**USDA Forest Service, Alaska Region**
**DESIGNATION ORDER**
**for the**
**Wolverine Glacier Research Natural Area**
**on the**
**Chugach National Forest**
**Glacier Ranger District, Alaska**

Background:
In September 2000, the Forest Supervisor recommended establishment of four new Research Natural Areas (RNAs) in his Preferred Alternative for the Revised Land and Resource Management Plan of the Chugach National Forest. The Record of Decision for the Revised Forest Plan, [which I] signed in May 2002, documented the decision to follow the Forest Supervisor's recommendation to designate four Research Natural Areas on the Forest.

Among these is the Wolverine Glacier RNA northeast of Seward, Alaska. That decision was the result of an analysis of the factors listed in 36 CFR 219.25 and Forest Service Manual 4063.41. Results of that analysis are documented in the Revised Land and Resource Management Plan for the Chugach National Forest, the Final Environmental Impact Statement for the Chugach National Forest Land Management Plan Revision, and the Establishment Record for the Wolverine Glacier RNA. All of these documents are available to the public from the Chugach National Forest, 3301 "C" Street, Suite 300, Anchorage, AK 99503-3998. The Forest Plan documents are also available on the internet at: http://www.fs.fed.us/r10/chugach/forest_plan/plan_docs1.html

Designation:
Accordingly, by virtue of the authority delegated to me by the Chief of the Forest Service in Forest Service Manual 4063, and under regulations at 7 CFR 2.42, 36 CFR 251.23, and 36 CFR Part 219, I hereby establish the Wolverine Glacier Research Natural Area. It shall be comprised of 6,878 acres (2,783 hectares) of land on the Glacier Ranger District of the Chugach National Forest, Alaska. The Wolverine Glacier RNA shall include part or all of T3N R3E Section 2, 3, 4, 5, 8, 9 and T4N R3E Sections 14, 15, 16, 21, 22, 23, 24, 26, 27, 28, 33, 34, 35 on the U.S. Geological Survey 1:63,360 scale topographic map for the Seward B-5 and B-6 quadrangles, Alaska, as described in the section of the Establishment Record entitled "Location."

This is an administrative step to implement the decision to designate this area as RNA as discussed in the Record of Decision for the Revised Land and Resource Management Plan.

The Wolverine Glacier RNA will be managed in compliance with all relevant laws, regulations, and Forest Service Manual direction regarding RNA's, and in accordance with the management direction identified in the Revised Forest Plan.

Designated by /s/ Dennis E. Bschor 10/10/07
DENNIS E. BSCHOR Date
Regional Forester, Alaska Region

Concurrence of /s/ Paul Dunn 10/3/07
for DR. BOV B. EAV Date
Station Director, Pacific NW Research Station

**SIGNATURE PAGE**
**for**

**RESEARCH NATURAL AREA ESTABLISHMENT RECORD**

**Wolverine Glacier Research Natural Area**

**Chugach National Forest**

**Alaska**

The undersigned certify that all applicable land management planning and environmental analysis requirements have been met and that boundaries are clearly identified in accordance with FSM 4063.21, Mapping and Recordation and FSM 4063.41, Establishment Record Content, in arriving at this recommendation.

Prepared by /s/ Robert L. DeVelice Date 9/13/07
Robert L. DeVelice, Forest Ecologist, Chugach National Forest, with contributions by Judy Sherburne, formerly of Alaska Natural Heritage Program, University of Alaska.

Recommended by /s/ James M. Fincher Date 9/13/07
James M. Fincher, District Ranger, Glacier District

Recommended by /s/ Joe L. Meade Date 9/14/07
Joe L. Meade, Forest Supervisor, Chugach National Forest

Concurrence of /s/ Paul Dunn Date 10/3/07
for Dr. Bov B. Eav, Station Director, Pacific Northwest Station

**Establishment Record for**

**Wolverine Glacier**
**Research Natural Area within**

**Chugach National Forest, Alaska**

September 13, 2007

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## IDENTIFICATION

### Location Map

Wolverine Glacier RNA is located on the Kenai Peninsula in southcentral Alaska on the Glacier Ranger District of the Chugach National Forest (Figure 1). The RNA is about 25 miles (40 kilometers) northeast of the city of Seward. No roads or established trails exist on the RNA or to its boundary. The closest road is the Seward Highway at the Kenai Lake Work Center (shown in Figure 1 as "Lawing"). The Work Center is approximately 15 miles (24 kilometers) west of the RNA. Further details in regard to access to the RNA are described in the section of the Establishment Record entitled "Access".

### Boundary Map[1]

The location of Wolverine Glacier RNA within the public land survey system (PLSS) is shown in Figure 2.

### Legal Description[1]

An area within the Chugach National Forest, northwest of Nellie Juan River, comprising portions of T. 3-4 N., R. 3 E., Seward Meridian as shown on the attached map (Figure 2) entitled "Wolverine Glacier RNA", said map being made herewith a part of this description, and said area being more particularly bounded and described as follows:

Beginning at the section corner common to Sections 35 and 36, T. 4 N., R. 3 E., SM and Sections 1 and 2, T. 3 N., R. 3 E., SM (position approximately 60º 23' 10.8" N, 148º 52' 02.6" W), said corner being the true point of beginning and designated 'A' on the referenced map; thence S 33º W, approx. 4,740 ft to an east-west section line common to the N ½, S ½ and the S ½, S ½ in Section 2, T. 3 N., R. 3 E., SM, said corner designated 'B' on the referenced map; thence west along the said east-west section line, approx. 8,620 ft. through Sections 2, 3 and 4, T. 3 N., R. 3 E., SM to a north-south section line common with the W ½, E ½, SE 1/4 and the E ½, E ½, SE 1/4 in Section 4, T. 3 N., R. 3 E., SM and designated 'C' on the referenced map; thence S 45º W, approx. 5,600 ft through Sections 4 and 9, T. 3 N., R. 3 E., SM to a north-south section line common to the W ½, W ½, NW ¼ and the E ½, W ½, NW ¼ in Section 9, T. 3 N., R. 3 E., SM and designated 'D' on the referenced map; thence N 45º W, approx. 1,870 ft through Sections 9 and 8, T. 3 N., R. 3 E., SM to a north-south section line common to the E ½, E ½, NE ¼ and the W ½, E ½, NE ¼ in Section 8, T. 3 N., R. 3 E., SM and designated "E" on the referenced map; thence N 24º E, approx 720 ft to an east-west section line common to the NE ¼, NE ¼, NE ¼ and the SE ¼, NE ¼, NE ¼ in Section 8, T. 3 N., R. 3 E., SM and designated 'F' on the referenced map; thence northwesterly between two alpine lakes in Sections 5 and 8, T. 3 N., R. 3 E., SM to a point on the side of a ridge at the 2,800 ft contour interval in Section 5, T. 3 N., R. 3 E., SM, said point designated ' G' on the referenced map; thence northeasterly along the side of said ridge through Sections 5 and 4, T. 3 N., R. 3 E., SM, passing through National Geodetic Survey (NGS) station "Rocky" in Section 4, T. 3 N., R. 3 E., SM to an east-west section line common to Section 4, T. 3 N., R. 3 E., SM and Section 33, T. 4 N., R. 3 E., SM and

[1] Prepared by Randy D. Schrank, Professional Land Surveyor, Chugach NF, Anchorage, AK.

designated ‘H’ on the referenced map;  thence N 48º W, approx 3,710 ft to the highest peak in Section 33 (Elevation = 4,987 ft), said peak forming the watershed divide between Snow River watershed and Nellie Juan River watershed in Section 33, T. 4 N., R. 3 E., SM and designated ‘I’ on the referenced map;  thence northeasterly and northwesterly along said watershed divide between Snow River watershed and Nellie Juan River watershed through Sections 33, 28, 21 and 16, T. 4 N., R. 3 E., SM to a point on top of the ridge between Snow River watershed and Nellie Juan River watershed in Section 16, T. 4 N., R. 3 E., SM, said point designated ‘J’ on the referenced map;  thence easterly continuing along said watershed divide between Snow River watershed and Nellie Juan River watershed through Sections 16 and 15, T. 4 N., R. 3 E., SM, to the highest peak in Section 15 (Elevation = 4,805 ft), said peak forming the divide between the Snow River watershed, Nellie Juan River watershed and the Kings River watershed and designated ‘K’ on the referenced map;  thence easterly and southeasterly along the watershed divide between Kings River watershed and Nellie Juan River watershed through Sections 15, 14, 23 and 24, T. 4 N., R. 3 E., SM to the highest peak in Section 24, said peak designated ‘L’ on the referenced map; thence southwesterly, southerly and southeasterly along the ridgeline through Sections 24, 23 and 26, T. 4 N., R. 3 E., SM to a point on the north-south section line common to Section 25 and Section 26, T. 4 N., R. 3 E., SM, said point designated ‘ M’ on the referenced map;  thence south along the said north-south section line between Sections 25 and 26, T. 4 N., R. 3 E., SM and Sections 35 and 36, T. 4 N., R. 3 E., SM to the section corner common to Sections 35 and 36, T. 4 N., R. 3 E., SM and Sections 1 and 2, T. 3 N., R. 3 E., SM, said corner being the true point of beginning and designated ‘A’ on the referenced map.

The area of this RNA comprises approximately 6,900 acres.

Informational distances, geographic position and references to PLSS locations herein above were obtained by measurements and observations of the above referenced map being a portion of the US Forest Service 1999 Single Edition Quadrangles Seward (B-5) and Seward (B-6)), Alaska Map at a scale of 1:63,360 in original and according to the Department of the Interior, Bureau of Land Management (BLM) Township List program, version 2.11 protraction calculation software.  Reference Datum is NAD-83.

End of Description

## INTRODUCTION

The Wolverine Glacier Research Natural Area (RNA) encompasses 6,878 acres (2,783 hectares) on the Kenai Peninsula of southcentral Alaska (Figure 1; Photo 1). The RNA is located wholly on lands administered by the Glacier Ranger District of the Chugach National Forest. The RNA is entirely within recommended Wilderness but no portion has been congressionally designated for special management consideration (e.g., Wilderness, Wild and Scenic River).

Primary human use of the area has been for glacial research. Wolverine Glacier is one of three long-term glacier monitoring sites (i.e., "Benchmark Glaciers") tracked by the U.S. Geological Survey, Glacier & Snow Program, Fairbanks, Alaska[2]. The two other glacier-monitoring sites are Gulkana Glacier in the Alaska Range and South Cascade Glacier in Washington state. Climate, glacier-motion, mass-balance, and stream runoff-data are recorded at these three sites to develop a better understanding of glacier-related hydrologic processes.

## JUSTIFICATION

### Justification Statement

As mentioned in the "Introduction", Wolverine Glacier is one of three long-term glacial monitoring sites established in North America by the U.S. Geological Survey. The data collected are instrumental to understanding glacier-related hydrologic processes, hazards, and climate change. The monitoring site has been in continual operation since 1966, and provides an invaluable data source on glacial movement, mass balance, and stream runoff. A weather station is also on-site (Photos 2 and 3), providing the only high-altitude, long-term, year-round climate data for the mountains of south-central Alaska.

### Principle Distinguishing Features

Natural diversity elements represented in the Wolverine Glacier RNA include a wide array of alpine tundra plant communities (Photo 4) and all but the terminus of the glacier (which is native corporation land). More detailed information on the biophysical characteristics of the area is provided in the "Ecological Evaluation" section of this establishment record.

### Objectives

The objectives of Wolverine Glacier RNA are to:

1. Provide a data source for understanding glacier-related hydrologic processes, hazards, and climate change;
2. Represent a mid-elevation glacier and a diversity of alpine tundra vegetation communities for the purposes of research, education, and maintenance of biological diversity; and

[2] http://ak.water.usgs.gov/glaciology/wolverine/

3. Provide a reference area for determining the effects of resource management activities applied to similar ecosystems outside the RNA.

## LAND MANAGEMENT PLANNING

In 1984, the Wolverine Glacier area was proposed as RNA in the first Land and Resource Management Plan of the Chugach National Forest (USDA Forest Service 1984). In 2002, the area was designated as RNA in the Record of Decision for the Revised Forest Plan (USDA Forest Service 2002a). That selection was the result of analyses documented in the Revised Forest Plan (USDA Forest Service 2002b) and the Final Environmental Impact Statement for the Revised Forest Plan (USDA Forest Service 2002c). No major issues or conflicts specific to the Wolverine Glacier area were identified during the public review and comment period for the draft plan.

## MANAGEMENT PRESCRIPTION

The Forest Plan (USDA Forest Service 2002b) prescription for Research Natural Areas is included in the Appendix of this establishment record. RNA management emphasizes non-manipulative research, monitoring, education, and the maintenance of natural diversity. Natural ecological processes dominate, largely undisturbed by human activity. Management for recreation uses, habitat improvement or restoration, and resource development are not emphasized. Recreation uses that interfere with the purpose of the RNA will be restricted. Any proposed action within the RNA must be coordinated with USDA Forest Service Pacific Northwest Research Station.

No measures for control of native insects or diseases will be undertaken unless forests on adjacent lands are threatened. If non-native (exotic) invasive plants or animals are found in the RNA control measures will be exercised to eradicate them, when practical.

## USE OR CONTROL OF FIRE AND GRAZING

No prescribed fires are planned, but may be used as necessary to accomplish RNA objectives. Since the natural fire return interval of the area likely exceeds 1,000 years[3], it is unlikely that prescribed burning would be necessary to maintain the fire return cycle.

All of the Wolverine Glacier RNA is mapped within the limited fire suppression protection level[4]. The suppression objective of this protection level is to minimize suppression costs without compromising protection of adjacent resources. In the highly unlikely event that a fire starts in the area, surveillance is an acceptable suppression response as long as higher valued adjacent resources are not threatened. If it was decided that suppression was required, the fire control methods used would be those

[3] http://www.frcc.gov/docs/PNVG/Alaska/Coastal_Forests_CSLF.pdf
[4] http://www.dnr.state.ak.us/forestry/fire/fireplans.htm

causing the least disturbance.

No grazing by domestic livestock is planned, nor is there an existing or anticipated need for such grazing to maintain or restore ecological conditions.

## ECOLOGICAL EVALUATION

### Physical Site Description and Climatic Conditions

#### Location
Wolverine Glacier RNA is within the Glacier Ranger District of the Chugach National Forest. The center of RNA is approximately at 60° 24 minutes north and 148° 54 minutes west (Figures 1 and 2).

#### Size
Wolverine Glacier RNA is 6,878 acres (2,783 hectares) in size.

#### Elevation Range
Elevations within Wolverine Glacier RNA range from 1,300 to 5,500 feet (395 to 1,675 m).

#### Access
Access to Wolverine Glacier RNA is by aircraft. No roads or established trails exist on the RNA or to its boundary. The closest road is the Seward Highway at the Kenai Lake Work Center (shown in Figure 1 as “Lawing”). The Work Center is approximately 15 miles (24 kilometers) west of the RNA. Hiking in to the RNA from the Seward Highway would be a long and arduous journey and would not be an efficient means to access the area to carry out research projects.

Float plane access to the RNA via Upper Paradise Lake is possible but this lake is 1.5 miles (2.4 kilometers) west of the RNA and 1,350 feet (410 meters) below that boundary. The hike from the lake is steep and brushy and is not an efficient means of accessing the area with heavy loads.

The most efficient means of accessing the RNA is by helicopter. Since the entire RNA is within recommended Wilderness, permission would need to be obtained from the Regional Forester to land in the recommended Wilderness. Potentially suitable helicopter landing sites also exist just southwest of the RNA boundary and outside of recommended Wilderness west of the location marked with an “F” on Figure 2.

Aircraft operations on the Chugach National Forest are regularly restricted by storms, heavy precipitation, high winds, and limited visibility because of fog and low clouds. During colder months supercooled water droplets in the atmosphere can cause dangerous icing conditions, and the short days of this high latitude

location restrict daytime activities. Visitors arriving by aircraft cannot plan on adhering to a schedule and must be prepared to arrive or depart as circumstances dictate.

### Climatic Data

The U.S. Geological Survey, Glacier & Snow Program, Fairbanks, Alaska maintains a weather station on the western boundary of the Wolverine Glacier RNA an altitude of 3,250 feet (990 meters)[5]. Approximate coordinates are 60° 23 minutes north and 148° 56 minutes west. The station is slightly lower than the glacier's average equilibrium line altitude, and is approximately 1,650 feet (500 meters) from the west edge of the glacier.

Data have been gathered at the station since 1967. The dataset is 95 percent complete (i.e., there are missing records for 5 percent of the period)[6], and is particularly important because it provides the only high-altitude, long-term, year-round climate data for the mountains of southcentral Alaska. There are caveats to consider in regard to interpreting the precipitation data from this station. Analysis of stream flow and glacier mass balance data published 1967 through 1977 by Mayo et al. (1992) indicates that recorded annual precipitation catch represents approximately 33 percent of actual annual basin precipitation. Despite the uncertain catch efficiency, the recorded precipitation-gage catch is a useful indicator of when and relatively how much precipitation occurs in the basin.

Extrapolating from the data summarized in Table 1, mean annual precipitation is estimated at 125 inches (320 centimeters). Approximately, 35 percent of this precipitation falls between May through September and 65 percent falls between October through April. The mean annual temperature at the station is 29.5$^{o}$F (-1.4$^{o}$ C). These data are consistent with mean temperature and precipitation isohyte maps presented by Blanchet (1983) that estimate, depending on elevation within the RNA, mean annual temperature varying from 20 to 32$^{o}$F (-6.5 to 0$^{o}$ C) and mean annual precipitation from 120 to 150 inches (305 to 380 cm).

## Ecological Description

### Eco-region

Within the ECOMAP (1993) hierarchy, the entire Wolverine Glacier RNA occurs within the Humid Temperate Domain, Marine Division, Pacific Coastal Mountains Forest – Meadow Province, Chugach Mountains Section, Chugach Icefields Subsection (Bailey 1995; Davidson 1996)[7].

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[5] http://ak.water.usgs.gov/glaciology/wolverine/met/index.htm

[6] Climate records from this station summarized in Table 1 are for 20 years between 1969 and 1995 with complete data.

[7] Based on data from the “Ecosections and Sub-Sections” data theme of the Chugach National Forest GIS.

**Table 1** – Climate records for Wolverine Glacier, Alaska[8].

| | Mean Temperature | | Mean Precipitation | |
|---|---|---|---|---|
| | °F | °C | inches | cm |
| January | 17.2 | -8.2 | 4.1 | 10.4 |
| February | 19.0 | -7.2 | 3.2 | 8.2 |
| March | 21.0 | -6.1 | 3.3 | 8.3 |
| April | 25.7 | -3.5 | 2.6 | 6.5 |
| May | 33.3 | 0.7 | 1.5 | 3.9 |
| June | 40.1 | 4.5 | 1.5 | 3.8 |
| July | 45.5 | 7.5 | 1.8 | 4.5 |
| August | 44.8 | 7.1 | 3.2 | 8.1 |
| September | 37.8 | 3.2 | 7.0 | 17.7 |
| October | 28.6 | -1.9 | 5.3 | 13.4 |
| November | 21.7 | -5.7 | 3.6 | 9.2 |
| December | 19.2 | -7.1 | 4.3 | 11.0 |
| Mean Annual | 29.5 | -1.4 | 41.4[9] | 105.1 |
| Mean May-September | 40.3 | 4.6 | 14.9 | 38.0 |
| Mean October-April | 21.8 | -5.7 | 26.4 | 67.1 |

[8] Data obtained from http://ak.water.usgs.gov/glaciology/wolverine/met/index.htm. Mean temperature and mean precipitation records are for 20 years between 1969 and 1995 with complete data.
[9] See the "Climatic Data" section of this Establishment Record for caveats in regard to interpreting the precipitation data. Based on these interpretations, mean annual precipitation is estimated to be at least 125 inches (320 centimeters).

Landtype association and landtype (ECOMAP 1993; Davidson 1998) mapping of the area identifies the following three associations and associated landtypes in the RNA (see Figure 3 also):

00 Glaciers

This association covers about 69 percent of the RNA and is delimited by Wolverine Glacier itself. The dominate processes are those associated with ice and glaciers and the associated downslope movement and erosion. All of this association in the area is in the Glacier landtype.

10 Mountain Summits

This association covers about 30 percent of the RNA and includes the mountaintop, ridges, and benches not covered by the ice of Wolverine Glacier. Extreme climatic influences have resulted in the weathering and fracturing of bedrock by frost action. Rock outcrops and coarse textured soil are common. All of this association in the area is in the Rugged Mountains landtype.

90 Hills

This association covers only about 1 percent of the RNA. It is restricted to the lowest elevation southeastern portion of the RNA. It is characterized by low to moderate relief. Most of the forested vegetation in the RNA occurs in this association. The dominant physical process is erosion and sediment transport by water. About 70 percent of this association in the area is Low Relief Hills landtype (with the remainder in High Relief Hills).

**Plant Community Types**

Landcover types of the Wolverine Glacier RNA are shown in Figure 4 as mapped by Markon and Williams (1996) using the Alaska Vegetation Classification (Viereck et al. 1992). Table 2 summarizes the acreage for these types and a cross-walk to the National Vegetation Classification System (Federal Geographic Data Committee 1997). About two-thirds of the area is covered by ice and snow. Vegetation types (DeVelice et al. 1999) observed or expected in the RNA are listed in Table 3[10].

**Values**

**Flora**

The flora of Wolverine Glacier RNA has not been thoroughly collected, described, or studied. Table 4 lists the 67 vascular plant taxa currently known from the area.

[10] 7 vegetation plots were sampled to document vegetation compositional variation. The data for these plots are on file with the Forest Ecologist, Chugach National Forest, Anchorage, Alaska.

**Table 2** – Landcover classes of Wolverine Glacier RNA[11].

| Value | Landcover Class | NVCS | Acres | Hectares | Percent | Subtotal Percents |
|---|---|---|---|---|---|---|
| 1 | Closed Needleleaf Forest | I.A.8.N.c | 26 | 11 | 0 | |
| 2 | Open Needleleaf Forest | II.A.4.N.b | 5 | 2 | 0 | |
| 3 | Needleleaf Woodland | II.A.4.N.b | 10 | 4 | 0 | forest |
| 7 | Closed Mixed Forest[12] | I.C.2.N.a | 4 | 2 | 0 | 1 |
| 13 | Closed Tall Shrub | III.B.2.N.b | 362 | 147 | 5 | shrub |
| 15 | Closed Low Shrub | III.A, III.B.2 | 236 | 95 | 3 | 9 |
| 17 | Dry/Mesic Graminoid/Forb | V.A.5.N; V.B.2.N | 1204 | 487 | 17 | herbaceous 17 |
| 28 | Clear Water | non-veg. | 3 | 1 | 0 | |
| 29 | Turbid Water | non-veg. | 20 | 8 | 0 | |
| 33 | Bedrock or Unconsolidated | non-veg. | 373 | 151 | 5 | |
| 36 | Ice/Snow/Clouds | non-veg. | 4431 | 1793 | 64 | |
| 38 | Shadow | N/A | 52 | 21 | 1 | other |
| 39 | Sparsely Vegetated | VII | 153 | 62 | 2 | 73 |
| | | **GRAND TOTAL** | **6878** | **2783** | **100** | **100** |

[11] Data from the "Land Cover Classification" data theme of the Chugach National Forest GIS.
[12] Since broadleaf trees have not been observed within the RNA (Table 4), this class is likely misclassified and is actually "closed tall scrub".

**Table 3** – Major vegetation types (DeVelice et al. 1999) observed in Wolverine Glacier RNA during field surveys or expected in the area based on the habitat characteristics present.

| Vegetation Type | Obs. | Exp. |
|---|---|---|
| **Needleleaf Forest Types** | | |
| *Tsuga mertensiana/Alnus crispa* ssp. *sinuata* | | √ |
| *Tsuga mertensiana/Cassiope stelleriana* | | √ |
| *Tsuga mertensiana/Dryopteris dilatata* | | √ |
| *Tsuga mertensiana/Phyllodoce aleutica* | | √ |
| *Tsuga mertensiana/Vaccinium ovalifolium* | | √ |
| *Tsuga mertensiana/Vaccinium ovalifolium-Cassiope stelleriana* | √ | |
| *Tsuga mertensiana/Vaccinium ovalifolium/Fauria crista-galli* | √ | |
| *Tsuga mertensiana/Vaccinium uliginosum* | | √ |
| **Tall Shrub Types** | | |
| *Alnus crispa* ssp. *sinuata/Calamagrostis canadensis* | | √ |
| *Alnus crispa ssp. sinuata/Dryopteris dilatata* | √ | |
| *Alnus crispa* ssp. *sinuata-Rubus spectabilis* | √ | |
| *Salix barclayi/Calamagrostis canadensis* | √ | |
| **Low Shrub Types** | | |
| *Rubus spectabilis/Calamagrostis canadensis* | √ | |
| **Dwarf Shrub Types** | | |
| *Cassiope stelleriana-Luetkea pectinata* | √ | |
| *Cassiope stelleriana-Luetkea pectinata/Fauria crista-galli* | | √ |
| *Empetrum nigrum-Arctostaphylos alpina* | √ | |
| *Empetrum nigrum-Vaccinium uliginosum* | √ | |
| *Phyllodoce aleutica-Cassiope stelleriana* | √ | |
| **Graminoid Herbaceous Types** | | |
| *Calamagrostis canadensis* | √ | |
| *Carex macrochaeta* | | √ |
| *Carex pluriflora* | √ | |
| *Eriophorum angustifolium-Carex pluriflora* | √ | |
| *Eriophorum angustifolium-Trichophorum caespitosum* | √ | |
| *Festuca altaica/Geranium erianthum* | √ | |
| *Trichophorum caespitosum* | | √ |

**Table 3** – (continued)

| Vegetation Type | Obs. | Exp. |
|---|---|---|
| **Forb Herbaceous Types** | | |
| *Fauria crista-galli* | | √ |
| *Fauria crista-galli/Trichophorum caespitosum* | √ | |
| *Veratrum viride* | √ | |

**Table 4** – Vascular plant taxa observed in Wolverine Glacier RNA[13].

| Scientific Name | Common Name | Source[14] |
|---|---|---|
| TREES | | |
| *Tsuga mertensiana* | mountain hemlock | b |
| TALL SHRUBS | | |
| *Alnus crispa* ssp. *sinuata* | Sitka alder | b |
| *Rubus spectabilis* | salmonberry | b |
| *Salix barclayi* | Barclay willow | b |
| *Sambucus racemosa* | red elderberry | b |
| *Vaccinium ovalifolium* | early blueberry | b |
| DWARF OR SUBSHRUBS | | |
| *Arctostaphylos alpina* | alpine bearberry | a |
| *Cassiope mertensiana* | Mertens cassiope | a |
| *Cassiope stelleriana* | Stellers cassiope | a |
| *Diapensia lapponica* | diapensia | a |
| *Dryas octopetala* | white mountain-avens | a |
| *Empetrum nigrum* | crowberry | a |
| *Loiseleuria procumbens* | alpine azalea | a |
| *Luetkea pectinata* | partridgefoot | a |
| *Phyllodoce aleutica* | Aleutian mountainheath | a |
| *Salix arctica* | arctic willow | a |
| *Salix reticulata* | netleaf willow | a |
| *Salix rotundifolia* | least willow | a |
| *Spiraea beauverdiana* | Beauverd spirea | a |
| *Vaccinium uliginosum* | bog blueberry | a |
| *Vaccinium vitis-idaea* | lowbush cranberry | a |
| FORBS | | |
| *Achillea borealis* | yarrow | a |
| *Anemone narcissiflora* | narcissus anemone | a |
| *Arnica frigida* | snow arnica | c |
| *Artemisia arctica* | boreal sagebrush | a |
| *Cardamine microphylla* | smallleaf bittercress | a |
| *Cornus canadensis* | bunchberry dogwood | a |

[13] Vascular plant nomenclature follows Hultén (1968). Common names follow the Chugach National Forest plant species list (*unpublished*, Anchorage, AK).
[14] a = recorded in field plots sampled towards developing this establishment record; b = additional taxa observed outside of the field plots; c = additional species for the area with specimen records at the University of Alaska Museum Herbarium (http://www.uaf.edu/museum/herb/).

**Table 4** – (continued)

| Scientific Name | Common Name | Source |
|---|---|---|
| *Epilobium angustifolium* | tall fireweed | a |
| *Erigeron peregrinus* | subalpine fleabane | a |
| *Fauria crista-galli* | deer cabbage | b |
| *Fritillaria camschatcensis* | chocolate lily | a |
| *Geranium erianthum* | northern geranium | a |
| *Geum calthifolium* | calthaleaf avens | b |
| *Hedysarum alpinum* | alpine sweetvetch | a |
| *Heracleum lanatum* | cow parsnip | a |
| *Lupinus nootkatensis* | Nootka lupine | a |
| *Oxytropis campestris* | cold mountain crazyweed | a |
| *Pedicularis capitata* | capitate lousewort | a |
| *Polygonum viviparum* | alpine bistort | a |
| *Romanzoffia sitchensis* | Sitka mistmaiden | c |
| *Sanguisorba stipulata* | Sitka burnet | a |
| *Saxifraga bronchialis* | yellowdot saxifrage | c |
| *Saxifraga nelsoniana* | heartleaf saxifrage | c |
| *Sedum rosea* | roseroot stonecrop | a |
| *Senecio triangularis* | arrowleaf groundsel | a |
| *Streptopus amplexifolius* | twistedstalk | a |
| *Trientalis europaea* | starflower | a |
| *Valeriana sitchensis* | Sitka valerian | a |
| *Veratrum viride* | false hellebore | a |
| *Viola glabella* | yellow violet | a |
| GRAMINOIDS | | |
| *Calamagrostis canadensis* | bluejoint reedgrass | a |
| *Carex macrochaeta* | longawn sedge | a |
| *Carex michrochaeta* | smallawned sedge | a |
| *Carex microglochin* | fewseeded bog sedge | a |
| *Carex pluriflora* | manyflower sedge | a |
| *Eriophorum angustifolium* | tall cottongrass | b |
| *Festuca altaica* | Altai fescue | a |
| *Hierochloe alpina* | alpine holy grass | a |
| *Hierochloe oderata* | holy grass | c |
| *Luzula arcuata* | curved woodrush | c |
| *Luzula wahlenbergii* | Wahlenberg's woodrush | a |
| *Trichophorum casespitosum* | tufted bulrush | b |
| *Vahlodea atropurpurea* | mountain hairgrass | a |

**Table 4** – (continued)

| Scientific Name | Common Name | Source |
|---|---|---|
| FERNS AND FERN ALLIES | | |
| *Dryopteris dilatata* | wood fern | a |
| *Gymnocarpium dryopteris* | oak fern | a |
| *Lycopodium clavatum* | running clubmoss | a |
| *Lycopodium selago* | fir clubmoss | a |

**Fauna**
Animal species have not been systematically studied or inventoried in the Wolverine Glacier RNA.

Mammals

Table 5 is a list of 34 species of mammals that were seen in the RNA or may occur there based on distribution maps, habitat references, and/or conversations with local resource managers.

**Mountain Goat:**
The historical distribution of the mountain goat encompasses the high mountainous regions of southcentral Alaska to southcentral Washington. In southcentral Alaska, mountain goats are primarily located in the Chugach and Wrangell mountains. There are mountain goats in the Kenai Mountains, extending southwest of the Chugach Mountains. Of interest is a population that resides in the region of the Wolverine Glacier RNA.

Mountain goat populations are mostly stable or increasing throughout their range, in general. The Kenai population is estimated at 4,000 to 5,000 animals. The reproductive productivity of most herds is low with females producing a single kid (twinning is rare) and breeding may not always occur every year (Ted Spraker, Alaska Department of Fish and Game, *personal communication*).

Mountain goats are both grazers and browsers, depending upon the habitat and season (Wigal and Coggins 1982). During spring, they prefer south-facing slopes and avalanche chutes, where there is the earliest spring growth of plant shoots (Schoen and Kirchhoff 1982). In the summer they are found mostly in subalpine and alpine meadows taking grasses, sedges, forbs, ferns, and low shrubs. During the winter, some migrate to lower elevations at or below treeline (Smith 1986). Others overwinter on ridges where the vegetation is exposed by the wind. During this time, they shift to browsing on hemlock, spruce, shrubby vegetation, or, grazing on mosses and lichens (Fox and Smith 1988).

The proximity to escape terrain is a critical factor in evaluating mountain goat habitat. Goats move to steep, irregular terrain with drops and cliffs when approached by predators such as the gray wolf (Fox and Streveler 1986). Investigators have variously estimated the required near distance to escape terrain was 660 to 2,600 feet (200 to 800 meters; USDA Forest Service 1990). The combination of escape terrain and forage define mountain goat habitat.

**Table 5** – Mammals species observed or potentially occurring in Wolverine Glacier RNA[15].

| Scientific name | Common name | Comments |
|---|---|---|
| INSECTIVORA | | |
| *Sorex cinereus* | masked shrew | b |
| *Sorex monticolus* | dusky shrew | b |
| *Microsorex hoyi* | pygmy shrew | b n |
| CHIROPTERA | | |
| *Myotis lucifugus* | little brown myotis | b |
| LAGOMORPHA | | |
| *Lepus americanus* | snowshoe hare | b |
| RODENTIA | | |
| *Marmota caligata* | hoary marmot | a1 |
| *Spermophilus parryii* | arctic ground squirrel | b n |
| *Tamiasciurus hudsonicus* | red squirrel | b1 |
| *Glaucomys sabrinus* | flying squirrel | b |
| *Castor canadensis* | beaver | b |
| *Clethrionomys rutilus* | northern red-backed vole | b |
| *Microtus pennsylvanicus* | meadow vole | b |
| *Microtus oeconomus* | tundra vole | b |
| *Microtus miurus* | singing vole | b |
| *Ondatra zibethicus* | muskrat | b |
| *Synaptomys borealis* | northern bog lemming | b |
| *Zapus hudsonius* | meadow jumping mouse | b |
| *Erethizon dorsatum* | porcupine | b |

[15] Comment codes are defined as follows:
a = sign observed or sighting during field survey (1 = seen; 2 = scat; 3 = browse; 4 = diggings; 5 = tracks; 6 = beds; 7 = hair);
b = distribution records from Hall and Kelson (1959), Manville and Young (1965), or Alaska Department of Fish and Game (1978), Alaska Department of Fish and Game *personal communication*, and/or U.S. Forest Service *personal communication* (1 = seen);
n = questionable distribution or on edge of distribution.

**Table 5** – (continued)

| Scientific name | Common name | Comments |
|---|---|---|
| CARNIVORA | | |
| *Canis latrans* | coyote | b |
| *Canis lupus* | gray wolf | a5 |
| *Vulpes vulpes* | red fox | b |
| *Ursus americanus* | black bear | a14 |
| *Ursus arctos* | brown bear | a5 |
| *Martes americana* | marten | b |
| *Mustela erminea* | ermine | a |
| *Mustela nivalis* | least weasel | b |
| *Mustela vison* | mink | b |
| *Gulo gulo* | wolverine | b |
| *Lutra canadensis* | river otter | b |
| *Felis lynx* | lynx | b |
| ARTIODACTYLA | | |
| *Alces alces* | moose | a236 |
| *Oreamnos americanus* | mountain goat | a27 |
| *Odocoileus hemionus* | sitka black-tailed deer | b n |
| *Ovis dalli* | dall sheep | b |

Evidence of mountain goats (e.g., hair, scat) was seen on the hillside and immediately adjacent to Wolverine Glacier, higher and lower in elevation than the bench where the U.S. Geological Survey hut occurs (Photo 3). The exposure is southerly and southeasterly and the terrain is steep and, at times, precipitous. Low shrubs and herbaceous plants characterize the vegetation. This area resides between the high alpine and lower elevation forested regions along the Nellie Juan River. While in past years Dall sheep were seen on the ridge separating Paradise Valley from Nellie Juan River Valley, mountain goats were never observed in this area and appear limited to terrain immediately adjacent to the glacier (Larry Mayo, U.S. Geological Survey, *personal communication*).

**Black Bear:**
Black bears are associated with forests. Though highly adaptive, widespread habitat alteration has reduced or eliminated populations in the midwestern and eastern region of the United States. Alaska populations are generally stable, with some areas suffering population declines (Sterling Miller, Alaska Department of Fish and Game, *personal communication*). Some of the highest densities of Alaska black bears are in the coastal southcentral region. Bears and bear sign (e.g., beds, tracks, trails, diggings) were commonly seen in forested areas adjacent to the Wolverine Glacier RNA during field surveys in the development of this establishment record. Only about 1 percent of the RNA is forested (Table 2) but forest vegetation is common on the benches and slopes below the RNA.

**Hoary Marmot:**
Hoary marmots range throughout coastal southcentral and southeastern Alaska, with a few island exceptions. They reside in burrows at higher elevations near or above treeline and often on relatively warm south-facing slopes. They are common within Wolverine Glacier RNA.

## Birds

Table 6 is a list of 32 birds observed or heard in the Wolverine Glacier RNA during the field surveys in the development of this establishment record.

There are a total of 123 birds that either do occur or may occur within the Wolverine Glacier RNA. Table 7 is a list of 91 additional species which are likely to occur there based on known bird distributions (Alaska Natural Heritage Program 1995) and appropriate habitats within the RNA.

**Table 6** – Bird species observed in Wolverine Glacier RNA[16].

| Scientific name | Common name | Comments |
|---|---|---|
| *Branta canadensis* | Canada goose | a |
| *Aythya marila* | greater scaup | n |
| *Haliaeetus leucocephalus* | bald eagle | a |
| *Circus cyaneus* | northern harrier | a |
| *Dendragapus canadensis* | spruce grouse | a |
| *Lagopus mutus* | rock ptarmigan | a |
| *Lagopus leucurus* | white-tailed ptarmigan | a |
| *Lagopus lagopus* | willow ptarmigan | a |
| *Heteroscelus incanus* | wandering tattler | a |
| *Larus glaucescens* | glaucous-winged gull | a |
| *Calypte anna* | Anna's hummingbird | a |
| *Selasphorus rufus* | rufous hummingbird | a |
| *Corvus corax* | common raven | a |
| *Turdus migratorius* | American robin | a |
| *Catharus guttatus* | hermit thrush | a |
| *Myadestes townsendi* | Townsend's solitaire | a |
| *Regulus calendula* | ruby-crowned kinglet | a |
| *Anthus spinoletta* | water pipit | a |
| *Dendroica coronata* | yellow-rumped warbler | a |
| *Dendroica townsendi* | Townsend's warbler | a |
| *Seiurus noveboracensis* | northern waterthrush | a |
| *Wilsonia pusilla* | Wilson's warbler | a |
| *Passerculus sandwichensis* | savannah sparrow | a |
| *Junco hyemalis* | dark-eyed junco | a |
| *Spizella arborea* | American tree sparrow | a |
| *Zonotrichia atricapilla* | golden-crowned sparrow | a |
| *Passerella iliaca* | fox sparrow | a |
| *Melospiza lincolnii* | Lincoln's sparrow | a |
| *Plectrophenax nivalis* | snow bunting | a |
| *Leucosticte arctoa* | rosy finch | a |
| *Carduelis flammea* | common redpoll | a |
| *Loxia leucoptera* | white-winged crossbill | a |

[16] Nomenclature follows Armstrong (1980). Comment codes are defined as follows:
a = identified by sight or call during field survey;
n = not confirmed.

**Table 7** – Bird species potentially occurring in Wolverine Glacier RNA in addition to those listed in Table 6[17].

| Scientific name | Common name |
|---|---|
| *Gavia immer* | common loon |
| *Gavia arctica* | Arctic loon |
| *Gavia stellata* | red-throated loon |
| *Podiceps grisegena* | red-necked grebe |
| *Podiceps auritus* | horned grebe |
| *Cygnus columbianus* | tundra swan |
| *Cygnus buccinator* | trumpeter swan |
| *Anser albifrons* | greater white-front goose |
| *Anas platyrhynchos* | mallard |
| *Anas strepera* | gadwall |
| *Anas acuta* | northern pintail |
| *Anas crecca* | green-winged teal |
| *Anas clypeata* | northern shoveler |
| *Anas americana* | American widgeon |
| *Aythya valisineria* | canvasback |
| *Bucephala clangula* | common goldeneye |
| *Bucephala islandica* | Barrow's goldeneye |
| *Bucephala albeola* | bufflehead |
| *Histrionicus histronicus* | harlequin duck |
| *Mergus merganser* | common merganser |
| *Mergus serrator* | red-breasted merganser |
| *Accipiter gentilis* | northern goshawk |
| *Accipiter striatus* | sharp-shinned hawk |
| *Buteo jamaicensis* | red-tailed hawk |
| *Aquila chrysaetos* | golden eagle |
| *Falco columbarius* | merlin |
| *Falco peregrinus* | peregrine falcon |
| *Grus canadensis* | sandhill crane |
| *Charadrius semipalmatus* | semipalmated plover |
| *Tringa melanoleuca* | greater yellowlegs |
| *Tringa flavipes* | lesser yellowlegs |
| *Tringa solitaria* | solitary sandpiper |
| *Actitis macularia* | spotted sandpiper |
| *Phalaropus lobatus* | red-necked phalarope |
| *Limnodromus griseus* | short-billed dowitcher |
| *Calidris mauri* | western sandpiper |
| *Calidris minutilla* | least sandpiper |
| *Gallinago gallinago* | common snipe |

[17] Nomenclature follows Armstrong (1980).

**Table 7** – (continued)

| Scientific name | Common name |
|---|---|
| *Larus argentatus* | herring gull |
| *Larus philadelphia* | Bonaparte's gull |
| *Larus canus* | mew gull |
| *Sterna paradisaea* | Arctic tern |
| *Brachyramphus brevirostris* | Kittlitz's murrelet |
| *Bubo virginianus* | great horned owl |
| *Surnia ulula* | northern hawk-owl |
| *Satrix nebulosa* | great gray owl |
| *Asio flammeus* | short-eared owl |
| *Aegolius funereus* | boreal owl |
| *Aegolius acadicus* | northern saw-whet owl |
| *Ceryle alcyon* | belted kingfisher |
| *Picoides villosus* | hairy woodpecker |
| *Picoides pubescens* | downy woodpecker |
| *Picoides tridactylus* | three-toed woodpecker |
| *Colaptes auratus* | northern flicker |
| *Sayornis saya* | Say's phoebe |
| *Empidonax alnorum* | alder flycatcher |
| *Contopus sordidulus* | western wood-pewee |
| *Contopus borealis* | olive-sided flycatcher |
| *Tachycineta thalassina* | violet-green swallow |
| *Tachycineta bicolor* | tree swallow |
| *Riparia riparia* | bank swallow |
| *Hirundo pyrrhonota* | cliff swallow |
| *Hirundo rustica* | barn swallow |
| *Perisoreus canadensis* | gray jay |
| *Cyanocitta stelleri* | Steller's jay |
| *Pica pica* | black-billed magpie |
| *Corvus caurinus* | northwestern crow |
| *Parus atricapillus* | black-capped chickadee |
| *Parus hudsonicus* | boreal chickadee |
| *Parus rufescens* | chestnut-backed chickadee |
| *Sitta canadensis* | red-breasted nuthatch |
| *Certhia americana* | brown creeper |
| *Troglodytes troglodytes* | winter wren |
| *Cinclus mexicanus* | American dipper |
| *Ixoreus naevius* | varied thrush |
| *Catharus minimus* | gray-cheeked thrush |
| *Catharus ustulatus* | Swainson's thrush |
| *Regulus satrapa* | golden-crowned kinglet |

**Table 7** – (continued)

| Scientific name | Common name |
|---|---|
| *Bombycilla garrulus* | bohemian waxwing |
| *Lanius excubitor* | northern shrike |
| *Vermivora celata* | orange-crowned warbler |
| *Dendroica petechia* | yellow warbler |
| *Dendroica striata* | blackpoll warbler |
| *Euphagus carolinus* | rusty blackbird |
| *Pinicola enucleator* | pine grosbeak |
| *Carduelis hornemanni* | hoary redpoll |
| *Carduelis pinus* | pine siskin |
| *Loxia curvirostra* | red crossbill |
| *Zonotrichia leucophrys* | white-crowned sparrow |
| *Melospiza melodia* | song sparrow |
| *Calcarius lapponicus* | Lapland longspur |

**Kittlitz's Murrelet:**
An avian species of interest that may potentially occur in the Wolverine Glacier RNA is the Kittlitz's murrelet. The U.S. Fish and Wildlife Service has named the species as a candidate for protection under the Endangered Species Act. Over 95 percent of the world population of Kittlitz's murrelets (estimated at 18,300 individuals) resides in Alaska and over 16 percent reside in the Prince William Sound region (van Vliet 1993). Piatt and Ford (1993) point out that the terrestrial nesting distribution of murrelets coincides spatially with their saltwater feeding distribution. Wolverine Glacier is approximately 10 miles (16 kilometers) in a direct line to Prince William Sound.

Kittlitz's murrelets, unlike the congeneric marbled murrelet (*Brachyramphus marmoratus*), are associated with coastal glaciers during the breeding season. Pairs establish isolated nests on the ground in the vicinity of glaciers and cirques. Their plumage is brown, mottled with white, and is cryptic. Nests have limited vegetative cover (mean of 8 percent) and occur on the downhill side of a small rock or overhang, or, in a depression. The nearest coastline distance averaged 10.2 miles (16.4 kilometers) from a nest (Day et. al 1983). Wolverine Creek drains the glacier as a fast-flowing stream to the Nellie Juan River. The Nellie Juan, in turn, empties into Prince William Sound at Kings Bay approximately 8 miles (13 kilometers) downstream. While there are not records of breeding within the Wolverine Glacier RNA, there is potential nesting habitat adjacent to the recently receding glacier as it has exposed rocky areas scattered with glacial till which have been established by and mosses and lichens.

## Amphibians and Reptiles

The only three species of amphibians which may occur within the Wolverine Glacier RNA in order of decreasing likelihood are the wood frog (*Rana sylvatica*), the western toad (*Bufo boreas*), and the rough-skinned newt (*Taricha granulosa*).

## Fish

The freshwater fishes that reside in the lakes, ponds, and river systems within and immediately adjacent to the Wolverine Glacier RNA are unknown. There have been no surveys or sampling in the Nellie Juan River or Wolverine Creek systems by Alaska Department of Fish and Game or USDA Forest Service. Based on suspected general distributions of freshwater species, there are a number of potential residents. During years of excellent salmon returns, it is possible that the Nellie Juan River (outside the RNA boundary but within the same watershed as the RNA) may be used as spawning habitat by *Onchorynchus* spp..

According to Morrow (1980), the following families may be represented in the region of the RNA:

Lampreys - Petromyzontidae
Salmon and trout - Salmonidae
Whitefish - Salmonidae
Stickleback - Gasterosteidae
Sculpin - Cottidae

Insects

Listed below are all freshwater invertebrate species which were collected from the Wolverine Glacier area during field survey of the area towards the development of this establishment record. They were identified in the laboratory by Elaine Major at the Environment and Natural Resources Institute at the University of Alaska Anchorage.

| ORDER | FAMILY | GENERA |
|---|---|---|
| Ephemeroptera | Baetidae<br>Heptageniidae | Baetis<br>Cinygmula |
| Amphipoda | Gammarus | + |
| Trichoptera | Limnephilidae | Ecclisomyia |
| Coleoptera | + | + |
| Diptera | Chironomidae | + |
| Mollusca | Tricladida | + |

**Geology**

The geology of the Chugach National Forest has been mapped by Nelson et al. (1985). About 62 percent of the Wolverine Glacier RNA is mapped as glacier and the remaining 38 percent as sedimentary rocks, undivided, of the Valdez Group[18].

**Soils**

Soils of the Wolverine Glacier RNA have not been inventoried. However, it is likely that the principle soil taxa (Soil Survey Staff 2003) of the area are in "Lithic" subgroups with bedrock within 20 inches (50 centimeters) of the mineral surface. Lithic Cryorthents are likely the most common soils in the area and can be crudely described as cold, thin, and in the early

[18] Data from the "Geology" data theme of the Chugach National Forest GIS.

stages of development.

### Topography

The Wolverine Glacier RNA is characterized by two distinctive physical settings: 1) glacier ice comprising about two-thirds of the area and 2) mountain summits, ridges and benches comprising the remainder. The dominant processes present are the downslope movement and erosion associated with the glacier and the extreme climatic influences resulting in the weathering and fracturing of bedrock by frost with the downslope movement of fragments.

### Aquatic / Riparian

Based on the National Wetlands Inventory[19], 99.6 percent of the Wolverine Glacier RNA is non-wetland, upland systems and only 0.4 percent is classified as palustrine wetland.

### Rare, Threatened, Endangered or Sensitive Species

No endangered, threatened, or sensitive species are known to occur within the Wolverine Glacier RNA. Trumpeter swan, an Alaska Region sensitive animal species[20], may occur in the RNA based on the known distribution of the species.

The nine Alaska Region sensitive plant species (Stensvold 2005) listed in Table 8 potentially occur within the RNA based on the presence of favorable habitat. However, their presence has not yet been verified.

### Rare Elements & Rare Plant Communities

No rare elements and rare plant communities are known to occur within the Wolverine Glacier RNA.

## Resource Information

### Minerals

There are no known mineral values within Wolverine Glacier RNA and no present or historic mining activity. Based on information in Nelson et al. (1984), portions of the area have potential for gold and silver. This favorability is determined largely by the comparison of the geologic environment in the area in question with available geologic, geochemical, and geophysical criteria from areas of known deposits.

[19] The "USF&WS National Wetlands Inventory" data theme of the Chugach National Forest GIS.
[20] The Alaska region sensitive species lists are posted at the following USDA Forest Service intranet site: http://fsweb.r10.fs.fed.us/staffs/wfew/wfew_documents/sensitive_species_list.doc

**Table 8** – Sensitive plant species potentially occurring in Wolverine Glacier RNA[21].

| Scientific Name | Common Name | Habitats |
|---|---|---|
| *Aphragmus eschscholtzianus* | Esc. little nightmare | A |
| *Arnica lessingii* ssp. *norbergii* | Norberg arnica | AFMT |
| *Carex enanderi* | goose-grass sedge | AW |
| *Draba kananaskis* | tundra whitlow-grass | A |
| *Isoetes truncate* | truncate quillwort | S |
| *Ligusticum caldera* | Calder lovage | AFM |
| *Papaver alboroseum* | pale poppy | AM |
| *Romanzoffia unalaschcensis* | Unalaska mist-made | FRW |
| *Stellaria ruscifolia* ssp. *aleutica* | circumpolar starwort | ARW |

[21] Nomenclature follows Hultén (1968) except for *Draba kananaskis* and *Ligusticum calderi*, which follow Mulligan (1970) and Calder and Taylor (1968), respectively. Common names follow Stensvold (1994). Habitats are generalized from Stensvold (1994) as follows:

A = alpine and subalpine
F = forests (or forest edge)
T = tall shrubland
M = meadows
R = rock outcrops
W = marshy areas (or streamsides)
S = shallow freshwater.

The Final Environmental Impact Statement (FEIS) for the Forest Plan (USDA Forest Service 2002c) states that oil and gas leasing is unavailable in the RNA and further notes that none of the areas designated as RNA (including the Wolverine Glacier area) are within areas that have been identified as having potential for oil and gas development. Similarly, the FEIS and the Forest Plan (USDA Forest Service 2002c and 2002b, respectively) state that extraction of salable minerals (sand, gravel, hard rock for crushing, and landscape materials) will not be allowed in RNAs.

**Grazing**
No domestic livestock are on Wolverine Glacier RNA and there is no history of grazing by livestock. Grazing by domestic stock will be prohibited.

**Plants**
Only about one percent of the Wolverine Glacier RNA is forested. Because of its status as RNA, commercial and personal use timber harvest is not allowed under the Forest Plan (USDA Forest Service 2002b). Special forest products such as wildflowers and ferns occur in the area, but because of its status as RNA, commercial and personal use special forest products harvest in the RNA is not allowed under the Forest Plan.

**Watershed Values**
The entire Wolverine Glacier RNA lies within the Nellie Juan River watershed. The RNA contains essentially no sport fish habitat. Establishment of the RNA at this location will not conflict with watershed values or uses. Establishment of the RNA would maintain current water quality and flow.

**Recreation Use**
Wolverine Glacier RNA supports a variety of high-quality scenic and recreational resources provided by the glacier, rugged peaks, diverse wildlife, and scattered tarns. The potential for significant human-induced impacts within the RNA is likely minimal given the difficult access, rugged terrain, and lack of trails.

Under the Forest Plan (USDA Forest Service 2002b) no recreational developments will be constructed within the RNA nor will motorized recreational use be allowed. As stated in the FEIS for the Forest Plan (USDA Forest Service 2002c), existing nonmotorized use will be allowed as long as the use does not degrade RNA values. Sport hunting and fishing are not restricted in the RNA.

**Wildlife**
The Wolverine Glacier RNA features a diversity of wildlife and plant species and plant communities. Establishment of RNA will in no way adversely affect wildlife and plant values in the area. RNA designation will be beneficial in protecting wildlife and floristic values.

As stated in the FEIS for the Forest Plan (USDA Forest Service 2002c), habitat

manipulation for wildlife is not allowed unless specifically needed to restore natural ecosystem conditions or specifically designed for the protection of threatened, endangered, or sensitive species. Such manipulations are not presently called for or anticipated in the RNA.

### Transportation / Road System

The Forest Plan (USDA Forest Service 2002b) does not allow new Forest Service roads to be built in RNAs and new trail construction is prohibited (unless the new trail contributes to the objectives or to the protection of the RNA). There are no plans for road or trail construction within the Wolverine Glacier RNA. Establishment of the RNA would not affect any existing or proposed road access system on the Chugach National Forest.

## Historical Information

### Research / Education Use & Interest

The U.S. Geological Survey, Glacier & Snow Program, Fairbanks, Alaska has carried out measurements at Wolverine Glacier since 1966[22]. The measurements included snow depth, snow density, heights of the glacier surface and stratigraphic summer surfaces on stakes, and identification of the surface materials (Mayo et al. 2004). In addition, the U.S. Geological Survey maintains a weather station at the site (within the RNA) and a stream gauge on Wolverine Creek (outside the RNA). The extensive body of scientific literature that has been generated from this research is listed in the "Additional References" section of this establishment record.

Among the findings from the decades-long mass balance record for Wolverine Glacier are (Josberger et al. 2006, Figure 5):

- Glacier retreat accelerated after 1988 (net balance is negative for most years after 1988).
- The increased glacier turnover rate, primarily as a result of increased summer melting, indicates a more energetic hydrologic cycle.
- Correlations of the maritime-glacier winter balances with the Pacific Decadal Oscillation have weakened, suggesting that these once-dominant relations are being overwhelmed by a climate change on a larger scale.

### Cultural / Heritage

There are no Native inholdings or allotments in the Wolverine Glacier RNA. The RNA has not received an archeological survey and there are no known sites of cultural or historic significance within the RNA. Cultural sites have been discovered outside of the RNA in the Paradise Valley.

### Disturbance History

The primary natural disturbances affecting the Wolverine Glacier RNA are the

[22] Data from this research may be found at http://ak.water.usgs.gov/glaciology/wolverine/.

activity of glacier, snow avalanches, and landslides.

Primary human use of the area has been glaciological research use since the mid 1960s and occasional recreational visits. To date, the extent and intensity of human caused disturbance is small.

### Occurrence of Exotic Species

Existing surveys on the Chugach National Forest (DeVelice et al. 1999; DeVelice 2003; Duffy 2003) found that most areas of exotic plant occurrence on the Forest are presently in areas of intensive human-caused disturbance such as road edges, visitor facilities, trailheads, and trails. Exotic plants are presently rare within natural communities on the Forest.

No exotic plant records were found within the Wolverine Glacier RNA in a query of the Alaska Exotic Plant Information Clearinghouse database (AKEPIC[23]). In addition, no exotic plants were recorded during field surveys of the area in the development of this establishment record. Scattered populations of exotics may be present but the extent and number of individuals is likely small.

## Other Information

### Permanent Research Plots and/or Photo Points

The only known permanent installations in the Wolverine Glacier RNA are those associated with the ongoing U.S. Geological Survey research in the area including the weather station (Photo 2) and research hut (Photo 3).

### Potential Research Topics

- Continue the monitoring work initiated in 1966 towards understanding glacier-related hydrologic processes, hazards, and climate change.
- Study ecological pattern and process in relation to glacial activity and climatic drivers.
- Identify if cultural and heritage resources exist in the area.

## Evaluation of Specific Management Recommendations

### Potential or Existing Conflicts

See the “Resource Information” section above for a summary of potential and existing conflicts. In summary, there are no known conflicting uses within the Wolverine Glacier RNA for minerals, grazing, commercial or personal timber harvest, watershed values, recreation use, wildlife and floristic values, and transportation systems.

### Special Management Area

The Wolverine Glacier RNA is entirely within recommended Wilderness but no

[23] http://akweeds.uaa.alaska.edu/

portion has been congressionally designated wilderness, wild and scenic river, or national recreation area.

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## APPENDIX

### Management Area Prescription

The following text is from the Revised Land and Resource Management Plan of the Chugach National Forest (USDA Forest Service 2002b) and summarizes the management area prescription for Research Natural Areas:

## 141 - Research Natural Area Management Area – Category 1

**Theme -** Research Natural Areas (RNAs) emphasize non-manipulative research, monitoring, education, and the maintenance of natural diversity, allowing natural physical and biological processes to prevail without human intervention. RNAs serve as baseline reference areas for measuring long-term ecological change. This management area prescription specifies management area direction for designated Research Natural Areas.

### Management Intent

**Ecological Systems Desired Condition -** RNAs are characterized by essentially unaffected environments in which natural ecological processes dominate, largely undisturbed by human activity. Management activities on other lands are compared to the RNA to measure the effectiveness of various standards, guidelines and mitigation measures in reducing or preventing adverse environmental effects. Specific management direction, consistent with the purpose, will be developed for each RNA as it is established.

**Social Systems Desired Condition –** Management for recreation uses, habitat improvement or restoration and resource development are not emphasized. Recreation uses that interfere with the purpose of the RNA may be restricted. RNAs will provide outstanding opportunities for research, study, observation, monitoring, and those educational activities that maintain unmodified conditions. The Recreation Opportunity Spectrum will range from Primitive to Semi-primitive Nonmotorized. While a pristine condition is the goal in the selection of an RNA, there may be some evidence of past human use in this area, such as primitive trails or historic structures. Heritage resources will remain in an undisturbed state, with data recordation as the preferred method to mitigate the loss of heritage resources. Cabins and other historic, aboveground features will be present in their natural state, with no on-site interpretation.

There will be no roads, trails, fences, or signs in these areas unless they contribute to the RNA objectives or the protection of the area. Mining activities may occur on existing claims. In order to implement this prescription as intended, the Forest Service may request that the Bureau of Land Management withdraw areas, subject to the establishment of valid existing rights, within this management area prescription from location and entry under the United States mining laws.

## Research Natural Area Management Area - Activities Table

| | | | |
|---|---|---|---|
| **Physical Elements** | | | |
| Soil/Watershed Projects | C | | |
| **Biological Elements** | | | |
| Vegetation Management | N | Integrated Pest Management | C |
| Wildlife Habitat Projects | C | Management Ignited Prescribed Fire | C |
| Fish Habitat Projects | C | | |
| **Resource Production** | | | |
| **Forest Products** | | **Minerals/ Mining** | |
| Commercial Timber Harvest ASQ | N | Mineral Activities – Locatable | C |
| Commercial Timber Harvest - nonchargeable | N | Mineral Activities – Salable | N |
| Commercial Special Forest Products | N | | |
| Personal Use Timber Harvest | N | | |
| Personal Use Special Forest Products | N | | |
| **Use and Occupancy Activities** | | | |
| **Recreation/Tourism Activities** | | | |
| Recreational Gold Panning | N | Forest Service Recreational Cabins | N |
| Maximum ROS Class [1] | SPNM | Campgrounds | N |
| Nonmotorized Recreation Use - Summer | C | Minimum SIO [2] | VH |
| Nonmotorized Recreation Use - Winter | C | Hardened Dispersed Camping Sites | N |
| Day-use Facilities | N | Viewing Sites | N |
| **Transportation/Access** | | | |
| Marine Transfer Facilities | N | New Roads Built by Others | C |
| Boat Docks and Ramps | N | New Trails | C |
| Mode Changes: Parking Lots at Trailheads, Ferry Terminals, etc. | N | Administrative and Permitted Motorized Access | C |
| New FS Built Roads | N | | |
| **Lands/Special Uses** | | | |
| Electronic Sites | N | SUP Recreation Equipment Storage/Cache | N |
| Utility Systems | N | Outfitter/Guide Capacity Allocation (%) | NA |
| SUP Destination Lodges | N | Administrative Facilities | C |
| SUP "Hut-to-Hut" Type Recreation Cabins | N | | |

Y - the activity is allowed consistent with the management intent

C - the activity is allowed consistent with the management intent, standards and guidelines

N - the activity is not allowed in the management area

N/A - not applicable

[1] ROS (Recreation Opportunity Spectrum) classes: P - Primitive I and II; SPNM - Semi-primitive Nonmotorized; SPG - Semi-primitive Groups; SPM - Semi-primitive Motorized; RN - Roaded Natural; RM - Roaded Modified; R - Rural

[2] SIO (Scenic Integrity Objective) classes: VH - Very High; H - High; M - Moderate; L - Low; VL - Very Low

## Standards and Guidelines

### Soil/Watershed – Fisheries – Wildlife

| | | |
|---|---|---|
| Standards | 1. | Allow soil/watershed restoration projects and wildlife and fish habitat manipulation for the protection of threatened, endangered or sensitive species or where it is necessary to perpetuate or restore natural conditions for which the RNA was established. |

### Integrated Pest Management

| | | |
|---|---|---|
| Guidelines | 1. | Treatment measures may be taken on exotic plants and animals to minimize their impacts on ecological processes. |

### Fire and Fuels

| | | |
|---|---|---|
| Standards | 1. | Allow natural fires to burn to accomplish the objectives of the specific research natural area. |
| | 2. | Use management prescribed fire as necessary to accomplish RNA objectives. |

### Minerals

| | | |
|---|---|---|
| Guidelines | 1. | RNAs may be withdrawn, subject to the establishment of valid existing rights, from mineral entry for locatable minerals. |
| | 2. | Mineral activities may be limited, modified or restricted to maintain, to the extent possible, the natural values of the area. |

### Recreation

| | | |
|---|---|---|
| Standards | 1. | Allow non-vehicular recreation, except when it interferes with the purpose of the RNA. |

### Access and Transportation

| | | |
|---|---|---|
| Standards | 1. | Prohibit the construction of new trails unless they contribute to the objectives or to the protection of the RNA. |
| Guidelines | 1. | Close or obliterate existing roads, except where they provide necessary access for scientific or educational purposes. |
| | 2. | Existing trails may remain unless they are not consistent with the purpose of the RNA. |
| | 3. | Administrative and non-recreational motorized access (e.g., helicopter landings) may be allowed if such activities do not interfere with the objectives for which the RNA was established. |

**Access and Transportation (Continued)**

Guidelines

4. If no other reasonable access exists, provide such access, including roads for conducting mineral operations under a mining plan of operations. Aircraft access is allowed for minerals exploration and will be coordinated with the responsible line officer to minimize impacts to the natural character of the area.
5. If no other reasonable access exists elsewhere, provide reasonable access to private lands.

**Special Uses (Recreation)**

Standards

1. No competitive group events are allowed.

**Administrative Facilities**

Standards

1. Administrative facilities are not allowed. Temporary facilities may be permitted to support approved research projects.

## FIGURES

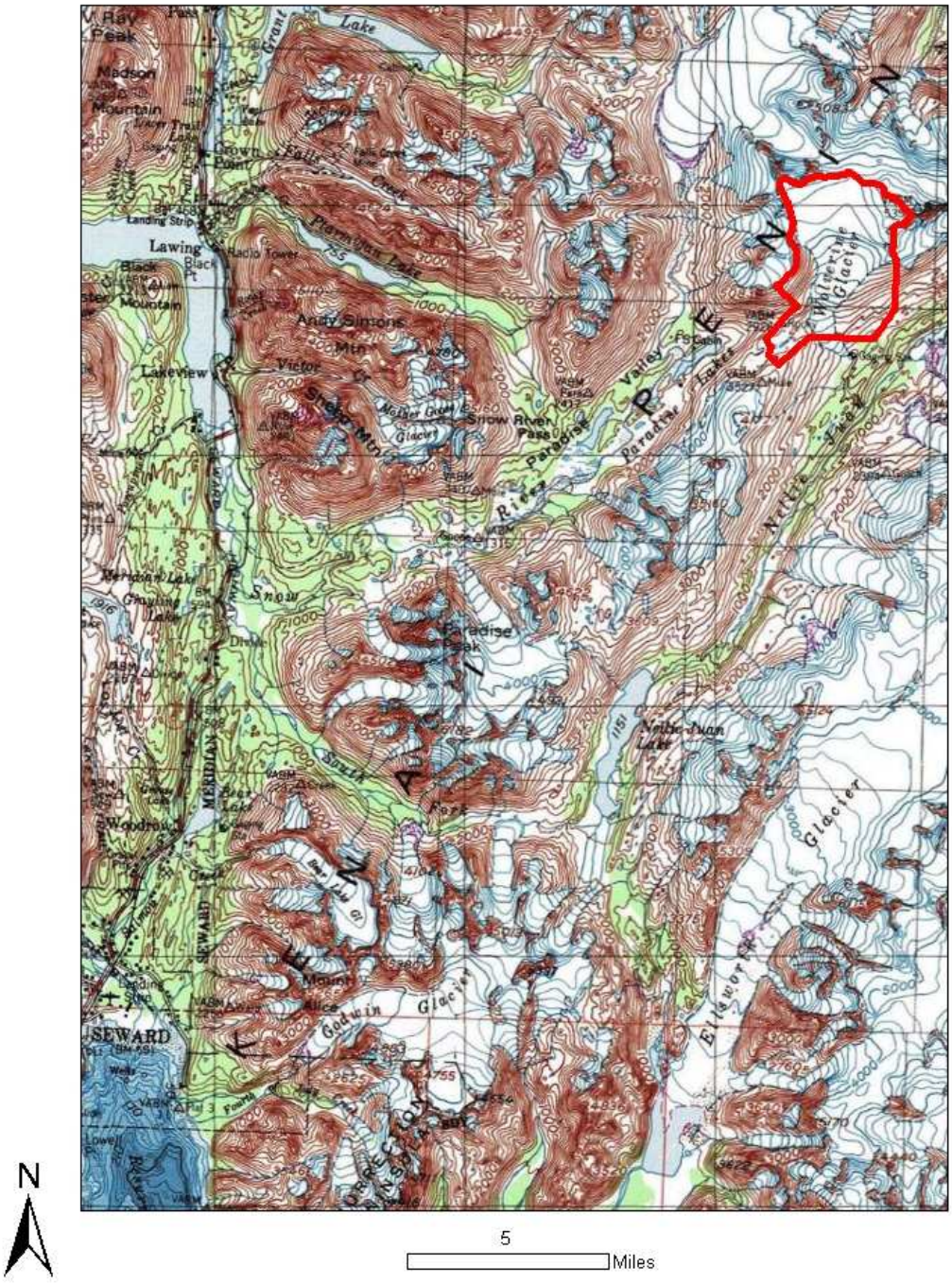


**Figure 1** – Location of Wolverine Glacier RNA northeast of the city of Seward, Alaska.

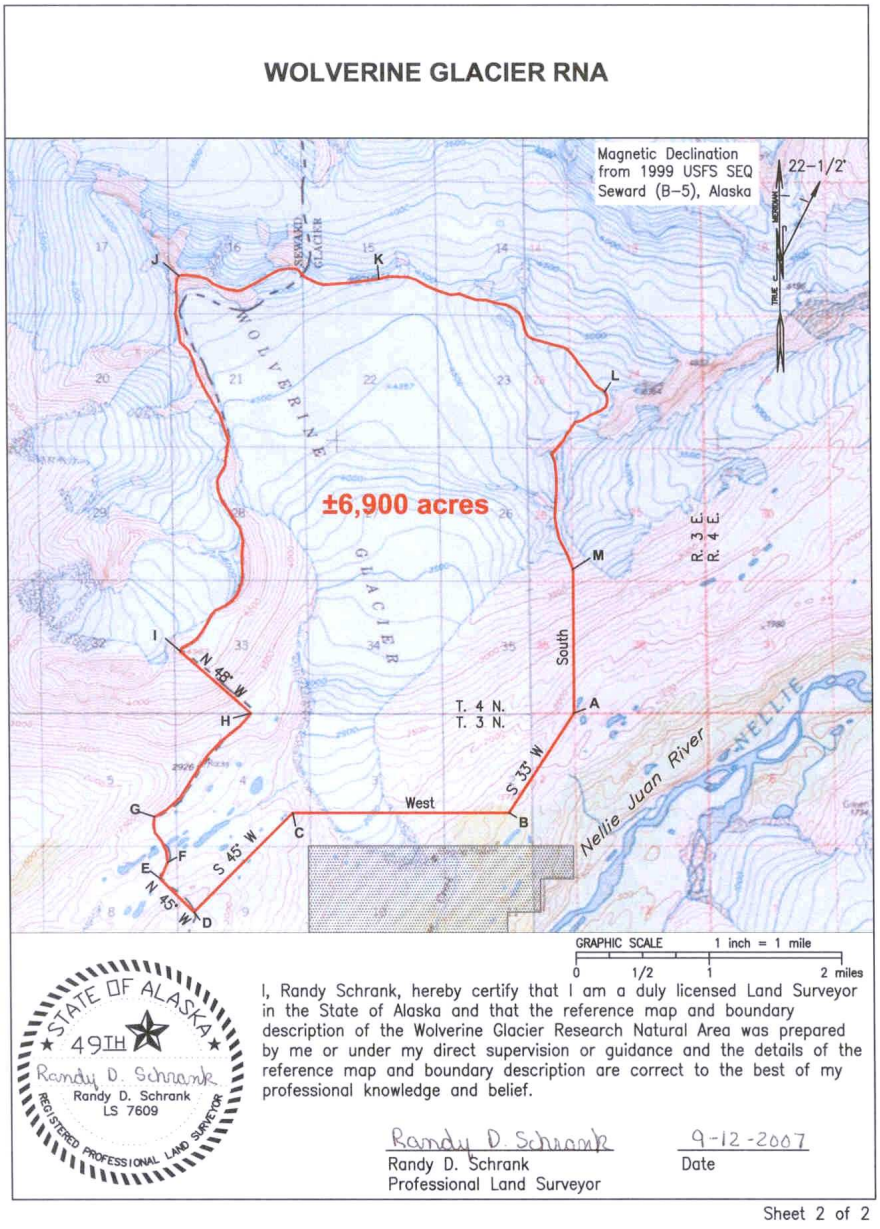


**Figure 2** – Location of Wolverine Glacier RNA within the public land survey system (with certification by licensed land surveyor).

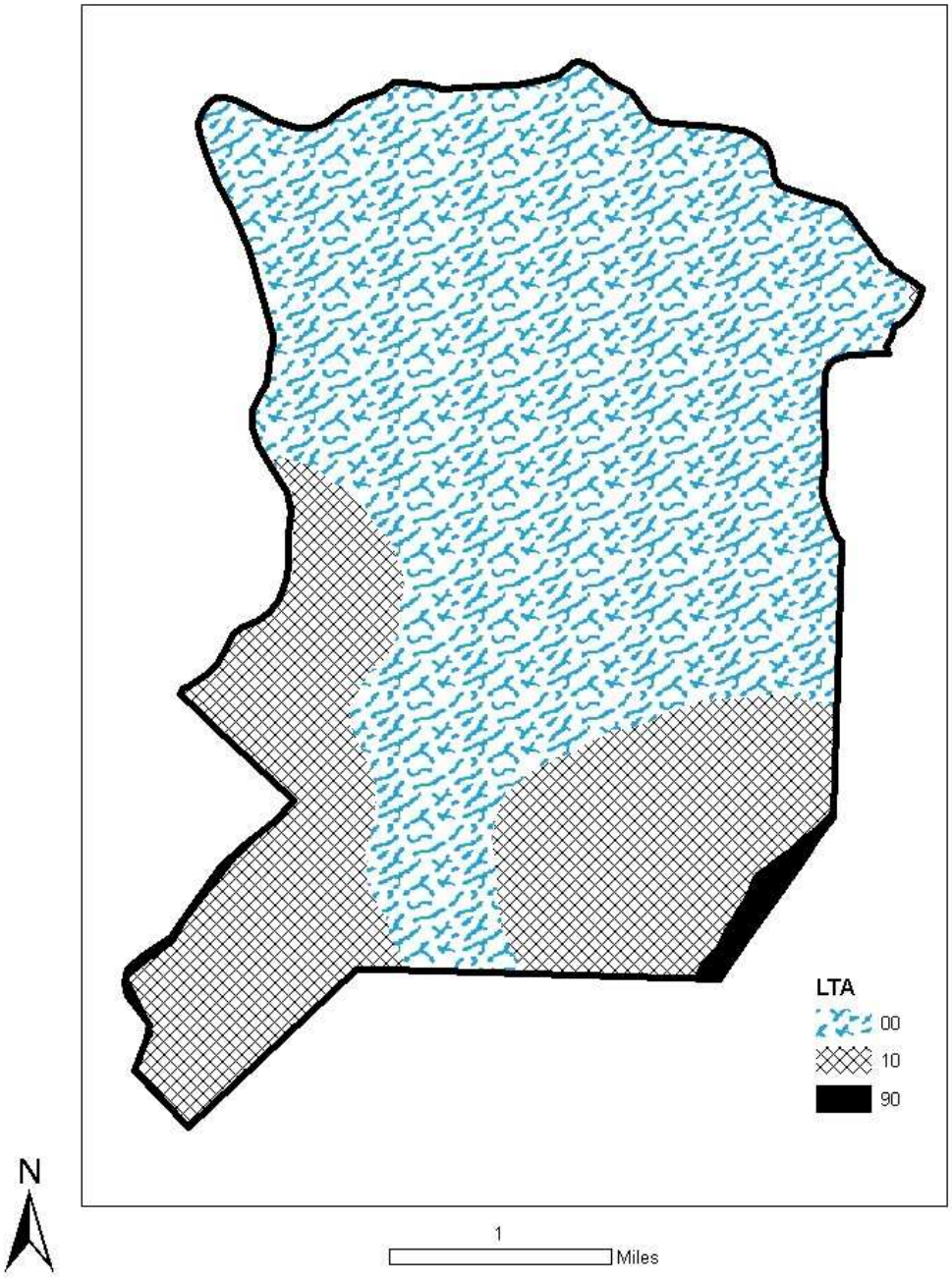


**Figure 3** – Landtype associations and landtypes of Wolverine Glacier RNA[25].

[25] Data from the "Landsystem Types" data theme of the Chugach National Forest GIS. Landtype Association 00 = glaciers (landtype is glacier); 10 = mountain summits (landtype is rugged mountains); and 90 = hills (landtypes are low relief hills and high relief hills).

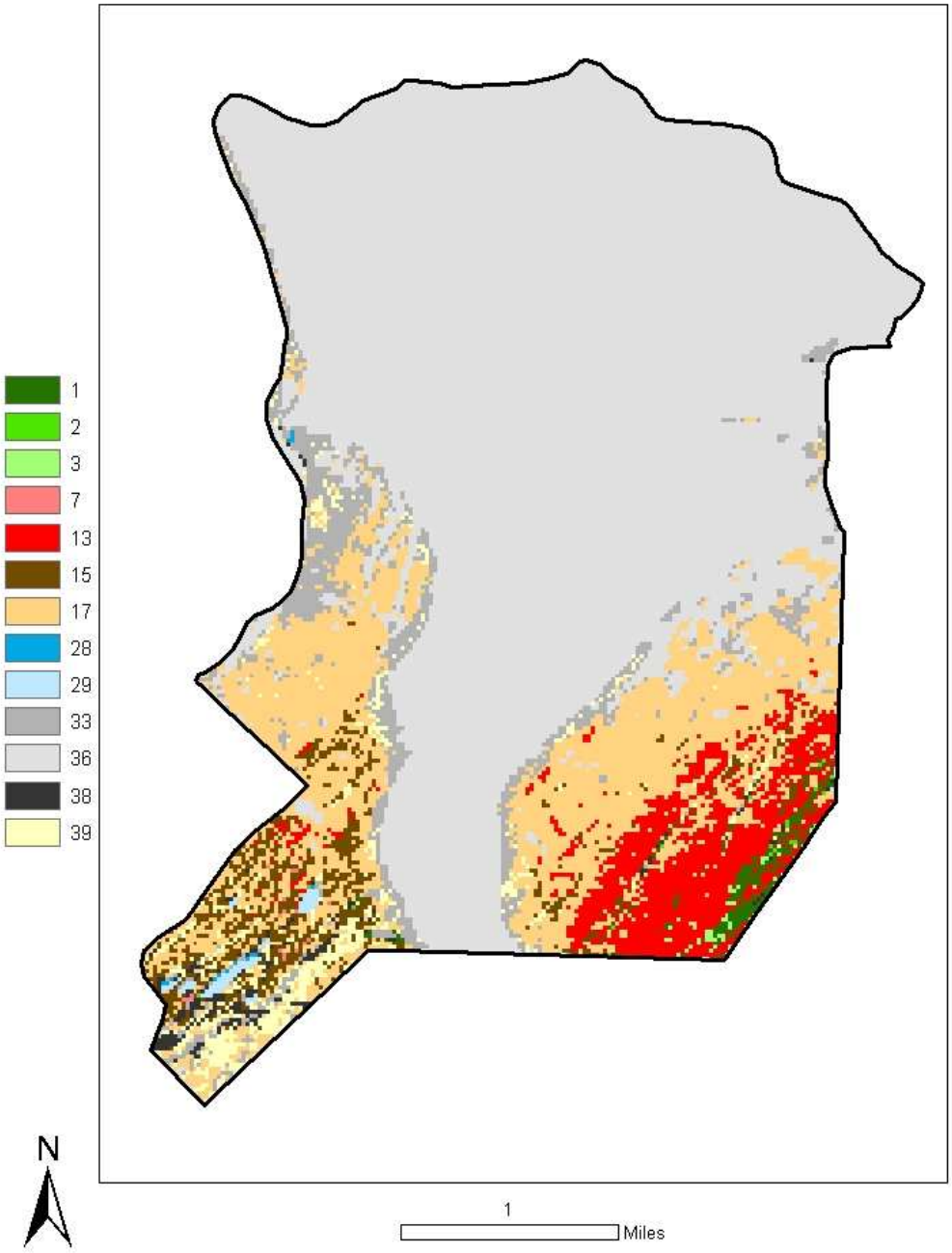


**Figure 4** – Landcover classes of Wolverine Glacier RNA[26]. See Table 3 for the description of cover class values.

[26] Data from the "Land Cover Classification" data theme of the Chugach National Forest GIS.

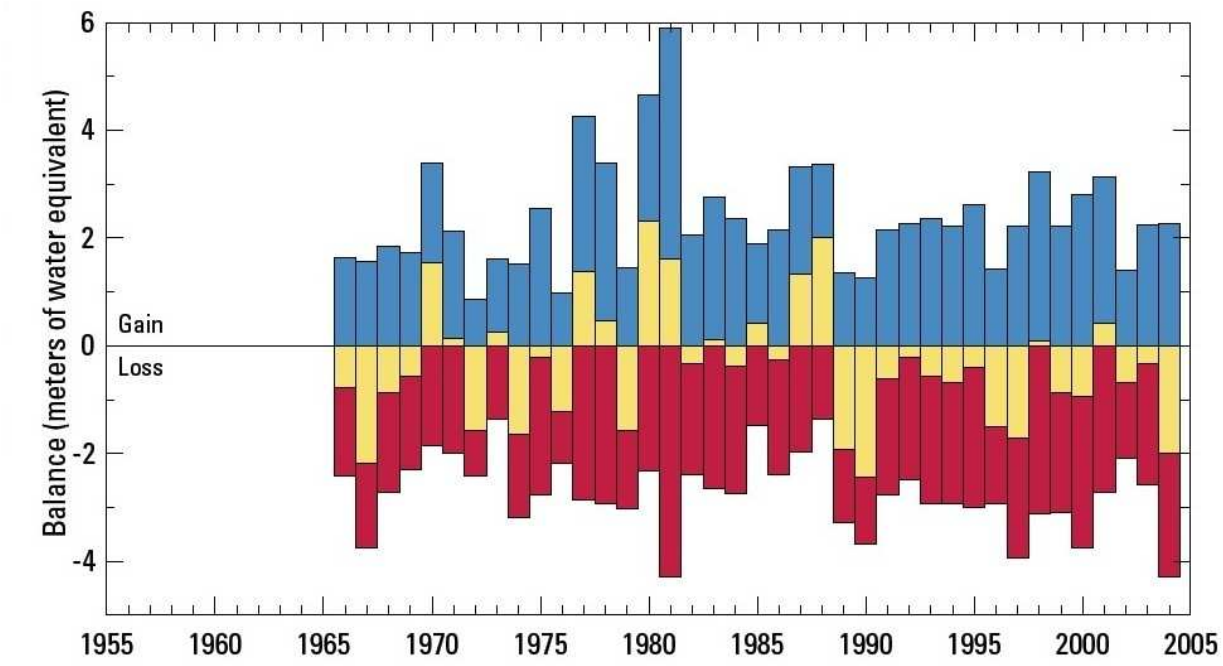


**Figure 5** – Time series water balance for winter (blue), summer (red), and net (yellow) for Wolverine Glacier (from Josberger et al. 2006 using data posted at http://ak.water.usgs.gov/glaciology).

## PHOTOGRAPHS[27]

**Photo 1** – Wolverine Glacier as viewed from the ridge on the western boundary of the RNA.

**Photo 2** – Wolverine Glacier weather station[28] on the ridge along the western boundary of the RNA.

[27] These digital images are all archived with the Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.
[28] Maintained by the U.S. Geological Survey (http://ak.water.usgs.gov/glaciology/Default.htm).

**Photo 3** – Wolverine Glacier research hut[28] above the glacier near the western boundary of the RNA approximately 1,800 feet (550 meters) northeast of weather station.

**Photo 4** – Alpine tundra vegetation and tarns on the ridge separating the Paradise Valley from the Wolverine Glacier RNA (a portion of the glacier is just visible in the distance).