Federal Research Natural Areas in Oregon and Washington a Guidebook for Scientists and Educators. 1972.
Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

BUTTER CREEK RESEARCH NATURAL AREA[1]

A subalpine mosaic of forest, shrub, and meadow communities in a rugged 2,OOO-acre drainage in the Washington Cascade Range near Mount Rainier.

Butter Creek Research Natural Area exemplifies an entire mosaic of subalpine communities including closed forest, parkland, shrubfields, and meadows. The 810-ha. (2,000acre) tract is located in Lewis County, Washington, and administered by Mount Rainier National Park (Longmire, Washington). The natural area includes all of Butter Creek drainage within the park; consequently, boundaries follow natural topographic features (ridge and mountain summits) except along the southern edge (fig. BU -1). It lies at 46^0 45' N.latitude and $121^0$44' W.longitude.

ACCESS AND ACCOMMODA TIONS

The natural area occupies a rugged drainage lacking trails and roads; consequently access is by cross-country travel which is frequently difficult and requires care. The upper end of the natural area is reached via the Pinnacle Peak trail which terminates at the edge of the tract in the saddle between Pinnacle and Plummer Peaks. Most of the meadow areas can be reached from this point by easy to moderately difficult cross-country travel. A Forest Service logging road up Butter Creek terminates in a clearcut about 0.8 km. (0.5 mile) south of the park boundary; the lower part of the natural area is reached in this way with Butter Creek itself providing the easiest cross-country route from the roadhead into the tract.

Commercial accommodations are located nearby at Longmire and Paradise Valley in the National Park and at Ashford and Packwood. There are numerous improved campgrounds in adjacent portions of Mount Rainier National Park and the Gifford Pinchot National Forest.

ENVI RONMENT

The natural area occupies the entire upper drainage of Butter Creek, including two major branches which are effectively divided for most of their length by a large downward trending ridge (fig. BU -1). This is one of the major drainage basins on the south slopes of the Tatoosh Range, an intruded mountain massif of east-west orientation. Various mountain peaks and ridges of this range, such as Wahpenayo, Lane, Pinnacle, Plummer, Unicorn, and Boundary Peaks, form a semicircular rim for the northerly boundaries of the tract (fig. BU-3). The natural area spans a wide range in elevations varying from about 1,040 m. (3,400 ft.) along Butter Creek to 2,116 m. (6,939 ft.) at the summit of Unicorn Peak. It also incorporates a variety of mountain landforms from precipitous rock outcrops to nearly level valley bottom. Gentle topography is confined to the valley bottoms along the lower reaches of Butter Creek and to occasional benches at higher elevations. Most of the natural area consists of moderate to steep (30- to 90-percent) mountain slopes, some of which are continuous over nearly the entire elevational span (fig. BU -3). Precipitous topography is most common along the bounding ridges and at intermediate elevations along the west branch of Butter Creek.

[1] Description prepared by Dr. C. T. Dyrness and Dr. J. F. Franklin, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon.

The natural area incorporates several miles of perennial stream. In addition, there are at least four ponds or lakes within the natural area, all located in the subalpine parkland. Three of these are located at about 1,555 m. (5,100 ft.) in the northwestern corner of the natural area on the slopes below Lane Peak. Cliff Lake, the largest, covers about 2.2 ha. (5.5 acres) and has a maximum depth of 9 m. (30 ft.) (Wolcott 1961). An unnamed lake (about 0.4 ha. or 1 acre in size and shallow) and a smaller pond are located about 300 m. (1,000 ft.) southwest of Cliff Lake. No fish inhabit either of the lakes (Wolcott 1961). The fourth pond is located just inside the northeastern corner of the natural area in the saddle between Pinnacle and Unicorn Peaks.

The geology of the Butter Creek Research Natural Area is probably better known than any other aspect of its natural history (Crandell 1969a, 1969b; Fiske, Hopson, and Waters 1963). The bulk of the natural area is located on Miocene-Pliocene intrusive igneous rocks (Fiske, Hopson, and Waters 1963) (fig. BU-2). These are the granodiorites and quartz monzonites of the Tatoosh pluton; included are subordinate amounts of quartz diorite, contact breccia, and fine-grained border rocks. Oligocene-Miocene volcanic rocks belonging to the Stevens Ridge formation dominate the western third of the natural area and occur along the bounding ridges elsewhere. These consist of rhyodacite ash flows with subordinate amounts of volcanic breccia and sandstones and siltstones of epiclastic and pyroclastic origin. The oldest volcanic rock formation, the Ohanapecosh, occupies a small area in the lower reaches of Butter Creek. The volcanic breccias and associated epiclastic and pyroclastic sandstones and siltstones of this formation are of Eocene age. Finally, small areas of dioritic rocks and of basaltic and andesitic rocks belonging to the Fifes Peak formation occur in alternating layers near the summit of Unicorn Peak.

Existing landforms and surficial geology are primarily the result of stream erosion and glaciation. Glaciers have occupied the drainage periodically (Crandell 1969b) and are responsible for the alplike appearance of the upper ridge and the U -shaped valley of the west branch of Butter Creek. The surficial geology of most of the tract appears to be relatively simple, undifferentiated bedrock types (Crandell 1969a). However, blockfield deposits are identified on the slopes below Pinnacle Peak and the ridgetop along the east boundary. In addition, taluses occur mainly on the slopes below the northwest boundary ridgetop from Wahpenayo to Lane Peaks (fig. BU-2).[2] Recent aeolian deposits of volcanic ejecta also blanket much of the natural area. These deposits are largely made up of pumice and volcanic ash of varying age. Ash layers W and Y from Mount St. Helens, which are about 450 and 3,250 to 4,000 years old, respectively, are known to occur on the tract (Crandell 1969b).

A wet, cool maritime climate prevails. Annual precipitation is heavy, with maxima in December and January and minima in July and August. Summers are generally cool with frequent cloudy days, but only about 10 percent of the precipitation occurs from June through August. A winter snowpack develops over the entire natural area, but its depth and total annual snowfall increase rapidly with elevation. The range of climatic conditions encountered on the natural area are approximated by the following data from the Longmire and Paradise Valley weather stations, 5 and 3 km. (3 and 2 miles) west and north of the natural area, respectively (U.S. Weather Bureau 1965):

	Longmire	*Paradise Valley*
Elevation	842 m. (2,762 ft.)	1,821 m. (5,550 ft.)
Mean annual temperature	7.3°C. (45.1°F.)	3.4°C. (38.2°F.)

[2] Blockfield deposits consist of angular rock fragments pried from underlying formations by freeze-thaw cycles of moisture in cracks. Taluses are loose accumulations of coarse and typically fresh and angular rock fragments with steeply sloping surfaces. Taluses can be differentiated from blockfield deposits by their location beneath cliffs and the wide range in rock fragment size from pieces a few centimeters across to blocks 10 m. or more in maximum diameter (Crandell 1969a).

	Longmire	*Paradise Valley*
Mean January temperature	-0.9°C. (30.3°F.)	-3.4°F. (25.8°F.)
Mean July temperature	16.2°C. (61.2°F.)	11.6°C. (52.8°F.)
Mean January minimum temperature	-4.1°C. (24.5°F.)	-7.0°C. (19.4°F.)
Mean July maximum temperature	23.8°C. (74.9°F.)	17.4°C. (63.3°F.)
Average annual precipitation	2,094 mm. (82.43 in.)	2,635 mm. (103.73 in.)
June through August precipitation	171 mm. (6.73 in.)	226 mm. (8.91 in.)
Average annual snowfall	474 cm. (186.5 in.)	1,362 cm. (587.4 in.)

Soils in the forested lower end of the natural area are largely Podzols and Regosols with limited areas of Alluvial soil in terrace positions along Butter Creek. The podzolic soils are formed primarily in layers of pumice and volcanic ash which have been aerially deposited over the surface of the bedrock. A typical soil on relatively gentle terrain just north of the confluence of the two major branches of Butter Creek exhibited the following horizons:

01 and 02 7 to 0 cm. Forest floor material of varying stages of decomposition.

A2 0 to 2 cm. Light gray sand-size pumice.

B2 2 to 20 cm. Dark brown loam with high pumice content and some pockets of fresh pumice.

IIAb 20 to 25 cm. Very dark grayish brown loamy sand.

IICb 25 to 32 cm. White un-weathered pumice sand with brownish yellow pockets caused by iron staining.

IIIB2b 32 to 45 cm. Brown pumiceous silt loam over bedrock (granodiorite).

Some gravels and cobbles are typically intermixed with the volcanic ash and pumice, especially in the buried horizons. Regosolic soils on steeper slopes are intimate mixtures of pumiceous materials and rock fragments showing little evidence of profile development.

Much of the upper, nonforested portion of the natural area consists of steep slopes characterized by talus and blockfield deposits. However, on more gentle terrain at high elevations are tracts of Alpine Turf and Alpine Meadow soils. These soils are characterized by black, generally thick A horizons underlain by a stony substratum.

BIOTA

There are at least four major categories of subalpine plant communities found within the Butter Creek Research Natural Area: (1) forests of Pacific silver fir *(Abies amabilis),* western hemlock *(Tsuga heterophylla),* and noble fir *(Abies procera)* typical of middle elevations in the Cascade Range; (2) subalpine forests typified by mountain hemlock *(Tsuga mertensiana)* and Pacific silver fir which ranged from a continuous closed canopy to isolated, patchy tree groups found near timberline; (3) shrub communities, generally dominated by Sitka alder *(Alnus sinvata),* or Alaska-cedar *(Chamaecyparis nootkatensis),* and vine maple *(Acer circinatum);* and (4) subalpine meadows of widely variable composition and structure. Each of these categories covers a significant area although no quantitative breakdown is available. SAF cover types represented include 226, Pacific Silver Fir-Western Hemlock, and 205, Mountain Hemlock-Subalpine Fir (Society of American Foresters 1954). Kuchler's (1964) Types 3, Silver Fir-Douglas Fir Forest; 4, Fir-Hemlock Forest; and 52, Alpine Meadows and Barren, are present. Lower elevations fall within the *Abies amabilis* Zone (Franklin and Dyrness 1969) and higher elevations cover both the closed forest and parkland (forest-meadow mosaic) subzones of the *Tsuga mertensiana* Zone (Franklin and Bishop 1969). True alpine vegetation is probably not present; precipitous slopes preclude vegetational development at the highest elevations (over about 6,300 ft. or 1,900 m.) where it might be expected.

Reconnaissance of the natural area was unusually limited in view of its large size and complexity. On-the-ground examination has been restricted to subalpine meadow areas near the northern boundary and several

forested sites adjacent to Butter Creek at the southern boundary. Sites occupied by shrubs and young trees which cover much of the central portion of the tract received only limited attention.

Forest communities in the southern portion of the natural area *(Abies amabilis* Zone) include seral stages of the *Abies amabilis/Vaccinium alaskense, Abies amabilis/Streptopus curvipes,* and *Abies amabilis/Oplopanax horridum* Associations described by Franklin (1966). Near the southern boundary stream, terraces adjacent to Butter Creek are occupied by an open, seral phase of the *Abies/Vaccinium* Association. Tree overstory is very scattered and made up of about equal amounts of noble fir and Pacific silver fir. Although both silver fir and western hemlock are also present, tree regeneration is generally dominantly noble fir. The dense shrub layer, dominated by *Vaccinium alaskense,* also includes vine maple, *Rubus spectabilis,* and *Sambucus racemosa.* The most important herbs are *Clintonia uniflora* and *Pteridium aquilinum,* with smaller amounts of *Anaphalis margaritaceae, Achlys triphylla, Tiarella unifoliata, Veratrmviride,* and *Smilacinastellata.*

An open, seral phase of the *Abies amabilis/ Streptopus curvipes* Association occupies rather extensive areas on moderate to steep slopes above Butter Creek. The overstory is made up of scattered, often very large noble fir (fig. BU-3) along with smaller Pacific silver fir. A thicket-like understory of vine maple makes travel through the area very difficult. Other species of some importance in these stands include *Pachistima myrsinites, Achlys triphylla, Clintonia uniflora, Streptopus Curvipes, Pteridium aquilinum, Galium triflorum, Polystichum munitum,* and *Rubus lasiococcus.* In wetter areas this community gives way to the *Abies amabilis/Oplopanax horridum.*

The *Abies/Streptopus* Association is also found with a dense tree overstory but only at scattered locations at low elevations. Dominant trees are old-growth Douglas-fir *(Pseudotsuga menziesii)* and western hemlock, with Pacific silver fir the most abundant species in the understory. The shrub layer is scattered, comprised of such species as *Acer circinatum, Vaccinium alaskense,* and *Rubus spectabilis.* The herb layer is well developed and typically includes *Achlys triphylla, Gymnocarpium dryopteris, Tiarella unifoliata, Streptopus curvipes, Rubus pedatus, R. lasiococcus, Viola sempervirens, Chimaphila menziesii, Pyrola asarifolia,* and *Trillium ovatum.*

The forests occupying the *Tsuga mertensSiana* Zone were examined to only a minor extent. Tree species present include mountain hemlock, Pacific silver fir, subalpine fir *(Abies lasiocarpa),* and whitebark pine *(Pinus albicaulis).* As mentioned, conditions vary widely from closed stands of both young and old age to small tree groups surrounded by meadows (fig. BU-3). In general, Pacific silver fir is less common in the parkland subzone above the line of continuous forest, and whitebark pine is uncommon in the lower elevation, closed forest. Community types probably include the *Abies amabilis-Tsuga mertensiana/Vaccinium membranaceum* and *Abies amabilis/Menziesia ferruginea* Associations described by Franklin (1966) as well as others,

Shrub communities are of several types, Stands dominated by 3- to 5-m. (9- to 15-ft.) tall Sitka alder, vine maple, or Alaska-cedar are believed to be topographic or topoedaphic climax types. They probably owe origin and maintenance to special environmental conditions, such as an extremely stony substrate and recurring snow avalanches. The effects of heavy snowloads are evident in the strong bowing of Sitka alder stems, and the resilience of the stems allows them to bend under avalanching rather than break. The avalanche communities are especially common on the slopes above the west branch of Butter Creek (fig. BU-3). In general, vine maple apparently dominates brushfields on drier sites and Sitka alder and Alaska-cedar on moister sites. An earlier description of the area (Anonymous 1942) mentions brushfields with *Rhododendron albiflorum* and *Srbus occidentalis* as major components. These have not been seen and may be misidentifications of the maple, alder, or Alaska-cedar communities.

Subalpine meadow vegetation begins at about 1,585-m. (5,200-ft.) elevation, although

most occurs between 1,675 and 1,830 m. (5,500 to 6,000 ft.). The extensive steeply sloping portion of this headwaters area is south-facing with very shallow soils (fig. BU -3). As a result, the habitat is relatively warm and dry during the growing season and supports two closely related subalpine meadow types characteristic of such habitats. These have tentatively been named the *Festuca viridula/Lupinus latifolius* and *Festuca viridula/Aster ledophyllus* types.[3] The *Festuca/Aster* community occurs on the driest portion of the slopes and includes as dominants the following species: *Festuca viridula, Aster ledophyllus, Carex spectabilis, Castilleja/miniatta, Erigeron salsuginosus, Agoseris alpestris, Lupinus latifolius, Polygonum bistortoides,* and *Phlox diffusa.* The most important species in the *Festuca/Lupinus* community are: *Festuca viridula, Lupinus latifolius, Carex spectabilis, Polygonum bistortoides, Castilleja oreopola, Pedicularis bracteosa, Ligusticum/ purpureum, Anemone occidentalis, Erigeron salsuginosus,* and *Potentilla ftabellifolia.* Localized seep areas on these otherwise dry slopes support such species as *Phyllodoce empetriformis, Veratrum viridum,* and *Valeriana sitchensis.*

Two closely related heather communities occupy the moister and cooler sites, such as ridgetops and protected east-facing slopes. These are the *Phyllodoce empetriformis/Lupinus latifolius,* and *Phyllodoce empetriformis/Vaccinium deliciosum* communities. Some of the dominant species in the *Phyllodoce/Lupinus* type are *Phyllodoce empetriformis, Cassiope mertensiana, Lupinus latifolius, Carex spectabilis,* and *Lycopodium* sp. Species characteristic of the *Phyllodoce/ Vaccinium* type include *Phyllodoce empetriformis, Cassiope mertensiana, Vaccinium deliciosum, Lupinus latifolius,* and *Antennaria lanata.*

Snowbed communities are found at highest elevations in those localized areas where snowbanks persist until late in the growing season. Generally these sites are easily recognized by the overwhelming dominance of *Carex nigricans.*

In general, *Phyllodoce* and related cooler, moister subalpine community types are most common at the head of the west branch of Butter Creek (e.g., around Cliff Lake) and least common at the head of the east branch below Pinnacle Peak. The *Festuca-types* are distributed in a reverse fashion, being most abundant on the slopes below Pinnacle Peak and extending toward Unicorn Peak.

Meadow-associated or timberline tree species have already been mentioned. None are known to invade the *Festuca-dominated* communities to any extent. However, both subalpine fir and mountain hemlock have invaded the *Phyllodoce* communities, a phenomenon commonly encountered in the Cascade Range and believed related to climatic fluctuations (Franklin et al. 1971).

A tentative list of mammals believed to inhabit the natural area as residents or transients is provided in table BU -1. Important resident birds include blue grouse *(Dendragapus obscurus),* Franklin's grouse *(Canachites canadensis),* white-tailed ptarmigan *(Lagopus leucurus),* gray jays *(Perisoreus canadensis),* and Clark's nutcrackers *(Nucifraga columbiana),* the last named an important vector for the distribution of whitebark pine seeds. A bird checklist and a mammalogical guidebook (Potts and Grater 1949) for Mount Rainier National Park are available at the Park headquarters.

HISTORY OF DISTURBANCE

Human disturbance in the tract is essentially absent except in a very small area near the terminus of the Pinnacle Peak trail. South of the saddle where it terminates, visitors have produced numerous trails, campfire spots, and patches of trampled vegetation.

Perhaps the most important natural disturbances are the avalanches which repeatedly plunge down some of the more precipitous slopes and the over-steepened headwater channels of Butter Creek (fig. BU -3). There is abundant evidence that avalanching is probably the single most impor-

[3] Data on subalpine meadows were in personal communication from Mr. Jan Henderson, Department of Botany, Oregon State University, Corvallis.

tant factor in controlling forest composition and age in the natural area.

RESEARCH

The Butter Creek Research Natural Area is currently being used as a sampling site in a study of alpine and subalpine meadow vegetation of Mount Rainier National Park.[4]

The natural area offers innumerable opportunities for ecological research on the communities, plants, and animals of subalpine regions in the Cascade Range. Its size makes it suitable for many types of research activities not possible in smaller tracts, such as studies of larger-sized animals. Furthermore, it provides a complete mosaic of subalpine communities rather than an isolated representation of only one. The great range in elevation makes it possible to study relationships over broad environmental and community gradients, from old-growth true fir-western hemlock stands to snowbed communities situated 760 m. (2,500 ft.) above. In addition, it offers an unparalleled opportunity to study succession following avalanching because of the wide range in age and abundance of avalanche tracks which are present. Finally, the western and eastern parts of the natural area have sharply contrasting bedrock, making possible comparative studies of communities on intrusive and extrusive igneous rock types.

MAPS AND AERIAL PHOTOGRAPHS

Special maps applicable to the natural area include: *Topography* - special 15' x 25' Mount Rainier National Park, Washington quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1955 and, for the southern third of the area, the 15' Packwood, Washington quadrangle, scale 1: 62,500, issued in 1962; and *geology* - *Geologic Map and Sections of Mount Rainier National Park, Washington,* scale 1: 62,500 (Fiske, Hopson, and Waters 1963), *Surficial Geology of Mount Rainier National Park, Washington,* scale 1:48,000 (Crandell 1969a), and *Geologic Mop of Washington,* scale 1: 500,000 (Huntting et al. 1961). The Superintendent (Mount Rainier National Park, Longmire, Washington) can provide details on the most recent aerial photograph and type map coverage for the area.

[4] Research by Mr. Jan Henderson, Department of Botany, Oregon State University, Corvallis.

LITERATURE CI D

Anonymous
1942. Research areas in the national parks. Ecology 23: 236-238.

Crandell, Dwight R.
1969a. Surficial geology of Mount Rainier National Park Washington. U.S. Geol. Surv. Bull. 1288, 41 p., illus.

1969b. The geologic story of Mount Rainier. U.S. Geol. Surv. Bull. 1292, 43 p., illus.

Fiske, Richard S., Clifford A. Hopson, and Aaron C. Waters
1963. Geology of Mount Rainier National Park Washington. U.S. Geol. Surv. Prof. Pap. 444, 93 p., illus.

Franklin, Jerry Forest
1966. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. 132 p., illus. (Ph.D. thesis, on file at Wash. State Univ., Pullman.)

Franklin, Jerry F., and Norman A. Bishop
1969. Notes on the natural history of Mount Rainier National Park. 24 p., illus. Longmire, Wash.: Mt. Rainier Nat. Hist. Assoc.

_____ and C. T. Dyrness
1969. Vegetation of Oregon and Washington. USDA Forest Servo Res. Pap. PNW-80, 216 p., illus. Pac. Northwest Forest & Range Exp. Stn., Portland, Oreg.

_____ William H. Moir, George W. Douglas, and Curt Wiberg
1971. Invasion of subalpine meadows by trees in the Cascade Range. Arctic & Alpine Res. 3: 215-224, illus.

Huntting, Marshall T., W. A. G. Bennett, Vaughan E. Livingston, Jr., and Wayne S. Moen
1961. Geologic map of Washington. Wash. Dep. Conserv., Div. Mines & Geol.

Kiichler, A. W.
1964. Manual to accompany the map of potential natural vegetation of the conterminous United States. Am. Geogr. Soc. Spec. Publ. 36, various paging, illus.

Potts, Merlin K., and Russell K. Grater
1949. Mammals of Mount Rainier National Park. 87 p., illus. Longmire, Wash.: Mt. Rainier Nat. Hist. Assoc.

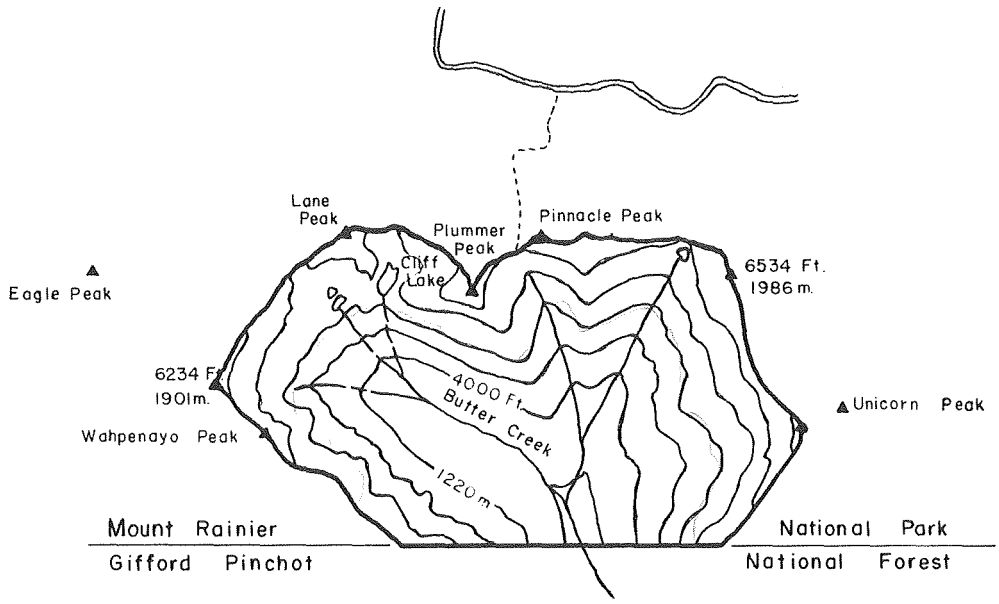
Society of American Foresters
1954. Forest cover types of North America (exclusive of Mexico). 67 p., illus. Washington, D.C.

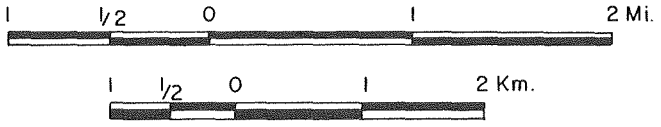
U .S. Weather Bureau
1965. Climatic summary of the United States - supplement for 1951 through 1960, Washington. Climatography of the United States 86-39, 92 p., illus.

Wolcott, Ernest E.
1961. Lakes of Washington. Vol. 1, Western Washington. Wash. State Dep. Conservo Div. Water Resour. Water Supply Bull. 14,619 p., illus.

Table BU-1. — Tentative list of mammals for Butter Creek Research Natural Area

Order	Scientific name	Common name
Insectivora	*Neürotrichus gibbsi*	shrew mole
	Scapanus orarius	coast mole
	Scapanus townsendi	Townsend mole
	Sorex cinereus	masked shrew
	Sorex obscurus	dusky shrew
	Sorex palustris	northern water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
Lagomorpha	*Lepus americanus*	snowshoe hare
	Ochotona princeps	pika
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias amoenus	yellow-pine chipmunk
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	northern flying squirrel
	Marmota caligata	hoary marmot
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon or creeping vole
	Microtus richardsoni	Richardson vole
	Neotoma cinerea	bushy-tailed wood rat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Spermophilus saturatus	Cascades mantled ground squirrel
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gopher
	Zapus princeps	western jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	mountain lion or cougar
	Lutra canadensis	river otter
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	short-tailed weasel or ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Spilogale putorius	spotted skunk or civet cat
	Ursus americanus	black bear
	Vulpes fulva	red fox
Artiodactyla	*Cervus canadensis*	wapiti or elk
	Odocoileus h. columbianus	black-tailed deer
	Oreamnos americanus	mountain goat





LEGEND

BOUNDARY, BUTTER CREEK RESEARCH NATURAL AREA

NATIONAL PARK BOUNDARY

ROAD

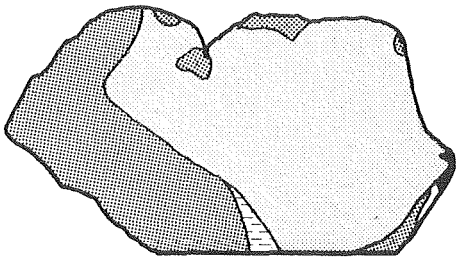
TRAIL

STREAM

PEAKS

CONTOUR LINE

Figure BU-1.– Butter Creek Research Natural Area, Lewis County, Washington.



TATOOSH PLUTON AND ASSOCIATED INTRUSIVES

GRANODIORITE AND QUARTZ MONZONITE

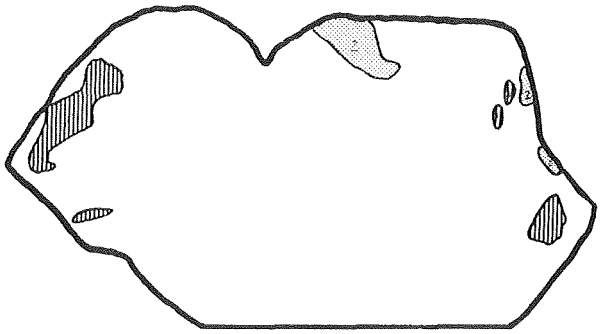
DIORITE, QUARTZ DIORITE, GRANODIORITE AND QUARTZ MONZONITE PORPHYRIES

EXTRUSIVE IGNEOUS ROCKS

RHYODACITIC ASH FLOWS OF STEVENS RIDGE FORMATION

VOLCANIC BRECCIA, SANDSTONE AND SILTSTONE OF OHANAPECOSH FORMATION

BASALT BASALTICANDESITE AND ANDESITE FLOWS OF FIFES PEAK FORMATION



TALUSES (EXCEPT DENSELY FORESTED TALUSES)

BLOCK - FIELD DEPOSITS

Figure BU-2.– Geology of Butter Creek Research Natural Area showing bedrock (upper) and surficial (lower) features (after Fiske, Hopson, and Waters 1963, and Crandell 1969a).

Figure BU-3.-Natural features of Butter Creek Research Natural Area. A: South slope of Plummer Peak; note the extensive avalanche tracks on the left and mixed forests of true firs, Douglas-fir, and western hemlock in the center and on the right (mid-July 1971). B: South slopes of Pinnacle Peak (center) and The Castle (right); note extensive avalanche tracks in the center of the picture (mid-July 1971). C: Mosaic of subalpine meadows and tree groups in the parkland subzone of the *Tsuga mertensiana* Zone on the south slopes of Pinnacle Peak (left) and The Castle (right) (August 1969). D: Shrub communities dominated by Sitka alder and vine maple along the west branch of Butter Creek (August 1969). E: Forest-meadow mosaic at the head of the west branch of Butter Creek; two small ponds are located on the bench near the center of the picture (August 1969). F: Basin at head of the east branch of Butter Creek; a small pond is located near the saddle at the left of the picture (mid-July 1971).

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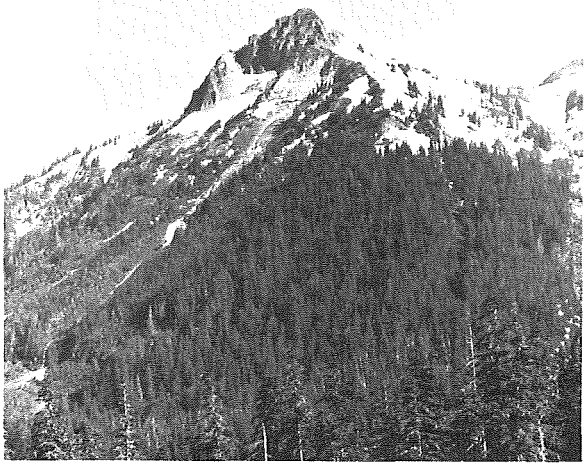

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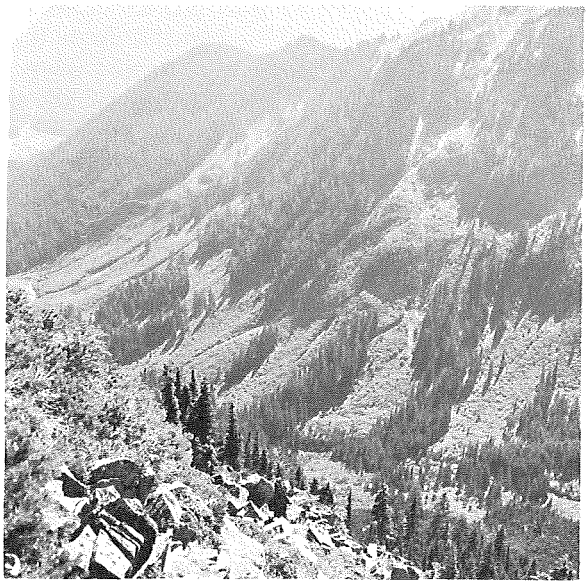
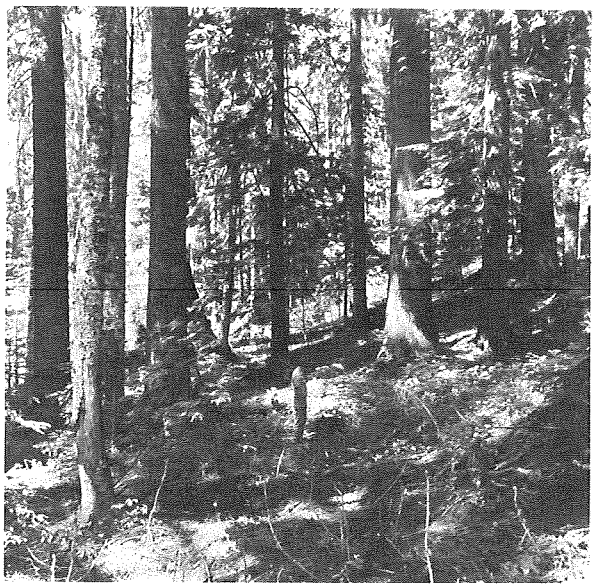


E

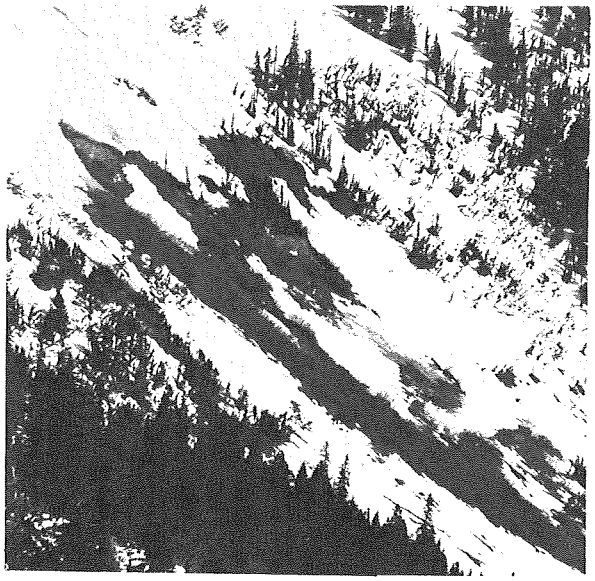
F

Figure BU-3.-Natural features of Butter Creek Research Natural Area (continued). G: Typical old-growth noble fir, Pacific silver fir, and western hemlock stand at the confluence of the west and east branches of Butter Creek. H: Typical specimen of old-growth noble fir in the lower part of the natural area. I: Avalanche track communities of Sitka alder (center) and mountain hemlock (upper right) emerging from the winter snowpack (mid-July 1971). J: Alaska-cedar-dominated avalanche track communities on the south slope of Plummer Peak (mid-July 1971). K: Butter Creek, Sitka alder communities, and noble fir forest at the southern boundary of the natural area; Plummer Peak in distance (mid-July 1971). L: View from Plummer Peak to the confluence of the east and west branches of Butter Creek (hidden in trees), showing the best developed forest stands in the natural area; note the younger, even-aged true fir stand in the center of the picture which has developed on an old avalanche track (mid-July 1971).



G

H



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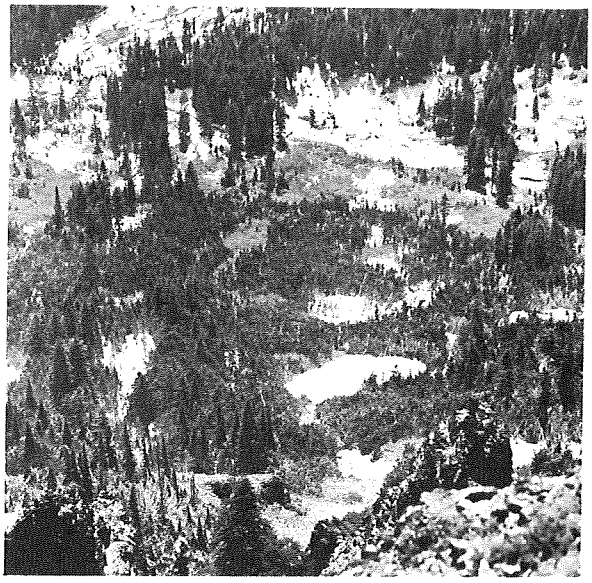

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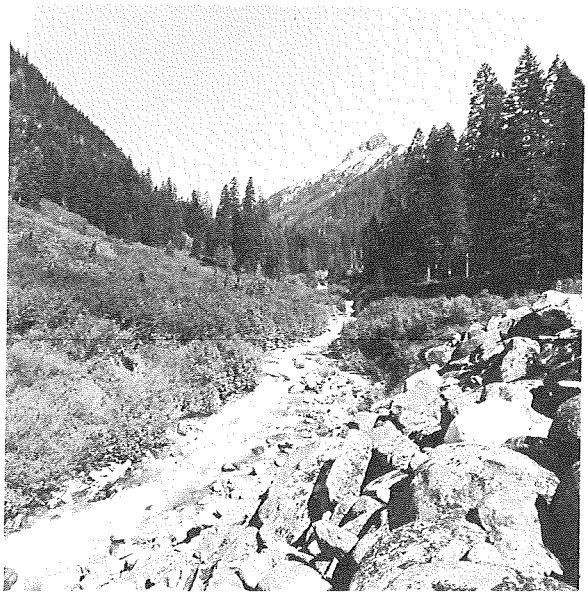

K

L