HABITAT DISTRIBUTIONS OF BIRDS AND MAMMALS IN LOSTINE CANYON, WALLOWA MOUNTAINS, NORTHEAST OREGON

by

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INTRODUCTION

Some bioecologists and biogeographers have recognized for a number of years the need for exact descriptions of habitats and the careful analysis of habitat distribution for each species (e.g. 10, p.297; 11, p.337-338; 16, p.473; 20, p.435-436; 25, p.29-30). All organisms are limited in their potential distribution by a genetically fixed tolerance for a range of conditions. Many animals, particularly vertebrates, select a narrower range to live in than their physiological limits dictate.

Each species will select certain features of the environment with which it will be associated for feeding purposes, the same or different features for carrying on reproduction, and the same or still different for shelter, etc. This selection is considered to be in part genetically determined and in part learned (25).

A community is composed of the individuals that find suitable conditions in the environment of an area and that are a part of a system of inter- and intraspecific

interactions.

There are several possible approaches to the study of communities. One is to consider each species separately and work out its relations to its environment. Understanding the several species in this way leads to an understanding of some of their interactions. Another approach is to select one community and work intensively with all of the organisms present to learn of the interactions, the populations' characteristics and the effect of that particular environment on the organisms. A third approach is to select a taxonomic group of animals in a specific geographic area and work out the community or communities in which they occur. All three approaches have merit. For reasons of personal interest the third procedure was used in this study.

There are several mountainous regions in the state from which we need information of a general ecological nature. The Wallowa Mountains were selected for this work, not because the area is of more importance than the other mountains, but for personal preference. Lostine Canyon provided the best access to the heart of the mountains and so was the specific area studied. It was felt that taking a larger unit than this canyon would have necessitated a more superficial approach. The establishment of this type of problem requires a compromise

choice between a smaller area with more intense study and a larger area with less concentrated study.

There have been few biological studies made in the Wallowa Mountains. Several field personnel of the U. S. Bureau of Biological Survey made collections of birds and mammals during the second and third decades of this century. Most of the information from them is reported in a general way in Vernon Bailey's Mammals and Life Zones of Oregon (1) and Gabrielson and Jewett's Birds of Oregon (19). Booth made a study of the avian ecology in the Blue Mountains of Oregon and Washington which included a brief survey of the Wallowa Mountains (2). Stevenson published a semi-popular account of the biota of the Wallowa Mountains and adjacent parts of Oregon (35). Ferguson investigated the distribution of the reptiles and amphibians of Wallowa County including Lostine Canyon (17 and 18). Other collectors have made individual collecting trips without attempting a serious study of the area.

As previously implied, the first objective of this study was to obtain information about the ecological relations of the birds and mammals of the Wallowa Mountains, and especially of Lostine Canyon.

Several schemes of classification of natural communities have been proposed during the last half century. A few

of these have received various modifications and have had rather wide usage.

The second objective of my study has been to see how some of these classification methods might be applied to animals in the Wallowas. I purposefully refrained from closely detailed study of specific classification schemes until after my field work and analysis so that my observations would be free from selective bias due to preconceived ideas.

PHYSICAL DESCRIPTION

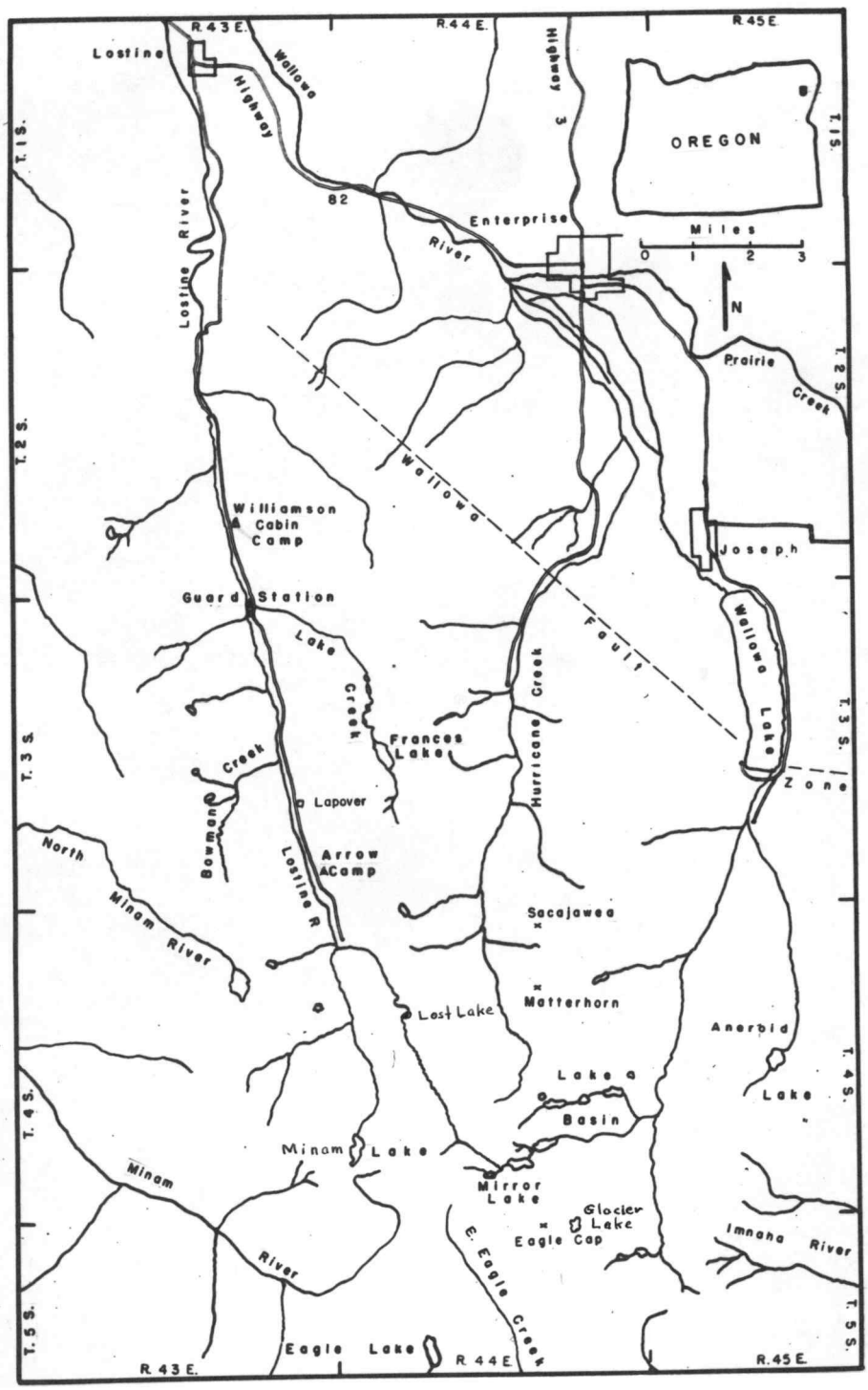
LOCATION

The Wallowa Mountains are found along the boundaries between Wallowa, Baker and Union Counties in extreme northeastern Oregon. Lostine Canyon, on the north side of the range, is found solely in Wallowa County. The town of Lostine is located at the mouth of the canyon. The distance from the town to Eagle Cap Peak at the other end of the canyon is about 25 miles. Lostine is located on State Highway 82, ten miles northwestwardly from Enterprise, the county seat.

The county and U.S. Forest Service maintain a dirt road which goes almost due south from Lostine for eighteen miles up the canyon. The Wallowa National Forest boundary crosses the road about 7 miles south of the town. The elevation at this point is approximately 4000 feet.

Between nine and ten miles south of Lostine the road reaches an elevation of 4800 feet. The field observations upon which this study is based were made in the area from this vicinity south along the main canyon and east fork to the summit of Eagle Cap, a distance of approximately 15 miles. The end of the road is nearly 5700 feet in elevation. Lost Lake, nineteen miles south of Lostine, is at 7000 feet elevation. Mirror Lake is roughly 7500 feet

elevation. It is twenty-one miles south and six miles east of Lostine. Eagle Cap Peak, rising abruptly from the southwest shore of the lake, is 9675 feet above sea level.


R.43E.
R.44E.
R.45E.
Lostine
Wallowa
Highway
Highway 3
T.1S.
OREGON
Miles
0 1 2 3
N
Lostine River
82
Enterprise
River
Prairie
Creek
T.2S.
Wallowa
Fault
Zone
Williamson
Cabin
Camp
Joseph
Guard Station
Lake
Creek
Wallowa Lake
T.3S.
Frances
Lake
Hurricane Creek
Bowman Creek
Lapover
Arrow
Camp
Lostine R
North
Minam River
Sacajawea
Matterhorn
Lost Lake
Anerbid
Lake
T.4S.
Lake a
Basin
Minam Lake
Minam
River
Mirror
Lake
Glacier
Lake
Eagle Cap
E. Eagle Creek
Imnaha River
T.5S.
Eagle Lake
R.43E.
R.44E.
R.45E.

PHYSIOGRAPHY

During the Permian period there was a time of volcanism which produced a formation now known as the Clover Creek greenstone. Following folding and metamorphosis of this formation sediments were deposited over it to form the lower sedimentary series during the Triassic period. These are composed of shales and sandstones with minor amounts of limestone, schist and others, up to about 2000 feet in thickness. This uplifted and eroded, and later subsided to form a shallow sea.

Two further formations were laid down in this sea. The first, the Martin Bridge, is composed of limestone which has been altered to varying degrees by metamorphosis. It varies from 200 to 2300 feet thick. The second was the Hurwal formation. It is up to 1500 feet thick. Adjacent to the underlying formation it is composed of clayey limestone and grades upward through calcareous shale to shale and hornfels. In places there are intercalated bands of limestone.

During the Jurassic there seems to have been uplifting, extensive folding and erosion rather than further deposition. Following these weakening processes the formations were intruded during the Cretaceous epoch by magma from below which eventually formed a large batholith of

granodiorite. The intrusion caused further folding and other changes in these layers. As this body cooled fissures developed which were in turn intruded, forming dikes of granodiorite-porphyry, aplite and lamprophyres. In the last stages of this process the metalliferous minerals now found in some areas were intruded.

During the Eocene and Miocene there was extensive erosion leading to a mature topography with relief up to 1500 feet. In water courses stream gravels were deposited. These courses were in a much different pattern than that which prevails today.

During the Miocene epoch the Columbia River basalts were extruded over the whole area, presumably to the depth of 3000 or 4000 feet. Then towards the end of the Pliocene gentle folding, severe faulting, and uplifting took place. Erosion followed with the establishment of the general drainage pattern, radiating from Eagle Cap, that is seen today. The Pleistocene then brought extensive glaciation with the attendant glacial outwash and deposits. There is one small glacial remnant to be found on the northeast face of Eagle Cap today. Non-glacial erosional agents have now resumed their leading role of changing the landscape.

Many of the features mentioned in the foregoing account can be observed in Lostine Canyon. The very definite U-shaped character of the canyon is evidence of the recent

glaciation. The walls are very steep and rise in places up to 4000 feet above the canyon floor. Hanging valleys are seen along these walls, a result of tributary glacial action. The floor is relatively wide and flat except where recent stream action is cutting down in some places to form a trench. The glaciers have left four general levels in the canyon. There is a rapid rise above the lowest level from about 4000 feet at the mouth of the canyon to about 5000 feet. Between the second and third levels another rise further south in the canyon is found from 5800 feet to about 6800 feet. The final rise of nearly 500 feet to the fourth level is more gradual and is found at the head of the canyon which leads into the Lake Basin. This basin is a series of cirque lakes left by the glaciers at 7000 feet to 7500 feet. Between these areas of rapid rise the canyon floor is relatively level.

Most of the rock to be found in the canyon is granodiorite. Some of the peaks have a small cap of the Columbia River basalt over the granodiorite. The floor and east wall of the canyon from Lapover northward have some of the sedimentary formations exposed. The floor and, in places, the wall up to a height of 500 feet or more are made up of the lower sedimentary series. The Martin Bridge formation is found above the lower sedimentary series as a belt 500 feet high. The Hurwal formation is next and varies from

about 500 feet to 2500 feet high. Above this are the granodiorite and basalts as found elsewhere. Recent alluvial deposits are accumulating at the mouth of the canyon and on the floor of the canyon from near Williamson Cabin Camp south to about Lapover.

Numerous dikes of basalt (and sometimes lamprophyre) are seen throughout the area. A few small faults are present (34).

CLIMATE

There are no weather stations maintained within the mountains proper on which to base a description of the climate of the area. The closest station with continuous records is in Wallowa at the base of the mountains, 7 miles northwest from Lostine. Its elevation is 2,935 feet. These records will give only a general picture of the actual conditions in the canyon because of various factors there which influence microclimate; e.g. elevation, exposure and vegetation.

The average annual precipitation at Wallowa is a little less than 17 inches. It is spread throughout the year with the maximum in the early winter months and a secondary maximum in late spring and early summer. Most of the winter fall is in the form of snow (average, 56.3 inches per year). This is even more true in the mountains. In mid and late summer it comes in the form of

thunder-storms, which at times are very severe. At Wallowa there is an average of 95 days per year with 0.01 inch or more of precipitation.

Some of the temperature values from Wallowa are as follows:

Annual average	44.9°	January average low	14.7°
Highest recorded	105.0°	January average high	32.8°
Lowest recorded	-38.0°	July average low	44.8°
Average number consecutive frost free days	110	July average high	85.2°

The temperature conditions in the mountains will be progressively cooler and with greater extremes with increasing elevation except where conditions of exposure counteract this generality (37).

These data indicate for the area a continental climate which is slightly moderated by the prevailing westerly flow of air from the Pacific Ocean.

Weather and physiography at times join to alter habitat conditions drastically. During winters of heavy snowfall there are snow slides and avalanches of varying sizes. In the summer there are sometimes thunder-storms which deposit large amounts of rain in a short period of time, causing the steep water courses to be scoured by mud and debris flows.

HISTORY

The information on the history of the area was obtained in a conversation with Michael Crow, a long time resident of Lostine, and personal correspondence with District Ranger G. J. Tucker of Enterprise.

The Nez Perce Indians were the main inhabitants of Wallowa County before the extensive settlement by white man. Chief Joseph's main summer camp was located at the confluence of the Wallowa and Lostine Rivers near the present town of Wallowa. Lostine River and Canyon were important to the Indians during summer and fall. The Lostine has good salmon spawning beds. The Nez Perce depended on fish for much of their livelihood and took advantage of summer salmon runs up the Lostine. They also hunted game and picked berries to add to the winter larder.

As in many areas the Indians were restricted and their activities reduced by the settlement of white men until their influence became unimportant or nonexistent. President Grant in 1873 established a 1,400,000 acre reservation for the Nez Perce which included most of the mouth of Lostine Canyon so that they had access to the good fishing grounds. Howéver, the sheepherders were soon moving in and had reached their peak in the early 1900's. Part of the Lostine Canyon was used as a driveway to the

higher reaches of the mountains. Much of the range was soon overgrazed and soil erosion became a problem. Low numbers of cattle were grazed in the lower part of the canyon. They have not been of much importance.

In 1902 the Wallowa National Forest was established. This encompassed much of the forest land of the county, including Lostine Canyon. The present site of Lapover, a dude ranch 15 miles south of Lostine, is private land originally obtained as a mineral claim some time before 1902.

About 1920 there was a very severe fire which burned from near the mouth of the canyon south to the vicinity of the fork in the river. This apparently burned out most of the vegetation along the floor and to varying heights up the walls of the canyon. There was very little of the climax forest left, and this occurred mostly in moist areas. There are lightning fires every year. The Indians probably didn't set fires purposely; however, they made no attempts at control. There was likely more destruction from fire then than now because of the suppression efforts carried on by the Forest Service.

During the 1930's the C. C. C. made the first improvements for public camping and improved the road. Little has been done since that time. The greatly increased use by campers and sportsmen in the canyon has

caused congestion and overuse of the facilities. In 1956 a program was initiated which will improve the road and camping areas.

In 1940 the Eagle Cap Wilderness Area was established. It is a 216,000 acre area which is roadless and in which all motorized equipment is forbidden. It is maintained as a watershed and for recreation. The upper five miles of Lostine Canyon and the lake basin are included. It is very popular and receives much use in August when the weather is most agreeable and the trails are generally free from snow. In some places the use by horses is quite heavy and may soon present a problem of overgrazing and require control.

METHODS

The observations upon which this study is based were gathered over a three-year period. A one-week exploratory trip was made in mid-August of 1954. Most of the information was gathered during 20 summer weeks of 1955 and 1956. Winter conditions were briefly observed in December 1955.

Each camp site that was selected was chosen because of its nearness to a variety of habitats. A total of five camping areas were used. Two areas were used twice. Over five weeks were spent in the wilderness area beyond the end of the road. Mirror Lake was the base of operation for most of this time.

After a period of scouting, representative areas (called stations) around the camp were chosen for more careful study. Information about the birds and some of the mammals was obtained by direct observation. A few birds were collected for more careful identification. A single shot 16 gauge shot gun with an auxiliary chamber bored for .38 special pistol cartridges was used for birds and bats. The cartridges were hand loaded with size 12 shot.

Information about small mammals was gained by the use of Museum Special snap traps. As far as possible, an area of uniform habitat conditions was used for each

station. Usually 40 traps were placed in a station for two trapping nights. No attempt was made to set traps according to a definite spacing arrangement. Placement was determined by presence of sign or cover. Peanut butter or rolled oats was used for bait. The birds and mammals which were preserved have been placed in the Oregon State College Museum of Natural History.

The information that was gathered about the animals was entered on Unisort Analysis (punch) cards in the field. One side of the cards was printed with lines and word reminders for material to be recorded so that nothing would be overlooked. The spaces were seldom all filled in, but these checking points assured that important items were not forgotten.

A list of plant species for each station was made at the location. Many of the plants that were not known on sight were collected and preserved for identification in the Oregon State College Herbarium. All of these specimens are deposited there.

No effort was made to gather quantitative information on plants or animals in a systematic manner. The size of the area made this impractical. If more time were available such information would add greatly to the understanding of the ecology of the area.

GENERAL VEGETATION FEATURES

The changing conditions of the past and present have produced a disturbed and fragmented vegetation. Snow slides and rapid run off from heavy rains have cut paths down the steep slopes. Areas of rock support few plants. The floor of the canyon has been altered by flooding and by deposition of debris from the mud-flows produced by sudden heavy rains. Fire has produced obvious alterations of the vegetation, especially at lower levels. These agents have left the vegetation in small patches at various stages of succession. The overgrazed condition is not as apparent now as formerly. The plants have been allowed to recover because of the greatly reduced numbers of sheep using the area.

There are two zones of vegetation recognized within the part of the canyon under study. The lower zone is characterized by Engelmann spruce and alpine fir as the apparent climax trees. There are only a few small areas approaching the undisturbed status.

Many seral conditions exist. In early stages of succession a ground cover of herbs and/or shrub species occur in differing composition, depending on the degree and time of disturbance, moisture, soil, exposure, seed source, and chance. In areas further along in development,

a dense stand of lodgepole pine is established. This quickly dominates and shades out other species. As the stand matures and opens up, the understory again becomes richer and other coniferous species become established. The stand will then give way to a mixed coniferous community of larch, Douglas fir, hemlock, grand and alpine firs and spruce. This will persist for a long period of time and slowly become a climax spruce-fir forest again if not disturbed.

The upper zone is also characterized by spruce and fir but with the addition of white-bark pine. The trees are all much smaller than at lower elevations. At about 6800 feet a narrow belt of a few mountain hemlocks mixed with spruce and fir is found as a transition between the upper and lower zones.

The more severe conditions associated with the greater altitude reduce and simplify the number of plant communities present. There is only one forest union present. Of the two shrub unions the willow is restricted to very wet conditions. The three herbaceous unions appear to be distributed according to conditions of soil depth and moisture. With so few unions present it would be difficult to try to separate seral from climax communities.

Hurricane, Wallowa, and East Eagle Canyons were each visited on half-day hiking trips to determine the nature of

the vegetation. It was found to be much the same as in Lostine Canyon. In East Eagle there seemed to be much more shrubby growth than elsewhere. In Wallowa Canyon the elements seemed to be in larger unbroken units, but otherwise very similar to Lostine. In upper Hurricane Canyon there was more swampy vegetation than in the upper east fork of the Lostine Canyon. Lincoln sparrows were seen in this swampy area and none were recorded from Lostine Canyon. Several people told me of large rock slides in lower Hurricane which were inhabited by marmots. I saw none of them in the Lostine.

ELEMENTS OF THE HABITAT

The habitat of any animal at any one location is composed of a combination of several elements. Most of these elements can be found associated with other elements, elsewhere, in different combinations. In order to better understand how an animal utilizes the habitat, it helps to separate and analyze these environmental elements and then see how they are interrelated. The vegetational elements are the most obvious and probably the most important. The non-living elements provide some physical features, e.g., rocks, streams, logs, etc., which are indispensible for a few species. If such features are absent the animals will not be found in that area. The physical features will be listed first.

PHYSICAL FEATURES

In preceding sections brief mention has been made concerning the physical features. For more accurate description and convenience of discussion, rock, water, and dead trees are divided into several arbitrary units.

Rocky Soil: This includes rocks from the size of small gravel up to about two feet. Due to the steepness of many slopes and the accompanying instability of the soil, many areas have much rock mixed in with the soil.

Boulders: Any rocks larger than two feet which are removed from the site of their parent mass are included in this unit. Much material of this description is found in talus slopes at many places in the canyon.

Solid Rock: Cliffs and benches are formed by large masses of relatively unweathered rock. Most of this is found in the lake basin or on the ridges.

Streams: This includes bodies of water which have a definite current. Lostine River with its tributaries is the watercourse of the canyon. In places in the lower reaches it attains widths up to 40 feet and has pools ten to twelve feet deep. The tributaries range from intermittent trickles to creeks several feet across. The flow of these waterways fluctuates greatly under the influence of spring snow melt and summer thundershowers interspersed with dry periods.

Lakes: Bodies of water without noticeable current compose this unit. Lost Lake is found on the floor of the upper valley. Mirror and Upper Lakes are found at the base of Eagle Cap at the upper end of the Lake Basin. Other lakes are nestled along the crests of the ridges; e. g., Maxwell, Chimney, and Frances Lakes. Water bodies of various sizes abound in the upper elevations of the whole range. They occur in the cirques left by former glaciers.

Snags: Along the floor of the lower canyon many dead trees have been left standing by the fire. On the canyon walls

there are many trees that have grown for many years before finally succumbing to the severe conditions. In exposed places lightning has killed many trees. Many more trees are barely alive which have very little foliage. These are all classed as snags.

Logs: Throughout the canyon there are many dead trees on the ground in various stages of disintegration. Some are the result of fire. Others have been piled like match sticks by snow slides. Many have died from other causes and have passed through the snag stage until they fell.

Clearings and Buildings: The animals are affected by man's changes in the physical composition of the environment. There are clearings for roads, trails, and camp and cabin sites. Buildings are found several places along the road. Corrals are used for controlling horses. There is a telephone line up to Lapover. Most camps have tables and fireplaces.

VEGETATIONAL ELEMENTS

A vegetation analysis usually includes information about the structure of the communities, their composition, and their place in succession. The literature describes the climax spruce-fir forest and some of the seral stages (8, 9, 27). With this information as a background observations were made on the apparent stability of the elements

to be described. Comments on these observations are presented where they have bearing in the discussion.

Layering of vegetation is one important aspect of structure. Each layer will have one or more characteristic assemblages of plants which present a particular physiognomy. In this discussion each unit of a characteristic physiognomy and species composition is called a union. For each union one or two species have been selected for a name to represent it. Because observations upon which these units are founded were limited and without a quantitative base, it should be stressed that the choice of species to represent the unions is purely subjective and that such species do not have greater importance than many of the other species included.

It was not found practicable to study the vegetation in enough detail in the canyon or at any intervening localities to make possible direct comparisons with the classifications of other workers in other specific areas. For this reason the names for unions presented here are common names and are placed in quotation marks to remove any confusion that might develop over names common to this and other areas.

For each union there is a brief descriptive statement followed by a list of the species of plants in that union. Each list is made up of species which occurred

with that union in one or more stands. In a more thorough study it would be advisable to have some means of eliminating the accidentals which are included in this study. Many species are found in more than one list.

These unions are highly variable. It is fully realized that the descriptions which follow simplify the situation considerably. In any one stand the unions may have only half of the species listed, and, undoubtedly have others not listed. There are always zones of intergradation in passing from one stand to another. These confounding features should be recognized whenever possible, but the endless variety does not allow description.

In a previous section it was mentioned that there are two zones of vegetation within the area of this study. We will now consider them in more detail.

Lower Zone

"Spruce-fir union": Engelmann spruce and alpine fir together appear to make up the climax dominant layer. There are only a few small areas approaching this condition, and even here they are for the most part vigorous young trees with other species mixed in. If half of the upper story of a stand was composed of these species it was placed in this category. It was found that under such conditions the tree reproduction was predominantly of these two species. In some areas isolated tall spires of

larch towering above the general level of the canopy are spaced throughout a stand. These are remainders from stands present previous to the fire. They generally have scanty foliage and approach the form previously designated as snags.

Species present:

Abies grandis	Picea engelmanni
Abies lasiocarpa	Pseudotsuga menziesii
Larix occidentalis	

"Larch union": The differences between this and the preceding union are slight. The same species are present with the addition of lodgepole pine. Due to the long life of most of the trees this union is relatively stable. It is characterized by having Engelmann spruce and alpine fir as less than half of the dominant layer. Given enough time these two species will presumably assume greater importance.

Species present:

Abies grandis	Picea engelmanni
Abies lasiocarpa	Pinus contorta
Larix occidentalis	Pseudotsuga menziesii

"Lodgepole pine union": In many areas lodgepole pine is the only tree species present in the dominant layer. Frequently, after fire, lodgepole becomes established and grows in vigorous dense stands. As the stand matures the canopy thins and other coniferous species become

established. The trees grow until they reach the height of the pine and then quickly replace it. Stands are placed in this union if lodgepole is abundant and taller than the other conifers that may be below it.

In a few isolated places on steep hillsides, single yellow pine trees stand on rock outcrops. They are not abundant enough in the canyon to be called a union.

Species present: Pinus contorta.

"Cottonwood union": Along the river and streams in the lower zone where recent alluvium has been deposited there are a few stands which have large cottonwood trees. Because these are the only big broad-leaved trees in the study area it is felt that they present a different enough element to be called a union.

Species present:

Abies grandis
Abies lasiocarpa
Larix occidentalis
Picea engelmanni
Pinus contorta
Populus trichocarpa
Pseudotsuga menziesii

"Dogwood union": This union of shrubs is usually found on wet soils where it forms dense thickets. It occurs most frequently along water courses and on slopes where there are recurrent snow slides.

Usually various species from the other shrubby unions are present with this one. This is interpreted as meaning the others are weakly represented. Rather than listing all

of the other unions every time, it will be understood that they are weak elements present with this union.

Species present:

Alnus sinuata	Rubus parviflorus
Cornus stolonifera	Salix spp.
Lonicera involucrata	Sambucus melanocarpa
Ribes lacustre	

"Maple union": The union presented here is characterized by its height, being two meters or taller. Under some conditions the maple grows up to seven meters high. The union is found either in the open or under a canopy.

Species present:

Acer glabrum	Populus tremuloides
Alnus sinuata	Prunus emarginata
Crataegus douglasii	Salix spp.

"Snowberry union": More species are included in this than in other shrub unions. It is also the most variable and the most widespread. It is found as an understory under trees, under the taller shrubs, or by itself in the open. Its members are from one-half to two and one-half meters high.

Species present:

Actaea arguta	Physocarpus malvaceus
Amelanchier florida	Ribes lacustre
Ceanothus velutinus	Rosa gymnocarpa
Holodiscus discolor	Rubus melanolasius
Juniperus occidentalis	Salix spp.
J. communis	Symphoricarpos alba
Lonicera involucrata	Vaccinium membranaceum

"Squawberry union": Though of less than a half meter in height and with few member species, this union is quite widespread. It is seldom found by itself but is associated with one or more layers of shrubs and/or an overstory of any of the tree unions.

Species present:

Berberis repens
Kalmia polifolia
Ledum glandulosum
Pachystima myrsinitis
Spiraea densiflora
Vaccinium scoparium

"Sagebrush union": A community dominated by sagebrush is often found on southwest facing slopes which have thin, dry, rocky soils. It is not seen associated with any overstory. A weak herb layer may be present.

Species present:

Artemisia tridentata
Ceanothus velutinus
Chrysothamnus nauseosus

"Lungwort union": Of the three herb unions this occurs on the most moist soils. This is by water courses or near seeps. It is found by itself or associated with a shrub union and sometimes a tree union.

Species present:

Achillea millifolium
Aconitum columbianum
Agastache urticifolia
Agrostis thurberiana
Anaphalis margaratacea
Anemone lyallii
Antennaria rosea
Astragalus alpinus
Calamagrostis rubescens
Carex disperma
C. festivella
C. gymnoclada
C. hoodii
C. microptera
C. practicola
Castilleja miniata
Cerastium vulgatum
Cinna latifolia

Clintonia uniflora
Descurania pinnata
Dodecatheon alpinum
Elymus glaucus
Epilobium glaberrimum
E. hornemanni
Erigeron coulteri
Fragaria vesca
var. bracteata
Galium bifolium
G. triflorum
Gentiana amarella
. var. acuta
Geum macrophyllum
G. strictum
Glycera elata
G. pauciflora
Gnaphalium thermale
Heracleum lanatum
Hierchloe odorata
Hypericum anagalloides
H. scouleri
Juncus ensifolius
J. regelii
Luzula campestris
L. wahlenbergii
Mertensia oblongifolia
Mimulus lewisii
M. moschatus
Mitella pentandra
Montia cordifolia
Osmorhiza nuda
Parnassia fimbriata
Phleum alpinum
Potentilla flabelliformis
Pyrola asarifolia
Ranunculus bongardi
Rubus melanolasius
R. parviflorus
Saxifraga arguta
Scrophularia lanceolata
Senecio suksdorfii
Smilacina sessilifolia
Streptopus amplexifolia
Swertia radiata
Thalictrum occidentale
Tiarella unifoliata (?)
Trifolium repens
Trisetum wolfii
Urtica lyallii
Veronica americana
V. wormskjoldii
Viola glabella

"Twinflower union": This most widely distributed herb union is seldom found by itself. It is found with a shrub union and usually both are under a tree union.

Species present:

Achillea millifolium
Agastache urticifolia
Anemone lyallii
Antennaria lanata
Astragalus canadensis
Calamagrostis rubescens
Carex raynoldsii
Castilleja miniata
Collinsia parviflora
Epilobium hornemanni
Festuca occidentalis
F. rubra
Fragaria vesca
var. bracteata
Galium triflorum
Geranium viscosissimum
Goodyeara decipiens
Hackelia jessicae
Hieracium albiflorum
Hypericum anagalloides
Linnaea borealis
Lomatium idahoensis
Luzula wahlenbergii
Melica subulata

Microsteris gracilis
Myosotis macrosperma
Osmorhiza nuda
Penstemon globosus
Phacelia leucophylla
  var. alpina
Poa pratensis
Polygonum douglasii
Potentilla flabellifolia
Pyrola dentata
  var. integra
Ranunculus bongardi
Rudbeckia occidentalis
Rumex acetocella
Scrophularia lanceolata
Silene menziesii
Smilacina sessilifolia
Stipa columbiana
Swertia radiata
Thalictrum occidentale
Thlaspe alpestre
Urtica lyallii
Verbascum blattaria
Viola nephrophylla

"Junegrass union": Dry soil conditions are usually found to have this union present. Often there is a shrub union present but seldom a tree union.

Species present:

Achillea millifolium
Agropyron spicatum
Agrostis hiemalis
Antennaria rosea
Arabis holboellii
Arenaria macrophyllum
Artemisia ludoviciana
  var. incompta
Astragalus canadensis
  var. morton
Bromus marginatus
Calachortus eurycarpus
Carex hoodii
Castilleja miniata
Cirsium utahensis
Crepis acuminata
Cryptantha ambigua
Epilobium minutum
Eriogonum heracleoides
Fragaria vesca
  var. bracteata
Geranium viscosissimum
Gilia aggregata
Habenaria unalaschensis
Hedysarum mackenzii
Juncus parryi
Koeleria cristata
Lesquerella sherwoodii
Melilotus officinalis
Penstemon deustus
P. globosus
P. venustus
Phacelia leucophylla
  var. alpina
Phleum alpinum
Poa gracillima
P. pratensis
Polygonum douglasii
Rumex acetocella
Sedum douglasii
Senecio canus
Solidago lepida
Stipa columbiana

Upper Zone

"White-bark pine union": There is only one tree union in the upper zone. The spruce and fir are both

smaller in this union than they are in the "spruce-fir union" of the lower zone. The pine becomes a more important member with increasing elevation.

Under extreme conditions the trees are stunted and misshapen presenting a very different form to animals. Groups of young trees also provide a different habitat form. In many areas the trees are spaced far enough apart either as individuals or clumps to give the effect of a woodland.

Species present:

Abies lasiocarpa *Pinus albicaulis*
Picea engelmanni

"*Labrador tea union*": The upland shrub community is only poorly developed at this elevation. It is found only under or very near the "pine union".

Species present:

Gaultheria humifusa *Vaccinium occidentale*
Ledum glandulosum

"*Willow union*": Along the stream courses and wet places of the upper valley floor are dense clumps of short willows. They are not found away from water nor are they associated with any other union.

Species present: *Salix* spp.

"*Heather union*": This is the most widespread of the three ground layer unions. It is found alone or under the

tree union with or without the "labrador tea union". It is best developed on well-drained, fairly deep soil.

Species present:

Allium validum
Anemone occidentalis
Antennaria lanata
Arabis lyallii
Arenaria obtusiloba
Aster alpigenus
Carex podocarpa
Cassiope mertensiana
Castilleja chrysantha
Deschampsia atropurpurea
Epilobium minutum
Erigeron peregrinus
Festuca rubra
Hieracium gracile
Hypericum anagalloides
Juncus drummondii
J. nevadensis
J. parryi
Kalmia polifolia
Lewisia triphylla
L. pygmaea
Ligusticum filicinum
Luzula piperi
L. wahlenbergii
Pedicularis racemosa
Phleum alpinum
Phyllodoce empetriformis
Poa epilis
Polygonum phytolaccaefolium
Potentilla flabellifolia
Ranunculus populago
Senecio subnudus
Sibbaldia procumbens
Spraguea umbellata
Vaccinium scoparium
Valeriana sitchensis
Veronica cusickii
V. wormskjldii
Viola nephrophylla

"Shooting star union": The assemblage of plants included in this category is found on wet soils. It is usually not associated with other unions but may be found in a few places under the tree union. There are numerous undrained pockets, seeps, and small water courses which provide a setting for these plants.

Species present:

Agoseris aurantiaca
Agrostis humilis
A. thurberiana
Allium douglasii
A. validum
Carex ablata
C. gymnoclada
C. illota
Carex microptera
C. neurophora
Castilleja chrysantha
C. miniata
Deschampsia caespitosa
Dodecatheon alpinum
Epilobium hornemanni
Erigeron simplex

Festuca rubra
Gentiana calycosa
Habenaria stricta
Heracleum lanatum
Hypericum anagalloides
Juncus drummondii
Kalmia polifolia
Koeleria cristata
Ligusticum filicinum
Lupinus wyethii
Luzula multiflora
Mertensia oblongifolia
Mimulus primuloides
Mitella pentandra
Montia cordifolia
Muhlenbergia filiformis
Parnassia fimbriata
Pedicularis groenlandica
var. surrecta
Phleum alpinum
Polemonium californicum
Polygonum phytolaccaefolium
Saxifraga arguta
Senecio porteri
Trisetum spicatum
T. wolfii
Viola palustris

"Pussy-paws union": This union is found in relatively dry sites. It is not very common. It is usually by itself but may associate with the tree union.

Species present:

Achillea millifolium
Agastache urticifolia
Arenaria formosa
Arnica mollis
Aster alpigenus
Carex pachystachya
Castilleja chrysantha
Clematis hirsutissima
Eriogonum piperi
Festuca rubra
Hypericum scouleri
Juncus parryi
Ligusticum filicinum
Linanthus nuttallii
Melica bulbosa
Pedicularis contorta
P. racemosa
Penstemon globosus
P. fruticosus
var. serratus
Phyllodoce empetriformis
Poa epilis
P. pratensis
Polygonum phytolaccaefolium
Potentilla flabellifolia
P. fruticosa
Spraguea umbellata
Thalictrum occidentale
Trisetum spicatum
Vaccinium scoparium
Valeriana sitchensis
Veronica wormskjoldi
Silene oregana

"Sheep Fescue union": This assemblage is presented with the knowledge that it is very tentative because of the very brief observations on which it is based. It is found on the exposed ridges and peaks mostly on the

northeast exposures where snow remains the longest. Further investigation undoubtedly would add much.

Species present:

Arabis lyallii
Arenaria obtusiloba
Carex podocarpa
C. phaeocephala
Chaenactis nevadensis
Claytonia bellidifolia
Collomia debilis
Draba paysonii
Eriogonum caespitosum
Festuca ovina var. *brachyphyllum*
Happlopappus lyallii
Horkelia gordoni
Hulsea algida
Oxyria digyna
Phacelio leucophylla var. *alpina*
Saxifraga bronchialis var. *austromontana*
Sedum radiatum
Silene acaulis
Sitanion hystrix
Smelowskia calycina

At any one spot there will usually be more than one union present. When two or more unions are repeatedly found together this combination is herein called an association. Due to the instability of the physical environment these associations are mostly in small units and are extremely variable.

A union in a given association may be well represented in one stand but almost absent in another. Even though the union is poorly represented and may be there partly by chance it probably expresses the physical conditions obtaining at that spot and thus gives a clue to the environmental potentialities. On the other hand, as far as the animals are concerned, when a union is so reduced it is for all practical purposes non-existent as a feature of the environment.

The associations are designated by the names of the unions of which they are composed. In some cases, if all the unions were included the name would become very unwieldy, so no more than three names are used. This situation is particularly true with some of the shrub unions of the lower zone.

Lower Zone

"Spruce-fir: maple: twinflower association"

Unions represented:

"spruce-fir"
"maple"
"snowberry"
"squawberry"
"twinflower"

This association occurs on moderately well-drained soils in areas which show no signs of recent disturbance. It represents the climax vegetation which would be most widespread in the lower zone if conditions were more stable. In actuality there are only a few small areas which presently support this unit.

"Spruce-fir: maple: lungwort association"

Unions represented:

"spruce-fir"
"maple"
"snowberry"
"squawberry"
"lungwort"

With the exception of the replacement of the "twinflower union" by the "lungwort union" this group is similar to the preceding association. It is found on poorly drained soils where there has been no recent

disturbance. This is usually close to the river. Because of the prevalence of disturbed conditions the association is limited.

"Spruce-fir: dogwood: lungwort association"

Unions represented:

"spruce-fir"
"dogwood"
"lungwort"

In the wettest undisturbed areas which support forest vegetation near the river this unit is found. In some places the tree union is young and vigorous, making a dense canopy. With such conditions the underlying unions are sparse.

"Larch: maple: twinflower association"

Unions represented:

"larch"
"maple"
"snowberry"
"squawberry"
"twinflower"

The difference between this association and the "spruce-fir: maple: twinflower" is mainly the percentage composition of the tree unions. To animals they probably are inseparable. This association is also found on moderately well-drained soils. It is fairly well distributed in the lower valley.

"Larch: dogwood: lungwort association"

Unions represented:

"larch"
"dogwood"
"lungwort"

This corresponds to the "spruce-fir: dogwood: lungwort association" and differs from it mainly by the stage of succession of the tree union. It, too, is found on poorly drained soils.

"Lodgepole pine: maple: twinflower association"

Unions represented:

"lodgepole pine"
"maple"
"snowberry"
"squawberry"
"twinflower"

This is the most common of the forest associations in the lower zone of the canyon. It grades from very dense tree cover with little in the way of understory to more open cover with the understories well represented to quite open with the understory reduced. Probably the most usual situation is a fairly dense pine cover with the ground moderately well covered by the squawberry and twinflower unions; while the two other unions are scantily represented.

"Lodgepole pine: dogwood: lungwort association"

Unions represented:

"lodgepole pine"
"dogwood"
"lungwort"

The association presented here is very limited in distribution. It is found on moist soils in only a few places. The moist soils usually support tree unions further along in succession.

"Cottonwood: dogwood: lungwort association"

Unions represented:

"cottonwood" "lungwort"
"dogwood"

In the lower canyon along the river where recent alluvium has been deposited and the soils are poorly drained there are small fragments of this association. These weak fragments are the uppermost extension of riparian conditions more strongly developed below the lower limit of this study.

"Dogwood: lungwort association"

Unions represented:

"dogwood" "lungwort"

On areas of moist soil which are unstable or for reasons of chance have no tree cover this association is found. It is common where snow slides are frequent, along steep water courses, and in places along the main river.

"Maple: twinflower association"

Unions represented:

"maple" "squawberry"
"snowberry" "twinflower"

On moderately well-drained soils lacking a tree cover, as on much of the steep valley walls, this association occurs. It is fairly variable. Sometimes the "maple union" is almost absent and one of the others makes up most of the cover; while in another location the "maple"

almost shades out the lower unions.

"Maple: Junegrass association"

Unions represented:

"maple" "squawberry"
"snowberry" "Junegrass"

This is very similar to the preceding association except for the replacement of the "twinflower union" by the "Junegrass union". It is found on drier soils.

"Sagebrush: Junegrass association"

Unions represented:

"sagebrush" "Junegrass"

On southwest facing slopes, areas with thin, rocky soil are likely to have this association. In a few areas diluted tongues extend out onto more fertile soils. It occupies only a very small total area.

Upper Zone

"White-barked pine: shooting star association"

Unions represented:

"white-barked pine" "shooting star"
"labrador tea"

This association is found in places where the soils are wet. Such conditions are found near water courses or over the several seeps found in the area. This association is quite variable but the least so of the three at this level.

"White-barked pine: heather association"

Unions represented:

"white-barked pine" "heather"
"labrador tea"

This is the most abundant of the upper zone associations. It is found over a wide range of conditions but not on very wet or very dry soils. Often the shrub union is scanty. The distribution of individual plant species within the association is very patchy.

"White-barked pine: pussy-paws association"

Unions represented:

"white-barked pine" "pussy-paws"
"labrador tea"

This association occurs on the driest soils which support tree growth. It is the least abundant of the three associations in this zone. The same patchiness is characteristic of this unit as with the preceding.

Plate 1

LOWER ZONE OF LOSTINE CANYON

This view is looking south in Lostine Canyon. The tip of Eagle Cap is visible in the left gap. The ridge between the gaps separates the east and west forks of the river. Most of the scene is of the southern-most third of the lower zone. Notice the large area of non-forested slope.

The grass in the right foreground represents the "Junegrass union" on rocky soil. The snag in the center is typical of many found along the canyon wall. They are used by many birds for perches, e.g. tanager, red-tail hawk, olive-sided flycatcher, and Clark's nutcracker, etc.

Plate 1

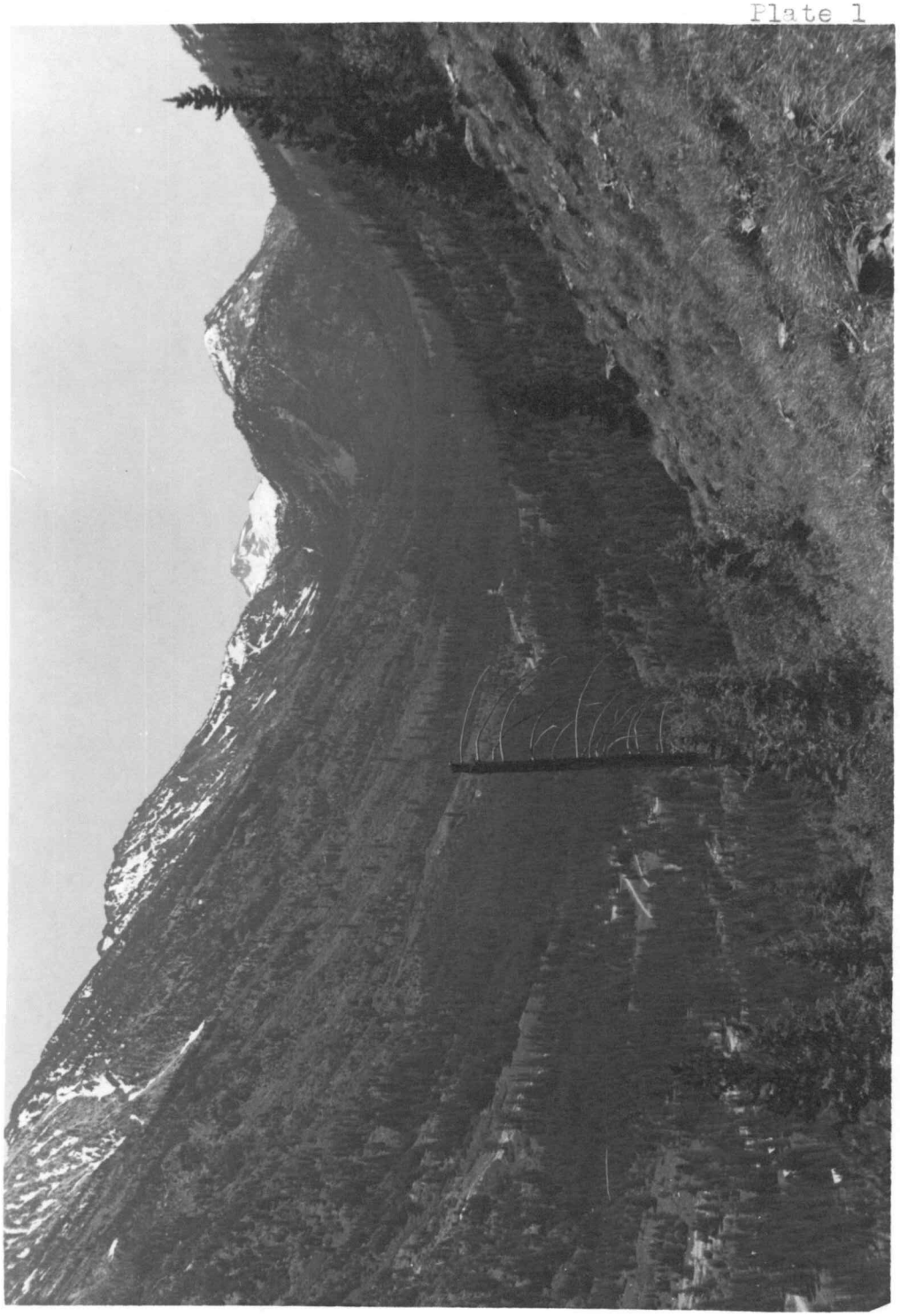


Plate 2

LOSTINE RIVER NEAR WILLIAMSON CABIN CAMP

In late summer the river has a very low volume of water as is shown here. During most of the summer little of the sandbars is visible.

The cottonwood trees of the middle distance are part of the "cottonwood union". The "cottonwood union" is weakly represented in the study area as can be seen in this picture.

The canyon wall in the distance is densely covered by a stagnated stand of the "lodgepole pine union". The clear areas extending down the slopes are a result of former snow slides.

Plate 2

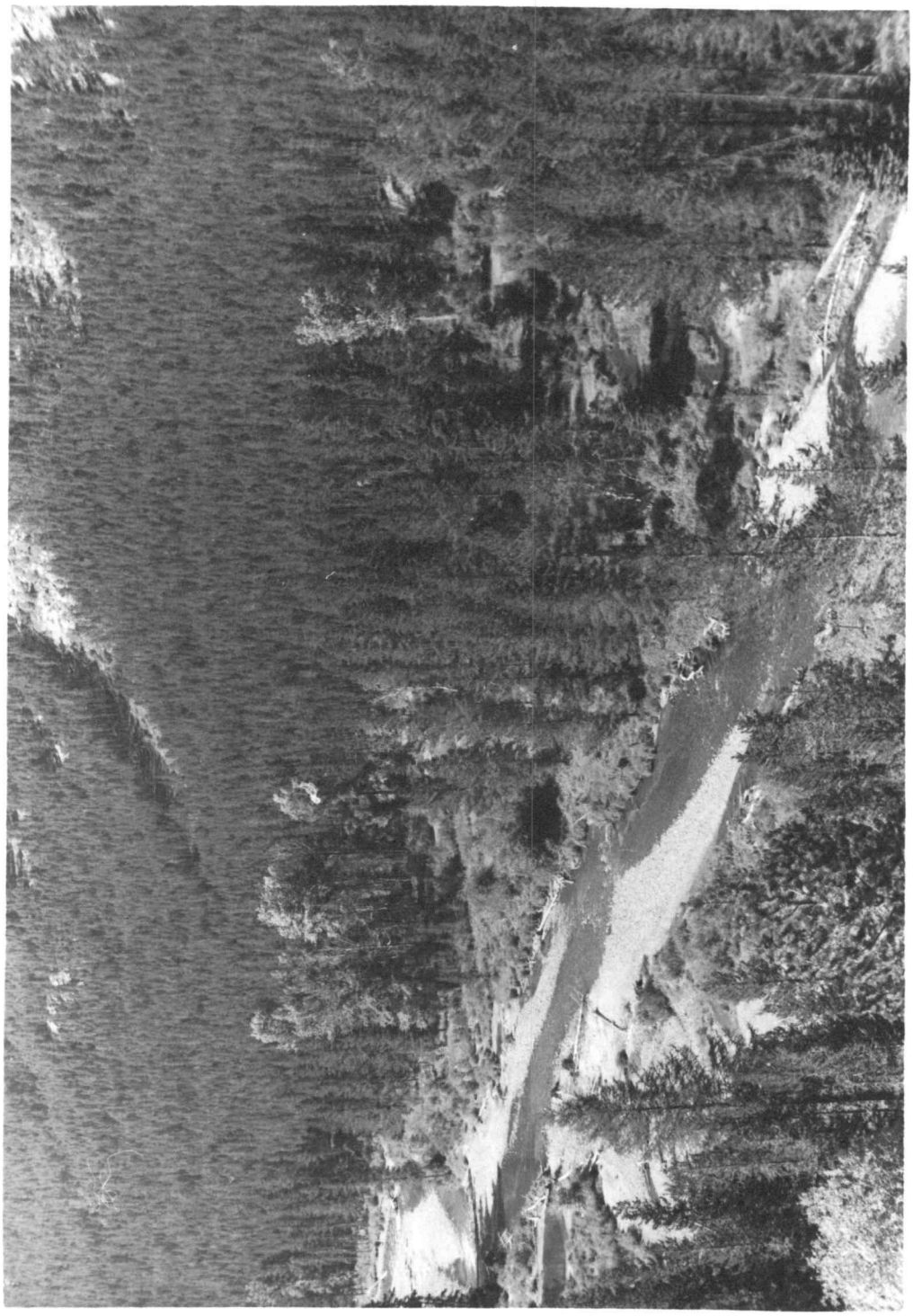


Plate 3

BANDS OF VEGETATION ON SEDIMENTARY MATERIALS

This picture was taken from the clear area within the lodgepole pine in the upper center of Plate 2. The dense tangle of logs left after the snow slide can be seen in the lower part of the picture.

In the distance a decided banding of vegetation can be seen on the hillside east of the river. This condition does not exist on the west side or on the east side south of Lapover. It is a result of the exposure of different layers of sedimentary rock formations and the consequent different soil-moisture relationships. The lightest colored area is covered by a sparse representation of the "Junegrass union", the most xeric of the vegetation. The brushy cover represents the "maple: Junegrass association". The trees are of the "lodgepole pine union". A short section of the river can be seen at the left of center.

Plate 3

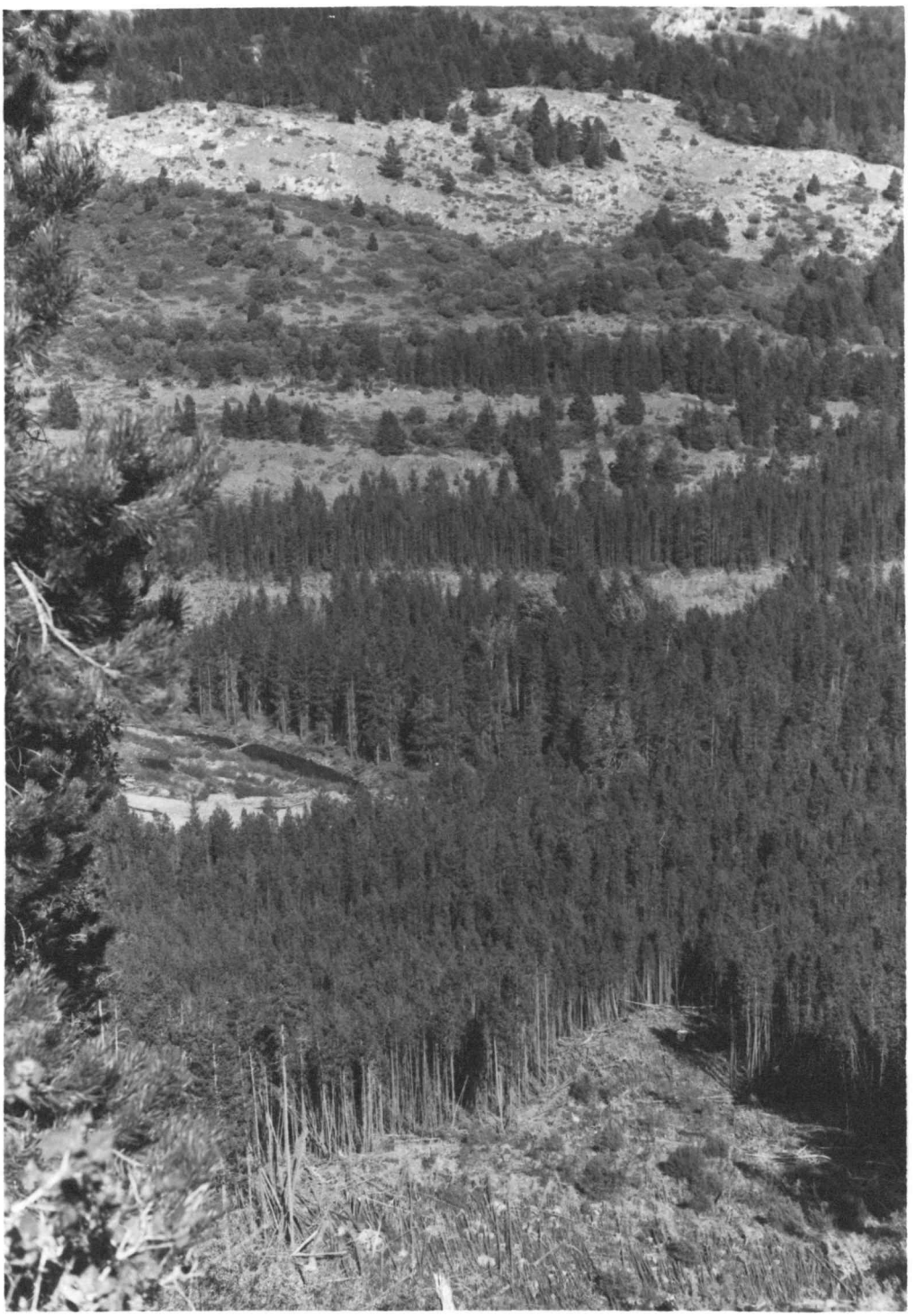


Plate 4

INTERIOR OF "SPRUCE-FIR: DOGWOOD: LUNGWORT ASSOCIATION"

On wet sites like this a dense growth occurs. The climax condition is demonstrated by the age range of the spruce and fir trees shown.

Plate 4

Plate 5

INTERIOR OF THE "SPRUCE-FIR: MAPLE: TWINFLOWER ASSOCIATION"

The shrubs of this association are not as dense as in the one illustrated by Plate 4. The "maple union" reaches its greatest height in this association as seen in the center of the picture.

Plate 5

Plate 6

INTERIOR OF THE "LARCH: MAPLE: TWINFLOWER ASSOCIATION"

The relative heights of the "maple" and "snowberry" unions are well shown in this picture. The "larch union" is not as complete as it is in many areas. The "squawberry" and "twinflower" unions are obscured by the "snowberry union" in the foreground.

Plate 6

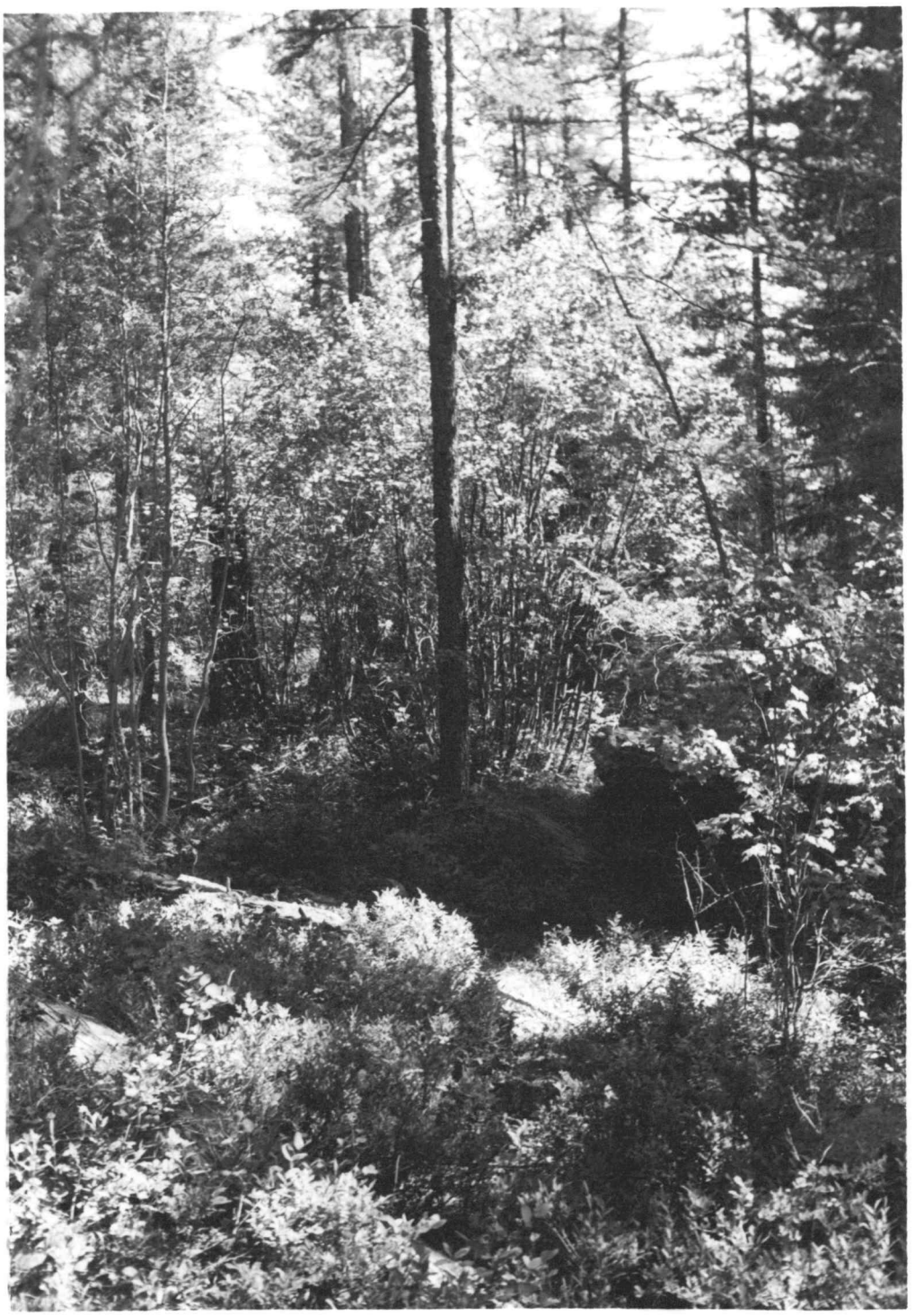


Plate 7

INTERIOR OF THE "LODGEPOLE PINE: DOGWOOD: LUNGWORT ASSOCIATION"

The density of the "dogwood union" is again seen. In the center foreground the lush character of the "lungwort union" appears.

Plate 7

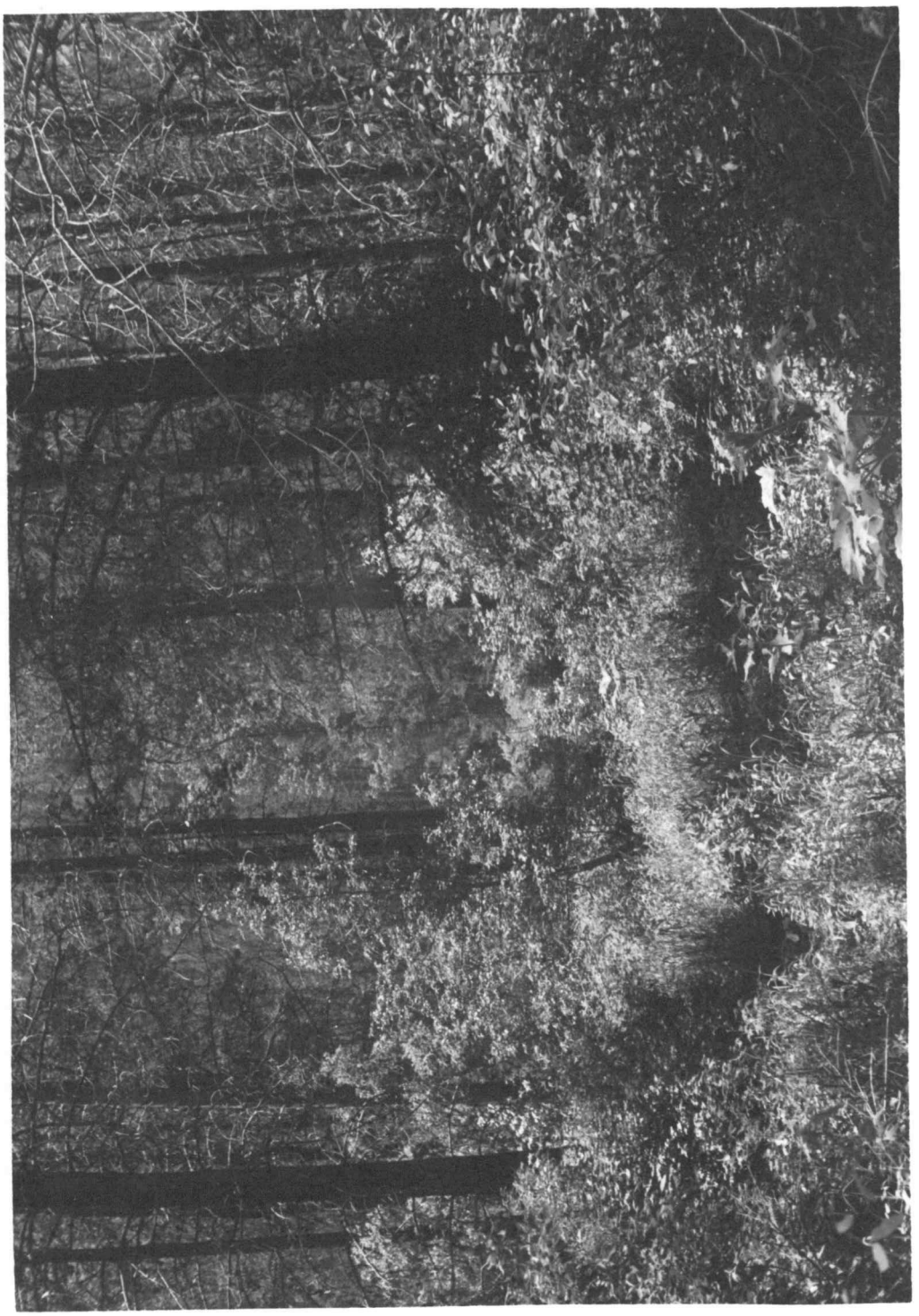


Plate 8

INTERIOR OF THE "LODGEPOLE PINE: MAPLE: TWINFLOWER ASSOCIATION"

As in much of this association the "maple union" is poorly represented in this area (not seen in this picture). The density of the "lodgepole pine union" suppresses the subordinate unions.

Notice the size and number of the logs on the ground. They are convincing evidence of the potential of the area. They were cut down after being killed by fire.

Plate 8

Plate 9

SPARSE INTERIOR OF "LODGEPOLE PINE: MAPLE: TWINFLOWER ASSOCIATION"

In many places the appearance of this association is similar to Plate 8 but in many others the two higher shrub unions are very poorly represented and the general aspect is like the scene shown here. Much of the ground cover is Vaccinium scoparium, or "squawberry", as the people of the area call it.

Plate 9

Plate 10

INTERIOR OF "MAPLE: JUNEGRASS ASSOCIATION"

The decaying burned log in the foreground indicates that at one time there was more of a tree cover present on this hillside. There are young trees (not shown) coming up in the area so that it can be assumed it will again be forested.

Much of this association is characterized by the patchy distributional relationship of the "maple", "snowberry" and "Junegrass" unions as is shown here.

Plate 10

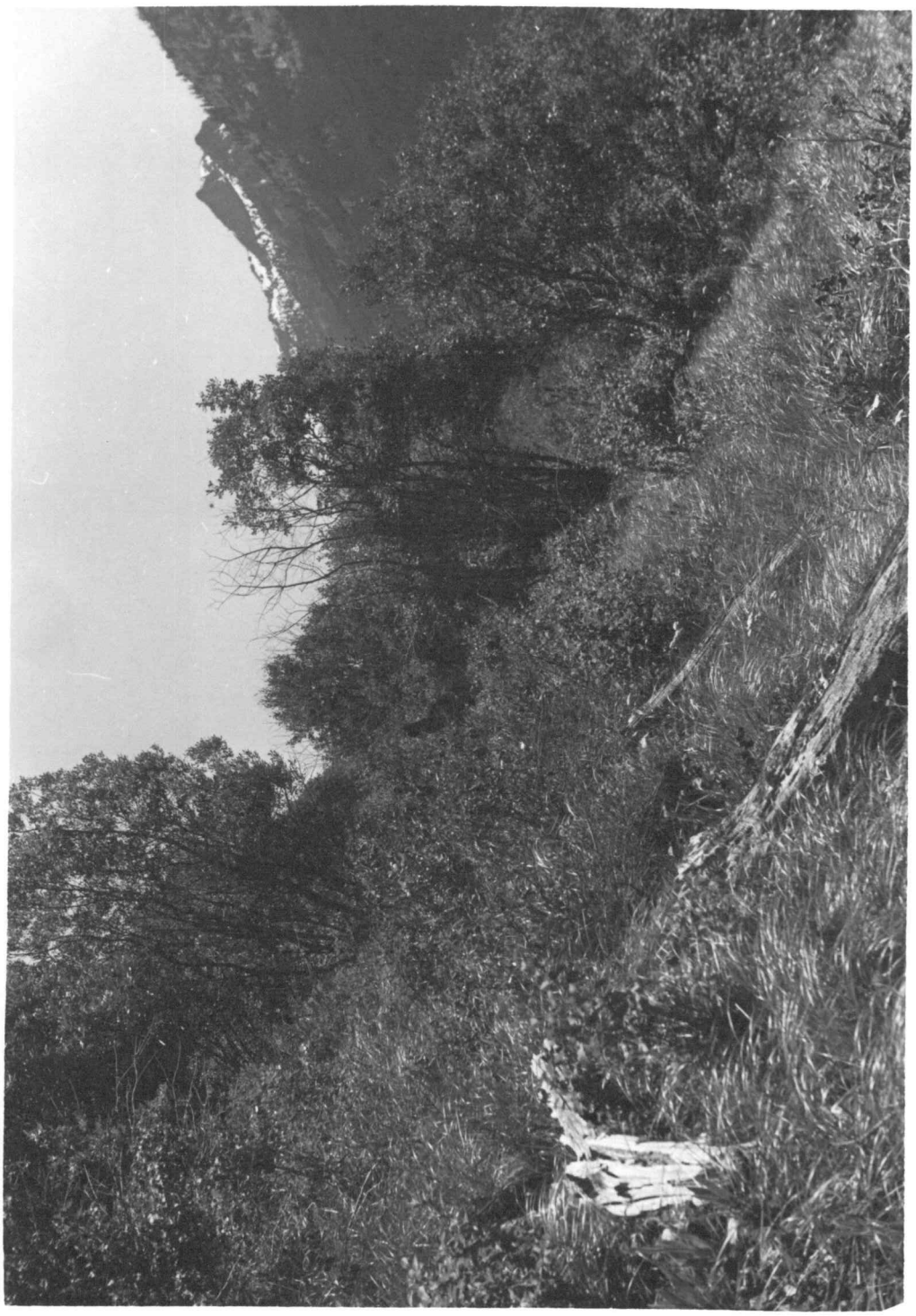


Plate 11

EAGLE CAP AND THE UPPER VALLEY

The watercourse in the foreground indicates the meandering drainage pattern found in the meadow of the upper valley. This is a little creek flowing across the meadow to join the main stream at the east (left) margin of the meadow. The vegetation is mostly a low-growing modification of the "heather union". In places a weak development of the "shooting star" or "pussy-paws" union substitutes for the "heather". This appears to be, in part at least, a response to soil-moisture conditions.

The stunted trees on the rocky band in the middle distance are typical of the "white-bark pine union" on areas just slightly elevated above the meadow. White-crowned sparrows frequently are found in or around these stunted trees.

Plate 11

Plate 12

INTERIOR OF THE "WHITE-BARK PINE: LABRADOR TEA: SHOOTING STAR ASSOCIATION"

The stratification within the association and the patchy distribution of the unions can easily be seen in this view. Small, dry streambeds, as present at the right, are common along the walls of the upper valley. In the background there are several logs which have recently fallen.

Plate 12

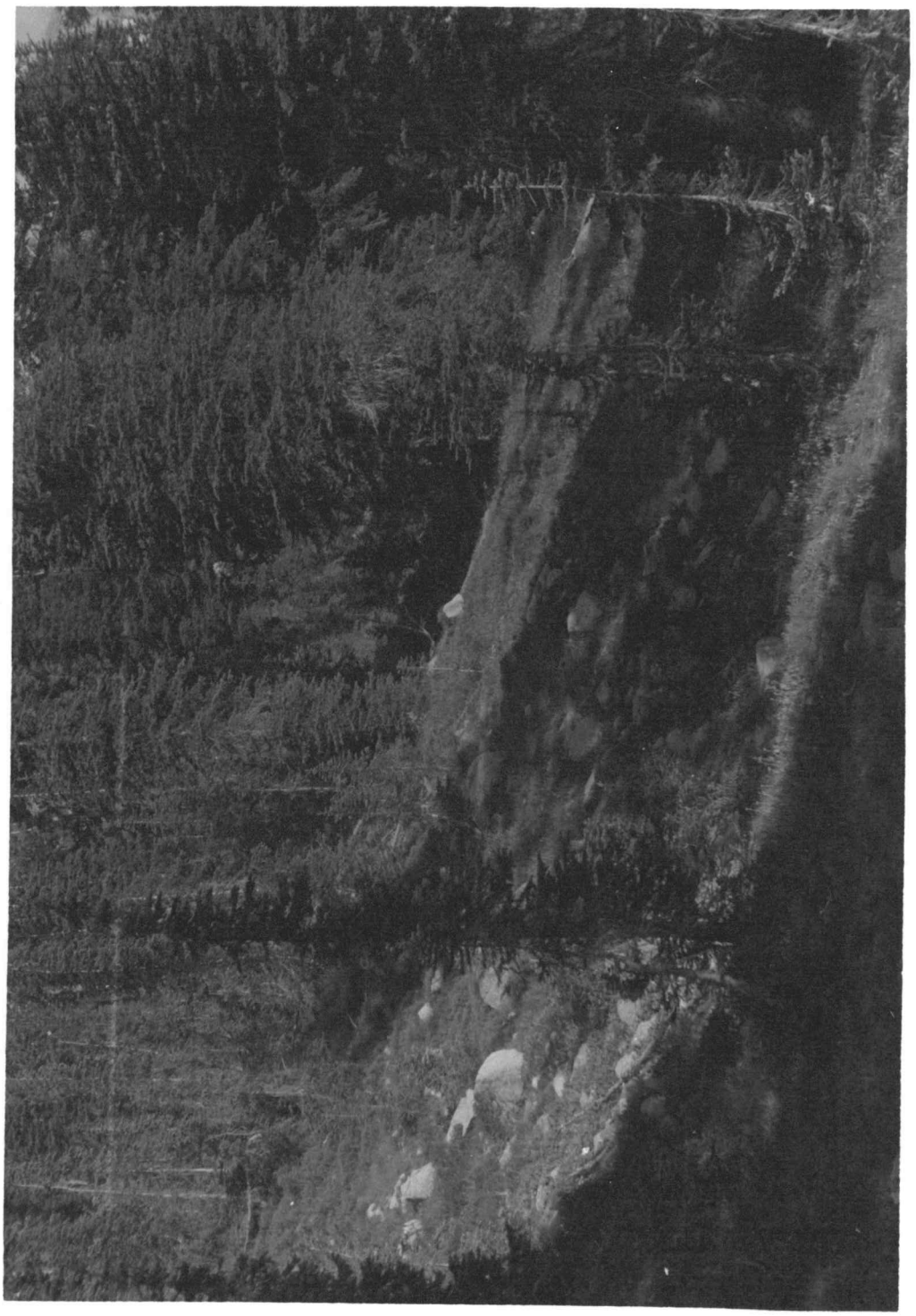


Plate 13

"WHITE-BARK PINE: LABRADOR TEA: HEATHER ASSOCIATION"

Much of the upper zone has vegetation similar to that in this picture. The soil is rocky, the ground is fairly well-covered by the "heather union", and the shrub and tree unions are spottily distributed.

Plate 13

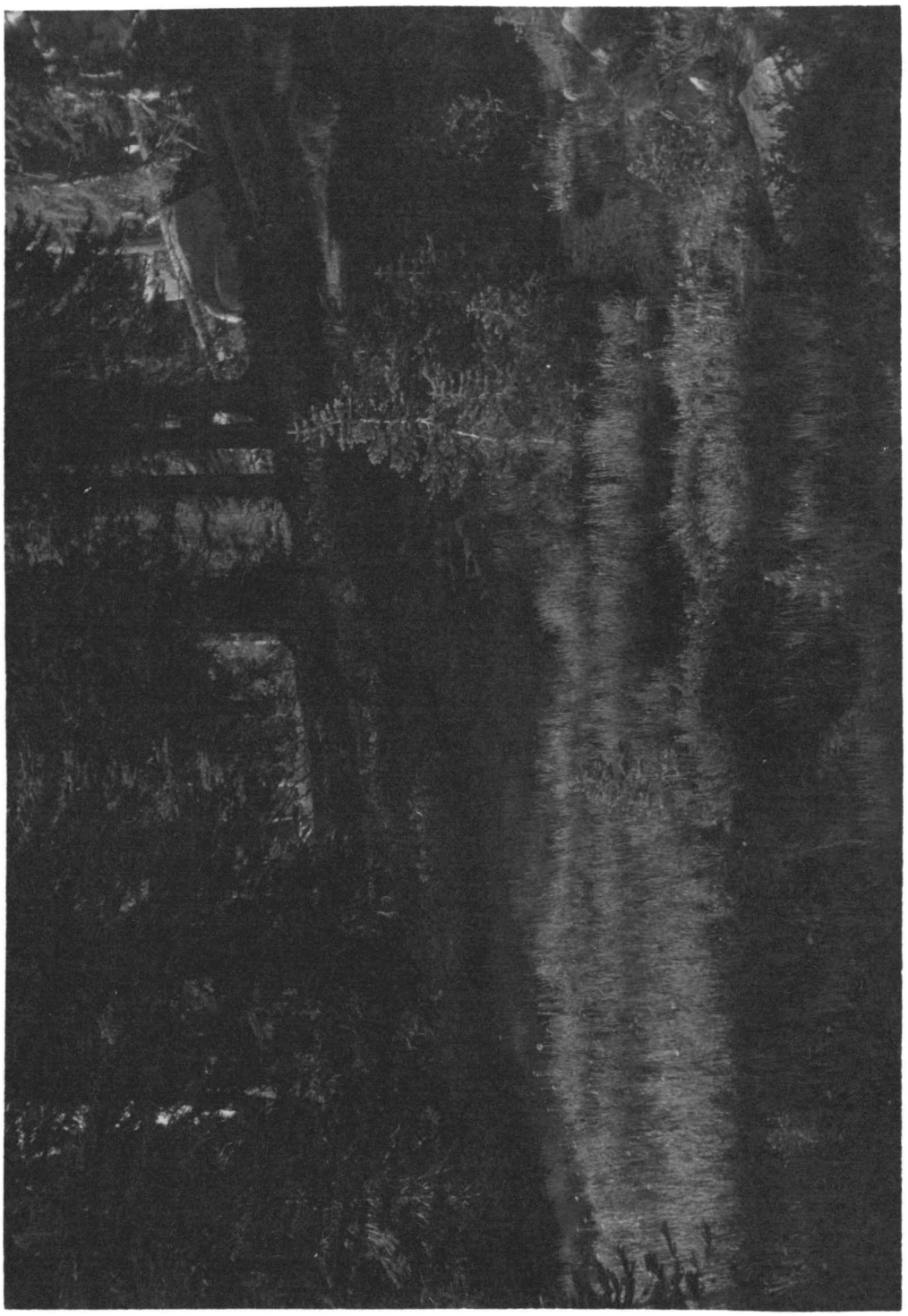


Plate 14

HEATHER-COVERED SLOPES

Many places in the Lake Basin have a cover of only the "heather union". This scene is the rise between the head of the valley and Mirror Lake. The small alpine firs in the foreground and scattered about the slope indicate the possibility of the establishment of the "white-bark pine; labrador tea: heather association" if given enough time.

The trail in the foreground and mid-distance shows much erosion. This condition frequently occurs in high mountain meadows which are heavily used. A new trail was established further up the slope by the Forest Service in an attempt to halt damage.

Plate 14

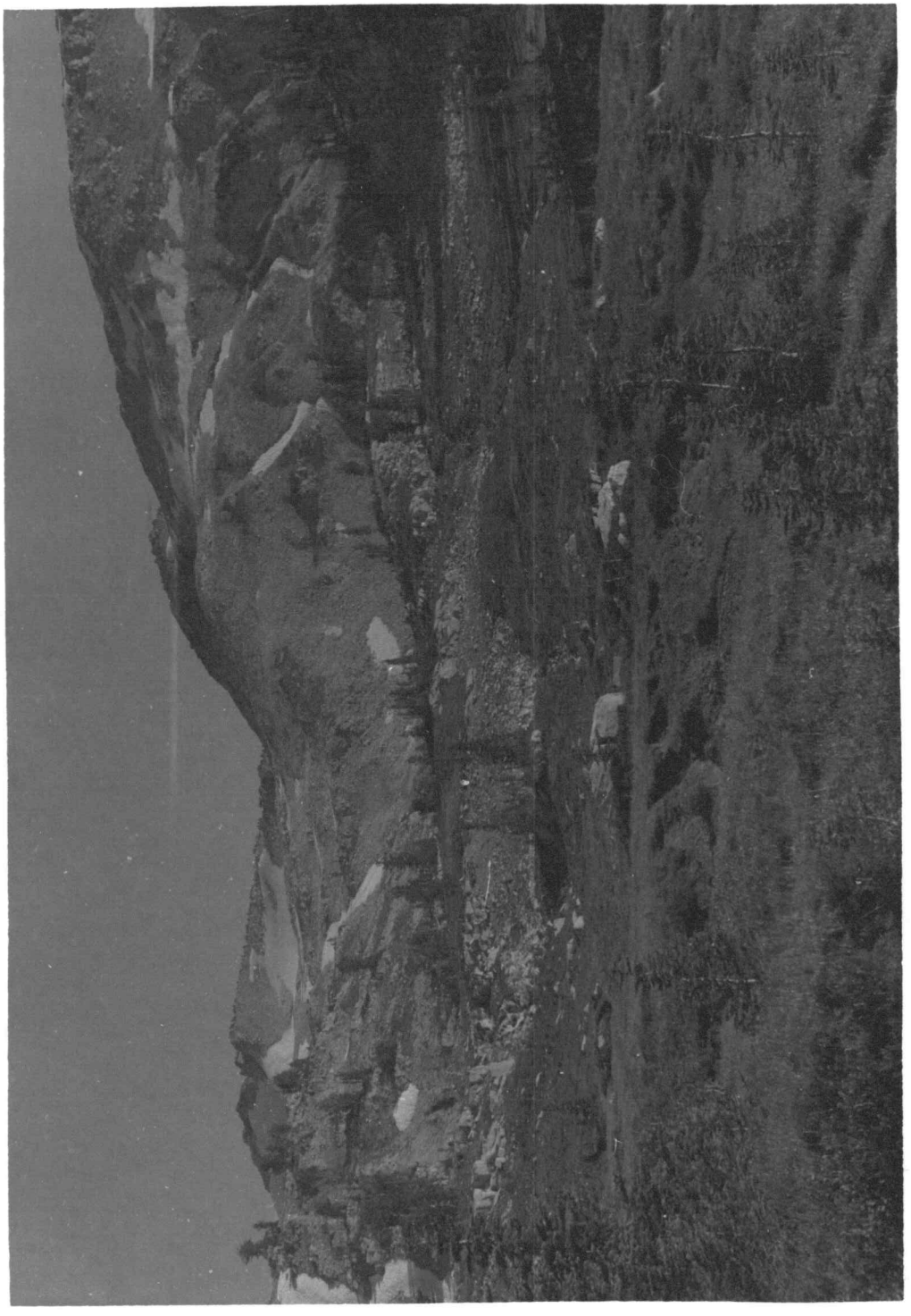


Plate 15

CLETHRIONOMYS NICHE IN THE "WHITE-BARK PINE: LABRADOR TEA: HEATHER ASSOCIATION"

Several red-backed voles were trapped under these logs. Individuals of that species were seldom recorded more than a few feet from such logs.

Plate 15

Plate 16

"SHOOTING STAR UNION"

The small rivulet shown in the foreground is one of several draining this wet area. These water-ways are used by shrews and voles as runways. Wherever soils of the upper zone are wet, the vegetation will be lush, as can be seen in this picture.

Plate 16

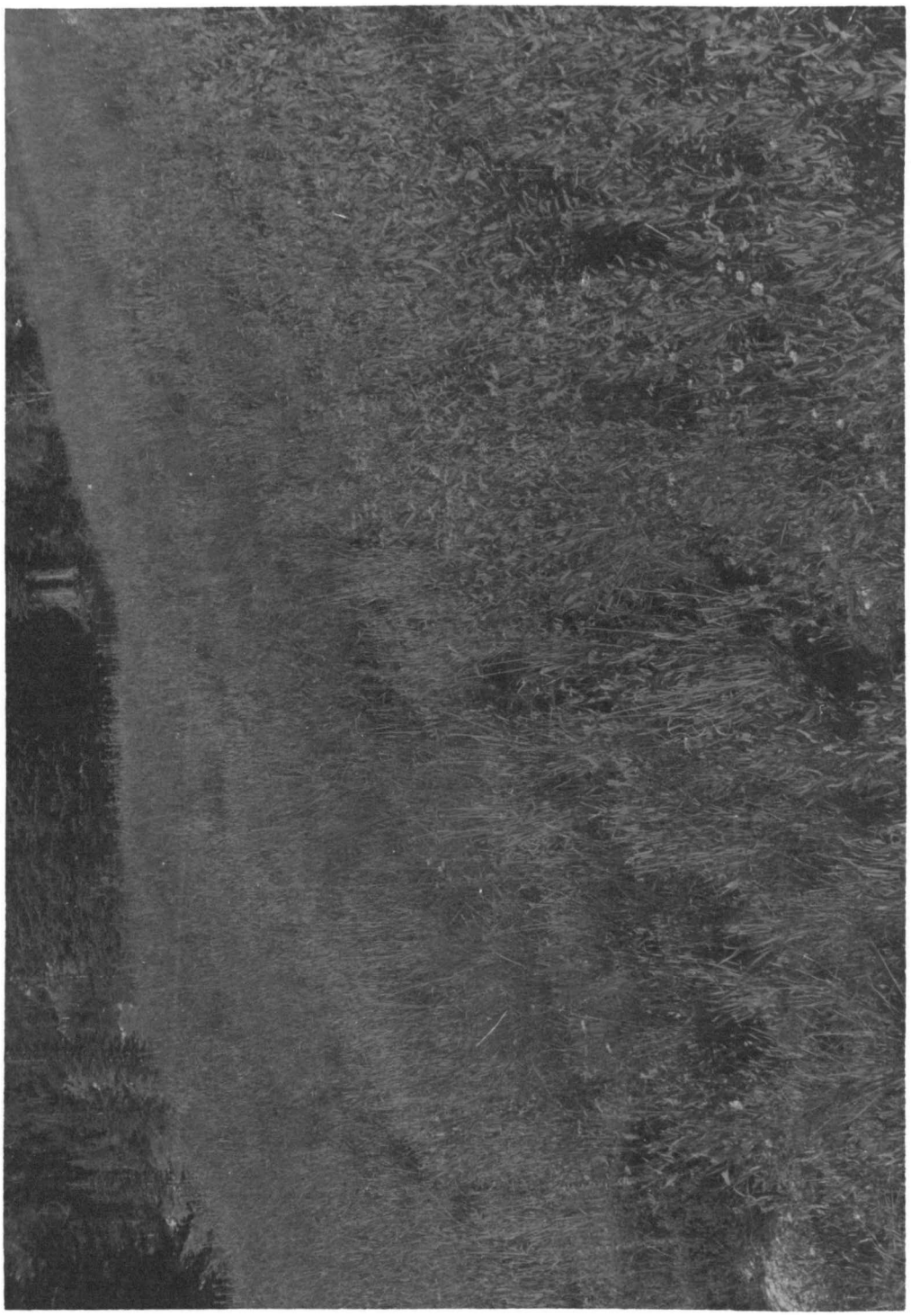


Plate 17

"PUSSY-PAWS UNION"

This picture was taken about 100 yards from the scene of Plate 16. This drier area supports a more open vegetation. The bare areas at the center-left are mounds of earth pushed by a ground squirrel from its burrow.

Plate 17

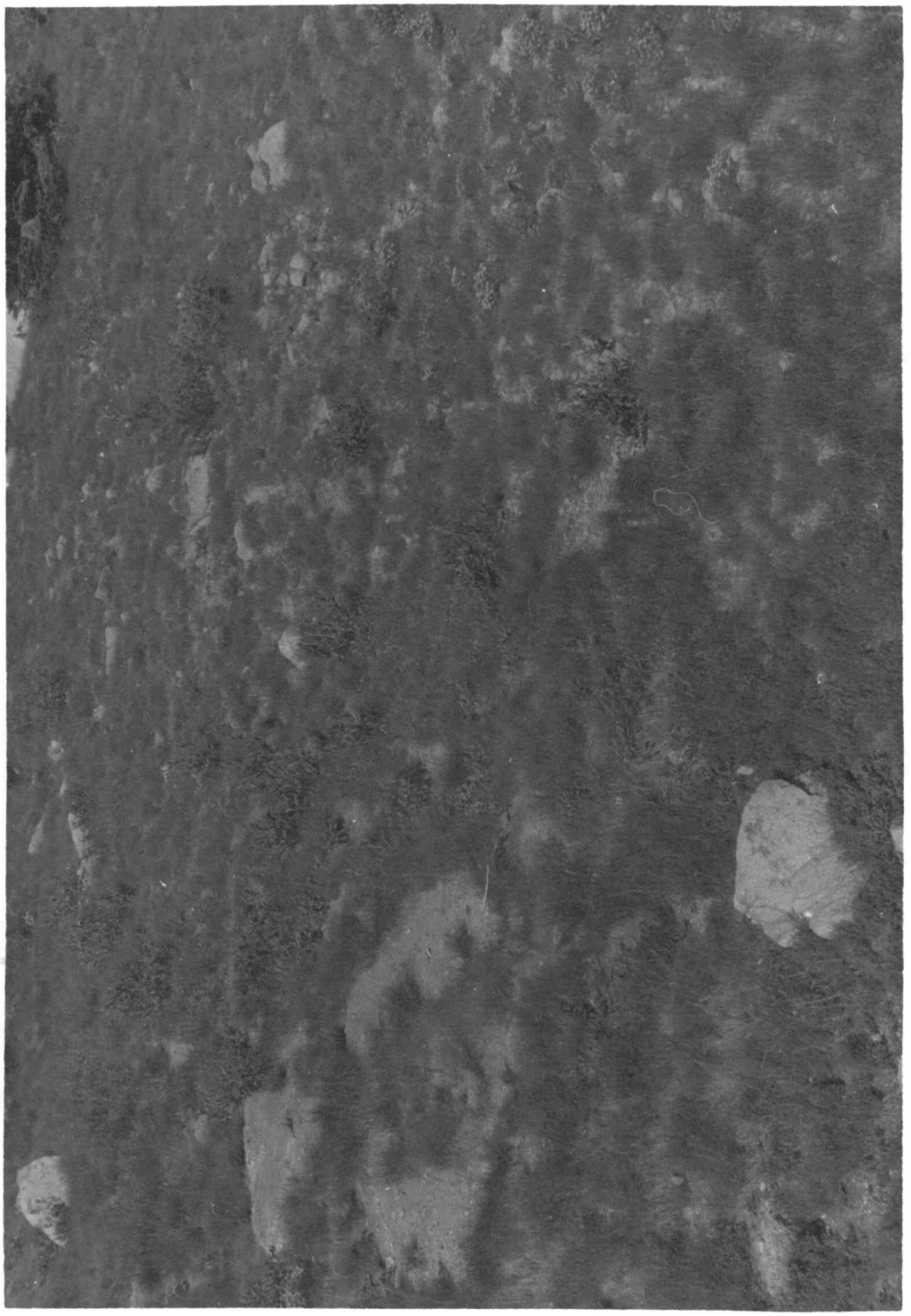


Plate 18

EFFECTS OF A SNOWSLIDE

The above average snowfall of the 1955-1956 winter caused several snowslides in the canyon. The severe damage to the trees which often resulted is demonstrated in this view in the upper zone. Some of the trees are a foot or more in diameter. Note the patches of snow which remain even in late July.

The talus slope in the upper-center is typical of much of the area. The cony is frequently found in such piles.

Plate 18

ANIMAL DISTRIBUTIONS

Now that the environment has been described we will turn our attention to the animals and discuss their use of the habitat units.

Many of the animals were not observed frequently enough to give an adequate estimate of their habitat preferences. In order to include as many of the members of the communities as possible they are placed in the list with a brief statement as to the conditions in which they were found.

For the species more frequently observed, mainly passerine and rodent species, the terms "occasional", "common", or "abundant" will be used to indicate relative numbers. These are strictly subjective terms and poor at best for conveying the idea of absolute numbers. It is felt that they are better than nothing and so are used. In any study of this nature it must always be decided whether to describe carefully and thoroughly a small area or do a less complete job on a larger area. The former course requires use of methods to obtain precise quantitative data. I do not feel that we have adequate procedures for doing this worked out as yet, for such variable conditions as found in the Wallowas. For this and other reasons I have worked on a larger area than can be handled in a quantitative manner. It

is hoped that these more subjective conclusions are similar to those which might have been obtained more precisely by objective methods.

Almost all of the species listed I observed myself, but a few are added from observations of Robert Stein, the Game Agent in Wallowa County, and a field party in the late 1930's from the University of California Museum of Vertebrate Zoology.

BIRDS

Anatidae

Four species of dabbling ducks were observed in the Lake Basin area during August of all three years. In decreasing abundance they were pintail (Anas acuta Linnaeus), baldpate (Mareca americana (Gmelin)), gadwall (Anas strepera Linnaeus) and mallard (Anas platyrhynchos Linnaeus). They appeared to be using the lakes as resting spots along a flyway of their southward migrations. During the last half of August, several flocks numbering up to 250 birds were seen each morning and evening as they flew out of the basin to gain altitude to cross the mountains and head south again.

On June 23, 1956 three female American mergansers (Mergus merganser Cassin) were briefly seen swimming in the river by the Williamson Cabin Camp.

Mr. Robert Stein reported seeing harlequin ducks (Histrionicus histrionicus (Linnaeus)), blue-wing teal (Anas discors Linnaeus) and green-wing teal (Anas carolinensis Gmelin) within the canyon.

Cathartidae

One turkey vulture (Cathartes aura (Linnaeus)) was seen near the Bowman Creek trail August 4, 1954.

Accipitridae

Goshawk (Accipiter atricapillus (Wilson)).

On several occasions a goshawk was seen hunting in the forests of the lower zone. Probably it was one bird, or, at most, a pair. One captured and flew away with a Columbian ground squirrel near the garbage pit at Arrow Camp.

Sharp-shinned Hawk (Accipiter striatus Vieillot).

Three different times a small, short-winged hawk was seen flying some distance away, once carrying an object that may have been a snake. It is possible that the bird seen was a Cooper's hawk but because I thought it was the smaller species and because Dr. Alden H. Miller collected a sharp-shinned hawk in the area these observations are credited to that species.

Red-tailed hawk (Buteo jamaicensis (Gmelin)).

Many times during the three summers red-tails were

seen soaring or occasionally skimming through the trees hunting. They were seen at all levels. Quite possibly all observations were of one family.

Swainson's Hawk (Buteo swainsoni Bonaparte).

This species is included on the basis of Mr. Stein's observations.

American Rough-legged Hawk (Buteo lagopus (Pontoppidan)).

This hawk is also included because of the Game Agent's observations.

Golden eagle (Aquila chrysaetos Linnaeus).

Eagles were seen a few times, usually as they soared high overhead. They appeared to be using the rocks of the highest ridges.

Marsh Hawk (Circus cyaneus (Linnaeus)).

One marsh hawk was seen hunting near Mirror Lake on August 12, 1956.

Osprey (Pandion haliaetus (Linnaeus)).

Mr. Stein said he has seen osprey in the canyon.

Falconidae

Prairie falcons (Falco mexicanus Schlegel) and sparrow hawks (Falco sparverius Linnaeus) were seen several times flying about the Lake Basin or over the higher rocky ridges. One falcon seemed to be hunting sporadically in the area for several days in August, 1956.

Tetraonidae

Mr. Stein reported having seen both ruffed grouse (Bonasa umbellus Linnaeus) and dusky grouse (Dendragopus obscurus (Say)) in the canyon. I saw ruffed grouse four times, all in the lower zone. They were all associated with the "lungwort union" and either the "dogwood" or "maple" unions under "larch" or "lodgepole pine" unions. In all cases the growth was dense.

Scolopacidae

Spotted Sandpiper (Actitus macularia (Linnaeus)).

Along the shore of any water body the spotted sandpiper is a common bird throughout the summer. They were frequently seen flying up and down the larger water courses in flocks up to 25 in number.

Solitary Sandpiper (Tringa solitaria Wilson).

One member of this species was seen in the upper valley along the main river on August 8, 1955.

Strigidae

I neither saw nor heard any owls that I could identify as such. I did find pellets which indicated the presence of a fairly large owl.

Dr. Alden H. Miller collected a horned owl (Bubo virginianus (Gmelin)). Mr. Stein lists horned owl and screech owl (Otus asio (Linnaeus)) for the area.

Caprimulgidae

Nighthawk (Chordeiles minor (Forster)).

Several times nighthawks were seen high in the air feeding. This was usually at dawn or dusk, though one was seen at noon.

Trochilidae

Calliope Hummingbird (Stellula calliope (Gould)).

This species is one of the common birds in the area studied. It is found in almost all habitat situations. It was most frequently seen in areas with some clear space near an exposed perch, e.g. dead twigs of trees, top of tall shrubs, or a telephone line. One would sit on the perch while the other performed the flight display. Once the members of the pair changed places, the male sitting while the female displayed. They feed from many kinds of flowers. They showed much interest in the orange flags used as trap markers.

Alcedinidae

Belted Kingfisher (Megaceryle alcyon (Linnaeus)).

Wherever there is enough water to support a fish, the kingfisher is likely to be seen at one time or another. They are common near any of the larger bodies of water, especially where there are perches over the water.

Picidae

Red-shafted Flicker (Colaptes cafer (Gmelin)).

The flicker is an occasional member of the avifauna. It occurs in both zones. They appear to favor areas with scattered trees rather than dense forest, though too few were seen to make a definite statement.

Pileated Woodpecker (Dryocopus pileatus (Linnaeus)).

This large woodpecker was seen only in the dense forests at the lower end of the lower zone. Many of the large down logs indicate by their large holes that these birds were probably once more common. It could be that there are not enough large, dead trees standing now to support more.

Hairy Woodpecker (Dendrocopos villosus (Linnaeus)).

Hairy woodpeckers were seen only occasionally. These were associated with the "white-bark pine union" of the upper zone. One was seen feeding on the trunk of a large Douglas fir tree on December 30, 1955 at the lower boundary of the study area. It would be expected that they would occur in the lower zone during the summer as well, but none were seen.

Downy Woodpecker (Dendrocopos pubescens (Linnaeus)).

One was seen feeding on the trunk of a tree in the "larch: maple: twinflower association" on August 28, 1955.

Tyrannidae

One western kingbird (Tyrannus verticalis Say) was seen and collected on August 21, 1955 near Mirror Lake where it had been feeding. It perched on a post and flew from it to catch insects.

An alder flycatcher (Empidonax traillii (Audubon)) was heard and seen by the river near Williamson Cabin Camp in the "cottonwood: dogwood: lungwort association". It could not be approached close enough to be collected.

Three specimens of Hammond's flycatchers (Empidonax hammondii (Xantus)) and two of Wright's flycatchers (Empidonax oberholseri Phillips) were collected. Due to the difficulty of identification field observations of these two species always leaves the observer a little uncertain as to which one he has seen. Many ornithologists state a definite habitat preference of the Hammond's to be forested areas while the Wright's prefers brushy areas. Of the five specimens collected this held true. On the basis of this information I believe the Hammond's flycatcher is a common bird of the lower zone. It appears to have a preference for that part of the "lodgepole pine: maple: twinflower association" in which there is a fairly complete canopy and the "snowberry" or "squawberry" unions are well represented. It perches on dead limbs of the pine near the canopy, from which it flies out to capture

insects on the wing between the trees. It is next most commonly found in the "larch: maple: twinflower association". The Wright's flycatcher is occasional in the lower zone where it feeds and perches under the canopy of the "maple: twinflower association". One was seen using the stunted element of the "white-bark pine union" in the lower part of the upper zone.

The wood pewee (Contopus richardsoni (Swainson)) is also an occasional member of the avifauna. Due to the wide variety of situations in which they were encountered there were not enough observations to determine definite habitat preference. They seem to feed anywhere in the open air above or near a perch that suits them.

Olive-sided flycatchers (Nuttallornis borealis (Swainson)) were occasionally seen and heard in isolated trees fairly high up on the canyon walls.

Corvidae

Canada Jay (Perisoreus canadensis (Linnaeus)).

Only one Canada Jay was seen. It was among some trees in the upper zone. They are probably much more common than this record would indicate.

Steller's Jay (Cyanocitta stelleri (Gmelin)).

The low numbers of this species that were seen is a little puzzling. The four that were recorded were all secretive and found in or near fairly dense forest growth

of both zones. One was seen at the northern end of the study area in December 1955.

Clark's Nutcracker (Nucifraga columbiana (Wilson)).

Early in the season this is a common bird of the rocky upper slopes and ridges. It is quite noisy and moves around frequently. Later in the season, after the young are good flyers, they visit the canyon floor more often. One was seen therealso in December 1955.

Paridae

Black-capped Chickadee (Parus atricapillus Linnaeus).

This chickadee was seen only a few times. In each case it was near the river in the lower zone associated with the "lodgepole pine" or the "cottonwood" union. A few were seen in similar situations in December 1955.

Mountain Chickadee (Parus gambeli Ridgway).

Mountain chickadees are common in the lower zone and abundant in the upper zone wherever coniferous trees were present. They feed from the small twigs of the trees. A few were seen in the lower zone in December 1955.

Sittidae

White-breasted Nuthatch (Sitta carolinensis Latham).

Two individuals were seen feeding on trunks of trees in the upper zone.

Red-breasted Nuthatch (Sitta canadensis Linnaeus).

One member of this species was recorded in late

August 1955 in typical "larch union" of the lower zone. Another was seen in December 1955.

Certhiidae

Brown Creeper (Certhia familiaris Linnaeus).

This little frequenter of tree trunks was recorded for the lower zone, but only a few were seen. They were also seen in December 1955. One was seen in a dense patch of spruce and fir in the "white-bark pine union" in the upper zone foraging on the trunks of the trees.

Cinclidae

Dipper (Cinclus mexicanus Swainson).

The dipper is a bird common to all of the medium and large size water courses in the area.

Troglodytidae

Winter Wren (Troglodytes troglodytes (Linnaeus)).

The winter wren is found as an occasional member of the avifauna in areas of the lower zone where there is a thick growth of young trees with dead branches and other debris on the ground under the "spruce-fir" or "larch" unions. In one area a dense stand of the "maple: twin-flower association" produced the same conditions. At the lower limit of the upper zone a wren was found in the debris left by a snowslide of the previous winter.

Turdidae

Robin (Turdus migratorius Linnaeus).

The robin is found as a common bird throughout the canyon. It feeds in areas of open ground from a few feet across to large meadows. It sings in small trees. If disturbed while feeding it hastily retreats to the trees.

Varied Thrush (Ixorius naevius (Gmelin)).

This thrush is heard or seen occasionally in each zone. It frequents forested situations. Because it is so much more frequently heard than seen its specific habitat preferences cannot be listed.

Hermit Thrush (Hylocichla guttata (Pallas)).

Hermit thrushes were occasionally heard singing in both zones. The song invariably came from some distance up the canyon wall where it couldn't be positively located. None were seen.

Russet-backed Thrush (Hylocichla ustulata (Nuttall)).

This bird is an abundant member of the avifauna of the lower zone. It is most frequently found in the moderately dense growth of the two "spruce-fir" associations and the two "larch" associations where the shrub unions are well represented and especially near streams. A few were seen in the upper zone.

Mountain Bluebird (Sialia currucoides (Bechstein)).

The bluebird is found as an occasional bird of the

upper zone. It nests in cavities in snags and feeds in areas of open ground.

Townsend's Solitaire (Myadestes townsendi (Audubon)).

Just a few solitaires were seen in each zone.

Sylviidae

Golden-crowned Kinglet (Regulus satrapa Lichtenstein).

This is a common bird of the lower zone. It shows a decided preference for the two "spruce-fir" associations where it feeds among the foliage of the trees. Some kinglets were seen feeding during December 1955.

Ruby-crowned Kinglet (Regulus calendula (Linnaeus)).

This kinglet is also a common bird of the lower zone. But in marked contrast to the previous species it shows a definite preference for the more open growth of most of the "lodgepole pine union". It is also an occasional inhabitant of the "white-bark pine union". It appears to be less restricted in the variety of situations in which it will feed than the other kinglet.

Motacillidae

American Pipit (Anthus spinoletta (Linnaeus)).

The pipit is occasionally seen feeding on or flying over the open slopes of the middle and higher parts of the upper zone.

Vireonidae

Warbling Vireo (Vireo gilvus (Vieillot)).

The vireo is a common bird of the lower zone. It appears to select the "maple" and "dogwood" unions either under a forest canopy or in the open. Most of their activities take place in the upper limbs of these shrubs and the lower limbs of trees.

Compsothlypidae

Orange-crowned Warbler (Vermivora celata (Say)).

Two individuals of this species were seen. Both were foraging in the branches of willow bushes in the lower zone.

Audubon Warbler (Dendroica auduboni (Townsend)).

The Audubon warbler is one of the most abundant birds in the area. It occurs wherever there are conifers. It sings and forages in these trees and even in the stunted trees up near the top of Eagle Cap. There is obviously a wide range of tolerance to habitat conditions within the species.

Townsend's Warbler (Dendroica townsendi (Townsend)).

In contrast to the last species this warbler is found as a common bird only in the "spruce-fir" and "larch" unions of the lower zone. Even within these unions they prefer areas in which the trees are of staggered heights. They usually feed and sing from the

middle and upper parts of the taller trees and the upper tips of the moderately tall trees. In the late summer this preference breaks down some and they may be found more widely distributed.

MacGillivray's Warbler (Oporornis tolmiei (Townsend)).

This species is a common bird of the lower zone. It appears to select the "dogwood", "maple", and "snowberry" unions wherever they occur without a dense overstory so that the shrubs are fairly thick. They appear occasionally in the upper zone associated with the "labrador tea union" or the dwarfed element of the "white-bark pine union".

Pileolated Warbler (Wilsonia pusilla (Wilson)).

This species seems to be similar in its habitat requirements to the preceding one. Too few were seen to be sure. It was found occasionally in both zones feeding and singing in tall shrubs or in the lower parts of trees.

Thraupidae

Western Tanager (Piranga ludoviciana (Wilson)).

Tanagers are common birds of the lower zone. They occur in any of the coniferous trees though appearing to prefer stands in which the trees are not too close together.

Fringillidae

Black-headed Grosbeak (Hedymeles melanocephalus (Swainson)).

This species was recorded only in the lower part of the lower zone as an occasional member of the avifauna. It was seen only in areas where there were shrubs of the "maple" and "snowberry" unions mixed with scattered trees of the "lodgepole" or "larch" unions.

Evening Grosbeak (Hesperiphona vespertina (Cooper)).

Along with several other species the evening grosbeak, though common, is highly mobile and feeds high in trees so that close observations are difficult. It is found in both zones feeding in large conifers.

Cassin's Purple Finch (Carpodacus cassinii Baird).

The finch is a common bird of both zones. It is highly mobile and feeds on the ground or in conifers.

Gray-crowned Rosy Finch (Leucosticte tephrocotis (Swainson)).

One pair was seen on the summit of Eagle Cap. The party from the University of California collected several from the peaks and ridges.

Pine Siskin (Spinus pinus (Wilson)).

The siskin is another of the very mobile species common in both zones. It seems to prefer open areas, avoiding the heavily forested parts. It frequently feeds on the ground or pulls seeds from herbs.

Red Crossbill (Loxia curvirostra Linnaeus).

This is also a common, mobile species of both zones. They feed on seeds of conifers, usually high in the trees.

White-winged Crossbill (Loxia leucoptera Gmelin).

This species was collected by the University of California field party at the lower limit of the upper zone. I saw none.

Oregon Junco (Junco oreganus (Townsend)).

The junco is an abundant species of both zones. It is found in areas with scattered trees of any species with or without shrubs as long as there is some open ground. They sing and seek refuge in the trees and feed on the ground.

Chipping Sparrow (Spizella passerina (Bechstein)).

The chipping sparrow is very similar to the junco in distribution. It is abundant throughout the area. It is less restricted to feeding on the ground than the junco in that it frequently forages in shrubs and low trees.

White-crowned Sparrow (Zonotrichia leucophrys (Forster)).

This sparrow is abundant in areas of the upper zone where there are shrubs or dwarf trees near water with open meadow around. They sing from exposed perches of the higher vegetation, hide within it and forage in the open around it. A few were heard in the lower zone.

Fox Sparrow (*Passerella iliaca* (Merrem)).

Only a few of this species were seen. These were in or near brush by streams in either zone.

Song Sparrow (*Melospiza melodia* (Wilson)).

The song sparrow was found in only a few places in dense shrubs near the river in the lower zone.

MAMMALS

Soricidae

Sorex vagrans Baird.

The vagrant shrew was trapped in all of the herbaceous unions and most of the associations but nowhere were there more than one or two in a station.

Sorex palustris Richardson.

Water shrews occur along water courses in both zones. Only three were trapped, an inadequate number to give much information on choice of habitat.

Vespertilionidae

Several species of bats were collected. These were all shot while on the wing. They were most commonly seen flying back and forth along a stretch of road or river. Due to the limited observation no further statement of habitat preference can be made. These species were Myotis lucifugus (LeConte), Myotis volans (H. Allen), Lasionycteris noctivagans (LeConte), Eptesicus fuscus (Palisot de Beauvois), and Lasiurus cinereus (Palisot de Beauvois).

Ochotonidae

Ochotona princeps (Richardson).

The cony is a common inhabitant of talus slopes and other accumulations of boulders and rocks where vegetation

is available for food. Because these conditions are more prevalent at the higher elevations more conies are found in the upper zone.

Leporidae

Lepus americanus Erxleben.

The snowshoe hare was occasionally seen in the "lodgepole pine: maple: twinflower association" where there was fairly dense cover. They were less frequently detected in other forested parts of the lower zone. They were most easily observed at night along the road in the car lights. I saw their tracks many places in the snow during our winter trip into the canyon.

Sciuridae

Citellus columbianus (Ord).

The Columbian ground squirrel is an abundant mammal of the meadows and clearings of the whole area. Individuals frequently take advantage of rocks or boulders in selecting a burrow site. The rocks serve to protect the entrance and stabilize the soil. Because of their scavenging habits these squirrels did much damage to animals caught in traps.

Citellus lateralis (Say).

Golden-mantled ground squirrels are common in the upper zone in rocky areas that are relatively near vegetative cover. They are much less frequently seen in the

lower zone where they seem to avoid overly dense vegetation as well as areas too far from cover. In two cases the artificial clearing provided by the road and a trail seemed to provide the necessary conditions.

Eutamias amoenus (J. A. Allen).

The yellow pine chipmunk is one of the most abundant mammals observed in the area. They appear to be most common where there is a moderate to dense cover of herbs and shrubs with or without a tree canopy. They were recorded in fair numbers in all situations except in large areas with only low growth such as found in much of the upper zone heather meadows.

Tamiasciurus hudsonicus (Erxleben).

The chickaree is found in all forested areas though there seems to be a slight preference for moderately dense "lodgepole pine union". They are nowhere abundant. The upper zone is rather sparsely populated by this species.

Glaucomys sabrinus (Shaw).

The flying squirrel is undoubtedly more common than indicated by the single record I obtained. It was caught at the entrance of a burrow at the base of a fallen tree in the "lodgepole pine: maple: twinflower association". The University of California party found a nest of this species.

Geomyidae

Thomomys talpoides (Richardson).

Pocket gopher sign is common in many clearings and non-forested areas. Some sign of winter activity was found even near the summit of Eagle Cap. There is an apparent preference for areas of moderately well drained soils which support the "maple: twinflower association" in which the "snowberry union" is well represented.

Castoridae

Castor canadensis Kuhl.

Beaver were found occasionally along the river in the lower zone. There were no dens found. It is assumed they use burrows in the banks.

Cricetidae

Peromyscus maniculatus (Wagner).

The deer mouse is found throughout the canyon except in wet situations or areas with little cover. They were most easily trapped in brushy areas of the lower zone (e.g., "maple: twinflower association" and "sagebrush: Junegrass association"). They were only occasionally recorded in the upper zone. They appear to select rocky soil, boulders, and logs. This may be because of the more open nature of the vegetation of the upper zone.

Clethrionomys gapperi (Vigors).

The red-backed vole is common in both zones. With

few exceptions they were trapped under or near a log. There were almost always several individuals caught at a station or none at all. These conditions are similar to those stated by Bailey (1, p.193) for this species.

Phenacomys intermedius Merriam.

As might be expected from one of the common names, the heather vole was most commonly caught in the "heather union" with or without the "white-bark pine" and "labrador tea" unions. They were occasionally trapped in the "maple: twinflower association" of the lower zone. I found no strong preference for areas near water courses as suggested by Edwards (14). His comments about cover seem to fit the animals in this canyon fairly well.

Microtus richardsoni (DeKey).

This large vole was found commonly along the banks of water courses and in the "lungwort" and "shooting star" unions in places where the soil was wet. The old nests, runways and piles of droppings were ample evidence that, as Bailey suggested (1, p. 211), they spread out away from the wet spots during the winter and are much more generally distributed.

Microtus longicaudus (Merriam).

The long-tailed vole was most frequently trapped in the "lungwort union" with or without the "dogwood union" but seldom with any tree union. In lesser numbers it was caught in the other two herbaceous unions of the lower

zone where these provided dense ground cover. Such conditions are not often encountered where there are taller unions present. In the upper zone a few were caught in the "heather" and "pussy-paws" unions.

Zapodidae

Zapus princeps J. A. Allen

The observations obtained of the jumping mouse show the potential species population fluctuation between years. In 1955 only four individuals were seen or trapped. In 1956 thirty-six were recorded even though trapping and observing were done in the same way and in the same or similar habitat conditions.

Half of the observations were obtained in areas where the "snowberry" and "twinflower" unions occurred together in fairly dense growth. The remainder were recorded at various other situations in the lower zone.

Erethizontidae

Erethizon dorsatum (Linnaeus).

Porcupines are commonly seen along the canyon floor of the lower zone. There are many trees that show slight to severe porcupine damage. Several entered our camps and chewed on various things, e.g. tires, a belt, rubber boots. Two were seen in the upper zone.

Canidae

Vulpes fulva (Desmarest).

In December of 1955 I saw tracks in the snow on the road that were probably made by red fox. In many places they paralleled snowshoe hare tracks on the snow.

Ursidae

Euarctos americanus Pallas.

Black bears occur throughout the area. One was seen in the Lake Basin. Bear sign was seen in many places.

Mustelidae

Martes caurina (Merriam).

Marten are included on the basis of the observations of Mr. Robert Stein.

Mustela frenata Lichtenstein.

Two long-tailed weasels were seen in the upper zone. The remains of a third were found near the river of the lower zone.

Taxidea taxus (Schreber).

Two badgers were seen. One was apparently hunting in a meadow of the upper valley well after sundown. Another, a young one, was on the road in the lower zone. It ran along in front of the car for a ways and finally retreated up the bank.

Felidae

Felis concolor Kerr.

Mr. Stein reported that cougars are in the area. In September of 1955 a hunter saw one on the canyon wall above the Williamson Cabin Camp.

Lynx rufus (Schreber).

Mr. Stein told me bobcats are also in the area. The same hunter that saw the cougar shot one of this species but I did not see it.

Cervidae

Cervus canadenis (Erxleben).

Mr. Ladd Osborn, the fire guard, saw elk a few times while we were in the canyon but I saw none. Mr. Stein said they occur in low numbers in the area.

Odocoileus hemionus (Rafinesque).

Mule deer are common in the canyon. There is an over population which the Game Commission is trying to reduce by special hunting seasons.

Bovidae

Oreamnos americanus (Blainville).

Seven mountain goats were released near the head of Wallowa Lake by the State Game Commission. Some of them are still alive and were seen in the summer of 1956. They have not been seen in Lostine Canyon but there is no reason to think they have not been there.

APPLICATION OF SOME ECOLOGICAL CLASSIFICATION SCHEMES

Over the years several schemes of community classification have been proposed. A few of them have gained rather wide acceptance and usage. Some of these schemes will be discussed in relation to the information obtained in this study.

LIFE ZONES

In The Mammals and Life Zones of Oregon by Bailey (1) and in Birds of Oregon by Gabrielson and Jewett (19) the much-used system of life zone classification has been applied to the whole state. All of the species of terrestrial vertebrates and many plant species are placed by Bailey in one or more life zones. According to these lists and the map in his publication the three upper life zones are found in the Wallowas.

Several other writers have discussed this scheme and its several weaknesses (2, p.103; 6; 7; 12; 22, p.160-161; 26, p.192-195; 30; 32). The common judgement seems to be that as a pioneer effort Merriam's work had great value by drawing attention to the altitudinal belts of vegetation in mountainous areas. The features of his transcontinental zones and his temperature laws have little value.

My own observations in Lostine Canyon seem to fit into this life zone pattern very well as far as it goes. The

lower zone is equivalent to the Canadian life zone and the upper zone to the Hudsonian life zone. The Alpine life zone is poorly represented on the treeless upper slopes. Probably the "sheep fescue union" I described would be in this uppermost zone. However, it can be easily seen that each life zone contains several units but that the system has no smaller units to recognize this variation.

Grinnell in 1928 proposed a series of categories which would make the life zones much more versatile. From smallest to largest they were: ecological niches, associations, faunal areas, life zones, regions, and World realms (20, p.436). I have not seen an attempt to use this system for an actual area.

His associations could well be equivalent to mine and the ecological niches equivalent to my unions and/or physical elements. I do not know what he might have intended the faunal areas to include but they probably would have been large sections of the country. In that case all of the Wallowas would be in one faunal area.

BIOTIC PROVINCES

A biotic province as proposed by Dice in 1943 (13, p.3) is

"...a considerable and continuous geographic

> area and is characterized by the occurrence of one or more important ecological associations that differ, at least in proportional area covered, from the associations of adjacent provinces."

Each province is made up of one or more biotic districts and one or more life belts which may or may not extend beyond the limits of a district, but not beyond a province. Belts are altitudinal phenomena. An ecological association is

> "...any ecologically uniform and relatively stable community below the rank of life belt and biotic district. The name is applied to well marked successional stages as well as to the climatic or edaphic climax of an area." (loc. cit.)

North America is divided into 29 biotic provinces. The Wallowa Mountains are placed in the Palusian Province. The part of Lostine Canyon studied would all be included in the Montane belt (op. cit., p.44). Presumably, all of the unions and associations described in my section on vegetational elements would be classed in this one belt as "ecological associations".

Larrison in 1946 (24) briefly discussed life zones and biomes and then described a transect of the Washington Cascades in terms of the "Biotic Province-Life Belt System" with the addition of several smaller categories which he defined. These smaller units within a life belt are: 1) life belt section, 2) habitat, and 3) sub-habitat.

The east half of the section described was included

in the Palusian Biotic Province - which by Dice's description (13) also contains the Wallowas. The descriptions of the belts and sections are quite brief but would indicate some similarities between the Cascades and Lostine Canyon. I would be inclined toward the opinion that if this system were used, the Cascades and Wallowas should definitely be in separate Biotic Districts. Because of the brevity of the descriptions and definitions and the lack of treatment of successional information I would find it difficult to apply the small units (i.e. section, habitat, and sub-habitat) he proposes.

Booth (2) in his discussion of the ecological distribution of birds of the Blue Mountains region described four formations each of which is equivalent to a life belt of Dice and Larrison. Each of his formations is divided into biotic associations. These associations are based on growth form or physical characteristics; e.g. sagebrush, rocky slope, streamside, etc. These are much larger than the "associations" of my description. He made no distinction between seral and climax communities.

Apparently most of the Lostine Canyon area that I studied would be included in Booth's subalpine forest formation. He discusses in this formation the following associations: subalpine forest, meadow, and rocky slope. His is one of the only studies which points out the

importance of some of the physical features of an environment to the distribution of some animals.

BIOMES

The biome classification arose from the concept which considers plants and animals together as single communities rather than as separate plant and animal communities. This is often called the biotic or bioecological viewpoint. The biome is the basic community unit of this system. The biome is a plant-animal formation which

> "...is composed of a plant matrix with the total number of included animals, of which the larger and more influent species may range over the entire area of the biome, including its subdivisions and developmental stages.
>
> "The extent and character of the biome are exemplified in the great landscape types of vegetation with their accompanying animals, such as grassland or steppe, tundra, desert, coniferous forest, deciduous forest,...." (4, p.20).

The world is divided into several major units which are called panclimaxes or panformations. The coniferous forests of the world would be an example. The next unit is continental in extent, e.g. the coniferous forest biome of North America. Each biome is in turn composed of one to several associations. Associations are subdivided into faciations which may each occupy a "few thousand square miles". Lociations, consociations, and societies are lesser units which have been less thoroughly discussed.

Seral communities are designated by abbreviated terms, i.e. associes, facies, locies, etc.

Both Peterson (28, 29) and Kendeigh (21, 22) have pointed out that most birds and many other animals seem to select a life form rather than individual species of plants. Because a biome includes seral stages which may have diverse life forms represented, they claim a biome is not as useful as a unit based on life form (as discussed in the next topic).

I do not know of any attempt made in the Pacific Northwest to classify with this system an area similar to Lostine Canyon. With the understanding I have of the categories I would tentatively place the canyon in the spruce-fir association of the coniferous forest biome. The two zones I recognize might be classed as faciations. Within these, the associations I listed would possibly be called lociations and locies. I do not know how the unions of my description would be recognized in this system.

GROWTH FORMS

Elton and Miller in their article "The ecological survey of animal communities: with a practical system of classifying habitats by structural characters" (16) discuss the aims of animal ecology and point out the need to understand the properties of the species networks as they occur in nature. At present we are working at the

periphery of the problem. One way to begin attacking the heart of the problem is to make intensive ecological surveys of relatively small areas. These surveys should include the whole biota.

As a tool to use in making the surveys they propose a habitat classification system. The main divisions are terrestrial, aquatic, aquatic-terrestrial transition; and divisions of less importance, subterranean, domestic, and general. The terrestrial category is subdivided into formation types. These are open ground type, field type, scrub type, and woodland type. Vertical units are also presented for use when applicable. They are subsoil and rock, topsoil, ground zone, field layer, low canopy, high canopy, and air above vegetation (op. cit., p.478-487).

There are several other classifications of growth form. Dansereau (5) has presented the best developed one for describing vegetation. There are six categories, each with several terms, for describing the plants within the vegetation and thus characterizing it. The first is life form. Tree, shrub, herb, bryoids, epiphytes and lianas are the terms used. Size is the second; tall, medium, and low being the terms. Each has a specified height in meters for application to each of the life forms. Function is covered by the terms deciduous, semi-deciduous, evergreen, and evergreen-succulent or evergreen-leafless. Leaf size and shape are classed as needle

or spine, graminoid, broad, compound, etc. Leaf texture is filmy, membranous, sclerophyll or succulent. Distribution within the vegetation (coverage) is described as barren or very sparse, discontinuous, tufts or groups, or continuous. Which and how many of these descriptive terms are to be used is determined by the needs of the user.

Neither of these growth form classifications have a hierarchy of categories for various units of vegetation so are not completely comparable to the other systems discussed. However, they are excellent for describing vegetation, especially if species lists and relative abundance information is included. They would be very useful in gathering information in the field, especially so for animal studies because they stress the structure of the community which appears to be of much importance to most animals.

Kendeigh (21, 22) has proposed the use of a unit based on growth form to fit into the biome scheme as a major subdivision of a biome which he called a biociation. It would be a "...climax biotic community with distinct species composition of animals occurring in a particular type of vegetation or habitat." Late seral communities of the same life form would be included. Early seral communities would be called biocies. He used this system with much success in analyzing the avian communities

of the ecotone between the evergreen needle-leafed forest and the deciduous broad-leafed forest in Michigan. The rest of the hierarchy, from association down to society, would be the same as has been described for the biome system. His biome has been increased in size over that defined by Clements and Shelford(4) to include the whole world--similar to their panclimax.

DAUBENMIRE'S CLASSIFICATION OF THE FORESTS OF THE NORTHERN ROCKY MOUNTAINS

Because of the proximity of the area, Daubenmire's description of the forest vegetation of northern Idaho and adjacent states has particular interest. His classification is based solely on climax vegetation (8, 9). The smallest category of this system is the union. It is

> "...the smallest structural unit in the organization of vegetation, each union consisting of a population of one species, or of several species that are closely similar in ecology (i.e., in microenvironmental requirements) as indicated by similarity of local environmental amplitude, phenology, and frequently by similarity of life form as well."

The association is his next larger unit. Of it he says:

> "The association is considered the basic unit of vegetational classification. It embraces all unions that are superimposed on the same area, and each distinctive combination of vascular plant unions is ordinarily considered a separate association." (8, p.302)

The next category of his classification is the

habitat type, a geographic unit. It is characterized by

> "...(a) a single climax association (actual or potential, as indicated by relic species), (b) relatively uniform successional sequences, and (c) essential equivalence of inherent land-use potentialities." (9, p.17).

Several closely similar habitat types are placed together in what he calls a zone.

Because Lostine Canyon is at least 100 miles west of the nearest point included in Daubenmire's work, it would not be expected that the small units of his descriptions would fit the conditions in the Wallowas without some modification. There are many species and genera common to the two areas but it would take a person better trained in plant ecology than me to determine ecological equivalence of species as is required to define his unions. The "unions" I described in the Lostine are based on life form. Some of my "unions" are made up of species he has placed in several unions.

It would probably be safe to say that Lostine Canyon, at least my "lower zone", could be included in his Picea engelmanni - Abies lasiocarpa zone. Many species of his Symphoricarpos rivularis, Physocarpus malvaceus, and Pachystima myrsinites unions are present in the canyon. Since much of the area I studied is seral his associations and unions could not be used for discussing animals' habitat selections.

It would appear that Daubenmire's classification would be useful to persons trained in zoology only within areas covered by his work and then only in climax situations unless the system were expanded to include seral communities. Within these limitations I think the system would be very useful because of the small, carefully defined communities which can be used for study of animal communities in small areas.

DISCUSSION

An ecological classification system to be of the most use to all the people who might use it is necessarily a very complex thing. It must contain many features. Few if any of its users would use all the properties of the system. Some of these features are (the sequence does not imply order of importance):

1) usability over the whole area of the earth
2) usable units for the full range of size and mobility from small, sedentary species to large, wide-ranging species
3) recognition of successional stages
4) adequate emphasis of growth form and physical elements at all levels of the hierarchy
5) usability for statements of potential productivity of environments
6) freedom from statement of cause until

such can be adequately determined

7) relative freedom from confusing terminology

8) recognition of variation due to seasonal aspects

A comparison between the systems as modified by various authors shows a similarity of some of the categories. They all seem to have a unit about the same as a life zone as it is applied to vertical variation in mountainous areas. This unit is broken into subdivisions similar to Daubenmire's associations. Each of these units is again variously divided to account for variation on a smaller scale. It is in the large categories which are continental in scope that there is the greatest difference between the systems. The area included in this study was too small to be of help in this matter.

If I were forced to choose a system I would prefer the Biome scheme as amended by Kendeigh (22) with additional smaller units that allow for Daubenmire's thoroughness and include his concept of the habitat type. The descriptions of the vegetation within the categories of the scheme could well be expressed by use of Dansereau's method of structural description accompanied by species lists and abundance data. Provision should be made for recognition of a series of physical elements, e.g. rocks, streams, stumps, etc., at all levels in the hierarchy where they are found.

SUMMARY

Lostine Canyon on the north side of the Wallowa Mountains was chosen for a study of bird and mammal communities. The investigation was an attempt first to obtain information about the animals' selections of specific features of their environments, and second, to compare the findings with several systems of habitat classification and description.

The whole area has had a very complex geological history. There are three types of rock exposed. These include several thick layers of sediments, large areas of granodiorite, and flows of Columbia River basalts. There has been much folding, faulting, and uplifting. The present landforms show conspicuously the effects of these movements and the sculpturing by rivers and glaciers.

The area is characterized by a continental climate which is moderated by the prevailing westerly winds from the Pacific Ocean. Within this framework there is a wide variety of microclimate due to differences in exposure, elevation, vegetation, etc. Precipitation joins with the steep topography to make the substrate very unstable in many areas.

The Nez Perce Indians probably had little effect on the area. About 1900 large numbers of sheep were summered in the mountains by white men and severe over-grazing

resulted. About 1920 there was a devastating fire in the lower part of the canyon. There has been a steady increase in the recreational use of the canyon. In 1940 the Eagle Cap Primitive Area was established.

It was recognized that certain physical features are necessary for some animals to be present in an area. Rocky soil, boulders, solid rock, streams, lakes, logs, snags, wires, clearings and buildings are the features defined.

The vegetation is described in terms of its structure. Each unit of characteristic physiognomy and species composition is called a union. There are five tree unions, seven shrub unions, and seven herb unions discussed. When two or more unions were frequently found together, the assemblage is called an association, of which there are fifteen. Two elevational zones are recognized. The lower zone has twelve of the fifteen associations.

There are 76 species of birds and 32 species of mammals listed. Of these, 32 birds and 14 mammals were not seen frequently enough to comment on abundance or habitat preference. The rest are characterized as "occasional", "common", or "abundant". It was not practical to attempt to record relative or absolute numbers. Some species showed a rather narrow choice of habitat, e.g., Townsend's warbler, golden-crowned kinglet, dipper,

Richardson's vole, and water shrew. Others were satisfied by a wider range of conditions.

Several schemes of habitat classification are discussed in relation to the information obtained in this study. These schemes are life zones, biotic provinces, biomes, growth form, and Daubenmire's classification of the forests of the northern Rockies. There seem to be features common to all these schemes, i.e., provision for units of about the magnitude of Merriam's vertical belts of vegetation in mountainous areas and units of smaller size within these belts. It is the larger categories which do not seem to agree. Most of the schemes do not allow for very small communities nor do they have units for recognition of physical features.

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APPENDIX: PLANT LIST

ACERACEAE	
Acer glabrum Torr. var. *douglasii* (Hook.) Wesml.	Mountain Maple
BERBERIDACEAE	
Berberis repens Lindl.	Creeping Oregon grape
BETULACEAE	
Alnus sinuata (Regel) Rydb.	Sitka Alder
BORAGINACEAE	
Cryptantha ambigua (Gray) Greene	
Hackelia jessicae (McGreg.) Brand	
Mertensia oblongifolia (Nutt.) G. Don	Leafy Lungwort
Myosotis macrosperma Engelm.	
CAPRIFOLIACEAE	
Lonicera involucrata Banks	Twinberry
Sambucus melanocarpa A. Gray	Black Elderberry
CARYOPHYLLACEAE	
Arenaria formosa Fisch.	
A. macrophyllum Hook.	
A. obtusiloba (Rydb.) Fern.	
Cerastium vulgatum Linn.	Mouse-ear Chickweed
Linnaea borealis Linn. var. *americana* (Forbes) Rehder	Twinflower
Silene acaulis Linn.	
S. menziesii Hook.	
S. oregana Wats.	
Symphoricarpos alba (L.) Blake	Snowberry
CELASTRACEAE	
Pachystima myrsinites (Pursh.) Raf.	Oregon Boxwood
COMPOSITAE	
Agoseris aurantiaca (Hook.) Greene	
Anaphalis margaritacea (L.) Benth. & Hook.	Pearly Everlasting
Antennaria lanata (Hook.) Greene	
A. mollis Hook.	
A. rosea Greene	
Artemisia ludoviciana Nutt. var. *incompta* (Nutt.) Cronq.	Wormwood

A. tridentata Nutt.	Sagebrush
Aster alpigenus Nutt.	
Chaenactis nevadensis (Kell.) Gray	
Chrysothamnus nauseosus (Kell.) Britt.	Gray Rabbit Brush
Cirsium utahense Petrak	Thistle
Crepis acuminata Nutt.	
Erigeron coulteri Porter	
E. peregrinus (Pursh.) Greene	
E. simplex Greene	
Gnaphalium thermale E. Nels.	
Happlopappus lyallii Gray	
Hieracium albiflorum Hook.	Hawkweed
H. gracile Hook.	
Hulsea algida Gray	
Senecio canus Hook.	
S. porteri Greene	
S. subnudus DC	
S. suksdorfii Greene	
Solidago lepida DC	
CORNACEAE	
Cornus stolonifera Michx.	Dogwood
CRASSULACEAE	
Sedum douglasii Hook.	Stonecrop
S. radiatum S. Wats.	
CRUCIFERAE	
Arabis holboellii Hornem.	
A. lyallii Wats.	
Descurainia pinnata (Walt.) Britt. var. *filipes* (A. Gray) Detling	Western Tansy Mustard
Draba paysonii MacBride	
Lasquerella sherwoodii Peck	
Smelowskia calycina C. A. Mey	
Thlaspe alpestre Linn.	Alpine Penny Cress
CUPRESSACEAE	
Juniperus communis Linn. var. *saxatilis* Pall.	Dwarf Juniper
J. occidentalis Hook.	
CYPERACEAE	Sedges
Carex ablata Bailey	
C. disperma Dewey	
C. festivella Mkze.	
C. gymnoclada Holm	
C. hoodii Boott	
C. illota Bailey	

Carex microptera Mkze.	
C. neurophora Mkze.	
C. pachystachya Cham.	
C. phaeocephala Piper	
C. podocarpa R. Br.	
C. practicola Rydb.	
C. raynoldsii Dewey	
ERICACEAE	
Cassiope mertensiana (Bong.) D. Don	
Gaultheria humifusa (Gray) Rydb.	
Kalmia polifolia Wang.	Laurel
Ledum glandulosum Nutt.	Labrador Tea
Phyllodoce empetriformis (Sm.) D. Don	Heather
Pyrola asarifolia DC	
P. dentata Smith var. *integra* Gray	
Vaccinium membanaceum Dougl.	Blue Huckleberry
V. occidentale Gray	Western Huckleberry
V. scoparium Leiberg	Squawberry
GENTIANACEAE	
Gentiana amarella Linn. var. *acuta* Michx.	
G. calycosa Griseb.	
Swertia radiata (Kell.) Kuntze	
GERANIACEAE	
Geranium viscosissimum Fisch. & Mey	
GRAMINEAE	
Agropyron spicatum (Pursh.) Scribn. & Smith	Bluebunch Wheatgrass
Agrostis hiemalis (Walt.) B.S.P.	
A. humilis Vasey	Mountain Bentgrass
A. thurberiana Hitchc.	
Bromus marginata Nees	
Calamagrostis rubescens Buckl.	Pinegrass
Cinna latifolia (Trev.) Griseb.	
Deschampsia atropurpurea (Wahl.) Scheele	Mountain Hairgrass
D. caespitosa (L.) Beauv.	Tufted Hairgrass
Elymus glaucus Buckl.	
Festuca occidentalis Hook.	
F. ovina L. var. *brachyphylla* (Schult.) Piper	Sheep Fescue
F. rubra Linn.	

Glyceria elata (Nash) Hitchc.	
G. pauciflora Presl.	
Hierchloe odorata (L.) Beauv.	
Koeleria cristata (L.) Pers.	Junegrass
Melica bulbosa Geyer.	
M. subulata (Griseb.) Scribn.	
Muhlenbergia filiformis (Thurb.) Rydb.	
Phleum alpinum L.	Alpine Timothy
Poa epilis Scribn.	Mountain Bluegrass
P. gracilima Vas.	
P. pratensis L.	Kentucky Bluegrass
Sitanion hystrix (Nutt.) J.G. Smith	
Stipa columbiana Macoun	
Trisetum spicatum (L.) Richt.	
T. wolfii Vasey	
HYDROPHYLLACEAE	
Phacelia leucophylla Torr. var. *alpina* (Rydb.) Dundas	
HYPERICACEAE	
Hypericum anagalloides Cham. & Schlecht.	Bog St. John's Wort
H. scouleri Hook.	Western St. John's Wort
JUNCACEAE	Rushes
Juncus drummondi Mey.	
J. ensifolius Wiks.	
J. nevadensis Wats.	
J. parryi Engelm.	
J. regelii Buch.	
Luzula campestris (L.) DC	
L. multiflora (Retz.) Lej.	
L. piperi (Coville) M.E. Jones	
L. wahlenbergii Rupr.	
LABIATAE	
Agastache urticifolia (Benth.) Rydb.	
LEGUMINOSAE	
Astragalus canadensis L. var. *mortoni* (Nutt.) Wats.	Morton's Milk Vetch
A. alpinus L.	Alpine Milk Vetch
Hedysarum mackenzii Rich.	
Lupinus wyethii Wats.	Lupine
Melilotus officinalis (L.) Lam.	Sweet Clover
Trifolium repens Linn.	White Clover

LILIACEAE	
Allium douglasii Hook.	Onion
A. validum Wats.	
Calochortus eurycarpus S.Wats.	Mariposa Lily
Clintonia uniflora (Schult.) Kunthe	
Smilicina sessilifolia (Baker) Nutt.	False Solomon's Seal
Streptopus amplexifolius (L.) DC	Twisted Stalk
ONAGRACEAE	
Epilobium glaberimum Barb.	Willow Herb
E. hornemanni Reich.	
E. minutum Lindl.	
ORCHIDACEAE	
Habenaria stricta (Lindl.) Rydb.	Bog Orchid
H. unalaschensis (Spreng.) Wats.	
PINACEAE	
Abies grandis (Dougl.) Lindl.	Grand Fir
A. lasiocarpa (Hook.) Nutt.	Alpine Fir
Larix occidentalis Nutt.	Western Larch
Picea engelmanni Parry	Engelmann Spruce
Pinus albicaulis Engelm.	White-bark Pine
P. contorta Dougl.	Lodgepole Pine
P. ponderosa Laws.	Yellow Pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
POLEMONIACEAE	
Collomia debilis (S.Wats.) Greene	
Gilia aggregata (Pursh) Spreng.	
Linanthus nuttallii Greene	
Microsteris gracilis (Dougl.) Greene	
Polemonium californicum Eastw.	
POLYGONACEAE	
Eriogonum caespitosum Nutt.	
E. heracleoides Nutt.	
E. piperi Greene	
Oxyria digyna (L.) Hill	Mountain Sorrel
Polygonum douglasii Greene	Knotweed
P. phytolaccaefolium Meisn.	
Rumex acetocella L.	Red Sorrel
PORTULACACEAE	
Claytonia bellidifolia Rydb.	Spring Beauty
Lewisia pygmaea Robins.	
L. triphylla (S.Wats.) Robins.	

Montia cordifolia (Wats.) Pax & Hoffm.	
Spraguea umbellata Torr.	Pussy-Paws
PRIMULACEAE	
Dodecatheon alpinum (A.Gray) Greene	Shooting Star
RANUNCULACEAE	
Aconitum columbianum Nutt.	Monkshood
Actaea arguta Nutt.	Baneberry
Anemone lyallii Britt.	
Clematis hirsutissima Pursh	
Ranunculus bongardi Greene	Buttercup
R. populago Greene	
Thalictrum occidentale Gray	Meadow-rue
RIBESACEAE	
Ribes lacustre (Pers.) Poir.	Prickly Currant
R. petiolare Dougl.	Western Black Currant
RHAMNACEAE	
Ceanothus velutinus Dougl.	Sticky Laurel
ROSACEAE	
Amelanchier florida Lindl.	Serviceberry
Crataegus douglasii Lindl.	Hawthorn
Fragaria vesca L. var. bracteata (Heller) Davis	Strawberry
Geum strictum Soland.	Yellow Avens
Holodiscus discolor (Pursh) Maxim.	Ocean Spray
Horkelia gordoni Hook.	
Potentilla flabellifolia Hook.	Cinquefoil
P. flabelliformis Lehm.	Shrubby Cinquefoil
P. fruticosa Linn.	
Physocarpus malvaceus (Greene) Kuntze	Ninebark
Prunus emarginata Dougl.	Bittercherry
Rosa gymnocarpa Nutt.	
Rubus melanolasius Focke	Western red-raspberry
R. parviflorus Nutt.	Thimbleberry
Sibbaldia procumbens Linn.	
Spiraea densiflora Nutt.	
RUBIACEAE	
Galium bifolium Wats.	Bed Straw
G. triflorum Michx.	
SALICACEAE	
Populus tremuloides Michx.	Aspen

Populus trichocarpa Torr. & Gray	Cottonwood
Salix spp.	Willow

SAXIFRAGACEAE

Mitella pentandra Hook.	Mitrewort
Parnassia fimbriata Konig	
Saxifraga arguta D. Don	
S. bronchialis Linn. var. *austromontana* (Weig.) Piper	
Tiarella unifoliata Hook.	Coolwort

SCROPHULARIACEAE

Castilleja chrysantha Greenm.	Indian paintbrush
C. miniata Dougl.	
Collinsia parviflora Dougl.	
Mimulus lewisii Pursh	Monkey flower
M. moschatus Dougl.	
Pedicularis contorta Benth.	
P. groendlandica Retz. var. *surrecta* (Benth.) Piper	Elephant's head
P. racemosa Dougl.	
Penstemon deustus Dougl.	
P. fruticosus (Pursh) Greene subsp. *serratus* Keck	
P. globosus (Piper) Penn. & Keck	
P. venustus Dougl.	
Scrophularia lanceolata Pursh	Figwort
Veronica americana (Raf.) Schwein.	Speedwell
V. cusickii Gray	
V. wormskjoldii Roem. & Schult.	

UMBELLIFERAE

Heracleum lanatum Michx.	Cow parsnip
Ligusticum filicinum Wats.	Thin-leaved lovage
Lomatium idahoensis Math. & Const.	Desert parsley
Osmorhiza nuda (Torr.) Nutt.	Sweet cicely

URTICACEAE

Urtica lyallii Wats.	Nettle

VALERINANACEAE

Valeriana sitchensis Bong.

VIOLACEAE

Viola glabella Nutt.
V. nephrophylla Greene
V. palustris Linn.