

AN ABSTRACT OF THE THESIS OF

MELVIN LOUIS SCHAMBERGER for the Ph. D.
(Name) (Degree)
in ZOOLOGY presented on April 16, 1970
(Major) (Date)
Title: THE MAMMALS OF MOUNT RAINIER NATIONAL PARK
Abstract approved: Redacted for privacy
Dr. Robert Storm

During 1966, 1967, and 1968 extensive field investigations were carried out in Mount Rainier National Park. These included continuous research during the summer months, and weekend activities during the winter months. Small mammals were trapped and observed, and the larger mammals were observed exclusively. The summer trapping consisted of two phases: the first phase involved random sampling in various sections of the park, where an area was sampled for 10 days with no further investigations being made at that site. This provided information related to habitat preferences, elevational and life zone distribution, interspecific associations, and relative numbers. The second phase involved the establishment of permanent trapping lines which were operated continuously for 10 days each year. This provided additional information on the above topics and served as a measure of population fluctuations during the course of the study.

A total of 57,246 trap nights from 58 trap sites produced 3,717

animals. There are 50 known mammalian species in the park, and an additional 14 species which were either formerly present and now extinct, or which may expand their range into the Mount Rainier area. The small mammal species which contributed most to the population were Peromyscus maniculatus (38%), Clethrionomys gapperi (14%), Eutamias townsendii (10.3%), and Zapus trinotatus (10.1%).

From the permanent trap lines a population cycle in Peromyscus was demonstrated, while other species did not seem to be effected.

An account is given for each species present in Mount Rainier National Park and a similar account for those species which are potential inhabitants. There is also a discussion by life zone of the mammals and their distribution in the park.

Mammals of Mount Rainier National Park

by

Melvin Louis Schamberger

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

June 1970

APPROVED:

Redacted for privacy

Professor of Zoology
in charge of major

Redacted for privacy

Chairman of Department of Zoology

Redacted for privacy

Dean of Graduate School

Date thesis is presented

April 16, 1970

Typed by Mary Jo Stratton for Melvin Louis Schamberger

ACKNOWLEDGEMENTS

This extensive field project required assistance, cooperation, and sympathy from many persons, especially the staff of Mount Rainier National Park. The rangers, naturalists, and seasonal staff gave many hours of their time towards the collection of data for this study. Each year at least eight persons were asked to help with the operation of the permanent trap lines. Without this assistance, that portion of the research would have been omitted.

Specifically, I am indebted to Park Staff Ranger David D. May for his interest in getting this project started. He was instrumental in obtaining a \$2500.00 contract from the Park Service to help defray costs of the field research.

The Mount Rainier Natural History Association aided in this study by providing a number of traps which were essential for the completion of field studies.

The administrative staff of Mount Rainier National Park extended considerable cooperation in the coordination of field operations with other park activities. Permits were provided for scientific collecting in the park, and horses and men were made available for packing equipment and supplies into the remote sections of the park.

I would like to thank Mr. Rufus Kiser for his valuable assistance with the plant taxonomy used in this research. His help with the collecting and identification of plant species provided the information from which life zone designations were made.

To my major professor, Dr. Robert Storm, I am indebted for his willingness to provide supplies and equipment necessary for the trapping and mounting of specimens. His valuable assistance in preparing this thesis was greatly appreciated.

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
Geology of Mount Rainier	1
Weather Characteristics	3
Soils	4
History of Use and Abuse of Mount Rainier National Park	4
Vegetation and Life Zones of Mount Rainier National Park	8
Humid Transition Life Zone	13
Canadian Life Zone	16
Hudsonian Life Zone	16
Arctic Alpine Life Zone	17
Previous Studies	18
Purpose of the Study	21
METHODS AND MATERIALS	23
Random Lines	24
Permanent Lines	26
Winter Trapping	27
RESULTS	
Random Lines	28
Permanent Lines	37
Winter Trapping	41
DISCUSSION AND ANALYSIS	45
Analysis of Trapping Data	45
Random Lines	45
Permanent Lines	46
Winter Trapping	49
Account by Species	50
Mammals of Mount Rainier National Park	50
Species Trapped or Observed in Mount Rainier National Park	50
Mammals of Uncertain Status in Mount Rainier National Park	78
Mammals and Life Zones of Mount Rainier	82
Humid Transition Life Zone	82

	<u>Page</u>
Canadian Life Zone	84
Hudsonian Life Zone	86
Arctic Alpine Life Zone	88
SUMMARY	90
LITERATURE CITED	92
APPENDICES	95
Appendix A - Habitat Descriptions	95
Appendix B - List of Plant Species Used to Determine the Life Zone of the Various Trapping Sites	112

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Merriams Life Zones as they compare with three other methods of vegetational classification.	9
2	Plants used at Carbon River trapping site to determine Life Zone of that site.	11
3	List of trap sites and life zones, including the number of plant species found at each site belonging to the different life zones.	14
4	Random trap lines: trap site, elevation, life zone, number of traps and trap nights, total number of animals captured, and number of species captured at each site.	29
5	Elevational list of random trap sites and the number of individuals of each species captured.	32
6	Yearly comparison of population numbers and percent by species for the random trap lines.	36
7	Permanent trap lines: trapping site, elevation, life zone, total trap nights, total numbers, and number of species captured.	38
8	Trapping records for permanent trap lines: summary by species for all three years.	39
9	Permanent lines: yearly breakdown of trapping records, indicating number of individuals of each genus captured.	40
10	Number and percentage comparison of results from permanent lines and from random lines.	42

<u>Table</u>		<u>Page</u>
11	Results of winter trapping: sites, dates, trap nights, number of each species caught, and totals.	43
12	Taxonomic list of mammals of Mount Rainier National Park.	51

MAMMALS OF MOUNT RAINIER NATIONAL PARK

INTRODUCTION

Mount Rainier was established as a National Park by an Act of Congress in 1899 (26, p. 2). Several sections of land were later added and the boundaries extended until the park now encompasses 377.78 square miles, over 241,780 acres (18, Sept. 1938). The park is located just west of the crest of the Cascade Mountains, about 50 miles east of the southern tip of Puget Sound. The co-ordinates of the park are from lat. $46^{\circ}45'$ N. to lat. $47^{\circ}00'$ N., and from long. $121^{\circ}40'$ W to $121^{\circ}55'$ W.

Since the park was established, there has been increasing protection of the flora and fauna; fires have been controlled, hunting and trapping prohibited, and general misuse kept to a minimum. Except in areas near tourist facilities, wild primitive conditions still remain and little disturbance has occurred. The main attraction of this park is the mountain from which the park has been named and most research has been of a geological nature.

Geology of Mount Rainier

Mount Rainier is one of several volcanic cones found scattered along the Cascades of Washington, Oregon, and northern California.

It is classed as a dormant volcano, and was active in relatively recent geological time (5). Presently, steam vents are found at the summit and hot springs bubble from several areas near Longmire and Ohanape-cosh. From its base in the Cascades, Mount Rainier rises 9000 feet to a lofty height of 14,408 feet. The ruggedness is expressed by the fact that the distance from the lowest point in the park, 1,560 feet, to the summit is but ten miles.

Mount Rainier is a composite cone, built primarily of projectiles and lava streams (5). From evidence found around the cone, Coombs (5) believes that at one time the mountain was some 2000 feet higher, but violent volcanic explosions removed the top, leaving the dome-shaped mountain as it now appears. Subsequent explosions left two small craters within the larger main crater at the summit.

The rocks of Mount Rainier can be divided into two major groups, the lavas and pyroclastics, and the granite rocks. Volcanic and plutonic rocks predominate, while sediments and metamorphics are of less common occurrence (5). The most common rock type is hypersthene andesite.

At least 28 active glaciers radiate from the central cone, covering over 45 square miles of the park. Outside of Alaska, this is the largest single peak glacier system in the United States. Tongues of ice extend from the glaciers to about the 4000 foot level with the glaciers averaging from 4-6 miles in length. Large streams and

rivers gush from beneath these glaciers, with the water color in summer turning to a dirty white from the pulverized rock particles. The deep glacial valleys are separated by steep rugged ridges. It is not uncommon to find an elevational difference of 3000 feet between a valley floor and the ridge above, less than a half-mile distant.

Since the entire park lies west of the Cascade Crest, all drainage eventually turns westward. All of the streams and rivers empty either into the Columbia River or into Puget Sound.

As would be expected in a young mountain, geologic processes are continually at work altering the topography of the park. Glacial erosion, avalanches, and mudflows continue to work away at the slopes. For the past hundred years, the glaciers have been retreating up their respective valleys. Studies on the Nisqually glacier have revealed that between 1857 and 1940 the glacier retreated 3723 feet (3; 18, Nov. 1940). In the past few years, with but a few exceptions, the glaciers have been continuing their retreat.

Weather Characteristics

The park lies along the Pacific Coastal Belt and characteristically receives considerable precipitation, particularly during the winter and spring months. The Carbon River area (2000 feet) receives annually 91 inches of rainfall; Longmire (2700 feet), 113 inches, and Paradise (5500 feet), 125 inches of rainfall. At higher

elevations much of this falls as snow; for example, at Paradise snowfall may reach 500 inches annually. During the winter, 25 feet of snow is not uncommon at Paradise, while Longmire may accumulate four feet (29). May, June, July, and August are the driest months, while November, December, January, and February have the highest amounts of precipitation. Temperature as well as precipitation varies a great deal with elevation. At Paradise, temperatures average about eight degrees below those at Longmire. The average yearly temperature is 45°F at Longmire, and 37°F at Paradise. Even during the summer months, the average low at Paradise is 42°F, the high about 60°F, while at Longmire the low is about 42°F, with the average high being in the 70's. In the winter, temperatures may drop below zero, but normally range in the 20's (29).

Soils

The soils of Mount Rainier are mostly volcanic in origin and are quite porous in nature. Many of the ridges are almost barren rock; talus slopes form beneath the cliffs. The high meadows are very sandy, while at lower elevations vegetation has added considerable humus to the soil (5).

History of Use and Abuse of Mount Rainier National Park

Mount Rainier National Park has had relatively little disturbance,

particularly when comparing it to the surrounding areas where logging activities have greatly affected wildlife communities. However, some abuses have occurred and are worth noting.

Due to the early preservation of this area, logging activities had not yet reached the slopes of Mount Rainier. The only trees removed have been those cut for the construction of roads, buildings, campground facilities and residential areas.

Some mining activity occurred in the park in 1897 and 1898 when the Starbo Mining Operation removed silver and copper from the White River District near Glacier Basin. Remains of this operation are still visible at the ruins of the old Starbo Camp. Shortly before the turn of the century many other mining claims were filed within the boundaries of the park. Through the persistent efforts of many persons interested in preserving the natural wonders of the national parks, legislation was passed which prohibited the filing of any additional claims. Since that legislation, most of the claims have been dropped but at the present time there are still two mining claims which remain in private hands (17, p. 42).

Limited grazing was also present in the park during the early years after establishment. The high meadows were used by flocks of domestic sheep. However, these meadows were not suited for this type of grazing due to storms and bad weather in general. In the Paradise area a few head of stock were kept to supply milk for the

cafeteria in Paradise. Legislation was also passed which banned grazing from national parks, and grazing has not been present for many years (17, p. 48).

During the first years after establishment of the park, poachers annually took many game and fur-bearing species. However, as the park developed, more effective enforcement of park regulations discouraged most of this activity. Occasionally hunters wander over the present park boundaries, but this does not pose any serious threat to wildlife numbers.

In the early days of the park service, many of the parks were viewed as "game sanctuaries," and it was a standard practice to control predators. Cougar, coyote, and bear were the main targets. At the present time, the only justification for the removal of animals is for the safety of park visitors, and an occasional black bear falls into this category.

Visitor abuse of fire occurred about the turn of the century when campers often set fire to clumps of alpine fir for entertainment in the evening (17, p. 47). Naturally, this practice has been stopped for many years. Lightning-caused fire has always been a natural catastrophic event, and was present before man formed the national park. Now a well developed system of fire lookouts is used for the early detection of fires. During July, August, and early September fire danger is often high, and once a fire is detected, immediate

efforts are made to control it. This practice will tend to maintain climax communities with a corresponding decrease in seral stages. Since some species are not climax species, this control of fire may have a serious effect on the relative abundance of some mammalian species.

Other minor abuses have occurred, including the establishment of a nine-hole golf course at Paradise in 1931. This has since been abandoned and the site has reverted to wildflowers. In the early 1900's the Yakima Indians used the high meadows for horse racing, mock battles, ceremonies and games during the summer months (12, p. 98).

Finally, mention must be made of the "abuse" associated with man's recreational pursuits. In many areas, notably around campgrounds and visitor attractions, the vegetation has been greatly altered, in some cases destroyed. Here also is a point of concentration for those species of wildlife which accept food from visitors, including deer, bear, chipmunks and ground squirrels.

Most of the forms of abuse are of a local nature and not of major consequence to the park in general. Visitor use is increasing each year, and pressures are present for the formation of new campground and tourist facilities.

Vegetation and Life Zones of
Mount Rainier National Park

Due to the large elevational differences found in Mount Rainier, a wide variety of vegetational types are present. Some system of habitat classification is essential, and in reviewing the various systems in use, the Life Zone concept seems to be most appropriate for this type of paper. Franklin discussed a number of these systems (9), and a chart from his thesis showing how these systems relate has been reproduced in Table 1. Merriam's Life Zones are generally known to most animal ecologists, and with some modifications are quite adaptable to Mount Rainier.

Timberline occurs between 6500 and 7000 feet on Mount Rainier, with mixed meadow and forest from the 5000 to 7000 foot level. Below 5000 feet the slopes are for the most part heavily forested. The eastern slopes are dryer than the western, and vegetation is affected accordingly. Although exposure, soil type, and topography do not permit clear-cut distinctions between the zones in some areas, the zones can be readily separated in most cases.

When Merriam first proposed the Life Zone concept, he used temperature as the determining factor in delineating the boundaries of the zones. This has received great criticism, and I have substituted in its place the method described below.

During the summer of 1968, Mr. Rufus Kiser assisted in this

Table 1. Merriam's Life Zones as they compare with three other methods of vegetational classification.

Vegetation Zones (Franklin)	Bioclimatic Zones in Coastal British Columbia (Krajina, 1965)	Climax Plant Associations in Western Washington (Scott, 1962)	Merriam's Life Zones in Cascade Range (Piper, 1906)
Western hemlock	Douglas fir - Western hemlock (drier subzone)	Western hemlock - Western red cedar	Humid Transition
	Coastal western hemlock		
Pacific silver fir	Pacific silver fir - Western hemlock (wetter subzone)	Pacific silver fir - Western hemlock	Canadian
Mountain hemlock	Subalpine Forest (lower subzone) Coastal mountain hemlock Subalpine Parkland (upper subzone)	Subalpine fir - Mountain hemlock	
Alpine	Alpine	Saxifrage - Heather	Arctic Alpine

project by preparing a taxonomic list of plant species present in each of 42 of the different study areas I used in Mount Rainier. In Peck's book, Manual of the Higher Plants of Oregon (19), and Abrams' Illustrated Flora of the Pacific States (1), each plant is assigned to a life zone by these authors. Some plants are considered typical of several zones, and are so indicated. From the taxonomic list prepared by Mr. Kiser, we assigned each study area to a particular life zone based on the relative number of plant species belonging to each zone. For example, one such list for Carbon River is found in Table 2. From this table, the following summary can be extracted:

Humid Transition	- 28 species
Canadian	- 10 species
Hudsonian	- 2 species
Arctic Alpine	- 1 species

Because of the preponderance of plant species characteristic of the Humid Transition Life Zone, the Carbon River site was classed as Humid Transition.

This same method was applied to each of the 42 sites. In some cases no clear distinction between zones occurred, so either "upper" or "lower" was added to indicate a close affinity to the next zone. An example of this situation is at Crater Creek, where the data indicated a border between two zones:

Humid Transition	- 8 species
Canadian	- 14 species
Hudsonian	- 11 species
Arctic Alpine	- 5 species

Table 2. Plants used at Carbon River trapping site to determine Life Zone of that site.

Mount Rainier National Park Carbon River - 1900 feet July 26, 1968	Humid Transition	Canadian	Hudsonian	Arctic Alpine
<u>Trees and shrubs</u>				
<u>Tsuga heterophylla</u>	x	x		
<u>Pseudotsuga taxifolia</u>	x			
<u>Abies grandis</u>	x	x		
<u>Thuja plicata</u>	x	x		
<u>Populus trichocarpa</u>	x	x		
<u>Salix scouleri</u>	x	x		
<u>Alnus rubra</u>	x			
<u>Rubus spectabilis</u>	x			
<u>Rubus parviflorus</u>	x			
<u>Acer glabrum</u>		x		
<u>Gaultheria shallon</u>	x			
<u>Vaccinium parvifolium</u>	x			
<u>Herbaceous plants</u>				
<u>Polystichum munitum</u>	x			
<u>Struthiopteris spicant</u>	x			
<u>Holcus lanatus</u>	x			
<u>Montia parvifolia</u>	x	x		
<u>Montia peifoliata</u>	x			
<u>Ranunculus repens</u>	x			
<u>Tiarella trifoliata</u>	x			
<u>Epilobium glandulosum</u>	x	x		
<u>Plantago major</u>	x			
<u>Galium aparine</u>	x			

(continued on next page)

Table 2. (continued)

Mount Rainier National Park Carbon River - 1900 feet July 26, 1968	Humid Transition	Canadian	Hudsonian	Arctic Alpine
<u>Anaphalis margaritacea</u>	x	x	x	
<u>Achillea millefolium</u>	x			
<u>Petasites speciosus</u>	x			
<u>Senecio sylvaticus</u>	x			
<u>Cirsium arvense</u>	x			
<u>Taraxacum officinale</u>	x			
<u>Agoseris glauca</u>			x	x
<u>Hieracium albiflorum</u>	x	x		

Here the trapping site was designated "Upper Canadian," indicating its close affinity to the Hudsonian Life Zone.

Table 3 is a listing by elevation of the 42 sites for which plant species lists were prepared. The number of species of plants at a site belonging to each zone is indicated, followed by the Life Zone designation for that site. All trapping sites have a further description in Appendix A.

A list of all trees and shrubs used for the purpose of life zone determination is found in Appendix B-1, followed by a similar list (Appendix B-2) of the herbaceous plants.

From Table 3, the approximate elevational occurrence of the Life Zones in Mount Rainier National Park are as follows:

Humid Transition Life Zone	- Below 3500 feet
Canadian Life Zone	- 3500-5000 feet
Hudsonian Life Zone	- 5000-6500 feet
Arctic Alpine Life Zone	- 6500 feet-summit

These figures are but averages, and local conditions will greatly influence the vegetation and Life Zones. Boundaries between zones are not well delineated, but rather a continuum exists with a gradual replacement of one plant species by another, and of one zone by another.

Humid Transition Life Zone (Below 3500 feet)

The mature forest of the lower elevation characterizes the Humid Transition, with a canopy of grand fir, Douglas fir, western

Table 3. List of trap sites and life zones, including the number of plant species found at each site belonging to the different life zones*.

Site	Elevation	Humid Transition	Canadian	Hudsonian	Arctic Alpine	Life Zone
Ohanapecosh Old Growth	1700	34	18	1	0	H. T.
Carbon River Rain Forest	1800	19	10	2	1	H. T.
Carbon River	1900	28	10	2	1	H. T.
West Side Road Junction	2200	28	14	2	2	H. T.
Stevens Canyon Entrance Station	2200	10	6	2	2	H. T.
Kautz Mudflow	2300	12	5	1	0	H. T.
Ohanapecosh River Bottom	2300	29	24	6	3	H. T.
Ipsut Creek	2400	43	28	8	5	H. T.
Longmire	2600	34	23	4	4	H. T.
Fish Creek	2700	35	20	6	4	H. T.
Ohanapecosh Wooded Area	2700	16	9	2	1	H. T.
White River	2700	31	18	4	3	H. T.
Stevens Canyon	2700	25	14	1	0	H. T.
Nickel Creek	3000	25	15	4	2	H. T.
Deadwood Creek	3200	24	20	2	1	U. H. T.
North Puyallup River	3500	15	10	2	1	U. H. T.
North Puyallup River Moraine	3500	18	20	11	6	U. H. T.
St. Andrews Creek	3800	19	16	7	5	U. H. T.
Canyon Bridge	4000	20	16	6	1	L. C.
Round Pass	4000	26	19	9	1	L. C.
Stevens Canyon (burn)	4000	5	6	6	1	Can.

(continued on next page)

Table 3. (continued)

Site	Elevation	Humid Transition	Canadian	Hudsonian	Arctic Alpine	Life Zone
Mountain Meadows	4000	4	17	17	7	U. Can.
Christine Falls	4200	24	16	4	1	U.H. T.
Ricksecker Point	4200	9	12	4	2	L. Can.
Tunnel	4200	17	16	7	2	L. Can.
Klapatche Point	4300	21	10	7	2	Can.
White River Campground	4300	12	16	7	3	Can.
Cayuse Pass	4600	8	11	11	4	U. Can.
Bench Lake	4600	6	11	14	6	Hud.
Lee Creek	4800	11	16	17	11	L. Hud.
Reflection Lake	4850	5	14	20	10	Hud.
Mowich Meadow	4900	2	7	11	4	Hud.
Crater Creek	5000	7	14	12	5	U. Can.
Sunset Lakes	5000	3	5	8	3	L. Hud.
Road to Sunrise	5200	14	23	15	8	U. Can.
Sunset Park	5200	4	7	8	4	L. Hud.
Ipsut Pass	5300	8	11	6	2	U. Can.
Sidehill, Road to Sunrise	5300	8	12	6	3	U. Can.
Sunset Permanent Line	5500	5	8	9	5	L. Hud.
Tipsoo Lake	5800	5	14	18	10	U. Hud.
Hudsonian Woods below Sunrise	5800	0	12	19	13	U. Hud.
Sunrise Park	6300	0	5	10	7	A. A.

*Abbreviations: H. T. = Humid Transition; U.H. T. = Upper Humid Transition; L.Can.= Lower Canadian; Can. = Canadian; U. Can. = Upper Canadian; L. Hud. = Lower Hudsonian; Hud. = Hudsonian; U.Hud. = Upper Hudsonian; A. A. = Arctic Alpine

red cedar, and western hemlock. There is a sparse understory with some vine maple in the more mesic areas. The shrub layer is also not dense except for mesic areas, and is primarily of Oregon grape, red huckleberry, Pacific blackberry, salmonberry, salal, and devil's club. The forest floor is usually moss-covered with many small spring flowers.

Canadian Life Zone (3500-5000 feet)

This is also a typically forested zone found at middle elevations. The trees here are often not quite as tall nor as large in diameter as those found at the lower elevations. Trees common to this zone are the western white pine, western hemlock, grand fir, Pacific silver fir, and Rocky Mountain maple. Here again the canopy keeps most of the light from reaching the forest floor, and the understory is even less dense than that of the Transition Zone. The shrub layer appears heavier, composed primarily of stinking currant, devil's club, blue huckleberry, and Pacific menziesii. The ground cover has little or no moss, and herbaceous plants are less common here than in the Transition Zone.

Hudsonian Life Zone (5000-6500 feet)

This zone is the border between the forests of lower elevations and the meadows of the higher elevations. The Lower Hudsonian is

mostly forested and has few scattered meadows, while the Upper Hudsonian is almost entirely meadow, with few scattered trees or clumps of trees. The forests of the Lower Hudsonian differ from the Canadian in that the Hudsonian trees are smaller in diameter and height with more taper to withstand the tremendous load of snow. The trees are primarily whitebark pine, mountain hemlock, alpine fir, and Alaska cedar. In wooded regions of the Hudsonian, the ground is almost bare of any plant growth with very few flowers or mosses. The shrub layer is sparse with some blueberry. In the meadows, a very different ground cover is observed, with meadow grasses and flowers growing in lush abundance. In the meadows one often finds dwarf huckleberry and pink mountain heather in thick mats. This zone extends from about 5000 feet to timberline, which occurs between 6500 and 7000 feet.

Arctic Alpine (6500 feet-summit)

Over 80 square miles of Mount Rainier lie above timberline and are included in the Arctic Alpine Zone. It is characterized by immense snowfields, glaciers, barren rock outcrops, and at the lower elevations, meadows. This zone begins at about the 6500-7000 foot level and extends to the summit of the mountain at 14,410 feet.

The following references contain additional information on the Life Zones of Mount Rainier National Park (2, 5, 6, 28, 25).

Previous Studies

Most of the scientific study in Mount Rainier has centered around geology, wildflowers, and the larger mammals. The smaller and less readily observed forms have received little attention.

Studies related to the mammals of the park first began in 1897 when a Biological Survey Party collected specimens and took notes on the fauna in general. This party included C. Hart Merriam, Vernon Baily, and Walter Fisher. They entered the park near the area now known as Longmire and moved on up to Paradise. They camped, made collections, and took notes. One hundred eighty specimens were collected, many of which are now housed at the United States National Museum in Washington, D. C. No formal publication resulted from this work, but scattered references are made to it (16; 18, June 1937; 28). Many of Dr. Merriam's personal notes are now housed at the University of California at Berkeley.

In 1919 the Biological Survey again sent an expedition into Mount Rainier. This was a co-operative venture between the Biological Survey, represented by Dr. W. P. Taylor, the National Park Service, represented by Park Ranger J. B. Fleet, and the State College of Washington, represented by W. T. Shaw. This study included the birds, mammals, and life zones of the park, and a publication resulted from this expedition, The Mammals and Birds of Mount Rainier National Park, by Walter P. Taylor and William T. Shaw (25).

This was a government publication, and a shorter paper appeared in Ecology (23).

On a less scientific level the rangers and staff have kept records of their observations on the various wildlife species, but most of the observations are related to the game and predator species. Many of these observations appeared through a newsletter, "Nature Notes," published by the staff of Mount Rainier National Park and mailed to interested persons. Nature Notes were published from 1923 to 1938 and included information of a general nature related to glaciers, wildflowers, geology, birds, and mammals.

Each year the superintendents of the various parks were required to formulate "Annual Reports," and they occasionally mentioned mammal species, but again the primary concern was with the larger species.

A naturalist, E. A. Kitchen, made many careful observations and several studies of the mammals, primarily on the deer, elk, and large carnivores. His notes are collected together as the "Kitchen's Reports," made between July 1934 and January 1936 (15).

In 1945 a large mudflow originated from the Kautz Glacier, moved down the valley, covered the road below Longmire, and deposited 40-50 feet of rock and debris over the road and forest. The trees were destroyed and successional stages began. This offered an opportunity to study the dynamics of small mammal replacement, and

Dr. Burton Ostenson and Dr. Murray Johnson began a "Small Mammal Replacement Study." This study covered several years and several reports were prepared and sent to Mount Rainier National Park and are presently on file in the park library (14). No formal publication resulted from this study.

In the early 1960's the park service was interested in determining the status of the mountain goats in the park and financed a study to this end. Dr. Murray Johnson and Roger Morrow began field work in 1962. A report was completed and given to the park service in 1964 (13).

At the present time, the park is conducting its own study on the elk to determine the relationships elk have to other species, their movements, and extent of damage, if any, to winter and summer feeding areas.

The Mount Rainier Natural History Association in 1949 published a booklet, "Mammals of Mount Rainier National Park" by Merlin K. Potts and Russell K. Grater (20). This publication was intended for park visitors and was primarily an identification guide to the more common species. It is now out of print and copies are no longer available.

There are two general publications which cover the mammals found in this part of the state of Washington. The earliest was by Walter Dalquest, entitled "The Mammals of Washington" (6), published

in 1948 by the University of Kansas. Some references are made to Mount Rainier National Park in this publication. The most recent publication is by Ingles, "Mammals of the Pacific States," published in 1965 by the Stanford University Press (11). This publication gives in general terms the distribution of mammals in Washington, Oregon, and California.

Purpose of the Study

At the present time, there is no current publication relating to the status of the mammals of Mount Rainier National Park. The species list compiled by the Park Service did not include all species present and in some cases scientific names were used which are no longer in use by mammalogists. Therefore, research was designed to provide information in three major areas: (1) To update and correct the species list. To do this, field observations and collections were made and specimens were identified and mounted. (2) To update and collect the information found in miscellaneous reports, personal observations, and records of the Biological Survey Parties; (3) To provide an ecological study of the relationships of the various small mammals found in Mount Rainier. Information related to population cycles, intra- and interspecific competition, relative abundance, habitat preference, elevational distribution, and related ecological problems had not previously been thoroughly investigated.

Since this is a national park, the area will remain undisturbed in the foreseeable future and this study can be used as a yardstick for future comparisons of small mammal populations as they vary with time. Also, few researchers have used such a large undisturbed area for ecological studies of small mammal communities, and in this area relationships within and between species should be as close to "natural" as could be found anywhere.

METHODS AND MATERIALS

To facilitate study, the park was divided into three major sections. By studying one of the three areas each summer for three years, representative areas from all parts of the park have been examined. The names of rivers, glaciers, ridges, and other reference points were taken from the Mount Rainier National Park quadrangle map, published by the United States Geological Survey (27). The Southwest Section, studied intensively in 1966, included the area between Eunice Lake and Paradise. The major drainage systems in the park of the Mowich, North Puyallup, South Puyallup, and Nisqually Rivers are contained in this section. The Northern Section, studied in 1967, included the area north from Eunice Lake to Sunrise, with the drainage systems of the Carbon River, West Fork of the White River, and Huckleberry Creek. The Southeast Section, examined in 1968, included that area from Sunrise south to Paradise. Here the main river systems are the White, Ohanapecosh, and Cowlitz Rivers.

From three summers of field operations and from weekends during two winters, considerable data were accumulated. Smaller mammals were trapped and shot, then identified and mounted. In addition, observations were made on both small and large mammals when opportunities existed. The collecting permit issued by the Park Service for this project prohibited the collection of fur bearers, game

species, and larger predators.

The summer and winter trapping mentioned above was of a random nature, with both trapping areas and trapping sites normally being trapped but once during the study. As a control, seven areas were selected in the park and a permanent trap line established at each of these areas. These permanent lines were operated each year of the study, usually during the first part of August. Reference in this paper to the permanent lines refers to those trapped each year, and reference to the random lines refers to those trapped but once.

Random Lines

The intensive study carried out in each of the three sections included trapping, field observations, identification, and preservation of study skins. In each of the sections, four to six base camps were established and around each of these several habitats were selected for trapping. In each of the habitats, called trapping sites, 100 small mammal traps were placed and kept in operation continuously for up to 10 days. The traps were primarily of three types: Sherman live traps, Museum Special snap traps, and rat traps. The live traps were baited with hulled oats and the snap traps were baited with a mixture of peanut butter and rolled oats. Usually 25 live traps and 75 snap traps were placed in each study area. Twenty-five stations were placed randomly in a circular fashion, about 25-30 paces apart.

At each station four traps, one live and three snap, were placed. This method gave some degree of uniformity, yet did not require considerable time to lay out. A detailed itinerary of the field operations during the summer months is included in Appendix C.

From each site, small mammals were collected, identified, measured, and numerous study skins prepared for later reference. A brief description was prepared for each habitat and is included in Appendix A. This description contains information on plant types and cover, topography, elevation, and soils. As was mentioned earlier, a taxonomic list of plant species was prepared by Mr. Rufus Kiser, but the list for each site is not included in this paper. Although daily trapping records were kept, the tables presented here are but a summary of those data. The complete records are on file in the library at Mount Rainier National Park, along with two progress reports.

Many of the sites trapped were accessible by road or by a short hike along established trails. A few of the areas were in the back-country and were only accessible by pack animals. The Park Service co-operated by supplying me with horses and men to move supplies and equipment into these remote areas. Each year one or more areas of this nature were sampled. A total of four different base camps were thus established: Sunset Lakes, Grand Park, Indian Bar, and Mystic Lake.

Permanent Lines

The permanent lines were established in 1966 and were operated each summer during the study. In each of the three sections of the park two lines were established, one in the Humid Transition Life Zone and the other at a higher elevation, usually in the Hudsonian Life Zone. Since they were all operated at about the same time, it was necessary to place them near Ranger Stations or fire lookouts so that Park Service personnel could assist in this phase of the research.

The permanent lines were established according to the method outlined by Calhoun (4) and used in the North American Census of Small Mammals. Trapping stations were staked out along a straight line at 50-foot intervals and numbered. The 33 stations formed a line 1650 feet long. Within 10 feet of each station, three traps were placed, one live trap and two snap traps. The first station had one extra trap, making a total of 100 traps in each line. Each year the traps were placed at the same location to give a greater degree of uniformity in results. These lines were in operation during the last part of July and the first part of August. Although some variation occurred, generally 10 nights of data were collected from each line each year. I established the lines, and each year put the traps in place and baited them the first day. From then on, either a Naturalist, Ranger, or Fire Control Aide checked the traps, removed the animals, recorded the results, and rebaited the traps. After 10 days, I

returned, collected the traps and results, and analyzed the data. A small museum of study skins was provided for each person assisting in this phase of the study, along with an identification guide. Thus in most cases identification of mammals was reasonably accurate. Since there was variation in the skill, interest, and ability of the different persons involved in this part of the study, a certain degree of error did exist. However, considerable valuable data were collected.

Winter Trapping

During the first two years of the study, one weekend each month during the winter was devoted to field observations and trapping. From September to May of 1966-67 and 1967-68 one or more areas were trapped each month to determine variations in winter populations and approximate dates of hibernation in species so inclined. One-hundred traps were placed in a site previously trapped during the summer. Unfortunately, only a few areas were available in the winter due to heavy snow pack and to the fact that only one road is kept open during the winter, thus restricting trapping to the lower elevations.

RESULTS

Random Lines

During the three summers, 51 random sites were trapped for small mammals. Table 4 is an elevational listing of these sites by the year in which they were trapped. This table includes the Life Zone of each site, elevation, number of traps and trap nights, the number of animals trapped, and the number of species taken from each site. During this phase of the research, 33,740 trap nights yielded 2208 animals.

A more detailed picture of the results from each site is presented in Table 5. This table is a listing of the sites by elevation and includes the number of individuals of each species captured at each site. Certain species demonstrated a remarkable ability to adapt to all elevations sampled, while others demonstrated elevational preferences.

Table 6 is a breakdown by year of the composition of the small mammal community as determined by the random lines. This table includes the species taken, the number taken each year, and the percent of the total population contributed by that species for that year. Numbers of some species remained fairly stable throughout the study, while others demonstrated considerable fluctuations in both numbers and percent of the population. Since each year represents a different

Table 4. Random trap lines: trap site, elevation, life zone, number of traps and trap nights, total number of animals captured, and number of species captured at each site. Listed by elevation by year of trapping.

Site Name	Elevation	Life Zone*	Number of traps	Trap nights	Number of animals	Number of species
			1966			
West Side Road	2200 ft.	H. T.	87	609	50	9
Kautz Creek	2300 ft.	H. T.	90	720	89	6
Fish Creek	2700 ft.	H. T.	100	800	86	9
North Puyallup River (north)	3500 ft.	U. H. T.	100	700	47	9
North Puyallup River (south)	3550 ft.	U. H. T.	100	700	44	4
Van Trump Creek	3900 ft.	L. Can.	100	900	123	9
Canyon Bridge	4000 ft.	L. Can.	100	900	119	11
Round Pass	4000 ft.	L. Can.	96	768	60	5
Ricksecker Point	4200 ft.	U. Can.	100	900	58	6
Mountain Meadows	4200 ft.	U. Can.	100	900	50	9
Klapatche Point	4450 ft.	Can.	50	350	5	2
Reflection Lake	4870 ft.	Hud.	100	900	50	7
Mowich Lake	5000 ft.	Hud.	100	900	61	8
Crater Creek	5000 ft.	U. Can.	100	900	118	10
Sunset Lakes	5000 ft.	L. Hud.	100	900	27	6
Sunset Valley	5200 ft.	L. Hud.	100	900	47	11
Ipsut Pass	5300 ft.	U. Can.	75	375	6	2
Colonnades	7000 ft.	A. A.	100	700	33	8

(Continued on next page)

Table 4. (continued)

Site name	Elevation	Life Zone*	Number of traps	Trap nights	Number of animals	Number of species
<u>1967</u>						
Carbon Rain Forest	2000 ft.	H. T.	100	900	79	5
Carbon River	2100 ft.	H. T.	100	900	128	9
Ipsut Creek	2200 ft.	H. T.	100	900	82	9
West Fork	2800 ft.	H. T.	200	800	55	6
White River	2800 ft.	H. T.	75	600	55	7
Deadwood Creek	3200 ft.	U.H. T.	100	800	44	6
Yakima Peak Burn	4800 ft.	U. Can.	50	400	11	1
Winthrop Glacier						
Outwash	5000 ft.	L. Hud.	50	450	21	3
Winthrop Glacier						
Moraine	5100 ft.	L. Hud.	50	450	12	3
Mystic Lake Patrol						
Cabin	5300 ft.	L. Hud.	100	900	62	10
Eleanor Trail	5300 ft.	L. Hud.	100	600	32	6
Mystic Lake	5400 ft.	Hud.	100	900	38	8
Grand Park Creek	5600 ft.	Hud.	100	600	22	6
Grand Park	5600 ft.	Hud.	100	600	17	7
<u>1968</u>						
Stevens Canyon						
Entrance Station	2200 ft.	H. T.	25	250	2	2
Ohanapecosh Bottom	2300 ft.	U. H. T.	31	248	17	4
Ohanapecosh Woods	2700 ft.	H. T.	100	800	6	4

(continued on next page)

Table 4. (continued)

Site name	Elevation	Life Zone*	Number of traps	Trap nights	Number of animals	Number of species
Stevens Canyon						
Entrance Station	2700 ft.	H. T.	100	900	30	6
Nickel Creek	3000 ft.	H. T.	100	900	37	7
Stevens Creek	4010 ft.	Can.	25	200	21	4
Tunnel	4200 ft.	L. Can.	30	90	3	3
White River Camp-ground	4300 ft.	Can.	100	900	67	10
Bench Lake	4500 ft.	L. Hud.	40	320	44	5
Cayuse Pass	4600 ft.	U. Can.	100	800	41	6
Lake Louise	4700 ft.	L. Hud.	100	900	54	4
Road to Sunrise (creek)	5200 ft.	U. Can.	60	500	30	9
Road to Sunrise (woods)	5300 ft.	U. Can.	50	500	13	5
Indian Bar	5500 ft.	Hud.	100	600	27	10
Subalpine Woods	5800 ft.	Hud.	100	700	28	9
Tipsoo Lake	5800 ft.	U. Hud.	100	300	24	7
Ohanapecosh Park	6000 ft.	U. Hud.	100	600	13	6
Yakima Park	6300 ft.	A. A.	50	450	18	5
Panhandle Gap	6500 ft.	A. A.	40	160	2	2

* Abbreviations: H. T. = Humid Transition; U. H. T. = Upper Humid Transition; L. Can. = Lower Canadian; Can. = Canadian; U. Can. = Upper Canadian; L. Hud. = Lower Hudsonian; Hud. = Hudsonian; A. A. = Arctic Alpine

Table 5. Elevational list of random trap sites and the number of individuals of each species captured.

Site	Elevation (hundred feet)	<u>Sorex cinereus</u>	<u>Sorex trowbridgii</u>	<u>Sorex vagrans</u>	<u>Sorex obscurus</u>	<u>Sorex palustris</u>	<u>Sorex bendirii</u>	<u>Neotrichus gibbsii</u>	<u>Ochtona princeps</u>	<u>Eutamias amoenus</u>	<u>Eutamias townsendii</u>	<u>Glaucomys sabrinus</u>	<u>Thomomys talpoides</u>	<u>Peromyscus maniculatus</u>	<u>Neotoma cinerea</u>	<u>Clethrionomys gapperi</u>	<u>Phenacomys intermedius</u>	<u>Microtus oregoni</u>	<u>Microtus richardsoni</u>	<u>Microtus townsendii</u>	<u>Microtus longicaudus</u>	<u>Zapus trinotatus</u>	<u>Mustela erminea</u>
Rainforest	18	1			2						6			69			1						
Carbon River	19				30			3			5			82						12	1	3	2
West Side Road	22	3	9					1			2			16		4	1	5				14	1
Stevens Canyon																							
Entrance Station	22						1				1												
Ohanapecosh Bottom	23				3									8				1				5	
Kautz Mudflow	23			12							12			17		16	1	9					
Ipsut Creek	24	10			1	4	1	2			2			54		1				2		6	
Fish Creek	27	2	27					1	3					18			1	2	9			22	1
Ohanapecosh Woods	27				1						1			2								2	
Stevens Canyon																							
Entrance Station																							
Woods	27	4	1								7			12		5						1	
White River	27				4	1								40		2						5	2
West Fork of																							
White River	28				3	2								46			1					2	
Nickel Creek	30	1	2		2						8			18				4				2	
Deadwood Creek	32				4	1					3			26		8	2						
N. Fork																							
Puyallup (s)	35		1								7			15		21							

(continued on next page)

Table 5. (continued)

Site	Elevation (hundred feet)	<u>Sorex cinereus</u>	<u>Sorex trowbridgii</u>	<u>Sorex vagrans</u>	<u>Sorex obscurus</u>	<u>Sorex palustris</u>	<u>Sorex bendirii</u>	<u>Neotrichus gibbsii</u>	<u>Ochtona princeps</u>	<u>Eutamias amoenus</u>	<u>Eutamias townsendii</u>	<u>Glaucomys sabrinus</u>	<u>Thomomys talpoides</u>	<u>Peromyscus maniculatus</u>	<u>Neotoma cinerea</u>	<u>Clethrionomys gapperi</u>	<u>Phenacomys intermedius</u>	<u>Microtus oregoni</u>	<u>Microtus richardsoni</u>	<u>Microtus townsendii</u>	<u>Microtus longicaudus</u>	<u>Zapus trinotatus</u>	<u>Mustela erminea</u>
N. Fork																							
Puyallup (n)	35	1			1						4			18		4				12		18	2
Van Trump Creek	37	1	2								6			56		32			6	6		10	1
Canyon Bridge	40	1	12		2			3	1		7			54		4		8		7		20	
Stevens Creek	40										1			16								3	
Round Pass	40			3							24			13		19						1	
Tunnel	42													1				1				1	
Ricksecker Point	42		3					1			20	2		19		12							
Mt. Meadows	42	1	7					4			1			16		17			3			5	1
White River																							
Campground	43		3	10	3			2			5			19		3			1			20	1
Klapatche Point	43													4				2					
Bench Lake	46									4	2			3					1			34	
Cayuse Pass	46		1								1			14		11			2			12	
Lake Louise	47										8			16			1					29	
Reflection Lake	48		1							2	26			7		6			1			7	
Yakima Peak Burn	48													11									
Mowich Lake	50		5		3			2	2		4			5	1	38					1		
Winthrop Glacier																							
Outwash	50		1							1				19									

(continued on next page)

Table 5. (continued)

Site	Elevation (hundred feet)	<u>Sorex cinereus</u>	<u>Sorex trowbridgii</u>	<u>Sorex vagrans</u>	<u>Sorex obscurus</u>	<u>Sorex palustris</u>	<u>Sorex bendirii</u>	<u>Neotrichus gibbsii</u>	<u>Ochotona princeps</u>	<u>Eutamias amoenus</u>	<u>Eutamias townsendii</u>	<u>Glaucomys sabrinus</u>	<u>Thomomys talpoides</u>	<u>Peromyscus maniculatus</u>	<u>Neotoma cinerea</u>	<u>Clethrionomys gapperi</u>	<u>Phenacomys intermedius</u>	<u>Microtus oregoni</u>	<u>Microtus richardsoni</u>	<u>Microtus townsendii</u>	<u>Microtus longicaudus</u>	<u>Zapus trinotatus</u>	<u>Mustela erminea</u>
Crater Creek	50		3	6	2		2			6	1		50	38					1			6	
Mowich Meadows	50		8							1				1	3	2							
Sunset Lakes	50		1						2	17					3	2	3						
Winthrop Glacier moraine	51		2	2										8									
Creek Road to Sunrise	52	1		2	3		4							9	4	1			1			5	
Sunset Park	52			5	10		1	2	13	1				1	1		3	2	2				
Mystic Lake Patrol Cabin	53		3	13	4	1								14	10	2	10	2				3	
Sidehill Woods	53			1							7	2		1	2								
Eleanor Trail	53				2					1				4	22	2			1				
Ipsut Pass	53													1	5								
Indian Bar	55			1	1	1				2				1	1	2	2	3				13	
Grand Park	56				2					3				1	5	3	1						
Grand Pk. Creek	56		1		6									6	6	2							
Mystic Lake	57				4					1	2			8	14	1	6					2	

(continued on next page)

Table 5. (continued)

Site	Elevation (hundred feet)	<u>Sorex cinereus</u>	<u>Sorex trowbridgii</u>	<u>Sorex vagrans</u>	<u>Sorex obscurus</u>	<u>Sorex palustris</u>	<u>Sorex bendirii</u>	<u>Neurotrichus gibbsii</u>	<u>Ochotona princeps</u>	<u>Eutamias amoenus</u>	<u>Eutamias townsendii</u>	<u>Glaucomys sabrinus</u>	<u>Thomomys talpoides</u>	<u>Peromyscus maniculatus</u>	<u>Neotoma cinerea</u>	<u>Clethrionomys gapperi</u>	<u>Phenacomys intermedius</u>	<u>Microtus oregoni</u>	<u>Microtus richardsoni</u>	<u>Microtus townsendii</u>	<u>Microtus longicaudus</u>	<u>Zapus trinotatus</u>	<u>Mustela erminea</u>
Tipsoo Lake	58				2					7	8			3		1		1				2	
Subalpine Woods (Sunrise)	58				1	1				4	3			6		3	2	3				5	
Ohanapecosh Park	60				1					1			1			2	2					6	
Yakima Park	63									11	1			3		2						1	
Panhandle Gap	65									1				1									
Colonnades	70			1						3				16			6	4				1	1
Number of trap sites at which this species was present		1	12	25	22	9	2	12	5	13	30	3	1	48	1	32	16	16	12	6	2	40	9

Table 6. Yearly comparison of population numbers and percent by species for the random trap lines.
Percentage figure given is the proportion represented by that species for that year.

Species	1966		1967		1968		Totals	
	No.	%	No.	%	No.	%	No.	%
<u>Sorex vagrans</u> and <u>S. obscurus</u>	99	9%	78	11%	35	7%	211	9.6%
<u>Sorex trowbridgii</u>	14	1%	15	2.5%	5	1%	34	1.5%
<u>Neurotrichus gibbsii</u>	15	1.2%	5	1%	6	1%	26	1.1%
<u>Eutamias amoenus</u>	18	1.5%	7	1.5%	30	6.5%	55	2.4%
<u>Eutamias townsendi</u>	157	15%	18	3%	53	11%	228	10.3%
<u>Peromyscus maniculatus</u>	326	30%	488	58%	133	28%	847	38.3%
<u>Clethrionomys gapperi</u>	216	20%	89	18%	34	7%	319	14.4%
<u>Phenacomys intermedius</u>	11	1%	13	2.5%	8	1.5%	32	1.4%
<u>Microtus oregoni</u>	40	3.7%	3	.5%	12	2.5%	55	2.4%
<u>Microtus richardsoni</u>	13	1%	3	.5%	8	1.5%	24	1%
<u>Microtus townsendi</u>	13	1%	14	2.5%			27	1.2%
<u>Zapus trinotatus</u>	104	10%	21	3%	141	29.5%	226	10%
Other	47		24		12		84	3.7%
Totals	1,073		658		477		2,208	
Trap nights	13,822		9,800		10,118		33,740	
Animals /trap night	0.07		0.067		0.047			

section of the park and no effort was made to trap the same type or number of habitats each year, it would be erroneous to derive population trends from this table alone.

Permanent Lines

At seven different locations in the park, permanent trapping lines were established and operated once each year for the duration of the study. These lines represented a control which was used to determine yearly population variations and species composition as it varies with elevation. The lines varied in elevation from 1900 feet at Ohanapecosh to 7000 at Freemont Lookout. The permanent lines were established after the method described and used by Calhoun in the North American Census of Small Mammals (4). All lines were operated by park staff personnel for 10 nights, as nearly as possible at the same time. Table 7 is a summary of the trap site information for each of the permanent lines. Due to a shortage of staff in 1967, the Carbon River area was not trapped that year. A total of 19,800 trap nights yielded 1215 animals.

Table 8 is a presentation of trapping results from the permanent lines. Each number represents the total for all three years of trapping.

Table 9 is a summary by genera of the total number of individuals captured each year with the percent that genus contributed to the total population for each year.

Table 7. Permanent trap lines: Trapping site, elevation, life zone, total trap nights, total numbers, and number of species captured.

Site	Elevation	Life Zone	Trap nights			Number of animals			Species		
			1966	1967	1968	1966	1967	1968	1966	1967	1968
Ohanapecosh	1900 ft.	H. T.	1000	1000	1200	90	97	56	8	7	8
Carbon River	2000 ft.	H. T.	1000		1000	77		64	7		7
Longmire	2600 ft.	H. T.	900	1000	1000	72	141	32	7	5	5
Lake James	4500 ft.	L. Hud.	700	1000	1000	74	162	104	7	8	6
Sunset Lookout	5500 ft.	Hud.	1900	1000	1000	32	40	7	6	5	3
Shriner Peak	5800 ft.	Hud.	900	1000	900	32	40	14	8	6	4
Freemont	7000 ft.	A. A.	1000	1300	1000	34	36	13	4	4	4
Totals			6400	6300	7100	411	514	290			

Table 8. Trapping records for permanent trap lines: Summary by species for all three years.

Site	Elevation (in 100 feet)	<u>Sorex</u> <u>trowbridgii</u>	<u>Sorex</u> <u>vagrans</u>	<u>Sorex</u> <u>obscurus</u>	<u>Sorex</u> <u>palustris</u>	<u>Sorex</u> <u>species</u>	<u>Neurotrichus</u> <u>gibbsii</u>	<u>Ochotona</u> <u>princeps</u>	<u>Eutamias</u> <u>amoenus</u>	<u>Eutamias</u> <u>townsendii</u>	<u>Peromyscus</u> <u>maniculatus</u>	<u>Neotoma</u> <u>cinerea</u>	<u>Clethrionomys</u> <u>gapperi</u>	<u>Phenacomys</u> <u>intermedius</u>	<u>Microtus</u> <u>oregoni</u>	<u>Zapus</u> <u>trinotatus</u>	<u>Mustela</u> <u>erminea</u>	
Ohanapecosh	19	23	5	3	2	13	21			7	142		23			4		243
Carbon River	20	4		4	1	15	5			4	88		1			17	1	140
Longmire	26	26	9	4	*		22			36	152		5					254
Lake James	45	18	4	3			6	2		1	165	1	80	1	14	45		340
Sunset	55		4	3		5		3	31	1	16			13	3			79
Shriner Peak	58	1	7				1		10	1	46		4	7	8	2		87
Freemont Lookout	70		1			2		2	24		48					5		82
Totals		68	30	17	3	35	55	7	65	50	657	1	113	21	25	73	1	1225

* Collected during winter trapping, but not during regular summer trapping.

Table 9. Permanent lines: Yearly breakdown of trapping records, indicating number of individuals of each genus captured.

	<u>Sorex</u>			<u>Neotrichus</u>			<u>Eutamias</u>			<u>Peromyscus</u>			<u>Clethrionomys</u>			<u>Microtus</u>			<u>Zapus</u>			<u>Other species</u>			<u>Totals</u>		
	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68
Ohanapecosh																											
Number	15	15	16	7	12	2	3	2	2	48	66	28	17	2	4				0	0	4				90	97	56
Percent	17	15	24	8	12	3	3	2	3	53	68	41	19	2	6						6						
Longmire																											
Number	18	8	14	9	11	2	10	24	2	34	98	10	1	0	4										72	140	32
Percent	25	6	44	12	8	6	14	17	6	47	70	31	1		12												
Lake James																											
Number	11	11	3	6					1	24	100	41	18	24	38	3	2	11	11	24	10	1	1		74	162	104
Percent	15	17	3	8					1	32	62	39	24	15	37	4	1	11	15	15	10	1	1				
Sunset Lookout																											
Number	4	7	1				17	10	5	0	16	0				3						8	7	1	32	40	7
Percent	13	18	14				53	25	72		40					9						25	18	14			
Shriner Peak																											
Number	4	3	1	1			7	4		12	24	9	4			5		3		1	1		7		32	40	14
Percent	13	8	7	3			22	10		38	60	64	13			16		21		3	7		17				
Freemont Lookout																											
Number	2		1				17	2	5	14	32	2								5		1	1		34	35	13
Percent	6		8				50	6	38	41	91	15								38		3	7				
Totals	54	44	36	22	24	4	54	42	15	132	336	90	40	26	46	11	2	14	11	25	20	10	16	1	334	514	226
Percent	16	9	16	7	5	2	16	8	7	40	65	40	12	5	20	3	13	6	.3	5	9	3	3	.4			

Table 10 is a comparison of the random line results with the permanent line results, showing both number of individuals of each genus captured and the percent of the population contributed by that genus.

Winter Trapping

For two winters, 1966-67 and 1967-68, one weekend each month was spent in the field collecting small mammals and making observations of winter activities of the mammals in the park. The sites trapped during the winter were the same areas that were sampled during one of the summer research periods. Table 11 is a summary of the trapping data from the winter months. A total of 3600 trap nights yielded 298 specimens. In such short-term trapping periods, deer mouse populations are often exaggerated due to the readiness with which this species enters traps, while other species such as the shrew-mole, various shrews, and some of the voles will appear to be absent or in very small numbers when in reality their population is much higher than indicated from two nights trapping.

Table 10. Number and percentage comparison of results from permanent lines and from random lines. Each percentage figure is the proportion of that genus caught in that year.

	<u>Sorex</u>			<u>Eutamias</u>			<u>Peromyscus</u>			<u>Clethrionomys</u>			<u>Microtus</u>			<u>Zapus</u>		
	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68	66	67	68
<u>Permanent lines, totals</u>																		
Number	54	44	36	54	42	15	132	336	90	40	25	46	11	2	14	11	25	20
Percent	16%	9%	16%	16%	8%	7%	40%	65%	40%	12%	5%	20%	3%	3%	.4%	3%	5%	9%
<u>Random lines, totals</u>																		
Number	113	93	40	175	25	83	326	488	133	216	89	34	66	20	28	104	21	141
Percent	10%	14%	8%	17%	5%	18%	30%	58%	28%	20%	18%	7%	6%	4%	6%	10%	3%	29%

Table 11. Results of winter trapping: Sites, dates, trap nights, number of each species caught, and totals.

Site	Month	Trap nights	<u>Sorex vagrans</u>	<u>Sorex obscurus</u>	<u>Sorex palustris</u>	<u>Neurotrichus gibbsii</u>	<u>Eutamias townsendi</u>	<u>Peromyscus maniculatus</u>	<u>Clethrionomys gapperi</u>	<u>Phenacomys intermedius</u>	<u>Microtus oregoni</u>	<u>Microtus richardsoni</u>	<u>Microtus townsendi</u>	<u>Zapus trinotatus</u>	Totals
<u>1966-1967</u>															
Reflection Lakes	Sept.	200					5	4	2	1		6		3	21
Van Trump Creek	Sept.	200						12	10			3	2		27
Mt. Meadows	Oct.	200			1			2						3	6
Lee Creek	Oct.	300	2		1			4	6			12		2	27
Fish Creek	Nov.	200	1		4	1		6			1	2			15
West Side Road	Dec.	200	2			1		9							12
Kautz Mudflow	Jan.	200	3	1					7						11
Longmire	Feb.	100	3					7	2						12
West Side Road	Mar.	200	2					9	2				1		14
Longmire	Apr.	200	1					20	1						22
Kautz Mudflow	May	200						15							15
Totals		2200													182

(Continued on next page)

[illegible]

DISCUSSION AND ANALYSIS

The relationship of mammals to their environment is a very complex one and it is difficult to relate all factors at one time. In order to facilitate a discussion of the ecology of the mammals, the discussion has been divided into three major sections: a) analysis of trapping data, b) a species-by-species account of all mammals found in Mount Rainier National Park, and c) a discussion of the mammals according to their occurrence by life zone. To avoid possible inconsistencies in common names, all names used in this discussion have been taken from the list found in Table 12 (page 51).

Analysis of Trapping Data

Random Lines

From the data recorded in Table 6, one can see that the deer mouse, Peromyscus, was the most abundant of the small mammal species. The deer mouse contributed 38% to the total population; far more than any other species. Other mammals which contributed significantly to the population were Clethrionomys gapperi, 14%; Eutamias townsendi, 10.3%; Zapus trinotatus, 10.1%; and the two common shrews, Sorex vagrans and S. obscurus, 9.6%. The rest of the species each contributed less than 3% of the population, although some of these had local areas of high populations, such as the yellow-

pine chipmunk and the Trowbridge shrew.

Of the 50 sites trapped during this phase, the deer mouse occurred at 48, the jumping mouse at 40, the red-backed vole at 32, the Townsend chipmunk at 30, the vagrant shrew at 24, and the dusky shrew at 22. The deer mouse is not only the most common but also is the most widespread of the small mammals (Table 5).

The list of sites in Table 5 is by elevation and some general elevational preferences are noticeable for a few of the species. For example, the Trowbridge shrew shows a definite preference for lower elevations. The Townsend chipmunk, although present at some of the higher elevations, has a higher population at low and middle elevations. On the other hand, the yellow-pine chipmunk shows a decided preference for high elevations on Mount Rainier. Other more subtle differences are noticed in actual field observations, and many of these will be discussed in the account by species. Some of the mammals, such as the pika, mantled ground squirrel, flying squirrel, pocket gopher, and woodrat are more abundant than trapping records alone indicate. Certain mammals are more trap-prone than others and these data alone are often not enough to determine relative abundance.

Permanent Lines

The permanent lines were selected in part for a comparison of the higher elevations with the lower, and most of the sites are found

either in the Humid Transition or the Hudsonian Life Zones. From the permanent lines several interesting aspects of small mammal populations are readily apparent. From Table 7 one can see that at lower elevations small mammal populations are larger than at the higher elevations. At lower elevations, the sites each demonstrated a total population of over 200 animals. However, above 5000 feet, the sites all produced less than 100 specimens. With some exceptions, results from the random sites sampled during the summer indicated this same tendency; i. e., lower over all populations at higher elevations, but the variety of species remains about the same. There are about the same number of species represented at high elevations as at low elevations, although the species composition may vary. It appears that the decrease in numbers at higher elevations is due to a decrease in the size of the populations rather than to a decrease in the number of species.

The relationship between the two chipmunks is also easily observed from Table 8. The Townsend chipmunk is the common form at low elevations and is often still present at middle elevations, but in very low numbers. The yellow-pine chipmunk is seldom found below 3500 feet, but becomes the most abundant of the two in the Hudsonian Life Zone.

Since only seven areas were sampled in this phase of the study, all habitat types were not included. Thus, although the water shrew

appears to be found only at low elevations (Table 8), in reality it is found into the Arctic Alpine. This is due to the fact that the sites at the higher elevations were not located along permanent streams and the water shrew does not venture far from water.

The permanent lines also demonstrate a high population of deer mice. With reference to this population, Table 9 indicates a dramatic variation from year to year. In looking at the total number of individuals taken each year, this population jumped from 132 individuals (40%) in 1966 to 336 individuals (65%) in 1967, and then dropped back to 90 individuals (again 40%) in 1968. Over all populations were lowest in 1968. When deer mouse populations were high in 1967, the only other species which also demonstrated a slight raise was the jumping mouse. Most of the other species either remained static or dropped off slightly. An interesting situation existed at Sunset Lookout (5500 feet). In 1966 and 1968, no deer mice were collected at this station. This is at higher elevations and is a rather open habitat that burned about 30 years previously. There is little brush and the few trees present are quite small. In the year of the high deer mouse population, this site produced 16 individuals. This is probably an indication of an attempt at range expansion into unfavorable habitat since in the year following no individuals were recorded for this area.

It would appear from these data that a typical population cycle occurred during this study; that populations built up in 1967 and fell

in 1968. The species most effected was the deer mouse but shrews, shrew-moles, and chipmunk numbers also were down.

In comparing the random site totals with those from the permanent lines, there is fair correlation between the percentages captured. During the random field work, the number of trap nights varied each year, and thus the percentage figure is more significant than is the total number captured. Table 10 shows a percentage increase in deer mice in 1967 and a similar decrease in 1968.

Winter Trapping

During the winter, only two consecutive nights of data were obtained and thus these data are but an indication of mammals present. From Table 11, 13 species were captured during the winter. The chipmunk, Eutamias townsendi, and the jumping mouse are both hibernating species. The chipmunk will arouse and become active but I have no trap records after September. The jumping mouse seems to enter hibernation in October and I have no records until the following June, although I would expect this species to be active before that time. There is only one road open during the winter months and the selection of trapping sites is very limited. In addition, by November most sites even at low elevations have a snow cover and it is impossible to set traps near the ground where most of the small mammal activity is found. These results are very sketchy, but some

information of value was recorded.

Account by Species

Mammals of Mount Rainier National Park

Table 12 is a listing of the mammalian species found in and near Mount Rainier. The table is in two parts, the first including those species which were either observed or trapped in the past few years. The second part of the list contains those species which fall into one of the two categories: 1) Species formerly present but not observed in recent years, and 2) species which have never been reported from the park but whose range is such that they may be found in the future.

Species Trapped or Observed in Mount Rainier National Park

The following section is an account of all species of mammals known to be present in Mount Rainier National Park. It is followed by a similar account of mammals which (a) were formerly present and are now extinct, or (b) species which may expand their range into Mount Rainier.

Sorex cinereus (masked shrew). This shrew is extremely rare in the park. From three summers of intensive field work only one specimen was captured. This individual was found at 5200 feet on the east side of the park. The habitat was in Hudsonian woods on a steep slope where water seepage formed a mesic, mossy environment.

Table 12. Taxonomic list of mammals of Mount Rainier National Park.

<u>Mammals trapped or observed in Mount Rainier National Park</u>	
<u>Sorex cinereus</u> Kerr	Masked shrew
<u>Sorex trowbridgii</u> Baird	Trowbridge shrew
<u>Sorex vagrans</u> Baird	Vagrant shrew
<u>Sorex obscurus</u> Merriam	Dusky shrew
<u>Sorex palustris</u> Richardson	Water shrew
<u>Sorex bendirii</u> (Merriam)	Marsh shrew
<u>Neurotrichus gibbsii</u> (Baird)	Shrew-mole
<u>Scapanus townsendii</u> (Bachman)	Townsend mole
<u>Scapanus orarius</u> True	Coast mole
<u>Myotis yumanensis</u> (H. Allen)	Yuma myotis
<u>Myotis volans</u> (H. Allen)	Hairy-winged myotis
<u>Lasionycteris noctivagans</u> (LeConte)	Silver-haired bat
<u>Eptesicus fuscus</u> (Palisot de Beauvois)	Big brown bat
<u>Lasiurus cinereus</u> (Palisot de Beauvois)	Hoary bat
<u>Plecotus townsendii</u> Cooper	Lump-nosed bat
<u>Ochotona princeps</u> (Richardson)	Pika
<u>Lepus americanus</u> Erxleben	Snowshoe hare
<u>Aplodontia rufa</u> (Rafinesque)	Mountain beaver
<u>Marmota caligata</u> (Eschscholtz)	Hoary marmot
<u>Callospermophilus saturatus</u> (Rhoads)	Cascades golden-mantled ground squirrel
<u>Eutamias amoenus</u> (J. A. Allen)	Yellow-pine chipmunk
<u>Eutamias townsendii</u> (Bachman)	Townsend chipmunk
<u>Tamiasciurus douglasii</u> (Bachman)	Douglas squirrel, chickaree
<u>Glaucomys sabrinus</u> (Shaw)	Northern flying squirrel
<u>Thomomys talpoides</u> (Richardson)	Northern pocket gopher
(Continued on next page)	

Table 12. (continued)

<u>Castor canadensis</u> Kuhl	Beaver
<u>Peromyscus maniculatus</u> (Wagner)	Deer mouse, white-footed deer mouse
<u>Neotoma cinerea</u> (Ord)	Bushy-tailed woodrat
<u>Clethrionomys gapperi</u> (Vigors)	Gapper red-backed mouse
<u>Phenacomys intermedius</u> Merriam	Heather vole
<u>Microtus oregoni</u> (Bachman)	Oregon meadow mouse, Oregon vole
<u>Microtus richardsoni</u> (DeKay)	Water rat, water vole
<u>Microtus townsendii</u> (Bachman)	Townsend meadow mouse, Townsend vole
<u>Microtus longicaudus</u> (Merriam)	Long-tailed meadow mouse
<u>Zapus trinotatus</u> Rhoads	Pacific jumping mouse
<u>Erethizon dorsatum</u> (Linnaeus)	Porcupine
<u>Canis latrans</u> Say	Coyote
<u>Vulpes fulva</u> (Desmarest)	Red fox
<u>Euarctos americanus</u> Pallas	Black bear
<u>Procyon lotor</u> (Linnaeus)	Raccoon
<u>Martes americana</u> (Turton)	Marten
<u>Mustela erminea</u> Linnaeus	Ermine
<u>Mustela frenata</u> Lichtenstein	Long-tailed weasel
<u>Mustela vison</u> Schreber	Mink
<u>Spilogale putorius</u> (Linnaeus)	Spotted skunk
<u>Felis concolor</u> Linnaeus	Mountain lion
<u>Lynx rufus</u> (Schreber)	Bobcat
<u>Cervus canadensis</u> (Erxleben)	Canadian elk
<u>Odocoileus hemionus</u> (Rafinesque)	Mule deer
<u>Oreamnos americanus</u> (Blainville)	Mountain goat

(continued on next page)

Table 12. (continued)

<u>Additional mammals which have uncertain status</u> <u>in Mount Rainier Park at present time</u>	
<u>Didelphis marsupialis</u> Linnaeus	Common opossum
<u>Myotis lucifugus</u> (LeConte)	Little brown myotis
<u>Myotis evotis</u> (H. Allen)	Long-eared myotis
<u>Myotis californicus</u> (Audubon and Bachman)	California myotis
<u>Sylvilagus floridanus</u> (J. A. Allen)	Eastern cottontail
<u>Otospermophilus beecheyi</u> (Richardson)	Beechey ground squirrel
<u>Ondatra zibethica</u> (Linnaeus)	Muskrat
<u>Rattus norvegicus</u> (Berkenhout)	Norway rat
<u>Mus musculus</u> Linnaeus	House mouse
<u>Canis lupus</u> Linnaeus	Wolf
<u>Martes pennanti</u> (Erxleben)	Fisher
<u>Gulo luscus</u> (Linnaeus)	Wolverine
<u>Lutra canadensis</u> (Schreber)	River otter
<u>Mephitis mephitis</u> (Schreber)	Striped skunk

Dalquest (6, p. 133) also reports one record from Mount Rainier, a specimen captured near Paradise also in the Hudsonian life zone.

Sorex trowbridgii (Trowbridge shrew). The Trowbridge shrew is typically found in the forested sections of the Humid Transition and Lower Canadian Life Zones, to about 4000 feet. It normally prefers the mesic habitats under heavy forests or along stream borders, but will occasionally be found around logs and brush in meadows. More specimens were collected on the west side of the park than on the east side. The shrews normally are confined to the forest floor and seldom venture above the floor on top of logs or other debris. On many occasions traps were placed in such a manner that one trap would be on a log or stump and another immediately beneath that same log. The trap on the log would capture chipmunks, deer mice, and an occasional red-back vole, but not shrews or shrew-moles. The trap beneath the log would not only capture the chipmunks and mice, but also the shrews and shrew-moles.

Sorex vagrans (vagrant shrew, wandering shrew). The vagrant shrew and the dusky shrew are the two most numerous shrew species in the park. They are difficult to identify and in the field total length proved to be the most useful method. The vagrant shrew is found from park boundaries to the upper limits of the Hudsonian. Specimens were taken from Sunrise (6000 feet) and Indian Bar (5500 feet). This insectivore is more common on the western slopes of the park and

reaches its highest numbers at moderate elevations, along streams or other mesic areas. Although this shrew prefers the moister habitats, it is found in small numbers in some of the xeric habitats such as morraines and talus slopes, and seems to have a wider habitat tolerance than other shrews found in the park. Shrews are normally considered as being nocturnal, but I have on several occasions encountered them during daylight hours. At Round Pass I was checking traps one morning about 9:00 a. m. and heard a trap snap. Upon checking the trap, a vagrant shrew was found.

Sorex obscurus (dusky shrew). The range and distribution of the dusky shrew and vagrant shrew greatly overlap. The dusky shrew is found up to about 6000 feet, but greatest numbers occur in the more mesic habitats of the Transition and Canadian Life Zones. This species is not as adaptable as the vagrant shrew and is not usually found in the dryer habitats. However, it is more frequently found in the Hudsonian woods than is the vagrant shrew. All shrews remain active during the winter and specimens were taken during all winter months.

Sorex palustris (water shrew, mountain water shrew). This amazing shrew is seldom found more than a few feet from water. Dalquest (6, p. 142), Ingles (11, p. 94), and others report that this shrew is common along mountain lakes in the Hudsonian and Canadian Life Zones. I attempted to trap this species along several lakes,

including Reflection Lakes, Mowich Lake, and Lake Louise, but none was captured in this habitat. The water shrew can be found along almost any stream from park boundaries on up into the Hudsonian. Taylor and Shaw (25, p. 33) report that this animal may be found as high as 8000 feet, and I have captured them near 6000 feet at Indian Bar. One individual was captured from a stream about 300 yards below the point where it emerged from beneath a glacier. This animal is also active during the daylight hours. At St. Andrew's Creek, I removed a partly eaten water shrew from a snap trap at the edge of the stream. I had scarcely gone 20 feet when the trap snapped, and upon returning I found another water shrew. Apparently, the second shrew had been feeding upon the first.

Sorex bendirii (marsh shrew, Bendire water shrew). The marsh shrew is rather uncommon in Mount Rainier. I secured only two specimens, one from a marsh near the Stevens Canyon Entrance Station (2200 feet) and the other along a stream passing through dense woods at the West Side Road Junction (2200 feet). Taylor and Shaw (25, p. 34) reported three captures, from Longmire (2700 feet), Ohanapecosh Hot Springs (2000 feet), and Mountain Meadows (4000 feet). The animal is restricted to moist meadows and the mesic borders along streams at lower elevations. It is primarily a Transition Life Zone species, occasionally being found in the Lower Canadian.

Neurotrichus gibbsii (shrew mole, Gibbs shrew mole). The

shrew-mole is found throughout the park in the Transition and Canadian Life Zones. Rarely does it occur in large numbers and are reluctant to enter traps. Often traps must be left for a week or more before the shrew-mole will begin entering them. The shrew-mole prefers mesic woods and stream borders and is seldom found in zeric habitats. The highest elevational records I have are from Sunset Valley at 5200 feet and Shriner Lookout at 5800 feet.

Scapanus townsendi (Townsend mole). The Townsend mole is not common in the park and is probably restricted to the west side. In general, habitat in the park is not well suited for the moles except in the meadows at higher elevations, and in the lawns around Longmire. Taylor and Shaw (25, p. 28) captured one specimen from Spray Park at 5500 feet.

Scapanus orarius (coast mole). This mole seems to be more widespread than the Townsend mole and may occur throughout the park in suitable habitat. One animal was observed at the Carbon River Entrance Station 1967 (2000 feet) and workings were observed at Longmire. Taylor and Shaw (25, p. 28) report collecting one specimen from Longmire (2700 feet) and another at Owyhigh Lakes (5100 feet). Since most of the suitable meadows are at higher elevations in the Upper Canadian and Hudsonian, the bulk of the population will probably be found at higher elevations in Mount Rainier.

Myotis yumanesis (dark yuma bat). The Biological Survey collected one specimen of this species from Sunset Park (5000 feet) in 1919 (25, p. 36). This individual was observed over an alpine meadow, feeding on flying insects. Bats are quite common at this elevation, and

no doubt additional collecting will reveal a much wider distribution in the park.

Myotis volans (hairy-winged myotis). Two specimens of this species were collected by the Biological Survey in 1919. One individual was collected at Longmire (2600 feet) and the other at St. Andrews Park (5000 feet) (25, p. 36).

Lasionycteris noctivagans (silver-haired bat). Only one record of this species has been taken from the park, collected by the Biological Survey in 1919. It was taken from Sunset Park (5000 feet). This bat, too, is no doubt more numerous than the records indicate.

Eptesicus fuscus (big brown bat). This species is found primarily at lower elevations in the Transition and Canadian Life Zones. I collected several specimens along the Ohanapecosh River as they traveled to and from feeding areas. This bat appears to be fairly common during the summer months, but may leave the park during winter months.

Lasiurus cinereus (hoary bat). This bat is found at the low and middle elevations. I secured one specimen along the Ohanapecosh River where it was flying near and above the canopy.

Plecotus townsendi (lump-nosed bat). One specimen was reported from Longmire by Potts and Grater (20, p. 62). Mount Rainier is marginal habitat for this species and it no doubt occurs only at low elevations and probably in very small numbers.

Ochotona princeps (pika, rock rabbit). This inhabitant of the Canadian, Hudsonian and Lower Arctic Alpine Life Zones is normally

found around rock and talus slopes. Although occasionally extending into suitable habitats in the Transition Zone, it is more typical of the higher elevations, extending up to 8000 feet. Since the preferred habitat of this species is around rock outcrops, it is seldom observed in forested areas. Its nasal call is familiar to hikers as they pass the pika's retreat in the rocks. The pika is active throughout the winter, and exists on the vegetation stored in its well known "haystacks." In January of 1967 while snowshoeing in the Nisqually Canyon, I found pika sign around some exposed rocks. Tracks and droppings were very numerous and an opening in the snow along the side of one of the rocks provided the route from the surface of the snow to the ground below.

Lepus americanus (snowshoe hare, varying hare). In Mount Rainier National Park two distinct subspecies are found. At lower elevations, L. americanus washingtoni is found. This subspecies does not assume the white winter coat and will remain brown in winter. This form is found from park boundaries, especially on the west side, extending to the Upper Transition. At the higher elevations of the Canadian and Hudsonian, L. americanus canadensis is found. This subspecies assumes the white winter coat and I have collected it in white pelage from Ricksecker Point (4200 feet). Potts and Grater (20, p. 47) believe the elevational boundary between the two subspecies is about 3000 feet. Considerable confusion exists with reference to the subspecific status and more information is needed. In general, the snowshoe hare is found from park boundaries up to the Hudsonian Life Zone. In the past few years, the population has not been high but tracks in the

snow could easily be found. The animal normally remains in or near wooded portions of the park, but will venture into the meadows to feed.

Alplodontia rufa (mountain beaver). The mountain beaver is a colonial animal, living in rather extensive burrow systems. I have found only a few active burrow systems, all in and around Stevens Canyon between 2300 and 3500 feet. At Carbon River there is an abandoned burrow system and just outside the park along the West Fork of the White River there are several active colonies. No doubt there are more systems at low elevations along the west side of the park. Taylor and Shaw (25, p. 84) located a colony along Paradise Creek at 5200 feet, and feel that they may extend to the Hudsonian at around 6000 feet. Normally, the mountain beaver is a Transition and Canadian Life Zone species, where they dig extensive tunnel systems wherever suitable soil and food conditions exist. They cut vegetation such as ferns, salmonberry, and salal and haul it to the burrow's entrance where piles of vegetation can often be observed. Usually the individual piles will be of one species of plant, but different entrances may have different plants. They are usually found in areas of dense vegetation, most often near mesic draws where herbaceous and deciduous growth is available for food.

Marmota caligata (Cascade hoary marmot, whistling marmot). The marmot is typically found from the Upper Canadian Life Zone above 4000 feet to 10,000 feet. This mammal prefers the rock slopes and open meadows where it often is seen basking on a rock in the sun.

The marmot is a hibernator and begins his sleep early in the fall when the snows begin to cover the higher slopes, perhaps as early as late September. An animal I collected in late August had a very thick layer of fat over the hips and flanks.

Callospermophilus saturatus (Cascades golden-mantled ground squirrel). This is the only ground squirrel found in Mount Rainier National Park and is primarily found in the Canadian and Hudsonian Life Zones. I have observed them as low as the Box Canyon (3100 feet) and as high as Mount Freemont (7200 feet). This animal prefers the dry open forests and broken meadows. It is more common on the eastern slopes of the park due to its preference for dry country. When found on the west side it is normally at higher elevations. It has an upper range on the mountain of between 8000 feet and 9000 feet.

Eutamias amoenus (yellow pine chipmunk). The yellow pine chipmunk makes its home in the open forests and meadows of the Canadian and Hudsonian Life Zones. This chipmunk avoids deep woods and by nature is quite nervous. In the mixed meadow-woods typical of the lower Hudsonian the Townsend chipmunk and yellow pine chipmunk are often found feeding in the same area. At higher elevations, the yellow pine chipmunk becomes more numerous, while at lower elevations the Townsend chipmunk is the most common chipmunk. Both chipmunks and the mantled ground squirrel have points of concentration where park visitors add peanuts and popcorn to their

natural food supply.

Eutamias townsendi (Townsend chipmunk). This chipmunk is larger and darker than the yellow pine and is more commonly found in the wooded areas at lower elevations. Although principally a Transition and Canadian Life Zone species, this animal does extend up into the Hudsonian. The chipmunks and ground squirrels are hibernating mammals and I have observed them in a state of torpor following a night's captivity in a live trap. The animals are usually in a ball-like position and if placed on a warm sunny log or rock, they will soon begin to stir and arouse from the torpor. Where the elevational ranges overlap between the two chipmunks, the Townsend chipmunk prefers the wooded areas, while the yellow pine chipmunk remains in or near the open meadows and parks.

Tamiasciurus douglasii (Douglas pine squirrel, chickaree). The chickaree is found from park boundaries throughout the forested portion of the park and has been observed venturing above tree line in the Arctic Alpine Zone. Taylor and Shaw (25, p. 100) observed this mammal at Steamboat Prow (8700 feet), Camp Curtis (9000 feet), and on Emmons Glacier (10,500 feet). The pine squirrel, as the name implies, utilizes the cones of the numerous conifers found in the park for food. Often a pile of scales from the cones can be observed around a log or other suitable perch. This animal is often seen in the winter months during periods of good weather.

Glaucomys sabrinus (Cascade flying squirrel). The flying squirrel is found throughout the park wherever coniferous trees are present, to about 5500 feet. Being a nocturnal animal, it is seldom observed by hikers and park visitors, but is actually quite common. I captured five animals from the forest floor in traps baited with peanut butter, and observed one animal gliding across a road at dusk.

Thomomys talpoides (northern pocket gopher). This species is found primarily above 4500 feet in the Upper Canadian and Hudsonian Life Zones. They prefer the dry sandy soil characteristic of the meadows at high elevations and are more numerous along the east slopes of the park. The pocket gopher is active under the snow during the winter, and evidence of this activity leaves an interesting pattern in the meadows. The animal forms tunnels in the snow just above ground line. Some of these tunnels are filled with excavated dirt and when the snow melts small ridges mark the location of the old tunnels. Being a burrowing mammal, soil conditions will tend to limit their distribution. This species prefers the meadows and will seldom venture into the clumps of trees in and near the meadows. At Grand Park I could not help but notice the effect of burrowing on the meadow vegetation. In areas of high pocket gopher activity the vegetation was covered with soil or the ground almost bare of any vegetation. In areas a short distance away lush meadow plants thrived. I suspect that pocket gopher activity has a great effect on plant succession in

these meadows. The pocket gopher does occasionally venture out of the burrows as a trap set for chipmunks at Ohanapecosh Park captured a pocket gopher.

Castor canadensis (beaver). The beaver is primarily found in the lower elevations of the park in the Transition and Canadian Life Zones up to about 4000 feet. There are several active dams in the park along the Nisqually, Ohanapecosh and White Rivers. No doubt other suitable rivers and streams also have beaver populations. Most of the glacier-fed rivers are not suitable for dam sites and the beaver is restricted to the small tributaries.

Peromyscus maniculatus (white-footed deer mouse). The deer mouse is found at all elevations in the park. Climbers have reported seeing this animal in their packs at Camp Muir (10,000 feet) and at Camp Curtis (9000 feet), as well as at the summit of the mountain (14,400 feet) (25, p. 63). Whether the animal is a resident there or has been carried up in climbers' packsacks is difficult to determine. Even though the strong winds keep large areas free of snow, there is little food. Although the deer mouse is widely distributed in the park there are certain habitats in all life zones which are avoided. The Hudsonian meadows are seldom invaded by the deer mouse, although in the woods surrounding the meadows this species will be encountered. At lower elevations, marshy areas are avoided. Thus the deer mouse appears to avoid mesic environments. Several variations have been

observed in pelage, a common variation being a white "blaze" on the forehead, and another being a white tip to the tail. There is also a difference in measurements between those animals living at low and high elevations. This species is considered trap prone and often more individuals of this species are taken than any other species. Evidence from the permanent lines operated over the three years of study demonstrate a cyclic tendency in this species. In 1967 the deer mouse population was considerably higher than in either 1966 or 1968. Such variations are quite typical. The trapping data indicate that this variation was found throughout the park and was an over all increase rather than a local one.

Neotoma cinera (bushy-tailed woodrat, packrat). Climbers and hikers along the Wonderland Trail often complain of being raided by this nocturnal animal. It appears to be more common in the Hudsonian Life Zone, but is found down to park boundaries and has been captured as high as Camp Muir at 10,000 feet (18, July 1931). At lower elevations the population is scattered, and they are not frequently encountered. They are fond of buildings at all elevations.

Clethrionomys gapperi (gapper red-backed mouse, red-backed vole). The red-backed mouse is found from lower elevations up into the Hudsonian Life Zone. Generally highest populations are found in dry woods, especially in the Upper Canadian and Lower Hudsonian. It is seldom found in meadows, but may be quite numerous in the

woods surrounding the meadows, where the red-back mouse population will often be higher than any other species. In the woods at lower elevations, populations are generally small. A climbing party found a red-back at Camp Misery (12,000 feet) (18, October 1930).

Phenacomys intermedius (heather vole). According to Dalquest (6, p. 339) and Taylor and Shaw (25, p. 67), the heather vole is characteristic of the Arctic Alpine and Hudsonian Life Zones, rarely being found below the Hudsonian. From my own field work, I have records of this animal as low as 2700 feet along Fish Creek. On Mount Rainier the upper limits of its range are around 8500 feet. This animal is characteristic of the meadows and open woods of the high elevations, being found under huckleberry and heather. At the lower elevations, I always found the animal, when present, immediately along the bank of a stream such as Deadwood Creek (3400 feet), West Fork (2800 feet), and Fish Creek (2700 feet). This species seldom comes to bait and most captures are accidental when the animal crosses the treadle of a snap trap. It will occasionally come to live traps baited with groats. Large mounds of feces, droppings of the heather vole, are often found in the higher meadows.

Microtus oregoni (Oregon vole, creeping vole). The Oregon vole is found from park boundaries to the Arctic Alpine Life Zone. Two distinct subspecies are found in Mount Rainier. The smaller of the two, M. oregoni oregoni is found from park boundaries to about

4000 feet, the Lower Canadian. This subspecies is found in small numbers in a wide variety of habitats. Wooded areas, stream borders, and seral stages are all used by the Oregon vole. The larger subspecies, M. oregoni cantwelli, is typically found above 4000 feet in the Upper Canadian, Hudsonian, and Lower Arctic Alpine Life Zones. Here the preferred habitat is the broken meadows and mesic streams passing through Hudsonian woods.

Microtus richardsoni (water rat, water vole). As the name implies, this vole is found along the waterways and marshes from park boundaries up into the Hudsonian Life Zone. Taylor and Shaw (25, p. 77) captured one individual of this species at Camp Muir (10,000 feet) far above any timber or meadow. This animal requires herbaceous growth, as do most of the voles, and it is an avid burrower, forming large runway systems along the streams, lakes, ponds, and marshes. Its burrows and trails often end at the water's edge and unbaited traps will capture it as they pass along the runways. The water vole is the largest North American vole and in Mount Rainier it is more common in the Hudsonian Life Zone where meadows are most commonly found.

Microtus townsendi (Townsend meadow vole). The Townsend vole is found in the Transition and Lower Canadian Zones along the west side of the park. The animals captured in this study were the first recorded for the park. Most specimens were taken from three locations:

the North Puyallup River (3550 feet), Nisqually Canyon (4000 feet), and Van Trump Creek (3900 feet). All of these habitats were moist areas with dense herbaceous and deciduous growth, including alder, salmonberry, and elderberry. There was a conspicuous absence of any canopy with very few coniferous trees present. Since this is the first record of this species in the park, it may well be a range extension up the valleys from the lowlands of the Puget Sound basin. All animals captured were taken from the west side but further expansion may eventually move this species to other parts of the park.

Microtus longicaudus (long-tailed meadow mouse). Little information is available regarding this animal as it relates to Mount Rainier. It is not very common, or if it is common, it is difficult to capture. Potts and Grater (20, p. 54) state that it is rarely found above 3000 feet. I have two records for this species, one from Carbon River (2100 feet) and the other from Mowich Lake (5000 feet). Both animals were taken in a mesic border near water where grasses and other herbaceous plants were available. After the Kautz mudflow of 1947, a study was undertaken to determine the reestablishment of small mammals into this area. In an unpublished report to Mount Rainier National Park, Johnson and Ostenson (14) report the capture of three long-tailed meadow mice. One was captured in the area of the mudflow and considered by these investigators as a migrant, and the other two came from an undisturbed area near a creek. From this

fragmentary information, it would appear that this animal is found occasionally and at lower elevations in the western portion of the park. This species is found in the same habitat as the Townsend vole and can easily be confused with it.

Zapus trinotatus (northwestern jumping mouse, Pacific jumping mouse). The jumping mouse is widely distributed in Mount Rainier and in certain locations very high populations occur. This animal extends to the Upper Hudsonian and Lower Arctic Alpine Life Zones. The jumping mouse avoids xeric habitats, preferring mesic stream borders and meadows, with areas of herbaceous and deciduous growth. Dry meadows and old burns are not normally inhabited by the jumping mouse and they likewise are not often found under the dense woods. This is a hibernating species and trapping data indicated that they hibernate by October. Considerable fat deposits can be found on these animals, especially in September.

Erethizon dorsatum (porcupine). In 1897 and 1919 when the Biological Survey made collecting expeditions into Mount Rainier, no evidence of the porcupine was found. The first record of the porcupine in Mount Rainier was in 1933 (20, p. 45) when an animal was observed near Paradise, and since then several observations have been made. I observed one along the West Side Road, about two miles from the North Puyallup River. The animal took refuge in a large rock pile and sign around the area indicated this was probably

the den area. In the Nisqually Canyon above the Canyon Bridge there were a number of 6-12 inch trees girdled by the porcupine. It appears that the porcupine has only recently invaded Mount Rainier and is in the process of expanding its range. Most sightings have been from the west side of the park but the animal will no doubt soon be found in all forested regions of the park.

Canis latrans (coyote). The yapping of a coyote at night may be the only indication a camper has of the presence of this animal, even though it appears to be quite common in the park. Most sightings of this animal come from higher elevations in the Hudsonian meadows. This is due in part to the better visibility in the open meadows. The coyote may be found from park boundaries to the Hudsonian. At one time, park officials believed that deer and goat herds were being kept at a low number because of coyote depredation. However, coyote numbers do not seem to be excessively high in the park and as with most natural populations, predator-prey ratios are generally kept at a healthy level by natural forces.

Vulpes fulva (red fox, cross fox, black fox). Few people are aware of the presence of the fox due to its secretive nature. I have but one recent report of a fox, from near Cayuse Pass in January, 1969. Taylor and Shaw (25, p. 43) found this species to be most common in the Hudsonian Life Zone, but it also is found at lower elevations. Several color variations occur in the park.

Euarctos americanus (black bear). Bear have been observed at all elevations in the park, including a report from a climbing party of a bear crossing the summit of the mountain at 14,400 feet. Their habitat preference seems to be twofold in Mount Rainier National Park - the high mountain meadows where grasses and blueberries are found, and around campgrounds where garbage cans are found. There are two basic color variations, the black and brown, with several phases in between. These animals go into a winter sleep that is not true hibernation. The time they enter and arouse from this sleep varies from year to year, with those at lower elevations remaining active longer and waking earlier than those at high elevations. The difference between Longmire (2700 feet) and Paradise (4500 feet) is about three weeks. Often the bear will move into higher elevation as summer progresses and retreat downward as winter approaches.

Procyon lotor (raccoon). The raccoon is a mammal of lower elevations, found typically in the Transition and Canadian Life Zones, seldom above 3000 feet (25, p. 45). The raccoon is most commonly found around areas of human habitation, such as Longmire, Ohanapecosh, and Paradise, where it becomes quite tame.

Martes americana (martin, pine martin). This beautiful carnivore is often encountered in Hudsonian woods and meadows during the summer months. During the winter, the animal will often move

down into the timbered sections of the park. The martin can be found from park boundaries into the Hudsonian Life Zone and is quite abundant in the park. I have encountered them along trails on several occasions. They appear quite curious and one individual watched us coming down a trail, climbed about 25 feet into a tree, and watched us pass. The martin is a furbearer and in the early days of the park, considerable numbers were trapped at lower elevations both inside and outside the park. Since they are now protected within the park, one would expect to find larger populations there. The Mount Rainier Nature Notes (18, January 1931) reported an interesting encounter between a martin and fox, the fox attacking and killing the martin. This is no doubt an exceptional case of predation.

Mustela erminea (short-tailed weasel, ermine). The ermine is the smallest carnivore in the park and is found from the boundaries up to the Arctic Alpine Life Zone. It appears to be more numerous in the Humid Transition and Canadian Life Zones, but I have captured it as high as 7000 feet in the Colonnades. It is most commonly found along streams or marshy areas where small mammal populations are usually highest. I captured two animals from a den along the White River, where a log jam along a small stream provided good cover and protection. On many occasions snap traps have been moved and their contents removed, probably the activity of the short-tailed weasel. An unusual record for this species was obtained from Fish Creek

(2700 feet) on June 29, 1966. A specimen was captured which was entirely white. The short-tailed weasel, even in winter coat, has a black-tipped tail. This specimen had no black at any place, indicating a true albino. During the winter months, a white coat may be worn by this species and many sightings, especially in the Paradise area, have been made of white weasel (18, August 1923).

Mustela frenata (long-tailed weasel). The long-tailed weasel is about twice the size of the ermine and has many of the same characteristics. It feeds on small mammals, may assume a white winter coat, and is a very efficient predator. Although found in all life zones, it has a preference for the Hudsonian meadows and alpine woods, where it is fairly abundant. One specimen was collected near Reflection Lakes.

Mustela vison (mink). The mink is more common in the Transition Life Zone and may extend into the Canadian. Mink have been observed at Longmire, Ohanapecosh Hot Springs, and Carbon River (25, p. 50). Mink are not abundant in the park and are rarely observed by hikers.

Spilogale putorius (little spotted skunk, spotted skunk, polecat). The spotted skunk is not very common in Mount Rainier but is found at lower elevations in the Transition Life Zone. In the winter of 1967-68, one of the ranger staff noticed a skunk in the middle of the road below Longmire. Believing the animal injured, he stopped to

offer assistance. The animal was uninjured, so he attempted to remove it from the road in order to insure its safety. The animal did not take kindly to the rough treatment and reacted in the emergency much as one might expect a skunk to react. There are a few other reports of the spotted skunk, but to date the larger striped skunk has not been observed in the park.

Felis concolor (mountain lion, cougar). This species hunts from lower elevations into the Hudsonian. Most sightings are from the higher elevations, probably due in part to the better visibility at these elevations, and each summer several sightings are reported by hikers. It is believed that the cougar relies heavily upon deer for food, and would thus move to lower elevations during the winter months, following the movement of the deer. In 1925, five cougar were reported killed in three days at Ohanapecosh Hot Springs during the winter (18, February 1925).

Lynx rufus (bobcat). The bobcat is more at home in the forested sections of the park and can be found from lower elevations to the Lower Hudsonian. In 1966, I observed an individual along the West Side Road about three miles from the North Puyallup River. During the winter, bobcat prints in the snow are very commonly observed in the Transition Zone.

Cervus canadensis (Canadian elk). At the turn of the century elk were not found in Mount Rainier or the surrounding mountains.

In 1912, 50 head were shipped to Yakima and released. From this original liberation, a few head crossed Steven's Pass. In 1915, 45 additional head were released in Wenatchee National Forest, some of which joined with the Yakima Herd (15, January 1, 1935). Small bands of animals were first recorded in the park in the early 1930's. Since then they have steadily increased in numbers. The largest concentrations appear to be on the east and north sections, although elk have been reported from most sections and elevations. They move up into the upper Canadian and Hudsonian during the heat of the summer, and then migrate down when snow reaches a depth which hinders travel and feeding activities. Along the Ohanapecosh River a number of animals find conditions suitable for wintering quarters. A study is now in progress by the ranger staff to determine the status of elk in this national park. From my own observations, I believe that the rather large number of elk is detrimental to the wildlife habitat in Mount Rainier. This animal does compete with deer for browse and at higher elevations I have observed meadows which are heavily trampled by elk. In some areas their trails are wider and deeper than those maintained by the park service. An elk exclosure established near Ohanapecosh several years ago demonstrates the extent of browsing in their winter range, where outside the exclosure there is little underbrush, but inside a good growth is found. This is an exotic species and will no doubt alter conditions

from their previous "natural" state

Odocoileus hemionus (mule deer; blacktail subspecies). The black-tailed deer is probably the one large mammal that is viewed by more people than any other animal in the park. Most of the deer in the park are black-tails, but there have been reports which indicate that a few mule deer may be found around the White River (25, p. 117). This animal is found at all elevations up into the Hudsonian. Many individuals are resident at lower elevations but a number of park deer migrate into the high meadows in the summer and then back into lower elevations as winter forces them lower for food and protection. Many animals congregate around Longmire where they get free hand-outs from park visitors. In the winter, these same deer remain in the area looking for food from the same source but it does not arrive. During severe winters a large number of these animals perish. The deer provides food for a number of large predators which either kill the deer or feed on the carcasses from animals which have died of natural causes. Included in this group are the mountain lion, coyote, and fox.

Oreamnos americanus (mountain goat). In a report just completed for the park service, The Mountain Goats of Mount Rainier, Johnson and Morrow (13) estimate the herd is between 350 and 450 goats. They range up to 11,000 feet and can often be observed on the higher peaks, snowfields, and glaciers. They range down to the

timber of the Hudsonian during the summer, perhaps seeking shade and food. There are several large bands (one I encountered had over 45 individuals) as well as many smaller groups. Even during the winter, they normally do not venture much lower than the Canadian Life Zone, still sticking to rock cliffs and exposed ridges at high elevations. They seem to range lower on the east side and have been sighted at Box Canyon (3000 feet) in the early spring. I encountered a female along the West Side Road in middle May at about 2300 feet. As I approached in the car, she had difficulty climbing a 15-foot bank, fell back and landed on her back. She remained in a small ditch, motionless, and permitted me to approach within three feet of her, still making no attempt to get away. Her left front leg appeared injured. Believing her to be incapable of getting along in the woods, I planned to get a ranger to dispose of her. By the time I had turned the car around, she had vacated the area and a search of the immediate region did not locate her. About five weeks later, a report came to me from a ranger that about one mile up the road from my first encounter, a female with kid had been observed. I believe this to be the same animal. There is an exposed rock cliff, Tumtum Peak (4500 feet) one mile east of where this animal was observed. Each winter a number of goats use this as their winter range. It appears that this animal had been wintering there and injured her leg. She moved down to a lower elevation, gave birth to her kid, and hopefully

recovered and moved back to rejoin the herd.

Mammals of Uncertain Status in Mount Rainier National Park

Didelphis marsupialis (common opossum). This mammal has not yet been reported from Mount Rainier. However, in recent years this species has been introduced in Washington and Oregon and some of these introductions have been quite successful. It has been expanding its range in both states and may reach the lower boundaries of the park in a few years, especially along the southern and western boundaries.

Myotis lucifugus (little brown myotis). This is a small bat which is difficult to separate from Myotis keenii. There have been no records of this species from Mount Rainier, although Dalquest (6, p. 147) includes Mount Rainier in the distributional range of this bat. Being endowed with flight, it is quite likely that this species eventually will be recorded from the park.

Myotis evotis (long-eared bat). Few records of this bat have been secured in Washington, and none from Mount Rainier. Dalquest (6, p. 152) reports that this species does most of its flying very late at night, probably accounting for the scarcity of records. The distributional records from Washington indicate that this species probably occurs on Mount Rainier.

Myotis californicus (California myotis). This bat has not been

recorded from the park, although Dalquest (6, p. 156) includes the area of Rainier in his distribution map for this species. Little work has been done on the bats and although I attempted to mist net them, shoot them, and have searched for suitable roosting sites, I secured few records of bats in the park. More intensive collecting will most likely prove the existence in the park of these three bat species.

Sylvilagus floridanus (eastern cottontail). The cottontail rabbit has been widely introduced in Washington and is now found around Tacoma and other towns in the Puget Sound region. This species may also find its way onto the lower slopes of the park, especially from the Carbon River and Nisqually River valleys. So far, no authentic records have been found for this species in the park.

Otospermophilus beecheyi (Beechey ground squirrel). This mammal also has no record of being present in the park. However, it has rapidly invaded cutover lands in Oregon and parts of southern Washington. I observed one animal about 15 miles south of the Ohanapecosh Campground some five miles from Packwood. Logging is rapidly reaching the park boundaries along the southern and western edges, and this mammal may well invade old burns at lower elevations.

Ondatra zibethica (muskrat). At the turn of the century, it was believed that muskrats were found in marshy regions at low elevations, such as the meadow at Longmire. However, by 1919 Taylor and Shaw (25) indicated that the muskrat had been trapped out from the park.

There are very few suitable locations in Mount Rainier, but a few do exist. It is entirely possible that a few individuals may be able to reinvade some of the lower beaver ponds and marshes.

Rattus norvegicus (brown rat, Norway rat). This animal was found at Longmire in the 1920's. An intensive campaign at that time eliminated this species, which was the intent of the trapping. Since then no new sightings have been reported, but this animal has also been expanding its range, following farms and cities into new regions. This animal may again be able to establish a foothold around the buildings within the park.

Mus musculus (house mouse). This animal was also present with the Norway rat in the early 1920's. The same trapping which eliminated the rat reduced the numbers of house mouse to the point where it apparently could no longer exist. I have trapped many deer mice around buildings within the park, but have not captured a single house mouse. It too adapts well to human habitation and again may be accidentally introduced around buildings.

Canis lupus (wolf). Even when C. Hart Merriam traveled through Mount Rainier in 1897 timber wolves were thought to be rare in the vicinity of Mount Rainier. In the winter of 1916, J. B. Fleet noted two wolves near Longmire. The last report I can find is in the Kitchen Reports (15, January 1, 1935) where mention is made of sighting three animals above Lake George along the west boundary of the park. At

present, the wolf is thought to be absent from the park, but may perhaps wander down from the North Cascades in the future.

Martes pennanti (Pacific fisher). This mammal is also extremely rare or more likely absent from Mount Rainier. In 1897, Merriam found some evidence of the fisher in Nisqually Valley, and around 1910 one animal was captured about four miles from Longmire. The fisher was never apparently abundant, but some animals still exist in the Cascades and individuals may wander into the park from time to time.

Gulo luscus (wolverine). This species was never common in Mount Rainier. Between 1900 and 1930, a few sightings were reported (13) and three animals were killed in or near Mount Rainier. In recent times, few animals have been seen anywhere in the state of Washington. Some are believed to live along the northern boundary of the state. It is possible that they may pass through the park, but at present are believed to be absent from Mount Rainier National Park.

Lutra canadensis (river otter). This animal was more common in the past and very few sightings have been made in recent years. This animal probably enters the park via the numerous large rivers, especially the White River, Carbon River, and perhaps the Nisqually River systems. It is unlikely that this animal is resident in the park at present.

Mephitis mephitis (striped skunk). This species is very common

in the lowlands around Puget Sound, but has not been recorded in the park. As agriculture extends closer to park boundaries along the Carbon and Nisqually Rivers it is quite possible that this species will be able to survive at lower elevations in the park. However, no evidence is at hand which indicates that this has happened at this time.

Mammals and Life Zones of Mount Rainier

As one travels from zone to zone, changes in the composition of small mammal communities can be discerned. In addition to zonal differences, distinct variations in habitat and mammalian species can be noted within each zone. The climax community dominates the zones, but additional variations in plant communities are evident: seral stages following fire or other natural catastrophic events, riparian borders along lakes and streams, and xeric regions near talus slopes and rocky ridges.

Humid Transition Life Zone (below 3500 feet)

In the Humid Transition, shrews are quite numerous, especially in the forested areas and mesic habitats. The Trowbridge shrew, vagrant shrew, and dusky shrew all demonstrate a wide distribution within this zone. The Trowbridge shrew reaches its highest population in this zone, while the vagrant and dusky shrews are equally common in the Canadian Zone. The Bendire marsh shrew is normally found

in this zone, although populations are very low. It is confined to the mesic meadows and marshes. The water shrew, S. palustris, is found here along streams and rivers.

Although moles are not really common in any of the life zones of the park, the Gibbs shrew-mole will normally be found in the forested portions of this zone.

The mountain beaver, Aplodontia, has scattered colonies in the Transition Zone and reaches its highest numbers here. It does extend up into the Canadian Zone, primarily from the major river valleys.

Of the sciurids, the Townsend chipmunk and Douglas pine squirrel are the species most likely encountered here. Both species are found in the Canadian and Lower Hudsonian Life Zones as well. The Townsend chipmunk prefers advanced seral stages and areas of heavy visitor use, while the pine squirrel is found wherever coniferous trees are found. The flying squirrel is also a resident of this zone but is rarely observed. It too is found up into the Hudsonian.

Large populations of the deer mouse, Peromyscus maniculatus, occur in this zone. In most habitats, the deer mouse outnumbers any other species. About the only habitat the deer mouse avoids is the extremely mesic marsh environment. Populations reach their highest numbers in the Transition and Canadian Life Zones and taper off at higher elevations.

Of the voles, the only species that I found to be centered in the

Transition is the Townsend vole. This animal is found primarily along the western slopes in the park and extends into the Lower Canadian. The red-back vole, Oregon vole, and Richardson's vole are all found in this zone, but seldom in large numbers.

Another species found characteristically in the Transition Zone is the jumping mouse. Highest numbers are found in mesic habitats, and under the climax forests.

The carnivores are normally more widespread in their distribution. The black bear ranges through all zones. Raccoons reach their highest numbers in the Transition Zone and trapping records indicate that the short-tail weasel is more common in this zone. The spotted skunk, although not common in the park, prefers this zone.

Deer and elk are quite common here. In summer the elk tend to move into the higher elevations more than do the deer.

Canadian Life Zone (3500-5000 feet)

In the Canadian Zone, the Trowbridge shrew becomes less common, while the dusky shrew and vagrant shrew maintain their populations. The water shrew, Sorex palustris, is found in small numbers along suitable streams. The total shrew population is less in the Canadian than in the Transition Life Zone; in the Transition Zone the trap sites averaged over ten shrews per site, while in the Canadian the average per site was about 5.5 individuals.

In certain habitats of the Canadian, the Townsend chipmunk reaches very high populations, particularly in the huckleberry patches that grow in openings near mountain lakes. The yellow-pine chipmunk is found in the Upper Canadian and prefers the open woods and meadows, as does the mantled ground squirrel. The pine squirrel and flying squirrel are inhabitants of this zone also.

Where soil conditions are suitable pocket gopher diggings can be observed. They prefer the light sandy soil away from wooded areas.

The deer mouse is found in most habitats of the Canadian, where highest numbers are attained in the more moist forests and mesic stream bottoms. Deer mouse populations are lowest in extremely wet meadows and in the very xeric seral stages.

The red-back vole reaches its highest numbers in the Canadian where it prefers the dry woods. Here the heather vole is found in small numbers, as is the Oregon vole. Along the mesic borders of small streams the tunnels of the water vole are found. This large vole is especially numerous in the meadows of the Upper Canadian and Hudsonian.

High populations of jumping mice were found in the Canadian along streams where considerable deciduous growth was present. Although the jumping mouse is very common in the Transition Zone, highest numbers were secured from the Canadian.

In the Canadian and Hudsonian, the martin and long-tailed

weasel reach their highest numbers. Bobcat, mountain lion, bear, coyote, fox, and mink are other carnivores which make their home in the Canadian.

Although elk are found in the Hudsonian and Transition Zones, during the summer their greater numbers are found in the Canadian. Deer are common here also and mountain goats may occasionally wander into the Upper Canadian from cliffs above.

Hudsonian Life Zone (5000-6500 feet)

In the woods and meadows of the Hudsonian, one rarely encounters the Trowbridge shrew, although both the dusky shrew and vagrant shrew are present. The water shrew will be found along the streams but populations are not high. Shrew populations are lower here than in the lower elevations.

Shrew-moles are found in the Hudsonian but not often. In the meadows, particularly on the west slopes, the larger moles, Scaphanus townsendi and S. orarius, may be found, but in small numbers. Few records have been secured for these species from the park.

Here and in the Upper Canadian, the pika reaches its greatest populations. The characteristic habitat of the pika is the open talus slopes and rock outcrops. The varying hare is found in the Hudsonian but is equally at home in the Transition and Canadian.

The marmot is a mammal characteristic of the higher elevations and can be observed from the Upper Canadian into the Arctic Alpine, with its population center in the Hudsonian. This species prefers the open meadows and rock slides and will venture into the woods in search of food.

In the Hudsonian, the mantled ground squirrel and yellow-pine chipmunk reach their highest numbers. Both prefer the mixed woods and meadows and their range overlaps with that of the Townsend chipmunk. The Townsend chipmunk is not nearly so common here as it is in the lower zones and stays close to trees.

The meadows of the Hudsonian and the lower Arctic Alpine support rather high populations of the pocket gopher. Their mounds and workings indicate their presence.

In the Hudsonian, deer mouse populations drop considerably from those found at lower elevations. Although numbers are small, they are still found in most habitats. They are seldom found in the middle of large meadows, but seem to stay near brush and trees.

In the Lower Hudsonian, red-backed voles are found, but their numbers drop as elevation is increased. The heather vole reaches its highest population in the heather and huckleberry patches near the meadows. In the same habitat, the Oregon vole is found while along the mesic stream borders the water vole occurs.

The jumping mouse, too, is found in the Hudsonian but its

population center is at lower elevations. The jumping mouse prefers the mesic environment near brush.

Of the carnivores, perhaps the martin is most characteristic of the Hudsonian. The bear, long-tailed weasel, bobcat, and mountain lion are other important carnivores of this zone.

Elk and deer both feed in and around the woods and meadows of the Hudsonian and mountain goats are often observed on the cliffs and meadows.

Arctic Alpine Life Zone (7000 feet-summit)

In the rigors of the Arctic Alpine community few mammals are able to maintain high populations. The lower portion of this zone does provide habitat for some species.

The only shrew which extends regularly into this zone is the water shrew. It is found up to 8000 feet (25, p. 33). I have captured this shrew at 6000 feet immediately below the point at which a stream emerged from a large snowfield.

Several rodents inhabit the lower portions of this zone, including the marmot. The marmot is often observed at the 6000-7000 foot levels and Taylor and Shaw report it may extend up to 10,000 feet (25, p. 90). The yellow-pine chipmunk and mantled ground squirrel also may extend into the lower Arctic Alpine, especially on the east side of the park. The pika may be observed up to 8000 feet around talus

slopes. The deer mouse has been observed at the very summit of the mountain at over 14,400 feet. Campers at Camp Muir (10,000 feet) have observed mice rummaging through their packs. Perhaps some of these mice have been transported to the summit via the packs of climbers or perhaps they are a resident population. At any rate, the deer mouse seems to survive at least as high as Camp Muir. One other rodent, the water vole, has also been trapped at Camp Muir (25, p. 73).

Several of the predators have been observed above timberline by visitors and staff at Mount Rainier. Bear tracks have been observed crossing the summit of the mountain and reported to the rangers (25, p. 38).

The only large mammal to be considered truly of the Arctic Alpine is the mountain goat. Even in the winter, these mammals stay as high as snow conditions will permit. The herd of about 400 is maintaining its numbers (13).

SUMMARY

During 1966, 1967, and 1968 extensive field investigations were carried out in Mount Rainier National Park. These included continuous research during the summer months, and weekend activities during the winter months. Small mammals were trapped and observed, and the larger mammals were observed exclusively. The summer trapping consisted of two phases: the first phase involved random sampling in various sections of the park, where an area was sampled for 10 days with no further investigations being made at that site. This provided information related to habitat preferences, elevational and life zone distribution, interspecific associations, and relative numbers. The second phase involved the establishment of permanent trapping lines which were operated continuously for 10 days each year. This provided additional information on the above topics and served as a measure of population fluctuations during the course of the study.

A total of 57,246 trap nights from 58 trap sites produced 3,717 animals. There are 50 known mammalian species in the park, and an additional 14 species which were either formerly present and now extinct, or which may expand their range into the Mount Rainier area. The small mammal species which contributed most to the population were Peromyscus maniculatus (38%), Clethrionomys gapperi (14%), Eutamias townsendii (10.3%), and Zapus trinotatus (10.1%).

From the permanent trap lines a population cycle in Peromyscus was demonstrated, while other species did not seem to be effected.

An account is given for each species present in Mount Rainier National Park and a similar account for those species which are potential inhabitants. There is also a discussion by life zone of the mammals and their distribution in the park.

LITERATURE CITED

1. Abrams, LeRoy. Illustrated flora of the Pacific states. Stanford, Stanford University, 1951. 4 vol.
2. Baily, Vernon. The mammals and life zones of Oregon. Washington, D. C., 1936. 416 p. (U.S. Dept. of Agriculture. Bureau of Biological Survey. North American Fauna no. 55)
3. Brockmann, C. Frank. Progressive summary of glacier recession in Mount Rainier National Park, Washington. October, 1940. 7 numb. leaves. (Unpublished report on file in Mount Rainier National Park Library, Longmire, Washington)
4. Calhoun, John B. and Andrew A. Arata. Revised sampling procedure for the North American census of small mammals (NACSM). Bethesda, Maryland. 1959. 12 p. (U.S. Public Health Service, National Institute of Public Health. Population dynamics of vertebrates. Release no. 10)
5. Coombs, Howard A. The geology of Mount Rainier National Park. University of Washington Publications in Geology 3:131-212. 1936.
6. Dalquest, Walter W. Mammals of Washington. Lawrence, 1948. 444 p. (University of Kansas Publications. Museum of Natural History. Vol. 2)
7. Finley, W. L. Birds and mammals of Rainier. Mazama 5: 319-326. 1919.
8. Fiske, Richard S., Clifford A. Hopson and Aaron C. Waters. Geology of Mount Rainier National Park, Washington. Washington, D. C., 1963. 93 p. (U.S. Geological Survey. Professional Paper no. 444)
9. Franklin, Jerry Forest. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. Ph. D. thesis. Pullman, Washington State University, 1966. 140 p.
10. Hopson, Clifford A. et al. The latest eruptions from Mount Rainier volcano. Journal of Geology 70:635-647. 1962.
11. Ingles, Lloyd G. Mammals of the Pacific States. Stanford, California, Stanford University, 1965. 506 p.

12. Johnson, Murray. Progress report and summary of replacement study, Kautz Creek. 1956. 9 numb. leaves. (Unpublished report on file in Mount Rainier National Park Library, Longmire, Washington)
13. Johnson, Murray and Roger Morrow. The mountain goats of Mount Rainier. 1966. 30 numb. leaves. (Unpublished report on file in Mount Rainier National Park Library, Longmire, Washington)
14. Johnson, Murray and Burton T. Ostenson. Report on reestablishment of small mammal populations, Kautz Creek flood area. 1954. 5 numb. leaves. (Unpublished report on file in the Mount Rainier National Park Library, Longmire, Washington)
15. Kitchen, E. A. Kitchen's reports, August 1934 to June 1936. (Unpublished file in Mount Rainier National Park Library, Longmire, Washington)
16. Lyon, Marcus Ward, Jr. Notes on mammals collected at Mount Rainier, Washington. Washington, D. C., 1907. p. 89-92. (Smithsonian Institution. Miscellaneous Collections vol. 50)
17. Martinson, Arthur David. Mountain in the sky: A history of Mount Rainier National Park. Ph. D. thesis. Pullman, Washington State University, 1966. 182 numb. leaves.
18. Nature Notes. 1923 to 1938. (Unpublished file in Mount Rainier National Park Library, Longmire, Washington)
19. Peck, Morton E. Manual of the higher plants of Oregon. Portland, Oregon, Binford and Mort, 1941. 866 p.
20. Potts, Merlin K. and Russell K. Grater. Mammals of Mount Rainier National Park. Longmire, Washington, Mount Rainier Natural History Association, 1949. 89 p.
21. Sampson, Alice. Wild animals of Mount Rainier National Park. Sierra Club Bulletin 6:32-38. January, 1906.
22. Schmoe, F. W. Our greatest mountain. New York, Putnam's, 1925. 266 p.
23. Taylor, Walter P. A distributional and ecological study of Mount Rainier, Washington. Ecology 3:214-236. 1922.

24. Taylor, Walter P. Some birds and mammals of Mount Rainier. *The Mountaineer* 14:27-35. November, 1921.
25. Taylor, Walter P. and William T. Shaw. Mammals and birds of Mount Rainier National Park. Washington, D. C., United States Government Printing Office, 1927. 249 p.
26. Tolbert, M. A. and Caroline Leona. History of Mount Rainier National Park. Seattle, Washington, Lownam and Hanford, 1933. 11 p.
27. U.S. Geological Survey. Mount Rainier National Park Quadrangle map. Washington, D. C., 1955. 1 sheet.
28. U.S. National Park Service. Report of the director to the Secretary of Interior for the fiscal year ended June 30, 1919. Washington, D. C. 1919.
29. U.S. Weather Bureau. Mount Rainier National Park, Washington. Climatological summary. Washington, D. C., 1960. 4 p. (Climatography of the United States 20-45)

APPENDICES

APPENDIX A

HABITAT DESCRIPTIONS
(listed by elevation)Permanent LinesOhanapecosh - 1900 feet - Humid Transition Life Zone

Location: West of Highway 5 about 1/2 mile south of Ohanapecosh Ranger Station. Began just west of elk exclosure and ran in a westerly direction to within 100 yards of Ohanapecosh River, then turned south and followed ridge above river.

Habitat: Open mature forest of Transition Life Zone with a small permanent stream. Few shrubs with fair ground cover.

Carbon River - 2000 feet - Humid Transition Life Zone

Location: One-half mile east of the Carbon River Entrance Station, south of the road. Line began just across road from utility area and ran east, parallel to the road.

Habitat: This is one of the very unique vegetational areas found within the park, an "inland rain forest." Quite flat, heavily forested with large coniferous trees. Mesic with numerous small permanent streams. Fairly dense shrub layer of salmonberry, huckleberry, and Devil's club; good ground cover of forbs.

Longmire - 2600 feet - Humid Transition Life Zone

Location: Just beyond the horse barns 1/2 mile south of Longmire. Line began 50 yards east of service road just before road leaves park and ran easterly.

Habitat: Heavily forested with dense shrub layer including patches of Devil's club and huckleberry. Small temporary streams provided for mesic areas. The dominant trees were western hemlock, Douglas fir, and western red cedar.

Lake James - 5000 feet - Lower Hudsonian Life Zone

Location: 15 yards east of Lake James Patrol Cabin.

Habitat: Highly varied, rather typical of broken habitats of this elevation. Small mesic meadows, patches of forest, rock outcrops, slides and a small stream are all included in this line.

Sunset Park - 5500 feet - Hudsonian Life Zone

Location: Line began about one mile southeast of the Golden Lakes, 100 yards northeast of Sunset Lookout and followed ridge in easterly direction.

Habitat: Exposed ridge supports very little vegetation. Scattered alpine fir, low heather and huckleberry bushes; ground cover of grasses and forbs. Line transected exposed rock outcrops, small grassy areas, and clumps of heather. A burn in the 1930's removed the original vegetation and this area is undergoing secondary succession.

Shriner Peak Lookout - 5800 feet - Hudsonian Life Zone

Location: Along eastern side of Mount Rainier National Park. Line began 100 yards east of lookout and followed ridge in an easterly direction.

Habitat: Area heavily used by elk which have trampled vegetation in some areas. The ridge is exposed, has a few small trees with good cover of heather and huckleberry. In protected area, small meadows densely vegetated with sedges, grasses, and forbs. Rock outcrops common along ridge provide a dry contrast to the mesic meadows.

Mount Fremont Lookout - 6000 feet - Arctic Alpine Life Zone

Location: Northeast of Mt. Rainier with access from Sunrise. The line began 100 yards south of lookout and ran in southerly direction along crest of the Sourdough Mountains.

Habitat: Very rocky and dry. Vegetation patchy with much of the area completely barren. Some grasses and flowers found among rocks. Patches of heather give some relief to the monotony of the

landscape. Snowbanks still present in August.

Random Lines

Carbon River Rain Forest - 1800 feet - Humid Transition Life Zone

Location: Along south side of Carbon River Road one mile east of Carbon River Entrance Station.

Habitat: Flat, mesic habitat containing a number of small streams. Remnant of a once more extensive inland rain forest. Outside the park this forest has been destroyed by logging. Dominant tree species western hemlock, Douglas fir and western red cedar. Moderate shrub layer includes salmonberry, Devil's club and blueberry. Dense ground cover of forbs and mosses. A great deal of moss hanging from the trees and large decaying moss-covered logs.

Carbon River - 1900 feet - Humid Transition Life Zone

Location: One mile west of Carbon River Campground, between road to campground and Carbon River. Traps placed in ecotone between river and forest.

Habitat: Generally flat with numerous mounds of large polished rocks and sand deposits. Ecotone about 200-300 feet wide, with no canopy but a dense understory of willow, alder, and an occasional cottonwood. Small trees of the above species, plus small Douglas fir, indicates successional stage. Ground covered with herbaceous plants. A large stagnant pool of shallow water present.

West Side Road Junction - 2200 feet - Humid Transition Life Zone

Location: One mile east of the Nisqually Entrance Station. Traps placed on both sides of main road.

Habitat: Climax forest typical of the Humid Transition Life Zone. Canopy completely closed by large western hemlock and western red cedar. Floor covered with small flowering plants and numerous large decaying logs. Understory sparse, predominately vine maple. Topography flat; a damp mesic habitat with small stream.

Stevens Canyon Entrance Station Marsh - 2200 feet - Humid Transition Life Zone

Location: Just north of the Stevens Canyon Entrance Station, between Highway 5 and the Ohanapecosh River.

Habitat: Small marsh (approximately two acres) with water the year around. Numerous sedges, bordered by the highway on two sides and forests around the rest. Some trees have fallen into the marsh, but no trees grow in the marsh itself.

Ohanapecosh River Bottom - 2300 feet - Humid Transition Life Zone

Location: Along west side of Highway 5, one and one-half miles north of the Stevens Canyon Entrance Station. Traps placed between river and Highway 5.

Habitat: Flat bottomland along river, with small stream. Mesic, with considerable amount of ground cover. Large western hemlock, Douglas fir, true firs, and western red cedar making canopy. No canopy along small stream, but considerable growth of red alder and other deciduous trees to about 15 feet in height. Ground densely covered with grasses, flowers, and shrubs of blackberry and huckleberry.

Kautz Mudflow - 2300 feet - Humid Transition Life Zone

Location: Along the service road leading to the dump. Traps were placed on both sides of service road about 100 yards south of the highway.

Habitat: Original vegetation destroyed in 1947 by the tremendous mudflow from the Kautz Glacier. The mudflow deposited great amounts of glacial material over the former road and surrounding forest. The trees eventually died, and as the needles fell, light penetrated to the barren ground below and succession began. Presently, the area is covered with invading Douglas fir, cottonwood and alder along with numerous shrubs and perennial plants. Rotting logs are numerous, providing cover for many small mammal species.

Ipsut Creek - 2400 feet - Humid Transition Life Zone

Location: Along the east side of Ipsut Creek, 1/2 mile south of

patrol cabin located at the Carbon River Campground.

Habitat: A mesic forest of western hemlock and western red cedar. Shrubs include salmonberry, Devil's club, and blueberry. Forest floor well covered with herbaceous plants. Relatively flat terrain permitted a fairly good build up of humus.

Ohanapecosh Wooded Area - 2400 feet - Humid Transition Life Zone

Location: Along west side of Highway 5 about 1/2 mile north of the point where Panther Creek flows under the highway.

Habitat: Old growth forests of western hemlock, Douglas fir, silver fir, and western red cedar. Few shrubs, mostly huckleberry. Ground cover sparse, with a few herbaceous flowering plants and mosses.

Fish Creek - 2700 feet - Humid Transition Life Zone

Location: Just north of the West Side Road, near old beaver ponds, four miles above the junction of West Side Road and Highway 5.

Habitat: A very mesic habitat, with small rivulets scattered throughout. Fish Creek has formed a small valley about 200 yards wide with the bottomland full of large, moss-covered boulders. Vegetation mostly herbaceous, not particularly dense, but covers the ground well. Trees mostly willow, alder, and maple. Light shrub layer, mostly of salmonberry and Devil's club. Many small areas are quite boggy and support a lush cover of grasses and sedges.

Stevens Canyon Entrance Station Woods - 2700 feet - Humid Transition Life Zone

Location: One and one-half miles southeast of the entrance station, along the east side of road.

Habitat: Dense woods with well developed canopy and moderate shrub layer of huckleberry. Devil's club present in mesic area along small stream. Ground covered with mosses and some herbaceous plants.

White River - 2700 feet - Humid Transition Life Zone

Location: East side of the White River, between river and Highway 5, one mile south of the northern boundary of Mount Rainier National Park.

Habitat: Flat, mesic, heavily forested area with several small creeks in the bottomland near the river. Large western hemlock, Douglas fir, and western red cedar were the most prominent canopy species. Understory included alder, vine maple, mountain ash, and blue elderberry. Few shrubs present, but ground well covered with ferns, mosses, and herbaceous plants.

West Fork of the White River - 2800 feet - Humid Transition Life Zone

Location: Just inside boundary of Mount Rainier National Park along north side of West Fork of White River. A Forest Service trail leads into the park, and traps were set along both sides of this trail.

Habitat: The West Fork forms a wide canyon which is steep-sided, with a very flat valley along the river. A heavy forest extends from the base of the slopes to a transition zone near the river. Western hemlock and western red cedar dominate the canopy, while along the river Douglas fir, alder, and vine maple are established. Shrubs found included red salmonberry, Devil's club, and blueberry. Ground well covered with herbaceous growth. Area seemed very mesic, with several small streams.

Nickel Creek - 3000 feet - Humid Transition Life Zone

Location: North of the highway at the point where Nickel Creek is crossed by the highway. Traps placed on west side of creek.

Habitat: Very dry woods, with sandy soil. Open woods with considerable shrub layer. Ground covered with bear grass and other herbaceous plants. Moderate slope, with exposed rocks.

Deadwood Creek - 3200 feet - Upper Humid Transition Life Zone

Location: North side of road to Sunrise, one mile west from where the road to Sunrise junctions with Highway 5. Traps placed on both sides of Deadwood Creek and along one of its tributaries.

Habitat: Well-forested with a mixed stand of white pine, hemlock, Douglas fir, grand fir, and western red cedar. Understory primarily small trees of the above species. Shrubs included mountain Oregon grape, gooseberry and blueberry, while the forest floor was covered with mosses and forbs. Immediately along stream a more mesic habitat permitted the dense growth of herbaceous plants. The topography of moderate slope, with humus buildup to about two inches.

North Puyallup River (North) - 3500 feet - Upper Humid Transition
Life Zone

Location: On the north side of North Puyallup River, across the river from parking area at end of West Side Road. Line began at north end of the old bridge, and ran parallel to the Wonderland Trail in a north-easterly direction.

Habitat: Two different habitats were sampled. One included a forested area similar to that sampled in the Deadwood Creek area. The other included mesic area near river with a dense alder thicket. Small streams passed through alder providing ample water for lush herbaceous vegetation.

North Puyallup River (South) - 3500 feet - Upper Humid Transition
Life Zone

Location: South side of the North Puyallup River, just above parking lot at end of West Side Road. Line generally followed Wonderland Trail in southerly direction.

Habitat: Line placed entirely within forested area above road. Typical Canadian Life Zone, with little light penetrating to the ground. Shrubs not abundant and the ground cover sparse. Hemlock, Douglas fir, and cedar were the common tree species.

Van Trump Creek - 3700 feet - Lower Canadian Life Zone

Location: Traps placed on both sides of Van Trump Creek about 1/2 mile north of the bridge where Highway 5 crosses Van Trump Creek, four miles northeast of Longmire.

Habitat: Two different habitats sampled. (1) Forested area mostly of Douglas fir, hemlock, and cedar. Steep slopes for the most part and quite dry. Common shrubs devil's club and huckleberry.

Decaying logs present with few herbaceous plants. (2) Small creek which entered Van Trump Creek. Creek formed very mesic area supporting a very dense thicket of small alder, salmonberry, vine maple, and huckleberry. Numerous large logs scattered along creek in various stages of decay. Steep slopes led into the area, but quite flat in the immediate vicinity of trapping. Ground covered with herbaceous plants.

Canyon Bridge - 4000 feet - Lower Canadian Life Zone

Location: East side of the Nisqually River about 1/2 mile above the Canyon Bridge over Highway 5.

Habitat: Two different areas sampled. (1) A small clump of Douglas fir and hemlock located between old road grade and river. Area very dry with little ground vegetation. Small gully passed through the habitat with the bottom of gully more mesic. Canopy kept most of the direct sunlight out. (2) Alder thicket, with trees in thicket growing almost horizontally due to heavy snow pack in winter. A few scattered small alpine fir and cedar. Ground very rocky, but supported a fairly good ground cover of herbaceous plants.

Stevens Creek - 4000 feet - Canadian Life Zone

Location: Traps placed along creek north of the point where the highway crosses the creek.

Habitat: Area dominated by alder. Old burn caused secondary succession, and the entire area is covered with deciduous and herbaceous plants. A few coniferous trees are invading the area. Alder thick and difficult to penetrate.

Round Pass - 4000 feet - Lower Canadian Life Zone

Location: On the West Side Road about six miles north of junction of West Side Road with Highway 5. Junction is one mile east of the Nisqually Entrance Station. Traps set on both sides of road at top of pass.

Habitat: Steep forested slopes characteristic of Canadian Life Zone. Mountain hemlock and Douglas fir dominant tree species; devil's club and blueberry making up most of the shrub layer. Forest floor well shaded, with numerous decaying logs. Later in the summer

much of this area becomes quite dry.

Tunnel - 4200 feet - Lower Canadian Life Zone

Location: Highway 5, about halfway between Deer Creek and Dewey Creek. Traps were placed along east side of road just north of tunnel.

Habitat: Mostly deciduous growth along a very steep slope. Considerable herbaceous plants and alder to about 15 feet in height.

Ricksecker Point - 4200 feet - Lower Canadian Life Zone

Location: About two miles north-east of Longmire. Just where Highway 5 divides into the scenic route along the canyon and the short-cut over the point. Traps placed along both sides of road.

Habitat: Typical forest of the Canadian Life Zone. Trees not large nor tall, but very dense. Little light penetrated to the floor of the forest. Huckleberry formed a rather thick shrub layer, but few herbaceous plants found. Needles covered forest floor, which was quite dry. Topography rolling and not steep.

Mountain Meadows - 4200 feet - Upper Canadian Life Zone

Location: North side of road to Mowich Lake, about two and one-half miles below the lake. Meadow Creek and its tributaries drain the meadows.

Habitat: Several small meadows surrounded by mature forests. Meadows apparently maintained by boggy nature of the soil. Traps placed both in meadows and in the surrounding forest. Meadows have small trees scattered throughout, and decaying logs are present. Meadow vegetation is mostly sedges, grasses, and forbs. Surrounding forest typical Canadian Life Zone, with shrub layer of huckleberry but little ground cover. Forests are well drained by the small streams.

White River Campground - 4300 feet - Canadian Life Zone

Location: Along south side of road into White River Campground, 1/2 mile east of patrol cabin.

Habitat: Relatively flat floodplain near White River. Dominance of herbaceous and deciduous growth with some fir. Small streams flow through and provide a very mesic habitat. Vegetation very dense, with much small fir, alder, huckleberry, and a profusion of grasses and forbs.

Klapatche Point - 4300 feet - Canadian Life Zone

Location: West end of Klapatche Ridge with access from West Side Road, about 200 yards east of road.

Habitat: Seral stage of secondary succession following burn. Traps placed on steep slope, quite bare of trees. Few shrubs invading the area along with small alder. Bear grass and other herbaceous plants formed most of the ground cover. Large logs left from the burn in various stages of decay. Soil shallow shale, giving impression of an impoverished habitat.

Bench Lake - 4600 feet - Hudsonian Life Zone

Location: Southeast of the Reflection Lakes. Traps placed along trail to lake, 1/4 mile from the road.

Habitat: Old burn has permitted secondary succession. This area invaded primarily by Hudsonian plant species. Open, no trees of any size, dense huckleberry cover, ground covered with herbaceous plants. Several small streams form quite mesic habitat. Topography flat and soil very sandy.

Cayuse Pass - 4600 feet - Upper Canadian Life Zone

Location: Traps placed along both sides of Highway 5 near the junction at the pass.

Habitat: Open woods of mountain hemlock and silver fir. Small open meadow with huckleberry and herbaceous plants. Considerable variation in habitat, from rock cliffs to the mesic stream.

Louise Lake - 4700 feet - Lower Hudsonian Life Zone

Location: Line began at point where bridge crossed Sunbeam Creek and continued north to the lake.

Habitat: Old burn provided for secondary succession. Small cedar and alpine fir to about 40 feet in height, with no real canopy present. Well developed shrub layer, and along numerous streams a dense ground cover of grasses and other herbaceous plants was present.

Lee Creek - 4750 feet - Lower Hudsonian Life Zone

Location: Both sides of the trail from Mowich Lake to Spray Park, at point where trail crosses Lee Creek. About one mile south of Mowich Lake parking area.

Habitat: Extremely mesic habitat along creek, occupying a rather extensive area, heavily vegetated with herbaceous and deciduous plants, with a few small fir trees dotting the area. Willow, alder, and huckleberry make up most of the woody plants. Rotting logs along with the dense vegetation offered a very excellent small mammal habitat.

Reflection Lake - 4860 feet - Hudsonian Life Zone

Location: Along Highway 5 about two miles south of Paradise. Study area located along north-east end of the lake.

Habitat: Quite open, with a few scattered clumps of sub-alpine fir or single trees found in meadow. Huckleberry quite common, along numerous small streams other deciduous trees and shrubs present. Meadows contained sedges, grasses, and flowering plants. Melt-water from snowbanks had collected in numerous temporary ponds, forming a very mesic environment.

Yakima Peak Burn - 4800 feet - Upper Canadian Life Zone

Location: On the east side of Highway 5, approximately 1.4 miles north of Chinook Pass.

Habitat: An old burn located on a very steep slope. Secondary succession in progress, and no canopy has been formed. Douglas fir, alpine fir, noble fir, hemlock, and vine maple found up to 30 feet in height. Scattered shrubs. Ground cover scattered in clumps with bracken fern, bear grass, and other herbaceous plants. Soil very light and sandy, and large areas with no vegetation common.

Mowich Lake - 5000 feet - Hudsonian Life Zone

Location: Along the north shore of Mowich Lake at the base of a steep talus slope.

Habitat: Forested area near lake with large boulders scattered about and talus slopes from nearby cliff extending into the forest. Traps placed in narrow belt of trees nestled between the lake and the cliffs. Edge of the lake provided a more mesic area in which some grasses were able to exist.

Winthrop Glacier Outwash Plain - 5000 feet - Lower Hudsonian Life Zone

Location: Both sides of the Wonderland Trail where the trail crosses the outwash plain of the Winthrop Glacier.

Habitat: The outwash plain had little vegetation. Boulder-strewn with sharp low ridges of polished rock. A few scattered mountain hemlock, Englemen spruce, Douglas fir, and alpine fir were found in the area, and were much stunted. In lower, sandy areas, patches of mountain alder were found. Ground cover mostly of mosses and lichens clinging to rocks. No humus buildup.

Crater Creek - 5000 feet - Upper Canadian Life Zone

Location: Creek flows from the south end of Mowich Lake. Traps were placed along the creek just below the first set of falls.

Habitat: Heavy forest typical of this elevation. Fir and hemlock not large, but form a dense, closed canopy. Shrub layer rather sparse, except for along creek. Ground cover is also meager.

Mowich Lake Meadows - 5000 feet - Lower Hudsonian Life Zone

Location: Meadows located on the south side of road leading to Mowich Lake, at curve where lake may first be seen from road.

Habitat: Small meadow bounded by forests and the road. Well covered with lush vegetation, including scattered small trees, dense patches of sedges, grasses, and heather. Small temporary pond located in the meadow, but for the most part, it is well drained. The meadow is apparently being invaded by the tree and shrub species, with

fir, Cascade azalea, and heather being the primary invading species.

Sunset Lakes - 5000 feet - Lower Hudsonian Life Zone

Location: Traps placed on both sides of the Wonderland Trail where it approaches Golden Lakes, northwest of Sunset Lookout. Line began in a series of small meadows and continued into wooded area near the first lake.

Habitat: Hudsonian forest with small mesic meadows. Surrounding forest quite dry, with little ground vegetation. Huckleberry the dominant shrub, and meadows dominated by grasses and forbs of many species.

Winthrop Glacier Moraine - 5100 feet - Lower Hudsonian Life Zone

Location: North of the Wonderland Trail in the moraine area west of the Winthrop Glacier.

Habitat: Large moss-covered rocks dominate the habitat. Trees fairly dense, consisting of mountain hemlock, Douglas fir, and alpine fir to about 40 feet in height. Western white pine, lodgepole pine, and Engleman spruce found scattered in the forest. Understory mostly of alder, and no shrubs noted. Ground cover mostly mosses and lichens covering the sandy, rocky soil.

Creek (Sunrise Road) - 5200 feet - Upper Canadian Life Zone

Location: West side of road to Sunrise, two and one-half miles east of the junction of Sunrise Road with campground road.

Habitat: Very mesic, with many small springs flowing from a steep slope. Area heavily forested with mountain hemlock, silver fir, and Alaska yellow cedar. Few shrubs, but a good ground cover of grasses and numerous flowering plants.

Sunset Park - 5200 feet - Lower Hudsonian Life Zone

Location: Small, steep-sided open valley about 1/2 mile south of Sunset Lookout, between Wonderland Trail and the lookout trail.

Habitat: Secondary succession following burn during the 1930's, mostly vegetated with grasses and heather, with some low huckleberry. Coniferous trees invading the area indicating a seral stage. Snow present at the time of trapping, which kept bottom of valley quite mesic. Some decaying logs present.

Sidehill Woods - 5300 feet - Upper Canadian Life Zone

Location: West side of Sunrise Road, three miles east of where Sunrise Road junctions with campground road.

Habitat: Dry woods, moderate slope heavily forested with mountain hemlock, Engleman spruce, silver fir, and alpine fir. Moderate shrub layer of huckleberry, and sparse ground cover of trillium and other herbaceous plants.

Eleanor Trail - 5300 feet - Lower Hudsonian Life Zone

Location: Northern portion of Grand Park about one and one-fourth mile north and east of the point from which Lake Eleanor Trail joins Lake James Trail.

Habitat: Rather large meadow surrounded by large areas of heavily forested sub-alpine woods. A small, almost dry stream passed through the habitat. Heather and blueberry common. Little ground cover in woods while in the meadow there was a profusion of grasses and flowering plants. Land generally flat or slightly rolling with a light soil of sand and small rocks.

Ipsut Pass - 5300 feet - Upper Canadian Life Zone

Location: Along the Wonderland Trail between Mowich Lake and Ipsut Creek Campground. Traps placed on ridge which opens at the pass, and along the base of bluff formed by the ridge.

Habitat: Very dry forest on a steep slope with rock outcrops common. Ground cover and shrubs are sparse, with dense canopy, filtering out most of light rays. Tree species present were those typical of this zone.

Mystic Lake Patrol Cabin - 5300 feet - Lower Hudsonian Life Zone

Location: One hundred yards south and west of the patrol cabin, along the stream draining the lake.

Habitat: Mostly dry forest except along the mesic stream where meadow existed. Forest of mountain hemlock, silver fir, alpine fir, and Alaska cedar. Purple heather and huckleberry principle shrubs. Along stream, dense cover of grasses and other herbaceous plants. Topography gently sloping.

Indian Bar - 5500 feet - Hudsonian Life Zone

Location: One-half mile northwest of Indian Bar Shelter. Traps placed along both sides of Ohanapecosh River.

Habitat: Topography in immediate area of trapping relatively flat, but steep cliffs rise along three sides of this area. Stream flows from glaciers a few hundred yards above trapping area. Scattered mountain hemlock and alpine fir. Ground densely covered with sedges, grasses, and flowers to about one foot in height. Several small streams form very mesic habitat. Heather and low huckleberry to two feet high.

Grand Park - 5600 feet - Hudsonian Life Zone

Location: Along the western edge of Grand Park, 1/2 mile north of Lake James Trail. Traps placed on both sides of a small dry creek bed which drains snow melt-water from the southwestern portion of Grand Park.

Habitat: The dry creek dropped from the park into a gully surrounded by alpine fir forest. Immediately around the creekbed a meadow existed containing heather, mountain ash, and other plants common to the high meadows. The forest contained primarily alpine fir, with blueberry contributing to the shrub layer. Notable lack of ground cover under the trees. Soil quite sandy and full of rock, with very little humus buildup.

Grand Park Creek - 5600 feet - Hudsonian Life Zone

Location: In the middle of Grand Park about 1/4 mile north of the Lake James Trail and 1/4 mile east of the Lake Eleanor Trail.

Habitat: Mostly a sub-alpine meadow with very flat topography. Small clumps of alpine fir present and occasional small patches of heather. Most of habitat dominated by assorted sedges, grasses, flowers, and other meadow plants. Soil with light sand and small rock.

Mystic Lake - 5700 feet - Hudsonian Life Zone

Location: Northeastern side of Mystic Lake along steep slope falling away from the lake, north of Wonderland Trail.

Habitat: Forested with small open meadows. Dominant tree species consisted of lodgepole pine, mountain hemlock, silver fir, and alpine fir. Ground cover in woods sparse, but in meadows large number of herbaceous plants present. Topography very steep and some soil buildup present.

Tipsoo Lake - 5800 feet - Upper Hudsonian Life Zone

Location: North of Highway 5, along the ridge at west end of lake.

Habitat: Small meadows interspersed in open woods of white-bark pine, alpine fir, silver fir, and Alaska red cedar. Numerous meadow plants covering ground, and some huckleberry. Rather steep slope, with poor soil development. Rock outcrops common and small rivulets present.

Sub-Alpine Wood (Sunrise) - 5800 feet - Hudsonian Life Zone

Location: Southeast of Yakima Park, where Sunrise Road crosses creek draining Yakima Park. Traps placed northwest of corner in road.

Habitat: Area covered with alpine fir, interspersed with meadows characteristic of the transition between the high meadows and forests. Well vegetated with alpine meadow plants, sedges, grasses, heather, low huckleberry, and others. Small stream has formed a gully with land moderately sloping.

Ohanapecosh Park - 6000 feet - Upper Hudsonian Life Zone

Location: Along Wonderland Trail, one and one-half miles northwest of Indian Bar Shelter.

Habitat: Meadow, surrounded by Hudsonian woods of mountain hemlock and alpine fir. Shrubs mostly heather and huckleberry, with ground covered with sedges, grasses, and flowers typical of high meadows.

Yakima Park - 6300 feet - Arctic Alpine Life Zone

Location: In Yakima Park, along north side of road, 1/2 mile east of Sunrise Lodge.

Habitat: Mostly meadow, with a few clumps of mountain hemlock and alpine fir. Meadow of sedges, grasses, and flowering plants typical of the high meadows. Land relatively flat to gently rolling. Soil very porous, sandy, and light in color.

Panhandle Gap - 6500 feet - Arctic Alpine Life Zone

Location: Along Wonderland Trail, between Indian Bar and Summerland. Traps placed on east side of trail.

Habitat: Very rocky with little soil. Scattered alpine flowers, heather, and clumps of whitebark pine and alpine fir, much stunted by wind action. Relatively flat, but dropping away steeply from the pass. Large snowfields nearby.

Colonnades - 7000 feet - Arctic Alpine Life Zone

Location: Along the crest of the Colonnades, about two and one-half miles southeast of Sunset Lookout. Line continued to within one mile of the end of the Colonnades.

Habitat: Ridge generally steep with large rock outcrops. Vegetation consisted of sedges, grasses, some forbs, considerable heather, and small huckleberry bushes. Area burned in the 1930's and numerous charred logs and snags present. Snow in the area at the time of trapping (August 23, 1966).

APPENDIX B

LIST OF PLANT SPECIES USED TO
DETERMINE THE LIFE ZONE OF THE
VARIOUS TRAPPING SITES

Trees and Shrubs

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Abies amabilis</u>	Pacific silver fir, amabilis fir	Canadian
<u>Abies grandis</u>	Grand fir	Canadian
<u>Abies lasiocarpa</u>	Subalpine fir	Hudsonian
<u>Abies procera</u>	Noble fir	Hudsonian; Canadian
<u>Acer circinatum</u>	Vine maple	Humid trans.
<u>Acer glabrum</u>	Rocky Mountain maple	Canadian
<u>Alnus rubra</u>	Red alder	Humid trans.; Canadian
<u>Alnus sinuata</u>	Sitka alder	Canadian; Hudsonian
<u>Amelanchier florida</u>	Pacific serviceberry	Humid trans.
<u>Apocynum androsaemi- folium</u>	Spreading dogbane	Humid trans.
<u>Arctostaphylos uva-ursi</u>	Kinnikinnick	Humid trans.; Boreal
<u>Aruncus sylvester vulgaris</u>	Goat's beard	Humid trans.; Canadian
<u>Cassiope mertensiana</u>	Western mountain heather	Arctic Alpine; Hudsonian
<u>Chamaecyparis nootka- tensis</u>	Alaska cedar	Humid trans.; Canadian
<u>Chimaphila umbellata</u>	Western prince's pine	Humid trans.; Canadian
<u>Cornus stolonifera</u>	American dogwood	Boreal

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Cytisus scoparius</u>	Scotch broom	Humid trans.
<u>Gaultheria ovatifolia</u>	Oregon spicy wintergreen	Humid trans.; Canadian
<u>Gaultheria shallon</u>	Salal	Humid trans.
<u>Linnaea borealis</u> var. <u>americana</u>	American twinflower	Humid trans.; Canadian
<u>Mahonia aquifolium</u>	Holly leaved mahonia	Humid trans.
<u>Mahonia nervosa</u>	Oregon grape	Humid trans.
<u>Mahonia repens</u>	Creeping mahonia	Humid trans.
<u>Menziesia ferruginea</u>	Pacific menziesia	Humid trans.
<u>Oplopanax horridum</u>	Devil's club	Humid trans.; Canadian
<u>Pachistima myrsinites</u>	Oregon boxwood	Humid trans.; Canadian
<u>Phyllodoce empetri-</u> <u>formis</u>	Pink mountain heather	Arctic Alpine; Hudsonian
<u>Picea engelmanni</u>	Engelmann spruce	Humid trans.; Canadian
<u>Picea sitchensis</u>	Sitka spruce	Humid trans.; Canadian
<u>Pinus albicaulis</u>	Whitebark pine	Hudsonian
<u>Pinus monticola</u>	Western white pine	Canadian
<u>Populus trichocarpa</u>	Black cottonwood	Humid trans.; Canadian
<u>Pseudotsuga menziesii</u>	Douglas fir	Humid trans.
<u>Rhododendron albi-</u> <u>florum</u>	White flowered rhododendron	Hudsonian
<u>Ribes bracteosum</u>	Stink currant	Canadian
<u>Ribes lacustre</u>	Prickly currant	Boreal
<u>Ribes petiolare</u>	Western black currant	Canadian
<u>Ribes sanguineum</u>	Red flowering currant	Humid trans.
<u>Rosa gymnocarpa</u>	Wood rose	Humid trans.

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Rubus lasiococcus</u>	Hairy fruited dwarf bramble	Boreal
<u>Rubus leucodermis</u>	White stemmed raspberry	Humid trans.
<u>Rubus parviflorus</u>	Thimbleberry	Humid trans.
<u>Rubus pedatus</u>	Five-leaved dwarf bramble	Boreal
<u>Rubus spectabilis</u>	Salmonberry	Humid trans.
<u>Rubus vitifolius</u>	Pacific blackberry	Humid trans.
<u>Salix lasiandra</u>	Red willow	Humid trans.
<u>Salix scouleriana</u>	Scouler willow	Humid trans.; Canadian
<u>Sambucus callicarpa</u>	Red elderberry	Humid trans.
<u>Sorbus sitchensis</u>	Sitka mountain ash	Humid trans.
<u>Sorbus occidentalis</u>	Western mountain ash	Hudsonian
<u>Spiraea densiflora</u>	Rose colored meadow- sweet	Boreal
<u>Spiraea douglasii</u>	Douglas' spiraea	Boreal; Humid trans.
<u>Salix sp.</u>	Willow	Humid trans.; Canadian; Hudsonian
<u>Taxus brevifolia</u>	Pacific yew	Humid trans.; Canadian
<u>Thuja plicata</u>	Western red cedar	Humid trans.; Canadian
<u>Tsuga heterophylla</u>	Western hemlock	Humid trans.; Canadian
<u>Tsuga mertensiana</u>	Mountain hemlock	Hudsonian
<u>Vaccinium deliciosum</u>	Blue-leaved huckleberry	Hudsonian
<u>Vaccinium membrana- ceum</u>	Mountain bilberry (blue huckleberry)	Canadian
<u>Vaccinium parvifolium</u>	Red bilberry or red huckleberry	Humid trans.
<u>Vaccinium uliginosum</u>	Bog blueberry	Hudsonian; Canadian

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Vaccinium caespitosum</u>	Dwarf huckleberry	Boreal
<u>Herbaceous Plants</u>		
<u>Achillea millefolium</u>	Yarrow	Humid trans.
<u>Achlys triphylla</u>	Vanilla-leaf	Humid trans.
<u>Actaea arguta</u>	Baneberry	Humid trans.; Canadian
<u>Adenocaulon bicolor</u>	Trail plant	Humid trans.; Canadian
<u>Adiantum pedatum</u>	Maiden-hair fern	Humid trans.; Canadian
<u>Agoseris glauca</u>	Pale agoseris	Hudsonian; Canadian
<u>Anaphalis margaritacea</u>	Pearly everlasing	Humid trans.; Canadian; Hudsonian
<u>Anemone deltoidea</u>	Columbia windflower	Canadian; Hudsonian; <i>Handy!</i> Arctic Alpine
<u>Angelica arguta</u>	Lyall's angelica	Canadian; Hudsonian; Arctic Alpine
<u>Aira caryophyllaea</u>	Silver hairgrass	Humid trans.
<u>Arnica latifolia</u>	Broad-leaved arnica	Canadian; Hudsonian; ? Arctic Alpine
<u>Asarum caudatum</u>	Long-tailed wild ginger	Humid trans.
<u>Aster alpigenus</u>	Alpine aster	Arctic Alpine; Hudsonian
<u>Athyrium felix-femina</u>	Lady fern	Humid trans.; Canadian; Hudsonian
<u>Caltha leptosepala</u>	Slender-sepaled marsh marigold	Canadian; Hudsonian; Arctic Alpine

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Campanula scouleri</u>	Scouler's campanula	Humid trans.
<u>Carex mertensii</u>	Merten's sedge	Hudsonian ?
<u>Carex obnupta</u>	Slough sedge	Humid trans.; Canadian
<u>Circaea pacifica</u>	Enchanter's nightshade	Humid trans.
<u>Cirsium arvense</u>	Canada thistle	Humid trans.
<u>Cirsium brevistylum</u>	Indian thistle	Humid trans.
<u>Clintonia uniflora</u>	Single-flowered clintonia	Humid trans.; Canadian
<u>Coptis laciniatus</u>	Oregon goldthread	Humid trans.; Canadian
<u>Corallorhiza mertensiana</u>	Coral root	Canadian
<u>Cornus canadensis</u>	Bunchberry	Humid trans.; Canadian
<u>Corydalis scouleri</u>	Scouler's corydalis	Humid trans.
<u>Cynoglossum grande</u>	Grand hound's tongue	Humid trans.
<u>Delphinium menziesii</u>	Menzie's larkspur	Humid trans.
<u>Dicentra formosa</u>	Western bleeding heart	Humid trans.
<u>Disporum smithii</u>	Large-flowered fairy bell	Humid trans.
<u>Dodecatheon jefferyi</u>	Jeffrey's shooting star	Humid trans.; Canadian; Hudsonian
<u>Dryopteris dilatata</u>	Spreading wood fern	Humid trans.; Canadian
<u>Elymus hirsutus</u>	Northern rye grass	Hudsonian
<u>Epilobium angustifolium</u>	Fireweed	Humid trans.
<u>Epilobium glandulosum</u>	Glandular willow herb	Humid trans.; Canadian
<u>Equisetum arvense</u>	Common horsetail	Humid trans.; Canadian; Hudsonian

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Eriophyllum lanatum</u>	Common woolly sunflower	Humid trans.; Canadian
<u>Erythronium montatum</u>	Alpine adder's tongue	Hudsonian; Arctic Alpine
<u>Fritillaria lanceolata</u>	Mission bells	Humid trans.
<u>Galium aparine</u>	Cleavers	Humid trans.
<u>Gentiana calycosa</u>	Explorer's gentian	Canadian; Hudsonian; Arctic Alpine
<u>Geum macrophyllum</u>	Large-leaved avens	Humid trans.; Canadian; Hudsonian; Arctic Alpine
<u>Heracleum lanatum</u>	Cow parsnip	Humid trans.; Canadian; Hudsonian; Arctic Alpine
<u>Heuchera glabra</u>	Alpine heuchera	Canadian; Hudsonian
<u>Heuchera micrantha</u>	Small-flowered heuchera	Humid trans.
<u>Hieracium albiflorum</u>	White-flowered hawkweed	Humid trans.; Canadian
<u>Holcus lanatus</u>	Velvet grass	Humid trans.
<u>Hydrophyllum tenuipes</u>	Slender-stemmed waterleaf	Humid trans.
<u>Hypochaeris radicata</u>	Hairy cat's ears	Humid trans.
<u>Juncus ensifolius</u>	Three stemmed rush	Humid trans.; Canadian
<u>Leptarrhena pyrolifolia</u>	Leather leaved saxifrage	Canadian; Hudsonian
<u>Ligusticum grayi</u>	Gray's lovage	Humid trans.; Canadian
<u>Lilium columbianum</u>	Columbia lily	Humid trans.
<u>Limnorchis dilatata</u>	Boreal bog orchid	Canadian
<u>Limnorchis viridiflora</u>	Green-flowered bog orchid	Canadian

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Lomatium angustatum</u>	Cascade lumatium	Canadian; Hudsonian; Arctic Alpine
<u>Luetkea pectinata</u>	Luetkea	Canadian; Hudsonian
<u>Lysichitum americanum</u>	Skunk cabbage	Humid trans.; Canadian
<u>Maianthemum dilatatum</u>	False lily of the valley	Humid trans.
<u>Mertensi paniculata</u>	Tall lungwort	Canadian
<u>Mimulus dentata</u>	Tooth-leaved monkey flower	Humid trans.
<u>Mimulus guttatus</u>	Common large monkey flower	Humid trans.
<u>Mimulus lewisii</u>	Lewis' monkey flower	Canadian; Hudsonian; Arctic Alpine
<u>Mimulus moschatus</u>	Muskflower	Humid trans.
<u>Mitella caulescens</u>	Star-shaped mitrewort	Humid trans.
<u>Moehringia latifolia</u>	Sandwort	Humid trans.; Canadian
<u>Monotropa uniflora</u>	Indian pipe	Humid trans.; Canadian
<u>Montia cordifolia</u>	Cordate-leaved montia	Humid trans.; Canadian
<u>Montia parvifolia</u>	Small-leaved montia	Humid trans.; Canadian
<u>Montia perfoliata</u>	Miner's lettuce	Humid trans.
<u>Montia sibirica</u>	Siberian montia	Humid trans.; Canadian
<u>Oenanthe sarmentosa</u>	Pacific oenanthe	Humid trans.
<u>Ophrys caurina</u>	Northwestern twayblade	Humid trans.
<u>Ophrys cordata</u>	Heart-leaved twayblade	Humid trans.; Canadian

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Osmorhiza occidentalis</u>	Western sweet cicely	Humid trans.; Canadian; Hudsonian; Arctic Alpine
<u>Oxalis oregana</u>	Wood sorrel	Humid trans.; Canadian
<u>Pectinata pentandra</u>	Alpine mitrewort	Canadian; Hudsonian
<u>Pedicularis groenlandicum</u>	Elephant's head	Hudsonian; Arctic Alpine ?
<u>Pedicularis latifolia</u>	Wide-leaved lousewort	Canadian; Hudsonian
<u>Pedicularis ranierensis</u>	Mount Rainier lousewort	Arctic Alpine
<u>Penstemon nemerosus</u>	Woodland penstemon	Humid trans.; Canadian; Hudsonian
<u>Petasites frigidus</u>	Alpine coltsfoot	Hudsonian; Arctic Alpine
<u>Petasites speciosus</u>	Western coltsfoot	Humid trans.
<u>Phacelia sericea</u>	Gray phacelia	Canadian; Hudsonian; Arctic Alpine
<u>Plantago major</u>	Wide-leaf plantain	Humid trans.
<u>Polemonium pulcherrinum</u>	Showy polemonium	Canadian; Hudsonian; Arctic Alpine
<u>Polygonum bistortoides</u>	Western bistort	Canadian; Hudsonian
<u>Polystichum munitum</u>	Sword fern	Humid trans.
<u>Potentilla flabellifolia</u>	Mount Rainier cinquefoil	Arctic Alpine
<u>Pteridium aquilinum</u>	Bracken fern	Humid trans.
<u>Pulsatilla occidentalis</u>	Pasque flower	Canadian; Hudsonian
<u>Pyrola minor</u>	Common wintergreen	Canadian

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Pyrola picta</u>	White-veined wintergreen	Hudsonian
<u>Pyrola secunda</u>	One-sided wintergreen	Humid trans.; Canadian
<u>Ranunculus repens</u>	Creeping buttercup	Humid trans.
<u>Saxifraga arguta</u>	Brook saxifrage	Canadian; Hudsonian; Arctic Alpine
<u>Sedum douglasii</u>	Douglas's stonecrop	Humid trans.
<u>Senecio sylvaticus</u>	Wood senecio	Humid trans.
<u>Senecio triangularis</u>	Spearhead senecio	Canadian; Hudsonian
<u>Smilacina amplexicaulis</u>	Western solomon's seal	Humid trans.
<u>Smilacina sessilifolia</u>	Nuttall's solomon seal	Humid trans.
<u>Spiranthes romanzoffiana</u>	Hooded ladies tresses	Humid trans.; Canadian
<u>Stellaria washingtonina</u>	Washington starwort	Canadian; Hudsonian; Arctic Alpine
<u>Stenanthium occidentale</u>	Western stenanthium	Canadian; Hudsonian; Arctic Alpine
<u>Streptopus curvipes</u>	Simple-stemmed twisted stalk	Humid trans.
<u>Taraxacum officinale</u>	Dandelion	Humid trans.
<u>Tellima grandiflora</u>	Large fringe cup	Humid trans.
<u>Tiarella trifoliata</u>	Three-leaved coolwort	Humid trans.
<u>Tiarella unifoliata</u>	Western coolwort	Humid trans.; Canadian
<u>Tofieldia occidentalis</u>	Western tofieldia	Humid trans.; Canadian
<u>Tolmiea menziesii</u>	Youth-on-age	Humid trans.; Canadian
<u>Trientalis latifolia</u>	Pacific starflower	Humid trans.

<u>Scientific name</u>	<u>Common name</u>	<u>Life zone</u>
<u>Trifolium hybridum</u>	Alsike clover	Humid trans.
<u>Trillium ovatum</u>	Trillium	Humid trans.; Canadian
<u>Valeriana sitchensis</u>	Northern valerian	Canadian; Hudsonian; Arctic Alpine
<u>Veratrum viride</u>	Green false hellbore	Hudsonian
<u>Viola glabella</u>	Woodland violet	Humid trans.
<u>Viola sempervirens</u>	Evergreen violet	Humid trans.
<u>Xerophyllum tenax</u>	Bear grass	Humid trans.