length (Spalding 1956), and they were in excellent health.

2. Ponds

The Beaver Pond

A major pond community within Manning Park occurs at the Beaver Pond, previously known as Windy Joe Pond, or Dead Lake. It is located beside the Similkameen River's main channel, just south of Highway 3 east of the Park Headquarters. The pond (which is' actually several connected bodies) was formed by dams built by beavers. The area surrounding the shallow, relatively calm water is one of the best places in the park to view wildlife (Alexander n.d.).

Some of the more notable flora here include bladderwort, a carnivorous plant, and duckweed, one of the world's smallest flowering plants. A detailed plant inventory of the Beaver Pond was not found.

Consult Carl et al. 1952'for a list of aquatic invertebrates that are found here. Buffam and Wade (1960) collected 42 varieties of invertebrates during June and July of one year; hundreds more could undoubtedly be found.

The aquatic and semi-aquatic vertebrates of'the Beaver Pond include mink, muskrats, Mallard, Barrow's Goldeneye, spotted frog, northwestern toad, and garter snakes. Although the' pond was created by beaver activity, beavers have been absent in some years during the past few decades. Spalding (1956) found that the peaks of beaver activity during the summer months were at around 6:00 AM and again at around 8:00 PM.

3. Rivers and Streams

Manning Park's most widespread freshwater habitats are its numerous rivers and streams, ranging from the relatively wide, slow moving Similkameen River to the many unnamed temporary mountain streams at higher altitudes. Fluvial communities hold enormous ,interpretive potential; potential that in Manning Park has been largely untapped.

The two main river systems in the park are the easterly-flowing Similkameen and the westerly-flowing Sumallo-Skagit (see Section I B 3 for physical descriptions). The conditions in these environments vary depending on numerous factors, including bottom structure, water velocity, temperature, nutrient content, and the degree of shading. The following discussion outlines what is known about stream communities within Manning Park, supplemented by information on the natural history of mountain streams in general.

Most fast-moving mountain streams can be roughly divided into two components: riffles and pools. Riffles are areas of fast, turbulent current caused by water moving over fallen trees, boulders, or outcrops of bedrock. Pools are usually deeper, with much slower moving water. The two stream components differ markedly in their community structure, with riffles being sites of higher productivity, and often with a more diverse array of organisms. Riffles offer particularly favourable microhabitats for animals; often as many as 50,000 insects per square metre occur in this oxygen- and food-rich environment (Toews and Brownlee 1981). Pools, on the other hand, are primary areas of decomposition, and are also important as resting places for fish.

An important component of the biological community in streams is organic drift. Drift is the primary food source of many animals, from filter feeding invertebrates to trout. It may be tiny food particles stirred up from the bottom or carried in from the land, or it may be organisms themselves that have fallen in or released their hold on the substrate. The amount of drift carried in the current varies at different times of the day, usually being greatest at night (Cole 1983). Often rapid temperature fluctuations cause large numbers of bottom organisms to dislodge themselves.

In general, the plant component of fluvial communities is sparse, owing to the difficulty of obtaining a firm hold in the current. Tiny plants such as diatoms and algae are frequently common in riffle areas, coating the rocks with a thin slippery film. These are usually the only submerged plants within the stream itself; the incidence of larger, rooted species is usually higher in areas of slower current.

While superficially these high energy environments appear to be devoid of animal life, closer inspection reveals a diverse array of exquisitely adapted creatures. See Section III D 2. for examples of animal adaptations to fast current habitats.

Invertebrates are common, especially under rocks in riffle areas. The larvae of insects (especially mayfly, stonefly, caddisfly, some beetles, and many types of flies, midges in particular) are the dominant group. Other invertebrates, such as amphipod crustaceans and leeches, may also be found.

This invertebrate fauna is exploited by two highly specialized bird species: the American Dipper and the Harlequin Duck (see Information Sheets in Appendix 7). The latter species is regularly seen foraging on the Sumallo and Similkameen Rivers (Carl et al. 1952), while the Dipper can also be found in smaller creeks. Both species forage underwater on aquatic insect larvae, and are probably one of that group's major large predators.

Tailed frogs (see Section III D 2.) are another characteristic resident of Manning Park's mountain streams.

Rainbow, Dolly Varden, and Cutthroat trout can all be found within Manning's rivers and streams; even the occasional Brook trout has been captured in the western reaches of the Sumallo (Harris 1984).

B. Energy Transfer, Cycles and Processes

1. Water Cycles

The movement of water into, within, and out of, the freshwater components of Manning Park's ecosystems is important to the many organisms inhabiting them. Water contains the food, nutrients, and other materials essential for aquatic life. The water bodies of Manning Park differ in the cycling of water through them, but certain basic processes are common to all. The following is a brief discussion of the water (hydrologic) cycle of rivers and lakes; for further details consult standard texts such as Wetzel (1975), Smith (1980) and Cole (1983). The entire process is closely linked to the water cycles in the terrestrial ecosystem; see section II B 2.

The entry of water into the freshwater system begins as rainfall falling to the ground. It is then drawn by gravity to the nearest stream or lake. In Manning Park, this movement is usually quite rapid, as the thin soil layer quickly becomes saturated. The underlying bedrock is a Barrier to downward movement of water, and flow is usually just below the surface of the soil, or even above the soil surface in times of heavy rain or rapid snowmelt.

The many mountain streams in Manning Park all contribute water to the larger rivers, and to the Lightning Lakes chain. Flow is generally rapid, especially in spring, due to the influx of water from melted snow. The water therefore remains here for a relatively short time. All rivers within the park ultimately connect with the Columbia River south of the border, then westward to the Pacific Ocean. Evaporation then returns water to the atmosphere, where it can once again fall onto the ground in Manning Park.

2. Nutrients

Nitrogen: Nitrogen is one of the nutrients that are essential for all life. Along with carbon, hydrogen, oxygen, sulphur, and phosphorus, it is indeed one of our most precious materials. Proteins, which are involved in many vital processes and structures, use nitrogen as their primary component; without adequate nitrogen levels life cannot continue. The nitrogen cycle with reference to terrestrial ecosystems has been described in section II B 2; readers should refer to that section for details not included here.

Nitrogen is provided to freshwater ecosystems in basically two ways: directly from the atmosphere in the form of rainfall, and from runoff over land. In Manning Park, the former route is particulary important, as the soils in this area are relatively nitrogen-poor. Nitrogen dissolves readily in water, and is rarely in short supply in rainwater. But most organisms cannot use nitrogen in the form in which it occurs in rainfall (two nitrogen molecules tightly bonded together). It must first be converted into a usable compound such as ammonia (nitrogen combined with hydrogen) or nitrate (nitrogen combined with oxygen). In'freshwater ecosystems, this process is accomplished almost exclusivevly by microscopic organisms such as bacteria and blue-green algae. Like the bacteria living in the roots of legume plants, these organisms possess the ability to break the bond holding the two nitrogen molecules together, and then combine them with either hydrogen or oxygen.

Once nitrogen has been converted into this useable form, it is absorbed by green algae and diatoms, and is taken up by the roots of aquatic plants such as pondweed, water lily, and emergent sedges and bulrushes. It then is cycled through the food chain, from herbivores to carnivores, and decomposers. Aquatic animals use the nitrogen for essential processes, in which it often ends up as a waste product that is excreted. Most aquatic animals, from water boatmen to rainbow trout, excrete nitrogen as ammonia, which is easily dissolved into the water. This ammonia can then be re-used by submerged plants, or it can revert to nitrogen gas that is returned to the atmosphere. See Figure 4 for a summary of the nitrogen cycle in an aquatic ecosystem such as Lightning Lake, and consult Wetzel (1976) and Cole (1983) for more details.

Phosphorus: Phosphorus, along with nitrogen, is another of the essential nurtrients required for life. It is a vital carrier of the energy used to fuel chemical reactions within cells, and is a component of DNA, the compound responsible for the genetic code (see terrestrial ecosystems for further details). Phosphorus is one of the rarest of the major nutrients, and is often a limiting factor in aquatic ecosystems. It is therefore one of the most frequently used measures of aquatic ecosystem "productivity": waters with low phosphorus levels are often considered unproductive, and vice versa. The relatively low productivity of the Lightning Lakes may be partly due to a phosphorus shortage.

The phosphorus that occurs in freshwater ecosystems arrives via surface and subsurface runoff from the surrounding soil (see Section II B 2. for details of the phosphorus cyle on land). It can take two forms: inorganic phosphorus or organic phosphorus.' The former form is usually phosphorus attatched to oxygen and either calcium or iron to form phosphate (which is important around the world as an agricultural fertilizer). Organic phosphorus is produced by plants and animals in the form of many different compounds.

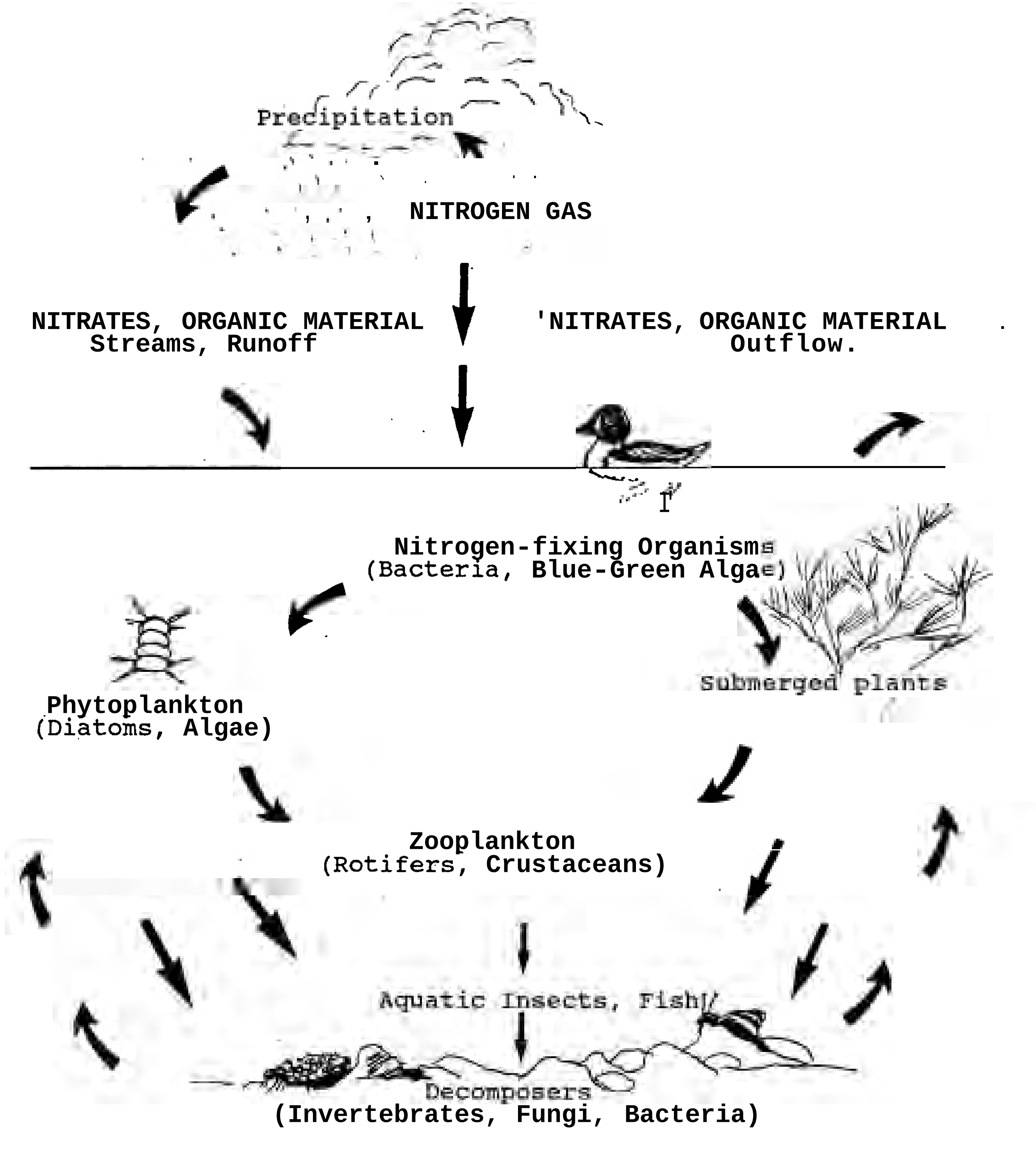


Figure 4. The nitrogen cycle in Lightning Lake.

Once in streams and lakes, phosphorus is rapidly assimilated by algae and other tiny plants of the phytoplankton. Then, as with nitrogen, it is passed through the food chain, to herbivores, carnivores and then decomosers. It is released back into the water via excretion by animals, and by bacterial decomposition of both dead animals and dead plants. The phosphorus cycle and the nitrogen cycles differ, however, in that phosphorus can become lost to the biological component of the system in the form of inorganic compounds deposited on the bottom. .Another . difference is the speed of the cycle: invertebrates of the zooplankton feeding on phytoplankton may excrete the eqivalent of their entire body's supply of phosphorus in a single day. This excreted phosphorus is taken back up by the phytoplankton, and the cycle continues. See Figure 5 for a summary of the phosphorus cycle in an aquatic ecosystem such as Lightning Lake, and consult Wetzel (1976) and Cole (1983) for more details.

Other: Phosphorus and nitrogen are by no means the only essential elements that cycle within the freshwater ecosystem. Others include iron, magnesium, silica, and many other trace elements and metals. Iron is particularly important for plant photosynthesis (see below for details); silica is needed for the hard outer skeleton of diatoms, abundant planktonic organisms.

Oxygen, too, cycles within the freshwater ecosystem. It is present in the atmosphere, and can dissolve directly into the water through the surface. It is also produced by aquatic plants as a product of photosynthesis, and released into the water where it readily dissolves. While some aquatic organisms, such as certain types of bacteria, can survive without oxygen, most require sufficient concentrations of dissolved oxygen to survive. In the mucky bottom of parts of the Beaver Pond, the decomposition of plant and animal matter uses up oxygen at a faster rate than it is produced. When that occurs, the only organisms that can survive are those that do not require oxygen for their vital metabolic functions. These microscopic bacteria release methane, which is the foul-smelling "swamp gas" familiar to many.

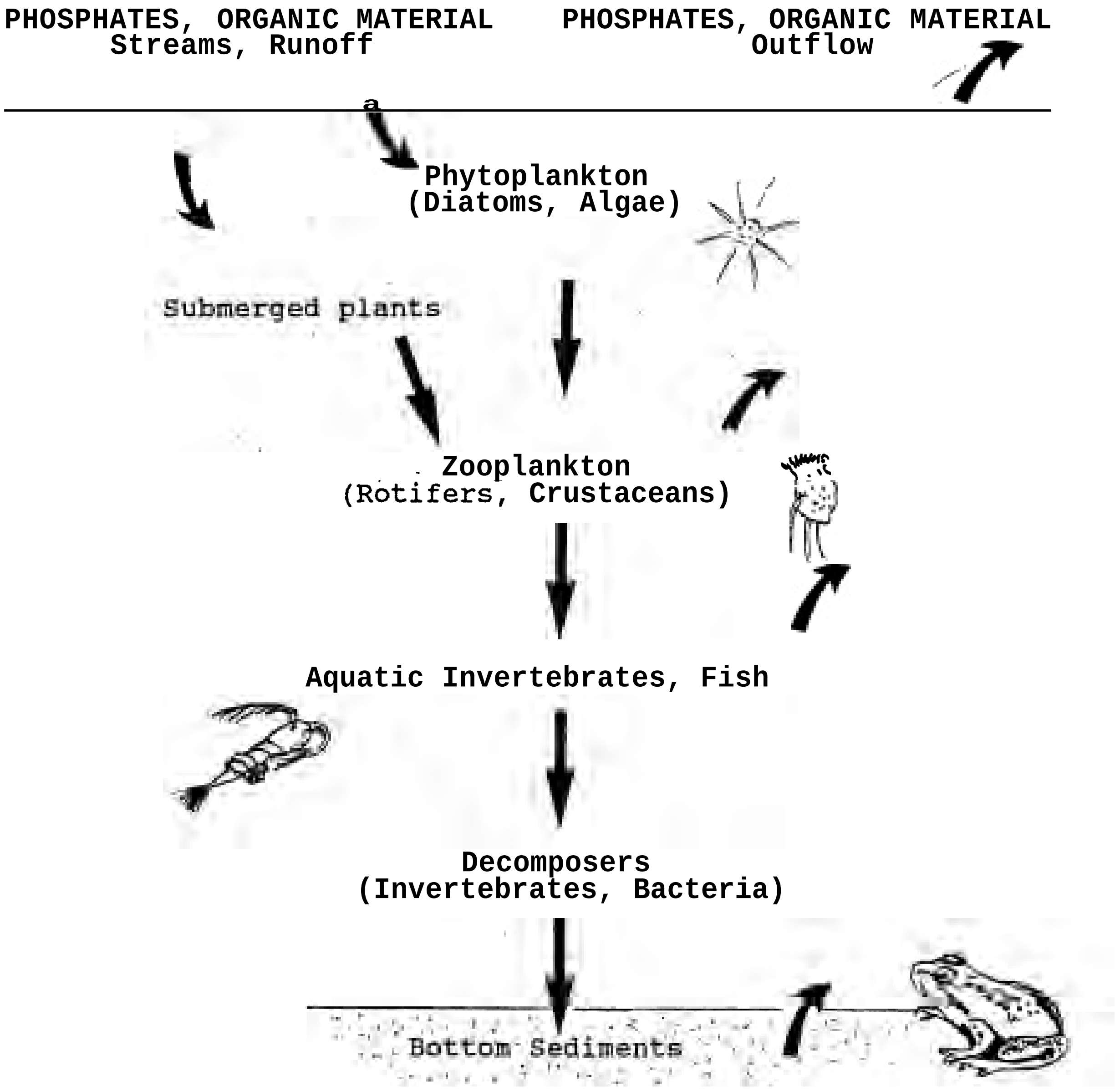


Figure 5. The phosphorus cycle in Lighting Lake.

3. Energy

Plants, Animals and Ecological Food Webs

The flow of energy through the freshwater ecosystem is perhaps the most important "cycle" of all. Starting with the sun's rays, and passing from plants to herbivores to predators and decomposers, energy is what keeps the entire system functioning. Some fascinating ecological relationships exist among the organisms of Manning Park's freshwater ecosystems, with species playing a unique role. The result is an intricate ecological web, in which all organisms are connected. An example of such a food web for Lightning Lake is illustrated in Figure 6.

In freshwater ecosystems, green algae are the most important primary'producersof food eaten by animals; indeed, in mountain streams they are often the only producers. In the larger water bodies such as the Lightning Lakes, submerged aquatics such as bladderwort also contribute to the "food base". Even more important than plants, however, in some systems, is the input of organic material (leaves, dead animals, etc.) from the terrestrial ecosystem. This is an important link between the two ecosystems, and is particularly vital in mountain streams where primary producers (green plants) are few.

The plants provide the food energy for aquatic herbivores such as microscopic zooplankton (e.g. rotifers, copepods), snails, and a number of aquatic insects such as water boatmen. The dead organic matter, or detritus, is consumed by the above animals plus a number of others: whirligig beetles and the aquatic larvae of many flying insects such as caddisflies, midges and mosquitoes are some examples. Many of these creatures possess interesting structures associated with their food-getting habits. For example, water boatmen have modified "feet", or tarsi, that aid it in scooping up material from the bottom. Some animals, such as snails are adept at grazing algae from rocks and fallen logs. Others, especially many aquatic insects are specialized as "shredders" of large pieces of vegetation (e.g. fallen leaves and needles) into pieces small enough to swallow. Thes animals are important converters of this material into energy that can be used by other members of the community.

The highest trophic level in the freshwater ecosystem is occupied by the predators, which include backswimmers, water striders, water scorpions, predacious diving beetles, the aquatic larvae of damselflies and dragonflies, trout, amphibians, plus many birds and some mammals. A mentioned earlier, the abundance of rainbow trout in Lightning Lake may account for the relatively low numbers of aquatic invertebrates. Adaptations for capturing and eating other animals are many: backswimmers are fierce predators with strong legs for grasping prey; water striders posess tiny hairs on their feet that detect vibrations caused by insects struggling on the surface; the hugely enlarged, hooked mouthparts of dragonfly larvae are extremely efficient grapples that can be shot forward to grasp passing animals, often larger

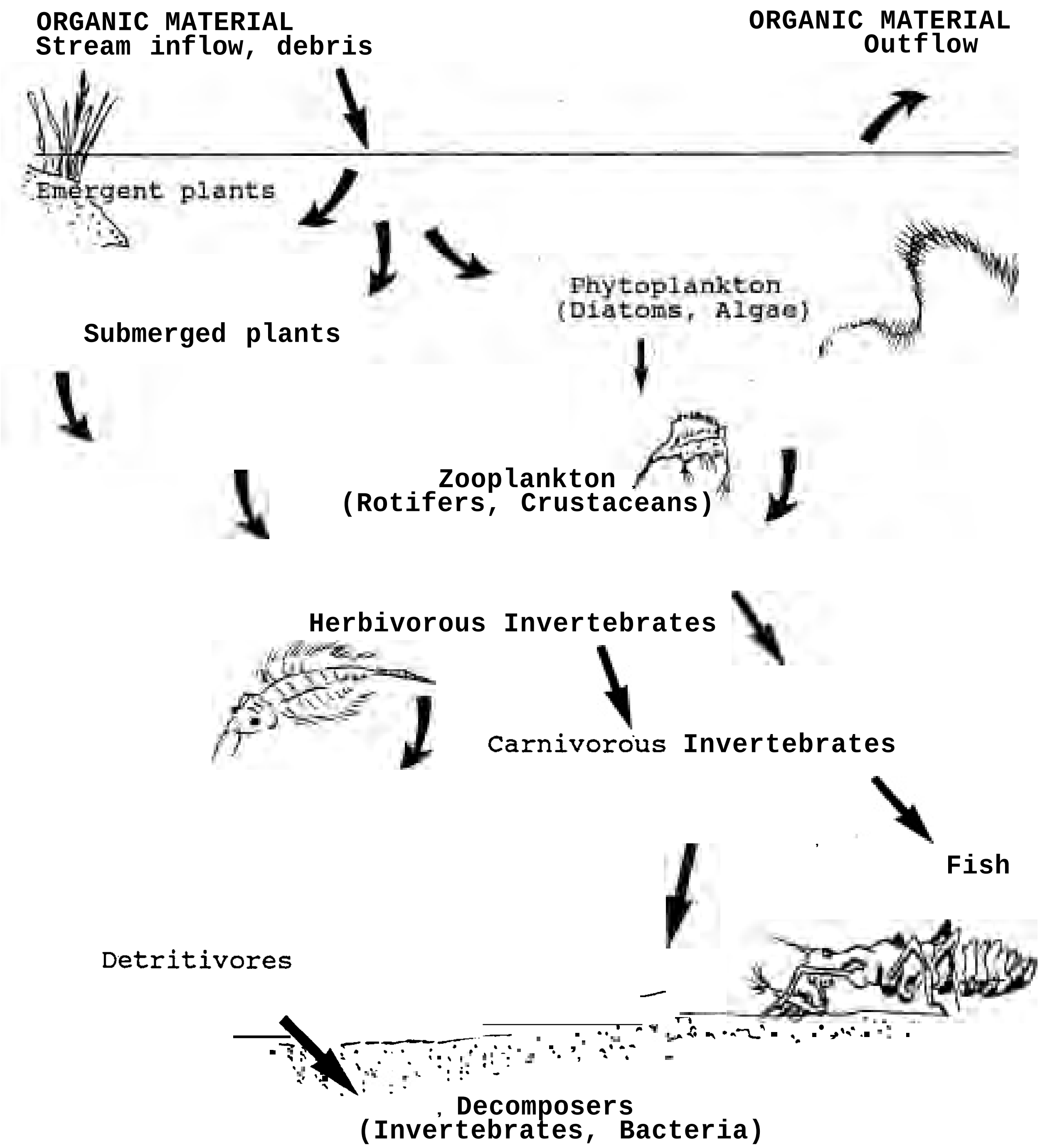


Figure 6. A hypothetical food web for Lightning Lake.

than themselves; and the larvae of predaceous diving beetles posess sickle-shaped mouthparts that'impale prey, allowing the captor to inject powerful digestive juices that dissolve the prey's body from the inside so that it can be sucked out.

C. Succession

1. Postglacial Succession'

The colonization of freshwater habitats following the retreat of glacial ice sheets some 16,000 years ago was probably rapid. Sediments washed into the valleys by glacial meltwater provided inorganic nutrients, providing suitable conditions for the probable first colonizers: phytoplankton such as diatoms and green algae. Invertebrates likely also arrived soon after the ice retreated. With the buildup of organic material within the water and on the surrounding land, aquatic macrophytes were able to take hold, and larger animals such as fish helped to shape the communities we see today.

2. Beaver Pond Succession

The construction of water control structures (dams) by beavers has profound effects on both aquatic and terrestrial communities. Higher water levels enhance conditions for some species, while making the environment unsuitable for others. The process of succession in beaver ponds is a case study example of succession in aquatic habitats in general.

Although the conditions of an area prior to colonization by beavers are variable, the common thread is a reliable source of water flowing through a primarily deciduous forest community, usually one in an early stage of succession (Forsyth 1985).

Upon arrival in the area, a colonizing beaver immediately starts work on a dam, usually in an area where the water channel is narrowest, thereby reducing the time and energy spent on construction. Beavers build dams that flood large areas of land for two reasons. First, it allows them to access an important food resource (trees) by swimming, rather than on foot. Beavers are rather clumsy on land, and are more vulnerable to predators such as bears. It is also easier to pull branches and trees in the water than it is to drag them along the ground. A second reason for the beaver's dam-building habit is that it provides them with a safe place to store food for use during the winter. Beavers build neatly interwoven caches of sticks and branches under the water, and they swim out from a hole in the floor Of their lodge to eat it, never having to go "outside" (above the ice, that is).

In any case, the result of damming is the death of flooding-intolerant trees and bushes. The dead remains of this vegetation, upon falling to the bottom of the newly formed pond, release valuable nutrients that are used by the newly forming aquatic plant community. In the deeper sections, plants such as water lily float their leaves on the surface while stretching their roots towards the bottom muck. sometimes these plants become sufficiently numerous to prevent light from reaching submerged plants such as milfoil. Their effect is to stabilize the bottom, and keep the water column itself relatively free of vegetation. Insects, particularly the larvae of caddisflies and midges, thrive on the mucky bottom, and numerous microscopic protozoans and bacteria become established within the ooze. the high rates of decomposition and relatively low levels of underwater plant activity generally result in oxygen-poor water that is not suitable for fish such as trout.

The pond margins become home to emergent plants such as sedges, bulrushes and arrowheads. Each species has a certain tolerance to being immersed in water; changes in the water level by as little as an inch up or down may kill off one species, allowing colonization by another. If beavers continuously increase the height of their dam, emergents have difficulty becoming established, and the pond margin remains relatively open. Usually, however, beavers maintain an extremely constant water level, allowing the creation of an extensive shoreline community. The habitat becomes home to amphibians such as the spotted frog, and marsh birds such as the Virginia Rail, Marsh Wren, Lincoln's Sparrow, Common Yellowthroat, and Redwinged Blackbird.

At the end of each summer, the stems and leaves of emergent vegetation die back. In time, the buildup of roots and dead organic material fills in the pond, and the area of open water decreases. Beavers usually attempt to keep this from occurring by removing bottom debris or raising the level of the dam. But eventually the trees in the surrounding area become depleted, and the beavers move to a new section of stream. As the bottom becomes exposed to the air, the rate of decomposition increases, and conditions become suitable for wet meadow species like mint, and some grasses. The pond becomes wet meadow, and ultimately, deciduous trees sprout and the community reverts to its original condition.

D. Adaptations

1. Plant Adaptations

Aquatic plants are relieved of many of the problems associated with water conservation encountered by plants growing in terrestrial habitats. However, living in a perpetually wet environment presents a whole new series of environmental constraints. Much of the following discussion is adapted from Brayshaw (1981). Some of these constraints are as follows:

i. Water movement can buckle, break or uproot plants. Water movement makes stem rigidity a disadvantage. Most aquatic plants have flexible stems and stem coverings that resist scouring.

ii. Oxygen and carbon dioxide are only moderately soluble in water - much less so than in air.. Pond, lake and bogs often have poorly aerated sediments -root's in aquatic plants are often particularly short of dissolved gases. Many aquatic plants use their roots only for anchorage, they work too ineffeciently to be useful in nutrient uptake.' Many aquatics have specialised cells that are hollow, designed to take gases down to waterlogged portions of the plant.

iii. Suspended solids in water often reduce light transmission levels to the point where plant growth is unsustainable. In these conditions plants that need light. to photosynthesis enough to grow to the surface cannot survive. Floating plants, such as duckweed, or plants with large storage organs (e.g. waterlilies) that can feed a light starved shoot are the only ones capable of utilizing such habitats.

iv. The unreliability of 'the amount of water in many systems presents a problem for the plant. For obvious reasons flood periods and drought periods present a whole new set of environmental hardships.. Some aquatic plants rely on birds to help them recolonize such ephemeral environments.

v. Insect and wind pollination is often severly disrupted by living in an aquatic environment. Highly modified reproductive systems are often seen in aquatic plants (see Brayshaw 1981 for details) - vegetative reproduction is an' important method of reproduction for many species.

vi. Few aquatic plants can use wind as a seed dispersal agent (cat-tails are a notable. exception).

2. Animal Adaptations

Adaptations to Fast-Moving Water

Invertebrates: Many invertebrate organisms in streams avoid. being swept away by the current by placing themselves in protected sites: in bottom sediments and gravel (e.g. midge larvae, nematode worms), on the "lee" side of rocks and boulders, or beneath submerged rocks and logs (e.g. blackfly larvae). The effect of these behaviours is to create "patches" of high invertebrate density in different parts of the stream. A random sample of bottom sediments that comes up devoid of life is therefore not neccessarily indicative of the entire stream.

Some invertebrates that inhabit riffles intentionally expose themselves to the current in order to harvest food particles in the passing water. Some of these inhabit a boundary layer immediately above the bottom substrate to prevent being washed downstream. Turbulence here creates a layer of'slightly slower water, often just a few millimetres .thick. Because this microhabitat is so thin, the animals that inhabit it must be small. In fact, within many groups of aquatic insects, particularly beetles, the average body size in fast water habitats is smaller than it is in slower waters (Cole 1983). Other invertebrates, such as some mayfly larvae, leeches, and flatworms, are also much flattened, which may further assist them in avoiding excessive current.

Some organisms, instead of attempting to avoid current, actually seek it. Many of these posess effective ways of holding themselves in position. The rear legs of mayfly and caddisfly larvae have well developed claws for grasping the substrate. The ventral (bottom) surface of some species of mayflies is roughened to form an adhesive pad, while net-winged midge larvae (Blephariceridae: presence in Manning Park not confirmed) have gone even further. They posess six suckers on their ventral surface, which help to hold on to smooth surfaces. Mountain midge larvae (Deuterophlebidae: presence in Manning Park not confirmed) have suckers as well, except they are located in pairs along each side of the body (Cole 1983). The larvae of blackflies have taken a somewhat different tack, having developed the ability to spin silken webs that stick to rocks. They cling to their web with claws located at the back of their body, and often reach upwards (or downwards if they are on the underside of a rock) to capture food particles passing by in the current. Some caddisfly larvae also spin webs, but they do so in order to capture passing food much in the manner os spiders on land. The main current adaptations of caddisflies are the cases they construct; these are often made of heavy material such as sand grains, small pebbles, or bits of shell, helping to anchor the animal on the bottom.

Perhaps the best examples of adaptation to fast-moving water occurs in one of Manning Park's most fascinating vertebrates, the tailed frog. These are inhabitants of mountain streams on the west side of the park, and their stream adaptations are summarized from Green and Campbell (1984).

The tadpoles of tailed frogs possess huge suckers under their heads, allowing them to cling to rocks in torrential currents. Their mouthparts are located in the center of this "ventral disk", with which they scrape algae and other plant material. Although they usually inch their way along a rock, they are aslo capable of swimming in short bursts.

Even as adults, tailed frogs display a variety of stream specializations. While most frog possess lungs, adult tailed frogs are practically lungless. The high oxygen levels in the well-aerated water currents allow them to meet their oxygen demands by respiring through their skin alone. During the. breeding season, male tailed frogs make no sounds as do most other frogs. Such sounds, which in other frogs serve to attract females, would be drowned out by the thundering of rushing water. Finally, tailed frogs practice internal fertilization, also unlike all but a few other frog species. The male's sperm is placed directly into the female's body with the help of his copulatory organ, or "tail". Were it simply released into the water, as in other frogs, the male's sperm would be quickly carried downstream and lost. Once fertilized, the female lays her eggs in long strings in a protected area such as under a rock.

Two bird' species, the Harlequin Duck and the American Dipper, also live in Manning Park's mountain streams. Both species obtain most of their food in fast flowing water, in which they are excellent swimmers. Dippers, it is said, can feed from the bottom of a stream in which the current is too strong for a person to stand, and are known to reach depths of 6 metres (20 feet) below the surface of deeper rivers (Ehrlich et al. 1988). They reach the bottom by flapping their wings, snatching up insects such as mayfly larvae, then bobbing back up to the surface. The plumage of dippers is soft and dense, trapping much air to increase buoyancy. Waterproofing is assisted by an unusually large oil gland at the base of the tail. Dippers can also close off their nostrils while swimming, and have a "third" eyelid that is transparent, protecting their eye from passing dirt underwater.

HUMAN HISTORY OF MANNING PROVINCIAL PARK

A. Original Inhabitants

Indian peoples may have first appeared in the southern interior of B.C. after the last northward retreat of glacial ice some 10,000 years ago (Ludowicz 1980). Archaeologists suggest that the Interior Salish subsistence and settlement pattern of the immediate prehistoric period is at least 3,000 years old in the region (Polotylo and Froese 1983). However, comparatively little archaeological research has been done to date on upland archaeological sites. Polotylo and Froese (1983), for example, note that most of our knowledge of southern interior archaeology is strongly biased towards one aspect of the annual round: winter village sites of the major riverine valleys. Activities carried out away from these sites are not well known to archaeologists. Undoubtedly, much more is yet to be discovered about prehistoric use of upland and mountain sites such as Manning Park and the Cascades Wilderness.

Manning Park and the immediately surrounding area is within the historical range of at least three Native ethno-linguistic groups (see Figure 7). Two of these, Thompson and Okanagan, are of the Interior subdivision of the Salish Language Family. The third, an Athapaskan-speaking group, formerly occupied an area centred in the Nicola Valley, but were assimilated by their Salishan neighbours during the 1800's. Only scanty ethnographic references to them remain (Teit 1900:167). A fourth, Coast Salish group of Halkomelem speakers may also have penetrated the area from the west. Other Salishan people from northwestern Washington, the Lushootseed, may also have entered the region through the Skagit Valley, since their range borders on the southern part of traditional Thompson territory.

The Similkameen Indians encountered by explorers and pioneers in the 1800's were apparently a mixture of Thompson and Okanagan Indians, with some Chilcotin background, as well (Ormsby 1976). During the 1860's they numbered around 300 and lived in the area between Hope and Okanagan Lake from the 49th parallel to about 45 miles north (Ormsby 1976:98).

It is unlikely that Indian peoples actually had permanent settlements within Manning Park or the Cascades Wilderness. Rather, these montane areas would have been a part of the extended range for these hunter-gatherers. The permanent winter villages of most of the region's Native inhabitants would have been at lower elevations to the north and east.

Winter villages.consisted of semisubterranean pit houses on alluvial benches. These are described in detail in several sources (cf. Teit 1900:192-194; Hill Tout 1978:58). They were generally built in the valleys of the principal rivers, within easy distance of water, and were inhabited during the winter months by groups of families related to each other,

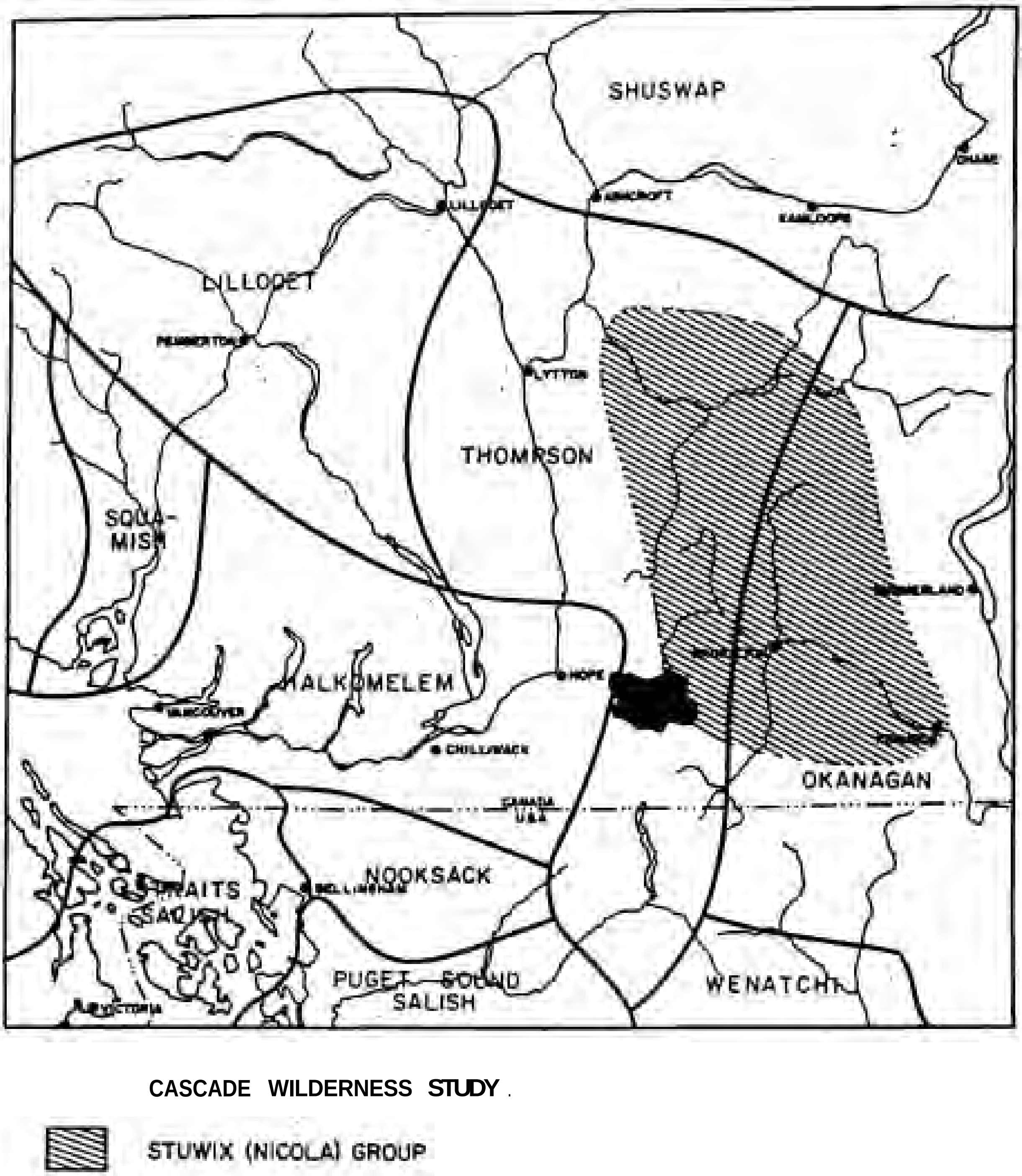


Figure 7. Indian ethno-linguistic areas in southwestern British Columbia. From CWS **1982.**

usually from 15 to 30 people per dwelling. Pithouses, or "kekuli-houses," as they were called in Chinook jargon, were usually clustered together in small groups; but sometimes they were single, and sometimes as many as 20 or more were built, in the same vicinity.

The pithouses were dug out with digging sticks, mostly by the women. Earth was removed in large baskets. Debarked timbers - usually lodgepole pine or Douglas-fir - were used for 'the supporting posts, the rafters, and the roof itself. They were lashed together with cordage from willow withes, silverberry bark, or some other plant material. The roofs were often covered with sheets of bark, such as red-cedar bark, then with a layer of dirt, A central hole in the roof allowed entrance to the house down a log with stair notches cut in it, and also provided an exit for the smoke from the fireplace in the centre. People slept on benches around the sides of the house, and often scaffolding was built around the upper part for storage of baskets of dried food and other goods.

From the winter villages, people dispersed in smaller family groups on their seasonal quests for food, materials, and medicines from the surroundinq lands. Usually this seasonal round involved visits to the rivers for salmon fishing, and two or more visits to upland areas for root digging, berry picking, and hunting. It was for these activities that Native people would have entered the Manning Park and Cascades Wilderness areas.

Few Native people travelled to the highest mountains of the area, except perhaps during sacred rites such as spirit quests by those seeking special supernatural powers. Mountain-tops were regarded with respect and awe, as indicated by the following statements about the Thompson belief system by Teit (1900:344):

> ...The stars, the dawn, mountains, trees, and and animals were all believed to be possessed of mysterious powers... It would seem that only the sun, the dawn of the day, the rain., tops of mountains, certain lakes, the spirit of sweat-bathing, and perhaps also the Old Man, can in any way be considered as tribal deities. All the others (including plants and animals) were guardian spirits that were individually acquired.
>
> Certain parts of the high mountains, especially peaks or hills, were considered sacred, being the residence of "land mysteries". Some of these places, when trodden upon by human foot, were always visited by snow or rain...
>
> The women, when picking berries or digging roots on certain mountains, always painted their faces red...that they be favored with good weather and good fishing...They (men) also did this to some of the mountain-peaks near their hunting grounds.

...Some of the first'berries picked each season were given as an offering to the earth, or more generally to the mountains...

...The Indians believe in the existence of a great many mysterious beings. The "land mysteries" are the spirits of mountain-peaks. In the lakes and at cascades live "water mysteries." Some of these appear in the form of men or women, grisly (sic) bears, fish of peculiar shape, etc., emerging from the water. Any person who may happen to see these apparitions will die shortly afterward'. The lakes and creeks in the high mountains to the west and south of Lytton are noted for being frequented by these mysteries. People passing within sight of these places always turn their faces away from them, lest they might. see an apparition, and die. Between three mountains near Foster's Bar a lake is situated in which strange mysteries may be seen, such as logs crossing the lake with dogs running backward and forward on them, canoes crossing without. occupants, and ice changing into people who run along the shore, all of which finally vanish. To see these is considered an evil omen.

A lake in the mountains near the country of the Coast tribes has never been known to freeze over, no matter how cold the weather, There is sometimes seen on its waters an apparition in the shape of a boat with oars, manned by Hudson Bay employees, dressed in dark-blue coats, shirts, and caps, and red sashes. They always appear at the same end of the lake, and row across to the other end, where they talk with one another in French. Then they row back as they came, and disappear. If four men are seen in the boat, it' is considered a good omen; but if eight men, the reverse is the'case, and the person seeing the apparition will become sick, or will die shortly afterward... .

Montane regions, including those of Manning. Park and Cascades Wilderness,. provided many, many important resources to Native people. Blacktail deer for meat and hides were hunted in this area, originally with bow and arrow and.snares. Prime deer were obtained in the fall when'the animals moved to lower elevations after a season's browsing in the high country. Anderson's Hudson' Bay Company expedition through the Tulameen River area encountered Indians in June 1946 checking their deer snares.

Several other mammals were hunted by native people in montane regions. Hoary marmot, or siffleur ("whistler") of the fur traders was sought for its fur, which produced warm blankets and sleeping robes (Cameron 1970), and also for its meat (Annie York, pers. comm. 1984). Black bear, mountain goat! elk, grizzly, beaver, and yellow-bellied marmot were all traditional game animals for the Thompson (Andrea Laforet, pers. comm. 1982). Porcupine, squirrel, and chipmunk were also eaten when nothing else was available, Voles and other small rodents were not usually eaten, but performed another service for Indian people, by accumulating caches of white-bark pine seeds, spring beauty corms, and other foods which women and children sought. These caches were greatly appreciated, and women seeking them usually underwent special observances, such as not eating on the morning before going to search for them. This was to show respect for the animals' "gift".

Birds that were hunted for food by the Thompson include at l'east two types of grouse, band-tailed pigeon, various types of duck, Canada goose, and swans, as well as sandhill crane from the Douglas Lake area.

Salmon and steelhead were obtained from some of the major streams and rivers, and were wind-dried, smoked, and valued for their roe and oil. A variety of smaller fish were sought from creeks and mountain lakes, including suckers, brook trout, squawfish, minnow, and peamouth chub (,Andrea Laforet, pers. comm. 1982). The Thompson believed that the presence of wild black currant along the edge of a lake or stream was a sure indication that fish could be found there.

Reptiles, amphibians, and insects were not eaten by Native. people of the area, and were, in some cases, regarded with abhorrence (Teit 1900).

Traditional plant foods from mountainous areas such as Manning Park and the Cascades Wilderness were many and varied. Information in the following discussion of plant resources is derived from Steedman. (1930), Turner, Bouchard and Kennedy (1981), Turner 1975, 1978, 1979, and Turner et al. (in press 1989). The listing is by no means complete, but is provided to show the rich diversity of plant resources utilized by Native peoples of the region.

Whereas men in most .cases did the hunting and fishing in Native societies, plant gathering was usally considered the job of women. Older children also contributed to this task. The importance of plants in the diets of hunter-gatherers such as those of the Columbia-Fraser Plateeau region has often been underrated. A recent re-evaluation by Hunn (1981) indicates that the contribution of plant resources, and hence of women, was substantial: "...the food-collecting societies of the southern half of the neighborhood of 70% of their food energy needs. from plant foods harvested by women" (p.132). Hunn's estimate pertains to the area just south of Thompson and Okanagan territory, but is probably valid for this region as well.

In early spring, the young stems of several plants were used as green vegetables: the shoots of thimbleberry, salmonberry, and blackcap, and the peeled leaf-stalks and flower.bud stalks of cow-parsnip, the inner part of fireweed shoots, the young shoots and budstalks of balsamroot, or spring sunflower, and the young greens of "Indian celery," or Indian consumption plant. The inner bark of certain trees, including ponderosa and lodgepole pines, was also sought in spring fro hillsides and lower mountain slopes. The trees were tested first to see if they were at the prie edible stage. Ponderosa pine was usually ready about two or' three weeks eaerlier than lodgepole pine. When the inner bark ws thick and juicy, the outer bark was remvoed from the trunk in a narrow, rectangular sheet and the edible inner tissue, sweet and resinous, was scraped off the wood into a container with a special implement. This was formerly a favourite food, but Forestry officials have discourages its use'in recent yers.

As the snows melted from the lower mountain slopes in May and June, some of the "root" foods were sought, before they came-into bloom. Primary edible "roots" of the region were the corms of spring beauty, or mountain potato, and yellow avalanche lily, or yellow erythronium. These were also available alter in the summer, after the plants had flowered. Other "root" reosurces were the bulbs of nodding wild onion, chocolate lily, and tiger lily, and the roots of balsamroot, wildthistles, and silverweed. Tiger lily bulbs are somewhat bitter and peppery, and were mainly used as a, condiment for soups and stews.

Several of these plants, including the avalanche lily corms, .wild onions, balsamroot, and thistles (as well as edible camas bulbs of the southern B.C. coast), contain as their priamry carbohydrate a long-chain sugar called <u>inulin</u> (cf. Turner and Kuhnlein 1983). This sugar is neither sweet nor very digestible for humans. Thus, to make them palatable and edible, they ahd to be specially processed by cooking for a long period of time in an underground pit, Pit-cooking allowed a break-down of the inulin to a sweet, digestible sugar, -<u>fructose</u>. These inulin foods, once cooked, were very sweet tasting and much more easily digested than the raw product. Another process that enhanced the conversion of inulin to fructose was evidently exposure to air of the harvested "roots". Some in particular--yellow valanche lily corms and nodding onion bulbs--were often left to "wilt" slightly before they were cooked. One native man (AP of Mount Currie) noted that he had observed grizzly bears, who relish the corms of yellow avalanche lily, digging them out and leaving them exposed to the air for several days before returning to eat them. This must have improved their taste and digestibility for the grizzly as it does for humans.

Pit-cooking roots was also an imporant proces sin preparing them for storage. After cooking, many fo the "roots" were spread out or strung on strings and dried for winter use or for trading. As archaeologists such as David Pokotylo (Pokotylo and Froese 1983) and Diana Alexander (pers. comm. 1987) hve been discovering, pit-cookign was a common activity of upland areas. Both pit-cooking and the drying of roots, berries, meat and fish was apparently done at or near the harvesting sites in the mountains. This would have been much easier and more practical, since the frsh foods would not keep well, and.would have been too heavy and bulky to pack any distance. One of the few known archaeological sites in Manning Park, near McDiarmid Meadows, contains a "cultural depression", which may be evidence of pit-cooking within the park.

By early summer, some of the edible fruits were beginning to ripen, and would have been sought by Native peoples in the lower reaches of the mountains. Saskatoon berries were among the earliest ripening, and in terms of quantities gathered, were probably the most important fruit. Mountain varieties could be picked into late summer. Other edible berries of the region include: wild rasberries, thimbleberries, blackcaps, wild strawberries (after which Strawberry Flats is ,undoubtedlynamed), choke cherries, red and blue elderberries (whose juice was used as a marinade for marmot and fish), wild gooseberries and currants of several species, high bush cranberries, and several species of wild huckleberries and blueberries. 'Fruits of kinnikinnick, red-osier dogwood, Oregon-grape, black hawthorn, .mountain ash, and false Solomon's-seal were also eaten by some people, but were not usually primary foods.

Of all the berries obtained in the mountains, one of the most appreciated is black huckleberry (cf. Hunn and Norton 1984). People generally go up'to pick them for a period of time in early to late August, depending on the location, and, formerly, sometimes stayed as long as two or three weeks, harvesting and processing them. Oval-leaved blueberry, red huckleberry, dwarf mountain hucklebery, Cascade blueberry, and grouseberry were also harvested. Spring beauty and yellow avalanche lily corms could also be dug at this time, and the men in the family would hunt for deer and other game.'

Soapberry, or soopollalie (Chinook jargon name), is a small, orange to reddish, transluscent berry that is extremely bitter, due to the presence of saponins, which are natural detergents. Soapberries were harvested in large quantities from the upland areas of Thompson and Okanagan country and whipped with water (and, more recently, sugar) to make a favourite confection called "Indian ice-cream". The berries, usually ripe during July, were harvested by placing a mat or container beneath a fruit-laden branch and hitting the base of the branch sharply with a stick; the ripe berries fall off onto the mat or container and can be quickly gathered. Special whippers, like dishmops, made from the inner bark of maple or silverberry, with a stick of the same material for a handle, were used to make "Indian ice-cream". It was served after meals or special feasts and parties, and is still a favorite with many Native people. Thompson people also consider it a "health food", good for colds, flu, and stomach problems,,and as a general "tonic". Since its use centers in the northern Interior Salish area, "Indian ice-cream" is truly a "British Columbia" food. The Thompson and Okanagan names for this confection stem for the term "to froth", or "to foam".

By the end of the summer, only some of the latest ripening fruits, such as choke cherry, blue elderberry, and highbush cranberry, remained to be picked. There were other important resources, however. One was the seeds of the whitebark pine.

Although the cones of this pine are small, its seeds are large-almost as large as those of the Southwest pinyon pines. The entire cones were usually picked from the trees, up near timberline, and were left to dry or roasted in the coals of a fire until the scales opened and the seeds could be extracted. These were then eaten right away or were stored for later use. Sometimes they were pounded to a powder and mixed with animal fat and dried berries (cf. Turner 1988).

Another food from' the mountains that was formerly very important, but is hardly known at all today, is the black tree lichen (Bryoria fremontii) (Turner 1977). Said to have been derived in mythical times from the hair braid of Coyote, it. was pulled from the branches of coniferous trees such as larch, and tied into large bundles or bales. It was then soaked and pounded to leach out the bitter-tasting, greenish lichen acidsm, and was pit-cooked,. sometimes with wile onions as flavoring. As with the inulin "root" foods, pit-cooking apparently broke down some of the complex, indigestible lichen carbohydrates into simpler, more digestible compounds. The pit-cooked lichen was eaten fresh, or dried in cakes or small fragments, to be soaked and cooked as a thickener for soups and stews later. When cooked, it has the appearance of black licorice, but is quite bland. Sometimes the juice of saskatoon berries.or other,fruits was added to it while it was dried. The lichen could be harvested.at virtually any time of year,. but it was usually obtained in late summer and early fall.

The mythical origin of black "tree hair" is given below, adapted from Mourning Dove (1933):

> Coyote and his son, Topkan, were travelling...They went along until they came to a large lake. Resting in the water were many sirnilkameen (white swans).. Coyote wanted one of those swans to eat, so he swam out into the lake. He kept ,underwater, but the swans were not fooled. 'They knew he was there.
>
> "Here comes Sinkalip!" they said. "See his tail floating! Let him catch a couple of us, and we will see what he will do."
>
> So. two of the younger swans allowed Coyote to catch them.. He carried them to.shore. They pretended to be dead. He tied them fast to Topkan. Then he climbed a pine tree to get the porcupine-gnawed pitch-top for fire-kindling.
>
> Just as he got to the.top of the tree, Coyote heard'his son crying. He looked down and saw the swans flapping their wings. They were starting to fly. Coyote jumped, but his long hair braid caught on a branch of the pine tree and did not come loose. Coyote swung there, helpless. He could'not untangle his hair.
>
> The swans flew past the tree, past Coyote, and up into the

sky. Dangling beneath them, tied to them by the thongs, was little Topkan. When the swans were high in the air they cut the thongs and Topkan fell to the ground and was killed (later to be brought back to life by Coyote). Then Coyote took his flint knife and chopped off his hair braid, and dropped to the earth. He looked up at his hair hanging from the branch.

"You shall not be wasted, my valuable hair. After this you shall be gathered by the people. The old women will make you into food," he said.

That was the Coyote's ruling near the Beginning. That is why his hair, the long, black timber-hair, hangs from the trees in the mountains. 'It is the black moss that people cook in pit-ovens.

A few types of wild mushrooms were harvested by Interior Salish peoples, and one of these in particular, the pine mushroom (Tricholoma magnivelare), was sought in upland forest areas, usually around October. Certain plants were also gathered to make teas: Trapper's tea and Labrador tea were both used, as will as the twigs and leaves of wild rose, and the leafy twigs of flat-topped spiraea. Kinnikinnick leaves were commonly toasted and used for smoking. Certain types of hard resin from coniferous trees such as larch and pine were chewed as gum.

Burning off hillsides and certain more restricted places was formerly practiced in many parts of British Columbia, including in the Interior Salish areas, as a means of habitat maintenance, to promote and sustain the growth of food plants such as spring beauty,' avalanche lily, tiger lily, blackcap, and huckleberries, and to produce better forage areas for deer and other game. For example, Hilda Austin, Thompson elder from Lytton, noted:

> (In the) olden days there was hardly any bushes, trees. The peoples burns, so the huckleberries can grow, blackcaps can grow...Nowadays the place is so bushy, just like it burns itself. Have to have men go and fight fires...

Annie York, Thompson elder of Spuzzum, described the burning over of blueberry patches:

> ...And when they're through picking around the edge of these little ponds (speaking about dwarf and Cascade blueberries.)..the bush begins to get kind of scruffy, kind of poor, so Uncle says, my grandfather says, "We're going to burn it." So they set fire to it, and then watched it burn around the lake. But they don't do it to everyone. They watch like this. So, one stays up there and everybody comes home. And, next day, after the fire went, it rains. And then that goes right out. That's what they do. Now you can go to Fozen Lake. Not the same. Because nobody does that, and you're not allowed to do it.

Aside from food resources, plants and animals from montane areas were also sought as materials in Native technology. Red-cedar roots were dug and tied in bundles, then split, and used to make the beautiful coiled root baskets for which the Thompson people in particular are famous. These coiled cedar-root baskets had an inner foundation of bundles of split root or cedar splints, and were decorated with intricate geometric patterns with grass stems and bitter cherry bark, both natural red and dyed black. The latter was produced by burying the bark in mucky, 'soil around the edge of a swamp for up to six months or more. Among the Lower Thompson especially, cedar wood was also used in construction, and cedar bark was used as well: the inner bark for clothing, mats and cordage, and sheets of bark for roofing and walls of houses. Sheets of other types of bark, including Engelmann spruce, white pine and subalpine fir, were also used,, both as roofing, and for making bark canoes and containers.

Woods were important as fuel, 'and also for making a variety of implements. As already mentioned, the wood of lodgepole pine was used in house construction. Rocky Mountain juniper wood was prized for bowmaking, and Rocky Mountain maple wood for snowshoe frames. Douglas-fir wood was used for dipnet poles and frames, and yew wood, when available, for bows, snowshoes and digging sticks. Oceanspray, or "ironwood", especially when hardened by baking in the embers of a fire, was an important material for making digging sticks and arrows. Saskatoon wood was .also used for these purposes.

Smoking and tanning hides required the use of special fuels, especially Rocky Mountain juniper, Douglas-fir bark and rotten wood, and pine cones. Tree fungus was also sometimes used in tanning. Fires were made traditionally by the drill-and-hearth method. Dry cottonwood root, willow root, pine and cedar, were all used as fire-kindling materials. Alder bark was used as a red dye, and Oregon-grape roots and wolf lichen for yellow dyes.

.Tree boughs also had special functions. Western Hemlock is called "scrubber-plant" in Thompson, because of the preferred use of its boughs to make scrubbing bundles for people in purification rituals, such as puberty rites or guarding spirit questing. Douglas-fir boughs were the most common material for lining and interspersing between layers of food in cooking pits, and were also used for bedding and flooring. The boughs of subalpine fir were prized for their fragrance, and were used as an incense and for bedding. Juniper boughs, probably due to their pungent odour and prickliness, were used for protection against sickness and death. They were burned as an incense. in the house of an ill or deceased person, or were boiled and the solution used as a wash by those handling sick people or corpses, or to cleanse the house, bedding and possessions of 'recently deceased people.

Cordage was made from a variety of materials. The bark and young branches, or withes, of willows (especially coyote willow), the inner bark of silverberry, and, where it was available, the branches and inner bark of red-cedar, were used for tying and binding, as well as for fish weirs. Vines of orange honeysuckle and white clematis were also sometimes used for tying. Spruce root, and the roots of other coniferous trees were also used. The stem fibre of Indian-hemp was a major material for twine and fish nets, and was widely traded throughout the southern interior. On the coastwards side, stinging nettle stem fibre was also used.

Cat-tail leaves and tule stems were used to make large mats, which were employed as mattresses, room dividers, and as the walls and roofs of temporary summer houses.

Tree pitch, of pine, or Douglas-fir, for example, was used for caulking and waterproofing. Even black tree lichen was used as a material--for making "shoes" and capes, and for chinking logs in cabins. Another important material from the mountains was "timbergrass" (pinegrass), which was used to make socks, for lining cooking pits, and for drying berries on, especially soapberries. This grass was often dried and stored with the soapberries, then, when they were reconstituted, used to "whip" the berries into "Indian ice-cream."

Many other plants found in Manning Park and the Cascade wilderness were used by Native peoples, and may well have been gathered or harvested from these areas for various purposes. Hundreds of different medicines used by the Thompson and Okanagan, for example, were made from plants. Some of these, such as Indian hellebore, baneberry, and water-hemlock, are highly toxic, and had to be used with extreme caution. According to some of the Native elders in the region, the only effective antidote to poisoning from Indian hellebore and water-hemlock is to give the victim salmon oil or salmon-head soup. Several accounts of accidental poisoning by these plants, and subsequent relief from administering salmon oil, have been provided by Native people, such as plant specialist Annie York of Spuzzum. Other plants believed to be poisonous are death camas, mountain bells (_Stenanthium occidentale_), and bog orchid.

Almost all the coniferous trees were used medically, most having many different applications (cf. Turner 1988). The pitch was especially valued as an external salve for skin ailments. Rocky Mountain juniper was well known as a diuretic, and was also used as a childbirth medicine and for high blood pressure and internal hemorrhaging. Western larch was also valued for its tonic properties, and the liquid oleoresin from the pitch blisters on the bark of young subalpine fir trees was taken for a variety of ailments, including tuberculosis, and cough and colds.

Some plants, especially those with attractive flowers such as red monkeyflower, red columbine, and larkspur, were used as charms to obtain good luck in gambling or love. Indian hellebore, well respected for its power as a poison and medicine, was also considered to be a good luck charm. People wanting special favours from it would go up into the mountains and find an Indian hellebore plant in a remote., unfrequented area, then bury a small piece of hair, or money, or anything symbolic of what was wanted, then pray to the plant, asking for its help.

Shrubby penstemon and Indian paintbrush were. both named "hummingbird's sucking substance." Penstemon stems and leaves were sometimes cooked together with wild onions; although they were not themselves eaten,, they were said to add flavoring. The attractive pink flower clusters of water knotweed were. sometimes used as fishing lures. Indian-pipe was called "wolf's urineH in Thompson, and was'believed to grow where wolves urinated. The hooked branching stems of Eriogonum were used by the Okanagan for a "wishbone" game. Mountain valerian was an important medicine for many different ailments. Young Thompson girls at puberty often braided headbands for themselves from the long stolons, or 'runners of wild strawberry. Trillium was revered as a special eye medicine; it was considered bad luck to pick, except by those. with serious intentions of using it as a medicine.. Rattlesnake plantain was used as a childbirth medicine, and also, the leaves were rubbed until they split apart, and the inner surfaces were used as a poultice for cuts and sores.

In all, over 300 different plants were used by the Thompson and Okanagan peoples, and many, if not most of these, occur within the boundaries of Manning Park and the Cascade Wilderness.

Natural resources were commonly traded by native peoples. Hazlenuts, oulachen grease, dried clams, and cedar products from the coast were exchanged.for dried saskatoons and soapberries, bitterroot, avalanche lily and spring beauty corms, dried salmon, and Indian-hemp fibre.' Teit (1900: 190) provides a list of exchange values for Indian-hemp "bark", including the following:

For 12 packages Indian-hemp bark:

1 pair cloth leggings with fringe ornamented with ribbons
1 second-hand Hudson Bay coat or shirt
1 dressed doeskin

For 5 packages Indian-hemp bark:

3 to 3 1/4 fathoms dentalia threaded on string
1 largest size cedar-root basket
2 salmon-skins full of salmon-oil
1 large dressed buckskin
1 Hudson Bay tomahawk
3 sticks salmon
1 copper kettle
1 old musket
1 steel trap
1 canoe

Indian trading expeditions across the Cascades were probably attempted only during the summer months, a's the higher mountain passes are completely snow free only during July and August. Three distinct trails in Manning Park and the Cascades Wilderness are known. The Skyline Trail (Figure 8), which is still in use today (see Appendix 10 for current status) begins in the Skagit River Valley at the mouth of the Skagit River at Ross Lake, near the present U.S. border. It passed up over the mountains south of Nepopekum Mountain, through Despair Pass, into the Lightning Creek Valley, and northeast across the Tulameen Plateau to the Princeton area. Today, the Skyline Trail is considered to be only the section between the Skagit River and Lightning Lake proper.

A second Indian trail, across the Tulameen plateau within the present-day Cascade Wilderness, was known as Blackeye's Trail, after Blackeye, a "respected Indian Chief" living near Tulameen (OSPS 1982). A third, used by Interior Indians on horseback, was known to Joe Hilton, a long-time trapper in the Manninq Park area (Hilton 1980). It ran along the Three Brothers mountain range into Copper Creek and out at Kennedy Lake, and was worn a foot deep in places (Hilton 1980), suggesting intensive use. Teit (1928: 252) proposed that the arrival of the horse in the early 1800's greatly increased Indian trade 'across the Cascades.

There are also three known archaeological sites (Collins and Joyce (1'977) of Indian origin in Manning Park. The first (B.C. Archaeological Site number DgRe 1) is located on the west side of the Similkameen River across from Coldspring Campground. This site contained two arrow heads, scrapers, and the remnants of other tools; it possibly represents a summer hunting camp. A second site is located on the north side of the Similkameen River at McDiarmid Meadows. It contained chipping remnants, scrapers, and a "cultural depression", possibly a firepit. The third site is just east of the park's present boundary, north of the Similkameen River a t its junction with the Pasayten River; it contained fire-cracked rock, chipped rock fragments, and bone.'

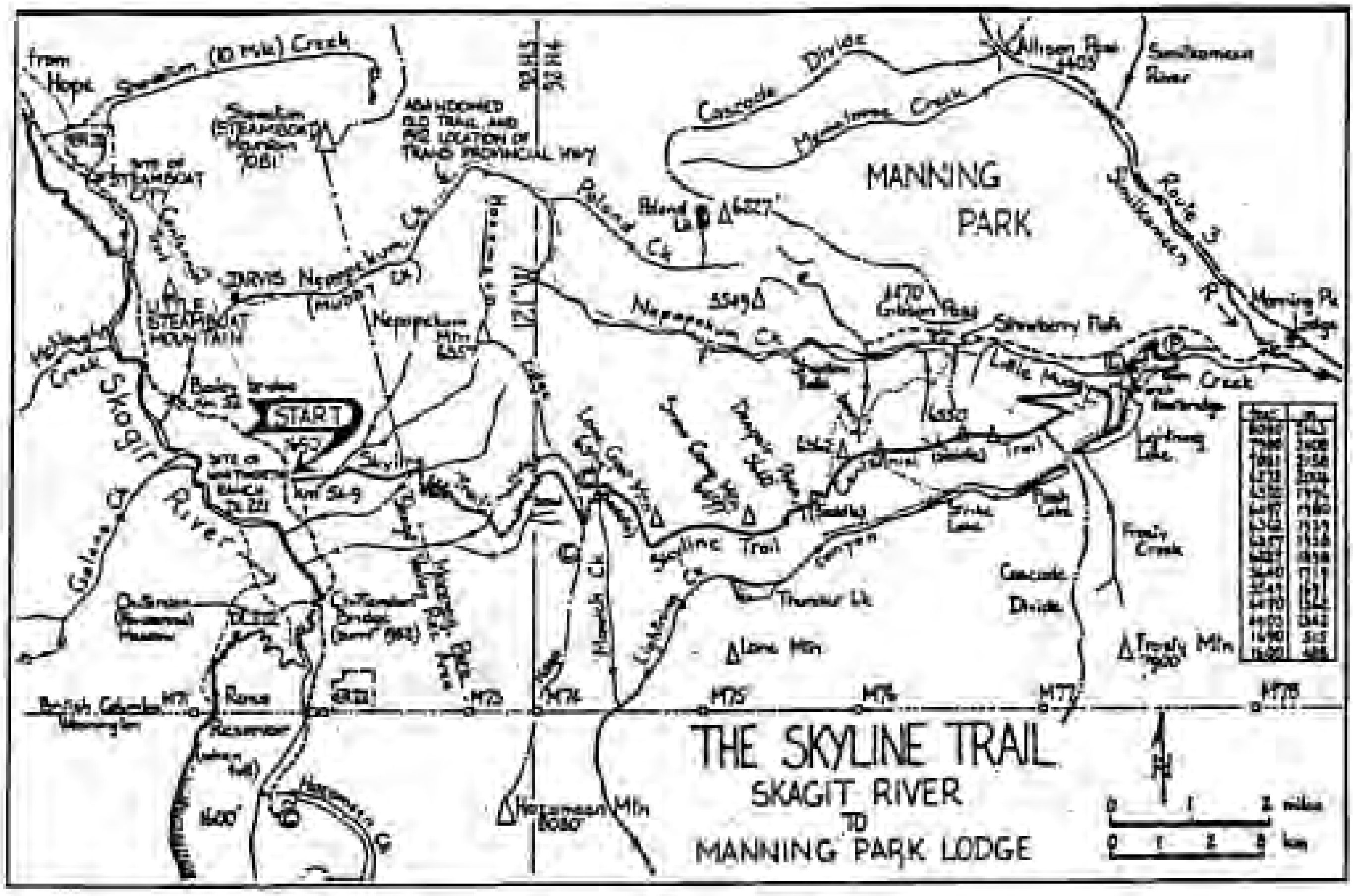


Figure 8. Map of the Skyline **Trail,** Manning Provincial **Park. From** Harris 1983.

B. Contact Period

The first white man to travel through what is now Manning Park was Alexander Ross (Ross 1855, Anon.. 1981a). Ross was an employee of the Pacific Fur Company, which was later taken over by the Northwest Company (McClanaghan, n.d.). He used the Skyline Trail to pass east through the Cascades in January 1813 (Lyons and Trew 1943; Anon. 1981a).

Archibald Macdonald explored the Similkameen in October of 1826, and produced a map of the area in 1827 (Lyons and Trew 1943).

C. Early Explorers and Trail Builders

1. Brigade Trails

By the early part of the 19th century, fur trading posts in what is now British Columbia were well established. Both the Northwest Company and the Hudson's Bay Company participated in the fur trade until 1821, when the less effective Northwest Company merged with its larger competitor, the H.B.C. (Kershaw and Spittle 1982). At the mouth of the Columbia River, Fort Vancouver (now Vancouver, Washington), was established in 1825 by the H.B.C. (Kershaw and Spittle 1982), while the major interior forts at that time were Fort Colville and Fort Kamloops.

Passage between the coast and the interior were crucial to the success of the Honourable Company's operations. Furs were brought to the coast for export, while trading goods and supplies for the interior forts were transported inland. Prior to the development of the Brigade Trail through the Cascades in the late 1840's, the Columbia River and its tributaries (such as the Okanagan) were the company's main route to the Pacific. 'The Fraser and Thompson Rivers were also used, but to a lesser extent. A more direct land route through the Cascades was difficult: and far more expensive, both in terms of time and money.

The importance of economical land routes through the Manning Park area first became apparent by the early 1840's, in the midst of boundary negotiations between British Columbia and the United States. The threat of losing free and unobstructed access to the Pacific via the Columbia River prompted Governor Simpson to establish fortp on Vancouver Island (Fort Camosun, 1844), and in the Fraser Valley (Fort Langley, 1845) (Kershaw and Spittle 1982). With the signing of the Oregon Treaty in 1846, the importance of a trading route north of the 49th parallel became apparent. Case and Case (1945) and Roe (1980) provide interesting accounts of the events during and after this time, from the American perspective.

Early in 1846, Alexander Caulfield Anderson's suggestion that the H.B.C. find an "all-Canadian" route between forts in the interior and on the Pacific was approved, in an attempt to keep the company's fur industry alive. Anderson, an H.B.C. employee since 1831, was in charge of Fort Alexandria on the Fraser River (Ormsby 1976), and could well appreciate the importance of his task. Anderson started his survey at Fort Kamloops, travelling to Fort Langley on horseback and in canoes via Lilloet and Harrison Lake (Hatfield 1980a). In June of that year, he began his return trip, this time striking out from what is now Hope, and 'passing due east through the Hope Mountain Range via the Coquihalla River. Landing at the Nicola River, the party travelled overland to Outram Lake (now under the Hope Slide), and then to the junction of the Sumallo and Skagit Rivers. From Hope to Skagit Bluffs, the high cliffs near this junction, the present-day Highway 3 closely follows Anderson's route (Figure 9).

Leaving Skagit Bluffs, Anderson travelled up Snass Creek, taking the east fork to its source high in the mountains, and then across the Cascade Divide to the eastern slopes. Looking down from 150 metres (500 feet) at the small lake forming the source of the Tulameen River, Anderson named it the Punch Bowl,' after the Committee's punch bowl in Athabasca Pass (OSPS 1982: 6 This was on June 3, 1846, and Anderson reported that the snow was still 3 metres (10 feet) deep (Hatfield 1980a). The party then travelled down the Tulameen River, often through deep canyons, and through what is now called Paradise Valley [then known as the Garden of Eden (OSPS 1982)]. From Tulameen, they headed northwest to Fort Kamloops.

Anderson's report to the H.B.C. was not optimistic. He considered 'the route through the Cascades too arduous, and the company therefore developed a route down the Fraser River from Fort Kamloops to Fort Yale (Kershaw and Spittle 1982).

This route, too, was unsatisfactory. The steep canyons of the Fraser River made trails through this area difficult, and the first attempts to use it resulted in horse deaths, stolen supplies, and a suicide (McClanaghan, n.d.). To make matters worse, the U.S. government had erected prohibitive tarrifs on cross-border trade (contrary to the terms of the Oregon Treaty). This, plus the continuing wars against the Cayuse Indians in the Columbia region made passage to the coast via the Columbia River both expensive and dangerous (McClanaghan, n.d.).

The urgency of finding a suitable route through to Fort Kamloops therefore increased, and Anderson's Cascades route was reconsidered. Henry Peers, an H.B.C. employee at Fort Langley was commissioned in 1847 to improve upon Anderson's route through the Cascades.

This was made possible by information Anderson himself obtained in 1846 when he approached Otter Flats, just north of Tulameen. Anderson's party had travelled through deep snow and the rough canyons of the Tulameen River. The men were hungry and

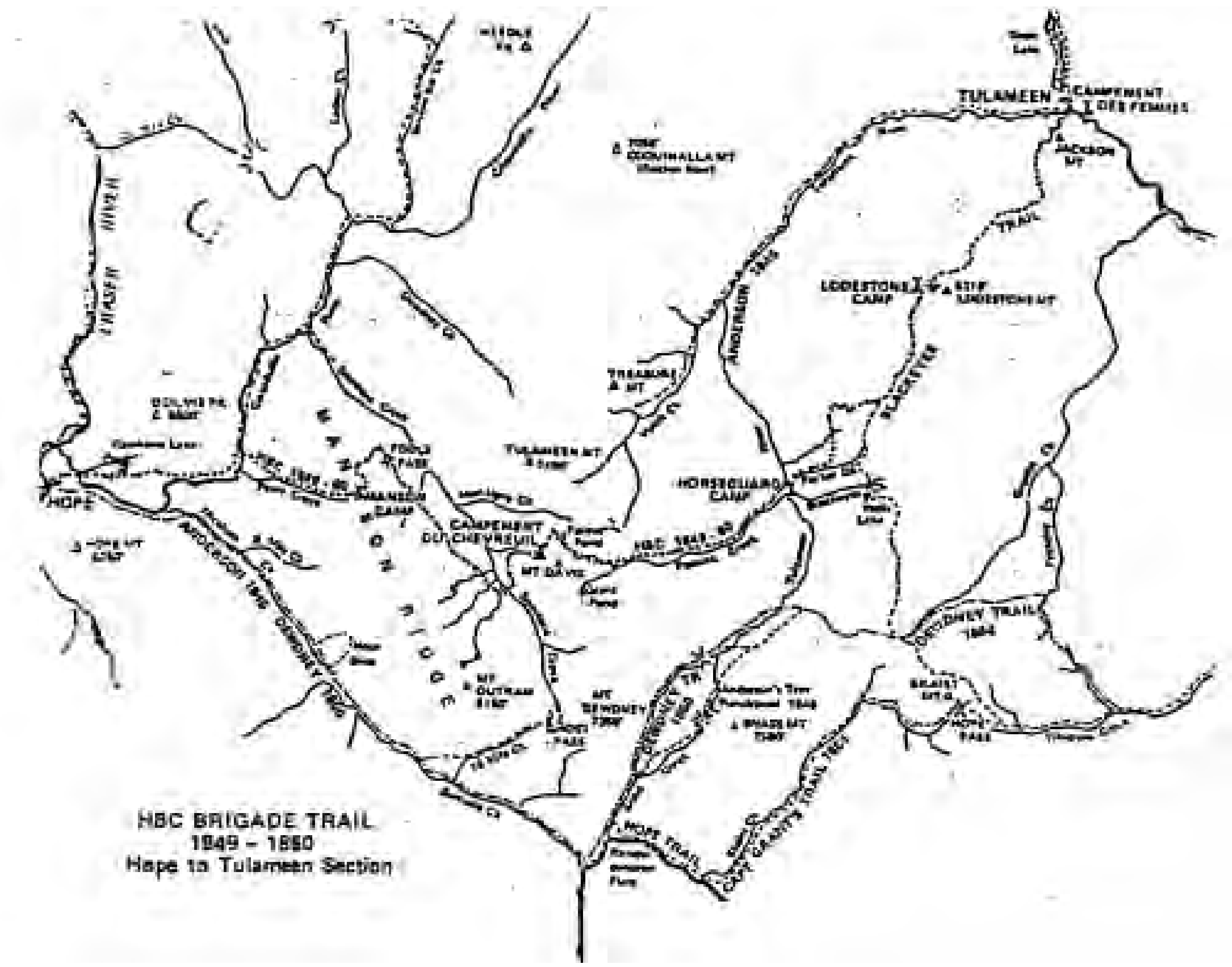


Figure 9. Map of the H.B.C. Brigade Trail between Hope and T'ulameen (from Hatfield 1980a).

exhausted when, on June 6, they encountered an Indian trail, and later that day met Blackeye, a "respected Indian Chief" after whom the trail was named. Blackeye provided the party with shelter and food ["carp" (McClanaghan, n.d.)] at Campenment des Femmes (Tulameen). He told Anderson of a route across the Tulameen plateau that avoided the treacherous canyons of the River itself. Creech (1941: 260) suggested that Anderson's Indian guide knew of this easier route, but was uncooperative because of his people's opposition to the opening of trade routes through the .Cascades. The Halkomelem speakers of the Fraser Valley apparently feared the loss of their position as middleman in trade between the Coast and Interior Salish peoples. They were also wary of the increased access that the Brigade Trails would provide for raiding parties of Interior tribes from the west (Creech 1941: 260).

In any case, Henry Peers, with Blackeye's son-in-law as his guide, established the first practical route between Fort Hope and Fort Kamloops in 1848. Instead of leaving the Coquihalla River to travel up Nicolum Creek, Peers' new trail continued to Peers' Creek, through Fool's Pass, then southwest to Sowaqua Cree, Podunk Creek, then connecting with Blackeye's Trail east of the Tulameen River. From there, it headed north to Fort Kamloops. Completed in 1849 by the Royal Engineers, the first Brigade to use the.route was a combined party from New Caledonia, Thompson's River (Fort Kamloops) and Fort Colville (McClanaghan, n.d.). The brigades departed together from Fort Hope, and travelled east through the Cascades and points west.

'various locations became traditional stopping points during journeys on the trail. Starting from Hope, the first such camp was Manson Camp, near the end of Peers Creek (Hatfield 1981). The second was Campement du Chevreuil, 19 miles (30.6 km) further east, and 180 metres (600 feet) west of the Cascades divide. This spot was important, since unlike Manson Camp, it contained grass for horses (Hatfield 1981). The third camp was Horse Guard, on the Tulameen River at Packer Creek (Hatfield 1981). The fourth and fifth camps were at Lodestone Lake and Campement des Femmes (Tulameen), respectively (Hatfield 1981).

This route would carry goods that amounted to a full shipload bound for England each year (May 1982), and was the H.B.C.'s main route' to the interior for the next 10 years ("Historical Background of Historic Trails in the 'Cascades Wilderness"). Commodities included furs for export, supplies to interior forts, and in later years, gold, cattle, and. mail. People, too, from doctors to pioneers to magistrates, would make their passage across the Cascades via this route.

During the 1850's, people that crossed the Cascades via this route included: Donald Manson, Chief Trader of the H.B.C. (Manson Camp, Manson's Ridge; OSPS 1982); a Mr. MacLean, also of the H.B.C., who lost 60-70 horses in the snow on the east side of Manson's Ridge on the 16th of October 1857 or 1858 (OSPS 1982); and Lt. H. Spencer Palmer, Royal Engineer, who told of his own animals being frightened by the bones of MacLean's dead horses while crossing Manson's Ridge in September of 1859 (OSPS 1982). Paul Fraser (relationship to Simon Fraser unclear) died near the Summit of the trail in July 1855 when a tree fell on his tent. His grave was marked by a pile of rough hewn logs (May 1982).

Loomis Trail: Hilton (1980) mentions a trail put in by Col. or Sgt. Loomis of the H.B.C. in the 1940's. The location and history of this trail is unclear.

2. Gold Rush Trails

Gold was first discovered in the Columbia River in 1855; the Fraser and Thompson Rivers in 1856. Late in 1859, it was discovered in the Similkameen River south of the border (by an American with the International Boundary Commission), and at Rock Creek east of Osoyoos that same year. These discoveries prompted a rush of gold seekers from the south. Canadian authorities viewed this as a two part problem: equipment and supplies were being brought into B.C. without paying import taxes, and vast quantities of gold could be exported free of duty. In response to threats such as these, W.G. Cox was appointed gold commissioner to regulate cross-border gold traffic, and [redacted] Haynes set up a Customs Office at what is now Osoyoos. But it became obvious that in order to maintain sovereignty in B.C.'s interior, a more effective transportation route across the Cascades was essential.

The logistical problems of developing such a route was reflected in a Victoria Daily Colonist article of the day: "...before miners of the Skagit can be supplied with provisions it will be necessary to institute a new race of quadrupeds - after the model of the flying dragons or winged horses of fairyland... a sufficient number of eagles may be broken to the service" (F. Mogensen, pers. comm.).

Governor Douglas began the quest for a "mule road to the Similkameen" by hiring a Similkameen Indian named "Skiyou" to explore a suitable route across the Cascades. According to Bishop Hills, an observer at the time, Skiyou and his Indian associates "shewed remarkable cleverness in sketching out a map of the route [to Similkameen], marking the rivers, mountain valleys, passes and buildings" (Ormsby 1976:xviii). Douglas' reliance on this source was, however, criticized by the press and by Col. Moody of the Royal Engineers (Ormsby 1976).

Dewdney Trail: In August 1860, Edgar Dewdney was commissioned by Governor Douglas to build a "the Queen's Trail" as Douglas called it. Dewdney was awarded the contract on the basis of his bid of 76 Pounds Sterling (roughly 400-500 dollars at that time; Heritage 1987) per mile, which was lower than that of the other applicants. He subsequently invited Walter Moberly, who was the second-lowest bidder on the contract, to join him in the venture. The trail was to follow a route surveyed by Sgt. W. McColl and Lt. H. Spencer Palmer and the Royal Engineers (Kershaw and Spittle 1982, Tagles 1982)'. Originally intended to finish at Anderson's Punch Bowl after roughly following Anderson's 18'46 route, Douglas extended the contract in 1861 as far as Vermillion Forks'(now Princeton).

The contract, which was signed on August 17, 186'0 (McClanaghan, n.d.) called for a trail no less than 4 feetwide, with a 1.5 foot smooth, hard strip along the center to allow pack animals a sure footing (Heritage 1987). The grade was to be no more than one foot rise elevation for every 12 feet of trail. It was to be clear of all trees and boulders, wet patches were to be filled or corduroyed with logs, and drainage across the trail was to be provided by proper culverts (Heritage 1987). Where bridges were required, they were to be no less than 12 feet wide (Heritage 1987).

Work actually began in late June of 1860 (OSPS 1982), and the trail followed Anderson's 1946 route as far as Rhododendron Flats and Snass Creek, whereupon the north fork, rather than the east fork of the Snass was followed to its source. It then led over the divide; past the upper reaches of the Tulameen River and on to Whipsaw Creek and Princeton to the east. The party of trail builders was varied, and included a number of Indians.

In 1861, the Royal Engineers started to upgrade Dewdney's pack trail to a wagon road (Busey 1983), in part because Governor Douglas was so impressed by the work (Turnbull 1980). Only a portion of this road was completed, and it ended at Snass Creek. Further road improvements eastward were inter upted by the gold' rush in the Cariboo to the north, which shifted the focus away from the Cascades routes (Busey 1983). Miners were also opposed to subsidizing the cost by paying a road tax of 0.5 cents per. pound (Ormsby 1976:14).

Hope Trail, or Hope Pass Trail: In 1861, while Dewdney was constructing his pack trail, the Royal Engineers, under Captain Jack M. Grant, were'already exploring alternative routes. The Snass Creek portion of the Dewdney Trail wound through treacherous, slide-prone canyons (Tagles 1982). In the fall of 1861, Grant established an easier (though higher) pack trail that followed the Sumallo River 6.5 km further east than Dewdney's trail, to the junction of the Sumallo and Skaist Rivers. Grant's trail then followed the Skaist river to its source, then across the Cascade divide at Hope Pass (1800 m) to Whipsaw Creek, northeastward along Whipsaw.Creek to the Similkameen River, then north to Vermillion Forks. This route proved to be the major route between Hope and Princeton for over 60 years. Goods being transported westward were often transferred to wagons at Snass Creek, where the Hope and Dewdney trails meet (Busey 1983).

Whatcom Trail: Meanwhile, on the American side of the border, news of the gold to be found prompted an influx of miners hoping to cash in on the profits. By 1858, thousands of miners were camped at Whatcom, on Bellingham Bay (Beckey 1969). While many began to move north across the border, pressure grew to

r

establish a feasible trail to B.C.'s interior. Whatcom businessmen had plans to wrest 'control from Fort Langley as the major shipping port for the region. The first attempt, intended to pass directly between Whatcom and Hope, was a failure, largely due to flooding (Beckey 1969).

The second attempt, now known as the Whatcom Trail was established by U.S. Army engineer Capt. W.W. De 'Lacy in 1858, winding from Bellingham Bay via Chilliwack Lake and the Skagit River to connect with the H.B.C. Brigade Trail (OSPS 1982). It was financed by a group of businessmen from Washington State, and volunteers from Whatcom assisted in its construction. The trail was intended to be used to export'gold without paying customs dues, as its route was east of British posts in the Fraser Valley. Roe (1980) provides an interesting account of the Whatcom Trail's construction, from the American perspective.

The route followed by de Lacy'headed north up the Skagit Valley, and en route, De Lacy received a copy of Anderson's "Routes to the Goldfields" (OSPS 1982). He then followed Anderson's 1846 pack trail up to his Punch Bowl, and crossed the Tulameen Plateau to meet the H.B.C. Brigade Trail (also Blackeye's Trail) near Lodestone Lake. Both the length (270 miles) and degree of difficulty of the Whatcom Trail made it impractical, however, and it was in use for only a few years (Anon. 1980).

D. Human Impact

Since the first Indians set foot in Manning Park and the Cascades Wilderness, the activities of people have left their mark in various ways. Some of these impacts, such as gathering berries, have been minor, while others, such as the construction of a major highway, have had major and lasting effects on the nature of the area. Eleven categories of human use of the area are described below.

1. Indians

The activities of Indian peoples in the areas of Manning Park and the Cascades Wilderness have been described previously (see Section A. Original Inhabitants). Their hunting and gathering activities may have influenced local populations of animals and plants, but the degree of influence' was probably slight. Controlled burning was probably done in the area, and may have affected vegetation patterns at least in the short term. Since the purpose of burning was to enhance conditions for food-producing plants, community composition likely changed to reflect this management practice.

2. Early Explorers and Trail Builders

The activities of early explorers and trail builders in this area were described in previous sections. Aside from damage to the areas along the trails themselves, the impact of these activities was probably relatively minor. During the construction of the various trails through the area, trees that obstructed passage were felled, and sometimes, subsequently burned. Trees were also cut for the construction of summer encampments along the trails. It may also have been common practice to burn areas along trails to create pasture for horses en route (See Fire, below).

Colville (1852) noted that swamps were drained along the Brigade Trail from Hope to Tulameen, to improve the footing for horses (McClanaghan, n.d.).

3. Mining

Manning Park and the Cascades Wilderness have a rich history of mining and prospecting that dates back to the days of the Gold Rush in the 1860's. Some claims were staked within what is now Manning Park (Mogensen, pers. comm.). Some of the ore notable records of mining and prospecting are described below.

The earliest mining activity was reported around 1860. Reports of instant wealth lured people from across the continent, and certain areas became flooded with gold-seekers. Bauerman (1884, in Lyons and Trew 1943:11) observed "...Chinamen panning for gold along the Similkameen River,.." around 1860. They apparently abandoned the area in the fall of 1861. Some of the earliest evidence for prospecting within Manning Park itself is along the Heather Trail, where a blaze near Buckhorn Camp is dated 1876 (Historic Parks and Sites Division 1976). Numerous other areas were also prospected, and some were mined.

A second flurry of prospecting activity took place around 1900, and into the early part of this century. Many claims were staked; some of these are visible on a Sketch Map of Portions of the New Westminster, Similkameen and Yale Mining Division (Figure 10) produced in 1915.

In a 1923 report to the Department of Lands and Surveys Branch, Jackson (1929a:151) noted that the park area was "well mineralized" and that there were "several prospects along the Roche River which have good showings". A year later (Jackson 1929b), he reported that "low-grade" sulphide ores, containing gold, silver, copper, zinc, lead, iron and antimony in greater or lesser quantities" had been found in the Sumallo River just upstream from the Skagit River.

At Mowich Camp, O.D. Day carved his initials and the date (1901); he may have been taking the Skyline Trail to the Interior, in search of gold (Mogensen, pers. comm.). Mining activity took place at Gibson's Pass prior to 1910 (Mogensen, pers. comm.). Harry Gordon, a trapper in the area, found boards there carved by a placer miner. Unsuccessful mining activity apparently also occurred at the base of Red Mountain (Mogensen, pers. comm.).

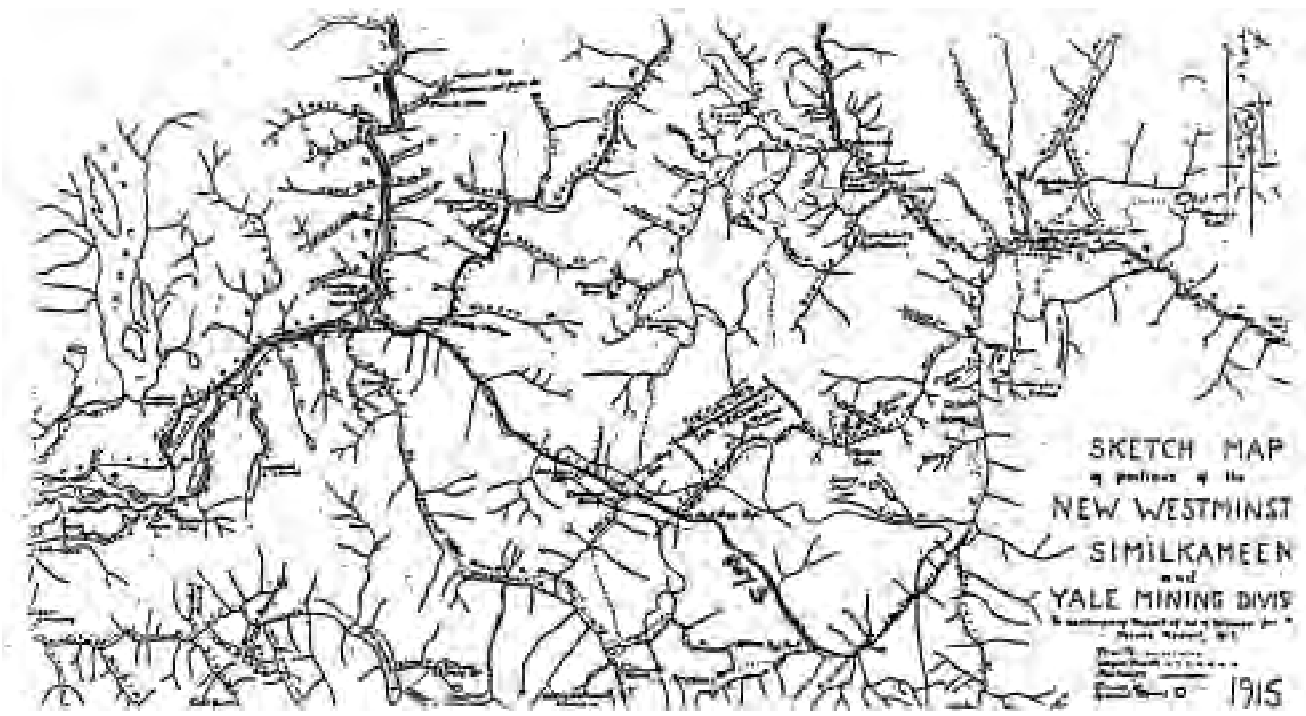


Figure 10. Sketch Map of portions of the New Westminster, Similkameen and Yale Mining Divisions (Brewer 1915). Squares represent mining claims. Note the proposed motor road to Princeton.

At Strawberry Flats, the remains of a ladder built of rough hewn wood could still be seen in 1983 (Mogensen pers. comm.). Hilton (1980) suggested that it was left there by three prospectors from the Guegenheimer's Mining Company in New York. They apparently prospected in the Big Muddy Creek area in January (year unknown), amassing a hoard of gold. How they prospected,in 3.5 metres (12 feet) of snow in the first place is difficult to.imagine (Hilton 1980). At any rate, the men hauled their loot by toboggan to Strawberry Flats, and cached it up a tree that they accessed with the makeshift ladder.

By far the most dramatic mining'activity in the area occurred at Shawatum Mountain (then known as Steamboat Mountain) around the turn of the century. Two men, Dan Greenwald and W. A. Stevens, announced their find in 1909, and registered their claim that year under. Steamboat Mountain Gold .Mines Limited. Several other companies became incorporated in the region.. The claim was valued at one million dollars, and shares sold on the stock market for 25 cents each, a high price at the time. Miners flooded into the area, and soon two tunnels were constructed; an upper one for high grade ore extended 12 metres (40 feet) into the mountain, and a lower one ran for 4.5 metres (15 feet). Three towns were constructed to provide services for the hundreds of men working the mines, complete with hotels, stores, restaurants, barber shops, real estate,offices, a newspaper, and even a fire warden. A Board of Trade was formed in May of 1911. At one point, it was reported that 20-40 men per day arrived in hopes of making their fortune.

The bubble was burst on June 29, 1911 when a Mr. Rand, a Fiscal Agent in Victoria, revealed to shareholders that the Steamboat Mountain Claim was a hoax. Close examination 'of the original gold-bearing samples revealed that they were produced by the rather devious method of firing gold particles from a shotgun, embedding them into the rocks. 'The gold used in the scam apparently originated from somewhere in Nevada. Charles Camsell, Chief of the Geological Survey of Canada, announced in August 1911 that the Steamboat Mountain Claim was at the edge of a coal, not gold, formation. As a result of the scandal, the entire operation collapsed, and the townsites were abandoned. Virtually nothing remains today except for a few log buildings set along numerous paths and clearings. The perpetrator'sof the hoax were ostracized. Greenwald denied his guilt and claimed in 1914 that he despised: "wicked men who lure poor miners to worthless ground by sending out false reports". He disappeared to South America. His partner Stevens apparently killed himself in California. (Extracted from the notes of F. Mogensen; see also Harris 1979, Harris 1982).

Other claims still exist in the Park. Big Ben Mines, at the headwaters of the Similkameen, has never been operated, but could be opened (Harris 1984). AM Claim is situated at the western boundary of Manning Park, at the head of Silverdaisy Creek.

In general, only the areas immediately surrounding mineral claims and prospecting areas were heavily impacted by mining activity.

4. Trapping

Manning Park has a long history of trapping, dating back to well before the turn of the century. After government regulations came into place, trapping in the area was controlled by rights, which were sold and resold to numerous owners through the years. Included with the trapping.rights was legal entry into several cabins and primitive shelters along the traplines. Each cabin had a name, and probably several stories associated with 'it (Mogensen, pers. comm.). Trappers were usually very adamant about informing others of,their plans while they worked their lines for extended periods.

Travel in winter was always by snowshoes, which they removed only before going to bed (Mogensen 198.0). On a good day, travel' from Princeton into Manning Park could be done in a single day; in bad weather it could take four days or more (Mogensen, pers. comm.). While working their lines, trappers regularly covered up to 800 kilometres (500 miles) in a month. In 1940, coyote pelts were worth $40, marten were $30 to $40, and beavers were around $20 (Hilton 1980).

A succession of trappers held the rights for the Manning Park area. These are listed here; see Appendix 7 for further information on each. The first was Paul Johnson (sp?), who arrived in the 1890's (Hilton 1980). Trapping rights were subsequently held by Levitt and Ryder (1906-1908), Harry Gordon (1908-1938) and Joe Hilton (1938-present) (Hilton 1980). In 1984, Hilton's grandson was apparently working the line with him (Mogensen, pers. comm.). Joe Hilton is currently the only person to possess private occupancy rights within the Park.

Many of the cabins built by trappers along their liens still stand; it would be useful to assess the current status of each (e.g. standing or not; state of repair). Many, if not most, of the cabins were built by Paul Johnson (sp?), who apparently hired a Mr. Carleson, of Princeton, to assist him (Hilton 1980). The locations of some of these were described by Joe Hilton: 1) near the present Lightning Lake Dam (called the Home Cabin); 2) at the junction of the two forks of Sunday Creek; 3) on the northwest bank of the Similkameen River, at its junction with Pasayten Creek (called the Roach Cabin); 4) at the headwaters of Station Creek (North Star Creek); 5) on Little Chuwanten Creek, near the U.S. border (Hilton rebuilt this cabin); 6) at Six Mile Marsh on Monument Creek (Hilton added to this cabin); on Friday Mountain (built by Harry Gordon); 7); on Copper Creek close to the union of two lakes (built by Harry Gordon); 8) below Placer Lake; 9) on the north bank of Memaloose Creek, between the present gravel pit and highway maintenance buildings (called the Grizzly Cabin); 10) on the north bank of the Similkameen, below its junction with Chuwanten Creek and Castle Creek, and near the head of the present Monument 83 Trail (this area was known as Poverty Flats); (all from the notes of F. Mogensen).

The impact of trapping on Manning Park is unclear. The trappers' traplines, plus the cabins they built probably disturbed little. It is difficult, however, to know whether the removal of furbearing mammals affected the composition of the Manning Park fauna. Joe Hilton is perhaps the best source of information on this subject. His recollections, recorded in 1963 and 1980, contain valuable data, some of which are summarized below.

In the early part of the century, trappers' enjoyed an abundance of furbearers: martens, in particular, but also coyotes, beavers, weasels, lynx, wolverines and fishers. Fishers disappeared around 1919, and were not caught again until 1952. Hilton (1963) claimed that Levitt and Ryder (see above) caused a noticeable decline in the numbers of many species after 1908. Most furbearers have declined in numbers since the Park's opening (Hilton 1980); development is a more likely cause than trapping. Further details could possibly be obtained from the Game Commissioner in Princeton, as trapping records were sent there each year (Hilton 1980).

5. Homesteading

Manning Park has a somewhat limited history of homesteading, and its impact has been only local in scope. Possibly the first homesteader was Joe Kanski (sp.?), who is reported to have settled in a meadow behind Cambie Campsite. (Hilton 1980). He built a drainage ditch that is still visible at the end of Rein Orchid Trail (heading counterclockwise; Anon. 1981a). Later, in the 1920's and 1930's, Mrs. Angela McDiarmid and her family regularly spent the summer at a cabin near the East Gate of Manning Park, returning to Princeton each winter. The cabin was destroyed with the construction of the Hope-Princeton Highway, and the meadow cleared by the McDiarmids is now a seral stage of the Interior Douglas-fir Zone (Master Plan 1981). Hilton (1980) also recalled that some people homesteaded in the Gibson Pass area in hopes of cashing in on the proposed Great Northern Railway Line through the Park. They gave up when the Railway's plans were cancelled.

6. Logging

Only sporadic efforts to harvest the rich timber resources of Manning Park have been made. It is reported that prospectors in the area once sold information on the location of good timber tracts for fifty cents an acre (Harris 1984). To procure a timber licence, it was necessary to stake, survey, and register one square mile of forest, and pay a ground rental; two such licences were granted prior to the Park's creation (Harris 1984).

Complaints against logging in the newly formed Manning Park were made in September of 1943; apparently a Mr. Bain attempted to act upon a logging permit he had acquired several years earlier (Mogensen, pers. comm.). The area around Chuwanten Creek was logged in 1972, and an area near Cambie Creek has also been logged (Benson 1980).

It has been suggested that logging, in conjunction with the clearing of land surrounding Manning Park, 'has allowed moose to spread southward into the Park; they first appeared in 1955 (Benson 1980).

selective logging of trees affected by Mountain Pine Beetle infestation took place near the lower end of Bonnevier Trail in 1982 (see section II C 4). Logs have also been removed for use as fuel within the park.

7. Recreation

The first reported fishing party at Lightning Lake was in 1870 (Underhill and Chuanq, 1976). Cambie Campsite, near the bank of the Similkameen River was a popular stopping point for' fishermen in later years.

The completion of a road (Highway 3) from Princeton to Allison Pass in 1930 provided easy access to hunters: and fishermen, and public use of the area increased dramatically. Hilton (1980) suggested that overfishing during the 1930's dramatically reduced the numbers of rainbow trout, while at the same time increasing the size of individual trout from 9 to 10 inches to 2 to 3 pounds. Apparently 400 to 500 men from nearby relief camps regularly visited the area and fished extensively (Hilton 1980).

Lyons and Trew (1945) estimated annual park attendance between 1930 and 1936 to be almost 600 people. Even prior to the Park's creation in 1941, the Lightning Lakes area was damaged by excessive use from campers and fishermen; the establishment of controlled campsites there in 1945 alleviated the problem somewhat (Anon. n.d. c).

Stocking of lakes within the Manning Park area occurred early in the area's history. Poland and Nicomen Lakes have both been stocked with rainbow trout (Benson 1980).

Lightning Lake was dammed in 1968, with the goal of improving beaches and camping areas. construction was such that the exit for water into the Similkameen River is 10 cm (4 inches) higher than that into the Skagit River. The area of open water has increased substantially, enlarging Lightning Lake and creating Lone Duck Lake. Marsh habitatson the margins of the old lake have disappeared. Damming also coincided with the virtual disappearance of beaver in the area, and the removal of driftwood may have reduced the abundance of fish (Hilton 1980). A fish ladder built at the south end of Lightning Lake is of unknown value to spawning rainbow trout.

The current Park policy is to maintain high levels of fish management in Lightning Lake, including restocking and enhancement of spawning areas (Master Plan 1981).

Skiing is by far the most important winter recreation activity in Manning Park. Development of ski facilities began, in the early 1950's after the installation in 1952 of a tow rope on Sugarloaf Hill, near Park Headquarters (Harris 1984). This hill was in operation for only four years, being displaced by the construction of the Blackwall Road. A new slope was cleared and a chair lift erected above the former Pinewoods service station in 1960 (Harris 1984.)

In 1962, plans for B.C. to host the Winter Olympics included the installation of a ski resort at Gibson's Pass. Although this plan was dropped, the interest it generated for skiing in Manning Park is largely responsible for subsequent ski facility development. The road to Gibson's Pass was constructed in 1964, and a twin tow rope was installed on a newly cleared slope there in 1965. The chairlift from the Pinewoods Hill (see above) was moved to this new location in 1966, but was replaced by the new Blue Chairlift only a year later. Subsequent additions to the Gibson's Pass ski facility include the clearing of a beginner's hill (1967), the installation of the T-Bar (1969), and the construction of the Orange Chairlift (1970) (Harris 1984). Periodic improvements to the ski trails themselves have resulted in a magnificent winter resort, enjoyed by thousands each year.

Pinewoods Lodge was constructed in 1957, and burned to the ground on November 11, 1970 (Harris 1984). It was rebuilt and reopened in 1972 under the new name of Manning Park Lodge, in a ceremony presided over by Premier W.A.C. Bennett (Harris 1984).

The road to subalpine meadows has opened up this area to tourists, greatly increasing their number.

All-terrain vehicles, four-wheel drive vehicles, and motorcycles in the Paradise Valley region of the Cascades Wilderness have left tracks in certain alpine and subalpine areas (Osmond-Jones 1977). These tracks are apparently causing erosion (Osmond-Jones 1977).

Much information is available on recreational opportunities immediately south of Manning Park, some of which may be relevant to this area. Consult Beckey (1969), Douglas (1950), Spring (1969), Spring and Manning (1976), U.S. North Cascades Study Team (1965), Williams (1974) and Wills (1962) for details.

8. Fire

Fire 'plays an important part in'the natural history of the Manning Park area. It is a natural process of regeneration, resulting in a patchwork of communities in various stages of succession.

Indian peoples in this area intentionally burned limited areas in order to enhance conditions for food plants, particularly berries (see Section A. Original Inhabitants)., The frequency of fire probably increased after the arrival of European explorers and settlers. It was apparently common practice for early trail builders to burn areas along trails to create pasture' for horses en route: Anderson wrote of his crossing of the Snass River on June 3 1846: "Set out at 3-1/4 A.M. and breakfasted at 6 among the rhododendrons.. Set fire to the fallen timber to make a landmark and improve horse .pasture for possible future use. Set out again at 8:20 and reached summit at noon." (Hatfield 1981).

Susan Allison, pioneer in the Princeton region, told of a huge forest fire that burned in August in the late 1860's along the Hope Pass Trail east of Skagit Bluffs (Ormsby 1986).

There is also a record recalled by Mr. Tower of fires having been set by Charlie Bonnevier and his partner "Belgie", two local prospectors. They burned hillsides south of McDiarmid Meadows, and on Bald Mountain, north of McDiarmid Meadows. The fires were apparently set to clear the ground for prospecting, a technique that was described as illegal but effective (Mehling 1983). The effects of the fire,, which was probably set around 1900, are still visible in the form of stands of relatively young trees (Mehling 1983).

The increase in the number of tourists visiting Manning Park after 1941 was probably accompanied by an increase in the number of forest fires; carelessness'with cigarettes and campfires .are two likely causes. A map (Figure 11) illustrates the locations of fires reported within Manning Park during,the period 1940-1972. One particularly large fire, dubbed the "Big Burn", was started in August 1945 by three motorcyclists camping just east of Allison Pass (Benson 1980). Before being doused by fall rains, it destroyed over 2000 hectares (5,000 acres) of forest (Heritage Fact Sheet- Manning Park), and prompted the erection of a huge cigarette hanging from a mock gallows. The inscription on the accompanying sign read: "THE ONE WHO DROPPED IT SHOULD ALSO BE HANGED". Much of the area was subsequently replanted with Douglas-fir seedlings (Benson 1980).

A more unusual source caused fires in Manning Park in the 1940's. During the last part of World War II, Japanese ships off the west coast launched incendiary balloons, in an attempt to start forest fires in the interior. A deputy ranger at the time estimated that at least eight fires within the park were started this way (Hilton 1980).

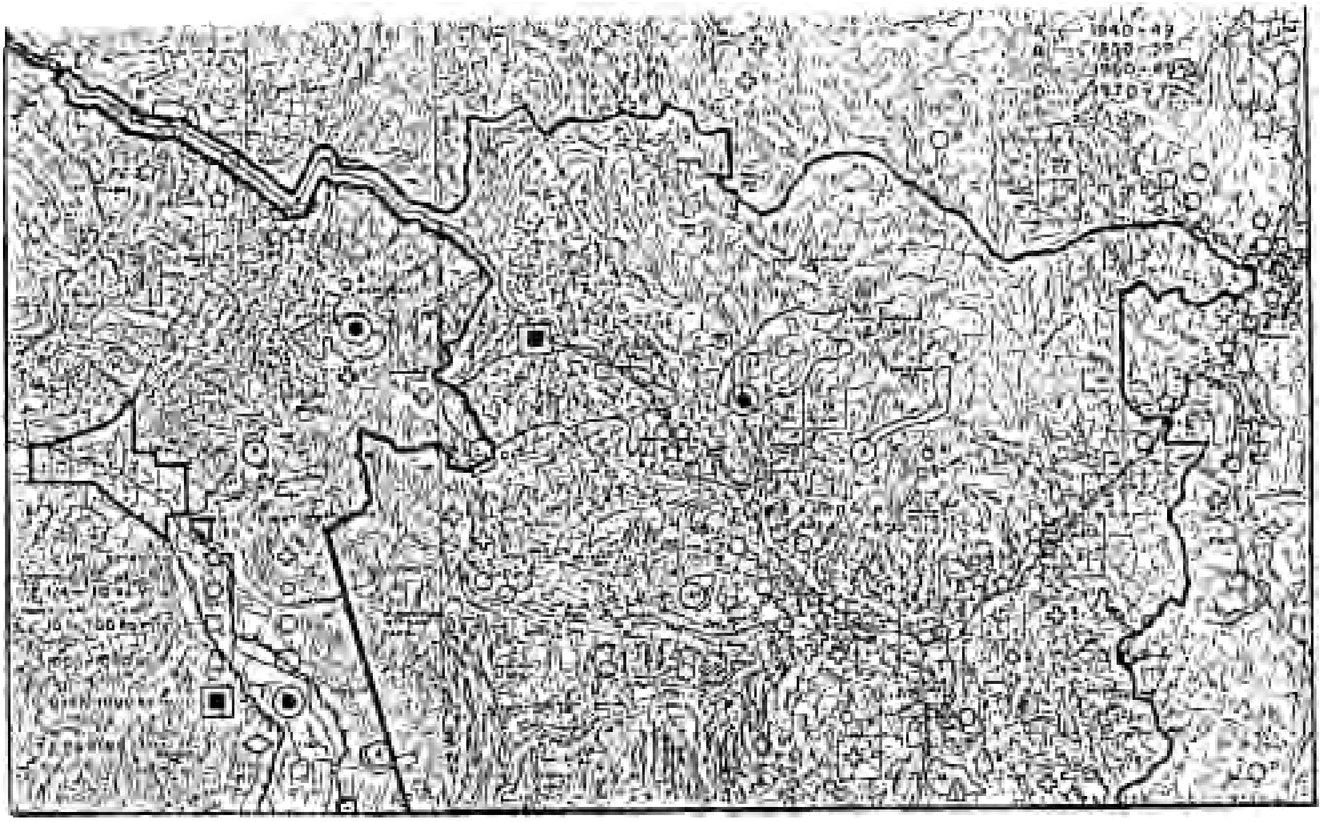


Figure 11. Map of fire locations within Manning Provincial Park between 1940 and 1972 (source unknown).

Other notable fires, .of unknown origin, include one at Strawberry Flats, started in the 1930's. A fire on Big Buck Mountain resulted in the extension of subalpine meadows, creating particularly beautiful landscape (Mogensen pers. comm.)..

After the arrival of Europeans, the overall incidence of fire probably increased, but since the creation of Manning Park, unplanned fires have been extinguished whenever possible. This is a policy that is reinforced in the most recent (1981) Master Plan. It reflects the desire to protect harvestable timber adjacent. to the park's boundaries, and also to protect developments within the park, such as Gibson Pass, Manning Park Lodge, and Allison Pass (Master Plan 1981). Current fire suppression practices will undoubtably cause changes in the community composition of Manning Park. Without fire as an agent of renewal, much habitat in early successional stages will disappear, and with it, many of the associated plants and animals.

9. Modern Transportation.

Highways: The earliest surveys for an actual road between Hope and Princeton were conducted in the early 20th century. In 1901, Edgar Dewdney, of Dewdney Trail fame, was commissioned by Premier Dunsmuir to survey potential routes (Turnbull 1980). Again, Walter Moberley was Dewdney's partner, and the two were accompanied by Henry Carry and a party of 30 men (Turnbull 1980). Dewdney's report was not optimistic: "The result of the survey shows that the Hope Mountains cannot be crossed without encountering serious engineering .difficulties which would necessitate a very large expenditure of money and' I know of nothing so pressing that would warrant a road's construction." (Turnbull 1980:39).

A map of the area dated 1915 (Figure 10) illustrates a "Proposed Motor Road to Princeton" that follows Silver Creek south from Hope, then along the Klesilkwa and Nepopekum Creeks, then joining the present route 3 east of Gibson Pass.

During the 1920's, more surveys were conducted and numerous routes were proposed (Lyons and Trew 1943). Actual construction began in 1929, and soon allowed access to the Park from Princeton west to Allison Pass (Lyons and Trew 1943). Labour 'was provided by Relief Camps near Princeton (McClanaghan n.d.). construction was halted in the early 1930's due to lack of funding, by which time the western section of the highway was partly completed, stopping 16 km (10 miles) west of Allison Pass.

During World War II, construction began again, this time using labour from both the Princeton Relief Camps and Japanese Internment Camps. Lyons and Trew (1943) reported that, after the start of WW II, several Japanese camps were established on both the east and west sides of Allison Pass. One of these was Tashme, in which around 2,300 Japanese men, women and children were held "for their own protection". Bussey (1983) suggested that another internment camp may have existed within Manning Park, near the west gate. Hilton (1980) recalled another camp, Old "Jap" camp at "Jap Creek" just north of Allison Pass. It was built by/for Japanese men working on the Highway. The men at the camp, who were single men from the Friday Creek and Copper Creek areas, apparently started work in 1943 (Hilton 1980).

The highway was finally completed in 1949, although the first car travelled from Hope to Princeton in 1943 (Lyons and Trew 1943). The cost was approximately 12 million dollars (Turnbull 1980).

Railroad: Although railway lines do not presently pass through Manning Park, surveys for such a purpose were occasionally conducted. One such investigation was done for the Great Northern Railway, and was completed between Princeton and Poland Lake via Gibson Pass before it became clear that the terrain made such a project impractical (Hilton 1980). Another survey was conducted for a railway line along Nepopekum Creek between the Skagit Valley and Strawberry Flats (Mogensen, pers. comm.). Apparently, a Mr. H.J. Cambie participated in a search for a route through the Cascades for the C.P.R.

Airplanes: An airstrip was once cleared in the Lodge area by Mr. Tower, who occasionally landed planes there. (Mehling 1983).

10. Introductions

The earliest recorded introductions into Manning Park were probably of grasses sown by travellers along the H.B.C. Brigade Trail. Eden Colville (1852) reported that grass seeds were sown at various camps along the trail from Hope to Tulameen, to provide fodder for horses (McClanaghan n.d.). Hatfield (1980a) noted that Timothy grass, a European species, presently grows at some of these camps; it almost certainly arrived there by this method. As there were no commercial sources of native grass seeds at the time, all of the grass species introduced were almost certainly of European origin. Other introduced grasses that have been found within Manning Park include Hungarian Brome-grass and Downy Brome-grass (Carl et al. 1952); whether these were also intentionally sown is unknown.

In the spread of other introduced plants khroughout North America, ManningPark has not been spared. In addition to the three grass species noted above, plants of European origin that have been recorded within the Park boundaries include Common St. John's Wort, Hemp Nettle, Mullein and Neckweed (Carl, et al. 1952).

Periodic attempts to graze livestock have also been made. Gregory (1929:117) reported that a local syndicate had imported a large flock of sheep in 1920, and had turned them out to graze "in the mountain section between Princeton and Hope". Sheep were also reported to have been ranged in the Three Brothers area during the 1930's (see below).

Jackson (1929a:150) conducted a survey of the Three Brothers region in 1923, from the Hope-Princeton Trail to Roche River and west to Cambie Creek, and noted that much of the area was suitable for grazing but that only a small portion near the Trail had been used for such a purpose. Cattle were apparently illegally ranged in the Three Brothers area as recently as 1976 (Malcolm Green and Alex Green, pers. comm. to Faye Mogensen). Cattle are ranged in the Paradise Valley region of the Cascades Wilderness (Osmond-Jones 1977). He reported that in the subalpine habitat, grazing appeared to have removed much of the natural cover of grasses and forbs, while hellebore may have become more abundant. At lower elevations,, damage was minimal. Cattle trails through wet areas have become "quagmires" (Osmond-Jones 1977:3).

11. Colonization of Man-made Habitats

There are several large expanses of man-made habitat in Manning Park. For the average park visitor the habitat that he is most familiar with will be the highway and the highway edge. Other man-made habitats such as the paddocks, lawns and ski hills associated with the lodge and related operations are also heavily visited.

The role that these open habitats have played in the distribu ion of species in the park has been briefly discussed in Section II D 3.

Most of the species of plants that have invaded these habitats have had one of two origins:.

1. Introduced plants, mostly of European origin.

2. Interior species that have been able to colonize the open man-made habitats.

In the first grdup species such as sorrel, strawberry blite, lamb's Quarters, chickweed, shepard's purse, clovers, St. John's Wort and others have been found (see Anon. n.d. k, Underhill 1972, 1973). In the second group plants like milkweed, Sumach and Gaillardia have been recorded in the park, moving in from the interior.

Some species have probably been deliberately brought into the park as roadside erosion control and species of agronomic grasses, clovers, sweet clovers and sainfoin are common components of right of way seeding mixtures. Unfortunately, these are also species that have high palatability to ungulates (they are, after all bred originally as livestock fodder). This tends to make the roadsides of Manning Park good places for

t

grazing animals such as deer, moose and bears. The toll on these populations is considerable (roadkilled animal file, Fraser Valley District Office).

Spreading of sand and gravel attracts wildlife along road edges as well - and again losses occur at some times of the year. evening grosbeaks have been killed in numbers in some years. (Wilson 1981, Rodgers 1980).

Some species of animals seem to be confined to man made habitats in Manning Park. Columbia ground-squirrels, yellow-bellied marmots, brown-headed cowbird; barn and cliff swallows and European starlings are reliably found in and around the lawns, road edges and buildings in the park.

For the naturalist looking to add new species to Manning's flora and fauna man-made habitats may be the most productive places to look. Few systematic searches appear to have been made - ski areas seem to have been particularly overlooked by naturalists judging from the lack of records from such areas.

E. Administration

The following is a chronology of the major events surrounding the creation and administration of Manning Park.

1931: Three Brothers Mountain Reserve was created, to save alpine meadows from overgrazing by sheep (Anon. 1981a). The Sheep Breeder's Association had proposed that sheep from the Fraser Valley be transported to graze on Three Brothers Mountain for the summer months (Anon. n.d.d). The idea was met with great public opposition, led by M.A. Grainger, of Princeton. He and others felt that sheep grazing would destroy the habitat; ranchers were also accused of shooting deer that supposedly competed with sheep for fodder. The Sheep Breeder's Association countered with the claim that disallowing such grazing would force them out of business, and stockmen would no longer come to the province. The conflict aroused a great deal of publicity, and a 6,440 hectare 15,900 acre Reserve was established by an Order-in-Council under the Land Act, on August 11, 1931. The reserve was placed over those lands lying west of the Similkameen River and Clearwater Creek, south of the main stream of Copper Creek, east of Shawatum Mountain and Snass Mountain, and halfway between mileposts 72 and 73 on the International Boundary inclusive (Green File 1988).

1934: A small herd of sheep was allowed to graze on the Reserve, as an experiment to determine the impact on natural vegetation (Lyons and Trew 1943). The action prompted strong public protest, and the issuing of grazing permits was halted (Anon. n.d.d).

1936: The Three Brothers Wildlife Reserve was established on April 3. It was within the area bounded by Skaist Creek, Whipsaw Creek, and the Hope-Princeton Highway (Green File 1988), and essentially doubled the area of the Three Brothers Mountain Reserve created in 1931.

1941: Ernest C. Manninq Park was created on June 17. It was. named in honour of the Chief Forester of the B.C. Forest Service, who died in a plane crash that year. The park, with a total area of 69,460 hectares (171,509 acres), was established as a Class "A" provincial Park in selected areas of the Three Brothers Wildlife Reserve in the vicinity ,of Three Brothers Mountain (Green File 1988).

1945: "The Big Burn" destroyed 2025 hectares (5,000 acres) of forest west of Allison Pass, resulting in an improvement in fire prevention, detection, and suppression services.

1945: Bob Boyd was appointed Ranger of Manning Park.

1948: a Parks Division within the B.C. Forest Service was created (Heritage Fact Sheet- Manning Park); this Division would administer Manning Park until 1956.

1949: In November, the completion of the Hope-Princeton Highway heralded a new era of increased Park use.

1949: On December 20, the boundaries of Manning Park were again revised to include regions in the Western area of the Three Brothers Wildlife Reserve rather than the originally described regions (Green File 1988).

1950: On July 17, due to the possibility of mining development in certain regions of Manning Park,, they were excluded from Park Boundaries .under the Forest Act (Green File 1988). The total Park area was now 71,310 hectares (176,080 acres).

1950: On September 27, amendments were made to the 1936 Order-In-Council governing the Three Brothers Mountain Wildlife Reserve. It became designated "Manning Park - Three Brothers Mountain Game Reserve". No shooting or trapping was allowed; however, exceptions were made to the operation of registered traplines within the reserve and the passage'of unloaded,firearms over the Hope-Princeton Highway (Green File 1988).

1951:. On February 16, portions of land along the p ope-Princeton Highway were included in Manning Park under the Forest Act (Green File 1988).

1954: On November 5, all vacant lands in an area in the eastern part of Manning Park near the Hope-Princeton Highway at the Pasayten River were "reserved for the use, recreation and enjoyment of the public" (U.R.E.P. Reserve) under the Land Act (Green File 1988).

1956: The Manning Park Development Plan was prepared by H.G. McWilliams. McWilliams (1956) was concerned that the majority of the Park's visitors stayed for only a few hours, and that thus far the Park had "emphasized its comparatively minor purpose as a roadside stop. He also pointed out that a lack of facilities and information left most visitors unaware of the Park's major attractions. McWilliams therefore proposed a zoning system: 1) Roadside Zone (i.e. immediately adjacent to the Hope-Princeton Highway); 2) Park Entrance Portal (to provide a formal introduction to the Park); 3) Roadside Points of Interest (e.g. Engineer's Road); 4) Roadside Camps and Picnic Sites: Pinewoods Lodge area (i.e. Manning Park Lodge). McWilliams also proposed the damming of Lightning Lake; which was accomplished in 1968.

1957: the Nature House in Manning Park was constructed, the first of its kind in the province (Heritage Fact Sheet- Manning Park).

1958: On June 10, a "reserve from alienation" was placed on those lands 10 chains on either side of the Hope-Princeton Highway, excluding those areas within Manning Park (Green File 1988).

1958: On August 1, the reserve established in 1954 near the confluence of the Similkameen and Pasayten Rivers was "set aside for the use, recreation and enjoyment of the public" (Green File 1988).

1968: On May 2, 1,166 hectares (2880 acres) of land were deleted from the west perimeter of Manning Park, under the Park Act (Green File 1988).

1973: A total of 72,617 hectares (179,430 acres) of land comprising Manning Park was incorporated into the Park Act (Green File 1988).

1975: A Master Plan was prepared by Mel Turner, which divided Manning Park into three zones or classes: Class I (Preservation); Class II (Primitive Access); and Class III (Easy Access).

1978: On April 27, the Park Act Regulations were amended to prohibit overnight camping in Manning Park unless granted by a Park Officer (Green File 1988).

1981: A Master Plan for Manning Park was prepared.

1986: The new Visitor Center was opened.

1987: On September 4, 1,214 hectares of land south of the Copper River were removed from Manning Park, in a revision of Schedule 2, Section 5.1, of the Park Act. The total area of Manning Park became 65,754 hectares (162,480 acres) (Green File 1988). A detailed description of the Park's 1987 boundaries is contained in Schedule 2, in the Green File at the Regional Office (Cultus Lake).

1988: On May 12, certain abandoned and cancelled mineral claims, totalling 109 hectares (270 acres), were added to Manning Park (Green File 1988).

BIBLIOGRAPHY

CL = on file at Fraser Valley District Office, Cultus 'Lake.
NV = on file at South Coast Regional Office, North Vancouver.

Akrigg, G.V. and Helen Akrigg. 1970. 1001 Place names in British Columbia. Second Edition.. Discovery Press, Vancouver.

Aldrich, Pears and Associates. 1986.. Manning Park Visitor Centre Specifications. 1573 East Pender Street, Vancouver, B.C. VSL 1V9. 96 p.

Alexander, Steacy. n.d. Park development project - Manning Park-Aquatic Ecosystems. Unpublished document, B.C. Parks Branch. (CL)

Amman, G.D and L. Safranyik. 1984. Insects of lodgepole pine: impacts and control. In Lodgepolepine: the species and its management. Symposium Proceedings, May 1984 - Spokane, Washington. Published in Vancouver, B.C.

Anderson, Frank Wesley, ed. 1969. The Dewdney Trail': Hope to Rock Creek. Frontier Publishing Ltd. Aldergrove, B.C.

Anderson, Frank Wesley, ed. 1979. The Dewdney Trail : Hope to Rock Creek. Frontier Publications Ltd. Aldergrove, B.C.

Anderson, P. 1984. Geology, petrology origin and metamorphic history of the Eagle Granodiorite and Nicola Group, Whipsaw Creek, Princeton area, southern British Columbia. Unpublished B.Sc. thesis. University of British Columbia, Vancouver B.C.., 201 pp.

Andrews, M. 1985. Holocene Paleoclimates: an Annotated Bibliography. Pp. 31-52 in Climatic Change in Canada 5. Critical Periods in the Quaternary History of Northern North America (C.R. Harington, ed.). Syllogeus Series No. 55, National Museums of Canada, Ottawa. 482 pp.

Anon. n.d.a). The Cascade Mountains. Martin Moyer Productions. Film available "Victoria Library" {check if is Parks Library)

Anon, n.d.b). The Engelmann Spruce - subalpine fir zone [of Manning Provincial Park]. Unpublished document, B.C. Parks Branch. (CL)

Anon. n.d.c). Ernest C. Manning provincial Park. Unpublished document. B.C. Parks Branch. 5 p. (NV)

Anon. n.d.d). The History of Manning Park. 4 p . Unpublished report, B.C. Parks Branch. (CL)

Anon. n.d.e). Lower Mainland Region Visitor Services Plan. B.C. Parks, Victoria. 25 p. (NV).

Anon. n.d.f). Manning Park - Mammal Checklist. Unpublished document, B.C. Parks Branch. 3 p. (CL).

Anon. n.d.g). Natural History Theme Document. Geology and Geomorphology - Manning Park. Unpublished document. B.C. Parks. (CL).

Anon. n.d.h). Notes on Butterflies and Moths of Manning Park. Manuscript o,nfile at Fraser Valley District Office.. 6 p. (CL)

Anon. n.d.i). Reptiles and Amphibians from Manning Park, B.C. Xeroxed list on file at Fraser Valley District Office. 2 p.

Anon. n.d.j). The Skagit & Sumallo Rivers Junction. Unpublished document, B.C. Parks Branch. (CL)

Anon. n.d.k). Plants invading Manning Park. Unpublished 'document. B.C. Parks Branch. (CL)

Anon. n.d.l). Preliminary list - flora of Blackwall Mountain. Unpublished document. B.C. Parks Branch. (CL)

Anon. n.d.m). Variations in rump patches and tail patterns found in Mule Deer in Manning Park. Incomplete xerox on file at Fraser Valley District Office. (More complete citation needed)

Anon. n.d.n). 1. Vegetational changes and environmental aspects between Hope and Princeton. 2.Life-forms, spatial relationships, and,xeric adaptations in the Ponderosa Pine- Bunchgrass Zone. 3. Ecological requirements and roles of 4 conifer trees. 4.Vegetation of the south and north facing slopes in the subalpine Engelmann Spruce Subalpine fir zone in Manning Park. Unpublished document. (CL)

Anon. 1929. Extracts from Reports of British Columbia Land Surveyors on Surveys Within,Yale District. B.C. Department of Lands Survey Branch. 180 pp.

Anon. 1967. Tentative Mammal List for Manning Park. Unpublished document. B.C. Parks Branch. 2 p.

Anon,. 1974a). A new plants list for Manning Park....summer/74 additions. Unpublished document, B.C. parks Branch. 2 p. (NV).

Anon. 1974b). Common mushrooms of Manning Park. Unpublished document. B.C. Parks Branch. Manning Provincial Park (CL) (NV)

Anon. 1975. Additions to the Park Flora and Fauna. Angelica dawsonii, Lygeaus kalmi kalmi and Cypphoderris mostrosa. Unpublished report. (NV)

Anon. 1980. Cascade Wilderness Study. Heritage Resources. unpublished Report to Resource Management Division, Heritage Conservation Branch, Ministry of Provincial Secretary and Government Services. 61 pp.

Anon. 1981a). A History of Manning Provincial Park. Unpublished Naturalist's Report. (CL)

Anon. 1981b). Visual Inventory Maps (Vancouver and Kamloops Forest Regions).. Recreation Section, B.C. Ministry of Forests.

Anon. 1982a). Mrs. Aurelia Angela McDiarmid 1889-1982. The Similkameen Spotlight (Princeton). Wednesday, June 9, 1982. (CL)

Anon. 1982b). Botanical Collecting in Manning Park. Unpublished document, B.C. Parks Branch. (CL)

,Anon. 1983a). Editorials - 'Privatization of Park okay', but not closure. The Hope Standard, Wednesday, July 20, 1983. (CL)

Anon. 1983b). Ski hill awaiting new management. The Hope Standard, Wednesday',August 24, 1983. (CL)

Anon. 1983c). Editorial Comment - Closure of Manning Park to affect Hope Businesses? Fraser Canyon News, July 20, 1983. (CL)

Anon. 1983d). Manning Park: Direct appeals launched to save skiing for another winter season. The Hope Standard, 'Wednesday, July 20, 1983. Hope. (CL)

Anon. 1983e). Manning Park - Trail rides, available again. Fraser Canyon News, Wednesday, August 24.

Anon. 1983f). Ministry of Lands, Parks and Housing is seeking an operator for winter ski lifts. Fraser Canyon News, Wednesday, August 24.

Anon. 1985. Values and options of the Cascade Wilderness. Presentation to Cabinet Committee on Economic Development, March 1985. Okanagan Sirnilkameen Parks Society. 27 pp.

Annstrong, B. and K. Williams. 1986. The Avalanche Book. Fulcrum, Inc., Golden, Colorado. iii + 231 pp.

Arno, Stephen F. 1984. Timberline - Mountain and Arctic Forest Frontiers. The Mountaineers. 306 Second Ave. Seattle, Washington. 304 p. (CL)

Baker, K. et al. 1976. Visitor use study of skiing facilities at Cypress, Manning and Mount Seymour Provincial Parks. Planning Division, B.C. Parks Branch, Victoria, B.C. vi + 59 pp. + maps.

Barbour, M.G., J.H. Burk and W.D. Pitts. 1980. Terrestrial Plant Ecology. The Benjamin/Cummings Publishing Company, Inc., Menlo Park California. xi + 604 pp.

Barry, R.G. 1981. Mountain weather and Climate. Methuen and Company, New York. xii + 313 pp.

Bauerman, H. 1884. Report on the geology of the country near the Forty-ninth Parallel of north latitude west of the Rocky Mountains. Geol. Surv. Can. Rept. Prog. 1882-83-84 pt. B p. 18..

B.C. Parks Branch. 1987. B.C. Provincial Parks Information Sourcebook. Ministry of Environment and Parks. 103 p.

Beckey, F.W. 1969. Challenge of the North 'Cascades. The Mountaineers, Seattle. xvi + 280 pp.

Benson, Neil. 1980. Report: Human Impact on Manning Park. Unpublished report, B.C. Parks Branch. (CL)

Bidwell, R.G.S. 1979. Plant Physiology. MacMillan Publishing Co, Inc. New York. 726 p.

Birks, H.J.B. 1981. The use of pollen analysis in the reconstruction of past climates: a review. Pp. 111-138 in Climate and History (T.M.L. Wigley, M.J. Ingram and G. Farmer, eds.). 'Cambridge University Press.

Booth, Barry P. 1987. The breeding status of the spotted owl in the Skagit River region of British Columbia. Unpublished report on file at the Region Office, North Vancouver. 18 p.

Borror, D.J., D.W. Delong and Charles A. Triplehorn. 1976. An Introduction to the Study of Insects - fourth edition. Holt, Rinehart and Winston, Toronto. 852 pp.

Borror, D.J. and R.E. White. 1970. A Field Guide to the Insects of North America. Houghton Mifflin Co., Boston.

Brayshaw, T. Christopher. 1976. Catkin Bearing Plants (Amentiferae) of British Columbia. Occasional papers of the British Columbia Provincial Museum No. 18. Victoria, B.C. 176 p.

Brayshaw, T. Christoper. 1'981. Pondweeds and bur-reeds and their relatives of British Columbia. Occasional papers of the British Columbia Provincial Museum No. 26. Victoria, B.C. 167 p.

Brewer. 1915. Map of the Yale District, Similkameen and Hope Mining Divisions.

Buffam, Frank and Wade, Keith. 1960. Report on the life of the Beaver Pond, Manning Provincial Park. Unpublished report on file at Fraser Valley District Office. 5 p.

Buffo, J., L.J. Fritschen and J.L. Murphy. 1972. Direct solar radiation on various slopes from 0 to 60 degrees north latitude. United States Department of Agriculture Forest Service Research Paper PNW-142. Pacific Northwest Forest and Range Experiment Station,.Portland, Oregon. 74 pp.

Bull, Evelyn, L. 1983. Bird response to beetle-killed Lodgepole Pine. Murrelet 64(3) 94-96.

Burt, William H. and Richard P. Grossenheider. 1976. A Field Guide to the Mammals of North America. Houghton Mifflin Company, Boston 289 p.

Bussey, Jean. 1983. Manning Park Highway Relocation Study.- Historic Resource Impact Assessment. Unpublished Document; Points West Heritage Consulting Ltd., Langley B.C. 15 p + appendices.
(CL).

Cairnes, C.E. 1923. Geological explorations in Yale and Similkameen Mining Division, southwest British Columbia. Geol. Surv. Can. Sum. Rept. 1922, pt. A.

Cairnes, C.E. 1924a). Reconnaisance of 'SilverCreek, Skagit and Similkameen Rivers, Yale District, B.C. Geol. Surv. Can. Sum. Rept. 1923, pt. A.

Cairnes, C.E. 1924b). Coquihalla Area, British Columbia. Geol. Surv. Can. Mem. 139.

Cameron, John N.. 1970. The history and natural resources of Manning Park., BSF Thesis, Vancouver, University of British Columbia B.C.

Campbell, R.W. and A.P. Harcombe. 1985. Wildlife Habitat handbooks for British Columbia: Standard Taxonomic List and Codes of Amphibians, Reptiles, Birds and Mammals. B.C. Ministry of Environment, Ministry of Forests and Ministry of Provincial Secretary and Government Services joint publication. Victoria, B.C.

Camsell, C. 1909. Preliminary report on part of the Sirnilkameen District. Ottawa. {incomplete citation)

Camsell, C. 1912. Geology of the Skagit Valley, Yale District, B.C. Geol. Surv. Can. Sum. Rept. 1911: 115-123.

Camsell, C. 1913. Geology and mineral deposits, Tulameen District, British Columbia. Geol. Surv. Can. Mem. 26.

Cannings, Richard, 1972. Birdwatching in Manning Park - an annotated list. Unpublished manuscript. B.C. Parks Branch. 14 p.
(CL) (NV)

Carl, G.C., W.A. Clemens and G.C. Lindsey. 1959. The Fresh-water Fishes of British Columbia. British Columbia Provincial Museum Handbook No. 5. 192 pp. + illustrations.

Carl, G. Clifford, C.J. Guiget and G.A. Hardy. 1952. A natural history survey of the Manning Park Area.., British Columbia. Occasional Paper #9. British. Columbia Provincial Museum, victoria, B.C. .

Case, R.O. and V. Case 1945. Last Mountains: The Story of the Cascades. Doubleday, Doran, Garden City, N.Y. 236 pp.

Chesterman, C.W. 1980. The Audubon Society Field Guide to North American Rocks and Minerals. Alfred A. Knopf Ltd., N.Y. 850 pp.

Chilton, R. 1981. A Summary of Climatic Regimes of British Columbia. B.C. Ministry of Environment, Assessment and Planning Division, Victoria. v + 46 pp.

Chuang, Ching-Chang. 1974. Lewisia tweedyi: a plant record for Canada. Syesis 7:259-260. (CL)(NV)

Clague, J.J. 1981. Late Quaternary geology and geochronology of British Columbia: Part 2: Summary and discussion of radiocarbon-dated Quaternary history. Geological Survey of Canada Paper 80-35: 1-41.

Clark, L.J. 1974. Wildflowers of British Columbia. Grey's Publishing'Ltd. Sidney, B'C.

Coates, J.A. 1970. Stratigraphy and Structure of Manning Park area, Cascade Mountains, British Columbia. Geol Assoc. Can., Spec Paper No. '6: 149-154.

Coates, J.A. 1974. Geology of the Manning Park Area, British Columbia.. Geological Survey of Canada Bull. 238. (CL)

Cole, G.A. 1983. Textbook of Limnology. Third Edition. The C.V. Mosby Company, St. Louis. xii + 401 pp.

Collins, M.P. and Edna Joyce. 1977. A guide to archeological sites in Parks. Parks and Outdoor Recreation Division Planning Report No. 77-4 . Victoria , B.C.

Courtin, P.J., K. Klinka and J. Heineman. 1981. Biogeoclimatic Units - Victoria Vancouver. Map producedby the Ministry of Forests, Victoria B.C.

Cowan, I.M. and Guiguet 1965. The Mammals of British Columbia. B.C. Provincial Museum Handbook.

Culbert, D. 1974. Alpine Guide to Southwest British Columbia. {incomplete citation)

Curtis, Helena. 1979. Biology. Worth Publishers, Inc. New York, New York. p. 1043.

Daly, R.A. 1912. Geology of the North American Cordillera at the Forty-Ninth Parallel. Geol Surv. Can. Mem. 38.

Davidson. J. 1916. Botanical exploration of the Skagit River Basin, B.C. Third Annual Report of the Botanical Office. Cited in Underhill and Chuang 1976.

Day, 195'3. Cited in Wood 1989 - no reference.

Douglas, George, W. 1982. The sunflower Family (Asteraceae) of British Columbia. Vol. 1. Senecioneae. No. 23 Occasional Papers Series, British Columbia Provincial Museum. Victoria, B.C. 180 pp.

Douglas, G.W. and T.M. Ballard. 1971. Effects of fire on alpine plant communities in the North Cascades, Washington. Ecology 52: 1058-1064.

Douglas, W.O. 1950. Of Men and Mountains. Harper and Row, N.Y.

Downs, Art, ed. 1980. The Hope Slide Story. Heritage Publishing Company Ltd. 62 pp.

Drucker, Phillip. 1955. Indians of the Pacific Northwest. Natural History Press, New York.

Dube, D.E. 1978,. Fire ecology in resource management: Workshop proceedings. Environment Canada, Canadian Forestry Service, Northern Forest Research Centre, Information Report NOR-X-210. 111 pp.

Duff, Wilson. n.d. The Indian History of British Columbia, Vol. 1. The impact of the white man. Anthropology in British Columia Memoir No. 5., B.C. Ministry of Provincial Secretary and Travel Industry. victoria, B.C.

Dunbar, David L. and Eric D. Forsman. 1986. Status of the Spotted, Owl in British Columbia. Draft of paper submitted to Can. Field Nat. (NV)

Dyckman, Claire and Stan Garrod, eds. 1977. Small Streams and Salomonid: A Handbook for Water Quality Studies. U.N.E.S.C.O., Paris. 222 pp.

Dymond, J.R. 1932. The trout and other game fishes of British Columbia. Federal Department of Fisheries, Ottawa. 51 pp.

Eberts, Tony. 1983. Unique Fauna threatened. The Outdoors Section, The Province. Friday, August 12, 1983.

Eckman, L.C. 1962. Scenic Geology of the Pacific Northwest. Binfords and Mort Publishers, Portland. xiv + 310 pp.

Edwards, R.Y. 1950. A Faunal investigation of E.C. Manning Park. B.C. Parks Branch Report, Victoria, B.C. 73 pp. (NV)

Edwards, R.Y. 1965. Bird finding in Manning Park British Columbia. Canadian Audubon Magazine Sept-Oct. 2-6. (CL)(NV)

Ehrlich, P.R., D.S. Dobkin and D. Wheye. 1988. The birder's Handbook. A Field Guide to the Natural History of North American Birds. Simon and Shuster Inc. XXX + 785 pp.

Environment Canada. 1982a. Canadian Climate Normals. Temperature and Precipitation: British Columbia. Environment Canada Atmospheric Environment Service, Ottawa. ix + 268 pp.

Environment Canada. 1982b. Canadian Climate Normals, Vol. 4. Degree Days. Environment Canada Atmospheric Environment Service, Ottawa. ix + 268 pp.

Environment Canada. 1982c. Canadian Climate Normals, Vol. 6. Frost. Environment Canada. Atmospheric Environment Service, Ottawa. xi + 276 pp.

Fitzgeorge-Parker, Ann. 1968. Gold Rush Justice. Burns and MacEachern Limited, Ottawa. 28 pp.

Fitz-Gibbon, Joyce, Al Grass, and Wayne Stetski. 1981. Provincial Parks, Lower Mainland Region, Interpretive Plan. March 1981 draft copy. Unpublished document, B.C. Parks. (NV)

Fladmark, Knut R. 1986. British Columbia Prehistory. Archaeological Survey of Canada, National Museum of Man, National Museums of Canada. x + 150 pp.

Forsyth A. 1985. Mammals of the Canadian Wild. Camden House Publishing Ltd. Camden East, Ontario. 351 pp.

Franklin, J.F. and C.T. Dryness. 1973. Natural vegetation of Oregon and Washington. USDA Forest Service General Technical Report PMW-8. Washington, D.C. U.S. Government Printing Office.

Fraser, Colin. 1978. Avalanches and Snow Safety. John Murray (Publishers) Ltd., London. xiii + 269 pp.

Gabriel, 1976. cited in Wood 1989 - no reference.

Goodwill, Vic. 1974. Addendum - Records by M&VG and RS in Manning Provincial Park B.C. in Goodwill, J.E.V. 1974. Southern Vancouver Island Nesting Season Records 1 June 1974 to 31 July 1974. Unpublished report. (CL) (NV)

Goodwill, Vic. 1.974. Addendum - Records by VG in Manning Provincial Park B.C. in Goodwill, J.E.V. 1974. Southern Vancouver Island Fall Migration Records. '1August to 31 November 1974. Unpublished report. (CL) (NV)

Goodwill, Vic. 1980. Addenda to Mannings Birds. Memo on file at Fraser Valley District Office. (CL)

Goward, Trevor. 1974. Notes re: common valley and alpine plants of Manning Park.. Unpublished document. B.C. Parks Branch. (CL)

Goward, Trevor. 1985. Flowering times of selected plants of the Beaver Pond Trail. Unpublished document. B.C. Parks Branch. (CL)

Goward, Trevor and Ching-Chang Chuang. 1974a. A tentative checklist of the plants of Chuwanten Mountain. (CL) (NV)

Goward, Trevor and Ching-Chang Chuang, 1974b. Chuwanten.: a horseless mountain. Unpublished special report. B.C. Parks Branch, Manning Provincial Park (CL) (NV)

Goward, Trevor and Ching-Chang Chuang. 1974c. A checklist of the plants of Strawberry flats in a look at the proposed development of the Gibson Pass ski complex (Parking Lot,,new ski hill, etc.) Unpublished special report. B.C. Parks Branch. 5 p. (NV)

Grass Al. n.d. A history of Manning Park. Unpublished report for Ministry of Land, Parks and Housing. cited in Harris 1984.

Grass, Al and Gail Ross. n.d. Land of the Golden Larch: Manning Park. (Discovery? check) pp. 43-46.

Gray, David R. 1975. The marmots of Spotted Nellie Ridge. Nature Canada 4(1):3-8.

Green File. 1988. Park Status Sheet. (CL)

Green, D.M. and R.W. Campbell. 1984. The Amphibians of British Columbia. British Columbia Provincial Museum Handbook No. 45. vii + 101 pp.

Greenwood, Joan. n.d. Lost in the Wilds. Westworld . Xerox of article on file at Fraser Valley District Office - publication information unknown (CL).

Gregory, P.W. 1929. Extract from the report of P.W. Gregory. Dated November 27th, 1920. Pp. 1.16-117 in Extracts from Reports of British Columbia Land Surveyors on Surveys within Yale District 1891-1928. B.C. Department of Lands, Survey Branch, Victoria. 180 pp.

Haas, Norma. 1965. A study of the needle variation in the alpine fir Abies lasiocarpa, August 1965. unpublished document, B.C. Parks Branch. (CL)

Hainsworth, F. 'Reed. 1981. Animal Physiology - Adaptations in Funtion. Addison-Wesley'Publishing Company. Don Mills, Ontario. 669 p.

Halasz, Gabor. 1986. The 'Whistler' in Manning Provincial Park, British Columbia. Discovery 15(2):70-71.

Hansen, H.P. 1955. Postglacial forests in south central and central British Columbia. American Journal of Science 253: 640-658.

Harcombe, Andrew and Robert Cyca. 1979. Exploring Manning Park. Douglas & McIntyre. North Vancouver, B.C.'

Harcombe, A. and J.E. Underhill. 1970. Moths and Butterflies of Manning Park. British Columbia Parks Branch. Dept. Recreation and Conservation. 10 p. (CL)

Hare, F.K. and M.K. Thomas. 1974. Climate Canada. Wiley Publishers of Canada Ltd., Toronto. 256 pp.

Harington, C.R., and G. Rice, eds. 1984. Climatic Change in Canada 4. Annotated Bibliography of Quaternary Climatic Change in Canada. Syllogeus Series No. 51, National Museums of Canada, Ottawa. 368 pp.

Harris, Bob. n.d. Paradise Valley section of the Dewdney Trail - in the heart of the Cascade Wilderness. Xeroxed magazine article - publication unknown (CL)

Harris, Bob. 1976. Hiking Trails. The Hope Trail: Skaist River Section just north of Manning Park. B.C. Outdoors, February 1976: 28-29.

Harris, Bob. 1977a. Hiking Trails. Coquihalla Canyon near Hope, B.C. B.C. Outdoors, February 1977: 18-19.,

Harris, Bob. 1977b. Hiking Trails. Trail from Manning Park to the Punch Bowl. B.C. Outdoors, December 1977: 20-21.

Harris, Bob. 1979. Hiking Trails. A walk to Silverdaisy: Furs and mines in the Skagit. B.C. Outdoors, February 1979: 20-22.

Harris, Bob. 1980a. Hike Into History. Pp. 56-59 in Downs (1980).

Harris, Bob. 1980b. Hiking Trails. Scenic Alpine Beckons. B.C. Outdoors, October 1980: 14-47.

Harris, Lorraine. n.d. Manning Park - Before and After. Unpublished draft manuscript. 1101 -2222 Bellevue St. West, Vancouver, B.C. 13 p. (NV)

Harris, Lorraine. n.d. Manning Park. All Season's Playground. Unpublished draft manuscript. 901 -2150 Bellevue St. West Vancouver, B.C. 13 p. (NV)

Harris, Lorraine. 1984. Manning Park. An All-Seasons Playground. Hancock Publishing House. Vancouver, B.C. 47 pp.

Harris, R.C. 1976. Correspondence to D. Suttill. File No. 3-2-32-99.

Harris, R.C. 1981a. Clearing the Dewdney Trail through Paradise Valley, 1981, in the Cascade Wilderness. 17 pp.

Harris, R.C. 1981b. Reopening the Dewdney Trail through Paradise Valley. Third Progress Report, 1981, September 28. 11 pp.

Harris, R.C. 1981c. Review of the Second Draft (1981 Apr.) of the Provincial Study concerning the Cascade Wilderness immediately north of Manning Provincial Park. 29 pp.

Harris, R.C. 1982. The Steamboat trail. Hope to Skagit Valley 1910-1911. British Coumbia Historic News.Spring:17-21.

Harris, R.C. 1983. Hiking the Skyline Trail: Skagit River to Manning Park Lodge. B.C. Outdoors, September 1983: 43-46.

Harris, R.C. and H.R. Hatfield. 1977. Old Pack Trails in the Proposed Manning Park Extension. Okanagan Similkameen Parks Society. 28 pp.

Harris, R.C. and H.R. Hatfield. 1978. Old Pack Trails in the Proposed Cascade Wilderness. Okanagan Similkameen Parks Society. Summerland, B.C.

Harris, S.L. 1976. Fire and Ice: The Cascade Volcanoes. The Mountaineers, Seattle. 320 pp.

Harrison, Linda. 1980. Wildlife Viewing Areas for Future Interpretive Planning in Manning Provincial Park, B.C. Unpublished student report, Fish, Wildlife and Recreation Option, B.C. Institute of Technology.

Hatfield, H.R. n.d.a. Blazing Old Trails. The Historic HBC Trail from' Fort Hope to Tulameen is once again a pathway to adventure. (Magazine unknown, File No. 3-2-32-4.

Hatfield, H.R. n.d.b. The proposed Cascade Wilderness. Okanagagan Historical Society and Okanakgan Similkameen Parks Society. 9 pp.

Hatfield, H.R. 1980a. H.B.C. Brigade Trail, Part 1. Trails of the Cascade Wilderness. Whiskey Jack, March/April:24-27

Hatfield, H.R. 1980b. H.B.C. Brigade Trail, Part 2. Cascade Wilderness trails. Whisky Jack, May/June:24-25.

Hatfield, H.R. 1981. Old Trails of the Cascade Wilderness. Heritage West, Winter: 18-21

Heritage. 1987. The Dewdney Trail: Hope to Fort Steele. Heritage House Publishing Company Ltd. 158 pp.

Hill, Dorothy, Sumallo Grove Interpretive Trail. Unpublished report, B.C. Parks Branch, Manning Prov. Park. 15 p. (NV)

Hills, L.G. and E.V. Sangster. 1980. A review of paleobotanical studies dealing with the last 20,000 years; Alaska, Canada, and Greenland. Pp. 73-224 in Climatic Change in Canada (C.R. Harington, ed.). Syllogeus Series No. 26, National Museums of Canada, Ottawa.

Hilton, Joseph. 1963. Some notes on the history of Manning Park -(based on the recollections of Joe Hilton). Unpublished manuscript. B.C. Parks Branch (CL).

Hilton, Joseph. 1980. Mr. Joesph [sic] Hilton's recollections as told to the park naturalists, Mr. D. Gough and Mr. A. Midnight. Unpublished manuscript. B.C. Parks Branch. (CL)

Historic Parks and Sites Division. 1976. Human History - Manning Provincial Park. File 3-2-15-4 Manning Park. Unpublished report, B.C. Parks. 3 pp.

Hong, Won, S. 1983. The genus Gymnomitrion in North America, west of the Cascades. Lindbergia 9:169-177.

Hong, Won., S. 1984. Correspondance with G. Trachuk re.: collection of Liverworts in Manning, Garabaldi and Strathcona Prov. Parks. (NV).

Horton, K.W. 1953. Cited in Wood 1989 - no reference.

Hunn, E. S. 1981. On the relative contribution of men and women to subsistence among hunter-gatherers of the Columbia Plateau: A comparison with Ethnographic Atlas summaries. Journal of Ethnobiology 1(1): 124-134.

Hunn, E. S. and H. H. Norton. 1984. Impact of Mt. St. Helens Ashfall on fruit yield of mountain huckleberry, Vaccinium membranaceum, Important Native American food. Economic Botany 38 (1): 121-127.

Hutchins, H.E. and R.M. Lanner. 1982. The central role of Clark's Nutcracker in the dispersal and establishment of whitebark pine. Oecologia 55: 192-201.

Jackson, G.J. 1929a. Extract from the Report of G.J. Jackson. Dated December 15th, 1923. Pp. 150-151 in Extracts from Reports of British Columbia Land Surveyors on Surveys within Yale District 1891-1928. B.C. Department of Lands, Survey Branch, Victoria. 180 pp.

Jackson,' G.J. 1929b. Extract from the Report of G.J. Jackson. Dated December 26th, 1924. Pp. 155-157 in Extracts from Reports of British Columbia Land Surveyors on Surveys within Yale District 1891-1928. B.C. Department of Lands, Survey Branch,. Victoria. 180 pp.

Jeletzky, J.A. 1965. Late Upper Jurassic and Lower Cretaceous fossil zones of the Canadian Western Cordillera, British Columbia. Geol. Surv. Can. Bull 103. 70 pp.

Jeletzky, J.A., 1970. Lower Cretaceous and late Upper Jurassic. biochronology and facies of Manning Park area, British Columbia., Geol. Surv. Can. Rept. of Activities. Paper 70-1, pt. A: 214-223.

Jeletzky, J.A. 197?. Jurassic and Cretaceous Rocks along Hope-Princeton Highway and Lookout Road, Manning Park, British Columbia. Geological Survey of Canada: Supplement to Section 10 of 24th International Geological Congress Guidebook. A03-C03.

Johnston, Bill. 1982. Case study: cascade Wilderness. Historic Routes '82. A seminar summary. Outdoor Recreational Council of British Columbia. 9-15.

Kendrew, W.G. and D.P. Kerr. 1951. The Climate of British Columbia and the Yukon Territory. Federal Deparment of Transport, Meteorological Branch. 222 pp.

Kershaw, Adrian and John Spittle. 1982. Historic tails in B.C. Historic Routes '82. A seminar summary. Outdoor Recreational' Council of British Columbia. 9-15.

Kettner, Bonni Raines, 1983. Gov't gets jump on `privatization'. Focus, .The Province. Sunday July 10, 1983. Vancouver B.C. (CL)

Xing, David G., Al Grass and Ken Summers. 1973. Observations of the dipper in the Skagit Valley of British Columbia. The Murrelet 54(2):16-19. (NV)

Kleinspehn, K. 1980. Some Geological Facts: Manning Park 50-100 m.y.a. Taped interview. (MP) cited in Ross, M. 1981.

Kopp, Brad. 1985. Trails in the cascade Wilderness Area (Merrit Forest District) Unpublished Report. 6 pp. + Appendices and Maps.

Larcher, W. 1975. Physiological Plant Ecology. Springer-Verlag. New York. 252 p.

Loope and Gruell. 1973. cited in Wood 1989 - no reference.

Loton, J.E. 1976. Cone serontiny-fire relationships in lodgepole pine. In. Tall Timbers Fire Ecology Conference Proceedings 14:267-278.

Ludowicz, Deanna G. 1980. Prehistoric and historic patterns of resource utilization in the 'southcentralinterior plateau, B.C. Seminar presented to the Regional Advisors Meeting, Princeton, B.C. unpublished notes. (CL)

Lyons, C.P. 1946. Spectacular ski exploration maps - Manning Park sports possibilities. Vancouver Sun, Saturday, April 13. (CL)

Lyons, C.P. and D.M. Trew'. 19.43 Reconnaissance and preliminary recreation plan - E.C. Manning Park (Manning Park). Parks Section, Forest Econo ics, B.C. Forest Service. Victoria, B.C. 55 p.

MacMillan, H.R. 1939. correspondence to W.G. Firth, B.C. Department of Lands, Survey Branch. November.9, 1939. 2 pp.

Manning Park Nature House. 1975. Checklist of the birds of Manning Provincial.Park. 4 p.

Marc, Jacques. 1978. Forest 'capability in lower' mainland Provincial Parks. Unpublished student report, BCIT Forest Resources Technology Program, Burnaby, British Columbia.

Mark, David and Ben Feltner. n.d. Site B-14: Manning Park. Where to find birds in British Columbia, second edition. Vancouver, B.C.

Mathewes, R.W. 1985. Paleobotanical evidence for climatic change in southern British Columbia during late-glacial and Holocene time. Pp. 397-422 in Climatic Change in Canada 5. Critical 'Periodsin the Quaternary History of Northern North America (C.R. Harington, ed.). Syllogeus Series No. 55, National Museums of Canada, Ottawa. 482 pp.

Mathews, W.H. 1944. Glacial Lakes and ice retreat in south-central British Columbia. Trans. Roy. Soc. Can. Sec. IV: 39-57.

Mathews, W.H. 1950. Physical features of the Lightning Lakes Valley, southwestern British Columbia (Abstract). Bull. Geol. Soc. Amer 61: 1529.'

Mathews, W.H. 1968. Geomorphology of Lightning Creek Valley, Manning Park, British Columbia. Syesis 1:65-79. (NV)

May, B. 1982. Whatcom Trail. Unpublished information sheet. B.C. Parks.

McCune, Sane. 1983. B.C.'s garage sale called `privatization'. Business section, The Province, Sunday, July 17, 1983. Vancouver B.C.

McClanaghan, Dale. n.d. Trails across the Cascades - being a history of European exploration and establishment of overland trade routes across the Cascades Mountains to the interior of British Columbia from Fort Hope. Historic Sites Research Division, Heritage Conservation Branch, Ministry of Recreation and Conservation, Victoria, B.C. (CL) (NV)

McCrory, Wayne and Stephen Herrero. 1987. Preservation and management of the grizzly bear in B.C. Provincial Parks - the urgent challenge. McCrory Wildlife Services, Box 146, New Denver, B.C. V0G 1S0. Consult nts report prepared for B.C. Parks and Outdoor Recreation Division, 4000 Seymour Place,, Victoria. 186 p. (NV) a

McGrenere, Barb and Jim Wilson. 1985. Paintbrush Interpretiv'e Trail. B.C. Parks, Ministry of Lands, Parks and Housing, Victoria, B.C. 23 p.

McKee, Bates.. 1972. Cascadia- the geologic evolution of the. Pacific Northwest. McGraw-Hill Inc. Toronto. 394 p.

McTaggart, K.C. and R.M. Thompson. 1967. Geology of part of the northern Cascades in southern British Columbia. Can. J. Earth Sci. 4: 1199-1228.

McWilliams, H.G. 1956. Manning Park Development Plan. cited in Anon, 1981a.

Mehling, Carol. 1983. What I learned from Mr. Tower. Unpublished Report. (CL)

Mehling, Carol. 1984. Trail Report: Mount Cheam. 1 p. (CL)

Meidenger,' Del. 1988. Recommended vernacular names for common plants of British Columbia. Research Report - Internal reports of the Minstry of Forests and Lands Research Program. Victoria, B.C. 64 p.

Milliken, A.C. 1980. Paul Fraser's Grave. pp. 60-62 in Downs (1980).

Milne, Lorus and Margery Mile. 1980. The Audubon Society Field Guide to North American Insects and Spiders. Alfred A. Knopf, New.York. 989 p.

Ministry of Forests. 1981. Biogeoclimatic Units - Victoria - Vancouver. 1:500000 n.t.s. sheet 92 s.e. Map available from Ministry of Forests, Information Services Branch, 1450 Government St, Victoria, B.C. V8V 1X5. (NV)

Ministry of the Environment. 1981. Flash Lake. Map of depths in meters. Resource Analysis Branch, Ministry of the Environment, Biological Systems Section. 1 p. Victoria, B.C. (NV)

Ministry of the Environment. 1981. Lightning Lake. Map of depths in meters. Resource Analysis Branch, Ministry of the Environment, Biological Systems Section 1 p. Victoria, B.C. (NV)

Ministry of the Environment. 1980. Strike Lake. Map of depths in meters. Resource Analysis Branch, Ministry of the Environment, Biological Systems Section 1 p. Victoria, B.C. (NV)

Ministry of Lands, Parks and Housing. 1982. Natural Regions and Regional landscapes for British Columbia's Provincial Park System.

Ministry of Recreation and Conservation; 1978. Dewdney Trail - 1865. A guide to travel on the restored section of the Dewdney Trail between Christina Lake and Rossland. B.C. Ministry of Recreation and Conservation. Heritage Conservation Branch publication. Victoria, B.C. 8 p.

Misch, P. 1966. Tectonic evolution of the Northern Cascades of Washington State; in Tectonic history and mineral deposits of the western Cordillera, sen. ed. H.C. Gunning: Canadian Institute of Mining and Metallurgy, Special Volume 8:101-148.

Mitchell, W.R. and R.E. Green. 1981. Identification and interpretation of ecosystems of the Western Kamloops Forest Region. Volume II Dry and subcontinental Climatic Regions. Information Services Branch, B.C. Ministry of Forests, Victoria.

Monqer, J.W.H. 1985. Structural Evolution of the southwestern intermontane belt, Ashcroft and Hope map areas,, British Columbia., In Current research, Part A. Geological Survey of Canada,,Paper 85 1A, pp. 349-358.

Mogensen, Faye. 1982a. Dry Ridge Trail .Unpublished document, B.C. Parks Branch. (CL)

Mogensen, Faye. 1982b. Terrestrial ecosystems - Food Chains - a few examples. Unpublished document, B.C. Parks Branch. (CL)

Mogensen,,Faye. 1982c. Terrestrial ecosystems [Rein Orchid Trail] Unpublished document, B.C. Parks Branch. (CL)

Mogensen, Faye. 1982d. Terrestrial ecosystems [McDiarmid Meadows] Unpublished document, B.C. Parks Branch. (CL)

Mogensen, Faye. 1982e. Strawberry Flats. Unpublished document, B.C. Parks Branch. (CL)

Mogensen, Faye. 1982f. Terrestrial ecosystems [Rhododendron Flats]. Unpublished document, B.C. Parks Branch. (CL)

Mogensen, Faye. 1984. Notes from Magnus Thorstenson. Unpublished Report. (CL)

Monger, J.W.H. ,1985. Structural evolution of the southwestern intermontane belt, Ashcroft and Hope Map areas, British Columbia. Current Research, Part A. Geological Survey of Canada. Paper 85-1A. p 349-385. (NV)

Mourning Dove. 1933. How Coyote happened to make the black moss food. In: Coyote Stories. The Caxston Printers; Ltd., Caldwell, Idaho.

National Geographic Society 1984. Field Guide to the Birds of North America. National Geographic Society.

Oarshall, Harry, Gilbert McArthur, Dave Suttill and Mel Turner. 1981. Cascade Wilderness Study, Status report. B.C. Ministry of Municipal Affairs and Housing. 140 p. (CL)

O'Brien. Derek. Manning Park Avifauna Report. Summer 1974. 10 p.

Okanagan Similkameen Parks Society. 1984. Cascade Wilderness.' Presentation to Ministry of Forests, February 25, 1984.

OSPS 1982. Old Pack Trails in the Cascade Wilderness. Okanagan and Similkameen Parks Society, Summerland.

Osmond-Jones, Ted. 1977. A brief assessment of wildlife. and related values in the Paradise Val'ley Area adjacent to Manning Park. Unpublished memo, Wildlife . 'Section, Environmental Management Div. Parks Branch. 6 p.

Ostrem, G. 1968. The height of glaciation limit in southern British Columbia and Alberta. Geogr. Annaler 48, Ser. A:126-138.

Paden, John. 1972.. letter to D. Belton re: identification of <u>Exobasidium vaccinii</u> from Manning Provincial Park. (CL) (NV)

Parks and Outdoor Recreation Division. 1981. E.C. Manning Park Master Plan. B.C. Parks, Victoria, B.C. 36 p. (NV)

Perry, T.L. 1981. A citizens' guide to the Skagit Valley. Published by the Run Out Skagit Spoilers Committee. Vancouver, Canada. 85 p.

Pettingill, Olin Sewall, Jr. 1985. ornithology in Laboratory and Field. Fifth Ed. Academic Press, Toronto. 403 p.

Pharo, Chris. n.d. Heather Trail, Westworld. Summer:83-84.

Polotylo, D. L. and P. D. Froese (1983. Archaeological evidence for prehistoric root gathering on the southern Interior Plateau of British Columbia: a case study from upper Hat Creek Valley. Canadian Journal of Archaeology 7 (): 127-157.

Porter, Marian. 1987. Results of the fifth annual Manning Park Bird Blitz. Unpublished memo. (NV).

Prosser, C. Ladd. 1973. Comparative Animal Physiology. Third edition. W. B. Saunders Co., Toronto. 966 p..

Ramsden, Eric. 1960. Manning's bid for Winter Olympics - Park could park 10,000 cars. 'Vancouver Sun, Saturday, June 18.

Reid, R. W. 1963. Biology of the mountain pine beetle, Dentroctonus monticolae Hopkins in the East Kootenay Region of British Columbia. III Interactions between the beetle and'its host, with emphasis on brood mortality and survival. Canadian Entolmologist 95:25-238.

Rice, H.M.A. 1947. Geology and mineral deposits of the Princeton Map area, British Columbia. Geol. Survey .of Canada Me. 243, 136 pp.

Rodgers, John. 1980. Mysteriously, hundreds of birds are dying. Vancouver Sun, July 28. Outdoors Section. Vancouver B.C. (CL).

Robinson, R.C. 1962. Blue stain 'fungi in lodgepole pine (Pinus contorta Dougl var. latifolia Engelm.) infested by mountain pine beetle (Dendroctonus monticolae Hopk.) Canadian Journa'lof Botany 40:609-614.

Robinson, P. 1981. Management options for mountain pine beetle in Manning Park. Unpublished manuscript. BC Parks Branch (CL).

Roe, J. 1980. The North Cascadians. Madrona Publishers, Seattle. X + 214 pp.

Ross, Alexander. 1855. The fur traders of the far West: A narrative of adventures in Oregon and the Rocky Mountains. Vol. 1 (Citation incomplete).

Ross, Gail. 1982 The rhododendron roadside attraction - Manning Provincial Park - the red rhododendron capital of British Columbia. p. 12-13. Nature Canada

Ross, Gail, Al Grass 1981. Where's the Wildlife - a brief guide to the birds and mammals of Manning Provincial Park. Discovery, Vol?:56-60.

Ross, Gail. '1986. Manning Park's Rhododendrons. Discovery 15(2):51-52.

Ross, Gail. 1983. Manning Park Interpretive and Information Plan.

Ross, Martin. 198.1. Geology of Manning Park. Unpublished manuscript. Manning Provincial Park. (CL)

Rushton, Gerry. n.d. Report on life supported by Lodgepole pine (Pinus contorta) in Manning Park. Unpublished mimeo. (CL)

Rushton, G.E. 1962. Study of Alpine larch (Larix lyallii) of Manning Park. Unpublished mimeo. (CL) (NV)

Safranyik, L., D.W. Shrimpton and H.S. Whitney. 1974. Management of lodgepole pine to reduce losses from the mountain pine beetle. Canadian Forsest Service. Forest Technical Report 1. Ottawa, Canada.

Sather, Michael. 1982. A cursory creel census of Lightning Lake in Manning Provincial Park. Park Resources Section, Provincial Parks Branch, Parks and Outdoor Recreation Division, Ministry of Lands, Parks and Housing. Victoria B.C. 12 p. (NV)

Scott, W.B. and E.J. Crossman. 1973. The Fresh Water Fishes of Canada. Bulletin 184 of the Fisheries Research Board of Canada, Ottawa. xi + 966 pp.

Shaw, J. n.d. Mountain Adaptations [of Manning Park Organisms]. Unpublished document, B.C. Parks Branch.' (CL)

Shaw, Janice. 1980. Recreational Opportunities document - Manning Provincial Park. Unpublished report. B.C. Parks (CL).

Smith, R.L. 1977. Elements of Ecology and Field Biology.. Harper & Row, New York. 497 p.

Smith, R.L. 1980. Ecology and Field Biology. Third Edition. Harper and Row, Publishers, New York. xii + 835 pp.

Smith, G.O. and F.C. Caulkins. 1904. A geological reconnaissance across the Cascade Range near the Forty-ninth Parallel. U.S. Geol. Surv. Bull. 235.

Smith, S.B. 1951. Analysis of a Creel Census on Lightning Lakes in E.C. Manning Park. B.C. Game Dept. Internal Report. Partial xerox on file at Regional Office in North Vancouver. (NV)

Spalding, D.J. 1956. Wildlife investigations in Manning Park, Summer 1956. Unpublished report, B.C. Forest Service, Parks and Recreation Division, Victoria, B.C. 14 p.

Steedman, E.V. (ed.) 1930. The ethnobotany of the Thompson Indians of British Columbia. Based on field notes by James A.
Sowden, Peggy. 1974. Manning Park' Mammal Records - 1974. Unpublished manuscript. B.C. Parks Branch. 14 p. (CL) (NV)

Spring, Ira, and Harvey Manning. 1976. 101 Hikes in the North Cascades. The Mountaineers, Seattle, Washington.

Spring, R. 1969. The North Cascades National Park. Superior publishing Company, Seattle. 143 pp.

Stream Enhancement Research committee. 1980. Stream Enhancement Guide. Federal Department of Fisheries and Oceans, B.C. Ministry of Environment, Vancouver. V + 882 pp. + Appendices.

Stringer, G.S. 1952. Analysis of a Creel [sic] on Lightning Lakes in E.C. Manning Park. B.C. Game Dept. Internal Report. 8 p. (NV)

Stuart, K.M. 1984. Wildlife-Vehicle Collisions- Lower Mainland (Region 2) April 1982-1983. B.C. Wildlife Branch Publication. Victoria, B.C. 18 p. (CL)

Sutherland, Ron. 1981. A recent Cascade Hike - Saving the Cascade Trails. Heritage West Winter:22.

Suttill, David. 1980. Historic trails of the Cascade Wilderness. Datum - Heritage Conservation Branch Newsletter 5(4)

Szczawinski, A.F. 1962. The Heather Family of British Columbia. B.C. Provincial Museum Handbook No. 19. Victoria, British Columbia. 205 p.

Tagles, Robin. 1982. The Gold Rush Trails: The Dewdney & Hope Trails. Unpublished manuscript. B.C. Parks. (CL)

Teit, J. A. 1900. The Thompson Indians of British Columbia. Memoir of the American Museum of Natural History, Vol. I Part IV. (F. Boas ed.) New York.

Teit.J.A. 1927. U. S. Bureau of American Ethnology, 45th Annual Report, 28:443-522. (Facsimile reproduction 1973, The Shorey Bookstore, Seattle, W.A.)

Teit, James. 1930. Salish Tribes of the Western Plateaus. BAE-AR No. 45.

Thomson, David. compiler, 1974. Mammals of Manning Park. Unpublished manuscript. Manning Provincial Park. 6 p. (CL)

Thompson, G. 1984. The Pond. The MIT Press, Cambridge, Massachusetts 256 pp.

Thompson, Ida. 1982. The Audubon Society Field Guide to North American Fossils. Alfred A. Knopf Ltd., N.Y. 846 pp.

Thorne, Peter. 1978. Fossils in Manning Park. Wildlife Review Spring:12-13. (NV) (CL)

Tilden, J.W. and Arthur C. Smith. 1986. A Field Guide to Western Butterflies. Houghton Mifflin Company, Boston. 370 p.

Toews, D.A.A. and M.J. Brownlee. 1981. A handbook for fish protection on forest lands in British Columbia. Field Services Branch, Federal Department of Fisheries and Oceans, Vancouver. 173 pp.

Tomback, D.F. 1980. How nutcrackers find their seed stores. Condor 82: 10-19.

Trowbridge, R.L. and A. Macadam. 1983. Prescribed Fire - Forest Soils: Symposium Proceedings. Information Services Branch, B.C. Ministry of Forests, Victoria. 118 pp.

Turnbull, Elsie G. 1980. Hope-Princeton Highway....Today and Yesterday. p. 30-35 in Downs (1980).

Turner, M.H. 1979. A plan for the allocation and management of Provincial Parks and Recreation areas in the lower mainland region. Parks and Outdoor Recreartion Division, Ministry of Lands, Parks and Housing , North Vancouver, B.C. 57p.

Turner, M.H. 1979. A conceptual plan for Manning Park. Parks and Outdoor Recreation Division, Ministry of Lands, Parks and Housing, North Vancouver, B.C.

Turner, N.J. 1975. Food Plants of British Columbia Indians, Part 1. Interior Peoples. Handbook No.34, British Columbia Provincial Museum, Victoria, B.C.

Turner, N.J. 197 . Economic important of black tree lichen (Bryoria fremontii to the Indians of western North America. Economic Botany 31 461-470.

Turner, N.J. 1978. Food Plants of British Columbia Indians, Part 1. Interior Peoples. Handbook No. 36, British Columbia Provincial Museum, Victoria, B.C.

Turner, N.J. 1979. Plants in British Columbia Indian Technology. Handbook No. 38, British Columbia Provincial Museum, Victoria, B.C.

Turner, N.J. 1988. Ethnobotany of Coniferous Trees in Thompson and Lillooet Interior Salish of British Columbia. Economic Botany 42 (2): 177-194.

Turner, .J., R. Bouchard and D.I.D. Kennedy. 1981. Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washing n. Occasional Paper No. 21, British Columbia Provincial Museum, ictoria, B.C.

Turner, N.J., and H.V. Kuhnlein. 1983. Camas (Camassia spp.) and riceroot (Fritillaria spp.): two liliaceous "root" foods of the Northwest Coast Indians. Ecology of Food and Nutrition 13: 199-219.

Turner, N.J., L.C. Thompson, M.T. Thompson and A. York. 1989 (in press). Knowledge and Usage of Plants by the Thompson Indians of British Columbia. Royal British Columbia Museum, Victoria, B.C.

Trout, 188'6. How to get there - the Hope Trail. Trout's Prospectors Manual of 1886. pp 21-26.

Underhill, J.E. 1960. Report. [of a coyote attack]. Carbon copy of a report on file at the Fraser Valley District Office. 2 p.

Underhill, J.E. 1970. Rock reading tour to the lookout.. Unpublished pamphlet, Manning Provincial Park Nature House. (CL)

Underhill, J.E. 1971a). Some Butterflies of Manning Park. Parks Branch publication. Victoria, B.C. 4 pp. (NV)

Underhill, J.E. 1971b). Mountain Flowers of Manning Park - a guide to 56 plants of the meadows and rocks above 6000'. Parks Branch publication'. Victoria, B.C. 12 pp. (NV)

Underhill, J.E. 1971c). The plants of Manning Park. Parks Branch publication. Victoria, B.C. 72 pp. (NV)

Underhill, J.E. 1972. The plants of Manning Park - Appenda 1972. Parks Branch publication. Victoria, B.C. 1 p. (NV)

Underhill, J.E. 1973. The plants of Manning Park - Appenda 1973. Parks Branch publication. Victoria, B.C. 8 pp. (NV)

Underhill, J.E. and C.C. Chuang. 1977. Wildflowers of Manning Park. Published jointly .by the B.C. Parks Branch and 'the B.C. Provincial Museum. 144 p.

U.S. Forest Service. 1961. Snow. Avalanches: a handbook of forecasting and control measures. U.S. Department of Agriculture Handbook No. 194. 84 pp.

U.S. North Cascdes Study Team. 1965. The North Cascades: a report to the Secretary of the .'Interior and the Secretary of Agriculture. U.S. Secretary of the Interior and the Secretary of Agriculture, Washington, D.C. xii + 1.90 pp.

UNESCO. 1981. Avalanche atlas: Illustrated international' avalanche classification. International Commission on Snow and Ice of the International Association of Hydrological Sciences. United Nations Educational, Scientific, and Cultural Organization, Paris. 265 pp.

Valentine, K.W.G., P.N. Sprout, T.E. Baker and L.M. Lavkulich. 1978. The soil landscapes of British Columbia published by the Resource Analysis Branch, Ministry of the Environment, Victoria, British Columbia. 197 pp.

van Zyll de Jong, C.G. 1985a. Handbook of Canadian Mammals 1. Marsupials and Insectivores. National Museum of of Natural Sciences of Canada Publication. Ottawa, Ontario. 210 p.

van Zyll de Jong, C.G. 1985b. Handbook of Canadian Mammals 2. Bats. National Museum of of Natural Sciences of Canada Publication. Ottawa, Ontario. 212 p.

Vander Wall, S.B. and R.P. Balda. 1981. Ecology and evolution of food-storage behavior in conifer-seed-caching corvids. Zeit. Tierpsychol. 56: 217-242.

Vold, Terje and Paul Daykin. 1981. Cascade Soil Survey. Working Report. Terrestrial Studies Branch. Victoria, B.C.

Walter, John. 1980. Manning: Park for All People. Pp. 46-55 in Downs (1980).

Wareing, Jane. 1982a). The alpine tundra. Unpublished document, B.C. Parks Branch. (CL)

Wareing, Jane. 1982b). Interior Douglas-fir Zone [of Manning Provincial Park]. Unpublished document, B.C. Parks Branch. (CL)

Wareing, Jane. 1982c). Rein Orchid Trail. Unpublished document, B.C. Parks Branch. (CL)

Wareing, Jane. 1982d). Rhododendron Flats. Unpublished document, B.C. Parks Branch. (CL)

Wareing, Jane. 1982e). The Subalpine Meadows (parkland). Unpublished document, B.C. Parks Branch. (CL)

Water Management Branch. 1982. Aquatic plants and water chemistry in the lakes of B.C. Lightning Lake. Computer printout on file at Fraser Valley District Office. 1 p.

Wein, R.W. 1975. Vegetation recovery in arctic tundra and forest-tundra after fire. Federal Department of Indian Affairs and Northern Development, Arctic Land Use Research Program, Ottawa. 115 pp.

Weller, M.W. 1981. Freshwater Marshes: Ecology and Wildlife Management. University of Minnesota Press, Minneapolis. xv + 146 pp.

Werner, Floyd, G. 1982. Common names of Insects and Related Organisms. Published by the Entomological Society of America.

Western Environmental Services. 1972. Manning Park - complement of report fall 1971. Preliminary assessment of biophysical needs. Unpublished document produced for Dept. of Recreation and Conservation, Victoria, B.C. 11 p.

Westerborg, Betty. 1965. Geology [of Manning Provincial Park]. Unpublished report on a field trip with a geologist in Manning Park... B.C. Parks (CL) (NV)

Wetzel, R.G. 1975. Limnology. W.B. Saunders Company, Philadelphia. xii + 743 pp.

Whitelaw, Margaret. 1984. The Future of Manning Park. Victoria Naturalist.

Whitton, B.A., ed. 1975. River Ecology. Blackwell Scientific Publications, Oxford. x + 725 pp.

wilderness Advisory committee. 1986. The wilderness Mosaic. Wilderness Advisory Committee, Vancouver, British Columbia.

Williams, R.L. 1974. The Cascades. Time-Life Books, N.Y. 184 pp.

Wills, R.H. 1962. High Trails: a Guide to the Cascade Crest Trail. University of Washington Press, Seattle. xiii + 157 pp.

Wilson, D.J. 1981. Traffic takes heavy Grosbeak toll. B.C. Naturalist 19(1): 18-19.

Wood, Paul M. 1989. A mountain Pine Beetle Management Plan for Manning Provincial Park. 3523 West 22nd Avenue, Vancouver, B.C. V6S 1J4. Consultant's report produced for Regional Director, South Coast Region, B.C. Ministry of Parks. 39 p.

Woodcock, Don. 1979. B.C.'s Country the Easy Way. Pacific Search. July/August:37-38.

Wydosky, R.S. and R.R. Whitney. 1979. Inland Fishes of Washington. University of Washington Press, Seattle. xxxii + 220 pp.

Ziller, W.G. 1969. <u>Sarcotriochila alpina</u> and <u>Lolpohodermium laricinum</u> causing larch needle blight in North America. Plant Disease Reporter: 53 (3) :237-239.

Zwinger, A.H. and B.E. Willard. 1972. Land Above the Trees: A Guide to American Alpine Tundra. Harper and Row; Publishers. xviii + 489 pp.

Appendix 1.

A Checklist of the Plants

of Manning Provincial Park

This list represents a compilation of plants known to occur in Manning Provincial Park, and updates lists compiled by Carl et al. (1952), Underhill and Chuang (1971), Underhill (1971a, 1972, 1973, 1974), Douglas (1982), Brayshaw (1971 and 1975). Some older collections such as Macoun's and Davidson's from the early 1900's reported some species that have not been recollected from the park since. The collection localities or identifications may be suspect; the population may no longer exist in the park; or they may have escaped subsequent investigations.' These have been reported with a question mark like this: ?Allium acuminatum.

In most cases older taxonomy has been updated - both binomials and common names follow Meidenger (1986) where possible. Where species did not appear there, taxonomy follows Hitchcock and Cronquist (1976). In a few cases older taxonomy could not be traced and we' could not find a name in a modern taxonomic treatment - time constraints precluded in-depth searches of synonomys. These have been included in quotes like this: - "Agoseris carnea?"

Latin Name	Common Name
-Abies amabilis	amabilis fir
-Abies grandis	grand fir
-Abies lasiocarpa	subalpine fir
-Acer circinatum	vine maple
-Acer glabrum	Douglas maple
-Achillea millefolium	yarrow
-Achlys triphylla	vanilla-leaf
-Aconitum columbianum	Columbian monkshood
-Actaea rubra	baneberry
-Adenocaulon bicolor	pathfinder
-Adiantum pedatum	maidenhair fern
-Agoseris aurantiaca	orange agoseris
-"Agoseris carnea?"	
-Agoseris glauca	pale agoseris
-Agoseris grandiflora	large-flowered agoseris
-Agoseris heterophylla	annual agoseris
-Agropyron caninum	awned wheatgrass
-Agropyron pectiniforme	crested wheatgrass
-Agropyron repens	quackgrass
-Agrostis alba	redtop
-Agrostis exarata	spike bentgrass
-Agrostis humilis	alpine bentgrass
-Agrostis scabra	hair bentgrass
-Agrostis rossae	Ross' bentgrass
-Agrostis thurberiana	Thurber's bentgrass

-Agrostis variabilis	mountain bentgrass
-Alectoria sp(p)	Alectoria lichen
-Alisma gramineum	narrowleaf waterplantain
?Allium acuminatum	Hooker's onion Blue
-Allium cernuum	nodding onion
-Allotropa virgata	candystick
-Alnus incana ssp. tenuifolia	mountain alder
-Alnus rubra	red alder
-Alnus viridis ssp. sinuata	Sitka alder
-Alopecurus aequalis	little meadow-foxtail
-Alopecurus geniculatus	water meadow-foxtail
-Alopecurus pratensis	meadow-foxtail
-Amelanchier alnifolia	saskatoon
-Anaphalis margaritacea	pearly everlasting
-Androsace septentrionalis	northern fairy-candelabra
-Anemone drummondii	alpine anemone Blue
-Anemone lyallii	Lyall's anemone
-Anemone multifida	cut-leaved anemone
-Anemone parviflora	small-.floweredanemone
-Angelica arguta	sharp-tooth angelica
'-Angelica dawsonii	Dawsdn's angelica
-Antennaria lanata	woolly pussytoes
-Antennaria microphylla	rosy pussytoes
-Antennaria neglecta	field pussytoes
-Antennaria parvifolia	Nuttall's pussytoes
-Antennaria racemosa	racemose pussytoes
-Antennaria umbrinella	umber pussytoes
-Apocynum androsaemifolium	spreading dogbane.
-Aquilegia formosa	red columbine.
?Arabis divaricarpa	spreading-pod rockcress
-Arabis drummondii	Drummond's rockcress
-Arabis glabra	tower mustard
-Arabis holboellii	Holboell's rockcress
-Arabis lyallii	Lyall's rockcress
?Arabis lyrata	lyre-leaved rockcress
-Arabis sparsiflora	sickle-pod rockcress
-Arabis microphylla	small-leafed rockcress
-Arceuthobium americanum	American dwarf mistletoe
-Arctium minus	common burdock
-Arctostaphylos uva-ursi	kinnikinnick
-Arenaria capillaris	thread-leaved sandwort
-Arenaria lateriflora	side-flowered sandwort
-Arenaria microphylla	large-leaved sandwort
-Arenaria obtusiloba	blunt-leaved sandwort
-Arenaria rubella	alpine sandwort
-Arenaria serpyllifolia	thyme-leaved sandwort
-Arnica alpina	alpine arnica
-Arnica amplexicaulis	streambank arnica
-Arnica cordifolia	heart-leaved arnica
-Arnica diversifolia	diverse arnica
-Arnica fulgens	orange arnica
-Arnica latifolia	mountain.arnica
-Arnica mollis	hairy arnica
-Arnica parryi	Parry's arnica
-Arnica rydbergii	Rydberg's arnica

-Artemisia absinthium	wormwood
-Artemisia ludoviciana	western mugwort
-Artemisia michauxiana	Michaux's mugwort
-Artemisia tridentata	big sagebrush
-Aruncus dioicus	goatsbeard
-Asarum caudatum	wild ginger
-Asclepias speciosa	showy milkweed
-Asplenium trichomanes	maidenhair spleenwort
-Aster conspicuus	showy aster
-Aster eatonii	Eaton's aster
-Aster engelmannii	Engelmann's aster
-Aster foliaceus	leafy aster
-Aster modestus	great northern aster
-Astragalus miser	timber milk-vetch
-Astragalus robbinsii	Robbins' milk-vetch
-Athyrium filix-femina	lady fern
-Balsamorhiza sagittata	arrow-leaved 'balsamroot
-Barbilophozia floerki var. floerkei	
-Barbilophozia hatcheri	
-Barbilophozia lycopodioides	common leafy liverwort
-Betula papyrifera	paper birch
-Botrychium boreale	boreal grape-fern
-Botrychium lunaria	moonwort
-Botrychium multifidum	leathery grape-fern
-Botrychium virginianum	rattlesnake fern
-Brassica kabor	wild mustard
?Brickellia oblongifolia	narrow-leaf brickellia
-Bromus carinatus	California brome
-Bromus inermis ssp. inermis	smooth brome
-Bromus marginatus	
-Bromus sitchensis	Alaska brome
-Bromus suksdorfii	
-Bromus tectorum	cheatgrass
-Bromus vulgaris	Columbia brome
-Cacaliopsis nordosmia	silvercrown
-Calamagrostis canadensis	bluejoint
-Calamagrostis purpurascens	purple pinegrass
-Calamagrostis rubescens	pinegrass
-Calochortus macrocarpus	sagebrush mariposa lily
-Caltha leptosepala	white marsh-marisold
-Calypso bulbosa	fairyslipper
-	
-Campanula rotundifolia	common harebell
-Capsella bursa-pastoris	shepherd's purse
?Cardamine bellidifolia	alpine bitter-cress
-Cardamine oligosperma	little western bitter-cress
-Cardamine pensylvanica	Pennsylvania bitter-cress
?Cardamine umbellata	Siberian bitter-cress
-Carex aurea	golden sedge
-Carex bebbii	Bebb's sedge
-Carex brunnescens	brownish sedge
-Carex buxbaumii	Buxbaum's sedge
-Calyrogeia neesiana	
-Carex canescens	grey sedge

-Carex deweyana	Dewey's sedge
-Carex diandra	lesser panicled sedge
-Carex disperma	soft-leaved .sedge
-"Carex hidsii?" prob = C.hoodii	
-Carex hoodii	Hood's sedge
-Carex interior	inland sedge
-Carex laeviculmis	smooth-stemmed sedge
-Carex luzulina	woodrush sedge
-Carex leptalea	bristle-stalked sedge
-Carex macrochaeta	large-awned sedge
-Carex mertensii .	Mertens' sedge
-Carex nardina	spikenard sedge
-Carex nigricans	black alpine sedge
-Carex pachystachya	thick-headed sedge
-Carex phaeocephala	dunhead sedge
-Carex pyrenaica	Pyrenean sedge
-Carex rossii	Ross' sedge
-Carex rostrata'	beaked sedge
-Carex sitchensis	Sitka sedge
-Carex spectabilis	showy sedge
-Carex vesicaria	inflated sedge
-Cassiope mertensiana	white mountain-heather
?Castelleja appletgatei	Applegate's paintbrush
?Castilleja angustifolia	northwestern paintbrush
?Castillega elmeri	Elmer's paintbrush
-Castilleja miniata	common red paintbrush
?Castilleja suskdorfii	Suskdorf's 'paintbrush
-Ceanothus sanguineus	redstem ceanothus
-Ceanothus velutinus	snowbrush
-Centaurea maculosa	spotted knapweed
-Cephalozia pleniceps	
-Cerastium arvense.	field chickweed
-Cerastium beeringianum	alpine chickweed
-Cerastium nutans	mouse-eared chickweed
-Cerastium vicoscum	sticky mouseweed
-Cerastium vulgatum	common chickweed
-Chamaecyparis nootkatensis	yellow-cedar
-Cheilanthes gracillima	lace lipfern Blue
-Cheilanthes siliquosa	cliff brake?
-Chenopodium album	lamb's-quarters
-Chenopodium capitatum	strawberry-blite
-Chiloscyphus polyanthos	
-Chimaphila menziesii	Menzies' pipsissewa
-Chimaphila umbellata	prince's pine
-Chrysanthemum leucanthemum	ox-eyed daisy
-Cichorium intybus	chicory
-Cicuta douglasii	water-hemlock
-Cinna latifolia	nodding wood-reed
-Circaea alpina	enchanter's nightshade
-Cirsium arvense	Canada thistle
-Cirsium edule	edible thistle
-Cirsium vulgare	bull thistle
-Cladina rangiferina	reindeer lichen
-Claytonia lanceolata	western springbeauty
-Claytonia perfoliata	miner's-lettuce

-Claytonia sibirica	Siberian miner's-lettuce
?Clematis ligusticifolia	white clematis
-Clematic occidentalis	blue clematis
-Clintonia uniflora	queen's cup
-Collinsia parviflora	small-flowered blue-eyed Mary
-Collomia linearis	narrow-leaved collomia
-Comandra umbellata	pale comandra
-Corallorhiza maculata	spotted coralroot
-Cornus canadensis	bunchberry
-Cornus nuttallii	western flowering dogwood
-Cornus sericea	red-osier dogwood
-Corydalis sempervirens	pink corydalis
-Corylus cornuta	beaked hazelnut
-Cosmos pinnatus	Cosmos
-Crataegus douglasii	black hawthorn
-Crepis atrabarba	slender hawksbeard Red
-Crepis intermedia	gray hawksbea'rd
-Crepis tectorum	annual hawksbeard
-Cryptogramma crispa	parsley fern
-Cynoglossum officinale	common hound's-tongue
-Cystopteris fragilis	fragile fern
-Cytisus scoparius	Scotch broom
-Dactylis glomerata	orchardgrass
-Delphinium bicolor	Montana larkspur
-Delphinium menziesii	Menzies' larkspur
-Deschampsia atropurpureum	mountain hairgrass
-Deschampsia elongata	slender hairgrass
?Dicentra formosa	bleeding heart
-Dicentra uniflora	steer's head Blue
-Dicranum fuscescens	curly heron's-bill moss
-Dicranum scoparium	broom moss
-Digitalis purpurea	foxglove
-Disporum hookeri	Hooker's fairybells
-Dodecatheon dentatum	dentate shootingstar
-Dodecatheon pulchellum	few-flowered shootingstar
-Draba incerta	difficult whitlow grass
-Draba lonchocarpa	lance-fruited draba Blue
-Draba nemerosa	woods draba
?Draba nivalis var. elongata	
-Draba oligosperma	few-seeded draba
-Draba praealta	tall draba
-Draba stenoloba	Alaska draba
-Dryas octopetala	white mountain-avens
-Dryopteris dilatata	woodfern
-Dryopteris felix-mas	male fern
-Elatine triandra	three-stamened waterwort
-Eleocharis palustris	common spike-rush
-Eleocharis pauciflora	few-flowered spike-rush
?Elmera racemosa	elmera Blue
-Elodea longivaginata	water weed
-Elymus glaucus	blue wildrye
-Elymus hirsutus	hairy wildrye
-"Elymus virescens?"	"Pacific Wildrye"
-Empetrum nigrum	crowberry.

-Epilobium anagallidifolium	alpine willowherb
-Epilobium angustifolium	fireweed
-Epilobium glaberrimum	smooth willowherb
-Epilobium glandulosum	sticky willowherb
?Epilobium hornemannii	Hornemann's willowherb
-Epilobium latifolium	broad-leaved willowherb
-Epilobium luteum	yellow willowherb
-Epilobium minutum	small-flowered willowherb
?Epilobium paniculatum	tall annual willowherb.
-Equisetum arvense	common horsetail.
-Equisetum fluviatile	swamp horsetail
-Equisetum pratense	meadow horsetail
-Equisetum variegatum	northern scouring-rush
-Erigeron acris	bitter fleabane
-Erigeron aureus	golden fleabane
-Erigeron compositus	.cut-leaved daisy
-Erigeron humulis	alpine daisy
-Erigeron peregrinus	subalpine daisy
?Erigeron speciosus	showy fleabane
-"Erigeron uniflorus?"	
-Eriogonum umbellatum	sulfur buckwheat
-Eriophorum angustifolium	narrow-leaved cotton-grass
-Eriophorum chamissonis	Chamisso's cotton-grass
-Eriophorum gracile	slender cotton-grass
-Eriophyllum lanatum	woolly eriophyllum
-Erodium cicutarium	stork's-bill
-Erythronium grandiflorum	glacier lily
-Festuca occidentalis	western fescue
-Festuca ovina	sheep fescue.
-Festuca rubra	red fescue
-"Festuca subsecunda?"	
-Festuca subulata	bearded fescue
-Festuca viridula	green fescue
-Fragaria vesca	wood strawberry
-Fragaria virginiana	wild strawberry
-Fritillaria lanceolata	chocolate lily
-Fritillaria pudica	yellow bell
-Gaillardia aristata	brown-eyed.Susan
-Galeopsis tetrahit	common hemp-nettle
-Galium boreale	northern bedstraw
-Galium bifolium	low mountain bedstraw
-Galium trifidum	small bedstraw
-Galium triflorum	sweet-scented bedstraw
-Gaultheria humifusa	alpine-wintergreen
-Gaultheria ovatifolia	western tea-berry
-Gaultheria shallon	salal
-Gentiana glauca	glaucous 'gentian
-Gentianella amarella	northern gentian .
-Geranium viscosissimum	sticky geranium
-Geum macrophyllum	large-le ved avens
-Geum triflorum	old man's whiskers
-Gilia aggregata	scarlet gilia
-Glyceria elata	tall mannagrass
-Glyceria grandis	reed mannagrass
-Glyceria pauciflora	fewflowered mannagrass

-Glyceria striata	fowl mannagrass
-Gnaphalium microcephalum	white cudweed
-Goodyera oblongifolia	rattlesnake-plantain
-Grindelia squarrosa	curly-cup gumweed
-Gymnocarpium dryopteris	oak fern
-Hackelia diffusa	spreading stickseed
-Haplopappus lyallii	Lyall's goldenweed
-Helianthella uniflora	little sunflower
-Hemitomes congestum	gnome-plant
-Heracleum sphondylium	cow-parnsip
-Heuchera cylindrica	round-leaved alumroot
-Heuchera glabra	smooth alumroot
-Heuchera micrantha	small-flowered alumroot
-Hieracium albiflorum	white-flowered hawkweed
-Hieracium cynoglossoides	hound's-tongue hawkweed
-Hieracium gracile	slender hawkweed
-Hieracium umbellatum	narrow-leaved hawkwe'ed
-Hippuris vulgaris	mare's-tail
-Holcus lanatus	Yorkshire fog
-Holodiscus discolor	ocean-spray
-Hordeum jubatum	foxtail barley
-Hordeum vulgare	barley
-Hydrophyllum capitatum	bullhead waterleaf
-Hydrophyllum fendleri	Fendler's waterleaf
-Hylocomium splendens	step moss
-Hypericum perforatum	common St. John's-wort
-Hypochaeris radicata	hairy cat's-ear
-Hypopitys monotropa	pinesap
-Ipomopsis aggregata	scarlet gilia
-Isothecium spiculiferum	variable moss
-Iva xanthifolia	poverty-weed
-Juncus ariculatus	jointed rush
-Juncus bufonius	toad rush
-Juncus drummondii	Drummond's rush
-Juncus efussus	common rush
-Juncus ensifolius	dagger-leaved rush
-Juncus filiformis	thread rush
-Juncus longistylis	long-styled rush
-Juncus mertensianus ssp. mertensianus	Mertens' rush
-Juncus parryi	Parry's rush
-Juncus regeli	Regel's rush
-Juncus tennuis var. dudleyi	slender rush
-Jungermannia lanceolata	
-Juniperus communis	common juniper
-Juniperus scopulorum	Rocky Mountain juniper
-Kalmia microphylla spp. microphylla	alpine bog-laurel
-Koeleria cristata	junegrass
-Lactuca biennis	tall blue lettuce
-Lactuca tatarica ssp. pulchella	blue lettuce
-Lappula echinata	European stickseed
-Lapsana communis	nipplewort
-Larix lyallii	alpine larch
-Lathyrus nevadensis	purple peavine
-Ledum glandulosum	trapper's tea
-Ledum groenlandicum	Labrador tea

-Lemna minor	common duckweed
-Lemna trisulca	ivy-leaved duckweed
-Leontodon autumnatis	fall dandelion
-Lepidium virginicum	tall pepper-grass
-Leptarrhena pyrolifolia	leatherleaf saxifrage
-Letharia vulpina	wolf lichen
-Leucanthemum vulgare	oxeye daisy
-Lewisia columbiana	Colubia lewisia
-Lewisia pygmaea	alpine lewisia
-Lewisia rediviva	bitterroot
-Lewisia tweedyi	Tweedy's lewisia'
-Lilium columbianum	tiger lily
-Lilium philadelphicum	wood lily
-Linnaea borealis	twinflower
-Listera borealis	northern twayblade'
-Listera caurina	northwestern twayblade
-Listera convallarioides	broad-leaved twayblade
-Listera cordata	heart-leaved twayblade
-Lithospermum ruderale.	lemonweed
-Lloydia serotina	alp lily
-Lolium perenne	perennial ryegrass
-Lomatium ambiguum	swale desert-parsley
-Lomatium dissectum	fern-leaved desert-parsley
-Lomatium geyeri	Geyer's desert-parsley
?Lomatium macrocarpum	large-fruited desert-parsley
?Lomatium nudicaule	barestem desert-parsley
-Lonicera ciliosa	western trumpet honeysuckle
-Lonicera involucrata	black twinberry
-Lonicera utahensis	Utah honeysuckle
-Lophozia guttulata	
-Lophozia sudetica	
-Lophozia ventricosa	
-Lophozia wenzelii	
-Lotus micranthus	small-leaved deervetch
-Lotus denticulatus	meadow birds-foot trefoil
-Luetkea pectinata	partridgefoot
-Luina hypoleuca	silverback luina
-Lupinus latifolius	broadleaf'lupine
-Lupinus lepidus	prairie lupine
-Lupinus sericeus	silky lupine
-Luzula campestris var.. mutiflora	field woodrush
-Luzula hitchcockii	Hitchcock's woodrush
-Luzula parviflora	'small-flowered woodrush
-Luzula piperi	Piper's woodrush
-Luzula spicata	spiked woodrush.
-Lycopodium annotinum	stiff clubmoss
-Lycopodium clavatum	running clubmoss
-Lycopodium complanatum	ground-cedar
-Lycopodium selago	fir clubmoss
-Lysichiton americanum	skunk cabbage
-Madia glomerata	clustered tarweed
-Mahonia aquifolium	tall Oregon-grape
-Mahonia nervosa	dull Oregon-grape
-Mahonia repens	creeping Oregon-grape

?Malus fusca	Pacific crab apple
-Marchantia polymorpha	
-Matricaria matricarioides	pineapple weed
-Medicago facata	yellow lucerne
-Medicago sativa	alfalfa
-Melampyrum lineare	cow-wheat
-Melilotus alba	white.sweet-clover
-Melilotus officinalis	yellow sweet-clover
?Mentha arvensis	field mint
?Menyanthes trifoliata	buckbean
-Menziesia ferruginea	false azalea
-Mertensia oblongifolia	leafy bluebells
-Microsteris gracilis	pink twink
-Mimulus alsinoides	chickweed monkey-flower
-Mimulus guttatus ssp. guttatus	yellow monkey-flower
-Mimulus lewisii	pink monkey-flower
-Mimulus moschatus	musk-flower
-Mimulus tilingii	mountain monkey-flower
-Mitella breweri	Brewer's mitrewort
-Mitella pentandra	five-stamened mitrewort
-Mitella trifida	three-toothed mitrewort
-Mnium	leafy moss
-Monarda fistulosa	wild bergamot
-Moneses uniflora	single delight
-Monotropa uniflora	Indian-pipe
-Montia parvifolia	small-leaved montia
-Montia perfoliata	miner's lettuce
-Montia siberica	Siberian mmontia
?Myosotis laxa	small-flowered forget-me-not
-Myriophyllum spicatum	spiked water-milfoil
-Oenothera grandiflora	big-flowered primrose
-Onobrychis viciifolia	sainfoin
-Oplopanax horridus	devil's club
-Orobanche uniflora	naked broomrape
-Orthilia secunda	one-sided wintergreen
-Osmorhiza chilensis	mountain sweet-cicely
-Osmorhiza occidentalis	western sweet-cicely
-Osmorhiza purpurea	purple sweet-cicely
-Oxyria digyna	mountain.sorrel
-Parnassia fimbriata	fringed grass-of-Parnassus
-Papaver rhoes cv."Shirley"	Shirley poppy
-Paxistima myrsinites	'falsebox
-Pedicularis bracteosa	bracted lousewort
-Pedicularis groenlandica	elephant's head
-Pedicularis racemosa	sickletop lousewort
-Pellia endivifolia	
-Peltigera canina	dog lichen
?Penstemon confertus	yellow penstemon
-Penstemon davidsonii	Davidson's penstemon
-Penstemon fruticosus	shrubby penstemon
?Penstemon ovatus	broad-leaved penstemon
-Penstemon procerus	small-flowered penstemon
-Penstemon scouleri	Scouler's penstemon
-Penstemon serrulatus	coast penstemon

-Perideridia gairdneri	yampah
-Petasites frigidus	sweet coltsfoot
-Phacelia hastata	silverleaf phacelia
-Phacelia heterophylla	varileaf phacelia
-Phacelia sericea	silky phacelia
-Phalaris arundinacea	reed canarygrass
?Philadelphus lewisii	mock-orange
-Phleum alpinum	alpine timothy'
-Phleum pratense	timothy
-Phlox diffusa	spreading phlox
-Phyllodoce empetriformis	pink mountain-heather.
-Phyllodoce glanduliflora	yellow mountain-heather
?Physocarpus capitatus	Pacific ninebark
-Picea engelmannii	Engelmann spruce
-Picea sitchensis	Sitka spruce
-Pinguicula vulgaris	butterwort
-Pinus albicaulis	whitebark pine
-Pinus contorta var. latifolia	lodgepole pine'
-Pinus monticola	western white pine
-Pinus ponderosa	ponderosa 'pine
-Plantago major	common plantain
-Platanthera dilatata	white bog-orchid
-Platanthera hyperborea	green-flowered bog-orchid
-Platanthera obtusata	one-leaved rein-orchid
-Platanthera orbiculata	round-leaved rein-orchid
-Platanthera stricta	slender bog-orchid
-Platanthera unalascensis	Alaska rein-orchid
-Pleurozium schreberi	red-stemmed feathermoss
-Poa alpina	alpine bluegrass
-Poa annua	annual bluegrass
-Poa arctica	arctic bluegrass
-Poa bulbosa	bulbous bluegrass
-Poa compressa	Canada bluegrass
-Poa cusickii	Cusick's bluegrass
-Poa gracillima	Pacific bluegrass
-Poa grayana	Gray's bluegrass
-Poa interior	inland bluegrass
-Poa nervosa	Wheeler's bluegrass
-Poa palustris	fowl bluegrass.
-Poa pratensis	Kentucky bluegrass
-Poa rubicola	timberline bluegrass
-Poa sandbergii	Sandberg bluegrass
-Poa stenantha	Trinius' bluegrass
-Polemonium occidentale	western Jacob's ladder
-Polemonium pulcherrimum	showy Jacob's-ladder
-Polemonium viscosum	sticky Jacob's-ladder
-Polygonum achoreum	achoreum knotweed
-Polygonum aviculare	prostrate knotweed
-Polygonum convolvulus	dullseed
-Polygonum douglasii	Douglas' knotweed
-Polygonum minimum	leafy dwarf knotweed
-Polygonum vivaparum	alpine bistort
-Polystichum lonchitis	mountain holly fern.
-Polystichum munitum	sword fern
-Polytrichum juniperinum	juniper haircap moss

-Populus balsamifera	poplar
-Populus tremuloides	trembling aspen
-Potamogeton alpinus	northern pondweed
-Potamogeton amplifolius	large-leaved pondweed
?Potamogeton fibrillosus	fibrous-stip pondweed
-Potamogeton pbtusifolius	Potamogeton obtusifolius
-Potamogeton pectinatus	fennel-leaved pondweed
-Potamogeton praelongus	white-stalked pondweed
-Potamogeton pusillus	small pondweed
-Potamogeton richardsonii	Richardon's pondweed
-Potamogeton vaginatus	sheathed pondweed
-Potentilla diversifolia	diverse-leaved cinquefoil
-Potentilla drummondii	Drummond's cinquefoil
-Potentilla flabellifolia	fan-leaved cinquefoil
-Potentilla fruticosa	shrubby cinquefoil
-Potentilla glandulosa	sticky cinquefoil
-Potentilla gracilis	graceful cinquefoil'
-Potentilla nivea	snow cinquefoil
-Potentilla norvegica	Norwegian cinquefoil
-Potentilla palustris	marsh cinquefoil
-Potentilla villosa	vilous cinquefoil
-Prunella vulgaris	self-heal
-Prunus emarqinata	bitter cherry
-Prunus virginiana	choke cherry
-Pseudotsuga menziesii var. glauca	interior Douglas-fir
-Pseudotsuga menziesii var. menziesii	coast Douglas-fir
-Pterospora andromedea	pinedrops
-Ptilidium californicum	
-Pulsatilla occidentalis	western pasqueflower
-Pyrola asarifolia	pink wintergreen
-Pyrola chlorantha	green wintergreen
-Pyrola minor	lesser wintergreen
-Pyrola picta	white-veined wintergreen
-Ranunculus abortivus	.kidney-leaved buttercup
-Ranunculus aquatilis	white water-buttercup
-Ranunculus eschscholtzii	subalpine buttercup'
-Ranunculus glaberrimus	sagebrush buttercup
-Ranunculus gmelinii	small yellow water-buttercu
-Ranunculus macounii	Macoun's buttercup
-Ranunculus repens	creeping buttercup
?Ranunculus reptans	spear-leaved buttercup.
-Ranunculus sceleratus	blister buttercup
-Ranunculus uncinatus	little buttercup
-Rhinanthus crista-galli	yellow rattle
-Rhododendron albiflorum	white-flowered rhododendron
-Rhododendron macrophyllu'm	Pacific rhododendron
-Rhus glabra	sumac
-Rhytidiadelphus loreus	lanky moss
-Rhytidiopsis robusta	pipecleaner moss
-Ribes cexeum	squaw currant
-Ribes divaricatum	wild gooseberry
-Ribes glandulosum	skunk currant
-Ribes howellii	maple-leaved currant
-Ribes hudsonianum	northern black currant
-Ribes irriguum	Idaho gooseberry

-Ribes lacustre	black gooseberry
-Ribes laxiflorum	trailing black gooseberry
-Ribes montigenum	mountain gooseberry
-Ribes viscosissimum	sticky currant
-Romanzoffia sitchensis	Sitka mistmaiden
-Rorippa curvisiliqua	western yellow'cress
-Rorippa islandica.	marsh yellow cress'
-Rosa gymnocarpa	baldhip rose
-Rosa nutkana	Nootka rose
-Rubus idaeus	red raspberry
-Rubus lasiococcus	dwarf bramble
-Rubus leucodermis	black raspberry
-Rubus parviflorus	thimbleberry
-Rubus pedatus	five-leaved bramble
-Rubus spectabilis	salmonberry
?Rubus ursinus	trailing blackberry
-Rudbeckia hirta	black-eyed susan
-Rumex acetosella	sour weed
-Rumex crispus	curly dock
-Rumex obtusifolius	broad-leaved dock
-Rumex salicifolius	willow dock
-Sagina saginoides	arctic pearlwort
-Salix arctica	arctic willow
-Salix barclayi	Barclay's willow
-Salix cascadensis	Cascade willow
-Salix commutata	variable willow
-Salix drummondiana	Drummond's willow
-Salix exigua	coyote willow
-Salix farriae	Farr's willow
-Salix lasiandra	Pacific willow
-Salix maccalliana	Maccall's willow
-Salix monticola	mountain willow
-Salix myrtillifolia	bilberry willow
-Salix nivalis	snow willow
-Salix nivalis var. saximontana	snow willow var. saximontana
-Salix rigida	rigida willow
-Salix scouleriana	Scouler's willow
-Salix sitchensis,	Sitka willow
-Sambucus cerulea	blue elderberry
-Sambucus racemosa	red elderberry
-Sanicula graveolens	Sierra sanicle
?Saxifraga adcendens	wedge-leaved saxifrage
-Saxifraga arguta	brook saxifrage
-Saxifraga bronchialis	spotted saxifrage
?Saxifraga cernua	nodding saxifrage
-Saxifraga ferruqinea	Alaska saxifrage
?Saxifraga lyallii	red-stemmed saxifrage
-Saxifraga mertensiana	wood saxifrage
-Saxifraga occidentalis	western saxifrage
-Saxifraga oppositifolia	purple mountain saxifrage
-Saxifraga punctata	dotted saxifrage
-Saxifraga rhomboidea	diamond-leaf saxifrage
-Saxifraga tolmiei	Tolmie's saxifrage
-Scapania undulata	

-Scirpus microcarpus	small-flowered bulrush
-Sedum divergens	spreading stonecrop
-Sedum lanceolatum	lance-leaved stonecrop
-Sedum spathulifolium	broadleaf stonecrop
?Sedum stenopetalum	worm-leaved stonecrop
-Selaginella densa	compact selaginella
-Senecio canus	woolly groundsel
-Senecio cymbalarioides	alpine meadow butterweed
-Senecio elmeri	Elmer's butterweed
-Senecio fremontii	dwarf mountain butterweed
-Senecio indecorus	rayless mountain butterweed
-Senecio integerrimus	western groundsel
-Senecio pauciflorus	rayless alpine butterweed
-Senecio pauperculus	Canadian butterweed
-Senecio pseudaureus	streambank butterweed
-Senecio streptanthifolius	Rocky Mountain butterweed
-Senecio sylvaticus	wood groundsel
-Senecio triangularis	arrow-leaved groundsel
-Shepherdia canadensis	soopolallie
-Sibbaldia procumbens	sibbaldia
-Silene acaulis	moss campion
-Silene douglasii	Douglas' campion
-Silene menziesii	Menzies' campion
-Silene parryi	Parry's campion
-Sisymbrium altissimum	tall tumble-mustard
-Sisymbrium loeselii	Loesel's tumble-mustard
-Sitanion hystrix	squirreltail grass
-Sium sauve	water-parsnip
?Smelowskia calycina	alpine smelowskia
-Smilacina racemosa	false Solomon's-seal
-Smilacina stellata	star-flowered false Solomon's-seal
Smilacina trifolia	three-leaved false Solomon's-seal
?Solidago canadensis	Canada goldenrod
-Solidago multiradiata	northern goldenrod
-Solidago spathulata	spike-like goldenrod
-Sonchus asper	prickly sow-thistle
-Sorbus sitchensis	Sitka mountain-ash
-Sparganium emersum var. angustifolium	narrow-leaved bur-reed
-Spergularia rubra	red sand-spurry
-Sphagnum	sphagnum
-Spiraea betulifolia	birch-leaved spirea
-Spiraea douglasii ssp. douglasii	hardhack
-Spiraea pyramidata	pyramid spirea
?Spiranthes romanzoffiana	ladies' tresses
-Stellaria calycantha	northern starwort
-Stellaria crispa	crisp starwort
-Stellaria longipes	long-stalked starwort
-Stellaria longifolia	long-leaved starwort
-Stellaria media	chickweed
-Stenanthium occidentale	mountainbells
-Stipa lemmonii	Lemmon's neddlegrass
-Stipa occidentalis	stiff needlegrass
-Stokesiella oreganum.	Oregon beaked moss

-Streptopus amplexifolius	clasping twistedstalk
-Streptopus roseus	rosy twistedstalk.
-Suksdorfia ranunculifolia	buttercup-leaved saxifrage
-Symphoricarpos albus	common snowberry
-Tanacetum vulgare	common tansy
-Taraxacum alaskanum	Alaska dandelion
-Taraxacum laevigatum	red-seeded dandelion
-Taraxacum officinale	common dandelion
-Tellima grandiflora	tall fringecup
-Thalictrum	meadowrue
-Thelypteris phegopteris	beech fern
-Thlaspi arvense	field pennycress
-Thuja plicata	western redcedar
-Tiarella trifoliata	three-leaved foamflower
-Tiarella unifoliata	one-leaved foamflower
-Tofieldia glutinosa	sticky false asphodel
-Tolmiea menziesii	piggy-back plant
-Tragopogon pratensis	meadow salsify
?Trientalis europaea	northern starflower
-Trientalis latifolia	broad-leaved starflower
-Trifolium hybridum	alsike clover
-Trifolium pratense	red clover
-Trifolium repens	white clover
-Trillium ovatum	western trillium
-Trisetum canescens	tall trisetum
-Trisetum cernuum	nodding trisetum
-Trisetum spicatum	spike trisetum
-Tritomaria quiquedentata	
-Trollius laxus	globeflower
-Tsuga heterophylla	western hemlock
-Tsuga mertensiana	mountain hemlock
-Typha latifolia	cattail
-Urtica dioica	stinging nettle
-Utricularia vulgaris	greater bladderwort
-Vaccinium caespitosum	dwarf blueberry
-Vaccinium deliciosum	blue-leaved huckleberry'
-Vaccinium membranaceum	black huckleberry
-Vaccinium occidentale	western huckleberry
-Vaccinium ovalifolium	oval-leaved blueberry
?Vaccinium oxycoccos	bog cranberry
-Vaccinium parvifolium	red huckleberry
-Vaccinium scoparium	grouseberry
-Valeriana scouleri	Scouler's valerian
-Valeriana sitchensis	Sitka valerian
-Veratrum viride	Indian hellebore
-Verbascum thapsus	great mullein
-Veronica americana	American brooklime
-Veronica officinalis	common speedwell
-Veronica peregrinus	purslane speedwell
-Veronica serpyllifolia	thyme-leaved speedwell
-Veronica wormskjoldii	alpine speedwell
-Viburnum edule	highbush-cranberry
-Vicia americana	American vetch
-Viola adunca	early blue violet
-Viola canadensis	Canada violet

-Viola glabella	stream violet
-Viola orbiculata	round-leaved violet
-Viola palustris	marsh violet
-Viola purpurea	goose-foot violet
-Woodsia oregana.	Oregon woodsia
-Zigadenus venenosus	meadow death-camas

APPENDIX 2.

Some Invertebrates of

Manning Provincial Park

This list is based on published and unpublished material. Manning Park has not been systematically surveyed for most invertebrate groups, although it has probably been relatively well collected considering its location and access. Searches of material in major collections would undoubtedly reveal many more species.

CRUSTACEA

A small list of freshwater crustacea is found in Carl et al. (1952).

MOLLUSCA

A small list of freshwater molluscs is found in Carl et al. (1952).

SPIDERS

This partial list of the spiders of Manning Park is from Carl et al. (1952).

Round shouldered Weaver	Aranea raji Scopoli
Orb Weavers	Aranea dumetorum Villeys Aranea displicata Hentz Aranea diademata Linnaeus
Stilt Spiders	Tetraanatha senca Seeley Tetraanatha laboriosa Hentz Pityohphantes subarcticus Chamberlin & Irie
Jumping Spider	Metaphidippus aleatorius Emerton
Crab Spider	Misumenoides aleatorius (Hentz) Evartica hoyi Peckham

TICKS

The only tick identified for Manning Park in the literature is from Carl et al. (1952); collected from a Mountain Goat.

Wood Tick,	Dermacentor andersoni Stiles

INSECTS

Where possible, the cbmmon names for insects were from Werner (1982), if the species was not yet named by the Entomological Society of America other sources were checked such as Borror and White (1970). Underhill and Harcombe's (1971) butterfly. list was used as a source of names for those Lepidoptera not given common names in Werner.

BEETLES - Order: COLEOPTERA

FLAT-HEADED WOODBORERS - Family: BUPRESTIDAE

Buprestis aurulenata L.
Buprestis maculativentris var. maculativentris (Kby.)
Buprestis confluenta Say.
Buprestis fasciata Fab.
Malanophila drummondi Kby.
Anthaxia aeneogaster Cast.
Chrysobothris pseudotsuqa Van D. Six.
Chrysobothris trinervia Kby.
Agrilus politus Say.

LONG-HORNED 'BEETLES - Family: CERAMBYSIDAE

Traqosoma despsarium.var. harrisi LeC.
Spondylis.upiformis Mann.
Asemum moestum His.
Tetropium velutinum LeC.
St'enocorus inquisitor L.
Leptalia frankenhaeuseri Mannh.
Pachyta armata LeC.
Pachyta lamed Linn.
Evodinus vancouveri Csy.
Leptacmaeops longicornis (Kby)
Cortodera conifera Hopping.
Acmaeops pratensisi (Laich.)
Acmaeops proteus (Kyb.)
Gaurotes cressoni Bland.
Anoplodera sexmaculata (L.)
Anoplodera amabilis Lec.
Anoplodera instabilis (Hald.)
Anoplodera nigrella(Say.)
Anoplodera laetifica (LeC.)
Anoplodera sanguinea (LeC.)
Anoplodera crassipes (LeC.)
Anoplodera tibialis (LeC.)
Anoplodera apera (LeC.)
Anoplodera chrvsocoma (Kby.)
Grammoptera filicornis (Csy.)

Leptura obliterata Hald.
Leptura propinqua Bland.
Gonocallus collaris (Kby.)
Xylotrechus undulatus (Say)
Monochamus maculosus latus Csy.
'Monochamus oregonensis LeC.

BARK AND AMBROSIA BEETLES - Family: SCOTYLIDAE

Mountain Pine Beetle Dendroctonus ponderosa

DRAGONFLIES - Order: ODONATA

From R.A. Cannings and K.M. Stuart (1977). In this list * = found near Princeton; ** = found southeast of Hope.

SPREAD-WINGED DAMSELFLIES - Family: LESTIDAE

Lestes disjunctus Selys
Lestes dryas Kirby
Lestes unguiculatus Hagen

NARROW-WINGED DAMSELFLIES - Family: COENAGRIIDAE

Amphiagrion abbreviatum (Selys)
Coenagrion resolutum (Hagen)
Enallagma boreale Selys
Enallagma cyathigerum (Hagen)
Ischnura cervula Selys
Ischnura perparva Selys

DARNERS - Family: Darners

Aeshna eremita Scudder
Aeshna interrupta Walker *
Aeshna palmata Hagen
Aeshna umbrosa Walker

CLUBTAILS - Family: GOMPHIDAE

Ophiogomphus severus Hagen *

GREEN-EYED SKIMMERS - Family: CORDULIIDAE

Cordulia shurtleffi Scudder *
Somatochlara semicircularis (Selys)

COMMON SKIMMERS - Family: LIBELLULIDAE

Leucorrhinia borealis Hagen
Leucorrhinia intacta (Hagen)
Leucorrhinia proxima Calvert

Libellula julia Uhler
Libellula lydia Drury
Libellula quadrimaculata Linnaeus
Sympetrum costiferum (Hagen) *
Sympetrum danae (Sulzer)
Sympetrum internum Montgomery
Sympetrum madidum (Hagen)
Sympetrum obtrusum (Hagen)
Sympetrum pallipes (Hagen) **

BEES AND WASPS - Order: HYMENOPTERA

TENTHREDINID SAWFLIES - Family Tenthredinidae

Henri Goulet conducted a survey of this family near Blackwall Peak and at Strawberry Flats in 1988, and collected 20 species of the Genus Tenthredo, including two new species in the originalis group. Goulet is an authority on the Park's insect fauna and should be contacted for further information, particularly on the potential of insects for interpretation. His address is Biosystematics Research Centre, K.W. Neatby Building, C.E.F., Ottawa, K1A 0C6, Ph. (613) 996-1665.

BUTTERFLIES AND MOTHS - Order: LEPIDOPTERA

SWALLOWTAILS - Family: Papilionoidea

Western Tiger Swallowtail	Papilio rutulus Luc.
Black and White Swallowtail	Papilio eurymedon Luc.
Mountain Swallowtail	Papilio zelicaon Luc.
Indra Swallowtail	Papilio indra Reak.

PARNASSIANS - Family: 'Parnassidae

Clouded Parnassian	Parnassius phoebus Fab.
Pellucid Parnassian	Parnassius clodius Men.

ORANGE-TIPS - Family: Pieridae

Stella Orange-tip	Anthocaris sara Bdv.

WHITES: Family: Pieridae

Marbled White	Euchloe ausonides Bdv.
Western White	Artogeia protodice L.
Green-veined White	Artogeia napi (L.)
Cabbage Butterfly	Artogeia rapae (L.)
Pine White	Neophasia menapia F. and F.

SULPHURS - Family: Pieridae

Orange or Clouded Sulphur	Colias eurytheme Bdv.

RINGLETS

Plain Ringlet	Coenonympha tullia Mull.

WOOD NYMPHS - Family: Satyridae

Sylvan Wood Nymph	Cercyonis sthenele Behr.

ARCTICS - Family: Satyridae

Tawny Arctic	Oeneis chryxus D. and H.

ALPINES - Family: Satyridae

Vidler's Alpine	Erebia vidleri Elwes
Common Alpine	Erebia epipsodea Butl.

SILVER-SPOTS

Dusky or Hydaspe Silver-spot	Speyeria hydaspe (Bdv.)
Bremner's Silver-spot	Speyeria bremnerii (Bdv.)
Bean's Silver-spot	Speyeria atlantis beani (Bar & Benj.)
Cariboo Silver-spot or Eurynome Fritillary	Speyeria mormonia eurynome (Edw.)

FRITILLARYS - Family: Nymphalidae

Chariclea Fritillary.	Boloria chariclea Schneid.
Western Meadow Fritillary	Boloria epithore Edw.

CHECKERSPOTS - Family: Nymphalidae

California Checkerspot	Euphydryas anicia D. and H.
Alberta Checkerspot	Euphydryas colon Edw.
Northern Checkerspot	Chlosyne palla Bdv.

CRESCENT-SPOTS

Meadow Crescent-spot	Phyciodes campestris Behr.
Pearl Crescent-spot	Phyciodes tharas Dru.

COMMAS

Brown Comma	Polygonia satyrus Edw.
Green Comma	Polygonia faunus Edw.
Gray Comma	Polygonia zephyrus Edw.

TORTOISE-SHELLS

California Tortoiseshell	Nymphalis californica Bdv.
Milbert's Tortoiseshell	Nymphalis milberti Latr.
Compton's Tortoiseshell	Nymphalis vau-album Den, & Schiff.
Mourningcloak Butterfly	Nymphalis antiopa L.

ADMIRALS AND LADIES

Red Admiral	Vanessa atalanta L.
West Coast Lady	Vanessa carye Hbn.
Painted Lady	Vanessa cardui (L.)
White Admiral	Limenitis lorquini Bdv. and Lec.

ELFINS AND HAIRSTREAKS

Marbled Elfin	Callophrys eryphon Bdv.
Western Elfin	Callophrys augustinus Kirb.
Green Hairstreak	Callophrys dumentorum Bdv.
Blue Hairstreak	Callophrys spinetorurn Hew.
Sylvan Hairstreak	Strymon sylvanus Bdv.
Grey Hairstreak or Cotton Square Borer	Strymon melinus Hbn.

COPPERS

Dusky Copper	Lycaena mariposa Reak.
Purple Copper	Lycaena helloides Bdv.
Blue Copper	Lycaena heteronea Bdv.

BLUES

Pembina Blue	Plebejus icarioides pembina Bdv.
Cascade .Blue	Plebejus saepiolus Bdv.
Orange-banded Blue	Plebejus melissa Edw.
Silvery Blue	Agriades glandon Prun.
Colorado Blue	Glaucopsyche lygdamus Dbldy.
Western Tailed Blue	Everes comyntas God.

SKIPPERS - Family: Hesperiidae

Canadian Skipper	Hesperia manitoba Scud.
Arctic Skipper	Carterocephalus palaemon Pall.
Two-banded Skipper	Pyrgus ruralis Bdv.

DUSKY WINGS

Variable Dusky Wing	Erynnis persius Scud,

HAWK-MOTHS - Family: Sphingidae

Vancouver Sphinx	Sphinx perelegans Hy Edw.
Eyed Hawk-moth	Smerinthus cerisyi Kby.
Snowberry Bee-hawk	Hemaris diffinis Bdv.
Bedstraw Hawk-moth	Celerio gallii Rott.
Californian Silk-moth	Platysamia euryalus Bdv.
Polyphemus Moth	Telea polyphemus Cram.

SHEEP-MOTHS

Common Sheep-moth	Pseudohaiis eglanterina Bdv.

SCAPE-MOTHS

Western Scape-moth	*Cisseps packardii* Grt.

TIGER-MOTHS - Family: Arctiidae

Mottled Tiger	*Halisidota maculata* Harr.
Ruby Tiger	*Phragmatobia fuliginosa* L.
Bruce's Tiger	*Neoarctia brucei* Hy. Edw.
Ornate Tiger	*Apantesis celia* Saund.
Nevada Tiger	*Apantesis nevadensis* G. & R.
Columbian Tiger	*Apantesis elongata* Stretch.
Wandering Tiger	*Diacrisia vagans* Bdv.
Brown Tiger	*Diacrisia pteridis* Hy Edw.
Western Web-worm	*Hyphantria textor* Harr.
St. Lawrence Tiger	*Parasemia parthenos* Harr.

FORESTERS - Family: Noctuidae

Northern Forester	*Androloma mac-cullochi* Kby.
Sylvan Forester	*Alypia langtoni* Couper.

OWLET MOTHS

Western Panthea	*Panthea portlandia* Grt.
	Panthea virginaria Grt.

DAGGER MOTHS

Colorado Dagger	*Acronicta grisea* Wlk.
Gentle Dagger	*Acronicta mansueta* Sm.
Doleful Dagger	*Acronicta distans* Grt.
Pacific Dagger	*Acronicta perdita* Grt.
The Little Bear	*Merolonche ursina* Sm.

DARTS

Plaited Dart	*Euxoa plagigera* Morr.
Ridings' Dart	*Euxoa ridingsiana* Grt.
Tippling Dart	*Euxoa intrita* Morr.
Mountain Dart	*Euxoa rufula* Sm.
	Euxoa infracta Morr.
Reaper Dart or Dark-sided Cutworm	*Euxoa messoria* (Harr.)
	Euxoa acormis
Oregon Dart	*Euxoa colata* Grt.
Divergent Dart	*Euxoa divergens* Wlk.
Obelisk Dart	*Euxoa obeliscoides* Gn.
Fillet Dart	*Euxoa redimacula* Morr.
Red Dart	*Euxoa costata* Grt.
Ochreous Dart or Red-backed Cutworm	*Euxoa ochrogaster* (Gn.)
Elegant Dart	*Euxoa excellens* Grt.
Black-collared Dart	*Euxoa brocha* Morr.
Yellow Dart	*Pseudorthosia variabilis* Grt.
Vancouver Dart	*Agrotis vancouverensis* Grt.
Voluble Dart	*Agrotis volubilis* Harv.

Long-cloaked Dart'/ Black Cutworm	Agrotis ypsilon Rott.
Gothic Dart or Dingy Cutworm	Feltia ducens Wlk.
	Feltia geniculata G & R
Unicolorous Dart	Spaelotis clandestina (Harr.)
Great Grey Dart	Eurois occulta Linn.
Great Brown Dart	Eurois astricta Morr.
Great Black Dart	Eurois nigra Sm.
~early-wingedDart	Peridroma margaritosa Haw.
Labrador Dart	Paradiarsia littoralis Pack.
The Soothsayer	Graphiphora haruspica Grt.
	Diarsia dislocata Sm.
Hungry Dart	Diarsia esurialis Grt.
Black-lettered Dart	Amathes c-nigrum (Linn.)
Spotted Clay Dart	Amathes smithi Snell.
Ruby Dart	Amathes oblata Morr.
Collared Dart	Amathes collaris G & R
	Amathes xanthographa
	Setagrotis planifrons Sm.
	Setagrotis atrifrons Grt.
Divided Dart	Anomogyna perquiritata Morr.
Western Dart	Anomogyna muste lina Sm.
	Anomogyna imperita Hbm.
	Anomogyna homogena McD.
	Anomogyna vernilis Grt.
Yellow-spotted Dart	Adelphagrotis indeterminata Wlk.
Broad-winged Dart	Anaplectoides pressus Grt.
Green-winged Dart	Anaplectoides prasina Schiff.
Red-breasted Dart	Protolampra rufipectus Morr..
Cloudy Dart	Pseudoglaea olivata Harv.
Catocaline Dart	Cryptocala acadiensis Beth.
	Abagrotis duanca Sm.
Projecting Dart	Rhynchagrotis exsertistigma Morr.
	Pronoctua typica Sm.
Pleated Dart	Ufeus plicatus Grt.
The Trefoil or Clover Cutworm	Scotogramma trifolii (Hufnagel)
The Oregonian	Scotogramma oregonica Grt.
Farnham's Scotogramma	Scotogramma farnhami Grt.

POLIAS

Large Grey Polia	Polia discalis Grt.
Mystic Polia	Polia nimbosa Gn.
Pale-tinted Polia	Polia purpurissata Grt.
Harnessed Polia	Polia subjuncta G & R
Nevada Polia	Polia nevadae
Garden Polia	Polia radix Wlk.
Mountain Polia	Polia segregata Sm.
Tacoma Polia	Polia tacoma Stkr.
	Polia meodana Sm.
Powdered Polia	Polia pulverulenta Sm.
Ingraved Polia	Polia ingravis Sm.
Crested Polia	Polia cristifera Sm.
Invalid Polia	Polia invalida Sm.
The Snaky Polia	Lacinipolia anguina Grt.
Pacific Polia	Lacinipolia pensilis Grt.

Cinnamon Polia	Lacinipolia stricta Wlk.
Prairie Polia	Lacinipolia olivacea Morr.
SEALS	
Maimed Seal	Lasionycta mutilata Sm.
	Lasionycta marloffi Dyar.
	Lasionycta conjugata Sm.
Columbia Seal	Lasiestra leucocycla Staud.
Uniform Seal	Lasiestra uniformis Sm.
Catocaline Anarta	Anarta cordigera Thun.
Black-mooned Anarta	Anarta melanopa Thun.
PENMANS & WOODLINGS	
Rosy Penman	Sideridis rosea Harv.
The Cobbler	Astrapetis sutrina Grt.
Brown Stylus	Anhimella contrahens Wlk.
Dingy Stylus	Protorthodes curtica Sm.
Shaded Umber	Nephelodes emmedonia Cram.
white-lined American	Tholera americana Sm.
Brown Spectales	Stretchia muricina Grt.
Hoary Penman	Orthosia pulchella Harv.
The Girdler	Dargida procincta Grt.
Angled Straw	Zosteropoda hirtipes Grt.
	Aletia oxygala Grt.
Heterodox Wainscot	Leucania insueta Gn.
	Copicucullia solidaginis Strur.
Oblique Rover	Pleroma obliquata Sm.
Grey Rover	Pleroma cinerea Sm.
	Cucullia intermedia Spry.
Grey Falconer.	Cucullia florea Gn.
BEAUTIES	
Mountain Beauty	Oncocnemis hayesi Grt.
Marbled Beauty	Oncocnemis chorda Grt.
Columbia Beauty	Oncocnemis columbia McD.
Twin-lined Beauty,	Oncocnemis barnesi Sm.
Black-banded Beauty	Oncocnemis piffardi Wlk.
	Oncocnemis riparia Grt.
Black-lined Beauty	Homohadena fifia Dyar.
PEASANT MOTHS	
Narrow-banded Peasant	Bombycia rectifascia Sm.
Dark-gray Peasant	Litholomia napaea Morr.
American Peasant	Lithomoia solidaginis Hbn.
	Lithomoia napae Morr.
SWORDGRASSES	
American Swordgrass	Xylena nupera Lint.
Western Swordgrass	Xlena cineritia Grt.
Variegated Rover	Platypolia contadina Sm.

QUAKERS

Wood-coloured Quaker	Apamea lignicolora Gn.
Purple-washed Quaker	Apamea antennata Sm.
Brown-banded Quaker	Apamea auranicolor Grt.
Airy Quaker	Apamea vultuosa Grt.
Northern Quaker	Apamea arctica Frr.
Chestnut Quaker	Apamea castanea Grt.
Dewy Quaker	Apamea alia Gn.
	Apamea centralis Sm.
Spalding's Quaker	Apamea spaldingi Sm.
Black Quaker	Apamea impulsa Gn.
Brown-banded Quaker	Apamea indocilis Wlk.
Red-winged Quaker	Agroperina lateritia Hufn.
Ruby Quaker	Agroperina dubitans Wlk.
Lined Quaker	Agroperina indela Sm.
Destructive Quaker	Crymodes devastator Brace
Mountain Quaker	Crymodes longula Grt.
	Luperina passer Gn.
Red-spotted Quaker	Aseptis binotata Wlk.
Twin-spot Quaker	Aseptis adnixa Grt.
Island Swallow	Ipimorpha nanaimo Barnes
Pallid Rustic	Serseptis pallescens Sm.
American Small Angle Shades	Euplixia benesimilis McD.
	Achytonix epipaschia Sm.
Victorian Twin-spot	Cerma cuerva Barnes
Canadian Giant	Andropolia contacta Wlk.
Grey Giant	Andropolia aedon Grt.
Tinted Giant	Andropolia theodori Grt.
Confused Hyppa	Hyppa indistincta Sm.

RUSTICS

Civil Rustic	Platgperigea extima Wlk.
Mooned Rustic	Platyperiqea meralis Morr.
Kaslo Rustic	Protoperigea anotha Dyar.
Western Elder Moth	Zotheca tranquilla Grt.
White-spotted Midget	Eutricopis nexilis Morr.
Spotted Buff Gem	Heliothis phloximphqa G. and R.
	Canthylidia villosa

Y-MARKS - Family: Noctuidae

Yellow-winged Y	Synqrapha orophila Hamp.
Silver Cloud	Syngrapha rectangula Kby.
Plain Silver Y	Synqrapha celsa Hy. Edw.
Mountain Silver Y	Syngrapha angulidens Sm.
Blue Metal Mark	Synqrapha selecta Wlk.
Celery Looper	Anagrapha falcifera Kby
Broken-banded Y	Autographa ampla Wlk.
White Y Mark	Autoqrapha v-alba Ottol.
Alberta Beauty	Autographa sansoni Dod.
Wavy Chestnut Y	Autoqrapha mappa G. and R.
Common Silver Y or Alfalfa Looper	Autoqrapha californica (Speyer)
Shaded Gold-spot	Autographa metallica Grt.

UNDERWINGS

Western Underwing	Catocala aholibah Stkr.
Pacific Underwing	Catocala nevadensis Beut.

GRASS MOTHS

Range Grass Moth	Caenurgina distincta Neum.
The Brown Neck	Toxocamua victoria Grt.
Great Orange Arches	Synedoida ochracea Behr.
Divergnet Arches	Synedoida diveraens Behr.
Northern Arches	Synedoida hudsonica G. and R.
Shadowy Arches	Synedoida adumbrata Behr.
Hawthorn Moth	Scoliopteryx libatrix L.
The Green Lattice	Gnophaela latipennis Bdv.

PROMINENTS - Family: Notodontidae

Common chocolate-tip	Ichthyura apicalis Wlk.
White-C Chocolate-tip	Ichthyura albosigma Fitch
Bruces's Chocolate-tip	Ichthyura brucei Hy. Edw.
Pacific Prominent	Hyperaeschra pacifica Behr.
Elegant Prominent	Odontosia elegans Stkr.
Fissured Prominent	Pheosia rimosa Pack.
Rusty Prominent	Dicentria semirufescens Wlk.
Willow Kitten	Cerura occidentalis Lint,
Small Pebble	Gluphisia septentrionalis Wlk.
Banded Pebble	Gluphisia severa Hy.' Edw.

TUSSOCK MOTHS - Family: Liparidae

Common Vapourer Moth	Notolophus antiqua L.
Douglas Fir Tussock	Hemerocampa pseudotsugata McD.
The Satin Moth	Stilpnotia salicis Linn.
Western Tent-caterpillar	Malacosoma pluviale Dyar.
Small Lappet	Epicnaptera americana Harr.

LUTESTRINGS

The Scribe	Habrosyne scripta Gosse.
The Peach-blossom Moth	Euthyatira pudens Gn.
Columbian Lutestring	Ceranemota fasciata B. and McD.
Scarce Lutestring	Ceranemota tearlei Hy. Edw.

HOOK-TIPS - Family: Drepanidae

Common Hook-tip	Drepana arcuata Wlk.

EMERALDS

Columbian Emerald	Nemoria darwiniata Dyar.
Bank's Emerald	Chlorosea banksaria Sperry.

WAVES

Five-lined Wave	*Scopula quinque linearia* Pack.
	Scopula enucleata Gn.
Columbian Wave	*Scopula subfuscata* Tayl.
	Scopula inductata Gn.
Alpine Wave	*Carsia paludata* Thun.
Grey seraphim	*Lobophora simsata* Swett.
Kaslo Seraphim	*Lobophora magnoliatoidata* Dyar.
White-striped Black	*Neodezia albovittata* Gn.
Brown Tissue	*Triphosa haesitata* Gn.

PUGS

	Eupithecia ornata Hlst.
Smoky Pug	*Eupithecia perfusa* Hlst.
White Pug	*Eupithecia cretaceata* Pack.
Arbutus Pug	*Eupithecia vancouverata* Tayl.
Clouded Brown	*Eustroma semiatrata* Hlst.
	Eustroma fasciata B. & McD.
Brown-toothed Beauty	*Eustroma atrifasciata* Hlst.
Barred Yellow	*Lygris propulsata* Wlk.
Banded Grey	*Lygris destinata* Moesch.
The Phoenix	*Tygris xylina* Hlst.

CARPETS

Eyed Carpet	*Plemyria georgii* Hlst.
	Dysstroma truncata Hufn.
Walker's Carpet	*Dysstroma walkerata* Pears.
Dark Marbled Carpet	*Dysstroma citrata* Linn.
Handsome Carpet	*Dysstroma ethela* Hlst.
Graceful Carpet	*Dysstroma formosa* Hlst.
Dyar's Carpet	*Thera otisi* Dyar.
Fawn Carpet	*Stamnoctenis morrisata* Hlst.
Common Highflyer	*Hydriomena furcata* Thun.
Variable Highflyer	*Hydriomena irata* Swett.
Scarce Highflyer	*Hydriomena perfracta* Swett.
	Hydriomena ruberata Frey.
American Carpet	*Xanthorhoe munitata* Hbn.
Variable Carpet	*Xanthorhoe defensaria* Gn.
McDunnough's Carpet	*Xanthorhoe macdunnoughi* Swett.
Mountain Carpet	*Xanthorhoe fosaria* Tayl.
Marbled Slate	*Entephria multivagata* Hlst.
Bird's Head Carpet	*Mesoleuca gratulata* Wlk.
Striped Carpet	*Epirrhoe alternata* Mull.
White-barred Black	*Spargania luctuata* Schiff.
The Argent and Sable	*Eulype hastata* L.
Twin-spot Wave	*Perizoma basaliata* Wlk.
Pearsall's Wave	*Venusia pearsalli* Dyar.
Northern Wave	*Deilinia bryantaria* Tayl.
Red-lined Wave	*Drepanulatrix carnearia* Hlst.
Large Banded Wave	*Drepanulatrix litaria* Hlst.
Quadrate Wave	*Drepanalatrix quadraria* Grt.
Spurred Wave	*Drepanalatrix unicalcararia* Gn.

Bordered Fawn	Sericosema juturnaria Gn.
Black-banded Orange	Isturgia truncataria Wlk.
Spotted Granite	Semiothisa granitata Gn.
Dark-bordered Granite	Semiothisa setonana McD
Striped Ochre	Semiothisa neptaria Gn.
Four-lined Granite	Itame fulvaria Vill.
Short-lined Granite	Itame quadrilinearia Pack.
Toothed Granite	Itame bitactata Wlk.
The Virgin	Itame denticulodes Hlst.
Three-dotted Border	Protitame hulstiaria Tayl.
Large Sulphur	Elposte lorquinaria Gn.
Powdered Carpet	Hesperumia sulphuraria Pack.
	Ultralcis latipennis Hlst.

Appendix 3.

An Annotated checklist of the Fishes of Manning Provincial Park

To date, no extensive survey of the Manning Park's fish fauna has been conducted, and only two species (Dolly Varden and Rainbow Trout) were recorded in Carl et al.'s (1952) survey. The other species listed here are tentqtive, and are included on the basis of their presence in drainage systems that enter the park. The primary source of distribution information was Carl et al. (1959), on which the terminology used here is based. Consult Scott and Crossman (1973) for further information.

Rocky Mountain Whitefish — Prosopium williamsoni
Has not been located within Manning Park, but is present in the Similkameen River east of Similkameen Falls, and likely extends into the park itself (Carl et al. 1952).

Dolly Varden — Salvelinus malma
Present within the park, in the Sumallo and Skagit Rivers (Carl et al. 1952), and also the Similkameen and its tributaries (Carl et al 1959).

Brook Trout — Salvelinus fontinalis
Has been recorded within the park, in the Sumallo River west of the Skagit (Harcombe and Cyca 1978). Native to eastern North America, this species has been widely introduced in southwestern B.C. and has also been found in the Skagit River west of the park (Carl et al. 1959).

Cutthroat Trout — Salmo clarki
May not occur in the park, but am anadromous form (the coastal cutthroat trout: Salmo clarki clarki) was introduced into the Similkameen River system near Princeton prior to 1959 (Carl et al. 1959), and may have spread into the park itself.

Rainbow Trout — Salmo qairdneri
Also known as the Kamloops trout, and conspecific with the anadromous steelhead trout, this is the most widespread game fish within the park. It is present in the smaller tributaries, as well as the larger channels of both the Sumallo-Skagit system and the Similkameen system [including all of the Lightning Lakes (Carl et al. 1952)]. Introduced into Poland and Nicomen Lakes.

Kokanee — Oncorhynchus nerka
Not recorded from the park itself, but is widespread in interior B.C. (Carl et al. 1959) and may enter our area. This is the freshwater form of the sockeye salmon.

Largescale Sucker *Catostomus macrocheilus*
Not recorded from the park itself, but is widespread throughout. B.C., including the Columbia River system (Carl et al. 1959), and possibly enters our area. Inhabits primarily lake margins and the mouths of streams.

Bridgelip sucker *Catastomus columbianus*
Not recorded from the park itself, but very likely occurs here. This fast-water species is common in tributaries of the Similkameen River (Carl et al. 1952).

Northern Mountain Sucker *Catastomus platyrhynchus*
Not recorded from the park itself, but may occur here. It has been recorded from the Similkameen River system between the mouth of Otter Lake on the Tulameen River and Wolfe Creek east of Princeton (Carl et al. 1959).

Redside Shiner *Richardsonius balteatus*
Not recorded from the park itself, but the park is within the mapped range of this widespread species (Carl et al. 1959). This is an unlikely species, as it prefers lakes and slow streams.

Northern Squawfish *Ptychocheilus oregonensis*
Not recorded from the park itself, but the park is within the mapped range of this widespread species (Carl et al. 1959). This is an unlikely species, as it is primarily a lake fish, and is found only in slow-moving rivers and streams.

Peamouth Chub *Mylocheilus caurinus*
Not recorded from the park itself, but the park is within the mapped range of this widespread species (Carl et al. 1959). This is an unlikely species, as it prefers lakes and slow streams;

Chiselmouth *Acrocheilus alutaceus*
Not recorded from the park itself, but has been recorded from the Similkameen drainage east of the park (Carl et al. 1959). An unlikely species.

Lake Chub *Couesius plumbius*
Not recorded from the park itself, but likely occurs here. This wide ranging species inhabits a broad range of environments, including fast-moving streams, and has been recorded from the Similkameen drainage (Carl et al. 195.9).

Leopard Dace *Rhinichthys falcatus*
Not recorded from the park itself, but has possibly been recorded from the Similkameen drainage east of the park (Carl et al. 1959). An unlikely species.

Longnose Dace *Rhinichthys cataractae*
Not recorded from the park itself, but likely occurs here. Primarily a stream fish, this widepread species has been recorded from the Similkameen drainage (Carl et al. 1959).

Threespine Stickleback _Gasterosteus aculeatus_
Not recorded from the park itself, but has been found in Xawkawa Lake west of Hope (Carl et al. 1959). An unlikely species.

Prickly Sculpin _Cottus asper_
Not recorded from the park itself, but is widespread in B.C., including the tributaries of the Columbia River (Carl et al. 1959).

Torrent Sculpin _Cottus rhotheus_
Not recorded from the park itself, but quite possibly occurs here. This stream-inhabiting species has been recorded from the Similkameen drainage east of the Park (Carl et al. 1959).

Mottled Sculpin _Cottus bairdi_
Not recorded from the park itself, but possibly occurs here. This stream species has been recorded from the Similkameen drainage east of the Park (Carl et al. 1959).

Appendix 4.

An Annotated Checklist to the Amphibians and Reptiles of Manning Provincial Park

Amphibians

Long-toed Salamander — <u>Ambystoma macrodactylum</u>
Occurs throughout most of the park, Probably most common at lower elevations, but has been found as high as 6,500 feet in the Three Brothers area. This species is often found in surprisingly dry conditions (under logs on hot dry slopes), but more commonly occurs in relatively moist settings. It has also been recorded from Lone Duck Lake, and along the Similkameen and North Star Rivers.

Tailed Frog — <u>Ascaphus truei</u>
Found in and around streams throughout most of the park, and has been collected from the Skagit and Similkameen Rivers; also; in smaller streams at Buckhorn Camp and the Three Brothers Area,

Western Toad — <u>Bufo boreas</u>
Common throughout the park: most frequently seen at night. Tadpoles of this species have been found in a variety of settings, including the Beaver Pond and a pool at Allison Pass.

Pacific Tree Frog — <u>Hyla regilla</u>
Found in most forested areas in the Park, up to at least 6,900 feet in elevation. The loud mating calls produced by males of this species are heard in many areas during May and June.

Spotted Frog — <u>Rana pretiosa</u>
Generally distributed in areas with permanent water bodies. This species is common around the Lightning Lakes and Beaver Pond, and has also been recorded from Allison Pass, Little Muddy Creek and in the Three Brothers area.

Red-legged Frog — <u>Rana aurora</u>
Green and Campbell 1985 report this species as occurring in Manning Park. Care should be taken in identifying this species as it is similar in appearance to the Spotted Frog. See Green and Campbell (1985) for identification.

Reptiles

Painted Turtle — <u>Chrysemys picta</u>
Surprisingly uncommon, as the Lightning Lakes and Beaver Pond areas of the park contain much suitable habitat for this widespread species.

Rubber Boa — <u>Charina bottae</u>
Observed infrequently. This secretive species may be more common than would appear based on the scarcity of records in this area.

Alligator Lizard *Gerrhonotus coeruleus*
Fairly common in suitable habitat (rockslides, dry south-facing slopes). Rocky areas along the Highway are often the best places to look for this species.

Western Terrestrial Garter Snake *Thamnophis elegans*
Generally distributed in the Park, and has been captured at Allison Pass, Lightning Lake and at Goodfellow Creek in the Three Brothers area. Carl et al. (1952) noted that this species was frequently killed by passing cars along Highway 3 i'n September. Typical habitat in the park includes rockslides and grassy clearing.

Northwestern Garter Snake *Thamnophis ordinoides*
Less common than its cousin, above; has been captured near Manning Park Lodge. This is generally a coastal species; Manning Park is the easternmost recorded locality in British Columbia.

Common Garter Snake *Thamnophis sirtalis*
We could locate no records of this species in Manning Park, however it has been collected both sides of the park and should be looked for.

Appendix 5.

Checklist to the Birds of Manning Provincial Park

Updated 1989.

This checklist has been updated to include all records known up to February 1989. It is based on previous checklists; Cannings (1972); Carl et al. (1952); Edwards (1949,); Fraser (pers. obs.), Goodwill (1970, 1974a, 1974b); and O'Brien (1974). Taxonomy here follows AOU checklist (1983).

Species Codes:

- C = Common, seen or heard every time the bird is looked for in suitable habitat.
- U = Uncommon, seen or heard regularly but not every time it is looked for.
- R = Rare; seen only once or tqice a year, 'but usually at least once a year.
- Ca = Casual, not seen every year, but two or more records for the park.
- A = accidental, only one record for the park.
- T = Transient, passes through the park, usually on spring or fall migration.
- N = ResideNt, present year-round, or at least there are records for most months of the year.
- W = Winter.
- S = Summer
- * = nesting record - many species that undoubtedly breed in the park have not yet had nests documented, these are not marked here.

LOONS

Red-throated Loon	A	Gavia stellata
Pacific Loon	A	Gavia pacifica
*Common Loon	CS	Gavia immer

GREBES

Pied-billed Grebe	RT	Podilymbus podiceps
Horned Grebe	RT	Podiceps auritus
Red-necked Grebe	RT	Podiceps grisegena
Eared Grebe	RT	Podiceps nigricollis
Western Grebe	UT	Aechmophorus occidentalis

PELICANS

American White Pelican	'A	Pelecanus erythrorhynchos

HERONS		
Great Blue Heron	US	Ardea herodias
Green-backed Heron	A	Butorides striatus
WATERFOWL		
*Canada Goose	CT	Branta canadensis
Wood Duck	RT	Aix sponsa
Green-winged Teal	UT	Anas crecca
Mallard	US	Anas platyrhynchos
Northern Pintail	UT	Anas acuta
Blue-winged Teal	UT	Anas discors
Cinnamon Teal	UT	Anas cyanoptera
Northern Shoveler	RT	Anas clypeata
American Wigeon	CT	Anas americana
Redhead	RT	Aythya americana
Ring-necked Duck	RT	Aythya collaris
Lesser Scaup	RT	Aythya affinis
Harlequin Duck	US	Histrionicus histrionicus
Oldsquaw	RT	Clangula hyemalis
Surf Scoter	CA	Melanitta perspicillata
White-winged Scoter	CA	Melanitta fusca
Common Goldeneye	RT	Bucephala clangula
*Barrow's Goldeneye	CS	Bucephala islandica
Bufflehead	RT	Bucephala albeola
Hooded Merganser	RT	Lophodytes cucullatus
Common Merganser	CS	Mergus merganser
Ruddy Duck	RT	Oxyura jamaicensis
VULTURES AND HAWKS		
Turkey Vulture	RT	Cathartes aura
Osprey	RT	Pandion haliaetus
Bald Eagle	UW	Haliaeetus leucocephalus
Northern Harrier	UT	Circus cyaneus
Sharp-shinned Hawk	US	Accipiter 'striatus
*Cooper's Hawk	CT	Accipiter cooperii
'Northern Goshawk	UN	Accipiter gentilis
Swainson's Hawk	UT	Buteo swainsoni
Red-tailed Hawk	CT	Buteo jamaicensis
Ferruginous .Hawk	RT	Buteo regalis
Rough-legged Hawk	RT	Buteo lagopus
Golden Eagle	RT'	Aquila chrysaetos
*American Kestrel	CS	Falco sparverius
Merlin	'RS	Falco columbarius
Peregrine Falcon	RT	Falco peregrinus
Prairie Falcon	RT	Falco mexicanus
GROUSE		
*Spruce Grouse	UN	Dendragapus canadensis
*Blue Grouse	CN	Dendragapus obscurus
Rock Ptarmigan	A	Lagopus mutus
*White-tailed Ptarmigan	UN	Lagopus leucurus
*Ruffed Grouse	CN	Bonasa umbellus

RAILS		
Virginia Rail	RS	Rallus limicola
Sora	US	Porzana carolina
American Coot	A	Fulica americana
PLOVERS AND SANDPIPERS		
Killdeer	UT	Charadrius vociferus
Greater Yellowlegs	UT	Tringa melanoleuca
Lesser Yellowlegs	RT	Tringa flavipes
Solitary Sandpiper	CT	Tringa solitaria
*Spotted Sandpiper	CS	Actitis macularia
'Western sandpiper	RT	Calidris mauri
Least Sandpiper	UT	Calidris minutilla
Baird`s Sandpiper	RT	Calidris bairdii
Pectoral Sandpiper	RT	Calidris melanotos
Long-billed Dowitcher	RT	Limnodromus scolopaceus.
Common.Snipe	RS	Gallinago gallinago
Wilson's Phalarope	RT	Phalaropus tricolor
Red-necked Phalarope	RT	Phalaropus lobatus
Red Phalarope	RS	Phalaropus fulicaria
GULLS		
Franklin's Gull	CaT	Larus pipixcan
Bonaparte's Gull	UT	Larus philadelphia
Mew Gull	RT	Larus canus
California Gull	US	Larus californicus
Herring Gull	US	Larus argentatus
Common Tern	RT	Sterna hirundo
Arctic Tern.	A	Sterna paradisaea
DOVES		
Rock Dove	R	Columba livia
Band-tailed Pigeon	US	Columba fasciata
Mourning Dove	US	Zenaida macroura
OWLS		
*Great Horned Owl	UN	Bubo virginianus
*Northern Hawk-Owl	RN	Surnia ulula
Northern Pygmy-Owl	UN	Glaucidium gnoma
*Spotted Owl	UN	Strix occidentalis
*Barred Owl	UN	Strix varia
Long-eared Owl	RT	Asio otus
Short-eared Owl	RT	Asio flammeus
Boreal Owl	RW	Aegolius funereus
*Northern Saw-whet Owl,	UN	Aegolius acadicus
NIGHJARS		
Common Nighthawk	CT	Chordeiles minor
SWIFTS		
Black Swift	CS	Cypseloides niger
Vaux's Swift	CS	Chaetura.vauxi

HUMMINGBIRDS

slack-chinned Hummingbird CaS	Archilochus alexandri
Calliope Hummingbird RS	Stellula calliope.
*Rufous Hummingbird CS	Selasphorus rufus

KINGFISHERS

*Belted Kingfisher. CS	Ceryle alcyon

WOODPECKERS

Lewis' Woodpecker RS	Melanerpes lewis
*Red-naped Sapsucker CS	Sphyrapicus nuchalis
*Red-breasted Sapsucker CS	Sphyrapicus ruber
*Williamson's Sapsucker RS	Sphyrapicus thyroideus
Downy Woodpecker UN	Picoides pubescens
*Hairy Woodpecker CN	Picoides villosus
White-headed Woodpecker A	Picoides albolarvatus
*Three-toed Woodpecker CN	Picoides tridactylus
*Black-backed Woodpecker RN	Picoides arcticus
*Northern Flicker CS	Colaptes auratus
*Pileated Woodpecker CN	Dryocopus pileatus

FLYCATCHERS

*Olive-sided Flycatcher CS	Contopus borealis
*Western Wood-Pewee CS	Contopus sordidulus
*Willow Flycatcher CS	Empidonax traillii
Least Flycatcher AS	Empidonax minimus
Hammond's Flycatcher CS	Empidonax hammondii
*Dusky Flycatcher CS	Empidonax oberholseri
Pacific-slope Flycatcher CS	Empidonax difficilis
Say's Phoebe RS	Sayornis saya
Western Kingbird RS	Tyrannus verticalis
Eastern Kingbird RS	Tyrannus tyrannus

LARKS

*Horned Lark CS	Eremophila alpestris

SWALLOWS

*Tree Swallow CS	Tachycineta bicolor
*Violet-green Swallow CS	Tachycineta thalassina.
*Northern Rough-winged Swallow CS	Stelgidopteryxserripennis
Bank Swallow RS	Riparia riparia
*Cliff Swallow CS	Hirundo pyrrhonota
*Barn Swallow CS	Hirundo rustica

JAYS AND CROWS

*Gray Jay CN	Perisoreus canadensis
Steller's Jay CN	Cyanocitta stelleri
*Clark's Nutcracker CN	Nucifraga columbiana
*American Crow CN	Corvus brachyrhynchos
Black-billed Magpie UT	Pica pica
*American Crow CN	Corvus brachyrynchus
*Common Raven CN	Corvus corax

CHICKADEES

*Black-capped Chickadee	UN	Parus atricapillus
*Mountain Chickadee	CN	Parus gambeli
Boreal Chickadee	CN	Parus hudsonicus
*Chestnut-backed Chickadee	CN	Parus rufescens

NUTHATCHES & CREEPERS

*Red-breasted Nuthatch	CN	Sitta canadensis
White-breasted Nuthatch	R	Sitta carolinensis
*Brown Creeper	CN	Certhia americana

WRENS

Rock Wren	RT	Salpinctes obsoletus
Bewick's Wren	RT	Thryomanes bewickii
House Wren	A	Troglodytes aedon
*Winter Wren	CS	Troglodytes troglodytes,

DIPPERS

*American Dipper	CN	Cinclus mexicanus

KINGLETS

*Golden-crowned Kinglet	CN	Regulus satrapa
*Ruby-crowned Kinglet	CS	Regulus calendula

THRUSHES & MOCKINGBIRDS

Western Bluebird	RS	Sialia mexicana
*Mountain Bluebird	CS	Sialia currucoides
*Townsend's Solitaire	CS	Myadestes townsendi
*Swainson's Thrush	CS	Catharus ustulatus
*Hermit Thrush	CS	Cathrus guttatus
*American Robin	CS	Turdus migratorius
*Varied Thrush	CS	Ixoreus naevius
Northern Mockingbird	A	Mimus polyglottos

PIPITS

*Water-Pipit	CS	Anthus spinoletta

WAXWINGS

Bohemian Waxwing	A	Bombycilla garrulus
*Cedar Waxwing	CS	Bombycilla cedrorum

STARLINGS

*European Starling	CN	Sturnus vulgaris

VIREOS

Solitary vireo	US	Vireo solitarius
Warbling Vireo	CS	Vireo gilvus
Red-eyed Vireo	RS	Vireo olivaceus

WARBLERS

Tennessee Warbler	A,	Vermivora peregrina
*Orange-crowned Warbler	UN	Vermivora celata
Nashville Warbler	R	Vermivora ruficapilla
*Yellow Warbler	CS	Dendroica petechia
Magnolia Warbler	RT	Dendroica magnolia

*Yellow-rumped Warbler	CS	Den'droicacoronata
Black-throated Gray Warbler	UN	Dendroica nigrescens
*Townsend's Warbler	CS	Dendroica townsendi
American Redstart	CaS	Setophaga ruticilla
Northern Waterthrush	CaS	Seiurus noveboracensis
MacGillivray's Warbler	CS	Oporornis tolmiei
*Common Yellowthroat	CS	Geothlypis trichas
Wilson's Warbler	CS	Wilsonia pusilla
TANAGERS		
Western Tanager	CS	Piranga ludoviciana
SPARROWS		
Black-headed Grosbeak	RS	Pheuticus melanocephalus
Rufous-sided Towhee	US	Pipilo erythrophthalmus
*Chipping Sparrow	CS	Spizella passerina
Vesper Sparrow	'A	Pooecetes gramineus
Savannah Sparrow	CS	Passerculus sandwichensis
*Fox Sparrow	CS	Passerella iliaca
*Song Sparrow	CS	Melospiza melodia
*Lincoln's Sparrow	CS	Melospiza lincolnii
Golden-crowned Sparrow	CT,RS	Zonotrichia atricapilla
*White-crowned Sparrow	CS	Zonotrichia leucophrys
*Dark-eyed Junco	CN	Junco hyemalis
Lapland Longspur	RT	Calcarius lapponicus
Snow Bunting	RW	Plectrophenax nivalis
BLACKBIRDS		
*Red-winged Blackbird	CS	Agelaius phoeniceus
Western Meadowlark	US	Sturnella neglecta
Yellow-headed Blackbird	US	Xanthocephalus xanthocephalus
Brewer's Blackbird	US	Euphagus cyanocephalus
*Brown-headed 'Cowbird	CS	Molothrus ater
Northern Oriole	CaS	Icterus galbula
FINCHES		
Rosy Finch	US	Leucosticte arctoa
*Pine Grosbeak	CN	Pinicola enucleator
Purple Finch	UT	Carpodacus purpureus
*Cassin's Finch	CS	Carpodacus cassinii
Red Crossbill	CN	Loxia curvirostra
White-winged Crossbill	UN	Loxia leucoptera
Common Redpoll	UW	Carduelis flammea
Pine Siskin	CN	Carduelis pinus
American Goldfinch	UT	Carduelis tristis
Evening Grosbeak	CS	Coccothraustes verspertinus
House Sparrow	R	Passer domesticus

Appendix 5.

AN ANNOTATED CHECKLIST. OF THE MAMMALS OF MANNING PARK

Taxonomy and common names in this list follow. Campbell and Harcombe 1985. Information is mostly from Carl et al. (1952), Edwards 1942,. Thomson 1974 and Sowden 1974. For the purposes of this checklist. the terms race and subspecies are used interchangeably.

Virginia Opossum *Didelphis virginiana*
A roadkilled specimen of this species was found at the parkinglot at Westgate in July of 1984 (Fraser pers. obs.). It is likely that this travelled in the undercarriage of a vehicle entering the park from the Fraser Valley or the Delta Area, where the species is common. Manning is considered too harsh a climate for this species to become established.

Masked 'Shrew *Sorex cinereus*
also called Cinerous Shrew. Specimens collected by Carl et al. (1952) indicate that both the western race *S.c. streatori* and the interior race *S.c. cinereus* were found at the Ranger ,Station. Manning Park is in an area of overlap of the two species,.

Vagrant Shrew *Sorex vagrans*
Manning Park is within the mapped range of this species as presented by van Zyll de Jong (1983) - however, there is no record of this species in the park. It is difficult to separate from the Dusky Shrew and therefore easily overlooked. A shrew found in grassy or open areas in the park may be of this species. See van Zyll de Jong (1983) for identification.

Dusky or Montane Shrew *Sorex monticolus*

(*Sorex obscurus* of Carl et al.) Specimens of both *S.m. obscurus*, the interior race and *S.m. setosus* the western race have been collected at Allison Pass (Carl et al. 1952.).

Water Shrew *Sorex palustris*
Found in suitable habitat throughout the lower elevations of the park (Carl et al 1952.)

Trowbridge's Shrew *Sorex trowbridgii*
Not recorded from the park as yet, it has been found as far east as Hope (van Zyll de Jong 1983) and should be looked for in well drained coniferous forest at low elevations in Manning Park and the Skagit and .CascadesWilderness areas.

Shrew-Mole *Neurotrichus gibsii*
Records from Mile 12, 17, and 42.5 of the Hope Princeton Highway in Carl et al. (1952). Found along stream margins and other low elevation habitats. Usually under forest duff and leaf litter;

Little Brown Myotis — *Myotis lucifugus*

Within the mapped range of this species (Cowan and Guiget 1965, van Zyll de Jong 1985). A species found in a variety of habitats all across southern Canada. Found where ever some trees and water are found (van Zyll de Jong 1985). No specific records for Manning Park but it is probably one of the Myotis spp. recorded in several reports.

Yuma Myotis — *Myotis yumanensis*

Two specimens collected *M.y. saturatus* at Mile 17 and 23 of the Hope Princeton Highway reported in Carl et al. 1952

Long-eared Myotis — *Myotis evotis*

Manning Park is within the mapped range of this species (van Zyll de Jong 1985). It is a bat characteristic of rocky outcroppings in coniferous forests of the Pacific coast and western Mountains (Cowan and Guiget 1965). To be expected in Manning Park.

Long-legged Myotis — *Myotis volans*

Manning Park is within the mapped range of this species (van Zyll de Jong 1985) - likely to be here as this is a bat typically of "the mountainous west". Emerges early in the evening when it is still twilight (Cowan and Guiguet 1965).

California Myotis — *Myotis californicus*

Manning Park is within the mapped range of this species (van Zyll de Jong 1985). He states " found in a wide range of habitats in British Columbia, from the humid coast forest to semidesert and from sea level to elevations of at least 1800 m." To be expected.

Silver-haired Bat — *Lasionycteris noctivagans*

Common, earliest bat out in the evening in Manning Park. Specimens from Manning Provincial Park reported in Carl et al. (1952).

Big Brown Bat — *Eptesicus fuscus*

The commonest bat in Manning Park -"or at least the most easily shot" (Carl et al. 1952). Thomson (1974) reports it as occurring in buildings in the park.

Red Bat — *Lasiurus borealis*

A rare bat in British Columbia known only from one specimen collected in the Skagit Valley. May be of regular occurrence in the Skagit Valley as this area is contiguous with the species rhnge in the United States as mapped by van Zyll de Jone (1985).

Hoary Bat — *Lasiurus cinereus*

A migratory species, Manning is within the mapped range of the species (van Zyll de Jong 1985). May occur during the summer months and probably migrates through the park in the fall.

Townsend's Big-eared Bat — *Plecotus townsendii*
May occur in the Park it had been collected as far east as Hope (Cowan and Guiget 1965). Within the mapped range of the species in van Zyll de Jong (1985). Habitat includes humid forests as well as arid scrub and pine forests. Caves, abandoned mines and buildings are used for roosting (van Zyll de Jong 1985).

Pika — *Ochotona princeps*
Two races occur in the park a large darker race on the west side *O.p. brunnescens* - at least to Mile 20 (Carl et al. 1952) and a smaller paler race with nearly white feet, *O.p. fenisex* occurring from Allison Pass east. The western race *brunnescens* also has a rare, nearly all black form (Cowan and Guiget 1965).

Snowshoe Hare — *Lepus americanus*
A cyclical species with abundances changing from year to year. Found throughout the park but Carl et al. 1952 reports it to be more abundant on the eastern side of the park.

Mountain Beaver — *Aplodontia rufa*
Occurs in pockets of coastal forest in Manning Park, Burrows have been found both on the valley floor and at 6,000 feet in Allison Pass, at 6,500 feet on Mt. Frosty, and above the second Lightning Lake. Most easterly record is above Rabbit Flats east of Hampton Creek (Carl et al. 1952). Manning Park is at the eastern most portion of this species range. See species accounts for more information.

Yellow-pine Chipmunk — *Tamias amoenus*
A widely distributed chipmunk throughout the drier areas of the park, from valley bottom to the top of Mt. Frosty (Carl et al. 1952). There are two forms found in the park; *E.a. affinis* at the eastern part of the park, intergrading along the Cascade summit with *E.a. felix*, a darker subspecies found in the western reaches of the park east to at least the rangers station. *E.a. felix* is the coastal form, not the interior form a s incorrectly referred to in Carl et al. (1952).

Townsend's Chipmunk — *Tamias townsendii*
Larger and darker than the Yellow-pine Chipmunk, the Townsend s Chipmunk has a more restricted distribution in the park. recorded from the Cambie Beaver Pond, Lighting Lakes, and the Skagit Valley. They are reliably seen at Sumallo Grove during the summer months, The two species were found occupying common range near the Copper Mine (Carl et al. 1952). There 'are two forks found in the park - a low elevation form, *E.t. townsendii* with ochraceous outermost side stripes, found in the Skasit drainage, and a high elevation form *E.t. cooperi*, with grey outmost side stripes found in Allison Pass, Lightning Lakes etc. (Cowan and Guiget 1965).

Yellow-bellied Marmot — *Marmota flaviventris*
Restricted to road edges and clearings throughout the park, probably colonized the park once the ope-princeton was constructed.

Hoary Marmot *Marmota caligata*
Common at high elevations in the park., especially at Black Wall and Three Brothers, but sometimes found at lower elevations as well.

Columbian Ground Squirrel *Spermophilus columbianus*
A relatively new species for the park - it was not seen by Edwards (1949) or Carl et al. (1952). The population around the lodge building is at the western limits of its range - and probably arrived via the Hope-Princeton Highway. A highly visible but vulnerable outlying population. Recently this population has expanded up into the subalpine meadows at Marmot Bowl (Thomson 1974).

Cascade Golden-mantled Ground Squirrel *Spermophilus saturatus*

Common throughout the area, probably most easily seen at the Lookout Area. Frequents talus slopes and other rocky areas. Mostly found east and south of the Similkameen-Tulameen Rivers, east of the Cascade Summit. Manning Park is the best place to see this species in British Columbia.

Red Squirrel *Tamiasciurus hudsonicus*
This is the common squirrel in the eastern portion of the Park and Carl. et al. report it as occurring at least as far west of Allison Pass as Mile 21 of the Hope Princeton Highway, and at Whitworth Ranch in the Skagit Valley.

Douglas' Squirrel *Tamiasciurus douglasii*
The common tree squirrel of the western portion of the park, extending as far east as Allison Pass. Hilton (in Carl. et al. 1952) reports them as occurring as far east as the mouth of the Chuwanteen Creek, and Thomson (1974) reports sighting animals as far east as Windy Joe Mountain and the amphitheatre. A specimen record of one at the Beaver Pond (the Dead Lake of Carl et al.) and numerous sight records of these at the Visitor's Centre indicate that there is a good deal of overlap in the range of the two tree squirrel species in the park.

Northern Flying Squirrel *Glaucomys sabrinus*
Common throughout the park, but nocturnal. Sometimes found by tapping on snags with old woodpecker hole in them. Often soars over the amphitheatre during evening programs (Fraser pers. obs.).

Northern Pocket Gopher *Thomomys talpoides*
Common throughout the park although seldom seen. Burrow activity indicates that the species is found up to altitudes of 6500 ' (Carl et al. 1952).

Beaver *Castor canadensis*

Carl et al. (1952) reports that Beaver have been long established in the park as evidenced by abandoned and active Beaver ponds. Beaver activity in the park has apparently declined over the history of the park. Edwards '1949 considered the area as marginal habitat for beaver - although he did propose., a reintroduction program for the species in the early 1950's. Beavers have contributed significantly to the landcape diversity of the park.

Deer Mouse *Peromyscus maniculatus*

A common species throughout the lower elevations of the park., Edwards mentions that the species was not found in the alpine.

Bushy-tailed Waodrat *Neotoma cinerea*

Occupies cliffs, rockslides and man made structures throughout the park.

Southern Red-backed Vole *Clethrionomys gapperi*

Common throughout the park in forested habitats. Juveniles are particularly easily found in the forested campsites. Found in spruce, lodgepole pine and alpine fir forests.

Heather Vole *Phenacomys intermedius*

Carl et al. (1952) .collected this species in Manning Prov. Park at elevations above 4500 feet.

Meadow Vole *Microtus pennsylvanicus*

A common vole in the eastern portion of the park. Found in . a variety of habitats, both lw elevation and alpine meadows, forest glades, sedge meadows and grassy edges around ponds.

Long-tailed Vole *Microtus lonqicaudus*

Found at Mile 17 and 21 and at North Star Creek and. at the Beaver Ponds (Carl et al.). Usually found in forest edge habitats (Cowan and Guiget 1965).

Creeping Vole *Microtus oregoni*

Cowan and Guiget (1965) mention collections' from Allison Pass.in Manning Park. This vole lives largely underground and is seldom found on the surface, although is can use other vole's runways in heavily grassed areas. Carl et al. list it as "not abundant".

Water Vole *Microtus richardsoni*

This, the largest vole in the province is usually found along the banks of streams at 'or near timberline in mixed stands of low willows and dense herbage (Cowan and Guiget 1965). Specimens recorded from Timberline Valley (Carl et al.) and the summit of the Hope-Princeton (Cowan and Guiget 1965).

Muskrat *Ondatra zibethicus*

Rare, but may be increasing. Carl et al. list this as an uncommon species in the Manning Park area, and says that the only habitat that seems suitable in the park is a large slough at the, junction of Copper Creek and the Similkameen river.

Scattered sightings at the Beaver Pond, Tenwty Minute Lake (specimen) and other areas in the park indicate that the species at least passes through Manning Park. Reports in the early 1980's 'indicated that the species was seen regularly at the Beaver Pond,

Northern Bog Lemming <u>Synaptomys borealis</u>
Carl et al. list this as an uncommon species in the Manning area with specimens taken at three locations in the park ranging from 4000 to 6500 feet in elevations.

Western Jumping Mouse <u>Zapus princeps</u>
Found throughout the eastern sections of the park preferring margins of streams and other openings. See the next species.

Pacific Jumping Mouse <u>Zapus trinotatus</u>
Found in the western part of the park, this species prefers moist meadows and the edges of riparian thickets (Cowan and Guiget 1965). Range in the park overlaps with the next species in the area around the lodge and Beaver Pond. Common in some years at Eastgate and McDiarmid Meadows (Fraser pers. obs.).

Porcupine <u>Erethizon dorsatum</u>
Found primarily on the east side of the park.

Gray Wolf <u>Canis lupus</u>
Hilton (in Carl et al. 1952) found this species in the park during the winter months and regarded it as a transient. No reports from Edwards or Carl et al. during their summer survey work,

Coyote <u>Canis latrans</u>
A common animal in the park, found in almost all habitats and elevations - most easily seen in open places such as Strawberry Flats or above timberline. Lyons describes an interesting attack by a pair of coyotes on a scout troop camping in the park during the summer of *****, were several boys were bitten and dragged while in their sleeping bags. They were eventually driven off by the leaders.

Red Fox <u>Vulpes vulpes</u>
Hilton (in Carl et al.) reports having seen fox occasionally in the Similkameen Valley from Copper Creek almost to Allison Pass. Specimens have been taken in trap lines in the park.

Black Bear <u>Ursus americanus</u>
Fairly numeroqs in the park. See Carl et al. for details of diet and habitat preference in the park.

Grizzly or Brown Bear <u>Ursus arctos</u>
An occasional visitor to the park. Grizzlies are found both to the south and the north of the park and it has been proposed that Manning Park would be a good area for reintroduction of Grizzlies (McCrory and Herrero 1987).

Raccoon — *Procyon lotor*
No records for Manning Park -

Marten — *Martes americana*
Carl et al. regarded Martens abundant but seldom seen, based mainly on trapping records. Mostly confined to virgin-spruce forests. As with many mammals Manning is in an area of overlap of a coastal subspecies (M. a. caurina) and an interior one (M. a. abietinoides).

Fisher — *Martes pennanti*
Carl et al. regarded this as a rare animal in the 'park, again based on trappers returns.

Ermine — *Mustela erminea*
Also called Short-tail d Weasel. This is the common weasel of the lower elevations of the park. Again two 'races are probably found in the park. M.e. fallenda of southwestern British Columbia and M.e. invicta of the interior.

Long-tailed Weasel — *Mustela frenata*
Commoner at the higher elevations of the Park, although it has been recorded at lower elevations just outside the park;

Mink — *Mustela vision*
Evenly distributed throughout the park, along shores of lakes and ponds.

Wolverine — *Gulo gulo*
Very rare in the park - only a handful of records and most of them are recorded as "unconfirmed". To be expected but in very low numbers

Badger — *Taxidea taxus*
Found just outside of the park,, east of Eastgate.

Spotted Skunk — *Spilogale putorius*
At the very eastern edge of its range at Manning Park. Cark et al. report an animal taken at Lightning Lake about 1927. This is the only record for the park.

Striped Skunk — *Mephitis mephitis*
Found in small numbers throushout the park.. Again a coastal race (M.m. spissigrada) and an interior race are involved (M.m. hudsonica).

River Otter — *Lutra canadensis*
Found in small numbers throughout the park in suitable habitat.

Mountain Lion — *Felis concolor*
Rare, but probably resident in the Park. Thomson (1974) felt that increasing deer populations had led to an increase in this species as well.

Lynx _Lynx canadensis_
Resident, but in small numbers throughout the park.

Bobcat _Lynx rufus_
Taken regularly but rarely in the Skagit Valley (Carl et al. 1952). It has also been recorded from just outside the eastern edges of the park and may occur there as well. Western form is a dark form _L. r. fasciatus_ and the eastern one is L .r. _pallescens_.

Elk _Cervus elaphus_
Carl et al. report an introduced population 20 miles north of the Park, but knew of no records for the park proper. High elevation summer range for this species is plentiful in the park, however winter range is limited. The status has changed however and Thomson (1974) reports that "some move down from their winter range north of Manning park to summer in the Alpine meadows. Reported bugling at Buckhorn Campsite in Sept. 1973 by P. Swift".

Mule Deer _Odocoileus hemionus_
Both races of Mule Deer found in British Columbia occur in the park - with much intergration. Coast Deer or Columbia Blacktail is the western form (O.h. columbianus) - it is smaller, darker with a different tail pattern from the interior race O.h. hemionus. See Cowan and Guiguet (1965) for details.

White-tailed Deer Odocoileus virginianus
Reports summarized in Thomson (1974) from subalpine meadows are probably based on misidentifications as the species rarely occurs outside the East Kootenays. There are however specimens records as close as Wells Gray Provincial Park (Cowan and Guiget 1965). Until documented with good field notes or a photograph, this species should not be regarded as part of the fauna of Manning Provincial Park.

Moose _Alces alces_
Moose have only recently been found in the park. Carl et al. knew of no records from the park - later checklists listed it has rare in the winter months. They have been recorded on both sides of the park although most sightings are in the eastern sections of the park. Cowan and Guiget (1965) describe the spread of this species in British Columbia.

Mountain Goat _Oreamnos americanus_
Mountain Goats have been found in only a restricted area in Manning Park. Carl et al. recorded it from the Moutains about Lightning Creek - extending up the creek as far as Frosty and Lone Goat Mountain. Close to the Park, a relatively easily observed group was known from Mile 21 of the Hope-Princeton Highway. Thomson 1974 however reported that it had not been seen for "several years" and speculated that hunting pressure contributed to the decline. A 1980 'reportsaid "rarely seen' in Skagit Bluffs area or Cascade WIlderness.

Mountain Sheep *Ovis canadensis*

A lone ram was reported to have ranged on the Three Brothers Mountain area during the 1930's - no recent records (Carl et al. 1952).

Appendix 7.
Information Sheets on Selected Manning Park Organisms:

The following pages contain brief descriptions of the natural history of selected Manning Park vertebrates, extracted primarily from Ehrlich et al. (1988), Forsyth (1,985), and catalogue accounts prepared by students in Biology 329 at the university of Victoria (on file at UVic).

They are intended to be a source for interpreters, providing answers to some of the most commonly asked questions, and pointing to references in which further details may be found. Many of these references are articles published in scientific journals (e.g. Canadian Journal of Zoology, Journal of Mammalogy, Condor), available at most university libraries. The University of British Columbia will forward copies of most articles upon request. In these information sheets, references that contain only the author(s) and year are given in full in the general bibliography for this document.

In most cases, specific data on populations within the park are not available; perhaps such information could be appended in the future. Treatment of species not included here would be a valuable contribution..

SPECIES ACCOUNTS:

Rainbow Trout
Harlequin Duck
White-tailed Ptarmigan.
Spotted Owl
Black-backed Woodpecker
American Dipper
Shrew Mole
Pika
Mountain Beaver
Hoary Marmot
Columbian Ground Squirrel

SPECIES ACCOUNT: Rainbow Trout

Description

This is an extremely variable species, typically trout-like in form, but with colour ranging from bluish to greenish on the sides, and with dark spots on upper sides and back, and on the dorsal, caudal, and usually anal, fin. Young may be difficult to identify, having 9 to 13 dark parr marks along the sides, and 5-10 on the back, ahead of the dorsal fin. Scale, gill, and fin characteristics are also used to describe this and other fish species; see Carl et al. (1959) and Wydosky and Whitney (1979) for complete descriptions and illustrations.

Habitat

Natural populations of rainbow trout occur from northern B.C. to southern California. It has been widely introduced to previously unoccupied lakes both within its natural range, and across the rest of North America. In Manning Park, it is found in streams and lakes on both sides of the Cascades divide, and is the common game fish of the Lightning Lakes Chain, and has been introduced into Poland and Nicomen Lakes. This species inhabits cool, well-oxygenated water, preferably less than 21 degrees C.

Diet

Rainbow trout are entirely carnivorous, eating aquatic invertebrates and flying insects that have landed on the surface of the water. Larger fish will also eat smaller fish, and cannibalism is not uncommon.

Reproductive Biology

This species is as variable in its reproduction as it is in its appearance. The most common pattern in Manning Park is probably migration out of lakes such as the Lightning Lakes and into tributary streams to spawn. Migration probably occurs around May or June. Inlet streams usually contain more food and nutrients than outlet streams, and these are the preferred spawning sites. As with Pacific salmon, females construct nests (redds) in gravel beds, and males jostle for position beside her to fertilize her eggs. After several weeks, the fry hatch, and occupy the calmer pools until they are large enough to withstand the current in the more productive riffle areas. They remain in the stream for a variable length of time, usually descending into the lake before their first winter. They reach maturity after 3 or 4 years (males usually before females) and may spawn several times throughout their life. Some populations of rainbow trout never enter lakes, and complete their entire life cycle within a stream. As with fishes in high altitude lakes, these fish usually remain small, and may retain a juvenile pattern throughout their life.

References: Rainbow Trout

Cartwright, J.W. 1961. Investigation of the rainbow trout of Kootenay Lake, British Columbia. B.C. Fish and Game Branch, Management Publication No. 7. 46 pp.

Crossman, E.J. 1959. Distribution and movements of a predator, rainbow trout, and its prey the redside shiner, in Paul Lake, British Columbia. Journal of the Fisheries Research Board of Canada 16(3): 247-267.

Griffiths, J.S. 1968. Growth and feeding of the rainbow trout Salmo gairdneri and the lake trout Salvelinus namaycush from Babine Lake, British Columbia. Honour's Thesis, Department of Zoology, university of Victoria. 56 pp.

Jenkins, T.M., Jr., C.R. Feldmeth and G.V. Elliott. 1970. Feeding of rainbow trout (Salmo gairdneri) in relation to abundance of drifting invertebrates in a mountain stream. Journal of the Fisheries Research Board of Canada 27(12): 2356-2361.

McCrimmon, H.R. 1971. World distribution of rainbow trout (Salmo gairdneri). Journal of the Fisheries Research Board of Canada 28(5): 663-704.

Northcote, T.G. 1962. Migratory behavior of juvenile rainbow trout in inlet and outlet streams of Loon Lake, B.C. Journal of the Fisheries Research Board of Canada 19(2): 173-200.

Scott, W.B. and E.J. Crossman. 1973. Fresh Water Fishes of Canada. Bulletin 184 of the Fisheries Research Board of Canada, Ottawa. xi + 966 pp.

Woodin, R.M. 1974. Age, growth, survival, and mortality of rainbow trout (Salmo gairdneri gairdneri Richardson) from Ross Lake Drainage. Master's Thesis, University of Washington, Seattle. 119 pp.

Wyman, K.H., Jr. 1975. Two unfished salmonid populations in Lake Chester Morse. Master's Thesis, University of Washington, Seattle. 53 pp.

SPECIES ACCOUNT: Harlequin Duck

Description

A colorful, medium sized diving-duck, with distinct differences between the sexes. See descriptions in National Geographic Society (1984) and other field guides.

Habitat

Winters along both the east and west coast of North America; also in Asia. During the breeding season, it nests near fast-flowing mountain streams,, but also breeds on small rocky islands on the coast. Harlequins are regularly sighted in Manning Park; and are known to breed along the Similkameen and Sumallo Rivers.

Diet

Summer diet is'composed mainly of aquatic invertebrates, primarily insect larvae, which they capture by diving and "walking" on the bottom of streams, often with very fast currents. Winter .diet consists of marine crustaceans and mollusks, and occasionally fish.

Reproductive Biology

Pair-bond formation in this species occurs in the wintering areas, and pairs arrive on the breeding grounds in late spring. Females build a shallow, grass and down-lined nest on the ground, concealed beneath dense vegetation, and usually within 20 metres of water. Mating in this area probably occurs around May or June and only the female cares for the eggs and young; her 5-6 eggs hatch after around 30 days. During incubation, the female remains on the nest at all times, except for infrequent breaks for drinking and feeding. The downy chicks are mobile from hatching, and immediatly follow their mother to a nearby stream to search for food. They probably fledge after around 60-70 days, and become sexually mature after their second year.

References: Harlequin Duck

Bellrose, F.C. 1976. Ducks, Geese and Swans of North America, 2nd edition. Stackpole Books, Harrisburg, Pennsylvania.

Iwama, K.M. 1984. Histrionicus histrionicus pacificus: Pacific Harlequin Duck. University of Victoria, Biology 329 Catalogue Account (unpublished).

Jewett, S.G., W.P. Taylor, W.T. Shaw and J.W. Aldrich. 1953. Birds of Washington State. university of Washington Press, Seattle. 767 pp.

Michael, C.W. and E..Michael. 1922. An adventure with a pair of Harlequin Ducks in the Yosemite Valley. Auk 39: 14-43.

Pearse, T. 1945. Mating of the Pacific Harlequin Duck. Canadian Field-Naturalist 59: 66-67.

Pool,. W. . .1962. Feeding Habits of the Harlequin Duck,. Wildlife Trust Annual Report (1960-1961) 13: 126-'129.

SPECIES ACCOUNT: white-tailed Ptarmigan

Description

See illustration and description in National Geographic Society (1984). The feet of this species are exquisitely adapted to their harsh habitat. They are fully feathered, providing excellent insulation against the cold. Prior to snowfall, the toes develop extensive fringing along their edges, and the claws increase in length. These modifications increase the surface area of the feet by up to 400 percent, and reduce the depth to which the feet sink below the surface of the snow by half. This allows ptarmigans to walk across the snow using significantly less energy.

Habitat

This is an alpine species, breeding on high alpine and subalpine meadows, moving to lower elevations in winter.

Diet

White-tailed .Ptarmigans are primarily herbivorous, eating mostly buds, leaves and flowers. Willows are a staple food in. many areas. Insects are eaten occasionally, particularly by young birds.

Reproductive Biology

Males court females on the alpine breeding grounds by strutting and calling,, and his red eye combs become bright and swollen. Nests are shallow, grass and feather lined depressions placed'out in the open, or sometimes under a low shrub. Although he may remain with his mate until the eggs hatch (possibly serving as a sentinel to signal danger), the male usually deserts. after they are laid, and the female performs all of the incubation duties. She is a "close sitter", and will often.not move unless actually touched. This is a strategy to avoid detection: others include the female's delaying nesting until her cryptic summer plumage,is fully in place, and also'her practice of eating white feathers near the nest and covering eggshells. The 4-8 eggs hatch after 22-24 days, and the chicks.immediately leave the nest to be led to food by their mother. They grow quickly, and can fly short distances after only 7-10 days.

References: White-tailed Ptarmigan

Giesen, K.M. and C.E. Braun. 1979. Nesting behavior of female White-tailed Ptarmigan in Colorado,.Condor 81: 215-217.

Giesen, K.M. , C.E. Braun and T.A. May. 1980. Reproduction and nest-site selection of White-tailed ptarmigan.in Colorado..Wilson Bulletin 92: 188-199.

Hohn, E.O. 1977. The "snowshoe effect" of the feathering on ptarmigan feet. Condor 79: 380-382.

Johnsgard, P.A. 1973. Grouse and Quails of North America. University of Nebraska Press, Lincoln.

SPECIES ACCOUNT; Spotted Owl

Description

A medium-sized, owl without ear tufts, distinguished from the similar Barred owl by the presence of spots, rather than horizontal bars, on the breast. Females are larger than males. Calls, given at night, are varied; one of the more common is a "hoo-hoo-hoooo", with the third syllable longer than the first two. See illustrations and descriptions in National Geographic Society (1984) and other field guides.

Habitat

Very rare in British Columbia, this species inhabits dense coniferous forest (especially old-growth Douglas-fir) from southern British Columbia to Mexico. Manning Park is probably the best place in the province to look for this species. It is generally non-migratory, but may move to lower elevations during the winter. Its thick layer of feathers makes it vulnerable to overheating, and daytime roosts are usually on north-facing slopes with a dense canopy. A single pair of Spotted owls requires a home range size of 570 to 610 hectares (14001500 acres); the loss of habitat through logging has caused a severe population decline throughout most of their range. (In 1979, 40 hectares (100 acres) of old growth timber in Oregon was valued at US $1,600,000).

Diet

This nocturnal hunter eats mostly small mammals, some birds, reptiles and insects. Diet in British Columbia is primarily northern flying squirrels, and bushy-tailed woodrats and occasionally deer mice. Excess food is often cached. Indigestible remains (fur, bone) are regurgitated as pellets, which may accumlate under a traditional daytime roost.

Reproductive Biology

Spotted owls nest in tall coniferous trees, and often use the abandoned nests of other raptors, or ravens. They are also known to nest on cliffs, or on the floor of caves. Pairs probably mate for life, often occupying the same nest site in different years, but they often do not breed two years in succession. Mating occurs in late winter, and 1-3 chicks are hatched in April or May after an incubation period of 28-32 days. Only the female incubates the eggs and broods the chicks, and the male is the sole provider of food until the chicks are two weeks old. Chicks are able to fly after 34-36 days, but survival to breeding age (probably 3 years) is low.

References: Spotted Owl

Barrows, C. 1981. Roost selection by Spotted Owls: an adaptation to heat stress. Condor 83: 302-309..

Broadley, T. 1984? A Catalogue Account for the Spotted Owl (Strix occidentalis) with Emphasis on the Pacific Northwest Distribution. University of Victoria, Biology 329 Catalogue Account (unpublished).

Campbell, E.C. and R.W. Campbell. 1984. Status report on the Spotted Owl (Strix occidentalis) in Canada - 1984. Committee on the Status of Endaangered Wildlife in Canada Status Report. Canadian Nature Federation, Ottawa.

Campbell, R.W., E.D. Forsman and B.M. Van Der Ray. 1984. An Annotated. Bibliography of Literature on the Spotted Owl. B.C. Ministry of Forests, Land Management Report Number 24.

Dunbar, D.L. and E.D. Forsman. 1986. Status of the Spotted Owl in British Columbia. Submitted to Canadian Field-Naturalist (on file at District Office in North Vancouver).

Forsman, E.D., E.C. Meslow and H.M. Wight. 1984. Distribution and biology of the Spotted Owl ,inOregon. Wildlife Monographs 87: 1-64.

Garcia, E.R. 1979. A Survey of the Spotted Owl in Washington. Pp. 8-28 in Proceedings of the National Audubon Society Symposium on Owls of the West: their ecology and conservation (P.P. Schaefer and S.M. Ehlers, eds.). National Audubon Society Western Education Center, Tiburon, California.

Howie, R. 1980. The Spotted Owl in British.Columbia. Pp. 96-105 in Proceedings. of the Symposium on Threatened and Endangered Species and Habitats in British Columbia and the Yukon (R. Stace-Smith, L. Johns and P. Joslin, eds.). B.C. Ministry of the Environment, Victoria.

SPECIES ACCOUNT: Black-backed Woodpecker

Description

A medium-sized black and white woodpecker, easily confused with the Three-toed Woodpecker but for this species' solid black back. See illustrations in National Geographic Society (1984) and other field guides.

Habitat

This is a widespread woodpecker, observed virtually throughout North America. It is essentially non-migratory, inhabiting coniferous forests throughout the year. The sudden appearance, or 'irruption of large numbers' of this species in an area during winter is not uncommon (see references below). In Manning Park, they are a rare resident.

Diet

This species is primarily insectivorous, feeding mainly on the larvae of wood-boring beetles, but also ants and some vegetation (fruit, and cambium, the inner lining of tree bark). It. searches for much of its food under bark, and trees with easily-peeled bark are favoured. Characteristic feeding damage is a patch of bare wood from which the bark has been peeled: the bark is removed by a series of direct blows followed by slanting blows from each side that causes it to flake off in pieces.

Reproductive Biology

In the spring, both sexes (but primarily the male) construct a chip-lined cavity in a dead or dying tree, often a fir. The opening is beveled in such a way as to form a "doorstep", and is around 4 cm in diameter. Two to six eggs are laid in May or, June, and the female performs most of the incubation duties, which last for around two weeks. Once the eggs have hatched, both sexes feed the young primarily soft-bodied insects, and fledging occurs after around 3-4 weeks. The young are loud and very aggressive, and may sometimes make it difficult to the adults to exit the nest. Adults, too, are very antagonistic towards woodpeckers and other species, displaying to and attacking intruders vigourously. One brood is produced per year.

References: Black-backed Woodpecker

Bock, C.E. and D.H. Bock. 1974. On the geographical ecology and evolution of the Three-toed Woodpecker, P. <u>tridactilus</u> and P. <u>arcticus</u>. American Midland Naturalist 92: 397-405.

Guiguet, C.J. 1954. The birds of British Columbia (Woodpeckers, Crows and allies). B.C. Provincial Museum Handbook No. 6. 51 pp.

Kilham, L. 1966. Nesting activities of Black-backed woodpeckers.

Condor 68: 308-310.

Larrison, E.J. 1981. Birds of the Pacific Northwest. University of Idaho Press, Idaho.

Short, L.L. 1974. Habits and interactions of North American Three-toed Woodpeckers, Picoides arcticus and Picoides tridactylus. American Museum Novitates 2547: 1-42.

Spring, L.W. 1965. Climbing and pecking adaptations in some North American Woodpeckers. Condor 67: 457-488.

Tavlor, N. 1986. A catalogue account of the Black-backed Three-toed Woodpecker Picoides arcticus in North America. University of Victoria, Biology 329 Catalogue Account (unpublished).

Yunick, R.P. 1985. A review of recent irruptions of the Black-backed Woodpecker and Three-toed Woodpecker in eastern North America. Journal of Field Ornithology 56: 138-152.

King, D.G., A. Grass and K. Summers. 1973. Observations on the dipper in the Skagit Valley of British Columbia. The Murrelet 54: 16-19.

Morse, P.J. 1979. Pairing and courtship in the North American Dipper. Bird-Banding 50: 62-65.

Price, F.E. and C.E. Bock. 1983. Population Ecology of the Dipper (Cinclus mexicanus) in the Front Range of Colorado. Studies in Avian Biology No. 7. Cooper Ornithological Society, Los Angeles.

SPECIES ACCOUNT: Shrew Mole

Description

The shrew mole is part way between a shrew and a mole in appearance (and also in habits; see below).. Its total length is 1013 cm (4-5 inches), 35 cm (1-2 inches) of which is tail, and it typically weighs less than 10 grams (around a third of an ounce). Unlike other moles, the front feet are longer than they are wide, making them less effective shovels. . Colour is dark grey to black, often with a metallic gloss. See illustrations in Forsyth (1985) and van Zyll de Jong (1985a).

Habitat

Shrew moles are found west of the Cascades, from extreme southern B.C. . to southern California. Manning Park is probably the best place in B.C. to find this secretive species. They prefer moist (but not wet) habitats with a loose litter layer in 'which they can construct tunnels. Forested hillsides and stream margins appear to be favoured habitats. They are the least' efficient member of the mole family in terms of digging ability, and spend much time on the surface, even venturing up into low vegetation.

Diet

The diet of shrew moles is poorly known, but they are thought to prey upon earthworms and other soil 'invertebrates. They also consume limited amounts of vegetable matter, seeds in particular. They locate their food primarily by smell, as their eyesight is poor. To compensate, the nose is highly developed, and the long snout is waved from side to side, much in the way a blind person uses a cane.

Reproductive Biology

Both sexes probably become sexually mature after their first year of life. Females produce from 1 to 4 young, after a gestation period of 4 to 6 weeks. The breeding season is extended, from February through September. Little else.is known of the breeding of this species, except that their characteristic musky odour is strongest in reproductively active males.

References: Shrew-mole

Forysth, A. 1985. Mammals of the Canadian Wild. Cambden House Publishing , Cambden East, Ontario.

van Zyll de Jone. 1.983. Mammals of Canada I, Insectivores.. National Museum of Canada;

References: Pika

Barash, D.P. 1973. Territorial and foraging behaviour of pika (Ochotona princeps) in Montana. American Midland Naturalist 89: 202-207.

Broadbrooks, H.E. 1965. Ecology and distribution of the pikas of Washington and Alaska. American Midland Naturalist 73: 299-335.

Bunnell, S.D. and D.R. Johnson. 1974. Physical factors affecting pika density and dispersal. Journal of Mammalogy 55: 866-869.

Conner, D.A. 1983. Seasonal changes in activity patterns and the adaptive value of haying in pikas (Ochotona princeps). Canadian Journal of Zoology 61: 411-416.

Cowan, I.M. 1954. The distribution of the pikas (Ochotona) in British Columbia and Alberta. Murrelet 35: 20-24.

Kawamichi, T. 1976. Hay territory and dominance rank of pikas (Ochotona princeps). Journal of Mammalogy 57: 133-148.

Millar, J.S. 1974. Success of reproduction in Pikas, Ochotona princeps (Richardson). Journal of Mammalogy 55: 527-542.

Millar, J.S. and F.C. Zwickel. 1972. Determination of age, age structure, and mortality of the pika, Ochotona. princeps (Richardson). Canadian Journal of Zoology 50: 229-232.

Millar, J.S. and F.C. Zwickel. 1972. Characteristics and ecological significance of hay piles of pikas. Mammalia 36: 657-667.

Shrimpton, M. 1984. Pika: Ochotona princeps. University of Victoria, Biology 329 Catalogue Account (unpublished).

Svendson, G.E. 1979. Territoriality and behaviour in a population of pikas (Ochotona princeps). Journal of Mammalogy 60: 324-330.

SPECIES' ACCOUNT: Mountain Beaver

Description

The mountain beaver is a medium-sized rodent, around 32 cm (13 in) in total length, 1-1.5 kg (2-3 lb) in weight, with a very short (2-3 cm) tail. Eyes and ears are small, but whiskers are very long, 'and the fur is dark brown in colour. See illustrations in Burt and Grossenheider (1976), Cowan and Guiguet (19xx), and photo in Forsyth (1985).

Habitat

Mountain beavers range from southern B.C. to southern California, extending no more than a few hundred miles inland from the Pacific coast. Within Manning Park, they are found on wet hillsides, primarily in the western part of the park. They are incapable of closely regulating their body temperature, and therefore seek moist habitats with soils sufficiently loose to permit digging. Assisted by their strong shoulder muscles', they construct extensive burrow systems that are sometimes 100 metres in diameter. The burrows themselves are usually 15-20 cm in diameter, and may be up to a metre' belowthe surface.

Diet

Mountain beavers eat only plant material: grasses, deciduous twigs (especially alder, hazel, maple and currant), and shrubs form the bulk of their diet. In winter, coniferous leaves (cedars, Douglas-fir) are also eaten. They are known to climb trees to reach their. food, reaching heights of over 5 m to clip off branches. Like the pika, mountain beavers harvest plant material and transport it to their burrows for consumption. Also like pikas, mountain beavers eat their feces to extract further nutrition from their food. Each fecal pellet is extracted from. the anus, and piled within special chambers in their burrow. Fermentation of these piles probably breaks down the pellets further, and releases nutrients, B vitamins in particular.

Reproductive Biology

Unlike most rodents, mountain beavers reproduce at relatively low rates. Females become sexually mature after their second year, and produce one litter of 2 to 6 young per year. Mating occurs in late winter, and the young are born in early spring after a gestation period of around 30 days. The young are weaned after around two months, and soon establish their own burrow systems near their mother's. They do not reach adult size until at least a year later.

Other Names

Mountain boomer. Also Og-ool-lal, Sewellel (Chinook Indians of Puget Sound); Squallal (Yakima Indians); Showt'l (Nisqually Indians); Swok-la (Sumas Indians of B.C.).

References: Mountain Beaver

Black, H.C. and B.P. Lovejoy. 1979. Growth and weight of the mountain beaver (Aplodontia rufa pacifica). Journal of Mammalogy 55: 364-369.

_____. 1979. Movements and home range of the pacific mountain beaver (Aplodontia rufa pacifica). American Midland Naturalist 101: 393-402.

Borreco, J.E. and F.D. Neal. 1981. Distribution and relationship of mountain beaver to openings in sapling stands. Northwest Science 55: 79-86.

Camp, C.L. 1918. Excavations of, burrows of the rodent Aplodontia, with observations of the habits of the animal.' University of California Publications in Zoology 17: 517-536.

Cramblet, H.M. and R.L. Ridenhour. 1956. Parturition in Aplodontia. Journal of Mammalogy 37: 87-90.

Herlocker, E. 1950. Mountain Beaver: a biological curiosity. Audubon Magazine 52: 387-390.

Ingles, L.G. 1959. A quantitative study of mountain beaver. activity. American Midland Naturalist 61: 419-423.

_____. 1960. Tree climbing by mountain beaver. Journal of Mammalogy. 41: 120-121.

_____. 1961. Reingestion in the mountain beaver. Journal of Mammalogy 42: 411-412.

Johnson, M.K. 1975. Tent building in the mountain beaver (Aplodontia rufa pacifica). Journal of Mammalogy 56: 175-176.

Martin, P. 1971. Movements and activities of the mountain .beaver (Aplodontia rufa). Journal of Mammalogy 52: 717-723.

Pfeiffer, E.W. 1957. The reproductive cycle of the female mountain 'beaver. Journal of Mammalogy 39: 223-225.

Racey, K. 1922. The mountain beaver (Aplodontia rufa). Canadian Field-Naturalist 36: 30-32.

Toth, B. 1988. The oldest living rodent, Aplodontia rufa. University of Victoria, Biology 329 Catalogue Account (unpublished).

SPECIES ACCOUNT: HOARY MARMOT

Description

This is the largest squirrel in North America, reaching up to 90 cm (30 inches) in total length, and a weight of up to 29 pounds, though more normally less than 20 pounds. Its thick silvery coat provide it with much protection from the cold.

Habitat

This is an subalpine and alpine species, ranging along the western cordillera from Alaska to Montana. In Manning Park, it is common at high elevations, especially at Blackwall Peak and, the Three Brothers region. It typically burrows in rocky talus areas next to meadows.

Diet

Hoary marmots are completely herbivorous, eating grasses and herbaceous vegetation, including roots, flowers and berries. They greatly increase their weight by late summer, developing a thick layer of fat that provides them with energy for survival through the winter. Hoary marmots may spend 'as much as two-thirds of their lives in hibernation.

Reproductive Biology

In spring, male hoary marmots wrestle for control a group of females, called,a harem. They mate with these females, and try to prevent other males from doing likewise. Females produce a single litter of 4 or.5 young per year, after a gestation period of around one month. Only the female cares for the offspring, which are sexually mature in 2 to 3 years.

References: Hoary Marmot

Barash, D.P. 1974. The social behavior of the hoary marmot (Marmota caligata). Animal Behavior 22: 256-261.

Barash, 'D.P. 1981. Mate guarding and gallivanting by male hoary marmots (Marmota caliqata). Behavioral Ecology and Sociobiology 9: 187-193.

Blower, M. 1986. A Catalogue Account of the Hoary Marmot: Marmota caligata. University of Victoria Biology 329 Catalogue Account (unpublished).

Gray, D.R. 1967. Behavior and activity in a colony of hoary marmots,(Marmota caliqata) in Manning Park B.C. and a comparison of. behavior with other marmot species. B.Sc. Honours Thesis. University of Victoria.

Halasz, G. 1986. The 'Whistler' in Manning Provincial Park, British Columbia. Discovery 15(2): 70-71.

Holmes, W.G. 1984. The ecological basis of monogamy in Alaskan. hoary. marmots. Pp. 250-274 in Biology of Ground-dwelling Squirrels: Annual Cycles, Behavioural Ecology, and Sociality (J.O. Murie and G.R. Michener, eds.). University of Nebraska Press, Lincoln.

Noyes, D.H. and W.G. Holmes. 1979. Behavioral responses of free-living hoary marmots golden eagle. Journal of Mammalogy 60: 408-411.

Taulman, J.F. 1977. Vocalizations of the hoary marmot, Marmota caligata. Journal of Mammalogy 58: 681-683.

SPECIES ACCOUNT: Columbian Ground Squirrel

Description

A rather large squirrel, up to 38 cm (15 in) in total length, Weight changes dramatically among different times of the year: on entering hibernation in July, they may exceed 800 grams (29 oz); upon emergence in March they often weigh less than 450 grams (one pound). Fur is mottled grey, with rufous legs and underparts. See illustration in Burt and Grossenheider (1976), and photographs in Forsyth (1985).

Habitat

Columbian Ground Squirrels occur on either side of the Rockies, from southern B.C. and Alberta to southern Oregon. They have only recently spread westward along Highway 3. into Manning Park (see Human History section D 11.), and are now common around the park buildings and along the side of the highway. 'They prefer well drained soil in which to construct extensive burrow systems; slopes with a southern exposure are favoured habitats.

Diet

This species is primarily vegetarian (roots,, stems, leaves and flowers of herbaceous plants), but will also eat insects and small vertebrates. Edible human garbage, if offered, is rarely refused.

Reproductive Biology

Mating occurs in early spring, and males fight to secure a territory that includes at least one female. They mark their territory. with scents produced by glands on various parts of their body. Social communcation (scent marking, calling, playing, grooming) is an important part of this species' natural history throughout the year. After mating, males insert a solid plug into the female's vagina to prevent her from being mated by another male for at least a day, After a gestation period of just over 3 weeks, females produce a litter of 2 to 4 young., Female offspring tend to remain near their mother's burrow system, but males usually disperse into other areas. Both sexes mature .after two years, growing more slowly than most other ground squirrels,

References: Columbian Ground Squirrel

Betts, B.J. 1976. Behaviour in a population of Columbian ground squirrels, Spermophilus columbianus. Animal Behavior 24: 652-680.

Boag, D.H. and J.O. Murie. 1981. Population ecology of Columbian ground squirrels in southwestern Alberta. Canadian Journal of Zoology 59: 2230-2240.

Elliot, C.L. and J.T. Flinders. 1980. Seasonal activity pattern of Columbian ground squirrels in the Idaho Primitive Area. Great Basin Naturalist 40: 175-177.

_____. 1986. Food habits of the Columbian ground squirrel in Southcentral Idaho. Canadian Field-Naturalist 99: 327-330.

Festa-Bianchet, M. and W.J. King. 1984. Behaviour and dispersal of yearling Columbian ground squirrels (Spermophilus columbianus). Canadian Journal of Zoology 65: 161-167.

Lambeth., R. and M. Hironaka,. 1982. Columbian ground squirrels in subalpine forest openings in central Idaho.' Journal of Range Management 35: 493-497.

Michener, G.R. 1977. Effect of climate conditions on the annual activity and hibernation cycle of Richardon's ground squirrel and Columbian ground squirrel. Canadian Journal of Zoology 55: 693-703.

Walker, J.M. 1984. Infanticide in the Columbian ground squirrel. Journal of Mammalogy 65: 137-138.

Woods, S.E. Jr. 1980. The Squirrels of Canada. National Museums of Canada, Ottawa.,

Appendix 8.

Annotated List of People Associated

with the

History of Manning Park

and the Cascades Wilderness Area

Akrigg, Mr.: (former Park resident; daughter is Mrs. Helen Akrigg, of Vancouver (Anon., n.d. d).

Allison, John Fall (1825-1897): pioneer in the Princeton region. Born in Leeds, Yorkshire, Allison moved to New York with his family in 1837. In 1849 he left home to seek his fortune in the goldfields of California (Turnbull 1980). Several years later, in 1860, he moved north to Hope, and mined in the nearby flats.. After meeting Governor Douglas, he was commissioned to verify reported gold strikes in the Similkameen River, and on his return westward across the Cascades, he reported a new pass (now Allison Pass) that was lower than those currently used by the Hudson's Bay Company (Turnbull 1980). Allison married Susan Moir, of Hope, in 1868, and they became the first permanent white settlers in the Princeton area. At the junction of the Similkameen and Tulameen Rivers, he and a partner raised cattle, which were driven to Hope along the Hope Trail (Turnbull 1980). Allison died after a series of financial failures, in 1897. His life is chronicled in some detail in his wife's published memoirs (Ormsby 1976).

Anderson, Alexander Caulfield (1814-1884): Hudson's Bay Company. Born in Calcutta to British parents that ran an indigo plantation, Anderson received a liberal education in England before moving to Montreal in May of 1831. After joining the Hudson's Bay Company that year, he moved west, marrying in 1837, and fathering 13 children. In 1846, he was commissioned to clear an "all-Canadian route through the Cascades". He retired from the H.B.C. in 1854, and moved to Victoria. (All from May 1982 and Ormsby 1976).

Bauerman, H.: Geologist with the International Boundary Commission. He explored the geology of the Similkimeen River region from 1859 to 1861; his report was published in 1884 (Bauerman 1884).

Begbie, Judge Matthew Baillie (1819-1894): Chief Justice for the Colonial Government; he travelled through the Cascades along the Brigade Trail in 1859 (Hatfield 1980). Begbie was the "first Judge of Mainland British Columbia, whose strong personality brought law and order to the Colony, subdued the wild miners up from California, and ensured that 'British Columbia should remain British' (Fitzgeorge-Parker 1968).

Blackeye: an Indian Chief from Otter Flats, north of Tulameen.

Bonnevier, Charles (1865-1952): prospector in the Manning Park area. Bonnevier arrived in New York from Sweden late in the late 1800's and first appeared in the Manning Park area in 1898 or 1899 (Hilton 1980). He and his partner, a Belgian nicknamed "Old Belgie", searched for gold in Whipsaw 'Creek to Big Muddy Creek west of Shadow' Falls (Hilton 1963). He claimed that he could pan $50 in gold in one day across from the railway in Princeton (Hilton 1980), and he operated Red Star Mine for 23 years (Mogensen, pers. comm.). One of his favorite foods was beans, but he also ate bannock and mowich, or deer meat (Hilton 1980). Bonnevier was the first person to go through Allison Pass on the new Highway 3, in a ceremony presided by Premier Byron Johnson on November 2, 1949, and attended by some 6,000 people (Turnbull 1980). Wearing an old mackinaw shirt and a black hat, he led a packhorse through the evergreen-arched barrier and announced: "Fifty-four years I've waited for this day!" (Turnbull 1980:41). It is said that Bonnevier carried one of his first ounces of gold with him until his death. He is buried behind a large tree in an unmarked grave about one quarter-mile up a hill above the East Gate of Manning Park (Historic Parks and Sites Division 1976, Hilton 1980, Anon. n.d. d).

Boyd, Robert ("Bob"): Superintendent of Manning Park from 1946 to 1963. Boyd spent 12 years in B.C.'s Forest Service prior to his appointment as Forest Ranger in Manning Park. He was known as "The Laird of Manning Park" because of his dedication and involvement in the Park's early years, and a sign declaring this was hung in the ranger station dining hall (L. Harris, n.d.). With little manpower to assist him, he developed the park's facilities,in its early years. In 1946-1948 he built a horse barn that still stands, and in 1950 he supervised the construction of the ranger station, Manning Park Lodge. (formerly Pinewoods Lodge) and a gas station. With the help of the B.C. Telephone Company, he converted a trail up to the Three Brothers Mountain's spectacular alpine meadows into a road.. During the 1950's he became concerned about the very real possibility of losing Park lands to mining claims, and initiated a revision of the Parks Act to prohibit prospecting and the staking of claims in a Class A Provincial Park. (From L. Harris n.d.).

Broman (sp.?): prospector in the Manning Park area. He built'two cabins within the park (see Hilton 1963 for further information).

Bushby, Arthur Thomas (1835-1875): private secretary to Judge Matthew Begbie in 1859.. 'He subsequently held a number of legal posts on the coast and in the interior (Ormsby 1976).

Camsell, Charles: Chief of the Dominion Geological Survey who helped expose the Steamboat Mountain hoax in 1911.

Carleson, Mr.: a man from Princeton that was hired by the trapper Paul Johnson (sp?) to build cabins in Manning Park at the turn of the century (Hilton 1980).

Carry, Henry: member of a party under Edgar Dewdney that surveyed potential routes for the Hope-Princeton highway in 1901 (Turnbull 1980).

Cawley, Francis: homesteader in the Whitworth Ranch area of the Skagit Valley around 1883.(Mogensen, pers. comm.).

Chance, Johnny M.: prospector in the area northeast of Manning Park. He discovered gold (by chance) in Granite Creek in 1885 (Ormsby 1976).

Chuang, Ching-Chang: botanist for the B.C. Provincial Museum who did extensive collections in Manning Park and added many species to the list of flora.

Coates, J.A. (?-1968): geologist in the Manning Park area. Coates studied the geology of the Park for his Ph.D. degree at the University of British Columbia. His book., "Geology of the Manning Park Area, British Columbia" remains the standard text on this 'subject. It was published in 1974, six years after Coates died .in a plane crash in the District of MacKenzie. D.J. McClaren, Director of the Geological Survey of Canada, described him as a "fine, competent scientist" (Coates 1974).

Colville, Eden: Co-Governor, with Sir George Simpson, of the Hudson's Bay Company in North America; he travelled the Brigade Trail in 1849 (Hatfield 1981).

Cox, W.G.: gold. commissioner in the B.C. interior around 1860 (Ormsby 1976).

Crowley, Jack: .prospectorin the Manning Park area.' He built a cabin at the present location of the Circle K Motel, and his tunnels on the hillside above the motel'maystill be visible (Hilton 1963). Hilton (1963) related the story of Crowley having to be carried from beyond Sunday Summit to the road at Kennedy Mountain,, and,then on to Princeton. He had apparently overindulged in seviceberries.

Davis, W.A. "Podunk" (1859-?): prospector and trapper in the Manning Park area. Born in Kentucky, and arriving in B.C. to prospect in 1887, Davis was described as being a tall, handsome man with a long beard, who made his.own whiskey from potatoes, and at the age of 67 was as spry and agile as a mountain sheep (Thorstenson, pers. comm. to Mogensen 1984). He spent most of his time in the Hope Mountains and around Whipsaw Creek. Davis is remembered most for his part in the rescue of Nurse Mary Warburton, who was lost in the park for 5 weeks in 2926.

De Lacy, Captain W.W.: builder of the historic Whatcom Trail. De Lacy was a U.S. Army Engineer, and was contracted to build the trail in August of 1848.

Dewdney, Edgar (1835-1916): builder of the historic' Dewdney Trail. Dewdney was born in Devonshire, England, and arrived in B.C. in 1859. After completing the Dewdney Trail, he worked on other engineering projects for the government, then held a number of posts, including Lieutenant' Governor of British Columbia. He died in Victoria in 1916. See Ormsby (1976) for a more detailed account of his life.

Douglas, James (1803-1877): Chief Factor of the Hudson's Bay Company, later Governor of Vancouver Island (1851-1864) and of the Crown Colony of British Columbia (1858-1864) (Ormsby 1976).

Edwards, Y.E.: naturalist employed by the Parks Division during the late 1940's and early 1950's, who completed one of the first faunal inventories for Manning Park.

Fraser, Paul (1799-1855): Chief Trader for the Hudson's Bay Company at Fort Kamloops in the 1850's. He was described as being "autocratic, curt even to his brother officers, a tyrant with an uncontrollable temper" (Milliken 1980: 61). One particularly savage beating resulted in the death of one of his men, a French Canadian named Falardeau. Fraser later commented to the coffin-maker, an Iroquois named Baptiste, that "rough, unplaned boards are good enough for that rascal" (Milliken 1983: 62). Baptiste retorted: "Hehm! When you die you may not have enough boards to be buried in..." (Milliken 1983: 62). These were prophetic words, as Fraser died on the Brigade Trail two months later, at Encampement du Chevrevil in 1855. Fraser was in his tent while his men set up camp, and was killed by a felled tree. His body was buried in a shallow grave, without a coffin, and with little ceremony (Milliken 1980). The grave was rediscovered in 1935 by Walter Jameson and Harry Squakin (Milliken 1980).

Goodfellow, Rev. J.C.: an historian of the Sirnilkameen and Tulameen area (Milliken 1980).

Gordon, George: homesteader in the Whitworth Ranch area of the Skagit Valley around 1883 (Mogensen, pers. comm.).

Gordon, Harry: trapper in the Manning Park area earlier this century. Arriving from Ontario, Gordon bought the trapping rights for the park area from Levitt and Ryder in 1908. Gordon trapped from 1908 until 1938, except for a period of service during World War I (Hilton 1963). His brother Bill trapped with him for several years before moving to Ollala to ranch (Hilton 1963). See Hilton (1963) for further information.

Gough, Don: Superintendent of Manning Park from 1981 to 1983.

Grainger, M.A.: former chief forester and an authority on the Hope-Princeton area (MacMillan 1939). Grainger served on Princeton's Board of Trade, and opposed grazing in the "Hope-Summit County". He appealed to the Commissioner of Grazing in 1929, stating that the area should be saved as a park reserve (Cameron 1970).

Grant, Captain John Marshall, R.E.: builder of the Hope Pass Trail.

Green, Herb: former Superintendent of Manning Park.

Greenwald, Dan: perpetrator, along with W.A. Stevens, of the Steamboat Mountain hoax.

Harris, R.C: an active proponent of preserving the Cascades Wilderness as a recreational and historic treasure.

Hatfield, H.R.: an active proponent of preserving the Cascades Wilderness as a recreational and Historic treaure..

Haynse, John Carmichael: set up a Customs Office at Rock Creek, in 1860, as part of an attempt to control the rush of Americans to the gold mines along the Similkameen and its tributaries.

Hilton, Joe: trapper and one of the best sources of information on the goings on in the park during the past 50 years. Hilton bought the trapping rights for the Park area from Harry Gordon in 1938. At his peak, Hilton maintained 20 cabins along his trap route, (some of which were primitive shelters; Mogensen; pers. comm).

Howett, Charlie: miner, and homesteader in the Skagit Valley during the early 1900's; remains of his root cellar still exist (Mogensen pers. comm.).

Johnson, Paul, or possibly Jonsonn, Poul (Mogensen, pers. comm.): the first white trapper in the Manning Park area (Historic Parks and Sites Division 1976). Of Sewdish origin, Johnson arrived in the Park in the 1890's, and was based in a Cabin at the present damsite area adjacent to Lone Duck Lake (Hilton 1963). He hunted and trapped from Whipsaw Creek to Lightning Lake (Mogenson, pers. 'comm), and once claimed that he killed 100 black bears in a season (Hilton 1963). His blazes can still be seen on trees by the Memaloose Creek trail (Historic Parks and Sites Division 1976).

Kanski, Joe: homesteader in the Manning Park area. Heritage (1987) gives Kansky as the spelling, and indicates that he was German. In 1902, he built a cabin near the present amphitheatre (Master Plan 1981). He also built a wagon and drained a nearby swamp: his drainage ditch is still visible (Heritage 1987): Apparently he often disappeared for long periods after arriving from Princeton on foot (Hilton 1980).

Kennedy, Hughey: a prospector in the Manning Park area. He was apparently also an avid fossil collector, and his cabin near Whipsaw Creek was known as the "Fossil House".

Levitt, Mr.: trapper in the Manning Park area in the early 20th century. He and his partner, Mr. Ryder, were known as "State of Mainers", after their home state. They purchased trapping rights for the park area from Paul Johnson around 1906 (Hilton 1963). Hilton (1963) suggested that during the two years they actively trapped (1906-1908), Levitt and Ryder caused a noticeable decline in the number of furbearing mammals.

Lyons, Chester ("Chess") P.: well known naturalist, and author of "Trees, Flowers and Shrubs to know in British Columbia".

Maclean, Donald: Hudson's Bay Company Chief Trader at Fort Kamloops from 1855-1860. He was apparently a man of violent temper (Ormsby 1976:119).

Manning, Ernest C. (1890-1941): Chief Forester for British Columbia from 1936 until his death in 1941 (Heritage Fact Sheet- Manning Park). Manning was born April 17, 1890 in Selwyn, Ontario, and joined the, B.C. Forest Service in 1918. He was a leading advocate for conservation and parks in B.C.'s forests, and Manning Park was named for him after he died in a plane crash on February.6 of the year of the park's creation. A cairn was erected in his honour at Similkameen Falls. When boundary changes were made to accommmodate mining interests, the Falls were no longer within the Park, and the cairn was moved to its present location adjacent to Manning Park Lodge (L. Harris, n.d.).

Manson, Donald: Chief Trader for the Hudson's Bay Company in 'the 1850's. He apparently had a.reputation for brutality towards his men (Milliken 1980).

McDiarmid, Aurelia Angela (1889-1982): pioneer in the Princeton area. Mrs.' McDiarmid was the 13th of 14 children born to John Fall and Susan Allison, and was born on the Allisons' farm adjacent to Princeton. After attending school in Vananda and Victoria, she returned to Princeton; and married Henry McDiarmid, a miner.and Forest Ranger. Henry died young, leaving Mrs. McDiarmid to raise their 9 children alone. Mrs. McDiarmid and her children reportedly led the family cow up the long trail from Princeton to the family's acreage (160 acres, 20 acres of which was cleared of trees) each summer. The acreage is now called McDiarmid Meadow (now a Parks Branch pasture), and is located near the East Gate of Manning Park (Hilton 1963). Apparently they built two homesteads, one on either side of the Similkameen River, but only the one on the south side of the River was ever used. Mrs. McDiarmid had a great love for the hills and wildlife, and was a great story teller. Summers on her homestead were a treasured experience for many children besides her own. (All from Hilton 1963, 1980, Anon. 1981a, Anon. 1982a., and Mogensen, pers. comm.).

McDonald, Angus (1816-1889): Chief Trader for the Hudson's Bay Company at Fort Colville in the 1850's. He travelled from Hope to Fort Colville via the Brigade Trail in 1859 (Hatfield 1981).

Melrose, George: District Forester in Kamloops during the 1920's. Melrose travelled through the Three Brothers* Plateau (which was in the Kamloops Forest District), and recognized its potential for grazing. He is largely responsible for the creation of the Three Brothers Mountain Game 'Reserve (later part of Manning Park). (All from L. Harris, n.d.)

Moberly, Walter 1832-1915): Edgar Dewdney's partner in the construction of the Dewdney Trail. He was born in Oxfordshire, England, and moved to Canada when still young. Trained in Toronto as a civil Engineer, he arrived in B.C. in 1858, joining Dewdney in the construction of their mule trail in 1860. Moberly later worked on numerous other survey and construction projects for both roads and railways (Ormsby 1976).

Moir, Jane: arrived in Hope from England in 1860, with her mother, stepfather and younger sister, Susan. Jane Moir married Edgar Dewdney in Hope on March 23, 1864 (Turnbull 1980). Theirs was the first marriage performed in Christ Church, built in 1861 at the cornet of Eraser Avenue and Park Street (Heritage 1987). The church, which is still in use, is one of the oldest in the province. Moir accompanied Dewdney on his many government postings, and was said to enjoy her supporting role immensely (Ormsby 1976).

Moir.,Susan (1845-1937): pioneer in the Hope-Princeton area: Moir arrived in Hope from England in 1860, with her mother, stepfather and elder sister, Jane. Susan Moir married John Fall Allison in Hope in 1868 (Heritage 1987), and was the first white woman to cross Manning Park (Mogensen pers. comm.). The couple raised 14 children in the Princeton region. Moir led a difficult life, wraught with fires, floods and harsh winters, but she maintained her composure' and joy for living throughout. Her memoirs (Ormsby 1976) are by far the best source of information on pioneer life in the Hope-Princeton region. She also became good friends with her Similkameen Indian neighbors, and recorded and published many of their legends and customs. Her memoirs are definitely a "must read".

Montigny, Edouard: assisted Henry Peers in the construction of the Hudson's Bay Brigade Trail in 1848-1849 (Hatfield 1981). He was the "son of Ovide de Montigny who came to the mouth of the Columbia in the Tonquin with the Astorians in 1811" (Hatfield 1981); Edouard Montigny worked from the eastern (Tulameen) end of the trail, while Peers concentrated on the Hope end.

Moody, Lt.-Col. Richard Clement (1813-1887): Royal Engineer from 1830-1866 (see Ormsby 1976 for further details).

O'Reilly, Peter (1828-1905): magistrate for the District of Fort Hope, with responsibilities over the Similkameen (Manning Park) area from 1859 to 1862 (Ormsby 1976).

Palmer, Lt. H. Spencer: Royal Engineer during the 1850's.

Pasayten, Pete: a man shot by L.E. Lael on August 26, 1861 (1961???), according to a gravestone near Monument 83. There is some dispute over whether or not the grave is a hoax. (All from Mogensen, pers. comm.; see also Hilton 1980).

Peers, Henry Newsham: Surveyor of the H.B.C. Brigade Trail which, in 1848, was an improvement over A.C. Anderson's (1846) route.

Rand, Mr.: Fiscal Agent in Victoria. He exposed the Steamboat Mountain hoax.

Ross, Alexander: the first white man to enter the Manning Park area. He was an employee of the Pacific Fur Company, which was taken over by the Northwest Company in the 1920's; Ross is also noted for his establishment of Fort Kamloops in 1812 (McClanaghan, n.d.).

Ross, Gail: Naturalist in Manning Park and later became Visitor Services Coordinator for the District. While there, she compiled extensive literature on Manning Park.

Ryder, Mr.: trapper in the Manning Park area in the early 20th century. He and his partner, Mr. Levitt, were known as "State of Mainers", after their home state. They purchased trapping rights for the park area from Paul Johnson (sp?) around 1906 (Hilton 1963). Hilton (1963) suggested that during the two years they actively trapped (1906-1908), Levitt and Ryder caused a noticeable decline in the number of furbearing mammals.

Simpson, Sir George: Co-Governor, with Eden Colville, of the Hudson's Bay Company in North America (Hatfield 1981).

Smith, Parson: trapper and prospector in Manning Park and the surrounding area during the late 1800's. He is remembered for his poetry, which he often carved onto trees (Hilton 1980). One of these carvings is at Monument 85 by the Pasayten River at the Park's eastern, boundary. It reads:"I've roamed in foreign parts, my boyAnd many lands I've seen,But Columbia is my idol yetOf all landShe is Queen.Parson Smith 86." (Anon. n.d. 1).He also carved a post at the base of a trail near Sunday Creek with a heart on the north side, "Going N 19__, going S 19__" on the south side, "For the love of Mary" on the third side., and a bottle on the fourth side (Mogensen, pers. comm.).

Stevens, W.A.: perpetrator, along with Dan'Greenwald, of the Steamboat Mountain hoax.

Stevett (sp?), Martin: trapper and homesteader in the Skagit Valley during the early 1930's (Mogensen pers. comm.).

Thomas, Bert: authority on the Hope-Princeton area (MacMillan 1939).

Towers, Thomas (?): rancher in the area immediately east of Manning Park. He arrived in the area from Montana in 1942, and ran horses in Manning Park itself, "until parks ran him out". He established Towers' Ranch, near the East Gate of the Park, and cut and cleared many trails "from Ross Lake to Monument 78". For a short period he ran a horse concession in the park, but the profits were "not enough for cigarette money", due to lack of riders. (All from Mehling 1983; see for further details).

Underhill, J. Edward ("Ted"): biologist in Manning Park area, who made extensive collections of plants.

Unknown name: a man living in Sumallo Grove, who was told that he had tuberculosis, disappeared with only salt 'and a gun, supposedly to live out his last days in peace. Many years later, he appeared in Hope, having'been mauled by a bear. Apparently he had slipped on a log, and fallen into the bear's den. Having dropped his gun, he was bitten and clawed severely; but while the angry bear was tugging on one arm, he managed to work his knife out of his pocket, and kill it. He placed rattlesnake plantain on his wounds, and recovered fully. (All from Mogensen 1984.)

Warburton, Nurse Ada May (Mary): a woman that became lost during a journey through Manning Park in 1926. Warburton had come to B.C. from Scotland in 1923, and worked as a nurse in Hope. On August 26, 1926, she left Hope on foot, intending to walk along the Hope-Princeton Trail and on to the Okanagan to pick fruit. When she did not arrive at Princeton as planned four days later, search parties were sent out from both Hope and Princeton. Snaw (which fell early that year) forced most searchers to abandon the effort, but Const. F. Dougherty, Provincial Police, and W.A. "Podunk" Davis, prospector, continued. Davis found Warburton on September 25, when he and Dougherty were setting up camp for the night. It seems that while walking along the Dewdney Trail, she missed the turnoff to the Hope Trail, and continued up the Snass River to Paradise meadows. She had apparently also slipped on a log crossing a stream, losing her compass, spare clothing and blankets, leaving her with only her tarot cards, which she read regularly. Having subsisted on leaves and water, Warburton had given up all hope. When her tarot cards produced the ace of spades (death), she decided to end her life by cutting her wrists in an icy creek. But she heard Davis and Dougherty cutting saplings for shelter, called out, and was rescued. Many years later near Squamish, she disappeared again, and this time was never found. (All from Tagles 1982 and Greenwood n.d.)

Whitworth, Henry Robert (1864-?): founder of Whitworth Ranch, in the Skagit Valley near the U.S. border. Whitworth was born in England, and emigrated to Canada in 1882. After living in Manitoba, during which he served the Crown in the Riel Rebellion, he set up a cattle ranch in the Skagit Valley. He built a ten room house, with outbuildings and furniture, all built from lumber on his land, milled on a portable sawmill. He scored a coup when he and his family transported a piano over the rough trails to their ranch. In addition to dairy and beef cattle, he and his family raised horses, pigs and chickens. Tragedy befell the family when they all became ill, and were forced to move to Hope (possibly around 1911). A caretaker was left in charge, but he died, and the livestock perished from starvation. The Whitworths never returned, and the ranch was deserted for many years except for overnight stays by trappers and hikers. The buildings fell into ruin, and were eventually destroyed by the Forest Service. (All from Mogensen, pers. comm.).

Appendix 9.

Annotated List of Place Names from Manning Park and the Cascades Wilderness Area

The following is a preliminary list of place names from the area in and around Manning Park. It is incomplete, both in the sense that not all place names are listed, and not all place names that are listed are accompanied by an explanatory note. It is hoped that the list will be added to by others with knowledge of the area. Note that almost all of the people that appear in this appendix also appear in Appendix 8, with varying amounts of biographical information.

Allison Pass: after its discoverer, John Fall Allison, a pioneer in the Princeton area.

Beaver Pond: formerly known as Dead Lake (Carl et al. 1952) and Windy Joe Pond (Spalding 1956). It was probably created by beaver activity, but beaver occupancy in recent years has been sporadic. They were observed in 1984 after an absence of at least a few years (Mogensen, pers. comm.).

Bell Creek:

Belly Can Pass: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Big Buck Mountain: possibly after the presence of large deer?

Big Burn Creek: after the "Big Burn", a large fire that destroyed 5,000 acres of surrounding forest in 1945.

Blackeye's Trail: after an Indian Chief from Otter Flats, north of Tulameen.

Blackwall Mountain, Blackwall Peak: formerly known as Haystack Mountain (J.E. Underhill, pers. comm. in Anon. 1981a). It was probably named after the steep black sides below its summit.

Bojo Mountain:

Bonnevier Creek, Bonnevier Ridge,, Bonnevier Trail: after Charles Bonnevier, a prospector and homesteader in the Manning Park area. Bonnevier built the trail as a packhorse route to the Ridge, connecting with the Hope Pass Trail 35 miles away (Mogensen pers. comm.).

Boundary Creek: after its proximity to the Canada-U.S. border.

Boyd's Meadow: after Robert (Bob) Boyd, the 'first superintendent of Manning Park.

Buckhorn Creek:

Burr Lake: after a citizen of Princeton (Lyons and Trew 1943).

Cable Creek:

Cambie campsite, Cambie Creek: possibly after H.J. Cambie, who assisted in the search for a route through the Cascades for the Canadian Pacific Railway. Cambie .Campsite, once popular with campers and fishermen, was abandoned around 1980. It is near one of the few archaeological sites in Manning'Park.

Camp of Deer: alternative name for Campenment'du Chevreuil, after the French "chevreuil", meaning roebuck, or deer (Harris 1981). Also known as Deer Camp (OSPS 1.982).

Campenment des Femmes: an Indian camp along Anderson's route, at the present site of the town of Tulameen. It was named because Indian men used it as a base from which to hunt, while the women stayed behind (May 1982).

Campenment du Chevreuil: after the French "chevreuil", meaning roebuck, or deer (Harris 1981). Also known as Camp of Deer, or Deer Camp (OSPS 1982).

Canam Mine: (in a subalpine area at 5,000 feet, near the headwaters of Silverdaisy Creek (Carl et al. 1952)).

Castle Creek:

Cayuse Flats: an historically important camp (MacMillan 1939), named after "cayuse", the term given to horses of the Hudson's Bay Company Brigades. It was once known as Powder Flats (Heritage 1987).

Cedar Creek: former name for the headwaters of the Skagit River (J.E. Underhill pers. comm. in Anon. 1981a).

Cedar Flats: an historically important camp located at the junction of the Skaist and Skagit Rivers (MacMillan 1939).

China Wall: (a conspicuous volcanic dyke just east of the Park's eastern boundary, best seen looking south from Mile 57 on Highway 3 (Carl et al. 1952).

Chittenden Meadow:

Chuwanten Creek, Chuwanten Mountain:

Clearwater Creek:

Coldspring Campground: after the spring that is found there;

Conglomerate Flat: after surface geological features, conglemorates, in the form of a "natural concrete", also known as pudding stone (OSPS 1982).

Copper Creek: possibly after the deposits of copper ore that occur in the surrounding area.

Coquihalla River: previously spelled Quequealla (McClanaghan n.d.).

Corral: also known as Horseguard, or Horseguard Meadow, which may refer to soldiers that corralled their'horsesat this site while searching for outlaws (Harris 1981).

Corral1 Creek: also known as Twelve Mile Creek (MacMillan 1939).

Crowley Creek: probably after Jack Crowley, a prospector in the Manning Park area.

Daynor Creek:

Dead Lake: former name of Beaver Pond (Carl et al. 1952).

Deer Camp: alternative name for Campenment du Chevreuil, after the French "chevreuil", meaning roebuck, or deer (Harris 1981). Also known as Camp of Deer (OSPS 1982).

Derek Falls: after Derek Moore, son of T.O. Moore, park superintendent from 1975 to 1979 (Anon. 1981a).

Dewdney Trail: after Edgar Dewdney, its builder.

Dry Ridge Trail: after its very dry exposure.

Eastgate: at the East Gate of Manning Park.'

Eighteen Mile Creek:

Fat Dog Creek: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Ferguson Creek:

Flash Lake: named by Lyons and Trew (1943).

Fool's Pass: named becuse misty skies in this area may mislead westward travellers into thinking they have reached Manson's Ridge (OSPS 1982).

Fourteen Mile Ranch: = Trites Ranch (Heritage 1987). Purchased in 1928 by A.B. Trites, it became a highly modernized, if unsuccessful, dairy ranch. Much of it was occupied by Tashme, a Japanese internment camp in the 1940's (Heritage 1987).

Fourth Brother Mountain: naked by Lyons and Trew (1943).

Friday Mountain:

Frosty Creek, Frosty Mountain, Frosty Mountain Trail: probably after the mountain's high altitude (the highest in the Park), and the snow cap present for much of the year.

Garden of Eden: former name of Paradise Valley; probably named after an early settler named Paradis (Harris 1981).

Ghost Pass Trail: an apparently little-used horse trail running from the Hope Trail at Eighteen Mile Creek to the Fraser River (Hatfield '198.1) It was located in 1929 by C.E. Devereux.

Ghostpass Creek, Ghostpass Lake:

Gibson.Pass:

Goodfellow Creek: after Reverend' Goodfellow, of Princeton (Cameron 1970).

Grainger Creek: after M.A. Grainger, of Princeton. He was in part responsible for the creation of the Three Brothers Mountain Reserve in 1931 (Cameron 1970).

Grant Lake: probably after Captain Jack M. Grant, of the Royal Engineers. Grant established the Hope Trail, or Hope Pass Trail.

Grassy Mountain:

Hampton Campground, Hampton Creek:

Haystack Mountain: former name of Blackwall Mountain, or Blackwall Peak (J.E. Underhill, pers. comm. in Anon. 1981a). The name Haystack probably refers to the shape of the summit.

Holding Creek:

Hoph: after Fort Hope, established on October 30, 1848 by James Douglas, Chief Factor of the H.B.C.. Hope was incorporated into a village in 1929 (Heritage 1987).

Horseguard, Horseguard Meadow: also known as Corral, may refer to soldiers searching for outlaws, that corralled their horses at this site (Harris 1981).

Hozameen Range:

Jackass Mountain Group: a geological unit named after Jackass Mountain, south of Lytton. The name apparently originates from a burro that once fell off a cliff on the mountain (Kleinspehn 1980).

Johnson Peak: possiby after Paul Johnson (sp?), the first white trapper in Manning Park.

Kettle Mountain: so named because its rounded top resembles an up-turned kettle; also known as Skaist Mountain (MacMillan 1939).

Lamont Creek: also known as Nine Mile Creek (MacMillan 1,939)

Lightning Lake: named by Lyons and Trew (1943).

Lightning Lakes: formerly known as the Quartet Lakes, these are now known as Lightning, Flash, Strike, and Thunder Lakes (J.E. Underhill, pers. comm in Anon. 1981a).

Little Muddy Creek:

Lone Duck Lake: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980). The lake was formed in 1968 by the damming of Lightning Lake.

Lone Goat Mountain: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Lone Man Ridge: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Lone Mountain, Lone Peak: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Manson Camp, Manson's Ridge: after Donald Manson, Chief Trader of the Hudson's Bay Company in the 1850's.

McDiarmid Meadows: after a pioneer family that homesteaded near the East Gate of Manning Park in the late 1920's and early 1930's (Cameron 1970).

Memaloose Creek: after "Memaloose", an Indian word meaning dead deer (J.E. Underhill, pers. comm in Anon. 1981a).

Middle Creek:

Monument 78, Monument 83: two of the many monuments along the Canada-U.S. boundary.

Monument Creek: after the series of monuments erected at the Canada-U.S. boundary.

Mount Angus: possibly after Angus McDonald, Chief Trader for the Hudson's Bay Company during the 1850's.

Mount Davis: previously called Deer Mountain (McClanaghan, n.d.).

Mount.Dewdney: after Edgar Dewdney, builder of the Historic Dewdney Trail.

Mount Ford:

Mount Gordon: (5,500 feet, north of Canam Mine (Carl et al. 1952)).

Mount Outram: James Outram was a British Climber that climbed in the Rockies near Banff around 1900. Is Mount Outram named after him?

Mowich Camp, Mowich Creek: after "Mowich", an Indian (?) word meaning "deer meat". During the years.1982-1984, deer 'were abundant around Mowich Camp (Mogensen, pers. comm.). A previous spelling of this camp is Mowitch, and a previous name is Horsefeed and Water (Harris 1983).

Mule Deer Campground: formerly named Poverty Flats by trappers that found game scarce there .(Cameron 1970).

Nepopekum Falls, Nepopekum Mountain:

Nicomen Lake, Nicomen Ridge:, after "Nicomen", an Indian word probably meaning "near a small creek", but may have other meanings as well (An'on. 1981a).

Nine Mile Creek: also known as Lamont Creek (MacMillan 1939).

North Star Creek:

Pacific Crest Trail: a hiking trail along the mountain ridges from Canada to Mexico.

Packer Creek:

Paddy Pond: named by Thomas (?) Tower after Paddy, the father of Pat Wright, who owns a cabin there (at the headwaters of Hubbard Creek) (Harris 1981). This lake is now known as Poland Lake (Spalding 1956).

Paintbrush Nature Trail: probably after the Indian Paintbrush plants that grow in the area.

paradise Valley: probably named after an early settler named Paradis (Harris 1981). The valley was previously known as Garden 'of Eden (Harris 1981).

Pasayten Creek: possibly after Pasayten Pete, whose gravestone lies near Monument 83. Alternatively, Pete may have been named after the river.

Passage Creek:

Peers Creek: after Henry Peers, who established .the H.B.C. Brigade trail through the Cascade Mountains.

Perdue Creek:

Placer Lake:

Poland Creek, Poland Lake: after a Mr. Poland, who surveyed for the proposed Great Northern Railway line through Manning Park (Hilton 1980). This'lake was previously known as Paddy Pond (Spalding 1956).

Poverty Flats: former name of Mule Deer Campground; named by trappers that found game scarce'there (Cameron 1970).

Powder Camp, Powder Flats: former name of Cayuse Flats (Heritage 1987). The camp was named by 'Mr. and Mrs. John Fall Anderson after an incident in which Mr. Anderson was packing up his gear while on a journey between Hope and Princeton. The camp somehow caught fire, and Anderson and his partner threw their sacks of blasting powder into the creek to prevent them from exploding (Ormsby 1976)'.

Princeton: after the Prince of Wales (later King Edward 'VII of England). Originally called Vermillion Forks (after the.presence of red earth), followed by Allison's Flat, the site was originally inhabited by Interior Salish Indians. The town of Princeton was surveyed by the Royal Engineers in 1860, and named by Governor Douglas in honour of the Prince of Wales's visit to Canada and the U.S. that year (Turnbull 1980).

Quartet Lakes: former name of Lightning Lakes, these are now known as Lightning, Flash, Strike, and Thunder Lakes (J.E. Underhill, pers. comm in Anon. 1981a).

Quequealla: previous spelling of Coquihalla (McClanaghan n.d.).

Red Mountain: probably after the very red soil found there.

Rhododendron Flats: after the presence of large expanses of wild pink rhododendrons.

Roach River Trail: a former name of the Skyline Trail (Harris 1983).

Roche River: An early name for the Similkameen River, after Lt. Richard Roche, RN, who headed the British survey of the International Boundary in the area in 1860 (Harris 1983).

Ross Lake: probably after A. Ross, the first white man to pass through what is now Manning Park.

Sandstone Creek:

Seventeen Mile Creek:

Shadow Creek, Shadow Falls:

Shawatum Mountain: known as Steamboat Mountain for a period of over 30 years around the turn of this century (Harris 1982, 1983).

Silverdaisy Creek, Silverdaisy Trail:.

Similkameen River: after "Similkameen", an Okanagan Indian name probably meaning "white swan" (Turner, pers. comm.). Other spellings include "Tsemelkameh", "Shimilichameach", "Samilkaneigh" and "Similkameugh" (Anon. 1981). Two possible alternative meanings are "Valley of Eagles" and "Salmon River". Anderson (1872) suggested the former meaning because although the Similkameen did not then contain salmon, it may have "in bygone days". Teit (1930) referred to the Okanagan Indians as the Eagle People, as eagles were abundant in the Similkameen Valley, and their tail feathers were exported. The headwaters of the Similkameen River (above Memaloose Creek) was previously known as Cambie Creek (J.E. Underhill pers. comm. in Anon. 1981a). Underhill also noted that traditionally, the Simflkameen proper started at the junction of Cedar and Memaloose Creeks. An earlier name for the Similkameen River was'apparently "Roche River", after Lt. Richard Roche, RN, who headed the British survey of the International Boundary in the area in 1860 (Harris 1983), and also Rogue's River (Ormsby 1976).

Six Mile Marsh:

Skagit River: after "Skagit", an Indian name, referring to an Indian settlement on the Skagit River (Cameron 1970). The headwaters of the Skagit River was previously known as Cedar Creek (J.E. Underhill pers. comm. in Anon,. 1981a).

Skaist Mountain: also known as Kettle Mountain, because its rounded top resembles an up-turned kettle (MacMillan 1939).

Skyline Trail: previously also known as Roach River, Trail (Harris 1983.).

Smuggler's Creek: named* by Bob Boyd, Manning Park's first superintendent (Hilton 1980). Rum runners???

Snass Creek,, Snass Mountain: after "Snass" an Indian name, meaning "rain" (Akrigg and Akrigg 1970.). It was formerly known as Canyon Creek (Jackson 1929b:156).

Snow Camp Mountain:

Spotted Nellie Ridge: named by Bob Boyd, Manning Park's first superintendent (Hilton 1980).

Station Creek:

Steamboat Mountain: interim name of Shawatum Mountain. It was originally named Shawatum Mountain in 1860 by the International Boundary Commission, but the name Steamboat became popular from 1879 until, the Steamboat gold rush ended in 1911. "Steamboat" was the name of a raft used by two Hope residents, W.L. Flood and J. Corrigan, to float down the Skagit River to an 1879 gold strike at the mouth of Ruby Creek. The two men built their raft at the mouth of 'the Klesilkwa River, near the present Twentysix Mile Bridge, and dubbed the construction location "Steamboat Landing". They never did make it to Ruby Creek (where the Ross Dam now stands), having wrecked their craft on the first logjam they encountered. (All from Harris 1982, 1983).

Strike Lake: named by Lyons and Trew (1943).

Sumallo River: after "Sumallo", an Indian name, probably referring to "upriver Indians" (Cameron 1970). It may previously have been spelled "Simmallaow" (Heritage 1987).

Sunday Creek:

Taboo Creek:

Tashme: derived from the first two letters of three provincial commissioner's names: Taylor, Shirras and Mead (Ref: A history of Manning Park). Tashme was a Japanese internment camp, located on Trites Ranch, 14 miles east of Hope (see D. Human Impact).

Three 'Brothers .Mountains: a range whose peaks are named First, Second and Third Brother Mountains.

Thunder Lake: named by Lyons and Trew (1943).

Timberline Valley: (in Three Brothers area (Carl et al. 1952)).

Trites Ranch: alternative name for Fourteen Mile Ranch (Heritage 1987). Purchased in 1828 by A.B. Trites, it became a highly modernized, if unsuccessful, dairy ranch. Much of it was occupied by Tashme, a Japanese internment camp in the 1940's (Heritage 1987).

Twelve Mile Creek: also known as Corral1 Creek (MacMillan 1939).

Twenty Mile Creek:

Twenty Minute Lake: probably named because it takes twenty minutes to walk .around the lake, or because it takes twenty minutes to ski there from Manning Park Lodge.

Vermillion Forks:. a former name of Princeton (Turnbull 1980). It was probably named after the reddish colour of the soil in the surrounding area.

Whatcom Trail: trail from Bellingham Bay to the Punch Bowl, Tulameen River. Whatcom is the former name of what is now Bellingham, Washington. It was there in 1958 that a group of Wash'ington State businessmen decided to finance a route to the goldfields of B.C.'s interior (Hatfield 1980).

Whipsaw Creek: after whipsawing, a method of cutting lumber requiring two people: one stood in a pit and pulled the saw down through the log, and a second person stood on top of the log to pull the saw back up (Heritage 1987).

Whitworth Ranch: after Henry Whitworth, who settled there in the early 1900's.

Windy Gap: (at 6,500 feet, near Three Brothers Mountain (Carl et al. 1952)).

Windy Joe Mountain: after Joe Hilton, trapper and.long-time resident of the Manning Park area. While snowshoeing on a particular hillside, Hilton often commented to his trapping partner that the.sides of the trees that were facing them were always bare of snow. It seems possible that Joe's loud and well-used voice may have caused this phenomenon (Hilton 1980).

windy Joe Pond: (see above) previous name of Beaver Pond (Spalding 1956).

Appendix 10.

Current Status of Historic Trails in Manning Park and the Cascades Wilderness

1. Skyline Trail

The Skyline Trail, which in 1967 became part of the centennial Trail from Simon Fraser University, is a well used route across the Cascades west of the lower Skagit Valley. Originally thought to have been an Indian trading route, the trail has since been used by travellers of all description. It was entirely rebuilt by the U.S. half of the International Boundary Commission around 1859. In 1967, the western part of the trail was rebuilt to improve access, and near its eastern end, a branch trail down to Strawberry Flats was constructed. Harris (1983) gives an excellent description of the route, which is pictured in Figure 8. See also OSPS (1982).

2. Brigade Trail

The Hudson's Bay Company Trail from Hope to Tulameen (and beyond) was used by fur brigades for a period of 11 ''years, between 1849 and 1860. During that time it was the major route across the Cascades for thousands of horses and hundreds of men. Much of it still exists, largely within the Cascades Wilderness, and' is presently maintained by the Okanagan - Similkameen Parks Association. Hatfield (1980a, 1980b) provides an excellent description of the route, including a map, which is included here (Figure 9). See also Suttill (1980) and OSPS (1982).

3. Dewdney Trail

Edgar Dewdney's famous trail, built in 1860, was heavily used as 'a route across the Cascades only along its western portion, between Hope and the junction of the Sumallo River and Snass Creek. From there, travellers usually avoided the rough canyons of Snass Creek and the Tulameen River, and instead continued along the Sumallo River until its junction with Skaist Creek (Hope Pass Trail: see below').

Much of the western portion of the Dewdney Trail (between Hope and the Sumallo-Snass junction) has been destroyed by the construction of the Hope-Princeton Highway. This is unfortunate, as this section was upgraded to a wagon road in 1861. Some sections still exist within Manning Park along the north side of Highway 3; Bussey (1983) identified four of these as being relatively intact and illustrative of early techniques in road construction. Bussey also identified several historic sites (mostly old buildings) that may also hold interpretive potential.

The eastern portion of the Dewdney Trail in this region (between the Sumallo-Snass junction and Tulameen) was not upgraded to wagon road status, and received far less use than did the southerly extension, the Hope Pass Trail. Nonetheless, much of it is still intact, and passes through the heart of the Cascades Wilderness. It has recently been cleared and maintained as a hiking and riding trail. The route is described by Harris (1980, 1981a, 1981b, 1981c.), OSPS (1982) and others.

4. Hope Pass (Hope') Trail

The Hope Pass Trail, also known as the Hope Trail, was, constructed shortly after the Dewdney Trail was built in 1860, and was the major artery across the Cascades for several decades. Its southernmost section (between Snass Creek and Skaist Creek) is still largely intact., despite nearby,Highway construction. From Skaist Creek, the trail continues northeastward througth the Cascade Wilderness, and is currently 'maintained as a hiking and riding' trail. The route is described by Harris (1976, 1982), Hatfield n.d. and others.

5. Whatcom Trail

The Whatcom Trail, constructed by Captain W.W. de Lacy in 1858 for merchants from Whatcom (now Bellingham Bay), Washington, was only briefly used as a gold rush route. Much of it still remains, however, and good sections may be found in the Cascade Wilderness. The route is described in detail by OSPS (1982).

APPENDIX 11.

An Annotated List of the Common Mushrooms of

Manning Provincial Park

This deals with some of the more showy mushrooms' of Manning Provincial Park (Anon. 1974 b). The only other records of fungi that were encountered for Manning Park were as follows: Hypodermella laricis and Lophodermium laricinum, both parasites on alpine larch (Rushton 1962, Ziller 1969); and an Exobasium fungi, tentatively idnetified as Exobasidium vaccinii (Paden 1972) a parasite causing swollen branches and witches brooms on members of the Ericaceae. Undoubtedly hundreds of other species exist in the park.

COMMON MUSHROOMS OF MANNING PARK

The following annotated.list deals only with some of the more howy fungi to be found in the park. A question mark after the pecies name indicates that the identity is not positive. Since no icroscope was available, identifications were made without etermining spore shape and size. For edibility, check literature, ut watch for maggots and mould. In any case, it's against the law o pick anything in the park.

'common Badhamia" - on dead stalk of "cow parsnip"! in large patch, slime mould in spore producing stage, dark brown ball on tiny stalk, total height 1/16". Also a club-shaped variety (yellow) same height, found on fallen logs.

'pyrola rust spots" - orange dots, regularly spaced, on the underside of leaves of <u>Pyrola secunda</u>. "most likely a rust that is commonly spotted on Pyrola plants" -- Adam Szczawinski (curator of Botany, Prov. Museum).

Agaricus campestris - "meadow mushrooms" May 27, open grassy field at East Gate.

Aleuria aurantiaca - "orange fairy cup".

Amanita muscaria - July 29 in area of old corral. Squirrels may eat this, found one that had been broken and chewed.

Aminita pantherina - July 29 on sandy rocky soil in old corral.

Aminita vaginata - "Sheathed Amanita" Aug. 14 on the horse trail from the corral. In silty area under spruce with the base deep in soil. No annulus.

Boletus aurantiacus - "orange-capped boletus" after Aug. 3 Lone Duck Lake and Allison Pass. White flesh turns purple-brown where bruised. Dark spots on surface area of tubes means flies have laid eggs in those tubes,

Boletus edulis - "king boletus" July 6 Lightning Lake and Aug. 28 Allison Pass; latter had 14" dia. cap and 4" dia. stem.

Boletus granulatus - through the summer Pinewoods area. Favourite of squirrels,

Boletus tormentosis - "wooly-capped" boletus, common after July 30 in Pinewoods area. Flesh quickly blue staining when bruised, pores dark cinnamon brown in young specimens.

Calbovista subsculpta - "warted giant puffball" open grassy fields at East Gate Pinewoods area, Nepopekum Trail.

Calvatia gigantea - "giant puffball" Pinewood Lodge lawn, specimen 1.5" dia.

Cantharellus multiplex(?) - June 22 'in spruce-pine forests across highway from East entrance to Hampton Campground. Two dried-up specimens found in dense blueberry patch (just in bud) among mosses and needle litter.

Chlorociboria aeruginosa - blue-green stains on rotten wood. The fruiting bodies of the fungus (apothecis) are cupped-shaped reaching a dia. of 5mm. They are also blue-green and appear in late August.

Clavaria botrytis(?)n - "purple-topped coral" July 31 onwards, specimens follow literature descriptions except have brown tips not purple.

Clavaria flava'(aurea)? - June 29 and into early July between Pinewoods and Lightning Lake "yellow coral fungus".

Clavaria pistillaris(?) - June 20 Canyon Nature Trail (southern side) on first switchback, single stems 1/2" tall, cream to cinnamon brown with red-brown tips, some single, some branched into 3-4 tips though stems remain single.

Clavaria sp. - Aug. 12 old horse trail from corral, "fingers with flags", unbranched club-shaped "fingers", 3/4" - 1.5" tall, flesh-coloured with purple-tinged tips, some fingers have simple club shape while others are "clubs" with a longitudinal groove and 1/2", twisting, vertical "flag" coming from the top. Grow in clusters right on the trail i.e. 'packed, sandy soil.

Collybia velutipes - "velvet-stemmed collybia" on semi-rotten wood along trail at south end of Lightning Lake.'

Coprinus atramentarius - "inky cap" July 15 at East Gate meadows.

Coprinus comatus - "inky-cap" "shaggy mane" reported July 24 Gibson's Pass Rd. north side just before ski area. Also reported Lone Duck Lake. Positive identification made Aug. 3 near bridge across Lightning Lake.

Coprinus micaceus - "glistening inky cap" August 13 south face of Blackwall Mtn. at borderline of timber and rocky meadow area.

Cortinarius cinnamomeus - "cinnamon cortinarius" Sept. 1 trail up Windy Joe.

Cortinarius spp.(?) - horse trail from old corral PILEUS - 2" dia. squamose, tan, convex when young GILLS - adnexed, alternate long and short, spores cinnamon FLESH - white, solid, 2" long, bottom half barrel-shaped tapering upward abruptly. FLESH - light brown not changing colour when bruised.

Cortinarius violaceus - "violet cortinarius" Gibson's Pass Rd. 1/4 mile west of Lightning Lake campsite. PILEUS - minutely scaly, purplish-grey GILLS - colour like pileus, spores cinnamon-brown STEM - solid, remains of cobweb veil. GILLS - alternate. long-short, adnate becoming seceding.

Fuligo septica - a slime mould, Lightning Lake narrow channel, wet face, 8" dia., golden crust (lime) inside dry dark purple-brown powdery spores Aug. 3.

Gomphidius glutinosus - "peg-top gomphidius" beside Memaloose trail at Gibson's Pass under spruce and alpine fir Aug. 28. GILLS - blacken with age and flesh becomes pinkish.

Gyromitra esculenta - "brain mushroom" end of May and occasionally through the summer. Pinewoods area.

Gyromitra gigas - "giant helvella" June 7 50' - 100' south of fish ladder at end of Lightning Lake along return trail on south side of iake.

Gyromitra infula - Aug,. 12 "hooded gyromitra" beside old horse trail from corral where a tree had fallen leaving disturbed soil around its roots.

Helotium sp. - tiny orange gelatinous cup fungi with short stem, in groups on decaying logs and branches.

Hydnum imbricatum - reported near old barn and corral Aug. 2

Hydnum imbricatum - (scabrosum)(?) - Aug. 15-20 Rein Orchid Trail semi-open pine-spruce forest with moss and falsebox. PILEUS - dull dark brown with purplish tinge, prominent scales same colour, convex becoming plane, 4" broad SPINES - pale grey-brown with lilac tinge becoming darker brown with age, sharply pointed, decurrent, 3/16" - 1/4" long, darker brown where bruised STEM - shorter than width of cap, tapering sharply at the base, brown with tiny dark spots on the upper section, white with sooty black smudges near base FLESH - dingy white, very strong mushroomy smell

Hydnum scabrosum(?) - "rough-capped hydnum" Aug. 9 north-facing slope Twenty-Minute Lake near trail PILEUS - 2.5" broad,.convex, brown, scaly and cracked FLESH - cream slowly darkening when bruised SPINES - 1/16" - 1/8" long, grey-brown tinged with lilac, extend down stem but getting smaller STEM - 1/2" - 3/4" thick, 2" long, solid, stained somewhat grey at base TASTE - like cucumber at first, but becoming bitter and leaving an after-taste.

Lactarius deliciosus - July 29 in old corral on rotten wood

Lactarius representaneus - Aug. 21 on Canyon Nature Trail, also Aug. 26 by Staff Residence. PILEUS - tormentose, tan colour. GILLS - creamy, staining lilac where bruised. LATEX - white. STEM - 1 1/2" - 2" long, 3/4" - 1" wide, yellow-brown, stuffed to hollow, purple flesh.

Lactarius rufus (subdulcis ?) - Aug. 25 found at Lone Duck Lake, Rein Orchid Trail, and Allison Pass. PILEUS - red-brown, 1 1/2" across plane, no nipple, minutely scaly, not viscid. GILLS - cream. 'LATEX - white.

Lycoperdon perlatum - "broad or gemmed puffball" Aug. 24 near Lightning Lake bridge; also along old horse trail.

Lycoperdon pyriforme - "pear-shaped or clustered puffball" Aug. 2.8 after rain in sold gravel at Pinewoods and Allison Pass.

Marasmius androsaceus - "black-stemmed marasmius" Aug. 14 old Pinewoods horse trail growing on single pine needles.

Morchella angusticeps - "narrow-capped morel" in riverside 'silt under young cottonwood and willow at East Gate. May 29.

Morchella esculenta - "edible morel" June 25, damp weather, one specimen near naturalists' trailers.

Panus torulosus - "leathery Panus" Sept. 1

Peziza repanda(?) - early June, Lone Duck Lake, sandy soil near shoreline.

Polyporus squamose - July 26 Nepopekum Trail

Russula brevipes - "short-stemmed russula", some classify as Suillus brevipes Pinewoods area through August, infundibuliform even when young, 4" - 12" diam.

Russula delica - "white russula", late May early June along Rein Orchid Trail; also June 22 on Nepopekum Trail.

Russula emetica - "emetic russula", last 3 weeks in Aug. Pinewoods and Cambie Valley north of 'highway.

Russula fallax(?) - same period and habitat as emetic russula but with pink stem. PILEUS - red with faded areas, up to 4" broad, viscid when wet, convex to plane, peels readily, FLESH - red just under surface but white elsewhere, very peppery taste, smells somewhat like strawberry, GILLS - adnexed, mostly equal length but a few'subdistantones, fairly thick, medium distance apart, STEM - 3/4" - 1/2" thick, flesh white but surface tinged salmon pink, solid, smooth, no colour change when rubbed...

Russula sp. - early June PILEUS - 1.5" dia. viscid, umbilicate-depressed,,streaked pale pinkish, margin not ribbed, flesh milky-white under skin.. GILLS - decurrent, equal, close milky pink, not forked, not waxy STEM - solid, central, bent, tapering to narrow base., avg. width 1/2". Growing in thick pine needle duff under lodgepole pine, alpine fir, falsebox, grouse-berry, found in clump of 9 about 150 yds. east of park hdq. building on south side of highway, 20 ft. south of the path there on end of small promontory.

Russula sp. - Aug. 14 common to Pinewoods-Lightning Lake area PILEUS - light brown on margin but darkening towards centre, glabrose, easily peeled, margin striate, 4" dia., viscid when wet, FLESH - white, thin, mild taste, GILLS - adnexed, equal length, creamy orange, subdistant, sometimes forked near stem, STEM - white, glabrous, 2.5" long, 1/2" - 3/4" wide at base tapering upward, spongy to stuffed.

Xeromphalina campanella(?) - "golden trumpets" near top of Dry Ridge Trail in water saturated moss PILEUS - tan, funnel-shaped, margin striate GILLS - decurrent, spores white.

APPENDIX 12

Some Rare Plants of Manning Park. Reproduced from Anon (1982b)

Alpine/Sub-Alpine

- Anemone drummondii - Alpine Anemone

  Family: Ranunculaceae
  Location: Mount Frosty; Chuwanten Mtn.; Three Brothers
  - Not plentiful.

- Arenaria obtusiloba - Blunt-leaved Sandwort

  Family: Caryophyllaceae
  Location: Three Brothers; Mount Frosty

- Arenaria rubella - Red Sandwort

  Family: Caryophyllaceae
  Location: Three Brothers
  - Rock crevices and open gravel slopes.

- Dicentra uniflora - Steer's Head

  Family: Fumariaceae
  Location: Dry Ridge Trail above Cascade Viewpoint parking lot
  - Blooms in June after snowmelt; flower is inconspicuous.

- Dodecatheon pauciflorum - Dwarf Shooting Star

  Family: Primulaceae
  Location: Moist runnels on south face of Blackwall Peak and Three Brothers
  - This species occurs here in a beautiful dwarf form.

- Draba incerta - Difficult Whitlow Grass

  Family: Cruciferae
  Location: Mount Frosty, 7800' on talus slope

- Draba oligosperma - Few - seeded Whitlow Grass

  Family: Cruciferae
  Location: Three Brothers

- Dryas octopetala - White Dryas
  Var. hookeriana

  Family: Rosaceae
  Location: First Brother

- Epilobium alpinum - Alpine Fireweed or Alpine Willow-Herb

  Family: Onagraceae
  Location: Lower Memaloose Trail next to river; Strawberry Flats; near very red rock on Lookout Road

- Fritillaria pudica - Yellow Bell

Family: Liliaceae
Location: Rock bluffs above Lookout; along road to Alpine Meadows past Lookout

- Hemieva (Suksdorfia). ranunculifolia

Family: Saxifragaceae
Location: Blackwall Peak; Cascade Lookout; Skyline. Trail
- Sporadic in damp places on rocky slopes.

- Hydrophyllum capitatum - Ballhead Waterleaf

Family: Hydrophyllaceae
Location: Casecade Lookout; Poland Lake Trail

- Kalmia polifolia - Swamp Laurel

Family: Ericaceae
Location: Three Brothers
- Behind wilderness shelter at Buckhorn Camp, Heather Trail.

- Lewisia columbiana - Columbia Lewisia

Family: Portulacaceae
Location: Near summit of Lone Goat Mtn.

- Lewisia pygmaea - Dwarf or Pygmy Lewisia

Family: Portulacaceae
Location:, Growing near base of south cliff of Blackwall Peak

- Lloydia serotina - Alpine Lily

Family: Liliaceae
Location: Northeast face of Blackwall Peak

- Pedicularis groenlandica - Elephant's Head

Family: Scrophulariaceae
Location: Across road from Dry Ridge Trail, near a spring; base of the peak of Chuwanten; near Poland Lake; Big Buck Ridge (Heather Trail)
- moist areas in high meadows.

- Petasites frigidus - Coltsfoot

Family: Compositae
Location: Beside Monument 83 Trail, immediately past Similkameen River bridge: Three Brothers
- borders of mountain rivulets.

- Phvllodoce glanduliflora - Yellow Mountain Heather

  Family: Ericaceae
  Location: Three Brothers; Blackwall Peak; Allison Pass.
  - a hybrid between this and P. empetriformis occurs on Mount Frosty..

- Polygonum vivaparum - Alpine Bistort

  Family: Polygonaceae
  Location: Three Brothers; Mount Frosty
  - only one specimen found.

- Potentilla fruticosa - Shrubby cinquefoil.

  Family: Rosaceae
  Location: Three Brothers; Blackwall Peak; Orchid Meadows

- Sagina saginoides - Alpine or Arctic Pearlwort

  Family: Caryophyllaceae
  Location: Three Brothers; Mount Frosty

- Silene acaulis - Moss Campion

  Family: Caryophyllaceae
  Location: Three Brothers; Mount Frosty
  - rocky crevices and pockets

- Stenanthiurn occidentale - Western Mountain Bells.

  Family: Liliaceae
  Location: Blackwall Peak; Allison Pass
  - moist runnels

Vallev

- Apocynum androsaemifolium - Spreading Dogbane

  Family: Apocynaceae
  Location: Lodge area - on dry road banks
  : 3 miles up on Monument 83 Trail
  : Thunder Lake

- Balsamorhiza sagittata - Spring Balsamroot or Spring Sunflower

  Family: Compositae
  Location: Lookout Road (just before hairpin turn)
  : Windy Joe
  - reaching western limit of its distribution here

- Calypso bulbosa - Calypso Orchid

Family: Orchidaceae
Location: Spruce forests behind Lodge and Barn; Cambie Campsite; Hampton Campsite; Monument 83 Trail

- Campanula rotundifolia - Harebell, Bluebell, Lady's-Thimble

Family: Campanulaceae
Location: Strawberry Flats
: Hozameen Ridge
: Skyline Trail above Thunder Lake
: Sumallo Valley near west gate

- Corydalis sempervirens - Evergreen Corydalis or Pink Corydalis

Family: Fumariaceae
Location: East Gate - side of road.
: Windy Joe Trail - apparently an accidental occurrence

- Dodecatheon dentatum - White Shooting Star

Family: Primulaceae
Location: Monument 83 Trail
: Chuchuwanten Crossing, Cascade Loop Trail

- Fritillaria lanceolata - Chocolate Lily

Family: Liliaceae
Location.: Cambie Campsite; Beaver Pond.
- not common

- Gaillardia aristata - Brown-eyed Susan

Family: Compositae
Location: Along highway and in meadow near East Gate
: Near Rein Orchid Parking Lot

- Geranium viscosissimum - Sticky Geranium

Family: Geraniaceae
Location: Beaver Pond Nature Trail - lower trail
: East Gate

- Hackelia jessicae or micrantha - Mountain Forget-me-not

Family: Boraginaceae
Location: 'StrawberryFlats*
: Monument 78 Trail
: Valley north of Lone Goat Mtn.

- Lewisia tweedyi - Tweedy's Lewisia

Family: Portulacaceae
Location: Monument 78 Trail - approximately 1 km north of junction with Mount Frosty Trail
- This is the first record in Canada, indicating a northward extension of the known range of this species by at least 160 km.

- Luina hypoleuca - Silverback

Family: Compositae
Location: Allison Pass
: vicinity of Mule Deer Campsite
: Gibson Pass
- A coastal species which may reach its eastern limit of distribution here.

- Luina nardosomia - Silvercrown

Family: Compositae
Location': Monument 78 Trail, 1 mile north of junction. with Frosty Trail

- Mimulus alsinoides - Little Monkey Flower

Family: Scrophulariaceae
Location: In.crannies in cliff above bottom of Lookout Road

- Orobanche uniflora - One-Flowered Cancerroot

Family: Lentibulariaceae
Location: At roadside between Lookout and Alpine
: Southwest slope of Blackwall Peak
: East of Frosty Pass, Cascade Loop Trail

- Phacelia spp.

Family: Hydrophyllaceae

P. hastata - White - leaved Phacelia - Lodge Area; Allison Pass; Sumallo Valley
P. heterophylla - Varied - leafed Phacelia - Sumallo Valley
P. sericea - Mountain Phacelia - Cascade Lookout; Thunder Lake; Three Brothers

- Prunus virginiana - Choke Cherry

Family: Rosaceae
Location: vicinity of Mule Deer Campsite
: Strike Lake

- Pterospora andromedea - Pinedrops

Family: Ericaceae
Location: *Rhododendron Flats
: Rein Orchid
: Canyon Nature Trail

- Rhododendron macrophyllum

Family: Ericaceae
Location: Rhododendron Flats; The Burn
- reaches the northern limit of its distribution within the park.

- Tofieldia glutinosa var. intermedia.- Western False Asphodel

Family: Liliaceae
Location: Memaloose Trail - behind Allison Pass '(near .creek)

- Viola Purpurea - Purple Marked Violet

Family: Violaceae
Location: Rock slopes 'above Thunder Lake - rare in B.C.

Rare In Park

(Not necessarily rare in the Province)

- Asclepias speciosa - Milkweed

Family: Asclepiadaceae
Location: Lookout Road

- Artemesia tridentata - Sagebrush

Family: Compositae
Location: Immediately west of Monument 83 Wilderness Campsite

Rare Plants in Strawberry Flats

- Epilobium alpinum - Alpine Fireweed
- Campanula rotundifolia - Harebell
- Hackelia jessicae - Mountain Forget-Me-Not

MAP POUCH CONTENTS

Canada Department of Agriculture. 1975. Soil Map of the Princeton Area. 92H/SE. 1: 125 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Canada Land Inventory. 1972. Land Capability for Wildlife - Ungulates - Hope 92H. 1: 250 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Canada Land Inventory. 1972. Land Capability for Wildlife - Waterfowl - Hope 92H. 1: 250 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Coates, J.A. 1974. Columnar sections of the Pasayten Group, and the eastern belt of map-unit 10 of the Jackass Mountain Group, Manning Park, British Columbia.. Figure 6 in J.A. Coates 1974. Geology of the Manning Park Area, British Columbia. Geological Survey of 'Canada Bulletin 238, Ottawa.

Coates, J.A. 1974. Diagrammatic cross-sections of the geology of Manning Park, British Columbia. Figure 3 in J.A. Coates. 1974. Geology of the Manning Park Area, British Columbia. Geological Survey of Canada Bulletin 238, Ottawa.

Coates, J.A. 1974. Fossil locality map of Manning Park area, British Columbia. 1: 50 000. Figure 12 in J.A. Coates 1974. Geology of the Manning Park Area, British Columbia. Geological Survey of Canada Bulletin 238, Ottawa.

Coates, J.A. 1974. Jurassic,, Hauterivian and Albian fossils, Manning Park Area, British Columbia. Tables 4, 5, 7-9 in J.A. Coates. 1974. Geology of the Manning Park Area, British Columbia. Geological Survey of Canada Bulletin 238, Ottawa.

Coates, J.A. and T. Richards. 1973. Geological Map of Manning Park Area, Yale District, British Columbia. 1: 50 000 Figure 2 in J.A. Coates. 1974. Geology of the Manning Park Area, British Columbia. Geological Survey of Canada Bulletin 238, Ottawa.

Courtin, P.J., K. Klinka and J. Heineman. 1981. Biogeoclimatic Units, Victoria Vancouver. NTS Sheet 92/SE. 1: 500 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Blue Secretariat. 1974. Climate Station Network Maps, Princeton Map Sheet. 1: 500 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian.' 1987. Skagit Recreation Area Present Spotted Owl Habitat. 92H/02. 1: 50 000. Available from .Surveys and Resource

Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit Recreation Area Present Spotted Owl Habitat. 92H/03. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit River Watershed Deer Habitat Capability. 92H/02. 1: 50 000. Available from Surveys and Resource Mapping Branch,, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit River Watershed Deer Habitat Capability. 92H/03. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria; B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit River Watershed Deer Habitat Suitability. 92H/02. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit River Watershed Deer Habitat Suitability. 92H/03. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Fuhr, Brian. 1987. Skagit River Watershed Elk Habitat Suitability. 92H/02. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1x5.

Fuhr, Brian. 1987. Skagit River Watershed Elk Habitat Suitability. 92H/03. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Ministry of Energy, Mines and Petroleum Resources. 1988. Revised Mineral Inventory Map. 92H/SE. 1: 126 720. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Ministry of Environment. 1973. Manning Park and Skagit Recreation Area. 1: 50 000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Ministry of Forests. ,1985. Biogeoclimatic Units of the Vancouver Forest Region. 1: 50'000. Available from Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.

Ministry 'of Environment. 1981. Supplement to Ministry of Environment. 1973. Manning Park and Skagit Recreation Area. 1: 50 000. Available from Surveys and Resource Mapping Branch,' Parliament Buildings, Victoria, B.C. V8V 1X5.

Parks, Campsites, Trails and Points of Interest [Manning and Cathedral Lakes provincial Parks]. Available from Surveys and Resource Mapping Branch, parliament Buildings, Victoria, B.C. V8V 1X5.

Voldt, T. and P. Dakin. 1980. Cascade Wilderness Study. Soils.. Terrestrial Studies Branch, Ministry of Environment, Victoria. Available from Surveys and Resource Mapping branch, Parliament Buildings, Victoria, B.C. V8V 1X5

Voldt, T. and P. Dakin. 1980. Cascade Wilderness Study. Terrain. Terrestrial Studies Branch, Ministry of Environment, Victoria. Available from,Surveys and Resource Mapping Branch, Parliament Buildings, Victoria, B.C. V8V 1X5.