National Park Service - Alaska Region
Inventory & Monitoring Program

ECOLOGICAL SUBSECTIONS OF WRANGELL-ST. ELIAS NATIONAL PARK & PRESERVE

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Introduction

There has been increasing interest in inventory and monitoring of natural resources in National Parks, Monuments, and Preserves in Alaska. However, the choice of where to sample is difficult due to the large area involved. One useful strategy is to stratify sampling by ecosystem regions, to ensure adequate coverage of all ecosystems and economical allocation of the sampling effort. The purpose of this ecological unit map is to aid sampling for inventory and monitoring studies in Wrangell-St. Elias National Park, Alaska (Fig. 1).

The guiding principle in definition of ecosystem regions is that ecosystems consist of the sum of the biotic and abiotic environment, and meaningful boundaries can be drawn that separate zones of relatively uniform ecological conditions (Bailey, 1996; Rowe and Sheard, 1981). Because the various tiers of the ecosystem (geology, landforms, soils, vegetation, etc.) are linked, they tend to change together and can be used in concert to define and map ecosystem regions.

Ecosystem regions (or "ecological units") defined by the above approach can be delineated at various scales, from tiny microsites to global-scale regions. The system of units used here was developed for mapping by the U.S. Forest Service and consists of the numerous levels, intended

for use at different scales (Table 1). As discussed below, the units in the present study are *Subsections*, subdivided further into finer units where possible.

Ecological units delineated at the scale of this study are complex mosaics with many different kinds of vegetation and soils. A particular kind of vegetation or soil may occur in more than one unit; for example, black spruce (*Picea mariana*) woodland on wet soils with permafrost occurs as a component of many of the ecological units recognized here. However, the exact set of components in an ecological unit, their relative area, and their location on the landscape is unique for each unit. In other words, each unit consists of a mosaic of vegetation, landforms, and soils that is consistent and different from all the other units.

Because this map and write-up are based entirely on remotely-sensed data interpreted during the spring and summer of 2001, they should be considered preliminary. Use of the map and its verification by fieldwork should lead to refinement of boundaries, subdivision or amalgamation of units, and more comprehensive map unit descriptions.

Methods

The ecological units were delineated following the basic principles outlined by Bailey (1996) and Wertz and Arnold (1972). Ecological units were recognized by qualitative interpretation and synthesis of the available data for the study area, using the author's knowledge of what is ecologically important. Quantitative methods (e.g., map overlay and statistical analysis) were not used directly to define the ecological units or draw boundaries, although these methods were used to produce descriptive tables for the ecological units. These ecological units are best thought of as hypotheses about what constitutes ecologically significant regions in the study area, hypotheses that can be tested against any data that may be collected there in the future (Rowe and Sheard, 1981).

According to Bailey (1996), ecological units delineated at the scale of the present study (1:250,000) generally coincide with geologic or geomorphologic features. While geologic and geomorphic features typically determine the boundaries between ecological units in this study, the purpose was not to produce a geologic or geomorphologic map. Instead, the scale of these features and their close linkage to biotic features make them the best basis for mapping ecological units.

Ecological units were delineated in ArcView 3.2a (Copyright 1992-2000, Environmental Systems Research Institute, Inc.) using as base maps satellite imagery (Thematic Mapper images 30 June 1986 path 63 row 18, 27 July 1985 path 65 row 17, 7 Aug 1985 path 62 row 18, 30 July 1986 path 65 row 16, and 8 Aug 1995 path 65 row 16) and US Geological Survey Topographic Maps (a digital raster graphic mosaic of 1:250,000 and 1:63,360 scale maps). Satellite images were not available for a portion of the study area (Fig. 2), and thus somewhat less accurate boundary placement can be expected there. The on-screen scale used when locating polygon vertices by clicks with the mouse was about 1:80,000 to 1:100,000, with the purpose to produce boundaries that are accurate and smooth at 1:250,000 scale. Because of the scale of mapping, line placement is accurate to within about 250 m. Users should be careful when enlarging the map to scales larger than it was drawn (i.e. larger than 1:100,000). The two base maps (topographic and satellite image) were alternated frequently to check the location of boundaries against both topography and surface reflectance.

Boundaries were drawn by mentally synthesizing the basemap information with data from the following references:

- High-altitude color-infrared aerial photographs (1:60,000 scale, 1978-1986) viewed in stereo for landforms and vegetation;
- Geologic maps for major bedrock (Miller, 1957; Plafker and Miller, 1957; MacKevett, 1978; Richter, 1976; Beikman, 1980; Winkler and Plafker, 1993) and surficial (Plafker and Miller, 1958; Ferrians, 1965; Nichols and Yehle, 1969; Yehle 1980, 1981) geologic features;
- Soil maps by Clark and Kautz (1990) for part of the Copper River Basin region; and

- Land cover maps from Thematic Mapper satellite imagery classified into 20 vegetation and other land cover classes (the Copper River Land Cover Mapping Project (1984) by the State Of Alaska Department of Natural Resources in cooperation with U.S. Geological Survey, EROS Alaska Field Office; and Alaska Interim Land Cover Mapping Program (1985) by the U.S. Geological Survey).

In response to the needs of the expected users of the maps, ecological units were delineated as finely as the methods would allow. Ecological *Subsections* were delineated and named by conventions outlined in Cleland *et al*. (1997). Most of the subsections could be readily subdivided into more detailed units. However, not all of these more detailed units are fine enough to qualify as the next level down in the National Hierarchical Framework of Ecological Units, the *Landtype Association* (Table 1; Cleland *et al*., 1997). Furthermore, field sampling would be needed to verify the composition of any landtype associations. Thus the finer units are here referred to simply as "detailed ecological units".

Ecologic units that occurred in the National Park were extended beyond the park boundary to their natural limits. Placement of ecologic unit boundaries outside of National Park Service boundaries should be considered tentative.

After ecological unit boundaries were finalized, the ArcView polygon shapefile was converted into an ARC/INFO 8.0.2 coverage. The fields in the polygon attribute table of this coverage are:

AREA polygon area in units of decimal degrees
PERIMETER polygon perimeter decimal degrees
WRST_SUBSEC# ARC/INFO's internal polygon identification number
WRST_SUBSEC-ID user-option polygon identification number
PARK_CODE four-character NPS abbreviation for the park unit or units where the polygon occurs
ECOREGION from an unpublished map by G. Nowacki, P. Spencer, T. Brock, M. Fleming, and M. Torre Jorgenson, 6/2000
SECTION_NA full name for the ecological section
SUBSECT_CO symbol for the ecological subsection
SUBSECT_NA full name of the ecological subsection
DETSUB_CO symbol for detailed ecological unit
DETSUB_NA full name of detailed ecological unit
PHYSIOGRAP physiography (landform) descriptor
LITHOLOGY lithology (rock or sediment) descriptor

Soil and permafrost information is somewhat speculative (outside of the area covered by Clark and Kautz, 1990); it is based on aerial photograph interpretation of vegetation and landforms, and the author's experience in similar regions elsewhere in Alaska (Swanson, 1996a,b). Patterned ground is not visible on the aerial photographs used, but the types most likely to be present are given under "soils" in the ecological unit descriptions. For more information on arctic and subarctic patterned ground, see Washburn (1956, 1979), and Williams and Smith (1989).

The elevations in the map unit descriptions were computed by ArcView overlay of the ecological units onto the 90 m Digital Elevation Model of Alaska. *Elevations and areas of the ecological units were computed only for those portions of the ecological units that occur within the boundaries of Wrangell-St. Elias National Park and Preserve*.

Climatic summaries for stations with long-term records in or near the study area is present in Tables 18-24. These summaries were computed from National Weather Service data by USDA-NRCS in Portland, Oregon.

For locations of the ecological units, see the ARC/INFO coverage that accompanies this report.

Ecological Unit Descriptions – Alaska Range Region

The map legend for ecological units of the Alaska Range Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 2. The criteria used to delineated the subsections

are summarized in Table 10. Mean climatic data for Nabesna, Alaska (near the southeastern limit of this ecoregion, elevation 2900 ft.) are given in Table 20.

JKV Jack Valley Subsection

The undulating forests and wetlands of the Peggy and Karen Moraine compose much of the Jack Creek Valley Subsection.

Detailed ecological units in the Jack Valley Subsection:
JKV1 Chalk Creek Fans - 31 km^2
JKV2 Jack Creek Valley - 35 km^2
JKV3 Peggy and Karen Moraine - 212 km^2

JKV1 Chalk Creek Fans

Geology and Physiography: gently sloping alluvial fans of Chalk, Lost, Trail, and uppermost Platinum Creeks, and the nearly level floodplain of uppermost Platinum Creek.

Elevation: 910 to 1187 m (2986 to 3894 ft)

Soils: Probably stratified sand, gravel, and silt, with little horizon development. Permafrost status is uncertain; probably lacking for the most part except where the surface soil is fine-grained.

Vegetation/land cover: mostly open spruce forest (probably mostly white spruce) with low shrubs. The “dwarf shrubs – sedge bog” shown on the land cover map is doubtful on these well-drained landforms.

Notes:

JKV2 Jack Creek Valley

Geology and Physiography: U-shaped glacial valley between the Boyden Hills and Wrangell Mountaine. Sediments are mostly fan alluvium and colluvium, presumably over glacial till.

Elevation: 808 to 1135 m (2651 to 3724 ft)

Soils: on upper parts of fans, well-drained sandy and gravelly soils with permafrost absent or below 1 m depth. On lower parts of fans, loamy soils with permafrost at <1 m depth and a surface organic layer.

Vegetation/land cover: near active channels of fan streams, dense shrubs. Other dry parts of fans have open spruce forest with low shrubs. Lower, concave parts of fans have black spruce woodland. Flats near Jack Creek have some spruce forest and some wet low shrubs.
Notes:

JKV3 Peggy and Karen Moraine

Geology and Physiography: rounded hills, locally dissected by streams, composed of glacial till, probably in many places quite thin over bedrock.
Elevation: 903 to 1516 m (2963 to 4974 ft)
Soils: probably loamy soils with rocks, with a surface organic layer, and permafrost likely to be present.
Vegetation/land cover: probably black spruce woodland or open forest on higher sites and low shrubs and tussock wetlands in depressions.
Notes:

MES Mentasta Sedimentary Mountains Subsection

The Mentasta Sedimentary Mountains, visible in the background of this photograph, are rugged, sparsely vegetated mountains with little permanent ice and snow due to their interior location and relatively low elevation. Sedimentary rock layering is visible here in the form of light and dark bands. The Jack Valley Subsection (JKV) occupied the flats in the foreground.

Detailed ecological units in the Mentasta Sedimentary Mountains Subsection:
MES1 Mentasta Sedimentary Mountains - 161 km^2

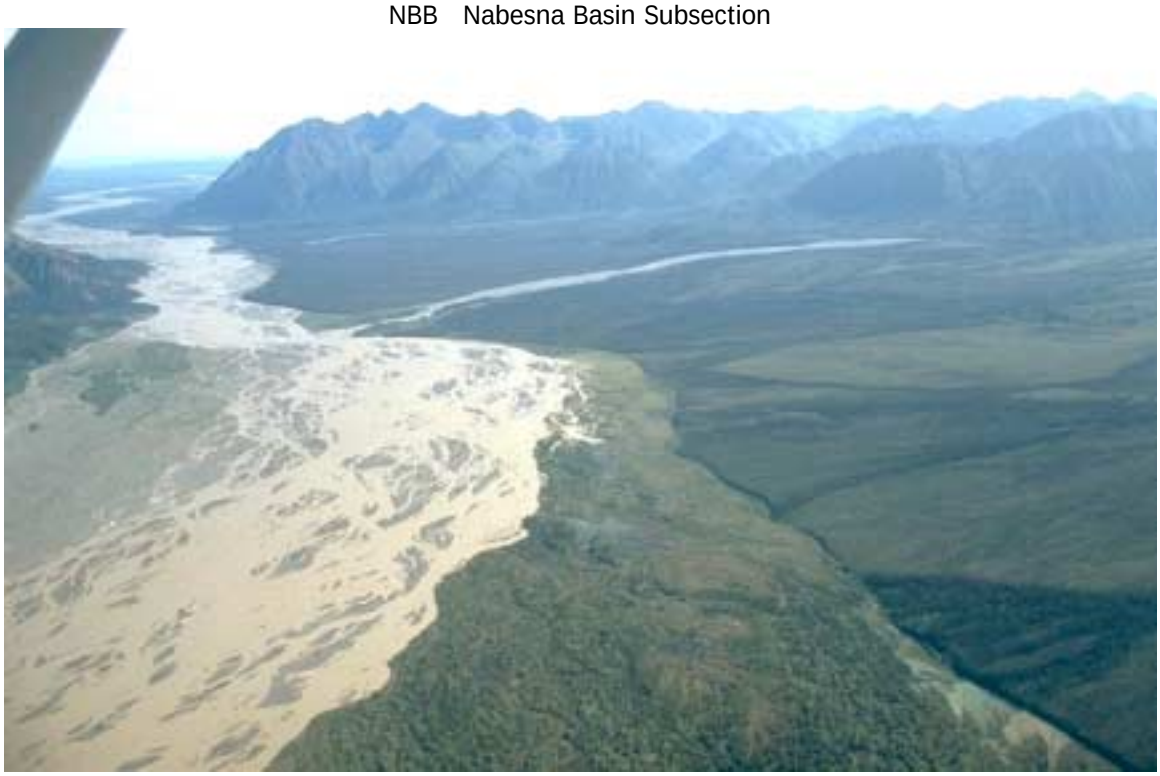
MES1 Mentasta Sedimentary Mountains

Geology and Physiography: rugged mountains composed mostly of argillite, siltstone, and graywacke. The highest parts have cirque glaciers that change downslope into rock glaciers. Lower-elevation cirques have just rock glaciers.
Elevation: 703 to 2498 m (2306 to 8196 ft)
Soils: high elevations have mostly bare rock, rock rubble, snow and ice without soil, except locally on stable sites, where coarse-loamy soils with numerous rocks and little horizon development occur. Permafrost is probably present but below 1 m depth. Lower slopes probably have well-drained, loamy soils with rocks and little horizonation. Permafrost here may in places be above 1 m depth.

Vegetation/land cover: high elevations are mostly bare rock, rock rubble, snow and ice, with dwarf shrub and dry herbaceous tundra on stable soils. Lower slopes have deciduous shrubs, locally with scattered white spruce trees.

Notes: for general information on rock glaciers, see Wahrhaftig and Cox (1959).

NBB Nabesna Basin Subsection



The Nabesna Basin is surrounded by rugged mountains in the northern part of Wrangell-St. Elias National Park and Preserve. The Nabesna River runs across the left side of this photograph and out into the Yukon-Kuskokwim Lowland in the left background. Its large braided river floodplain has both unvegetated gravel bars and, in the center foreground, less frequently flooded areas with shrubs and balsam poplar trees. Fans and terraces formed by smaller streams, visible on the right back to the mountains, are another important component of the Nabesna Basin Subsection.

Detailed ecological units in the Nabesna Basin Subsection:
NBB1 Nabesna Basin Fans and Terraces - 78 km^2
NBB2 Nabesna Basin Moraines - 119 km^2
NBB3 Nabesna Basin Scoured Hills - 58 km^2
NBB4 Upper Nabesna River Floodplain - 100 km^2

NBB1 Nabesna Basin Fans and Terraces

Geology and Physiography: alluvial fans from tributaries of the Nabesna River, and nearly level alluvial terraces from the Nabesna River, now above the reach of flood waters. Composed mostly of sand and gravel, probably with a cap of silt and sand in places.

Elevation: 665 to 1187 m (2182 to 3894 ft)

Soils: mostly dry, stratified sand and gravel with little horizon development and no permafrost. Under white spruce forest there is probably a surface organic layer and thin surface cap of sand and silt. Under black spruce woodland there is probably a thick cap of silt, sand, and volcanic ash, a thick (>10 cm) organic surface layer, and permafrost within 1 m of the surface.

Vegetation/land cover: highly variable depending on disturbance and succession. Active channels are unvegetated or sparsely vegetated with shrubs and herbs (especially along Bond Creek). Less disturbed surfaces have deciduous shrubs, balsam poplar scrub or forest, and white spruce forest. Some late-successional areas have black spruce woodland (especially west of Copper Creek).

Notes:

NBB2 Nabesna Basin Moraines

Geology and Physiography: mostly rounded low hills with some short, steep slopes, composed of Pleistocene glacial till, presumably coarse-grained but covered with some loess and volcanic ash. Some kettle ponds and small lakes.

Elevation: 711 to 1221 m (2333 to 4006 ft)

Soils: in low areas, wet soils with permafrost at about 0.5 m depth and a thick (> 20 cm) organic surface layer. Soils are drier and permafrost deeper as one moves upslope. Permafrost is probably absent on hill crests and steep, south-facing slopes.

Vegetation/land cover: low areas are mostly dwarf shrub-sedge wetland or black spruce woodland. Better-drained hillslopes and crests have open forest or woodland of black or white spruce; shrubs, aspen, or birch forest on burns. A few steep south-facing slopes have dry herbaceous vegetation.

Notes: for information on soils and fire effects on landscapes such as this, see Viereck (1973, 1983) and Swanson (1996b).

NBB3 Nabesna Basin Scoured Hills

Geology and Physiography: low hills that were overridden by Pleistocene glaciers. Probably bedrock and patches of thin glacial till over bedrock. Irregular topography.

Elevation: 767 to 1342 m (2516 to 4403 ft)

Soils: in low areas, wet soils with permafrost at about 0.5 m depth and a thick (> 20 cm) organic surface layer. Soils are drier and permafrost deeper as one moves upslope. Permafrost is probably absent on hilltops and steep, south-facing slopes.

Vegetation/land cover: low areas are mostly dwarf shrub-sedge wetland or black spruce woodland. Better-drained hillslopes and crests have open forest or woodland of black or white spruce, with shrubs, aspen, or birch forest on burns. A few steep south-facing slopes have dry herbaceous vegetation.

Notes:

NBB4 Upper Nabesna River Floodplain

Geology and Physiography: floodplain of a braided glacial river. Mostly active gravel bars but includes some less frequently flooded areas that are still susceptible to flooding and erosion by river channel migration. Includes the Jacksina Creek floodplain, a braided tributary stream.

Elevation: 652 to 962 m (2139 to 3156 ft)

Soils: dry soils composed of stratified sand and gravel, with little horizon development and lacking permafrost.

Vegetation/land cover: mostly unvegetated sand and gravel bars and water. Some areas of shrubs and balsam poplar. In the upper part, some small areas have open white spruce forest.

Notes:

SMM Southern Mentasta Mountains Subsection

The Southern Mentasta Mountains, visible on the right side of this photograph, are relatively low mountains composed of a variety of rock types. They have mostly bare rock or alpine vegetation, but little permanent snow or ice due to their relatively low elevation and dry, interior climate.

Detailed ecological units in the Southern Mentasta Mountains Subsection:
SMM1 Boyden Hills - 148 km^2
SMM2 Suslota Hills - 102 km^2

SMM1 Boyden Hills

Geology and Physiography: low mountains with some steep scree slopes but generally rounded ridgetops. Composed of andesitic volcanic and volcaniclastic rocks, basalt, limestone, and diorite. Lower parts were covered by glaciers from the Wrangell Mountains to the south during the Pleistocene.

Elevation: 786 to 2197 m (2579 to 7208 ft)

Soils: mostly coarse loamy soils with rocks. Permafrost is probably present but below 1 m depth in most places. Some organic horizon development is likely under the densest vegetation. Sorted circles, nets, and stripes are probably common at high elevations.

Vegetation/land cover: high elevations are mostly dwarf shrubs and dry herbaceous vegetation, or sparse vegetation of these plants with rock rubble. At lower elevations shrubs are denser and taller. Open spruce forest or woodland occurs at the lowest elevations, mainly along Platinum Creek.

Notes: Soda Lake in the north part of this unit is formed by a landslide that dams Soda Creek.

SMM2 Suslota Hills

Geology and Physiography: hills and low mountains composed of andesitic volcanic and volcaniclastic rocks, basalt, limestone, and schist. Higher elevations have a few rock glaciers in cirques.

Elevation: 842 to 2254 m (2762 to 7395 ft)

Soils: at high elevations mostly rock and rock rubble without soil or weakly developed rocky soils, with permafrost probably present but below 1 m depth. At lower elevations under shrubs, there is probably an organic horizon over coarse-loamy material with rocks. Permafrost here is probably absent on south-facing slopes, and present but below 1 m depth

on other sites, except some gentler footslopes where it is probably within 1 m and soil are wetter.

Vegetation/land cover: higher elevations are mostly bare rock, rock rubble, and sparse vegetation of dwarf shrubs and herbs. Shrubs increase in height and density at lower elevations. Some slopes (mostly south-facing) have open white spruce over deciduous shrubs, though air photos suggest less forest than shown on the land cover map. There appears to be a little dry herbaceous vegetation on a south-facing slope at low elevation in the far west.

Notes:

Ecological Unit Descriptions – Chugach-St. Elias Region

The map legend for ecological units of the Chugach-St. Elias Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 3. The criteria used to delineated the subsections are summarized in Table 11.

BAI Bagley-Seward Icefield Subsection

The Bagley-Seward Icefield subsection. This large, gently sloping glacier fills deep valleys near the crest of the Chugach Mountains. Mountains surrounded by glacial ice (nunataks) are visible in the background.

Detailed ecological units in the Bagley-Seward Icefield Subsection:
BAI1 Bagley Nunataks - 227 km^2
BAI2 Bagley-Seward Icefield - 2154 km^2

BAI1 Bagley Nunataks

Geology and Physiography: rugged mountains surrounded by the Bagley Icefield and Jeffries Glacier. Composed of fine-grained clastic sedimentary rocks and mafic volcanic rocks.

Elevation: 975 to 2874 m (3199 to 9429 ft)

Soils: mostly bare rock, scree, or rock rubble without soil, probably with some small pockets of loamy soil with rocks in small crevices. More soil cover in the far west; soils there are probably mostly coarse-grained and dry with little horizonation.

Vegetation/land cover: mostly unvegetated rock, scree, snow, and ice, probably with crustose lichens on rocks and scattered vascular plants on small patches of stabilized soil. In the far western part, especially on "Juniper Island", gentler slopes are covered with tundra vegetation, probably dry herbaceous vegetation, fruticose lichens, and low shrubs.

Notes: this unit was delineated to encompass all the rock exposed, and also includes considerable high-angle ice and snow. To reach most portions of this unit an organism would be forced to cross at least 2 km of glacier. The westernmost nunataks are considerably lower in elevation (4000-5000 ft) than those in the east (6,000 to 9,000 ft.), hence there is more vegetation in the east. The western nunataks are also adjoined by several ponds with ice forming one shore and the nunatak forming the other.

BAI2 Bagley-Seward Icefield

Geology and Physiography: relatively gently sloping glacier, with little exposed rock.
Elevation: 911 to 2696 m (2989 to 8845 ft)
Soils: none
Vegetation/land cover: mostly snow, with glacial ice exposed in lower elevations at the end of summer
Notes:

BRV Bremner Valley Subsection

Detailed ecological units in the Bremner Valley Subsection:
BRV1 Bremner River and Active Floodplain - 46 km^2
BRV2 Bremner River Vegetated Floodplain - 35 km^2
BRV3 Bremner Valley Glaciated Slopes - 279 km^2

BRV1 Bremner River and Active Floodplain

Geology and Physiography: floodplain of a braided river. Includes a few vegetated islands, each with a pond in the center.
Elevation: 35 to 262 m (115 to 860 ft)
Soils: mostly sand and gravel with no soil development. On vegetated islands soils are probably stratified sand and gravel with weak A horizons.
Vegetation/land cover: mostly water and unvegetated sand and gravel. The vegetated islands appear to have mostly dense willow and alders.
Notes: the ponds in the vegetated islands have clear water, indicating their source is groundwater from the riverbed. It is unclear how these islands formed and how they are protected from erosion by the river.

BRV2 Bremner River Vegetated Floodplain

Geology and Physiography: nearly level plain composed of coarse-grained alluvium, probably with a silty surface layer, with numerous ponds and one sizeable lake. Groundwater table appears to be near the surface in most places, and flooding appears to be infrequent.
Elevation: 76 to 268 m (249 to 879 ft)
Soils: probably wet soils composed of stratified sand, gravel, and silt. Locally there may be substantial surface organic layer.
Vegetation/land cover: probably mostly dense alder and willows, with wet herbaceous or emergent vegetation in depressions.
Notes: water in ponds and lakes is not turbid, suggesting its source is groundwater discharge or runoff from adjacent uplands.

BRV3 Bremner Valley Glaciated Slopes

Geology and Physiography: broad valley composed of glacially scoured bedrock (mostly metagraywacke and argillite), probably with a patchy thin mantle of glacial till. Local topography consists of numerous narrow east-west trending ridges with short, steep slopes formed by bedrock with varying degrees of resistance to glacial erosion.
Elevation: 77 to 680 m (253 to 2231 ft)

Soils: probably thin, dry, loamy soils with numerous stones, over bedrock. Distinct horizons due to podzolization are likely. Clefts between the bedrock ridges probably have wet, stoney ,loamy soils.

Vegetation/land cover: probably mostly open white spruce forest (possibly with some paper birch) with alder and willow understory. Tree overstory often lacking in the narrow clefts between bedrock ridges.

Notes:

BSG Bering and Stellar Glaciers Subsection

Detailed ecological units in the Bering and Stellar Glaciers Subsection:
BSG1 Upper Bering Glacier - 1 km^2 (in Wrangell-Stl Elias NPP)

BSG1 Upper Bering Glacier

Geology and Physiography: very large valley glacier fed by the Bagley Ice Field and several other, smaller tributary glaciers in the Chugach Mountains. Mapped here down to the firn line.

Elevation: 465 to 1485 m (1526 to 4872 ft)

Soils: none

Vegetation/land cover: mostly snow over glacial ice. Some supraglacial rock debris is present near adjacent mountain sides, but becomes covered by snow and ice as it moves down-glacier.

Notes:

CBM Churchill-Bona Massif Subsection

Detailed ecological units in the Churchill-Bona Massif Subsection:
CBM1 Churchill-Bona Massif - 1007 km^2
CBM2 Russell Glacier - 142 km^2

CBM1 Churchill-Bona Massif

Geology and Physiography: high volcanoes, largely covered by glaciers. Lava is mostly andesitic.

Elevation: 1225 to 5019 m (4019 to 16467 ft)

Soils: mostly rock or rubble without soil. At low elevations in the far west there are local patches of soil, probably rather dry, weakly developed, coarse-grained soils with permafrost below 1 m depth.

Vegetation/land cover: mostly bare rock, talus, scree, snow and ice. At low elevations in the far western part there are a few patches of dwarf shrubs and dry herbaceous vegetation.

Notes: Mount Churchill is the source of the White River volcanic ash deposit. Ash from two major eruptions, about 1250 and 1900 years ago, was carried north and east from Mt. Churchill and is up to 1 m thick in the White River Basin just to the north and up to 0.6 m thick along the Alaska Highway (Lerbekmo and Campbell, 1969; Richter et al., 1995)

CBM2 Russell Glacier

Geology and Physiography: large valley glacier flowing north out of the St. Elias Mountains. This unit includes parts of glacier below the firn line, where ice and rock rubbles are exposed by melting in the summer. Glaciers consist of clean ice with medial moraines (debris bands) in the upper part, with progressively more surface rubble at lower elevations, becoming ice-cored rubble near the glacial terminus.

Elevation: 1234 to 2256 m (4049 to 7402 ft)

Soils: mostly glacial ice or rock rubble without soil; near the glacier's terminus some rock rubble with loamy matrix is incipient soil.

Vegetation/land cover: mostly ice and rock rubble. A few herbaceous plants and shrubs have probably colonized the superglacial rubble at low elevations.
Notes: The source areas for this glacier is mainly in the Churchill-Bona Massif unit.

CHM Chitina Moraines Subsection

Detailed ecological units in the Chitina Moraines Subsection:
CHM1 Barnard Deglaciated Zone - 10 km^2
CHM2 Chitina Moraines - 64 km^2

CHM1 Barnard Deglaciated Zone

Geology and Physiography: regions just beyond the current terminus of the Barnard Glacier, consisting of freshly scoured bedrock, fresh moraine, lakes, and braided stream deposits.
Elevation: 514 to 679 m (1686 to 2228 ft)
Soils: loamy or sandy soils with many coarse fragments, good drainage, and little or no profile development.
Vegetation/land cover: mostly sparsely vegetated or unvegetated on 1978 aerial photographs, but probably being rapidly colonized by shrubs and herbaceous vegetation.
Notes:

CHM2 Chitina Moraines

Geology and Physiography: hummocky topography with numerous small lakes, composed of ice-stagnation moraine, probably coarse-grained. Includes some alluvial fans from adjacent mountains with similar vegetation and soils, and some glacially streamlined bedrock with thin glacial till cover.
Elevation: 421 to 916 m (1381 to 3005 ft)
Soils: probably loamy soils with coarse fragments, fairly well drained, with a surface organic layer. Permafrost status uncertain, most likely to be present in depressions.
Vegetation/land cover: mostly closed white spruce forest. May be some open black spruce forest in depressions.
Notes:

CLG Chitina and Logan Glaciers Subsection

The lower (western) end of the Chitina and Logan glaciers is a large area of debris-covered stagnant ice. Topography is irregular, with many ponds, and some parts of the debris over the ice have been colonized by vegetation. In the background are the University-Centennial Mountains (UNM) on the left, the Mount Logan Massif (LML), white-topped in the distant center, and the Northern Chugach Cirque-Glacier Mountains (NCC) on the right.

Detailed ecological units in the Chitina and Logan Glaciers Subsection:
CLG1 Chitina Glacier - 168 km^2
CLG2 Chitina-Logan Glacier Vegetated Moraine - 25 km^2
CLG3 Logan Glacier - 80 km^2
CLG4 Walsh Glacier - 68 km^2

CLG1 Chitina Glacier

Geology and Physiography: a long, mostly debris-covered glacier with its source in the St. Elias Mountains. Most of this glacier has a pitted surface due to stagnant wastage of ice.
Elevation: 623 to 2009 m (2044 to 6591 ft)
Soils: mostly rock rubble and ice with no soil.
Vegetation/land cover: mostly rock rubble, with some ice and water. Probably some sparse shrubs and herbs on rubble at low elevations.
Notes: for information on stagnant glaciers, see Clayton (1964).

CLG2 Chitina-Logan Glacier Vegetated moraine

Geology and Physiography: moraines that are continuous with debris-covered ice but have substantial vegetation cover; probably still ice-cored at least in part. Moraine is probably mostly rock rubble with few fines. Numerous small ponds are present.
Elevation: 625 to 983 m (2051 to 3225 ft)
Soils: probably rock rubble with a loamy matrix, with little soil development beyond weak A horizon formation.
Vegetation/land cover: probably deciduous shrubs, with open white spruce forest in the far west.
Notes:

CLG3 Logan Glacier

Geology and Physiography: a long, partially debris-covered glacier with its source in the Chugach and St. Elias Mountains. The southern part of this east-west trending glacier (the left side when facing downstream; that part fed mainly by the Ogilvie Glacier) has a pitted surface due to wastage of stagnant ice. The northern half (right side when facing downstream) has large medial moraines but appears active. This unit extend approximately up to the firn line on the glaciers.

Elevation: 758 to 1590 m (2487 to 5217 ft)

Soils: mostly rock rubble and ice with no soil.

Vegetation/land cover: mostly rock rubble and ice, with some water in ponds. Probably some sparse shrubs and herbs on rubble at low elevations.

Notes: for information on stagnant glaciers, see Clayton (1964).

CLG4 Walsh Glacier

Geology and Physiography: valley glacier originating in the St. Elias Mountains, largely covered with rock debris in the US part. Glacier appears stagnant, with numerous superglacial ponds.

Elevation: 831 to 1465 m (2726 to 4806 ft)

Soils: most rock rubble and ice without soil.

Vegetation/land cover: mostly rock rubble and ice. The US part is almost all debris-covered. Some plants (probably deciduous shrubs and some herbs) have colonized the surface debris on the northeastern-most edge.

Notes: for information on stagnant glaciers, see Clayton (1964). The Walsh Glacier advanced over the Logan Glacier around 1960 (Paige, 1965).

CRC Copper River Canyon Subsection

The Copper River cuts through the Chugach Mountains in the Copper River Canyon Subsection. Most of it is occupied by the active floodplain with its unvegetated gravel bars and turbid river water. An area of vegetated floodplain is visible on the flats to the right.

Detailed ecological units in the Copper River Canyon Subsection:
CRC1 Copper River and Active Floodplain - 51 km^2
CRC2 Copper River Canyon Glaciated Slopes - 28 km^2
CRC3 Copper River Vegetated Floodplain - 9 km^2

CRC1 Copper River and Active Floodplain

Geology and Physiography: active floodplain of a braided river, and open river water.
Elevation: 31 to 182 m (102 to 597 ft)
Soils: mostly water or active gravel bars without soil. Less disturbed parts with sparse vegetation have sandy and gravelly soils with little or no horizonation.
Vegetation/land cover: mostly water and unvegetated sand and gravel. Probably sparse shrubs and herbaceous vegetation in a small areas with less disturbance. Includes a few vegetated island with dense alder and willows.
Notes: this floodplain broadens considerably for about 15 km above the Allen Glacier, probably due to the damming effect of the glacier and its moraines.

CRC2 Copper River Canyon Glaciated Slopes

Geology and Physiography: slopes composed of glacially scoured bedrock (mostly metagraywacke and argillite), probably with a patchy mantle of glacial till. Local topography consists of northeast-southwest trending low ridges formed by bedrock with varying degrees of resistance to glacial erosion. Includes some alluvial fans from adjacent mountain streams, and some small lakes near the Copper River floodplain with till and/or bedrock banks.
Elevation: 116 to 412 m (381 to 1352 ft)
Soils: probably thin, dry, loamy soils with numerous stones over bedrock. Distinct horizons due to podzolization are possible. Clefts between the bedrock ridges probably have wetter, stoney loamy soils.
Vegetation/land cover: probably mostly white spruce woodland (possibly with some paper birch) with alder and willow understory. Tree overstory lacking in many areas.
Notes:

CRC3 Copper River Vegetated Floodplain

Geology and Physiography: braided river floodplain, probably composed sandy and gravelly alluvium. The portion of this unit that occurs in the study area is vegetated because it is partially protected from erosion by a bedrock ridge ("The Peninsula").

Elevation: 72 to 160 m (236 to 525 ft)

Soils: probably mostly dry soils composed of stratified sand, gravel, and a little silt. Little horizon development except for thin A horizons. Similar but wetter soils in wet meadow areas.

Vegetation/land cover: probably willows, alder, and cottonwood. Some patches of wet herbaceous and shrubby vegetation.

Notes:

IBF Icy Bay Foothills Subsection

Detailed ecological units in the Icy Bay Foothills Subsection:
IBF1 Icy Bay Foothills - 311 km^2

IBF1 Icy Bay Foothills

Geology and Physiography: rugged low mountains, with some moraines at low elevations. Includes some recently deglaciated, glacially scoured bedrock near Tsaa Fiord. Composed of Tertiary clastic sedimentary rocks.

Elevation: 0 to 1242 m (0 to 4075 ft)

Soils: probably coarse-grained, well-drained soils with weak horizonation other than accumulation of organic matter near the surface.

Vegetation/land cover: at high elevations, sparse vegetation with exposed rock , scree, and snow. Shrub tundra at higher elevations grades downslope to tall shrubs. Few spruce trees are present, mainly in the far southeast. Recently deglaciated bedrock areas are largely barren but probably being colonized by herbs and shrubs.

Notes: the bedrock and topography of this unit resembles the Robinson Mountain Foothills, but it is mapped separately here because of its isolated occurrence in Icy Bay and lack of spruce forest at low elevations. The absence of spruce forest here is probably due to lack of a seed source. For information on plant succession and soil formation in recently deglaciated regions of southeast Alaska similar to parts of this unit see Crocker and Major (1955), Crocker and Dickson (1957), Mirsky (1966), James (1988), Chapin *et al*. (1994), and Fastie (1995).

IRG Icefield Ranges and Glaciers Subsection

Detailed ecological units in the Icefield Ranges and Glaciers Subsection:
IRG1 Icefield Ranges - 161 km^2
IRG2 Icefield Ranges Glaciers - 164 km^2

IRG1 Icefield Ranges

Geology and Physiography: rugged high mountains, nearly engulfed in glacial ice. This unit occurs mostly in Canada. Bedrock lithology is unknown.

Elevation: 1184 to 4436 m (3885 to 14554 ft)

Soils: none

Vegetation/land cover: snow over glacial ice, exposed bedrock, and rock rubble.

Notes: this unit includes mountains north of the crest of the St. Elias Mountains; elevations are a bit lower and ice cover more complete than in the St. Elias Crest unit. The northern and eastern boundaries of this unit is at the firn line on glaciers and the analogous level on rock, above which all gentle slopes are snow-covered and little or no vegetation is present.

IRG2 Icefield Ranges Glaciers

Geology and Physiography: glaciers filling valleys between peaks of the Icefield Ranges in the St. Elias mountains. Includes the Hubbard, Lowell, and Tweedsmith Glaciers in the United States.

Elevation: 1140 to 2077 m (3740 to 6814 ft)

Soils: none

Vegetation/land cover: permanent snow and ice.

Notes: this unit ranges extensively into Canada, and the delineation mapped here is truncated artificially in Canada. The lower elevation limit of this unit is the firn line.

MAG Malaspina Glacier Subsection

The Malaspina Glacier is a very large, gently sloping sheet of ice on the coastal plain near the Gulf of Alaska. It is fed by glaciers from the St. Elias Mountains in the background of this photograph. The white, flat area in the left center of the photograph is a part of the Malaspina Glacier located near these feeder glaciers where the ice is fairly free of surface debris. Beyond this area and closer to the camera are gray, contorted bands of supraglacial debris over ice. The margins of the glacier are completely covered by debris. On the margin of the glacier near the camera is Malaspina Lake, a highly changeable water body that lies between the glacier and slightly higher land to the south near the oean. Debris over ice has become vegetated in a broad band around most of the margin of the glacier; a bit of this is visible in the foreground where not flooded by Malaspina Lake.

Detailed ecological units in the Malaspina Glacier Subsection:
MAG1 Malaspina Glacier - 1845 km^2
MAG2 Malaspina Vegetated Supraglacial Moraine - 452 km^2

MAG1 Malaspina Glacier

Geology and Physiography: gently sloping fan-shaped glacier, largely covered with debris in its distal (outer) parts. This is a classic piedmont glacier, where a valley glacier descends out of

the mountains and spreads out on a plain. The glacier is mapped here approximately up to the firn line after Plafker and Miller (1958) and more recent satellite images.

Elevation: 10 to 977 m (33 to 3205 ft)

Soils: none

Vegetation/land cover: mostly glacial ice and unvegetated surpaglacial debris. Scattered plants are colonizing the supraglacial debris in more stable areas.

Notes: the Malaspina Glacier has received a lot of attention from researchers because it is probably the best place on earth today to observe a large stagnant glacier wasting away on nearly level topography. This phenomenon is of special interest because the glacial deposits that cover large areas of northern North America and Europe were probably deposited by similar stagnant glaciers. Some good source of information to this work, with references to numerous other studies, are Plafker and Miller (1958), Sharp (1958), and Gustavson and Boothroyd (1987). The glacier is so thick that much of its bed is below sea level.

MAG2 Malaspina Vegetated Supraglacial Moraine

Geology and Physiography: hummocky coarse-grained glacial till, probably underlain by stagnant glacial ice in most areas. Contains many kettle ponds formed by thaw of the underlying ice. Includes Malaspina Lake, which lies between the glacier and slightly higher land to the south. This lake expanded greatly between the date of Plafker and Miller's (1958) map and the c. 1980 imagery used in this study. This unit includes a similar region adjacent to the Malaspina Glacier that is actually fed by the Lucia and Atrevida Glaciers.

Elevation: 0 to 496 m (0 to 1627 ft)

Soils: probably coarse-grained soils with little horizon development beyond organic-matter accumulation in the upper part.

Vegetation/land cover: mostly deciduous shrubs, with some sparsely vegetated areas (especially in the upper, more northerly part) and spruce forest (along the lower, southerly part).

Notes: for more information on the Malaspina Glacier, see the Malaspina Glacier detailed ecological unit above.

MBM Mt. Bear Massif Subsection

The Barnard Glacier flows out of the high, rugged mountains of the Mt. Bear Massif. The rock composing the dark stripes fell on the margins of tributary glaciers, and then ended up in the middle of the glacier after the tributaries merged. The bedrock here is mostly marble.

Detailed ecological units in the Mt. Bear Massif Subsection:
MBM1 Barnard Glacier - 160 km^2
MBM2 Klutlan Glacier - 80 km^2
MBM3 Mt. Bear Massif - 1095 km^2

MBM1 Barnard Glacier

Geology and Physiography: valley glacier flowing southward out of the St. Elias Mountains. This unit includes parts of the glacier below the firn line, where ice and rock rubble are exposed by melting in the summer. Glacier consist of some clean ice in upper parts, with progressively more surface rubble at lower elevations, becoming ice-cored rubble on stagnant ice near the glacial terminus.

Elevation: 533 to 2196 m (1749 to 7205 ft)

Soils: mostly glacial ice or rock rubble; near the glacier's terminus some rock rubble with loamy matrix is incipient soil.

Vegetation/land cover: mostly ice and rock rubble. A few herbaceous plants and shrubs have probably colonized the superglacial rubble at low elevations.

Notes: for information on stagnant glaciers, see Clayton (1964).

MBM2 Klutlan Glacier

Geology and Physiography: valley glacier flowing northeastward out of the St. Elias Mountains. This unit includes parts of glacier below the firn line, where ice and rock rubbles are exposed by melting in the summer. Glaciers consist of some clean ice in upper parts, with progressively more surface rubble at lower elevations. Probably becomes completely rubble-covered at low elevations in Canada.

Elevation: 1735 to 2282 m (5692 to 7487 ft)

Soils: glacial ice or rock rubble without soil.

Vegetation/land cover: mostly ice and rock rubble. A few herbaceous plants and shrubs have probably colonized the superglacial rubble at low elevations in Canada.
Notes: The source area for this glacier is in the Churchill-Bona and Mt. Bear Massif units.

MBM3 Mount Bear Massif

Geology and Physiography: rugged high mountains composed mostly of marble. Largely ice-covered in the higher, northern part. In the southern part, sharp ridges are exposed between valley glaciers.
Elevation: 869 to 1242 m (2851 to 4075 ft)
Soils: mostly rock, talus, ice, and snow without soils. In vegetated areas at low elevations in the far southern part, some coarse-grained, rather dry soils with little horizonation and permafrost absent or below 1 m.
Vegetation/land cover: mostly unvegetated bare rock, talus, snow, and ice. At low elevations in the far south, on south-facing slopes there are some areas of deciduous shrubs.
Notes:

MLM Mt. Logan Massif Subsection

Detailed ecological units in the Mt. Logan Massif Subsection:
MLM1 Mt. Logan Massif - 196 km^2

MLM1 Mount Logan Massif

Geology and Physiography: rugged high mountains and glaciers. Includes Mt. Logan, Kings Peak, McArthur Peak, and the somewhat lower ridges (though still above 7,000 ft.) to the west of these peaks that are mostly covered by the Quitina Sella Glacier. No information on the geology of this region was obtained for this report.
Elevation: 2034 to 3428 m (6673 to 11247 ft)
Soils: mostly bare rock, rock rubble, snow, and ice without soil, probably with some small pockets of loamy soil with rocks in small crevices.
Vegetation/land cover: mostly unvegetated rock, scree, snow, and ice, probably with a few crustose lichens on rocks and perhaps a few vascular plants on small patches of stabilized soil.
Notes:

NCC Northern Chugach Cirque-Glacier Mountains Subsection

The Northern Chugach Cirque-Glacier Mountains are in the background of this photo. These mountains are rugged, with sparse alpine vegetation, and small glaciers confined to high cirques. The Tana Valley Subsection (TAV) covers the valley bottoms and forested lower slopes.

Detailed ecological units in the Northern Chugach Cirque-Glacier Mountains Subsection:
NCC1 Chugach High Valleys - 1296 km^2
NCC2 Granite Valley - 127 km^2
NCC3 Northern Chugach Cirque-Glacier Mountains - 3935 km^2
NCC4 Northern Chugach Valley Glaciers - 412 km^2

NCC1 Chugach High Valleys

Geology and Physiography: U-shaped valleys in the Chugach Mountains that were glaciated during the Pleistocene but are largely vegetated today. Sediments are composed mostly of slope deposits. In wider valleys where the valley bottom is rather flat, forested, and composed of glacial till or scoured bedrock (the Bremner and Tana Valleys), the valley bottom is mapped as a separate unit and the Chugach High Valleys unit is mapped on the adjacent steeper slopes.

Elevation: 40 to 1804 m (131 to 5919 ft)

Soils: probably mostly loamy soils with abundant rocks, well-drained, with little horizonation except an A horizon and/or a thin surface organic mat. Permafrost is probably present at least in places but below 1 m depth.

Vegetation/land cover: mostly dense alder and willow shrubs. At higher elevations and on unstable sites, vegetation is sparser. White spruce trees occur locally at low elevations.

Notes: this unit is strongly affected by snow avalanches and other slope processes. For general information on avalanches and alpine slope processes, see Rapp (1959), Luckman (1978), and Blirka and Nemec (1998). Avalanches probably prevent trees from colonizing parts of this unit that are otherwise suitable (i.e. low enough in elevation).

NCC2 Granite Valley

Geology and Physiography: U-shaped, glacially scoured valley, probably with patchy thin glacial till over bedrock. Bedrock is mostly metamorphosed clastic sedimentary rocks. Includes the braided floodplain of Granite Creek. Tongues of talus and young glacial moraines occur on the south side.

Elevation: 564 to 1354 m (1850 to 4442 ft)

Soils: probably mostly coarse-grained, well-drained, weakly-developed soils; may be strong A or O horizon development under dense shrubs. Permafrost is probably absent or below 1 m depth.

Vegetation/land cover: appears to be mostly willow/alder brush with sparse vegetation on bedrock knobs and braided stream floodplain.

Notes:

NCC3 Northern Chugach Cirque-Glacier Mountains

Geology and Physiography: rugged mountains composed mostly of metagraywacke, schist, and argillite, located mostly south of the Border Ranges Fault. Includes many cirque glaciers, but glaciers generally terminate too high to merge into valley glaciers. Many glaciers terminate in an ice-cored moraine or rock glacier.

Elevation: 240 to 3017 m (787 to 9898 ft)

Soils: mostly bare rock, rock rubble, snow, and ice without soil. At low elevations, soils are probably weakly developed, dry, and coarse-grained, with permafrost absent or below 1 m depth.

Vegetation/land cover: mostly snow, ice, bedrock, talus and scree. Lower slopes have discontinuous patches of shrubby vegetation.

Notes: this unit has unstable slopes with much rockfall. A large rockslide is present near 60° 49.4'N, 142° 32.0' W.

NCC4 North Chugach Valley Glaciers

Geology and Physiography: valley glaciers flowing northward out of the Chugach Mountains. Includes parts of glaciers below the firn line, where ice and rock rubble are exposed by melting in the summer. Glaciers consist of some clean ice in upper parts, with progressively more surface rubble at lower elevations, becoming ice-cored rubble near the glacial termini. Also includes some small lakes on the glacier margins.

Elevation: 419 to 2456 m (1375 to 8058 ft)

Soils: mostly glacial ice or rock rubble; near the glaciers' termini some rock rubble with loamy matrix is incipient soil.

Vegetation/land cover: mostly ice and rock rubble. A few herbaceous plants and shrubs have probably colonized the superglacial rubble at low elevations.

Notes: the source areas for these glaciers are mainly in the Northern Chugach Glaciers and Ridges and Bagley-Seward Icefield units.

The Northern Chugach Foothills are relatively low mountains with a mixture of both rounded and sharp ridge crests. U-shaped valleys such as the Goat Valley in the center of this photograph were occupied by glaciers in the Pleistocene, but glaciers are absent from the subsection today. Vegetation is mostly alpine tundra, alpine barrens, or subalpine shrubs. The high mountains in the background and the forested slope on the right are in other subsections.

Detailed ecological units in the Northern Chugach Foothills Subsection:
NCF1 Goat Valley - 47 km^2
NCF2 Haganita Valley - 274 km^2
NCF3 Kiagna Valley - 65 km^2
NCF4 Northern Chugach Foothills - 1137 km^2

NCF1 Goat Valley

Geology and Physiography: U-shaped valley, probably with thin glacial till over bedrock (the bedrock is mostly metamorphosed clastic sedimentary rocks). Streams from small side valleys are incised into the slopes and have formed alluvial fans in places along the valley bottom.

Elevation: 556 to 1489 m (1824 to 4885 ft)

Soils: probably mostly coarse-grained, well-drained, weakly-developed soils; may be strong A horizon or O development under dense shrubs. Permafrost probably absent or below 1 m depth.

Vegetation/land cover: appears to be mostly open white spruce forest with willow/alder understory. Higher elevations are shrubs only. Unstable gulley slopes are unvegetated.

Notes:

NCF2 Hanagita Valley

Geology and Physiography: broad, U-shaped mountain valley. Probably composed mostly of glacial till over metamorphic bedrock.

Elevation: 238 to 1337 m (781 to 4386 ft)

Soils: probably loamy soils with many rocks, mostly well-drained, with permafrost probably absent or below 1 m depth. In valley bottoms there are patches of wet soils, probably with a thick organic surface layer or composed entirely of peat, with permafrost present at least in part.

Vegetation/land cover: mostly willow-alder shrubs, or spruce woodland or open forest with shrub understory.

Notes:

NCF3 Kiagna Valley

Geology and Physiography: U-shaped, valley, probably with glacial till over bedrock (mostly metamorphosed clastic sedimentary rocks). Streams from side valleys appear to be incised into the glacial till.

Elevation: 652 to 1523 m (2139 to 4997 ft)

Soils: probably mostly coarse-grained, well-drained, weakly-developed soils; may be strong A horizon or O development under dense shrubs. Permafrost probably absent or below 1 m depth. Some wet soils probably with a thick organic surface horizon and permafrost are along the Kiagna River.

Vegetation/land cover: appears to be mostly open white spruce forest with willow/alder understory. Higher elevations are shrubs only, while patches of black spruce woodland occur on wet soils along the Kiagna River.

Notes:

NCF4 Northern Chugach Foothills

Geology and Physiography: relatively gentle mountains composed of metamorphic rocks (schist, phyllite, amphibolite, and marble) and granitic rocks. Located north of the Border Ranges Fault. Glaciers are absent, and ridge crests may be rounded, rather flat, or sharp.

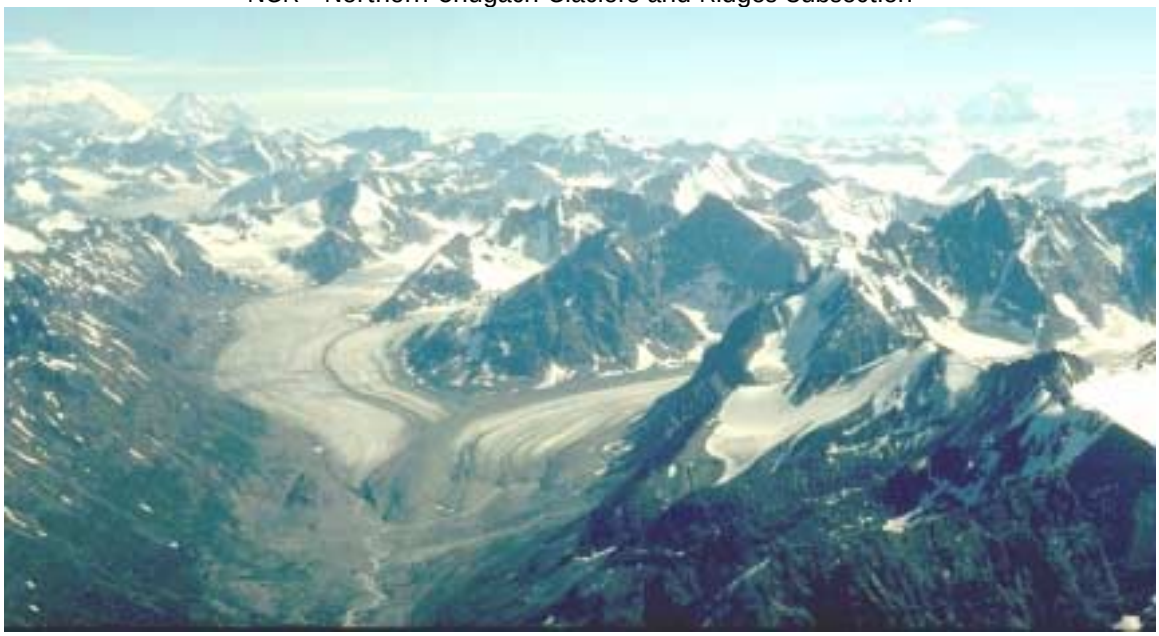
Elevation: 146 to 2203 m (479 to 7228 ft)

Soils: probably rocky soils with a loamy matrix, mostly well-drained, with permafrost absent or below 1 m depth.

Vegetation/land cover: higher elevations are rock rubble, sparsely vegetated with low shrubs and herbs. Slopes at middle elevations are willow and alder shrubs. A white spruce overstory with shrubs is present at low elevations.

Notes:

NGR Northern Chugach Glaciers and Ridges Subsection



The Northern Chugach Glaciers and Ridges are rugged mountains with considerable cover by ice and snow. Glaciers cover essentially any sites with slopes gentle enough to accumulate snow, and vegetation is nearly absent. Mt. Logan (left background), Mt. St. Elias (right background), and the valley bottom and vegetated slope on the lower left are in other subsections.

Detailed ecological units in the Northern Chugach Glaciers and Ridges Subsection:
NGR1 Northern Chugach Glaciers and Ridges - 1817 km^2

NGR1 North Chugach Glaciers and Ridges

Geology and Physiography: rugged mountains composed mostly of metamorphosed clastic sedimentary rocks and lesser amounts of felsic intrusive rocks, with some intermediate intrusive rocks in the northeast. All except ridge tops are covered by glaciers, and glaciers fill adjacent valleys.

Elevation: 416 to 3633 m (1365 to 11919 ft)

Soils: mostly absent. May be some small pockets of loamy soil with rocks in small crevices.

Vegetation/land cover: mostly bare rock, scree, snow and ice. Probably some crustose lichens on rocks and scattered vascular plants on small patches of stabilized soil at lower elevations. Locally on stable south slopes there is probably dry herbaceous vegetation, fruticose lichens, and low shrubs.

Notes: this unit is differentiated from the Bagley-Seward Icefield by its steeper glaciers and more exposed rock. It is differentiated from the White-Hawkins Massif unit by its lower elevation, less ice cover, and position north of the crest of the Chugach Mountain range.

NIB Nikolai Butte Subsection

Detailed ecological units in the Nikolai Butte Subsection:
NIB1 Nikolai Butte - 126 km^2

NIB1 Nikolai Butte

Geology and Physiography: rugged mountains, flat-topped with steep sides in the central part, elsewhere with sharp ridge crests. Composed mostly of limestone, with a little greenstone at low elevations. Small glaciers are present at high elevations.

Elevation: 802 to 2700 m (2631 to 8858 ft)

Soils: mostly bare rock, rock rubble, snow, and ice without soil. At low elevations, weakly developed, dry, coarse-grained soils with permafrost absent or below 1 m depth.

Vegetation/land cover: mostly bare rock, talus, snow, and ice. At low elevations there are deciduous shrubs and some open spruce forest.

Notes:

RBM Robinson Mountains Subsection

Detailed ecological units in the Robinson Mountains Subsection:
RBM1 Dahlgren Ridge - 108 km^2
RBM2 Robinson Mountains Foothills - 26 km^2

RBM1 Dahlgren Ridge

Geology and Physiography: rugged mountains of intermediate elevation with considerable cover by snow and ice. Includes Dahlgren Ridge, plus other ridges in the Robinson Mountains. Composed of Tertiary clastic sedimentary rocks.

Elevation: 1231 to 2924 m (4039 to 9593 ft)

Soils: mostly snow, ice, bare rock, scree, or rock rubble without soil. Coarse-grained soils with little horizonation are probably present under scattered vegetated areas.

Vegetation/land cover: mostly unvegetated rock, scree, snow, and ice, probably with crustose lichens on rocks and scattered vascular plants on small patches of stabilized soil. Scattered patches of denser vegetation, probably mostly deciduous shrubs, are present on south-facing slopes at low elevations.

Notes: .

RBM2 Robinson Mountains Foothills

Geology and Physiography: rugged mountains with relatively low elevations, composed of mostly of Tertiary clastic sedimentary rocks.

Elevation: 0 to 1923 m (0 to 6309 ft)

Soils: probably mostly loamy soils with abundant rocks, well-drained, with weak horizons. At lower elevations under coniferous forest there are probably Spodosols (Podzols).

Vegetation/land cover: the highest elevations and steepest slopes have sparsely vegetated bedrock and scree. Elsewhere at high elevations are shrub tundra and subalpine low and tall shrubs. Lower slopes have spruce or spruce-hemlock forest.

Notes:

The Southern St. Elias Mountains, visible in the background of this photo, are very high and have a large amount of permanent ice and snow. The Seward Glacier, winding through the mountains in the middle background, is part of this subsection; it carries ice from the Bagley-Seward Icefield (subsection BAI, out of sight to the north) down to the Malaspina Glacier (subsection MAG, in the foreground). Appreciable vegetation cover in the Southern St. Elias Mountains Subsection is found only in the foothills - the first row of low mountains behind the Malaspina Glacier.

Detailed ecological units in the Southern St. Elias Mountains Subsection:
SSM1 Hubbard Glacier - 136 km^2
SSM2 Seward Glacier - 144 km^2
SSM3 Southern St. Elias Mountains - 1205 km^2
SSM4 Southern St. Elias Valley Glaciers - 109 km^2
SSM5 Southern St. Elias Vegetated Foothills - 332 km^2
SSM6 St. Elias Crest - 703 km^2

SSM1 Hubbard Glacier

Geology and Physiography: large valley glacier with a wide calving front into Disenchantment Bay. Includes the Hubbard Glacier and its major tributary the Valerie Glacier, mapped up to the firn line.

Elevation: 0 to 1862 m (0 to 6109 ft)

Soils: none.

Vegetation/land cover: ice and snow, with rubble over ice on lateral margins of the glacier.

Notes: Hubbard Glacier is the largest tidewater glacier in North America. It has extended farther out into Disenchantment Bay in the past. Prior to 1860 it blocked Russell Fiord, producing a freshwater lake with a surface higher than sea level. Hubbard Glacier is currently advancing and in 1986 it briefly blocked Russell Fiord again, before breaching and draining the lake (Winkler, 2000). It is expected to block Russell Fiord again in the near future (Barclay *et al.*, 2001)

SSM2 Seward Glacier

Geology and Physiography: large valley glacier draining the Bagley-Seward Icefield. Mapped here above the firn line.

Elevation: 780 to 1403 m (2559 to 4603 ft)

Soils: none
Vegetation/land cover: snow over glacial ice, with a minor amount of supraglacial rock rubble.
Notes:

SSM3 Southern St. Elias Mountains

Geology and Physiography: rugged high mountains with considerable cover by ice and snow, composed of weakly metamorphosed, Mesozoic clastic sedimentary rocks.
Elevation: 246 to 4129 m (807 to 13547 ft)
Soils: mostly ice, snow, rock, and rock rubble without soil.
Vegetation/land cover: mostly ice, snow, rock, and unvegetated rock rubble. Some small areas of shrub vegetation occur at low elevations in the far south.
Notes: this unit is differentiated from the similar St. Elias Crest unit by its different lithology and generally somewhat lower elevation.

SSM4 Southern St. Elias Valley Glaciers

Geology and Physiography: small valley glaciers on the south side of the St. Elias Mountains. These glaciers drain cirques in the adjacent mountains, not the large icefields further north. All have significant debris cover in the lower part, except for the Turner Glacier; the latter is the only one of the group that calves into the ocean. Glaciers are mapped here up to the firn line.
Elevation: 0 to 1115 m (0 to 3658 ft)
Soils: none
Vegetation/land cover: ice, snow, and surpaglacial rock debris. Probably a few plants have colonized the more stable parts of the supraglacial debris.
Notes: the Variegated Glacier in this unit is a good example of a surging glacier and has been the subject of much research (Raymond and Harrison, 1988; Sharp, 1988; Humphrey and Raymond, 1994; Lawson, 1996)

SSM5 Southern St. Elias Vegetated Foothills

Geology and Physiography: rugged but relatively low mountains on the south side of the St. Elias Mountains. Contains relatively little permanent ice and snow. Bedrock is mostly weakly metamorphosed, Mesozoic clastic sedimentary rocks, with some Tertiary clastic sedimentary rocks in the Samovar Hills. Includes some moraines and ice-marginal lakes at footslopes along boundaries with glaciers.
Elevation: 0 to 1946 m (0 to 6385 ft)
Soils: probably coarse-grained, well-drained soils with weak horizonation other than accumulation of organic matter near the surface.
Vegetation/land cover: at higher elevations, mostly sparsely vegetated bedrock and scree. Lower and more stable sites have shrubs, which become denser and taller at lower elevations. Spruce trees appear to be small and/or rare or absent, even at low elevations along Icy Bay where the climate is probably suitable. This is probably because spruces have as yet failed to disperse in from seed sources along the coast after the recent deglaciation of Icy Bay.
Notes:

SSM6 St. Elias Crest

Geology and Physiography: high, rugged mountains with considerable cover by snow and ice. These mountains are surrounded by various large glaciers, including the Seward and Hubbard Glaciers. Composed of Paleozoic metamorphic rocks.
Elevation: 700 to 5438 m (2297 to 17841 ft)
Soils: mostly snow, ice, bare rock, scree, or rock rubble without soil.
Vegetation/land cover: mostly unvegetated rock, scree, snow, and ice.
Notes:

The Sulzer-Natazhat Mountains are rugged, high mountains in the background of this photograph, behind the White River Basin. The high mountain on the right is Mt. Natazhat. For another view of the Sulzer-Natazhat Mountains Subsection, see the White River Basin Subsection in the Kluane Range Ecoregion.

Detailed ecological units in the Sulzer-Natazhat Mountains Subsection:
SUM1 Griffin Glacier - 31 km^2
SUM2 Sulzer-Natazhat Mountains - 503 km^2

SUM1 Griffin Glacier

Geology and Physiography: valley glacier, largely covered with rock debris.
Elevation: 1275 to 2136 m (4183 to 7008 ft)
Soils: most rock rubble and ice without soil.
Vegetation/land cover: rock rubble and ice. The lowermost part in the far north has some deciduous shrub vegetation.
Notes: this glacier is mapped here roughly up to the firn line. Much of the glacier is debris-covered due to the relative small supply of snow relative to rock debris on the glacier. Most of the debris-covered parts of this glacier are stagnant and pitted. The most distal (northernmost) part of the debris has been colonized by plants, although it still appears to be ice-cored. For information on stagnant galciers, see Clayton (1964).

SUM2 Sulzer-Natazhat Mountains

Geology and Physiography: rugged mountains composed mostly of Mesozoic and Paleozoic greenstone, argillite, shale, graywacke, volcanice breccia, andesite, and basalt. Glaciers and permanent snowfield mantle the highest part of the ridges, and they feed valley glaciers that are almost completely debris-covered.
Elevation: 1128 to 4061 m (3701 to 13323 ft)
Soils: soils are absent from higher areas with bedrock, rock rubble, ice and snow. Vegetated areas at lower elevations in the north probably have dry, rocky soils with permafrost likely to be present but below 1 m depth.
Vegetation/land cover: higher elevations have exposed bedrock, rock rubble, snow, and ice. Low elevation areas along the northern edge have deciduous brush and spruce woodland.

Notes: these mountains have less ice cover and glaciers are more rubble-covered than mountains of similar height but further south in this ecoregion. This is due to less snowfall in the Sulzer-Natazhat Mountains than in mountains closer to the Gulf of Alaska. The Sulzer-Natazhat Mountains received a heavy deposit of the White River volcanic ash from Mt. Churchill to the north, about 1250 and 1900 years ago (Lerbekmo and Campbell, 1969; Richter et al., 1995). This ash probably has eroded off of most steeper slopes but iforms a mantle on lower, gentler slopes in the northern part of SUM2. Bare ash is visible as white patches on aerial photographs.

TAV Tana Valley Subsection

The Tana Valley is a large, U-shaped valley that was filled by glaciers in the Pleistocene. It is bordered on either side in this photograph by the Northern Chugach Cirque-Glacier Mountains (NCC). The Tana Valley Subsection includes both the braided floodplain of the Tana River (TAV2), and forested adjacent lower valley slopes (the Tana Morainal Valley, TAV1). A unique wet portion of the Tana River Floodplain is found along the west fork of the Tana River, visible in the photograph of the NCC Subsection described previously.

Detailed ecological units in the Tana Valley Subsection:
TAV1 Tana Morainal Valley - 58 km^2
TAV2 Tana River Floodplain - 83 km^2

TAV1 Tana Morainal Valley

Geology and Physiography: glacial till and glacially scoured bedrock knobs in a U-shaped glacial valley. Includes some small alluvial fans.
Elevation: 417 to 770 m (1368 to 2526 ft)
Soils: probably mostly loamy soils with abundant stones, generally well-drained, with a thin surface organic layer. Some wet soils with a thicker organic surface layer are present in depressions, possibly with permafrost,.
Vegetation/land cover: mostly open white spruce forest over deciduous shrubs. Possibly some black spruce forest in wet depressions.
Notes:

TAV2 Tana River Floodplain

Geology and Physiography: floodplain of a glacier-fed river. The main fork is braided, and the west fork has an unusual channel form of narrow and presumably deep anastomosing channels linking numerous ponds.

Elevation: 396 to 571 m (1299 to 1873 ft)

Soils: along the main fork of the Tana River, coarse-grained alluvium with very weak or no soil development. Along the west fork, wet soils, probably stratified sand, gravel, and silt, with little development other than reduction, buried organic layers and, in places, a surface organic layer. Permafrost is probably absent, except perhaps on slightly higher terrace surfaces.

Vegetation/land cover: along the main fork of the Tana River, mostly unvegetated sand and gravel with sparse vegetation of shrubs and herbs in places. Along the west fork of the Tana River, dense shrubs, wet herbaceous, and emergent vegetation.

Notes: sedimentation by the main fork of the Tana River has raised the base level of the west fork, so that the west fork floodplain is gently sloping with abundant ponds and wetlands, and groundwater near the surface.

UCM University-Centennial Mountains Subsection

Detailed ecological units in the University-Centennial Mountains Subsection:
UCM1 St. Elias Vegetated Valleys - 156 km^2
UCM2 University-Centennial Mountains - 1126 km^2
UCM3 University-Centennial Valley Glaciers - 106 km^2

UCM1 St. Elias Vegetated Valleys

Geology and Physiography: coarse-grained slope deposits from granitic and mafic volcanic rocks.

Elevation: 517 to 1935 m (1696 to 6348 ft)

Soils: dry, rocky, coarse-grained soils with little horizon development. Permafrost is probably absent or below 1 m depth.

Vegetation/land cover: mostly deciduous shrubs, generally rather dense, with an open spruce overstory in places

Notes:

UCM2 University-Centennial Mountains

Geology and Physiography: rugged mountains composed mostly of granitic rocks in the east and mostly mafic volcanic rocks in the west, with some non-carbonate metamorphic rocks. Higher elevations are mantled by snow and ice, but most glaciers do not reach valley level.

Elevation: 538 to 4399 m (1765 to 14432 ft)

Soils: mostly rock, rock rubble, snow, and ice without soil. In vegetated areas in the south, some coarse-grained, weakly developed soils with permafrost absent or below 1 m depth.

Vegetation/land cover: mostly bare rock, scree, talus, snow, and ice. At low elevations and mainly in the southern part there is sparse vegetation, some open and closed shrubs, and spruce woodland.

Notes:

UCM3 University-Centennial Valley Glaciers

Geology and Physiography: valley glaciers flowing southward out of the St. Elias Mountains. Includes parts of glaciers below the firn line, where ice and rock rubble are exposed by melting in the summer. Glaciers consist of some clean ice in upper parts, with progressively more surface rubble at lower elevations, becoming ice-cored rubble near the glacial termini.

Elevation: 485 to 2161 m (1591 to 7090 ft)

Soils: mostly glacial ice or rock rubble; near the glaciers' termini some rock rubble with loamy matrix is incipient soil.

Vegetation/land cover: mostly ice and rock rubble. A few herbaceous plants and shrubs have probably colonized the superglacial rubble at low elevations.

Notes: includes the Chitistone, Twaharpies, Hawkins, and unnamed glaciers.

WBR Waxel-Barkley Ridge Subsection

Detailed ecological units in the Waxel-Barkley Ridge Subsection:
WBR1 Guyot Hills - 55 km^2
WBR2 Tyndal Glacier - 16 km^2
WBR3 Waxel-Barkley Ridge - 830 km^2

WBR1 Guyot Hills

Geology and Physiography: isolated, mostly ice-covered mountain protruding through the Yahtse and Guyot Glaciers. Composed mostly of sandstone and siltstone
Elevation: 390 to 1703 m (1280 to 5587 ft)
Soils: mostly ice, snow, rock, and rock rubble without soil.
Vegetation/land cover: mostly unvegetated ice, snow, bedrock, and rock rubble. A few small patches of shrubs on favorable sites.
Notes: the southeastern part of this mountain is placed in the Icy Bay Foothills unit because it has significant vegetation cover and little permanent snow or ice.

WBR2 Tyndal Glacier

Geology and Physiography: a relatively small outlet glacier fed by cirques on the south side of the St. Elias Mountains. Mapped here up to the firn line.
Elevation: 287 to 888 m (942 to 2913 ft)
Soils: none.
Vegetation/land cover: mostly ice and snow, with some debris cover in medial moraines.
Notes: this glacier receded about 16 km between the date of Plafker and Miller's (1958) map and the satellite image used here (1986), exposing a fiord (Taan Fiord) that was previously completely ice covered. The glacier receded about 1 km between the times of our 1985 and 1986 images.

WBR3 Waxel-Barkley Ridge

Geology and Physiography: high, rugged mountains with considerable cover by snow and ice. Includes Waxell and Barkley ridges, plus the lower ridges surrounding Mt. Huxley. These mountains are surrounded by various large glaciers and icefields: the Bagley Icefield and the Bering, Yahtse, Stellar, and Agassiz Glaciers. Composed of Tertiary clastic sedimentary rocks and mafic volcanic rocks.
Elevation: 150 to 3605 m (492 to 11827 ft)
Soils: mostly snow, ice, bare rock, scree, or rock rubble without soil. Coarse-grained soils with little horizonation are probably present under vegetated areas in the south.
Vegetation/land cover: mostly unvegetated rock, scree, snow, and ice, probably with crustose lichens on rocks and scattered vascular plants on small patches of stabilized soil. Some patches of deciduous shrubs are present on south-facing slopes at low elevations in the far southern part.
Notes: this unit is differentiated from the St. Elias Crest unit by its different bedrock lithology and generally lower elevation. It is similar to the Southern St. Elias Mountains unit (with minor differences in lithology) and could be joined with the latter for many purposes.

WHM White-Hawkins Massif Subsection

Detailed ecological units in the White-Hawkins Massif Subsection:
WHM1 White-Hawkins Massif - 550 km^2

WHM1 White-Hawkins Massif

Geology and Physiography: rugged mountains composed of clastic sedimentary rocks and basalt, with some felsic intrusive rocks near Mt. Tom White. All except ridge tops are covered by glaciers.

Elevation: 952 to 3368 m (3123 to 11050 ft)

Soils: mostly absent. May be some small pockets of loamy soil with rocks in small crevices.

Vegetation/land cover: mostly bare rock, scree, snow and ice. Probably some crustose lichens on rocks and scattered vascular plants on small patches of stabilized soil at low elevations in the southern part.

Notes: this unit is differentiated from the Bagley-Seward Icefield by its steeper glaciers and more exposed rock. It is differentiated from the North Chugach Ridges and Glaciers by its gnerally higher elevation, greater ice cover, and position on the crest and south side of the Chugach Mountain range. The air photos and satellite images suggest that most of this unit can receive snow all summer long.

WSF Western St. Elias Foothills Subsection

Detailed ecological units in the Western St. Elias Foothills Subsection:
WSF1 Andrus Mountains - 280 km^2
WSF2 MacColl Ridge - 234 km^2
WSF3 MacColl Ridge Fans - 41 km^2
WSF4 Young Creek Valley - 111 km^2

WSF1 Andrus Mountains

Geology and Physiography: rugged mountains composed of clastic sedimentary rocks. Includes several cirques, mostly occupied by long lobate rock glaciers, although two cirques contain small glaciers.

Elevation: 621 to 2688 m (2037 to 8819 ft)

Soils: mostly absent at high elevations. In vegetated areas, soils are probably coarse-grained and well drained. Permafrost, where present, is probably below 1 m depth.

Vegetation/land cover: higher elevations are mostly scree, bare rock, and rock rubble. Gentler ridges have dwarf shrubs and dry to mesic herbaceous vegetation. Lower elevations have mostly dense shrubs (alder and willow), with scattered spruce in some places.

Notes: the predominance of rock glaciers in these mountains is due to a lower supply of snow relative to rock rubble that is supplied to these cirques, as compared to higher mountain ranges or ranges nearer to the coast. For general information on rock glaciers, see Warhhaftig and Cox (1959). A rock glacier in the study area is described in Elconin and LaChapelle (1997).

WSF2 MacColl Ridge

Geology and Physiography: rounded ridge dissected by streams to produce a series of scree-sloped valleys. Composed of clastic sedimentary rocks.

Elevation: 373 to 1865 m (1224 to 6119 ft)

Soils: soils are probably coarse-grained and well drained. Permafrost, where present, is probably below 1 m depth.

Vegetation/land cover: steep slopes of valleys are mostly scree. Gentler ridges have dwarf shrubs and dry to mesic herbaceous vegetation. Lower elevations have mostly dense shrubs (alder and willow), with scattered spruce in some places.
Notes:

WSF3 MacColl Ridge Fans

Geology and Physiography: alluvial fans from short, steep streams (many are probably ephemeral) that originate on MacColl Ridge. Includes some small areas of hummocky glacial moraine.
Elevation: 330 to 690 m (1083 to 2264 ft)
Soils: probably mostly well drained, loamy or sandy soils with coarse fragments, with permafrost absent or below 1 m depth.
Vegetation/land cover: open white spruce and birch forest, with deciduous shrubs in the burn in the western part and along drainages.
Notes:

WSF4 Young Creek Valley

Geology and Physiography: broad, U-shaped glacial valley, probably composed of glacial till, with numerous small incised tributary drainages.
Elevation: 631 to 1342 m (2070 to 4403 ft)
Soils: probably loamy soils with some coarse fragments and an organic surface layer. Permafrost status unknown, but soils are probably fairly well drained with permafrost absent or below 1 m.
Vegetation/land cover: mostly open spruce forest. Steep eroding banks of gulleys are unvegetated, and higher elevations in the east have deciduous shrubs with few trees.
Notes:

YGG Yahtse and Guyot Glaciers Subsection

Detailed ecological units in the Yahtse and Guyot Glaciers Subsection:
YGG1 Yahtse-Guyot Icefield - 955 km^2
YGG2 Yahtse-Guyot Outlet Glaciers - 61 km^2

YGG1 Yahtse-Guyot Icefield

Geology and Physiography: mostly gently sloping glacier, with a few small nunataks of sandstone and siltstone bedrock. The icefield is mapped here down approximately to the firn line.
Elevation: 338 to 2195 m (1109 to 7201 ft)
Soils: none.
Vegetation/land cover: mostly snow over glacial ice, with a few small areas of unvegetated exposed rock.
Notes: this icefield flows into Icy Bay via several outlet glaciers.

YGG2 Yahtse-Guyot Outlet Glaciers

Geology and Physiography: rather gently sloping glaciers, extending from the firn line of the Yahtse-Guyot Icefield down to the glacial calving areas in Icy Bay.
Elevation: 0 to 849 m (0 to 2785 ft)
Soils: none.
Vegetation/land cover: glacial ice with seasonal snow cover.
Notes: in the late 1800's these glaciers completely filled Icy Bay; the glacial front has retreated rapidly by calving into the Bay since that time (Porter, 1989). The glaciers retreated about 16 km between the date of Plafker and Miller's (1958) map and the satellite image used in this study (1985).

Ecological Unit Descriptions – Copper River Basin Region

The map legend for ecological units of the Copper River Basin Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 4. The criteria used to delineated the subsections are summarized in Table 12. Mean climatic data for Chitina, Gulkana, and Slana Alaska in the Copper River Basin are given in Tables 18, 19, and 22, respectively.

ALP Ahtna Lacustrine Plain Subsection

The Ahtna Lacustrine Plain Subsection. This nearly level plain with black spruce forest on wet soils occupies the former bed of a large lake.

Detailed ecological units in the Ahtna Lacustrine Plain Subsection:
ALP1 Dadina Plain - 588 km^2
ALP2 Klawasi Plain - 1241 km^2
ALP3 Sanford River Floodplain - 27 km^2

ALP1 Dadina Plain

Geology and Physiography: plain composed of silty and clayey glaciolacustrine deposits, deeply incised by several streams flowing from the Wrangell Mountains to the Copper River. Contains numerous small lakes, some of which appear to be ephemeral. Drumlins (glacially streamlined hills) are common in the northern and western part. Strandlines (former beaches) are visible in the west and probably are composed of sandier material.

Elevation: 178 to 853 m (584 to 2799 ft)

Soils: loamy soils with drainage conditions that vary with topography and post-fire succession. In depressions soils are wet and permafrost is near the surface, while on better-drained sites and in burned areas permafrost is often below 2 m depth.

Vegetation/land cover: open and closed spruce forest and woodland, denser in older stands and drier sites. Burned areas have deciduous forest or shrubs.

Notes: this unit is quite similar to the Klawasi Plain and differentiated on the basis of dissection by streams, more lakes, and generally denser trees.

ALP2 Klawasi Plain

Geology and Physiography: plain composed of silty and clayey glaciolacustrine deposits. Drumlins (glacially streamlined hills) are visible in places. Strandlines (former beaches) are present and probably are composed of sandier material

Elevation: 333 to 854 m (1093 to 2802 ft)

Soils: loamy soils with drainage conditions that vary with topography and post-fire succession. In depressions soils are wet and permafrost is near the surface, while on better-drained sites and in burned areas permafrost is often below 2 m depth.

Vegetation/land cover: mostly open spruce forest and woodland, denser in older stands and on drier sites. Burned areas have deciduous forest or shrubs.

Notes: the Lower Klawasi Mud Volcano is in this unit. This is a unique saline spring that also emits mud and gases, sometime explosively. The gases (a mixture of carbon dioxide, methane, and nitrogen) are toxic and have killed plants and wildlife in the vicinity. The water is thought to originate from the interaction of deep groundwater with magma and rocks surrounding the magma (Granz et al., 1962)

ALP3 Sanford River Floodplain

Geology and Physiography: floodplain of a small braided glacial river. All parts are subject to flooding or channel migration.

Elevation: 462 to 829 m (1516 to 2720 ft)

Soils: stratified sand and gravel, well-drained, lacking permafrost, with little or no loamy surface layer.

Vegetation/land cover: mostly unvegetated gravel bars. Along margins of the floodplain, some less disturbed areas have deciduous brush or poplar forest, locally with white spruce.

Notes:

CVF Chitina Valley Floodplains and Terraces Subsection

Much of the Chitina Valley Floodplains and Terraces Subsection is sparsely vegetated gravel bars of the braided Chitina River, which cover the foreground of this photograph.

Detailed ecological units in the Chitina Valley Floodplains and Terraces Subsection:
CVF1 Chitina River Meandering Floodplain - 58 km^2
CVF2 Chitina Valley Outwash Terraces - 149 km^2
CVF3 Lower Chitina River Floodplain - 99 km^2
CVF4 Nizina River Floodplain - 39 km^2
CVF5 Upper Chitina River Floodplain - 297 km^2

CVF1 Chitina River Meandering Floodplain

Geology and Physiography: floodplain of a meandering river and its tributaries. Probably composed of stratified sand and gravel, with a mantle of silt and sand on higher and more densely vegetated areas. Includes lower parts of the Tana and Chakina River floodplains. Bounded by high bluffs.

Elevation: 274 to 514 m (899 to 1686 ft)

Soils: probably mostly stratified sand and gravel, with a loamy surface layer that generally increases in thickness with distance from the channel. A surface organic layer is present under the more densely vegetated areas. Soils are probably generally well drained and lack permafrost, except possibly under black spruce forest.

Vegetation/land cover: a transect moving away from the channel on the inside of a meander typically would run across unvegetated gravel bar, deciduous shrubs and poplar forest, and white spruce forest. Some late successional areas near the foot of bluffs appear to have open black spruce forest or woodland.

Notes: this reach of the Chitina is unusual because glacial outwash rivers are typically braided. The meanders of this part of the Chitina are incised into the underlying deposits, indicating that the river was meandering before it downcut. Erosion on the outside of meander bends is eliminating the incised meanders, but they are still apparent. For a general discussion of river channel form, see Leopold and Wolman (1957).

CVF2 Chitina Valley Outwash Terraces

Geology and Physiography: nearly level terraces composed of sand and gravel from braided glacial outwash rivers. Currently not affected by flooding and generally unlikely to be re-occupied by the existing rivers.

Elevation: 252 to 687 m (827 to 2254 ft)

Soils: probably stratified sand and gravel with a surface layer of silt and sand of unknown thickness. Probably well drained and lacking permafrost.

Vegetation/land cover: mostly open spruce forest or mixed spruce and hardwoods. The latter are more common on old burns.

Notes: location of these deposits is tentative and based here only on air photograph interpretation.

CVF3 Lower Chitina River Floodplain

Geology and Physiography: floodplain of a braided glacial outwash river. Composed of coarse-grained alluvium.

Elevation: 152 to 396 m (499 to 1299 ft)

Soils: mostly stratified sand and gravel, dry, with no soil horizon development. Small vegetated areas may have a surface and several buried A or O horizons, and a finer mantle of silt and sand.

Vegetation/land cover: mostly unvegetated gravel bars and water. Includes small areas that are less disturbed, with deciduous shrubs or balsam poplars.

Notes:

CVF4 Nizina River Floodplain

Geology and Physiography: braided floodplain of a glacial outwash river. Composed of sand and gravel. Includes the McCarthy River Floodplain.

Elevation: 283 to 488 m (928 to 1601 ft)

Soils: stratified sand and gravel, dry, with little or no horizon development.

Vegetation/land cover: mostly unvegetated gravel bars. Small, less-disturbed areas have deciduous shrubs or white spruce forest.

Notes: the Kennicott River is subject to glacial outburst floods, (resulting from the sudden drainage of a lake impounded by a glacier; Rickman and Rosenkrans, 1997) as are many rivers in this region.

CVF5 Upper Chitina River Floodplain

Geology and Physiography: floodplain of a braided glacial outwash river. Composed of coarse-grained alluvium.

Elevation: 328 to 741 m (1076 to 2431 ft)

Soils: mostly stratified sand and gravel, dry, with no soil horizon development. Vegetated areas may have a surface and several buried A or O horizons, and a finer mantle of silt and sand.

Vegetation/land cover: mostly unvegetated gravel bars. Less intensely disturbed areas have deciduous shrubs or balsam poplars, becoming closed and mixed with white spruce at later successional stages.

Notes:

The Chitina Valley Moraines and Hills Subsection is mostly elongate low hills composed of glacial till (drumlins), such as those in the lowland of this photograph. It also has bedrock hills scoured and streamlined by thick glacial ice in the Pleistocene, such as the buttes visible in the right and middle background.

Detailed ecological units in the Chitina Valley Moraines and Hills Subsection:
CVM1 Chitina Drumlins - 1174 km^2
CVM2 Gilahina Buttes - 57 km^2
CVM3 Kiagna Till Slope - 110 km^2
CVM4 May Creek Moraine - 9 km^2
CVM5 South Chitina Terrace - 123 km^2
CVM6 Steamboat Butte - 8 km^2
CVM7 Sunshine Hills - 83 km^2

CVM1 Chitina Drumlins

Geology and Physiography: low drumlins (elongate hills streamlined by glaciers). Elongate lakes are common in between drumlins. Probably composed of glacial till, with glacially scoured bedrock on the highest hills.

Elevation: 183 to 900 m (600 to 2953 ft)

Soils: probably mostly loamy soils with rocks, with wetness and permafrost variable depending on slope position and post-fire succession. In unburned forest, depressions probably have soils with permafost at about 0.5 m depth and a thick organic surface layer. Convexities have drier soils with permafrost deeper or absent. In burns permafrost is often deeper (if it was present before the burn) and soils drier.

Vegetation/land cover: Later successional stages are spruce forest, probably black spruce woodland or open forest in low areas and black or white spruce on convex positions. Aspen and birch are commonly mixed with spruce on convex positions. Burns have deciduous shrubs or trees; trees are tallest and densest on topographic convexities.

Notes: this unit is low enough in elevation that it could have been part of glacial Lake Atna (Ferrians, 1989). However, drumlinoid topography suggests that glaciers were grounded here at least during the lastest stages of glaciation. Till is likely to be finer-grained than would be expected due to admixture of lake sediment. For general information on glacial landforms such as drumlins, see Sugden and John (1976) or Bennett and Glasser (1996). For general information on fire effects on soils and vegetation in Interior Alaska, see Viereck (1973; 1983).

CVM2 Gilahina Buttes

Geology and Physiography: bedrock knobs in the Chitina Valley composed of gabbro, gneiss, and granitic rocks (the lithology of outlier in the northwest is unknown). Scoured and streamlined when over-run by Pleistocene glaciers.

Elevation: 352 to 845 m (1155 to 2772 ft)

Soils: probably rocky soils with loamy matrix, dry, and mostly lacking permafrost. The small areas of lowland between the buttes probably have wetter soils with a thick surface organic layer and permafrost within 1 m of the surface.

Vegetation/land cover: mostly dense alder shrubs with scattered white spruce. Depressions between buttes have black spruce woodland.

Notes:

CVM3 Kiagna Till Slope

Geology and Physiography: long slope between the Chitina River and mountains to the south. Probably composed mostly of glacial till, with some alluvium from small streams.

Elevation: 387 to 1139 m (1270 to 3737 ft)

Soils: probably rocky soils with loamy matrix. Soils are probably wet and have permafrost within 1 m of the surface over much of this unit; convex areas and some areas with larger trees along drainages are probalby drier and lack permafrost.

Vegetation/land cover: mostly open spruce forest or spruce woodland, probably black spruce; mixed white spruce and hardwoods along drainages.

Notes:

CVM4 May Creek Moraine

Geology and Physiography: small end moraine with hummocky topography and numerous ponds, built by a glacier flowing out of the Nizina River valley.

Elevation: 448 to 498 m (1470 to 1634 ft)

Soils: probably loamy soils with rocks, permafrost status unknown but likely to be present, at least on convex slopes.

Vegetation/land cover: appears to be spruce woodland with shrub understory.

Notes: this moraine is Holocene in age (<10,000 years, i.e. relatively young).

CVM5 South Chitina Terrace

Geology and Physiography: a mostly gently north-sloping surface composed of moraines and alluvial fans from the mountains to the south. Sediments are probably rocky with loamy matrix. Includes a prominent escarpment down to the Chitina River floodplain.

Elevation: 176 to 1030 m (577 to 3379 ft)

Soils: probably loamy soils with rocks, and variable wetness and permafrost conditions: on convex slopes soils are relatively dry and permafrost may be present at 1 to 2 m depth, while in burned areas it is probably below 2 m depth. In convex areas soils are wetter and permafrost is probably present within 1 m of the surface.

Vegetation/land cover: open and closed white spruce forest on well-drained, unburned sites, and open black spruce forest in depressional areas. On burns, mostly deciduous forest and shrubs.

Notes:

CVM6 Steamboat Butte

Geology and Physiography: a bedrock hill (lithology unknown) rising out of the Chitina Drumlins. Streamlined by glacial erosion and covered by glacial till.

Elevation: 270 to 561 m (886 to 1841 ft)

Soils: probably well-drained rocky soils with loamy matrix. Permafrost is probably absent or below 2 m depth.

Vegetation/land cover: open white spruce forest with birch and alder.

Notes:

CVM7 Sunshine Hills

Geology and Physiography: low bedrock hills that were over-run by glaciers during the Pleistocene. Consist of schist, phyllite, amphibolite, and marble, covered by glacial till except on hilltops.

Elevation: 481 to 1143 m (1578 to 3750 ft)

Soils: probably rocky soils with loamy matrix. Permafrost status is uncertain; it is most likely to be present in concavities.

Vegetation/land cover: upper slopes and tops of hills have deciduous shrubs, with mostly open spruce forest or mixed forest elsewhere.

Notes:

DLP Duck Lake Plain Subsection

The Duck Lake Plain is gently undulating, with numerous small lakes and black spruce forest or woodland.

Detailed ecological units in the Duck Lake Plain Subsection:
DLP1 Duck Lake Plain - 369 km^2

DLP1 Duck Lake Plain

Geology and Physiography: nearly level plain composed of fine-grained lacustrine or glaciolacustrine deposits. Contains numerous small lakes and ponds that appear to be of both glacial and thermokarst origin.

Elevation: 578 to 871 m (1896 to 2858 ft)

Soils: mostly wet soils with permafrost within 0.5 m of the surface. The surface organic layer is probably > 20 cm thick in most places.

Vegetation/land cover: mostly black spruce woodland with sedges, cottonsedge, and low shrubs. Some areas with better drainage and no recent fires have open black spruce forest. Small areas of deciduous forest occur on high spots that have burned in the not-too-distant past.

Notes:

Detailed ecological units in the Kotsina-Kuskalana Hills and Terraces Subsection:
KHT1 Kotsina Terrace - 178 km^2
KHT2 Kuskalana Hills - 63 km^2

KHT1 Kotsina Terrace

Geology and Physiography: terrace composed of andesite bedrock with a thin mantle of coarse-grained lacustrine deposits or till. Includes beach lag deposits from glacial Lake Atna (Yehle, 1980).

Elevation: 237 to 676 m (778 to 2218 ft)

Soils: probably loamy soils with rocks. Permafrost status is uncertain, but most likely absent or deep (> 1 m) over most of the unit, except in lower, concave areas, which probably have permafrost within 1 m of the surface and a thick organic surface layer.

Vegetation/land cover: open to closed deciduous, mixed, or spuce forest, the latter most common at early post-fire successional stages. May be mostly white spruce, except in some depressions.

Notes:

KHT2 Kuskalana Hills

Geology and Physiography: irregular hills composed of patchy glacial till and possibly lacustrine sediment over bedrock of unknown composition. Bedrock has been streamlined by glacial ice.

Elevation: 170 to 613 m (558 to 2011 ft)

Soils: probably mostly rocky soils with a loamy matrix over bedrock or stoney glacial till, dry, and lacking permafrost. In some depressions, wet soils with a thick organic layer and permafrost at about 0.5 m depth.

Vegetation/land cover: mostly open or closed white spruce forest, with birch and alders. Some depressions have black spruce woodland.

Notes:

MCF Middle Copper River Floodplain and Terraces Subsection

The braided floodplain of the Middle Copper River includes both unvegetated gravel bars and areas of shrubs and poplars. The River is incised here into the Ahtna Lacustrine Plain (ALP), which lies above and behind the bluffs on either side of the river.

Detailed ecological units in the Middle Copper River Floodplain and Terraces Subsection:
MCF1 Copper River High Terraces - 75 km^2
MCF2 Middle Copper River Floodplain - 6 km^2
MCF3 Middle Copper River Floodplain and Terraces - 20 km^2

MCF1 Copper River High Terraces

Geology and Physiography: alluvial terraces composed mostly of sand and gravel. Height above present-day Copper River is variable, up to about 100 m. Terraces are above the reach of floods by the Copper River, but may locally be flooded by smaller tributary streams. The southernmost terrace near the confluence of the Copper and Chitina Rivers has a thick eolian silt and sand mantle (Nichols and Yehle, 1969).

Elevation: 180 to 515 m (591 to 1690 ft)

Soils: mostly well-drained soils with a loamy surface layer about half a meter thick over sand and gravel and lacking permafrost. Some areas have a thicker loamy surface layer, permafrost within 1 m depth, and a thick (> 20 cm) organic surface layer.

Vegetation/land cover: highly variable, depending on fire history and soil wetness. Unburned areas are mostly closed spruce forest, with lesser areas of black spruce woodland in areas with permafrost. Burned areas usually have deciduous forest or brush.

Notes: the Copper River has apparently been downcutting in post-glacial time, leaving former floodplain areas as high terraces.

MCF2 Middle Copper River Floodplain

Geology and Physiography: active channel and newly vegetated gravely bars of the Copper River. Channel form is weakly braided in the upper part, becoming distinctly braided below. All areas are subject to flooding and/or channel migration.

Elevation: 154 to 341 m (505 to 1119 ft)
Soils: stratified sand and gravel, well-drained, lacking permafrost, with little or no loamy surface layer.
Vegetation/land cover: mostly water or unvegetated sand and gravel. Less disturbed areas have deciduous shrubs or poplar trees.
Notes:

MCF3 Middle Copper River Floodplain and Terraces

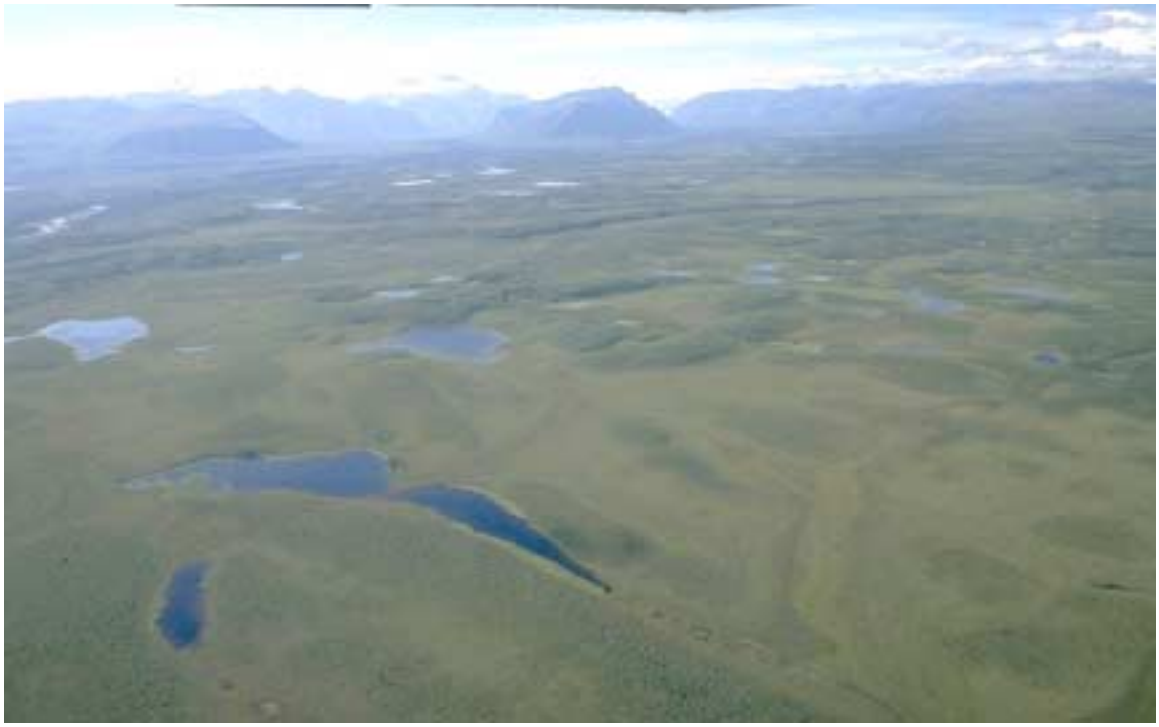
Geology and Physiography: floodplain and low terraces of the Copper River in a section where channel is braided and meandering. Includes some terraces above the reach of present-day floods, but terraces are mostly low and still subject to erosion by the migrating river channel.
Elevation: 303 to 550 m (994 to 1804 ft)
Soils: probably dry, stratified sand and gravel on young or frequently flooded surfaces. Older, forested surfaces probably have similar soils, with a loamy surface layer up to half a meter or so thick and a thin (< 20 cm) organic surface. Some areas under black spruce forest probably have a thick (1 m or more) loamy surface layer, thick organic surface layer (> 20 cm), are wetter, and have permafrost.
Vegetation/land cover: highly variable depending on flooding and successional stage. Ranges from sparse vegetation, deciduous shrubs, and poplar forest on young or frequently flooded surfaces, to white spruce and black spruce forest on older surfaces.
Notes: in this region the active floodplain and terraces are not readily separable. Along the Copper River further downstream the terraces are large, high, and clearly abandoned. Upstream from this unit the river has a more braided channel form and unflooded terraces are not high but broad and easily delineated. Vegetation and soils along this stretch of river probably resemble in a general way those described for the Chena River by Viereck (1970).

NAP Natat Plain Subsection

Detailed ecological units in the Natat Plain Subsection:
NAP1 Natat Plain - 143 km^2

NAP1 Natat Plain

Geology and Physiography: nearly level region composed mostly of fine-grained lacustrine, glaciolacustrine, or alluvial deposits.
Elevation: 672 to 1091 m (2205 to 3579 ft)
Soils: mostly wet soils with permafrost within 0.5 m of the surface. The surface organic layer is probably > 20 cm thick in most places and could be > 40 cm thick in some lower areas.
Vegetation/land cover: slightly higher areas have open black spruce forest or woodland with low shrubs. Lower areas have sedges, cottonsedge, and low shrubs. Small areas of deciduous forest occur on high spots that have burned in the not-too-distant past.
Notes: this plain has a pattern of broad, shallow channels that was probably produced by wanderings of slow-moving rivers in the past.



The Tanada Moraine is an undulating plain with numerous lakes, and vegetation mostly of spruce woodland and low shrubs. The flat-topped ridges in the background are part of the adjacent Tanada Mountains Subsection (TNM) in the Wrangell Mountains Ecoregion.

Detailed ecological units in the Tanada Moraine Subsection:
TAM1 Tanada Creek Floodplain - 7 km^2
TAM2 Tanada Moraine - 318 km^2
TAM3 Tanada Moraine Reach of the Copper River - 13 km^2

TAM1 Tanada Creek Floodplain

Geology and Physiography: floodplain of a small stream with mostly meandering channel form and non-glacial source. Upper (easternmost) part appears to be an area of major icing (aufeis). Sediment is probably relatively fine-grained (silty) compared to larger streams in the region.

Elevation: 755 to 868 m (2477 to 2848 ft)

Soils: mostly stratified silt and sand, with permafrost lacking in early-successional vegetation and present in later-successional vegetation.

Vegetation/land cover: deciduous shrubs, poplar, and white spruce forest near the channel; black spruce woodland in rarely flooded areas.

Notes:

TAM2 Tanada Moraine

Geology and Physiography: undulating glacial moraine with numerous lakes. Topography is drumlinoid (streamlined by flow of glacial ice) in some areas.

Elevation: 646 to 1031 m (2119 to 3383 ft)

Soils: probably loamy soils with some rocks, possibly covered by silty loess. Permarfrost is probably present but is probably deep (below 1 m) on hill crests; on low slopes and in depressions it is probably nearer the surface (0.5 m), soils are wet, and a thick organic surface horizon is present (10-40 cm). Wet, organic soils (peat accumulation > 40 cm) are probably present in many depressions.

Vegetation/land cover: spruce woodland with low shrubs on slopes. Wet sedge, cottonsedge, and low shrubs in depressions.

Notes: on slopes with permafrost in landscapes such as this, fires can have a large effect on the permafrost and soil wetness: permafrost often thaws and soils become drier after fires. For more details, see Viereck (1973, 1983) and Swanson (1996b).

TAM3 Tanada Moraine Reach of the Copper River

Geology and Physiography: floodplain and low terraces of a river with meandering and braided channel form.

Elevation: 759 to 879 m (2490 to 2884 ft)

Soils: in early successional vegetation, stratified sand and gravel with thin loamy surface, dry, without permafrost. In spruce forest or woodland, a thicker loamy surface is probably present over sand and gravel; in oldest stands, permafrost is probably present at about 1 m depth.

Vegetation/land cover: unvegetated or sparse herbs and shrubs on gravel bars, deciduous shrubs and poplar forest, spruce woodland or open forest on less disturbed areas.

Notes:

UCO Upper Copper River Floodplains and Terraces Subsection

This part of the Copper River floodplain has a braided channel with barren gravel bars and areas being colonized by shrubs, poplar trees, and white spruce. It runs across the Ahtna Lacustrine Plain (ALP) with less incision than farther downstream.

Detailed ecological units in the Upper Copper River Floodplains and Terraces Subsection:
UCO1 Upper Copper - Chistochina River Floodplains - 42 km^2
UCO2 Upper Copper River Terraces - 90 km^2

UCO1 Upper Copper - Chistochina River Floodplains

Geology and Physiography: active floodplains of rivers with braided and meandering channel form. Composed of sand and gravel. All parts are subject to flooding or channel migration.

Elevation: 486 to 735 m (1594 to 2411 ft)

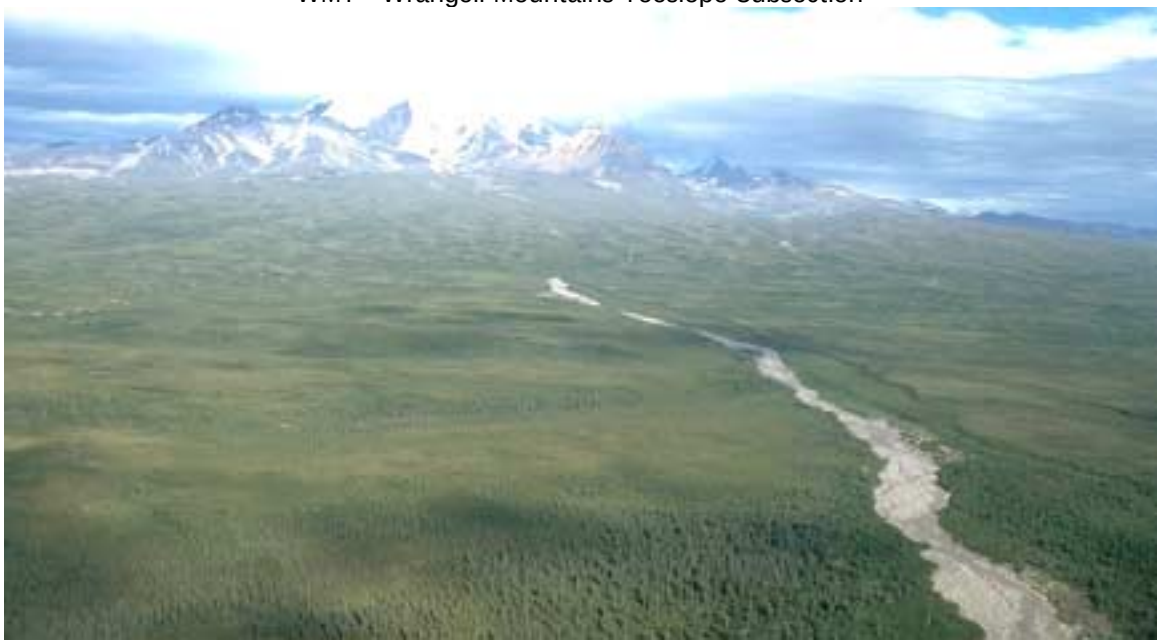
Soils: mostly stratified sand and gravel, well-drained, lacking permafrost, with little or no loamy surface layer.

Vegetation/land cover: mostly unvegetated gravel bars, water, deciduous shrubs, or poplar trees. A few small areas of spruce forest or woodland on less disturbed surfaces are present.
Notes:

UCO2 Upper Copper River Terraces

Geology and Physiography: low alluvial terraces of the Copper and Chistochina Rivers. Probably beyond the reach of floodwaters of these rivers in most parts, but still could be re-occupied by the active channel if it migrates. Probably composed of sand and gravel with a surface layer of silt and sand.
Elevation: 486 to 761 m (1594 to 2497 ft)
Soils: probably mostly loamy soils with sand and gravel a unknown depth – probably 0.5 to 1.5 m. Permafrost is probably present in most areas at 0.5 to 1.5 m depth, and an organic surface layer is present.
Vegetation/land cover: mostly open black spruce forest and woodland, with some open white spruce forest, deciduous forest on burns, and dwarf shrub-sedge in wetter areas.
Notes:

WMT Wrangell Mountains Toeslope Subsection



The Wrangell Mountains Toeslope is the gently undulating, mostly forested region in the lower half of this photograph, back about as far as the small stream floodplain is visible. This toeslope is mostly covered by glacial till, above the highest shorelines of the former (Pleistocene) Lake Ahtna. The Wrangell Mountains Toeslope subsection has mostly spruce open forest and woodland, with shrubs more abundant near treeline. Mt. Drum is visible in the background.

Detailed ecological units in the Wrangell Mountains Toeslope Subsection:
WMT1 Capital Mountain Fans - 80 km^2
WMT2 Cheshnina Moraine - 113 km^2
WMT3 Drum Moraine - 323 km^2
WMT4 Wrangell Mountains Toeslope - 582 km^2

WMT1 Capital Mountain Fans

Geology and Physiography: alluvial fans, floodplains, and terraces of small streams (Boulder Creek, Drop Creek) on the north side of Capital Mountain. Composed of silt, sand, and gravel.
Elevation: 566 to 1052 m (1857 to 3451 ft)

Soils: in black spruce forest or low shrub areas, probably loamy wet soils with permafrost at 0.5 to 1 m depth and a surface organic layer 10-40 cm thick. In areas near active channels with shrubs, poplars, or white spruce, soils are probably dry, lack permafrost, and consist of a thin layer of silt and sand over sand and gravel.

Vegetation/land cover: portions of fans that have not been flooded for a long time have open black spruce forest or woodland, or low shrubs and sedge. Areas near to active channels have sparsely vegetated gravel bars, deciduous shrubs, poplar forest, or white spruce forest depending on disturbance and successional stage.

Notes:

WMT2 Cheshnina Moraine

Geology and Physiography: rounded hills consisting of glacial till and possibly ice-contact deposits over bedrock. Till is probably mostly loamy with many coarse fragments.

Elevation: 547 to 1040 m (1795 to 3412 ft)

Soils: loamy soils with rocks, mostly well-drained. Permafrost may be present but is probably below 1 m depth.

Vegetation/land cover: mostly open white spruce forest, or post-fire succesional deciduous shrubs.

Notes:

WMT3 Drum Moraine

Geology and Physiography: irregular to rolling plain, sloping generally to the west, at the foot of Mt. Drum. Consists of moraine, including till and ice-contact deposits: a complex mixture of material with a wide range of grain sizes from silt to boulders. Includes some alluvial fan deposits from small streams flowing off Mt. Drum.

Elevation: 617 to 1005 m (2024 to 3297 ft)

Soils: probably mostly loamy (locally sandy) soils with rocks and fairly good drainage due to slopes. Permafrost status is unknown; permafrost is likely to be present at 1-2 m depth in loamy soils and deeper or absent in sandy soils.

Vegetation/land cover: mostly open spruce forest or woodland, with deciduous shrubs in burned areas and near the upper boundary where elevation approaches treeline.

Notes: the lower boundary of this unit approximately follows the upper limit of glaciolacustrine deposits in Nichols and Yehle (1969). Geological material in the Drum Moraine is generally coarser than in the adjacent glaciolacustrine sediments. The Upper Klawasi and Shrub Mud Volcanoes are in the Drum Moraine unit. These are unique saline springs that also emit mud and gases, sometime explosively. The gases (a mixture of carbon dioxide, methane, and nitrogen) are toxic and have killed plants and wildlife in the vicinity. The water is thought to originate from the interaction of deep groundwater with magma and rocks surrounding the magma (Granz et al., 1962; Richter et al., 1998).

WMT4 Wrangell Mountains Toeslope

Geology and Physiography: undulating plain with regional slope to the west and north, away from the Wrangell Mountains. Probably composed mostly of glacial till over bedrock. Bedrock (mostly andesite) is exposed locally in gulleys and on rock knobs.

Elevation: 601 to 1288 m (1972 to 4226 ft)

Soils: probably mostly loamy soils with rocks and fairly good drainage due to slopes. Permafrost status is unknown; permafrost is likely to be present at 1-2 m depth.

Vegetation/land cover: mostly spruce woodland and open forest. Has more deciduous shrubs (probably alder) than adjacent lower parts of the Copper River Basin, due to its position near treeline.

Notes: this unit is situated mostly above the strandlines (beaches) marking the highest extent of glacial Lake Ahtna (Ferrians, 1989). There are many irregular ridges and mostly dry channels that run across the regional slope. They were probably formed when ice filled the Copper River Basin (Nichols, 1989), depositing moraines and cutting meltwater channels along the upper margin of the ice.

Ecological Unit Descriptions – Gulf of Alaska Coast Region

The map legend for ecological units of the Gulf of Alaska Coast Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 5. The criteria used to delineated the subsections are summarized in Table 13. Mean climatic data for Yakataga and Yakutat, Alaska in the Gulf of Alaska Coast ecoregion are given in Tables 23 and 24.

MAF Malaspina Foreland Subsection

The Malaspina Foreland is a nearly flat area along the Gulf of Alaska. Sparsely vegetated beach, lagoon, and delta deposits of the Malaspina Coast are visible near the ocean here. The vegetated area immediately behind the beach ridges in the center, and the unvegetated river plain in the middle right are non-marine deposits of Malaspina Drift Plain. The Malaspina Glacier and Malaspina Lake (in the adjacent Malaspine Glacier Subsection, MAG) are visible in the background.

Detailed ecological units in the Malaspina Foreland Subsection:
MAF1 Icy Bay Coastal Plain - 13 km^2
MAF2 Malaspina Coast - 42 km^2
MAF3 Malaspina Drift Plain - 205 km^2
MAF4 Malaspina Outwash Streams - 49 km^2

MAF1 Icy Bay Coastal Plain

Geology and Physiography: nearly level plain, covered until sometime in the 20th century by the Guyot Glacier and exposed by retreat of that glacier. Probably composed of coarse-grained glacial till and outwash, with some alluvium from small streams originating in the mountains to the east.

Elevation: 0 to 345 m (0 to 1132 ft)

Soils: probably coarse-grained, dry soils with little horizon development.

Vegetation/land cover: mostly unvegetated at the date of the air photos (1978) but by the satellite image date (1985) about one third covered by dense deciduous shrubs. Vegetation

succession should progress rapidly here, with shrub cover soon becoming complete, followed by trees if a seed source is available.

Notes: for more information on plant succession and soil development on deposits such as these in southeast Alaska, see Crocker and Major (1955), Crocker and Dickson (1957), Mirsky (1966), James (1988), Chapin *et al*. (1994), and Fastie (1995).

MAF2 Malaspina Coast

Geology and Physiography: low areas near the ocean composed of young marine deposits: sandy beach, bar and spit deposits; and wet lagoon and delta deposits.

Elevation: 0 to 26 m (0 to 85 ft)

Soils: highly variable depending on geologic material and age of the surface. Recently deposited, coarse-grained materials probably have dry soils with little horizon development, with surface organic matter accumulating under shrubs and then Spodosols (Podzols) forming under mature forest. Fine-grained materials and depressional areas probably have wet soils that with time develop a thick organic surface layer.

Vegetation/land cover: vegetation is complex due to disturbance and succession. Active beaches and tidal flats are mostly unvegetated. Higher areas have herbaceous vegetation, shrubs, or spruce forest, depending on the successional stage.

Notes: delineation of this unit mostly follows marine deposits as mapped by Plafker and Miller (1958).

MAF3 Malaspina Drift Plain

Geology and Physiography: undulating plain composed of glacial till and glacial outwash alluvium from the Malaspina Glacier. Probably mostly coarse-grained material. Includes a small area of similar deposits from Variegated and Hubbard Glaciers near the mouth of Russell Fiord.

Elevation: 0 to 244 m (0 to 801 ft)

Soils: probably most dry, coarse-grained soils. On young alluvial deposits with sparse vegetation or shrubs there is probably little horizonation due to the youth of the deposits. The oldest moraine deposits with mature spruce forest probably have the distinct horizons of a Spodosol (Podzol): organic surface, bleached E horizon, and underlying reddish brown B horizon.

Vegetation/land cover: highly variable due to disturbance and plant succession. Active floodplains have little or no vegetation. Floodplains that have not been flooded for a period of years are being colonized rapidly by herbs, deciduous shrubs, and poplars. Older surfaces, especially older moraines, have coniferous forest (spruce or spruce-hemlock).

Notes: plant succession and soil development on deposits like these elsewhere in southeast Alaska (especially Glacier Bay) have been the subject of much research (Crocker and Major, 1955; Crocker and Dickson, 1957; Mirsky, 1966; James, 1988; Chapin *et al*., 1994; Fastie, 1995). See the Malaspina Glacier subsection in the Chugach-St. Elias Ecoregion for more information on the Malaspina Glacier.

MAF4 Malaspina Outwash Streams

Geology and Physiography: floodplains of braided glacial outwash rivers draining from the Malaspina Glacier.

Elevation: 2 to 231 m (7 to 758 ft)

Soils: probably mostly stratified sand and gravel with little soil development.

Vegetation/land cover: mostly unvegetated gravel bars. Some less disturbed areas have herbaceous vegetation, deciduous shrubs, and poplar forest.

Notes:

Ecological Unit Descriptions – Kluane Range Region

The map legend for ecological units of the Kluane Range Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 6. The criteria used to delineated the subsections are summarized in Table 14. Mean climatic data for Nabesna, Alaska (near the northwestern limit of this ecoregion, elevation 2900 ft.) are given in Table 20.

CHB Chisana Basin Subsection

The Chisana Basin Subsection includes braided, sparsely vegetated floodplains of the Chisana River (background) and smaller tribuary streams (foreground), with undulating, mostly forested moraines in between.

Detailed ecological units in the Chisana Basin Subsection:
CHB1 Chisana Basin Alluvial Fans - 55 km^2
CHB2 Chisana Basin Moraines - 369 km^2
CHB3 Upper Chisana River Floodplain - 61 km^2

CHB1 Chisana Basin Alluvial Fans

Geology and Physiography: coarse-grained alluvium in fans from tributary streams to the Chisana River

Elevation: 928 to 1422 m (3045 to 4665 ft)

Soils: areas with sparse vegetation or open herbs and shrubs are probably stratified sand and gravel with little horizon development. The white spruce forests probably have similar soils with a surface organic layer. Older white spruce and black spruce forests probably have a fine-grained surface layer of alluvium, loess, or volcanic ash, with a thicker organic surface and permafrost possibly present.

Vegetation/land cover: highly variable depending on disturbance and successsional stage. Active river channels have little or no vegetation. Less disturbed areas have herbs and deciduous shrubs, possibly balsam poplar forest. Older surfaces have open or closed white spruce forest. A few areas most distant from the active channels have black spruce woodland.

Notes:

CHB2 Chisana Basin Moraines

Geology and Physiography: gently sloping moraines deposited during the Late Pleistocene, mainly by ice flowing out of the Wrangell Mountains to the southwest. Probably covered by loess and volcanic ash.

Elevation: 913 to 1808 m (2995 to 5932 ft)

Soils: probably soils formed in fine-grained volcanic ash and loess over coarser moraine, with variable wetness depending on position. Gentle hill crests and shoulders probably have permafrost at 1 m or more and thinner organic surface layers (perhaps 10-20 cm). Lower areas probably have permafrost at about 0.5 m and thicker organic surface layers.

Vegetation/land cover: mostly low shrubs (at higher elevations in the west and southwest, and in burned areas) or spruce woodland with low shrubs.

Notes: this moraine has a curious system of incised channel in the north just east of the Chisana River. It may have been produced by subglacial drainage during the Pleistocene.

CHB3 Upper Chisana River Floodplain

Geology and Physiography: coarse-grained floodplain of a braided river

Elevation: 927 to 1547 m (3041 to 5075 ft)

Soils: mostly active gravel bars and water without soil. Less-disturbed areas, especially in the south, probably have soils composed of stratified sand and gravel with very weak A horizon development

Vegetation/land cover: mostly unvegetated gravel bars and water. Less-disturbed areas, especially in the south, have sparse to open cover of herbs and deciduous shrubs.

Notes:

NIM Nutzotin Igneous Mountains Subsection

Detailed ecological units in the Nutzotin Igneous Mountains Subsection:
NIM1 Nutzotin Igneous Mountains - 526 km^2

NIM1 Nutzotin Igneous Mountains

Geology and Physiography: rugged mountains composed of andesitic volcanic rocks and granitic intrusives. Higher elevations have numerous cirque glaciers, and high valley sides have numerous rock glaciers originating from talus slopes (for general information on rock glaciers, see Wahrhaftig and Cox, 1959).

Elevation: 1059 to 2568 m (3474 to 8425 ft)

Soils: high elevations have snow, ice, bare rock and rock rubble without soil. Vegetated areas probably have loamy soils with abundant rocks, little horizon development, and permafrost at perhaps 1 to 2 m depth. Low elevations with denser shrub cover probably have similar soils with a surface organic horizon.

Vegetation/land cover: mostly snow, ice, bare rock and rock rubble, and open dwarf shrubs. In the southeastern part elevations are lower and lower valley slopes have closed or open low or mid-sized shrubs.

Notes:

The Nutzotin Sedimentary Mountains are rugged mountains with relatively little permanent ice and snow due to their interior location and relatively modest height. They have mostly sparse alpine tundra vegetation except in major valleys such as the one pcitured here, where forest occurs on lower slopes. The Chisana River cuts across the subsection with a large braided floodplain, visible on the left.

Detailed ecological units in the Nutzotin Sedimentary Mountains Subsection:
NSM1 Chisana Canyon Floodplain - 13 km^2
NSM2 Mt. Allen Highland - 75 km^2
NSM3 Nutzotin Glaciated Ridges - 17 km^2
NSM4 Nutzotin Mountains Valleys - 118 km^2
NSM5 Nutzotin Sedimentary Mountains - 1628 km^2

NSM1 Chisana Canyon Floodplain

Geology and Physiography: braided river floodplain, composed mostly of sand and gravel alluvium.

Elevation: 821 to 996 m (2694 to 3268 ft)

Soils: mostly dry soils of stratified sand and gravel with little horizon development and no permafrost.

Vegetation/land cover: mostly unvegetated gravel bars and water. Includes some areas of sparse shrubs and herbs, and open deciduous shrubs or small balsam poplars.

Notes: this unit includes the part of the Chisana River floodplain that passes through the Nutzotin Mountains.

NSM2 Mt. Allen Highland

Geology and Physiography: a high region in the Nutzotin Mountains, with substantial cover by glaciers. Bedrock is mostly argillite and graywacke. Glaciers have a high proportion of debris to snow input, and as a result become rock glaciers at their downstream ends.

Elevation: 1626 to 2814 m (5335 to 9232 ft)

Soils: mostly bare rock, rock rubble, snow, and ice without soil. Some dry, weakly developed, very rocky soils with sandy loamy matrix probably occur on stabler sites. Permafrost is probably present but mostly below 1 m depth.

Vegetation/land cover: mostly snow, ice, scree, and rock rubble. Some dwarf shrubs and herbs on favorable sites.

Notes:

NSM3 Nutzotin Glaciated Ridges

Geology and Physiography: rounded low ridges that were probably overridden by glaciers during the late Plesitocene. Composed of argillite, siltstone, and graywacke with a discontinuous mantle of glacial till and colluvium, probably topped with volcanic ash on gentle slopes.

Elevation: 941 to 1306 m (3087 to 4285 ft)

Soils: mostly loamy soils with rocks, fairly dry, with permafrost possibly present but below 1 m depth. Soils on gentle slopes may have several decimeters of volcanic ash. Concave footslopes probably have wetter soils with permafrost.

Vegetation/land cover: ridgetops appear to be low shrubs with scattered white spruce trees. Steep slopes have denser shrubs and more trees. Some black spruce woodland with low shrubs on footslopes.

Notes:

NSM4 Nutzotin Mountain Valleys

Geology and Physiography: U-shaped valleys in the Nutzotin Mountains that were glaciated during the Pleistocene. Sediments include alluvium from small rivers in the axis of the valley, fan alluvium from small side drainages, slope deposits, and glacial till.

Elevation: 794 to 1416 m (2605 to 4646 ft)

Soils: highly variable depending and landform. Coarse-grained soils and soils under early successional vegetation on fans and floodplains are probably mostly stratified sand, gravel, and silt, fairly dry and without permafrost. Gentle slopes lower on fans and on moraines probably have a surface organic layer 10-30 cm thick and permafrost within 1 m depth. The latter soils probably have a layer of volcanic ash just under the organic mat.

Vegetation/land cover: well-drained soils on floodplains on alluvial fans have mostly white spruce forest, probably mixed with poplars (on floodplains) or with an alder understory (on fans). Gently sloping and wetter parts of fans and moraines probably have black spruce woodland with low shrubs.

Notes:

NSM5 Nutzotin Sedimentary Mountains

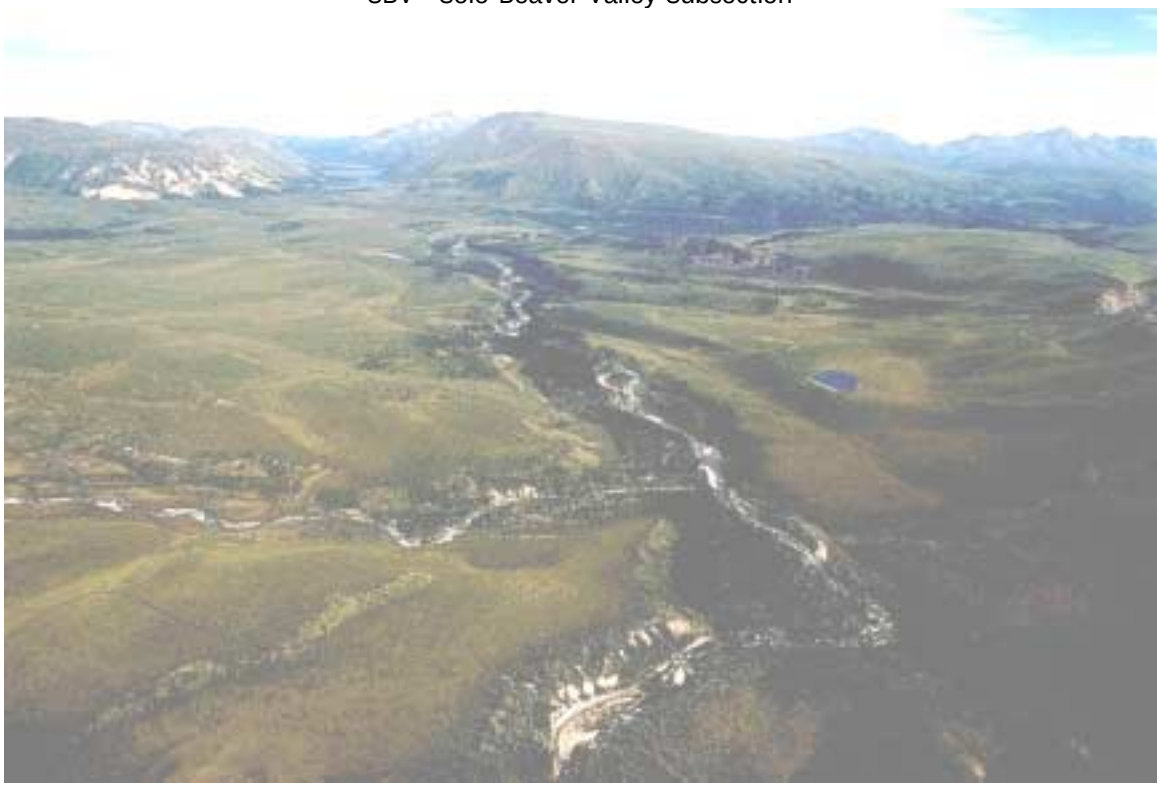
Geology and Physiography: rugged mountains composed mostly of argillite and graywacke, with some volcanics in the east and a dioritic intrusive in the west. Mountains were glaciated during the Pleistocene but today have only a few small cirque glaciers. Many valley bottoms have rock glaciers, most of which are now vegetated. For general information on rock glaciers, see Wahrhaftig and Cox (1959)

Elevation: 658 to 2555 m (2159 to 8383 ft)

Soils: probably very gravelly soils with a sandy loam matrix, well-drained, with little horizon development. Permafrost is probably present, but likely to be below 1 m depth.

Vegetation/land cover: mountain slopes have mostly unvegetated rock, rock rubble, and scree. More stable surface at high elevations have dwarf shrub tundra. Lower slopes have low to mid-sized shrubs. On favorable sites, especially south-facing slopes at low elevation, there is an open spruce overstory above the shrubs.

Notes:



The Solo-Beaver Valley is a wide valley with rolling morainal hills and river floodplains. Most of it is near treeline; and trees occur mainly along streams, with low shrubs elsewhere. The Horsfeld Plateau, in the Southern Nutzotin Hills and Mountains Subsection (SNH), is visible in the background.

Detailed ecological units in the Solo-Beaver Valley Subsection:
SBV1 Beaver Creek Morainal Valley - 203 km^2
SBV2 Solo Flats - 181 km^2
SBV3 Upper Beaver Creek Floodplain - 31 km^2

SBV1 Beaver Creek Morainal Valley

Geology and Physiography: gently sloping valley and low hills, composed mostly of late Pleistocene glacial till, mantled with the White River volcanic ash. Also includes some floodplains too narrow to map separately, and alluvial fans from side valleys.

Elevation: 952 to 1651 m (3123 to 5417 ft)

Soils: probably loamy soils with some rocks, with a finer surface layer of volcanic ash of variable thickness. Higher areas probably are drier with permafrost at 1-2 m depth and surface organic layer 0 to 20 cm thick. Low areas probably have a thicker organic layer and permafrost nearer the surface.

Vegetation/land cover: shown as dominantly needleleaf woodland on the land cover map, but air photos and altitude suggest that low shrubs dominate, possibly low shrubs and cottonsedge, and trees are restricted to favorable sites.

Notes:

SBV2 Solo Flats

Geology and Physiography: broad, nearly level valley at relatively high elevation. Composed of Quaternary sediments including alluvium, probably glacial till, and possibly lake sediment, all mantled with White River volcanic ash.

Elevation: 1154 to 1559 m (3786 to 5115 ft)

Soils: wet soils with a thick organic surface layer over volcanic ash and permafrost within 0.5 m of the surface. Many areas probably also have organic soil (peat) buried under the ash.

Vegetation/land cover: mostly tundra wetland vegetation consisting of low shrubs and graminoids. Probably some black spruce woodland on favorable sites. The closed needleleaf forest shown on the McCarthy quadrangle landcover map is mismapped wet sedge and water (fen)

Notes: there is a large river overflow icing area (aufeis) at the confluence of Beaver and Carl Creeks in the far northern part of this unit. For general information on icings, see Carey (1973).

SBV3 Upper Beaver Creek Floodplain

Geology and Physiography: floodplain of small streams, including Beaver Creek and its tributaries (Ptarmigan Creek, Klein Creek, and Carl Creek). Includes meandering and braided channel forms; braided forms are mostly vegetated, in contrast to glacial braided rivers. Also includes some alluvial fans from small side drainages. Probably composed of stratified sand, gravel, and silt.

Elevation: 959 to 1404 m (3146 to 4606 ft)

Soils: highly variable with successional stage. Gravel bars, shrubs, and poplar forest probably have dry sandy and gravelly soils with little horizon development and no permafrost. Under black spruce woodland and tussock wetland there is probably a thick (>10 cm) surface organic layer, soils are wetter and probably have a fine-grained mantle, an permafrost is present. Permafrost is probably more widespread in the east, where it may occur under shrub areas with relatively coarse-grained soils.

Vegetation/land cover: gravel bars are unvegetated or sparsely vegetated with herbs and shrubs. Deciduous shrubs, balsam poplar, and white spruce forest occur as a function of successional stage. Some rarely flood sections, especially in the south on Ptarmigan Creek, have black spruce woodland or tussock wetland. Higher elevations in the west lack trees and instead have deciduous shrubs.

Notes: there is a large overflow icing (aufeis) area on the lower part of Carl Creek. For general information on icings, see Carey (1973).

The Fogenbera Lava Hills and Mesas are distinctive flat-toppped hills composed of volcanic rock that make up the majority of the Southern Nutzotin Hills and Mountains Subsection. They have sparsely vegetated rock rubble or alpine tundra vegetation. The valley curving in from the left is in the Solo-Beaver Valley Subsection (SBV).

Detailed ecological units in the Southern Nutzotin Hills and Mountains Subsection:
SNH1 Chisana Hills - 161 km^2
SNH2 Fogenbera Lava Hills and Mesas - 536 km^2
SNH3 Horsfeld Plateau - 72 km^2

SNH1 Chisana Hills

Geology and Physiography: rounded low mountains composed mostly of andesitic volcanic rocks, with some intrusives (diorite) and clastic sedimentary rocks.

Elevation: 1114 to 1890 m (3655 to 6201 ft)

Soils: probably mostly well-drained loamy soils with rocks, with permafrost present but below 1 m depth. Surface organic layers are probably thin (0 - 20 cm) on convex and steep slopes, possibly thicker on more gentle slopes.

Vegetation/land cover: ridge crests are probably dwarf shrubs and herbs, with sparsely vegetated rubble in places. Lower slopes appear to be mostly low- to mid-sized shrubs. The needleleaf woodland on the land cover map seems doubtful here.

Notes:

SNH2 Fogenbera Lava Hills and Mesas

Geology and Physiography: low mountains with rounded or flat summits, composed of mostly andesitic volcanic rocks.

Elevation: 974 to 2145 m (3196 to 7037 ft)

Soils: mostly coarse-grained loamy soils with abundant rocks. At high elevations the surface organic layer is thin and active layer probably 1 to 2 m thick. Patterned ground (sorted circles, nets, and stripes) is probably common. On lower slopes there is probably a thicker surface organic layer and fewer rocks, and permafrost within 1 m of the surface.

Vegetation/land cover: steep upper slopes below flat-topped mountains are mostly bare rock and scree. More stable (i.e. flatter) high-elevation areas have open or closed dwarf shrubs. Lower slopes have low shrubs, with sparse spruce overstory in places.

Notes: there is a large rockslide on the south side of Euchre Mountains, near the terminus of the Chisana Glacier.

SNH3 Horsfeld Plateau

Geology and Physiography: low mountains with broad, flat-topped summit and steep sides. Composed mostly of granitic rocks, with some argillite and graywacke on the north side. Mantled with slope deposits in many places, probably in the form of a pediment (a relatively thin layer of slope deposits over bedrock; French and Harry, 1992).

Elevation: 960 to 1828 m (3150 to 5997 ft)

Soils: higher areas probably have loamy soils with abundant rocks and little surface organic layer, fairly well drained, with permafrost present but usually at more than 1 m depth. Sorted circles and nets are probably common. Lower elevations with denser vegetation probably have wetter soils, loamy with fewer rocks, with a surface organic layer perhaps 20-30 cm thick, and permafrost at less than 1 m depth.

Vegetation/land cover: higher elevations are dwarf shrubs and rock rubble. Lower elevations are mapped as needleleaf woodland on the land cover map, although closed low shrubs seems more likely based on the high elevation and air photo tones.

Notes:

WRB White River Basin Subsection

The White River Basin Subsection includes hummocky, forested glacial moraines (dark colored in the foreground), the extensive braided floodplain of the White River (in the middle ground), and alluvial fans (an example of an alluvial is on the far side of the White River Floodplain, deposited by a small tributary stream from the background mountains). Mt. Sulzer, in the Sulzer-Natazhat Mountains Subsection (SUM, in the Chugach-St. Elias Ecoregion), is visible in the background.

Detailed ecological units in the White River Basin Subsection:
WRB1 Burnt Hill Moraine - 230 km^2
WRB2 Guerin Moraine - 37 km^2

WRB3 Pingpong Hills - 16 km^2
WRB4 Sulzer-Natazhat Alluvial Fans - 257 km^2
WRB5 White River Floodplain - 105 km^2

WRB1 Burnt Hill Moraine

Geology and Physiography: basin covered with late Pleistocene moraine deposited by glaciers originating mainly in the St. Elias Mountains to the south. Probably covered by loess and volcanic ash. Includes numerous small ponds and several large lakes.

Elevation: 870 to 1422 m (2854 to 4665 ft)

Soils: most soils probably have permafrost, with a thick active layer (1-2 m) and thin organic surface layer (0-20 cm) on hill crests and thicker organic layer with permafrost at less than 1 m depth in depressions. The latter soils are also quite wet. Soil material is probably mostly fine-grained volcanic ash, with stoney glacial till at depth, locally near the surface on hill shoulders and summits.

Vegetation/land cover: mostly black spruce woodland with low shrubs. Depressions appear to have low shrub-cottonsedge vegetation, and some hilltops have denser spruce forest.

Notes:

WRB2 Guerin Moraine

Geology and Physiography: hummocky moraines on a valley floor at the foot of the mountains, from the Guerin, Natazhat, and Griffin glaciers (the latter has been mostly destroyed by Holmes Creek). Includes both older (probably late-Pleistocene moraines) mantled by the White River Ash and younger moraines (near to Guerin Glacier) that may be still ice-cored.

Elevation: 1139 to 1657 m (3737 to 5436 ft)

Soils: the younger moraines probably have loamy soils with numerous rocks and little soil development. The older moraines probably have soils consisting of a thin organic layer (locally absent) over volcanic ash. Rocky glacial till occurs deep in the soil profile, locally near the surface where ash has been eroded off.

Vegetation/land cover: on the older moraines, mostly spruce woodland with low shrubs, with patches of unvegetated volcanic ash. On the younger moraines, vegetation appears to be mostly deciduous shrubs and herbs, probably sparse in the most unstable areas.

Notes: the ash-covered moraine is pictured and described on p.118 in Winkler (2000). The White River Ash erupted from Mt. Churchill about 1250 and 1900 years ago (Lerbekmo, and Campbell, 1969; Richter *et al.*, 1995). It is about 1 m thick on the older moraines (Winkler, 2000).

WRB3 Pingpong Hills

Geology and Physiography: rounded or flat-topped hills, probably composed of andesitic volcanic rocks and with a mantle of White River volcanic ash.

Elevation: 954 to 1319 m (3130 to 4327 ft)

Soils: Soils on steep, south-facing slopes are probably dry, and lack permafrost and an ash mantle. Areas under black spruce woodland probably are wetter, with an organic surface layer over volcanic ash and permafrost within 1.5 m.

Vegetation/land cover: steep, south-facing slopes appear to be dry herbs, deciduous shrubs, and aspens. Elsewhere vegetation is mostly black spruce woodland.

Notes:

WRB4 Sulzer-Natazhat Alluvial Fans

Geology and Physiography: large coalescing alluvial fans from streams that originate in the Sulzer-Natazhat Mountains to the south. Older surfaces are probably mantled with a thick layer of White River volcanic ash and probably some loess also.

Elevation: 889 to 1437 m (2917 to 4715 ft)

Soils: soils are absent from active floodplains. In the white spruce forest and deciduous shrubs on the more active parts of the fans, soils are probably stratified sand, gravel, and silt, with a thin organic surface and probably some buried organic layers, and permafrost probably absent

except perhaps in some mature spruce forest. In the (probable) black spruce woodland, soils are likely to consist of an organic layer over volcanic ash, with permafrost within 1 m of the surface.

Vegetation/land cover: highly variable as a function of flood disturbance and successional state. Active channels are unvegetated (or nearly so) sand and gravel. Recently abandoned channels have an incomplete cover of herbs, deciduous shrubs, and balsam poplars. Less disturbed areas between these channels have open or closed spruce forest (probably white spruce). Extensive fan surfaces between these relatively active areas have spruce (probably black spruce) woodland with low shrubs.

Notes: The White River Ash erupted from Mt. Churchill about 1250 and 1900 years ago (Lerbekmo and Campbell, 1969; Richter et al., 1995). It is about 1 m thick in this region (Winkler, 2000). In the active parts of the fans the ash has probably eroded off, while in places where stream channels have not migrated since deposition of the ash the full 1 m should be present.

WRB5 White River Floodplain

Geology and Physiography: floodplain of a braided river.

Elevation: 880 to 1368 m (2887 to 4488 ft)

Soils: mostly sand and gravel without soil. In areas less disturbed by flooding, weakly developed soils of stratified sand and gravel with a little silt.

Vegetation/land cover: mostly unvegetated sand, gravel, and water. Areas less disturbed by floods have vegetation mostly of herbs, willows, and small balsam poplars.

Notes: a good source of information on braided rivers is the study of the nearby Donjek River (Yukon Territory) by Williams and Rust (1969).

Ecological Unit Descriptions – Tanana-Kuskokwim Lowlands Region

The map legend for ecological units of the Tanana-Kuskokwim Lowlands Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 7. The criteria used to delineated the subsections are summarized in Table 15. Mean climatic data for Northway, Alaska in the Tanana-Kuskokwim Lowlands are given in Table 21.

JAF Jatahmund Basin Floodplains and Terraces Subsection

The Jatahmund Basin Floodplains and Terraces Subsection includes river deposits with various kinds of vegetation and soils. The active floodplain of the Chisana River (the light-colored band, JAF2) is sparsely vegetated gravel bars. In bands parallel to it are white spruce and poplar forest of the vegetated floodplain (JAF3). The foreground is spruce forest and wetlands on the wetter soils of the Jatahmund Basin Terraces and Fans (JAF1).

Detailed ecological units in the Jatahmund Basin Floodplains and Terraces Subsection:
JAF1 Jatahmund Basin Terraces and Fans - 150 km^2
JAF2 Lower Chisana Braided Floodplain - 28 km^2
JAF3 Lower Chisana Vegetated Floodplain - 42 km^2
JAF4 Lower Nabesna River Floodplain - 4 km^2
JAF5 Lower Nabesna River Vegetated Floodplain - 8 km^2
JAF6 Stuver Creek Floodplain - 8 km^2
JAF7 Jatahmund Basin Backswamps - 0 km^2

JAF1 Jatahmund Basin Terraces and Fans

Geology and Physiography: gently sloping alluvial surfaces produced by Pleistocene glacial outwash, locally overlain by recent alluvium from small streams. The latter is particularly common near the Nutzotin Mountains.

Elevation: 654 to 1031 m (2146 to 3383 ft)

Soils: probably moderately wet soils with permafrost formed in fine-grained loess, alluvium, and volcanic ash over sand and gravel.

Vegetation/land cover: mostly black spruce woodland with low shrubs. Locally near active small streams there is open or closed white spruce or mixed spruce-hardwood forest, or dense tall shrubs along channels.

Notes: in some places this unit has the peculiar pattern of isolated, evenly spaced large trees described in more detail under the Snag Alluvial Fans and Plain unit of the Yukon-Tanana Uplands.

JAF2 Lower Chisana Braided Floodplain

Geology and Physiography: active floodplain of a braided river, composed mostly of sand and gravel.

Elevation: 654 to 896 m (2146 to 2940 ft)

Soils: mostly stratified sand and gravel, possibly with a thin silt and sand surface layer, with little horizon development and no permafrost.

Vegetation/land cover: mostly unvegetated gravel bars. Some areas of open shrubs or sparse vegetation of shrubs and herbs.

Notes:

JAF3 Lower Chisana Vegetated Floodplain

Geology and Physiography: portions of the Chisana River floodplain that are now rarely flooded but were recently occupied by the active channel and could at any time be re-occupied.

Elevation: 654 to 825 m (2146 to 2707 ft)

Soils: mostly dry soils composed of stratified sand and gravel, with a surface loamy mantle that is probably thin (< 0.5 m), and buried organic layers. A surface organic layer is probably thin or absent in young stands and up to 30 cm thick in old spruce. Permafrost may be locally present under old spruce.

Vegetation/land cover: highly variable as a function of successional stage. The most recently disturbed areas have open scrub or open young white spruce and poplar forest. Older stands have closed or open forest of white spruce or mixed spruce and poplar.

Notes:

JAF4 Lower Nabesna River Floodplain

Geology and Physiography: floodplain of a braided river. Composed mostly of sand gravel, probably becoming finer at the lower end. Includes the active channel and recently abandoned areas with discontinuous vegetation that could be re-occupied by the active channel any time.

Elevation: 572 to 653 m (1877 to 2142 ft)

Soils: mostly stratified sand and gravel with little horizon development.

Vegetation/land cover: mostly unvegetated or sparsely vegetated gravel bars. Sparse vegetation consists of deciduous shrubs and herbs. Includes some more vegetated gravel bars with open shrubs or small balsam poplars.

Notes:

JAF5 Lower Nabesna River Vegetated Floodplain

Geology and Physiography: alluvial surface deposited by a braided river, now abandoned and rarely flooded but potentially subject to re-occupation by the active channel. Composed of sand and gravel. The surface appears to be only a few meters above the present river level.

Elevation: 578 to 670 m (1896 to 2198 ft)

Soils: mostly dry soils composed of stratified sand, gravel, and silt with buried organic layers and no permafrost. There is probably a loamy surface layer in many places and a surface organic

layer (< 20 cm thick) under spruce. The black spruce areas probably have a thicker loamy surface and a surface organic layer, and permafrost between 0.5 and 1 m depth.

Vegetation/land cover: appears to be mostly balsam poplar, white spruce, or mixed poplar-spruce forest. Some shrub areas along the meandering small channel in the center. On the periphery are some areas that appear to be open black spruce forest with low shrubs.

Notes:

JAF6 Stuver Creek Floodplain

Geology and Physiography: floodplain of a small braided river. Includes the active channel and rarely flooded areas that were recently occupied by the active channel and could at any time be re-occupied.

Elevation: 726 to 928 m (2382 to 3045 ft)

Soils: mostly stratified sand and gravel, possibly with a thin silt and sand surface layer, with little horizon development and no permafrost. In vegetated areas, dry soils of stratified sand and gravel, with a surface loamy mantle that is probably thin (< 0.5 m), and buried organic layer present. The surface organic layer is probably thin or absent in young stands and up to 30 cm thick in old spruce.

Vegetation/land cover: includes unvegetated and sparsely vegetated gravel bars, willow and poplar scrub, open mixed young forests of white spruce and poplar, and closed white spruce forest.

Notes:

JAF7 Jatahmund Basin Backswamps

Geology and Physiography: former floodplain areas now abandoned by rivers. Probably composed of 1 to several meters of loamy sediment and peat over sand and gravel. Contains numerous lakes of mixed oxbow and thermokarst origin.

Elevation: (occurs outside park boundaries)

Soils: mostly wet loamy or peat soils with permafrost at about 0.5 m depth.

Vegetation/land cover: mostly black spruce woodland, or low shrubs and cottonsedge.

Notes: this unit occur only north of Wrangel-St. Elias NPP boundaries.

The Jatahmund Basin Moraines have hummocky topography with numerous small lakes and wetlands in depressions and slightly higher, forested land in between.

Detailed ecological units in the Jatahmund Basin Moraines Subsection:
JAM1 Jatahmund Moraines - 178 km^2
JAM2 Jatahmund Basin Dry Moraines - 214 km^2

JAM1 Jatahmund Moraines

Geology and Physiography: hummocky plain composed of Pleistocene glacial moraine. Deposited by glaciers that flowed northward down the Nabesna and Chisana Valleys. Contain numerous ponds and small lakes.

Elevation: 666 to 866 m (2185 to 2841 ft)

Soils: soils are relatively dry and permafrost is absent or below 1 m depth on sharply convex hilltops. The fine-grained mantle over rocky glacial till is probably thin here. More gentle hilltops probably have permafost at 0.5 to 1.5 m and a surface organic layer up to 20 cm thick. The depressions between hills probably have wet, organic soils with permafrost at about 0.5 m, or similar soils with 20 to 40 cm of organic material over loess and volcanic ash.

Vegetation/land cover: varies greatly over short distances due to topography and soil wetness. Convex hilltops have spruce or hardwood forest, depending on the post-fire successional stage. Low areas between the hills have mostly low shrubs and cottonsedge, with some black spruce woodland.

Notes: this unit occurs mostly in Tetlin National Wildlife Refuge.

JAM2 Jatahmund Basin Dry Moraines

Geology and Physiography: hummocky plain composed of Pleistocene glacial moraines deposited by glaciers that flowed northward down the Nabesna, Chisana, Stuver Creek, and Snag Creek Valleys. Generally higher and with fewer wetland depressions than the Jatahmund Moraines.

Elevation: 668 to 1122 m (2192 to 3681 ft)

Soils: most convex hills and slope probably have a layer of loess and volcanic ash over loamy soil with numerous rocks. Permafrost is probably present in most areas but below 1 m depth on

convex hilltops, expecially in burns. On gentler slopes and in older forests soil are wetter and permafrost probably within 1 m of the surface. Small depressional areas probably have organic soils.

Vegetation/land cover: convex hilltops and slopes, which occupy most of this unit, have open spruce or hardwood forest, depending on post-fire successional stage. Depressional areas are occupied by ponds, wet moss-sedge, or black spruce woodland.

Notes: for general information on the response of soils and permafrost to fires on this kind of landscape, see Viereck (1973, 1983) and Swanson (1996b).

Ecological Unit Descriptions – Wrangell Mountains Region

The map legend for ecological units of the Wrangell Mountains Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 8. The criteria used to delineated the subsections are summarized in Table 16.

BDM Baldwin Mountains Subsection

Detailed ecological units in the Baldwin Mountains Subsection:
BDM1 Baldwin Mountains - 323 km^2
BDM2 Skolai Creek Floodplain - 7 km^2

BDM1 Baldwin Mountains

Geology and Physiography: rugged mountains composed of andesite and dacite. Includes lava plateaus, U-shaped valleys formed by glacial erosion, and sharp ridges between glacially eroded valleys. Higher plateau areas are covered by glaciers.

Elevation: 690 to 2764 m (2264 to 9068 ft)

Soils: high elevations are snow, ice, rock, and rock rubble without soil. Vegetated areas probably have rocky soils with coarse-loamy matrix. Permafrost is probably present but below 1 m depth, and soils are relatively dry. Sorted stripes, circles, and nets may be present on some gentle slopes.

Vegetation/land cover: higher elevations are unvegetated snow, ice, rock, and rock rubble. Lower elevations have mostly closed or open dwarf shrubs, with some taller shrubs on some lower slopes, especially on generally south-facing slopes.

Notes:

BDM2 Skolai Creek Floodplain

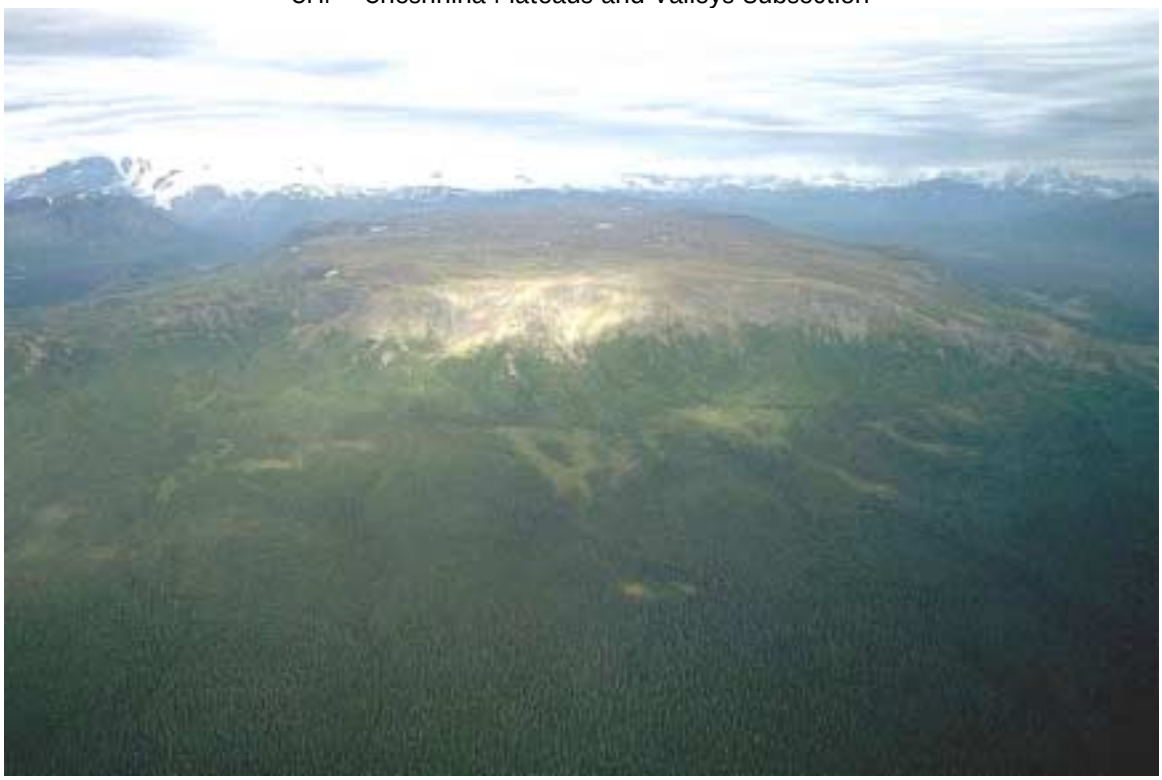
Geology and Physiography: floodplain of a braided glacial outwash stream, composed of sand and gravel. Includes two small lakes dammed by moraines and alluvial fans.

Elevation: BDM2 1350 to 1484 m (4429 to 4869 ft)

Soils: probably stratified sand and gravel with little horizon development, good drainage, and no permafrost.

Vegetation/land cover: the most active parts are unvegetated or sparsely vegetated gravel bars. Less disturbed parts have deciduous shrub vegetation.

Notes:



Alpine vegetation occurs on the flat top of an andesitic lava plateau in the Cheshnina Plateaus and Valleys Subsection. Lower slopes of the plateau have a glacial till mantle over the lava and denser shrub vegetation.

Detailed ecological units in the Cheshnina Plateaus and Valleys Subsection:
CHP1 Cheshnina and Chetaslina Valleys - 11 km^2
CHP2 Cheshnina Lava Plateaus - 213 km^2
CHP3 Cheshnina Till Plateau - 89 km^2
CHP4 Dadina River Valley - 39 km^2

CHP1 Cheshnina and Chetaslina Valleys

Geology and Physiography: U-shaped valleys that were occupied by valley glaciers in the Pleistocene. Composed mostly of glacial till, colluvium, and alluvium; the latter occurs in a narrow strip along the valley axis and in alluvial fans from tributary streams.

Elevation: 791 to 1099 m (2595 to 3606 ft)

Soils: probably mostly gravelly soils with coarse-loamy matrix. Permafrost is probably lacking in most areas, and a surface organic layer is present but probably thin (< 20 cm).

Vegetation/land cover: mostly open white spruce forest with a low shrub understory. Early succesional alluvium and higher elevations have deciduous shrubs or shrubs and poplar forest.

Notes:

CHP2 Cheshnina Lava Plateaus

Geology and Physiography: mountains with broad, gently sloping tops and steep sides. Composed of mostly andesitic lava from Mt. Wrangell.

Elevation: 730 to 1692 m (2395 to 5551 ft)

Soils: mostly well-drained, rocky soils with a coarse-loamy matrix. Horizonation is probably minimal except for a thin organic surface layer under dense shrubs. Permafrost is probably present except on some low-elevation slopes; the active layer may be about 1 m on gentle plateau surface and deeper elsewhere. Sorted circles, nets, and stripes are probably common on plateau surfaces.

Vegetation/land cover: plateau surfaces have dwarf shrub tundra, with denser shrubs at lower elevation. Plateau slopes have scree or shrubs, ranging from sparse dwarf shrubs at higher elevations to dense low- to mid-height shrubs at low elevations.

Notes:

CHP3 Cheshnina Till Plateau

Geology and Physiography: undulating surface of andesitic lava flows that were over-run by ice during the Pleistocene. Probably covered by thin glacial till in most places, with some scoured bedrock.

Elevation: 730 to 1305 m (2395 to 4281 ft)

Soils: mostly coarse-loamy soils with rocks, well-drained, with permafrost possibly present but below 1 m depth.

Vegetation/land cover: mostly deciduous low shrubs, with some dwarf shrub tundra at high elevations in the east. Low elevations have a woodland overstory of white spruce.

Notes:

CHP4 Dadina River Valley

Geology and Physiography: U-shaped mountain glacial valley. Includes alluvium from the Dadina River (a braided glacial river) and from alluvial fans of smaller tributary streams, plus lesser amounts of colluvium and glacial till on valley sides.

Elevation: 780 to 1155 m (2559 to 3789 ft)

Soils: highly variable due to succession and differences in wetness. The central part of the floodplain is probably dry, stratified sand and gravel with little horizonation. Nearer to the valley footslopes soils are wetter, and may have a substantial surface organic layer and permafrost. On the alluvial fans on the valley sides, soils are probably stratified sand and gravel or gravel with coarse-loamy matrix, with permafrost probably lacking in drier, upper parts and present in wetter, lower parts.

Vegetation/land cover: the active floodplain of the Dadina River is mostly unvegetated gravel bars. Less disturbed parts of the floodplain appear to be dry deciduous shrubs or poplars in places and wet sedge and low shrubs in others. Alluvial fans appear to be spruce woodland or open forest with shrub understory. Wetter lower parts may be black spruce, drier parts are probably white spruce.

Notes: there is evidence of groundwater discharge in this valley, especially on the nearly level floodplain near the foot of the alluvial fans in the southwester (lower) part.

The rugged mountains of the Cross Range Subsection have mostly alpine vegetation or barrens. Snow and ice are restricted to higher elevations here than in the more maritime mountains further south.

Detailed ecological units in the Cross Range Subsection:
CSR1 Cross Creek Floodplain - 4 km^2
CSR2 Cross Range - 1123 km^2

CSR1 Cross Creek Floodplain

Geology and Physiography: floodplain of a braided mountain stream, composed of sand and gravel.

Elevation: 1278 to 1524 m (4193 to 5000 ft)

Soils: stratified sand and gravel with little or no horizon development, well-drained, and lacking permafrost.

Vegetation/land cover: mostly unvegetated or sparsely vegetated gravel bars. Some areas of low shrubs or balsam poplars.

Notes:

CSR2 Cross Range

Geology and Physiography: rugged mountains with numerous small glaciers near the crest. Composed of a complex mix of lithologies, including shale, argillite, sandstone, limestone, granodiorite, greenstone (basalt), and andesite. Most valleys are rather V-shaped, suggesting erosion more by streams than glaciers.

Elevation: 729 to 2988 m (2392 to 9803 ft)

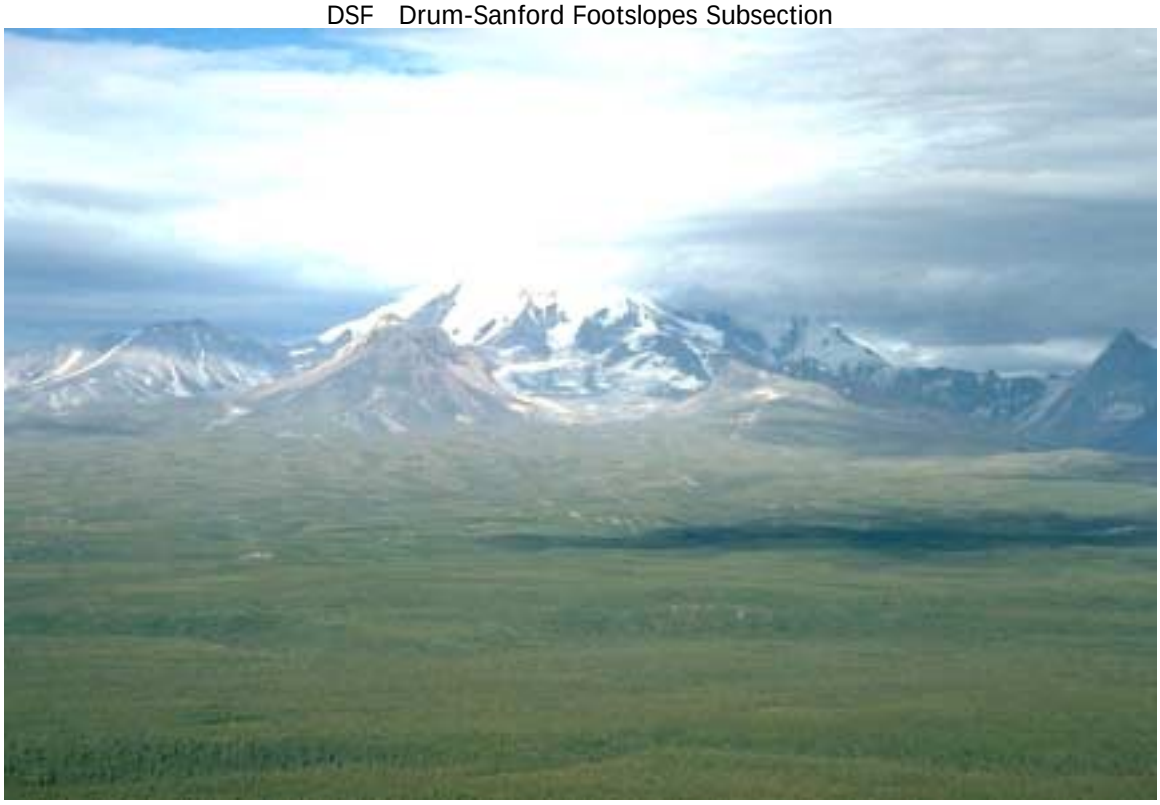
Soils: high elevations are mostly ice, snow, rock, and rock rubble without soil. Lower slopes have rocky soils with a coarse-loamy matrix, probably well-drained and with permafrost either below 1 m depth or absent. Little horizonation is probably present except for a thin surface organic layer under the densest vegetation.

Vegetation/land cover: high elevations are mainly ice, snow, bedrock, talus, and scree. Lower slopes show progressively greater cover by shrubs and taller shrubs, with dwarf shrubs above

and open to closed low- to mid-height shrubs below. There are a few white spruce trees at lowest elevations.

Notes: this unit resembles the McCarthy Mountains in lithology and ruggedness, but is located on the north side of the Wrangell Mountains, and probably has a drier climate.

DSF Drum-Sanford Footslopes Subsection



This subsection includes the footslope of Mt. Drum, the large volcano in the middle of this photograph. The footslope is the gently sloping region with alpine or subapline vegetation (mottled grayish), above the forested area in the foreground of this photograph but below the steep slopes and glaciers of Mt. Drum.

Detailed ecological units in the Drum-Sanford Footslopes Subsection:
DSF1 Mt. Drum Footslope - 328 km^2
DSF2 Mt. Sanford Footslope - 417 km^2
DSF3 Upper Sanford River Floodplain - 35 km^2

DSF1 Mt. Drum Footslope

Geology and Physiography: long slope on the lower part of Mt. Drum, with a hummocky or undulating surface in most places and with occasional small valleys radiating out from Mt. Drum. Appears to have be mostly covered with glacial till from glaciers that filled the Copper River Basin and from Mt. Drum itself; till is probably thick in the lower part and thins uphill, becoming patchy or absent near the upper boundary of this unit. Bedrock is mostly andesite.

Elevation: 852 to 1665 m (2795 to 5463 ft)

Soils: probably mostly coarse-loamy soils with abundant rocks, and permafrost present but probably below 1 m depth. At lower elevations under denser vegetation there is probably an organic surface layer and permafrost may be between 0.5 and 1 m depth.

Vegetation/land cover: sparse dwarf shrub tundra at high elevations, with shrubs becoming denser and taller at low elevations.

Notes: the ridges that occur near the lower boundary of this unit appear to be both terminal moraine ridges and ridges between ice-marginal stream channels, both of which run across the main slope of Mt. Drum.

DSF2 Mt. Sanford Footslope

Geology and Physiography: long slope on the lower part of Mt. Sanford, with glacial moraine ridges deposited by a large glacier in the Copper River Basin during Pleistocene time. Till is probably thick in the lower part and thins uphill, becoming patchy or absent near the upper boundary of this unit

Elevation: 910 to 1648 m (2986 to 5407 ft)

Soils: probably mostly coarse-loamy soils with numerous rocks, with little organic surface layer, and permafrost probably present but below 1 m depth. In concavities under denser vegetation there is probably an organic surface layer and permafrost at 0.5 to 1 m depth.

Vegetation/land cover: on dry and windswept convex slope positions, mostly open dwarf shrub tundra. On moister and more protected concave positions, shrubs are denser and taller.

Notes: the lower boundary of this unit is gradational into moraines on gentler slopes in the Copper River Basin.

DSF3 Upper Sanford River Floodplain

Geology and Physiography: floodplain of a braided glacial outwash river, and alluvial fans of small tributary streams. Areas that are now stable could be re-occupied by migrating river channels.

Elevation: 790 to 1153 m (2592 to 3783 ft)

Soils: mostly stratified sand and gravel with little horizon development, well drained, and lacking permafrost. Under denser vegetation there is probably a thin (< 20 cm) organic surface layer and a mantle of silt and sand. Lower parts of some alluvial fans may have permafrost.

Vegetation/land cover: active floodplain has mostly unvegetated gravel bars. Less disturbed areas have deciduous shrubs or white spruce forest.

Notes:

JLP Jacksina Lava Plateau Subsection

The Jacksina Lava Plateau has extensive gently sloping alpine areas underlain by volcanic bedrock.

Detailed ecological units in the Jacksina Lava Plateau Subsection:
JLP1 Jacksina Lava Plateau - 631 km^2
JLP2 Upper Jacksina Valley - 53 km^2

JLP1 Jacksina Lava Plateau

Geology and Physiography: flat-topped low mountains or mesas, dissected by several U-shaped glacial valleys and numerous small streams incised into V-shaped gulleys and small valleys. Bedrock is mostly andesite and basalt.

Elevation: 957 to 2750 m (3140 to 9022 ft)

Soils: probably mostly very weakly developed soils consisting of sandy-loamy matrix between rock fragments. Permafrost is probably present but below 1 m depth. Stone circles, nets, and stripes are probably common on the more stable plateau surfaces.

Vegetation/land cover: the highest plateaus have mostly rock rubble, probably with crustose lichens and a few vascular plants on favorable sites. Lower plateau surfaces have open dwarf shrub tundra. Steeper slopes of valleys have mostly unvegetated rock rubble, with more stable sites in open or closed low shrubs. The forest shown on the land cover map in this unit is doubtful.

Notes:

JLP2 Upper Jacksina Valley

Geology and Physiography: U-shaped valley occupied by glaciers in the Pleistocene. Composed mostly of coarse-grained alluvium from the braided river flowing down the axis of the valley; also fan alluvium from side drainages.

Elevation: 1033 to 1632 m (3389 to 5354 ft)

Soils: coarse sand and gravel soils with little horizon development, well-drained, and lacking permafrost or permafrost is below 1 m depth.

Vegetation/land cover: little or no vegetation on active gravel bars. Less disturbed areas have deciduous shrubs (perhaps including poplar trees) of varying densities, depending on the successional stage. Some places appear to have significant lichen cover. The spruce woodland shown on the land cover map is doubtful here.

Notes:

JVR Jarvis Range Subsection

Detailed ecological units in the Jarvis Range Subsection:
JVR1 Jarvis Range - 319 km^2

JVR1 Jarvis Range

Geology and Physiography: rugged mountains with substantial glacier cover, composed of mostly of andesite, dacite, and basalt. Mt. Jarvis is an extinct volcano that probably last erupted about 1 million years ago (Richter *et al.*, 1995).

Elevation: 1029 to 4082 m (3376 to 13392 ft)

Soils: mostly rock, rock rubble, snow, and ice without soil. Small patches of coarse-loamy soil with many rocks probably exits at low elevations on stable sites.

Vegetation/land cover: mostly unvegetated rock, rock rubble, snow, and ice. Some dwarf shrub tundra occurs on favorable sites at low elevation.

Notes:

MCM McCarthy Mountains Subsection

The McCarthy Mountains are in the background of this photograph of the Chitina Valley. These mountains are rugged but relatively low in elevation and have little permanent ice and snow. The Kennicott and Root Glaciers (flowing together from the left and right, respectively in the center background) are also in this subsection, but their sources are in the higher Wrangell Mountains further north.

Detailed ecological units in the McCarthy Mountains Subsection:
MCM1 Crystalline Hills - 189 km^2
MCM2 Kennicott and Root Glaciers - 184 km^2
MCM3 Kusulana Valley - 33 km^2
MCM4 McCarthy Mountain Valleys - 254 km^2
MCM5 McCarthy Mountains - 1802 km^2
MCM6 McCarthy Mountains Floodplains - 52 km^2
MCM7 Upper Nizina-Chitistone Floodplain - 94 km^2

MCM1 Crystalline Hills

Geology and Physiography: rugged mountains, though relatively low in elevation compared to the adjacent high mountains to the north. The northwestern part is composed mostly of weakly metamorphosed volcanic (basalt and andesite) and volcaniclastic rocks, while the southeastern part is mostly gabbro and gneiss.

Elevation: 441 to 2065 m (1447 to 6775 ft)

Soils: mostly rocky soils with a coarse-loamy matrix, well-drained, and with little horizon development. Permafrost status is uncertain, but if present it is probably below 1 m depth in most places. Soils at lower elevation under dense shrubs probably have a surface organic horizon.

Vegetation/land cover: high elevations have mostly exposed rock, talus, and scree with little vegetation. More stable lower slopes and valley bottoms have deciduous shrubs that generally increase in height and density downslope.

Notes:

MCM2 Kennicott and Root Glaciers

Geology and Physiography: large valley glaciers that are outlets for icefields high in the Wrangell Mountains to the north. Mostly debris-covered in the lower part of the Kennicott Glacier.

Elevation: 419 to 2101 m (1375 to 6893 ft)

Soils: snow, ice, and rock rubble without soil.

Vegetation/land cover: snow and ice, with rock rubble in the lower part. Probably a few shrubs and herbs have colonized superglacial rock rubble near the terminus.

Notes: historic photographs show that the Kennicott Glacier has receded more than 2,000 ft (610 m) since 1909 (Winkler, 2000). These glaciers dam some streams from side valleys, impounding lakes that occasionally drain catastrophically and cause flooding on the Kennicott River. Hidden Creek Lake on the west side is the one responsible for most of the flooding (Rickman and Rosenkrans, 1997)

MCM3 Kuskulana Valley

Geology and Physiography: broad, U-shaped valleys with undulating surface, occupied by valley glaciers during the Pleistocene. Composed mostly of glacial till and scoured bedrock, with some slope deposits on valley sides.

Elevation: 869 to 1242 m (2851 to 4075 ft)

Soils: slopes and hill crests, mostly coarse-loamy soils with rocks, well-drained, with little development beyond a surface organic layer that is probably less than 20 cm thick in most places. Permafrost may be present in these soils but is probably below 75 cm depth. Some podzolization and E horizon development is possible. Wet, organic soils, some with permafrost and some without, occur in depressions.

Vegetation/land cover: on slopes and hills, open or closed deciduous shrubs. In depressions, mostly wet sedge or sedges and low shrubs.

Notes: this unit is geomorphically like the McCarthy Mountain Valleys, but is higher in elevation (mostly above treeline) and has prominent string fens (wetlands with peat soils, consisting of pools and low ridges of peat) in depressions on the valley bottom.

MCM4 McCarthy Mountain Valleys

Geology and Physiography: broad, U-shaped valleys occupied by valley glaciers during the Pleistocene. Composed mostly of glacial till, with some slope deposits on valley sides and scoured bedrock in the upper Gilakina River region.

Elevation: 450 to 1346 m (1476 to 4416 ft)

Soils: mostly coarse-loamy soils with rocks, well-drained, with little development beyond a surface organic layer that is probably less than 20 cm thick in most places. Some podzolization and E horizon development is possible. Wetter soils, probably with permafrost, probably occur in some depressions.

Vegetation/land cover: mostly open white spruce or mixed spruce-birch forest. Some closed deciduous mid- to tall shrubs are present, especially on valley sideslopes. Some depressional areas, especially in the Gilakina River valley, probably have black spruce woodland or low shrubs and sedges.

Notes:

MCM5 McCarthy Mountains

Geology and Physiography: rugged mountains, though relatively low in elevation compared to the adjacent high mountains to the north. Composed of variety of sedimentary rocks (limestone, sandstone, shale, and chert) and mafic igneous rocks (greenstone). Contains some areas of igneous intrusive rocks (mostly dacite and andesite). Ridges are quite sharp and valleys U-shaped due to glacial erosion in the Pleistocene; modern glaciers are small and restricted to the highest cirques.

Elevation: 419 to 2696 m (1375 to 8845 ft)

Soils: mostly rocky soils with a coarse-loamy matrix, well-drained, and with little horizon development. Permafrost is probably present in many places, but where present it is probably

generally below 1 m depth. Soils at lower elevation under dense vegetation probably have a surface organic horizon.

Vegetation/land cover: high elevations have mostly exposed rock, talus, and scree with little vegetation. More stable lower slopes and valley bottoms have deciduous shrubs that generally increase in height and density downslope. Some white spruce forest occurs at low elevations, especially in the eastern part.

Notes: some parts of this unit have numerous rock glaciers. One near McCarthy has been studied in detail (Elconin and LaChapelle, 1997). The geologic hazards of the McCarthy Creek valley have been studied in detail (Jones and Glass, 1993)

MCM6 McCarthy Mountains Floodplains

Geology and Physiography: floodplains of small braided mountain rivers. Composed of sandy and gravelly alluvium.

Elevation: 546 to 980 m (1791 to 3215 ft)

Soils: probably mostly stratified sand and gravel without permafrost or much horizon development beyond thin buried organic horizons. Later successional areas probably have a surface layer of silt and sand. Some wet soils occur near where the Lakina Glacier creek flows into the Gilakina River.

Vegetation/land cover: unvegetated or sparse shrubs and herbs on the active floodplain. Less disturbed sites have deciduous shrubs or balsam poplar trees. Later successional stages have white spruce forest. There is an area of wet shrubs and sedge near where the creek from Lakina Glacier flows into the Gilakina River.

Notes:

MCM7 Upper Nizina-Chitistone Floodplain

Geology and Physiography: floodplain of a braided glacial rivers. Composed of coarse-grained alluvium. Includes some gently sloping alluvial fans from small tributary streams.

Elevation: 457 to 1000 m (1499 to 3281 ft)

Soils: stratified sand and gravel with little horizon development, well drained, and lacking permafrost. A finer mantle of stratified silt and sand is probably present but thin in vegetated ares. Soils in spruce forest probably have an organic surface layer and may have patchy permafrost.

Vegetation/land cover: active channels are unvegetated or sparsely vegetated with shrubs and herbs. Less disturbed areas have dense shrubs or balsam poplars, or open white spruce forest.

Notes:

Mt. Drum is a large volcano with considerable ice and snow cover. The Mt. Drum Subsection includes the glaciers and steep, sparsely vegetated slopes down to the abrupt change to gentler slopes near the middle of this photograph.

Detailed ecological units in the Mt. Drum Subsection:
MTD1 Mount Drum - 309 km^2

MTD1 Mt. Drum

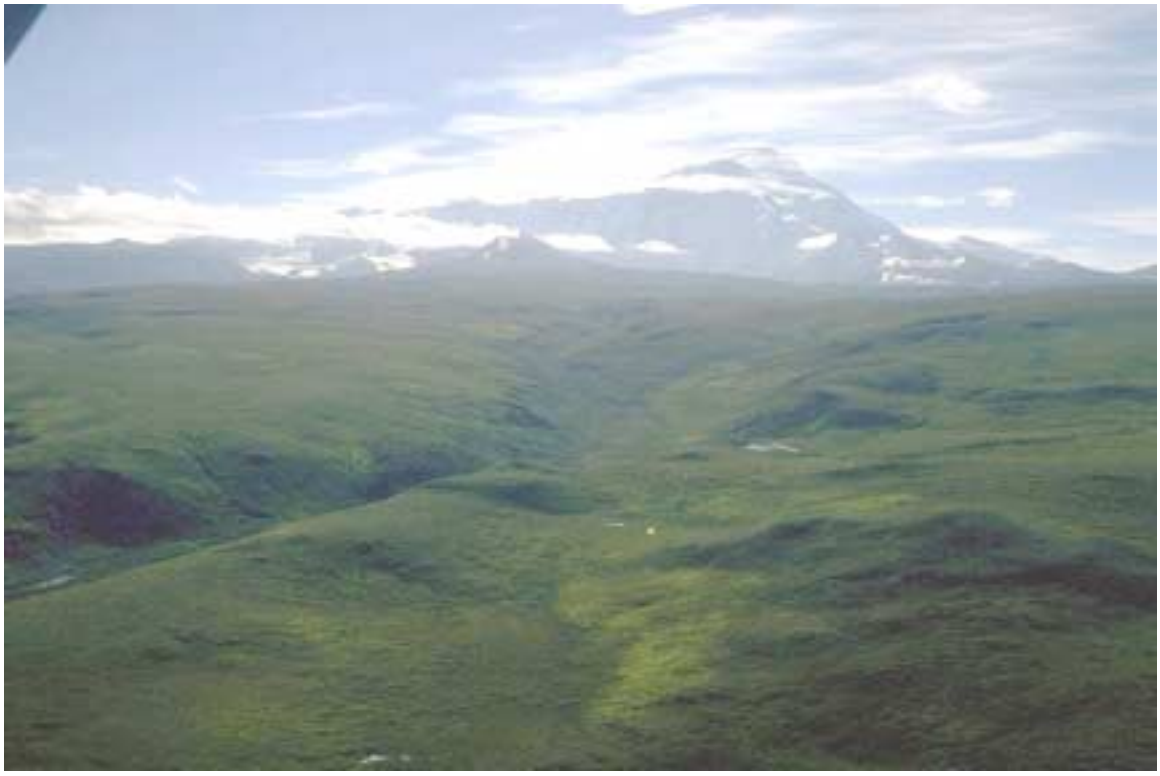
Geology and Physiography: rugged high mountains, with sharp ridge crests and considerable snow and ice cover. Composed mostly of andesite. Strongly dissected by existing and past glaciers.

Elevation: 931 to 3595 m (3054 to 11795 ft)

Soils: mostly rock, rock rubble, snow, and ice without soil. Vegetated areas probably have rocky soils with coarse-loamy matrix, well-drained, with permafrost present but probably below 1 m.

Vegetation/land cover: mostly unvegetated rock, rock rubble, snow and ice. Dwarf shrub tundra occurs on stable surfaces at low elevations. On some rather steep, mostly south-facing slopes at low elevation there is some closed deciduous shrubs.

Notes: Mt. Drum last erupted between 150,000 and 250,000 years ago (Richter *et al.*, 1995)



Mt. Sanford Subsection includes a large volcano with large glaciers and spectacular cliffs. The Mt. Sanford Lava Slopes (MTS3), visible in the foreground of this photo, are relatively gently slopes with alpine vegetation that encircle higher portions of the mountain, visible behind. The higher portions consist of glaciers and barren rock ridges with little vegetation (MTS2 and MTS5)

Detailed ecological units in the Mt. Sanford Subsection:
MTS1 Capital Mountain - 101 km^2
MTS2 Mt. Sanford Barren Ridges - 305 km^2
MTS3 Mt. Sanford Lava Slopes - 227 km^2
MTS4 Mt. Sanford Valley Glaciers - 164 km^2
MTS5 Sanford Icecap - 178 km^2

MTS1 Capital Mountain

Geology and Physiography: rugged mountains formed by volcanism about 1 million years ago. Mostly andesite, with colluvial deposits in valleys. Presently without glaciers, but has been dissected by past glaciation into cirques and U-shaped valleys separated by sharp ridges.

Elevation: 1182 to 2253 m (3878 to 7392 ft)

Soils: high elevations are mostly rock and rock rubble without soil. Vegetated areas in valley bottoms probably have rocky soils with a coarse-loamy matrix, well-drained, with permafrost probably present but mostly below 1 m depth in most areas.

Vegetation/land cover: higher elevations are mostly bare rock, talus and scree. Valley bottoms are mostly dwarf shrub tundra

Notes:

MTS2 Mt. Sanford Barren Ridges

Geology and Physiography: mountains slopes deeply dissected by glacial valleys. Composed mostly of andesite, with a large rhyolite flow in the northeast. Some small glaciers are present on some high, relatively gently sloping surfaces.

Elevation: 1094 to 2763 m (3589 to 9065 ft)

Soils: mostly rock, rock rubble, ice, and snow without soil.

Vegetation/land cover: mostly rock, rock rubble, ice, and snow. Some patches of dwarf shrub tundra on stable sites at low elevation.
Notes:

MTS3 Mt. Sanford Lava Slopes

Geology and Physiography: long mountain slopes composed of andesite, with an area of rhyolite in the northeastern part.
Elevation: 1032 to 2017 m (3386 to 6617 ft)
Soils: probably rocky soils with a coarse-loamy matrix, well-drained, with permafrost probably present but below 1 m depth in most areas. Some wetter soils with permafrost higher in the profile may occur in concave areas. Stone circles, nets, and stripes are probably common.
Vegetation/land cover: mostly dwarf shrub tundra, with shrub density increasing at lower elevations. Some slopes at the very lowest elevations have closed low deciduous shrubs.
Notes:

MTS4 Mt. Sanford Valley Glaciers

Geology and Physiography: glaciers flowing down the side of a large volcano. Glaciers are mostly debris-covered. Mapped approximately up to the firn line (the point on the glacier above which winter snow never melts completely). Glaciers are fed by the icecap that covers Mt. Sanford.
Elevation: 1027 to 2707 m (3369 to 8881 ft)
Soils: rock rubble and ice without soil.
Vegetation/land cover: mostly unvegetated rock rubble with scattered ponds, and some clean ice. Probably a few shrubs and herbs occur on the rubble at low elevations.
Notes: most of these glaciers are almost completely debris covered below the firn line. Most are not fed by a continuous stream of ice from the accumulation area on Mt. Sanford, but instead the ice (and a large amount of rock) falls several thousand feet off cliffs that ring the summit of Mt. Sanford, and re-forms into the glaciers below.

MTS5 Sanford Icecap

Geology and Physiography:. central part is the relatively gently sloping glacier covering the top of Mt. Sanford. Margins consist of steep icefalls, cliffs with falling ice and rock, and a few small bedrock peaks consisting mostly of andesite.
Elevation: 1775 to 4945 m (5823 to 16224 ft)
Soils: snow, ice, and rock without soil
Vegetation/land cover: mostly snow and ice, with some exposed rock and rock rubble.
Notes: Mt. Sanford probably last erupted about 100,000 years ago. The 2400 m (8,000 ft.)-high cliff on the south side of Mt. Sanford is one of the highest and steepest in North America (Richter *et al.*, 1995).

MWM Mt. Wrangell Mountainside Subsection

Detailed ecological units in the Mt. Wrangell Mountainside Subsection:
MWM1 Chetaslina Mountains - 234 km^2
MWM2 Mt. Wrangell Valley Glaciers - 243 km^2
MWM3 Mt. Wrangell Barrens - 215 km^2

MWM1 Chetaslina Mountains

Geology and Physiography: rugged mountains composed of andesite and dacite. Dissected by streams and Pleistocene glaciers into sharp ridges and steep-sided valleys. Little permanent snow or ice.
Elevation: 868 to 2570 m (2848 to 8432 ft)
Soils: higher elevations are bare rock and rock rubble without soil. Vegetated areas have rocky soils with a coarse-loamy matrix, well-drained. The surface organic horizon is probably

present but thin under dense shrubs at low elevation. Permafrost is probably present but below 1 m depth.

Vegetation/land cover: higher elevations are unvegetated bedrock, talus, and scree. More stable slopes have dwarf shrub tundra. Shrubs become denser and taller at lower elevations, with some closed low- to mid-height shrubs at low elevations.

Notes:

MWM2 Mt. Wrangell Valley Glaciers

Geology and Physiography: valley glaciers that are outlets to the icecap on top of Mt. Wrangell. Glaciers are mapped here up to the firn line. Most have debris bands and a debris-covered zone at the terminus, but less debris cover than the Mt. Sanford Valley Glaciers.

Elevation: 583 to 2441 m (1913 to 8009 ft)

Soils: ice and rubble without soil.

Vegetation/land cover: ice or rock rubble on ice. Some shrubs and herbs have probably colonized superglacial rubble near the termini of some glaciers.

Notes: several of these glaciers were the subject of a study by Sturm (1995), who observed short-term velocity fluctuations, possibly due to heating by the underlying volcano.

MWM3 Mt. Wrangell Barrens

Geology and Physiography: relatively gently sloping surface of andesitic lava, rimmed by a steep slope at the lower side in places. Covered in many places by a layer of rubbly glacial till from glaciers of the adjacent icecap.

Elevation: 1033 to 2445 m (3389 to 8022 ft)

Soils: mostly well-drained, rocky soils with a coarse-loamy matrix. Permafrost is present but may be a meter or two below the surface. Sorted circles, nets, and stripes are probably present on plateau surfaces.

Vegetation/land cover: mostly unvegetated rock rubble or scoured bedrock, or sparsely vegetated with dwarf shrubs.

Notes:

NAM Nabesna Mountains Subsection

Detailed ecological units in the Nabesna Mountains Subsection:
NAM1 Nabesna Mountains Valley Glaciers - 580 km^2
NAM2 Nabesna Mountains Glaciers and Peaks - 216 km^2
NAM3 Nabesna Mountains - 461 km^2

NAM1 Nabesna Mountains Valley Glaciers

Geology and Physiography: valley glaciers fed by icefields along the crest of the Wrangell Mountains. Mapped here approximately up to the firn line (line where winter snow melts completely the following summer). Includes two large glaciers, the Nabesna and Chisana glaciers.

Elevation: 882 to 2987 m (2894 to 9800 ft)

Soils: ice and rubble-covered ice without soil.

Vegetation/land cover: mostly ice, with some rubble-covered ice at low elevations. There may be a few shrubs and herbs colonizing superglacial rubble at low elevations.

Notes: these glaciers have less debris cover than many glaciers in the Wrangell and St. Elias Ranges. The Nabesna and Chisana glaciers have several ice-marginal lakes that probably drain catastrophically and cause floods (Post and Mayo, 1971).

NAM2 Nabesna Mountains Glaciers and Peaks

Geology and Physiography: rugged high mountains composed mostly of andesite, largely ice covered. The lower boundary of the glaciers in this unit is approximately the firn line.

Elevation: 1744 to 3246 m (5722 to 10650 ft)

Soils: snow, ice, rock and rock rubble without soil.
Vegetation/land cover: mostly snow and ice, with some exposed bedrock and rock rubble.
Notes: the lower boundary of this unit corresponds approximately to the firn line on glaciers and the lower limit of abundant summer snowbanks on rock areas. This unit is differentiated from the Regal Range to the south by its lower elevation, more exposed rock, and location north of the crest of the Wrangell Mountains.

NAM3 Nabesna Mountains

Geology and Physiography: rugged high mountains composed mostly of andesite and dacite. Includes some coarse-grained, Holocene glacial moraines in valleys.
Elevation: 1251 to 3084 m (4104 to 10118 ft)
Soils: at high elevations, mostly rock, rock rubble, snow, and ice without soil. Vegetated areas have rocky soils with coarse-loamy matrix, well-drained, with little horizon development, and with permafrost probably present but below 1 m depth.
Vegetation/land cover: at higher elevations, mostly unvegetated or sparsely vegetated bedrock and rock rubble, with some snow and ice. On more stable sites at lower elevations there is low or dwarf shrub tundra.
Notes:

RER Regal Range Subsection

Detailed ecological units in the Regal Range Subsection:
RER1 Regal Range Glaciers and Peaks - 1369 km^2
RER2 Regal Range Lower Peaks - 403 km^2
RER3 Regal Range Valley Glaciers - 327 km^2

RER1 Regal Range Glaciers and Peaks

Geology and Physiography: rugged high mountains composed mostly of andesite, nearly completely ice covered. The lower boundary of the glaciers in this unit is approximately the firn line.
Elevation: 1433 to 4973 m (4701 to 16316 ft)
Soils: snow, ice, rock and rock rubble without soil.
Vegetation/land cover: mostly snow and ice, with some exposed bedrock and rock rubble.
Notes: the lower boundary of this unit corresponds approximately to the firn line on glaciers and the lower limit of abundant summer snowbanks on rock areas. This unit is differentiated from the Wrangell Icecap to the west by steeper glaciers and more exposed rock.

RER2 Regal Range Lower Peaks

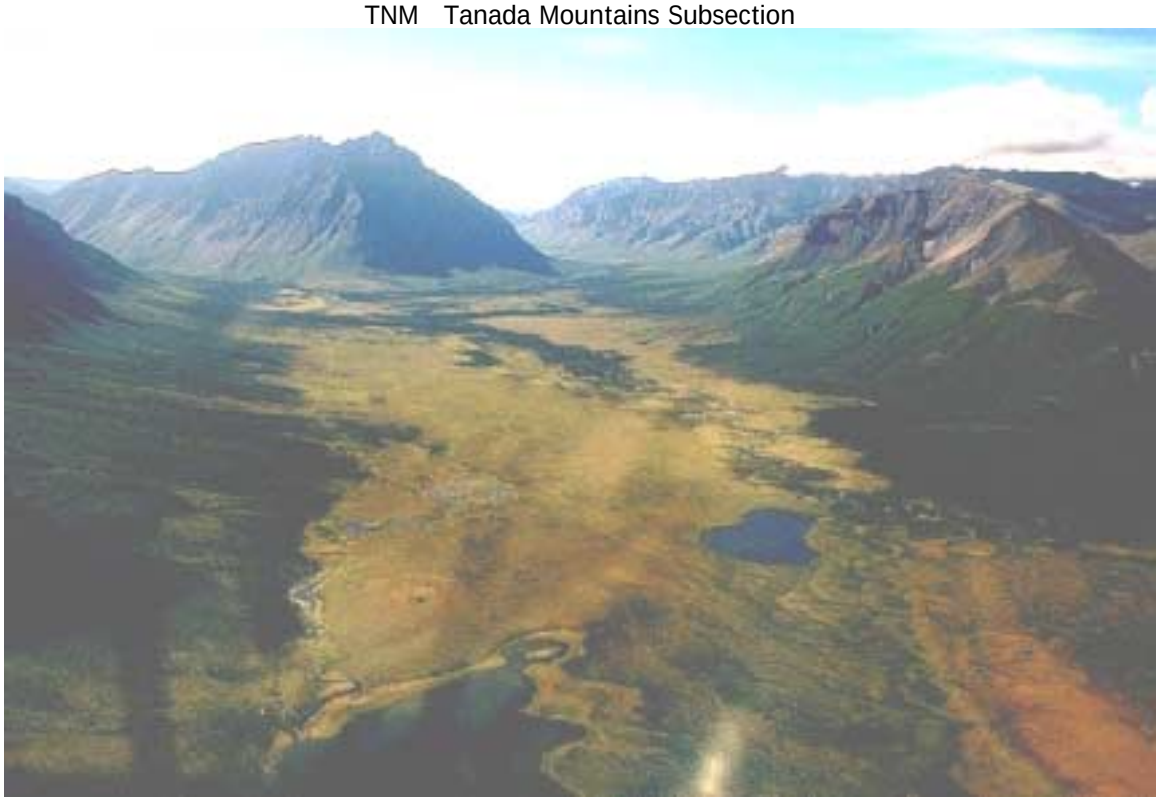
Geology and Physiography: rugged high mountains composed mostly of andesite and dacite.
Elevation: 978 to 2715 m (3209 to 8907 ft)
Soils: mostly rock, rock rubble, snow, and ice without soil. Vegetated areas have rocky soils with coarse-loamy matrix, well-drained, with little horizon development, and with permafrost probably present but below 1 m depth.
Vegetation/land cover: mostly unvegetated or sparsely vegetated bedrock and rock rubble, with some snow and ice. At lower elevations there is dwarf shrub tundra. Shrubs are fairly dense and taller on a few south-facing slopes at low elevation.
Notes: these mountains are less ice-covered than the adjacent Regal Range Glaciers and Peaks unit and have different lithology than the McCarthy Mountains.

RER3 Regal Range Valley Glaciers

Geology and Physiography: valley glaciers fed by icefields high in the Regal Range. All have debris bands and a debris-covered zone at the terminus, but only on the Kuskulana Glacier is the stagnant, debris-covered zone extensive.
Elevation: 670 to 2614 m (2198 to 8576 ft)

Soils: ice and rubble without soil.
Vegetation/land cover: ice or rock rubble on ice. Some shrubs and herbs have probably colonized supraglacial rubble near the termini of some glaciers.
Notes: the upper boundary of the glaciers mapped here is approximately the firn line.

TNM Tanada Mountains Subsection



The Tanada Mountains include rugged, sparsely vegetated mountains (visible in the background), more rounded and vegetated foothills (visible at middle distances on both sides of the valley), and several broad, U-shaped valleys such as the one here along Goat Creek. The southern tip of Tanada Lake is visible in the foreground.

Detailed ecological units in the Tanada Mountains Subsection:
TNM1 Copper Goat Valley - 231 km^2
TNM2 Tanada Foothills - 243 km^2
TNM3 Tanada Mountains - 419 km^2

TNM1 Copper Goat Valley

Geology and Physiography: broad, U-shaped valley of the Copper River and Goat Creeks, occupied by glaciers in the Pleistocene. Composed of alluvium from the river in the axis of the valley, fan alluvium from side drainages, and glacial till. Active floodplains are narrow and streams not highly braided.
Elevation: 864 to 1209 m (2835 to 3967 ft)
Soils: highly variable depending on position in the landscape. On alluvial sediments along the Copper River and most alluvial fans, soils are probably sand and gravel, well-drained, with little horizon development, and lacking permafrost or with permafrost below 1 m depth. On finer-grained alluvium, soils are probably wetter, with permafrost within 1 m depth, and a surface organic layer possibly as thick as 40 cm. On undulating glacial till soils probably are loamy with numerous rocks, with permafrost probably present but perhaps 1-1.5 m below the surface.

Vegetation/land cover: on coarse-grained alluvium along the Copper River and on alluvial fans, mostly closed or open deciduous shrubs. Open spruce forest occurs locally but is not widespread as shown on the land cover map. Undulating areas of glacial till appear to have dwarf shrub or low shrub tundra. Valley bottoms bordering small streams (Goat Creek and the unnamed stream in the large valley just east of the Copper River) appear to have low shrub and tussock tundra.
Notes:

TNM2 Tanada Foothills

Geology and Physiography: low mountains, round or flat-topped. Composed of andesite and basalt, at low elevations mantled with glacial till.
Elevation: 878 to 2015 m (2881 to 6611 ft)
Soils: mostly coarse-loamy soils with abundant rocks, mostly well-drained, with permafrost probably present but below 1 m depth in sparsely vegetated areas and perhaps about 1 m depth elsewhere. Stone circles, nets, and stripes are probably common.
Vegetation/land cover: mostly open low or dwarf shrub tundra. Some steep slopes are unvegetated rubble, and some lower slopes have dense mid-sized shrubs. The spruce woodland shown on the land cover map is doubtful, except for a few trees at the lowest elevations.
Notes:

TNM3 Tanada Mountains

Geology and Physiography: rugged mountains composed mostly of andesite. Strongly dissected by Pleistocene glaciers into a series of U-shaped valleys and sharp ridges. Lacks glaciers at present except in the vicinity of Tanada Peak.
Elevation: 912 to 2797 m (2992 to 9177 ft)
Soils: unvegetated areas are mostly rock and rock rubble without soil. Vegetated areas probably have rocks soils with a coarse-loamy matrix, with little horizon development except for a thin organic horizon under denser shrubs. Permafrost is probably present but below 1 m depth in most areas.
Vegetation/land cover: upper parts of ridges are mostly exposed rock, talus and scree. More stable parts of slopes and dwarf shrub tundra, with closed low shrubs at lowest elevations.
Notes:

WRI Wrangell Icecap Subsection

Detailed ecological units in the Wrangell Icecap Subsection:
WRI1 Wrangell Icecap - 1145 km^2

WRI1 Wrangell Icecap

Geology and Physiography: mostly gently sloping snow-covered glacier, on an active volcano composed of andesite.
Elevation: 1545 to 4288 m (5069 to 14068 ft)
Soils: none
Vegetation/land cover: mostly snow and ice, with small areas of exposed rock.
Notes: this unit was delineated to avoid exposed rock, steep glacial ice, and glacial ice below the firn line. For general information on Mt. Wrangell, see Richter *et al.* (1995). Mt. Wrangell has been the subject of glaciological studies, with special attention on the interaction of glaciers with volcanism and geothermal heating (Benson, 1961; Benson and Motyka, 1978; Benson and Follett, 1986; Sturm, 1995). These studies show that the large icecap on Mt. Wrangell is susceptible to rapid melting by geothermal heat, and this may make Mt. Wrangell even more susceptible to volcanic mudflows than most volcanoes (Yehle and Nichols, 1980).

Ecological Unit Descriptions – Yukon-Tanana Uplands Region

The map legend for ecological units of the Yukon-Tanana Uplands Ecoregion of Wrangell-St. Elias National Park and Preserve is given in Table 9. The criteria used to delineated the subsections are summarized in Table 17.

CAH Carden Hills Subsection

The Carden Hills are rounded low mountains in the background, surrounded by the Snag-Beaver Creek Plain Subsection.

Detailed ecological units in the Carden Hills Subsection:
CAH1 Carden Hills - 102 km^2

CAH1 Carden Hills

Geology and Physiography: hills and low mountains composed of mafic and ultramafic intrusives, metavolcanics and metasediments. Lower elevations are colluvium from these rocks, plus an unknown amount of loess and volcanic ash. No evidence of glaciation.

Elevation: 722 to 1650 m (2369 to 5413 ft)

Soils: at high elevations, mostly rock rubble with a loamy matrix and permafrost probably present but below 1 m depth. Lower down on south-facing slopes, probably loamy soils with rocks (especially higher on the slope), a relatively thin surface organic layer (< 20 cm) and permafrost absent or below 1 m depth. On north-facing slopes and gentler footslopes, soils are wetter, probably have a thick (> 20 cm) organic layer and permafrost within 1 m of the surface.

Vegetation/land cover: higher elevations have sparse vegetation of dwarf shrubs, with considerable rock rubble. South-facing slopes at lower elevations have mixed spruce and hardwood forest, with mostly deciduous shrubs near treeline. North-facing slopes, and footslopes of all aspects, have low shrubs or black spruce woodland.

Notes: these mountains seem to have an unusually large barren area at high elevations relative to similar low mountains in Interior Alaska. This may be due to the unique ultramafic parent material, which is rich iron, magnesium, calcium, and probably some other metals. Ultramafic rocks in temperate regions have unique soils and vegetation and the same is probably true for the subarctic.

SBP Snag-Beaver Creek Plain Subsection

The Snag-Beaver Creek Plain is a nearly level, rather wet, broad basin surrounded by low mountain ranges. The Beaver Creek Flats portion pictured here (SBP1) is dominated by cotonsedge tussocks, low shrubs, and small black spruce trees. The more extensive and somewhat drier Snag Alluvial Fans and Plain portion of this subsection (SBP4) is shown in the foreground of photographs of the preceding (CAH) and following (WEM) subsections. Note the peculiar pattern of regularly spaced clumps of vegetation on the SBP in the foreground of the latter photo (shown below under WEM).

Detailed ecological units in the Snag-Beaver Creek Plain Subsection:
SBP1 Beaver Creek Flats - 83 km^2
SBP2 Beaver Creek Terrace - 1 km^2
SBP3 Lower Beaver Creek Floodplain - 9 km^2
SBP4 Snag Alluvial Fans and Plain - 353 km^2
SBP5 Snag Creek Floodplain - 27 km^2

SBP1 Beaver Creek Flats

Geology and Physiography: nearly level wetland plain, probably composed of peat over loamy alluvium, loess, and volcanic ash, over sand and gravel.
Elevation: 639 to 913 m (2096 to 2995 ft)
Soils: probably mostly organic soils with water table near the surface and permafrost at about 0.5 m depth. In some places the organic surface layer is probably thinner (20-40 cm) but most is probably > 40 cm thick. There is probably a layer of volcanic ash (possibly as much as 30 cm) within the peat (Lerbekmo and Campbell, 1969; Richter *et al.*, 1995).
Vegetation/land cover: probably mostly low shrub-cottonsedge wetland, with patches of spruce woodland or open forest.
Notes:

SBP2 Beaver Creek Terrace

Geology and Physiography: nearly level alluvial plain, probably composed of sand and gravel with a thin mantle of silt, sand, anhd volcanic ash.
Elevation: 634 to 648 m (2080 to 2126 ft)
Soils: probably fairly dry soils with a thin loamy mantle over sand and gravel. A surface organic layer is present but probably less than 30 cm. Permafrost may be present but soils are not very wet.
Vegetation/land cover: mostly open spruce or mixed spruce-hardwood forest.
Notes: this unit occurs mostly outside of the US. The Beaver Creek Canadian Customs Station and airport are located on this terrace.

SBP3 Lower Beaver Creek Floodplain

Geology and Physiography: floodplain of a small river with mostly meandering channel form and a little braiding.

Elevation: 761 to 874 m (2497 to 2867 ft)

Soils: sparsely vegetated areas probably have stratified sand and gravel with little horizon development. Shrub and hardwood forest areas probably have a loamy layer over the sand and gravel, with buried organic layers and a thin organic surface layer. Spruce forest areas may have a thick loamy layer (perhaps over 0.5 m) and an organic surface layer 10 cm or more thick. Permafrost is probably present in mature spruce.

Vegetation/land cover: gravel bars near the channel have sparse vegetation of deciduous shrubs and herbs. Other near-channel areas have dense tall shrubs, poplar, or birch forest. Less frequently flooded surfaces have closed or open spruce forest.

Notes: vegetation and succession on this floodplain probably resemble in a general way that of the Chena River (Viereck, 1970).

SBP4 Snag Alluvial Fans and Plain

Geology and Physiography: gently north-sloping plain composed of glacial outwash alluvium from the Snag Creek and Chisana River Valleys, overlain by alluvium from Snag Creek and other smaller creeks from the Nutzotin Mountains. Probably consists of sand and gravel mantled with loamy alluvium, loess, and volcanic ash. Includes some areas of deep, fine grained sediment (probably loess and colluvium) with many thermokarst ponds in places surrounded by adjacent bedrock hills.

Elevation: 634 to 1199 m (2080 to 3934 ft)

Soils: probably mostly rather wet soils formed in loamy alluvium, loess, and volcanic ash, with permafrost at a depth of 1m or less.

Vegetation/land cover: probably mostly low shrubs and cottonsedge, or black spruce woodland with low shrubs. This unit has a peculiar vegetation pattern consisting of what appear on air photographs to be clumps of black spruce (possibly clones) that are very evenly and widely spaced.

Notes: thermokarst is probably prevalent at the foot of the bedrock hills because these have more ice-rich and finer-grained sediment (eolian, colluvial, and possibly overbank flood sediments) than nearby areas exposed to higher-energy alluviation. For general information on thermokarst, see Czudek and Demek (1970). The surface of this unit has an intricate pattern of former river channels with soils that vary by position. This region probably has 30 cm or more of White River volcanic ash (Lerbekmo and Campbell, 1969; Richter et al., 1995). This area is probably unique in that there is permafrost and a thick deposit of volcanic ash that is probably largely intact due to the stability of the surface; this may be somehow related to peculiar vegetation pattern noted above.

SBP5 Snag Creek Floodplain

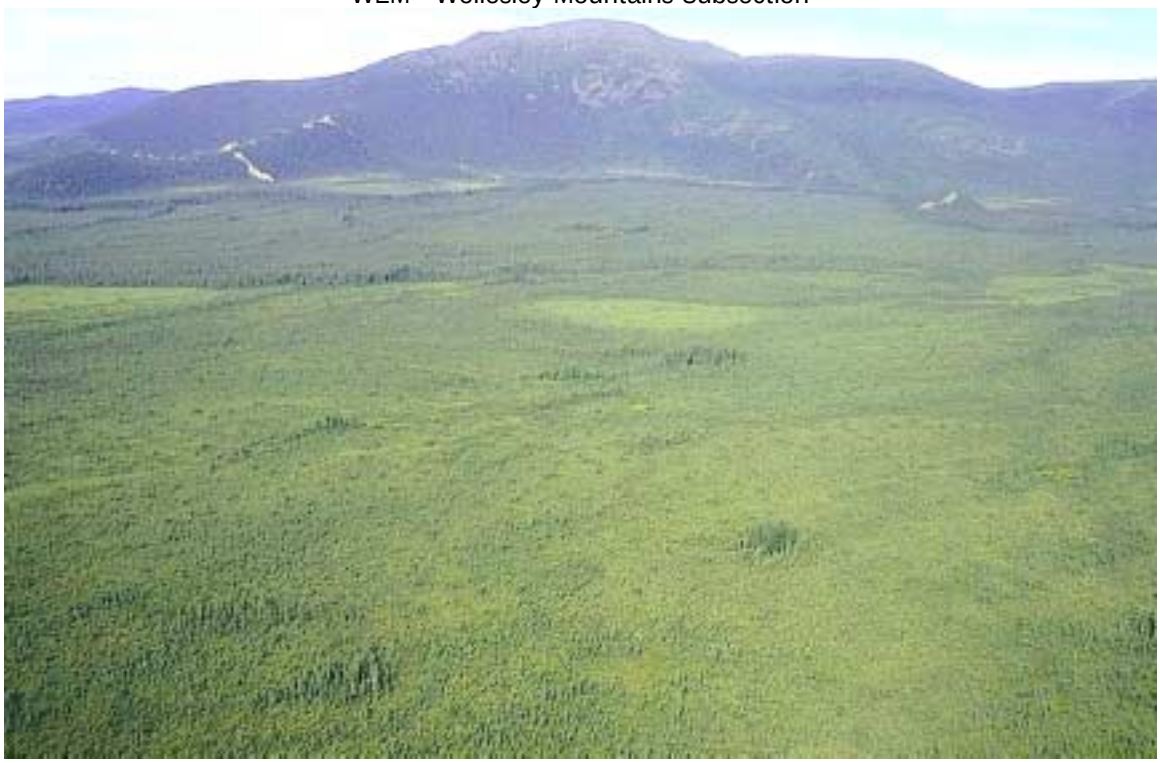
Geology and Physiography: floodplain of a small braided stream.

Elevation: 655 to 1052 m (2149 to 3451 ft)

Soils: probably dry soils of stratified sand, gravel, and silt, with little horizon development in the active channel and frequently flooded areas. More stable surface probably have a mantle of silt and fine sand on the sand and gravel, buried organic layers, and a surface organic layer. Older spruce forest probably has permafrost.

Vegetation/land cover: the active channel is barren or sparsely vegetated with shrubs and herbs. More stable areas have balsam poplar and white spruce forest. A few infrequently flooded areas have open black spruce forest.

Notes: the lowest temperature ever recorded in North America (in fact the coldest recorded anywhere on the Earth except northeastern Russia and Antarctica) was along Snag Creek just northeast of the Preserve Boundary in the Yukon Territory (-81° F; -63° C)



The Wellesley Mountains Subsection includes rounded hills and low mountains, forested except on high ridgetops.. The Snag-Beaver Creek Plain Subsection (SBP) is in the foreground of this photograph. Note clumps of spruce trees in foreground.

Detailed ecological units in the Wellesley Mountains Subsection:
WEM1 Wellesley Mountains - 38 km^2

WEM1 Wellesley Mountains

Geology and Physiography: hills and low mountains composed mostly of conglomerate, with colluvium at lower slope positions. Probably has a mantle of loess and volcanic ash, thickness unknown. No evidence of glaciation.

Elevation: 667 to 1478 m (2188 to 4849 ft)

Soils: on ridge crests above tree line, dry rocky soils with loamy matrix and permafrost present but below 1 m depth. Sorted nets and stripes are probably present. On south-facing slopes, probably loamy soils with rocks (especially higher on the slope), a relatively thin surface organic layer (< 20 cm) and permafrost absent or below 1 m depth. On north-facing slopes and gentler footslopes, soils are wetter, probably have a thick (> 20 cm) organic layer and permafrost within 1 m of the surface.

Vegetation/land cover: the highest ridge crests have low or dwarf shrubs, with some exposed rock rubble. North-facing slopes have mostly black spruce woodland and low shrubs. South-facing slopes have mixed spruce (probably mostly white) and hardwoods, probably both open and closed. The closed needleleaf forest shown on the land cover map is doubtful (mostly likely it is hillslope-shaded needleleaf woodland or low shrubs)

Notes: Unusual equidistant spacing of spruce clones can be seen in low-lying areas.

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Table 1. National Hierarchical Framework of Ecological Units*

Ecoregion (<1:5,000,000)
Subregion
  Section (1:7,500,000 to 1:3,500,000)
  Subsection (1:3,500,000 to 1:250,000)
Landscape
  Landtype association (1:250,000 to 1:60,000)
Land unit
  Landtype (1:60,000 to 1:24,000)
  Landtype phase (>1:24,000)

*from Cleland *et al.*, 1997; typical mapping scales for each level are given in parentheses

Table 2: Index to the Ecological Units of the Alaska Range Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
JKV	Jack Valley	JKV1	Chalk Creek Fans
		JKV2	Jack Creek Valley
		JKV3	Peggy and Karen Moraine
MES	Mentasta Sedimentary Mountains	MES1	Mentasta Sedimentary Mountains
NBB	Nabesna Basin	NBB1	Nabesna Basin Fans and Terraces
		NBB2	Nabesna Basin Moraines
		NBB3	Nabesna Basin Scoured Hills
		NBB4	Upper Nabesna River Floodplain
SMM	Southern Mentasta Mountains	SMM1	Boyden Hills
		SMM2	Suslota Hills

Table 3: Index to the Ecological Units of the Chugach-St. Elias Ecoregion of Wrangell-St. Elias National Park

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
BAI	Bagley-Seward Icefield	BAI1	Bagley Nunataks
		BAI2	Bagley-Seward Icefield
BRV	Bremner Valley	BRV1	Bremner River and Active Floodplain
		BRV2	Bremner River Vegetated Floodplain
		BRV3	Bremner Valley Glaciated Slopes
BSG	Bering and Stellar Glaciers	BSG1	Upper Bering Glacier
CBM	Churchill-Bona Massif	CBM1	Churchill-Bona Massif
		CBM2	Russell Glacier
CHM	Chitina Moraines	CHM1	Barnard Deglaciated Zone
		CHM2	Chitina Moraines
CLG	Chitina and Logan Glaciers	CLG1	Chitina Glacier
		CLG2	Chitina-Logan Glacier Vegetated Moraine
		CLG3	Logan Glacier
		CLG4	Walsh Glacier

CRC	Copper River Canyon	CRC1	Copper River and Active Floodplain
		CRC2	Copper River Canyon Glaciated Slopes
		CRC3	Copper River Vegetated Floodplain
IBF	Icy Bay Foothills	IBF1	Icy Bay Foothills
IRG	Icefield Ranges and Glaciers	IRG1	Icefield Ranges
		IRG2	Icefield Ranges Glaciers
MAG	Malaspina Glacier	MAG1	Malaspina Glacier
		MAG2	Malaspina Vegetated Supraglacial Moraine
MBM	Mt. Bear Massif	MBM1	Barnard Glacier
		MBM2	Klutlan Glacier
		MBM3	Mt. Bear Massif
MLM	Mt. Logan Massif	MLM1	Mt. Logan Massif
NCC	Northern Chugach Cirque-Glacier Mountains	NCC1	Chugach High Valleys
		NCC2	Granite Valley
		NCC3	Northern Chugach Cirque-Glacier Mountains
		NCC4	Northern Chugach Valley Glaciers
NCF	Northern Chugach Foothills	NCF1	Goat Valley
		NCF2	Haganita Valley
		NCF3	Kiagna Valley
		NCF4	Northern Chugach Foothills
NGR	Northern Chugach Glaciers and Ridges	NGR1	Northern Chugach Glaciers and Ridges
NIB	Nikolai Butte	NIB1	Nikolai Butte
RBM	Robinson Mountains	RBM1	Dahlgren Ridge
		RBM2	Robinson Mountains Foothills
SSM	Southern St. Elias Mountains	SSM1	Hubbard Glacier
		SSM2	Seward Glacier
		SSM3	Southern St. Elias Mountains
		SSM4	Southern St. Elias Valley Glaciers
		SSM5	Southern St. Elias Vegetated Foothills
		SSM6	St. Elias Crest
SUM	Sulzer-Natazhat Mountains	SUM1	Griffin Glacier
		SUM2	Sulzer-Natazhat Mountains
TAV	Tana Valley	TAV1	Tana Morainal Valley
		TAV2	Tana River Floodplain
UCM	University-Centennial Mountains	UCM1	St. Elias Vegetated Valleys
		UCM2	University-Centennial Mountains
		UCM3	University-Centennial Valley Glaciers
WBR	Waxel-Barkley Ridge	WBR1	Guyot Hills
		WBR2	Tyndal Glacier
		WBR3	Waxel-Barkley Ridge
WHM	White-Hawkins Massif	WHM1	White-Hawkins Massif
WSF	Western St. Elias Foothills	WSF1	Andrus Mountains
		WSF2	MacColl Ridge
		WSF3	MacColl Ridge Fans
		WSF4	Young Creek Valley
YGG	Yahtse and Guyot Glaciers	YGG1	Yahtse-Guyot Icefield
		YGG2	Yahtse-Guyot Outlet Glaciers

Table 4: Index to the Ecological Units of the Copper River Basin Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
ALP	Ahtna Lacustrine Plain	ALP1	Dadina Plain
		ALP2	Klawasi Plain
		ALP3	Sanford River Floodplain
CVF	Chitina Valley Floodplains and Terraces	CVF1	Chitina River Meandering Floodplain
		CVF2	Chitina Valley Outwash Terraces
		CVF3	Lower Chitina River Floodplain
		CVF4	Nizina River Floodplain
		CVF5	Upper Chitina River Floodplain
CVM	Chitina Valley Moraines and Hills	CVM1	Chitina Drumlins
		CVM2	Gilahina Buttes
		CVM3	Kiagna Till Slope
		CVM4	May Creek Moraine
		CVM5	South Chitina Terrace
		CVM6	Steamboat Butte
		CVM7	Sunshine Hills
DLP	Duck Lake Plain	DLP1	Duck Lake Plain
KHT	Kotsina-Kuskalana Hills and Terraces	KHT1	Kotsina Terrace
		KHT2	Kuskalana Hills
MCF	Middle Copper River Floodplain and Terraces	MCF1	Copper River High Terraces
		MCF2	Middle Copper River Floodplain
		MCF3	Middle Copper River Floodplain and Terraces
NAP	Natat Plain	NAP1	Natat Plain
TAM	Tanada Moraine	TAM1	Tanada Creek Floodplain
		TAM2	Tanada Moraine
		TAM3	Tanada Moraine Reach of the Copper River
UCO	Upper Copper River Floodplains and Terraces	UCO1	Upper Copper - Chistochina River Floodplains
		UCO2	Upper Copper River Terraces
WMT	Wrangell Mountains Toeslope	WMT1	Capital Mountain Fans
		WMT2	Cheshnina Moraine
		WMT3	Drum Moraine
		WMT4	Wrangell Mountains Toeslope

Table 5: Index to the Ecological Units of the Gulf of Alaska Coast Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
MAF	Malaspina Foreland	MAF1	Icy Bay Coastal Plain
		MAF2	Malaspina Coast
		MAF3	Malaspina Drift Plain
		MAF4	Malaspina Outwash Streams

Table 6: Index to the Ecological Units of the Kluane Range Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
CHB	Chisana Basin	CHB1	Chisana Basin Alluvial Fans
		CHB2	Chisana Basin Moraines
		CHB3	Upper Chisana River Floodplain
NIM	Nutzotin Igneous Mountains	NIM1	Nutzotin Igneous Mountains
NSM	Nutzotin Sedimentary Mountains	NSM1	Chisana Canyon Floodplain
		NSM2	Mt. Allen Highland
		NSM3	Nutzotin Glaciated Ridges
		NSM4	Nutzotin Mountains Valleys
		NSM5	Nutzotin Sedimentary Mountains
SBV	Solo-Beaver Valley	SBV1	Beaver Creek Morainal Valley
		SBV2	Solo Flats
		SBV3	Upper Beaver Creek Floodplain
SNH	Southern Nutzotin Hills and Mountains	SNH1	Chisana Hills
		SNH2	Fogenbera Lava Hills and Mesas
		SNH3	Horsfeld Plateau
WRB	White River Basin	WRB1	Burnt Hill Moraine
		WRB2	Guerin Moraine
		WRB3	Pingpong Hills
		WRB4	Sulzer-Natazhat Alluvial Fans
		WRB5	White River Floodplain

Table 7: Index to the Ecological Units of the Tanana-Kuskokwim Lowlands Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
JAF	Jatahmund Basin Floodplains and Terraces	JAF1	Jatahmund Basin Terraces and Fans
		JAF2	Lower Chisana Braided Floodplain
		JAF3	Lower Chisana Vegetated Floodplain
		JAF4	Lower Nabesna River Floodplain
		JAF5	Lower Nabesna River Vegetated Floodplain
		JAF6	Stuver Creek Floodplain
		JAF7	Jatahmund Basin Backswamps
JAM	Jatahmund Basin Moraines	JAM1	Jatahmund Moraines
		JAM2	Jatahmund Basin Dry Moraines

Table 8: Index to the Ecological Units of the Wrangell Mountains Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
BDM	Baldwin Mountains	BDM1	Baldwin Mountains
		BDM2	Skolai Creek Floodplain
CHP	Cheshnina Plateaus and Valleys	CHP1	Cheshnina and Chetaslina Valleys
		CHP2	Cheshnina Lava Plateaus
		CHP3	Cheshnina Till Plateau
		CHP4	Dadina River Valley
CSR	Cross Range	CSR1	Cross Creek Floodplain
		CSR2	Cross Range
DSF	Drum-Sanford Footslopes	DSF1	Mt. Drum Footslope
		DSF2	Mt. Sanford Footslope
		DSF3	Upper Sanford River Floodplain
JLP	Jacksina Lava Plateau	JLP1	Jacksina Lava Plateau
		JLP2	Upper Jacksina Valley
JVR	Jarvis Range	JVR1	Jarvis Range
MCM	McCarthy Mountains	MCM1	Crystalline Hills
		MCM2	Kennicott and Root Glaciers
		MCM3	Kusulana Valley
		MCM4	McCarthy Mountain Valleys
		MCM5	McCarthy Mountains
		MCM6	McCarthy Mountains Floodplains
		MCM7	Upper Nizina-Chitistone Floodplain
MTD	Mt. Drum	MTD1	Mount Drum
MTS	Mt. Sanford	MTS1	Capital Mountain
		MTS2	Mt. Sanford Barren Ridges
		MTS3	Mt. Sanford Lava Slopes
		MTS4	Mt. Sanford Valley Glaciers
		MTS5	Sanford Icecap

MWM	Mt. Wrangell Mountainside	MWM1	Chetaslina Mountains
		MWM2	Mt. Wrangell Valley Glaciers
		MWM3	Mt. Wrangell Barrens
NAM	Nabesna Mountains	NAM1	Nabesna Mountains Valley Glaciers
		NAM2	Nabesna Mountains Glaciers and Peaks
		NAM3	Nabesna Mountains
RER	Regal Range	RER1	Regal Range Glaciers and Peaks
		RER2	Regal Range Lower Peaks
		RER3	Regal Range Valley Glaciers
TNM	Tanada Mountains	TNM1	Copper Goat Valley
		TNM2	Tanada Foothills
		TNM3	Tanada Mountains
WRI	Wrangell Icecap	WRI1	Wrangell Icecap

Table 9: Index to the Ecological Units of the Yukon-Tanana Uplands Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection		Detailed Ecological Unit	
Symbol	*Name*	*Symbol*	*Name*
CAH	Carden Hills	CAH1	Carden Hills
SBP	Snag-Beaver Creek Plain	SBP1	Beaver Creek Flats
		SBP2	Beaver Creek Terrace
		SBP3	Lower Beaver Creek Floodplain
		SBP4	Snag Alluvial Fans and Plain
		SBP5	Snag Creek Floodplain
WEM	Wellesley Mountains	WEM1	Wellesley Mountains

Table 10. Summary of Criteria Used to Delineate Subsections in the Alaska Range Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
JKV – Jack Valley	Broad, U-shaped glacial valley between the Mentasta and Wrangell Mountains. Includes moraines and alluvial fans. Separation from the Copper River Basin to the west is somewhat arbitrary; the Jack Valley as drawn here is narrower between the mountains, has more alluvial fans, has steeper regional slope, has more lakes than the areas just to the west, and it is completely above any glacial Lake Atna shorelines or sediments
MES – Mentasta Sedimentary Mountains	That part of the Mentasta Mountains located south of the Denali Fault and composed Cretaceous and Jurassic marine sedimentary rocks.
NBB – Nabesna Basin	A small topographic basin between the Wrangell, Mentasta, and Nutzotin Mountains, along the upper part of the Nabesna River. Includes floodplains, alluvial fans, Pleistocene moraines, and glacially scoured bedrock hills.
SMM – Southern Mentasta Mountains	That part of the Mentasta Mountains located along the south-southwestern flank of the range and composed mostly of volcanic rocks and volcaniclastic rocks, with some diorite, limestone, and schist. Besides differences in rock type, this unit is generally lower in elevation and less rugged than the Mentasta Sedimentary Mountains to the north.

Table 11. Summary of Criteria Used to Delineate Subsections in the Chugach-St. Elias Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
BAI – Bagley-Seward Icefield	Gently sloping glaciers (Bagley Icefield, Seward Icefield, Jeffries Glacier, and Columbus Glacier) near the crest of the Chugach and sothwestern St. Elais Mountains. Includes nunataks isolated from other rock outcrops by several kilometers of glacier.
BRV – Bremner Valley	A major valley within the Chugach Mountains. Includes the Bremner River floodplain and relatively gently sloping, glacially scoured bedrock with forest vegetation near the valley bottom. Steeper, unforested, colluvial slopes located just above in elevation are placed with the surrounding mountains.
BSG - Bering and Stellar Glaciers	Large glaciers flowing south out of the Chugach Mountains, from the Bagley Icefield to the coastal plain below where it forms a large piedmont lobe. Separated from the Bagley-Seward Icefield unit at the point where the slope steepens to the south and ice flow is channeled through the Waxel-Barkely Ridge. Occurs almost completely outside of the study area.
CBM – Churchill-Bona Massif	Large volcano and adjacent mountains on the crest and north slope of the St. Elias Range at its northeastern edge; composed mostly of young (Quaternary and Tertiary) volcanic rocks.
CRC – Copper River Canyon	Includes the Copper River floodplain and a small area of relatively gently sloping, glacially scoured bedrock on the canyon bottom. The very steep sides of the canyon are placed in the surrounding mountain units.
CLG – Chitina and Logan Glaciers	Several large coalescing glaciers that originate on the north side of the Chugach Mountains and in the St. Elias Mountains. Includes vegetated ice-cored moraines of these glaciers and extends up in elevation approximately to the firn line (the line above which snow does not melt entirely in the summer).
CHM – Chitina Moraines	Hummocky, stagnant-ice moraines in the Chitina River Valley near the terminus of the Chitina Glacier. These moraines do not appear to be ice-cored, in contrast to nearby younger moraines of Hawkins, Barnard, Chitina, and Logan Glaciers. Thus they are stable and densely forested. A small region near Barnard Glacier that appears to lack ice-core and is being rapidly colonized by vegetation is also included.
IBF - Icy Bay Foothills	Rugged but relatively low mountain slopes on the south side of the Chugach Mountains, with considerable vegetation cover and relatively little cover by snow and ice. This unit occurs along the recently deglaciated Icy Bay and as yet lacks spruce forest.
IRG - Icefield Ranges and Glaciers	Rugged High Mountains nearly completely engulfed in glacial ice, in the St. Elias Mountains but northeast (inland) of the highest peaks in the range. This unit occurs mainly in Canada.
MAG - Malaspina Glacier	A large, gently sloping glacier on the plain south of the Chugach Mountains. Mostly snow, ice, and unvegetated rubble over ice, but Includes some vegetated moraine over buried glacial ice.
MBM – Mt. Bear Massif	Mountain on the crest and south slope of the St. Elias Range, composed mostly of marble, and associated large valley glaciers.
MLM – Mt. Logan Massif	Very high, rugged, mountains with glaciers covering all except the highest peaks. Differentiated from the Bagley-Seward Icefield by its steeper glaciers and more exposed rock. Generally higher and more ice-covered than the similar Northern Chugach Glaciers and Ridges unit, although the boundary with the latter unit is somewhat arbitrarily drawn along the divide between the Fraser Glacier and the Ogilvie Glacier.
NCC – Northern Chugach Cirque-Glacier Mountains	Portions of the Chugach Mountains north of the crest that have cirque glaciers only; glaciers that originate here generally do not reach valley bottom (in contrast to the Northern Chugach Ridges and Glaciers unit). However, the Northern Chugach Cirque-Glacier Mountains includes some large valley glaciers that originate in higher mountains to the south. Most of this unit lies to the south of the Border Ranges Fault, while the Northern Chugach Foothills units lies wholly north of the fault. This fault is geologically important but here separates rocks of roughly similar composition (mostly metamorphosed, clastic sedimentary rocks and granitic intrusives). Thus the Northern Chugach Mountains unit was extended north of the fault where necessary to include regions with cirque glaciers and rugged topography that were judged inappropriate for the Northern Chugach Foothills unit.
NCF – Northern Chugach Foothills	Relatively gentle mountains composed of metamorphic rocks (schist, phyllite, amphibolite, and marble) and granitic rocks. Located north of the Border Ranges Fault and south of the Chitina River. Glaciers are not present. Includes a large east-west valley, the Haganita Valley.
NGR - Northern Chugach Glaciers and Ridges	Portions of the Chugach Mountains north of the crest where snow and ice covers all except the highest ridge crests. Differentiated from the Bagley-Seward Icefield by steeper glaciers and more exposed rock. Differentiated from the Northern Chugach Cirque-Glacier Mountains unit by higher elevation and greater ice cover.
NIB – Nikolai Butte	Limestone mountains at the western edge of St. Elias range. Differentiated from the other carbonate unit in the St. Elais, the Mt. Bear Massif, because it is generally much lower and less ice-covered, and located well west of the Mt. Bear massif.
RBM - Robinson Mountains	Rugged but relatively low mountains on the south side of the Chugach Range. These mountains occur south of the mostly ice-covered, higher part of the Chugach Range and have a

	significant amount of exposed rock and vegetated slopes (as opposed to snow and ice). Lower elevations have coniferous forest, unlike the nearby Icy Bay Foothills.
SSM - Southern St. Elias Mountains	Rugged high moutains with considerable cover by ice and snow. Includes the highest peaks in the St. Elias Range (except Mt. Logan) and adjacent high areas just south of the crest. Includes some small vegetated foothill areas on its southern edge. Bounded to the north by extensive, nearly level icefields
SUM – Sulzer Natazhat Mountains	Mountains north of the main glacier-mantled crest of the St. Elias Range and north of the main zone of Quaternary-Tertiary volcanic rocks. Composed of a variety of older volcanic, sedimentary, and metasedimentary rocks.
TAV - Tana Valley	A major valley within the Chugach Mountains. Includes the Tana River floodplain and relatively gently sloping, glacially scoured bedrock with forest vegetation near the valley bottom. Adjacent much steeper, unforested, colluvial slopes are placed with the surrounding mountains.
UCM - University-Centennial Mountains	Mountains in the St. Elias Range north of the Chitina River and Logan Glacier but south of the high volcanic crest of the range. Composed of granitic rocks, metamorphic rocks (not marble), or older (Mesozoic or Paleozoic) volcanic rocks. Adjacent mountain units are either carbonates (marble or limestone) or younger volcanics. Intermediate in elevation and ice cover between the mostly ice-covered high mountains to the north and mostly glacier-free foothills to the southeast.
WBR - Waxel-Barkley Ridge	A high ridge in the southern part of the Chugach Range, surrounded almost completely by large icefields. Separated from the Northern Chugach Glacier and Ridges and Northern Chugach Cirque-Glacier Mountains because it is on the more maritime, south side of the Chugach Range. Located west of the Southern St. Elias Mountains unit and has Tertiary clastic sedimentary rocks and mafic volcanic rocks as opposed to older, generally metamorphosed sedimentary rocks in the SSM unit.
WHM – White Hawkins Massif	High mountains at the crest of the Chugach Range and mostly west of the Bagley-Seward Icefield. Differrentiated from the latter by its steeper glaciers and more exposed rock. Differentiated from the Norther Chugach Glaciers and Ridges unit by its higher elevation, greater ice cover, and position on the crest and south side of the Chugach Mountains.
WSF – Western St. Elias Foothills	Relatively low mountains at the west end of the St. Elias Range, located north of the Chitina River. Composed of clastic sedimenary rocks. Rock glaciers rather than typical ice glaciers predominate in the higher (northern) part and no rock or ice glaciers are present in the south.
YGG - Yahtse and Guyot Glaciers	Large glaciers flowing south and east out of the Chugach Mountains, from the Bagley Icefield into Icy Bay. Separated from the Bagley-Seward Icefield unit at the point where the slope steepens to the south and ice flow is channeled through the Waxel-Barkely Ridge. These glaciers calve into the ocean, while the Bering and Stellar Glacier unit and Malaaspina Glacier units end as piedmont glaciers on land.

Table 12. Summary of Criteria Used to Delineate Subsections in the Copper River Basin Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
ALP - Ahtna Lacustrine Plain	Lowland composed of silty and clayey lacustrine and glaciolacustrine sediments. Was covered by glacial Lake Ahtna. Upper boundary coincides with steeper slopes, coarser-grained moraine sediments, occasional bedrock outcrops, and vegetation changes approaching treeline.
CVF - Chitina Valley Floodplains and Terraces	Active floodplains and alluvial (glacial outwash) terraces of the Chitina River and its tributaries. The terraces are separated from the surrounding moraine on the basis of flatter topography and presumed coarser texture. These terraces could in principle have been joined into a subsection with either the active floodplains or the adjacent moraines; the former was chosen mainly because the floodplains would have otherwise been too narrow to map in some places.
CVM - Chitina Valley Moraines and Hills	Moraines with numerous drumlins (glacially streamlined hills composed of till), and a few areas of bedrock that was over-run by ice but mostly mantled with till. Located in the relatively narrow, southeasternmost part of the Copper River Basin, the Chitina Valley
DLP - Duck Lake Plain	Nearly level plain composed of fine-grained lacustrine or glaciolacustrine sediments. Resembles the Ahtna Lacustrine Plain (and in fact was probably covered by glacial Lake Ahtna at some point) but has more small thermokarst lakes.
KHT - Kotsina-Kuskalana Hills and Terraces	Area at the mouth of the Chitina River Valley with bedrock exposures or a thin layer of till, glaciolacustrine sediment, or beach deposits over bedrock. Adjacent areas to the east and west have thicker till or glaciolacustrine sediment.
MCF - Middle Copper River Floodplain and Terraces	Floodplain and alluvial terraces of the Copper River above the confluence with the Chitina River. The upper boundary of this unit is placed somewhat arbitrarily just above the Copper River's confluences with several major tributaries (the Gulkana, Gakona, and Sanford Rivers).
NAP - Natat Plain	Nearly level, wet plain probably composed of fine-grained sediments and containing numerous meandering channel scars from river channel wanderings in the past. Alluvial terraces adjacent to modern rivers (Upper Copper River Terraces) appear to be younger, drier, and attributable to

	modern rivers.
TAM - Tanada Moraine	Hilly glacial moraine with drumoinoid topography and numerous lakes, located in the far northeastern part of the Copper River Basin. Includes floodplains of streams that pass across the moraine.
UCO - Upper Copper River Floodplains and Terraces	Floodplains and alluvial terraces of the Copper River and its tributaries. Separated somewhat arbitrarily from the Middle Copper River Floodplains and Terraces just above confluence of several major tributaries ((the Gulkana, Gakona, and Sanford Rivers).
WMT - Wrangell Mountains Toeslope	Region of irregular small hills but with regional slope to the west; consists of glacial till, in many places thin over bedrock. Mostly above the highest level of glacial Lake Ahtna and probably composed of coarser sediments than the glaciolacustrine units below. Includes some alluvial fans from adjacent mountains. The upper boundary is drawn near treeline, where till becomes thinner and more patchy, and bedrock exposures more common.

Table 13. Summary of Criteria Used to Delineate Subsections in the Gulf of Alaska Coast Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
MAF - Malaspina Foreland	Low areas near the Gulf of Alaska composed of unconsolidated Quaternary deposits (alluvial, marine, and glacial deposits). Does not include glacial deposits underlain by buried glacial ice.

Table 14. Summary of Criteria Used to Delineate Subsections in the Kluane Range Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
CHB - Chisana Basin	A small topographic basin between the Wrangell and Nutzotin Mountains, along the upper part of the Chisana River. Includes floodplains, alluvial fans, and Pleistocene moraines.
NIM - Nutzotin Igneous Mountains	The part of the Nutzotin Mountains composed mostly of andesitic volcanic rocks and granitic intrusives. Topography is more rugged and mountains higher than in the Southern Nutzotin Hills and Mountains
NSM - Nutzotin Sedimentary Mountains	The part of the Nutzotin Mountains composed mostly of argillite and graywacke. More rugged and different rock types than the Southern Nutzotin Hills and Mountains. Similar topography to the Nutzotin Igneous Mountains, but the latter is composed mostly of igneous rocks.
SBV - Solo-Beaver Valley	A long, rather narrow lowland in the Nutzotin Mountains. Covered mostly by glacial till, with some alluvium. Adjoins two other lowlands, the Chisana and White River Basins; these two lowlands are wider and covered mostly by alluvial fans.
SNH - Southern Nutzotin Hills and Mountains	The part of the Nutzotin Mountains, located generally in the southern part, that is composed of igneous rocks and has topography of rounded low mountains or flat-topped mesas. In contrast to other units in the Nutzotin Mountains, does not have cirques or sharp ridge crests, and has much less exposed rock or rubble.
WRB – White River Basin	A topographic depression between the St. Elias and Nutzotin Mountains. Dominated by large alluvial fans, but includes some moraines and low bedrock-cored hills. Differentiated from the Solo-Beaver Valley by the latter's higher elevation (above treeline while the White River Basin is mostly below), narrower form, and lack of large alluvial fans.

Table 15. Summary of Criteria Used to Delineate Subsections in the Tanana-Kuskokwim Lowlands Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
JAF – Jatahmund Basin Floodplains and Terraces	Alluvial deposits in the lowland north of the Denali fault, deposited by the Nabesna and Chisana River, Stuver Creek, and some smaller streams from the Nutzotin Mountains.
JAM – Jatahmund Moraines	Pleistocene glacial moraines in the lowland north of the Denali fault, deposited by glaciers from the Nabesna, Chisana, Stuver Creek, and Snag Creek Valleys.

Table 16. Summary of Criteria Used to Delineate Subsections in the Wrangell Mountains Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
BDM - Baldwin Mountains	Area near the crest of the Wrangell Mountains and composed of young lava flows as the rest of the Mountains are, but lower in elevation and less ice-covered than adjacent parts of the Wrangells. Mountains to north and south are mixed sedimentary and older igneous lithologies.
CHP - Cheshnina Plateaus and Valleys	A region of sloping lava plateaus and large U-shaped valleys on the south side of Mt. Wrangell. Distinguished from the Mt. Wrangell Foothills by lower elevation, less rugged topography, and greater vegetation cover.
CSR - Cross Range	Mountains on the north side of the Wrangells, composed of mixed sedimentary and igneous rocks; north and east of the main Wrangell lava flows. Separated from the Nutzotin Mountains to the north by the Totschunda Fault System. Resembles the McCarthy Mountains but is located on the north side of the Wrangell Mountains.
Drum-Sanford Footslopes	Long, relatively gentle slopes on the lower half of Mt. Sanford and Mt. Drum. Appears to be covered by glacial till in most places, although till is probably thin and patchy at higher elevations and on steep slope of small valleys. The upper boundary of this unit is at about 5,000 ft. (1524 m) elevation, the point where vegetation becomes very sparse and moraine morphology is lost; in some places the upper boundary is drawn where topography becomes steeper and dissected by valley glaciers. The lower boundary with the Copper River Basin is gradational and basically arbitrary; below slopes are gentler, soils wetter, glacial till thicker, and trees rather than shrubs dominate the vegetation.
JLP - Jacksina Lava Plateau	Flat-topped low mountains and mesas composed of young lava flows and dissected by wide U-shaped valleys. Elevation is lower and there is much less ice cover than the mountains to the south. The Tanada Mountains to the north have similar lithology, but have sharp rather than flat-topped ridges. The Cross Mountains to east are sharp-crested and have different lithology.
JVR - Jarvis Range	Rugged mountains with substantial glacier cover. Glaciers are much steeper than on the Wrangell Icecap to the south, while the Jacksina Lava Plateau to the north is less rugged and has much less ice cover.
MCM - McCarthy Mountains	Rugged mountains that are relatively low in elevation and on the south side of the Wrangell Mountains. Composed of a wide variety of rocks (sedimentary and igneous) in complex mixture, but do not include any of the Quaternary-Tertiary lava flows that compose the main mass of the Wrangell Mountains.
MTD - Mt. Drum	Includes the glaciers and rugged, mostly unvegetated upper slopes of Mt. Drum.
MTS - Mt. Sanford	Includes the icecap on the top of Mt. Sanford, the mostly unvegetated and rugged upper slopes of the mountain, valley glaciers, and also Capital Mountain.
MWM – Mt. Wrangell Mountainside	High-altitude areas just below the Wrangell Icecap and composed of the same Quaternary-Tertiary lava flows as the rest of the mountain. Includes gently sloping, nearly barren lava surfaces near the icecap; dissected, sharp-crested mountains with little ice cover on the south side; and valley glaciers draining the Wrangell Icecap.
RER - Regal Range	Rugged, very high, ice-covered mountains near the crest of the Wrangell Mountains. Has steeper glaciers and more exposed rock than the Wrangell Icecap to the east. Composed of Quaternary-Tertiary lava flows, in contrast to the lower mountains to the north and south. Differentiated from the Baldwin Mountains to the east by the latter's lower elevation, gentler topography, and less ice cover.
TNM - Tanada Mountains	Rugged but relatively low mountains at the northern edge of the Wrangells. Composed of the same Quaternary-Tertiary lava flows as the Jacksina Lava Plateau, but consist of sharp-crested ridges that grade northward into rounded foothills. Lower and less ice-covered than the Jarvis Range. Lithology different from that of the Cross Range.
WRI - Wrangell Icecap	Large, relatively gentle glacier covering Mt. Wrangell and the region to the east of Mt. Wrangell. Surrounding units are steeper and have more exposed rock. The numerous outlet glaciers of this icecap are separated from it at approximately the firn line.

Table 17. Summary of Criteria Used to Delineate Subsections in the Yukon-Tanana Uplands Ecoregion of Wrangell-St. Elias National Park and Preserve

Subsection	Summary of Delineation Criteria
CAH – Carden Hills	Hills and low mountains located north of the Denali Fault and east of the Chisana River, composed of mafic and ultramafic intrusives, metavolcanics and metasediments.
SBP – Snag-Beaver Creek Plain	Alluvial deposits with a mantle of peat, loess, and volcanic ash. The alluvium was deposited mostly by Snag and Beaver Creeks in between various low mountain ranges. Alluvial deposits east of the large moraine from the Chisana Valley are placed in this unit, while those to the west are placed in the Jatahmund Basin Floodplains and Terraces unit.
WEM – Wellesley Mountains	Hills and low mountains composed mostly of conglomerate, located north of the Denali fault and east of the Chisana River.

Table 18. Temperature and precipitation summary for CHITINA, AK1824. 61° 31' N 144° 26' W, 600 ft. above sea level.

Start yr. - 1950 End yr. - 1970
Temperature: 20 years available out of 21 requested in this analysis
Precipitation: 20 years available out of 21 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	0.6	-16.7	-8.1	46	-51	0	0.58	0.21	1.12	1	3.3
February	17.1	-4.7	6.2	42	-40	0	1.01	0.44	1.80	2	6.2
March	31.8	4.8	18.3	48	-32	0	0.34	0.26	0.57	1	2.2
April	44.7	23.1	33.9	60	-1	8	0.18	0.09	0.37	0	0.3
May	56.9	34.3	45.6	76	16	180	0.36	0.15	0.64	1	0.0
June	65.3	43.7	54.5	84	30	423	0.59	0.68	1.61	1	0.0
July	67.2	46.7	57.0	85	33	516	1.31	0.86	1.72	4	0.0
August	63.9	43.4	53.6	79	26	409	1.22	0.54	1.80	3	0.0
September	56.0	34.8	45.4	67	15	172	1.32	0.36	2.28	4	0.0
October	38.7	20.4	29.5	60	-11	17	1.11	0.49	1.64	2	1.4
November	18.0	2.4	10.2	46	-36	0	1.29	0.37	2.34	2	4.5
December	6.3	-11.1	-2.4	42	-47	0	1.71	0.32	2.78	3	4.8
Yearly : Average	38.9	18.4	28.7	---	---	---	----	----	----	---	---
Extreme	91	-56	---	88	-51	---	----	----	----	---	---
Total	---	---	---	---	---	1726	11.01	3.78	11.62	24	22.6

Average # of days per year with at least 1 inch of snow on the ground: 11

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 19. Temperature and precipitation summary for GULKANA FAA/AMOS, AK3465. 62° 09' N 145° 27' W, 1570 ft. above sea level.

Start yr. - 1949 End yr. - 1999
Temperature: 51 years available out of 51 requested in this analysis
Precipitation: 51 years available out of 51 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	1.8	-15.0	-6.6	40	-52	0	0.48	0.22	0.71	1	6.8
February	13.4	-7.7	2.9	41	-44	0	0.52	0.19	0.80	1	7.6
March	28.1	1.7	14.9	46	-33	0	0.33	0.11	0.56	1	5.0
April	42.1	19.8	30.9	59	-10	8	0.21	0.05	0.38	0	2.5
May	55.3	32.8	44.0	74	19	146	0.63	0.20	1.00	1	0.5
June	65.4	42.3	53.8	83	29	412	1.47	0.80	2.05	4	0.0
July	68.5	46.2	57.3	84	34	536	1.83	1.10	2.48	5	0.0
August	64.8	42.4	53.6	81	25	417	1.58	0.86	2.22	5	0.1
September	53.9	33.4	43.7	69	13	147	1.53	0.68	2.27	4	1.1
October	34.9	18.4	26.6	55	-13	11	0.95	0.43	1.40	3	8.1
November	13.7	-1.5	6.1	42	-34	0	0.73	0.23	1.14	2	8.8
December	4.5	-11.3	-3.4	38	-46	0	0.88	0.29	1.37	2	9.8
Yearly :											
Average	37.2	16.8	27.0	---	---	---	----	----	----	---	---
Extreme	91	-58	---	86	-52	---	----	----	----	---	---
Total	---	---	---	---	---	1678	11.14	8.60	12.94	29	50.4

Average # of days per year with at least 1 inch of snow on the ground: 178

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 20. Temperature and precipitation summary for NABESNA, AK6147. 62° 24’ N 143° 00 ’ W, 2900 ft. above sea level.

Start yr. - 1967 End yr. - 1999
Temperature: 22 years available out of 33 requested in this analysis
Precipitation: 22 years available out of 33 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	-0.3	-13.5	-6.9	34	-44	0	0.35	0.09	0.59	1	5.4
February	8.7	-8.1	0.3	40	-39	0	0.43	0.09	0.84	1	6.1
March	24.3	0.9	12.6	46	-25	0	0.16	0.10	0.29	0	3.6
April	39.7	15.3	27.5	57	-9	3	0.30	0.09	0.54	0	3.6
May	53.7	30.3	42.0	74	16	115	0.91	0.40	1.35	2	6.0
June	63.0	38.9	50.9	82	28	320	2.44	1.05	3.62	6	0.7
July	65.5	42.5	54.0	82	31	428	2.87	1.19	4.30	6	0.0
August	61.6	38.4	50.0	80	20	308	1.85	0.96	2.63	5	0.3
September	50.0	27.8	38.9	68	8	67	1.01	0.44	1.58	3	3.7
October	28.7	12.6	20.6	53	-12	2	0.47	0.22	0.73	1	9.1
November	9.0	-5.4	1.8	36	-34	0	0.50	0.15	0.83	1	9.6
December	3.4	-9.8	-3.2	37	-36	0	0.44	0.14	0.79	1	6.8
Yearly :											
Average	33.9	14.1	24.0	---	---	---	----	----	----	---	---
Extreme	85	-48	---	87	-44	---	----	----	----	---	---
Total	---	---	---	---	---	1243	11.74	5.91	13.81	27	54.9

Average # of days per year with at least 1 inch of snow on the ground: 168

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 21. Temperature and precipitation summary for NORTHWAY FAA AIRPORT, AK6586. 65° 86’ N 141° 56’ W, 1710 ft. above sea level.

Start yr. - 1949 End yr. - 1999
Temperature: 51 years available out of 51 requested in this analysis
Precipitation: 51 years available out of 51 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	-10.8	-27.6	-19.2	23	-62	0	0.27	0.11	0.41	0	5.4
February	2.0	-20.5	-9.2	32	-56	0	0.25	0.09	0.39	0	4.6
March	22.9	-8.7	7.1	46	-43	0	0.20	0.07	0.31	0	3.4
April	41.8	15.0	28.4	62	-19	9	0.20	0.06	0.33	0	2.3
May	56.5	32.7	44.6	76	17	172	0.93	0.35	1.42	2	0.8
June	66.7	44.3	55.5	84	32	460	1.81	0.92	2.59	5	0.0
July	69.5	48.1	58.8	84	36	580	2.37	1.27	3.34	6	0.0
August	64.8	42.8	53.8	83	21	428	1.40	0.77	1.96	4	0.2
September	52.5	31.2	41.8	71	12	116	0.89	0.36	1.33	2	1.1
October	29.2	12.7	21.0	53	-21	1	0.51	0.20	0.77	1	6.5
November	5.1	-10.9	-2.9	30	-44	0	0.34	0.15	0.49	0	6.4
December	-7.1	-23.0	-15.1	25	-55	0	0.29	0.16	0.41	0	5.9
Yearly :											
Average	32.7	11.3	22.0	---	---	---	----	----	----	---	---
Extreme	91	-72	---	90	-63	---	----	----	----	---	---
Total	---	---	---	---	---	1766	9.46	6.21	11.49	20	36.6

Average # of days per year with at least 1 inch of snow on the ground: 189

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 22. Temperature and precipitation summary for SLANA, AK8547. 62° 42’ N 143° 59 ’ W, 2200 ft. above sea level.

Start yr. - 1957 End yr. - 1999
Temperature: 41 years available out of 43 requested in this analysis
Precipitation: 41 years available out of 43 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	5.2	-12.0	-3.4	38	-46	0	0.66	0.17	1.24	1	6.3
February	16.9	-3.7	6.6	41	-35	0	0.80	0.28	1.44	2	7.1
March	28.0	2.5	15.2	47	-27	0	0.64	0.15	1.24	1	5.7
April	42.3	17.7	30.0	61	-9	5	0.45	0.14	0.91	1	4.0
May	56.1	30.7	43.4	77	17	128	1.07	0.31	1.79	2	2.2
June	66.5	40.2	53.3	84	28	374	1.99	1.03	2.94	6	0.1
July	68.7	44.3	56.5	85	32	486	2.70	1.22	3.96	7	0.0
August	64.8	39.7	52.3	82	26	350	2.16	1.04	3.13	5	0.0
September	53.0	30.3	41.7	72	11	102	2.13	0.85	3.43	4	2.9
October	34.6	15.8	25.2	56	-14	4	1.07	0.36	1.71	2	9.0
November	15.5	-2.2	6.7	41	-31	0	0.87	0.29	1.45	2	8.4
December	7.9	-9.1	-0.6	37	-42	0	0.79	0.31	1.34	2	8.4
Yearly :											
Average	38.3	16.2	27.2	---	---	---	----	----	----	---	---
Extreme	93	-57	---	89	-46	---	----	----	----	---	---
Total	---	---	---	---	---	1450	15.33	6.40	19.12	35	54.0

Average # of days per year with at least 1 inch of snow on the ground: 96

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 23. Temperature and precipitation summary for YAKATAGA FAA AIRPORT, AK9930. 60° 05’ N 142° 30’ W, 30 ft. above sea level.

Start yr. - 1949 End yr. - 1982
Temperature: 28 years available out of 34 requested in this analysis
Precipitation: 28 years available out of 34 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	32.5	21.0	26.8	48	0	4	6.61	3.52	9.33	12	16.5
February	36.6	24.2	30.4	48	3	4	7.25	3.97	10.15	13	21.7
March	38.9	26.1	32.5	49	6	2	5.21	3.27	6.96	10	16.9
April	43.7	30.6	37.1	59	19	13	6.10	3.04	8.76	10	5.1
May	49.4	36.8	43.1	64	27	103	5.53	3.33	7.51	11	0.6
June	54.5	43.8	49.1	66	34	272	4.64	1.98	6.90	8	0.0
July	58.3	47.9	53.1	71	39	403	5.55	2.68	8.03	9	0.0
August	58.5	47.1	52.8	68	36	390	8.34	4.90	11.40	11	0.0
September	54.8	42.7	48.8	66	31	258	13.22	8.82	17.25	16	0.0
October	47.3	35.3	41.3	58	21	80	14.83	10.65	18.71	19	2.6
November	39.4	28.9	34.1	53	12	16	11.27	5.89	15.99	15	8.2
December	34.2	24.1	29.1	48	4	4	10.82	8.23	13.25	18	22.5
Yearly :											
Average	45.7	34.0	39.9	---	---	---	----	----	----	---	---
Extreme	78	-11	---	71	-2	---	----	----	----	---	---
Total	---	---	---	---	---	1549	99.37	61.06	109.83	152	94.1

Average # of days per year with at least 1 inch of snow on the ground: 85

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

Table 24. Temperature and precipitation summary for YAKUTAT WB AIRPORT, AK9941. 59° 31’ N 139° 40’ W, 30 ft. above sea level.

Start yr. - 1949 End yr. - 1998
Temperature: 50 years available out of 50 requested in this analysis
Precipitation: 50 years available out of 50 requested in this analysis

	Temperature (Degrees F.)						Precipitation (Inches)				
Month	avg daily max	avg daily min	avg	2 yrs in 10 will have max temp. >than	2 yrs in 10 will have min temp. <than	avg # of grow deg days*	avg	2 yrs in 10 will have less than	2 yrs in 10 will have more than	avg # of days w/.1 or more	avg total snow fall
January	31.2	17.9	24.6	45	-13	2	11.25	5.44	16.28	15	35.8
February	35.3	21.4	28.3	48	-8	2	10.55	4.69	15.55	14	36.8
March	38.5	23.2	30.9	51	-3	1	10.41	5.45	14.75	15	37.3
April	44.4	29.2	36.8	63	13	18	9.25	5.60	12.53	13	16.9
May	50.6	36.5	43.6	71	25	123	9.32	5.56	12.69	13	1.2
June	56.3	43.5	49.9	76	32	298	6.43	2.96	9.41	10	0.0
July	59.7	47.8	53.8	77	38	427	8.14	4.09	11.67	11	0.0
August	60.0	46.7	53.3	75	34	409	12.08	6.31	17.14	13	0.0
September	55.5	41.1	48.3	69	26	252	18.26	11.53	24.35	17	0.0
October	47.3	34.2	40.7	58	15	78	20.85	14.41	26.77	20	5.4
November	38.3	26.1	32.2	51	2	12	15.01	8.18	21.03	17	21.8
December	33.5	21.8	27.6	47	-8	2	14.39	8.61	19.57	18	37.6
Yearly :											
Average	45.9	32.5	39.2	---	---	---	----	----	----	---	---
Extreme	87	-24	---	81	-16	---	----	----	----	---	---
Total	---	---	---	---	---	1626	145.93	112.03	173.06	176	192.9

Average # of days per year with at least 1 inch of snow on the ground: 127

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

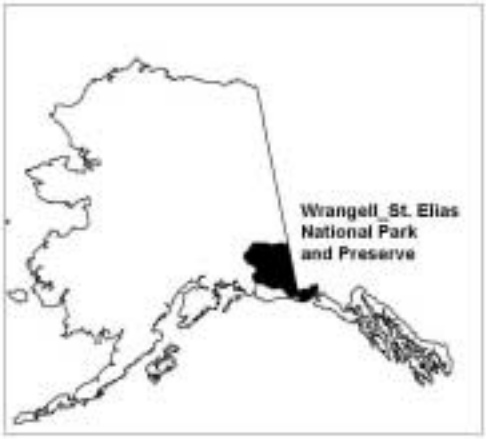

Fig. 1. Location of Wrangell-St. Elias National Park and Preserve in Alaska

Fig. 2. Area mapped without satellite image.

Fig. 3. Map of Ecological Subsections of Wrangell-St. Elias National Park and Preserve