United States
Department of
Agriculture

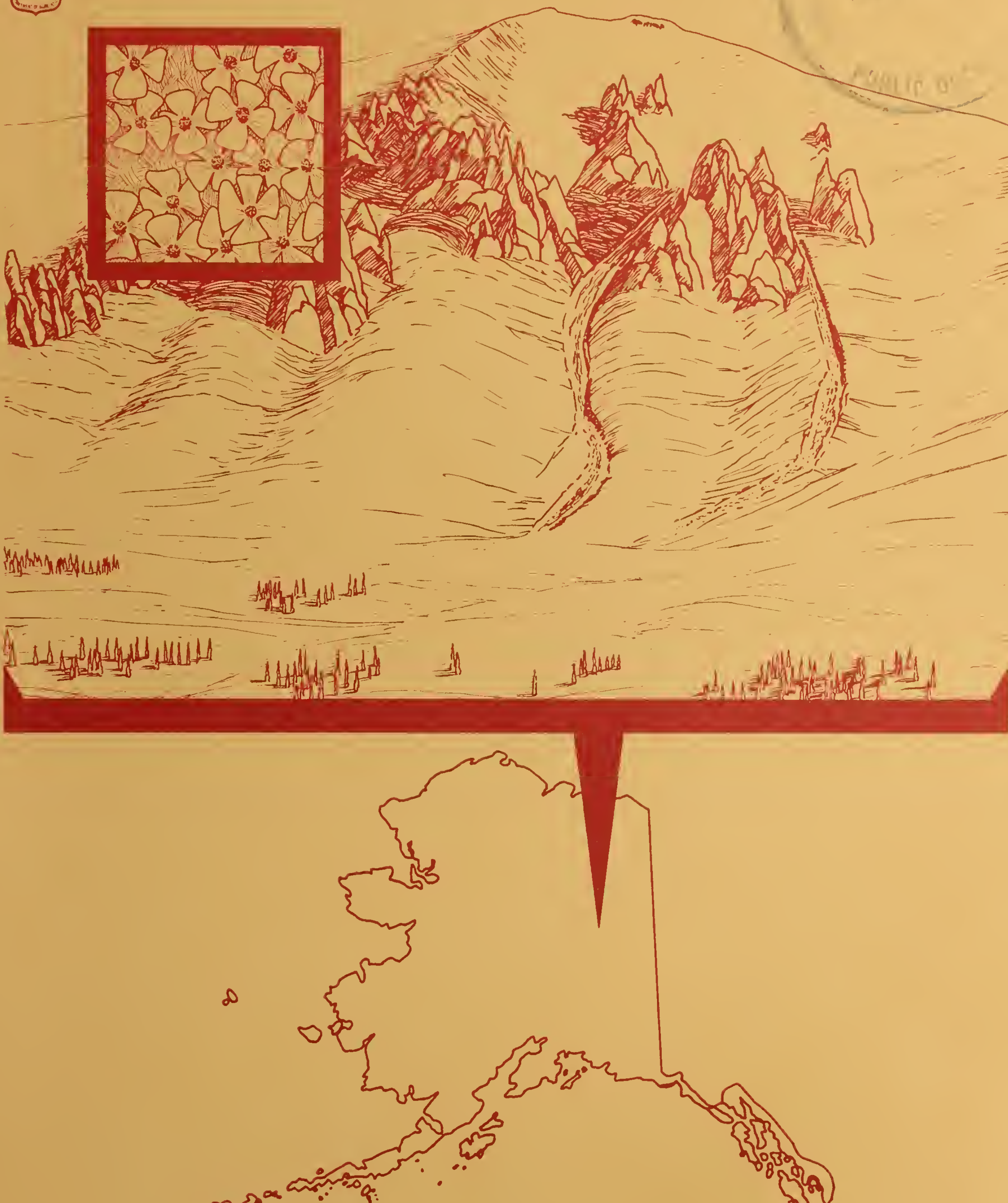
Forest Service

Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-224
August 1988

Alaska Research Natural Area: 1. Mount Prindle

Glenn Patrick Juday



Author

Glenn Patrick Juday is assistant professor of forest ecology, and Alaska ecological reserves coordinator, Agricultural and Forestry Experiment Station, University of Alaska Fairbanks, Fairbanks, Alaska 99775.

Foreword

The concept of establishing natural areas for education and scientific research is not new. As early as 1917 in the United States, the Ecological Society of America set up the Committee on the Preservation of Natural Conditions and published its findings in 1926. Other professional societies—Society of American Foresters, the Society of Range Management, and the Soil Conservation Society of America—proposed programs to identify and set aside areas where natural forest, range, and soil conditions could be preserved and studied.

The name Research Natural Area (RNA) was adopted and, in 1966, the Secretaries of Agriculture and the Interior formed the Federal Committee on Research Natural Areas to inventory research sites established on Federal land and to coordinate their programs. A 1968 directory from the Federal committee listed 336 RNA's nationwide, of which 13 were in Alaska.

By 1969, the International Biome Program (IBP) was active across the United States, and a tundra biome team was headquartered at the University of Alaska. The IBP proposed the establishment of an ecological reserves system for Alaska—"field sites uniquely suited for natural research and education. All identified sites...to illustrate one or more ecological phenomena particularly well." Called Research Natural Areas in the United States, such areas are still called Ecological Reserves in Canada and other parts of the world.

In 1973, the Joint Federal-State Land Use Planning Commission for Alaska assumed the role of lead agency in establishing Research Natural Areas and provided badly needed funds and staff support. By fall 1976, a resource planning team of the commission had prepared a comprehensive plan for establishment and management of the RNA's. A total of 222 sites, representing a wide range of physiographic regions and planning areas in the State, were recommended.

In 1976, the commission formed the Ecological Reserves Council to represent Federal, State, and private agencies. It also entered into a contract with the University of Alaska to assist in carrying out the Council's recommendations.

Present members of the Ecological Reserves Council are:

U.S. Department of the Interior:
- Bureau of Land Management
- Fish and Wildlife Service
- National Park Service

U.S. Department of Agriculture:
- Forest Service—
  - Alaska Region
  - Pacific Northwest Research Station

National Marine Fisheries Service

Alaska Department of Fish and Game
Alaska Federation of Natives
University of Alaska Fairbanks

A management-coordinator position for gathering on-the-ground data for the Research Natural Areas in Alaska has been filled since 1978 by Dr. Glenn Juday—originally under the planning commission, then by contract between the University of Alaska and the USDA Forest Service.

In 1985, the Ecological Reserves Council proposed to the Director of the Forest Service's Pacific Northwest Research Station that the reports for the Research Natural Areas be published formally by the Station. The Station agreed to publish them in the General Technical Report series, the first being, "Alaska Research Natural Area: 1. Mount Prindle."

KENNETH H. WRIGHT (Retired)
USDA Forest Service

Abstract

Juday, Glenn Patrick. 1988. Alaska Research Natural Area: 1. Mount Prindle. Gen. Tech. Rep. PNW-GTR-224. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 34 p.

The 2412-hectare Mount Prindle Research Natural Area is located in central Alaska on the border of the Steese National Conservation Area and White Mountains National Recreation Area. It is managed by the U.S. Department of the Interior, Bureau of Land Management, Steese-White Mountains District. Mount Prindle was selected as a Research Natural Area (RNA) because it contains outstanding examples of solifluction lobes; habitat for wheatear (a small thrushlike bird), caribou, and Dall sheep; the yellow-flowered mustard *Draba paysonii*, which is uncommon in Alaska; a diversity of alpine plant communities; and examples of both glaciated and unglaciated subarctic landforms. Other features of scientific interest, including two debris torrent channels and the rare moss *Oligotrichum falcatum* Steere, were discovered during site documentation. The highland region centered on Mount Prindle was once the heart of the calving area for the Steese-Fortymile caribou herd but was mainly abandoned in the early 1960's; the reason it was abandoned is not known. Mount Prindle RNA is characterized by an unusually high number of scientifically and educationally interesting natural features, typical of this portion of the Yukon-Tanana uplands, within a compact area. The area has high potential for public education and research use.

Keywords: Alaska, alpine tundra, caribou (*Rangifer tarandus*), cryoplanation terrace, Dall sheep (*Ovis dalli*), debris torrent, *Draba paysonii*, ecosystems, glaciations, granite, Natural Areas (Research), Research Natural Area, scientific reserves, solifluction lobe, tors, treeline.

Contents

Introduction

Mount Prindle was named in 1960 for Louis Marcus Prindle (1865-1956), a geologist with the U.S. Geological Survey who worked in central Alaska from 1902 through 1911 (Orth 1971). The mountain and its associated ridge system form the boundary between the White Mountains National Recreation Area and the Steese National Conservation Area in central Alaska. The location of Mount Prindle Research Natural Area (RNA) is shown in figure 1A; access in figure 1B. Both the White Mountains and the Steese areas were established by the Alaska National Interest Lands Conservation Act of 1980 and are managed by the Bureau of Land Management, U.S. Department of the Interior. The Mount Prindle RNA includes most of the complex summit region of the mountain (fig. 2).

Management of the Mount Prindle RNA is the responsibility of the Steese/White Mountain District Manager, Bureau of Land Management, U.S. Department of the Interior (1150 University Avenue, Fairbanks, AK 99709). Permission is not needed for educational use and observational, nondestructive research, but scientists interested in using the area are urged to contact the district manager and the Alaska Ecological Reserves Coordinator, Agricultural and Forestry Experiment Station, University of Alaska Fairbanks, Fairbanks, AK 99775, to outline activities planned.

Mount Prindle RNA was established through the Land and Resource Management Plans for the Steese National Conservation Area and the White Mountains National Recreation Area. The plans contain special management direction for the RNA. The guiding principle of management is prevention of unnatural activities that modify ecological processes. Long-term research can be conducted in the RNA with minimal interference and reasonable assurance that land development will not interfere with the research. In return, scientists and visitors should notify the district manager of their proposed use, abide by any applicable regulations, and provide the agency with published results or progress reports.

In the late 1970's, an area encompassing Mount Prindle, but larger than the RNA, was nominated as a National Natural Landmark (Young and Walters 1982). A Mount Prindle RNA was first proposed during the joint land use planning for the Steese National Conservation Area and the White Mountains National Recreation Area. A 1982 planning document defined the natural features needed to qualify areas for designation as new RNA's in the Steese and White Mountains areas (Juday and others 1982). Mount Prindle was visited and studied for RNA suitability using these criteria in 1982. When land resource management plans for the Steese and White Mountains Areas were drafted in 1983, the public was asked to comment on use of Mount Prindle as an RNA. Mount Prindle RNA was established in 1986 by the final adoption of the revised Steese and White Mountains plans (Bureau of Land Management 1984a, 1984b). The RNA encompasses 2407 ha, about 60 percent in the White Mountains National Recreation Area and 40 percent in the Steese National Conservation Area.

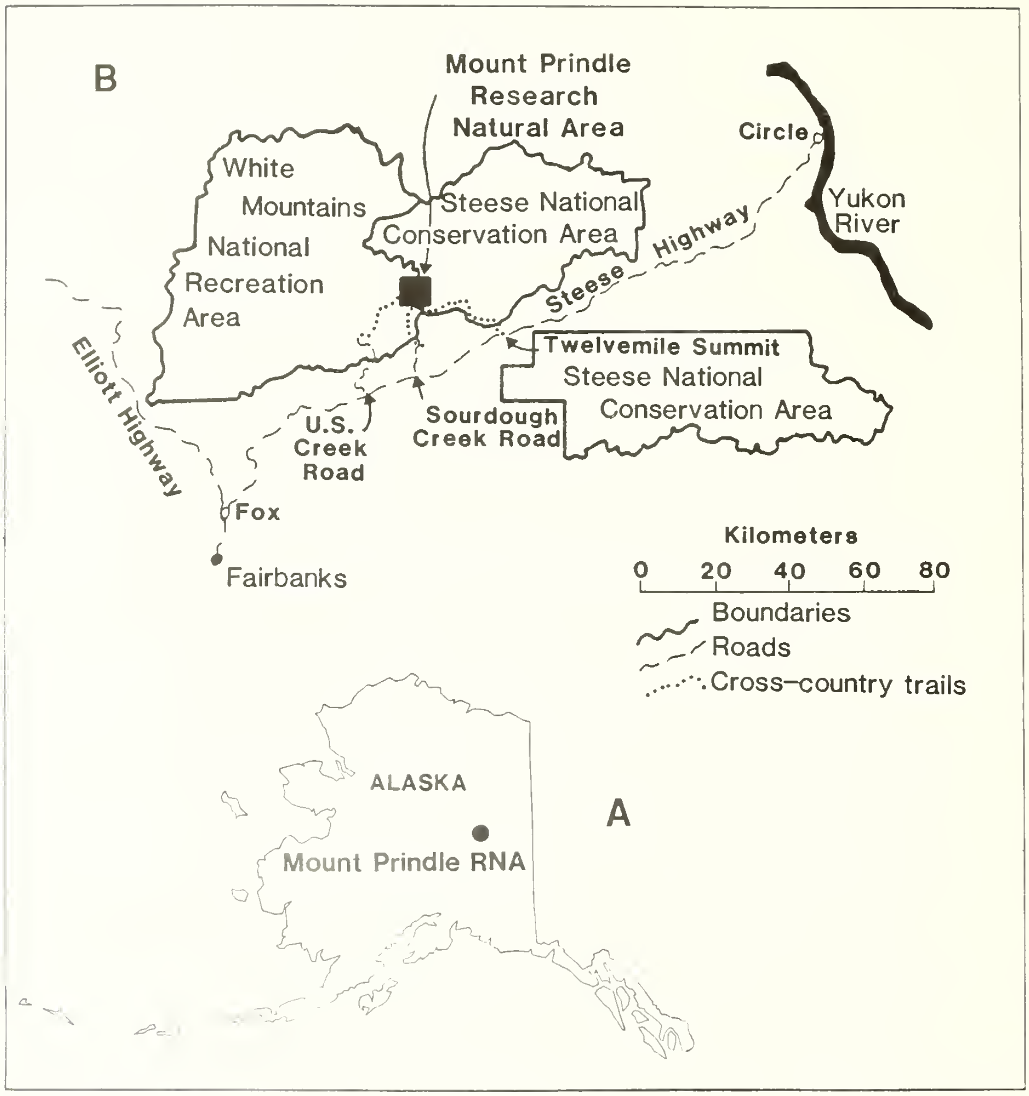


Figure 1—Mount Prindle Research Natural Area. A. Location.4
B. Access.

The Steese and White Mountains plans also established a primitive recreation management zone in the uplands surrounding the RNA. The primitive recreation zone is an area of important Dall sheep and caribou habitat that will be kept free of mining and other human disturbance. The plans approved a new shelter cabin site southeast of the RNA and a trail corridor in or near the RNA. The trail corridor, a zone within which a trail can be built, passes between locations east and west of the RNA; the actual route of the trail has not been identified. The need to avoid sensitive features of the RNA will be a factor in determining the precise location of the trail and cabin.

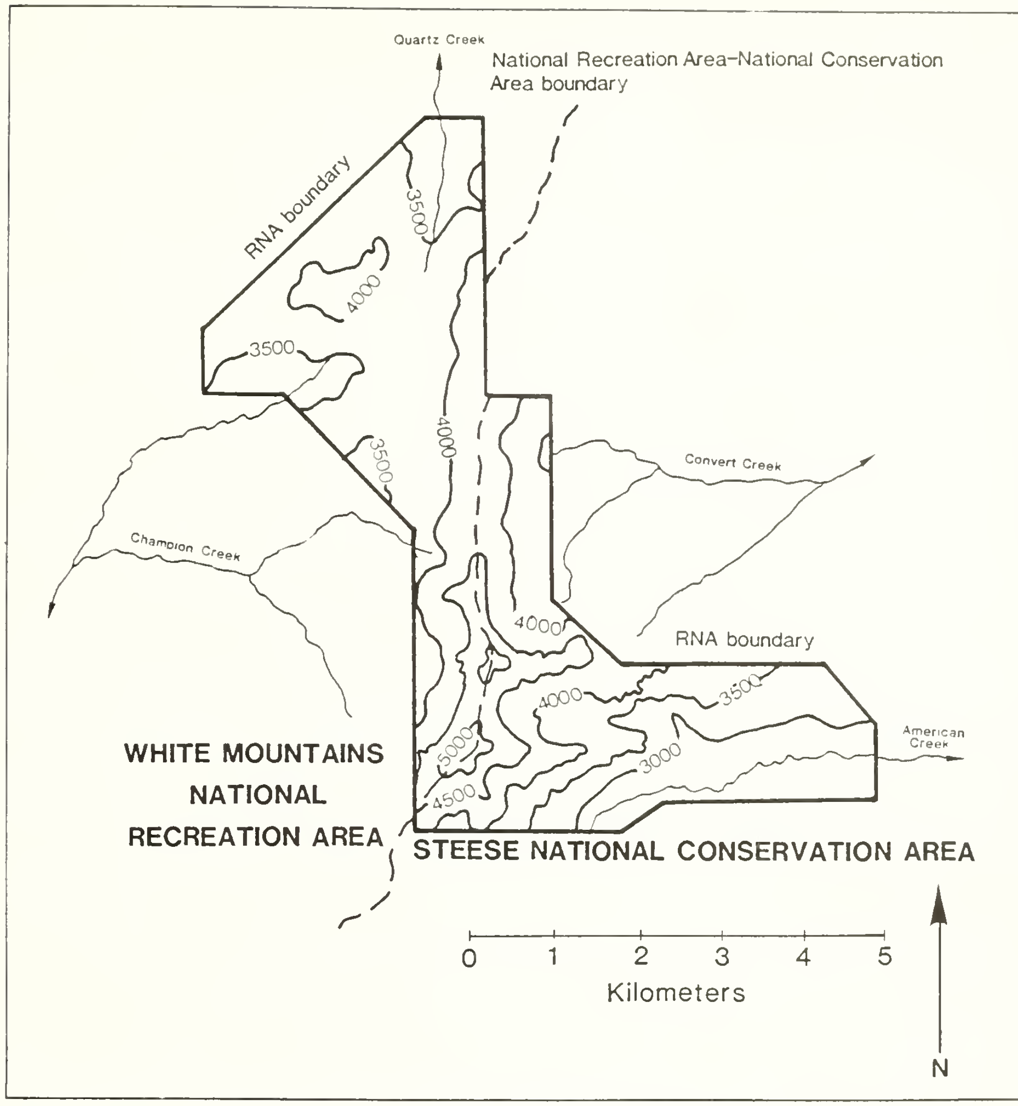


Figure 2—Boundary and topographic map of Mount Prindle Research Natural Area (contours in feet).

The principal historical use of the Mount Prindle area has been geologic study, caribou hunting, and mineral prospecting. Geologic study and prospecting began with the work of L.M. Prindle in the early 1900's. As the Steese-Fortymile caribou herd drastically declined in the 1940's and 1950's, sport hunting declined in importance. Since the 1970's, recreation (mainly hiking) and scientific study have assumed greater importance as uses of the area. Through the mid-1980's, however, the RNA has had only a few visitors in any year.

The Mount Prindle RNA is located in the Steese-White Mountains District of the Bureau of Land Management. The summit of Mount Prindle is located at 65°27′ N., 146°30′ W. (fig. 3). The RNA occupies all or portions of sections 15, 16, 21, 22, 26, 27, 28, 34, and 35 of T. 8 N., R. 6 E., and all or portions of sections 1, 2, 3, 10, and 11 of T. 7 N., R. 6 E., and most of section 6, T. 7 N., R. 7 E., Fairbanks Meridian. The highest elevation within the RNA is 1611 m; the lowest elevation is about 762 m.

Figure 3—Aerial view of west-facing portion of the summit of Mount Prindle, March 11, 1986.

Access and Accommodations

Structures and Trails

As of 1986, there were no structures in or near Mount Prindle RNA. The Steese National Conservation Area land use plan identifies a site just south of the RNA, on the floor of American Creek Valley, where a trail shelter or cabin will be built as funds allow. A trail corridor, as defined in the Steese and White Mountains plans, connects the Twelvemile Summit area on the Steese Highway, American Creek Valley, and the Bear Creek lowlands at the head of Beaver Creek. When trail construction is funded, the Bureau of Land Management will conduct an environmental analysis to determine where the trail will be. If certain natural features in the RNA are found to be sensitive to disturbance, the trail will be built to avoid the RNA or an appropriate portion of it.

Parking, Roads, and Rights-of-Way

The Mount Prindle RNA can be reached by road three ways. Visitors taking the Nome Creek route must park at the end of the U.S. Creek road southwest of the summit and walk about 16 km cross-country into the area (fig. 1B). The U.S. Creek road is a medium-standard public access road off the Steese Highway. The U.S. Creek road is passable by most vehicles except after heavy rains; it is not maintained in the winter. The U.S. Creek road ends at Nome Creek; a very low standard road continues about 7 km along Nome Creek toward Mount Prindle. The cross-country portion of the Nome Creek route rises gradually through the uppermost reaches of Nome Creek Valley and approaches the RNA along the lowlands of Champion Creek of west Mount Prindle (fig. 2). The White Mountains National Recreation Area land use plan approved the relocation, extension, and upgrading of the Nome Creek road into a major access route for recreational use of Beaver Creek. A survey for the new road was completed in 1987; construction will begin when funds are appropriated.

The second access route is along Sourdough Creek, due south of the summit of Mount Prindle. The Sourdough Creek road (fig. 1B) is a placer mining access road and is passable mainly by four-wheel-drive vehicles. The road ends 15 km from the summit. The route from the end of the road to the peak is cross-country; most of the elevation gain is within the first 3 km. The Sourdough Creek road provides access to the main watershed divide ridge system of the region, which leads to the summit of Mount Prindle.

The third access route begins at the Twelvemile Summit trailhead parking area on the Steese Highway southeast of the summit (fig. 1B). The Steese Highway is a high-standard paved and gravel road maintained throughout the winter (as funds permit). From the trailhead, visitors must walk cross-country along the ridge summit. The Twelvemile Summit route follows generally favorable, rolling alpine terrain for 25 to 30 km, depending on which part of the RNA a visitor is approaching. No rights-of-way affect the RNA.

Reasons for Establishing the Research Natural Area

Juday and others (1982) defined the natural feature "type needs" used in the search for RNA's in the Steese National Conservation Area and White Mountains National Recreation Area. Type needs are plant communities, rare plants, geologic features, and animal species that are characteristic of a given region and are necessary for a complete and representative system of RNA's. They are of central importance for developing management guidelines. For animal species, the occurrence of the target species in some particular setting or habitat usually makes up the type need. A rich combination of type needs was found at Mount Prindle, and these needs (table 1) are the basis for this description of the RNA.

The Mount Prindle region contains excellent examples of both glaciated landforms and periglacial (unglaciated) features in proximity, illustrating how two sets of different cold-climate processes produce very different landscapes. At least four glacial advances spanning several hundred thousand years are evident. The small glaciers of Mount Prindle were isolated in a vast unglaciated region and were barely nourished by the ice age climates. The features marking the fluctuations of these small glaciers are useful in studies of past climates. The periglacial landscape processes have operated for even longer periods and have produced remnant features such as tors and cryoplanation terraces, as well as depositional features such as solifluction lobes (for definition, see table 1). The solifluction lobes in the RNA are some of the best developed in central Alaska.

Cliffs and monoliths produced by both sets of processes are regionally important as perches for raptors and escape-terrain for Dall sheep. Boulders and rockpiles are important nesting habitat for the wheatear, a thrushlike songbird that migrates to Eurasia for the winter. Two recently active debris torrent channels have carved the east face of Mount Prindle, providing spectacular evidence of large-scale weathering processes. Mount Prindle is one of the highest elevations in the western Yukon-Tanana uplands and is habitat for a yellow-flowered mustard *Draba paysonii*, a plant common in the Rocky Mountains but rare in Alaska. A rare moss was also discovered in the RNA. The area was the core of the calving area for the Steese-Fortymile caribou herd until the early 1960's and is still important summer range for a smaller, resident caribou herd. The RNA also supports many typical alpine plant communities and a typical assemblage of alpine and treeline birds and small mammals. Mount Prindle RNA has an unusually high number of scientifically and educationally interesting natural features, both rare and typical of the central and western portion of the Yukon-Tanana uplands, within a relatively compact area. Because the RNA is close to a road system and will eventually have trails and cabins for public use, it has a high potential for supporting public education and scientific research.

Table 1—Natural feature type needs used in the selection of the Mount Prindle Research Natural Area

Type needs	Comments and definition
Animal species:	
Mammals—	
Dall sheep	Occurrence in alpine areas of the central Yukon-Tanana uplands, isolated from the main Brooks Range and Alaska Range populations and with good examples of escape terrain
Caribou	Occurrence in overwintering habitat
Bird—	
Wheatear	Occurrence in alpine regions with perching, foraging, lookout, display, and nesting habitat on large boulders or rocks
Plant species:	
Uncommon plant, *Draba paysonii*	A small yellow-flowered mustard known in Alaska previously from only two locations
Geologic features:	
Landforms—	
Cliffs	Vertical exposures of essentially unvegetated bedrock
Periglacial features	Stone stripes, stone polygons, and especially solifluction lobes (areas of slow downslope movement of seasonally thawed, saturated fine soil that creeps over frozen subsoil)
Plant communities:	
Moist white spruce slope forest (treeline variant)	White spruce (open needleleaf)[a]
Moist willow flood plain tall shrub	Willow (willow thickets)[a]
Birch dry upland dwarf shrub	Mesic shrub birch-ericaceous shrub[a]
Ericad upland dry dwarf shrub	Shrub birch-ericaceous shrub bog[a]
Snowbed herb-graminoid meadow	Alpine herb-sedge (snowbed)[a]
Upland tussock meadow	Tussock tundra[a]
Foliose lichen	Foliose and fruticose lichen[a]

[a] Closest Alaska vegetation classification system unit of Viereck and others (1986).

Environment

Climate

Only short, fragmentary records are available about the climate of the Yukon-Tanana upland region of interior Alaska. Some inferences about precipitation at high elevations have been made on the basis of downstream hydrologic behavior of the Chena River at Fairbanks. Santeford (1976) produced a linear regression defining the increase in precipitation above the Fairbanks (the nearest first-order station) mean with increasing elevation. The increase was expressed as multiples of the Fairbanks mean. Precipitation doubled at about the 750-m elevation. These inferences and some records from the Caribou-Poker Creeks research watershed (Haugen and others 1982) indicate that the mean annual precipitation near Mount Prindle is between 600 and 1000 mm, two to three times as much as at Fairbanks.

Strong winds rearrange snow into drifts and snowbeds that locally augment the annual total. Areas blown free of snow (deflation patches) are drier than the mean annual precipitation would indicate (fig. 4).

Mean annual temperatures in the RNA are well below freezing, although local variations caused by mountain effects, variation in aspect, and cold air inversions are extreme. A snowpack begins accumulating at the highest elevations from September 1 to October 1, although snow can fall almost any time except for a few weeks near the summer solstice. Precipitation is at a minimum in spring and early summer; it increases in typical monsoon fashion throughout the summer. Summer rainshowers produced by terrain-induced convection are typical of the area.

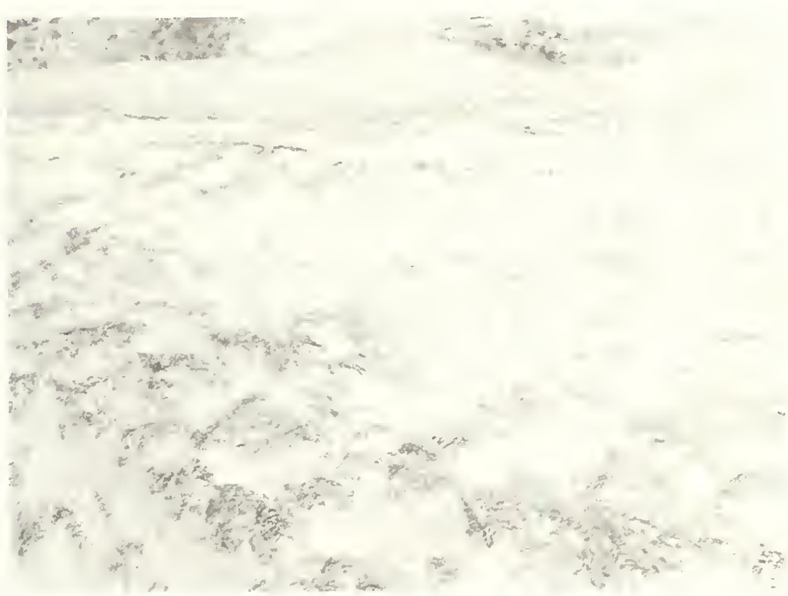


Figure 4—Aerial view of upland tundra in the central portion of Mount Prindle Research Natural Area, March 11, 1986. Snow deflation and collection areas can be seen on the slightly undulating landscape.

Geology[1]

Bedrock geology.—The Mount Prindle region is part of the Yukon-Tanana Terrane (Pessel and others 1987). The Yukon-Tanana Terrane includes at least two sequences of metamorphic rocks that are Paleozoic to Late Precambrian in age. Both metamorphic sequences were formerly known as Birch Creek schist (Mertie 1937) but were differentiated in later research (Pessel and others 1987). The metamorphic layers form a gradient from slightly altered rocks north and west of Mount Prindle to intensively metamorphosed rocks south of the mountain. Pessel and others (1987) propose the name "Grit-metagrit sequence" for the metamorphics that underlie the region around Mount Prindle. They interpret these rocks as originating in a submarine sediment fan. The sediments were mainly channel and overbank deposits. Three units were recognized in the sequence: (1) an upper grit layer, (2) a lower grit layer, and (3) a marble-chlorite marker that divides the upper and lower grit layers (Pessel and others 1987). The lower grit and marble-chlorite layers are assigned to Late Precambrian age. The upper grit layer is Late Precambrian or Cambrian.

The Mount Prindle RNA contains portions of two plutons (injected magma) of the Hope granite suite (Burns and Newberry 1987). The Hope suite is part of a belt of Late Cretaceous to Early Tertiary intrusive bodies extending across east-central Alaska into the Yukon Territory (Burns and Newberry 1987). The Mount Prindle pluton makes up the summit in the southern portion of the RNA (fig. 5), and a part of the Quartz Creek pluton makes up the highlands in the northwest part of the RNA (fig. 6A). Biotite and muscovite in the granites of the Mount Prindle pluton have been

[1] Portions of this section first appeared in *Natural Areas Journal* (Juday 1987); used with permission of the Natural Areas Association.

Figure 5—Southeast-facing granitic summit of Mount Prindle is black with felsic lichens; looking west.

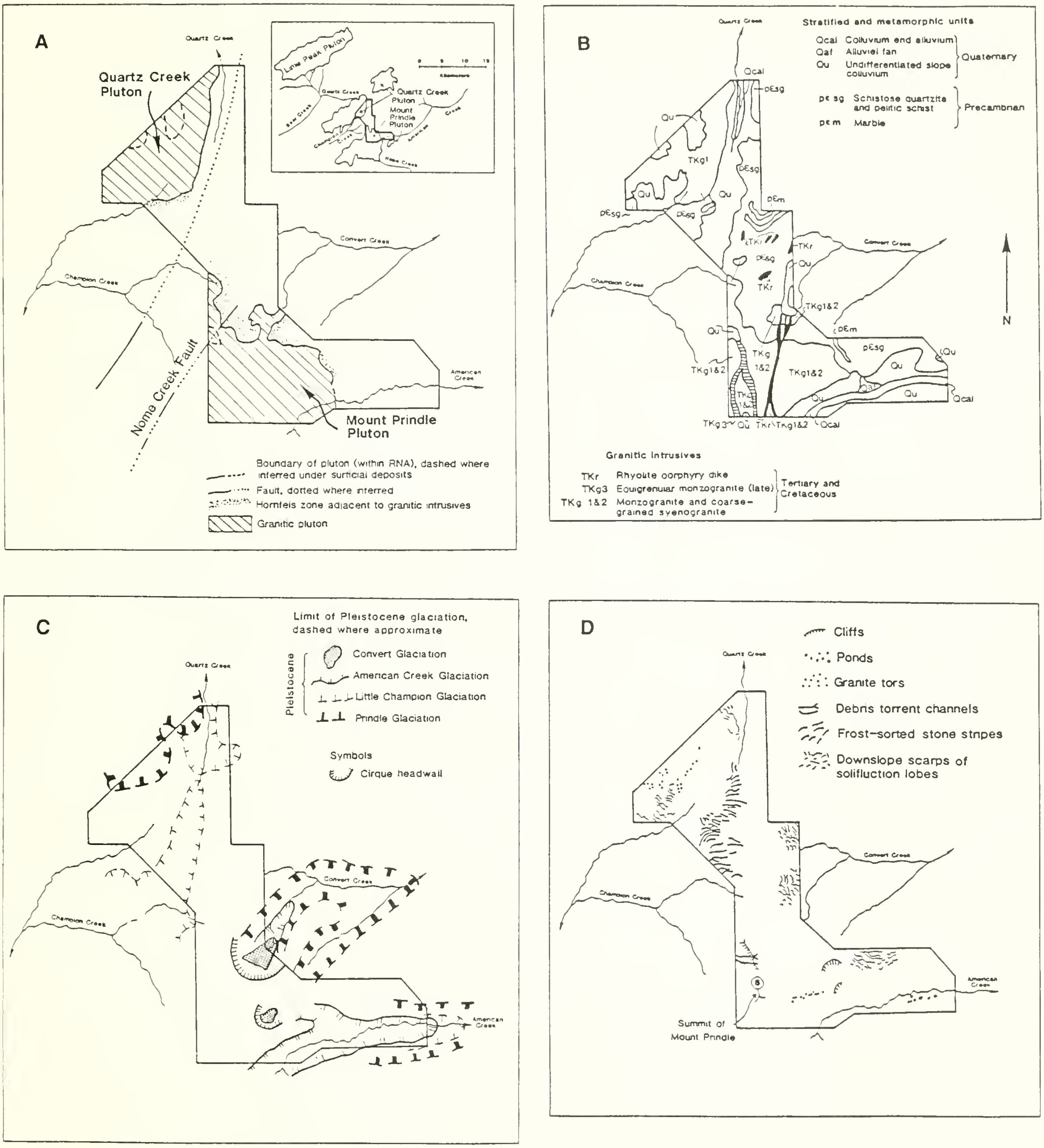


Figure 6—Geologic features of Mount Prindle Research Natural Area. A. Location of plutons and faults; adapted from Burns and Newberry (1987). B. Bedrock geology; adapted from Smith and Pessel (1987). C. Glacial geology; adapted from Weber and Hamilton (1984). D. Landform features; interpreted from high altitude aerial photos and field notes.

dated by the K-Ar method as 58.5 ± 1.8 to 56.5 ± 1.7 million years old (Holm 1973). The emplacement of both the Mount Prindle and the Quartz Creek plutons in the latest Cretaceous or early Tertiary transformed the surrounding schist to upper hornblende hornfels within a surrounding zone of about 1 km (fig. 6A) (Holm 1973). The plutons are displaced by at least four prominent faults or lineaments in the vicinity of the RNA (Swainbank 1987). The northeast-trending Nome Creek Fault (Holm 1973) extends into the RNA about 3 km north of the summit (fig. 6A); the northeasterly trending lineament cutting across upper Champion Creek is a strong regional feature (fig. 6A) (Swainbank 1987).

Bedrock geology of the RNA is shown in figure 6B. Precambrian pelitic schists with small outcrops of marble make up the highlands between the Quartz Creek and Mount Prindle granite plutons. Moderate lower slopes are covered with Quaternary colluvium. Quaternary alluvial deposits are restricted to narrow zones along American Creek and Quartz Creek.

The Mount Prindle pluton has been differentiated into three granites based on chemical composition and mineral crystal size (Smith and Pessel 1987). The intrusive sequence began with an early coarse-grained phase. A later fine-grained, equigranular phase cuts across the earlier rocks. A late phase is represented by fine equigranular/porphyritic granite with zinwaldite mica (Smith and others 1987). Burns and Newberry (1987) combined the first and second phase granites of the Mount Prindle pluton into one intrusive unit based on the lack of intrusive contacts between them and the composition of rare earth elements; figure 6B reflects this approach. The last intrusive event was the emplacement of a rhyolite porphyry dike in the early granites and the adjacent schist north of the summit (fig. 6B).

Veins of topaz and tourmaline are characteristic of the Mount Prindle pluton; small amounts of flourite are reported in the RNA (Holm 1973, Weglarz and Albanese 1987). Weglarz and Albanese (1987) mapped two areas of greisen immediately north of the summit of Mount Prindle, and three small flourite occurrences. Greisen is an altered granite rich in quartz and mica that is characteristic of regions where tin is mined.

Glacial geology.—Mount Prindle stands out in the largely unglaciated Yukon-Tanana uplands as a location with clear evidence of local multiple alpine glaciations (fig. 6C) (Péwé and others 1967). Weber and Hamilton (1984) state:

> The Mount Prindle area exhibits dramatic evidence for Pleistocene glaciation. Deep cirques occupy the heads of a radiating series of U-shaped troughs 9 to 11 km long that change abruptly downvalley into V-shaped canyons. Sharp narrow aretes between smooth cirque headwalls contrast with nearby unglaciated uplands that exhibit tors, cryoplanation terraces, and other nonglacial erosion forms.

The contrast between the gently rolling nonglacial topography and areas of clear, recent (as well as older and more subtle) glaciation makes the Mount Prindle RNA an outstanding educational resource (fig. 7). Weber and Hamilton (1984) recognize evidence for four glacial episodes at Mount Prindle. The earliest and the most extensive was the Prindle Glaciation (fig. 6C), which took place more than 250,000 years ago but probably less than 700,000 years ago. The Prindle Glaciation produced extensive glacier deposits in valleys south and west of the mountain that were not covered by later glacial advances. These deposits suggest that the climate during Prindle Glaciation was different from the Wisconsinan (most recent ice age) because Mount Prindle must have intercepted a greater flow of moist air from the south during Prindle times. A possible explanation is that the Alaska Range was not as effective a barrier to Pacific moisture as it is now, most likely because it was lower in elevation (Weber 1986).

Weber and Hamilton (1984) place the subsequent Little Champion Glaciation before 125,000 years ago. The Little Champion probably corresponds to the Illinoian Glaciation of the mid-North American chronology. Glacially scoured cirques of Little Champion age have not been greatly altered by cryoplanation. Valley floors of Little Champion age have been only slightly incised by modern streams (Weber and Hamilton 1984).

The American Creek Glaciation is probably of early Wisconsinan age and took place earlier than 40,000 years ago. During the American Creek Glaciation, most of the valleys radiating from the summit of Mount Prindle supported glaciers, but they did not fill the valleys laterally and did not extend downvalley as far as during the Little Champion Glaciation. The fourth and latest glaciation was the Convert Glaciation in late Wisconsinan times. It produced ice only in small areas totaling about 100 ha, mainly in northeast-facing cirques around the peak of Mount Prindle. No feature of

Figure 7—Glaciated U-shaped valley of American Creek seen from the summit of Mount Prindle. This glacial valley in the rolling Tanana-Yukon uplands is isolated by great distances from other glacial terrain.

the Convert Glaciation extends below 1025-m elevation. A rock glacier still occupies the north-facing cirque at the head of Convert Creek. Its position suggests that it formed as a periglacial feature during the Convert Glaciation; the weathered forms of the rock resemble those deposited in the American Creek Glaciation. The rock glacier probably incorporated the older rock during its advance in Convert times.

Excellent examples of the terminal moraines from both the American Creek and Little Champion Glaciations are present in the American Creek Valley just east of the boundary of the RNA (fig. 6C). Weathered, oxidized till can be seen in unvegetated exposures on the steep sides of the valley at about the position of the terminal moraines of both glaciations (fig. 8). A series of very small ponds mark a probable stagnant ice zone on the floor of American Creek Valley. These ponds may have formed as ice block depressions but more likely were thawing centers in ice-rich permafrost in the terminus region (Weber and Hamilton 1984). These are the only lakes in the region, and they provide a small bit of wildlife habitat diversity. The terminal moraine region there supports a special plant community, an open lichen mat with isolated trees and shrubs on nutrient-poor gravel pavements. The ancient Prindle moraine lies at about the current treeline position on the south-facing slope above American Creek.

Periglacial features.—The Quartz Creek pluton in the northwestern portion of the RNA was affected by only the earliest (Prindle and Little Champion) glaciations; portions of the level upland surface there and elsewhere in the RNA were never glaciated (fig. 6C). Unglaciated areas and areas of older glaciation have been shaped by special landscape weathering processes characteristic of cold regions.

Frost action in cold regions produces erosional debris features and remnant landforms. Other processes transport frost-shattered debris downslope and produce depositional landforms.

Figure 8—Two terminal moraines and scars on north-facing slope above American Creek, section 6, T. 7 N., R. 7 E. The oldest moraine is farthest downvalley, to the left or east (not shown).

The broad ridge summit in the northwest portion of the RNA is a cryoplanation terrace (fig. 9). Péwé (1975) defines cryoplanation terraces as:

> ...large bedrock steps or terraces on ridgecrests and hilltops (Eakin, 1916, p. 78); the terraces possess at least one scarp (ascending and (or) descending) and a tread surface. The tread or "flat" area is 10 to several hundred meters wide and long, and slopes from 10 to 15^0, parallel to the ridgecrest. Terrace scarps are from 1 to 30 m high. ...terraces...are more poorly developed on granite and tilted sedimentary or low-grade metamorphic rocks. Residual bedrock knobs (tors) project above some terrace treads. ...As terraces form, frost-rived debris is shed as a blanket of mass-wasting material from the terraces down the slopes to creek valley bottoms.

Several granite tors occur in the northwest section of the RNA (figs. 6D and 9). They protrude from land surfaces that are actually deep accumulations of rock and boulder debris. These granite features are locally important components of wheatear habitat. Frost-shattered rubble is often sorted by freeze-thaw action into stone stripes. A particularly striking set of stone stripes is found in the RNA in the area of Precambrian schist between granite plutons (figs. 6A and 6D).

Figure 9—Aerial view of a cryoplanation surface (in background horizon) in the granite tors area of the western portion of Mount Prindle RNA, March 11, 1986. Tallest tors are 10-12 m high. This area supports one of the densest concentrations of nesting wheatears, which hop down into the hollow spaces in rockpiles surrounding the tors.

Soils

Most of the Mount Prindle RNA is underlain by continuous permafrost. An area of white spruce forest on the lowest elevation, south-facing slopes above American Creek may be free of permafrost, or the soils there may have a very deep active layer. One of the most striking features of the area is the very large and well-developed solifluction lobes on south-facing slopes (figs. 6D and 10). Solifluction lobes are formed over permafrost when warm, steep slopes thaw and cause a gradual creeping downhill movement of a slurry of rock, soil, vegetation, organic layers of soil, and water. The downslope fronts of the lobes in the western portion of the RNA are marked by near-vertical scarps as high as 2 m. Well-developed stands of willows grow on several of the advancing fronts (fig. 11). Occasionally, the upper portions of the lobes are marked by tension cracks in the vegetation and organic soil layer up to 1 m wide; these cracks reveal the churning mixture of angular stones, soil, and organic fragments below (fig. 12). These solifluction lobes are among the largest in central Alaska.

Weber and Hamilton (1984) describe some of the characteristics of moraine and till soils in the Mount Prindle region. They provide information on color and depth of weathering, which indicate the relative age of the glaciations they name.

Figure 10—Well-developed solifluction lobes on south-facing slopes above American Creek, 2.5 km west of the summit of Mount Prindle. Dark lines marking lobate shapes around the lower margin are willow shrubs.

Figure 11—Close view of willow shrubs along a 1.7-m scarp at head of a solifluction lobe.

Figure 12—Tension crack at the upslope tail of a large solifluction lobe. Churned soil and rock are obvious in the crack; plot frame is 0.2 by 0.5 m.

Two debris torrent channels on the west slope of Mount Prindle (fig. 6D) are interesting landforms within the RNA. Neither was obvious during a visit to the site in June and late July of 1982, but they were a striking feature in September (fig. 13). The channels probably formed in September 1982. Heavy, late summer rains saturated soils in the region. At high elevations such as Mount Prindle, this interval of heavy precipitation was terminated by cold temperatures and snow. During the 1st week in September, a very strong warming trend, centered in east-central interior Alaska, melted the accumulated snow very rapidly. The thaw on top of saturated soils released a torrent of water that was funneled into two oversteepened channels. The water moved downhill, picking up soil, rocks, and vegetation, and scouring out the channels. The debris torrent load was deposited in two fans at the base of the mountain (fig. 14). These surfaces offer an outstanding opportunity for successional studies in which the timing and character of the initial disturbance event are known. Two shorter, thinner, and shallower tracks mark the same channels in a 1981 aerial photograph of the area, indicating that the activity may be periodic.

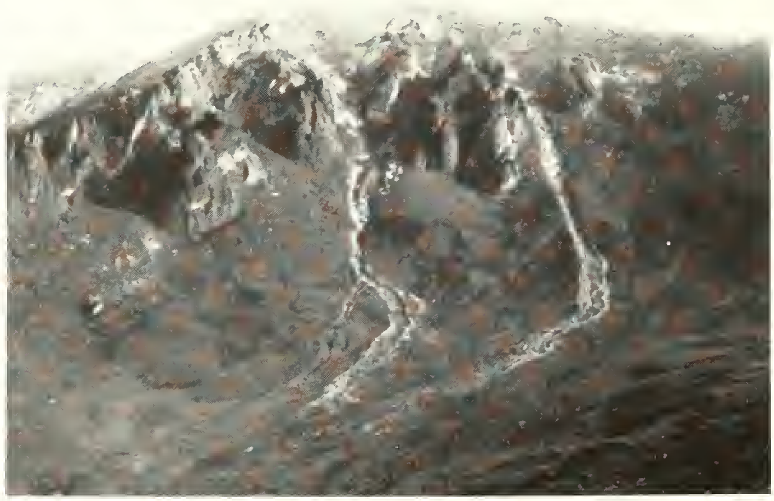


Figure 13—Two debris torrent channels, west-facing slope of Mount Prindle, in the southwest corner of Mount Prindle Research Natural Area, on September 24, 1982, 2 weeks after a scouring flood.

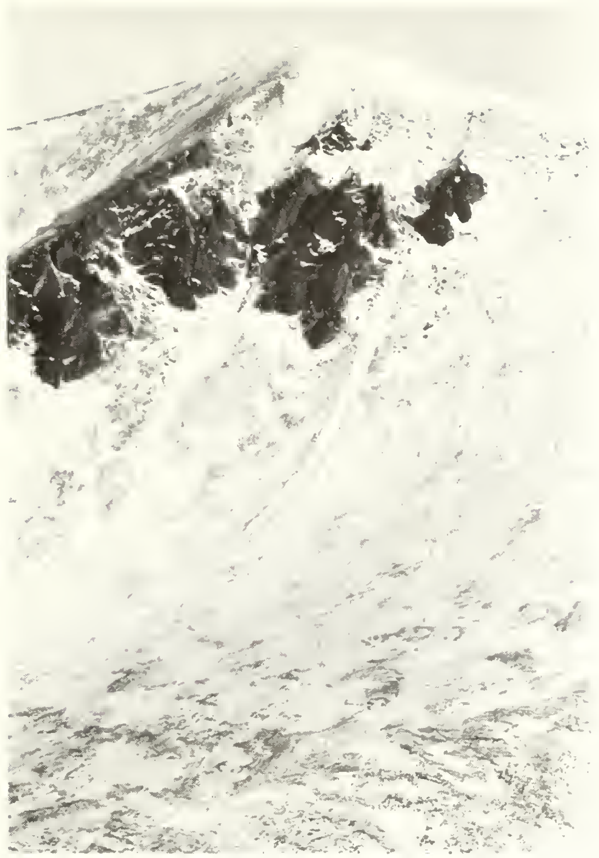


Figure 14—Aerial view of the two debris torrent channels on the west-facing slope of Mount Prindle, March 11, 1986.

Biota

Vegetation

Rare plants.—Time available for site documentation work at Mount Prindle RNA was limited. As a result, the main goals in relation to vegetation were: (1) to verify the presence of any uncommon plant species on the type needs list (table 1) or other unexpected or special species, and (2) to determine the presence of plant communities on the type needs list. No permanent plots or documentary photo stations were established, although voucher specimens of plants of special interest were made (table 2). Plants were collected along the main ridge crest from the summit of Mount Prindle to the northern end of the RNA. The two most notable finds were *Draba paysonii*, a yellow-flowered mustard (fig. 15), and the rare moss *Oligotrichum falcatum* Steere. For many years *O. falcatum* was known in Alaska only in the Brooks Range (Murray 1985). Including the Mount Prindle collection, there are now two collections from interior Alaska, as well as two from western Alaska (Long 1985).

The taxonomy of *Draba paysonii*, including the typal variety and a variety *treleasii*, was defined by Hitchcock (1941) in a revision of the western *Drabas*. He described the plant as:

> Common and quite widespread on rocky ridges near timberline and above in our western mountains from Wyoming to Alberta; west to British Columbia, the Cascade and Olympic Mountains of Washington; south to the region of Lake Tahoe, California, and Mt. Rose, Nevada.

Table 2—Plant species collected in the Mount Prindle Research Natural Area, July 1982[a]

Collection number	Species
DM8523	*Potentilla elegans* Cham. & Schlecht.—a species described as "rare" in Hultén's (1968) "Flora of Alaska"; a scattered distribution in 3 locations in Alaska and several areas in eastern Siberia; only 1 previous collection in the Yukon-Tanana uplands
DM8524	*Oxytropis nigrescens* (Pall) Fisch. ssp. *bryophila* (Greene) Hult.—a well-distributed Beringian species
DM8526 and DM8527	*Draba paysonii* Macbride—a Rocky Mountain species now known to be highly disjunct to east-central Alaska
DM8528	*Senecio yukonensis* Pors.—a species distributed almost exclusively in the higher elevations of the Yukon-Tanana uplands, adjacent high elevations in the Yukon Territory, parts of the Alaska Range, and the eastern Brooks Range of Alaska. Although not a rare species overall, some of the most abundant occurrences are in the Yukon-Tanana uplands.
DM8529	*Claytonia porsildii* Yurtsev—a proposed new name for the taxon treated as *C. arctica* Adams by Porsild (1975). *Claytonia porsildii* may be related to *C. sarmentosa* C. A. Mey., which is a widespread Beringian endemic of far eastern Siberia and all of northern Alaska. *Claytonia arctica* previously has been reported from Siberia and the Near Islands of the Aleutians, 3 collections in the central Brooks Range, and the Olgilvie Mountains in Yukon Territory. Identification of the collected material is not final.

[a]Collected by David Murray; preserved in the University of Alaska Fairbanks Herbarium.

Mulligan (1971), however, identified only one population of *D. paysonii* in Alaska, at Mount Harper (64°14′ N., 143°21′ W.), 180 km southeast of Mount Prindle. Another collection at the University of Alaska Herbarium (Lloyd A. Spetzman, 6/25/1957) was made on Horn Mountain, south of the Alaska Highway, at the edge of the Macomb Plateau (64°38′ N., 144°43′ W.). The Alaska populations are separated by more than 1600 km from the northern margin of the principal range in central British Columbia.

Mulligan (1971) reviewed the cytotaxonomy of three closely related *Draba* species of Canada and Alaska, *D. ventosa* A. Gray, *D. ruaxes* Payson & St. John, and *D. paysonii*. *Draba paysonii* is a triploid ($2n = 42$, basic chromosome number $x = 14$), which reproduces asexually. It produces viable seed apomictically without pollen stimulation. Pollen grains of greenhouse-grown plants were from 0 to 25 percent fertile.

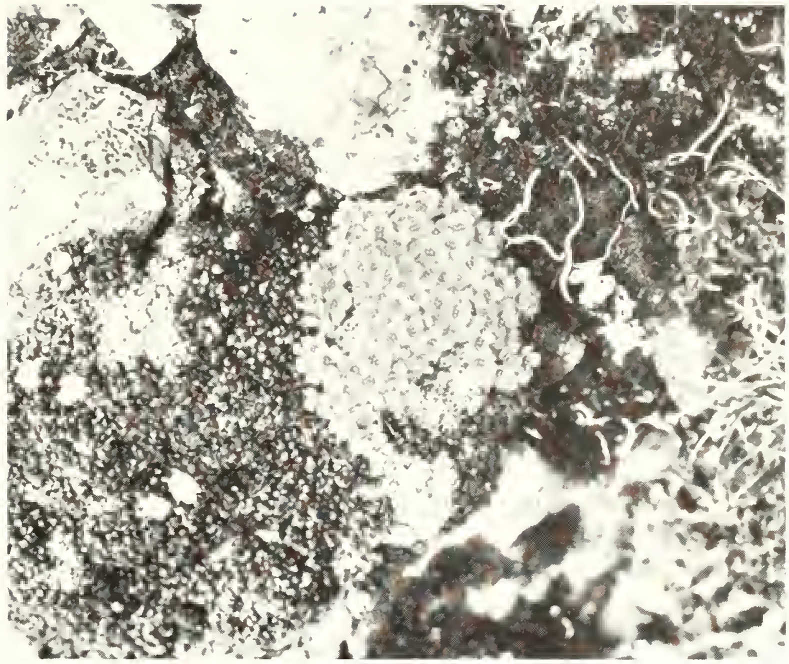


Figure 15—*Draba paysonii*, a yellow-flowered mustard, uncommon in Alaska.

Plant communities.—Figure 16 shows the pattern of plant communities in the RNA. Map units are defined in terms of plant community type needs; table 1 identifies the nearest Alaska vegetation classification system level IV equivalent (Viereck and others 1986). Table 3 is a list of the common plants seen in the RNA.

The dry dwarf shrub tundras, both ericad and birch, are typically distributed on the granite ridge crests of both the summit region (Mount Prindle pluton) and the northwestern tors area (Quartz Creek pluton). In general, Mount Prindle supports typical "granite tundra." Dwarf birch shrub tundra, corresponding to both ericad and birch dry dwarf shrub tundra on the type needs list, is typical of semistabilized slopes. *Betula nana* and *B. glandulosa* are dominant species of these types. Common species are *Arctostaphylos alpina*, *Arctagrostis latifolia*, *Dryas integrifolia*, *Salix arctica*, *S. reticulata*, *S. phlebophylla*, *Carex bigelowii*, *Hierochloe alpina*, *Vaccinium vitis-idaea*, *Ledum palustre*, and *Empetrum nigrum*.

An interesting variant is the recurring pattern of vegetation on white gravel soils formed from the decomposition of marble outcrops (fig. 6B). Common species include *Anemone narcissifolia*, *Dryas integrifolia*, *D. octopetala*, *Astragalus* spp., *Ledum decumbens, Salix phlebophylla*, *Parrya nudicaulis*, and moss. In addition to the species noted in the herbarium collection list, *Pedicularis langsdorfii*, *Diapensia lapponica*, *Loiseleuria procumbens*, and *Corydalis pauciflora* were also seen on the ridge crest.

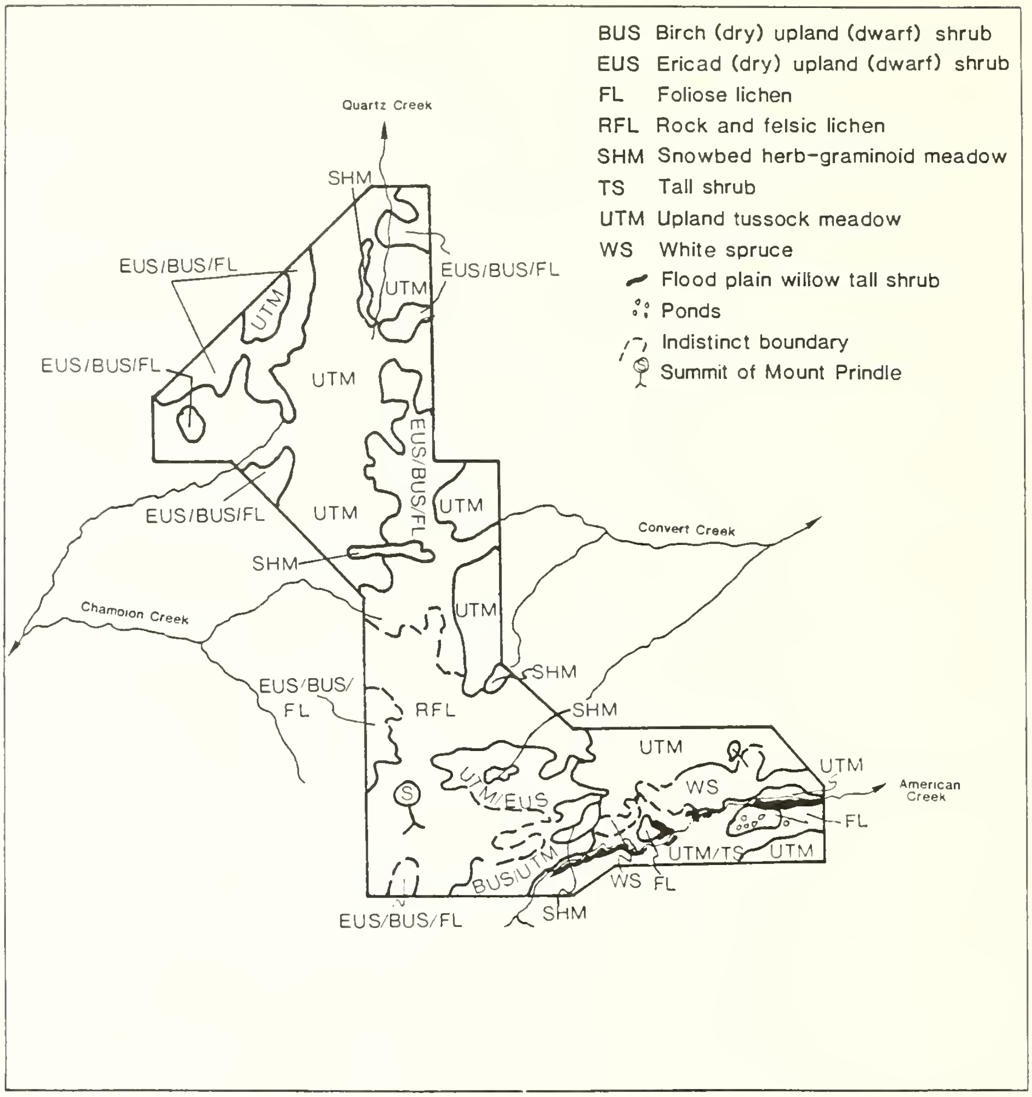


Figure 16—Vegetation cover map of Mount Prindle Research Natural Area; interpreted from NASA color infrared high altitude aerial photo at approximate contact scale of 1:63,000, project 02929 ALK 60, frame number 8863, photo taken August 5, 1980.

Some of the driest boulder areas on the ridge crests are dominated by foliose lichens. At about 1400-m elevation, vascular plant cover becomes sparse and lichens dominate. The foliose lichen cover on the granitic surfaces of the upper slopes of the summit is nearly complete, except on the harshest and most exposed sites. This community, because of its nearly black color (especially when the lichens are unhydrated), is often mistaken for the bare surface of a granitic exposure (fig. 5). The summit is unusually rich in these felsic (granitic) lichens, and identification of specimens is still underway.

Upland tussock meadow is particularly common on slopes and benches underlain by Precambrian schist between the two granitic plutons. Stone stripes are prominent, but they are overtopped by a continuous soil and vegetation mat. Prominent species are *Eriophorum vaginatum*, *Vaccinium uliginosum*, *Empetrum nigrum*, *Petasites frigidus*, and *Polygonum bistorta* in addition to species already mentioned.

Table 3—Common vascular plants seen in the Mount Prindle Research Natural Area[a]

Scientific name	Common name
Anemone narcissiflora L.	[b]
Arctagrostis latifolia (R.Br.) Griseb.	Polar grass
Arctostaphylos alpina (L.) Spreng.	Alpine bearberry
Astragalus spp.	Milk vetch
Betula glandulosa Michx.	Glandular birch
Betula nana L.	Dwarf birch
Carex bigelowii Torr.	Bigelow sedge
Carex rotundata Wahlenb.	[b]
Cassiope tetragona (L.) D. Don	Lapland cassiope
Claytonia porsildii Yurtsev[c]	Porsild spring beauty
Corydalis pauciflora (Steph.) Pers.	[b]
Diapensia lapponica L.	[b]
Draba paysonii Macbride	[b]
Dryas integrifolia M. Vahl	[b]
Dryas octopetala L.	[b]
Empetrum nigrum L.	Black crowberry
Eriophorum angustifolium Honck.	Cottongrass
Eriophorum vaginatum L.	Cottongrass
Hierochloe alpina (Sw.) Roem & Shult	Alpine holy grass
Juncus triglumis L.	[b]
Ledum decumbens (Ait.) Small	Narrow-leaf Labrador-tea
Ledum palustre L.	Labrador-tea
Loiseleuria procumbens (L.) Desv.	Alpine azalea
Minuartia obtusiloba (Rydb.) House	[b]
Oxytropis nigrescens (Pall.) Fisch.	[b]
Parrya nudicaulis (L.) Regel	[b]
Pedicularis langsdorfii Fisch.	Langsdorf lousewort
Petasites frigidus (L.) Franch.	Coltsfoot
Picea glauca (Moench) Voss	White spruce
Polygonum bistorta L.	Bistort
Potentilla elegans Cham. & Schlect	[b]
Salix arctica Pall.	Arctic willow
Salix phlebophylla Anderss.	Skeletonleaf willow
Salix reticulata L.	Netleaf willow
Senecio yukonensis Pors.	[b]
Vaccinium uliginosum L.	Bog blueberry
Vaccinium vitis-idaea L.	Mountain-cranberry

[a] Scientific names follow Hultén (1968), unless noted; common names follow Hultén (1968) and Viereck and Little (1972).

[b] Species does not have a common name.

[c] Proposed name for *C. arctica* Adams.

Snowbed herb-graminoid meadows are located on wet seeps at the base of persistent snowbanks. Snowbanks form in deep crevices, channels, and concave slopes where swirling winds off the summit drop their snowload. The vegetation under the snowbeds themselves is species-poor, consisting primarily of *Cassiope tetragona*. Snowbed meadows support *Eriophorum angustifolium*, *Carex rotundata*, and *Juncus triglumis*, among other species; *Diapensia lapponica* and *Dryas octopetala* are found on raised frost boils.

Moist white spruce slope forest (treeline variant) is found in the western portion of the RNA, above American Creek in the southeastern portion of the RNA (fig. 16). Some of this forest is at elevations higher than 920 m, which is unusually high for forests in this part of Alaska. One white spruce increment core showed a count of 100 rings, indicating an origin some time before 1882, possibly in response to climatic warming that began in the 1830's. The American Creek (early Wisconsinan) moraine below the forest has constricted the drainage of American Creek, producing a dense, moist willow flood plain (tall shrub) community on the infill basin of the dammed-up flood plain.

A special botanical feature of the RNA is tall willow stands on the scarps of large solifluction lobes on the south-facing slopes above American Creek. They provide a means of geobotanical dating of the activity of the solifluction lobes.

Fauna

The principal wildlife groups of interest in the Mount Prindle RNA are (1) birds, especially the northern wheatear and other songbirds and shorebirds; and (2) mammals, especially two species of big game—caribou and Dall sheep.

Birds.—The northern wheatear is a thrushlike, alpine tundra ground-dwelling bird (fig. 17). The western North American population of the wheatear nests in alpine areas of central and western Alaska and adjacent Yukon Territory, then migrates to Eurasia or North Africa to overwinter. This traditional migration pattern is consistent with a route available during the Pleistocene when Alaska was isolated from the rest of North America by the cordilleran ice sheets but maintained a broad land connection to Eurasian tundra steppe via the Bering land bridge. Gabrielson and Lincoln (1959) describe the wheatear as "particularly common in the complex of mountains between the Yukon and Tanana where most of the birds in the National Museum have been collected." The granite tors portion of the northwest part of the RNA is prime wheatear habitat. Wheatears nest in the crevices and cavities of the deep rockpiles that form from the frost-shattering of erosion-resistant (mostly granite) rock (Armstrong 1983, Chernov 1985, Gabrielson and Lincoln 1959). Chernov (1985) describes the summer diet of wheatears as restricted to slower moving, large, surface-dwelling insects (fig. 18). He reports that wheatears prefer crane-flies and are one of the few birds that consume large numbers of bumblebees (*Bombus hyperboreus*, *B. lapponicus*, and *B. balteatus*). Large beetles, especially carrion (*Thanatophilus* spp.), carabid (*Pterostichus* spp.), and water beetles (*Colymbetes* and *Graphoderus*), are also important food for wheatears. Chernov (1985) notes that in Eurasia the wheatear is 1 of only 10 subarctic bird species that eat predominantly animal food. In Eurasia, the wheatear has become established in human settlements, but this relation does not seem to hold in North America.

Figure 17—Wheatear male (center) perching on rock at Eagle Summit (30 km east of Mount Prindle). Wheatears are white and gray with black spots, a natural camouflage among the lichen-covered granite tors in their nesting habitat; photo courtesy of R.H. Day, University of Alaska.

Figure 18—Wheatear male with large insect in beak; photo, courtesy of R.H. Day, University of Alaska.

During the site visit in late June 1982, adult foraging male wheatears were observed feeding heavily on aquatic insects, which they brought back to nests under the granite tors. They could be approached to within 2 m, and the duration of their foraging trips and nest visits were easily timed.

Table 4 is a checklist of birds known or likely to occur in the RNA. Birds sighted in the tundra uplands of the RNA include the Lapland longspur and horned lark. Lapland longspurs are insectivorous; this species consumes a considerable biomass of invertebrates. Custer and others (1986) estimated that each adult Lapland longspur near Barrow captures between 3,000 and 10,000 insects and seeds per day for self-maintenance during the warm season, and an additional 3,000 insects per day when raising five young.

Table 4—Checklist of birds known to occur or that may occur in the Mount Prindle Research Natural Area[a]

Order and common name	Scientific name	Comments
Anseriformes:		
Mallard	*Anas platyrhynchos*	Probable migrant on pond
Green-winged teal	*Anas crecca*	Probable migrant on pond
Greater scaup	*Aythya marila*	Probable migrant on pond
Lesser scaup	*Aythya affinis*	Probable migrant on pond
Falconiformes:		
Red-tailed hawk	*Buteo jamaicensis*	
Rough-legged hawk	*Buteo lagopus*	
Golden eagle	*Aquila chrysaetos*	Seen in vicinity
Marsh hawk	*Circus cyaneus*	
Gyrfalcon	*Falco rusticolus*	
Peregrine falcon	*Falco peregrinus*	Seen in White Mountains
Galliformes:		
Spruce grouse	*Canachites canadensis*	
Willow ptarmigan	*Lagopus lagopus*	
Rock ptarmigan	*Lagopus mutus*	Remains of kill seen near tors
Charadriiformes:		
Semipalmated plover	*Charadrius semipalmatus*	
American golden plover	*Pluvialis dominica*	
Spotted sandpiper	*Actitis macularia*	Probable along streams
Northern phalarope	*Lobipes lobatus*	Seen in vicinity
Long-billed dowitcher	*Limnodromus scolopaceus*	
Semipalmated sandpiper	*Calidris pusilla*	
Least sandpiper	*Calidris minutilla*	
Pectoral sandpiper	*Calidris melanotos*	
Long-tailed jaeger	*Stercorarius longicaudus*	Common in vicinity
Mew gull	*Larus canus*	Probable migrant at low elevation
Strigiformes:		
Great horned owl	*Bubo virginianus*	
Short-eared owl	*Asio flammeus*	
Boreal owl	*Aegolius funereus*	
Piciformes:		
Hairy woodpecker	*Picoides villosus*	Probable in spruce forest
Downy woodpecker	*Picoides pubescens*	Probable in spruce forest
Passeriformes:		
Alder flycatcher	*Empidonax alnorum*	
Horned lark	*Eremophila alpestris*	Seen in snowbed meadow at tors
Violet-green swallow	*Tachycineta thalassina*	Seen in White Mountains
Cliff swallow	*Petrochelidon pyrrhonota*	
Gray jay	*Perisoreus canadensis*	Seen in vicinity
Common raven	*Corvus corax*	
Black-capped chickadee	*Parus atricapillus*	
Boreal chickadee	*Parus hudsonicus*	Probable in spruce forest
Dipper	*Cinclus mexicanus*	
American robin	*Turdus migratorius*	
Varied thrush	*Ixoreus naevius*	Probable in spruce forest
Hermit thrush	*Catharus guttatus*	Seen in forest, American Creek
Swainson's thrush	*Catharus ustulatus*	
Gray-cheeked thrush	*Catharus minimus*	
Mountain bluebird	*Sialia currucoides*	
Wheatear	*Oenanthe oenanthe*	Seen nesting under tors
Townsend's solitaire	*Myadestes townsendi*	
Arctic warbler	*Phylloscopus borealis*	
Ruby-crowned kinglet	*Regulus calendula*	Seen in White Mountains
Water pipit	*Anthus spinoletta*	Seen in vicinity
Bohemian waxwing	*Bombycilla garrulus*	
Northern shrike	*Lanius excubitor*	
Orange-crowned warbler	*Vermivora celata*	
Yellow warbler	*Dendroica petechia*	
Wilson's warbler	*Wilsonia pusilla*	Seen in forest, American Creek
Gray-crowned rosy finch	*Leucosticte tephrocotis*	
Hoary redpoll	*Carduelis hornemanni*	
Common redpoll	*Carduelis flammea*	
Savannah sparrow	*Passerculus sandwichensis*	
Dark-eyed junco	*Junco hyemalis*	
Tree sparrow	*Spizella arborea*	
Chipping sparrow	*Spizella passerina*	
White-crowned sparrow	*Zonotrichia leucophrys*	Seen in forest, American Creek
Golden-crowned sparrow	*Zonotrichia atricapilla*	
Fox sparrow	*Passerella iliaca*	Seen in forest, American Creek
Lapland longspur	*Calcarius lapponicus*	Seen in snowbed meadow at tors
Snow bunting	*Plectrophenax nivalis*	Probable migrant only

[a] Nomenclature follows USDA Forest Service (1979) and American Ornithologists' Union (1957).

GPO 591-132/82022

Several shrub-thicket birds that nest on the ground or low in trees, including fox sparrow, white-crowned sparrow, hermit thrush, and Wilson's warbler, were sighted in the forest patch above American Creek. Mount Prindle is also a raptor nesting area; it probably supports golden eagles (Bureau of Land Management 1984a, 1984b).

Mammals.—Table 5 is a list of mammals for Mount Prindle RNA. Caribou are the largest ungulates in the RNA. From about 1900 to 1960, the migratory Steese-Fortymile herd, 1 of 102 caribou herds in North America, used the Mount Prindle region as its traditional calving ground (Valkenburg and Davis 1986). The RNA still supports animals from the smaller, resident White Mountain herd of about 800 animals (Williams and Heard 1986).

The Steese-Fortymile herd historically ranged between the Whitehorse and Lake Laberge area of south-central Yukon in Canada to the area between the Tanana and Yukon-Porcupine Rivers in Alaska. Since the early 1960's, its range has contracted to the Yukon-Tanana uplands between the Yukon-Alaska border and the Steese Highway. Valkenburg and Davis (1986) cite several population estimates for the herd for a 65-year period. In 1920, the estimated herd size was more than 580,000; it declined to about 60,000 in the early 1950's and 5,300 in 1973; then increased to about 14,000 in 1984. Generally, the reliability of population estimates has improved since the late 1950's.

From about 1900 to the winter of 1960, Mount Prindle was in the center of the Steese-Fortymile herd calving area that encompassed alpine areas of the White Mountains between Beaver Creek and the Steese Highway. In the late 1950's, the herd began to calf also in the upper Birch Creek drainage. For the years 1961 through 1963, Mount Prindle was a secondary calving area only. Since 1964, the Steese-Fortymile herd has not used Mount Prindle as a calving ground but has calved instead farther and farther southeast. Between 1980 and 1985, the herd dispersed widely over a large area during calving, even using forest habitats below treeline. In both tundra and forest calving habitat, *Eriophorum* flower buds are the principal late winter food of caribou (Valkenburg and Davis 1986).

Caribou typically are faithful to a calving ground even though the portion of it they use may shift from year to year. The complete abandonment of the White Mountain calving ground, centered around Mount Prindle, is the only well-documented case of its kind (Valkenburg and Davis 1986). The reasons for the abandonment are not known. The Steese-Fortymile herd may reoccupy the White Mountain calving ground some time in the future.

Currently, caribou from the smaller resident White Mountain caribou herd forage in the RNA in the spring and early summer, but they calve in the Lime Peak area, 20 km to the northwest.

Table 5—Checklist of mammals known to occur or that may occur in the Mount Prindle Research Natural Area[a]

Order and common name	Scientific name	Comments
Insectivora:		
Masked shrew	*Sorex cinereus*	
Dusky shrew	*Sorex obscurus*	
Arctic shrew	*Sorex arcticus*	
Pygmy shrew	*Microsorex hoyi*	
Chiroptera:		
Little brown myotis	*Myotis lucifugus*	Possible in forest
Lagomorpha:		
Collared pika	*Ochotona collaris*	Specimen from Eagle Summit
Snowshoe hare	*Lepus americanus*	
Rodentia:		
Alaska marmot	*Marmota boweri*	
Arctic ground squirrel	*Spermophilus parryii*	
Red squirrel	*Tamiasciurus hudsonicus*	
Beaver	*Castor canadensis*	
Northern red-backed vole	*Clethrionomys rutilus*	
Tundra vole	*Microtus oeconomus*	
Singing vole	*Microtus miurus*	
Muskrat	*Ondatra zibethicus*	
Brown lemming	*Lemmus sibiricus*	Specimen from Eagle Summit
Porcupine	*Erethizon dorsatum*	Possible in forest
Carnivora:		
Coyote	*Canis latrans*	
Gray wolf	*Canis lupus*	
Red fox	*Vulpes vulpes*	
Black bear	*Ursus americanus*	
Grizzly bear	*Ursus arctos*	
Marten	*Martes americana*	
Ermine	*Mustela erminea*	
Least weasel	*Mustela nivalis*	
Mink	*Mustela vision*	
Wolverine	*Gulo gulo*	
River otter	*Lutra canadensis*	
Lynx	*Felis lynx*	
Artiodactyla:		
Moose	*Alces alces*	Shrub zone in valleys
Caribou	*Rangifer tarandus*	Former calving ground
Dall sheep	*Ovis dalli*	Seen in area

[a] Nomenclature follows USDA Forest Service (1979).

In April 1983, the Bureau of Land Management, in cooperation with the Alaska Department of Fish and Game, began a study of Dall sheep in the Steese and White Mountains areas. Several animals were radio-collared; their movements were followed as long as the radios functioned. The study was still active in 1987; results will be published after its completion (Bruce Durtsche, Bureau of Land Management, personal communication). Dall sheep forage in the RNA in the spring and early summer. They have been observed moving up in elevation with snowmelt and the appearance of new green forage. The Dall sheep move through the area in ram bands and ewe bands.

Dall sheep seldom use even productive areas of alpine forage extensively unless escape terrain (cliffs and rugged ground) is available (Nichols 1978a, 1978b). Escape is their principal form of defense against predators. Being mostly unglaciated, the central and western Yukon-Tanana uplands generally lack cliffs and steep or rough, broken ground. The cliffs of the glacially carved upper American Creek Valley serve as a regionally scarce area of escape terrain (fig. 6D). By the standards of the Alaska Range or Brooks Range, however, the escape terrain available to sheep at Mount Prindle is suboptimal. Even much of the old glacial topography in the area is weathered and subdued.

One of the most significant ways Dall sheep use the RNA is as a traditional lambing ground. Dall sheep lambing takes place in the upper American Creek Valley (Bruce Durtsche, personal communication). The populations of Dall sheep in the Yukon-Tanana uplands are few and are isolated from genetic interchange with the large populations of the Alaska Range and Brooks Range (Nichols 1978a, 1978b). Large mammals in such circumstances typically require special conservation measures, such as protection of sensitive habitat and careful monitoring and control of mortality.

Grizzly bear feed intensively in the Mount Prindle region in the spring. Intensive-use feeding areas for bears are relatively uncommon in the Steese National Conservation Area.

History of Disturbance

Mineral Potential

The Mount Prindle-Lime Peak area was the subject of an extensive mineral assessment by the Alaska Division of Geological and Geophysical Surveys (DGGS) in 1986 and 1987 (Smith and others 1987). The DGGS estimates a 50-percent probability that a 141 510-ha area surrounding Mount Prindle contains as much tin and silver as a moderate-sized tin district—290 000 metric tons of tin and 311 000 kg of silver with a gross value of about $3 billion. This estimate was made by comparing the geology and mineralization of the study area with mining regions elsewhere in the world. The estimate is for comparative purposes and does not represent a judgment that any resources are economically recoverable.

The Hope suite granite plutons strongly resemble tin-producing regions such as Cornwall in southern Great Britain (Park and MacDiarmid 1964, Smith and others 1987). About two-thirds of the tin and silver potential in the DGGS assessment area is associated with specific portions of the Lime Peak pluton; the other third is divided among the remainder of the Lime Peak pluton and the Quartz Creek and Mount Prindle plutons. The potential for uranium and lode gold was also defined in the DGGS assessment.

Holm (1973) reports a tin anomaly (values to 200 p/m) in the upper American Creek drainage. Newberry (1987) identifies a granite dike and greisen vein in a cliff 2 km south of the southwestern corner of the RNA that is probably responsible for the high tin values downstream. Newberry (1987) states, "Hence, although they are themselves of negligible economic value, the rocks on upper American Creek indicate the local development of moderate-grade chlorite greisens in the Mt. Prindle pluton and may imply the presence of higher-grade mineralization at depth." Another tin anomaly on an unnamed tributary of American Creek 2 km south of the southeastern corner of the RNA was also judged not significant itself but an indication of mineralization at depth.

In the mid-1970's, a significant uranium anomaly was discovered in a spring system at the base of Mount Prindle, outside the RNA. Barker and Clautice (1977) report uranium concentrations of as much as 400 p/m from stream sediments, and values up to 570 p/m from sediments at the spring. The anomaly probably represents a hydrologically controlled local concentration. The MAPCO Corporation conducted a 2-year diamond drilling program for uranium but obtained only dry holes in the Mount Prindle pluton (Burton and Newberry 1987). The Hope suite granites showed no signs of major uranium mineralization in the DGGS assessment (Burton and Newberry 1987).

No significant gold prospects were mapped in the region of the Mount Prindle RNA in the DGGS assessment (Newberry and others 1987). Weber and Hamilton (1984) report:

> The origin of gold in this area is not clearly understood, but it is probably related to Tertiary dikes, veins, and small hypabyssal intrusions rather than to the main Mount Prindle intrusion. To the best of our knowledge, no gold is being mined within the area that was once occupied by glaciers. These ice bodies probably eroded alluvial placer deposits that had developed in the upper parts of each valley so that gold presently is found only below the maximum glacial extents.

Estimates of the tin and silver resources of the entire Mount Prindle pluton (including the most promising areas south of the RNA) at the 25-percent probability level and lower are available (Pessel and Newberry 1987). These resources (if they exist) are probably buried at some depth in granite. Recovery of any minerals that may exist would require tunneling and shaft construction, in addition to a new road system and support facilities. The entire mineral assessment region is withdrawn from mineral development by the current land and resource management plans for the Steese National Conservation Area and the White Mountains National Recreation Area. Proposals to revise or amend the plans for mineral development will be evaluated by the Bureau of Land Management for their effects on scientific, ecological, and recreational resources as required by the Alaska National Interest Lands Conservation Act.

Research

One of the principal research attractions of the Mount Prindle RNA is the opportunity for studying alpine landforms, both glacial and nonglacial. The large solifluction lobes on the south-facing slopes above American Creek give researchers the opportunity to monitor solifluction creep rates and processes. The especially well-developed stands of willows that occupy the scarp fronts of the creep zone are several decades old and could be useful in determining past movements. The debris torrent channels on the west slopes, which were scoured in late summer 1982, provide a unique opportunity for studying alpine tundra succession on a surface of known age. The time of the earliest (Prindle) glaciation in the RNA has been fixed within only a broad range; further research is needed to refine the dating of this glaciation.

The reasons for the abandonment of the traditional calving area at Mount Prindle by the Steese-Fortymile caribou herd is a major research question. The RNA is an ideal location for initiating studies of winter caribou habitat relations. Most theories of the cause for the abandonment have focused on predation or disturbance of caribou and have neglected habitat factors. Plant (especially lichen) communities in the RNA have the appearance of partial recovery from a closely grazed or cropped condition. If Mount Prindle again becomes a major calving ground, a comparison of the "resting" versus the grazed condition of the caribou range would be valuable.

Another wildlife research opportunity involves the breeding population of wheatears. During the site visit in 1982, wheatears could be approached to within 2 m, indicating the opportunity for studying behavior of this small bird. The RNA also offers good opportunities for studies of wheatears' use of specific habitat features, such as boulders and rock crevices for nesting.

The compilation of the flora of the Mount Prindle RNA is not complete. This is especially true of the nonvascular plants, including "felsic" lichens and mosses. The population of *Draba paysonii* should be monitored occasionally and other rare alpine species searched for. At least one permanent alpine vegetation transect should be established on a physiographically stable surface. The small treeline area in the southeast portion of the RNA above American Creek would allow a study of treeline dynamics; trees on treeline sites outside the RNA could be cored or even destructively sampled in conjunction with study of the trees within the area.

Further research on Dall sheep and caribou in the RNA is needed, especially Dall sheep lambing in the RNA. The importance of restricted cliff habitat for raptors, Dall sheep, and caribou needs to be determined.

Maps and Aerial Photographs

Mount Prindle is on the Circle B-5, B-6, C-5, and C-6 USGS topographic quadrangle maps (1:63,360 scale, 1954 base with 1963 revisions). Holm (1973) provides a bedrock geology map at about 1:10,500 scale. Weber and Hamilton (1984) present a map of the glacial geology of the Mount Prindle area at about 1:125,000 scale. The set of maps that accompanies the DGGS mineral assessment of the Lime Peak-Mount Prindle area (Smith and others 1987) covers most aspects of geology and mineralization of the Mount Prindle RNA. All maps in the set are at 1:63,360 scale. Maps of the bedrock geology (Smith and Pessel 1987) and mineral occurrences (Weglarz and Albanese 1987) in this series are particularly useful.

Controlled vertical air photo coverage of the Mount Prindle RNA is available: color infrared high altitude airphotos, taken from a U-2, are available for August 23, 1981, and August 5, 1980, at contact scale of about 1:63,000; airphoto frame number 8863 (1980 airphoto) gives complete coverage of the Mount Prindle RNA. The Steese-White Mountains District Office of BLM in Fairbanks can provide up-to-date information on maps and air photo coverage of the area.

Units of Measure

When you know:	Multiply by:	To find:
Hectares (ha)	2.47	Acres
Meters (m)	3.281	Feet
Kilometers (km)	0.621	Miles
Celsius (°C)	1.8 then add 32	Fahrenheit (°F)
Kilograms (kg)	2.203	Pounds
Kilograms	32.151	Troy ounces
Metric tons	1.103	Tons

References

American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. Baltimore, MD: The Lord Baltimore Press. 691 p.

Armstrong, R.H. 1983. A new, expanded guide to the birds of Alaska. Anchorage, AK: Alaska Northwest Publishing Company. 332 p.

Barker, J.C.; Clautice, K.H. 1977. Anomalous uranium concentrations in artesian springs and stream sediments in the Mount Prindle area, Alaska. Washington, DC: U.S. Bureau of Mines; Open File Rep. 130-77.

Bureau of Land Management. 1984a. Proposed resource management plan/final environmental impact statement for the Steese National Conservation Area. Fairbanks, AK: Bureau of Land Management Fairbanks District Office. 321 p.

Bureau of Land Management. 1984b. Proposed resource management plan/final environmental impact statement for the White Mountains National Recreation Area. Fairbanks, AK: Bureau of Land Management Fairbanks District Office. 317 p.

Burns, L.E.; Newberry, R.J. 1987. Intrusive rocks of the Lime Peak - Mt. Prindle area. Part A: Tin-related granites of the Lime Peak - Mt. Prindle area. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 3-1 to 3-62. Chapter 3.

Burton, P.J.; Newberry, R.J. 1987. Other commodities in the Lime Peak - Mt. Prindle area. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 6-73 to 6-74. Section in Chapter 6.

Chernov, Yu. I. 1985. The living tundra. New York, NY: Cambridge University Press. 213 p.

Custer, T.W.; Osborn, R.G.; Pitelka, F.A.; Gessaman, J.A. 1986. Energy budget and prey requirements of breeding Lapland longspurs near Barrow, Alaska, U.S.A. Arctic and Alpine Research. 18(4): 415-427.

Eakin, Henry M. 1916. The Yukon-Koyukuk region, Alaska. U.S. Geol. Surv. Bull. 631. Washington, DC: U.S. Department of the Interior. 88 p.

Gabrielson, Ira N.; Lincoln, Frederick C. 1959. Birds of Alaska, Wildlife Management Institute. Harrisburg, PA: Stackpole Company. 920 p.

Haugen, R.K.; Slaughter, C.W.; Howe, K.E.; Dingman, S.L. 1982. Hydrology and climatology of the Caribou-Poker Creeks Research Watershed. CRREL 82-26. Hanover, NH: U.S. Army Cold Regions Research and Engineering Laboratory. 42 p.

Hitchcock, C. Leo. 1941. A revision of the *Drabas* of western North America. Seattle, WA: University of Washington, Publications in Biology. 132 p.

Holm, Bjarne. 1973. Bedrock geology and mineralization of the Mount Prindle area, Yukon-Tanana Upland, Alaska. Fairbanks, AK: University of Alaska. 55 p. M.S. thesis.

Hultén, Eric. 1968. Flora of Alaska and neighboring territories. Stanford, CA: Stanford University Press. 1,008 p.

Juday, G.P.; Knapman, L.; Field, L.; Taylor, Dale. 1982. A preliminary report of ecological reserve project activity, Fairbanks District BLM: identification of type needs and candidate Research Natural Areas in the White Mountains NRA - Steese NCA. Fairbanks, AK: Bureau of Land Management, Steese-White Mountains District. Unpublished report on file. 9 p.

Juday, Glenn Patrick. 1987. Selecting natural areas for geological features: a rationale and examples from Alaska. Natural Areas Journal. 7(4): 137-156.

Long, D. 1985. Illustrated moss flora of arctic North America and Greenland. 1. Polytrichaceae. Meddelelser om Grønland, Bioscience. 17: 1-57.

Mertie, J.B., Jr. 1937. The Yukon-Tanana region, Alaska. USGS Bull. 872. Washington, DC: U.S. Geological Survey. 276 p.

Mulligan, Gerald A. 1971. Cytotaxonomic studies of *Draba* species of Canada and Alaska: *D. ventosa*, *D. ruaxes*, *D. paysonii*. Canadian Journal of Botany. 49(8): 1455-1460.

Murray, B. 1985. Checklist of bryophytes and lichens of the Ogotoruk Creek region. In: Everett, K.R.; Murray, B.M.; Murray, D.F.; Johnson, A.W.; Linkins, A.E.; Webber, P.J., comps. Reconnaissance observations of long-term natural vegetation recovery in the Cape Thompson region, Alaska, and additions to the checklist of flora. CRREL Rep. 85-11; Appendix A. Hanover, NH: U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory: 49-73.

Newberry, R.J. 1987. Lode mineralization in the Lime Peak - Mt. Prindle area. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 6-1 to 6-77. Chapter 6.

Newberry, R.J.; Smith, T.E.; Swainback, R.C.; Wiltse, M.A.; Burton, P.J.; Pessel, G.H., comps. 1987. Metallogenic map of the Lime Peak - Mount Prindle area, east-central Alaska. Rep. Invest. 87-4. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys. Plate 6-2; scale 1: 63,360.

Nichols, Lyman, Jr. 1978a. The Dall sheep in Alaska. Alaska Department of Fish and Game Wildlife Notebook Series. Juneau, AK: Alaska Department of Fish and Game. 2 p.

Nichols, Lyman, Jr. 1978b. Dall's sheep. In: Schmidt, J.L.; Gilbert, D.L., comps., eds. Big game of North America-ecology and management, Wildlife Management Institute. Harrisburg, PA: Stackpole Books: 173-189.

Orth, Donald J. 1971. Dictionary of Alaska place names. U.S. Geol. Surv. Prof. Pap. 567. Washington, DC: U.S. Department of the Interior. 1,084 p.

Park, Charles F., Jr.; McDiarmid, Roy A. 1964. Ore deposits. San Francisco, CA: W.H. Freeman and Company. 475 p.

Pessel, G.H.; Newberry, R.J. 1987. Probabalistic estimation of mineral resources in the Lime Peak - Mt. Prindle area. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 7-1 to 7-17. Chapter 7.

Pessel, G.H.; Reifenstuhl, R.R.; Albanese, M.D. 1987. Regional geology. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 2-1 to 2-26. Chapter 2.

Péwé, T.L.; Burbank, L.; Mayo, L.R. 1967. Multiple glaciation in the Yukon-Tanana upland, Alaska. U.S. Geol. Surv. Misc. Geol. Invest. Map I-507. Washington, DC: U.S. Department of the Interior. 1: 500,000.

Péwé, Troy L. 1975. Quaternary geology of Alaska. U.S. Geol. Surv. Prof. Pap. 835. Washington, DC: U.S. Department of the Interior. 145 p.

Porsild, A.E. 1975. Materials for a flora of central Yukon Territory. Publ. Bot. 4. Ottawa, ON: National Museums of Canada; National Museum of Natural Sciences. 72 p.

Santeford, Henrey S. 1976. A preliminary analysis of precipitation in the Chena Basin, Alaska. Tech. Memo. NWS AR-15. Anchorage, AK: National Oceanic and Atmospheric Administration. 12 p.

Smith, T.E.; Pessel, G.H., comps. 1987. Bedrock geologic map of the Lime Peak - Mt. Prindle area, east-central Alaska. Rep. Invest. 87-4. Fairbanks, AK: Alaska Division of Geological and Geophysical surveys. Plate 2-1A; scale 1: 63,360.

Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. 1987. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys. [Chapters paged separately].

Swainbank, Richard C. 1987. Regional structure. In: Smith, T.E.; Pessel, G.H.; Wiltse, M.E., eds. Mineral assessment of the Lime Peak - Mt. Prindle area, Alaska. Volume I: Text. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys: 2-27 to 2-74. Section in Chapter 2.

U.S. Department of Agriculture, Forest Service. 1979. Species list of Alaskan birds, mammals, fish, amphibians, reptiles, and invertebrates. Alaska Reg. Rep. 82. Juneau, AK: U.S. Department of Agriculture, Forest Service, Alaska Region. 102 p.

Valkenburg, Patrick; Davis, James L. 1986. Calving distribution of Alaska's Steese-Fortymile caribou herd: a case of infidelity? In: Gunn, Anne; Miller, Frank L.; Skjenneberg, Sven, eds. Proceedings, 4th international reindeer/caribou symposium; 1985 August 22-25; Whitehorse, Yukon, Canada. Spec. Issue 1 Rangifer. Harstad, Norway: Nordic Council for Reindeer Research (NOR): 315-323.

Viereck, L.A.; Dyrness, C.T.; Batten, A.R. 1986. The 1986 revision of the Alaska vegetation classification. Fairbanks, AK: U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry. Unpublished manuscript. 112 p.

Viereck, Leslie A.; Little, Elbert L., Jr. 1972. Alaska trees and shrubs. Agric. Handb. 410. Washington, DC: U.S. Department of Agriculture. 265 p.

Weber, F.R.; Hamilton, T.D. 1984. Glacial geology of the Mount Prindle area, Yukon-Tanana upland, Alaska. In: Short notes on Alaskan geology 1982-83. Prof. Rep. 86. Fairbanks, AK: Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys: 42-48.

Weber, Florence R. 1986. Glacial geology of the Yukon-Tanana upland. In: Hamilton, T.D.; Reed, K.M.; Thorson, R.M., eds. Glaciation in Alaska-the geologic record. Anchorage, AK: Alaska Geological Society. 265 p.

Weglarz, T.B.; Albanese, M.D., comps. 1987. Compilation of known mineral occurrences, Lime Peak - Mt. Prindle area, east-central Alaska. Rep. Invest. 87-4. Fairbanks, AK: Alaska Division of Geological and Geophysical Surveys. Plate 6-1; scale 1: 63,360.

Williams, T. Mark; Heard, Douglas C. 1986. World status of wild *Rangifer tarandus* populations. In: Gunn, Anne; Miller, Frank L.; Skjenneberg, Sven, eds. Proceedings, 4th international reindeer/caribou symposium; 1985 August 22-25; Whitehorse, Yukon, Canada. Spec. Issue 1 Rangifer. Harstad, Norway: Nordic Council for Reindeer Research (NOR): 19-28.

Young, Steven B.; Walters, J.C. 1982. Proposed geological and ecological natural landmarks in interior and western Alaska, volume 2. Contributions from the Center for Northern Studies 21. Wolcott, VT: Center for Northern Studies: 288-292.

Juday, Glenn Patrick. 1988. Alaska Research Natural Area: 1. Mount Prindle. Gen. Tech. Rep. PNW-GTR-224. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 34 p.

The 2412-hectare Mount Prindle Research Natural Area is located in central Alaska on the border of the Steese National Conservation Area and White Mountains National Recreation Area. It is managed by the U.S. Department of the Interior, Bureau of Land Management, Steese-White Mountains District. Mount Prindle was selected as a Research Natural Area (RNA) because it contains outstanding examples of solifluction lobes; habitat for wheatear (a small thrushlike bird), caribou, and Dall sheep; the yellow-flowered mustard *Draba paysonii*, which is uncommon in Alaska; a diversity of alpine plant communities; and examples of both glaciated and unglaciated subarctic landforms. Other features of scientific interest, including two debris torrent channels and the rare moss *Oligotrichum falcatum* Steere were discovered during site documentation. The highland region centered on Mount Prindle was once the heart of the calving area for the Steese-Fortymile caribou herd but was mainly abandoned in the early 1960's; the reason it was abandoned is not known. Mount Prindle RNA is characterized by an unusually high number of scientifically and educationally interesting natural features, typical of this portion of the Yukon-Tanana uplands, within a compact area. The area has high potential for public education and research use.

Keywords: Alaska, alpine tundra, caribou (*Rangifer tarandus*), cryoplanation terrace, Dall sheep (*Ovis dalli*), debris torrent, *Draba paysonii*, ecosystems, glaciations, granite, Natural Areas (Research), Research Natural Area, scientific reserves, solifluction lobe, tors, treeline.

Pacific Northwest Research Station
319 S.W. Pine St.
P.O. Box 3890
Portland, Oregon 97208

U.S. Department of Agriculture
Pacific Northwest Research Station
319 S.W. Pine Street
P.O. Box 3890
Portland, Oregon 97208