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Natural Resource Program Center

An Inventory of the Vascular Flora Wrangell-St. Elias National Park and Preserve, Alaska

Natural Resource Technical Report NPS/CAKN/NRTR—2007/067

ON THE COVER
Background: Logan Glacier, St. Elias Mountains. Left grouping of plants (clockwise from top): *Rumex beringensis*, *Phacelia mollis, Montia bostockii* and *Stellaria alaskana.* Right grouping: *Taraxacum carneocoloratum, Botrychium yaaxudakeit, Aphragmus eschscholtzianus* and *Draba ruaxes*.
Photographs by: Mary B. Cook and Carl A. Roland.

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Mary B. Cook
Wrangell-St. Elias National Park and Preserve
P.O. Box 439, Copper Center, AK 99573

Carl A. Roland
Denali National Park and Preserve
P.O. Box 9, Denali Park, AK 99709

Patricia A. Loomis
ABR, Inc. - Environmental Research & Services
P.O. Box 80410, Fairbanks, AK 99708

Central Alaska Network

Denali National Park & Preserve
Wrangell-St. Elias National Park & Preserve
Yukon-Charley Rivers National Preserve

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List of Acronymns

AKEPIC	Alaska Exotic Plant Information Clearinghouse
AKNHP	Alaska Natural Heritage Program
ALA	University of Alaska Herbarium, Fairbanks, Alaska
CAKN	Central Alaska Inventory and Monitoring Program
CAN	Canadian Museum of Nature, Ottawa, Ontario, Canada.
DENA	Denali National Park and Preserve
EPMT	Exotic Plant Management Team
GH	Gray Herbarium, Harvard University, Cambridge, Massachusetts
GIS	Geographic Information System
H	Eric Hultén's Herbarium (now mostly at the Swedish Museum of Natural History in Stockholm, Sweden)
ISC	Iowa State University, Ames, Iowa
LCU	Catholic University of America, Washington, District of Columbia
L, LD	Botanical Museum, Lund, Sweden
LECB	Saint Petersburg University, Saint Petersburg, Russia
MICH	University of Michigan, Ann Arbor, Michigan
NAD	North American Datum
NPS	National Park Service
NY	New York Botanical Garden, New York, New York.
PH	Academy of Natural Sciences. Philadelphia, Pennsylvania.
PR	National Museum in Prague, Czech Republic
QFA	Université Laval, Sainte-Foy, Québec, Canada
RM	University of Wyoming, Laramie, Wyoming.
S	Swedish Museum of Natural History, Stockholm, Sweden
UC	University of California, Berkeley, California
WRST	Wrangell-St. Elias National Park and Preserve, Alaska
US	Smithsonian Institution, U.S. National Herbarium, Washington, D.C.
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
WTU	University of Washington Herbarium, Seattle, Washington
YUCH	Yukon-Charley Rivers National Preserve

Abstract

Mary B. Cook, Carl A. Roland and Patricia A. Loomis. 2007. An Inventory of the Vascular Flora of Wrangell-St. Elias National Park and Preserve, Alaska. Wrangell-St. Elias National Park and Preserve, P.O. Box 439, Copper Center, AK 99573.

An inventory of the vascular plant flora of Wrangell-St. Elias National Park and Preserve, Alaska, was conducted from 1994 to 1997 and in 2003. This 13.2 million acre National Park comprises 16% of all National Park Service lands. The objectives of the inventory were to assess the genetic diversity of the region, identify rare taxa and areas of phytogeographic interest and to assist park managers with planning and environmental compliance. Three hundred seventeen sites were surveyed and 6,680 specimens vouchered. The specimens documented 917 taxa in the park, 11 new to the flora of Alaska and 217 new to the park's flora. There was one U.S. Fish and Wildlife Candidate Species, 524 occurrences of 91 taxa with an Alaska Natural Heritage Program state rank of three or less, 129 range extensions of more than 250 km and 99 taxa which reach their North American distribution limits in the park. Distribution maps and annotations for 269 notable taxa were prepared (115 for this document). The rate of accumulation of new species was not consistently reduced during the inventory, so it is likely that our knowledge of the park's vascular flora is incomplete.

The known flora is predominately North American (33%), circumpolar (26%) and amphiberingian (22%). The endemic flora is comprised of 56 Alaska-Yukon, 42 amphiberingian, 43 Cordilleran and 42 Pacific Coastal species. The biogeographic composition of the park's flora is similar to Denali National Park and Preserve and Yukon Charley National Preserve except this park has a higher ratio of North American taxa and a lower ratio of amphiberingian taxa than the other two parks. The park's flora is also similar to the southwest Yukon except for a slight increase in amphiberingian taxa. The endemic flora is distributed unevenly across the landscape of the park, with more endemic taxa in the mountain than basin regions. Alaska-Yukon endemics are more frequent in the Nutzotin and Mentasta Mountains; amphiberingian endemics are more frequent in the northern Chugach Mountains and southern Wrangell foothills; Cordilleran endemics are more frequent in the northern Chugach Mountains and Chitina River basin; and Pacific coastal endemics are more frequent in the coastal mountains and foothills. The rare flora is also distributed unevenly across the landscape of the park with the greatest numbers in the Nutzotin, Mentasta, northern Chugach, northern St. Elias, southern Wrangell Mountains and the Chitina River basin. There is a trend for rare plants to occur above 4000 ft (1219 m), in the alpine zone and in the xeric moisture class. The primary sources of the park's flora were the ice-free areas of the Upper Yukon Valley, the ice-free areas of the Alaska Range to the northwest, the Western North America Cordillera to the east, and unglaciated coastal refugia.

The inventory has revealed rich and unique botanical resources which the National Park Service has the privilege and responsibility of protecting. Information from the inventory has enhanced our understanding of the genetic diversity and phytogeography of our flora and the data continue to be used for park planning and compliance activities. However, there are still large areas in the park that have not been surveyed, and we lack sufficient knowledge about most rare species (distribution, life history and populations ecology) to develop protection plans.

Executive Summary

Introduction

- The results of the vascular plant inventory that was conducted in Wrangell-St. Elias National Park and Preserve, Alaska, from 1994 to 1997 and in 2003 is presented in this document.

- The 1994-1997 inventory was funded by the National Park Service Natural Resource Preservation Program and the 2003 inventory was funded by the National Park Service Inventory and Monitoring Program.

- The justification for the inventory is found in: (1) the park purpose which is to "… maintain unimpaired the scenic beauty and quality of high mountain peaks, foothills, glacial systems, lakes and streams, valleys, and coastal landscapes in their natural state…"; (2) four of the seven management objectives identified in the Final Environmental Statement for the park which require that the species occurring on its land are known; (3) the Natural Resource Management Guideline for the National Park Service, NPS-77 which states that, "..a basic vegetation inventory is the first step in vegetation management", and that "…the presence and extent of endangered species of flora and fauna will be determined"; (4) the Natural Resource Initiative of 1997 funded to accelerate inventorying and monitoring of ecological resources, and, (5) the Omnibus Management Act of 1998 that gave superintendents specific legal authority to conduct and support science in National Parks.

- Knowledge of the diversity, abundance and distribution of 12 basic datasets, including the vascular flora, was identified in the Natural Resource Initiative as the first step in protecting the parks from degradation and in developing the science program.

- Eric Hultén, in his history of botanical exploration in the Alaska and the Yukon, identified the Wrangell-St. Elias region as one of three areas in Alaska that was poorly known. This is illustrated in the absence of common boreal species in the park on distribution maps in his 1968 flora. The botanical surveys conducted after this flora was written were restricted to a few areas in the park.

- The **primary purpose** of the inventory was to assess the biodiversity of the region so that it may be protected.

- Specific **objectives** of the 1994-1997 inventory were to:
    - Establish a database of all plants known to occur in the park and maintain information on the rarity, distribution, synonymy, taxonomy and collections of these plants.
    - Conduct inventories of the vascular flora of selected areas within the park.

  - Identify populations of rare taxa, unique floristic associations and areas of phytogeographic interest that the park may need to protect.
  - Prepare a voucher collection of all plants known to occur in the park.
  - Enhance our understanding of the history, genetic diversity and biogeography of the park's flora.
  - Provide the structure for a continued assessment of the park's flora.

- Specific objectives of the 2003 inventory were to:
  - Document 90% of the plants expected to occur in the park by surveying targeted habitats and communities within unsurveyed regions.
  - Significantly improve current knowledge of the distribution of the plant species that occur in the Central Alaska Network.
  - Describe the taxonomic, ecological and geographic characteristics of selected species of special management concern.
  - Acquire more information about the relative abundance of selected species within the park.
  - Gather a vouchered set of specimens of each species for research and park uses and populate national and local databases with taxonomic and accompanying data.
  - Acquire new inventory information in a format compatible with ongoing plant inventory efforts.

Chapter 1. Description of the Study Area

- Wrangell-St. Elias National Park and Preserve encompasses 13.2 million acres of subarctic and coastal ecosystems in south-central Alaska. This area represents 16% of all National Park Service land. The park occupies the area from the United States-Canada border along the 141st parallel to 145° 24' near Glennallen west longitude and from 62° 24' at Wellesley Mountain in the Tanana drainage, to the Gulf of Alaska at 59° 42' north latitude.

- **Physiography, geology and lithology** vary dramatically across the park and include ancient Jurassic weathered mountains in the Yukon-Tanana uplands, Pleistocene alluvial deposits of the Tanana lowlands, volcanic ice covered peaks in the Wrangell-St. Elias Mountains, Pleistocene glacial Lake Ahtna in the Copper River Basin, marine and sedimentary mountains of the Southern St. Elias Mountains.

- Five large **mountainous regions** define the landscape of the park:
  - The **Wrangell Mountains**, a volcanic range extending for 100 miles (160 km) and with peaks reaching 16,390 ft (4995 m), dominate the landscape in the center of the park. The most common bedrock in the Wrangell Mountains is Wrangell lava, although the southern Wrangells have large exposures of Chitistone and Nizina limestone, Nikolai Greenstone and metamorphosed sedimentary rocks.

- The **St. Elias Mountains** extend for 300 miles (480 km) northwest along the Alaska-Canada boundary and are more precipitous and heavily glaciated than the Wrangell Mountains with peaks rising to 18,008 ft (5489 m). The most common surficial rock types are Wrangell lava, Nikolai greenstone and marine sedimentary rocks of the Hasen Creek formation such as argillite, chert, conglomerate, limestone and shale.
- The **Chugach Mountains** are heavily glaciated due to their proximity to the Gulf of Alaska and extensive glaciation during the Pleistocene as indicated by the steep-sided U-shaped valleys, trimlines, hanging glaciers and sparsely vegetated morainal features. The lithology is dominated by rocks of the Valdez group, a marine sedimentary unit composed primarily of greywacke, argillite, slate and phyllite.
- The **Mentasta and Nutzotin Mountains** represent the eastern arc of the Alaska Range south of the Denali Fault. Summits are lower than 9187 ft (2800 m). The lithology is largely composed of marine sedimentary rocks with exposures of Nikolai greenstone and thin-bedded limestone.

- Headwaters of four major interior **river drainages** are found within these mountains: the Chitina, Copper, White and Tanana (including the Nabesna and Chisana Rivers). The park's northern and southern boundaries are lowland basins: the Tanana Basin to the north of the Nutzotin Mountains, and the Malaspina Forelands on the Gulf Coast of Alaska.

- The river basins in the park are mantled with quaternary surficial deposits of diverse origins. Surficial deposits include drift from the Wisconsin and older glaciations, eolian deposits, Holocene alluvium and lacustrine sediments. The alluvial fans created by these river systems are major geomorphic landforms in the park.
  - The principal depositional feature in the Copper River basin was the presence of the huge pro-glacial Lake Ahtna, which formed behind an ice dam at the confluence of the Copper and Chitina Rivers during the Pleistocene Epoch.
  - The upper Nabesna and Chisana Rivers occupy relatively narrow valleys in contrast to the large expanses of open, low elevation terrain present in the Copper River basin. The valley floors of these braided rivers lie within the active floodplains of the streams.
  - The surficial deposits in the large, open valleys of the Chitina and White Rivers are a mix of alluvium on the floodplains and glacial outwash and drift from the Wisconsin glaciation on surfaces that have not been reworked by fluvial processes.
  - Extensive areas in the White River valley are blanketed with volcanic tephra, locally two feet deep, from two eruptions of Mt. Churchill 1900 and 1250 years ago.

- The principal **climatic gradient** in the park parallels the southeast-northwest trending topography. Three of the major climatic divisions of Alaska are represented in the park: South Coast maritime, Copper River and Interior Basin. The combined effect

of the maritime influence from the Gulf of Alaska and complex mountainous topography result in extremely varied climatic conditions throughout the park.

- Precipitation ranges from a yearly average of 338 cm (132 in) at Yakutat, located in the maritime climatic zone, to 20 cm (8 in) at Slana in the interior climatic zone.
- Temperatures on the coast are mild ranging from a mean daily high of 15° C (59° F) to a mean daily low of -9° C (16° F) whereas temperatures at Slana range from a mean daily high of 20° C (68° F) to a mean daily low of -25° C (-13° F).

- The **distribution of vegetation** in the park is controlled by climate, ecological history, physiography, lithology, and landscape variables such as slope, aspect and elevation.
  - Vegetation in the lowlands of the park ranges from coastal Sitka spruce forests along the Malaspina Forelands to the interior taiga forests. Areas underlain by permafrost in lowland basins and north-facing slopes support slow-growing black spruce (*Picea mariana*) muskeg. Wetland areas are common in the lowlands, particularly on the coast, in the open Copper and Chitina River basins, around the area of Lake Ahtna, and north of the Alaska Range.
  - River corridors and upland areas with better drainage support more productive forest types than sites with permafrost. White spruce (*Picea glauca*) forest occupies uplands, occasionally mixed with paper birch (*Betula papyrifera*) on rolling hillsides in northern areas of the park and aspen (*Populus tremuloides*) in dry or recently burned sites.
  - Alpine plant communities are extremely variable depending on site characteristics and geographic location. In well-drained sites too dry or rocky to support dwarf birch alpine vegetation occurs above 3350 ft (1100 m) and in more favorable sites it occurs above the elevational limit of the shrub-tundra zone, which varies between approximately 4260 ft (1400 m) and 5480 ft (1800 m).

- Eight of 32 **ecological regions** representing the major ecosystems of Alaska are found in the park. These are further classified into 16 ecological sections, 65 subsections and 182 ecological units. The ecological section level of classification is the most applicable for the description of floristic and vegetation patterns within the park.

- Most of the park was covered by the **Cordilleran ice sheet** or by the large pro-glacial Lake Ahtna during the peak of the Wisconsin glaciation. The major river valleys became ice-free and Lake Ahtna drained 9,400 years before the present.

- There were **unglaciated areas** within the Late Wisconsin ice sheet adjacent to Lake Ahtna, on coastal refugia, on exposed sites in the dry northern interior of the park bordering the Tanana Valley and southeastern edge of Beringia, and on nunataks in the Wrangell-St. Elias Mountains.

- Five of the 11 Alaska-Yukon **floristic regions** described by Eric Hultén are found in the park:

    1. Western Pacific Coast Region (from Yakutat Bay to Icy Bay;
    2. Central Pacific Coast Region (the Bagley Icefield and southern Chugach-St. Elias Mountains);
    3. Alaska Range Region (the Mentasta, Nutzotin, Wrangell and most of the St. Elias Mountains);
    4. Central Yukon Region (between the Nabesna River and the Alaska-Yukon boundary mostly north of the Nutzotin Mountains), and
    5. Upper Yukon Region (along the Alaska -Yukon border north of Mt. St. Elias).

Chapter 2. History of Botanical Collecting

- The following sources were researched to compile the history of botanical collecting in the park: (1) Eric Hultén's 1941-1950 and 1968 floras of Alaska and the Yukon and his history of botanical collecting (1940); (2) all known USGS reports, early military reports and published accounts of expeditions in the park; (3) published literature for collections made after Hultén's floras were published; (4) the data for specimens housed at the University of Alaska Fairbanks Herbarium, and (5) data from collections made by park staff. All data were entered into the park's collection database.

- Twenty-six collections comprising 1331 specimens were made from within the park boundaries prior to its establishment. The most notable historical collections from the park include the following:

    - Frederick Funston collected near Esker Stream and Manby Point on the Malaspina Forelands in 1892.
    - The Harriman Expedition collected at the Hubbard Glacier in 1899.
    - William L. Poto collected along the Mt. Drum Trail in 1902 as part of the USGS Mt. Wrangell and Central Copper River Region Exploration Expedition.
    - Frank Charles Schrader and G.H. Hartman collected in the northern Wrangell Mountains between the Nabesna and Copper Rivers in 1902 as part of the same expedition.
    - David W. Eaton, DeLorme D. Cairnes and H.F. Lambart collected along the Yukon border in the park from 1909-1913 as part of the Yukon-Alaska International Boundary Survey.
    - Hamilton M. Laing, a biologist with the Department of Mines of British Columbia, collected at the head of the Chitina River as a member of the Mt. Logan expedition in 1925.
    - David F. and Barbara Murray collected at May Creek, Nizina, Chitistone Pass, Skolai Pass, Guerin Glacier, Russell Glacier and Sheep Glacier in the Wrangell-St. Elias Mountains from 1966 to 1981.
    - Richard W. Scott collected at Frederika Glacier, Chitistone Pass and Snag Glacier in the Wrangell Mountains in 1967 and 1968 while conducting an ecological phytogeographical study.

  - George Argus collected numerous *Salix* specimens in 1967 near Esker Stream on the Malaspina Forelands in 1967.
  - Olle Nordell and Alf Schmitt collected at Kennicott and Bonanza Ridge in the Wrangell Mountains in 1976.
  - Ransom Saltmarch collected on the slopes of Mt. Wrangell in 1978 while conducting research for a novel.

- An additional 36 individuals collected along the two roads into the park or on roads adjacent to the park. Among these collectors are: E.L. Blaschke (1820), Edwin F. Glenn (1899), Martin Woodlock Gorman (1898 and 1899), Arthur James Collier (1902), Adolphus Washington (1905), I.E. Dehl (1908), Walter Harrison Evans (1909), Bayne-Beauchamp Expedition (1932), William Albert Setchell (1932), Frits Warmolt Went (1934), Jacob Peter Anderson (1935 and 1944), Elisabeth Kol (1936), H.M. Raup (1944), Artheme-Antoine Dutilly and Ernest LePage (1945-1947), Eric Hulten (1961), M. Sharrock (1962), R. Pegau (1968, 1970), and Leslie Viereck (1957-1980).

- Park staff collected 1145 specimens at 215 unique localities throughout the park from 1982 to 1994.

Chapter 3. Methodology

- The **park's vascular plant list**, developed prior to 1994, was digitized in 1994 when records for 10,684 vouchers (with georeferences when available) were entered into our collection database.

- These records included: (1) park collections which had been reviewed and annotated by botanists at the University of Alaska Fairbanks Herbarium (ALA) in 1993; (2) vouchers in the published literature; (3) specimens housed at ALA; (4) stations for taxa occurring within the boundaries of the park in the 1968 flora of Hultén; (5) historic collections of notable plants cited in Hultén (1940-1950), and (5) historic collections of William L. Poto referenced in his 1902 field notes.

- A **list of species expected to occur** in the park was developed in 1994 and updated throughout the inventory. The expected species list included: (1) species with published localities adjacent to the park in Alaska and the Yukon; (2) data from ALA within 50 km of the park's border, and (3) species that have ecological ranges within Alaska or the Yukon that indicate they might occur within the park.

- The expected species list was evaluated by habitat variables and in association with the georeferenced voucher data used to conduct a **gap analysis**. Survey regions and habitats were prioritized based on this analysis.

- We developed a set of **relational databases** (taxonomic, site and collection) in which the biogeography, taxonomy and rarity of each species were recorded and site characteristics for each rare plant collection was documented and evaluated.

- Specific **sites were selected** using infra-red aerial photography and surficial geology maps with consideration given to means of access (road, fixed-wing, raft, helicopter, horse or foot) and coordination with other park projects.

- We conducted **surveys** of selected sites north of the Bagley Icefield from 1994-1997 and in 2003 focused on the geographic and taxonomic data gaps throughout the park with the coastal areas having the greatest priority.

- A complete **floristic reconnaissance** of each site was conducted with an effort to survey as many distinct plant communities as possible. All plant species were recorded and collections made of species new to the park, species of special concern, specimens not identifiable in the field and more common species as time permitted. Each survey route was mapped on an aerial photograph and a topographic map and georeferences of sites and collections recorded.

- **Specimens** were initially identified by the collector and then verified by botanists at the University of Alaska Fairbanks Herbarium (Carolyn Parker, Alan Batten and David Murray). The following specialists reviewed problematic taxa: George W. Argus (Canadian Museum of Nature, Ottawa) – *Salix;* Reidar Elven (Botanical Museum, Oslo, Norway) – *Draba lactea* and *Cerastium regelii*; Mark Egger (University of Washington, Seattle) – *Castilleja*; Barbara Ertter (University of California, Berkeley) – *Potentilla diversifolia* and *P. drummondii*; Donald Farrar (Iowa State University) – *Botrychium*; Signe Frederickson (University of Copenhagen, Denmark) – *Festuca*; G.A. Mulligan (Agriculture and Agri-Food Canada, Ottawa) – *Arabis* and *Draba*; David F. Murray – *Papaver* and *Carex* section Atratae; Robert Soreng (Smithsonian, U.S. National Herbarium) – *Poa*, and Marcia Waterway (McGill University, Macdonald Campus, Québec. Montréal) – *Carex laxa*.

- **Distribution maps** were prepared for selected taxa by assembling the following locality data into a Geographic Information System (GIS): all collections from this inventory and previous park collections; specimen records from the University of Alaska Fairbanks Museum Plant Documentation Center, and published localities from regional floras and monographs.

- The **taxonomic and biogeographic composition** of the flora was evaluated by querying the park's taxonomic database. The distribution of the rare and endemic floras was evaluated using available GIS coverage and the regional floristic units derived from the ecological section map of Swanson (2001). **Floristic analyses** and tests for relationships between variables were conducted using SPSS Statistical Software.

Chapter 4. Results - Highlights

- We surveyed 317 sites, 233 from 1994 to 1997 and 84 during the 2003 field season. Over 7000 specimens were collected, of these 6860 were vouchered. We took 5,186 slide photographs to document sites and species. These have been labeled and archived.

- Voucher data was submitted to NPSpecies in 2006, to John Kartesz for inclusion in his digital Synthesis of the North American Flora, to specialists for treatments in the Flora of North America, to the Alaska Natural Heritage Program, and to the University of Alaska, Fairbanks, Northern Plant Documentation Center.

- **Eleven taxa new to the flora of Alaska** were documented, nine of which are still only known in Alaska from our collections in the park. The taxa new to Alaska are: *Arabis calderi*, *A. codyi, A. drepanoloba, A. lemmonii, Botrychium lineare, B. montanum, Carex tahoensis, Draba lonchocarpa* var. *thompsonii, Festuca minutiflora, Najas flexilis* and *Trichophorum pumilum* var. *rollandii*.

- None of the taxa new to Alaska were on the expected species list for the park, nine of the taxa have a North American distribution and eight are restricted to the North American Cordillera.

- The majority (seven) of the species new to the flora of Alaska was collected south of the Wrangell Mountains and nine were collected above 3000 ft (914 m).

- *Arabis codyi* and *Botrychium lineare* are extremely rare and critically imperiled globally (with a Nature Conservancy global rank of G1) and all of the taxa new to the flora of Alaska are extremely rare in Alaska (Alaska Natural Heritage Program state rank of S1).

- Specimens documented 217 **taxa new to the park's flora**, an increase of 23% from prior to the inventory, for a total of 917 documented taxa. The greatest numbers of taxa new to the park were in the Chitina River Basin (79), the Nutzotin Mountains (70), the Tanana River Basin (50) and the Northern Chugach Mountains (45).

- There has not been a consistent reduction in the **rate of accumulation of new species** to the park's flora since 1994, indicating that the documentation of the park's flora is incomplete and that more species are expected to occur here.

- We documented one **U.S. Fish and Wildlife Candidate species** (*Botrychium lineare*), but no currently listed threatened or endangered species.

- Under the previous U.S. Fish and Wildlife Endangered species classification there were four species that had been listed as Category 2 species (*Carex lenticularis* var. *dolia*, *Cryptantha shackletteana, Montia bostockii*, and *Taraxacum carneocoloratum*) and six as Category 3 species (*Draba ruaxes, Papaver alboroseum, Phippsia algida, Papaver walpolei, Parrya nudicaulis and Thlaspi arcticum*).

- We documented 55 new **Alaska Natural Heritage Program** (AKNHP) taxa with a state rank of three or less and 448 new occurrences during the inventory. There are now 91 AKNHP taxa and 524 occurrences in the park, 32 that are known from five or fewer localities in the state.

- **Thirty-one taxa occurring in the park have been down listed** by AKNHP, in part due to our inventory effort.

- Collections made during the inventory documented **range extensions of more than 250 km** from previously published localities for 129 taxa.

- Ninety-nine taxa (11% of the flora) reach their **North American distribution limits** within the boundaries of the park.

- The 185 taxa on the **rare plant watch list** for the park include: (1) AKNHP taxa with state ranks of three or less; (2) taxa known from five or fewer localities in the park and which appear to be rare, not just under collected; (3) taxa which are at the limits of their global distribution in the park; (4) endemic species with global ranks of G3 or G4; and (5) species which are disjunct from their main range in Alaska.

- We documented only three new non-native species to the park since the focus of the inventory was natural areas away from the road system. One species is considered invasive (*Polygonum aviculare*) and is of low priority for control.

- The only invasive plant populations documented during the inventory in natural areas were on the upper Chitina River and Stuver Creek in the Nutzotin Mountains.

Chapter 5. Results - Regional Summaries

The results of the inventory were summarized for each of the 18 regions in the park. Regional summaries included: (a) a general description of the region (extent within the park, major landforms and lithologies); (b) the focus of the inventory within the region (if other than spatial coverage); (c) the survey effort as indicated by the number of sites and collections in the region; (d) the number of new taxa documented by vouchers from the region; (e) the number of significant range extensions (> 250 km from previous collections) documented by vouchers from the region; (f) the number of global and state rare plant collections from the region ('rare' is defined as those taxa with a Natural Heritage Program rank of three or less); (f) a comparison of survey results with other regions; (g) a description of notable sites and plant associations; (h) an assessment of the inventory completeness in that region, and, (i) suggestions for future survey efforts in that region. Each regional description is accompanied by photos of sites within the region and a map showing the distribution of inventory sites and collections made prior to the inventory.

- **Yukon-Tanana Uplands:** This is the oldest region in the park, accredited to the margin of North America in Jurassic times, encompassing 151,375 acres, 1.15% of the park's area and 16th in size among the 18 regions (and 16th by ice-free acreage). We surveyed ultramafic lithologies of Carden Hills, Wellesley Mountains and associated wetlands. Three sites were surveyed, the fewest actual number in a region (representing two sites per 100,000 ice-free acres). The number of collections was near the average for a region ranking fourth by ice-free area. We documented 22 taxa

new to the park, three significant range extensions and five new rare plant species. The wetland and sub-alpine communities had the greatest numbers of notables.

- **Mentasta Mountains:** The eastern extent of the Alaska Range, this region covers 161,507 acres, comprises 1.92% of the park's ice-free area, has 0.15% ice coverage and ranks 15th in size (14th by ice-free acreage). The focus of our surveys was limestone and greenstone lithologies, south-facing alpine slopes, south-facing river bluffs, and wetlands. We surveyed 22 sites and collected 482 vouchers, a higher than average survey effort with the number of collections ranking third among regions per unit area. We documented one taxa new to the state, 32 taxa new to the park, nine significant range extensions, 56 endemic taxa and 59 occurrences of 20 rare plant taxa, 11 which are globally rare, and four which were unique to this region. The numbers of rare taxa and occurrences were the highest of any park region per unit area, and the numbers of taxa new to the park and significant range extensions ranked second. Three of the most significant collections from the entire inventory were made in this region: *Cryptantha shackletteana* known from only two other localities in the world, both in Alaska; *Draba lonchocarpa* var. *thompsonii* disjunct by 1100 km from British Columbia, and *Papaver walpolei*, 970 km disjunct from the closest locality on the Seward Peninsula in northwest Alaska. Soda Lake, in the eastern Mentasta Mountains, is a unique natural area not only for its wildlife habitat but for the high number of notable vascular plants found here (nine rare, one new to the state, 17 endemic and five significant range extensions).

- **Nutzotin Mountains:** This region is wedged between the Denali and Totschunda Faults, covers 979,545 acres, 3.6% in ice, comprises 11.24% of the park's ice-free land and is the sixth largest region (second in ice-free acres). The focus of our surveys was the areas of high endemism documented by previous park collections, limestone and fine volcanic lithologies, steppe communities on south-facing river and lake bluffs, and unusual landforms such as Beaver Butte and Euchre Mountain. The actual survey effort was highest of any region, and third by ice-free area. The collections documented one taxa new to Alaska, 55 taxa new to the park, 19 significant range extensions, 99 occurrences of 29 rare plant taxa (seven unique to this region) and 57 endemic taxa. This region had the second highest actual number of taxa new to the park, third highest number of significant range extensions and the highest numbers of rare taxa and occurrences. The isolated peaks in the Wiki and Ptarmigan basins had a high number of these notables, most likely since they are areas that were ice-free earlier than the surrounding areas.

- **Northern St. Elias Mountains:** Underlain by the Alexander Terrane, this region covers 1,350,215 acres, 47.59% in ice, 8.42% of the park's ice-free land and is the fourth largest region (and fourth by ice-free acres). The focus of our surveys was volcanic ash deposits, limestone lithologies, and nunataks at the head of the Chitina River. The numbers of sites and collections were less than half the averages representing only one site and 47 collections per 100,000 ice-free acres. We documented one taxa new to the state (*Arabis calderi*), 15 taxa new to the park, seven

significant range extensions, 30 occurrences of 20 rare plant taxa and 44 endemic taxa.

- **Northern Wrangell Foothills:** This region covers 670,346 acres, 8.95% in ice, 7.26% of the park's ice-free area and ranks eighth in size (fifth by ice-free acres). Our surveys focused on the high elevation plateaus in the upper Nabesna, Jacksina and Copper drainages, the upper Copper River floodplain and associated wetlands, and limestone and greenstone lithologies. Our survey effort in this region, which was below the regional average, documented 19 taxa new to the park, 10 significant range extensions, 24 occurrences of 15 rare taxa and 40 endemic taxa. One of the most notable finds for the entire inventory was *Cerastium regelii* from the Lakes Plateau in the Upper Jacksina, which is 1071 km disjunct from its arctic distribution.

- **High Wrangells:** Covering 1,440,615 acres, this region is predominately ice (67.67%), is 5.5% of the park's ice-free area and ranks third in size (ninth by ice-free acres). Our interest was in the nunataks (which we were unable to survey) and calcareous lithologies. Our survey effort by unit area was the lowest for any region. We documented four new taxa to the park, one significant range extension, one occurrence of one new rare plant and 38 endemic taxa.

- **Mts. Drum and Sanford:** This region encompasses 509,361 acres on the west slopes of the Wrangell Mountains, 22.52% of the acreage is ice, representing 4.70% of the park's ice-free area and ranking 11th in size (10th for ice-free acreage). Our survey effort, below the regional averages, documented four significant range extensions, one species new to the park, no new rare taxa but 14 new rare occurrences.

- **Southern Wrangell Foothills:** This portion of the Wrangell Mountains covers 630,979 acres, 11.16% in ice, 6.67% of the park's ice-free area and ranks ninth in size (sixth for ice-free acreage). We surveyed calcareous and volcanic lithologies, and unique landforms such as the high elevation plateaus and isolated mountains in the Chitina Valley. Our actual survey effort was above average but below the per unit area average. The vouchers documented 28 taxa new to the park, 10 significant range extensions, 55 occurrences of 20 rare plant taxa (three unique to the region) and 60 endemics. The number of rare occurrences ranked third among regions. Two important notables from this region are *Botrychium* cf. *hesperium* which is disjunct from British Columbia, and *Douglasia alaskana*, known in the park from only two close localities and considered rare in Alaska.

- **Northern Chugach Mountains:** The largest region in the park both by actual and ice-free acreage, the Northern Chugach Mountains cover 1,994,038 acres, 26.44% in ice and 17.45% of the park's ice-free area. We surveyed representative calcareous units, varying moisture regimes, landscape types, and unique landforms such as Towhead Mountain, a monadnock. The numbers of sites and collections ranked second among regions, almost three times the averages, but was below average by unit area. The vouchers documented four species new to the state (*Arabis calderi, A.*

codyi, A. drepanoloba and *Festuca minutiflora*), 39 taxa new to the park, 22 significant range extensions, 52 occurrences of 23 rare plant taxa (four unique to the region) and 68 endemics. This region had the second highest numbers of range extensions and rare taxa.

- **Southern Chugach-St. Elias Mountains:** The second largest region in the park**, t**his region covers 1,831,603 acres, 85.31% estimated to be ice, representing 3.20% of the park's ice-free area (ranking 11th for ice-free area). The focus of our survey was the nunataks in the Bagley Icefield in 1994, and nunataks and slopes between Icy Bay and the Hubbard Glacier in 2003. The actual and per unit area survey efforts were lower than average. We documented one species new to the state (*Botrychium montanum*), 18 taxa new to the park, 10 significant range extensions, 14 occurrences of 10 rare plant taxa (two unique to the region) and 33 endemics. One of the most notable collections from the inventory was of the rare *Sedum divergens*, the third record for Alaska, which documents the western extent of its North American distribution.

- **Coastal Foothills and Mountains:** This region covers 822,706 acres, 81.17% as ice (primarily as the Malaspina Glacier), represents 1.84% of the park's ice-free area, and is the seventh largest region (15th by ice-free acreage). The survey effort was much higher than the actual and per unit area regional averages. The vouchers documented 27 taxa new to the park, nine significant range extensions, 18 occurrences of nine rare plant taxa and 44 endemics. The numbers of notables per unit area ranked second (for range extensions, rare taxa and rare occurrences) or third (for taxa new to the park). Two highly notable collections from this region are extremely rare in Alaska: *Agoseris aurantiaca* (our collection documents its western extent in North American), and *Carex hoodii* (the second record for Alaska).

- **Tanana River Basin:** This region includes those portions of the Nabesna and Chisana Rivers below 3000 ft (914 m) and the lowlands north of the Nutzotin Mountains which drain into the Tanana River. The area covers 257,007 acres, 3.05% of the park's ice-free area and is 13th in size (12th in ice-free acres). Our survey effort was greater than the actual and per unit area regional averages. The vouchers documented *Trichophorum pumilum* var. *rollandii* (new to Alaska), eight significant range extensions, 21 occurrences of 11 rare plant taxa and 32 endemics. The wetlands and south-facing steppe slopes adjacent to rivers had the highest numbers of notables.

- **White River Basin:** This region covers 168,561 acres, 1.99% of the park's ice-free area and is 14th in size (13th in ice-free acres). We focused our surveys on wetlands and steppe bluff communities. The survey effort was below the actual regional averages. We documented 13 taxa new to the park, four significant range extensions, six occurrences of four rare plant taxa and 40 endemics. The collection of *Botrychium tunux* in this region was notable since this locality extends its range from the coast.

- **Upper Copper River Basin:** This region is that portion of the Copper River basin north of the Sanford River in the area of pro-glacial Lake Ahtna. The area covers 525,318 acres, 6.25% of the park's ice-free area, ranking tenth in size (seventh by ice-free acreage). We surveyed wetlands and floodplains on the Copper River above Slana, wetlands along Tanada Creek and seven lakes between the Sanford and Slana Rivers. The survey effort was below the actual and per unit area averages. We documented 30 taxa new to the park, six significant range extensions, five occurrences of three rare plant taxa and 15 endemics.

- **Middle Copper River Basin:** This region is that portion of the Copper River Basin south of the Sanford River and north of the confluence with the Chitina River. The area covers 472,040 acres, 5.62% of the park's ice-free area, 12th in size among regions (eighth in ice-free acreage). We surveyed a variety of wetland communities, bluff and mineral spring communities. We surveyed nine sites and collected 167 specimens, a survey effort less than the actual and per unit regional averages. We documented 46 taxa new to the park, five significant range extensions, six occurrences of six rare plant taxa and 24 endemics.

- **Lower Copper River Basin:** This region includes the Copper River south of the Chitina River and that portion of the Bremner River basin below 3000 ft (915 m) that flows into the Copper River. The area is 1.31% of the park's ice-free area, and is the second smallest region. The focus of the survey was the extensive dunes and wetlands at the mouth of the Bremner River. The survey effort was the lowest or second to lowest by unit area. The vouchers documented one species new to the park, two significant range extensions and one occurrence of one rare plant species.

- **Chitina River Basin:** This region encompasses 995,940 acres, 10.96% of the park's ice-free area, the fifth largest region in the park (third by ice-free acreage). We surveyed wetlands and dunes of the Lakina, Kuskulana, Hanagita, Granite, Tana and upper Chitina River drainages. The number of sites was the highest for a region and the number of collections was the third highest. However, the per unit area values for survey effort were average or less than average. We documented four taxa new to the flora of the state (*Arabis lemmonii*, *Carex tahoensis, Najas flexilis* and *Trichophorum pumilum* var. *rollandii*), 67 taxa new to the park (the highest for any region), 31 significant range extensions (the highest of any region), 21 occurrences of 21 rare plant taxa (ten unique to the region) and 52 endemics. The highest numbers of notables were in floodplain wetlands.

- **Malaspina Forelands:** This is the smallest region in the park, covering 76,230 acres, 14.15% in ice and 0.78% of the park's ice-free area. We surveyed forest, beach strand, wetland, floodplain, glacial moraine scrub and dune communities. The actual survey effort was below the regional average, but above the per unit area average. The vouchers documented 21 taxa new to the park, five significant range extensions, two occurrences of two rare taxa and 19 endemics. The per unit area numbers of taxa new to the park and significant range extensions were the highest among regions.

Chapter 6. Results: Floristics and Phytogeography

Floristics

- There are 853 species (917 taxa including subspecies and varieties) of vascular plants documented by vouchers within the park. This represents approximately 56% of the species in the Alaskan flora and 71% of the Yukon Territory flora.

- For comparison, 631 species (674 taxa) have been documented for Yukon-Charley Rivers National Preserve and 753 species (816) were documented for Denali National Park and Preserve.

- The number of species **per unit area** in this park is 40% of the per unit area value for Yukon-Charley Rivers National Preserve and 80% of the per unit area value for Denali National Park and Preserve. This most likely demonstrates the species area relationship where smaller sample units have on average more species per unit area than larger areas, and may also indicate the **incompleteness of the inventory in this park**.

- The flowering plants (Magnoliophyta) comprise 95% of the park's recorded flora including 263 monocot and 603 dicot species. Recorded are 26 species of ferns (Pteridophyta), 11 lycopod species (Lycodophyta), nine horsetail species (Equisetophyta) and five conifer species (Coniferophyta). **The ratio of the flora by plant division** for Denali National Park and Preserve is very similar to this park, varying by 1% or less in all classes.

- **The most divserse families** in the flora are the Cyperaceae with 107 taxa, the Asteraceae and Poaceae each with 82 taxa, and the Brassicaceae with 71 taxa . These are also the four most diverse families in Denali National Park and Preserve and in Yukon-Charley Rivers National Preserve.

- Ninety percent of the flora is comprised of non-woody species (63% forbs, 22% graminoids, 5% lower vascular). Woody species are represented by eight tree species, 54 shrub species and 25 dwarf shrub species. The **life form composition** of the flora of Denali National Park and Preserve and Yukon-Charley National Preserve are very similar to this park, varying by less than 1% for all classes except for the forb class in Denali National Park & Preserve which was 60% of the flora.

Biogeography

- The biogeographic composition of the flora is 32.6% North American, 26.1% circumpolar, 22.2% amphiberingian, 12.0% incompletely circumpolar, 6.1% Alaska-Yukon endemic and 1.1% amphiatlantic.

- The ranks of these elements are similar for Denali National Park and Preserve and Yukon-Charley Rivers National Preserve except for the North American element which ranks second for the other two parks, and comprises 7-10% more of this park's

flora. Also, this park has 1-2% more Alaska-Yukon endemics than both parks and 1% fewer amphiberingian taxa.

- The biogeographic composition of the park's flora is very similar to the **flora of the southwest Yukon** except for the amphiberingian element which is 5% more of the park's flora.

The Rare Flora

- The **most important families in the rare flora** are the Brassicaceae, Cyperaceae and Poaceae. The rare flora is dominated by forbs (57 species) and graminoids (24 species).

- The **biogeographic distribution of the rare flora** is predominately North America (49%) and Alaska-Yukon endemic (22%).

- Sixty-six percent of the rare plants were found at elevations over 4000 ft (1219 m), 54% were in the xeric moisture class and 37% were in the mesic moisture class.

- **Region size and survey effort** is influencing our knowledge of the distribution of the rare flora since there are significant linear relationships between (1) the number of rare species in a region and the size of a region, (2) the number of rare species and number of survey sites in a region, and (3) the number of rare species and number of collections in a region.

- There were significant linear relationships between survey effort (number of rare plant collections and number of sites) and the **distribution of rare plants by life zone, lithology and landcover** type but not for elevation or moisture class.

- Twenty-two of the rare species (24%) are constantly sparse and geographically restricted in specific habitats and are considered **most susceptible to extirpation**, 29% are locally abundant in specific habitats but restricted geographically, and 24% are constantly sparse in specific habitats but occurring over a large range.

- The rare flora is **widespread but unevenly distributed** among the regions of the park. There are 45 rare species that occur in only one region and 70% occur in the mountain regions of the park.

- Rare species are most frequent in the Nutzotin Mountains (30 taxa), the Northern Chugach Mountains (25 taxa), the Chitina River Basin (24 taxa), the Mentasta Mountains (20 taxa), and the Northern St. Elias and Southern Wrangell Mountains (20 taxa each).

- The distribution of the rare flora across park regions is correlated to the distribution of Alaska-Yukon, Amphiberingian and Cordilleran endemic species.

Floristic Regions

- Georeferences for 10,262 voucher records were used to compile a species by region matrix and evaluated using a nearest neighbor cluster analysis to determine if there were regional floristic patterns across the park.

- The classification resulted in six floristic regions with montane and lowland components:
    1. Tanana (Tanana River Basin and Tanana Uplands);
    2. Alaska Range (Mentasta Mountains, Nutzotin Mountains and White River Basin);
    3. Lake Ahtna (upper Copper River and Mts. Drum and Sanford);
    4. Transitional (Southern Wrangell Foothills, Northern Chugach Mountains, Middle Copper River Basin and Chitina River Basin);
    5. Coastal (Southern St. Elias Mountains, Coastal Mountains and Foothills and Malaspina Forelands), and
    6. Lower Copper River.

The Endemic Flora

- A geospatial analysis of the distribution of endemic elements in areas that were ice-free at the end of the Wisconsin glaciation (Lake Ahtna, Wrangell-Chugach Mountain nunataks and Tanana lowland-upland refugia) was performed using the voucher data. The analysis indicated that:
    - Alaska-Yukon and Cordilleran endemics are predominate in the areas that were ice-free at the end of the Wisconsin glaciation, coinciding with their origins and ecological affinity for alpine habitats.
    - The Lake Ahtna region was not the source of amphiberingian endemics in the Upper Copper River, High Wrangells and Mt. Sanford and Drum regions.

- The uneven distribution of endemic species across park regions provides valuable insights into the origin of the park's flora.
    - **Alaska-Yukon endemics** are most frequent in the Tanana River Valley, Mentasta and Nutzotin Mountains and **amphiberingian endemics** are most frequent in the Northern Chugach Mountains, Southern Wrangell Foothills and Nutzotin Mountains.
    - There is a high correlation between the distribution of Alaska-Yukon and amphiberingian endemics, as would be expected since their sources are similar, the main difference being that amphiberingian endemics are found on both sides of the Bering Strait.
    - The greatest numbers of amphiberingian and Alaska-Yukon endemics are in the northeast corner of the park in the Nutzotin Mountains, the region closest to the Upper Yukon portion of Beringia that has been identified by phytogeographers as a **center of endemism**. These species have radiated from the Upper Yukon south through the mountain and basin regions of the park.

- The Bagley Icefield and Southern St. Elias Mountains appear to be an effective **barrier to the migration** of Alaska-Yukon endemics to the southern regions of the park. Additionally, Alaska-Yukon endemics have an affinity for steppe environmental conditions, quite unlike conditions on the coast.
- **Amphiberingian endemics** are more widespread throughout the park than Alaska-Yukon endemics. This is due to their broader ecological affinity and to the pervasiveness of the Beringian flora in Alaska during the Pleistocene Epoch. These endemics have high numbers in the southern Wrangell foothills and northern Chugach Mountains indicating the influence of coastal refugia with species of amphiberingian origin.
- **Cordilleran endemics** are most frequent in the Chitina River valley and Northern Chugach Mountains (the terminus of the Western North American Cordillera) and they radiate north and south into the mountain regions of the park. They are primarily alpine species, which supports their origin from alpine nunataks in the Cordillera.
- **Pacific coastal endemics** are most frequent in the coastal mountains and foothills and radiate to the southern Wrangell foothills and basin regions (except the White River basin). The absence of the Pacific coastal endemic element in the northern mountains of the park indicates that the high Wrangell Mountains are an effective barrier to migration. The presence of Pacific coastal endemics in northern basins indicates that their distribution has been influenced more by coastal refugium in Prince William Sound via the lower Copper River than by the current coastal flora. This is because interior Pacific coastal endemics are mostly non-alpine which indicates they are derived from a coastal refugium with lowland to sub-alpine floras rather than extant coastal nunataks that have predominately alpine floras.

Origin of the Park's Flora

- There were at least three areas within the park that were ice-free in the late Wisconsin (approximately 20,000 years ago), and were most likely the immediate sources of the park's modern day flora: (1) unglaciated areas adjacent to pro-glacial lake Ahtna; (2) an area in the Yukon-Tanana lowlands and uplands at the northern edge of the ice sheet in the northeast corner of the park, and (3) nunataks in the Wrangell Mountains.

- The primary sources for these ice-free areas were: (1) Beringia, particularly the Upper Yukon Valley which bordered the park's northeast corner; (2) the ice-free areas in the Alaska Range to the northwest and the Western North American Cordillera to the east, and (3) coastal refugia.

Chapter 7. Annotated List of Noteworthy Finds

- Alaska-Yukon distribution maps and annotations were prepared for 269 notable taxa, 115 are in this document, the others were previously published.

- The maps and annotations in this document include: (1) the 11 taxa new to the flora of Alaska; (2) all Alaska Natural Heritage Program taxa with a state rank of three or

less, and (3) taxa for which our 2003 collections documented extensions of their known ranges by more than 250 km.

Chapter 8. Conclusions and Recommendations

- The inventory has succeeded in increasing our knowledge of the diversity, abundance, distribution and history of the vascular plant flora in Alaska and in this park and has made this data available to researchers and the National Park Service. The information from the inventory is being used to protect the park's biodiversity by:
    - Contributing to North American and Alaskan floristic and biodiversity assessments;
    - Contributing to the development of long term ecological monitoring in the park;
    - Facilitating 234 environmental reviews and providing documentation for 16 environmental assessments;
    - Contributing to planning efforts for visitor use, backcountry recreation, trail management, grazing management and facility development, and
    - Contributing to cultural landscape studies of the Bremner Historic District and the Kennecott Mill Town and an archeological survey in the Wiki Basin.

- There was not a consistent reduction in the rate of accumulation of new or rare species to the park's vascular flora during this inventory, a reliable indicator that more speces occur in the park than currently documented.

- The absence of invasive plant species in the park's natural communities is one extremely important condition of ecosystem integrity and is of high value to maintain. Preventing the spread of invasive plants into the natural areas of the park should be a management priority.

- I identified populations of rare taxa, unique floristic associations and areas of phytogeographic interest and developed a rare plant watch list for the park. Using our voucher data, I described the biogeography, composition, regional floristic patterns and sources of the park's flora including the rare and endemic elements across the regions of the park. I also identified geographic and ecological gaps to assist in future inventory efforts.

- This biogeographic analysis is an exploratory assessment, illuminating only major patterns. This is due to the delineation of regions as the operational unit and the use of voucher specimens that tend to represent the rare or unusual at a site. It would be preferable to conduct this analysis using operational geographical units derived from a systematic grid across the park. Also, a more comprehensive interpretation could be completed after areas with poor representation are surveyed and a matrix used that includes all known species (not just collections).

- The methodology used in the inventory has provided the structure for a continued assessment of the park's flora.

- Conservation of the park's rich botanical resources will depend on future inventory, monitoring and research actions, including:
    - Thorough evaluations of the cumulative impacts of park projects to species composition, sensitive communities, rare plant populations and exotic species distribution.
    - Assessments of bryophyte and lichen biodiversity, a significant portion of the biomass and diversity in the park.
    - Inventories of the geographic and ecological floristic gaps throughout the park.
    - Distribution and status surveys of rare species such as *Cryptantha shackletteana*, an Alaskan endemic known from only three localities in the world. We lack sufficient knowledge about the rare species in the park (distribution, life history and population ecology) to develop protection plans.
    - Status surveys and monitoring plans for high visitor use areas, such as Bonanza Ridge where rare plants were documented in 1978 and where the invasive plant *Taraxacum officinale* is spreading.
    - Expansion of the invasive plant program to include inventory, monitoring and control of invasive plants in areas off of the road system (backcountry access points, fixed wing landing sites, grazing allotments, access to private lands and river corridors).
    - Support of research that addresses the biosystematics and ecology of rare and endemic species.
    - Maintenance of vouchers and data collected during this inventory so they are accessible to the public and to researchers.
    - Development of products that will distribute and interpret the information from this inventory more widely, such as a rare plant field guide.
    - Support of long term ecological monitoring that will describe and quantify variables that affect plant biodiversity.
    - Support of population level monitoring of species at the edge of their ecological and biogeographic ranges and in areas that function as key migratory corridors and habitats.

Introduction

The vascular plant inventory that was conducted in Wrangell-St. Elias National Park and Preserve, Alaska, from 1994 to 2004 is presented in this document. This work included two significant inventories. The first inventory was conducted from 1994 to 1997 and was funded by the National Park Service Natural Resource Preservation Program. The second inventory was conducted in 2003 and was funded by the National Park Service Inventory and Monitoring Program. The justification for acquiring basic information on the distribution of vascular plants in the park, the objectives of both inventories, and the organization of this document are described in the following introduction.

Purpose and Background

Wrangell-St. Elias National Park and Preserve[1] was established in 1980 under the Alaska National Interest Lands Conservation Act (ANILCA Public Law 96-487). Four of the seven management objectives identified in the Final Environmental Statement for the park (Alaska Planning Group 1973, p. 8) require that the species occurring on its land are known. These management objectives are:

1. Ensure retention of the magnificent Wrangell-St. Elias landscapes and living systems in a natural state.
2. To the extent possible, allow the natural fluctuations and equilibrium of self-regulating ecosystems to continue unimpeded.
3. Develop and implement a viable research program to provide basic information required for effective park management.
4. Lay early emphasis on identification of especially fragile areas through appropriate research.

The Natural Resources Management Guideline for the National Park Service, NPS-77 (USDI 1991, p. 15) states that, “A basic vegetation inventory is the first step in vegetation management”, and the General Management Plan for the park mandates that the presence and extent of endangered species of flora and fauna will be determined (USDI 1986, p. 42). Yet, fourteen years after the park was established, an inventory of it’s flora had not been initiated.

This lack of baseline information may be justified when the size of the park (13.2 million acres) and the inaccessibility of most of the area is considered. Not surprisingly, there has been little botanical exploration within the park for these reasons. Eric Hultén, in his history of botanical exploration in Alaska, identified the Wrangell-St. Elias region as one of three areas in Alaska that was poorly known (Hultén 1941-1950). The distribution maps in his Flora of Alaska (Hultén 1968) illustrate this lack of information. For example, many common boreal species have no collections within the boundaries of the park. Although a few botanical surveys were conducted since this flora was written, they

[1] Hereafter, Wrangell-St. Elias National Park and Preserve will be referred to as ‘the park’.

were restricted to four areas within the park: Chitistone and Skolai Rivers, McCarthy and the upper White River.

The diversity of the park's landscape (four mountain systems, three climate zones and eight ecoregions) and the complex geologic and ecological history are likely to be reflected in the composition of the park's flora. Collections made by park staff during a park-wide vegetation mapping project conducted from 1984 to 1992 indicated that the park was a region with varied and numerous unsurveyed areas, landforms and associated plant communities. Many additions were made to the park's flora during this period. Twenty-two rare and endemic plant species previously unknown in the park were discovered. As park botanists began to compile information from these collections, geographic and ecological patterns in the distribution of endemics and rare plants began to emerge. Trends in the origin of the flora also became evident, since taxa with Beringian, arctic, circumpolar, cordilleran and Pacific coastal affinities were found within its boundaries. Using this new information, park botanists began to formulate a strategy for an inventory of the unsurveyed regions, a daunting task with the immense scale and heterogeneity of the landscape involved.

As visitor use, particularly in the backcountry, increased over the next ten years, the need to identify locations of rare plants and communities in order to protect them became apparent. A park-wide inventory of the flora was also necessary in order to assess the genetic diversity of the region and to clarify the biogeography of the region so that the biodiversity of the park could be protected. These goals were developed into a study proposal, "Vascular Floristic Inventories of Selected Areas within Wrangell-St. Elias National Park and Preserve" (Cook 1993) which was funded May 1994 to September 1997 by the National Park Service Natural Resource Preservation Program.

We were still in the process of working up collections and compiling data from this first inventory when the Parks Omnibus Management Act was passed in 1998. This Act mandated the establishment of the National Park Service Inventory and Monitoring program through the Natural Resource Initiative. The purpose of this program is to establish baseline and long term trend information for National Park Service resources. Inventory and Monitoring (I & M) programs were funded and established for all National Park Service units and are administered through multi-park networks. The I & M program for Wrangell-St. Elias National Park and Preserve is administered with the programs for Denali National Park and Preserve and Yukon-Charley Rivers National Preserve and is referred to as the Central Alaska Network (CAKN).

A summary of existing biological inventory information was compiled for the park in 1999 in which unique resources, management issues, priorities for inventory and monitoring, and available literature documenting species occurrences were identified (Cook 1999). This information was used to write a pre-proposal to acquire funding to thoroughly compile existing data and to conduct a scoping workshop in which networks would agree on inventory priorities. At the April 2000 scoping meeting in Anchorage, the Central Alaska Network identified vascular plants as a high priority for species' inventories. The 1994-1997 inventory at the park was invaluable in helping to articulate

the need for further inventory work at the park and to identify priorities during the scoping meeting. Prior to the 2002 inventories, compilation of existing data for each park was contracted to the Alaska Natural Heritage Program (AKNHP) which populated the NPSpecies and NRBib databases, and developed an expected species list for each park.

The Alaska Region Inventory and Monitoring plant working group in August 2000 developed a matrix of plant inventory study design options to assess feasibility and cost estimates for the Alaska Region plant inventories (Cook 2000). Of the four inventory level options, the targeted reconnaissance as used in the 1994-1997 inventory at Wrangell-St. Elias National Park and Preserve, was selected as the most cost effective and likely to meet the program's objectives. The Central Area Network Plant Inventory Plan (Cook and Roland 2000) incorporated this methodology for the inventories of Denali National Park and Preserve (conducted in 2001), Yukon-Charley Rivers National Preserve (conducted in 2002) and Wrangell-St. Elias National Park and Preserve (conducted in 2003).

Objectives

The objectives of the 1994-1997 vascular plant inventory were to:

1. Establish a database of all plants known to occur in the park and maintain information on the rarity, distribution, synonymy, taxonomy and collections of these plants.
2. Conduct inventories of the vascular flora of selected areas within the park.
3. Identify populations of rare taxa, unique floristic associations and areas of phytogeographic interest which the park may need to protect.
4. Prepare a voucher collection of all plants known to occur in the park.
5. Enhance our understanding of the history, genetic diversity and biogeography of the park's flora.
6. Provide the structure for a continued assessment of the park's flora.

The objectives of the Central Alaska Network vascular plant inventory were developed using the National I & M program guidelines (Cook and Roland 2000). They were to:

1. Document 90% of the plants expected to occur in the park by surveying targeted habitats and communities within unsurveyed regions.
2. Significantly improve current knowledge of the distribution of the plant species that occur in the Central Alaska Network.
3. Describe the taxonomic, ecological and geographic characteristics of selected species of special management concern.
4. Acquire more information about the relative abundance of selected species within the park.
5. Gather a vouchered set of specimens of each species for research and park uses and populate national and local databases with taxonomic and accompanying data.
6. Acquire new inventory information in a format compatible with ongoing plant inventory efforts.

Scope and Organization of Report

The purpose of this document is to synthesize existing knowledge (as of 2004) concerning the flora of Wrangell-St. Elias National Park and Preserve. Data has been summarized for inventories completed during the summers of 1994-1997 and 2003, park collections made prior to 1994 and between 1997 and 2003, collections housed at the University of Alaska, Fairbanks Museum, and published botanical surveys. Although the 1994-1997 and 2003 inventories were separate efforts with different funding sources, the objectives were similar and the methodologies were the same. Therefore both efforts are described in this report as one inventory.

The study area description (Chapter 1) provides the background for understanding the complexity of the landscape and ecological history of the park, and develops the framework for interpreting the origins of the flora. Extensive research was completed on the history of botanical collecting in the park, from the earliest expedition in 1883 to collections made by park staff just prior to this inventory. This historical synthesis (Chapter 2) has been critical for understanding the geographic gaps in the park and bringing to life the rigors of botanical collecting in Alaska. Pre-inventory, inventory and post-inventory methodology, including data management for both inventory efforts are described in Chapter 3.

The inventory results are contained within four chapters. The significant results of the inventory are summarized in Chapter 4 and a summary of results by park region is presented in Chapter 5. A floristic and phytogeographical interpretation is given in Chapter 6, along with comparisons to the floras of Denali National Park and Preserve and Yukon Charley Rivers National Preserve. The fourth results chapter (Chapter 7) is an annotated list with distribution maps of 115 notable taxa documented during the inventory. The significance of the inventory and applications for park management and conservation are discussed in the concluding chapter. Chapter 1, the study area description, was written by Carl Roland in 1997 for a rare plant document and revised for this report by Mary Beth Cook in 2004. Chapter 7, the annotated list of notable taxa was written by Patricia Loomis in 2004 and edited by Mary Beth Cook the same year. All other text was written by the primary author, Chapter 3 (history of collecting) from 1998 to 1999, Chapter 4 (results highlights) in 2004, Chapter 5 (regional summaries) in 2006, Chapter 6 (floristics and phytogeography) in 2004 and 2005, and the remaining text in 2006 and 2007.

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Figure 1.1. Map of Wrangell-St. Elias National Park and Preserve, Alaska, showing major geographical features.

Chapter 1: Study Area Description

General Location

Wrangell-St. Elias National Park and Preserve encompasses 13.2 million acres in south-central Alaska (Figure 1.1) The eastern boundary of the park is the United States-Canadian border along the 141st parallel from latitude 62° 24’ N at Wellesley Mountain in the Tanana drainage, south to Mt. St. Elias where the boundary runs east through the Seward Glacier to Mt. Alverstone and then south to Yakutat Bay. The southern boundary follows the Malaspina Foreland coastline in the Gulf of Alaska at latitude 59° 42’ N west to Yana Stream, continues north to Icy Bay, then northwest along the southern edges of Guyot and Yahtse Glaciers and the Bagley Icefields, then continues northwest to the Copper River. The western border follows the east bank of the Copper River to Slana extending as far west as longitude 145° 24’ near Glennallen. The northern border extends east from Slana at 62° 42’N through the Mentasta Mountains to the Canadian border.

Physiography and Geology

Five large mountainous regions define the landscape of the park: the Wrangell Mountains, the St. Elias Mountains, the Chugach Mountains (which includes the Granite Range), the Mentasta Mountains, and the Nutzotin Mountains. Headwaters of four major interior river drainages are found within these mountains: the Chitina, Copper, White Rivers and Tanana (including the Nabesna and Chitina Rivers). The park’s northern and southern boundaries are lowland basins: the Tanana Basin to the north of the Nutzotin Mountains and the Malaspina Forelands on the Gulf Coast of Alaska.

Mountain Regions

The Wrangell Mountains: The Wrangell Mountains, a volcanic range with peaks reaching as high as 16,390 ft (4995 m) dominate the landscape in the center of park. These mountains, 100 miles long and 60 miles wide, rise east of the Copper River and north of the Chitina River and are included entirely within the borders of the park. The Wrangell Mountains are heavily glaciated. Ice covers most uplands with elevations above 7500 ft (2400 m) and long valley glaciers extend from the major peaks into forested areas.

The most common bedrock in the Wrangell Mountains is Wrangell Lava, a term that connotes a predominance of andesite and basaltic flows, tuffs, and breccias (MacKevett 1978, Richter 1976). The conjunction of volcanic mountain-building processes and heavy glaciation has resulted in massive, ice-laden peaks with long, relatively flat-topped ridges composed of lava flows radiating from them. These ridges are steep sided, with cliffs sculpted by the action of glacial ice.

Two areas in the Wrangell Mountains were not covered by the Quaternary-Tertiary lava flows – the Cross Range on the north side of the Wrangell Mountains, and the McCarthy Mountains on the south side of the Wrangell Mountains. These mountains are composed

of mixed sedimentary and igneous rocks. Elsewhere in the southern Wrangell Mountains, lava caps a basement terrain of metamorphosed igneous and sedimentary rock (MacKevett 1978). There are extensive exposures of Chitistone, Nizina and McCarthy formation limestones and metamorphosed sedimentary rocks of the Skolai and Hasen Creek formations. The Chitistone and Nizina limestone units have a maximum aggregate thickness exceeding 3600 ft (1100 m). They overlie Nikolai Greenstone, a thick sequence of metamorphosed late Triasssic basalt flows. The terrain of limestone areas (such as the valleys of the Nizina and Chitistone rivers) is characterized by vertical cliffs with numerous caves and subterranean streams. Areas bordering the Chitina Valley contain the Chitina Valley batholith, a granodiorite pluton centered in the upper Chitina River drainage.

The St. Elias Mountains: The St. Elias Mountains are 300 miles long and 90 miles wide, extend northwest along the Alaska-Canada boundary from Cross Sound, Icy Strait, and Lynn Canal, south and west to the Bering and Tana Glaciers, and northwest to the Chitistone and White Rivers (Orth 1967). The Chitina, Logan and Walsh Glaciers, dominant features of the St. Elias Mountains, divide the range into northern and southern regions in the park. Drainages in the northern St. Elias Mountains flow into the Yukon, Tanana or Chitina Rivers whereas the southern St. Elias Mountains, which are predominately ice, flow into the Gulf of Alaska.

The landscape of the St. Elias Mountains is similar to that of the southern Wrangell Mountains both in geomorphology and lithology. The St. Elias Mountains straddle the border with the Yukon Territory and contain part of the Alexander terrane, which extends into southeastern Alaska. Peaks such as Mounts Bona and Churchill in the northern St. Elias Mountains are higher than 15,000 ft (4575 m) and are blanketed with ice above 7500 ft (2288 m). The high St. Elias ridge in the southern part of the range near the coast is from 14,000 ft (4270 m) to 18008 ft (5492 m) with ice generally as low as 2000 ft (610 m). Much of the St. Elias Range is unvegetated rock and ice, and is exceptionally precipitous and inaccessible.

The St. Elias Mountains north of the Chitina River are dominated by the Churchill-Bona Massif, a large volcano on the crest and north slope of the range, and by the Mt. Bear Massif on the crest and south slope which is mostly of marble. The Churchill-Bona Massif is composed mostly of Quaternary and Tertiary volcanic rocks. The Sulzer-Natazhat Mountains, north of the Churchill-Bona Massif, is composed of older volcanic, sedimentary, and metasedimentary rocks. The Centennial Mountains, south of the volcanic crest, are composed of granitic, metamorphic, or older Mesozoic and Paleozoic volcanic rocks. Along the lower flanks of the northern St. Elias Mountains, the most common rock types are Wrangell lava, Nikolai greenstone and marine sedimentary rocks of the Hasen Creek formation such as argillite, chert, conglomerate, limestone and shale (MacKevett 1978). The limestone mountains of Nikolai Butte are on the western edge of the northern St. Elias Mountains.

The southern St. Elias Mountains bordering the Gulf of Alaska is comprised of rocks of the Chugach and Yakutat terranes. Generally, marine Tertiary rocks of the Yakutat

terrane are found in the foothills and metamorphosed sedimentary and volcanic rocks are found on the higher peaks.

The Chugach Mountains & Granite Range: The Chugach Mountains, 250 miles long and 60 miles wide extends from Knik Arm near Anchorage west to the Tana River and south to the Bering Glacier (Orth 1971). The Granite Range extends 27 miles east from the Tana River to the Canadian Border. The crest of the Chugach Mountains is at the White-Hawkins Massif at the west end of the Bagley Icefield. The icefields and glaciers south of the crest flow into the Gulf of Alaska.

The southern Chugach Mountains in the park are dominated by rocks of the Orca Group (Winkler 2000). These are sequences of sandstone, siltstone and mudstone and interbedded submarine basaltic flows, breccia and tuff. The lithology of the northern Chugach Mountains is dominated by rocks of the Valdez group, a marine sedimentary unit composed primarily of graywacke, argillite, slate and phyllite (MacKevett 1978). This rock unit is up to several thousand meters thick and was formed in a deep sea sedimentary environment of late Cretaceous to Jurassic age. These rocks are from fine, angular scree, fracturing parallel to the bedding planes. The Granite Range is formed by the Chitina Valley batholith (MacKevett 1978). Large areas of the landscape underlain by granite are very precipitous and recently ice-free. In these areas, there is often little, if any, plant cover. Localized areas in the northern part of the Chugach Mountains contain exposures of metamorphosed Skolai-group rocks. These units are mostly marble and schist and provide some diversity in the otherwise relatively uniform lithological environment of the Chugach Mountains. Exposures of marble occur proximal to Canyon, Goat, Grant, and Skull Creeks.

The mountains in this region are heavily glaciated due to their proximity to moist air from the Gulf of Alaska and to the extensive glaciation during the Pleistocene. Steep-sided U shaped valleys, obvious trimlines, hanging glaciers, sparsely vegetated morainal features and other evidence of recent glaciation are common in the Chugach Mountains. Tributary valleys at elevations that would support mature forest in the Alaska Range have numerous periglacial features and support only open scrub tundra on poorly developed lithosols.

The Mentasta and Nutzotin Mountains: North of the Wrangell Mountains, across the Copper and White Rivers, and bisected by the Nabesna and Chisana rivers lies the eastern arc of the Alaska Range, represented within the park by the Mentasta and Nutzotin Mountains. In contrast to the massive, heavily glaciated Wrangell Mountains, the summits of these mountains are lower than 9187 ft (2800 m) and contain smaller alpine glaciers, which are confined to the vicinity of the highest peaks.

The lithology of the eastern Alaska Range is largely composed of marine sedimentary rocks of late Jurassic to early Cretaceous age, referred to as the Nutzotin Mountains sequence (Richter 1976). There are also exposures of Nikolai Greenstone and both thin-bedded and massive limestone units of late Triassic age (Richter 1976). Thin-bedded limestone areas are characterized by extensive rubble slopes. Outcrop features and cliffs

dominate the landscape where massive limestone bedrock is exposed. In numerous areas, sharp contact zones between greenstone and limestone units are visible. The northern Mentasta Mountains consist primarily of marine sedimentary rocks, whereas the south-southwestern slopes are mostly volcanic, with some diorite, limestone and schist and are generally less rugged than the northern Mentasta Mountains.

The Nutzotin Mountains between the Chisana and Nabesna Rivers have units of igneous rocks (andesitic volcanic and granitic intrusives) and sedimentary rocks (argillite and greywacke). The topography is more rugged and the mountains are higher than the Nutzotin Mountains south of the Chisana River that composed of igneous rocks with low mountains and flat-topped mesas. The Solo-Beaver Creek Valley is above treeline and is covered primarily with glacial till.

Drainage Basins

The river basins in the park are mantled with quaternary surficial deposits including drift from the Wisconsin and older glaciations, eolian deposits, Holocene alluvium, and lacustrine sediments. The alluvial fans created by these river systems are major geomorphic landforms in the park.

The principal Quaternary feature in the Copper River basin lowland is pro-glacial lake Ahtna, which formed behind an ice dam at the confluence of the Copper and Chitina Rivers during the Pleistocene era. Lake Ahtna covered more than 5,200 km^2 of the Copper River basin extending north from the dam throughout much of the basin to a maximum elevation of 2625 ft (800 m) on the flanks of the Wrangell Mountains (Ferrians 1989). This lake probably formed during a glacial advance around 50,000 years ago and persisted with fluctuations in its level (reflected in clear strand lines at 2625, 2444, 2297, and 2100 ft (800, 745, 700 and 640 m) in elevation) until approximately 9,400 years ago, when it drained out through the Copper River into Prince William Sound (Ferrians 1989). Tazlina Lake, in the western part of the Copper Basin, is a relict corner of the much larger pro-glacial Lake Ahtna. Lake sediments evident on the landscape today were deposited by turbidity currents and underwater mudflows in layers a few centimeters to 164 ft (50 m) thick. Much of this material entered the lake from the numerous glaciers and glacier-fed-streams that fed into the lake from the surrounding mountains (Ferrians 1989).

The upper part of the Copper River valley above Drop Creek is mantled with drift from the Wisconsin glaciation (Richter 1976), suggesting that this region was under glacial ice during the time of glacial Lake Ahtna. The numerous small lakes and kettle holes that dot the upper Copper River and Tanada Creek drainages were formed in this drift as the ice retreated into the mountains at the end of the Wisconsin glaciation.

In contrast to the large expanses of open, low elevation terrain present in the Copper River basin, the upper Nabesna and Chisana Rivers occupy relatively narrow valleys. North of the Alaska Range, large tongues of Wisconsin-age drift emanate from the mouths of these river valleys, extending up to 12 miles (20 km) beyond the mountains, indicating that the valley floors were deeply buried under glacial ice during the

Pleistocene. The valley floors of these braided rivers have wide floodplains bordered by numerous fluvial or glacial fluvial terraces.

The surficial deposits in the large, open valleys of the Chitina and White Rivers in the eastern part of the park are a mix of alluvium on the floodplains and glacial outwash and drift from the Wisconsin glaciation on surfaces that have not been reworked by fluvial processes. The White River basin is dominated by large alluvial fans with some moraines and low hills and is below treeline. Extensive areas in the White River valley are blanketed with volcanic tephra, locally two feet deep, from two eruptions of Mt. Churchill 1900 and 1250 years ago.

Climate

Three of the major climatic divisions of Alaska are represented in the park: South Coast, Copper River and Interior Basin (Milkovich, 1989) (Figure 1.2). The combined effect of maritime influence from the Gulf of Alaska and complex topography result in extremely varied conditions. There are relatively few weather stations within the park, and most of those that exist are at low elevation (Figure 1.3). Data presented here were assembled from Leslie 1986, Wahl et al 1987 and Milkovich 1989 (Figure 1.4). Strong gradients in precipitation and temperature are characteristic of the climate of the park. The principal climatic gradient parallels the southeast-northwest trending topography.

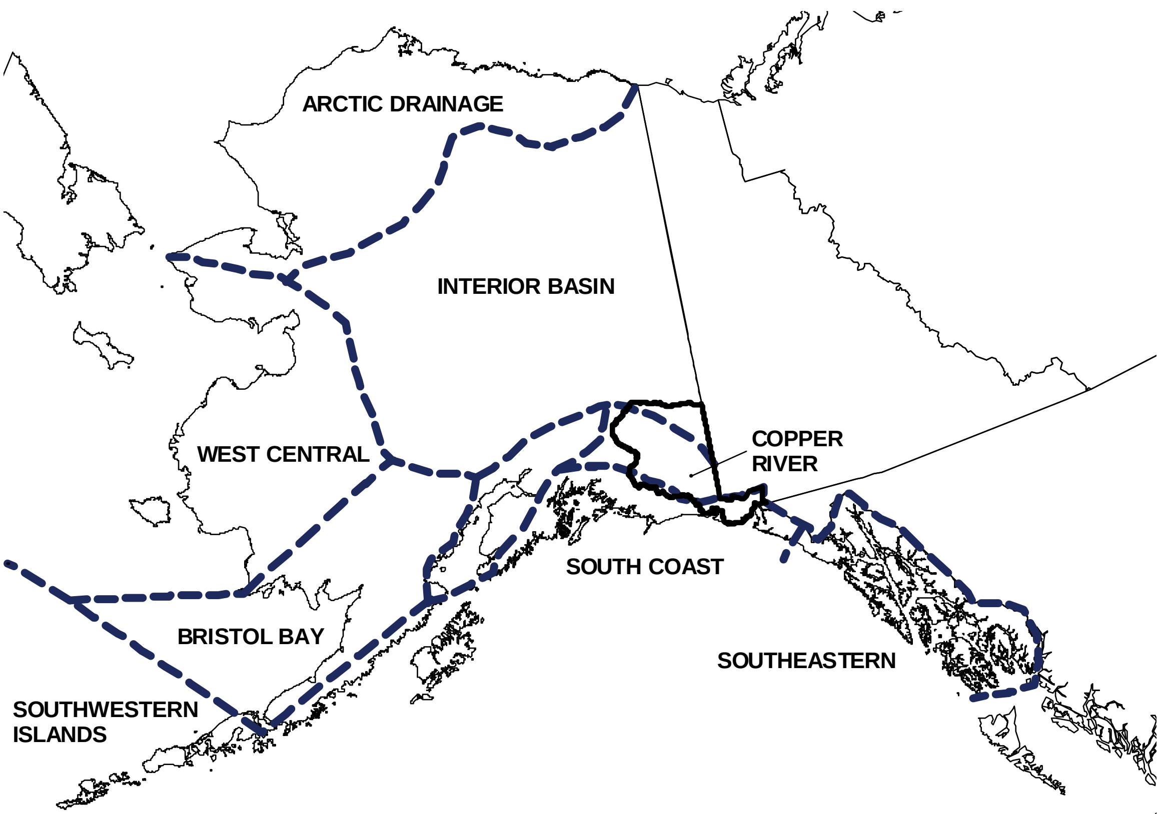

Figure 1.2. Climate divisions of Alaska (from Milkovich 1989).

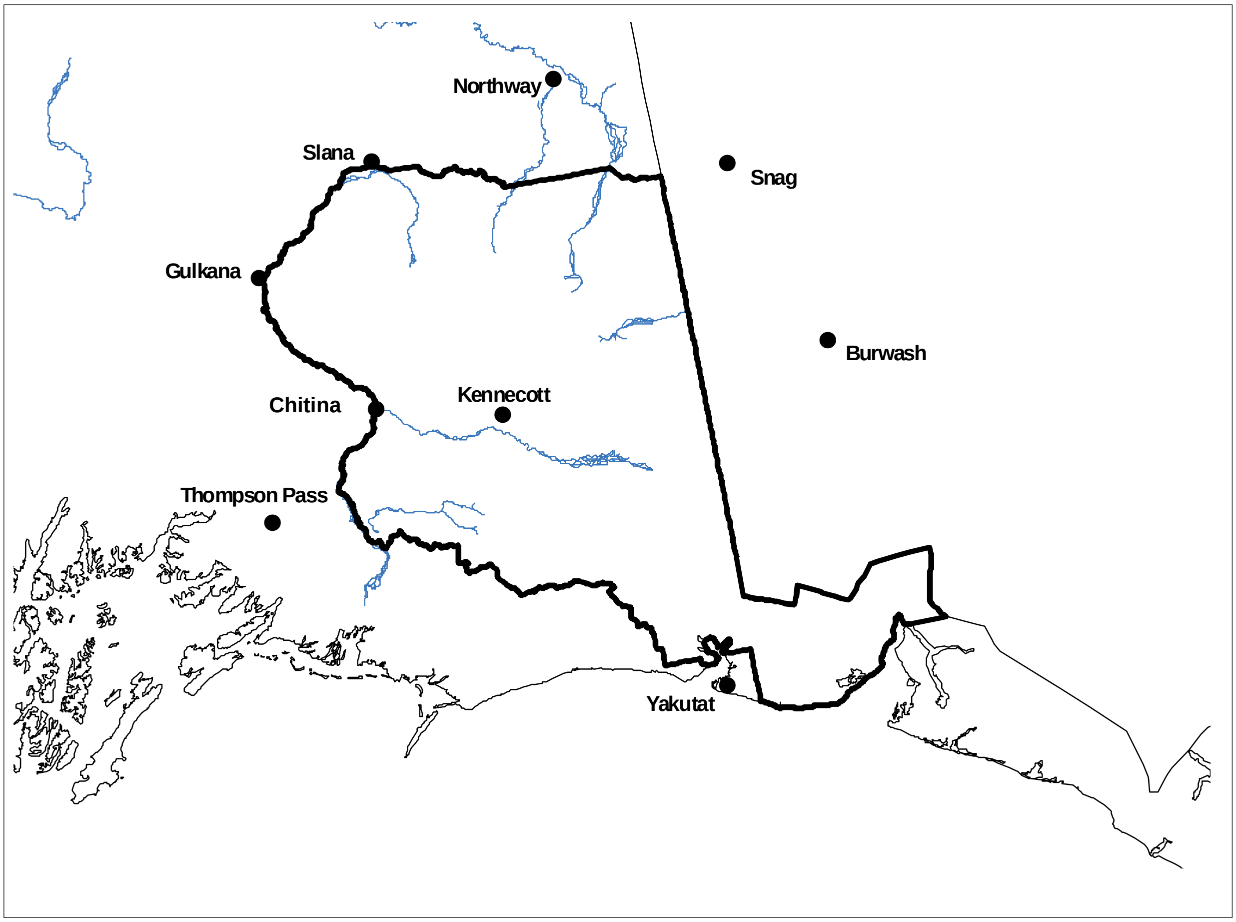

Figure 1.3. Location of climate stations in the vicinity of Wrangell-St. Elias National Park and Preserve.

South Coast Climate Division

The coastal areas of the park have a maritime climate. Temperatures on the Gulf coast are mild, by Alaskan standards, with mean daily maximums averaging well above freezing, even in the coldest month of January. Seasonal variation in temperature at Yakutat is strongly buffered by the oceanic influence, as evidenced by the relatively flat curve for the average monthly temperature and summer temperatures rarely above 20° C (68° F). This area has protracted periods of cloudy weather, and drizzle and fog are common. The onshore flow of moisture-laden air from the Pacific encounters the high relief of the southern St. Elias and Chugach Mountains resulting in high precipitation totals for coastal stations such as Yakutat, in the form of rain and occasional heavy snow. Precipitation is highest in autumn and early winter along the south coast. Yakutat receives an average of more than 20 in (500 mm) of rain in October.

Mountainous areas in the Chugach Mountains and southern Wrangell Mountains, while not as wet as the coast, receive considerable precipitation with a noticeable gradient from the coast to the interior. Thompson Pass receives its maximum precipitation in October, averaging eight inches (190 mm), whereas Kennecott, in the Copper Basin climate

division, receives its greatest precipitation in April, averaging three inches (85 mm). Seasonal differences in temperature are more pronounced at these stations than on the coast, with cooler winter temperatures and somewhat warmer summers. As a result, most of the autumn and early winter precipitation falls as snow at these stations.

Interior Basin Climate Division

In contrast to the southern part of the park, conditions north of the Alaska Range are dominated by continental influences, characterized by very dry, sunny conditions and extreme seasonal differences in temperature (see climate diagrams for Northway, Burwash and Snag. This area has a cold subarctic climate and lies within the zone of discontinuous permafrost. Short day-lengths and cold air masses from Siberia and the Canadian arctic result in extremely low winter temperatures and virtually all precipitation that falls between October through April is in the form of dry snow. The semi-arid climate and warm, dry continental conditions cause seasonal drought during summer months. Temperatures during the long days of summer reach as high as 33° C (91° F).

Copper River Climate Division

Conditions in the Copper River basin are continental yet transitional between the maritime climate of the coast and the more strongly continental climate of the interior basin. Climate diagrams for the stations at Chitina, Gulkana, and Slana represent the conditions in the Copper River basin. Temperature and precipitation norms for lowland areas in this region are intermediate between the coast and interior due to the fact that the huge Wrangell Mountains act as a secondary barrier to maritime air masses. Precipitation is higher in the Copper River basin than in the interior and summer temperatures in the lowlands of the Copper River basin are warmer than those on the coast, but are, on average, not so warm as in the interior.

Although these trends are useful for understanding the climate of the park, they are based on few monitoring stations, most of which are at low elevation. Due to the pronounced topographic relief, as much variation in growing conditions may exist within some individual valleys in the park as across its extent (at least in temperature). High elevation areas have much larger amounts of orographically induced precipitation (Milkovich 1989). Similarly, temperatures in the alpine areas are lower in the summer and somewhat warmer in winter than those at lowland sites. Furthermore, localized conditions caused by the presence of huge ice fields, high summits and large river corridors create a mosaic of climatic conditions within each climate division in the park.

Vegetation

It is difficult to generalize over such a large area when discussing the plant communities that occur in the park since there is so much topographic, geologic and climatic variation. However, the following general life zone patterns, delineated primarily by elevation, are useful for recognizing the dominant plant communities that occur here.

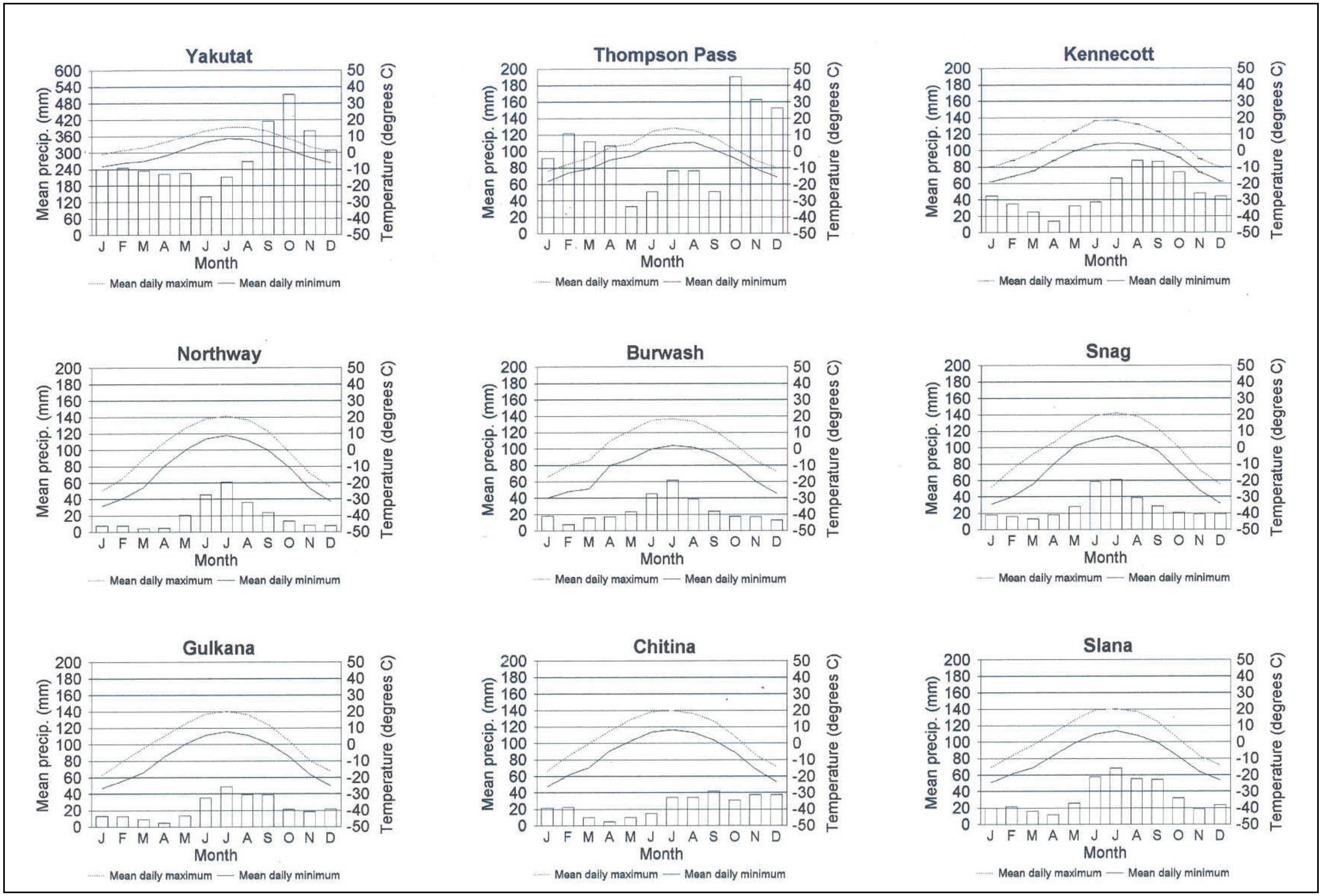

Figure 1.4. Climate diagrams for stations in the vicinity of the Park. Data is from Leslie (1986), Milkovich (1989) and Wahl et. al (1987).

Lowlands

The lowlands in the park range from coastal Sitka spruce forests along the Malaspina Forelands to the interior taiga forests. Areas underlain by permafrost in lowland basins and north-facing slopes support slow-growing black spruce (*Picea mariana*) muskeg. Common understory shrubs in these areas include Alder (*Alnus crispa*), Dwarf birch (*Betula glandulosa*), Crowberry (*Empetrum nigrum*), Labrador tea (*Ledum groenlandicum*), Shrub cinquefoil (*Potentilla fruticosa*), several willows (including *Salix alaxensis*, *Salix arbusculoides*, *Salix glauca*, and *Salix planifolia* subsp. *pulchra*) and blueberry (*Vaccinium uliginosum*). Common mosses include *Hylocomnium splendens*, *Pleurozium schreberi* and *Sphagnum* spp. Black spruce stands burn periodically, and trees of more than 100 years of age are uncommon (Viereck et al 1992).

Wetland areas are common in the lowlands, particularly on the coast, in the open Copper and Chitina River basins, around the area of extant Lake Ahtna, and north of the Alaska Range. Wetlands are dominated by sedges and mosses with grasses, forbs and scattered shrubs. Dominant species in wetlands include the grasses *Arctagrostis latifolia*, *Arctophila fulva* and *Calamagrostis canadensis*, the sedges *Carex aquatilis*, *Carex canescens*, *Carex limosa*, *Carex saxatilis*, *Carex utriculata*, and several species of *Eriophorum* (including *E. angustifolium*, *E. russoleum* and *E. vaginatum*). Shrub species that occur in wetlands include Cassandra (*Chamaedaphne calyculata*), sweetgale (*Myrica gale*) and Bog rosemary (*Andromeda polifolia*). Horsetails (*Equisetum palustre* and *E. fluviatile*), spike rush (*Eleocharis palustris*), and buckbean (*Menyanthes trifoliata*) are also common and widespread in lowland wetlands.

Uplands

River corridors and upland areas with better drainage support more productive forest types than sites with permafrost. White spruce (*Picea glauca*) forest occupies uplands, occasionally mixed with paper birch (*Betula resinifera*) on rolling hillsides in northern areas of the park and aspen (*Populus tremuloides*) in dry or recently burned sites. In southerly aspects, spruce forest is gradually replaced by aspen woodland with increasing slope and the driest sites within the forest zone are occupied by dry steppe vegetation dominated by grasses, sagebrush, scattered shrubs of juniper and a variety of herbaceous perennials. Terraces along the major rivers support colonial herbs in newly abandoned channels grading into thickets of alder (*Alnus crispa*) and willow (*Salix* spp.). Older surfaces support mature balsam poplar forest (*Populus balsamifera*) grading into closed white spruce (*Picea glauca*) forest.

Sub-alpine Communities

Tree line varies with aspect and local conditions. In the White River, it is between 3700 ft (1219 m) and 3900 ft (1280 m) (Denton 1974). In the vicinity of Skolai and Chitistone valleys, subalpine white spruce forest extends up to about 3350 ft (1100 m) (Scott 1972). Tree line is lower in much of the Chugach Range, especially in the smaller tributary valleys where forest has yet to develop. This is probably attributable to the relatively recent de-glaciation of much of this terrain, rather than to climatic conditions.

As the upper elevational limit of trees is approached, spruce forest becomes more open and there is a higher cover of tundra shrubs. Depending on slope and aspect, shrub tundra with high graminoid and forb cover occupies mesic slope facies at elevations between 3350 ft (1100 m) and 5180 ft (1700 m). In the southern Wrangell Mountains and Chugach Range, shrub tundra and meadows within it contain a group of species generally absent in northern regions of the park. These taxa generally have coastal distributions, stretching south into the temperate zone in the Pacific Northwest. The increase in coastal species abundance is likely a result of the warmer, wetter transitional climate of these areas in comparison with cold, dry interior regions. This trend is particularly evident in lush meadow areas where the vegetation is often dominated by species with cordilleran and coastal affinities such as *Arnica latifolia*, *Erigeron peregrinus*, *Carex nigricans*, *Heracleum lanatum*, *Juncus mertensianus*, *Luetkea pectinata*, *Senecio triangularis*, *Vahlodea atropurpurea*, and *Valeriana sitchensis*.

Alpine Communities

Alpine tundra is extremely variable depending on site characteristics and geographic location. In well-drained sites too dry or rocky to support dwarf birch it occurs above about 3350 ft (1100 m) and in more favorable sites it occurs above the elevational limit of the shrub-tundra zone, which varies between approximately 4260 ft (1400 m) and 5480 ft (1800 m).

Snow bed areas and north-facing slopes in the alpine zone are characterized by a high cover of heaths (principally *Cassiope tetragona*), mountain avens (*Dryas alaskensis*), polar willow (*Salix polaris*) and netted willow (*Salix reticulata*) with a characteristic assemblage of common forbs including *Antennaria monocephala*, spring beauty (*Claytonia sarmentosa*), mountain sorrel (*Oxyria digyna*), *Polyganum viviparum*, and buttercups (*Ranunculus eschscholtzii*, *R. nivalis* and *R. pygmaeus*). Club moss (*Huperzia selago*) and the grasses *Hierochloe alpina* and *Trisetum spicatum* are also common in snow bed sites. A small group of species is noticeably more abundant in snow bed sites in the southern Wrangell Mountains and Chugach range as compared to northern regions of the park. *Luetkea pectinata*, *Potentilla diversifolia* and *Sibbaldia procumbens,* for example, are abundant in the south and west parts of the park and uncommon or absent in the north and east.

Dwarf scrub-sedge alpine tundra associations occupy mesic topographic positions. These associations occur in more insolated sites than snow beds and north-facing heath tundra. Dwarf-scrub-lichen tundra occurs on windswept ridges, sometimes with relatively sparse vascular plant cover of *Dryas* spp. and graminoids and abundant lichen of the genera *Cetraria*, *Cladonia* and *Stereocaulon*.

Dry sites from the sub-alpine to alpine zone support a range of plant communities from discontinuous graminoid-forb associations to continuous *Dryas*-graminoid-forb tundra depending on slope, aspect, substrate and slope morphology. Xeric alpine plant communities harbor numerous rare and endemic plant species

Ecological Regions

Eight of 32 ecological regions described by Nowacki, et. al. (2001) representing the major ecosystems of Alaska are found in the park (Figure 1.5, Table 1.1). The eight ecological regions in the park were further classified by Swanson (2001) into 16 ecological sections, 65 subsections and 182 ecological units (Figure 1.6). The ecological section level of classification is the most applicable for the description of floristic and vegetation patterns within the park and is described further in the methods and results chapters of this document. An overview of the eight ecological regions in the park is given here to provide a context for understanding the park's biological diversity.

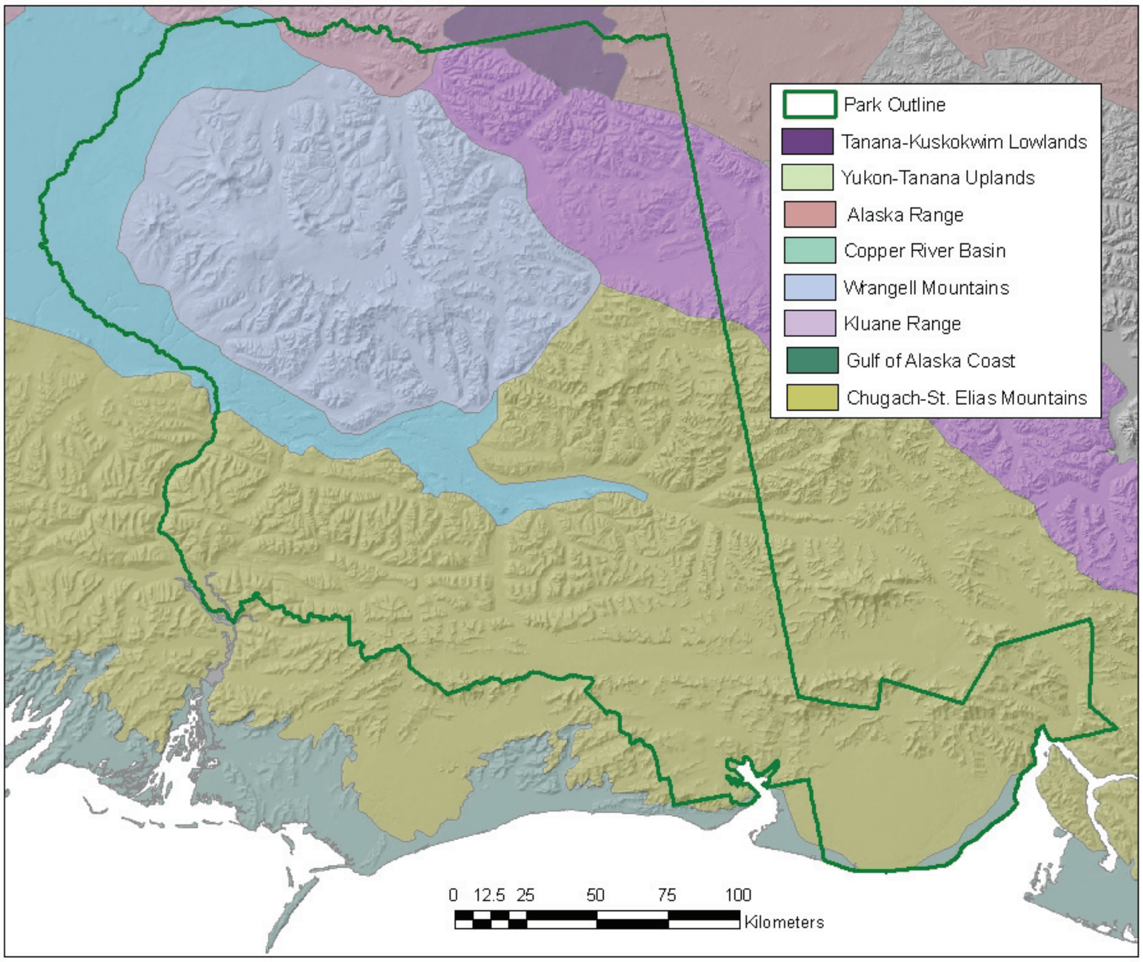

Figure 1.5. Ecological regions of Wrangell-St. Elias National Park and Preserve, according to Nowacki et. al. (2001) (Mercator Projection, NAD 1927).

Table 1.1 Ecoregions occurring in Wrangell-St. Elias National Park and Preserve with associated acreages, number of sections, subsections and units. Classification is by Swanson (2001).

Ecoregion	Acres	% of Park Area	% of Alaska-Yukon Ecoregion within Park	#/Sections	#/Subsections	#/Units
Alaska Range	195,133.09	1.48	0.76	2	4	10
Chugach-St. Elias Mountains	6,368,757.49	48.25	27.67	4	25	61
Copper River Basin	1,482,086.27	11.23	31.34	2	10	31
Gulf of Alaska Coast	67,477.04	0.51	1.55	1	1	4
Kluane Range	1,219,481.07	9.24	23.59	2	6	20
Tanana-Kuskokwim Lowland	180,369.97	1.37	1.14	1	2	9
Wrangell Mountains	3,537,164.53	26.80	100.00	4	14	40
Yukon-Tanana Upland	124,087.80	0.94	0.49	1	3	7

Alaska Range

This ecoregion is represented in the park by the Mentasta Mountains which are the eastern end of the Alaska Range arc that spans interior Alaska south of the Denali Fault. It is only 1.48% of the park's area (195,133 acres) and covers less than 1% (0.76%) of this ecosystem type in Alaska. This region also encompasses the basin between the Wrangell, Mentasta and Nutzotin Mountains along the upper Nabesna River, and the valley along Jack Creek. The Nabesna Basin includes floodplains, alluvial fans, Pleistocene moraines and glacially scoured bedrock hills. Jack Creek Valley is a U-shaped glacial valley with moraines and alluvial fans and is above glacial Lake Ahtna. Elevations range from 1968 ft (600 m) to 8147 ft (2444 m) at Noyes Mountain. Climate is strongly continental and permafrost is discontinuous. Spruce and hardwood forests occur on the lower slopes of the mountains, dwarf scrub communities are common at the higher elevations. There are wetlands in the poorly drained areas and dry, south-facing bluffs along the slopes facing the Nabesna River.

Chugach-St. Elias Mountains

The Chugach-St. Elias Mountains ecoregion encompasses almost half of the park's area (48.25%, 6.37 million acres) and represents nearly a third of the area (27.27%) of this type in Alaska and the Yukon Territory. It is also the most diverse ecoregion with four ecosections, 25 subsections and 61 ecological units. The region occurs in the park between the Malaspina Forelands along the coast north to the Chitina River, west to the Copper River and east to the Canadian border. The Chugach-St. Elias Mountain ecoregion encompasses the four following ecosections: northern St. Elias Mountains, northern Chugach Mountains, maritime high Chugach-St. Elias Mountains, and the Robinson Mountains and glaciers.

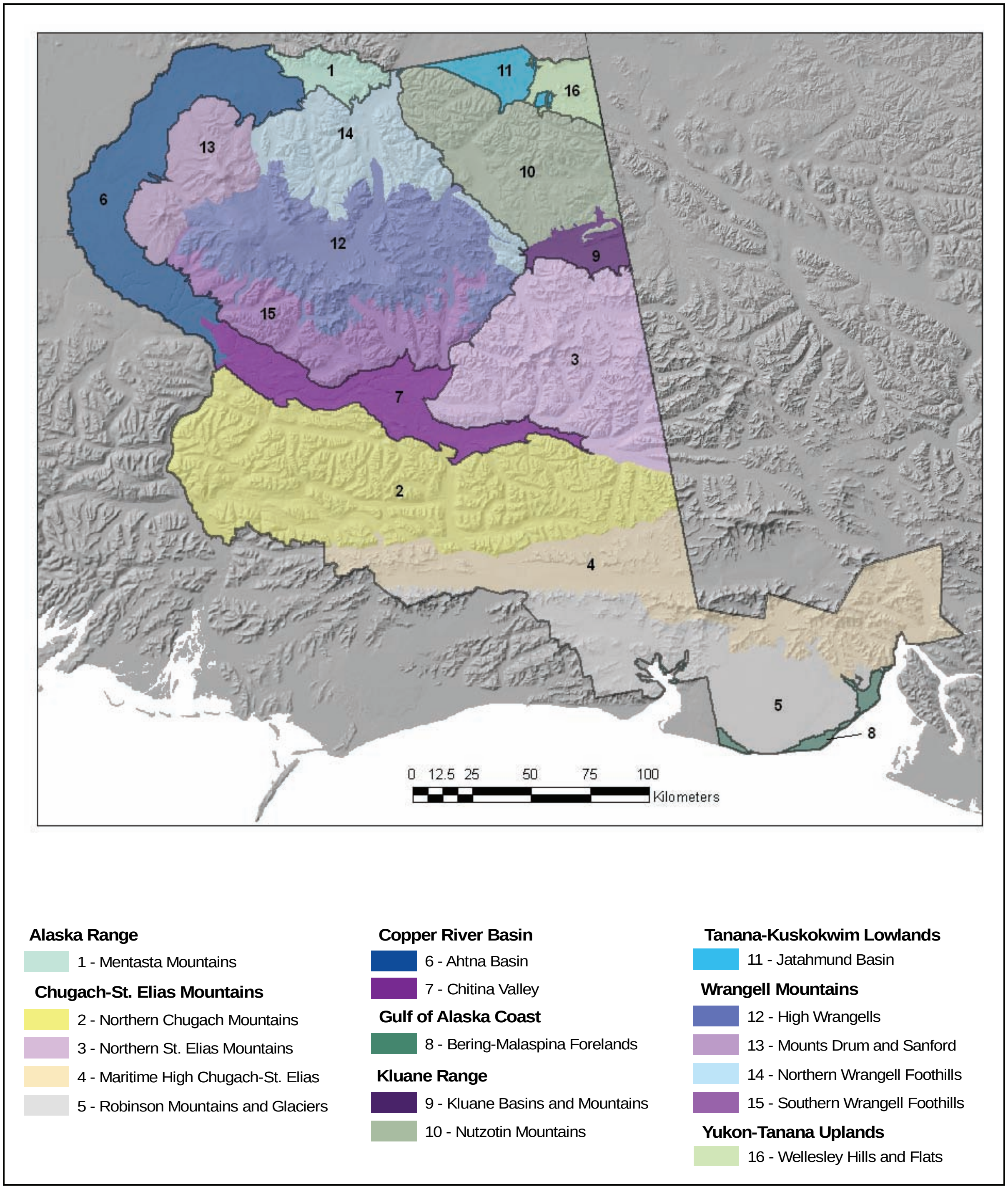

Figure 1.6. Ecological sections within Wrangell-St. Elias National Park & Preserve, Alaska, as delineated by Swanson (2001) (Mercator Projection, NAD 1927).

The northern Chugach Mountains ecosection includes rugged peaks with cirque glaciers, high elevation mountains covered by snow and ice, foothills, forested moraines on the Chitina Glacier, and the major river valleys of the Bremner (which flows into the Copper River), the Tana and the Hanagita (which flow into the Chitina River). The northern St. Elias Mountains ecosection are the St. Elias mountains north of the Chitina River. The Chugach-St. Elias Mountains ecosection include (1) the White-Hawkins Massif at the crest of the Chugach Mountains and west of the Bagley Icefield, (2) the Bagley-Seward Icefield and associated nunataks, (3) the Icefield Ranges and Glaciers which are mostly in Canada, (4) the Mt. Logan Massif, and (5) the vegetated foothills of the southern St. Elias Mountains on the south edge of the Hubbard and Seward Glaciers.

The Robinson Mountains and Glaciers section includes (1) the Bering and Stellar Glaciers which flow south out of the Chugach Mountains and are mostly outside of the park, (2) the Icy Bay foothills which are recently deglaciated, (3) the Malaspina Glacier, a large piedmont glacier, (4) the Robinson Mountains which are rugged, low mountains mostly outside of the park, (5) the Waxell-Barkley Ridge which is high in the southern Chugach Mountains and is surrounded by icefields; and (6) the Yahtse and Guyot Glaciers which calve into the ocean

Climate for this ecoregion is maritime on the coast and transitional between maritime and continental in the interior, receiving more precipitation annually than the Alaska Range or the Wrangell Mountains. Elevations range from sea level to 18,008 ft (5488 m) at the summit of Mt. St. Elias. The extensive ice fields and high mountain ranges in this region function as barrier to plant migration to and from the interior except for through the Copper River corridor.

Much of the ecoregion is barren or recently vegetated with dwarf and low scrub communities. Wetlands occur in lowlands and floodplains. Forests are found in river valleys of the northern Chugach Mountains, vegetated foothills of the southern St. Elias and on the Malaspina Glacier.

Copper River Basin

The Copper River basin ecoregion extends from the 3000 ft (900 m) contour interval on the flanks of the Wrangell Mountains west and outside of the park to the Susitna River. It occupies the site of glacial Lake Ahtna described above and also includes the floodplains, terraces, moraines and hills of the Chitina River valley, the hills and terraces of the Kotsina and Kuskulana Rivers on the southwest slopes of the Wrangell Mountains, Tanada River floodplain and moraines, and the toe slopes of the Wrangell Mountains. The region is 11.23% of the park’s area (1.48 million acres) and 31.34% of this ecosystem type in Alaska. The permafrost table is shallow and the soils poorly drained. The terrain is smooth to rolling with elevations ranging from 1378 ft to 3000 ft (900 m to 420 m). The ecoregion has a strongly continental climate with the basin acting as a cold air sink in the winter (Nowacki et. al 2001). The region is dominated by lakes, wetlands and floodplains.

Gulf Coast of Alaska

The Gulf Coast of Alaska ecological region occurs from coastal southeast Alaska at Icy Point to central coastal Alaska on the Kenai Peninsula. This region is represented in the park by the Bering-Malaspina Forelands ecosection, which occurs between Yakutat and Icy Bays along the Malaspina Forelands in a narrow coastal strip at the toe of the Malaspina Glacier. The ecoregion includes the Malaspina Foreland coast, the drift plain and outwash streams from Malaspina Lake and glacier as well as the coastal plain of Icy Bay. Only 0.51% of the park's area is in this ecoregion and it represents 1.55% of the State's coverage of this ecological type.

The region is free from permafrost and has a maritime climate with heavy precipitation throughout the year. Elevations range from sea level to 3787 ft (1154 m) in the Chaix Hills. The temperate rain forests of the Malaspina Forelands are mostly closed, old growth Sitka spruce. Hemlock is rare. The understory is a dense jungle of tall shrubs and ferns impassable in many places since the floor is strewn with fallen trunks buried beneath a thick carpet of moss. There are also extensive wetlands between the forests and the moraines.

Kluane Ranges

The Kluane Ranges ecological region in the park includes the Nutzotin Mountains and Hills, the upper floodplain, alluvial fans and Pleistocene moraines of the Chisana River, the lowlands of the Beaver Creek morainal valley and floodplain, Solo Creek Flats, and the White River basin between the St. Elias and Nutzotin Mountains. This region is 9.24% of the park's area (180,370 acres) and 23.59% of this ecosystem type. The majority of this ecoregion is in the Yukon where it is defined by the interior St. Elias Range underlain by the Wrangellia and Alexander terranes. There are two ecosections within this region in the park: the Nutzotin Mountains and Kluane Basins and Mountains represented by the White River Valley. The region has a dry, continental climate and discontinuous permafrost. There is a great deal of topographic and community diversity in the Nutzotin Mountains where 20 ecological units are recognized.

Tanana Kuskokwim Lowlands

The area in the park north of the Mentasta and Nutzotin Mountains and east of Carden Hills is part of the Tanana-Kuskokwim Lowland ecoregion, represented in the park by the Jatahmund Basin ecosection. It includes the lower alluvial floodplains and terraces of the Chisana, Nabesna, Stuver and Snag Creek Valleys, and Pleistocene glacial moraines deposited by glaciers of these river valleys. It is only 1.37% of the park's area (180,370 acres) and 1.14% of this ecoregion type in Alaska. Much of this region was not glaciated at the end of the Wisconsin Glaciation. Permafrost is discontinuous and shallow resulting in poorly drained soils. The region is dominated by wetlands with bogs, fens, thaw, oxbow and morainal lakes. The climate is strongly continental. Elevations range from 2000 ft (600 m) along the rivers to 4000 ft (1200 m) on some of the lowland hills.

Wrangell Mountains

The Wrangell Mountains ecological region occurs entirely within the park and covers approximately one-third of the park's area (26.8%, 3.54 million acres). The region occurs east of the Copper River and above the 3000 ft (900 m) contour interval, north of the Chitina River, south of Jack Creek at the Nabesna River and south of the 2000 ft (600 m) contour interval on the south side of the White River. Four ecological sections occur in the Wrangell Mountains: the northern Wrangell foothills, Mts. Drum and Sanford, the high Wrangell Mountains, and the southern Wrangell foothills. It is second in ecological diversity as measured by the number of subsections (14) and ecological units (40) found within the region. The subsections of the Wrangell Mountains are delineated by elevation, steepness of terrain, relative cover of ice and the extent of the Quaternary-Tertiary lava flows which dominate the landscape.

The climate is strongly continental with harsh winters and short summers. Elevations range from 2000 ft (600 m) to 16,390 ft (4995 m) at the summit of Mt. Blackburn. Permafrost is discontinuous. There are extensive scree and rock slopes, dwarf scrub communities on well drained sites and tall scrub communities along drainages and on floodplains. Needle-leaf (white and black spruce) and broadleaf forests (mostly aspen, with patchy black cottonwood in the south and patchy paper birch in the south and north) occur at lower elevations.

Yukon-Tanana Uplands

The Yukon-Tanana Uplands ecological region occurs in the northeast corner of the park between Snag Creek and the Canadian border and north of the Nutzotin Mountains. It is represented in the park by the Wellesley Hills and Flats ecosection and includes Carden Hills, Wellesley Mountain and alluvial deposits of Snag and Beaver Creeks. The ecoregion is 1.42% of the park's area (124,088 acres) and only 0.49% of the ecosystem type in Alaska. The defining element of the Yukon-Tanana Uplands is the Yukon-Tanana terrrane, accreted to the margin of North America in Jurassic time. It is therefore the oldest landform in the park. The Carden Hills are composed of mafic and ultramafic intrusives, metavolcanics and metasediments whereas the Wellesley Mountains are composed of conglomerate. The alluvial deposits of Snag and Beaver Creeks have a mantle of peat, loess and volcanic ash. The mountains and hills in this region are weathered, relatively low and capped by coarse rubble. This ecoregion in the park was not glaciated at the end of the Wisconsin glaciation. Permafrost is discontinuous and the climate is strongly continental. The low lying areas between the hills are primarily wetlands. Dwarf scrub communities in alpine tundra and open spruce forests are the dominant vegetation types in the upland areas. Elevations range from 1640 ft (500 m) to 5565 ft (1696 m) in Carden Hills.

Ecological History

History of Glaciation

The park has experienced pronounced environmental and ecological upheaval during the course of the Quaternary period. Maps of the maximum extent of the Wisconsin glaciation show this region within the area covered by the Cordilleran ice sheet (Clague

1992, Hamilton 1994, Hamilton and Thorson 1983; Manley 2004, Figure 1.7). In summarizing the literature on late Cenozoic glaciation of Alaska, Hamilton (1994) showed that there have been four major periods of ice advance in Alaska over the past 1.6 x 10^6 years. Recent glacial history is recorded by drift deposits in the White River valley, which show a nonglacial interval that extended from about 49 thousand years before the present (ka) to 30 ka. Glaciers advanced from 29 ka, reaching a maximum extent at around 13.7 ka. Deglaciation then occurred fairly quickly, with the major valleys becoming free of ice by 12.5 ka (Denton 1974).

Glaciation on the northern flank of the Alaska Range, appears to have attained its maximum extent about 20 ka, with deglaciation beginning approximately 17 ka, although with the interruption of three subsequent periods of minor glacial ice re-advance ending at approximately 10 ka (Hamilton 1994). During this period, the Copper River was dammed by ice coalescing from glaciers emanating from the Chitina Valley and the Chugach Mountains (Nichols 1989). The lake that formed behind this dam (Lake Ahtna) predates the last interstadial period (Ferrians 1989). A strand line at 655 m elevation dated to the period 31.3 ka to 28.3 ka, suggests that the lake was at its lowest level toward the end of the last interstadial. The lake finally emptied with the retreat of the glacier occupying the mouth of the Copper River canyon, approximately 9.4 ka.

Refugia

Although glacial ice and pro-glacial lake Ahtna covered the landscape over most of what is now the park, there is evidence that there were ice-free areas within the park at the end of the Wisconsin glaciation. There were most likely nunataks in the Wrangell Mountains and areas such as the Samovar Hills, Blossom Island and Flora Hills on the coast were probably coastal refugia (Pielou 1991). In addition, there may have been unglaciated areas within the Late Wisconsin ice sheet adjacent to Lake Ahtna (Hamilton and Thorson 1983). Finally, it is probable that there were ice-free refugia on exposed sites in the dry northern interior of the park (the northern Mentasta and Nutzotin Mountains and upper White River Valley) bordering the Tanana Valley. This region lies at the southeastern edge of Beringia, the vast region of northern Asia and North America (including the former Bering Land Bridge) that was free of ice throughout the Pleistocene era (Hopkins 1966).

Vegetation History

Copper River Basin: While the glacial history of an area may be discerned from surface features such as moraines and the extent of drift deposits, the vegetation history of an area is more difficult to ascertain. Past vegetation must be inferred from fossil pollen strata excavated from lake sediments and from paleosols and exposures of plant macrofossils that are relatively rare on the landscape. For this reason, our understanding of the past vegetation of the landscape within the park is less clear than the glacial chronology.

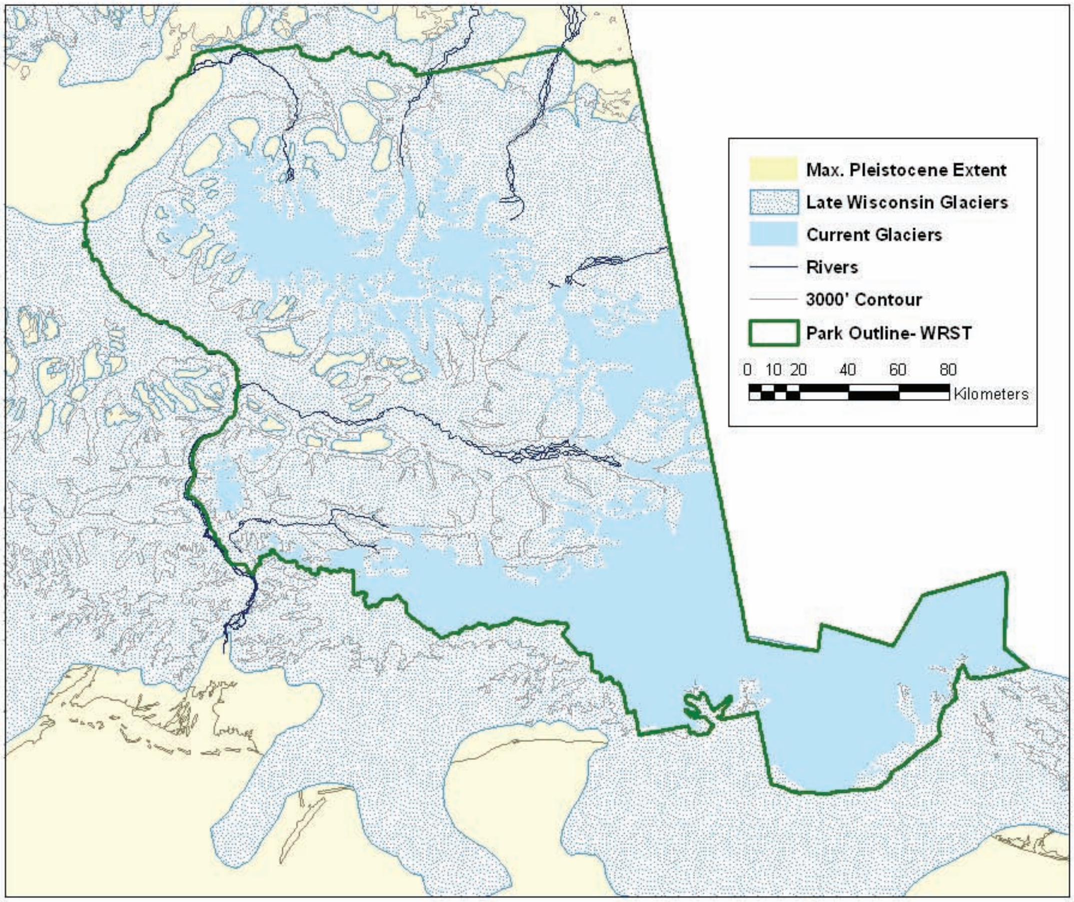

Figure 1.7. Generalized map of the maximum extent of the Pleistocene Cordilleran Ice Sheet in Wrangell-St. Elias National Park and Preserve, Alaska ((Mercator Projection, NAD 1927).

The history of the vegetation of the Copper River Basin is known from a few lacustrine sediment cores and several sites where pollen and plant macrofossils have been excavated from outcrops (for a review, see Ager 1989). Data from this area allow reconstruction of the vegetation that existed in this area during the last interstadial (nonglacial period). Ager states that most of the area was covered by ice and lake waters during the full glacial period, thereby severely limiting the sites available for colonization by plants. Several cores from more recent time allow for reconstruction of the development of modern vegetation that started during the last deglaciation and continued until the present (Ager 1989).

The first records of the vegetation that developed in the Copper River basin late in the Wisconsin period with the recession of the glaciers (about 13.5 ka) indicate herb-shrub tundra dominated by sedges (*Cyperaceae*) and dwarf birch (*Betula*). Tundra landscapes dominated the lowlands in the Copper River basin until the invasion of *Populus* and *Alnus* approximately 10 ka. Pollen spectra indicate a rapid invasion of these taxa, such that by 9 ka the lowlands and well drained areas supported dense cover of poplar and willow stands, alder thickets and shrub tundra (Ager 1989).

Spruce apparently entered the Copper River basin from the north via Mentasta Pass by 9 ka, spreading rapidly southward (Ager and Brubaker 1985). There is evidence of spruce forest in the low valleys of the northern Chugach Mountains by about 8.5 ka (Williams and Galloway 1986). *Picea*, *Alnus* and *Betula* are the most abundant pollen types in sediments from the early Holocene period until the present, indicating that boreal forest has been the dominant vegetation type in the Copper Basin since the invasion of spruce (Ager and Brubaker 1985, Ager 1989).

A study by Sirkin and Tuthill (1987) provides an outline of the pattern of deglaciation and a history of the vegetation in the Chugach Mountains in the vicinity of the lower Copper River. Deglaciation in this area began in the major valleys and spread gradually into tributary valleys. Melting proceeded gradually until glaciers became more or less restricted to alpine cirques in the northern part of the Chugach Mountains, as they are today. Sirkin and Tuthill found that the floodplain of the Copper River south of Chitina was free of ice by 11.36 ka. The lower valleys of the Tasnuna and Bremner rivers (the major tributaries of the middle Copper River) were ice-free by 8.79 ka and 9.92 ka respectively, considerably later than surfaces in the northern parts of the Copper River basin.

According to Sirkin and Tuthill, shrub-herb tundra was the colonial vegetation in this region following deglaciation. Low pollen influx in early sediments suggests a relatively sparse vegetation, with substantial increases in vegetative cover as the climate ameliorated during the Holocene. Alder dominance progressed in a similar fashion to deglaciation, spreading gradually from the lower valleys into mountainous areas. Dense alder cover was established in the Bremner and Tasnuna valley around 9 ka, succeeded by spruce forest in the late Holocene. Since white spruce (*Picea glauca*) has not been recorded in Holocene sediments from the southern Chugach, Sirkin and Tuthill assume that Sitka spruce (*Picea sitchensis*) populated the early boreal forests of this region. This species would have spread into the area from refugia along the southern Coast of the Gulf of Alaska.

The vegetation history of the glaciated areas of the park during the past 40,000 years, although it is known only in its general outline, is relatively uncontroversial. This is partly due to the fact that vegetation only existed in these areas during nonglacial intervals, when the climate is thought to have been reasonably similar to that of the present day. Vegetation types deduced from pollen profiles from the previous interglacial and the early Holocene appear to have analogs on the current landscape (i.e. boreal forest and shrub tundra) (Ager 1989). In contrast, no modern analogs have been found for full-glacial pollen assemblages found in cores taken from unglaciated regions, although elements of alpine fell-field and northern steppe communities are both present (Ager 1983). This has resulted in some controversy concerning the nature of the full-glacial vegetation of Alaska (Guthrie 1968; Hopkins et. al. 1982; Guthrie 1968a, 1968b, 1982, 1985, 1990; Young 1976; Yurtsez 1963, 1972, 1981; Murray et. al. 1983; Cwyar and Ritchie 1980; Ritchie and Cwynar 1982; Matthews 1976, 1982). This debate is relevant to the northern part of the park; the only region likely to have had substantial areas free of glacial ice and hence capable of supporting any vegetation during the Wisconsin glaciation.

Tanana River Valley: In a summary of the environmental history of the Tanana Valley, Ager (1975) concluded that the dominant late-glacial vegetation there (prior to 14 ka) was an open steppe-tundra composed of grasses, sedges, sagebrush (*Artemisia*), and a variety of opportunistic herbs such as *Plantago* and members of the *Asteraceae* and *Caryophyllaceae*. A climatic trend that resulted in warmer, moister climatic conditions resulted in the transition to shrub-dominated tundra throughout the lowlands of the Tanana Valley for the period spanning from 13.5 ka to about 10 ka. Trees, absent from the area during the full-glacial, invaded as early as 11 ka, beginning a rapid shift toward boreal forest vegetation in interior Alaska.

The pollen assemblage for the past 8.4 ka indicates a mostly forested landscape dominated by spruce, although during the period from 8.4 to 7 ka there was a decline in spruce abundance on the landscape, suggesting a more open mix of forest types, with increased abundance of broadleaf species such as birch and aspen.. During the past 6.5 ka, however, pollen influx data document a "remarkably stable" vegetation pattern for the Tanana Valley, according to Ager (1975).

White River Valley: Rampton (1974) obtained a sediment core representing a 31,000 year record for Antifreeze Pond near Beaver Creek in the White River drainage in westernmost Yukon Territory. This site is somewhat higher (situated at 610 m elevation) than Ager's Tanana Valley sites and within 24 km of the maximum extent of the Wisconsin glaciation in the White River valley. He divided the 31,000 year profile into 6 pollen zones representing time periods containing relatively homogeneous pollen assemblages and distinguishable from preceding and subsequent assemblages based on the amount and types of the pollen present in them.

The general outline of the vegetation of the Holocene depicted in Rampton's reconstruction is similar to that of Ager's for the Tanana Valley sites, although the timing of the changes in vegetation is different. For instance, Rampton assigned the change from herb-dominated communities with relatively high graminoid and *Artemisia* percentages to shrub tundra dominated by birch to a date of about 10 ka, about 3 ka after the Tanana Valley transition . The invasion of forest is also delayed at this site, although somewhat less so, with a spruce woodland invading the area by approximately 8.7 ka. Rampton's data show the dominance of spruce forest (with high alder cover) prevailing throughout the mid to late Holocene, just as for the Tanana Valley sites investigated by Ager.

The principal difference in interpretation between the two studies lies in the reconstruction of the late Wisconsin vegetation. Both sites reflect an absence of trees during the late Wisconsin glaciation. Similarly, both found relatively low birch pollen percentages and high percentages of graminoid and herbaceous pollen with increased levels of sagebrush (*Artemisia* spp.). However, Ager interprets the high graminoid-herbaceous content of the pollen rain from this period as indicative of "steppe-tundra" while Rampton's interpretation stresses low pollen influx rates as indicative of very sparse fellfield or sedge-moss tundra. In this interpretation, Rampton is in accord with that of Ritchie and Cwynar (1982).

These differences in interpretation could stem from differences between the sites. The proximity of the Antifreeze Pond site to the glacial front may have resulted in "harsher" climatic conditions and cooler summers thus producing a vegetation with the general aspect of a sparse fellfield. By comparison, the lower elevation sites in the Tanana Valley were further from the Cordilleran icesheets (hence perhaps warmer during summer months) and may have supported a more productive vegetation similar to open steppe or graminoid tundra.

No doubt the vegetation covering the unglaciated portions of the northern part of the park during glacial intervals was a mosaic of types, depending on local conditions and landscape position. Regardless of the precise nature of the vegetation, the implications of the paleoecological context for the rare flora of our area are the same. First, plants of dry tundra and associated open communities could disperse over much of the landscape much more readily during the glacial period than at present, due to the absence of tree and shrub cover and second, unglaciated sites in the park are expected to contain more "relict" populations of such species than deglaciated terrain that was revegetated during a time when shrub tundra and then forest were expanding quickly across the landscape.

Floristic Regions

The ecological and landscape diversity of the park is reflected in the distribution of plants found here. Eric Hultén divided Alaska and the Yukon into eleven floristic regions based on his extensive understanding of the phytogeography of the area (Hultén 1941-1950, p. 5). The park falls into five of these regions: the western Pacific Coast region from Yakutat Bay to Icy Bay along the coast; the central Pacific coast region which includes the Bagley Icefield and southern Chugach Mountains; the Alaska Range region which includes the Mentasta, Nutzotin and Wrangell Mountains and most of the St. Elias Mountains, the central Yukon which reaches the park between the Nabesna River and the boundary primarily north of the Nutzotin Mountains, and the upper Yukon region which is found along the Alaska -Yukon border north of Mt. St. Elias (Figure 1.8). No other management unit in Alaska encompasses such high floristic diversity as measured by Hultén’s floristic regions.

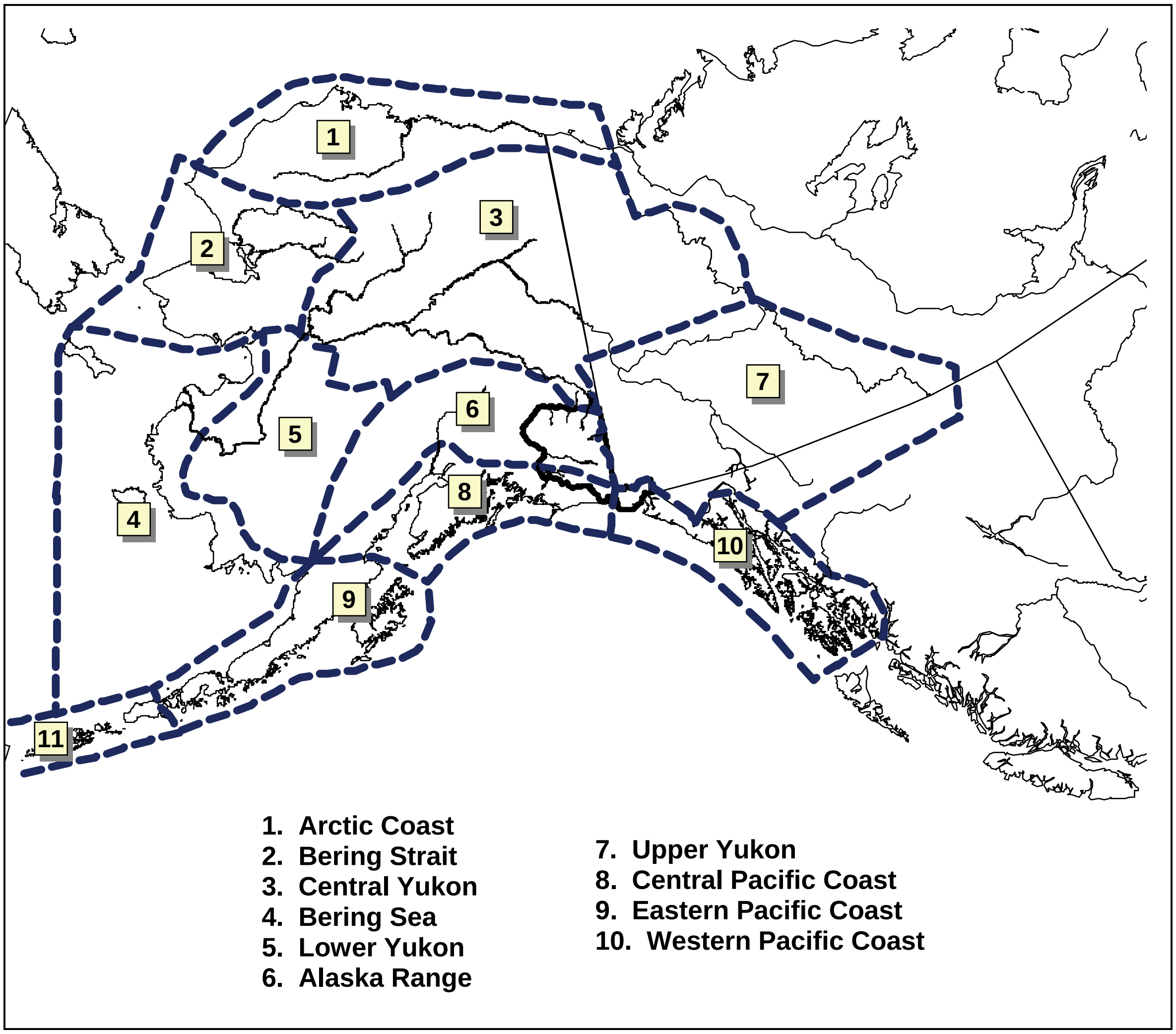

Figure 1.8. Floristic regions of Alaska and the Yukon according to Hultén (1941-1950).

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Chapter 2: History of Botanical Collecting

Eric Hultén described the history of botanical collecting in Alaska and the Yukon from 1741 to 1940 (Hultén 1940). Hultén examined most collections made in Alaska prior to 1950 and included an annotated list of collections and a distribution map for each species in his 1941-1950 flora of Alaska and the Yukon (Hultén 1941 – 1950). These distribution maps are updated in his 1968 flora. Hultén's floras, Hultén's history of botanical collecting, all known USGS reports, early military reports, published accounts of expeditions in the vicinity of the park, published literature for collections made after Hultén's floras were written, and the data for specimens housed at the University of Alaska Fairbanks Herbarium were reviewed. Collection data from these sources was entered into the park's collection database and is summarized in the following review of botanical collecting.

Hoefs, et. al. (1975) describe the history of botanical collecting in the Kluane area, adjacent to the park's eastern boundary. These Yukon collections are not included in the following review even though they border the park. Collections from Chitina, Gulkana, Gakona, Slana, Tonsina, Yakutat Bay and general localities such as 'Copper River basin' have been included in the following review for the park. However, a species collected at a locality bordering the park is not included in the verified species list for the park if it is the only known locality and is not known from within the park's boundary.

Forty-four individuals collected 2105 specimens within the park and in the close vicinity prior to 1984. Twenty-six of these collections comprising 1331 specimens were from within the park boundaries (Figure 2.1, Appendix 2.1) Eight of the 26 park collections were significant, the remaining 18 collections had less then ten known specimens.

The significant collections were made by: Hamilton L. Laing in 1925 at the head of the Chitina River (243 specimens); David F. and Barbara Murray from 1966-1981 at May Creek, Nizina, Chitistone Pass, Skolai Pass, Guerin Glacier, Russell Glacier and Sheep Glacier (333 specimens); Richard W. Scott at Skolai Pass, Frederika Glacier, Chitistone Pass and Snag Glacier in 1967 and 1968 (214 specimens); Olle Nordell & Alf Schmitt at Kennecott and Bonanza Ridge in 1967 (207 specimens); William L. Poto in 1902 primarily along the Mt Drum trail (116 specimens); David W. Eaton from 1909 to 1913 along the Yukon border (98 specimens in the park, 200 total); Ransom Saltmarch in 1978 on the slopes of Mt. Wrangell (76 specimens) and Frank Charles Schrader with G.H. Hartman on the north side of the park between the Nabesna and Copper Rivers (50 specimens) (Hultén 1941-1950; Porsild 1939; Murray 1968, 1971; Nordell & Schmitt 1977; Poto 1902; Saltmarch 1978 and Scott 1968). Our discussion of the history of botanical collecting emphasizes these major collections and those smaller collections with notable taxa.

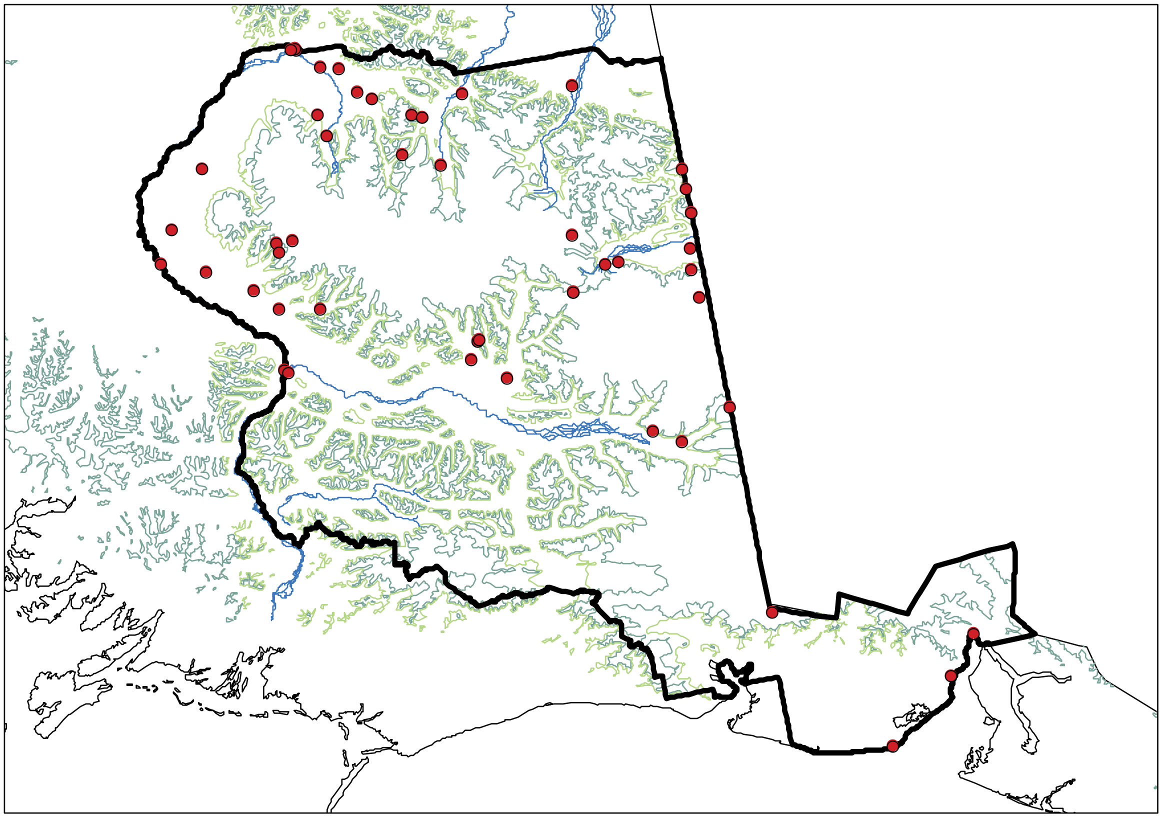

Figure 2.1. Location of historical vascular plant collections within Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection, NAD 1927).

Pre-1950 Collections

Mt. St. Elias Expeditions

The earliest plant collections made in the vicinity of the park were made by J. Albert Rudkin in 1883 on a trip from Juneau to Mt. St. Elias. The collection of 31 vascular plants was reported by N.L. Britton at a meeting of the Torrey Botanical Club (Britton 1884). The New York Botanical Garden where the specimens are deposited was contacted to determine if the labels on the specimens had additional locality information, but they did not. Therefore, it was not possible to determine if any of these specimens were actually collected within the park. If the collections were made in the park, *Blechnum spicant* (L.) Roth would be new to the park flora. Additional information on this expedition to Mt. St. Elias has not been located. Another early collection made in the vicinity of Mt. St. Elias was of *Hedysarm alpinum* L. made by Edward Leonidovich Blashke (Hultén 1940, p. 300, Hultén 1945, p. 1110). Blashke was a surgeon in the Russian-American Company from 1834 to 1841 and collected primarily in the vicinity of Sitka and Kodiak. Information about an expedition to Mt. St. Elias during the years that Blashke was in Alaska has not been found.

The first recorded attempt to climb Mt. St. Elias was by Frederick Schwatka, William Libbey, H.W. Seton-Karr and Jack Dalton in 1886 from the Yahtse River on the

northwest side of the Malaspina Glacier near Icy Bay (Schwatka 1891). This attempt was followed by Harold W. Topham in 1888 (Topham 1889) and by Israel C. Russell in 1890 and again in 1891 (Russell 1891A 1891B, 1892). Russell's descriptions of the vegetation and flora of the Malaspina Forelands are extensive. He was particularly enthralled with the "Gardens of the Glaciers" two of which he named Blossom Island and Floral Pass:

> This oasis in a desert of ice is so beautiful and displays so many instructive and attractive features that I wish the reader to come with me up the flowery slopes and study the interesting pictures to be seen from its summit.
>
> The narrow ravine back of our camp is festooned and overhung with tall ferns, shooting out from the thickets on either hand like bending plumes. You will notice at a glance, if perchance your youthful excursions happened to be in the northeastern states, as were mine, that many of the plants about us are old friends, or at least former acquaintances. The tall fern nodding so gracefully as we pass is an *Asplenium*, but of ranker growth than in most southern regions. These tall white flowers with aspiring, flat-topped umbels, looking like rank caraway plants, but larger and more showy, belong to the genus *Archangelica*, and are at home in the Cascade range and the rocky Mountains as well as here. The lily-like plant growing so profusely, especially in the moist dells, with tall, slim spikes of greenish flowers and long parallel veined leaves is *Veratrum viride*. these brilliant monkey-flowers, bending so gracefully over the banks of the pond, are closely related to the little *Mimulus* which nods to its own golden reflection in many of the brooks of New England. That purple *Epilobium*, with now and then a pure white variety, so common everywhere on these hills, is the same wanderer that we have seen over many square miles beneath the burnt woods of Maine. These bushes with obscure white flowers, looking like little waxen bells, we recognize at once as huckleberries; in a short time they will be loaded with luscious fruit. Inviting couches of moss beneath the spruce trees are festooned and decorated with fairy shapes of brown and green, that recall many a long ramble among the Adirondack hills and in the Canadian woods. The lycapods, equieseta and ferns are many of them identical with the tracery on mossy mounds covering fallen hemlocks in the Otsego woods in New York, but display greater luxuriance and fresher and more brilliant colors. That graceful little beach-fern, here and there faded to a rich brown, foretelling of future changes, is identical with the little fairy form we used to gather long ago along the borders of the Great Lakes.
>
> Asters and gentians, delicate orchids and purple lupines, besides many less familiar plants, crowd the hillsides and deck the unkept meadows with a brilliant mass of varied light. In the

> full sunshine, the hill-slopes appear as if the fields of petals clothing them had the prism's power, and were spreading a web of rainbow tints over the lush leaves and grasses below.

Although Russell expounded on the flora of Blossom Island in over three pages, no botanical collections are mentioned. Other than a few National Park Service FIREPRO collections, no botanical surveys are known to have been conducted in these areas that impressed Russell so much.

A translated abstract of Vittorio Sella's diary, who accompanied the Duke of Abruzzi on the successful ascent of Mt. St. Elias in 1897, indicates that a secondary goal of the expedition was to collect samples of the flora and fauna (Fondazione Sella 1994). However, no collections have been documented in the literature or are known to exist from this expedition or any subsequent expedition.

Yakutat Bay

The vicinity of Yakutat and Yakutat Bay has been extensively explored by various botanists beginning with Thaddeus Haenke and Luis Nee on Malaspina's Expedition in 1791. Hultén (1940) and Stair and Pennell (1946) reviewed these collections. They include: William H. Dall in 1892; Frederick Funston in 1892; the Harriman Expedition including Frederick V. Coville, Thomas H. Kearney, William Trelease, Thomas Vernon, W.H. Brewer, Wesley Roswell Coe, Trevor Kincaid and de Alton Saunders in 1899; Charles V. Piper in 1904; D.S. Birkett in 1907; Edmund Heller and Kate Stephens in 1908; Albert S. Hitchcock in 1909; George B. Rigg in 1913; Ernest P Walker in 1922, and Stair in 1945. Most of these collections were made on the Yakutat Forelands or in Yakutat Bay outside of the park, or if localities were given, they were too general to determine if the collections were made within the park.

The Harriman Expedition made four collections at Hubbard Glacier and five collections at Disenchantment Bay which are likely to be in the park (Hultén 1941-1950). These collections are deposited at the U.S. National Herbarium in Washington, D.C. Species collected by the Harriman Expedition in Yakutat Bay that would be new to the park if they were collected within the park are: *Polypodium glycyrrhize* D.C. Eaton subsp. *occidentale* (Hook.) Hult., *Puccinellia nutkaensis* (Presl) Fern & Weath., *Ribes bracteosum* Dougl., *Saxifraga nelsoniana* L. subsp. *pacifica* Hult. comb. nov., *Streptopus roseus* Michx. subsp. *curvipes* (Vail) Hult. and *Poa eminens* Presl.

Frederick Funston (1896) provided a detailed description of the areas he surveyed as well as the challenges of collecting on the Alaska coast:

> Immediately on establishing my camp I began the work of collecting, though at this season but few plants were in flower. I endeavored to obtain twenty sheets of dried specimens of each species, but in some cases only a partial series could be secured on account of the scarcity of the plant. The drying papers were changed two or three times every day and dried by hand over a fire before they were returned to the presses, this work being rendered

> necessary by the great humidity of the atmosphere and the almost daily rains. During the season about 10 cords of wood were used in keeping up these fires.

He collected 3000 specimens representing 154 species from May 25 to September 2, 1892. These specimens are preserved at the U.S. National Herbarium and were classified by Frederick Vernon Coville. Most of his collections were made in Yakutat and Disenchantment Bays, Haenke and Khantakk Islands outside of the park and Preserve. However he did take a canoe trip to, "...McGrath's camp, on the opposite side of the bay near Point Manby but found little here that I had not already collected" (Funston and Coville 1896, Figure 2.2). A collection of *Mertensia maritima* (L.) S.F. Gray (Funston #50) was published from this locality. It was made on June 28, 10 km N of Point Manby and is the only collection of this species from the park.

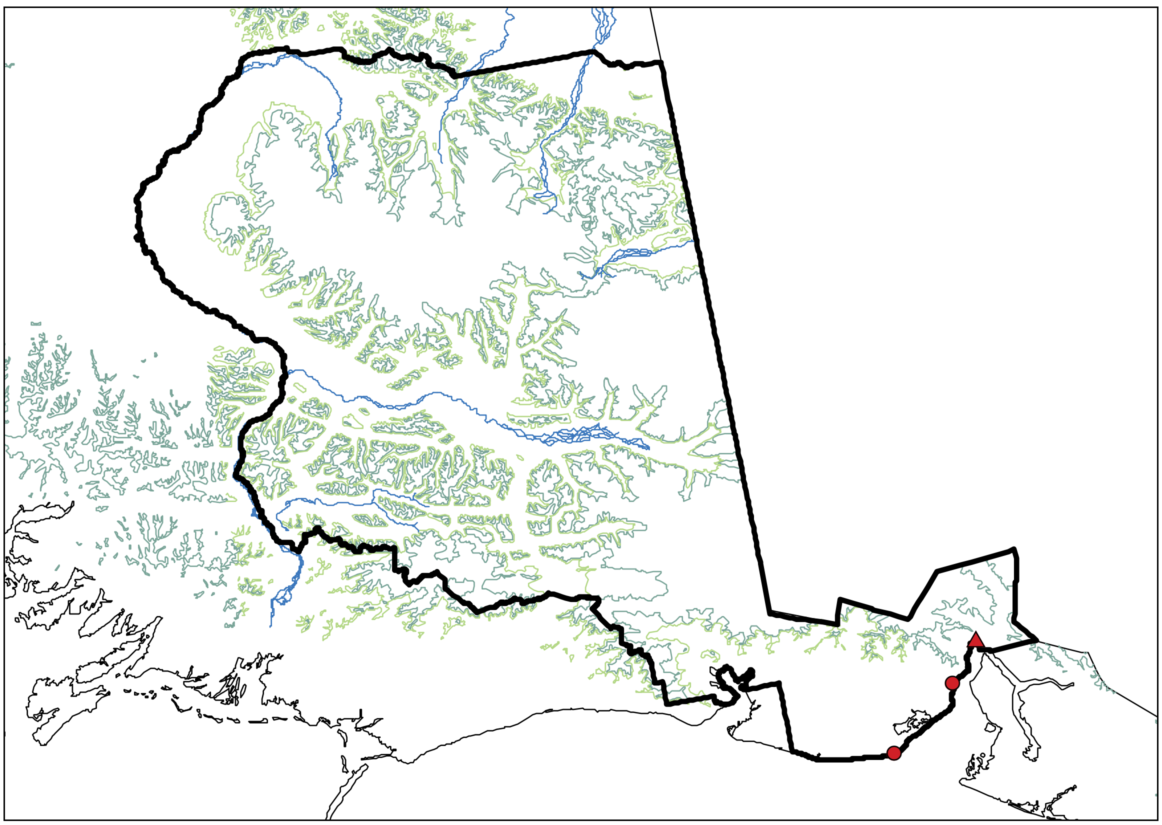

Figure 2.2 Location of collections made within Wrangell-St. Elias National Park and Preserve, Alaska, by Frederick Funston at Pont Manby and Esker Stream in 1892 (●) and by the Harriman Expedition at the Hubbard Glacier in 1899 (▲), Mercator Projection NAD 1927.

Funston also planned on staying the summer at Jack Dalton's cabin which was near Esker Stream on the Malaspina Forelands and within the Preserve (Bleakley, pers. com. 1999), but "... a dense ice pack which lay off this shore nearly all the summer precluded any attempt to effect a landing" (Funston and Coville 1896). Funston must have landed here at least once, for seven collections made on August 15 and 16 were published (Funston and Coville 1898). These collections were: *Cryptogramma acrostichoides* R. Br. (#129), *Polystichum lonchitis* (L.) Roth (#126), *Phleum commutatum* Gandoger (#119), *Poa alpina* L. (#127), *Euphrasia subarctica* Raup. (#125), *Geum calthifolium* Menzies (#130) and *Sibbaldia procumbens* L. (#124). *Polystichum lonchitis* is known only from four other localities in the Chugach Mountains south to the Chaix Hills on the Malaspina Forelands. *Geum calthifolium* is known only from the vicinity of Mt. St. Elias from a collection by David W. Eaton in 1913. It has been collected by park staff in the Robinson Mountains between the Bering Glacier and Icy Bay just outside of the park.

Copper River Military Exploring Expedition of 1898

Eric Hultén, in his history of botanical exploration in Alaska notes that Frank Charles Schrader collected between Valdez and the Copper River on the 1898 military exploring expedition under the command of Captain William R. Abercrombie (Hultén 1940). However, none of the published reports (Abercrombie 1898, 1900, Schrader 1900) mention botanical collections and discuss vegetation only in the most general terms and only in relation to timber, food and horse feed. Also, I have not seen a reference to any collections made by Schrader in 1898 in Hultén 's 1940-50 annotated flora. Schrader's field notes could verify this. Abercrombie believed that an agricultural industry was possible in the Copper River Valley, based on the report of Jacob Sittel, a landscape gardener from Portland Oregon then residing in Copper Center (Abercrombie 1898, p.330-331). After describing his garden (three kinds of lettuce, onions, peas, beets, carrots, turnips, cabbage, kale, corn and beans), Sittel describes the common native shrubs and forbs of the area but has no references to botanical collections.

Martin Woodlock Gorman - 1899

Martin Woodlock Gorman made two trips up the White River in 1898, collecting 200 numbers on the first trip. The second trip was to the upper reaches on about July 19 according to Hultén (1940). His raft was destroyed on this trip and most of his collection was lost. At least eight of Gorman's upper White River collections referenced in Hultén (1941-1950) appear to have been made in the park and to have survived the trip. These specimens are deposited at the U.S. National Herbarium, the New York Botanical Garden and the Canadian Museum of Nature in Ottawa, Ontario, Canada. His collection of *Carex limosa* L. is of interest since it has not subsequently been collected in the northern regions of the park. It is only known from the Central and southern Wrangells and in the Chugach Mountains. He also collected *Lomatogonium rotatum* (L.) E. Fries which is known only from three other stations in the park: two on the upper Chitina River and one on the 141st meridian north of Mt. St. Elias.

USGS Copper River District Exploration - 1900

Arthur Coe Spencer and Frank Charles Schrader explored the geology and mineral resources of the Chitina and Copper Rivers for the United States Geological Survey

(USGS) in 1900. Hultén (1940) reported that Spencer made collections along the Copper River in July. However, I have not been able to find annotated specimens in Hultén 's 1941-1950 flora nor a mention of botanical collections in the published USGS report (Schrader and Spencer 1901). Hultén says that Schrader collected 300 specimens from 1898 to 1902 in Alaska and that they are housed at the U.S. National Herbarium. This collection is not included in the National Herbarium's database of historical collections. A review of Spencer and Schrader's field notes might clarify this discrepancy.

USGS Mt. Wrangell and Central Copper River Region Exploration - 1902

The USGS sponsored an expedition in 1902 to the central and northern Copper River region under the direction of Walter C. Mendenhall (Mendenhall and Schrader 1903, Mendenhall 1905). Two teams of surveyors and geologists were assembled. Frank Charles Schrader and D.C. Witherspoon surveyed the upper Copper, Nabesna and Chisana drainages. Mendenhall and T.G. Gerdine mapped the south and west slopes of the Wrangell Mountains and the southern face of the Alaska Range draining into the Copper River. Schrader and G.H. Hartman made plant collections at Batzulnetus, Mt. Gordan, Drop Creek and along the Jacksina, Nabesna and upper Copper Rivers (Figure 2.3, Appendix 2.2). Fifty of these collections were referenced by Hultén (1941-1950) and are deposited at the U.S. National Herbarium. All are common boreal forest or tundra species except for *Castilleja raupii* Pennell which they collected on the Nabesna River. This is the only report of this species from the park. It is a North American endemic restricted in Alaska to the east-central portion of the state and should be looked for in subsequent surveys. This *Castilleja raupii* station appears to be on the Tanana River at the Yukon border on Hultén 's 1940 distribution map (Hultén 1940, p. 1471) since Schrader and Hartman's Nabesna River stations were mapped at the confluence with the Tanana River rather than on its upper reaches, where they surveyed. [1]

Collections of William L. Poto

The second USGS team lead by Mendenhall was accompanied by William L. Poto. Poto made a significant plant collection of 175 specimens which is housed at the U.S. National Herbarium. One hundred fifteen of these specimens were examined by Hultén (Hultén 1941-1950) (Figure 2.3, Appendix 2.3). Although Poto was never mentioned in any of the official USGS Copper River expedition reports, he was included in Hultén 's history of botanical collecting (Hultén 1940).

[1] A feature of the base map in Hulten's 1941-1950 flora which may lead to the mis-mapping of specimens, is the incorrect placement of Mentasta Creek and the Chistochina and Jacksina Rivers on the north side of the park (Hulten 1941, p. 128). Hulten's map shows the three drainages flowing into the Tanana River. The Chistochina River is mapped approximately where Teslin River should be, the Jacksina River is in the location of the Chisana River, and Mentasta Creek is approximately where Snag Creek is. The Chistochina River and Mentasta Creek actually flow into the Copper River on the northwest side of the park, and the Jacksina River flows into the Nabesna River in the foothills of the northern Wrangell Mountains.

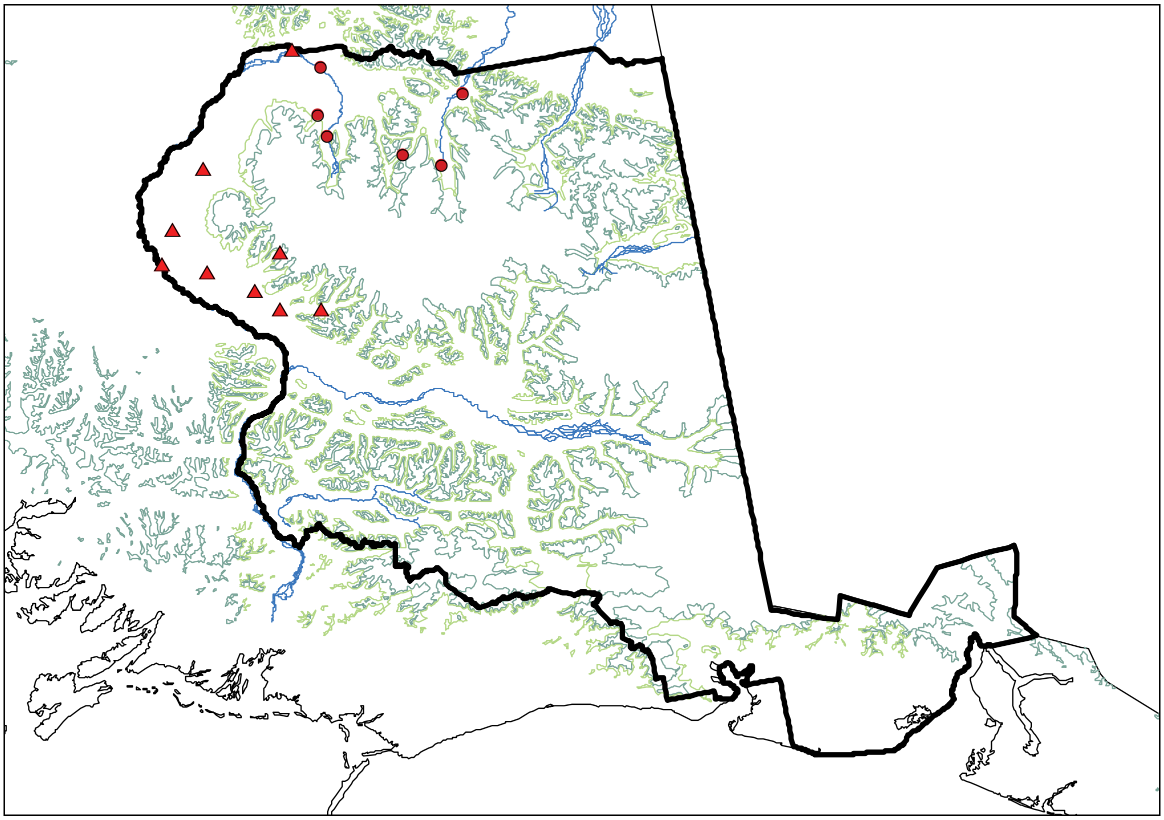

Figure 2.3. Location of collections made during the USGS Mt. Wrangell and Central Copper River Region Expedition of 1903 by F.C. Schrader and G.H. Hartman (●) and by W.L. Poto (●). Mercator Projection NAD 1927.

Mendenhall's name on the labels, but a list published by Mendenhall in a USGS report (Mendenahll 1902) describes the plants as being classified by Coville and Wight and collected by Poto. There is no record who classified Poto's Copper River collection. Poto collected from May 13 to September 16 from Copper Center to Slana along the Millard Trail taking side trips up drainages into the Wrangell Mountains. The Millard Trail was 55 ½ miles from Copper Center to Slana. It crossed the Copper River at Copper Center, skirted the base of Mounts Drum and Sanford taking the high ground of the bend of the Copper River and followed an old Indian trail reaching the Copper River again just south of the Slana River (Abercrombie 1898). Poto also collected in the Chistochina drainage just outside of the park. Some of his more interesting collections include the following:

- *Aconitum delphinifolium* DC. "Plant common in river valley, everywhere" (Poto 1902). The location was between the Sanford River and an observation made at snowline on Mt. Wrangell. Hultén mapped this collection at the confluence of the Jacksina and Tanana Rivers (see note above on his mapping of these drainages) and described the location as "Copper River Region". This is the only collection from the Wrangells until a 1978 Saltmarch collection on the Dadina drainage. Subsequent collections were made on the

Chetaslina drainage and in the northern Wrangell, Mentasata and Nutzotin Mountains.

- *Angelica lucida* L. "Camp 7/23-25. Wild parsnip. Plant not very common. Found in river valley. Observed 4 ft high, usual height 2 ft + -" (Poto 1902). This central Wrangell collection is the most northern locale in the park. Other collections are in the southern Wrangells south throughout the Chugach Mountains and the coastal regions.
- *Arnica diversifolia* Greene. Poto 165. "Plant not common. Seen occasionally in rather marshy, grassy places. Height 1 to 2 ft" (Poto 1902). This locality was on the divide between Slate Creek and Chisna at 4000 ft (1219 m), which is on the upper Chistochina River approximately 40 miles north of the park. The only locality in Alaska on the map in Hultén 1968 is on the upper Chitina which probably would be Laing's collection. But none of his specimens were identified as this species by Porsild (1939). The map in Hultén 1940-50 (p. 1681) has the locality on Slate Creek in the proper location. This is the only location of this plant in Alaska in Hultén's 1968 flora. Hultén (1968) notes that it may be of hybrid origin and Cody concurs specifying that the parents are most likely *A. latifolia* and *A. amplexicaulis.*
- *Boykinia richardsonii* (Hook.) Gray. "Probably wild ginger. Not very common. Found in damp grassy places along foot of ridge. Height 6 to 24 in. 4500 ft. W. Fork of Eagle Creek" (Poto 1902). This is the closest locality of this Alaskan endemic to the park. It has never been collected within the park. Poto's collection is just north of the park in the Alaska Range near Slana. The other collection close to the park is from Trail Creek near Mentasta Pass made in 1975 by M. Lewis where it was common in wet areas.
- *Corydalis sempervirens* (L.) Pers. "Plant not common, only one observed. Found on old burnt hillside" (Poto 1902). This is the only collection from the vicinity of the park, although it has been observed in the Klutina drainage just outside the park. Poto's collection is from Mitchell Creek, a creek name not currently on USGS maps. Collection localities on adjacent days were near the mouth of the Slana River and Tetelna (Indian Creek).
- *Lomatogonium rotatum* (L.) E. Fries. "Plant not common. Observed only at old camping place" (Poto 1902). This species is of limited distribution in the park, known only from the Upper White and Chitina Rivers and a collection at Copper Center outside of the park.
- *Sanguisorba stipulata* Raf. "Plant observed quite frequently on trail to camp. Height 6 to 18 in." Poto (1902). Hultén has mapped this collection in the correct location, on the upper Chistochina drainage near Tetlena (Indian) Creek and the forks of Eagles Creek. This is the most northern collection in the vicinity of the park. The rest of the collections within the park are in the southern Wrangell and Chugach Mountains.
- *Silene repens* Patrin. "Sanford River. Inconspicuous little plant, rather common on gravel bars" (Poto 1902). This is the most southerly collection of *Silene repens*. All other collections are in the Mentasta or Nutzotin

Mountains on bluffs. It has not been collected since Poto in the Sanford River drainage. It was also collected by the northern USGS contingency of 1902, Schrader and Hartmann along the Nabesna River.

- *Swertia perennis* L. "Plant rather common in wet places along river. Height 4 to 12 in." (Poto 1902). This collection was made on the upper Chitistochina drainge between Tetelna (Indian) Creek and Eagle Creeks and is the most northern location in the vicinity of the park where it is found only south of the Chitina River.
- *Wilhelmsia physodes* (Fiscy.) McNeill. "Plant observed only in rocky, mossy spot on slope of ridge. Height 3 in." (Poto 1902). There are only two known locations in the vicinity of the park, Poto's collection and one by David W. Eaton who was a member of the U.S.-Canadian Boundary Survey in 1909 on the White River near the boundary. Eaton's collection was not mapped by Hultén even though it was cited in Hultén's 1941-1950 flora. This plant has not been found elsewhere in the park.

An interesting observation of Poto's was that of Solomon's Seal on a Kotsina River side trip. Any of the species of *Smilacina* would be notable from this drainage. The only species of *Smilacina* in the park, *S. stellata*, is known from one location and that is in the Nutzotin Mountains a distance of approximately 100 miles north of the Kostina River. The next closest locale is Long Lake on the Glenn Highway, 175 miles to the west.

Diehl and Heideman 1908

I.E. Diehl 1908 "...obtained a small collection, now in Univer. of Calif., at Ketchikan, Juneau, Treadwell, Fort Liscum and Copper R "(Hultén 1940). No other reference to Diehl has been found. Judging by the species collected on the Copper River, he was on the lower reaches of that drainage, perhaps on the coast. If the collections were made in the interior, the following would be notable: (1) *Menziesia ferruginea* Sm. This locality does not appear on the maps in Hultén 1968 (p. 720) or Hultén 1941-1950 (p. 1226). It would be a significant range extension north and east. It was collected by Funston, Kincaid, Stair and Pennell at Yakutat. Hultén shows a station in the vicinity of Cordova which could be Diehl's collection. *Menziesia* has not been collected in the Copper River valley. (2) *Aruncus dioicus* (Walt.) Fern. is known only from the Bremner River south, and the vicinity of Mt. St. Elias near the border. This would be an interior range extension. (3) *Vaccinium alaskensis* How. is known only from the Bremner River south to the coast. (4) *Salix sitchensis* Sanson is known only from the Bremner River, the Upper Chitina River, the Chugach Mountains and on the coast.

Charles W. H. Heideman collected in the upper Copper River valley and on Mt. Wrangell, Mt. Drum and Mt. Sanford. Most of Heideman's collection was destroyed by shipwreck and fire (Hultén 1940, p. 321). Those that survived are at the U.S. National Herbarium. Seventy-one of Heideman's collections examined by Hultén (1941-1950) had a locality of Copper Center (Appendix 2.4). However, the following collections indicate that he collected in a broader area than Copper Center and that perhaps some of his Wrangell Mountain collections survived the shipwreck but were labeled collectively as from Copper Center: (1) the alpine species: *Cassoipe tetragona* (L.) D. Don, *Dryas drummondii* Richards. and *D. integrifolia* M. Vahl; (2) *Geranium erianthum* DC.,

known primarily from sublapine meadows in the southern Wrangells through the Chugach Mountains and to the coast; (3) *Aguilegia brevistyla* Hook., of restricted distribution and known from upland mixed woodlands in the Chitina drainage and Mentasta Mountains; (4) *Arenaria capillaris* Poir., known only from the park on a mononodock in the Tana River at 4700 ft (1432 m) and just outside the park at Hundell Creek in the Chugach Mountains at 5300 ft (1615 m), and (5) *Lomatogonium rotatum* (L.) E. Fries, an upland to sub-alpine meadow plant of limited distribution in the park known only from the Upper White and Chitina Rivers. Two other of Heideman's collections are notable: *Erigeron lonchophyllus* Hook., which has never been collected within the park and *Petasites sagittatus* (Bank) Gray, common in bogs along the roads adjacent to the park, which has been observed in the park, but has not yet been collected.

Collections of the Yukon-Alaska International Boundary Survey 1909-1913

The 141st meridian of the Alaska-Yukon boundary was surveyed by Canadian and American survey parties from 1906 to 1913 and amazingly, some of the surveyors were able to make plant collections. Lewis Green in The Boundary Hunters (1982) recounts the story of the entire boundary survey. The survey within the park was lead by F. Lambart and J.D. Craig of the Canadians and Thomas Riggs, Jr. of the Americans. In 1909, base lines were established in the White River valley from the border to Skolai Pass, along Holmes Creek up the Klutlan Glacier to Mt. Natazhat and north to Mirror Creek. During 1912, triangulation was through the Wrangell Mountains from McCarthy, through Skolai Pass to the boundary where nine stations from 1909 were recovered, continuing down the Nizina River to a line in the Chitina River Valley. In 1913 the line from Mt. Natazhat to Mt. St. Elias was completed. The surveyors traveled across the Nizina River overland to a base camp at the head of the Chitina River. During this season they mapped Anderson Glacier and the area between Logan Glacier and Mount St. Elias. One party also attempted to climb Mt. St. Elias. The Canadian party in 1913, lead by F. Lambart, worked in the Mt Natazhat area camping at the foot of Klutlan Glacier and climbed Mt. Natazhat. It is a wonder that any specimens from the Alaska-Yukon boundary survey survived as indicated by Green’s description of the trials of the 1912 survey work (1982, p. 168):

> It had not been an easy season. One group lived for some time on two sheep and some ptarmigan they managed to shoot and a lucky find of a sack of flour left cached in a tree some six years before. One man fell over a cliff, and though he was unhurt, he decided he had had enough and left the survey as did another man pulled unhurt from a crevasse. If that were not enough, the party reached McCarthy only to find that snowslides had knocked out the Copper River and Northwestern Railway. They could do nothing else but walk for sixty more miles and then descend the Copper River for eighty-five miles in small overloaded boats.

David W. Eaton, of the Alaskan Boundary Commission, collected along the Yukon-Alaska International Boundary in 1909, 1912 and 1913 while surveying the 141st Meridian for the Canadian Geological Survey. Eaton collected 37 specimens in 1909 in the White River valley near the border, 44 specimens in 1912-1913 along the 141st meridian north of Mt. St. Elias and 14 specimens in the Chitina Valley in 1913 (Hultén

1941-1950) (Figure 2.4, Appendix 2.5). His collection of 200 specimens made on both side of the border are preserved at the U.S. National Herbarium.

Notable collections of Eaton's made in the vicinity of the 141st Meridian north of Mt. St. Elias are: (1) *Geum calthifolium Menzies* - this is the most northern station in the park, it is known only from the coast. (2) *Swertia perenne* L - has a limited distribution in the park. It is known only from the Chugach Mountains and near Indian Creek just outside of the park near Chistochina. (3) *Fauria crista-galli* (Menzies) Makino. - this is the most northern station in the park, it is known only from the coast. (4) *Lomatogonium rotatum* (L.) E. Fries - has a limited distribution in the park, it is known only from the upper Chitina and White Rivers, although it was collected by Poto on the Chistochina River and by Heideman at Copper Center just outside of the park. (5) *Aruncus dioicus* (Walt.) Fern. - along with Diehl's Copper River collection, the most northern stations in the park, otherwise known only from coastal localities. (6) *Wilhelmsia physodes* (Fisch.) McNeill has never been collected by park staff within the park and is known only from Poto's collection on the Chetaslina River and Eaton's collection[2].

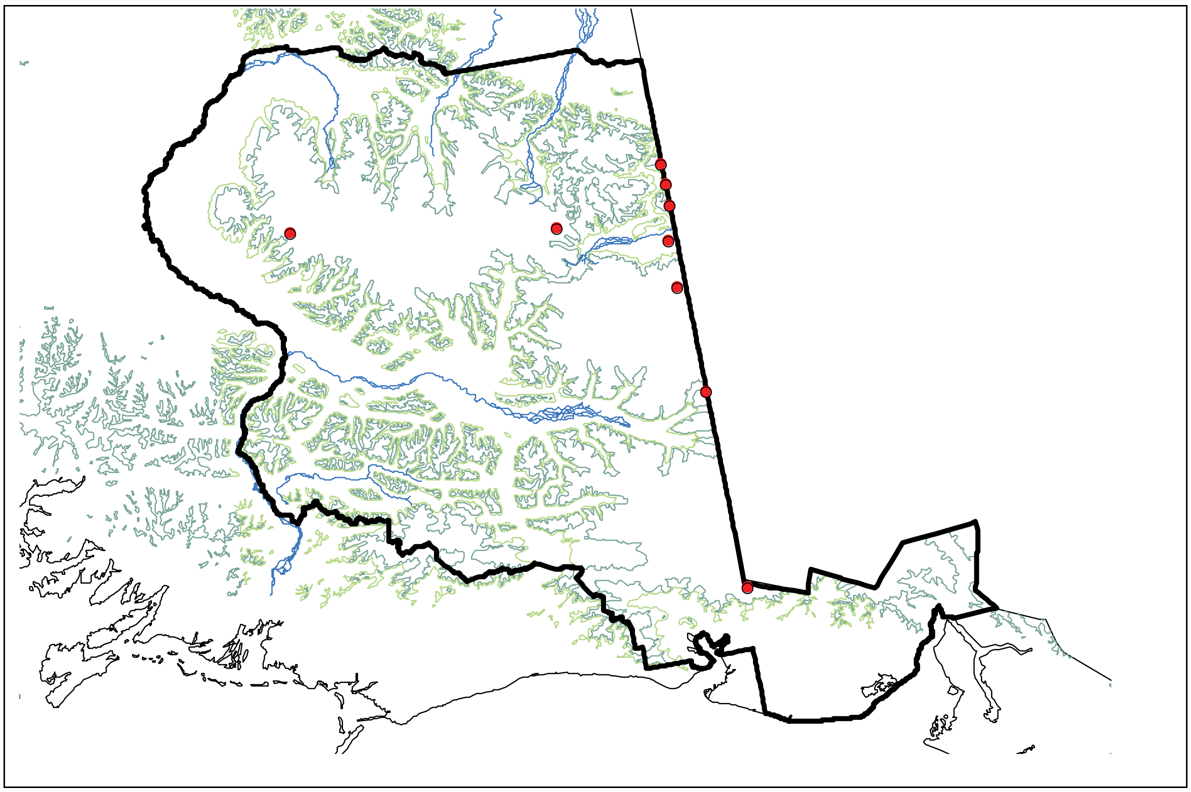

Figure 2.4. Location of vascular plant collections made within Wrangell-St. Elias National Park & Preserve, Alaska, by H.F. Lambart, D.W. Eaton and D.D. Cairnes of the U.S.-Canadian Boundary Survey from 1909 to 1913 (Mercator Projection NAD 1927).

[2] The stations in Hulten (1968) appear to be mapped incorrectly. One station is shown in the park on the upper Copper, this was probably Poto's collection. Eaton's collection was not mapped.

DeLorme D. Cairnes, geologist with the Canadian Geological Survey also collected in the White River vicinity in 1912 and near Mt. St. Elias in 1913 while surveying the boundary. Nine collections are referenced in Hultén (1941-1950) and are deposited at the Canadian Museum of Nature in Ottawa and at the New York botanical Garden. Collections made by Cairnes in 1911 and 1912 between the Porcupine and Yukon Rivers during the International Boundary Survey were classified by J.M. Macoun and published in several documents (Cairnes 1911, 1subsp. & Macoun 1912). A publication of his 1912-1913 collections or a reference as to who classified the specimens has not been located.

Four additional collections were attributed to the boundary survey by Hultén (1941-1950): three 1913 collections of Lambart's from the Klutlan Glacier area (*Anemone parviflora* Michx., *Draba breweri* S. Wats. var. *cana* (Rydb.) Rollins and *Astragalus nutzotinensis* Rousseau) and a collection in 1912 by the Alaska Boundary Survey of *Primula cuneifolia* Ledeb. subsp. *saxifragifolia* (Lehm.) Sm. & Forrest. on "Mt. Wrangell at very high elevations" (Hultén 1947, p. 1270). The Alaska Boundary Survey specimen is at the U.S. National Herbarium whereas Lambart’s collections are at the Canadian Museum of Nature in Ottawa.

1925 Mt. Logan Expedition

One of the most interesting historical collections made in the park is that of Hamilton M. Laing, a biologist with the Department of Mines of British Columbia, who was a member of the Mt. Logan Expedition of 1925. His collection of 243 vascular plants was classifed by A.E. Porsild and published in his Contributions to the Flora of Alaska (Porsild 1939). Laing’s collection is at the Canadian Museum of Nature in Ottawa. Although the locality for all of Laing's collections is "head of Chitina River" expedition accounts describe him travelling between Hubrick's camp (now Hubert's Landing) and the Logan Glacier on both sides of the river while tending base camp alone as the rest of the expedition climbed Mt. Logan from May 18 to July 6 (Lambart 1926a, 1926b). He may also have collected while enroute from McCarthy to Hubrick’s camp along the Chitina River May 12 to May 17. Laing remained alone to continue collecting until mid-August when the rest of the expedition left Hubrick's camp for McCarthy July 11.

Porsild honored Laing "... who...made an important contribution from a botanically unknown region" by naming a species of *Antennaria* after him, *A. laingii* (Porsild 1939). These specimens, Nos 210 (Type) and 238 were later assigned to *A. rosea* E.L. Greene by Hultén (1968) and to *A. rosea* E. L. Greene subsp. *confinis* (E.L. Greene) Bayer by Randall Bayer in his taxonomic revision of the genus *Antennaria* of Alaska and the Yukon (1993).

Porsild appears to have numbered Laing’s collection as he classified it, since the collection numbers are in the phylogenetic order of Porsild's paper. A list of Laing's collections can be found in Appendix 2.6. Laing's collection of species new to the flora of Alaska as reported by Porsild in 1939 include:

- *Juniperus horizontalis* Moench.
- *Juncus triglumis* L.subsp. *albescens* (Lange) Hult.
- *Cypripedium passerinum* Richards
- *Listera borealis* Morong
- *Draba incerta* Payson. Until our floristic inventory, this species was not known from the park and Preserve except for Laing's collection. It is now known from ten sites in the Chugach Mountains, one in the southern Wrangells and one in the Mentasta Mountains.
- *Erysimum inconspicuum* (S. Wats.) Macm.
- *Amelanchier florida* Lindl. This specimen was later assigned to *A. alnifolia* (Nutt.) Nutt by Hultén (1945). It has a limited distribution in the park within the Chitina River drainage. *A. florida* is to be looked for in the coastal areas of the park.
- *Potentilla hookeriana* Lehm.
- *Oxytropis deflexa* (Pall.) DC. var. *foliosa (Hook.)* Barneby
- *O. viscida* Nutt.
- *Linum perenne* L.
- *Elaeagnus commutata* Bernh.
- *Pyrola chlorantha* Sw.
- *P. grandiflora* Radius var. *canadensis* (Andres), n. comb.
- *P. grandiflora* Radius var. *Gormanii* (Rydb.), n. comb. The varietal distinctions for *P. grandiflora* have not been retained by Hultén (1968) or Cody (1996).
- *P. secunda* L.
- *Gentiana propinqua* Richards. subsp. *arctophila* (Griseb.) Hult. This subspecific rank is not retained by Cody (1996).
- *Erigeron eriocephalus* J. Vahl
- *Arnica alpina* (L.) Olin subsp. *attenuata* (Green) Maguire
- *Senecio ogotorukensis* Packer. This material was treated *as S. conterminus* Greenm. by Porsild (1939). However, Packer, in his taxonomic and phytogeographical review of arctic and alpine *Senecio,* reassigned this material to *S. ogotorukensis* Packer, *S. conterminus* being restricted to the southern Rocky Mountains (Packer 1972).
- *Crepis elegans* Hook.

Collections of species new to interior Alaska were:

- *Amerorchis rotundifolia* (Banks) Hult.
- *Platanthera obtusata (Pursh) Lindl.*
- *Goodyera repens* (L.) R. Br.
- *Dryas drummondii* Richards.
- *Geranium erianthum* DC.

- *Euphrasia subarctica Raup* Fern. & Wieg. Porsild identified this as *E. disjuncta* Fern. & Wieg. Hultén treats this collection as *E. subarctica* Raup in his Flora of Alaska and Yukon (1948, p. 1398) and Laing's collection is on the distribution map. However, this station is not included in Hultén 's 1968 Flora (p.814). In his 1973 supplement to the 1968 Flora of Alaska, Hultén follows the treatment of Sell and Yeo (Bot. Journ. Linn. Soc 63:3. 1970 p. 210 in Hultén 1973, p. 504) in which *E. disjuncta* is the name for the plant which ranges from Newfoundland to Lake Mistassini, whereas *E. subarctica* is the plant that ranges from Alaska to Lake Athabasca. A collection *of E. subarctica* by Went in 1938 at Copper Center was thought by Hultén to approach *E. mollis* which is not known from the park. A collection by Funston near Esker Stream on the Malaspina Forelands was originally identified as *E. mollis* by Coville (Funston and Coville 1942) but redetermined as *E. disjuncta* by Fern. & Wieg and as *E. subarctica* by Hultén (1948, p. 1398).
- *Viburnum edule* (Michx.) Raf
- *Senecio kjellmanii* Porsild.

Two additional species are noteworthy:

- *Silene menzeisii* Hook. Porsild identified this material as *S. Williamsii* Britt. (Porsild 1938), but Hitchcock and Maguire (1947) determined it to *S. menzeisii*. Our material from the upper Chitina matches well the characters described by Hitchock and Maguire for *S. menzeisii*, whereas our material from the Nabesna area fits their description of *S. williamsii*. These distributions coincide with those described by Hitchock and Maguire - *S. williamsii* being the Alaska-Yukon endemic and more restricted to the northern part of the park and *S. menziesii* being more of a Cordilleran species and found in the southern part of the park where Cordilleran endemics are more common.
- *Lesquerella arctica* Wormskj. S. Wats. subsp. *arctica.* This material was identified to *L. arctica* var. purshii Wats. by Porsild. However, Hultén (1945, p. 841) and Rollins (1978, p.142) do not recognize this variety which was primarily distinguished by the presence of pubescence on the siliques. Hultén cites Laing’s specimen #91, whereas Rollins cites specimen #92. This plant still has a restricted distribution in the park, known now from 13 stations in the Chitina River drainage and one station in the Mentasta Mountains.

Roadside collections 1934 - 1947

The first automobile traveled the Richardson Highway between Valdez and Fairbanks in 1913. Travel continued to increase on this route and it was graveled in 1940 to facilitate the World War II military effort. The Slana-Tok Highway was completed in 1942 as part of the Alaska-Canada highway military effort. The Edgerton Highway between Willow Creek and Chitina (now the Old Edgerton Highway) was traveled as early as 1910 but was stabilized in later years. Botanical collecting increased in the vicinity of the park due to these road improvements, but no new collections in the interior of the park were made until 1966 with the collections of Drs. David F. and Barbara Murray. During this period, collections were outside of the park in the bordering communities, with the exceptions of

a few collections made along the Nabesna and McCarthy Roads. These roadside collections are useful for reviewing what may have been overlooked in the botanical collections of the park interior.

F.W. Went 1934: Frits Warmolt Went, professor of plant physiology at the Institude of Technology in Pasadena, California, collected 47 specimens at Copper Center and 12 at Chitina in 1934 (Appendix 2.7) (Hultén 1940, 1941-1950). Wents collection is primarily at Lunds University in Norway with some duplicates at the University of California, Berkeley. Four of his collections are notable: (1) *Allium schoenoprasum* (l.) Hartm. has only been collected once in the park on the Nizina River. (2) *Erigeron lonchophyllus* Hook. has not yet been collected within the park, although it was collected by Heideman at Copper Center in 1908. (3) *Pyrola chlorantha* Sw. has only been collected once in the park, by Laing in 1925 at the head of the Chitina River and by J.P. Anderson in 1947 at Gakona. It is probably being overlooked. (4) *Silene williamsii* Britt. (Britt.) Hult.comb. nov., collected at Copper Center, is known in the park only on the north side, on the Nabesna River and the upper Copper River near Black Mountain.

Elizabeth Kol 1936: Elizabeth Kol, lecturer at the University of Szeged in Hungary collected vascular plants while conducting research on the cryoplankton of glaciers (Hultén 1940, Gombocz 1940). Her specimens were deposited at the University of Szeged. She collected in Juneau, Prince William Sound, Valdez, Thompson Pass, Kennecott, Tiekel, Fox Farm, Fairbanks and Denali National Park and Preserve. Eleven of her collections were within the park at Kennecott and the road from Chitina. One of these is interesting, her collection of *Salix pedicellaris* Pursh. from Kennecott, which she also collected at Thompson Pass and in Denali National Park and Preserve. This is a boreal eastern North American species, rare in the Yukon and not included in Hultén 's 1941-50 or 1968 flora for Alaska. Hultén may not have examined Kol' s specimens or he may have redetermined them.

J.P. Anderson 1935 & 1944: Jacob Peter Anderson made the largest collection of any one person in Alaska from 1subsp. to 1940. He made a significant contribution to our understanding of the Alaska flora as well as of our locale flora. Anderson collected at least 235 specimens in the vicinity of the park in 1935 and 1944 (Appendix 2.8). These are the specimens examined by Hultén in his 1941-1950 flora, other collections may not have been sent to Hultén. Four of these collections were made at Slana, one on the Nabesna Road and one on the McCarthy Road. Anderson's park collections were in Hultén's private collection which are mostly at the Swedish Museum of Natural History in Stockholm, Sweden. His collection prior to 1924 was destroyed by fire in November of that year. Some duplicates of this early collection are at other herbaria (Welsh 1974). Anderson's primary collection is at Iowa State University, Ames where he moved in 1941 and compiled a treatment of the Flora of Alaska and Adjacent Parts of Canada (Anderson 1959) which was revised by Stanley Welsh in 1974. Duplicates of Anderson's are at the University of Alaska, Fairbanks Museum, the U.S. National Herbarium and the New York Botanical Garden.

Species collected by Anderson in the vicinity of the park which have not been collected within the park are:

- *Amsinckia menziesii* (Lehm.) Nels. & Macbr. - collected at Tonsina Lodge and also by Dutilly, LePage and O'Neill in 1945 at Gulkana.
- *Arabis hirsuta* (L.) Scop. subsp. *pycnocarpa* (M. Hopkins) Hult. - collected at Gakona. Hultén (1968) maps stations at Chitina and at Yakutat but no data has been found for these localities.
- *Astragalus robbinsii* (Oakes) Gray (Hook.) Barneby - collected on the Slana-Tok highway.
- *Bromus ciliatus* L. - collected at Gakona .
- *Carex bonanzensis* Britt. - collected at Gakona.
- *Carex deflexa* Hornem. - collected mile 20 Slana-Tok Highway
- *Cornus stolonifera* Michx. - collected at Gulkana, also at Chitina and Tonsina by other collectors.
- *Juncus arcticus* Willd. subsp. *ater* (Rydb.) Hult. - collected at Gakona.
- *Juncus styguis* L. subsp. *americanus* (Buchenau) Hult. - Mile 172-174 Richardson Highway (near Meyers Lake).
- *Lemna trisulca* L. - Edgerton Highway mile 9
- *Myriophyllum alterniflorum* DC. - collected at Gakona. A specimen from Buckland River (near Kotzebue) identified as *M. alterniflorum* in Hultén 's 1949 flora (p. 1766) is the only other collection known from Alaska. In his 1967 supplement (p. 87) Hultén says the Buckland River collection was redetermined by Hans Luther and therefore he excluded this species from his 1968 flora. Hultén does not mention Anderson's collection in his 1967 supplement. Hultén probably redetermined Anderson's collection as well, but if he did overlook it, it would be the only station from Alaska. Anderson's specimen was given to Hultén and is most likely at Stockholm now, but it might be represented by a duplicate at the New York Botanical Garden, U.S. National Herbarium or Iowa State University at Ames. *Myriophyllum alterniflorum* is found in North America and Greenland in the boreal-montane zone above latitude 45 deg N.
- *Plagiobothrys cognatus* (Greene) Johnston - collected at Tiekel by Anderson and near Willow Creek by Dutilly and Lepage and O'Neill.
- *Poa alpigena* (E. Fries) Lindm. - collected at Gulkana. Hultén (1968) maps a station on the upper Copper River, but collection data has not been found for this locality.
- *Puccinellia borealis* Swallen - collected at Chitina.
- *Puccinellia distans* (Jacq.) Parl. - collected at Chitina.
- *Puccinellia nuttalliana* (Schult.) Hitchc. - collected at Willow Creek. There are also collections by Trelease and Funston in Yakutat Bay.

Species which Anderson collected which have a very limited distribution in park are:

- *Astragalus williamsii* Rydb. - collected on the Slana-Tok Highway by Anderson, it is known only from two locales on the Nabesna River in the park.
- *Carex laxa* Wahlenb. - collected on the Richardson Highway mile 172-174 (near Meyers Lake), is know from two localities in the park. It is considered

rare by the Alaska Natural Heritage Program (AKNHP) (see Chapter 4 for a discussion of the park's rare plants).

- *Elymus macrourus* (Turcz.) Drobov - collected at Slana and Gulkana by Anderson, and on the upper White River by Gorman in 1899, it has not been collected elsewhere in the park.
- *Fragaria virginiana* Duchesne - Anderson's collection between Slana and Nabesna is the only collection from park.
- *Glyceria borealis* (Nash) Batchelder - collected by Anderson at Gakona, the only other locality in the park is on the Tana River.
- *Puccinellia interior* Sorens.- collected by Anderson at Chitina and Copper Center, the only other station in the park is at Ptarmigan Lake.

Dutilly, LePage and O'Neill 1947: Artheme-Antoine Dutilly, Ernest LePage and O'Neill made sixteen collections in the vicinity of the park in 1947. Nine of these collections were within the park along the Nabesna Road and on the upper Copper River. Dutilly was director of the Arctic Institute of the Catholic University of America in Washington. LePage was professor at l'Ecole d'Ariclture in Rimouski, Quebec, and cure of the church in Saint-Simon (Pringle 1995). O'Neil may have been with the U.S. Army working on the road construction since a collection of theirs at the University of Alaska Fairbanks Museum from Slana bears this note: "Collected under the auspices of the Quartermaster General of the U.S. Army and the Arctic Institute of the Catholic University of America." They collected extensively in Alaska from 1947 to 1949. Their collection of *Carex holostoma* Drej from the Nabesna Road is notable in that it has a very limited distribution in Alaska (AKNHP Rank S2) and subsequently has been collected in the park only once in the Nutzotin Mountains.

Post-1950 Collections

Eric Hultén 1961: Eric Hultén collected in the vicinity of the park in 1961. The map in Hultén 's 1968 Flora indicates that he collected at Slana and Nabesna (Hultén 1968, Figure 7, p. xvii). Two collections of his from the vicinity of the park are at the University of Alaska Fairbanks Herbarium: *Androsace septentrionanlis* L. from Copper Center and *Saxifraga bronchialis* L. from Slana. The collection from Copper Center indicates that he probably collected in other localities along the road in the vicinity of the park.

There are 60 species with stations in the vicinity of the park in Hultén 's 1968 flora which do not have a corresponding annotation in Hultén 's 1941-1950 flora or any other literature. Thirty-six of these collections are on the road system between Chitina and Nabesna. These stations could represent Hultén 's collections from 1961 (Appendix 2.9). Notable collections from this set are:

- *Minuartia stricta* (Sw.) Hiem - station near Nabesna and known from only two other localities in the park: Bonanza Ridge and Horsfeld Creek.
- *Potentilla arguta* Pursh subsp. *convallaria* (Rydb.) Keck - station near Slana and not known from the park.
- *Rumex occidentalis* Wats. - station near Slana and never collected in the park.

The remaining 24 collection localities in Hultén (1968) without specimen references are primarily from Yakutat (Appendix 2.10). It is not possible to tell if the Yakutat stations are in the park, but if they were, the following would be new to the park's flora: *Lupinus polyphyllus* Lind., *Malus fusca* (Raf.) Schneid., *Montia chamissoi* (Ledeb.) Robins. & Fern, *Montia fontana* L., *Pinus contorta* Dougl. ex Loud. var. *contorta* and *Saussurea americana* DC.

D.F. and B. Murray 1966-1981: David F. and Barbara Murray's collections from 1966 to 1981 made a significant contribution to the park's flora, particularly the alpine flora (Murray 1968, 1971). The Murrays participated in the Icefield Ranges Research Project sponsored by the Arctic Institute of North America (Bushnell and Ragle 1969) collecting extensively in 1966 and 1967 in the Chitistone and Skolai drainages (Figure 2.5). Their collections are deposited at the University of Alaska Fairbanks Museum and at the Canadian Museum of Nature, Ottawa. They collected the following rare plants in the Skolai-Chitistone for the first time in the park: *Aphragmus eschscholtzianus* Andrz., *Douglasia gormanii* Const., *Draba praealta* E.L. Greene, *Draba ruaxes* Payson & H., *Minuartia biflora* (L.) Schinzl. & Thell., *Montia bostockii* (A.E. Porsild) Welsh, *Oxytropis huddelsonii* Pors., *Saxifraga adscendens* L. subsp. *oregonensis* (Raf.) Baciagalupi and *Stellaria umbellata* Turcz. The Murrays also collected 214 specimens on the upper White River at Sheep, Guerin and Russell Glaciers in 1968 and documented these rare plants: *Douglasia gormanii* Const, *Draba ruaxes* Payson & H., *Erysimum pallasii* (Pursh) Fern., *Oxytropis huddelsonii* Pors., *Papaver alboroseum* Hult., *Rumex beringensis* Yurtsev & Petrovsky and *Stellaria alaskana* Hult. (Murray 1971).

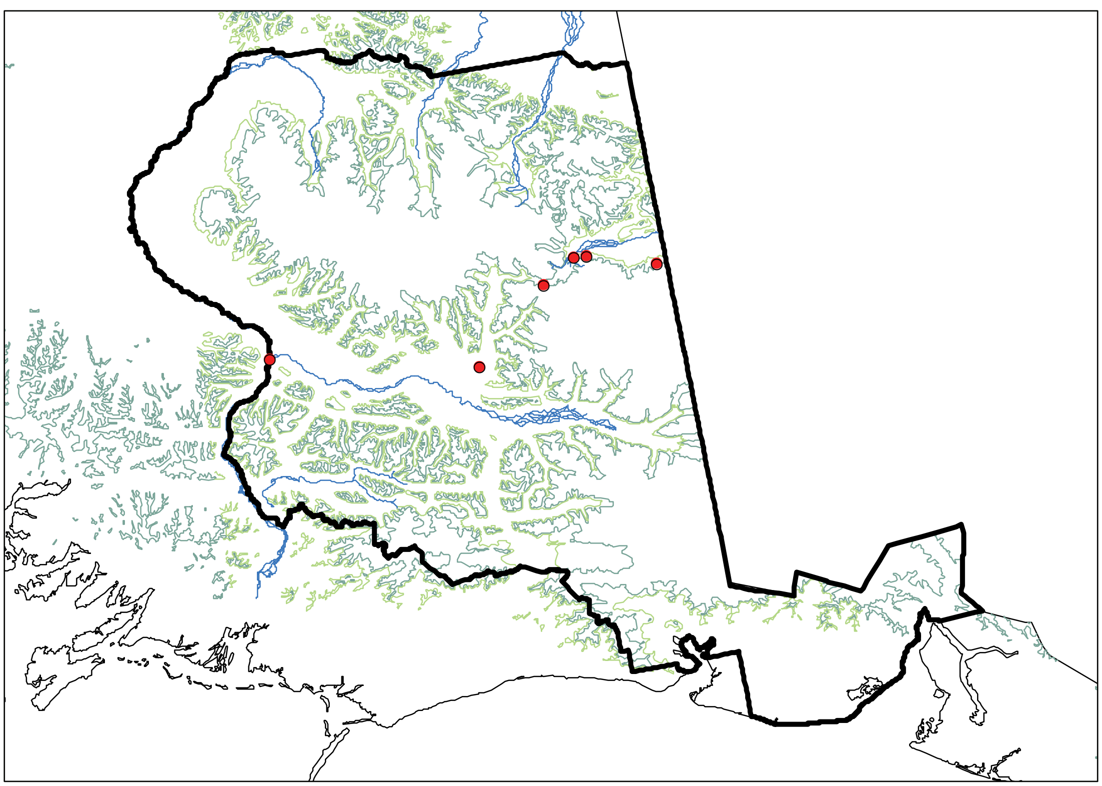

Figure 2.5. Location of vascular plant collections made by David F. and Barbara Murray within Wrangell-St. Elias National Park and Preserve, Alaska. Mercator Projection NAD 1927.

R.W. Scott 1967-1968: Richard W. Scott also participated in the Icefield Ranges Research Project and published a number of papers on his research including a phytogeographical study in Chitistone Pass (Scott 1968, 1974a 1974b and 1974c). Scott collected 214 specimens, documenting three rare plants that the Murrays did from the same vicinity, and in addition, *Erysimum pallasii* (Pursh) Fern and *Stellaria alaskana* Hult.

O. Nordell & Alf Schmitt 1967: Olle Nordell and Alf Schmitt collected 207 species in the vicinity of McCarthy on Bonanza Ridge, along McCarthy Creek and near Nikolai Mine in 1967. They collected the following five rare plants on Bonanza Ridge: *Aphragmus eschscholtzianus* Andrz., *Carex preslii* Steud., *Cystopteris montana* (Lam.) Bernh., *Juniperus horizontalis* Moench, *Minuartia biflora* (L.) Schinzl. & Thell. *and Papaver alboroseum* Hult. (Nordell and Schmitt 1977). Lunds University, Norway, where Nordell and Schmitt's specimens are housed, was contacted to determine if the *Carex preslii* specimens had been re-examined, but the specimens could not be located and may have been redetermined. Nordell and Schmitt commented that *Carex preslii* was common along the road to Bonanza Mine, yet it has not been collected elsewhere in the park, is known from only three localities in the state and is considered rare by the Alaska Natural Heritage Program.

Ransom Saltmarch 1978: Ransom Saltmarch was researching the Mt. Wrangell vicinity for a work of fiction he was writing entitled Wild Animus. He hiked up the Dadina River in 1978 and explored the area between the Chetaslina and Long Glaciers documenting the vascular plants, arthropods, mammals and birds that he observed and making plant collections which were verified by David F. Murray at the University of Alaska Fairbanks Museum (Saltmarch 1978).

Park Collections

The first collections by park staff were made in 1984 by Kathleen Teare and Cynthia R. (Randy) Meyers, who established the park herbarium, FIREPRO staff John Bolivar and Ken Hobson, and Carol Acuna, Yakutat seasonal ranger (Appendix 2.11, Figures 2.6). Four-hundred fourteen collections were accessioned into the park herbarium that year from park-wide localities. Of the 1145 collections made prior to our inventory, 594 (52%) were made by FIREPRO staff at 187 unique localities from 1984 to 1992 during a vegetation mapping project (Figure 2.7). The remaining collections were made during a bison range condition study (Miquelle 1985), mining compliance surveys (Cook 1988a, 1988b, 1989a, 1989b, 1989c, 1990a, 1990b, 1990c, 1990d, 1990e, 1991a & 1991b) a caribou range study (Jenkins, et. al. 1993) and a successional study on Guyot Glacier in Icy Bay (Beck 1989). None of these pre-inventory collections were from comprehensive surveys of the sites. The collections made by Mike Duffy in 1991 and 1992 contributed significantly to our knowledge of the distribution of the park's rare flora and his work helped to identify the need and scope of a comprehensive plant inventory (Duffy 1991, Duffy 1992). One-hundred eight specimens were curated into the park herbarium from 1998 to 2002 after the 1994-1997 inventory. Forty of these specimens were collected by Jennifer Allen and her crew in 1997 during a study of spruce bark beetle infestation (Wesser and Allen 1999).

It should be noted, that prior to the 1994-1997 inventory, the details summarized here on the historical collections in the park were not known and the park's collections were not georeferenced. It may appear that the park has been surveyed somewhat completely when all collections are mapped (Figure 2.8). However, most of these stations represent only a few collections and are not comprehensive surveys of those localities. Only four collections are from relatively complete inventories of a locality, those of David F. and Barbara Murray and Richard Scott from the Chitistone and Skolai, David F. and Barbara Murray from the Upper White River and Hamilton Laing at the head of the Chitina River.

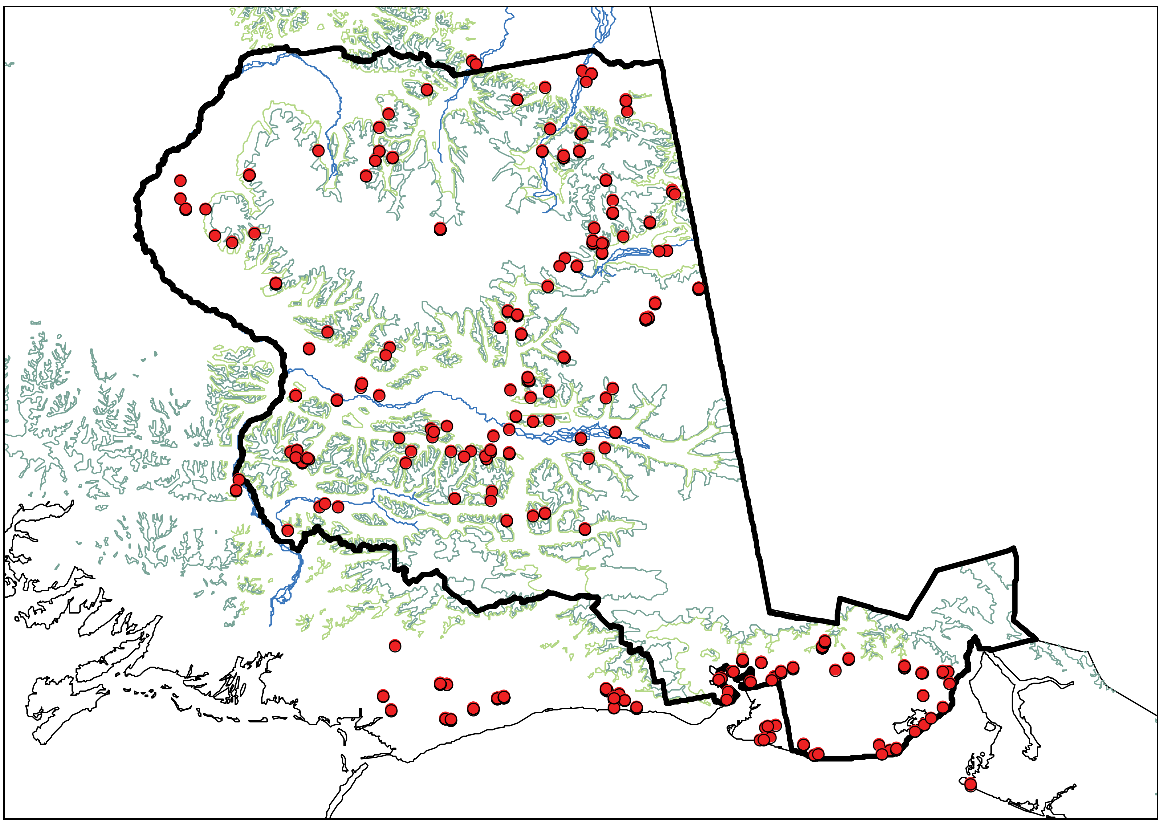

Figure 2.6. Location of FIREPRO vascular plant collection made in the vicinity of Wrangell-St. Elias National Park and Preserve, Alaska, from 1984 to 1992 (Mercator Projection NAD 1927).

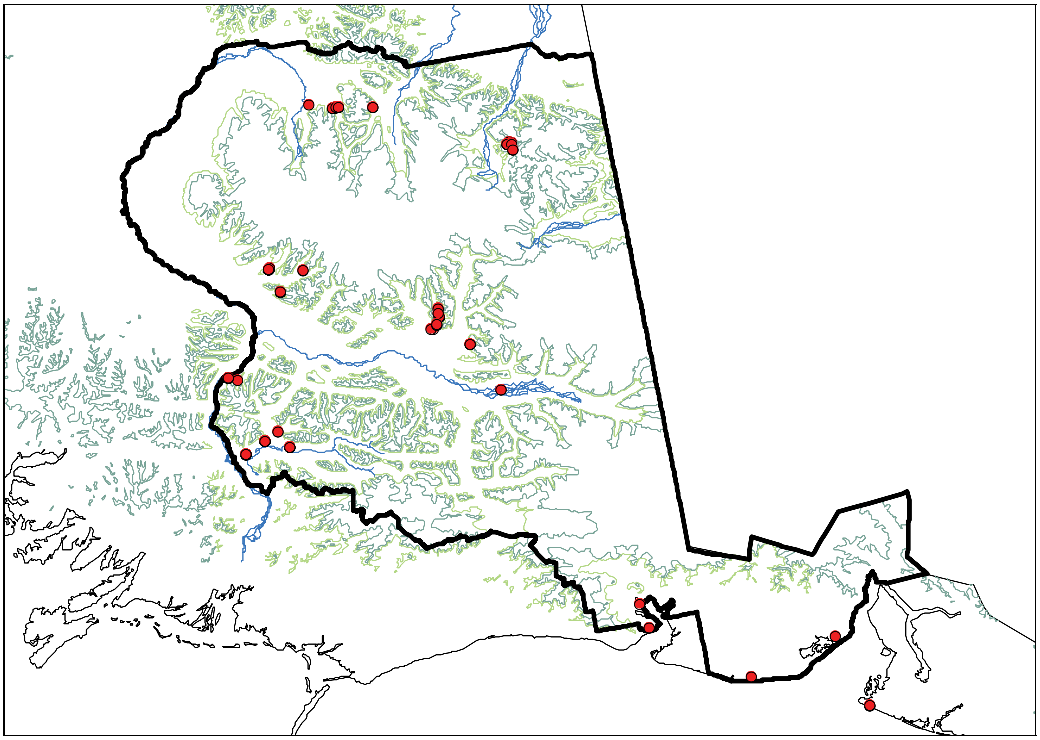

Figure 2.7. Location of vascular plant collections made by park staff within Wrangell-St Elias National Park and Preserve, Alaska, from 1984 to 1993 during projects other than the FIREPRO vegetation mapping project (Mercator Projection NAD

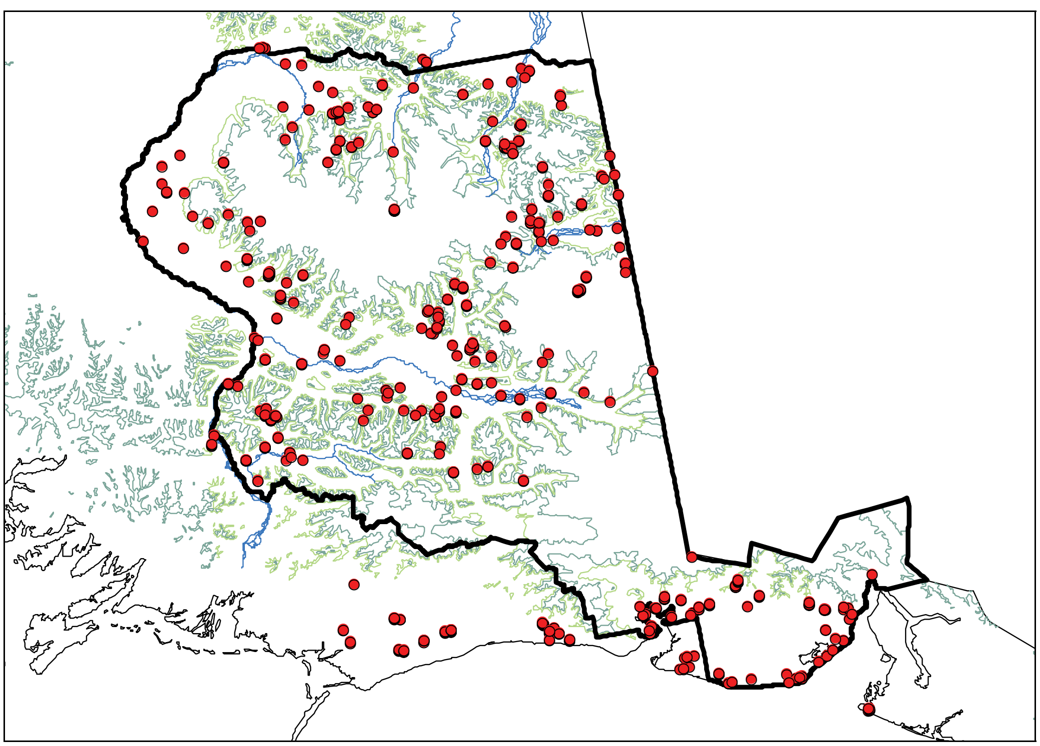

Figure 2.8. Location of all vascular plant collections made within Wrangell-St. Elias National Park and Preserve prior to 1994.

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Chapter 3: Methodology

We conducted a reconnaissance inventory of selected sites north of the Bagley Icefield from 1994-1997 and in 2003 focused on the geographic and taxonomic data gaps throughout the park with the coastal areas having the greatest priority. This chapter describes the pre-inventory activities contributing to the selection of sites, the field methodology, and the post inventory activities of data management, specimen curation and the synthesis and presentation of the data.

Vascular Plant Species List

Prior to the 1994 inventory, the park's vascular plant list was maintained as a text file and included: (1) park collections entered into the curation database (ANCS+); (2) taxa listed in field notes, reports and surveys, and (3) species cited in published literature. This list indicated if the record was supported by a voucher. Park herbarium specimens were reviewed and annotated by botanists at the University of Alaska Fairbanks Herbarium (ALA) in 1993 and the park's vascular plant list updated.

During the 1994-1997 inventory, 10,684 records were entered into our collections database and georeferenced when possible. These records included: (1) park collections; (2) vouchers in the published literature; (3) specimens housed at ALA; (4) stations for taxa occurring within the boundaries of the park in the 1968 flora of Hultén; (3) historic collections of notable plants cited in Hultén 1940-1950, and (4) historic collections of William L. Poto referenced in his field notes (Poto 1902). The vouchered plant list was provided to John Kartesz for inclusion in the Synthesis of the North American Flora computer software program (Kartesz and Meecham 1999). The complete species list (vouchers and literature citations) was submitted to NPSpecies through the Alaska Natural Heritage Program in 2001.

Expected Species List

A list of 128 species expected to occur in the park was developed after the 1994 field season to determine if we were overlooking the communities most likely to contribute new species to the park's flora. The list included species occurring adjacent to the park as published in Hultén (1968) and species that had ecological ranges within Alaska that indicated they should occur within the park.

The expected list was revised annually during the 1994-1997 inventory and updated with additional sources of literature. It was provided to the Alaska Natural Heritage Program (AKNHP) in 1999 when they prepared an expected species list for each of the Alaska parks as part of the regional pre-inventory planning effort. This list incorporated data from ALA and included collections made within 50 km of the park's border. I updated the list in 2003 with changes due to nomenclature, additions to the flora of the park, additional literature and new information from collections adjacent to the park including those from Kluane National park in the Yukon Territory. The new list consisted of 353 taxa (Appendix 3.1).

The 1994 and 2003 expected lists were evaluated by life zone, site moisture and life form. The two lists revealed similar trends for all three variables. Most expected species were in the lowland, upland or sub-alpine zone, in the mesic or xeric moisture class and were graminoids or forbs (Figure 3.1). After the 1994 inventory, we made an effort to survey more lowland plant communities. The expected species list was also evaluated by region (coastal versus non-coastal). The coastal and non-coastal species had similar distributions with respect to life zone and moisture class (Figure 3.2). The notable difference was the distribution of xeric species which ranked second for the non-coastal species and third (after hygric species) for the coastal species.

Selection of Survey Sites: 1994-1997

Site selection emphasized four types of areas north of the Bagley Icefield: (1) those areas known to have rare, endemic or disjunct species; (2) unique landforms (sand dunes, mud volcanoes and glacial nunataks); (3) areas with unique lithology (limestone, greenstone, volcanic ash, basalt, serpentine and areas of hydrothermal alteration); (3) areas where no floristic work had been done but which had a potential for the occurrence of rare species, species new to the park and unique floristic associations, and (4) azonal communities (south-facing bluffs, wetlands, aquatic communities, scree slopes). Additionally, selected survey sites were not likely to be visited in conjunction with other park management needs.

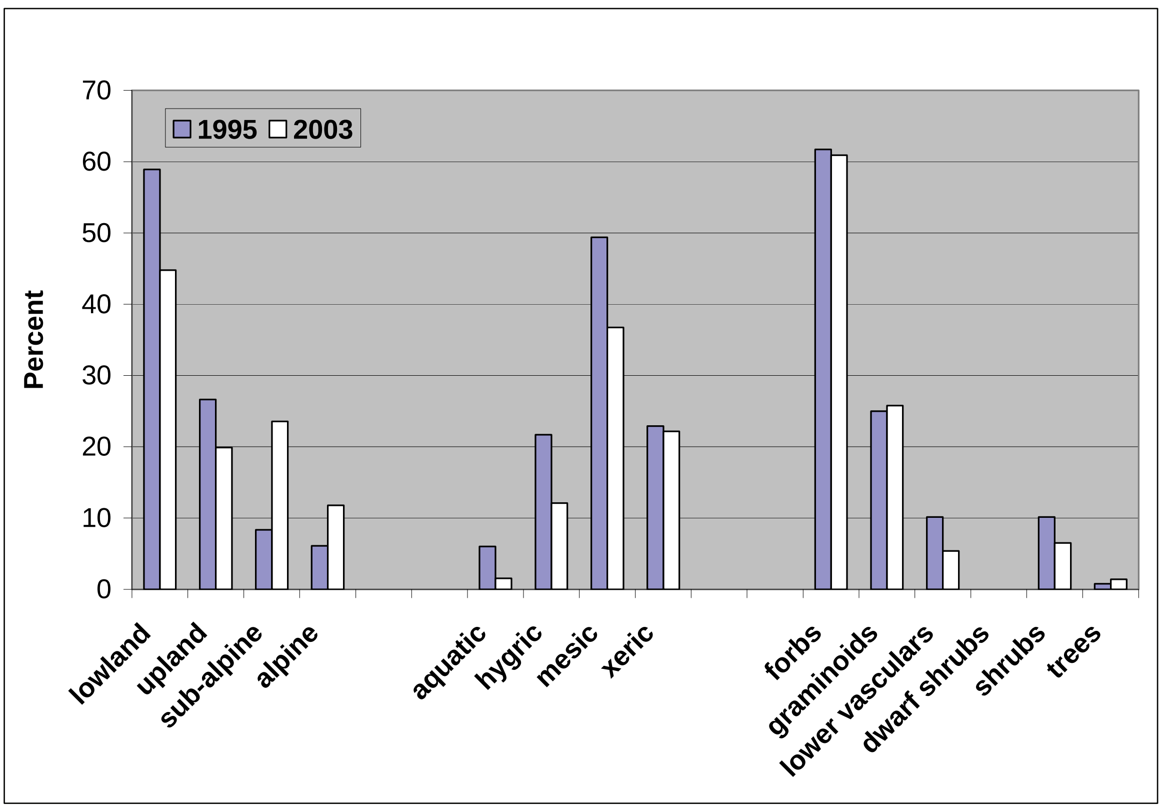


Figure 3.1. Ratio of vascular plant species expected to occur in the Wrangell-St. Elias National Park and Preserve, Alaska by life zone, moisture class and life form in 1995 (n=128) and 2003 (n=323).

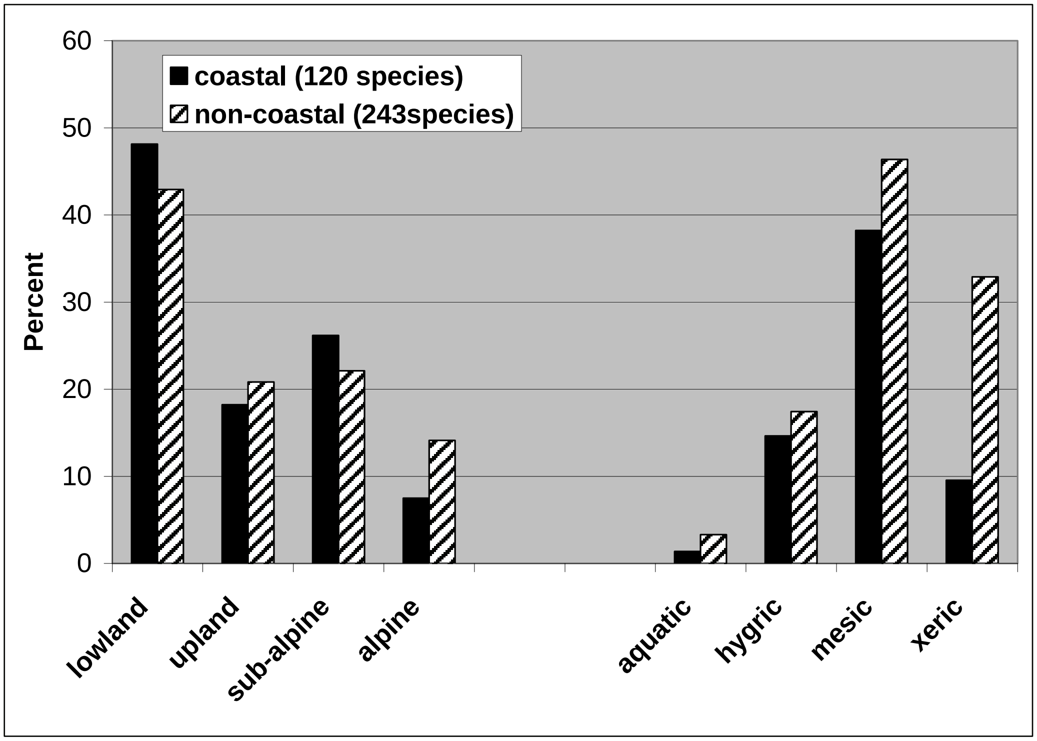
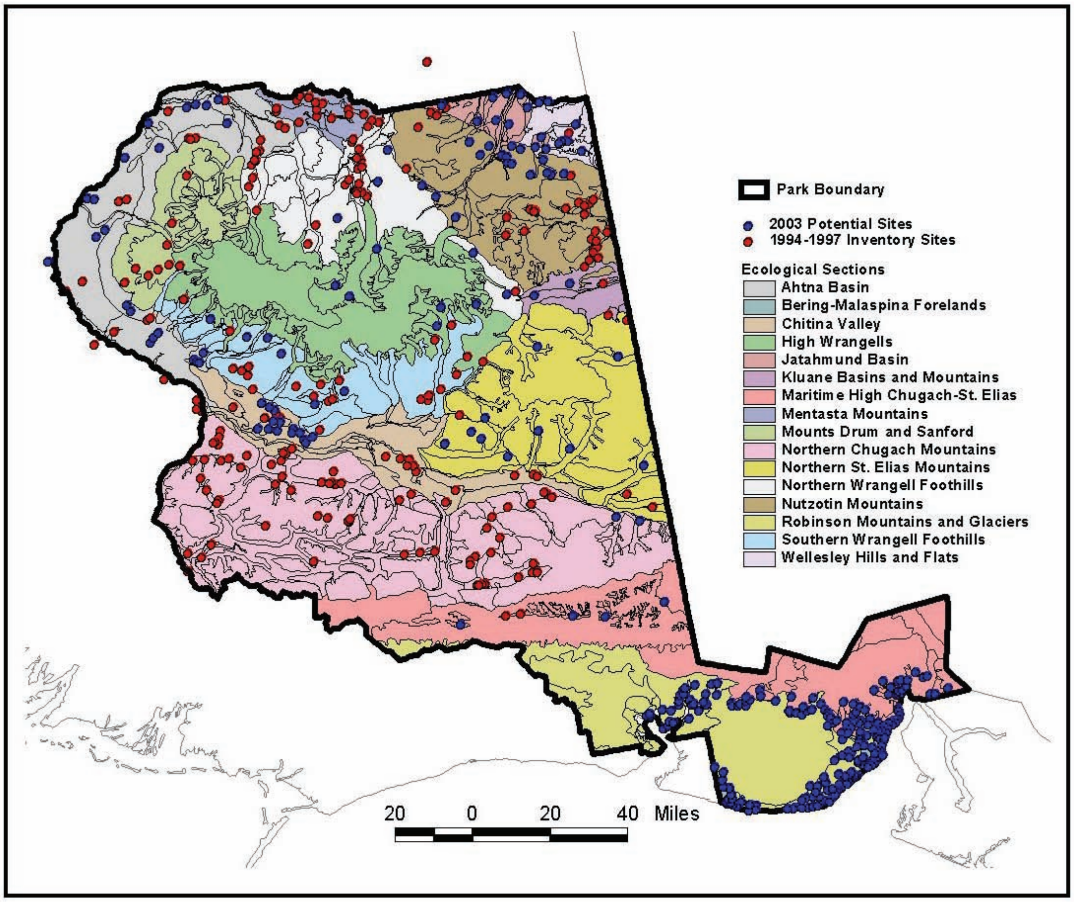


Figure 3.2. Ratio of expected species by predicted distribution class (coastal or non-coastal) using the 2003 expected species list for Wrangell-St. Elias National Park and Preserve, Alaska.

Sites were delineated, prioritized and grouped by region to facilitate logistics. A site database was developed in dBase III+ to record USGS quadrat, infra-red aerial photograph, access type, region, reason for selection and surficial geology map name. Maps and photos were compiled prior to the first field season. Reconnaissance flights were conducted in June of 1994 to evaluate the most feasible method of access and to prioritize sites based on the diversity of plant communities in the vicinity of the site. Surveys during 1994 and 1995 relied on helicopter access provided by other projects such as the Mentasta Caribou monitoring study and FIREPRO vegetation mapping. Therefore site selection was limited to regions where these projects were being conducted or to road, boat or foot access. During 1996, the inventory contracted a helicopter for 30 days so sites not likely to be accessed by another means were surveyed at this time, such as Juniper Island in the Bagley Icefield and the Granite Range.

Selection of Survey Sites: 2003

Site selection methods for 2003 inventory were essentially the same as those used in the 1994-1997 inventory, however, data from the previous inventory was available to refine our selection. Survey areas were determined by assessing: (1) the distribution of 1994-1997 inventory sites, collections, new taxa and rare plant localities across the park (Appendix 3.2); (2) the geographic gaps of surveyed regions using the ecological subsection map of the park (Figure 3.3), and (3) the distribution of the expected species by life zone, moisture class and life form. Eleven targeted survey areas initially selected from this assessment (Appendix 3.4) were subsequently prioritized into six areas as described below.



Section	*Acres*	*#/Inventory Sites*	*Acres/Site*
Mentasta Mountains	170,274.997	17	10,016.176
Chitina Valley	603,548.169	18	33,530.454
Northern Wrangell Foothills	755,252.982	21	35,964.428
Northern Chugach Mountains	2,393,086.062	65	36,816.709
Southern Wrangell Foothills	729,661.501	19	38,403.237
Nutzotin Mountains	998,123.582	25	39,924.943
Mounts Drum and Sanford	509,360.528	11	46,305.503
Ahtna Basin	997,358.990	9	110,817.666
Wellesley Hills and Flats	151,375.241	1	151,375.241
Jatahmund Basin	154,030.043	1	154,030.043
Kluane Basins and Mountains	159,284.344	1	159,284.344
Northern St. Elias Mountains	1,384,721.713	5	276,944.343
High Wrangells	1,440,615.25	5	288,123.050
Maritime High Chugach-St. Elias	1,503,676.057	2	751,838.029
Bering-Malaspina Forelands	76,229.761	0	n/a
Robinson Mountains and Glaciers	1,150,633.927	0	n/a
Total:	13,177,233.147		

Figure 3.3. Distribution of 1994 to1997 vascular plant inventory sites, potential 2003 survey sites and ecological sections indicating geographic gaps and acres represented by an inventoried site in each section, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

The major geographic gaps were the coastal regions, eastern Chugach Mountains, Northern St. Elias Mountains, High Wrangells, eastern portion of the Northern Wrangell Foothills, central Nutzotin Mountains, Jatahmund Basin and Wellesley Hills and Flats. The fewest sites by acreage were the coastal regions, High Wrangells, Northern St. Elias, Kluane Basin, Jatahmund Basin, Wellesley Hills and Ahtna Basin, all with over 100,000 acres represented by one survey site. Much of the area in the High Wrangells, Northern St. Elias and coastal regions are high mountains with extensive icefields, so I reviewed all of the infra-red aerial photographs to determine if there were ice-free areas that had been overlooked. This resulted in the selection of survey areas in the High Wrangells and Northern St. Elias ecological sections, additions to our initial list of priorities.

The resulting study area priorities for the 2003 inventory were: (1) Gulf of Alaska; (2) Southern St. Elias Mountains and Bagley Icefield; (3) Tanana Lowlands; (4) White River Basin, (5) wetlands in the Copper and Chitina River basins, and (6) geographic gaps in the Northern Wrangell-St. Elias and Nutzotin Mountains

Infra-red aerial photographs were reviewed of each study area to select potential survey sites. These were delineated on the photo and a georeference acquired using Arcview GIS software. Maps for each region were prepared in Arcview with a list of georeferences for field use. This list has been included in the Appendix as a tool for future inventories since not all sites were surveyed during 2003 (Figure 3.3, Appendix 3.5).

Field Inventory Methods

A complete floristic reconnaissance of each site was conducted. An effort was made to survey as many distinct plant communities as possible at each site. All of the plant species that were encountered during the survey were recorded. Initially, data sheets were used whereby each species was given a cover and abundance rating by community. However, after the first year of the survey (1994), we realized that this level of detail reduced the amount of time that could be used for searching. Thereafter, we focused on compiling a complete species list and a comprehensive voucher collection for the site. Survey time varied substantially from four days at a site to a few hours.

Each site was mapped on an aerial photo, USGS topographic map and a georeference recorded using a Global Positioning Unit. The datum used from 1994 to 1997 was WG84, NAD27 was used in 2003. The significance of the site, lithology, landforms and plant communities surveyed were described. Photographs were taken of unique species, significant plant communities and of the area surveyed (usually aerially).

An effort was made to collect every unique species at each site. However, due to time limitations we prioritized the collection of vouchers accordingly: those species new to the park, species of special concern (rare, endemic or invasive) and specimens not identifiable in the field. As time permitted, more common species were acquired. Collections were made only if the population was large enough to support removal of individuals and followed the Wrangell-St. Elias National Park and Preserve standard operating procedures for herbarium collections (Teare 1984) and the collecting protocol

of Parker and Murray (1992). Duplicate collections were made when possible, one for NPS and one for the University of Alaska Fairbanks Museum Herbarium (ALA).

Minimum collection data included: date, collection number, latitude and longitude, slope, aspect, elevation, substrate, plant community and associated species. Additional data often recorded, particularly for species of concern included: topographic position, associated landforms, soil moisture, soil type, drainage, parent material, cover class and frequency class, notes on characters not preserved well, phenology and ecological observations.

Specimens were pressed at the end of each field day. When specimens were removed from presses, tentative determinations or those that needed review were sorted separately from those whose identifications were known, and filed alphabetically by genus in specimen folders.

Field Personnel

Carl Roland and Mary Beth Cook conducted the inventory during the 1994, 1995 and 1996 field seasons. Carl Roland surveyed six sites on foot in the Mentasta Mountains in 1997 assisted by Jacqueline D'Auria. The following individuals were contracted in 1996 to conduct a 10 day survey each: Alan Batten assisted by Marilyn Barker, Carolyn Parker assisted by Mike Gratz, Dr. Leslie Viereck assisted by Dr. Teri Viereck, and Mike Duffy assisted by Jennifer Allen (Barnes). Katy Beck, Anne Leggett, Virginia Moran, Michele Potkin and Mike Loso also conducted surveys during the 1996 field season as volunteers.

The 2003 inventory was conducted primarily by Patricia Loomis. She was assisted by Bruce Bennett for the White River, Tanana lowland and Nutzotin Mountain surveys; by Alan Battan and Amy Larsen for the coastal surveys, and by Stacia Backensto and Katherine Beattie for the wetland surveys. Carl Roland and Alan Battan conducted a survey of the Chisana River from Chisana to the park border in 2003. Mary Beth Cook conducted surveys of 12 sites in 2003 and was assisted by Jim Baker, Janelle Eklund, Mason Reid and Jim Wilder.

Specimen Review

Specimens were initially identified by the collector and then further reviewed by the staff at the University of Alaska Fairbanks Herbarium including Carolyn Parker, Alan Batten and David Murray. The following specialists reviewed problematic taxa: George W. Argus (Canadian Museum of Nature, Ottawa) – *Salix*; Reidar Elven (Botanical Museum, Oslo, Norway) – *Draba lactea* and *Cerastium regelii*; Mark Egger (University of Washington, Seattle) – *Castilleja*; Barbara Ertter (University of California, Berkeley) – *Potentilla diversifolia* and *P. drummondii*; Donald Farrar (Iowa State University) – *Botrychium*; Signe Frederickson (University of Copenhagen, Denmark) – *Festuca*; G.A. Mulligan (Agriculture and Agri-Food Canada, Ottawa) – *Arabis* and *Draba*; David F. Murray – *Papaver* and *Carex* section Atratae; Robert Soreng (Smithsonian, U.S. National Herbarium) – *Poa*, and Marcia Waterway (McGill University, Macdonald Campus, Québec. Montréal) – *Carex laxa*.

Data Management

Development of Park Plant Databases

We developed floristic databases to allow us to conduct floristic analysis, track rarity and changes in nomenclature, prepare specimen labels, and numerous other functions. They were designed to export data in the required format to the park curation database (ANSC+), the National Park Service species database (NPSpecies) and to the Alaska Natural Heritage Program rare plant sighting form. The three primary relational databases are:

1. Taxon database – Each record represents a taxon that occurs or is expected to occur in the park. Fields contain information about the taxonomy, nomenclature, rarity, biogeography, habitat and life form of each taxon. It currently has 1889 records. The collection database is linked to this database by a taxonomic code.
2. Site database – This database is specific to a project. Each record is a unique plant collection locality. Fields describe a site where multiple plant collections were made. A collection database record is linked to the site database by a site number.
3. Collection database –Each record represents a single plant collection with fields describing the specific location and habitat of the collection. It includes information about the specimen, the collectors, the determination history and curation. Additional fields are used to print labels and to prepare data exports for ANSC+, NPSpecies and AKNHP. It currently contains 10,683 records. This includes records for all specimens known to have been collected in the park. The structure for the collection database is in Appendix 3.5

Data Entry and Verification

After a field inventory, site data was first entered into the site database. Then the collection data was entered from the collection log and updated when verifications and determinations were received. The specimen label provides one verification tool, it must match the specimen sheet in identification and collection number.

NPSpecies/ANCS+

We exported all required data to Excel files for import into NPSpecies (the National Park Service species database) and ANCS+ (the National Park Service curation database, now called ‘Rediscovery’) in September 2005.

Alaska Natural Heritage Program Rare Plant Sighting Forms

Using project data, we prepared Alaska Natural Heritage Program (AKNHP) rare plant sighting forms for relevant taxa and provided these data to AKNHP. Maps of the 117 rare plant occurrences from 2003 were prepared using ArcMap with a program written by Greg Daniels, Alaska Regional Office GIS specialist. One copy of each form and associated map was sent to AKNHP, and one is stored in the botanist’s office at the park. An example of a sighting form and map is in Appendix 3.6. AKNHP element occurrence ranks are updated annually in our database.

Data to University of Alaska Fairbanks Herbarium

Data for specimens residing at the University of Alaska Fairbanks Herbarium (ALA) was exported and given to the data manager at ALA. Specimens on loan to ALA will be accessioned by ALA.

Photo-documentation

All 35 mm photographic slides taken during the inventory were labeled and filed in folders. There are 2879 site photos for the 1994-1997 inventory which are filed with the archived project (described below). There are 1800 species photos from this inventory. These are filed alphabetically by species in the botanist's office. There 507 photos for the 2003 inventory which will be archived with the project. Select photos of species and sites have been scanned and are available in digital format for reports and presentations.

Curation of Project and Specimens

The 1994-1997 project was archived in May 2004 by Susan Sura. It is accession number WRST-00203, catalog number WRST-14429. The 2003 inventory project files are in the process of being archived. Specimens from the 1994-1997 inventory were cataloged into the NPS curation database (ANCS+) by exporting the data to an excel file and importing the data using a utility in the Rediscovery software. Accession numbers WRST-60, WRST-77, WRST-104 and WRST-115 were used for this inventory. The 2003 specimens are in the process of being curated and are accession number WRST-194. Most of the 2003 specimens will reside at ALA as a loan.

Distribution Maps of Notable Taxa

Distribution maps of 212 notable taxa were prepared for the 1994-1997 inventory and 115 maps were prepared for the 2003 inventory. The 1994-1997 inventory maps were published in the Canadian Field Naturalist (Cook and Roland 2002) and include species new to the state, major range extensions (greater than 200 km from previously published localities), and AKNHP elements with a state rank of three or less. The 2003 inventory maps are presented in Chapter Seven of this document. This set includes species new to the state, major range extensions and AKNHP element occurrences with a state rank of two or less.

To prepare the distribution maps the following locality data was assembled into a Geographic Information System: all records in the park collection database, specimen records from the University of Alaska Fairbanks Museum Plant Documentation Center, and published stations from regional floras and monographs (Aiken and Darbyshire 1990; Argus 1973; Argus 2000; Bayer 1993; Cody 1996; Cody et. al. 1998; Hultén 1941-1950; Hultén 1968; Porsild and Cody 1980). A program was written by Susan Huse of the Alaska Regional Office to automate map production using Arcview. The distribution maps are at two scales, one focused on the park and one encompassing all of Alaska and the Yukon Territory including adjacent parts of Canada.

Delineation of Landscape Units for Regional Summaries

In order to evaluate the status of our knowledge of the flora from the large geographic area encompassed by the park in a meaningful way, it was necessary to summarize the results by smaller regions than the scale of the entire park. Prior to the availability of the ecological subsection map by Swanson (2001), we used mountain and basin regions delineated using the 3000 ft (914 m) contour line as the break between river basins and mountain ranges. To facilitate discussion and data exchange across park units, the ecological subsection map of Swanson (2001) was used for this report since it is the standard for the National Park Service Inventory and Monitoring Program at this time. The ecological regions are too large to be useful for assessing patterns across the park, whereas there are too many subsections (65) and ecological units (182) to be manageable for analysis. Therefore, we choose the ecological section as the unit for this analysis. Five modifications were made to the boundaries of the ecological sections to be more useful for the floristic analysis. These changes were based on my knowledge of the flora and park landscape and resulted in 11 mountain regions and eight basin regions (Figure 3.4). These modifications are:

1. Basin and mountain regions were separated within the ecological sections along the 3000 ft (914 m) contour level;
2. The Ahtna Basin was divided into two regions at the Sanford River due to observed differences in the lowland flora of the upper Copper River and middle Copper River;
3. Polygons in the Robinson Mountains and Glaciers section that were predominately glaciers or ice cap and mostly over 3000 ft (914 m) elevation where joined with the Maritime High Chugach-St. Elias section;
4. Polygons in the Maritime High Chugach-St. Elias section and the Robinson Mountains and Glaciers section that were predominately hills, mountains or mountain footslopes and were mostly less than 3000 ft (914 m) elevation were joined with the Malaspina Glacier subsection of the Robinson Mountain section creating the Coastal Mountains-Malaspina Glacier region.
5. The Bagley and Seward Icefield polygons of the Maritime High Chugach-St. Elias section were parsed into a separate region due to the distinctiveness of the physiographic unit and the more interior location of these polygons.

Floristic Analysis

The taxonomic composition of the flora was evaluated by querying the taxon database for the following total counts: species, taxa, rare taxa, families, and species per family. The biogeographic composition of the flora was summarized by querying the taxon database for number of taxa in two biogeographic categories. To describe the distribution of the endemic and rare elements of the flora, all collections of rare and endemic taxa were assigned to a region and summarized. The distribution of the rare flora was also evaluated by two categories of rarity (Rabinowitz 1981) and by the following site characteristics: life zone, elevation, moisture class, plant community, slope and aspect. Tests for linear relationships between variables as well as the correlation, cluster and factor analyses used to describe components of the flora, were conducted using SPSS Statistical Computing Software Version 10.0.5.

Nomenclature

Nomenclature in this document follows the Flora of North America (1993-2005), Cody (1996) and Hultén (1968) for scientific names, and Kartesz (1999) for common names.

Additional Inventory Documents

Batten (1997), Duffy (1997), Parker (1997), and Viereck and Viereck (1997) prepared reports as contractors for surveys conducted during the 1996 field season. A manuscript on the notable collection of *Cryptantha shackletteana* L.C. Higgins in the Mentasta Mountains was published in the Canadian Field Naturalist (Roland and Cook 1998). A summary of the biogeography, rare flora and distribution maps of 212 notable taxa were published in the Canadian Field Naturalist (Cook and Roland 2002), and a draft field guide to the rare vascular flora of the park was prepared (Cook 2000).

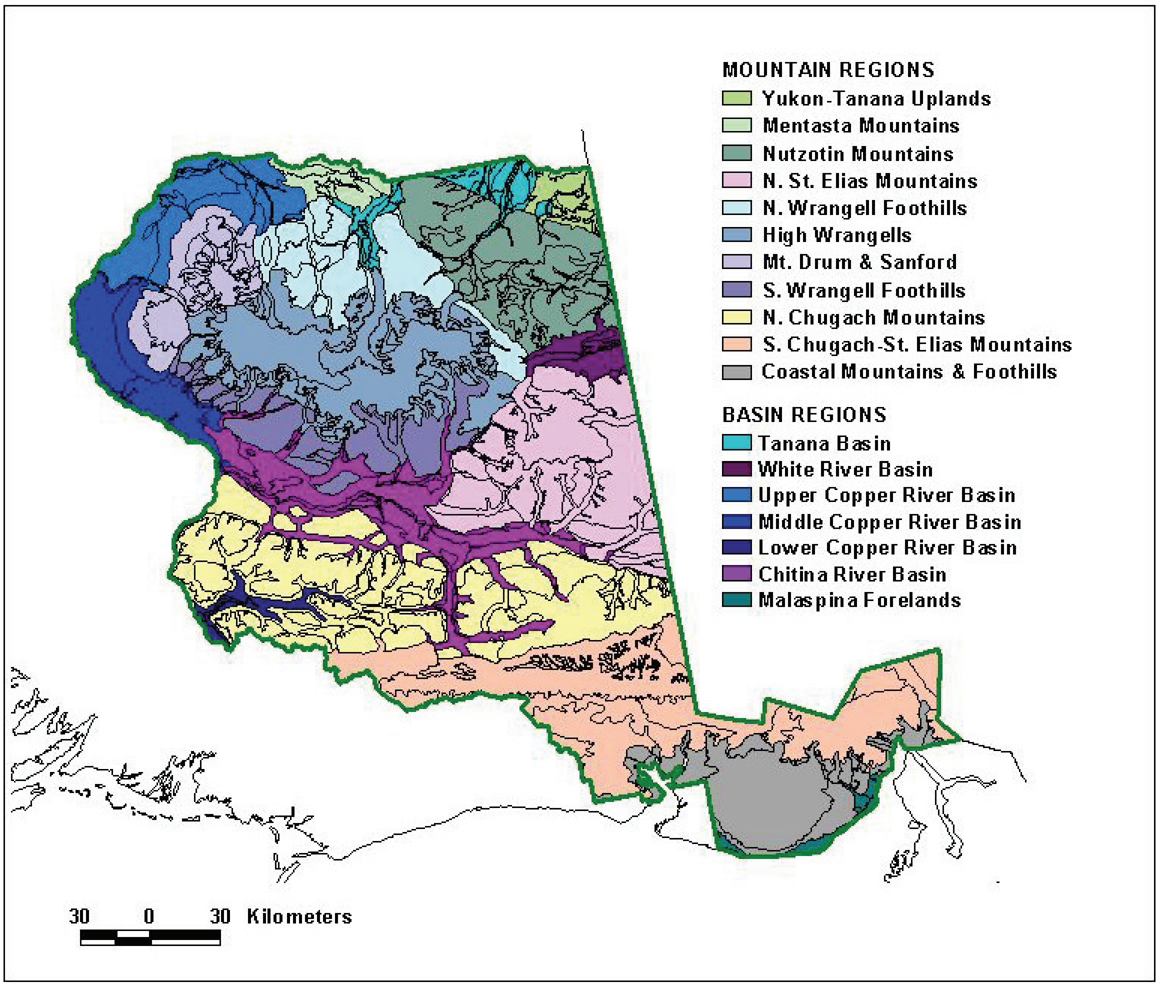


Figure 3.4. Units used for the floristic analysis and regional summaries. Polygons are derived from ecological subsection map of the park (Swanson 2001). Mercator Projection NAD 1927.

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Chapter 4: Results - Highlights

We surveyed 317 sites during this inventory, 84 of these were during the 2003 field season (Figure 4.1). Over 7000 specimens were collected, of these 6860 specimens were vouchered, 2626 from the 2003 survey. Sites surveyed from 1994 to 1997 were in all the drainage basins and mountain regions of the park north of the Bagley Icefield where the greatest geographic gaps occurred (with a focus on habitats known to harbor rare or endemic plant species, wetlands and areas with unique lithology). Most of the survey effort in 2003 was in the coastal regions accessible from Yakutat. Interior wetlands and the White and Chisana Rivers were also surveyed during 2003.

The significant results of the inventory are summarized in this chapter. This includes descriptions of: species new to the flora of Alaska, species new to the flora of the park, additions to the rare flora of the park, the status of U.S. Fish and Wildlife Candidate Species, major range extensions, species with distribution limits in the park, a proposed rare plant watch list, and the occurrence of non-native species documented during the inventory. A summary of results by park region is in Chapter 5 and the taxonomic & biogeographic composition of the flora is presented in Chapter 6. Annotations and distribution maps of notable finds mentioned in this and following chapters are presented in Chapter 7.

Taxa New to the Flora of Alaska (11)

Eleven taxa new to the flora of Alaska were documented during this inventory, nine during the 1994-1997 inventory and two during the 2003 inventory. These taxa are: *Arabis calderi* (Brassicaceae), *A. codyi*, *A. drepanoloba*, *A. lemmonii*, *Botrychium lineare* (Ophioglossaceae), *B. montanum*, *Carex tahoensis* (Cyperaceae), *Draba lonchocarpa* var. *thompsonii* (Brassicaceae), *Festuca minutiflora* (Poaceae), *Najas flexilis* (Najadaceae), and *Trichophorum pumilum*. var. *rollandii* (Cyperaceae).

Complete annotations for these notable collections are in Chapter 7, however a few general comments on the significance of these collections is appropriate here. None of the taxa new to Alaska were on the expected lists developed to focus the inventory efforts. Nine of the eleven taxa new to the state have a North American distribution and eight of these are restricted to the North American Cordillera. The majority of the taxa were found in the regions south of the Wrangell Mountains: five in the Chugach Mountains, and two in the Chitina River Basin. Only two of these taxa were found below 3000 ft (914 m): *Najas flexilis* and *Trichophorum pumilum* var. *rollandii*.

Nine of the taxa new to the State of Alaska are still only known in Alaska from our collections in the park. *Carex tahoensis* and *Najas flexilis* are now known from other localities in Alaska. All eleven taxa new to the flora of Alaska are considered to be extremely rare and critically imperiled in the State of Alaska by the Alaska Natural Heritage Program (state rank of S1). *Arabis codyi* and *Botrychium lineare* are extremely rare and are critically imperiled globally (Nature Conservancy global rank of G1).

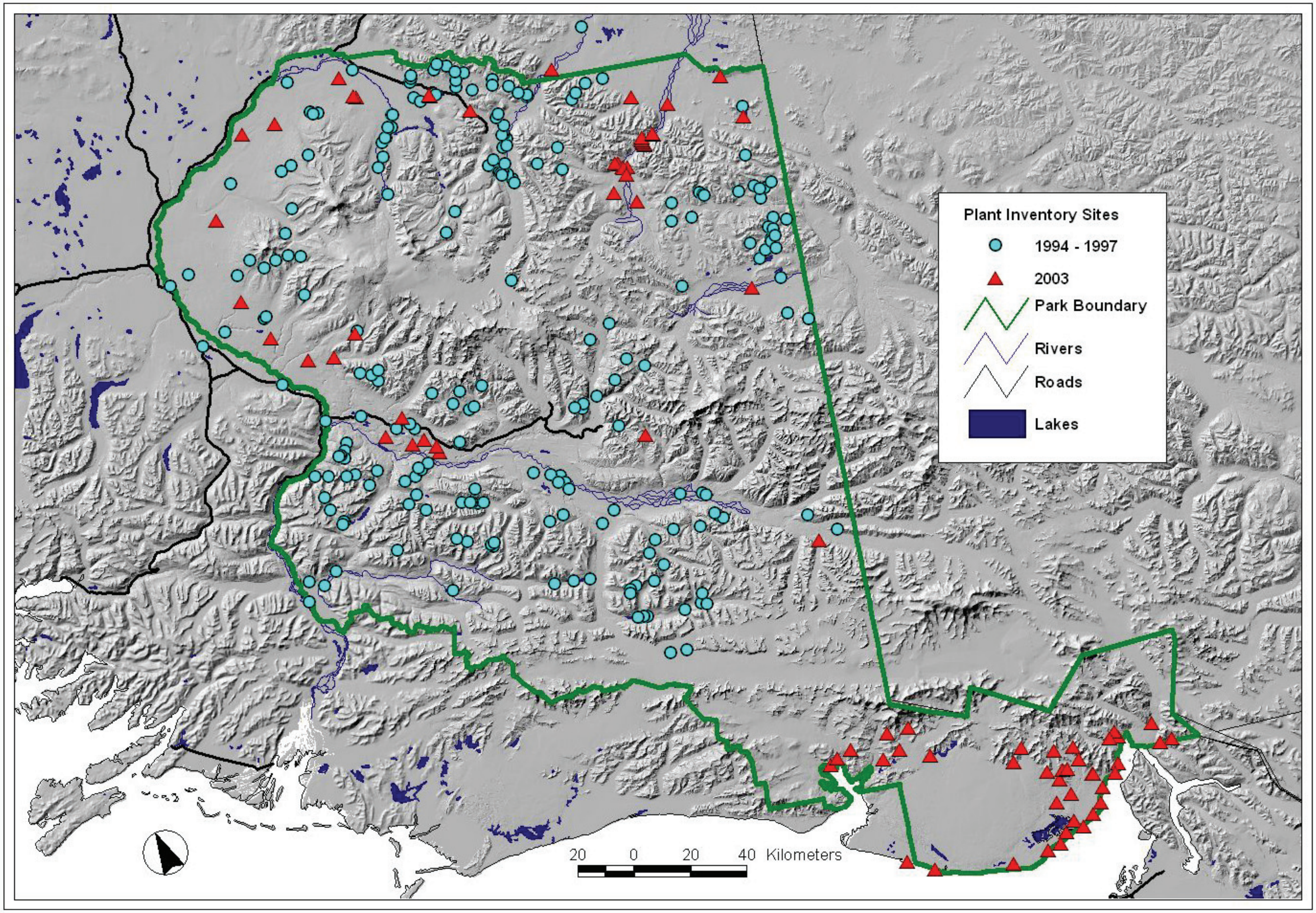


Figure 4.1. Location of 1994-1997 & 2003 plant inventory study sites within Wrangell-St. Elias National Park & Preserve, Alaska.

Botrychium lineare is also a U.S. Fish and Wildlife Service candidate species for protection under the Endangered and Threatened Species Act of May 4, 2002.

Arabis calderi, *Botrychium montanum* and *Carex tahoensis*. are considered threatened throughout their ranges (global rank of G3). The remaining taxa are apparently globally secure. Our collections of three of these taxa represent notable range extensions: *Botrychium montanum* is 870 km from the closest station in British Columbia, *Draba lonchocarpa* var. *thompsoni*i is 1100 km from a station in British Columbia and *Festuca minutiflora* is 445 km from a station in the Yukon Territory.

Taxa New to the Flora of the Park

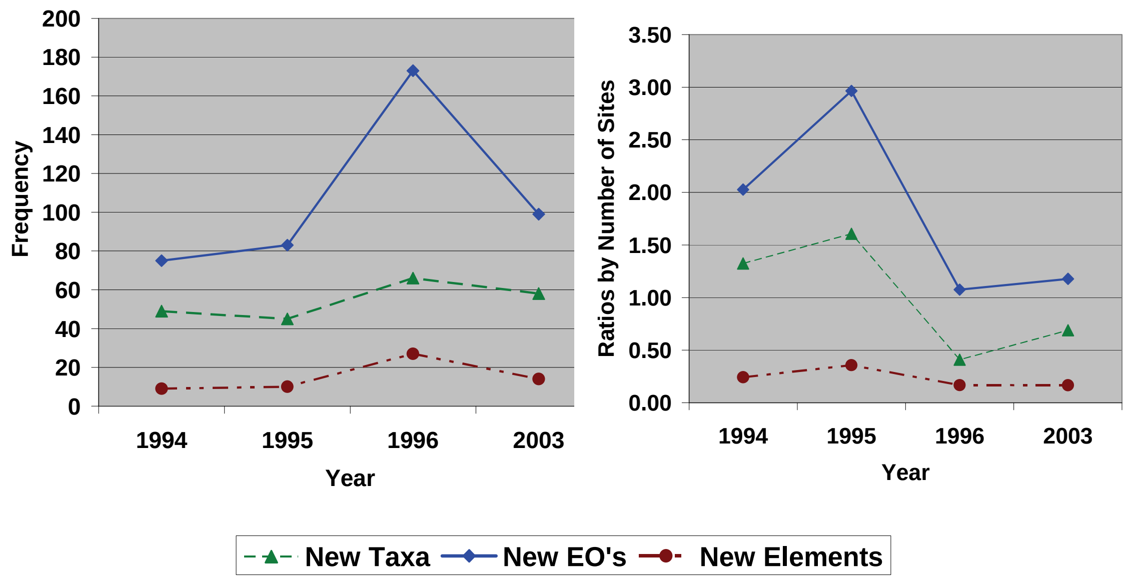
We have adduced 217 taxa to the park's flora during this inventory, 160 taxa from 1994 to 1997 and 57 taxa during the 2003 inventory for a total of 917 taxa documented by vouchers from within the park (Appendix 4.1). This represents a 32% increase in the number of taxa known from the park before the inventory began. Seventy-two (33%) of these taxa were on the expected lists for the park. Five new plant families and 20 new genera are included in these additions.

The average number of new taxa per park region was 24, with a range from zero to 79. The regions with the greatest number of new species were: the Chitina River Basin with 79 taxa, the Nutzotin Mountains with 70 taxa, the Tanana River Basin with 50 taxa and the Northern Chugach Mountains with 45 taxa.

A substantial number of new species to the park's flora have been added with each year of inventory effort (Figure 4.2). During 1994, when 37 sites were surveyed 49 taxa were added to the flora; in 1995, 45 taxa were added with 28 inventory sites and in 1996, 66 taxa were added to the park's flora. The number of new species in 2003 was greater than in all other years except for 1996. If inventory effort is measured as the number of sites surveyed, then the number of new species per inventory effort was greater in 2003 than in 1996. These values indicate that there has not been a consistent reduction in the rate of accumulation of new species to the park's flora and that the park's vascular flora is most likely still inadequately documented.

U.S. Fish and Wildlife Candidate Species

There are no federally listed threatened or endangered vascular plant species known to occur in the park. There is one species which is a candidate for listing. *Botrychium lineare*, Slender Moonwort, found at two localities in the Nutzotin Mountains during the 2003 inventory, was listed as a candidate for endangered status on May 4, 2004 by the U.S. Fish and Wildlife Service (50 CFR Part 17 Volume 69, Number 86). This inconspicuous fern is known from widely separated and extremely small populations in the Yukon Territory, New Brunswick, Quebec, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah and Washington. Final identification of species in the genus *Botrychium* currently relies on electrophoretic analysis. It is likely that as more surveys are conducted throughout its range, and the taxonomy of the genus *Botrychium* is clarified, its distribution may be more widespread than currently understood.



Year	# of Sites	# of New Taxa	# of New Taxa per Site	# of New Elements*	# of New Elements per Site	# of New EO's*	# of New EO's per Site
1994	37	49	1.32	9	0.24	75	2.03
1995	28	45	1.61	10	0.36	83	2.96
1996	161	66	0.41	27	0.17	173	1.07
1997	7	1	0.14	0	0.00	5	0.71
2003	84	57	0.68	14	0.17	99	1.18

Figure 4.2 Number of taxa new to Wrangell-St. Elias National Park and Preserve, Alaska, new Alaska Natural Heritage Program plants with a state rank of three or less (Elements) and occurrences of elements (EO's) found each year of the survey (left chart). Ratios of new taxa, Elements and EO's by the number of sites surveyed each year (right chart). Data for 1997 was not included in the charts due to the low number of sites surveyed that year.

It should also be noted that the authors of the general management plan for park listed the Alaska-Yukon endemic *Montia bostocki* as a U.S. Fish and Wildlife Service Category 2 species in 1985. Category 2 taxa were those taxa which current knowledge suggested proposals for listing as threatened or endangered were appropriate, but full data was not available. Category 3 taxa were those which had been withdrawn from consideration (because they were thought to be extinct, or they were taxonomically invalid, or they were found to be more widespread). Although the U.S. Fish and Wildlife Service discontinued the designation of Category 2 and 3 species in 1996, these lists are useful for tracking our inventory and conservation efforts. *Montia bostockii* and *Carex lenticularis* var. *dolia* were both Category 2 taxa in 1985, but were down listed in 1987 to Category 3 taxa. *Montia bostockii* is now known in many areas on the north side of park where it can be quite abundant in sub-alpine to alpine mesic to wet meadows, but it is still restricted throughout the rest of Alaska and the Yukon. *Carex lenticularis*. var. *dolia* is

now known from ten localities in the park and is more widespread throughout coastal Alaska than known in 1985.

Two additional taxa that occur in the park were listed as Category 2 taxa in 1987: *Taraxacum carneocoloratum* and *Cryptantha shackletteana*. *Taraxacum carneocoloratum* was known from only a few populations in the park prior to our inventory. It is now known from ten populations in the park and is more widespread in Alaska than known in 1987. *Cryptantha shackletteana* was not known in the park until 1996, and based on its worldwide distribution (restricted to two localities in the Yukon River valley) would not have been expected. In spite of surveys in adjacent drainages and in similar habitat in the park, only the one locality has been found. If this species is distinct from the Great Basin *Cryptantha spiculifera* (Payson) Piper, then it should be considered a candidate for the U.S. Fish and Wildlife endangered species list. However, since the known populations are on National Park Service land in inaccessible localities, extirpation would most likely be from natural causes, so federal protection status is unlikely.

There are six taxa occurring in the park which were listed as Category 3 taxa in 1987: *Draba ruaxes, Papaver alboroseum, Phippsia algida, Papaver walpolei, Parrya nudicaulis* and *Thlaspi arcticum.* *Phippsia algida* has been found in 21 localities in the park in alpine seeps and is not uncommon throughout the state. *Parrya nudicaulis* is common throughout the state and is widespread throughout the park in alpine tundra. Neither species is ranked as a S3 or lower by the Alaska Natural Heritage Program. The remaining four species have an Alaska Natural Heritage Program rank of S3 (less than 100 occurrences). Of these, *Papaver walpolei* and *Thlaspi arcticum* are truly rare in the park. *Papaver walpolei* is known from only one population even though adjacent alpine areas have been surveyed in the Mentasta Mountains. Likewise, *Thlaspi arcticum* is known only from two very close populations in the southwest Wrangells in spite of surveys on adjacent ridges.

Alaska Natural Heritage Program Tracked Taxa

The State of Alaska does not recognize a list of rare or sensitive plant species. Therefore, the National Park Service has had the policy of using the Alaska Natural Heritage Program (AKNHP) rare plant tracking list as guidance for its conservation and inventory efforts. Species with a state rank of S1, S2 or S3 are known from fewer than 100 occurrences in the State of Alaska, and are considered rare and worthy of monitoring.

Prior to 1994, 36 AKNHP rare plant taxa were documented as occurring in the park. There are now 91 AKNHP rare plant taxa and 524 occurrences known to occur in the park (Appendix 4.2). Eighty-six percent (448) of these occurrences were documented during this inventory. Half (46) of the rare plant taxa have a rank of S1 or S2 indicating that they are known from less than five occurrences (S1) or less than 20 occurrences (S2) in the state and are either critically imperiled (S1) or imperiled (S2). During each year of the inventory, except for 1997 (when only seven sites in the Mentasta Mountains were surveyed), from 9 to 27 new rare taxa were found in the park and from 75 to 173 new rare plant occurrences were documented (Figure 4.2). Fourteen new rare taxa were found in 2003, more than in 1994 and in 1995. Also, 99 new rare plant populations were found in

2003, surpassing the number of new rare plant populations found in 1994 and 1995. Although the number of new elements and occurrences per site was reduced by about half in 1996 from the 1994 and 1995 survey efforts, the values were the same or slightly higher for the 2003 inventory when compared with the 1996 survey. Therefore, the rate of accumulation of new rare plant species and populations of rare plants has not decreased significantly, another indication that the park's vascular flora may not be adequately documented.

There are fourteen taxa which had been included in previous park lists of AKNHP rare plants that are excluded from the current list. The exclusion of eight of these taxa is due to down listing, but the following six are excluded for other reasons.

1. *Botrychium hesperium* (Maxon & R.T. Clausen) W.H. Wagner & Lellinger – A specimen collected on the Cheshnina Plateau in 1996 (M. Cook 96716) was identified as *Botrychium* cf. *hesperium* by Dr. Donald Farrar, the expert on this genus from the University of Iowa. Dr. Farrar was unable to conduct electrophoresis on the samples and requested additional material. We returned to the site in 2003, but the phenology was too early and we were unable to locate the populations. This moonwort has a global rank of G3G4 but has not been ranked by the AKNHP since this would be the first collection of it in Alaska. The closest locality is in British Columbia where it is rare (S1S3).
2. *Calypso bulbosa* (L.) Oakes var. *occidentalis* (Holzinger) Boivin – We have not been able to confirm the varietal status of our specimens of *Calypso bulbosa*. There is some uncertainty about the validity of this variety. If it is accepted, it is rare (S3) in the State of Alaska.
3. *Draba oblongata* R. Br.– This mustard was reported from the Chitistone in the southeast Wrangell Mountains (Murray 1968). However, in 1997, the specimen could not be located at the Canadian Museum of Nature in Ontario where it is housed. It is likely the specimen has been redetermined (D.F. Murray, pers. com.). A species of Greenland and the Canadian high arctic, it is globally rare (G3). The specimen from the park has been the only report from Alaska.
4. *Melandrium macrospermum* Pors. (= *Gastrolychnis macrosperma* (Porsild), *Silene macrosperma* - (Porsild) Hultén) – Our one collection of this species from the Granite Mountains (C. Roland 94-184) was identified as *Gastrolychnis* cf. *macrosperma* by Carolyn Parker in 1996. It had an AKNHP State rank of S3S4 in 1994.
5. *Oxytropis tananensis* Yurtzev – Our collection from Clear Stream in the Chitina River basin in 1996 (M. Duffy & J. Barnes 96-003) was redetermined by Carolyn Parker in 1997 to *O. campestris* (L.) DC. var. *varians* (Rydb.) Cody. This plant has been collected just outside the park at the confluence of the Copper and Chitina Rivers by David F. Murray in 1981 (UAM Accession #61714) so it is likely to also occur in the park. It has a global rank of G2G3Q and an Alaska State rank of S2S3.
6. *Polstichum setigerum* (C. Presl) C. Presl – This fern was collected just outside the park border (M. Duffy 92112) in the Robinson Mountains on the coast between the Bering and Guyot Glaciers. It has a global rank of G2G3 and a Alaska State rank of S2S3.

Our inventory efforts have contributed significantly to the knowledge of Alaska's rare flora. Thirty-one taxa occurring in the park have been down listed by the AKNHP in large part due to our inventory effort. Eight of these taxa were on the park's tracking list during the inventory but have been down listed to S3S4 and so are not included on the tracking list provided to us by the AKNHP nor on the park's rare plant list. The previous ranks of the 23 down listed species still on the park's rare plant list are indicated on the tracking list for the park (Appendix 4.2). The species which are no longer on the park's tracking list are:

1. *Cystopteris montana* (Lam.) Bernh., ranked G4 S3 in 1996 and known from six localities in the park in the Mentasta and Wrangell Mountains it is now ranked S3S4.
2. *Draba palanderiana* Kjellman, known from four park localities and ranked G3 S2S3 in 1994 is now ranked S4.
3. *Draba stenopetala* Trautv., ranked G3 S2 in 1994 and known from 26 localities park-wide in the mountains is now ranked S3S4.
4. *Erysimum pallasii* (Pursh) Fern., ranked G4S3 in 1996 and known from 14 localities in the Nuztotin, Mentasta and St. Elias Mountains is now ranked S3S4.
5. *Festuca brevissima* Jurtzev, ranked G3 S3 in 1996 and now known from 21 localities in the Wrangell, Chugach and Nutzotin Mountains is now ranked S3S4.
6. *Minuartia dawsonensis* (Britt.) Mattf., ranked G5 S? in 1996 and known from 11 localities in the St. Elias and Nuztotin Mountains is now ranked S3S4.
7. *Phippsia algida*, known from 20 localities in the park and ranked as G4 S1 in 1994 is now ranked G5 S3S4.
8. *Swertia perennis* L., known from two localities in the park and ranked G5 S3 in 1996 is now ranked S4.

There are thirty taxa occurring in the park that are ranked S3S4 by the AKNHP and so are not on the AKNHP rare plant list. However, seven of these taxa have global ranks of G3G4 and are endemic species. A global rank of G3 indicates that the plant is either very rare and local throughout its range or found locally in a restricted range with 21 to 100 global occurrences and considered threatened throughout its range. Five of the species are endemic to Alaska and Yukon Territory (*Anemone multiceps*, *Astragalus nutzotinensis*, *Gentiana platypetala*, *Saxifraga spicata* and *Synthyris borealis*), one is an Amphiberingian endemic (*Draba stenopetala*) and one is a Pacific Coast endemic (*Carex circinnata*). I suggest that these species be included on the park watch list described below.

Range Extensions

Collections made during this inventory documented range extensions of more than 250 km from previously published localities for 129 taxa, 100 collected during the 1994-1997 inventory and 29 collected during the 2003 inventory (Appendix 4.3). The high number of notable range extensions from the park is an indicator of the "Wrangell Void" described by botanist Mike Duffy (1992) prior to the inventory. For comparison, Denali

National Park and Preserve reported range extensions of greater than 250 km for 34 taxa during inventories conducted from 1998 to 2001 (Roland 2004) and Yukon-Charley National Preserve reported range extensions of greater than 200 km for 19 taxa (Larsen and Rector 2004).

Distribution maps and annotations for notable range extensions collected from 1994 to 1997 have been published previously (Cook and Roland 2002). Distribution maps and annotations for notable range extensions collected during 2003 are in Chapter seven of this document.

Distribution Limits

Ninety-nine taxa (11% of the total flora) reach their North American distribution limits within the boundaries of the park, 36 of the taxa have an AKNHP rank of three or less. Of the remaining 63 taxa, 16 are known from fewer than 5 localities and appear to be rare in the park. I have included these 16 taxa on the park watch list described below. Of the 99 taxa which reach their distribution limits in the park, 42 taxa (42.2%) reach the northern limit of their distribution in the park, 38 taxa (38.4%) reach the southern limit of their distribution in the park, 27 taxa (27.0%) reach the western limit of their distribution in the park and 5 taxa (5.0%) reach the eastern limit of their distribution in the park (Appendix 4.4). The high ratio of species reaching their northern limit in the park is probably due to the park's proximity to the terminus of the North American cordillera whereas the high ratio of species reaching their southern extent in the park may be related to the high percentage of arctic-alpine species in the park (25%, 229 taxa).

Rare Plant Watch List

There are 98 taxa occurring in the park which are known from five or fewer localities and appear to be rare in the park (not just under collected) but are not on the rare plant list derived from the Alaska Natural Heritage Program tracking list (Appendix 4.5). Some of these taxa are at the limits of their global distribution in the park, others have an AKNHP state rank of S3S4 and are either Alaska-Yukon, amphiberingian or Pacific Coast endemics, and some are either disjunct from their main range in Alaska or represent the geographic limits of the species in Alaska. As Carl Roland (2004) described for Denali National Park and Preserve, managers of high priority conservation areas such as National Parks would be negligent if they did not protect disjunct and rare park populations. It is often these populations that are in environmental situations most conducive to evolutionary change. Also, the rarity in the park of these species may be indicative of unique ecological communities in the park or of an ecological history that we have yet to fully understand, such as the distribution of ice-free areas at the end of the Pleistocene or the extent of pro-glacial lakes.

The park specific rare plant watch list that I have prepared will be modified as our knowledge of the flora increases. There were many taxa known from only one or two localities that I suspect are under collected (such as aquatics and sedges) and so did not include them on the watch list. They may prove to be rare in the future if few new collections are made. Likewise, taxa on the list may be found to be more widespread. I

suggest that this watch list, used in conjunction with the AKNHP rare plant list, comprise the park's rare plant list to be used in conservation, planning and inventories.

Non-Native Flora

The focus of this inventory was native plant communities in areas away from the road system since most historic collections were along the road system and road accessible areas could be surveyed without special access in the future. Prior to the inventory, there were five vouchered non-native species known from the park: *Beckmannia erucaeformis* subsp. *baicalensis* from Tanada Lake, *Cerastium fontanum* from Bonanza Ridge (collected by Olle Nordell and Alf Schmitt in 1976), *Collomia linearis* from a McCarthy Creek gravel bar, *Lappula squarrosa* from a grazing lease on the Chitina River and *Papaver rhoes,* collected in the Chitina Valley by David W. Eaton in 1913. *Taraxacum officinale* was first observed by park personnel at the campground at McCarthy in 1989 but was not collected. *Taraxacum officinale* was collected in 1935 at Chitina and Willow Creek (just outside the park) by Jacob P. Anderson. *Taraxcum officinale* and *Lappula squarrosa* are the only invasive non-native plants in this group, the others are described as non-native or introduced by Eric Hultén (1968).

During the vascular plant inventory, only three new non-native species were found within the park: *Achillea millefolium* in the White River Valley, *Veronica serpyllifolia* subsp. *serpyllifolia* in the coastal St. Elias Mountains and *Polygonum aviculare* on Mt. Chitina at the head of the Chitina River. *Polygonum aviculare* is considered invasive the other two species are not. Additional populations of the following species were vouchered during the inventory: *Beckmannia erucaeformis* subsp. *baicalensis* from the upper Copper River, *Lappula squarrosa* from Reeves Field on the Nabesna River, Blondie Ridge and the Baldwin Glacier ridge in the Upper Chitina Valley, and *Taraxacum officinale* from Stuver Creek where the horse trail crosses the creek.

Surveys conducted by Roseann Densmore and Chris McKee from 2000 to 2003 identified seven new invasive non-native plants occurring in the park (Densmore et. al. 2002, McKee 2004). These populations were restricted to disturbed communities at the newly acquired Kennecott National Landmark and campground near McCarthy, at May Creek across the Nizina River from McCarthy, Chisana and the Peavine landing strip. An additional five new invasive species were identified by Densmore and McKee along the McCarthy and Nabesna Roads on state land. Surveys along one trail off the McCarthy Road, five trails off the Nabesna Road and four remote landing strips within the park did not reveal additional populations or species of invasive plants in 2004 (McKee 2004). Three additional non-native species were collected in 2003 during an environmental assessment in upper McCarthy Creek on private property within the park: *Avena sativa*, *Polygonum convolvulus* and *Secale cerale*. *Polygonum convolvulus* is invasive and a State of Alaska restricted noxious weed seed.

Surveys by the National Park Service Exotic Plant Management Team (EPMT) from 2005 to 2007 documented an additional 16 non-native species occurring in the vicinity of the park, four from park land. We now know of 45 non-native plant species occurring in the vicinity of the park, 25 on park land, 16 which are considered invasive and nine which have an Alaska Exotic Plant Information Clearninghouse rank of 50 or higher

(Appendix 4.6). The invasive plants are restricted to disturbed lands at McCarthy, Kennicott, May Creek, Chisana or Peavine landing strip except four localities discussed below. There are an additional eight non-native species occurring on state roads in the park or on private land in the park, six of which are considered invasive. One plant occurring in the park (*Leucanthemum vulgare*) is a U.S. Fish and Wildlife Listed Noxious Weed and three occurring on state roads adjacent to the park are U.S. Fish and Wildlife Noxious Weeds (*Melilotus alba*, *M. officinalis* and *Trifolium hybridum*).

The highest priorities for control of invasive species that occur within the park are *Leucanthemum vulgare* which occurs at Kennecott, *Taraxacum officinale* which occurs on the Bonanza Mine and Root Glacier trails at Kennecott, *Linaria vulgaris* and *Crepis tectorum* populations at McCarthy, and according to Densmore et. al. (2002) *Lappula squarrosa* which is known from Kennicott, a grazing lease on the Chitina River, Reeves Field on the Nabesna River and two sites on the upper Chitina River with natural disturbance. The highest priority for control of invasive species along the state roads adjacent to the park is *Melilotus alba* which has been reported in areas of natural disturbance on the Stikine and Nenana Rivers in Alaska (McKee 2004).

The only known invasive plant localities in natural areas of the park are the two localities of *Lappula squarrosa* on the upper Chitina River, *Polygonum aviculare* also from the upper Chitina River and *Taraxacum officinale* on Stuver Creek and landing strips in the Chitina River drainage. The Stuver Creek population may have been introduced by horses or by small fixed wing aircraft landing in the vicinity. Fixed wing aircraft may also have contributed to the spread of the populations on the upper Chitina River.
It is impressive that so few invasive plants have been reported thus far from within natural communities in the park considering the number of fixed wing landing sites there are in the park and the extent of historic and current grazing and horse use. The absence of invasive plant species in the park's natural communities is one important condition of ecosystem integrity and is of high value to maintain.

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Chapter 5: Regional Summaries

The results of the inventory have been summarized for each region in the park and are presented in this chapter. These regions were derived from the 17 ecological sections of Swanson (2001) modified as described in Chapter 3 of this document. The data summaries for the mountain regions are presented first and are followed by the data summaries for the basin regions. The order of presentation within the mountain and basin region sections is generally from north to south within the park.

The following information is provided for each regional summary: (a) a general description of the region (extent within the park, major landforms and lithologies); (b) the focus of the inventory within the region (if other than spatial coverage); (c) the survey effort as indicated by the number of sites and collections in the region; (d) the number of new taxa documented by vouchers from the region; (e) the number of significant range extensions (> 200 km from previous collections) documented by vouchers from the region; (f) the number of global and state rare plant collections from the region ('rare' is defined as those taxa with a Natural Heritage Program rank of three or less); (f) a comparison of survey results with other regions; (g) a description of notable sites and plant associations; (h) an assessment of the inventory completeness in that region, and (i) suggestions for future survey efforts in that region. Each regional description is accompanied by photos of sites within the region and a map showing the distribution of inventory sites and collections made prior to the inventory. The data is summarized in Tables 5.1, 5.2, 5.3 and 5.4. Annotations and maps for many of the rare plant taxa and significant range extensions mentioned in this chapter are in Chapter 7, Annotated List of Notable Finds. Taxa new to the park are followed by an asterisk (*) in the lists below. The following references were used for the descriptions of lithology and surficial geology: Brabb 1962, Mackevett 1978, Pflafker 1967 and 1992, Richter 1976, Richter et. al. 2000 and 2006.

Yukon-Tanana Uplands

Description of Region

The Yukon-Tanana Uplands region is in the northeast corner of the park, north of the Denali fault and delineated by the Yukon-Tanana terrane. It is the oldest region of the park, being accredited to the margin of North American in Jurassic times. This region has the same boundary as the Wellesley Hills and Flats ecosection within the Yukon-Tanana Upland ecoregion (Swanson 2001). It also includes the Jatahmund Basin moraines from the Tanana-Kuskokwim Basin ecoregion that are found within the Wellesley Hills and Flats ecosection. The region encompasses 151,375 acres, all ice-free, representing 1.15% of the park's area. The region was not glaciated at the end of the Wisconsin glaciation. The defining features of the region are the Carden Hills with its mafic, ultramafic and metavolcanic lithologies, Wellesley Mountain, composed of conglomerate and sandstone sedimentary rock and the alluvial deposits of Snag and Beaver Creek which have a mantle of peat, loess and volcanic ash. Elevations in this region range from 2400 ft (730 m) at Stevens Lake in the Wellesley Lakes basin to 5565 ft (1948 m) in the Carden Hills.

Table 5.1. Acres, ice and ice-free acres within Wrangell-St. Elias National Park and Preserve, Alaska, by vascular plant inventory region. Ice was estimated using 1:1 million ArcInfo coverage (NPS and ESRI 1992).

	Acres		***Ice***		***Ice-Free Acres***	
	#	%	Acres	%	#	%
Mountain Regions						
Tanana Uplands	151375.24	1.15	0.00	0.00	151375.24	1.80
Mentasta	161507.33	1.23	242.28	0.15	161265.05	1.92
Nutzotin	979544.84	7.45	35238.27	3.60	944306.57	11.24
N. St. Elias	1350216.43	10.27	642548.94	47.59	707667.49	8.42
N. Wrangell Foothills	670345.58	5.10	59996.64	8.95	610348.94	7.26
High Wrangells	1440615.25	10.96	974816.86	67.67	465798.39	5.54
Mts. Drum and Sanford	509360.53	3.87	114694.59	22.52	394665.94	4.70
S. Wrangell Foothills	630979.23	4.80	70413.77	11.16	560565.46	6.67
N. Chugach	1994037.72	15.17	527206.79	26.44	1466830.93	17.45
S. Chugach-St. Elias	1831603.16	13.93	1562566.10	85.31	269037.06	3.20
Coastal Foothills	822706.83	6.26	667812.56	81.17	154894.27	1.84
Basin Regions						
Tanana River	257006.76	1.95	287.15	0.11	256719.61	3.05
White River	168561.45	1.28	1432.17	0.85	167129.28	1.99
Upper Copper River	525318.07	4.00	65.22	0.01	525252.85	6.25
Middle Copper River	472040.92	3.59	0	0.00	472040.92	5.62
Lower Copper River	110412.21	0.84	0	0.00	110412.21	1.31
Chitina River	995940.01	7.57	74938.43	7.52	921001.58	10.96
Malaspina Forelands	76229.76	0.58	10784	14.15	65445.76	0.78
Totals:	13147801.31		4743043.80		8404757.54	

Focus of Survey

The focus of our survey in the Yukon-Tanana Uplands region was the Carden Hills and its ultramafic lithologies, Wellesley Mountain with its coarse rubble slopes, and the wetlands associated with these two features (Figure 5.1, Plate 5.1 and Tables 5.1 to 5.4). The hills and mountains in this region are old, low and weathered - a feature unique to mountains in the park. Since the region was not glaciated at the end of the Wisconsin glaciation, we hypothesized that there might be a high number of Alaska-Yukon and amphiberingian endemics occurring here. We also thought there would be a high number of species new to the park since there had only been three prior collections from this unique ecoregion in the northern corner of the park. And, we did not know if the ultramafic lithologies supported unusual plant associations. We were not able to survey the Snag and Beaver Creek floodplains or the extensive wetlands throughout the region.

Communities surveyed included: freshwater pondweed, freshwater pondlily, wet sedge marsh, subarctic lowland sedge bog meadow, subarctic lowland sedge wet meadow, tall open alder scrub, closed low shrub birch-willow scrub, closed white spruce forest, openwhite spruce-

Table 5.2. Number of vascular plant inventory sites and collections by region within Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

	Sites				Collections			
	#	%	Rank	#/IFA*	#	%	Rank	#/IFA*
Mountain Regions								
Yukon-Tanana Uplands	3	0.97	18	2	343	4.90	9	227
Mentasta	22	7.12	6	14	482	6.88	5	299
Nutzotin	39	12.62	3	4	990	14.14	1	105
N. St. Elias	6	1.94	14	1	331	4.73	10	47
N. Wrangell Foothills	11	3.56	11	2	415	5.93	8	68
High Wrangells	5	1.62	15	1	75	1.07	17	16
Mts. Drum and Sanford	13	4.21	9	3	105	1.50	16	27
S. Wrangell Foothills	19	6.15	7	3	553	7.90	4	99
N. Chugach	44	14.24	2	3	925	13.21	2	63
S. Chugach-St. Elias	8	2.59	13	3	243	3.47	12	90
Coastal Foothills	23	7.44	5	15	480	6.85	6	310
Basin Regions								
Tanana River	28	9.06	4	11	453	6.47	7	176
White River	4	1.29	16	2	252	3.60	11	151
Upper Copper River	16	5.18	8	3	204	2.91	13	39
Middle Copper River	9	2.91	12	2	167	2.38	15	35
Lower Copper River	4	1.29	17	4	45	0.64	18	41
Chitina River	45	14.56	1	5	741	10.58	3	80
Malaspina Forelands	10	3.24	10	15	199	2.84	14	304
sum	309				7003			
average	17			5	389			121

*IFA = 100,000 ice-free acres using 1:1 million ArcInfo coverage (NPS and ESRI 1992)

paper birch forest, open black spruce forest, dryas dwarf scrub tundra, ericaceous dwarf scrub tundra, sub-alpine graminoid-forb herbaceous meadow, bryoid herbaceous moss seeps and barren boulder slopes.

Summary of Results

Inventories were conducted of three sites in this region. This is the fewest number of sites inventoried in a region and represents only two sites per 100,000 ice-free acres (IFA). We collected 343 vouchers representing 190 taxa. The number of collections is close to the average for a region (389), but the number of collections per 100,000 IFA (227) ranked fourth highest amongst the 18 regions and was almost twice the average (121). These collections included vouchers for 22 taxa that were not known to the park prior to 1994 (six from the 2003 inventory). There were 15 new taxa per 100,000 IFA, almost twice the average.

Three significant range extensions (>200 km from published localities) were documented from this region: *Cryptogramma stelleri*, *Galium brandegei* and *Selaginella sibirica*, the last two

Table 5.3. Number of taxa documented by specimens, taxa new to the state and to Wrangell-St. Elias National Park and Preserve, Alaska, by inventory region from the 1994-1997 and 2003 vascular plant inventory.

	# Taxa	***#/Taxa New to State***	***#/Taxa New to the Park***			
			2003	**Total**	**#Unique**	**#/IFA***
Mountain Regions						
Yukon-Tanana Uplands	190	0	6	22	3	15
Mentasta	228	1	1	33	4	20
Nutzotin	345	1	5	55	8	6
N. St. Elias	198	1	1	15	1	2
N. Wrangell Foothills	198	0	1	19	2	3
High Wrangells	187	0	0	4	0	1
Mts. Drum and Sanford	127	0	0	12	0	3
S. Wrangell Foothills	336	0	1	28	3	5
N. Chugach	318	4	2	39	5	3
S. Chugach-St. Elias	166	1	7	18	3	7
Coastal Foothills	222	0	11	27	5	17
Basin Regions						
Tanana River	253	1	4	40	2	16
White River	226	0	3	13	1	8
Upper Copper River	157	0	4	29	3	6
Middle Copper River	262	0	4	46	4	10
Lower Copper River	64	0	0	1	1	1
Chitina River	394	3	5	67	14	7
Malaspina Forelands	127	0	15	21	10	32
average	222.11	0.67	3.89	27	3.8	9

*IFA = 100,000 ice-free acres using 1:1 million ArcInfo coverage (NPS and ESRI 1992)

species were also new to the park. Six occurrences of five state rare plants were documented in the Yukon-Tanana Uplands, three of the species are also globally rare (having a Heritage Rank of G3 or lower and known from fewer than 100 occurrences).

Two of the rare species were new to the park. Although the numbers of rare species and occurrences were low when compared with the other regions, the numbers per 100,000 IFA was close to the averages of three rare species and six occurrences per region. The endemic flora documented in the Tanana uplands was comprised of ten amphiberingian, nine Alaska-Yukon and two cordilleran taxa. There were no Pacific Coastal endemics in this region.

The rare plants documented from the Yukon-Tanana Uplands were: *Carex lapponica** (G4G4Q S2), *Cryoptogramma stelleri* (G5 S2S3), *Montia bostockii* (G3 S2S3), *Oxytropis huddelsonii* (G3 S2S3) and *Potamogteton subsibiricus** (G3 S2).

Table 5.3. Number of taxa documented by specimens, taxa new to the state and to Wrangell-St. Elias National Park and Preserve, Alaska, by inventory region from the 1994-1997 and 2003 vascular plant inventory.

	Significant Range Extensions		***Rare Taxa***			***Rare Occurrences***		
	#	**#/IFA***	**Inv****	**Total**	**#/IFA***	**Inv****	**Total**	**#/IFA***
Mountain Regions								
Tanana Uplands	3	2	5	5	3	6	6	4
Mentasta	9	6	20	20	12	58	59	36
Nutzotin	19	2	29	31	3	99	115	10
N. St. Elias	7	1	18	20	3	29	42	4
N. Wrangell Foothills	10	2	15	16	2	24	32	4
High Wrangells	1	0	1	11	0	1	20	0
Mts. Drum and Sanford	4	1	8	9	2	14	24	4
S. Wrangell Foothills	10	2	20	20	4	55	63	10
N. Chugach	21	1	23	25	2	52	54	4
S. Chugach-St. Elias	10	4	10	10	4	14	14	5
Coastal Foothills	9	6	9	10	6	18	19	12
Basin Regions								
Tanana River	8	3	11	13	4	21	25	8
White River	4	2	4	5	2	6	8	4
Upper Copper River	6	1	3	4	1	5	7	1
Middle Copper River	5	1	6	7	1	6	7	1
Lower Copper River	2	2	1	1	1	1	1	1
Chitina River	31	3	21	24	2	21	26	2
Malaspina Forelands	5	8	2	2	3	2	2	3
average	9	3	11		3	24		6

* Inv = this inventory
** IFA = 100,000 ice-free acres using 1:1 million ArcInfo coverage (NPS and ESRI 1992)

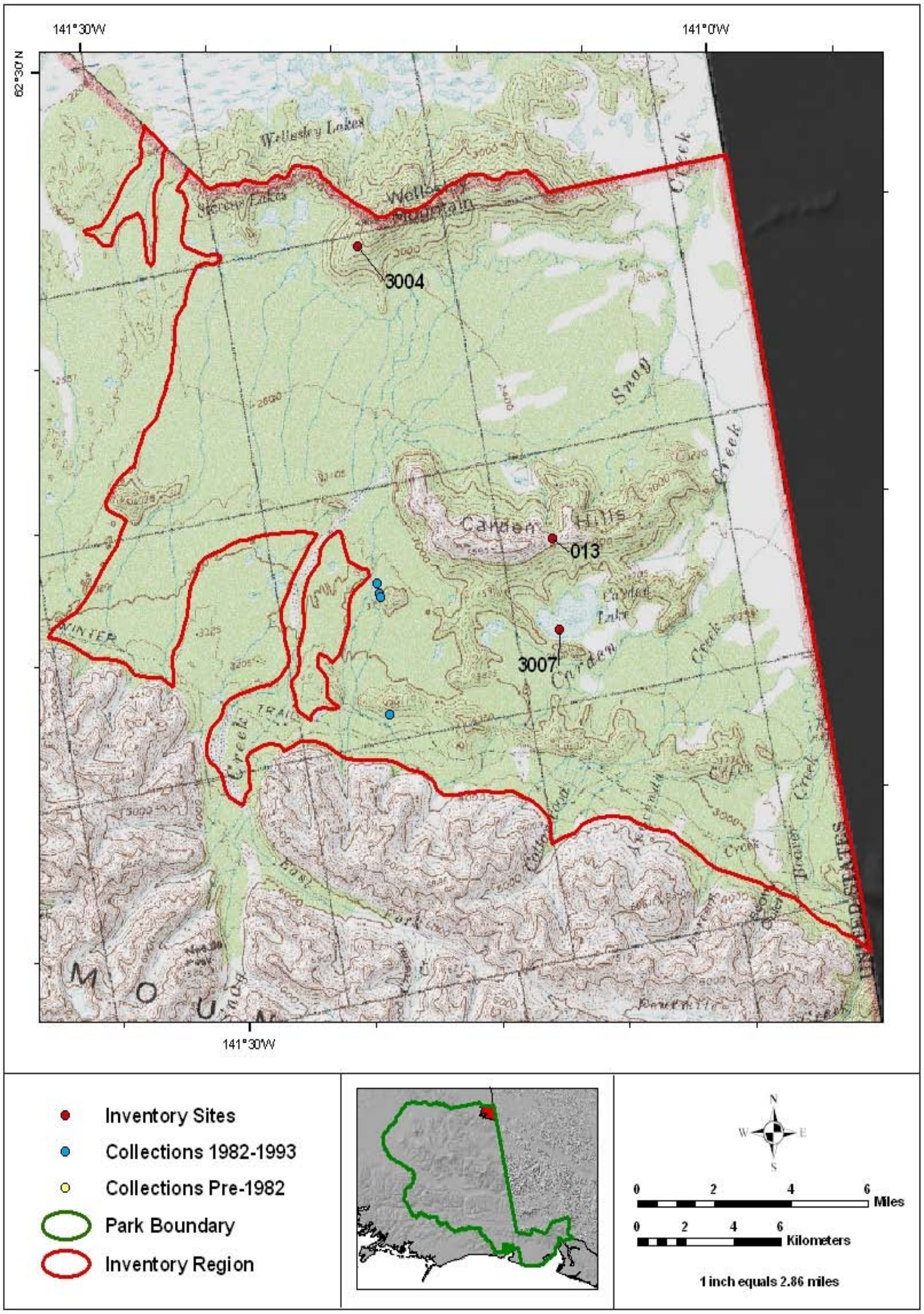


Figure 5.1 Yukon-Tanana uplands vascular plant inventory region, associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Carden Hills in foreground (Site 13)


Carden Lake (Site 3007)


Ultramafic rocks, Carden Hills (Site 13)


Carden Hills aerial view (Site 13)


Carden Lake from Carden Hills


Wellesley Hills (Site 3004) and Katherine Beattie


Bruce Bennett, Wellesley Hills (Site 3004)


Carden Lake ponds

Plate 5.1. Representative vascular plant inventory sites in the Tanana upland region, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

The most notable collections from this region were:

1. *Carex loliaceae* – a sedge of *Sphagnum* bogs, it was collected at Carden Lake (Site 3007). This is the only known locality in the park. It is a circumpolar species known in Alaska to the north and west of the park. Our collection extends its range 175 km south from the Tanana River drainage (UAF Arctos Database 2006).
2. *Erigeron lonchophyllus* – collected in a wet meadow at Carden Lake (3007), this is the only locality in the park. It was collected in Copper Center in 1908 by Charles Heidemann and in 1934 by Fritz Went (Hultén 1940-1946). Our collection extends its range 324 km south and east from a collection made in 1957 along the Alaska Highway (Jan Lake, Mile 1354) in the Tanana River drainage (UAF Arctos Database 2006).
3. *Galium brandegei* – collected in a wet meadow and in black spruce forest at Carden Lake (Site 3007), this is the only locality of Three-Petal Bedstraw in the park. Our collection extends its range 289 km southeast from the Alaska Range (Annotation Map 100).
4. *Iris setosa* – the first collection of this species in the park was made in 1996 in the Tana River drainage. The collection in 2003 at Wellesley Mountain is 160 km to the north. It was subsequently collected that summer on the coast 237 km to the south of the Tana River locality. Although this species is fairly common in coastal areas of Alaska, it is uncommon in the park, known from only these three localities. It is likely that it occurs more frequently in the Tanana lowlands within the park. The collection at Wellesley Mountains extends its range 93 km south from the Tanana River drainage.

Notable Sites/Plant Associations

The wetland communities at Carden Lake (Site 3007) and the sub-alpine communities in Carden Hills (Site 13) had the greatest numbers of notables. There were three rare species at Carden Lake, one significant range extension and 11 species new to the park, three known only from this locality. There were two rare species from Carden Hills, two significant range extensions and two species new to the park's flora. Wellesley Mountains (Site 3004) was notable for the high number of endemics found here, 21 species (14 amphiberingian, six Alaska-Yukon and two cordilleran).

Completeness of Inventory

This is one of the most poorly surveyed regions within the park. Although we only surveyed three sites in this region, the number of collections per site was high and the number of notables was average when compared to the values for other regions. Therefore, we would expect that with greater survey effort we would find additional notables. We were unable to survey significant wetland and lowland areas in this region and this should be a priority for future inventories.

Mentasta Mountains

Description of Region

The Mentasta Mountains region is the southeastern extent of the Alaska Range south of the Denali fault within the park boundary (Figure 5.2). The region corresponds to the Mentasta Mountain ecosection except for that portion of the Jack Creek Valley below 3000 ft (914 m) which is included in the Tanana River Basin in this study. Elevations range from 3000 ft (914 m) to 8147 ft (2485 m) at Noyes Mountain. The region covers 161,507 acres, 0.15% ice, comprising 1.23% of the park's area and 1.92% of the park's ice-free area. There is great topographical relief within this small region which harbors a mosaic of upland and alpine plant communities. There are also extensive south facing alpine slopes and southeast facing river bluffs.

The Totschunda Fault system runs through the southeastern corner of the region separating the Boyden Hills from the Mentasta Mountains. The northern portion of the region is primarily composed of marine sedimentary rocks from the Early Cretaceous and Late Jurassic. Near Soda Lake and the heads of Trail and Lost Creeks there are extensive areas of limestone and Nikolai greenstone from the Late Triassic. The western end of the Mentasta Mountains in the park is composed of intrusive rocks of Tetelna Volcanics and a diorite complex. The Boyden Hills are primarily Tetelna Volcanics with the southeastern end composed of mid-cretaceous plutons.

Focus of Survey

Our initial interest in this region was the limestone and greenstone lithologies at Soda Lake, and at the heads of Lost and Trail Creeks (Sites 23, 24, 42, 47 and 52). We were also interested in the unique location of the Boyden Hills (a volcanic island) and the bluffs adjacent to the Nabesna River. Due to the high numbers of notable plants found during the first year of the inventory, in subsequent years we sought to cover more of the spatial extent of the Mentasta Mountains and to survey the wetlands in the region. After Carl Roland discovered three populations of *Cryptantha shackletteana* at the southeast end of the range, we surveyed other localities in the region hoping to find additional populations. There had only been two vouchered plant collections made prior to our inventory in this region, so we anticipated a high number of new species to the park from the Mentasta Mountains and also a high number of Alaska-Yukon endemics since the mountains are at the eastern edge of the Alaska Range.

Some of the communities surveyed were: aquatic buttercup, fresh pondweed, sphagnum bog, floodplain fen, bryoid moss fen, shallow pond, open low willow scrub, mesic dwarf birch-willow scrub, open shrub birch scrub, subarctic lowland wet sedge meadow, open low willow shrub, mixed shrub sedge tussock tundra, barren scree, rock outcrops, steppe bluff, barren river gravel bar, wet sedge tundra, mixed shrub-sedge tussock tundra, mesic graminoid-forb herbaceous alpine meadow, alpine forb herbaceous, *Dryas* dwarf scrub tundra, dwarf willow-*Dryas* scrub tundra, *Dryas*-forb tundra, open white spruce forest, open black spruce muskeg, open paper birch forest, open balsam popular forest and open black cottonwood forest.

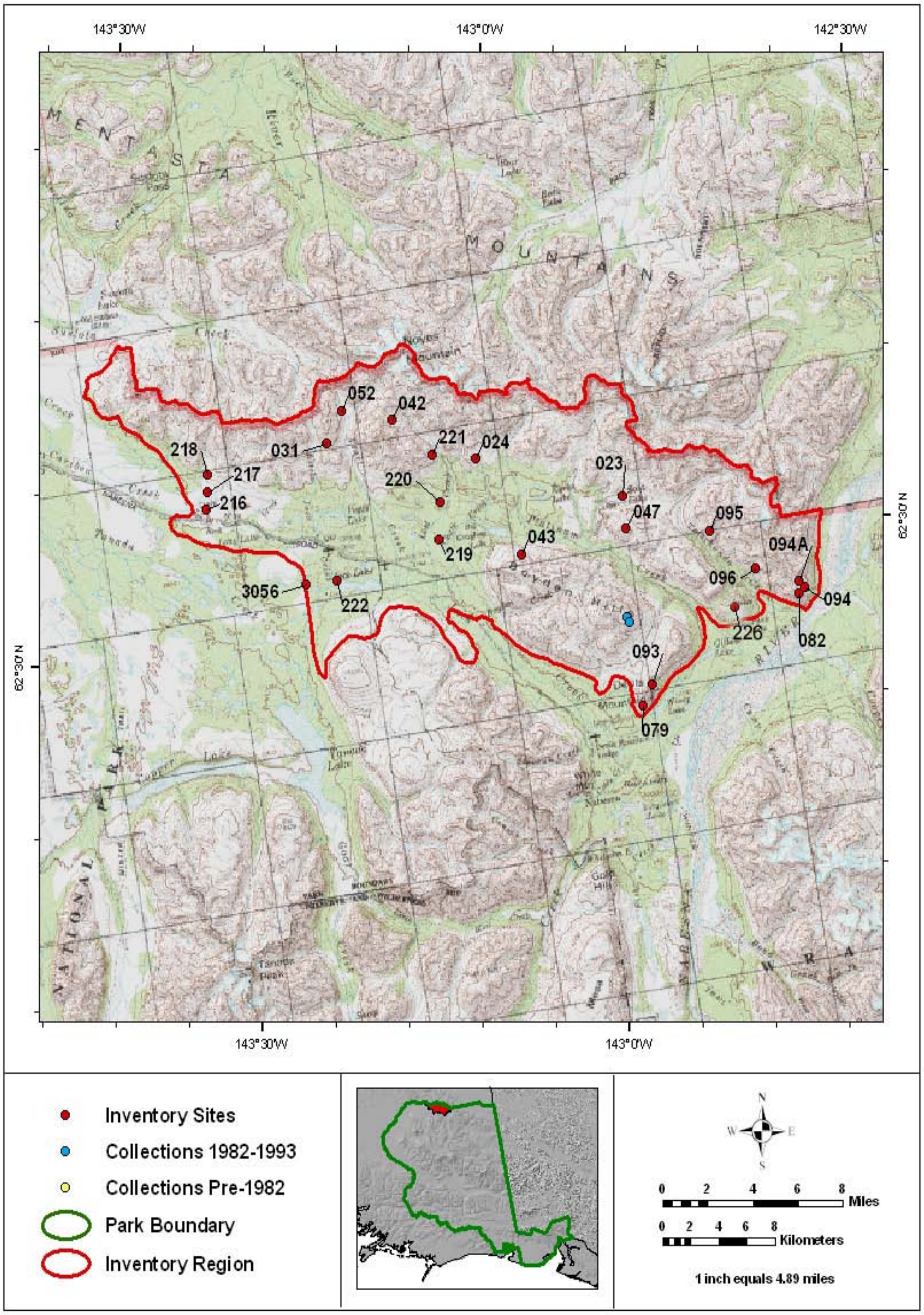


Figure 5.2 Mentasta Mountains vascular plant inventory region, associated 1994-1997 & 2003 survey sites and pre-inventory collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Left: Carl Roland holding *Cryptantha shackletteana.* The ridge above him (Site 82), at the confluence of the Nabesna River and Totschunda Creek, is where the species was first collected in the park.

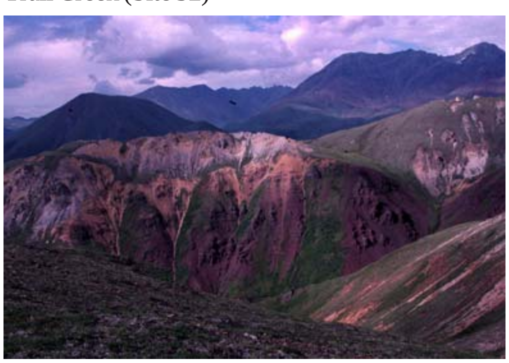
Right: Soda Lake ridge (Site 23) where a species new to the state and nine rare species were collected.

Lost Creek (Site 24)

Katy Beck at Lost Basin (Site 42) where *Papaver walpolei* was collected, an Amphiberingian endemic 970 km disjunct from its range on the Seward Peninsula.

Trail Creek (Site 52)

Carl Roland on Devil's Mt. bluff (Site 93)



Nikolai Greenstone & limestone (Site 47)

Boyden Hills (Site 43)

Plate 5.2. Representative vascular plant inventory sites in the Mentasta Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

The survey of 22 sites in the Mentasta Mountains resulted in the collection of 482 vouchers of 228 taxa (Figure 5.2, Plate 5.2 and Tables 5.1 to 5.4). This region had the second highest number of sites (14) and third highest number of collections (299) per 100,000 IFA although it ranked sixth and fifth for the actual number of sites and collections, respectively. These collections documented one taxa new to the state of Alaska (*D. lonchocarpa* var. *thompsonii)*, 32 taxa that were not known from the park prior to 1994, nine significant range extensions and 59 occurrences of 20 rare plant taxa, eleven of which are globally rare. Fifty-six endemics were documented from the Mentasta Mountains (20 Alaska-Yukon, 18 amphiberingian, nine cordilleran and one Pacific Coastal).

The values for the number of notable collections were exceptional. The number of significant range extensions ranked fifth, the number of rare taxa ranked fourth and the number of rare occurrences ranked second. Evaluated by 100,000 IFA, the Mentasta Mountains ranked second for the number of significant range extensions (a value of six, two times the average). It also ranked first for the number of rare taxa and occurrences per 100,000 IFA. There were 12 rare taxa per 100,000 IFA (four times the average) and 36 rare occurrences per 100,000 IFA (six times the average).

Seven of the significant range extensions were new to the park. The significant range extensions documented in the Mentasta Mountains were:

*Braya glabella**
*Cryptantha shackletteana**
Draba lonchocarpa
*var. thompsonii**
*Festuca lenensis**
*Oxytropis campestris subsp. jordalii**
*Papaver walpolei**
*Pedicularis pacifica**
Phlox sibirica subsp. richardsonii
Taraxacum carneocoloratum

Seven of the rare plants in the Mentasta Mountains were new to the park. The rare plants documented in this region were:

Aphragmus eschscholtzianus G3 S3
Carex atratiformis G5T5 S2
Chamaerhodos erecta subsp. *nuttallii* G5T5 S1 S2
*Cryptantha shackletteana** G1Q S1
Douglasia gormanii G3 S3
*Draba incerta** G5 S2S3
Draba lonchocarpa var. *thompsonii** G4T3T4S1
*Draba porsildii** G3G4 S1S2
Draba ruaxes G3S3
Erigeron grandiflorus subsp. *arcticus* G4T3T4 S3
*Festuca lenensis** G4 S3
Minuartia biflora G5 S2
Montia bostockii G3 S3
Oxytropis huddelsonii G3 S2S3
*Papaver walpolei** G3 S3
Phacelia mollis G3 S3S3
*Phlox hoodii** G5 S1S2
Phlox sibirica subsp. *richardsonii* G4T2T3Q S2?
Stellaria alaskana G3 S3
Taraxacum carneocoloratum G3Q S3

The most notable collections from this region were:

1. *Braya glabella* subsp.*glabella* – a North American arctic-alpine endemic species known only from Alaska and Colorado in the United States (but across arctic Canada), it is rare in Colorado (S1), in the Yukon (S2S3) and in Quebec (S1). It was collected at Soda Lake and Soda Lake Ridge (Sites 23 and 47) in the Mentasta Mountains, one locality in the Nutzotin Mountains and one locality in the Northern St. Elias Mountains (Cook and Roland 2002, Map 115). The collections in the Mentasta Mountains extend its range 372 km south from the Charley River Quad (UAF Arctos Database 2006).
2. *Carex atratiformis* from the Lost Creek Floodplain (Site 219), known from only 10 localities in Alaska (Annotation Map 34).
3. *Chamaerhodos erecta* subsp. *nuttalii* – an amphiberingean species that occurs on dry river terraces, is rare in Alaska and in British Columbia (S2). It was collected at two localities along the Nabesna River (Sites 79 and 93) and two localities along the Chisana River (Sites 3060 and 3063) in the Nutzotin Mountains. These stations connect its range 242 km to the west in the Anchorage Quad with its distribution 194 km to the east in the Yukon Territory (Annotation Map 95).
4. *Cryptantha shackletteana* from the ridge above the confluence of Totschunda Creek with the Nabesna River (Sites 82 and 94), known from only two other localities in the world and a USFWS Category 2 plant in 1993 (Roland and Cook 1998, Annotation Map 6).
5. *Draba lonchocarpa* var. *thompsonii* in scree at the headwaters of Lost Creek (Site 42), the only known locality in Alaska and 1100 km from populations in British Columbia (Annotation Map 15).
6. *Papaver walpolei* also from the headwaters of Lost Creek (Site 42) and 970 km disjunct from populations on the Seward Peninsula (Annotation Map 71).
7. *Phacelia mollis* – first collected in the park in 1989 at Jack Creek, then at Ptarmigan Creek in the Nutzotin Mountains in 1992, our inventory documented an additional 17 localities, ten of these in the Mentasta Mountains. It is an Alaska-Yukon endemic with a narrow distribution centered on the park north to the Charley River Quad and only as far east as the Mt Hayes Quad (Annotation Map 57).
8. *Phlox hoodii* from Devil's Mountain in the Boyden Hills (Site 79). It is known from fewer than 20 localities in Alaska (Annotation Map 82).

Notable Sites/Plant Associations

The Mentastsa Mountains had a number of notable sites. These included the alpine limestone areas at Soda Lake (Sites 23 and 47), upper Lost Creek (Site 42) and upper Trail Creek (Site 52); the steppe bluff at Devil's Mountain (Sites 79 and 93), the sedimentary alpine and sub-alpine communities at the confluence of Totschunda Creek with the Nabesna River (Sites 82, 94, 94A and 96) and the wetlands along the Tanada Lake trail (Site 3056).

- The ridges above Soda Lake had one species new to the state, 17 endemic species (four amphiberingian, nine Alaska-Yukon and three cordilleran), nine rare species, seven species new to the park and five significant range extensions. This is a unique natural area that should be protected. It is home to Dall sheep and has sensitive substrates (calcareous scree slopes), wildlife habitat (salt licks) and plant species.
- Upper Trail Creek had 16 endemic species, the ridge above Totschunda Creek had 14 endemic species and upper Lost Creek had ten endemic species.
- Upper Lost Creek also had ten rare species and three significant range extensions.
- Devil's Mountain had the largest population of *Penstemon gormanii* known in the park, covering large areas of the steppe sagebrush scrub community. This is an Alaska-Yukon endemic that was new to the park. Devil's Mountain also had seven rare species, one significant range extension, four additional Alaska-Yukon endemics and one amphiberingian endemic.
- One of the most interesting areas was the ridge above Totschudna Creek where populations of *Cryptantha shackletteana* were found. This area had an additional six rare species, two significant range extensions and five species new to the park.
- The Tanada Lake Trail had seven species new to the park and four significant range extensions.

Completeness of Inventory

This region had a high survey effort and one of the highest numbers of notable collections. The residual values from the linear regressions of rare frequency against acreage and number of collections in Chapter 6 indicate that the high number of rare plants in this region does not fit the expected linear relationship. I do not believe that this is due primarily to a higher survey effort in this region. This region has an unusual diversity of lithologies and landforms, high topographic relief, southerly aspects and a compressed mosaic of plant communities in a small area. Its proximal location to the central Alaska Range, which is a primary source of the park's endemic flora is also a factor in the high number of notable species found here. Future surveys in the region should focus on trying to determine the distribution of *Cryptantha shackletteana* and *Papaver walpolei* and on surveying wetland communities for some of the rare sedges known from the northern regions of the park.

Nutzotin Mountains

Description of Region

The Nutzotin Mountains region corresponds to the Nutzotin Mountain ecosection except for the ridge between Rock Lake and the White River (near Ping Pong Mountain) which was included in the White River Basin region in our study. This region encompasses 979,545 acres, 3.6 % ice, comprising 7.5% of the park's land and 11.24% of the park's ice-free area. Elevations range from 3000 ft (914 m) to 9480 ft (2891 m) at Mt. Allen.

The region is wedged between two fault systems - the Denali fault to the north, and the Totschunda Fault to the south. Between the Nabesna and Chisana Rivers the lithology is primarily marine sedimentary except for the head of Antler Creek which is composed of intrusive granodiorite and quartz monzonite. This lithology is also found at Gold Hill and between Carl and Baultoff Creeks. The area between the Chisana River and Snag Creek and north of Baultoff Creek is also marine sedimentary. The Wiki Peak, Ptarmigan Lake and Rock Lake areas are dominated by the Sonja Creek shield volcano and have a juxtaposition of volcanic lithologies including lavas, tuffs, rhyolite flows, rhyolite domes, andesite and tephrite flows. Euchre Mountain near Chisana is volcanic and is composed of andesite flows and some ash fall deposits. Limestone and Nikolai greenstone lithologies are found at the head of Snag Creek, Upper Baultoff Creek and Fogenbera Pass. Limetsone is found north of Ptarmigan Lake on Peak 4676 and in Cooper Pass.

Focus of Survey

The high number of rare and endemic plants found in this region prior to our inventory (mostly by botanist Mike Duffy in 1991-1992 while conducting vegetation mapping) was the primary reason that we developed a proposal to inventory the park's flora in 1993. Many of these plants were in the Wiki Peak- Ptarmigan Lake area, so the initial focus of our inventory in the region was to survey similar landforms and lithologies in the vicinity of the previous notable collections. Secondly, we attempted to survey all areas of limestone and fine volcanic materials in the region. We were also interested in lake and river bluffs that were primarily south-facing and likely to have steppe associated plant communities as well as isolated dome shaped landforms such as Euchre Mountain, Beaver Butte and those found near Ptarmigan Lake. We also surveyed the intrusive lithologies at the head of Antler Creek. Finally, we tried to obtain a reasonable spatial coverage of the region and to survey wetlands when we had access to them. Prior to the inventory, Danny Rosenkrans, park geologist, reported an unusual orange poppy on the ridges of Carl Creek, so the first year of the inventory we surveyed this ridge. Our specimens from this locality were thought to be an undescribed species by David F. Murray, *Papaver* specialist at UAF Herbarium. In the following two years, we surveyed additional localities of this species and collected seed and live material from the Carl Creek populations for Dr. Murray.

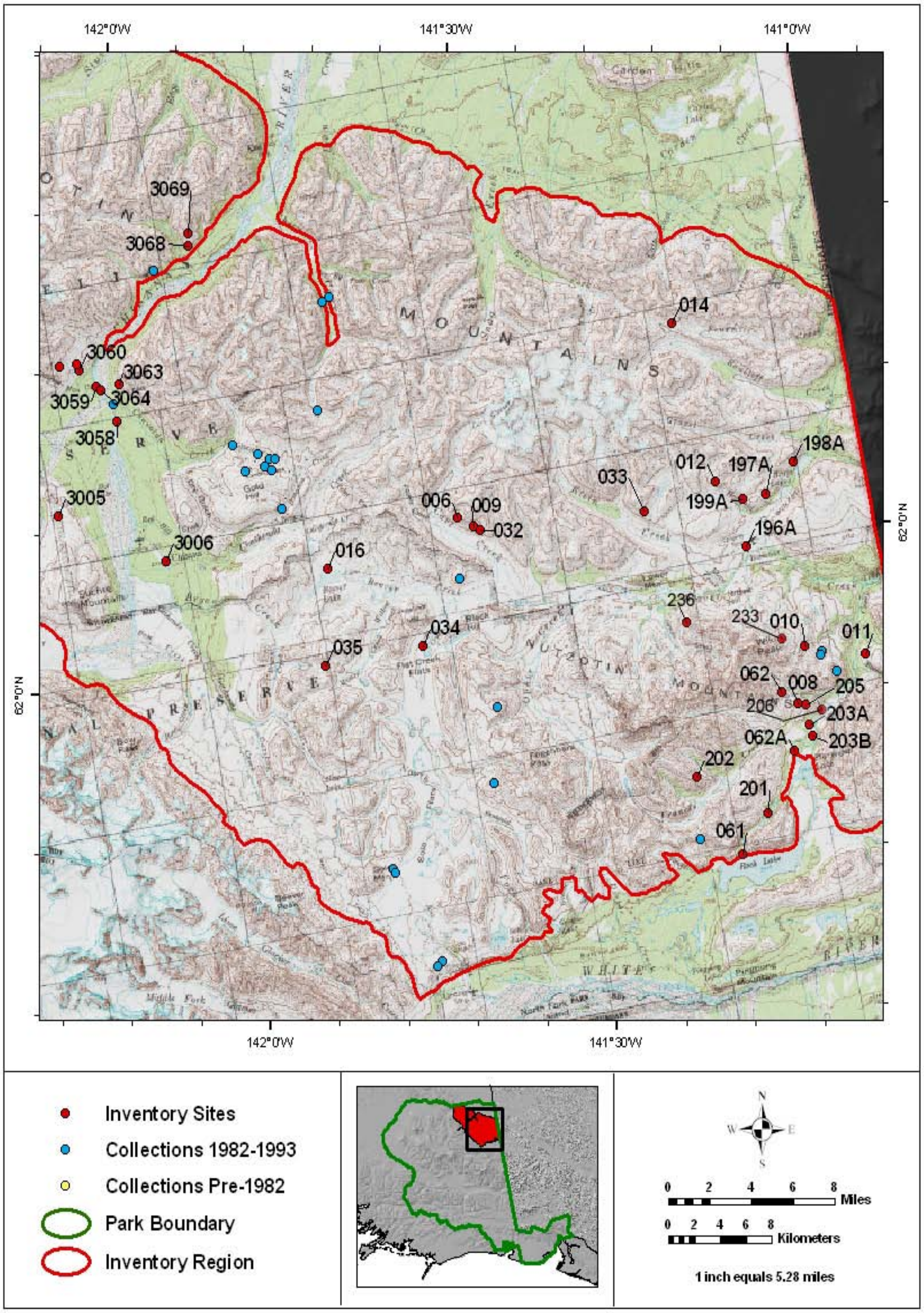


Figure 5.3a Nutzotin Mountains vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

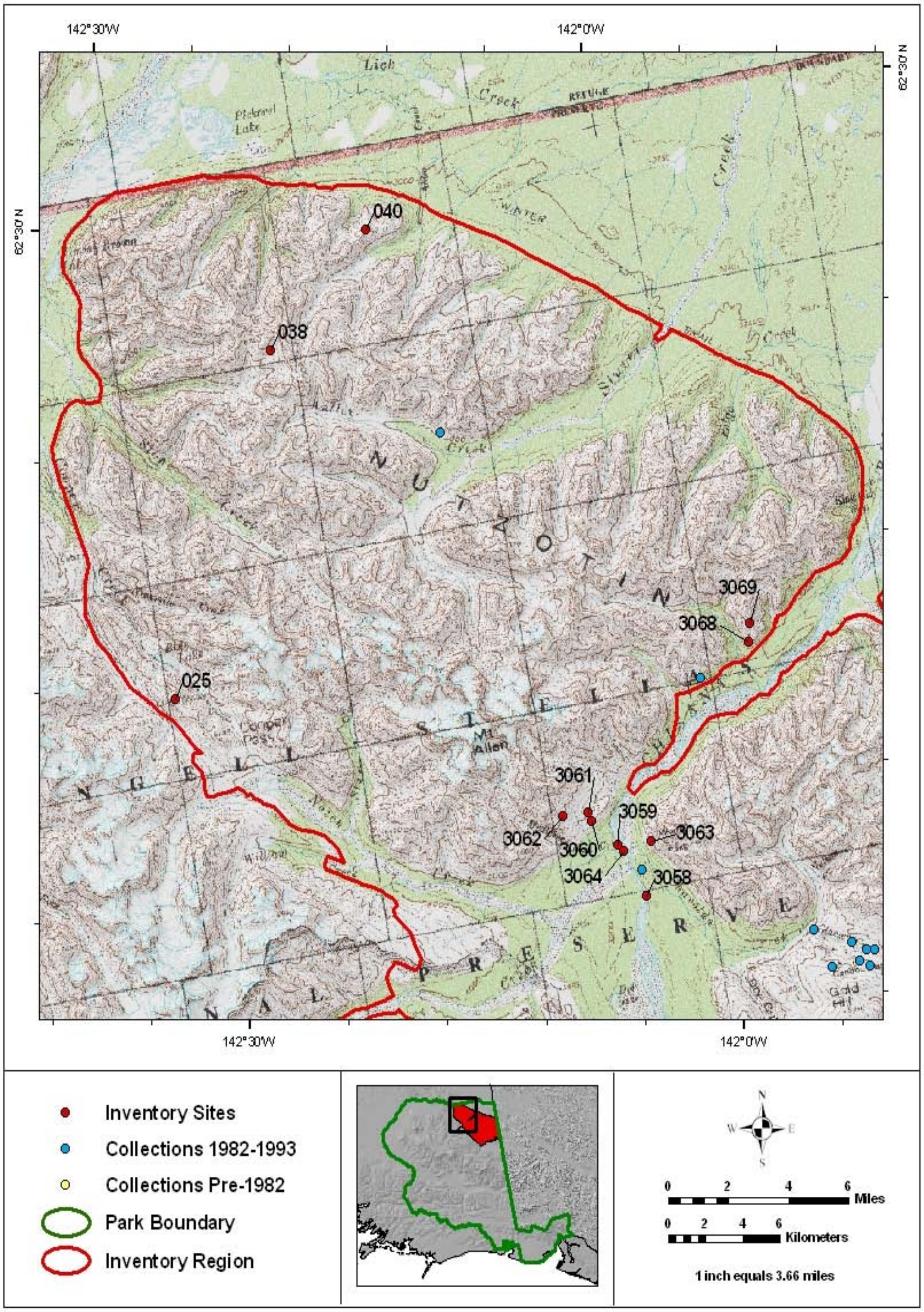
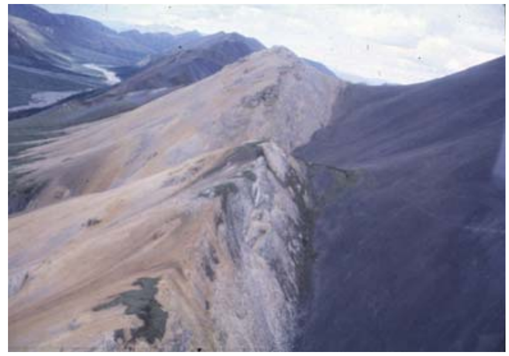


Figure 5.3b Nutzotin Mountains vascular plant inventory region (western section) associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Ptarmigan Lake from Wiki Basin (Site 62)



Baultoff Creek (Site 14)

Cooper Pass (Site 25)

Carl Creek ridge (Site 9)

Antler Creek basin (Site 38)

Lick Creek ridge (Site 40)

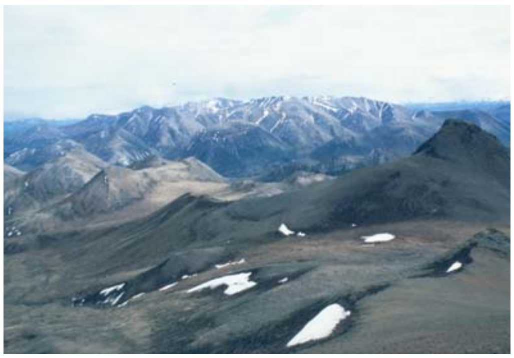
Rock Lake bluff (Site 61)

Flat Lake (Site 34)

Plate 5.3a. Representative vascular plant inventory sites in the Nutzotin Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Euchre Mt. in the foreground (Site 3005)

Braye Lakes (Site 198A)



Wiki Basin (Site 62)

Klein Creek ridge (Site 33)

Wiki Peak (Site 8)

Beaver Butte (Site 35)

Baultoff Creek (Site 14)

Horsfeld Creek lake (Site 196A)

Plate 5.3b. Representative vascular plant inventory sites in the Nutzotin Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

We surveyed 39 sites in the Nutzotin Mountains and collected 990 specimens (Figures 5.3a & 5.3b, Plates 5.3a & 5.3b and Tables 5.1 to 5.4). Although the number of sites ranked third highest for this region, the number per 100,000 IFA (4) was close to the average (5). This region had the highest number of collections of any region (990), over twice the average (389), but the number of collections per 100,000 IFA (105) was near the average (109). These collections documented one taxa new to the state of Alaska (*Botrychium lineare*), 55 taxa which were not known in the park prior to 1994 (five from the 2003 survey); 19 significant range extensions, 99 occurrences of 29 rare plant taxa and 57 endemic taxa. The endemic flora was comprised of 23 amphiberingian, 20 Alaska-Yukon and 14 cordilleran taxa.

The Nutzotin Mountains had the second highest actual number of new taxa to the park comprising 32% of the park's new flora, but it only had an average value (6) per 100,000 IFA. This region had the third highest number of significant range extensions but an average value (two) per 100,000 IFA. The Nutzotin Mountains had the highest actual numbers of new rare taxa and occurrences, but an average value of three taxa per 100,000 IFA and ten occurrences per 100,000 IFA, slightly higher than the average of six.

Eleven of the significant range extensions were new to the park. The significant range extensions documented from the Nutzotin Mountains were:

*Artemisia dracunculus**
*Botrychium ascendens**
*Botrychium lineare**
Callitriche anceps
Carex albonigra
*Carex obtosuta**
Cryptogramma stelleri
*Draba porsildii**
*Festuca brevissima**
Kobresia simpliciuscula
*Potentilla rubricaulis**
*Puccinellia vahliana**
*Rumex acetosa subsp. alpestris**
*Saxifraga bracteata**
*Selaginella sibirica**
Smelowskia calycina var. *integrifolia*
Smelowskia calycina var. *porsildii*
Taraxacum carneocoloratum
Trisetum sibiricum subsp. *litorale*

Twelve of the rare plant taxa in the Nutzotin Mountains are globally rare and 12 are also significant range extensions. Eleven of the rare taxa were new to the park. We did not collect specimens of two rare plants that occur in this region that were documented prior to this inventory: *Draba densifolia* (G3 S3) and *Maianthemum stellatum* (G5 S2) which are each only known from one locality in the park. These species are truly rare in the park since they were not found elsewhere during our inventory. The rare plants documented during this inventory from the Nutzotin Mountains were:

Aphragmus eschscholtzianus G3 S3
*Artemisia dracunculus** G5 S1S2
*Astragalus harringtonii** G5T3 S3
*Botrychium alaskense** G2G3 S2S3
*Botrychium ascendens** G2G3 S2
*Botrychium lineare** G1 S1
Carex holostoma G4? S2
*Carex phaeocephala** G4 S1S2
Chamaerhodos erecta subsp. *nuttallii* G5T5 S1S2
Cryptogramma stelleri G5 S2S3
Douglasia gormanii G3 S3
*Draba porsildii** G3G4 S1S2

Draba ruaxes G3 S3
Erigeron grandiflorus subsp. *arcticus* G4T3T4 S3
*Festuca lenensis** G4 S3
Minuartia biflora G5 S2
Montia bostockii G3 S3
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
Phacelia mollis G3 S2S3
*Phlox hoodii** G5 S1S2
Phlox sibirica subsp. *richardsonii* G4T2T3Q S2?
*Potentilla rubricaulis** G4 S2S3
*Puccinellia vahliana** G4 S2S3
Smelowskia calycina var. *porsildii* G5T2T3Q S2S3
Stellaria alaskana G3 S3
Stellaria umbellata G5 S2S3
Taraxacum carneocoloratum G3Q S3
Trisetum sibiricum subsp. *litorale* G5T4Q S2

The most notable collections from the Nutzotin Mountains were:

1. *Artemisia dracunculus* from Euchre Mountain (Site 3005), the only locality from the park and one of six localities in the state (Annotation Map 4).
2. *Botrychium ascendens* – from Gold Hill, the only locality in the park and one of four in the state (Annotation Map 63).
3. *Botrychium lineare* from the Chisana Airstrip (Site 3006) and Mt. Allen (Site 3060) a USFWS Candidate Species, the only Alaska locality, 230 km east of the Yukon population and 2,214 km disjunct from other North American populations (Annotation Map 64).
4. *Carex williamsii* – collected at the margin of a kettle lake in Horsfeld Creek (Site 196A) and the only collection from the park, this sedge is an amphiberingian arctic-alpine species that is rare in the Yukon Territory. This collection extends it range 205 km south from the Alaska Range (Cook and Roland 2002, Map 65).
5. *Coeoglossum viride* subsp. *viride* – collected at Lick Ridge (Site 40), this is the only locality for this subspecies in the park. The closest station is 366 km to the northwest in the Alaska Range. This subspecies (or variety according to Kartesz 1999) has a circumpolar arctic distribution and is known from only five other localities in the state. In North America is occurs in Alaska, Labrador, Newfoundland where it is rare (S2S3), Northwest Territories, Nunavat, Ontario where it is also rare (S2?) and Quebec. Although the University of Alaska Fairbanks Herbarium authorities accept this taxon, the Flora of North American authors do not (Flora of North America 2003).
6. *Douglasia gormanii* – was first documented in the park in 1967 in the High Wrangells and Northern St. Elias Mountains. We documented an additional 31 localities during our inventory, 16 of these in the Nutzotin Mountains. It is a rare Alaska-Yukon endemic whose distribution we now know to be centered on the park (Annotation Map 93).

7. *Festuca lenensis* – not known from the park prior to our inventory, it was collected from nine localities, seven of these in the Nutzotin Mountains. It is a rare amphiberingian arctic-alpine grass disjunct here from its primarily arctic distribution (Annotation Map 74).
8. *Montia bostockii* – when the park was established, this was the only rare species known. It was a USFS Category 2 in 1985 and a Category 3C in 1987. Prior to our inventory, it was known from five localities, we documented an additional 16 locations, six of these in the Nutzotin Mountains. Its distribution in Alaska is centered on the park (Annotation Map 86).
9. *Papaver radicatum* subsp. *kluanensis* – when this was first collected from Carl Creek in the Nutzotin Mountains, David F. Murray, the authority on the genus for North America, thought that this might be an undescribed taxon. Additional collections made during our inventory provided the material for Dr. Murray to develop the current treatment of the genus in the Flora of North America (2003). The specimens from Carl Creek had deep orange petals, which Dr. Murray recognizes as a color variant of *P. radicatum* subsp. *kluanensis*. This taxon is an Alaska-Yukon endemic with a narrow distribution centered on the park in the Nuztotin and Northern St. Elias Mountains (Annotation Map 70).
10. *Phlox richardsonii* – was collected first in the park in 1992 in the Nutzotin and Northern Wrangell Mountains. Our inventory documented it from an additional 15 localities, nine of these from the Nutzotin Mountains. It is a rare arctic-alpine Alaska-Yukon endemic with the southern extent of its Alaska distribution centered on the park in Alaska (Annotation Map 83).
11. *Potentilla furcata* – collected on a south-facing bluff on the Chisana River (Site 3060), 406 km south of the closest station in the Big Delta Quad, this species is a North American cordilleran endemic.
12. *Puccinellia vahliana* – collected at Copper Pass (Site 25), this circumpolar high arctic grass is known only from the arctic coast in Alaska except for our collection, 719 km to the south (Annotation Map 80).
13. *Potentilla rubricaulis* – is an arctic alpine species disjunct 900 km south from Northern Alaska and 235 km east of Yukon Territory collections. It was found at Euchre Mountain (Site 3005) in the Nutzotin Mountains and Granite Creek (Site 149) in the Northern Chugach Mountains (Annotation Map 98).
14. *Saxifraga bracteata* - disjunct from the coast by 259 km and the most interior locality in Alaska (Annotation Map 104).
15. *Saxifraga eschscholtzii* – collected on a ridge above the confluence of Edge Creek with the Chisana River (Site 3069), this is the only locality in the park. This collection extends the species' range 160 km south from the Alaska Range (Annotation Map 105).

16. *Taraxacum carneocoloratum* – this rare Alaska-Yukon endemic was first collected in the park in 1992 in the Nuzotin and Northern Wrangell Mountains. Our inventory documented an additional eight localities, four of these in the Nuztotin Mountains. Our collections are the western extent of its distribution in Alaska (Annotation Map 5).
17. *Trisetum sibiricum* subsp. *litorale* - from the Wiki Basin (Site 233) and 533 km south of the closest locality (Annotation Map 81).
18. *Smelowskia calycina* var. *porsildii* – is an arctic-alpine Alaska endemic disjunct from its arctic distribution by 794 km (Annotation Map 21).

Notable Sites/Plant Associations

The sites with the highest number of notable species in the Nutzotin Mountains were:

- <u>Euchre Mountain (Site 3005)</u> - a volcanic mountain near Chisana likely to have been a nunatak. Subalpine and alpine communities were surveyed here. There were 24 endemic species (12 amphiberingian, eight Alaska-Yukon and five cordilleran), 14 species new to the park, eight significant range extensions and six rare plant species.
- <u>Wiki Creek (Site 62)</u> – draining the southeast flank of Wiki Peak, the bedrock geology is Wrangell Lava. We surveyed alpine, sub-alpine, steppe bluff and wetland communities. This site had 12 endemic species, six species new to the park, five rare species and three significant range extensions.
- <u>Rock Lake (Site 30)</u> - a subarctic steppe bluff in a subalpine zone with Wrangell Lava lithology. There were 13 endemic species, nine species new to the park and four significant range extensions at this site.
- <u>Lick Ridge (Site 40)</u> - above Lick Creek in the northwest portion of the region and facing the Tanana Lowlands, the ridge is marine sedimentary with rock glacier deposits, alpine and subalpine plant communities. Nine endemic species were found here, seven rare species, seven species new to the park and five significant range extensions.
- <u>Carl Creek (Site 6)</u> - the southwest facing alpine slopes above Carl Creek with volcanic lithology. This site had ten endemic species, six species new to the park, five rare species and four significant range extensions.
- <u>Copper Pass (Site 25)</u> - a high elevation alpine locality in limestone, this site had 14 endemic species (six amphiberingian, six Alaska-Yukon and two cordilleran), five rare species, five species new to the park and one significant range extension.

Completeness of Inventory

Although there were high numbers of sites and collections in this area, the survey effort was average when evaluated by acreage. There were a high number of notables, but these values were also average when assessed by unit area. It is unlikely however, that the high number of

notables is due solely to survey effort, since survey effort per unit area was average. There remain large geographic gaps in this region, particularly in the northwest corner of the range between the Chisana and Nabesna Rivers. This area has difficult access with extremely precipitous ridges. Another geographic gap is the mountainous region between the Chisana River and Baultoff Creek. Numerous sites in this area were identified for the 2003 inventory, but we were not able to survey them. The southeast corner of the region between Rock Lake and Chisana is also poorly surveyed. In addition, we had hoped to survey Upper Sheep Creek where the only locality of *Smilacina stellata* had been found prior to our inventory, but were not able to do so.

Northern St. Elias Mountains

Description of Region

This region corresponds to the Northern St. Elias ecosection, is located south of the White River, north of the Chitina River and east of the Chitistone River and is underlain in large part by the Alexander Terrane . Four peaks over 10,000 ft (3050 m) dominate this precipitous mountainous area: Mt. Bona at 16,481 ft (5027 m), Mt. Churchill at 15,638 ft (4770 m), Mt. Natazhat at 13,435 ft (4098 m) and Mt. Sulzer at 10,926 ft (3332 m). The region covers 1,350,216.43 acres, 10.27% of the park's area, 8.42% of which is covered by ice, representing 8.42% of the ice-free area of the park. The Northern St. Elias Mountains are dominated by the volcanic rocks of the Churchill-Bona Massif, the Sulzer-Natazhat Mountains of older volcanic and sedimentary rocks and in the southwest by Wrangell lava, Nikolai greenstone and marine sedimentary rocks. The slopes of Mt. Natazhat have extensive areas of exposed volcanic ash, in some areas as deep as two feet (0.61 m). These deposits are from the eruption of Mt. Churchill 1900 and 1250 years before the present. There are extensive areas of limestone at Chitistone Mountain and between the Chitistone River and Dan Creek.

Focus of Survey

There were historical collections in this region made by David F. Murray on the north slopes of Mts. Natazhat and Sulzer in 1968 and by Hamilton M Laing in 1925 in the Upper Chitina Valley. In addition there were 18 FIREPRO collections, primarily in the mountains directly east of May Creek, but there were also a few made near Klutlan and Hawkins Glaciers. Our interests during this inventory were to survey the White River ash deposits at Mt. Natazhat and Cub Creek, the limestone regions near Chitistone Mountain and upper Dan Creek, the nunataks at the head of the Chitina River and to obtain some spatial coverage of this largely unsurveyed region.

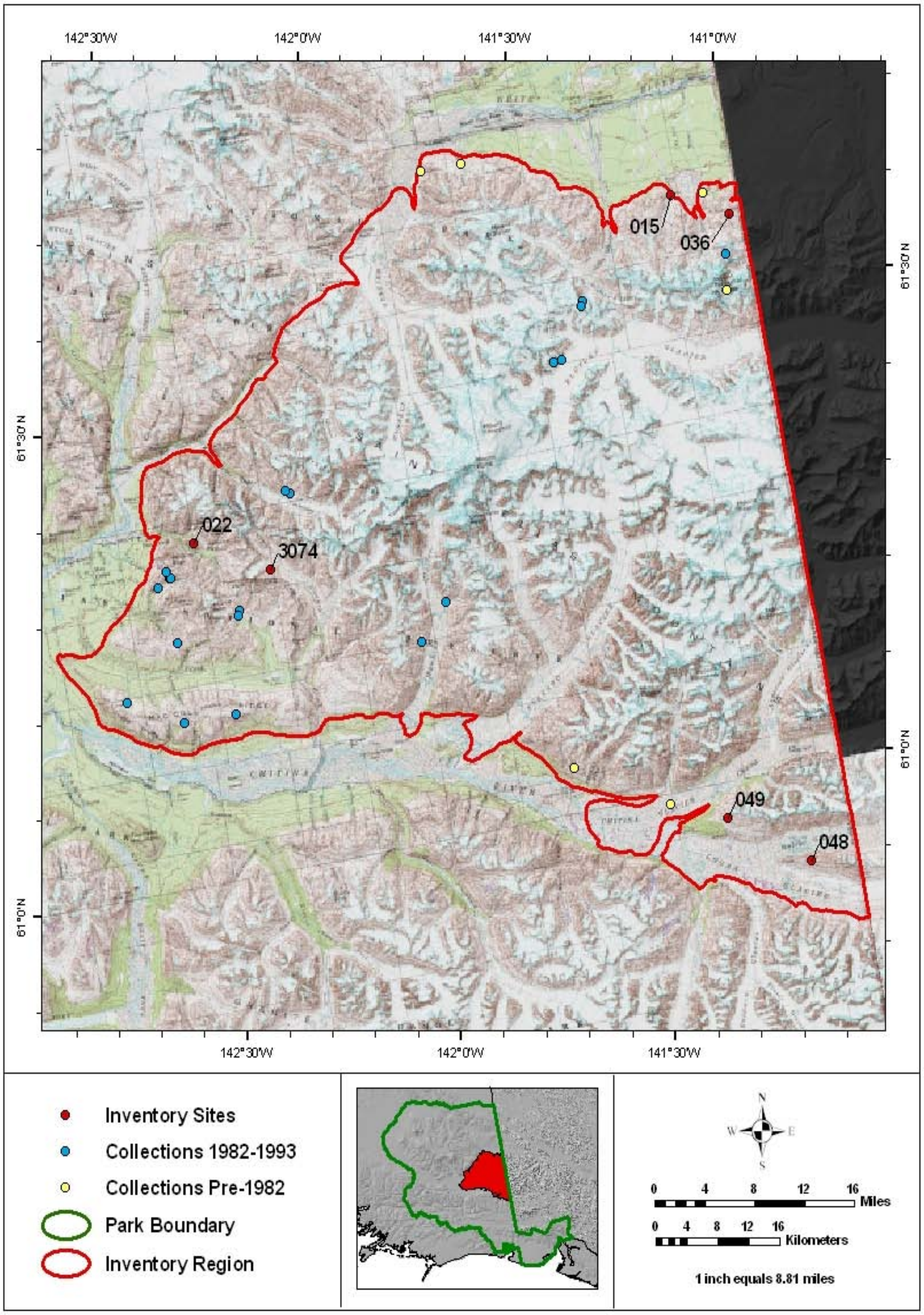


Figure 5.4 Northern St. Elias Mountains vascular plant inventory region, associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Cub Creek (Site 15)

Lime Butte (Site 22)

Mt. Chitina (Site 49)

Carl Roland, Mt. Natazhat (Site 36)

Blondie Ridge (Site 48)

Mt. Chitina (Site 49)

Mt. Chitina (Site 49)

Canyon Creek aerial (Site 3074)

Canyon Creek wetlands (Site 3074)

Plate 5.4. Vascular plant inventory sites in the northern St. Elias Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

We surveyed six sites in the Northern St. Elias Mountain region and collected 331 specimens which documented 190 taxa (Figure 5.4, Plate 5.4 and Tables 5.1 to 5.4). These specimens documented one taxa new to the state (*Arabis calderi*), 15 taxa which were not known in the park prior to 1994 (one from the 2003 survey); seven significant range extensions, 30 occurrences of 20 rare plant taxa and 44 endemic taxa. There were 17 Alaska-Yukon, 14 cordilleran and 13 amphiberingian endemic taxa in the Northern St. Elias Mountains.

The number of sites was less than half of the average for all regions, ranking 14, and representing only one site per 100,000 IFA. The number of collections was also below the average (331) and represented only 47 specimens per 100,000 IFA, much less than the average (121) per region. Although the number of new taxa was close to the average (27), there were only two new taxa per 100,000 IFA, less than half the average. The number of significant range extensions was close to the average but represented only one per 100,000 IFA. The number of rare taxa ranked fifth among regions and was above the average (11), but there were only three per 100,000 IFA. The number of rare occurrences also ranked fifth but there were only four per 100,000 IFA, less than the average (6). Four of the significant range extensions were new to the park. The significant range extensions from the Northern St. Elias Mountains were:

*Carex duriuscula**
*Danthonia intermedia**
*Douglasia arctica**
*Draba porsildii**
Silene menziesii
Smelowskia calycina var. *integrifolia*
Taraxacum carneocoloratum

Five of the significant range extensions are also rare and 13 of the 20 rare plant taxa from the Nutzotins are globally rare. Four of the rare taxa were new to the park. We did not collect specimens of two rare species documented prior to this inventory: *Juniperus horizontalis* and *Trisetum sibiricum* subsp. *litorale*. The rare plants documented during this inventory from the Northern St. Elias Mountains were:

Aphragmus eschscholtzianus G3 S3
*Arabis calderi** G3?Q S1
*Douglasia arctica** G3 S2S3
Douglasia gormanii G3 S3
*Draba incerta** G5 S2S3
*Draba porsildii** G3G4 S1S2
Draba ruaxes G3 S3
Erigeron grandiflorus subsp. *arcticus* G4T3T4 S3
Minuartia biflora G5 S2
Montia bostockii G3 S3
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
Phacelia mollis G3 S2S3
Rumex beringensis G3 S3
Saxifraga adscendens subsp. *oregonensis* G5T4T5 S2S3
Stellaria alaskana G3 S3
Stellaria umbellata G5 S2S3
Taraxacum carneocoloratum G3Q S3

The most notable collections from the Northern St. Elias Mountains were:

1. *Arabis calderi* - from Blondie Ridge (Site 48), new to the state and 1108 km disjunct from its distribution in Alberta (Annotation Map 8).
2. *Carex duriuscula* – the only collection of this amphiberingian sedge in the park is from upper Canyon Creek (Site 3074). This locality extends the range 328 km south from the Alaska Range (Annotation Map 37).
3. *Douglasia arctica* - from Mt. Natazhat (Site 36), an Alaska-Yukon endemic, known only from this locality in the park and disjunct 297 km from stations to the north in the Steese, White and Ogilvie Mountains (Annotation Map 92).

Notable Sites/Plant Associations

The sites within the Northern St. Elias Mountains that had the highest numbers of notables were:

- <u>Mt. Chitina (Site 49)</u> - This ridge is between the Chitina and Walsh Glaciers adjacent to the Yukon Territory and is primarily granite. Alpine and subalpine plant communities were surveyed resulting in the documentation of eight rare species, seven species new to the park, two significant range extensions and six endemic species (three cordilleran, two Alaska-Yukon and one amphiberingian).
- <u>Mt. Natazhat (Site 36)</u> - an area with extensive White River ash deposits adjacent to the Yukon territory. Alpine and sub-alpine communities were surveyed. Five rare species were found, three species new to the park, three significant range extensions and four endemics.
- <u>Blondie Ridge (Site 48)</u> - a nunatak between the Walsh and Logan glaciers which straddles the Canadian border, it is primarily marble. The notables from this site were: one species new to the state, five species new to the park, four significant range extensions, two rare species and three endemics (all cordilleran).
- <u>Canyon Creek (Site 3074)</u> - alpine and subalpine plant communities with a high proportion of wetlands, most of the area surveyed is greenstone. We documented six species new to the park, four rare species, two endemics (Alaska-Yukon) and one significant range extension.

Completeness of Inventory

In spite of a poor survey effort in this region, the second largest in the park, there were average absolute values for notables. The residual values in the regression analysis (Chapter 6) for the number of rare taxa found in relation to acreage and survey effort (sites and collections) indicated that the high number of rare plants found in this region is likely not due to survey effort since the per unit survey effort was so low. Surveying the geographic gaps in this region would most likely contribute additional taxa and notables to the flora of the park. Numerous sites identified for the 2003 inventory, were not surveyed. The access is extremely difficult in the interior of the region, even with the use of helicopter.

Northern Wrangell Foothills

Description of Region

This region corresponds to the Northern Wrangell Foothills ecosection except for that portion in the Upper Nabesna River below 3000 ft (914 m) which was included in the Tanana River Basin region for this study (Figure 5.5). The region extends from the upper Copper River east to the White River across the northern portion of the Wrangell Mountains. The Northern Wrangell Foothills covers 670,346 acres, 8.95% which is ice. It encompasses 5.10% of the park's area and 7.26% of the park's ice free area. Elevations range from 3000 to 9325 ft (subsp. to 2842 m) at the peak at the head of Cross Creek Glacier. The lithology between the Copper and Nabesna Rivers is volcanic. Between the Nabesna and White Rivers the volcanics are mixed with various instrusives including small areas of Nikolai Greenstone and limestone near Fish Creek in the Upper Nabesna River, in the vicinity of Bond Creek, between Notch and Cross Creeks and the ridge between the Chisana Glaciers and the White River.

Focus of Survey

The emphasis of our survey in this region was the high elevation plateaus in the upper Nabesna, Jacksina and Copper drainages, the upper Copper River floodplain and associated wetlands, and areas with limestone and greenstone lithologies. Prior to our inventory there had been 12 FIREPRO collections between the Copper and Nabesna Rivers and four collections on the ridge near Beaver Peak at the eastern end of the region. The later collections were the first documentation of *Taraxacum carneocoloratum* and *Smelowskia calycina* var. *porsildii* in the park. We revisited this ridge to look for additional populations of these plants and other associated rare taxa.

Summary of Results

We surveyed 11 sites in the Northern Wrangell Foothills and collected 415 vouchers (Figure 5.5, Plate 5.5 and Tables 5.1 to 5.4). These vouchers documented 198 taxa, 19 new to the park (one from the 2003 survey), ten significant range extensions, 24 occurrences of 15 rare taxa and 40 endemic taxa (19 amphiberingian, 15 Alaska-Yukon and six cordilleran).

The number of sites surveyed in this region was below the average (17) ranking 11 amongst regions and there were only two sites per 100,000 IFA, also below the average (5). Although the number of collections was above the average (389) there were only 68 collections per 100,000 IFA, almost half the average (121). The number of new taxa was much lower than the average (24) and there was only three new taxa per 100,000 IFA, one-third the average. The number of significant range extensions ranked fourth among regions and was near average but there was only two taxa per 100,000 IFA compared to the average of three. The numbers of rare taxa and occurrences were near the averages but the values for 100,000 IFA were less than the averages.

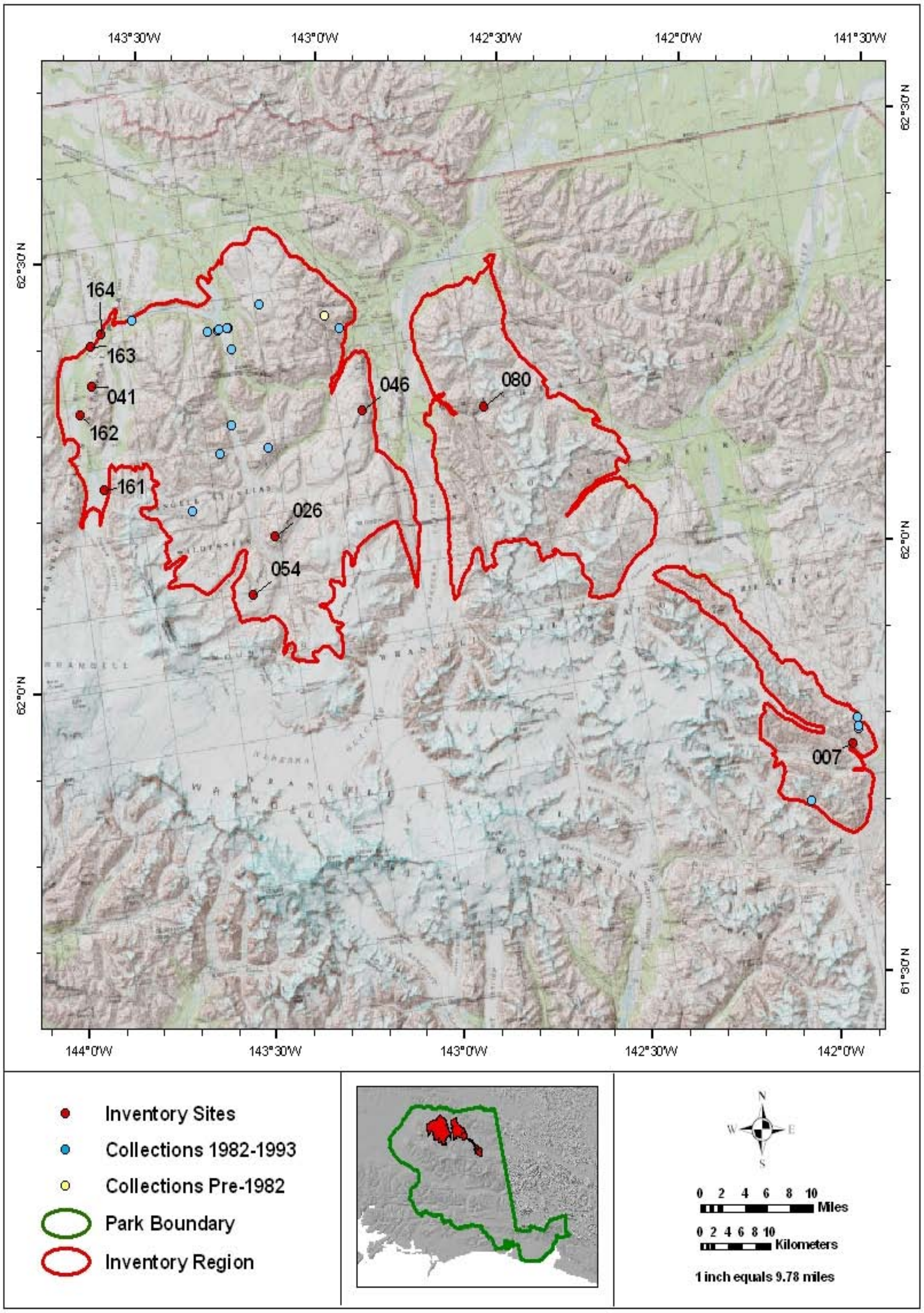
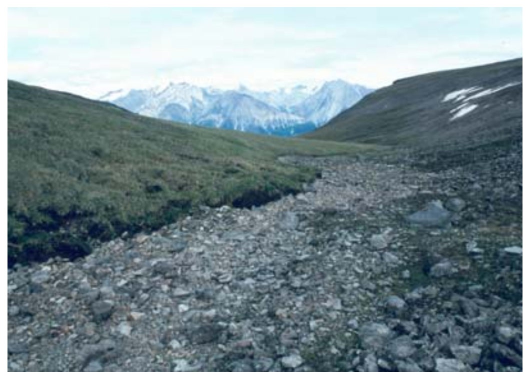


Figure 5.5. Northern Wrangell Mountain foothills vascular plant inventory region, associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Cone Ridge in foreground (Site 26)


Mesic tundra and basalt dome at Cone Ridge


Black Mountain (Site 41) from the Copper River


Jaegar Mesa (Site 46)


Lime Creek Ridge (Site 10)


Lakes Plateau (Site 54)

Plate 5.5. Representative vascular plant inventory sites in the northern Wrangell Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Two significant range extensions were new to the park. The significant range extensions documented during this inventory in the Northern Wrangell Foothills region were:

Braya purpurascens
Callitriche anceps
Carex microglochin
*Cerastium regelii**
Cryptogramma stelleri
Draba corymbosa
Draba macounii
*Selaginella sibirica**
Smelowskia calycina var. integrifolia

Three of the significant range extensions are also rare and ten of the rare plants are globally rare. One rare plant (Cerastium regelli) from this region was new to the park. The rare plants documented during this inventory in the Northern Wrangell Foothills region were:

Aphragmus eschscholtzianus G3 S3
*Cerastium regelii** G4Q S2S3
Cryptogramma stelleri G5 S2S3
Douglasia gormanii G3 S3
Draba ruaxes G3 S3
Minuartia biflora G5 S2
Montia bostockii G3 S3
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
Phacelia mollis G3 S2S3
Phlox sibirica
subsp. *richardsonii* G4T2T3Q S2?
Rumex beringensis G3 S3
Saxifraga nelsoniana
subsp. *porsildiana* G5T2T3Q
Smelowskia calycina
var. *porsildii* G5T2T3Q S2S3
Stellaria alaskana G3 S3
Taraxacum carneocoloratum G3Q S3

The most notable collections from the Northern Wrangell Foothills were:

1. *Cerastium regelii*, from the Lakes Plateau (Site 54). This is one of the rarest species is in the park. It is an arctic disjunct, separated by 1071 km from the closest population on Cape Newenham in Western Alaska (Annotation Map 25).
2. *Salix hastata* – collected along the upper Copper River near Black Mountain (Site 162), this is the only collection from the park. This locality is 171 km southeast of collections in the Alaska Range.
3. *Saxifraga nelsonii* subsp *porsildiana* – a rare amphiberingian arctic-alpine species collected at Jaegar Mesa in the Upper Jacksina River drainage (Site 46), this is the only known locality in the park (Annotation Map 106).
4. *Stellaria alaskana* – this rare Alaska-Yukon endemic was known from three localities prior to our inventory. We documented an additional twenty locations, seven of these from the Northern Wrangell Foothills.
5. The distribution of this species is centered on the Alaska Range and Wrangell-St. Elias Mountains (Annotation Map 28).

Notable Sites/Plant Association

The sites with the most notable species in the Northern Wrangell Foothills region were the high elevation (6200 - 6800 ft (1890 – 2073 m)) volcanic plateaus in the upper Jacksina River drainage: Jaegar Mesa (Site 46), Cone Ridge (Site 26) and Lakes Plateau (Site 54). Jaegar Mesa had extensive mesic tundra, Lakes Plateau had extensive lake associated wetlands, and Cone Ridge was dominated by rubble, gravel and boulder slopes. All three sites had six

endemic species. Jaegar Mesa had six rare species, five species new to the park and five significant range extensions. Lakes Plateau had eight species new to the park, five rare species and three significant range extensions. Cone Ridge had six rare species, three new to the park and one significant range extension.

Completeness of Inventory

The survey effort in this region was low but resulted in an average number of notables. A greater survey effort in this region, focusing on the geographic gaps and calcareous lithologies is likely to contribute to our knowledge of the flora. There have been no comprehensive inventories between the Upper Copper and the Jacksina River in the Northern Wrangell Foothills region. During a survey in 2001 for another project in the Goat Creek drainage (which flows into the Jacksina River) one rare plant (*Phlox richardsonii*) and one plant of limited distribution (*Viola biflora*) were found. The middle section of this region, between the Nabesna and Chisana Rivers had only one inventory site and many of the calcareous areas in this region have not been surveyed. We had also hoped to survey the western end of the Beaver Peak ridge since the eastern portion had so many notable plants.

High Wrangells

Description of Region

This region corresponds directly with the High Wrangells ecosection. It covers 1,440,615 acres, predominately ice (67.67%), covering 11% of the park and 5.5% of the park's ice-free area. It extends from Mt. Drum east to Russell Glacier and Chitistone Falls (Figure 5.6). Elevations range from 3000 ft (914 m) to 16,390 ft (4096 m) at Mt. Blackburn. The dominant lithologies are volcanic, colluvium, glacial till, igneous, andesite and dacite intrusives. There are areas of Chitistone and Nizina limestone and marine sedimentary rocks in the ridges between the upper Kuskulana River and Kennicott Glacier, sedimentary rocks east to the Fredrika Glacier, and shale, sandstone, and limestone near Chitistone Falls.

Focus of Survey

We were unable to survey the areas of primary interest in this region: nunataks and areas of calcareous lithologies (except for at Chitistone Falls). The sites that we did survey in this region were selected primarily because they were accessible, provided some spatial coverage and were close to other sites that had been selected.

Summary of Results

We surveyed five sites in the High Wrangells, three times less than the average (17) and one of the fewest for a region, ranking 15 and representing only one site per 100,000 IFA (Figure 5.6, Plate 5.6 and Tables 5.1 to 5.4). The number of collections was also low, 75 compared to the average of 389, ranking 17, with 16 specimens per 100,000 IFA. These collections documented 187 taxa, four new to the park (all from 1994-1997). This is also one of the lowest

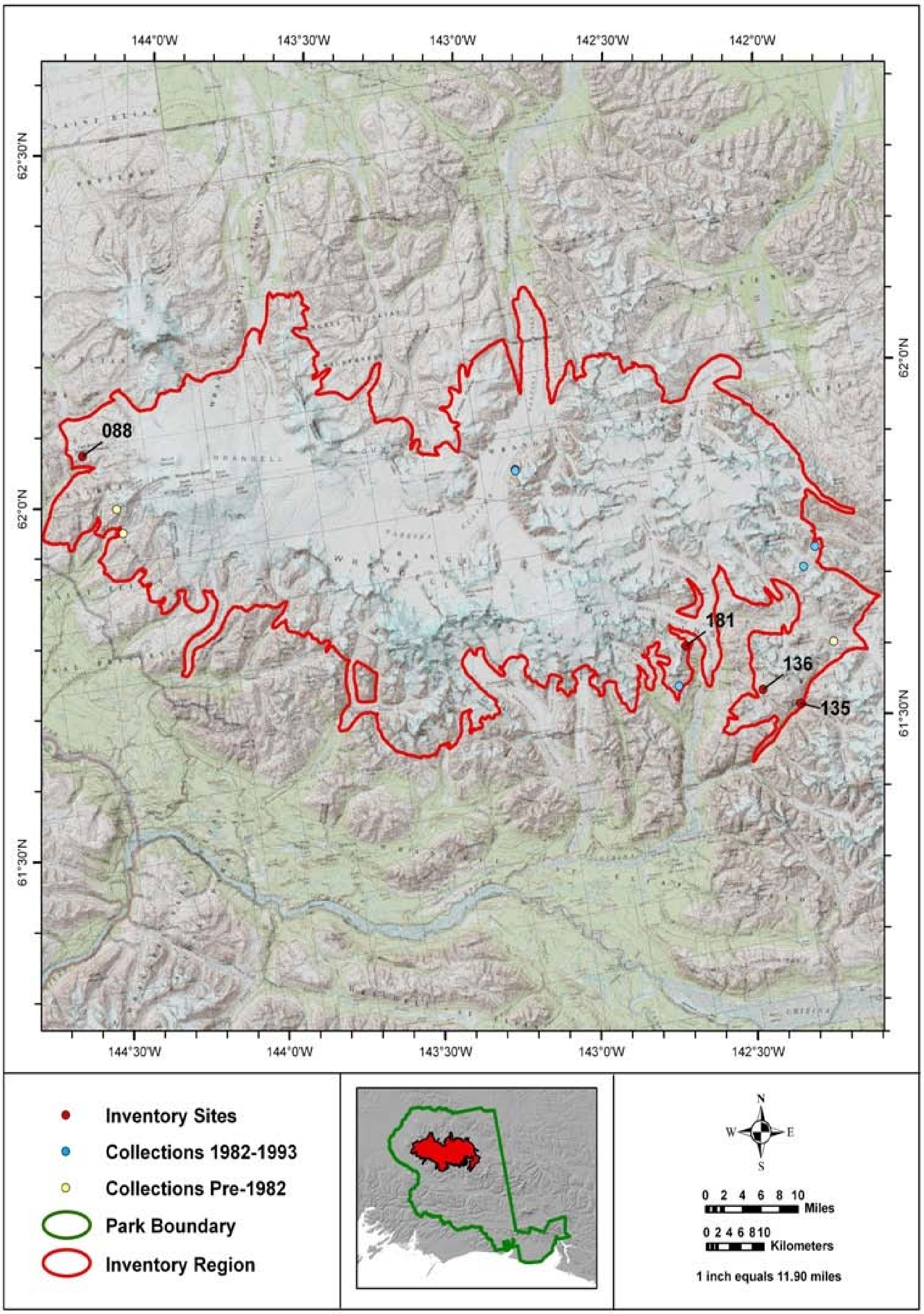
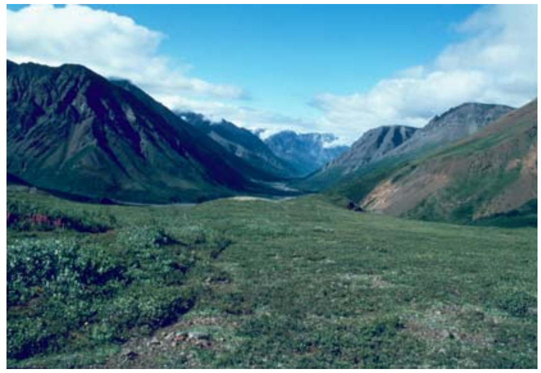


Figure 5.6. High Wrangell Mountains vascular plant inventory region, associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Upper Dadina (Site 88)


Hasen Creek (Site 136)


Nizina Glacier (Site 181)


Castilleja elegans - from the upper Dadina

Plate 5.6. Representative vascular plant inventory sites from the high Wrangell Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

values (seven times lower than the average). Thirty-eight endemics were documented: 20 amphiberingian, 11 Alaska-Yukon, six cordilleran and one Pacific Coastal. One significant range extension (*Castilleja elegans*) and one occurrence of one rare plant (*Botrychium alaskense* G2G3 S2S3) were documented during the inventory. Eleven rare taxa had been documented prior to our inventory in the High Wrangells (*Aphragmus eschscholtzianus, Douglasia gormanii, Draba praelta, D. ruaxes, Minuartia biflora, Oxytropis huddelsonii, Rumex beringensis, Saxifraga adscendens* subsp. *oregonensis, Stellaria alaskana* and *S. umbellata*).

Notable Sites/Plant Associations

Of the five sites surveyed in this region, Sentinel Ridge (Site 181), Hasen Creek (Site 136) and the upper Dadina (Site 88) had the most notables, although relative to the other regions, these values were low. The communities surveyed at these sites were alpine. The surficial geology at Hasen Creek and the upper Dadina is volcanic and Sentinel ridge is sedimentary. Sentinel ridge had five endemics, three rare and one species new to the park. The upper Dadina had four endemics, two significant range extensions and one rare species. Hasen Creek had two endemics, three rare species and one species new to the park.

Completeness of Inventory

Some of the only published collections from the park came from the eastern end of this region (Bonanza Ridge and Chitistone/Skolai Passes). We hoped to acquire better spatial coverage then represented by the previous collections, however we were not able to do so. This region had one of the lowest survey efforts by acreage (one site and 16 specimens per 100,000 IFA). The priorities for surveys in this region should be the nunataks, a number of which were identified for the 2003 inventory. Nunatak surveys would help clarify our understanding of plant dispersal at the end of the Wisconsin glaciation and are likely to reveal rare and endemic species.

Mts. Drum and Sanford

Description of Region

This region corresponds directly with the Mts. Drum and Sanford ecosection. It covers 509,361 acres, 22.52% which is ice. The region encompasses 3.87% of the park’s area and 4.70% of the park’s ice-free area. The region extends from the northern slopes of Capitol Mountain, east to the upper Copper River, south to the Dadina River and west to the 3000 ft (914 m) contour level on the flanks of Mts. Drum and Sanford (Figure 5.7). The lithology of the region is volcanic with pyroclastic and shield lava flows, volcanic domes, andesite plugs and some minor areas of intrusive and sedimentary rocks. The lower slopes of the mountains are primarily surficial drift from the Pleistocene glaciation.

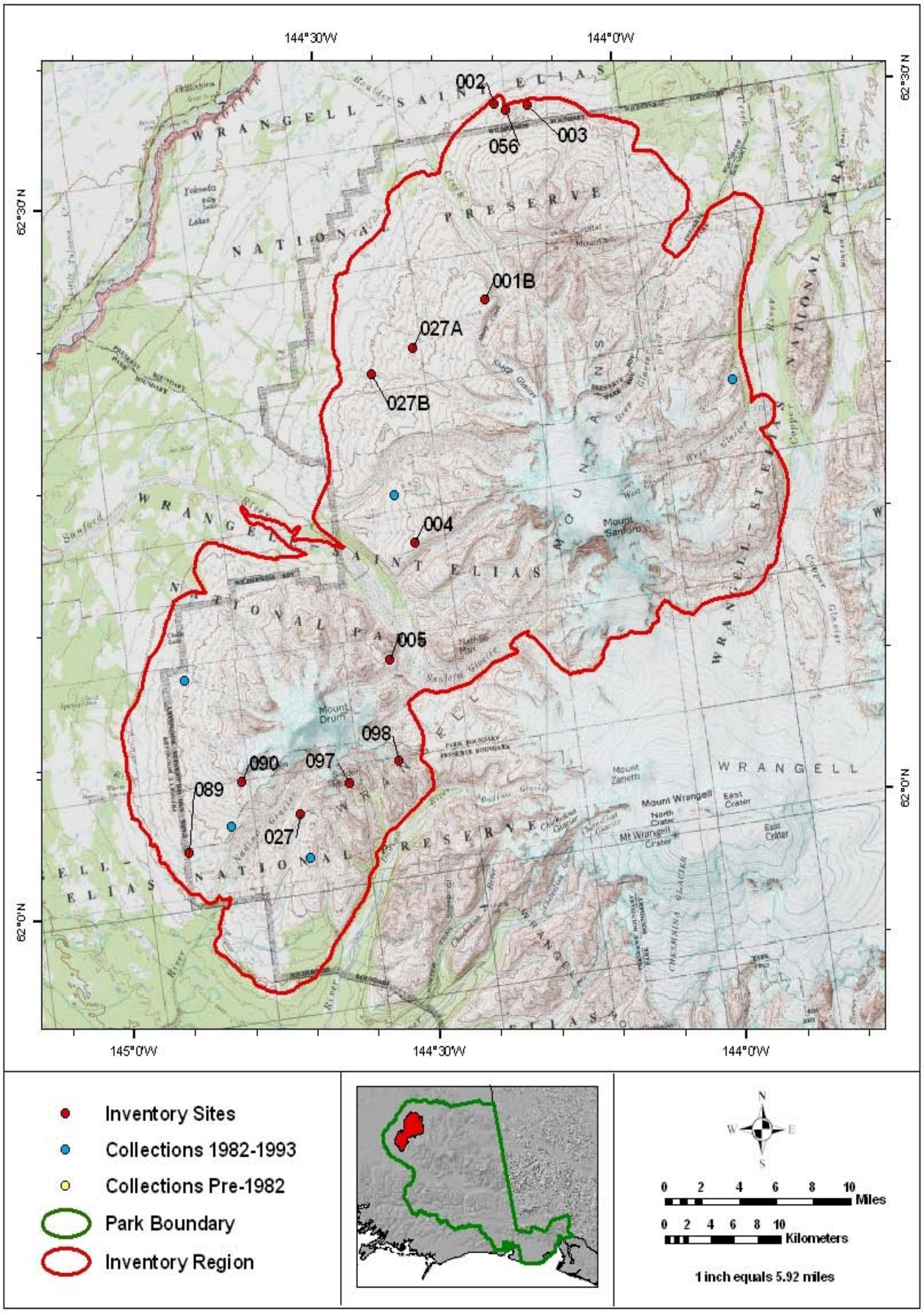


Figure 5.7. Mts. Drum and Sanford vascular plant inventory region, associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Ruddy Mt (Site 90)


Synder Peak (Site 97)


Synder Peak (Site 98)


Mt. Drum Lake (Site 89)


Mt. Sanford, SW slopes (Site 4)


Nadina Glacier (Site 27)

Plate 5.7. Representative vascular plant inventory sites in the Mts. Drum and Sanford region, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Focus of Survey

We tried to survey the spatial extent of this region, varying elevations, aspects and types of volcanic substrate.

Summary of Results

We surveyed 13 sites in the Mts. Drum and Sanford region and made 105 collections (Figure 5.7, Plate 5.7 and Tables 5.1 to 5.4). These collections documented 127 taxa, 12 taxa new to the park, five significant range extensions, 14 occurrences of eight rare plants and 30 endemics (16 amphiberingian, 11 Alaska-Yukon and three cordilleran species). The number of sites was close to the average (17), ranked ninth among regions, and represented only three sites per 100,000 IFA (below the average of five). The number of collections was less than one third of the average and represented 27 collections per 100,000 IFA (less than a quarter of the average) The number of range extensions, rare taxa and occurrences were below the averages (actual and per unit area).

The significant range extensions documented in the Mts Drum and Sanford Region were: *Castilleja elegans, Festuca lenensis, Phlox sibirica* subsp. *richardsonii* and *Smelowskia calycina* var. *integrifolia*. Only one species (*Festuca lenensis*) was new to the park and none of the rare taxa from this region were new to the park. Two of the range extensions are rare and seven of the rare plants are globally rare. The rare plants documented in the Mts. Drum and Sanford Region were:

Aphragmus eschscholtzianus G3 S3
Douglasia gormanii G3 S3
*Festuca lenensis** G4 S3
Montia bostockii G3 S3
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
Phlox sibirica subsp. *richardsonii* G4T2T3Q S2?
Rumex beringensis G3 S3
Stellaria alaskana G3 S3

The most notable species from this region were:

1. *Draba stenopetala* – this amphiberingian endemic with an arctic-alpine distribution was known from three localities in the park prior to our inventory. We documented an additional 26 localities, seven of these from the Mts. Drum and Sanford region. Prior to our inventory it was ranked G3 S2 by the AKNHP, it is now ranked G3 S3S4 largely due to our survey effort (Annotation Map 18).
2. *Rumex beringensis* – is another amphiberingian endemic with an arctic-alpine distribution whose distribution is centered on the Mts. Drum and Sanford region in the park (Annotation Map 84). Prior to our inventory it was known from three localities. We documented an additional 15 localities, six of these in the Mts. Drum and Sanford region. The park collections are the western extent of its distribution in North America.

Notable Sites/Plant Associations

The sites with the most notable species in the Mts. Drum and Sanford region were:

- Mt. Drum (Site 5) - on the northeast slope of Mt. Drum near the toe of the Sanford Glacier, this is an alpine site with volcanic lithologies (dacite domes and flows) and drift of an intermediate glaciation. The surveyed communities include dwarf scrub, scree slopes and ericaceous tundra. There is a suite of rare species that are found in the rocky alpine areas of the Western Wrangell Mountains, all of which were found here: *Douglasia gormanii*, *Draba stenopetala*, *Rumex beringensis* and *F. lenensis*. *Phylldoce aleutica* subsp. *glanduliflora* is disjunct here from its primarily coastal distribution. Four endemics, four rare species, two species new to the park and five significant range extensions were found here.
- Synder Peak (Sites 97 & 98) - volcanic flows, breccias, tuff and alluvium from the Alaska glaciation occur on the slopes of Synder Peak. Fellfields, mesic tundra, snowbeds and riparian seeps were surveyed here. The notable species found included seven endemics (four amphiberingian, and three Alaska-Yukon), four rare species, one species new to the park and three significant range extensions. *Castilleja elegans* and *Cassiope stelleriana* were two species with a coastal distribution that were found here.
- Nadina Glacier (Site 27) - is an alpine site with volcanic avalanche deposits. Mesic tundra and forb meadows were surveyed. Four endemic species (two amphiberingian, two cordilleran), three significant range extensions and one species new to park were documented by specimens. Coastal species found at this site included: *Castilleja elegans*, *Cassiope stelleriana*, *Hieracium triste* and *Juncus drummondii*.
- Ruddy Mountain (Site 90) – is another alpine site with volcanic and drift of Alaska glaciation lithologies. We surveyed morainal deposits, dry stony tundra, boulder slopes and debri slopes composed of cinders. Six endemic species (three Alaska-Yukon and three amphiberingian), and two rare species (*Douglasia gormanii* and *Oxytropis huddelsonii*), one species new to the park and one significant range extension were found here.

Completeness of Inventory

The survey effort in this region was below the average, both actual and by unit area. The number of notables was also less than average. The number of rare taxa found in this region fits the predicted linear relationships with acreage and survey effort (Chapter 6), so we could predict more notables with greater survey effort. Geographic gaps remain in this region on the east side of Mount Sanford between Copper Glacier and Capital Mountain where no surveys were made, on the north flank of Mount Drum and in the wetland areas at the extreme southern tip of the region on the south flank of Mount ***Drum.*** A FIREPRO collection made near West Glacier in 1992 by Mike Duffy on the east flank of Mt. Sanford, is the first documentation of the amphiberingian endemic, Rumex beringensis, in the park. This area would be worthy of further surveys for additional populations of endemic and rare taxa.

Southern Wrangell Foothills

Description of Region

This region corresponds with the Southern Wrangell Foothills ecosection except for the portions of the Kotsina, Kuskulana, Gilihina and Nizina River drainages below 3000 ft (914 m) which have been included in the Chitina River Basin for this study (Figure 5.8). The region extends from the Dadina River east to the Chitistone River along the southern slopes of the Wrangell Mountains. The Southern Wrangell Foothills region encompasses 630,979 acres, 11.16% of this ice. The region covers 4.8% of the park's total area and 6.67% of the park's ice-free area. The lithology of this region is the most complex of any region in the park. There are extensive areas of limestone and greenstone between the Kuskulana and Kotsina Rivers, between the Kuskulana and Kennicott Glacier and between the Root Glacier and the Chitistone River. There are also lava flows, marine sedimentary rocks and some areas with intrusive rocks such and gabbro and orthogneiss.

Focus of Survey

We attempted to survey the spatial extent of this region, the various calcareous and volcanic lithologies, aspects and elevations. Landforms of particular interest were the long, high elevation plateaus on the southern flanks of Mt. Wrangell and the isolated mountains in the Chitina Valley (Crystalline Hills, Chokosna ridge). A population of the rare Alaska-Yukon endemic, *Thlaspi arcticum*, had been found in 1991 by Mike Duffy during FIREPRO vegetation mapping on Iron Mountain. We surveyed similar habitat in the vicinity of Iron Mt. looking for additional populations of this species and other rare and endemic taxa that were associated with it.

Summary of Results

Nineteen sites were surveyed in the Southern Wrangell Foothills region, this is a little above the average (17), ranking seventh and representing three sites per 100,000 IFA, 60% of the average (Figure 5.8, Plate 5.8 and Tables 5.1 to 5.4). We collected 553 specimens, greater than the average (389), ranking fourth, but representing only 99 specimens per 100,000 IFA, 82% of the average (121). These collections documented 336 taxa, 28 taxa new to the park (one from the 2003 survey), ten significant range extensions, 55 occurrences of 20 rare plant taxa and 60 endemics (24 amphiberingian, 17 Alaska-Yukon, 15 cordilleran and four Pacific Coastal). The numbers of new taxa and significant range extensions were slightly above average. The numbers of rare taxa and occurrences were more than twice the averages, ranking fourth and third, respectively. The per unit area values were average for the significant range extensions and rare taxa, below the average for taxa new to the park and above average for rare occurrences.

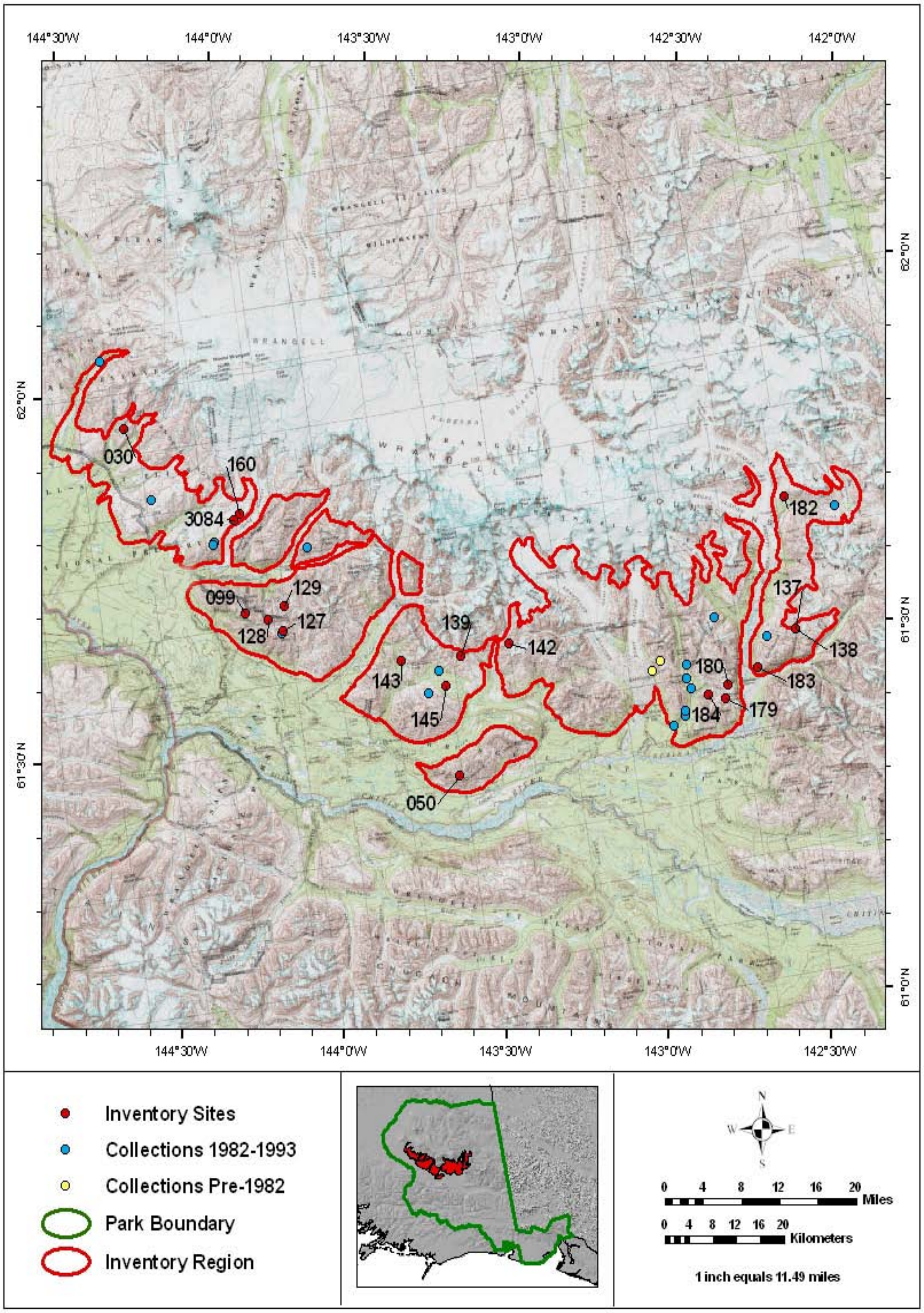


Figure 5.8. Southern Wrangell Mountain foothills vascular plant inventory region, associated 1994-1997 survey and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Iron Mountain (Site 172)


Grotto Creek (Site 137)


Mill Creek (Site 139)


Castle Peak Valley (Site 142)


Gilihina wetlands (Site 145)


Cheshnina Plateau (Site 160)


Nikolai Pass (Site 179)


Chetaslina Plateau (Site 30)

Plate 5.8. Representative vascular plant inventory sites in the southern Wrangell Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

The significant range extensions (four new to the park) documented in the Southern Wrangell Foothills were:

*Arnica mollis**	*Festuca brevissima*
Botrychium pinnatum	*Oxytropis campestris* subsp. *jordalii**
Castilleja elegans	*Selaginella sibirica**
Collomia linearis	*Taraxacum carneocolratum*
Draba corymbosa	*Viola selkirkii*

Four of the 20 rare plants from the Southern Wrangell Foothills region are also significant range extensions, twelve are globally rare and five were new to the park. The rare plants documented during this inventory were:

Aphragmus eschscholtzianus G3 S3	*Minuartia biflora* G5 S2
*Arnica mollis** G5 S1	*Oxytropis huddelsonii* G3 S2S3
*Botrychium alaskense** G2G3 S2S3	*Papaver alboroseum* G3G4 S3
Castilleja miniata G3 S3	*Poa leptocoma** G5 S2
Douglasia alaskana G2G3 S2S3	*Rumex beringensis* G3 S3
Douglasia gormanii G3 S3	*Saxifraga adscendens* subsp. *oregonensis* G5T4T5 S2S3
*Draba incerta** G5 S2S3	*Stellaria alaskana* G3 S3
Draba ruaxes G3 S3	*Taraxacum carneocoloratum* G3Q S3
Erigeron grandiflorus subsp. *arcticus* G4T3T4 S3	*Thlaspi arcticum* G3 S3
Juniperus horizontalis G5 S1S2	*Viola selkirkii** G5? S3

The most notable collections from the Southern Wrangell Foothills region were:

1. *Aphragmus eschscholtzianus* – collected from one locality in the High Wrangells prior to our inventory, we documented an additional 32 localities during our inventory, 14 of these from the Southern Wrangell Mountain region. It is an Alaska Yukon endemic whose distribution now appears to be centered on the park (Annotation Map 7).
2. *Arnica mollis* – from Mill Creek (Site 139), is known from only five other localities in the state. This collection connects its range 265 to the west in the Anchorage Quad with its distribution 445 km to the west in the Yukon Territory (Annotation Map 3).
3. *Botrychium cf. hesperium* – the authority on this genus, Donald Farrar at Iowa State University, did not have enough material to complete his electrophoretic study of our 1996 collections from Chetaslina Ridge (Site 160). We returned to make additional collections in 2003 but the phenology was too early and the populations could not be relocated. If this determination is verified, it would be a new record for Alaska and disjunct from British Columbia, Washington and Montana.
4. *Castilleja miniata* – documented from six localities in the park, the collection from Fireweed Mountain is the most interior collection of this coastal paintbrush within the state (Annotation Map 109).
5. *Douglasia alaskana* – another of the truly rare plants in the park, it is known only from Elliot Creek in the park (Site 128, Annotation Map 91).

6. *Papaver alboroseum* – known from three localities in the park prior to our inventory, we documented an additional 16 locations of this rare amphiberingian artic-alpine species, nine of these from the Southern Wrangell Mountain region. The western extent of this species' distribution in Alaska is in the park where more than half of the known populations are found (Annotation Map 69).
7. *Potentilla biflora* – known from 7 locations prior to our inventory, we documented an additional 21 locations of this amphiberingian arctic-alpine species, nine of these in the Southern Wrangell Mountain region (Annotation Map 96).
8. *Thlaspi arcticum* –first collected by Mike Duffy in 1991, this species is still only known from Iron Mountain (Site 127) and is one of the rarest plants in the park (Annotation Map 22).
9. *Viola renifolia* var. *brainerdii* – collected at Fireweed Mountain near McCarthy, this is the only collection from the park. This locality connects its distribution 178 km to the southwest on the Copper River Delta with Yukon collections 349 km to the east (Annotation Map 114).

Notable Sites/Plant Associations

The most interesting sites within the Southern Wrangell Foothills with regard to notable collections include the following.

- Nikolai Pass and Ridge (Sites 179, 180 & 184) – These are alpine sites with Nikolai greenstone, basaltic lava and felsic hypabyssal lithologies. We surveyed moist meadows, dry tundra and scree slopes and documented 34 notable plant species. There were 28 endemic species (14 amphiberingian, ten Alaska-Yukon and four cordilleran), seven rare species, seven species new to the park and five significant range extensions.
- Cheshnina Plateau (Sites 160 & 3084) - a southwest trending alpine plateau on the slopes of Mount Wrangell with volcanic and surficial deposits. This was the site of *Botrychium* cf. *hesperium*, 11 endemic species, seven rare species, eight significant range extensions and 11 species new to the park.
- Crystalline Hills (Site 50) - an alpine site with metamorphic marble lithologies, it is an island separated from the rest of the southern Wrangell Foothills. We surveyed dwarf scrub tundra, barren gravel and scree slopes, bryoid moss and wet seep communities. There were 18 endemic species here, eight rare species, six significant range extensions and four species new to the park.
- Chetaslina Ridge (Site 30) - this ridge on the slopes of Mt. Wrangell is primarily lava with a diversity of alpine communities. We documented 11 endemic species, three rare species, and five significant range extensions at this site.
- Iron Mountain (Site 127) - this is an alpine site of volcanic scree. There were 11 endemic species, five rare species (*Aphgramus eschscholtzianus*, *Draba ruaxes*,

Thlaspi arcticum, Papaver alboroseum and *Saxifraga adescendens* subsp. *oregonensis*), one species new to the park and two significant range extensions.

- Castle Peak (Site 142) - this is a high alpine basin in limestone. There were nine endemic species (three Pacific Coastal, three cordilleran, two amphiberingian and one Alaska-Yukon), four rare species, one significant range extension and three species new to the park's flora.
- Grotto Creek (Sites 137 & 138) - an alpine site on limestone, we documented eight endemic species, five rare species, and one species new to the park.

Completeness of Inventory

There were more than two times the average of rare plants in this region when compared with other regions. Also, the numbers of notables in this region per unit area were either average or greater than average. Yet, the per unit survey effort in this region was 60-82% of the average. The standardized residual for the linear relationship between collections and rare plants in this region was less than one, indicating that more rare plants were predicted to occur here based on the number of collections. But based on acreage and number of sites, more rare plants were found in this region than predicted. Since survey effort was lower than average, it is likely that the high number of notables here is less related to survey effort than to other factors.

This region is of particular interest due to its location in the transitional area between the coastal and interior regions. A number of notables were coastal disjuncts and more coastal plants are likely to be found with continued specimen documentation. There are extensive areas of calcareous lithology that were not surveyed in this region, as well as habitat for *Thlaspi arcticum.* The geographic gaps in this region include: the extensive plateau with high elevation wetlands between the Cheshnina River and Long Glacier, the ridge between Long Glacier and the Kluvesna River, the isolated mountain between the Chokosna and Gilahina Rivers and the mountainous terrane between the Lakina Glacier and Bonanza Ridge. Populations of *Botrychium* cf. *hesperium* at Chetaslina Ridge should be re-surveyed late in the season and specimens sent to Donald Farrar (ISC) for electrophoresis.

Northern Chugach Mountains

Description of Region

This region corresponds to the Northern Chugach Mountains ecosection except for the portions of the Tana, Granite and Hanagita Rivers that are below 3000 ft (914 m) and classified into the Chitina River Basin, and the portion of the Bremner River below 3000 ft (914 m) which is part of the lower Copper River basin region in this study). The region is bounded on the north by the Chitina River, on the south by the Bagley Icefield and extends from the Copper River in the west to the Yukon border in the east (Figures 5.9a and 5.9b). The portion of the Chugach Mountains in the park east of the Tana River is referred to as the Granite Range. The Northern Chugach Mountains is the largest region in the park encompassing 1,994,038 acres, 26.44%

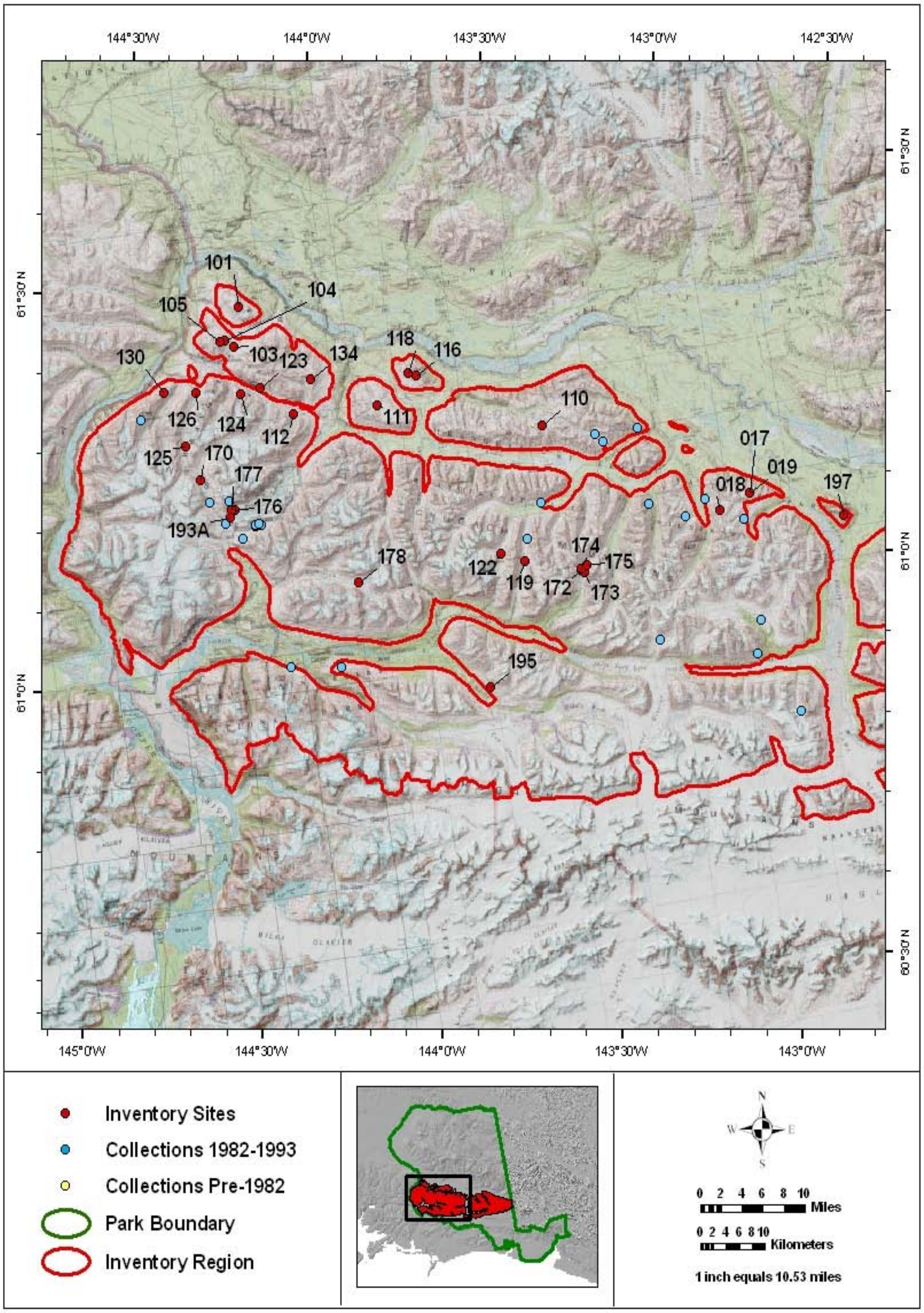


Figure 5.9a. Northern Chugach Mountains vascular plant inventory region (western section), associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

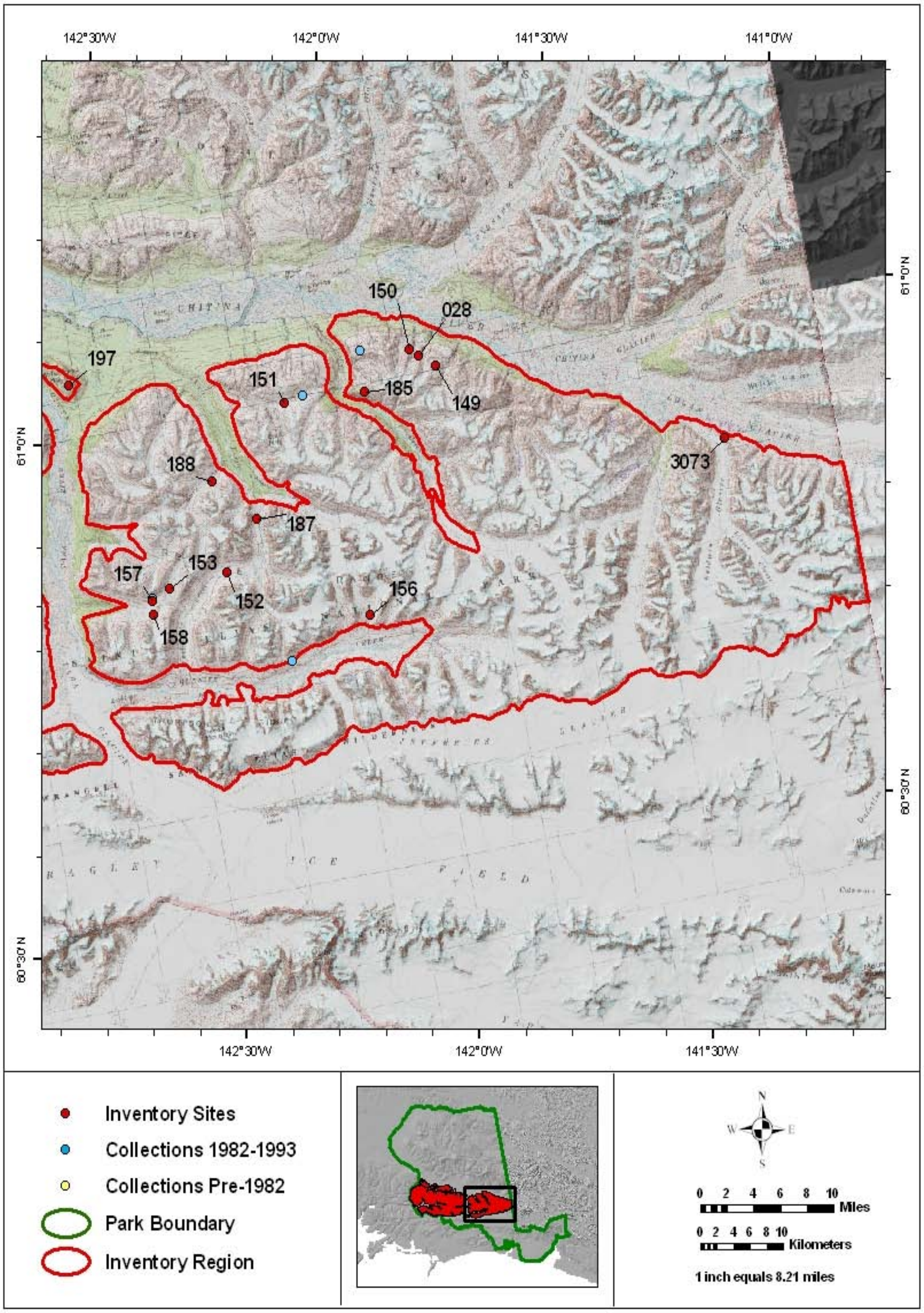


Figure 5.9b. Northern Chugach Mountains vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

West Fork Goat Creek (Site 151)

Martin Creek (Site 188)

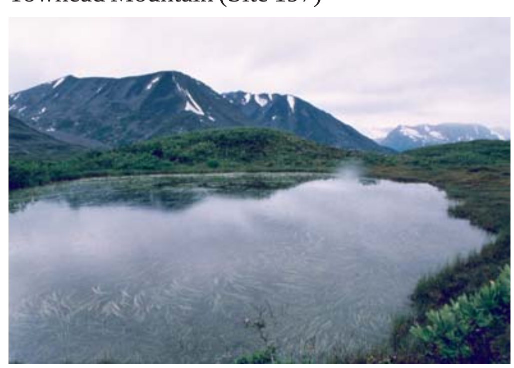
Les Viereck at Golchonda Creek (Site 172)

Canyon Creek Ridge (Site 123)

Upper Canyon Creek (Site 124)

Towhead Mountain (Site 197)

Mary Beth Cook collecting *Arabis codyi*, a species new to Alaska, on the ridge above Iron Creek.



Twelve Mile Basin (Site 158)

Plate 5.9. Representative vascular plant inventory sites in the northern Chugach Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

which is ice. The Border Ranges fault runs along the northern portion of this region. North of the fault is primarily metamorphic rocks with localized marble and Chitina Valley batholith intrusive units. South of the Border Ranges are greenschist, amphibolite, gneiss and schist lithologies. There are units of limestone and greenstone between the Copper River and Nerelna Creek and limestone between Goat and Quartz Creeks adjacent to the Chitina River in the Granite Range.

Focus of Survey

We tried to survey as many of the calcareous units as possible in this region. As with other regions we also tried to represent the spatial extent, varying elevations, slopes, moisture regimes and unique landforms such at Towhead Mountain, a monadnock in the Tana River.

Summary of Results

We surveyed 44 sites in the Northern Chugach Mountains (Figures 5.9a & 5.9b, Plate 5.9 and Tables 5.1 to 5.4). This was more than twice the average and the second highest number among regions, but only representing three sites per 100,000 IFA (less than the average). We collected 925 specimens, also the second highest among regions and almost three times the average but representing only 63 specimens per 100,000 IFA (also less than half of the average). These collections documented 318 taxa, four species new to the state (*Arabis calderi*, *A. codyi*, *A. drepanoloba*, and *Festuca minutiflora*), 39 taxa new to the park (two from the 2003 survey), 22 significant range extensions, 52 occurrences of 23 rare plant taxa and 68 endemics (25 amphiberingian, 21 cordilleran, 12 Alaska-Yukon and 10 Pacific Coastal).

There is a high number of notable species in this region in spite of a lower than average survey effort per unit area. This is the only region with more than two species new to the state. The Chitina River Basin had two species new to the state and four other regions had one species new to the state. The number of taxa new to the park ranked fifth among all regions. The numbers of significant range extensions and rare taxa ranked second and were more than twice the averages. The number of rare occurrences was also more than twice the average and ranked fourth among regions. The per unit values for the notables (new to park, range extensions, rare occurrences and taxa) were lower than the averages due to the large size of this region (the largest region in the park and 17% of the ice-free area).

The range extensions (ten new to the park) documented in the Northern Chugach Mountains were:

Antennaria rosea subsp. *arida*
Botrychium pinnatum
Callitriche anceps
Carex nigricans
*Carex obtusata**
Carex praticola
*Carex stylosa**
Cassiope mertensiana
Cryptogramma sitchensis
*Delphinium brachycentrum**
Draba corymbosa
*Draba kananaskis**
*Festuca brevissima**
Festuca saximontana
*Juncus filiformis**
Phyllodoce aleutica subsp. *glanduliflora*

Potentilla drummondii
*Potentilla rubricaulis**
*Selaginella sibirica**
Silene menziesii
*Taraxacum phymatocarpum**
Vahlodea atropurpurea subsp. *paramushirensis*

Four of the significant range extensions are also rare, eight of the rare taxa are globally rare, and ten of the rare taxa were new to the park. One rare species, *Agoseris glauca* (G5 S1) was collected prior to this inventory. *Douglasia alaskana* (G2G3 S2S3) was collected at two localities in the Northern Chugach Mountains just outside of the park during the inventory. The rare plant taxa documented during this inventory in the Northern Chugach Mountains were:

Agrostis thurberiana G5Q S2
Aphragmus eschscholtzianus G3 S3
*Arabis calderi** G3?Q S1
*Arabis codyi** G1G2 S1
*Arabis drepanoloba** G5T4? S1?
Astragalus harringtonii G5T3 S3
Carex lenticularis
var. *dolia** G5T3Q S3
*Carex phaeocephala** G4 S1S2
Castilleja miniata G3 S3
*Draba incerta** G5 S2S3
*Draba kananaskis** G1Q S1
*Draba porsildii** G3G4 S1S2
Draba ruaxes G3 S3
Erigeron grandiflorus
subsp.*arcticus* G4T3T4 S3
*Festuca minutiflora** G5 S1
Juniperus horizontalis G5 S1S2
Minuartia biflora G5 S2
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
Potentilla drummondii G5 S2
*Potentilla rubricaulis** G4 S2S3
Saxifraga adscendens
subsp. *oregonensis* G5T4T5 S2S3
Stellaria umbellata G5 S2S3

The most notable collections from this region were:

1. *Antennaria rosea* subsp. *arida* – from Upper Canyon Creek (Site 123), a North American cordilleran species new to the park, the only locality in the park and extending the range 533 km east of the Eklutna Valley, 235 km south of the Tanana River Valley and connecting its distribution with in the Yukon Territory.
2. *Arabis calderi* – from Baldwin Glacier (Site 3073), new to the state and 1108 km disjunct from its distribution in the Northwest Territories (Annotation Map 8).
3. *Arabis codyi* – from Iron Creek (Site 28), new to the state, known from only two other localities in the world, the closest 230 km to the east in the Yukon Territory (Annotation Map 9).
4. *Arabis drepanoloba* – from the ridge above Canyon Creek (Site 105), new to the state, and 290 km east of a collection in the Yukon Territory (Annotation Map 10).
5. *Draba kananaskis* – from Verde Ridge (Site 110) and Granite Creek (Site 149), 318 km east of the Kenai Peninsula localities (Annotation Map 14).
6. *Eriphorum gracile* – from upper Falls Creek (Site 170), the only collection in the park, this collection extends the species' range 590 km east into the Chugach Mountains from stations in the Anchorage Quad.
7. *Festuca minutiflora* – from Hanagita Peak (Site 122), new to the state, the only reported locality in Alaska, and 445 km disjunct from its Yukon Territory distribution (Annotation Map 75).

8. *Melandrium macrospermum* – collected from Granite Creek (Site 19), the only locality in the park, connecting its range 410 km to the southeast with its distribution in the Yukon Territory (Annotation Map 26).
9. *Potentilla drummondii* – not known in the state prior to our inventory, it has been collected at nine localities in the park, five from the Northern Chugach Mountain region (Sites 158, 170, 193A, 195 and a previous collection at Tebay Lake), two in the Chitina River Basin (Sites 154 and 191) and one in the Southern Chugach-St. Elias region (Site 3010, Annotation Map 97). After the determination of our specimens by Barbara Ertter at UC Berkeley, two previous collections in the state were determined to be this species.
10. *Taraxacum phymatocarpum* the only collection from the park (Goat Creek, Site 185), this locality connects the species' distribution 554 km to the north in the Steese White Mountains with its distribution 164 km to the east in the Yukon Territory (Cook and Roland 2002, Annotation Map 212).

Notable Sites/Plant Associations

- Goat Creek (Site 185) - an alpine site with volcanic and limestone lithologies, we documented 29 notable plants here including 19 endemic species, six rare species, nine significant range extensions and seven species new to the park.
- Tebay Lake (Site 193A) - a subalpine site with sedimentary lithology, we surveyed wet sedge-herb meadow communities and documented 14 endemic species, one rare species (*Potentilla drummondii*), seven significant range extensions and seven species new to the park.
- 12-Mile Basin (Sites 153, 157 & 158) - an alpine basin on glacial deposits. There were 13 endemic species here, four rare species (*Agrostis thurberiana*, *Carex phaeocephala*, *Carex lenticularis* var. *dolia* and *Potentilla drummondii*), 11 significant range extensions and seven species new to the park.
- Baldwin Glacier (Site 3073) - is a granitic ridge bounded by the Logan and Baldwin Glaciers on the eastern edge of the Granite Range. We surveyed alpine and sub-alpine communities and documented one species new to the state (*Arabis calderi*), 18 endemic species, two rare species, five significant range extensions and seven species new to the park.
- Nerelna Creek Plateau (Site 101) - an alpine plateau at the junction of the Chitina and Copper Rivers, the lithology is sedimentary with areas of Nikolai greenstone. We surveyed stony and mesic tundra and pond margins. There were eleven endemic species, five rare species (*Aphragmus eschscholtzianus*, *Castilleja miniata*, *Draba incerta*, *Erigeron grandiflorus* subsp. *arcticus* and *Minuartia biflora*), five significant range extensions and one species new to the park.

- <u>Middle Fork Bremner (Site 195)</u> - this is a subalpine site on glacial deposits.

  We surveyed rock outcrops, snowbeds, ponds, wet sedge tundra and black spruce forest. There were seven endemic species, two rare species (*Castilleja miniata* and *Potentilla drummondii*), five significant range extensions and three species new to the park.
- <u>Towhead Mountain (Site 197)</u> - this is a volcanic mononadock near the confluence of the Tana and Chitina Rivers. There are alpine, subalpine and dry south-facing steppe slopes at this site. We documented six endemic species (two Alaska-Yukon, two cordilleran, one amphiberingian and one Pacific Coastal), one rare species (*Draba incerta*), and three species new to the park.

Completeness of Inventory

This region had a high survey effort (ranking second among regions for the number of sites and collections) and a high number of notables (the highest number of species new to the state, fifth for the number of new taxa, second for the number of significant range extensions and rare taxa and fourth for the number of rare occurrences). However, the per unit area survey effort was low (since the area is so large) and the associated number of notables per unit area was low. The linear relationship between the number of rare in a region and survey effort (described in Chapter 6) indicates that additional notables would be found in this region with increased survey effort. The largest geographic gaps in this region are: the mountains between the Copper and Tana Rivers and south of the Bremner River; Thompson Ridge (east of the Tana River in the Granite Range) and the Granite Range east of Goat Creek.

Southern Chugach-St. Elias Mountains

Description of Region

This region encompasses those portions of the Maritime High Chugach St. Elias and Robinson Mountains and Glaciers ecosections above 3000 ft (914 m). This is the second largest region in the park, covering 1,831,603 acres, 85.31% estimated to be ice, 13.93% of the park's total area and 3.20% of the park's ice-free area (Figures 5.10a, 5.10b and 5.10c). Portions of the Chugach, Prince William and Yakutat Terranes occur in this region with sedimentary, volcanic and metamorphic lithologies. Metamorphic schists and gneiss dominate the region. Basalt and sedimentary mudstone and sandstone is found around Mt. Miller in the west of the region, marine siltstone, basaltic tuff, carbonanceous sandstone and coal is exposed between Mt. Miller and Mt. Huxely in the central portion of the region. Granitic plutons are exposed around Mt. Huxley. At the eastern end of the region, monzonite granite complex is found at Mount Hubbard, rhyolite and granite is exposed around Mt. Cook, interbedded mudstone, sandstone and volcanic rocks is exposed around Valerie Glacier and carbonaceous sandstone, siltstone, shale and non-marine coal are found around Tyndall Glacier.

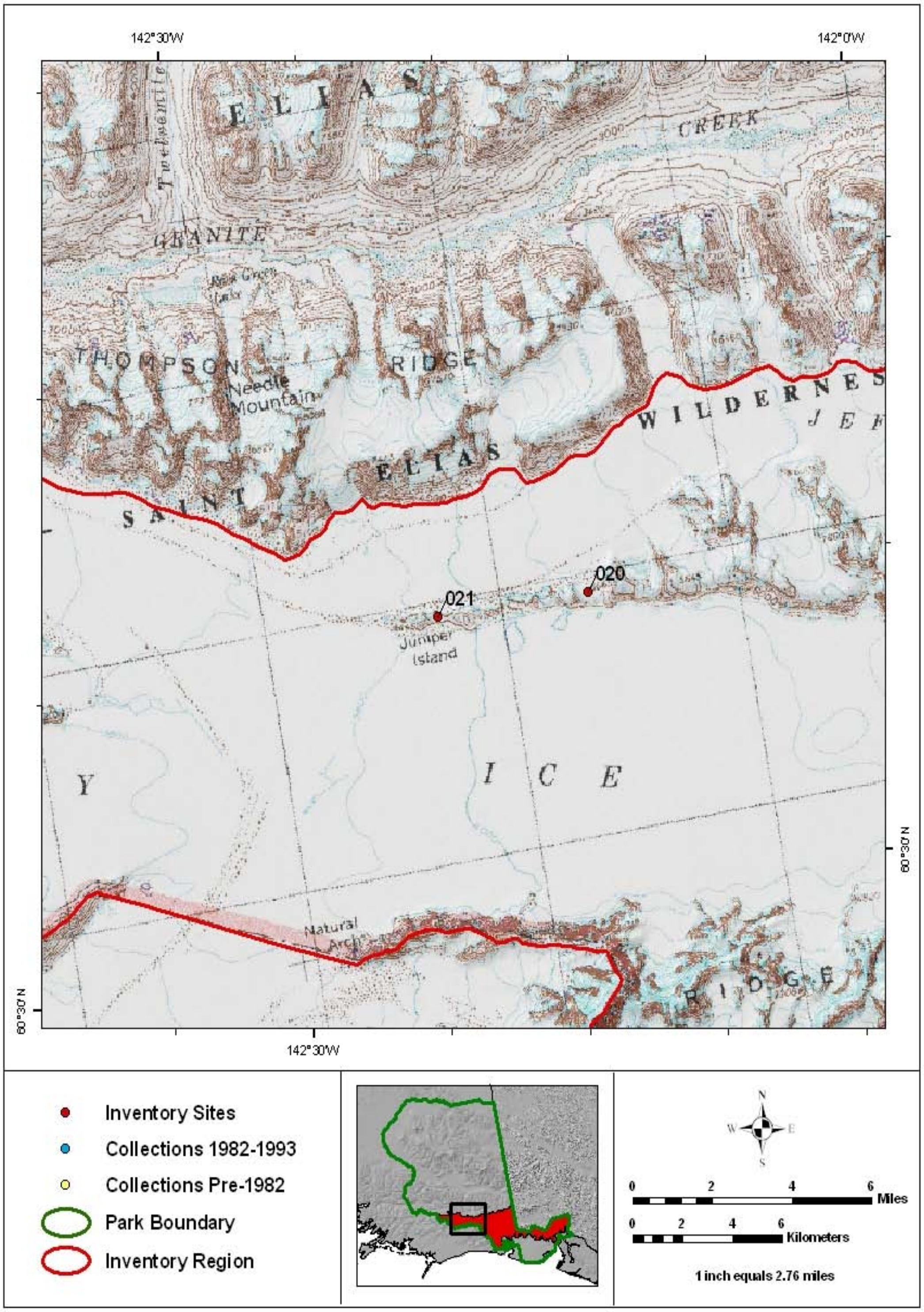


Figure 5.10a. Southern Chugach-St. Elias Mountains vascular plant inventory region (western section) and associated 1994-1997 survey sites, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

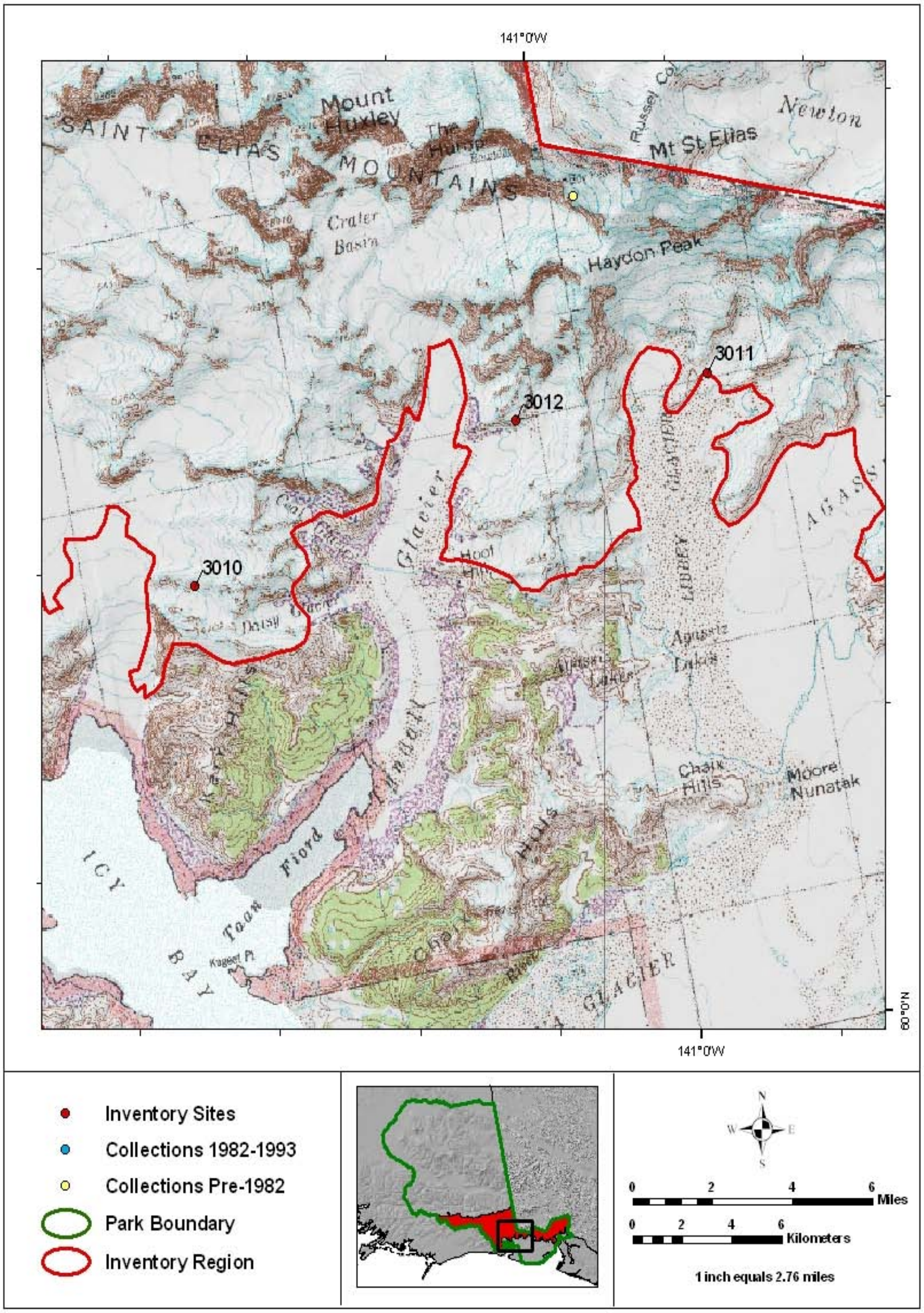


Figure 5.10b. Southern Chugach-St. Elias Mountains vascular plant inventory region (central section), associated 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

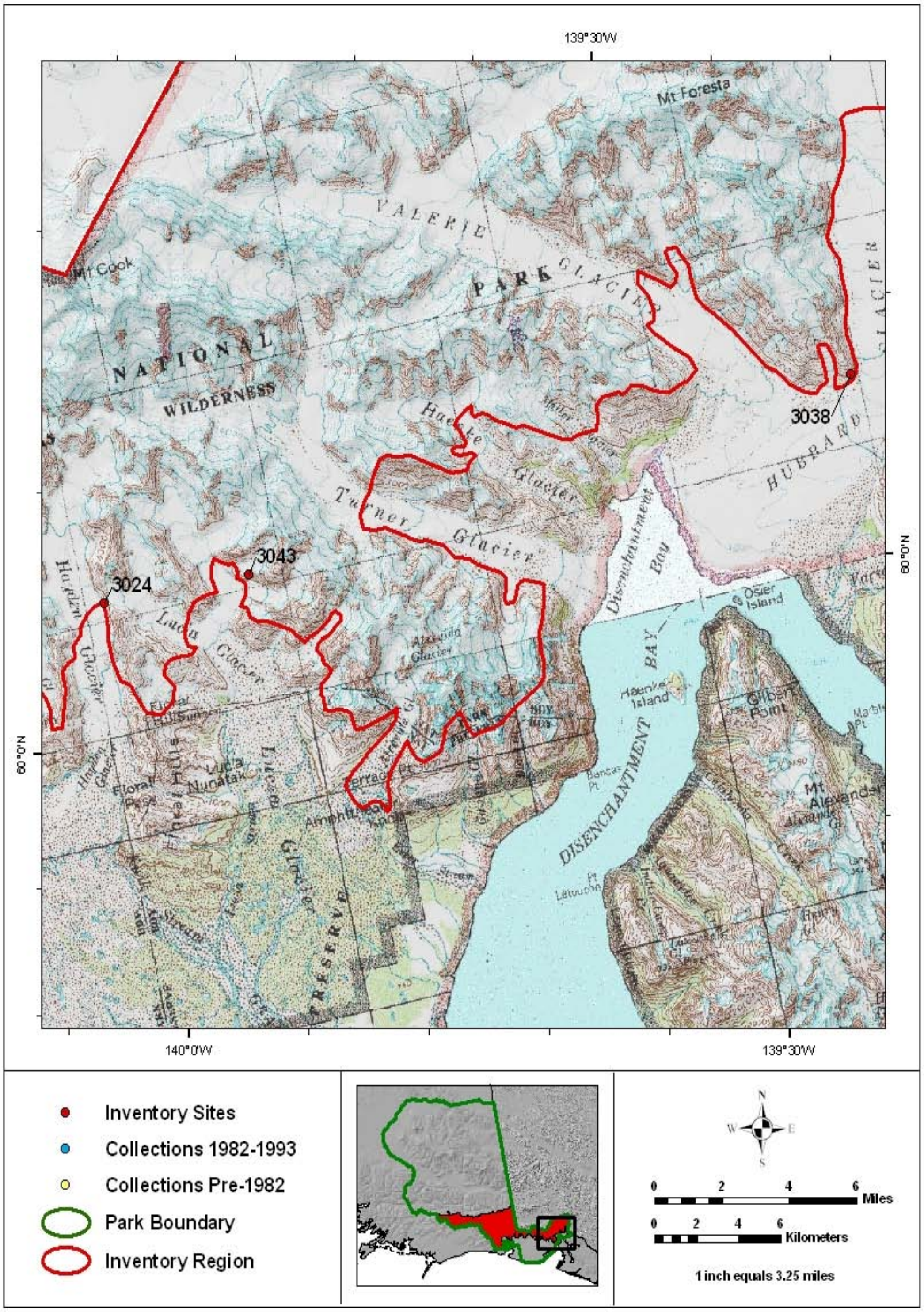
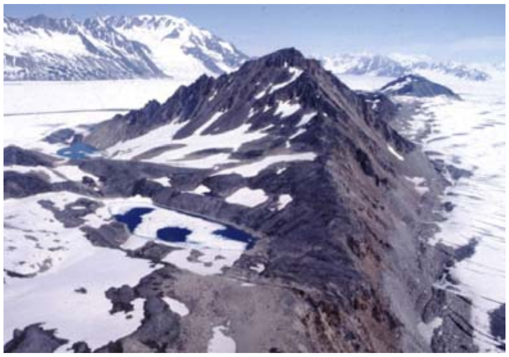


Figure 5.10c. Southern Chugach-St. Elias Mountains vascular plant inventory region (eastern section) and associated 2003 survey sites, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).



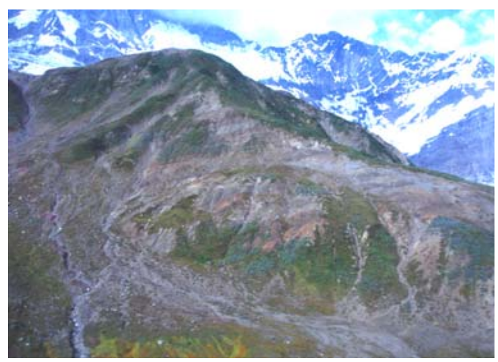
Juniper Island (Site 20)

Juniper Island (Site 20)

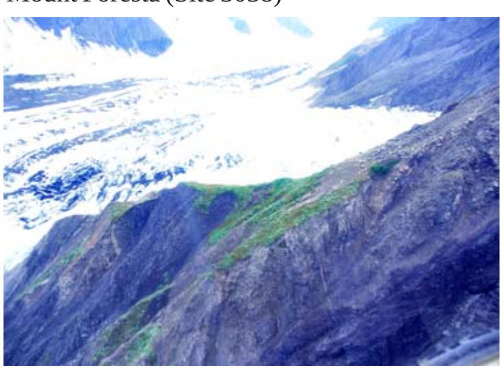
Karr Hills (Site 3010)

Upper Tyndall Glacier (Site 3012)

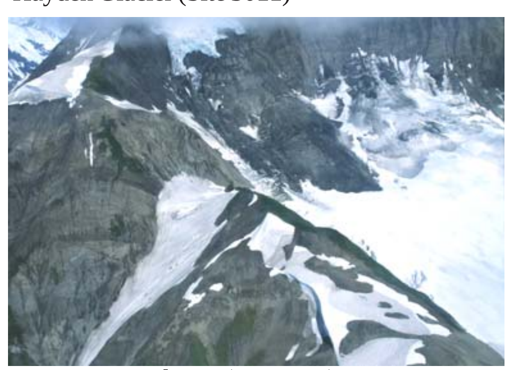
Mount Foresta (Site 3038)



Hayden Glacier (Site 3011)



Upper Lucia Glacier (Site 3043)



Upper Lucia Glacier (Site 3024)

Plate 5.10. Representative vascular plant inventory sites in the southern Chugach and southern St. Elias Mountains, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Focus of Survey

The focus of our survey in 1994-1997 was the nunataks in the Bagley Icefield. We were only able to survey two localities along the Juniper Island ridge during that survey. In 2003, we attempted to survey the spatial extent of the region within helicopter range from Yakutat. Seventeen potential sites were identified on nunataks and slopes adjacent to glaciers from Karr Hills above Icy Bay east to the Hubbard Glacier.

Summary of Results

We surveyed eight sites in the Southern Chugach-St. Elias region (Figures 5.10a, 5.10b & 5.10c, Plate 5.10 and Tables 5.1 to 5.4). This number was less than half the average and represented three sites per 100,000 IFA. There were 243 collections made in this region, less than the average, ranking 12, and representing 90 specimens per 100,000 IFA, less than the average (121). There was one species new to the state in this region (*Botrychium montanum*), 18 taxa new to the park (seven from the 2003 survey), ten significant range extensions, 14 occurrences of 10 rare plant taxa and 33 endemics (11 cordilleran, 11 Pacific Coastal, seven amphiberingian and four Alaska-Yukon). The number of new taxa was less than average, the number of significant range extensions was average, the number of rare taxa was near average and the number of rare occurrences was less than average. All of these values were lower than the averages per unit area. The significant range extensions (seven new to the park) from the Southern Chugach-St. Elias Mountain region were:

*Botrychium montanum**
*Carex albonigra**
*Carex circinnata**
*Carex praticola**
Epilobium lactiflorum
*Pedicularis pacifica**
*Poa leptocoma**
Potentilla drummondii
Sagina saginoides
*Sedum divergens**

Four of the significant range extensions were rare, four of the ten rare taxa are globally rare and six of the rare taxa were new to the park. The rare plants documented during the inventory in this region were:

*Agoseris aurantiaca** G5 S1
*Botrychium montanum** G3 S1
Carex lenticularis var. *dolia** G5T3Q S3
*Carex phaeocephala** G4 S1S2
Castilleja miniata G3 S3
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
*Poa leptocoma** G5 S2
*Potentilla drummondii** G5 S2
Oxytropis huddelsonii G3 S2S3
Papaver alboroseum G3G4 S3
*Poa leptocoma** G5 S2
*Potentilla drummondii** G5 S2
*Sedum divergens** G5? S1

The most notable collections from this region were:

1. *Agoseris aurantiaca* – from Tyndall Glacier (Site 3012), known from only three other localities in the state, this is the western extent of its distribution (Annotation Map 1).
2. *Botrychium montanum* – from Upper Lucia Glacier (Site 3043), new to the state and 870 km disjunct from its distribution in central British Columbia (Annotation Map 65).

3. *Carex circinnata* – from Mt. Foresta (Site 3038), the only collection from the park and connecting its distribution 203 km to the west near Cape Yakataga with its distribution near Haines (Annotation Map 35).
4. *Prunella vulgaris* subsp. *lanceolata* – from Mt Haydon nunatak (Site 3011), the only collection from the park, connects the range 338 km to the east in the Cordova Quad with its distribution in southeast Alaska 127 km at Yakutat.
5. *Sedum divergens* – from a ridge between upper Hayden and Lucia Glaciers (Site 3024), the third locality in Alaska and the western extent of this species' range (Annotation Map 31).

Notable Sites/Plant Associations

- <u>Juniper Island (Sites 20 & 21)</u> - this is the largest continuous nunatak in the park within the Bagley Icefield that is relatively accessible. The moraine at the western end of the Juniper Island ridge is contiguous with Thompson Ridge in the Northern Chugach. Juniper Island is composed of metamorphic rocks: amphibiolite, quartz-feldspar, biotite, garnet, schist and gneiss. There is a great diversity of alpine communities on the ridge that we surveyed with extensive south-facing boulder and scree slopes, rock outcrops, ponds and alpine mesic tundra. There were nine notables from these sites, including, 11 endemics (three cordilleran, five amphiberingian, two Alaska-Yukon and one Pacific Coastal), three significant range extensions, seven species new to the park and two rare species (*Papaver alboroseum* and *Oxytropis huddelsonii*).
- <u>Karr Hills (Site 3010)</u>- is a nunatak above Icy Bay with sedimentary bedrock geology. There are mixed alpine herb and snowbed communities here. We documented six endemic species, two significant range extensions, four species new to the park and three rare species (*Potentilla drummondii*, *Carex phaeocephala* and *Castilleja miniata*).
- <u>Hayden Glacier (Site 3024)</u> - is an alpine ridge with primarily mixed forb herbaceous plant communities. We documented six endemic species, one significant range extension, three species new to the park and three rare species (*Sedum divergens, Castilleja miniata* and *Carex phaeocephala*).
- <u>Upper Tyndall Glacier (Site 3012)</u> - is a nunatak below Haydon Peak with alpine mixed herb plant communities. There were six endemic species here, one significant range extension, two species new to the park and one rare species (*Agoseris aurantica*).
- <u>Mount Foresta (Site 3038)</u> - is an alpine ridge at the junction of the Valerie and Hubbard Glaciers with alpine mixed herb and *Vaccinium* tundra plant communities. There were four endemic species, four significant range extensions, seven species new to the park and three rare species (*Carex lenticularis* var. *dolia*, *Carex phaeocephala* and *Poa leptocoma*).

Completeness of Inventory

The relatively few number of notables in the Southern Chugach-St. Elias Mountains is most likely related to the lower survey effort in this region. Only half of the potential sites were surveyed. Higher survey effort will add to our knowledge of the flora of this region. Although there were few notables in this region, they were highly significant, being new to the state, extremely rare and/or major disjuncts. There has been no botanical exploration with supporting specimens in this region prior to our inventory. There are countless nunataks throughout this 1.8 million acre region which could provide valuable information about plant migration in Alaska, the influence of coastal refugia on Alaska's flora and on the composition and distribution of the park's flora. Access to the nunataks between Mount Miller and Mount Huxley is difficult even with helicopter access due to the limitations on flight ranges and coastal weather. Opportunities to coordinate with other survey or research efforts should be made in order to document the flora of this poorly known area.

Coastal Foothills and Mountains

Description of Region

This region includes those portions of the Maritime High Chugach St. Elias and Robinson Mountain and Glacier ecosections below 3000 ft (914 m) (Figures 5.11a and 5.11b). The Coastal Foothills and Mountains cover 822,706 acres, 81.17% ice (primarily as the Malaspina Glacier), 6.26% of the park's total area but only 1.84% of the park's ice-free area. The exposed lithology of the Coastal Foothills and Mountains surrounding Icy Bay is mudstone, siltstone and sandstone in a marine and glacio-marine continental shelf deposit. This lithology is found on the western end of the Samovar Hills nunatak. The central portion of the Samovar Hills is carbonaceous siltstone, coal and basalt. The eastern portion of the Samovar Hills and the remainder of the region to the east is grawack, siltstone and argillite.

Focus of Survey

One-hundred twenty sites within this region were identified for the 2003 survey. The sites covered the spatial extent of the region ranging from Karr Hills in Icy Bay east to the slopes adjacent to the Hubbard Glacier. The largest portion of these sites was on alpine and sub-alpine nunataks or slopes adjacent to glaciers. Forty-three sites were on the Malaspina Glacier in scrub vegetation or were wetlands.

Summary of Results

We surveyed 23 sites in the Coastal Foothills and Mountains, this was higher than the regional average, ranking fifth among regions and representing 15 sites per 100,000 IFA, more than twice the average (Figures 5.11a & 5.11b, Plate 5.11 and Tables 5.1 to 5.4). There were 480 collections made in this region, higher than the average, ranking sixth and representing 310 collections per 100,000 IFA, more than twice the average. There were 222 taxa documented in the region, 27 taxa new to the park (11 collected first during the 2003 inventory), nine significant range extensions, 18 occurrences of nine rare plant taxa and 44 endemics (30 Pacific

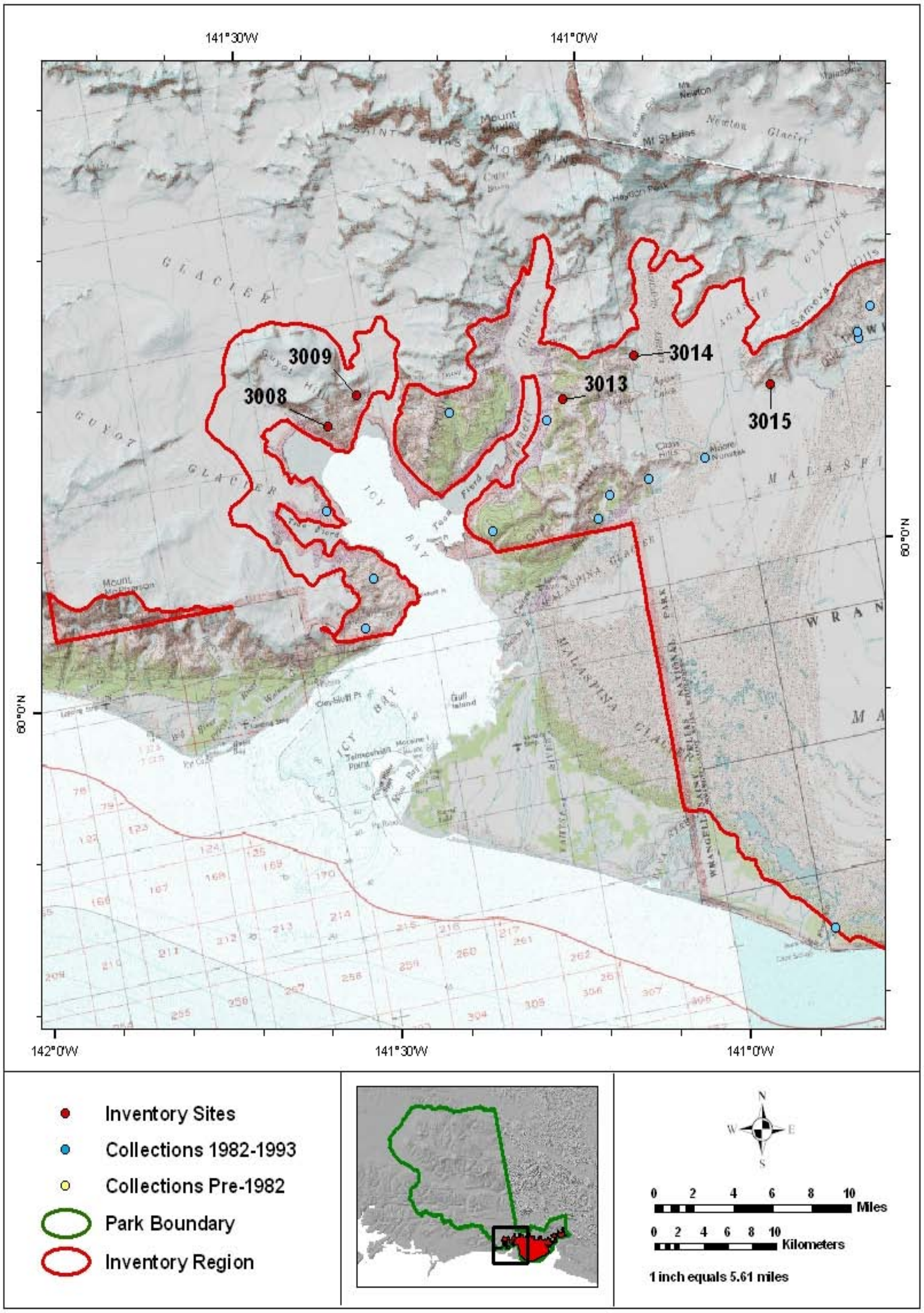


Figure 5.11a. Coastal mountains and foothills vascular plant inventory region (western section), associated survey sites from 1994-1997 & 2003, and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

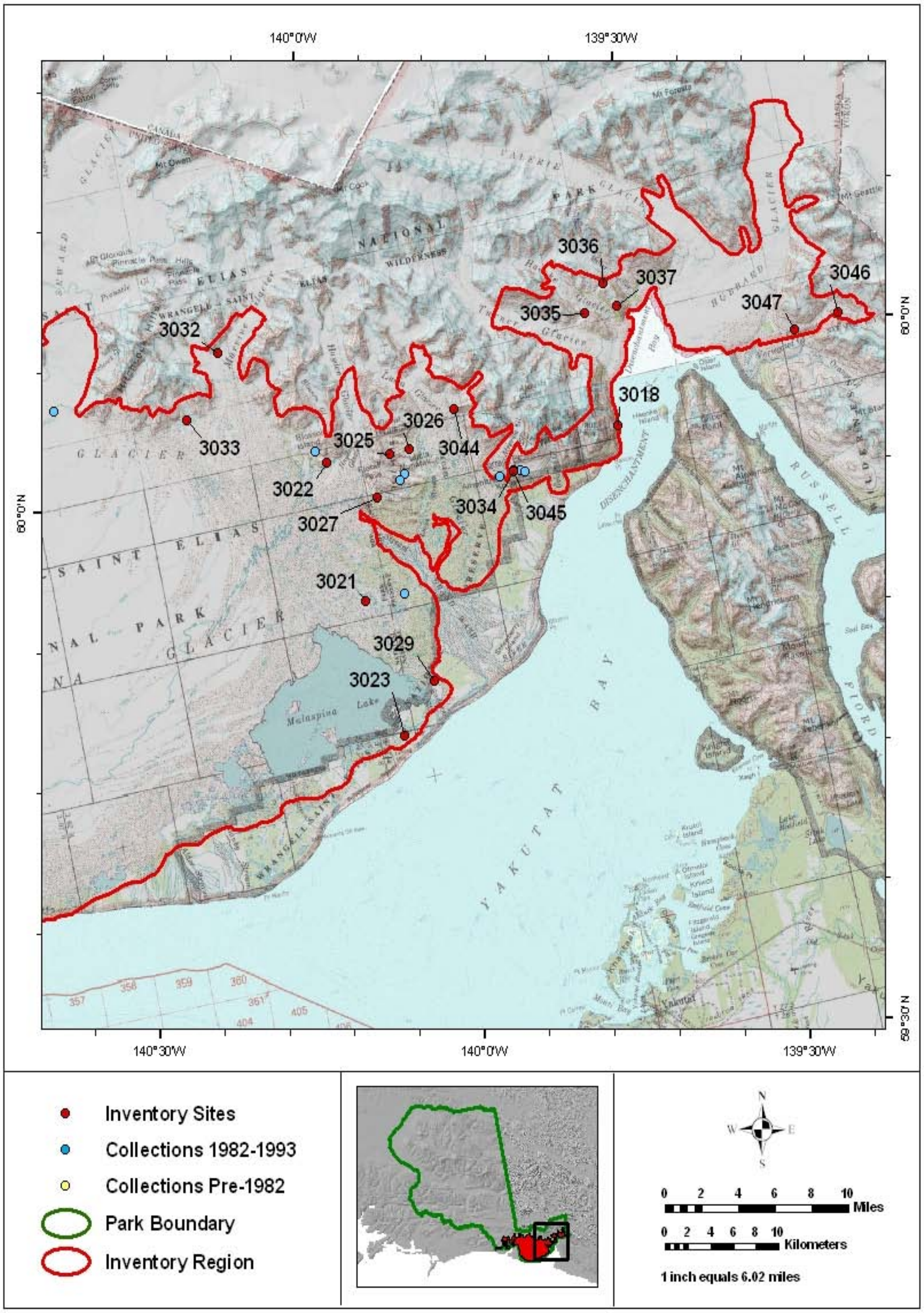
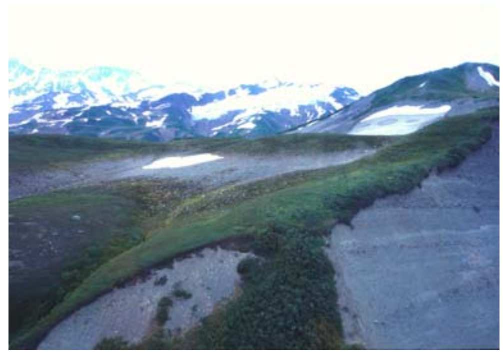


Figure 5.11b. Coastal mountains and foothills vascular plant inventory region (eastern section), associated survey sites from 1994-1997 & 2003, and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Marvine Glacier (Site 3032)

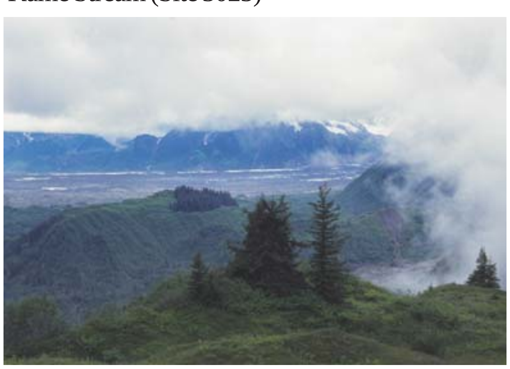

Mid-Tyndall Glacier (Site 3013)


Guyot Hills (Site 3008)


Malaspina Glacier (Site 3021)


Kame Stream (Site 3023)


Front Point (Site 3037)


Blossom Island (Site 3022)


Haenke Ridge (Site 3036)

Plate 5.11. Representative vascular plant inventory sites in the Pacific coastal mountain region of Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Coastal, six cordilleran, five amphiberingian and three Alaska-Yukon). The number of taxa new to the park was average, ranking eighth with more than twice the average number per 100,000 IFA. The number of significant range extensions was average, but the value per 100,000 IFA was twice the average. The numbers of rare taxa and occurrences were slightly lower than average but the values per 100,000 IFA were twice the averages. Four of the significant range extensions were new to park. The significant range extensions documented during this inventory were:

*Botrychium pinnatum**
*Callitriche hermaphroditica**
*Carex hoodii**
Carex nigricans
*Epilobium davuricum**
Epilobium luteum
Euphrasia mollis
Sanguisorba officinalis
Subularia aquatica

Six of the rare taxa were new to the park, one is a significant range extension and one is globally rare. The rare plant taxa documented in the Coastal Mountains were:

*Agoseris aurantiaca** G5 S1
Agrostis thurberiana G5Q S2
*Carex hoodii** G4G5 S1
Carex lenticularis var. *dolia** G5T3Q S3
*Carex phaeocephala** G4 S1S2
Castilleja miniata G3 S3
*Pedicularis macrodonta** G4Q S3
*Poa leptocoma** G5 S2

The most notable collections from the Coastal Mountains were:

1. *Agoseris aurantiaca* – from Haenke Glacier (Site 3037), the western extent of its distribution in North America (Annotation Map 1).
2. *Carex hoodii* – from Marvine Glacier (Site 3032) only the second record for Alaska (Annotation Map 40).
3. *Epilobium davuricum* – the only collection in the park, from Marvine Glacier (Site 3032), extending the species' range in Alaska from the interior mountains and arctic coast to the south coast, 429 km south of collections in the Yukon-Tanana Uplands on the Taylor Highway and Forty Mile River.
4. *Pedicularis macrodonta* – the only collection in the park, from Kame Stream (Site 3023), connecting its distribution 716 km to the west near Valdez with a station at Yakutat 38 km to the east.
5. *Plantanthera stricta* – the only collection in the park, from the Hitchcock Hills (Site 3033), connecting its distribution 279 km to the west near the Bering Glacier with a station at Yakutat 139 km to the east.
6. *Romanzoffia sitchensis* – a North American Pacific Coast endemic, the only collection in the park was from Bancas Point (Site 3018). This locality connects its distribution 354 km to the west in the Robinson Mountains with a station 85 km to the east on the Yakutat Forelands.
7. *Sanguisorba officinalis* – the only collection from the park, made in the Guyot Hills (Site 3008), connects its distribution 426 km to the west near Girdwood with its distribution 395 km to the southeast in the Sitka Quad (Annotation Map 99).

Notable Sites/Plant Associations

- Guyot Hills (Sites 3008 & 3009) - a peninsula at the head of Icy Bay, we surveyed alpine mixed herb and mountain heath communities. There were 35 notables species, including 19 endemic species (seven Pacific Coastal, five cordilleran, four amphiberingian and three Alaska-Yukon), four significant range extensions, 11 species new to the park and two rare species (*Agrostis thurberiana* and *Carex lenticularis* var. *dolia*).
- Samovar Hills (Site 3015) - the one site surveyed here was in an alpine tall forb herbaceous plant community and resulted in the documentation of 13 endemic species (two amphiberingian, three cordilleran, five Pacific coastal and one Alaska-Yukon), two significant range extensions and two species new to the park.
- Floral Hills (Sites 3025, 2026 and 3027) - these alpine and sub-alpine ridges are located between the Malaspina Glacier and Disenchantment Bay. We surveyed mixed herb, mountain heath, wet herb meadow and aquatic plant communities documenting 16 endemic species, two significant range extensions, three species new to the park and two rare species (*Carex lenticularis* var. *dolia* and *Poa leptocoma*).
- Marvine Glacier (Site 3032) - is a nunatak ridge at the head of the Malaspina Glacier. We surveyed the alpine mixed herb community here and documented seven endemic species, three significant range extensions, two species new to the park and two rare species (*Agrostis thurberiana* and *Carex hoodii*).
- Haenke Glacier (Sites 3036 & 3037) - is an alpine ridge between the Turner and Haenke Glaciers. We surveyed the alpine mixed herb community. There were 12 endemic species (five Pacific coastal and seven cordilleran), two significant range extensions, five species new to the park and two rare species (*Agoseris aurantica* and *Carex phaeocephala*).
- Variegated Glacier (Sites 3046 & 3047) - is located at the southeast corner of the park adjacent to the Hubbard Glacier. We surveyed *Vaccinium* tundra here and documented three endemic species, two significant range extensions, 2 species new to the park and three rare species (*Agrostis thurberiana*, *Carex phaeocephala* and *Castilleja miniata*).

Completeness of Inventory

Only 19% of the identified sites were surveyed in this region. The per unit area survey effort and numbers of notables per unit area were high for this region due largely to the extent of the Malaspina Glacier in the region. Most of the Malaspina Glacier was deducted from the acreage of the region since it is classified as ice in our GIS coverage. However, much of the margins and toe of the Malaspina Glacier are covered with glacial till and are vegetated by alder and willow scrub and spruce forests. Only one site was surveyed within these communities on the Malaspina Glacier. The wetlands surrounding Malaspina Lake are only represented by one

survey site as well. Although 17 of the sites surveyed in this region were nunataks, there remain numerous unsurveyed nunataks and geographic gaps in this region. The greatest geographic gaps are in the western portion the region, particularly the Malaspina Glacier, Karr, Chaix and Samovar Hills.

Tanana River Basin

Description of Region

This region corresponds to the Jatahmund Basin ecosection within the Tanana-Kuskokwim Lowland ecoregion except for it includes those portions of the Nabesna and Chisana Rivers below 3000 ft (914 m) (which were classified into the Northern Wrangell Foothill and Nutzotin Mountains ecosections respectively) (Figures 5.12a and 5.12b). The Tanana River Basin ice, 1.95% of the park's area and 3.05% of the park's ice-free area. The lithology of the Nabesna and Chisana Rivers within this region is Holocene alluvial deposits. North of the Nutzotins in the lowlands, the lithology is predominantly Pleistocene alluvial deposits and drift of the Pleistocene glaciation with a few regions of undifferentiated slope deposits.

Focus of Survey

The focus of our survey in this region were the Chitina and Nabesna Rivers with associated floodplain, wetland and bluff communities and the lowlands north of the Nutzotin Mountains with its extensive wetland communities.

Summary of Results

We surveyed 28 sites in the Tanana River Basin and collected 453 specimens (Figures 5.12a & 5.12b, Plate 5.12 and Tables 5.1 to 5.4). These specimens documented 253 taxa, one taxa new to the state (*Trichophorum pumilum* var. *rollandii*), 40 taxa new to the park (four from 2003), eight significant range extensions, 21 occurrences of 11 rare plant taxa and 32 endemics (14 Alaska-Yukon, nine amphiberingian, eight cordilleran and one Pacific coastal). The number of sites ranked fourth among regions, representing 11 per 100,000 IFA (more than twice the average). The number of collections was also higher than the average, ranking seventh with 176 per 100,000 IFA. The number of new taxa ranked fourth among regions representing 20% of all new taxa and with almost twice the average per 100,000 IFA. The number of significant range extensions was near the average as were the number of rare taxa. However, the number of range extensions, rare taxa and occurrences were above the averages when evaluated by unit area.

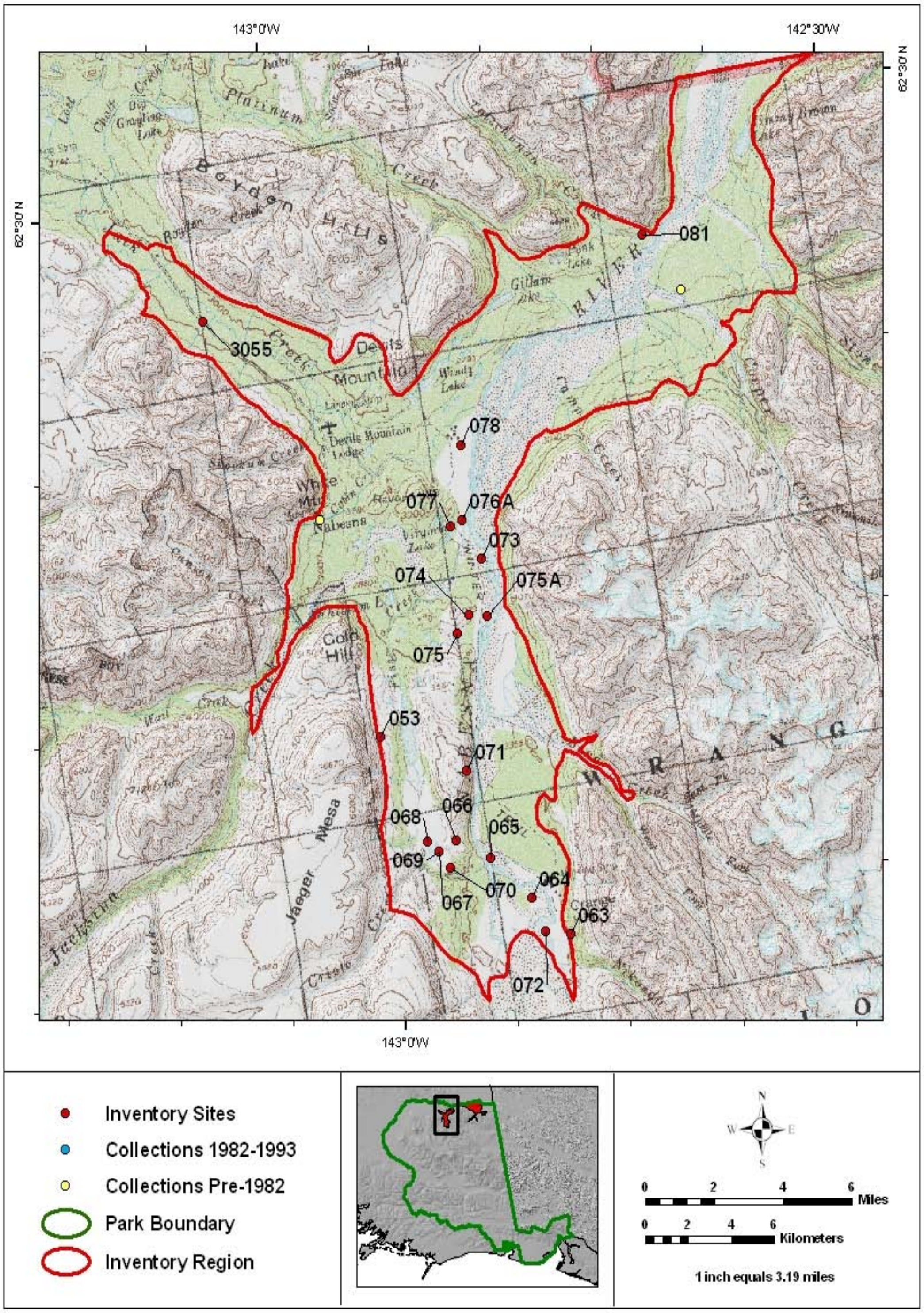


Figure 5.12a. Tanana River basin vascular plant inventory region (western section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

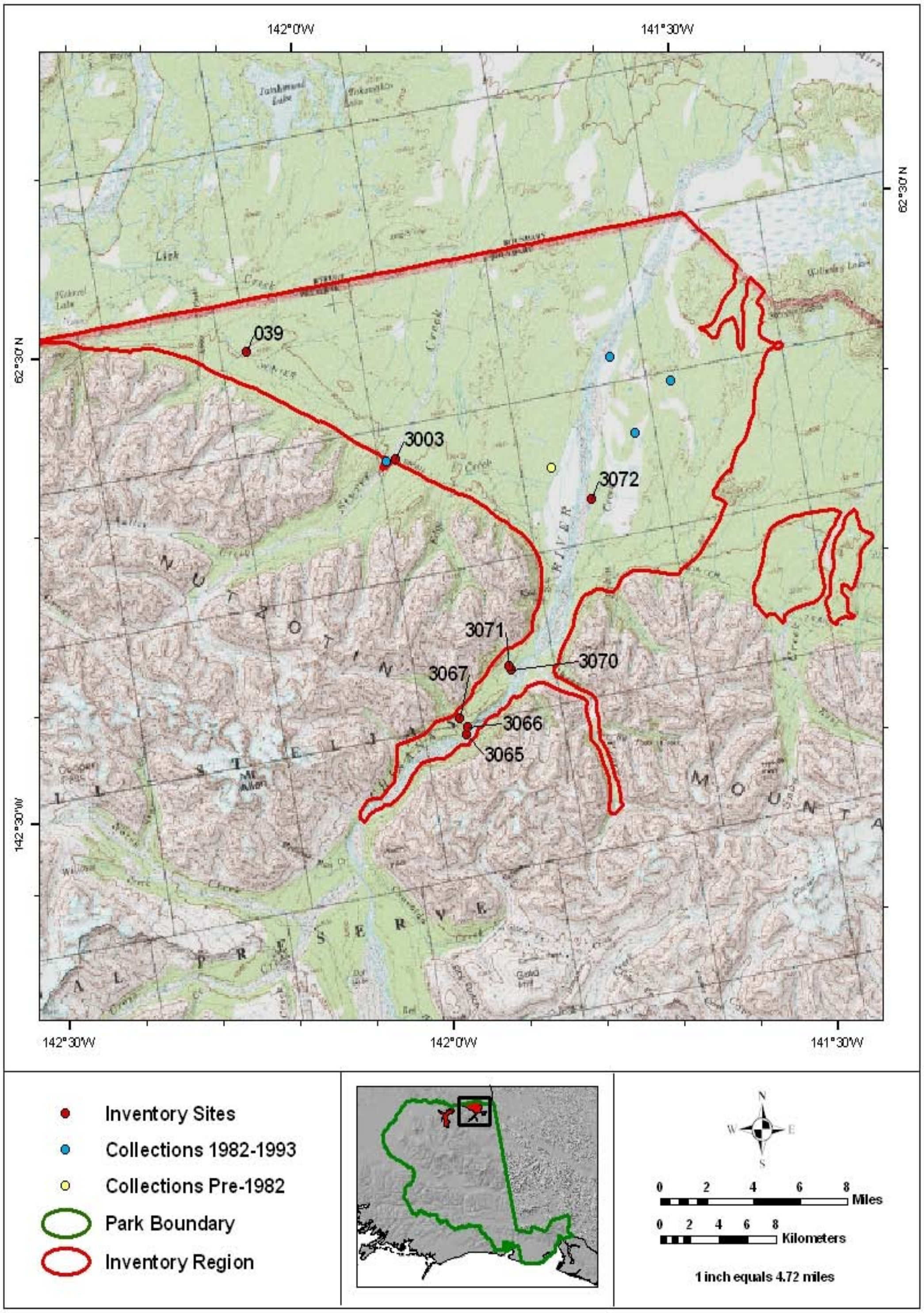
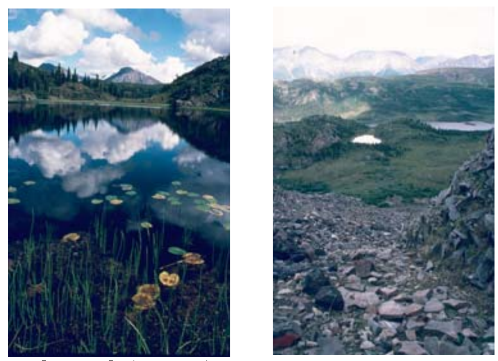


Figure 5.12b. Tanana River basin vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Nabesna River (Site 76)

Monte Cristo Creek (Site 66)

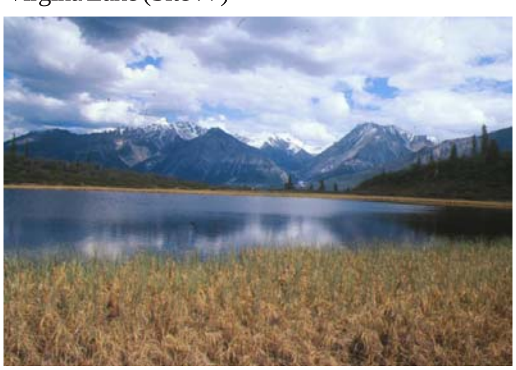
Stuver Creek fen (Site 3003)



Fish Creek (Site 53)

Virgina Lake (Site 77)

Lick Creek marsh (Site 39)



Nabesna River wetlands (Site 67)

Nabesna River bluff (Site 71)

Plate 5.12. Representative vascular plant inventory sites in the Tanana River basin region of Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

The significant range extensions (five new to the park) documented during this inventory were:

*Arenaria longipedunculata**	*Carex leptalea*
*Botrychium tunux**	*Cryptogramma stelleriana*
*Carex chordorrhiza**	*Hackelia deflexa*
*Carex laxa**	*Poa leptocoma**

Six of the significant range extensions are rare, three of the rare species are globally rare and seven of the rare species were new to the park. We did not document one rare species in this inventory, *Carex adelostoma*, which had been collected in this region in 1947. The rare taxa documented in the Tanana River Basin during this inventory were:

*Arenaria longipedunculata** G3Q S3	*Cryptogramma stelleri* G5 S2S3
*Astragalus harringtonii** G5T3 S3	*Lupinus kuschei* G3 S2
*Botrychium tunux** G1 S1	*Poa leptocoma** G5 S2
Carex holostoma G4? S2	*Poa secunda* subsp.*secunda* G? S1
*Carex lapponica** G4G5Q S2	*Salix setchelliana* G4 S3
*Carex laxa** G4 S1	*Tricophorum pumilum* var. *rollandii** G5 S1

The most notable collections from this region were:

1. *Arenaria longipedunculata* – from the Chisana River (Site 3065), one of only two collections in the park, and an extension of 453 km south from the Alaska Range (Cook and Roland 2002, Map 83).
2. *Botrychium tunux* – collected from two sites on the Chisana River (Sites 3065 & 3067) and one site on the White River (3001), a recently described species (Stensvold et. al. 2002), these collections extend the species' range 260 km into the interior of Alaska from the coast (Annotation Map 66).
3. *Carex laxa* –our two collections from Lick Creek in the Tanana lowlands (Site 39) and Monte Cristo Creek in the Nabesna River drainage (Site 66) are the only verified collections in Alaska (Annotation Map 42).
4. *Lupinus kuschei* – known from two localities along the Nabesna River (Sites 81 and 3002), two localities on the Chisana River (Sites 3065 and 3072) and two previous collections from the upper Copper River basin. Our collections have clarified the limited distribution of this narrow Alaska-Yukon endemic (Annotation Map 54).
5. *Penstemon gormanii* – an Alaska-Yukon endemic with a narrow distribution, known from four sites in the Nabesna River Valley in the park (Sites 74, 76A, 79 and 85, Annotation Map 113).
6. *Silene involucrata* subsp. *tenella* (= *Gastrolychnis angustiflora* subsp. *tenella* (Tolm.) Tolm.; *Silene tayloriae* (B.L. Robins) Hult.)- from a bluff on the Chisana River (Site 3067), the only collection from the park and of limited distribution in the state (Cook and Roland 2002, Annotation Map 89).

7. *Tricophorum pumilum* var. *rollandii* – the only known localities of this bulrush in the state are from the two collections in the park. It was collected near Medicine Man Creek on the Chisana River and in the Chitina River Basin (Annotation Map 50).

Notable Sites/Plant Associations

- Stuver Creek (Site 3003) - We surveyed forest, sedge meadow, tundra and seral herb communities at this site documenting four endemic species, five species new to the park and one rare species (*Carex lapponica*).
- Chisana River (Site 3065) - Gravel bar and river terraces were surveyed at this site. There were six endemic species (five Alaska-Yukon and one cordilleran), two significant range extensions (*Arenaria longipedunculata* and *Botrychium tunx*), three species new to the park and four rare species (*Arenaria longipedunculata, Botrychium tunx, Lupunis kuschei* and *Salix setchelliana).*
- Fish Creek (Site 53) - There are a series of perched lakes on limestone in Fish Creek. We surveyed deep and shallow lakes, wet sedge meadows, subalpine meadows, alder scrub, south-facing steppe and boulder slopes. There were six species new to the park from this site.
- Ponds on Nabesna River (Site 64) - We surveyed poplar woodland, morainal ponds and river terraces at this site and documented one endemic species, six species new to the park and one rare species (*Astragalus harringtonii*).
- Nabesna River bluff (Site 71) - This is a southeast facing meadow steppe community within the subalpine zone. Species commonly found on south-facing bluffs in the park that occurred here included: *Androsace septentrionalis, Artemisia hyperborea, Carex obtusata, C. rossii, Carex supina* subsp. *spaniocarpa, Draba breweri* var. *cana, D. nemorsa, Elymus alaskanus, Erigeron caespitosus, Erysimum inconspicuum, Halimolobus mollis, Linum perenne, Plantago canescens, Potentilla pensylvanica* and *Silene repens.* There was one significant range extension here (*Hackelia deflexa)* and five species new to the park.
- Totschunda Creek (Site 81) - We surveyed the floodplain, gravel bars and river terraces at the confluence with the Nabesna River. There were five endemic species here (four Alaska-Yukon and one cordilleran), three rare species (*Lupinus kuschei, Poa secunda* subsp. *secunda* and *Salix setchelliana*) and one species new to the park (*Silene williamsii*).
- Monte Cristo Creek (Sites 66, 67 & 70). We surveyed lakes and wetlands at the confluence of Monte Cristo Creek with the Nabesna River and documented three rare species (*Carex laxa, Cryptogramma stelleri* and *Montia bostockii*) one Alaska-Yukon endemic species (*Montia bostockii*), three significant range extensions (*Carex chordorrhiza, C. laxa* and *Cryptogramma stelleri*) and five species new to the park.

Completeness of Inventory

Only three sites were in the lowlands north of the Nuztotin Mountains, an area of 145,440 acres and a significant ecological region that has not been represented in any floristic work done in this park. We had hoped to survey this region in 2003 with helicopter access but our budget would not allow this. The extensive wetlands in this region are very likely to harbor rare wetland taxa. The first locality of *Carex laxa* in the state was found in this region in 1995 (Site 39) and wetlands are generally poorly represented in floristic surveys throughout the state.

White River Basin

Description of Region

This region is equivalent to the Kluane Basins and Mountains ecosection within the Kluane Ranges ecoregion except for the ridge just north of Ping Pong Mountain which is part of the Nuztotin Mountain ecosection in that classification (Figure 5.13). The White River Basin covers 168,561 acres, 0.85% in ice, 1.28% of the park's area and 1.99% of the park's ice-free area. The surficial geology of this region is primarily drift of the Pleistocene glaciation and Holocene and Pleistocene alluvial deposits. The ridges between Rock Lake and the White River are predominately volcanic, composed of basaltic, andesite and dacite lava flows.

Focus of Survey

We had hoped to conduct an inventory of the White River by raft in 2003, but low water conditions prevented us from doing so. Consequently, our survey effort in 2003 was limited to foot access from a fixed wing landing site on the White River near Ping Pong Mountain. In 1995 we also surveyed one site on a bluff between Cub and Travers Creek. Two of the lowland and bluff sites around Ptarmigan Lake also fall in this region. Communities identified to survey were floodplains throughout the river corridor, wetlands between Solo and Divide Creeks and river bluffs between Ping Pong Mountain and the park border. We were hopeful that we might find *Townsendia hookeri*, a western North American endemic species found on dry slopes and known from the Kluane Lake region in the Yukon Territory.

Summary of Results

We surveyed four sites in the White River Basin and made 252 collections (Figure 5.13, Plate 5.13 and Tables 5.1 to 5.4). These collections documented 226 taxa, 13 taxa new to he park (three from 2003), four significant range extensions (>200 km from published localities), six occurrences of four rare plant taxa and 40 endemics (19 Alaska-Yukon, 17 amphiberingian and four cordilleran). The number of sites was four times less than the average, ranking 16 and with less than half the average value per 100,000 IFA. The number of collections was also below the average, ranking 11, but slightly greater than the average per 100,000 IFA (121). The frequencies of notable collections from this egion were unremarkable. The values for taxa new to the park, range extensions, rare taxa and occurrences were from one-quarter to one-half the average values and the values per 100,000 IFA were either average or slightly above the averages among regions.

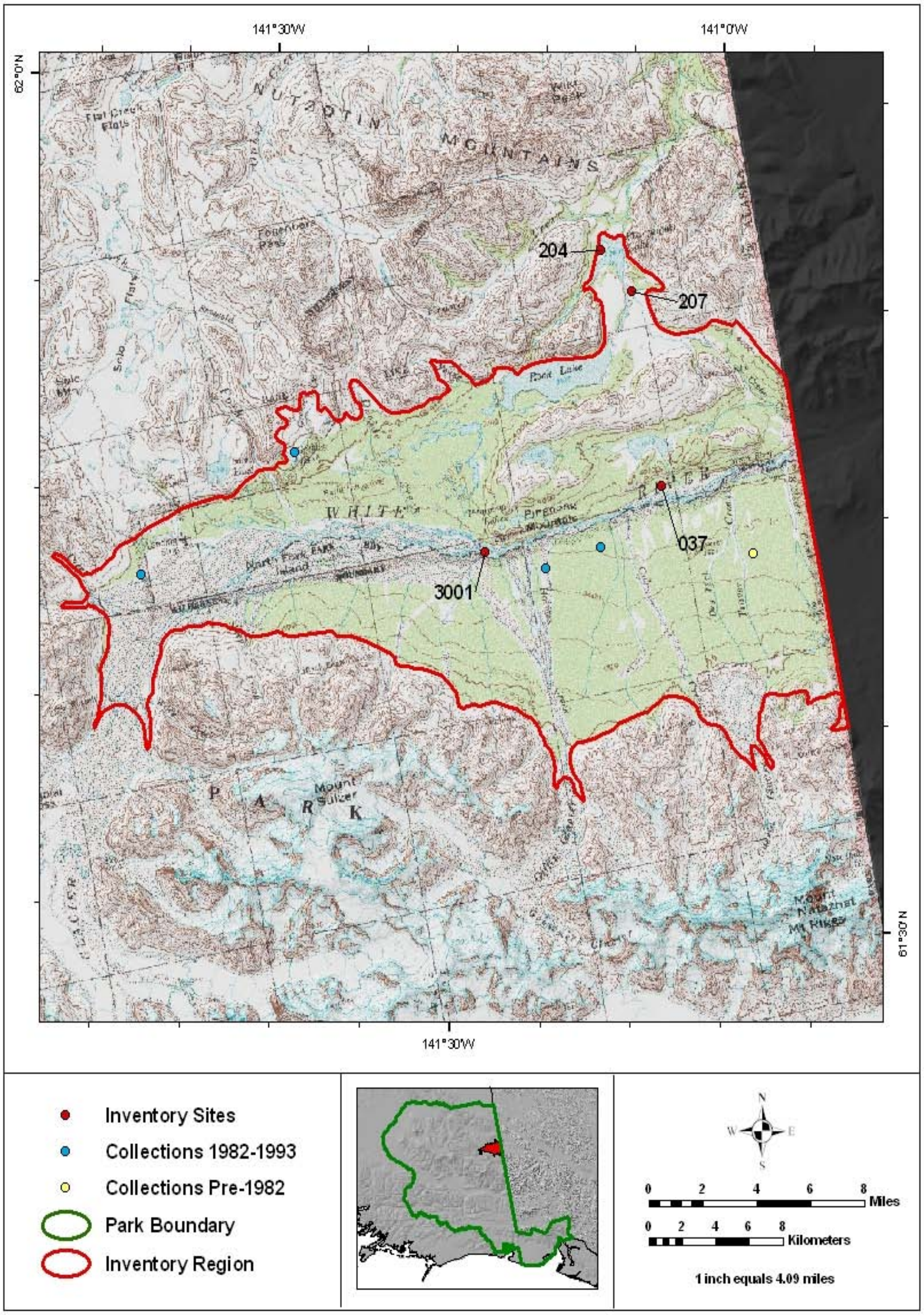


Figure 5.13. White River basin vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Bluffs in the White River drainage


Ptarmigan Lake long arm (Site 207)


Floodplain and terraces, White River (Site


Ptarmigan Lake bluff (Site 204)


Ping Pong Mountain basalt columns (Site


Floodplain, river terrace and basalt bluff (Site


Ping Pong Mountain ponds (Site 3001)


White River bluff (Site 37)

Plate 5.13. Vascular plant inventory sites in the White River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

The significant range extensions that were collected from the White River Basin were: *Botrychium tunux, B. yaaxudakeit*, *Carex filifolia* and *Carex parryana*. All of these range extensions (except for *Carex filifolia*) are also rare and new to the park. One rare species from the White River Basin region (*Erigeron grandiflorus* subsp. *arcticus*) had been collected prior to this inventory. The rare plants documented during this inventory from the White River Basin region were:

*Botrychium tunux** G1 S1	*Carex parryana** G4 S1
*Botrychium yaaxudakeit** G2 S2	*Salix setchelliana* G4 S3

The most notable of the collections from this region were:

1. *Botrychium yaaxudakeit* – from the vicinity of Ping Pong Mountain (Site 3001), recently described (Stensvold et. al. 2002), this locality extends its range 263 km into the interior from the coast (Annotation Map 67).
2. *Carex parryana* – also from the vicinity of Ping Pong Mountain (Site 3001) and the Chitina River (Site 190B). Parry's sedge is known in Alaska from only three other localities (Annotation Map 45).

Notable Sites/Plant Associations

The area surveyed from the Ping Pong Mountain base camp (Site 3001) covered a wide variety of plant communities. These included seral herb and willow scrub on the floodplain, open spruce forest, *Dryas* tundra, talus and scree slopes and sagebrush-grass south-facing steppe communities. There were nineteen endemic species (eight Alaska-Yukon, five amphiberingian and six cordilleran), nine species new to the park, three significant range extensions and five rare species (*Botrychium tunux, B. yaaxudakeit, Carex parryana, Oxytropis huddelsonii* and *Salix setchelliana*).

The south-facing bluff on the White River (Site 37) did not have a high number of notable species, but this community is sporadic through the river basins of the park and represents a community that was more prevalent at one time in Alaska. Steppe species found here include: *Arabis divaricarpa* var. *dacotica, A. holboellii, Artemisia frigida, Bromus pumpellianus, Carex filifolia, Carex rossii, Draba aurea, Erigeron caespitosus, Erysimum inconspicuum, Plantago canescens, Poa glauca, Potentilla hookeriana, P. pensylvanica, Silene repens, Solidago decumbens* var. *oreophila* and *Stellaria edwardsii*.

Completeness of Inventory

Our survey effort was low in this region and it remains one of the notable geographic gaps in the park. Although the one site surveyed in 2003 was centrally located to the region and an extensive area was surveyed from the base camp, there are significant wetland, floodplain and bluff communities that have not been represented in this inventory, particularly the region from Solo Creek to Ping Pong Mountain and from Ping Pong Mountain east to the park's border. The south facing slopes of the ridge between Rock Lake and the White River are also of interest for future surveys.

Upper Copper River Basin

Description of Region

This region corresponds to the Ahtna Basin ecosection of the Copper River Basin ecoregion, but only includes the area north of the Sanford River (Figure 5.14). The upper Copper River basin covers 525,318 acres, 0.01% of it ice, 4% of the park's area, and 6.25% of the park's ice-free area. The lithology of the upper Copper River basin below 2500 ft (763 m) is predominately Pleistocene glacial Lake Ahtna deposits with localized areas of Holocene and Pleistocene alluvium, Holocene eolian deposits (dunes on the Sanford River), volcanic debri flow on the Sanford River, lava flows at Boulder Creek, small areas of fine grained alluvium, and Holocene bluff colluvium on the steep Copper River bluffs. Between 2500 ft (763 m) and 3000 ft (914 m) the lithology is primarily drift of the Pleistocene glaciation with localized areas of lava flows (Capital Mountain and Boomerang Volcano) and alluvial deposits of Holocene and Pleistocene age.

Focus of Survey

We tried to inventory the spatial extent of high and low elevation wetlands and different lithologies in this region. Our effort in the 1994-1997 survey was along the upper Copper River above Slana during a survey by raft, the wetlands along Tanada Creek and two lakes (Fox Farm and Indian) between the Sanford and Slana Rivers. We surveyed five sites in 2003 between the Sanford and upper Copper Rivers.

Summary of Results

We surveyed 16 sites in the upper Copper River basin and vouchered 204 specimens (Figure 5.14, Plate 5.14 and Tables 5.1 to 5.4). These collections documented 157 taxa, 30 taxa new to the park (four from the 2003 survey), six significant range extensions, five occurrences of three rare plant taxa and 15 endemics (eight amphiberingian, three Alaska-Yukon, two cordilleran and two Pacific coastal). The number of sites was close to the average of 17, but less than average per 100,000 IFA. The number of collections was also lower than average and less than one third the value per unit area. The number of new taxa was above the average (27) and ranked sixth among regions, but was less than the average per unit area. The frequency of range extensions, rare taxa and occurrences was less than the averages for actual and per unit values.

The significant range extensions (four new to the park) that were documented in this region were:

*Carex chordorrhiza**
Carex viridula
*Isoetes maritima**
Hippuris montana
*Potamogeton obtusifolius**
*Pedicularis pacifica**

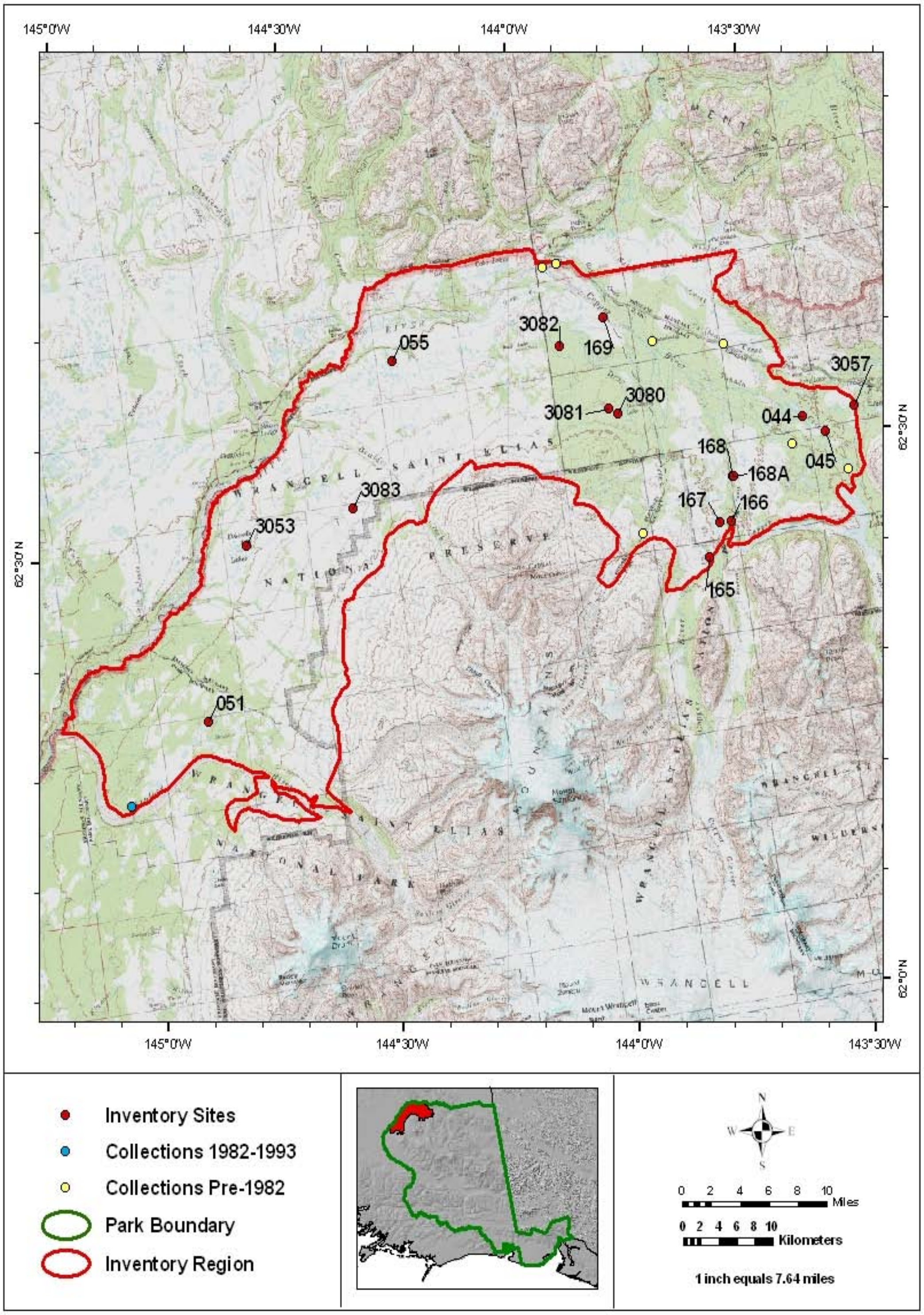


Figure 5.14. Upper Copper River basin vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Mud Lake (Site 161)


Upper Copper River Lake 2264' (Site 165)


Indian Lake (Site 55)


Tanada Lake trail (Site 171)


Billy Lake (Site 3053)


Fox Farm Lakes (Site 51)


Tanada Creek (Site 45)


Upper Copper River Lake 2990' (Site 165)

Plate 5.14. Representative vascular plant inventory sites in the upper Copper River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Two of the significant range extensions are rare and two of the rare species are globally rare. One rare species (*Lupinus kuschei*) was documented in this region prior to our inventory. The rare species which we documented were: *Carex adelostoma* (G4 S1), *Potamogeton obtusifolius* (G5 S1) and *Potamogeton subsibiricus* (G3 S3). The later two species were new to the park. The most notable collections from this region were:

1. *Carex adelostoma* – from three localities in the upper Copper River basin (Sites 51, 165 and 3053) and one in the middle Copper River basin (Site 3048), this rare species is known from only one other locality in the state, a 1947 collection from the Nabesna Road in the Tanana River Basin (Annotation Map 33).
2. *Isoetes maritima* – known only from this region in the park (Sites 3080 and 3083), extending its range 228 km north from the coast (Annotation Map 58).
3. *Lemna trisulca* – from Billy Lake (Site 3053), the only collection from the park. This is an aquatic with a spotty distribution in Alaska. This collection extends its range south and east into the Copper River basin. There is one collection just outside the park near Slana (40 km distant) made in 1954 by S. Galen Smith (University of Alaska Museum Arctos Database 2006).
4. *Potamogeton obtusifolius* – from the vicinity of Duck Lake (Site 3082), the only collection in the park, our collection extends the range of this rare species 172 km south into the Copper River Basin from the Alaska Range (Annotation Map 88).

Notable Sites/Plant Associations

- <u>Billy Lake (Site 3053)</u> - We surveyed fresh pondweed aquatic and subarctic lowland wet meadow communities here and documented 11 species new to the park and one rare species (*Carex adelostoma*).
- <u>Fox Farm Lake (Site 51)</u> - Shallow lake, sedge meadow and spruce forest communities were surveyed at this site. We documented two amphiberingian endemic species (*Salix pulchra* and *Sausurrea angustifolia*), seven species new to the park, one significant range extension (*Carex viridula*) and one rare species (*Carex adelostoma*).
- <u>Copper River lake (Site 165)</u> - this lake is adjacent to the Copper River near the outlet from Tanada Lake. We surveyed shallow lake, wet graminoid meadow and gravel bar communities and documented ten species new to the park and two rare species (*Carex adeolostoma* and *Potamogeton subsibiricus*).
- <u>Boomerang Lakes (Sites 3080 & 3081)</u> - These are two higher elevation (2750 ft) lakes with rocky bottoms. We surveyed freshwater aquatic, mesic meadow, rocky shore and willow scrub communities. There was one Pacific coastal endemic which was a significant range extension (*Isoetes maritima*),

six species new to the park and one rare species (*Potamogeton subsibiricus*). There were also two species which are of limited distribution in the park: *Subularia aquatica* and *Carex buxbaumii*.

Completeness of Inventory

We surveyed five of the ten sites identified for the 2003 survey. The survey effort in this region was low and this may explain the relatively low number of documented notables. The wetland communities are extremely variable in this region and poorly represented in our survey effort. Eighteen of the 91 documented rare taxa in the park are found in aquatic or wetland communities and it is likely that new species and populations will be found with additional surveys. The Ahtna Basin ecological region is unique to the Central Alaska network of parks and an effort should be made to acquire baseline information about its resources. A brief survey was made of the Sanford Dunes in 1992 by Mike Duffy and Mary Beth Cook during FIREPRO vegetation mapping, but this area could use a more comprehensive survey. In addition, river bluffs along the Copper River, Sanford River and Boulder Creek should be surveyed.

Middle Copper River Basin

Description of Region

This region corresponds to the Ahtna Basin ecosection of the Copper River Basin ecoregion, but only includes the area south of the Sanford River and north of the confluence of the Copper River with the Chitina River (Figure 5.15). The middleCopper River basin encompasses 472,040 acres, no ice and 3.59% of the park's area. The surficial geology of this region below 2500 ft (763 m) is composed primarily of Pleistocene glacial Lake Ahtna deposits. Holocene and Pleistocene alluvium is found along the rivers flowing out of the Wrangell Mountains and there are areas of Holocene bluff colluvium along the Copper River. Mineral spring deposits are found on the flanks of Mt. Drum at Upper Klawasi, Lower Klawasi and Shrub mud volcanoes. Volcanic pyroclastic flows (with pumice, ash, andesite and dacite) were deposited at the forks of the Chetaslina Rivers and at the junction of the Klawasi and Copper Rivers. Valley fill lavas are found along the Chetaslina Rivers and in the lowlands between the Cheshnina and Chitina Rivers. The surficial geology between 2500 (763 m) and 3000 ft (914 m) is predominately drift of the Pleistocene glaciation with volcanic debri flows on the upper Chetaslina Rivers and valley fill lavas on the upper Cheshnina River.

Focus of Survey

We tried to survey the spatial extent of the region and to represent the range of elevations and wetland types and to survey some of the bluff and mineral spring communities.

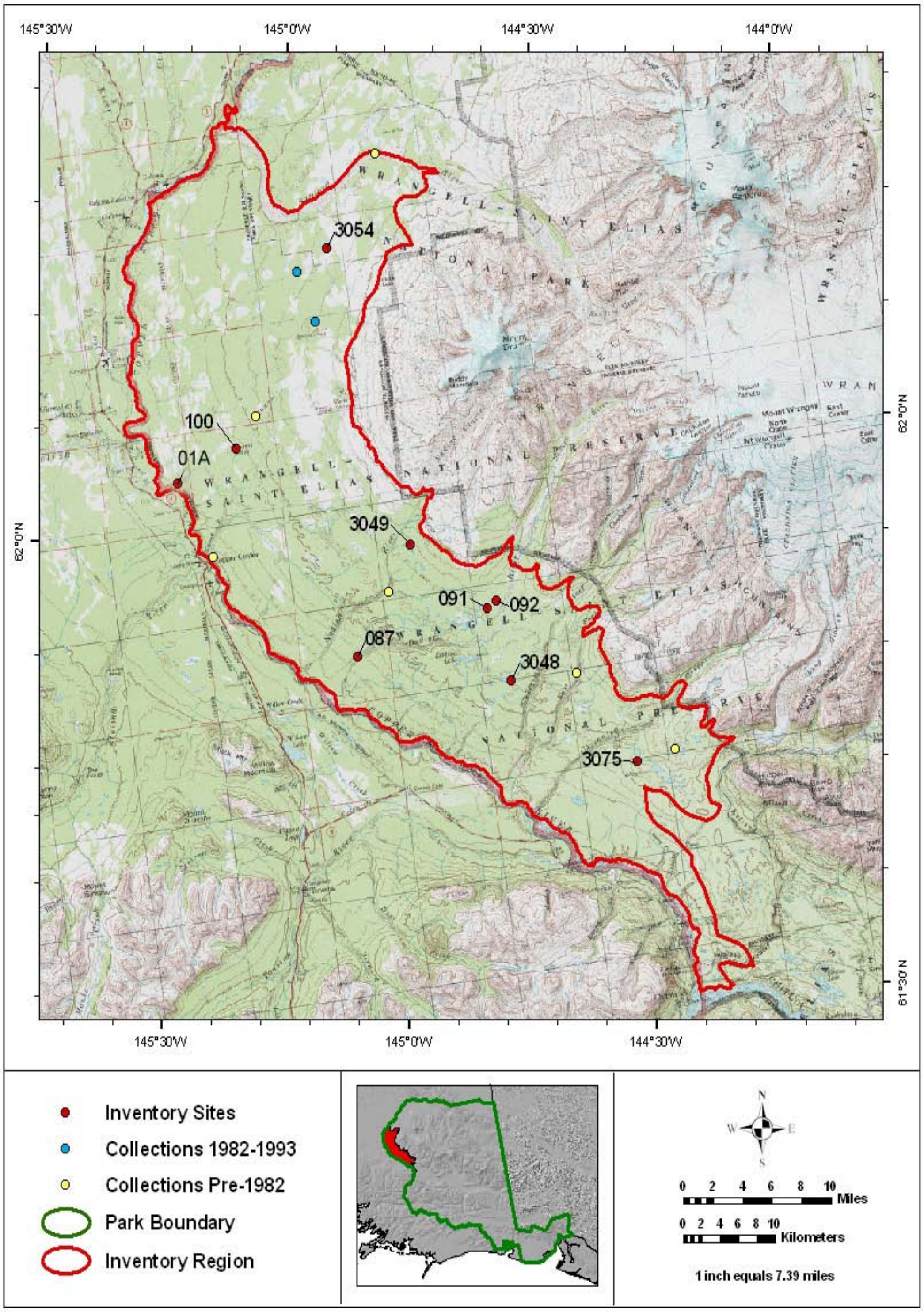


Figure 5.15. Middle Copper River basin vascular plant inventory region (eastern section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Klawasi Creek (Site 1a)

Dadina River bluff (Site 87)

Dadina River wetlands (Site 91)

Dadina Marsh (Site 92)

Nadina River pond (Site 3049)

Chetaslina River wetlands (Site 3048)

Plate 5.15. Representative vascular plant inventory sites in the middle Copper River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

Nine sites were surveyed in the middle Copper River basin and 167 collections were made (Figure 5.15, Plate 5.15 and Tables 5.1 to 5.4). These vouchers documented 262 taxa, 46 taxa new to the park (four from 2003), five significant range extensions, six occurrences of six rare plant taxa and 24 endemics (eight amphiberingian, seven Alaska-Yukon, five cordilleran and four Pacific coastal). The number of sites was almost half of the average (17), the number of collections was less than half the average (389) and both of these values were less than the unit area averages among regions. The number of taxa new to the park was high, ranking third among all regions, comprising 23% of the taxa new to the park and representing ten new taxa per 100,000 IFA, slightly greater than the regional averages. The frequencies of significant range extensions, rare taxa and occurrences were below the actual and per unit area averages.

The significant range extensions (four new to the park) documented by our vouchers in the middle Copper River basin were: *Carex chordorrhiza**,*Carex lasiocarpa* subsp. a*mericana*, Carex leptalea, Podagrostis aequivalis* and Ruppia cirrhosa*.*

One of the range extensions is rare and one of the rare species is globally rare (*Lupinus kuschei*). Four of the rare taxa were new to the park during this inventory. Ceratophyllum demersum (G5 S2) was collected in this region during the inventory just outside the park on the Old Edgerton Highway, but has not been documented from within the park. The rare taxa documented during this inventory in middle Copper River basin region were:

*Astragalus harringtonii** G5T3 S3	*Elymus calderi** G3G4 S2S3
Carex adelostoma G4 S1	*Juniperus horizontalis* G5 S1S2
Carex lenticularis var. *dolia** G5T3Q S3	*Lupinus kuschei* G3 S2
	Salix setchelliana G4 S3

The most notable collections from the middle Copper River basin were:

1. *Elymus calderi* - a rare Alaska-Yukon endemic from the Dadina Bluff (Site 87, Annotation Map 73).
2. *Podagrostis aequivalis* – a North American Pacific coastal species also from the Dadina Bluff (Site 87). This is the northern extent of its distribution and is 133 km north of the closest collection in the Cordova Quad (Cook and Roland 2002, Map 35).
3. *Ruppia cirrhosa* – from a pond in the Nadina River drainage (Site 3049), one of two non-coastal collections in Alaska, the only collection in the park and connecting its distribution 238 km to the west near Anchorage with stations 407 km to the southeast near Yakutat (Annotation Map 90).

Notable Sites/Plant Associations

- <u>Nadina pond (Site 3049)</u> - This rocky bottomed pond is in the Dadina River drainage at 2500 ft (763 m). We surveyed fresh pondweed and wet meadow

communities documenting one amphiberingian endemic, one significant range extension (*Ruppia cirrhosa*) and nine species new to the park.

- Chetaslina wetlands (Site 3048) - This was a shallow tannic pond with fresh water pondlily and sedge wet meadow communities. There were six species new to the park, one significant range extension (*Carex lasiocarpa* subsp. *americana*) and one rare species (*Carex adelostoma*).
- Sanford River wetland (Site 3054) - We surveyed fresh pondweed and subarctic lowland wet meadow communities at this site. There was one amphiberingian species (*Salix pulchra*), five species new to the park and one rare species (*Carex lenticularis* var. *dolia*).
- Dadina Bluff (Site 87) - This steep south-facing bluff on glacial till had one Alaska-Yukon endemic species documented by our collections (*Elymus calderi*), one significant range extension (*Podagrostis aequivalis* - on the floodplain below the bluff) and two rare species (*Elymus calderi* and *Juniperus horizontalis*).

Completeness of Inventory

Although the survey effort here was low, the number of species new the park ranked third for all regions. This is most likely due to the emphasis on wetlands in this region, a community that has been poorly represented in inventories in this park and throughout the state. The one bluff site that was surveyed was quite productive (two rare taxa, two species new to the park and a significant range extension). Bluff communities along the Copper, Nadina, Dadina, Chetaslina and Cheshnina Rivers should be surveyed in the future as well as the two remaining mineral springs (Upper Klawasi and Shrub). We were not able to survey the ash deposits at the Chetaslina Rivers and at the junction of the Klawasi and Copper Rivers. The spatial coverage is still poor for this region, particularly between the Sanford and Nadina Rivers.

Lower Copper River Basin

Description of Region

This region includes the Bremner River basin below 3000 ft (914 m) which drains into the Lower Copper River (Figure 5.16). It is part of the Northern Chugach Mountains ecosection in the classification by Swanson (2001). The lower Copper River basin covers 110,412 acres, all ice free, and 0.84% of the park's land. The upper reaches of the Bremner River (below 3000 ft) are undifferentiated slope deposits. The north side of the drainage is metamorphic greenschist and the south side is metamorphic schist. The floodplain of the Little Bremner River which drains from the north into the Bremner River is drift of the Pleistocene glaciation. The mouth of the Bremner River is Holocene and Pleistocene alluvial deposits and there are extensive Holocene eolian dune deposits adjacent to the Copper River.

Focus of Survey

The focus of the survey in this region was the extensive dunes and wetlands at the mouth of the Bremner River. We were not able to survey the middle and upper reaches of the Bremner River which occur in the region.

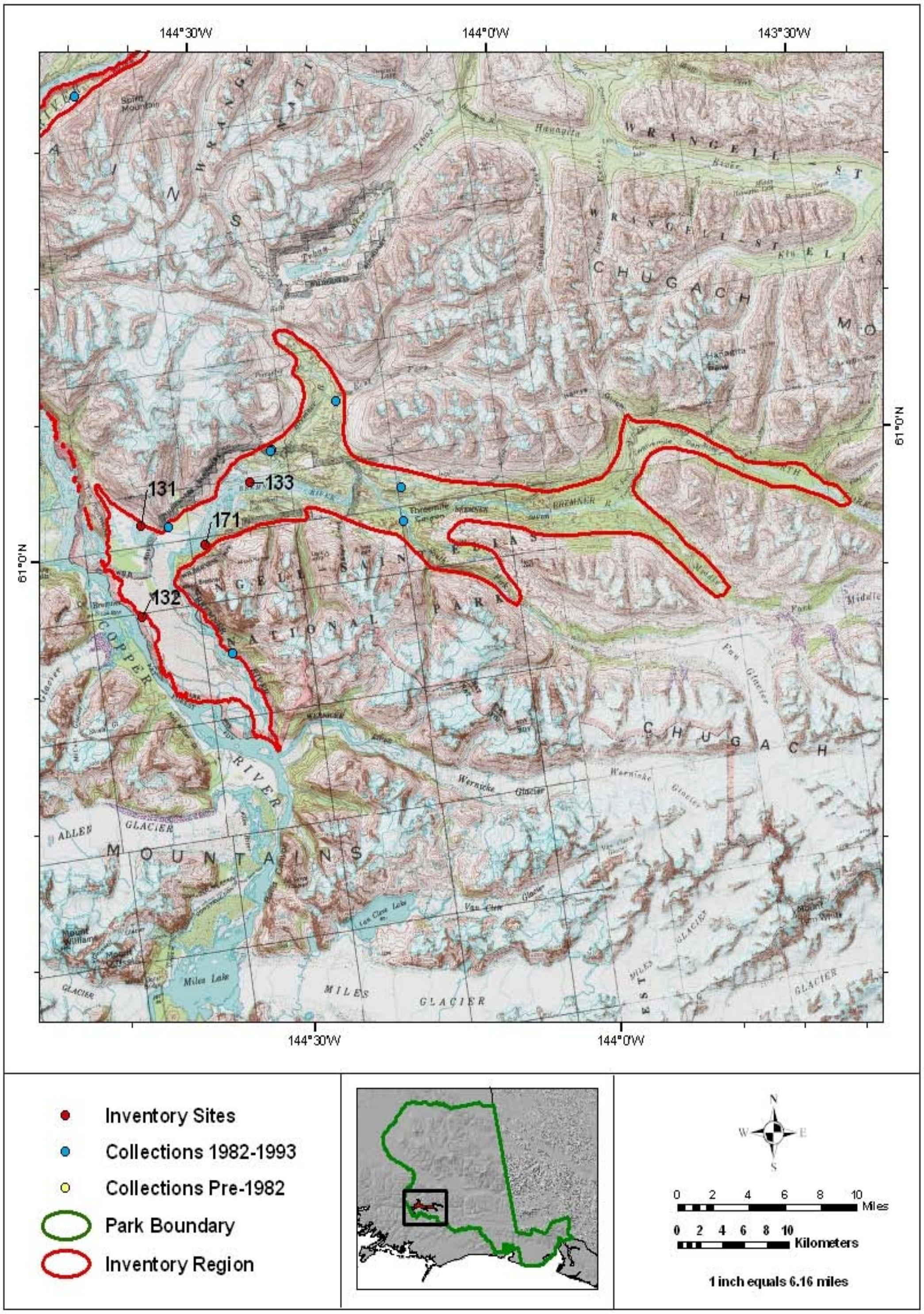


Figure 5.16. Lower Copper River basin vascular plant inventory region (eastern section), associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927)


The Peninsula fen (Site 131)


Copper & Bremner confluence (Site 132)


Copper & Bremner confluence (Site 132)


Happell River slough (Site 133)


Happell River slough (Site 133)


Bremner dunes (Site 127)

Plate 5.16. Vascular plant inventory sites in the lower Copper River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

Only four sites were surveyed in the lower Copper River basin, the second to lowest number for a region, but representing four sites per 100,000 IFA, a value near the regional average (Figure 5.16, Plate 5.16 and Tables 5.1 to 5.4). The number of collections (45) in this region is much lower than the average (389), representing one-third of the regional average per unit area. These vouchers documented one species new to the park (*Impatiens noli-tangere*), two significant range extensions (*Carex viridula* and *Euphrasia mollis*) and one occurrence of one rare plant species (*Salix setchelliana*). The frequencies of notables and per unit area values (new to the park, significant range extensions, rare taxa and occurrences) were low when compared with the rest of the regions.

The most notable species from the lower Copper River basin region was *Impatiens noli-tangere* from a fen at the mouth of the Bremner River. It is the only collection of this plant from the park, connecting its range 87 km to the west with its distribution 550 km to the east. This species is under review by the Alaska Natural Heritage program. It is imperiled (S2) in Manitoba and vulnerable (S3) in British Columbia, Alberta and Saskatchewan.

Notable Sites/Plant Associations

The sand dunes at the mouth of the Bremner River (Site 132) had one rare Alaska-Yukon endemic (*Salix setchelliana*) and the fen at the mouth of the Bremner River had one significant range extension (*Impatiens noli-tangere*) and one Pacific Coast endemic (*Salix sitchensis*). We surveyed only small portion of both of these communities within the region.

Completeness of Inventory

This region had a very low survey effort and respectively a relatively low number of notables. It would be desirable to survey the middle and upper reaches of the Bremner River watershed, particularly the wetland communities.

Chitina River Basin

Description of Region

This region corresponds to the Chitina Valley ecosection of Swanson (2001) except for it includes the Kotsina, Kuskulana, Gilihina and Nizina river drainages below 3000 ft (914 m) from the Southern Wrangell Foothills ecosection, and the Tana and Hanagita River drainages below 3000 ft (914 m) from the Northern Chugach Mountains ecosection (Figures 5.17a and 5.17b). The Chitina River Basin encompasses 995,940 acres, 7.57% of the park's total acreage and 7.52% of it ice (Tana, Barnard and Chitina Glaciers below 3000 ft). The region covers 10.96% of the park's ice-free area.

The surficial geology of the Chitina River Basin is predominately drift of the Pleistocene glaciation with localized areas of Holocene and Pleistocene alluvium and colluvium. There are volcanic debri flows at the mouth of the Kuskulana River near Strelna, valleyfill lavas on

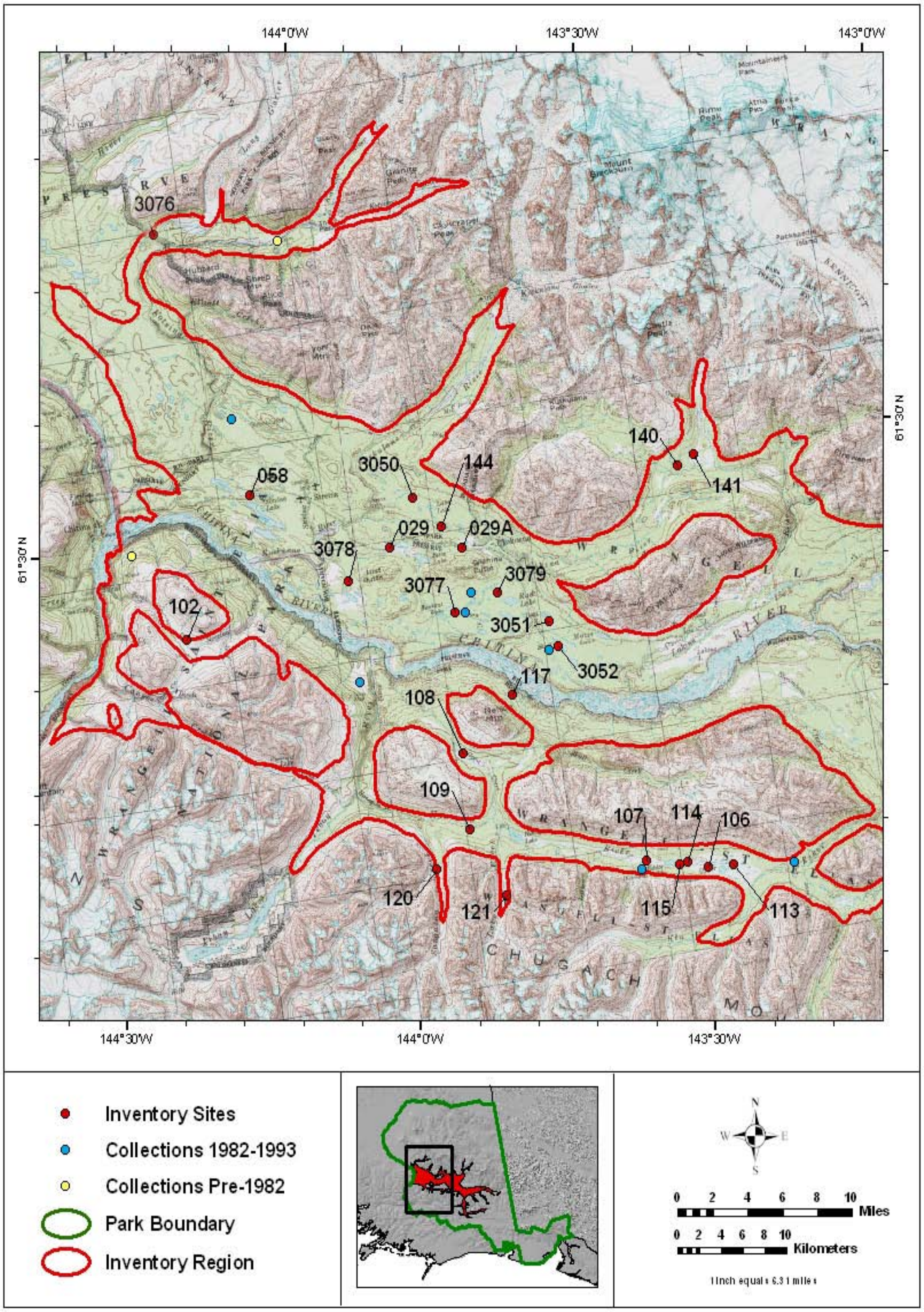


Figure 5.17a. Chitina River basin vascular plant inventory region (western section), associated 1994-1997 & 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

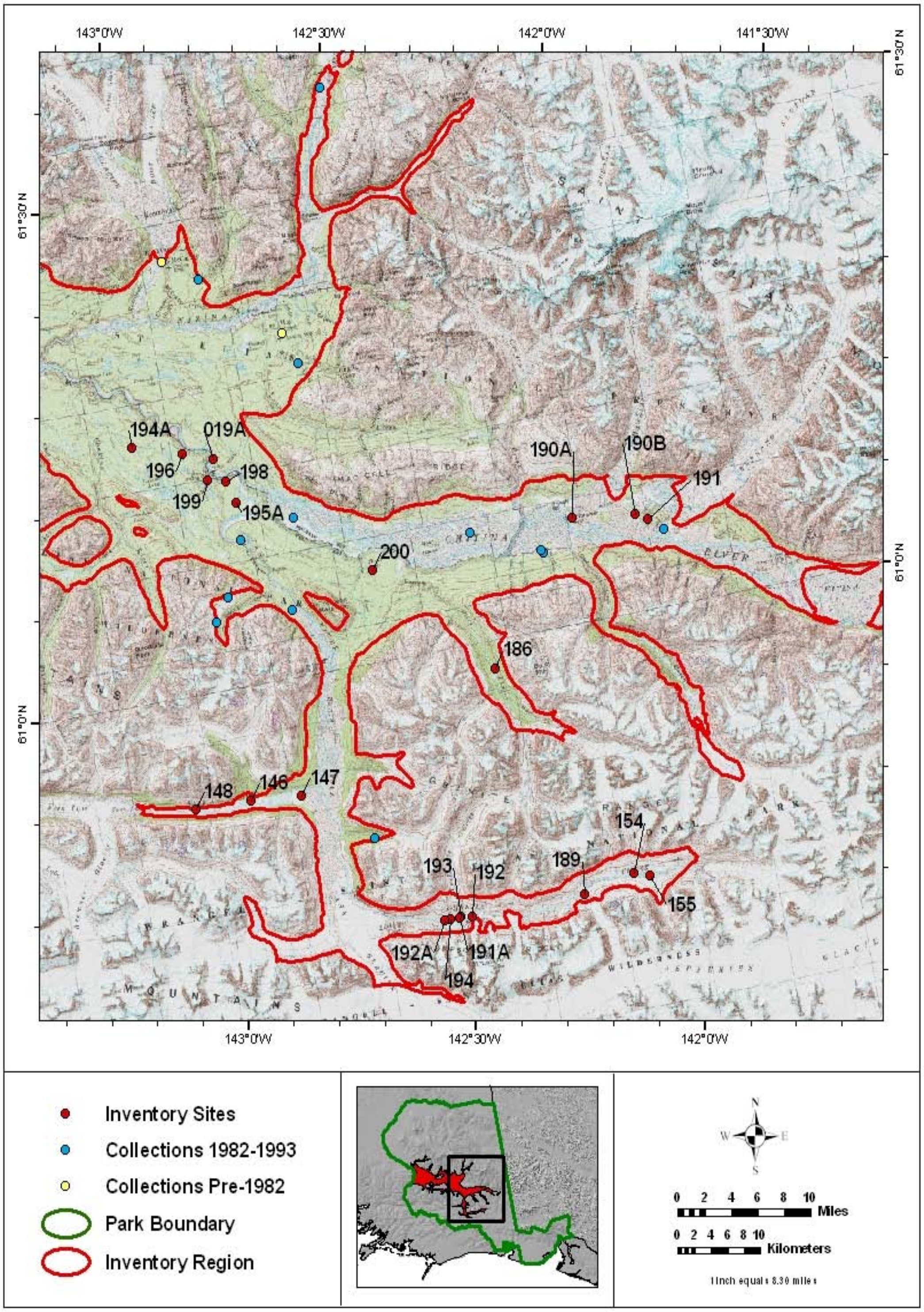


Figure 5.17b. Chitina River basin vascular plant inventory region (eastern section), associated 1994-1997 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).


Tana Dunes (Site 17)

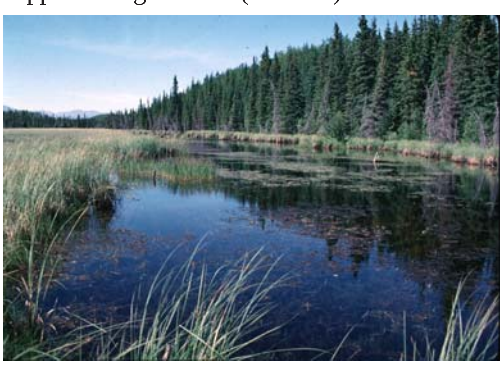

Clear Stream (Site 190B)


East Flowers Lake (SIte 200)


Nerelna Creek (Site 102)


Upper Hanagita River (Site 106)


W. Fork Tana River (Site 148)


Billy Lake marsh (Site 29)


Granite River (Site 154)

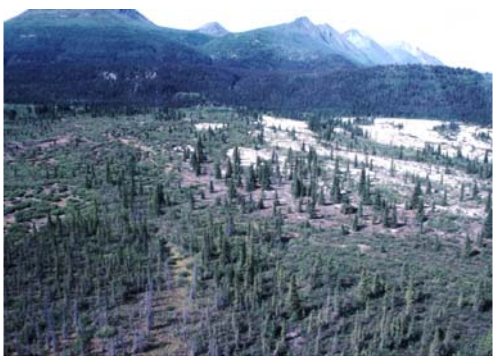
Plate 5.17a. Representative vascular plant inventory sites from the Chitina River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.


Grant Creek (Site 108)

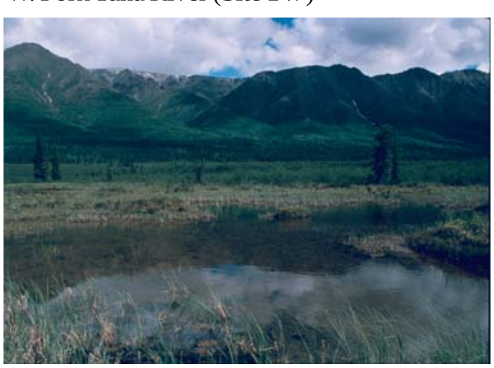

Tana Flats (Site 196)


Granite River (Site 194)


Granite Creek dunes (Site 192)


W. Fork Tana River (Site 147)


Clear Stream (Site 190B)


Upper Hanagita River (Site 106)


Granite River (Site 155)

Plate 5.17b. Representative vascular plant inventory sites from the Chitina River basin, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

the upper Kotsina Rivers, quartz intrusive rocks along the Kotsina River, calcareous metamorphic rocks between the Kotsina and Chitina Rivers and Holocene bluff colluvium at the confluence of the Chokosna and Chitina Rivers. The hill above Muskrat Lake is quartz intrusive rock and the Gilahina Butte is gabbro and orthogneiss. Calcareous metasedimentary rocks are found at the confluence of the Nizina and Chitina Rivers, the Lakina River and along the Tana River. The lower slopes of the Crystalline Hills on the northeast end are chert, limestone and shale. The mouth of Goat Creek, the southwest end of the Crystalline Hills and areas between the Kuskulana and Kotsina Rivers are marble. Greenstone is found in the floodplain between the Barnard and Chitina Glaciers. There are dune deposits on the lower Tana River. Granite Creek is composed of schist, greenschist, colluvium and drift of the Holocene glaciation.

Focus of Survey

The focus of our survey from 1994-1997 were the wetlands in the Lakina, Kuskulana, Hanagita, Granite, Tana and upper Chitina River drainages, the wetlands along the McCarthy Road and the dunes in the Tana and Granite River. Fourteen wetland sites in the lower Chitina River basin were identified for the 2003 survey, six of which were surveyed between the Kuskulana River and the Crystalline Hills.

Summary of Results

We surveyed 45 sites in the Chitina River Basin (Figures 5.17a & 5.17b, Plates 5.17a & 5.17b and Tables 5.1 to 5.4). This was the highest number of sites for a region, but only an average value (five) per unit area. We vouchered 741 specimens from this region, the third highest value for a region, but less than the regional average by unit area. These vouchers documented 394 taxa (the highest of any region), 67 taxa new to the park (the highest of any region, representing 34% of all new taxa), 31 significant range extensions (the highest of any region, representing 25% of all significant range extensions), 21 occurrences of 21 rare plant taxa and 52 endemics (18 cordilleran, 15 amphiberingian, 10 Alaska-Yukon and nine Pacific coastal). Thirteen of the taxa new to the park were unique to this region (the highest value among regions and more than three times the regional average). Although the frequencies of taxa new to the park and significant range extensions were the highest for any region, the unit area value for new taxa was less than the average of eight and there were three significant range extensions per unit area, near the regional average of two. The number of rare taxa ranked third among regions and was twice the regional average (representing 24% of all rare taxa), but there were only two rare taxa per unit area compared to the average of three for all regions. The number of rare occurrences ranked seventh among regions but was lower than the regional average of 24 and there were only two occurrences per unit area compared to the average of six among regions.

Twenty (65%) of the significant range extensions were new to the park The significant range extensions documented in the Chitina River Basin during this inventory were:

*Arenaria longipedunculata**
*Aster junciformis**
Botrychium pinnatum
*Carex chordorrhiza**
Carex lasiocarpa subsp. *americana**
Carex leptalea
*Carex parryana**

*Carex praticola**
Carex tahoensis
Carex viridula subsp. *viridula*
Castilleja elegans
Cryptogramma sitchensis
*Cypripedium parviflorum**
*Eriophorum viridicarinatum**
Euphrasia mollis
Festuca saximontana
Glyceria pulchella
Hackelia deflexa
*Juncus filiformis**
Mentha arvensis
*Myriophyllum verticillatum**
*Najas flexilis**
Nymphaea tetragona
*Poa leptocoma**
Potamogeton foliosus subsp. *foliosus**
Potentilla arguta subsp. *convallaria*
Potentilla drummondii
*Salix stolonifera**
Scutellaria galericulata
var. *pubescens**
*Subularia aquatica**
Vahlodea atropurpurea subsp. *paramushirensis**

Ten of the rare plant taxa were significant range extensions and three are globally rare. Sixteen (73%) of the rare taxa from this region were new to the park. Three rare plants occurring in this region , *Arnica diversifolia* (G5 S1), *Poa secunda* subsp. *secunda* (G? S1) and *Salix setchelliana* (G6 S2) were not collected during this inventory. The rare plants documented in the Chitina River Basin during this inventory were:

*Arabis lemmonii** G5 S1
Arenaria
*longipedunculata** G3Q S3
*Carex crawfordii** G5 S2S3
Carex eburnea G5 S2S3
*Carex interior** G5 S1
*Carex lapponica** G4G5Q S2
Carex lenticularis
var. *dolia** G5T3Q S3
*Carex parryana** G4 S1
*Carex phaeocephala** G4 S1S2
*Carex tahoensis** G3? S1
*Cypripedium parviflorum** G5 S2S3
*Eriophorum viridicarinatum** G5 S2
Glyceria pulchella G5 S2S3
Juniperus horizontalis G5 S1S2
Minuartia biflora G5 S2
*Myriophyllum verticillatum** G5 S3
*Najas flexilis** G5 S1S2
*Poa leptocoma** G5 S2
*Potamogeton subsibiricus** G3 S3
Potentilla drummondii G5 S2
Trichophorum pumilum
var. *rollandii** G5 S1
*Carex tahoensis** G3? S1
*Cypripedium parviflorum** G5 S2S3
*Eriophorum viridicarinatum** G5 S2
Glyceria pulchella G5 S2S3
Juniperus horizontalis G5 S1S2
Minuartia biflora G5 S2
*Myriophyllum verticillatum** G5 S3
*Najas flexilis** G5 S1S2
*Poa leptocoma** G5 S2
*Potamogeton subsibiricus** G3 S3
Potentilla drummondii G5 S2
Trichophorum pumilum
var. *rollandii** G5 S1

The most notable collections from the Chitina River Basin were:

1. *Arabis lemmonii* – from Granite Creek (Site 194), new to the flora of Alaska, delineating the western extent of its range, and 116 km west of a station near Kluane Lake (Annotation Map 11).
2. *Aster junciformis (= Symphyotrichum boreale, Aster borealis)* – only found in this region of the park at Muskrat Lake (Site 3077), Rock Lake (Site 3079) and Billy Lake (Site 29). These collections connect the species' range 220 km to the west in the Anchorage Quad with its distribution 189 km to the east in the Yukon Territory (Cook and Roland 2002, Map 207).

3. *Carex crawfordii* – The only collection of this sedge in the park is from Tana Flats (Site 196), extending its range 141 km south from the Tanana River Valley (Annotation Map 36).
4. *Carex laeviculmis* – Known only from this region in the park (Nerelna Creek wetlands, Site 102, and the West Fork of the Tana River, Site 147) these collections connect the species' range 127 km to west in the Valdez Quad with its distribution 344 km to the southeast in the Alsek River drainage.
5. *Carex tahoensis* –collected on the Granite River (Site 154), this sedge is new to the flora of Alaska and extends the range 250 km west from collections in the Yukon Territory (Annotation Map 47).
6. *Cypripedium parviflorum* – this rare orchid is known in the park from only this one site (Tooth Lake, Site 3051). This collection connects the range 433 km to the north near Eagle with stations 389 km to the southeast near the Alsek River (Annotation Map 68).
7. *Drosera anglica* – known in the park only from three sites in this region: Tana Flats (Site 199), Lakina Pond (Site 140), and Billy Lake (Site 29). These collections extend its range 171 km south from a collection at Mile 173 Richardson Highway (near Slana) into the Chugach Mountains and connect the distribution 256 km to the southeast at Yakutat.
8. *Eriophorum viridi-carinatum* – this rare cotton-grass is known in the park from one locality - a pond in the Lakina River drainage (Site 140). This collection connects its distribution 259 km to the west in the Anchorage Quad with a collection near Haines, 458 to the southeast (Annotation Map 489).
9. *Mentha arvensis* –from the Tana River (Site 196), the only collection from the park, connecting distribution 352 km to the west near Anchorage with the distribution 267 km to the southeast at Yakutat.
10. *Myriophyllum verticillatum* – from Billy Lake (Site 29), the only collection in the park, this is an uncommon aquatic species in Alaska. This collection connects its range 238 km to west in the Anchorage Quad with the distribution 363 to the east in the Yukon Territory (Annotation Map 56).
11. *Najas flexilis* – a rare aquatic, known only from Chokosna Lake (Site 29A) in the park, our collection was the first reported record for Alaska (Annotation Map 61).
12. *Potamogeton foliosus* – a pondweed known only from Tana Flats (Site 196) in the park, and recorded from only five localities in Alaska prior to our inventory (Annotation Map 87).
13. *Potamogeton zosteriformis* – the only collection in the park, from Muskrat Lake (Site 3077), this collection extends the range of the species 188 km east from the Anchorage Quad. We also made a collection just outside the park in the Copper River Basin in 1995 (Cook and Roland 2002, Map 19).

14. *Ranunculus macounii* – a North American boreal montane species, known only from one locality in the park, the collection from Tana Flats (Site 196) extends its range 97 km east into the Chugach Mountains from a station near Chitina.
15. *Trichophorum pumilum var. rollandii* – the Alaska distribution of this bulrush is restricted to two localities in the park which represent its western extent. The Chitina River basin collection was from Clear Stream (Site 190B), Annotation Map 50.

Notable Sites/Plant Associations

- <u>Barnard Glacier terminus wetlands (Site 190B and 191)</u> - These wetlands are some of the most interesting in the park due to the high number of notables found here and the mosaic of communities in a such a small area. The wetlands are on unconsolidated morainal deposits. We surveyed fresh herb marsh, seasonal pond, wet sedge tundra, willow-alder scrub, white spruce forest and graminoid-forb meadow communities. There were six rare species here: *Carex eburnea, Juniperus horizontalis, Carex parryana, Arenaria longipedunculata, Tricophorum pumilum* subsp. *rollandii* and *Potentilla drumondii*. There were 14 species new to the park and eight significant range extensions (*Arenaria longipedunculata, Carex parryana, Carex viridula* subsp. *viridula, Carex praticola, Juncus filiformis, Potentilla drummondii, Salix stolonifera* and *Vahlodea atropurpurea* subsp. *paramushirensis*).
- <u>Tana Flats (Sites 194A, 195A, 196, 198 & 199)</u> - These are the wetlands at the confluence of the Tana and Chitina Rivers. They are on unconsolidated surficial deposits. We surveyed wet sedge meadow, mixed freshwater herbaceous, open low willow scrub, fresh pondweed-spatterdock pond, sweetgale-graminoid bog, wet open black spruce forest, spruce-paper birch forest, subarctic lowland sedge wet meadow, dry pond meadow and wet sedge herb tundra. Our specimens documented two amphiberingian species, two rare species (*Carex crawfordii* and *Glyceria pulchella*), 27 species new to the park and six significant range extensions (*Carex lasiocarpa* subsp. *americana, Carex leptalea, Mentha arvensis, Potamogeton foliosus* subsp. *foliosus, Glyceria pulchella* and *Carex chordorrhiza.*
- <u>Granite River east (Sites 154 & 155)</u> - These sites were at the head of the Granite River on a glacial moraine. We surveyed tall willow scrub, dry bearberry-grass-juniper and wet sedge meadow communities. There were four cordilleran endemic species, three rare species (*Carex phaeocephala, C. tahoensis* and *Potentilla drummondii*), nine species new to the park and four significant range extensions.
- <u>Granite River west (Sites 192, 192A, 193 & 194)</u> - These sites were near Ross Green Lake. We surveyed sand dune, bedrock ridge, rocky lake margin, small kettle pond. rubble slope, floodplain, mesic shrub birch, sedge-moss, scrub and wet

sedge meadow communities. There was one species new to the state (*Arabis lemmonii*), two rare species (*Arabis lemmonii* and *Carex phaeocephala*), six endemic species (three cordilleran, two Pacific coastal and one Alaska-Yukon), five species new to the park and two significant range extensions (*Arabis lemmonii* and *Carex lasiocarpa* subsp. *americana*).

- Muskrat Lake (Site 3077) - this lake is on the river terrace between the Chitina River and the McCarthy Road. We surveyed freshwater aquatic, sedge meadow, white spruce balsam poplar forest and tall alder-willow scrub communities. There was one significant range extension (*Aster junciformis*) and nine species new to the park.

Completeness of Inventory

This region had the highest actual survey effort (numbers of collections and sites surveyed) and the highest numbers of taxa new to the park and significant range extensions. It also had 24% of the parks rare taxa (the second highest value for a region). The number of rare taxa here is related to the large size of the region (ranking third in ice-free acres) and the higher survey effort (as predicted by the linear relationships described in Chapter 6). However, the great diversity in landforms and lithology, location in a transitional area of the park and the region's extensive longitudinal span contribute to the high number of notables found here as well.

The survey effort by unit area was average (sites) or below average (collections) when compared with the rest of the regions. The largest geographic gaps in this region are: the upper and lower Kotsina River drainage, the upper Kuskulana River drainage, the lowlands between Fireweed Mountain and the Nizina River, the lowlands between the Nizina and Chitina Rivers, Tebay River drainage, Lake Creek drainge and the region between Steamboat Creek and the Chakina, south of the Chitna River.

Malaspina Forelands

Description of Region

This region corresponds to the Bering-Malaspina Forelands ecosection of the Gulf Coast of Alaska ecoregion (Figure 5.18). It is the smallest region in the park covering 76,230 acres, 0.58% of the park's area, 14.15% which is ice. The region comprises only 0.78% of the park's ice-free area. The surficial geology of the Malaspina Forelands is Holocene and Pleistocene alluvium, drift of the Pleistocene glaciation, colluvium in Grand Wash, drift of the Holocene glaciation around Malaspina Lake and Holocene beach deposits.

Focus of Survey

I identified 65 sites on the Malaspina Forelands to survey in 2003. The sites spanned the spatial extent of the region and represented forest, beach strand, wetland, floodplain, glacial moraine scrub and dune communities.

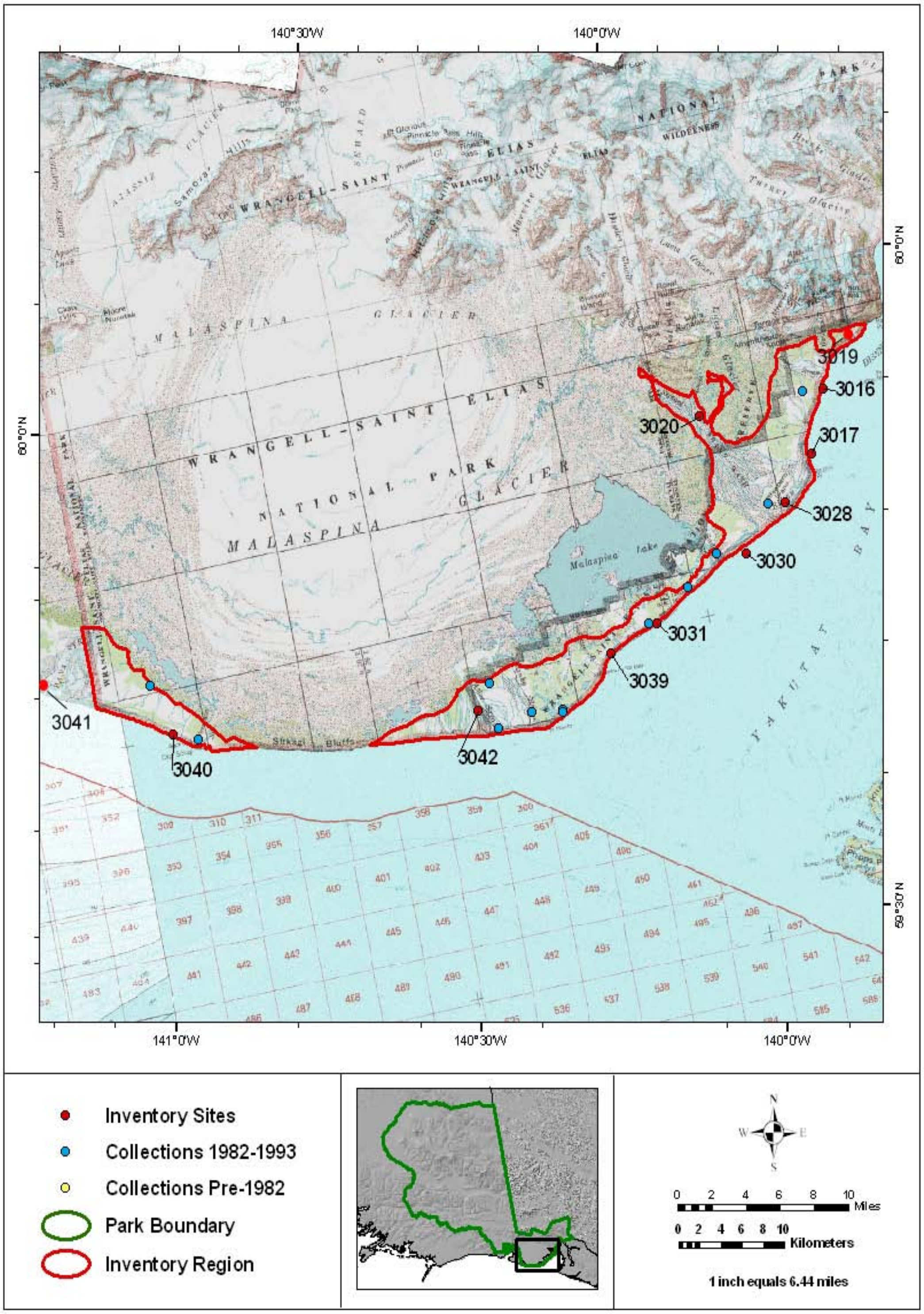


Figure 5.18. Malaspina Forelands vascular plant inventory region , associated 2003 survey sites and previous collections, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projection NAD 1927).

Black Creek (Site 3019).

Strawberry Island (Sites 3028 & 3016).

Strawberry Island estuary (Site 3017).

Strawberry Island wetlands & forest (Site

Upper Grand River Wash (Site 3020).

Pond on Strawberry Island (Site 3016).

Alan Batten collecting *Juncus falcatus* subsp. *sitchensis* at Yana Stream

Plate 5.18 Representative vascular plant inventory sites from the Malaspina Forelands, Wrangell-St. Elias National Park and Preserve, Alaska, 1994-1997 and 2003.

Summary of Results

We inventoried 10 sites on the Malaspina Forelands and collected 199 specimens (Figure 5.18, Plate 5.18 and Tables 5.1 to 5.4). These collections documented 127 taxa, 21 taxa new to the park, five significant range extensions, two occurrences of two rare taxa and 19 endemics (13 Pacific coastal, three amphiberingian, two cordilleran and one Alaska-Yukon). Although the number of sites in this region was less than the regional average of 17 and ranked tenth among regions, it had the second highest number of sites per unit area, over twice the regional average. The number of collections was lower than the regional average (389) but higher than the average unit area value (121). The Malaspina Forelands had 28 new taxa per unit area, the highest of any region even though the actual value was near the average of 27. There were ten new taxa unique to this region (not occurring elsewhere in the park), this is the second highest value among regions and over twice the average. The number of significant range extensions was below the regional average but the unit area value was the highest of all regions. The frequencies of rare taxa and occurrences were much lower than the regional averages. The number of rare taxa per unit area was average, but the number of rare occurrences per unit area was half of the regional average.

Two rare species were documented during the inventory of the Malaspina Forelands region: *Salix hookeriana* (G5 S2) and *Limosella aquatica* (G5 S3), the latter was also new to the park. The significant range extensions documented from the Malaspina Forelands were: *Carex mackenziei, Epilobium luteum, Euphrasia mollis, Galium aparine and Schoenoplectus tabernaemontanii*.

The most notable collections from the Malaspina Forelands region were:

1. *Carex mackenziei* – collected from Strawberry Island (Site 3028), and the only collection from the park, this locality is a major range connection between the mouth of Copper River and Juneau (Annotation Map 44).
2. *Eleocharis macrostachya* – known only from this region in the park, it was collected at Yana Stream (Site 3041) and Strawberry Island (Site 3028). This taxon was included in Hultén's treatment of *Eleocharis palustris.* The authors of the Flora of North America suggest that *E. macrostachya* is of hybrid origin between *E. palustris* and *E. erythropoda* or *E. uniglumis.*
3. *Epilobium luteum* – collected in 2003 at Alder stream (Site 3042), this beautiful robust yellow blossomed fireweed had also been collected in the Samovar Hills (the Coastal Mountains region) in 1987. These collections are a major range connection between a collection near the Bering Glacier to the west and Chicagof Island 304 km to the southeast (Cook and Roland 2002, Map 167).
4. *Galium aparine* – known only from this region in the park, collected at Schooner Beach (Site 3031) and Point Manby (Site 3039), these collections represent a major range connection between a collection on the Bering Glacier

forelands 215 km to west and a collection in Glacier Bay 277 km to the southeast.

5. *Juncus falcatus* subsp. *sitchensis* – A Pacific Coast endemic known only from ten other localities in Alaska, it was collected during the inventory at Point Manby (Site 3039), Yana Stream (Site 3041) and Strawberry Island (Site 3016). These collections connect its southeast Alaska distribution 73 km to the east at Yakutat with the disjunct distribution 1200 km to the southwest in the Aleutian Islands. It also occurs in the Pacific Islands (Kuriles) and British Columbia.
6. *Lathyrus palustris* subsp. *pilosus* – collected from two localities on the Malaspina Forelands - Point Manby (Site 3039) and Strawberry Island (Site 3028), these collections connect this species' distribution 40 km east at Yakutat with its coastal distribution 289 km to the west at Cordova. The more common species of *Lathyrus* found on the Malaspina Forelands is *L. maritimus*.
7. *Limosella aquatica* – a rare aquatic known only from Yana Stream (Site 3039) in the park, this locality connects its distribution 144 km to the west in the Bering Glacier Quad with a station 467 km to the east near Teslin in the Yukon (Annotation Map 111).
8. *Listera caurina* – the only collection in the park of this North American Pacific coastal endemic orchid is from Cape Sitkagi (Site 3040). This collection connects its range 150 km to the west at the Duktoth River with a collection 67 km to the east at Yakutat.
9. *Osmorhiza chilensis* – the only collection from the park is from Black Glacier Creek (Site 3019). This collection connects the species' distribution 796 km to the southwest on the Alaska Peninsula near Pedro Bay with a collection on the Yakutat Forelands 71 km to the east.
10. *Rumex fenestratus* – the only collection from the park is from Cape Sitkagi (Site 3040). This collection connects the distribution of this species 138 km to west at Hanna Lake in the Robinson Hills with a collection near Yakutat 84 km to the east.
11. *Rumex salicifolius* var. *mexicanus* – the only collection in the park from Yana Stream (Site 3041) is a range connection (Annotation Map 85).
12. *Schoenoplectus tabernaemontani* – known in the park from only two collections in the Chitina River Basin and from Strawberry Island (Site 3028) on the Malaspina Forelands, the coastal collection is a major range connection between Cordova and Haines (Annotation Map 49).

Notable Sites/Plant Associations

- <u>Esker Stream (Site 3016)</u> - This is the beach strand south of the mouth of Esker Stream. Coastal herbaceous meadow, Sitka Spruce forest and Balsam Poplar

forest communities were surveyed at this site. There were eight endemic species (five Pacific coastal, two amphiberingian and one cordilleran), two species new to the park and one significant range extension (*Euphrasia mollis*).

- Strawberry Island (Site 3028) - This site is at the mouth of Grand Wash on Yakutat Bay. Fresh sedge marsh, small pond and coastal dune communities were surveyed. We documented two significant range extensions (*Carex mackenziei* and *Schoenoplectus tabernaemontanii*), four endemics (one Alaska-Yukon, One Pacific coastal, one amphiberingian and one cordilleran) and five species new to the park.
- Yana Stream (Site 3041) - This site is just outside the park border at the western end of the region. We surveyed floodplain, open low scrub and
- fresh pondweed communities. There were two endemic species at this site, seven species new to the park, one significant range extension (*Euphrasia mollis*) and one rare species (*Limosella aquatica*).

Completeness of Inventory

Even though there was a high survey effort in this region per unit area when compared to other regions, there were only three sites in Sitka Spruce forest communities. This community is a small portion of the area of the park, but significant in that it is not found elsewhere in the park. FIREPRO surveys documented old growth Sitka Spruce forests occurring here, a community not documented by specimens from our inventory. There have also been reports of *Tsuga mertensiana* (Mountain Hemlock) and *T. heterophylla* (Western Hemlock) occurring in these forests, but no documentation has been obtained. Both species of hemlock occur on the Yakutat Forelands to the east and the Bering Glacier forelands to the west. This region had the highest number of species new to the park per unit area. This is in part due to the higher per unit survey effort, but also due to the paucity of collections from the region prior to our inventory. The greatest geographic gaps in the region are the forested and wetland areas west of the Sitkagi Bluffs and between Sudden Stream and Sitkagi Bluffs.

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Chapter 6: Floristics and Phytogeography

The taxonomic and biogeographic composition of the park's flora is described in this chapter and a comparison is presented with two other Alaska National Parks: Denali National Park and Preserve and Yukon-Charley Rivers National Preserve. The composition of the rare flora is evaluated with respect to taxonomy, biogeography, ecological site characteristics and type of rarity. This is followed by a description of the distribution of the rare flora across the regions of the park and the similarity among regions based on their rare flora. Next, the distribution of the endemic species within the park is presented with an analysis of similarity to each endemic element and to the rare flora. The entire flora is then evaluated by region to determine first, if there are regional floristic associations and secondly if there are defining components of the park's flora. Finally, an interpretation of dispersal patterns since the late Wisconsin glaciation is presented using our knowledge of the distribution of the endemic elements in the park.

Taxonomic Composition of the Flora

There are 853 species (917 taxa including subspecies and varieties) of vascular plants documented by vouchers within Wrangell-St. Elias National Park and Preserve at the time of this analysis in 2005. The species list is provided in Appendix 6.1. Ten species and eighteen subspecies which were previously included in the flora of the park (Cook and Roland 2002), are now excluded due to changes in nomenclature (Appendices 6.2 and 6.3). The park's documented flora represents approximately 56% of the species in the Alaskan flora, 71% of the Yukon Territory flora and 51% of the two floras combined (Table 6.1).

Table 6.1. Numbers of vascular plant species documented in Wrangell-St. Elias National Park & Preserve (WRST), Denali National Park and Preserve (DENA) and Yukon-Charley National Preserve (YUCH) during the Central Alaska Inventory, with ratios of the Alaska and Yukon floras.

Park	#/Species	%/Alaska Flora (n=1535*)	%/Yukon Territory Flora (n=1199*)	%/Alaska-Yukon Flora (n=1654*)
WRST	853	55.6	71.1	*51.6*
DENA	753	49.1	62.8	*45.5*
YUCH	*631*	*41.7*	*53.4*	*38.7*

*Kartesz and Meacham 1999

The number of species per unit area in Wrangell-St. Elias National Park and Preserve is 40% of the per unit area value for Yukon-Charley National Preserve (which covers only 2.5 million acres and has 631 species and 674 taxa), and 80% of the per unit area value for Denali National Park and Preserve (which has 753 species and 816 taxa and covers six million acres) (Table 6.2). Even when the area in ice is removed from the total area of the park, the number of species per unit area for this park is three times less than that of Yukon-Charley National Preserve. However, these differences do not necessarily reflect differences in species diversity between the three parks. Rather, differences most likely demonstrate the predictable species-area relationship seen in sampling areas of different sizes where smaller sample areas have on

average more species per unit area than larger sample areas. The lower number of species per unit area in this park may also indicate that the documentation of our flora is very incomplete.

The flowering plants (Magnoliophyta) comprise 95% of the flora including 263 monocot species and 603 dicot species. There are 26 species of ferns (Pteridophyta), 11 lycopod species (Lycopodophyta), 9 horsetail species (Equisetophyta) and five conifer species (Coniferophyta). The ratio of the flora by plant division for Denali National Park and Preserve is very similar to this park, varying by 1% or less in all classes (Table 6.3).

The species in Wrangell-St. Elias National Park and Preserve are distributed among 71 families and 270 genera. Families with the greatest number of species for the park are the Cyperaceae with 107 taxa, the Asteraceae and Poaceae each with 82 taxa, and the Brassicaceae with 71 taxa (Appendix 5.3). These are also the four most diverse families in Denali National Park & Preserve and Yukon-Charley National Preserve (Roland 2004, Larsen and Rector 2004).

Table 6.2. Number of vascular plants species per unit area (million acres) for Wrangell-St. Elias National Park & Preserve, Denali National Park and Preserve and Yukon-Charley National Preserve with area in ice removed from coverage.

	WRST	DENA	YUCH
Park Area (million acres)	13.2	6.0	2.5
Ice Area (million acres)	2.5*	1.2**	0
Ice-Free Area (million acres)	8.4	4.8	2.5
#/Species	853	753	631
#/Species per Unit Area (million acres)	102	126	252
#/Species per Ice-Free Unit Area (million acres)	80	157	252

* Swanson 1998, ** Digitized 1:63360 USGS quadrat

Table 6.3. Distribution of floras by plant division compared for Wrangell-St. Elias National Park & Preserve and Denali National Preserve.

	WRST		DENA*	
	#/Taxa	%/Flora	#/Taxa	%/Flora
Lycophyta	11	1.2	11	1.5
Sphenophyta	9	1.0	7	1.0
Pterophyta	26	2.9	25	3.3
Coniferophyta	5	0.6	4	0.5
Monocots	263	28.7	214	28.4
Dicots	603	65.7	492	65.3
	917		753	
Flowering Plants	866	94.5	706	93.8

*Roland 2004

Evaluating the flora by life-form, non-woody species comprise 90% of the flora. Forbs are predominate with 534 species (63% of the flora), followed by graminoids (185 species, 22% of the flora). Woody species are represented by 8 tree species (1% of flora), 54 shrub species (6% of the flora) and 25 dwarf shrub species (3% of the flora). The life form composition of the flora of Denali National Park and Preserve and Yukon-Charley National Preserve are very similar to this park, varying by less than 1% for all classes except for the forb class in Denali National Park & Preserve which was 60% of the flora as compared to 63% in Wrangell-St. Elias National Park and Preserve (Table 6.4).

Table 6.4. Distribution of floras by life form compared for Wrangell-St. Elias National Park & Preserve (WRST), Denali National Park and Preserve (DENA) and Yukon Charley National Preserve (YUCH).

	WRST		DENA*	YUCH**
Life Form	#/Species	%/Flora	%/Flora	%/Flora
Trees	8	1	1	1
Shrubs	55	6	7	5
Dwarf Shrubs	25	3	3	3
Forbs	534	63	60	62
Graminoids	189	22	24	22
Lower Vasculars	42	5	3	4
	853			
Woody	88	10	11	9
Non-Woody	775	90	87	88

*Roland 2004 ** Larsen and Rector 2004

Biogeographic Composition of the Flora

Wrangell-St. Elias National Park and Preserve is located within the distribution patterns of the major North American floristic elements, hence the plant species here have diverse origins and histories. They include species endemic to the area, broadly distributed boreal forest plants, arctic-alpine species, endemics of the western mountains and amphiberingian taxa of Asian origin. We recognize the following floristic elements within the vascular flora of the park.

Circumpolar Species – 26.1% of the flora (239 taxa)

This group includes those broadly distributed species that occur on all circumpolar continents including both Asiatic and European regions of Eurasia, Greenland and North America. We further divide this group of plants into boreal species primarily found in lowland and montane habitats and arctic/alpine taxa that generally occur in treeless landscapes in the arctic or alpine

regions. A third element of the circumpolar flora is a group of more wide-ranging species with broad ecological amplitudes that occur across both arctic and boreal zones. The ratio of these elements within the circumpolar flora and examples of taxa from each category are:

a) Arctic-alpine species (92 taxa) - Cardamine bellidifolia, Carex lachenallii, Draba fladnizensis, Erigeron humilis, Saxifraga oppositifolia and Silene acaulis.

b) Boreal-montane species (60 taxa) – *Carex tenuifolia*, *Linnaea borealis* and *Rosa acicularis*.

c) Widespread species (76 taxa) – Carex capillaris, Empetrum nigrum, Equisetum arvense and Poa glauca.

d) Introduced species (11 taxa) –*Achillea millefolium* and *Taraxacum officinale*.

Incompletely circumpolar species – 12.0% of the flora (110 taxa)

Species in this group have distributions that are very similar to the circumpolar plants of boreal distribution, but are not known from either Greenland or Europe. Examples of incompletely circumpolar species include *Calypso bulbosa, Carex limosa*, *Chamaedaphne calyculata, Equisetum fluviatile*, and *Moehringia lateriflora*. Eight of the incompletely circumpolar species are non-native, examples include *Crepis tectorum, Lepidium densiflorum* and *Veronica serpyllifolia* subsp. *humifusa*.

North American species – 32.6% of the flora (299 taxa)

Species in this group have distributions that are generally restricted to North America. Two additional groups of species with more narrow distributions can be identified within the North American element: cordilleran species, which occur in the western mountains, and Pacific coastal species, which are generally restricted to the coast ranges and the west coast of North America.

a) Arctic-alpine species (21 taxa) – *Erigeron compositus* and *Primula egaliksensis*

b) Boreal-montane species (107 taxa) – *Shepherdia candensis* and *Viburnum edule*

c) Cordilleran species (87 taxa) – *Luetkea pectinata* and *Salix commutata*

d) Pacific coastal species (51 taxa) – *Lupinus nootkatensis* and *Epilobium luteum*

e) Widespread species (24 taxa) – *Solidago multiradiata* and *Betula glandulosa*

f) Disjunct species (7 taxa) –*Carex interior* and *Phlox hoodii*

g) Introduced species (2 taxa) - *Collomia linearis* and *Deschampsia elongata*

Amphiberingian species – 22.2% of the flora (203 taxa)

These are species that occur in North America and northern Asia but are not known from either Greenland or Europe; hence their center of distribution generally lies within Beringia. amphiberingian endemic species such as Draba stenopetala and Rumex beringensis are restricted to Beringia and in North America would only be found in Alaska and the Yukon-Territory. There are 42 amphiberingian endemic taxa in the flora. We further separate the species within the amphiberingian biogeographic element into the following categories:

a) Arctic-alpine species (81 taxa) – *Artemisia arctica* and *Senecio atropurpureus*
b) Boreal-montane species (50 taxa) – *Achillea sibirica* and *Boschniakia rossica*
c) Pacific coastal species (35 taxa) – *Carex macrocheata* and *Fritillaria camschatcensis*
d) Widespread species (37 taxa) – *Parrya nudicaulis* and *Carex podocarpa*

Amphiatlantic species – 1.1% of the flora (10 taxa)

Taxa in this group have distributions that include North America, Greenland and Europe but are not known from Asia. *Carex nardina* and *Draba crassifolia* are examples of this element.

Alaska-Yukon endemic species – 6.1% of the flora (56 taxa)

These are species that are restricted to Alaska and Yukon Territory, and sometimes extend into neighboring regions of Northwest Territories and British Columbia.

a) Arctic-alpine species (20 taxa) – *Thlaspi arcticum* and *Smelowskia borealis*
b) Boreal-montane species (15 taxa) – *Salix setchelliana* and *Artemisia alaskana*
c) Cordilleran species (9 taxa) – *Synthyris borealis* and *Stellaria alaskana*
d) Pacific coastal species (12 taxa) – *Castilleja unalaschensis* and *Salix stolonifera*

Biogeographic Comparisons with Alaska-Yukon Regional Floras

I compared the biogeography of Wrangell-St. Elias National Park and Preserve with the flora of Denali National Park and Preserve and Yukon-Charley Rivers National Preserve; the flora of the southwest Yukon as described by Douglas (1974).

Comparison with the Floras of Two Alaska National Parks

The biogeographic elements of our flora and that of Denali National Park and Preserve and Yukon-Charley Rivers National Preserve reveal similar ratios between the elements for each park (Figure 6.1). There are however differences in ranks of the circumpolar, North American and amphiberingian elements between the three parks. The three elements with the strongest representation in all three parks are the North American, circumpolar and amphiberingian elements, however the flora of this park has 7-10% more North American taxa, 5% less circumpolar taxa, 4% less incompletely circumpolar taxa and 1% less amphiberingian taxa than both Denali National Park and Preserve and Yukon-Charley Rivers National Preserve. Wrangell-St. Elias National Park and Preserve also has 2% more Alaska-Yukon endemics than Denali National Park and Preserve and 1% more than Yukon-Charley National Preserve.

The higher ratio of the North American element in this park would be expected with its closer proximity to the major North American migration corridor along the cordillera. We would also

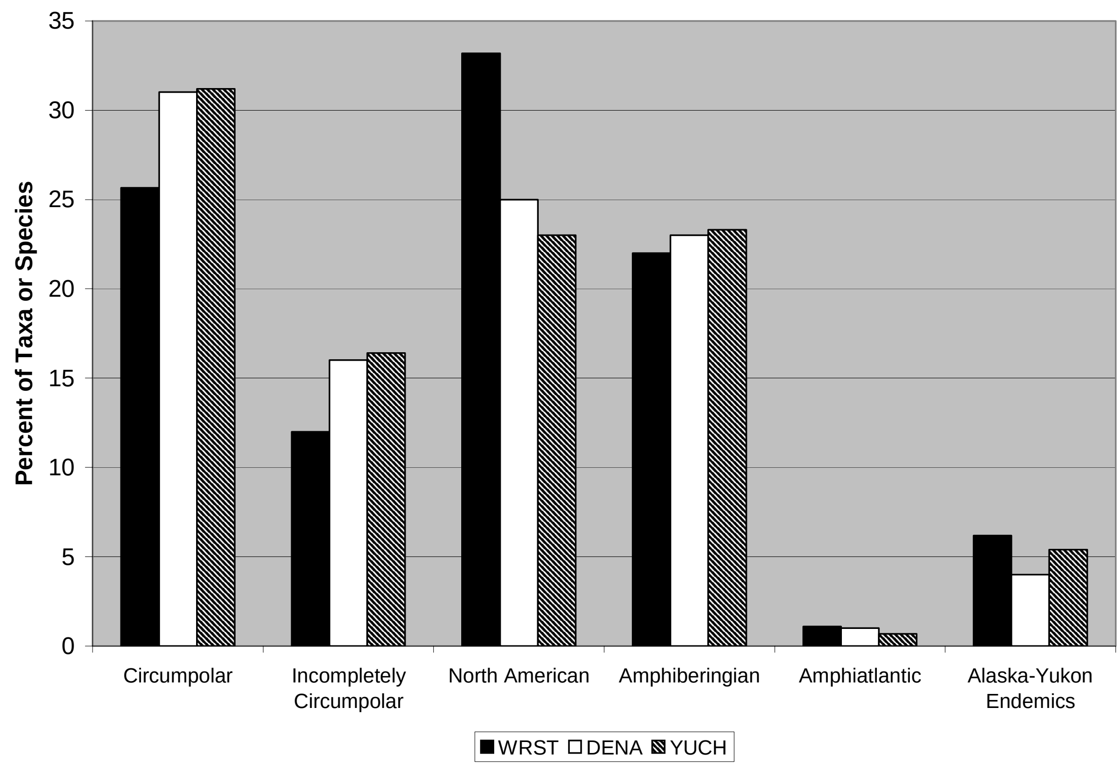
expect Yukon-Charley National Preserve and Denali National Park and Preserve to have much higher ratios of amphiberingian taxa than this park since both Parks had extensive ice-free regions within Beringia even at the maximum extent of the Pleistocene glaciation (Figure 6.2).

The slightly higher ratio of Alaska-Yukon endemic species in this park than in both Denali National Park and Yukon-Charley National Preserve may be due the greater coverage of mountainous terrain within Wrangell-St. Elias National Park and Preserve. Alpine plant communities are known to have more endemic species both because mountain peaks may have been ice free at some point during glacial history and because climatic conditions during periods of glaciation in ice-free areas were more similar to present day alpine conditions than to lowland conditions. Tolmatchev (1960) attributed the increase in endemic species with increased altitude to the greater isolation of mountains from another than from the lowlands. Another factor that may be contributing to the higher ratio of Alaska-Yukon endemics in this park, is its proximity to the Upper Yukon River valley, thought to be a center of Alaska-Yukon endemism (Hultén 1972, Lausi and Nimis 1985).

Comparison with the Southwest Yukon Flora

The composition of our flora is very similar to that described by George Douglas for the southwest Yukon (Douglas 1974). The northerly elements (circumpolar, incompletely circumpolar, North American arctic-alpine, amphiatlantic and amphiberingian) comprise 64% of the southwest Yukon and 63% of our flora. The southern elements (Cordilleran and Pacific Coast) contribute 16% to the southwest Yukon flora and 15% to the park flora. The North American boreal-montane group contributes 14% to the southwest Yukon flora and 12% to the Wrangell-St. Elias flora. The southwest Yukon flora had eight non-native species in 1974. However, an additional 16 non-native species have been reported for the Yukon Territory since 1998 (Cody et. al.1998, 2000, 2001, 2002 and 2003). The park now has 25 non-native species.

Alaska-Yukon endemics comprise 6% of our flora and 5% (32 species) of the southwest Yukon flora reported by Douglas (1974). Lausi and Nimis (1985) documented 23 Alaska-Yukon endemics for the southern Yukon in a phytosociological study along the Alaska Highway. Porsild (1951) estimated that amphiberingian species comprise approximately 33% of the Alaska-Yukon flora. Douglas (1974) noted the southward decrease in this element for the southwest Yukon flora (17%) from Porsild’s estimation for the Alaska-Yukon. The slight increase in amphiberingian species in the park flora (22%) as compared to the southwest Yukon flora would support this gradient as does the slight increase in this element for Yukon-Charley National Preserve and Denali National Park and Preserve.



	WRST			DENA*			YUCH**		
	#/Taxa	% of Taxa	Rank	#/Species	% of Species	Rank	#/Taxa	% of Taxa	Rank
Circumpolar	239	26.1	2	233	31	1	212	31.5	1
Incompletely Circumpolar	110	12.0	4	119	16	4	111	16.5	4
North American	299	32.6	1	186	25	2	152	22.6	2
Amphiberingian	203	22.1	3	176	23	3	157	23.3	3
Amphiatlantic	10	1.1	6	8	1	6	5	0.7	6
Alaska-Yukon Endemics	56	6.1	5	32	4	5	37	5.5	5
Totals	917			754			674		

*Roland 2004 **Larsen and Rector 2004

Figure 6.1. Biogeographic composition of the vascular floras of three Alaska National Parks: Wrangell-St. Elias (WRST), Denali (DENA), and Yukon-Charley (YUCH).

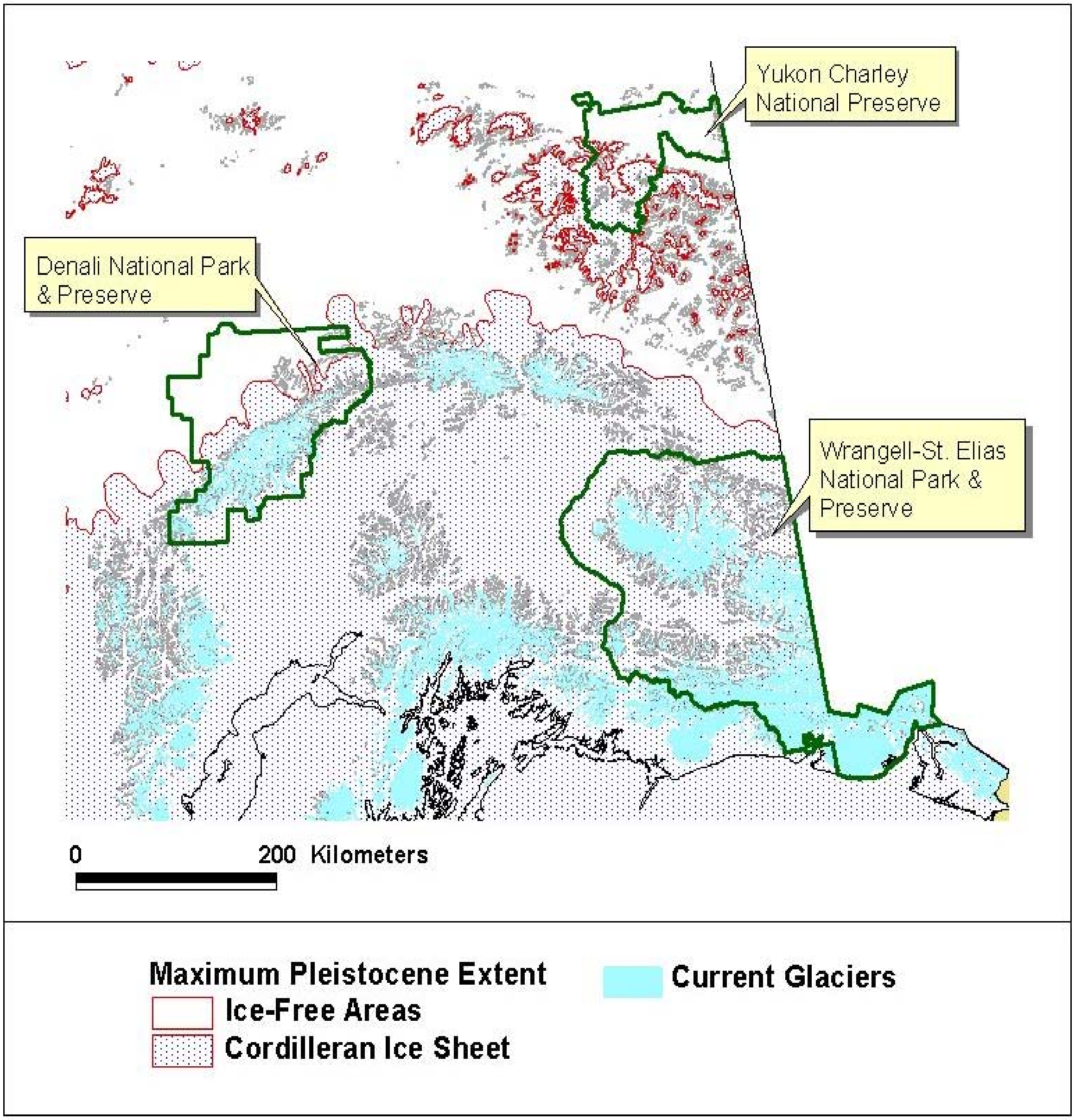


Figure 6.2. Maximum extent of Pleistocene Cordilleran Ice Sheet and glaciers during the last three million years within south-central Alaska (after Manley and Kaufman 2002). Mercator Projection (NAD 1927).

The Rare Flora

Taxonomic and Biogeographic Composition of the Rare Flora

The rare flora is defined as those taxa with an Alaska Natural Heritage Program (AKNHP) state rank of three or less. There were 91 rare taxa known from the park in 2005. The most important plant families in the rare flora are the Brassicaceae with 14 species, the Cyperaceae with 15 species and the Poaceae with nine species. These families are also within the four most diverse families for the entire flora. There are no rare tree species, two rare shrub species (*Juniperus horizontalis* and *Salix hookeriana*), one dwarf shrub (*Salix setchelliana*), seven lower vascular species (six in the genus *Botrychium*), 57 forb species and 24 graminoid species (13 in the genus *Carex*). The rare flora is comprised predominately of North American taxa and Alaska-Yukon endemics. The biogeographic composition of the rare flora with examples of species from each element follow.

1. North American species - 49.4% (45 species)
    - a) Arctic-alpine (1 species) - *Potentilla rubricaulis*
    - b) Boreal-montane (14 species) – Agoseris glauca, Carex parryana, Eriophorum viridi-carinatum, Maianthemum stellatum
    - c) Cordilleran (25 species) – Arabis calderi, A. lemmonii, Carex petasata, Festuca minutiflora
    - d) Pacific coastal (1 species) – *Sedum divergens*
    - e) Widespread (2 species) – Agrostis thurberiana, Poa secunda subsp. secunda
    - f) Disjunct from temperate zone (2 species) – *Carex interior, Phlox hoodii*
2. Alaska-Yukon endemics – 22.0% (20 species)
    - a) Arctic-alpine (5 species) - *Thlaspi arcticum* and *Douglasia arctica*
    - b) Boreal-montane (4 species) – *Cryptantha shackletteana*, *Lupinus kuschei*, *Salix setchelliana*
    - c) Cordilleran (6 species) – *Arabis codyi*, *Taraxacum carneocoloratum*
    - d) Pacific coastal (5 species) – *Aphragmus eschscholtzianus*, *Botrychium tunux*, *B. yaaxudakeit*
3. Amphiberingean species – 9.9% (9 species)
    - a) Arctic-alpine (7 species) - Festuca lenensis, Stellaria umbellate, Trisetum sibiricum subsp. litorale
    - b) Boreal-montane (1 species) – *Potamogeton subsibiricus*
    - c) Pacific coastal (1 species) – *Salix hookeriana*
4. Incompletely circumpolar species – 8.8% (8 species)
    - a) Boreal-montane (5 species) – *Tricophorum pumilum*, *Carex laxa*
    - b) Widespread (3 species) – *Ceratophyllum demersum*, *Myriophyllum verticillatum*

5. Circumpolar – *7.7% (7 species)*
   a) Arctic-alpine (4 species) – *Colpodium vahlianum, Cerastium regelii*
   b) Boreal-montane (2 species) – *Limosella aquatica, Viola selkirkii*
   c) Widespread (1 species) – *Cypripedium parviflorum*

6. Amphiatlantic species - 2.2% (2 species) - *Najas flexilis* which is a widespread species and *Potamogeton obtusifolius* which is a boreal-montane species.

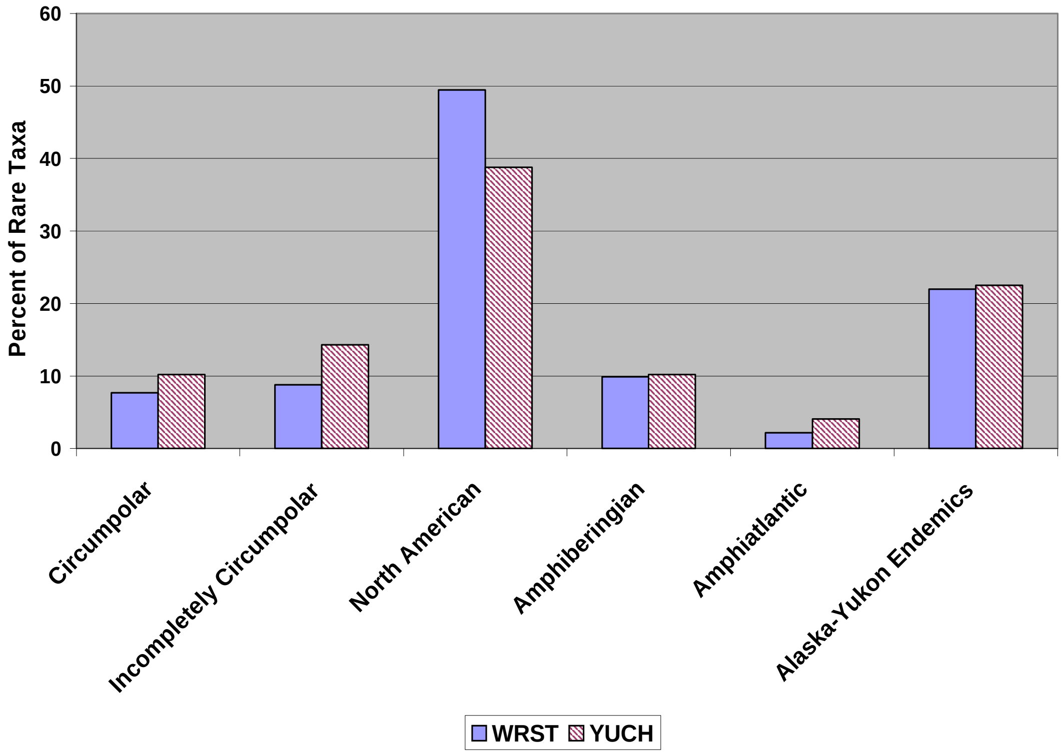
The main differences between the biogeography of the total flora and the rare flora are the increase in the ratio of Alaska-Yukon endemics in the rare flora which is only 6% of the total flora, and the decrease in the ratio of circumpolar and amphiberingian elements in the rare flora which is 26% and 22% of the total flora respectively.

The ecological distribution of the rare flora is: cordilleran (32.3%), boreal-montane (29.2%), arctic-alpine (21.8%), Pacific coastal (7.3%), widespread (7.3%) and temperate disjunct (2.1%). The primary differences in the ecological distribution of the rare flora as compared to the total flora are the increase in the cordilleran element in the rare flora, which is only 12% of the total flora and the decreases in the Pacific coastal and widespread elements in the rare flora which is 12% and 20% of the total flora respectively.

The ratios of the rare floras by biogeographic distribution class for this park and Yukon-Charley National Preserve are very similar (Figure 6.3). They differ primarily in the ratios of North American species, Wrangell-St. Elias National Park and Preserve having 9% more species than Yukon-Charley National Preserve, and in the ratio of incompletely circumpolar species, this park having 6% less. The rare floras were more similar than the total floras with respect to the circumpolar element, differing by less than 1% for the rare floras but differing by over 5% for the total floras. The rare flora of this park was comprised of 2% fewer Alaska-Yukon endemics than Yukon-Charley National Preserve.

Distribution of the Rare Flora by Form of Rarity

A theoretical framework describing different types of rarity was proposed by Rabinowitz (1981) to explore the ecological characteristics of rarity. The model may be used to contribute to the assessment of global conservation priorities when integrated with knowledge about a species local distribution patterns, population parameters and taxonomic uncertainties. Geographic range, habitat specificity and local population size are used to categorize a species into one of eight classes, seven of which are applicable to rare plants (Table 6.5). The literature and collection data were used to classify the rare flora of the park into these classes. The three dominant classes for the distribution of the park's rare flora by form of rarity are: constantly sparse and geographically restricted in a specific habitat (22 species, 24%), locally abundant in a specific habitat but restricted geographically (27 species, 29.2%) and constantly sparse in a specific habitat but occurring over a large range (22 species, 24%).



	WRST		YUCH*	
	#/ Rare Taxa	% of Rare Taxa	#/ Rare Taxa	% of Rare Taxa
Circumpolar	7	7.7	5	10.2
Incompletely Circumpolar	8	8.8	7	14.3
North American	45	49.5	19	38.8
Amphiberingian	9	9.9	5	10.2
Amphiatlantic	2	2.2	2	4.1
Alaska-Yukon Endemics	20	22.0	11	22.5
	91		49	

*Larsen and Rector 2004

Figure 6.3. Biogeographic composition of the rare floras of Wrangell-St. Elias National Park & Preserve (WRST) & Yukon-Charley National Preserve (YUCH).

Table 6.5. Distribution of the 91 rare plants documented in Wrangell-St. Elias National Park Preserve, Alaska, by form of rarity (Rabinowitz 1981).

GEOGRAPHIC RANGE:	Large		Small	
HABITAT SPECIFICITY:	Wide	Narrow	Wide	Narrow
LOCAL POPN SIZE: Large, dominant somewhere	Locally abundant over a large range in several habitats	Locally abundant over a large range in a specific habitat 5 species (5.5%)	Locally abundant in several habitats but restricted geographically 8 species (8.8%)	Locally abundant in a specific habitat but restricted geographically 27 species (29.7%)
Small, non-dominant	Constantly sparse over a large range and in several habitats 6 species (6.6%)	Constantly sparse in a specific habitat but over a large range 21 species (23.1%)	Constantly sparse and geographically restricted in several habitats 2 species (2.2%)	Constantly sparse and geographically restricted in a specific habitat 22 species (24.2%)

Species that are constantly sparse and geographically restricted in a specific habitat may be considered the most susceptible to extirpation (Table 6.6). All of the species but one in this class are endemics (Alaska-Yukon, amphiberingian, cordilleran or Pacific coastal endemics) and even though *Cerastium regelii* is circumpolar, it is restricted to a limited area of the high arctic. Seventeen of the 22 species reach their distribution limits within the park (compared to 45 of the 91 rare plants which reach their distribution limits in the park). Sixteen of these species are ranked S2 or less by the Alaska Natural Heritage Program and sixteen have a global rank of G4 or less. These twenty-three rare plant species should be considered as priorities for rare plant monitoring and the development of protection plans.

Table 6.6. Rare plants documented by vouchers within Wrangell-St. Elias National Park Preserve, Alaska, which classify as constantly sparse and geographically restricted in a specific habitat using the forms of rarity by Rabinowitz (1981).

Taxon	**Taxon**
ARABIS CALDERI	DRABA LONCHOCARPA var. THOMPSONII
ARABIS CODYI	DRABA PORSILDII
ARABIS DREPANOLOBA	DRABA PRAEALTA
ARABIS LEMMONII	DRABA RUAXES
ARENARIA LONGIPEDUNCULATA	FESTUCA MINUTIFLORA
BOTRYCHIUM YAAXUDAKEIT	PAPAVER ALBOROSEUM
CERASTIUM REGELII	PAPAVER WALPOLEI
CRYPTANTHA SHACKLETTEANA	SEDUM DIVERGENS
DOUGLASIA ALASKANA	SMELOWSKIA CALYCINA var. PORSILDII
DOUGLASIA ARCTICA	TARAXACUM CARNEOCOLORATUM
DRABA DENSIFOLIA	THLASPI ARCTICUM

Distribution of the Rare Flora by Selected Habitat Variables

Life zone, elevation, landcover type, moisture class and lithology were summarized for the 557 rare plant collections made during this inventory and compared with these characteristics for the 317 inventory sites (Figures 6.4 and 6.5). Trends in the distribution of the rare plant collections are: (1) 75% were made in the alpine zone; (2) 44% were made over 5000 ft (914 m) elevation, 66% were made over 4000 ft (1219 m); (3) 54% were from the xeric moisture class, 37% were from the mesic moisture class; (4) 44% were in herbaceous plant communities, 30% were from barren plant communities (<1% vegetation cover), and 42% were made from surficial deposit lithologies with 22% from volcanic lithologies.

There were linear relationships between the number of rare plant collections and the number of sites for these variables: life zone (p=0.043, r^2=0.84), lithology (p=0.026, r^2=0.56) and landcover type (p=0.017, r^2=0.56). This indicates that survey effort (as measured by the number of sites) in each class for these variables is related to the number of rare plants found in each class for that variable. For example, the high number of rare plants found in the alpine zone is related to the number of sites surveyed in the alpine zone. There were not linear relationships between the number of rare plant collections and the number of sites for elevation (p=0.388, r^2=0.18) and moisture (p=0.118, r^2=0.583). Survey effort in each moisture and elevation class is not related to the number of rare plant collections made in those classes. For example, the high number of rare plant collections made between 5000 ft (1524 m) and 6000 ft (1829) elevation is not related to the number of sites in this elevation class. The distribution of rare plant collections by elevation and moisture were independent from survey effort in this inventory. Therefore, elevation and moisture may be more reliable indicators of the distribution of rare plants than life zone, lithology and landcover type.

Distribution of the Rare Flora by Region

The rare flora (represented by our vouchers) is distributed unevenly across the mountain and basin regions of the park (Figure 6.6, Figure 6.7A and Table 6.7). The greatest numbers were in the Nutzotin Mountains (30 taxa), the northern Chugach Mountains (25 taxa), the Chitina River basin (24 taxa), the Mentasta Mountains (20 taxa), and the northern St. Elias and southern Wrangell Mountains (20 taxa each). The fewest rare species were in the lower Copper River basin (one taxa – *Saxifraga adscendens* subsp. *oregonensis*), the Malaspina Forelands (2 taxa), the upper Copper River basin (4 taxa), the Coastal foothills and mountains (8 taxa) and the high Wrangells (12 taxa). Sixty-seven rare species (70% of the total) occur in mountain regions and 53 rare species (55%) occur in basin regions, a pattern similar to that seen for the endemic species.

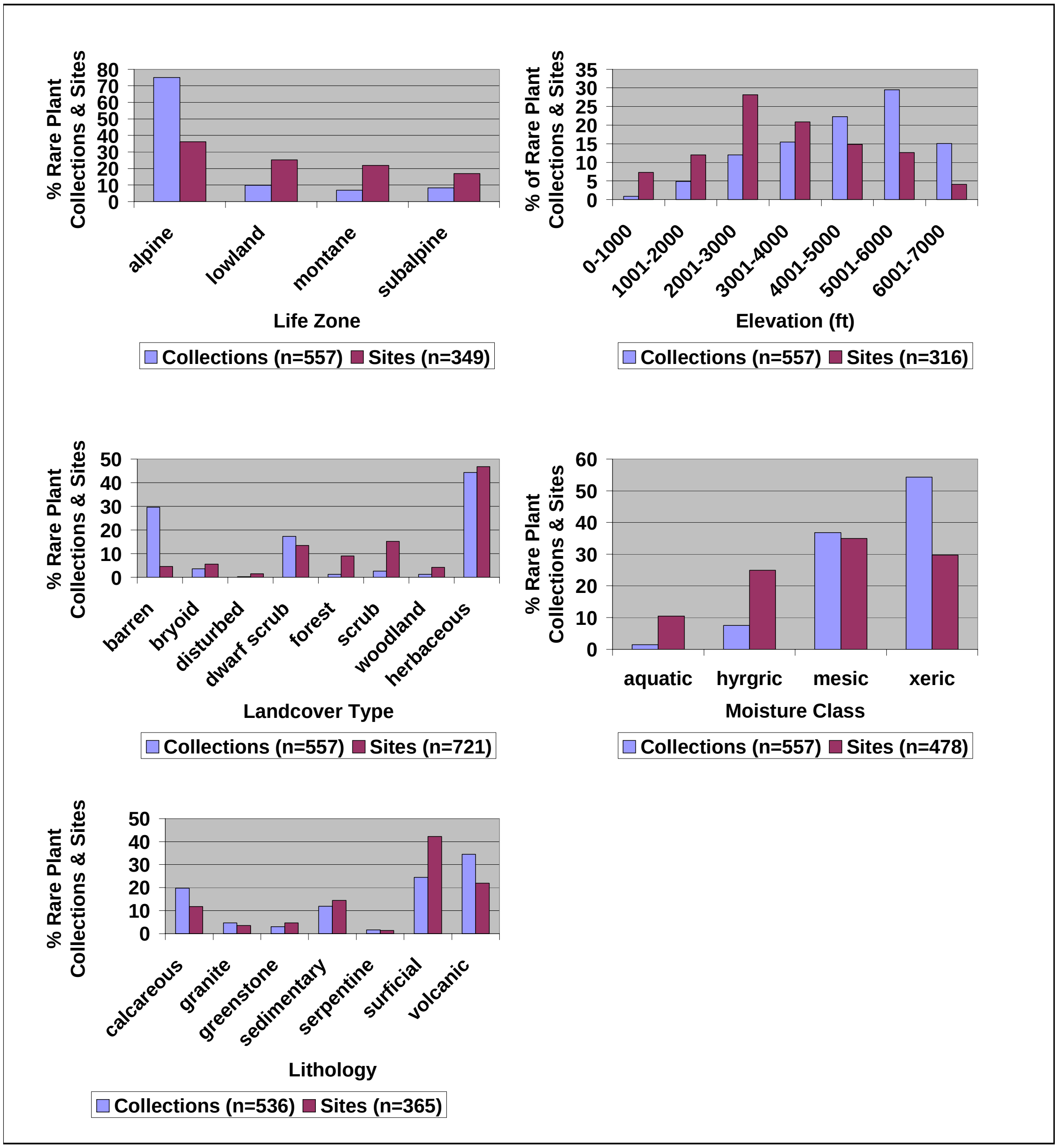


Figure 6.4. Comparison of ecological features of rare plant collections and sites documented during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park and Preserve, Alaska.

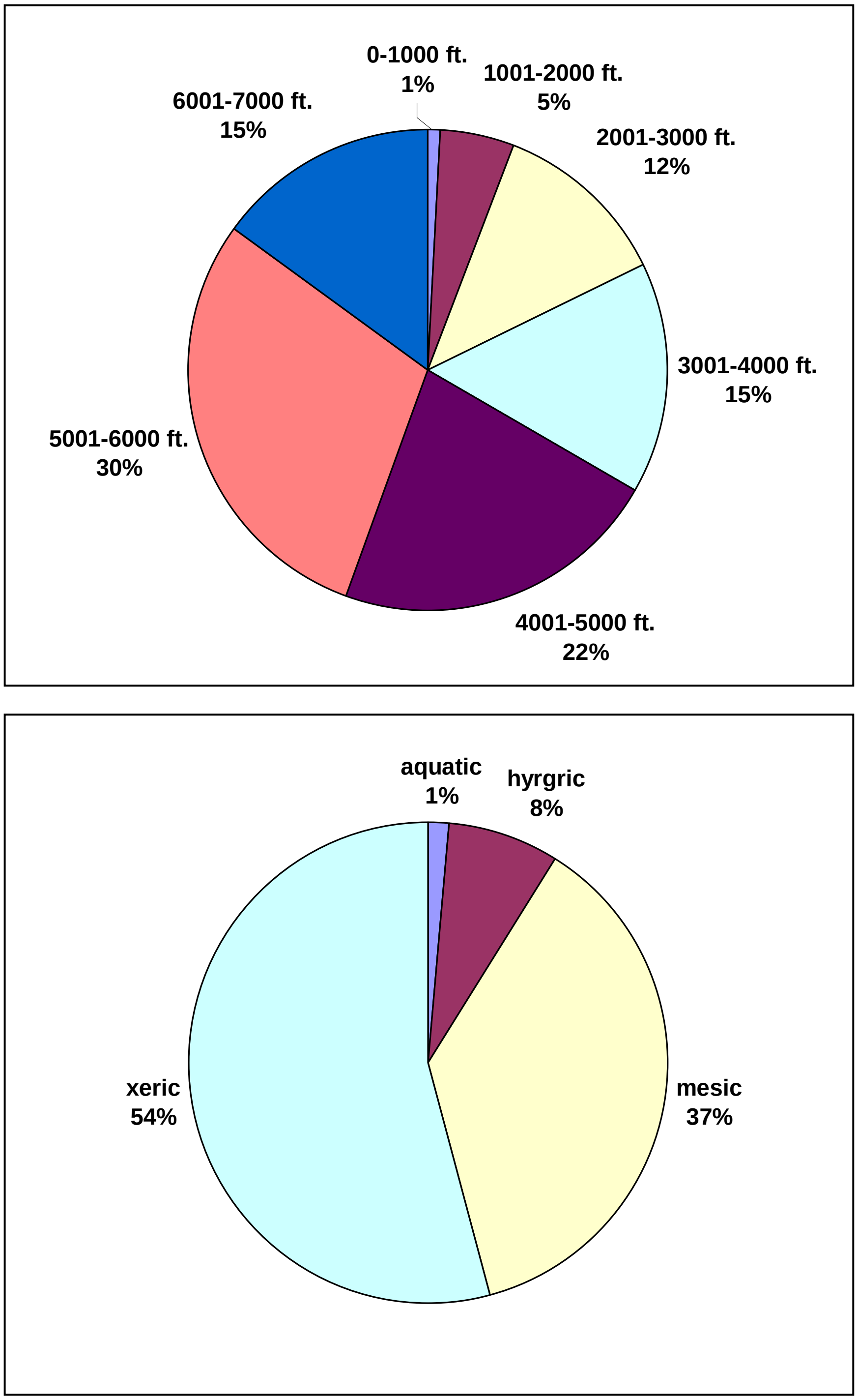


Figure 6.5. Ratio of rare plant collections by elevation (top) and moisture class (bottom) within Wrangell-St. Elias National Park and Preserve, Alaska.

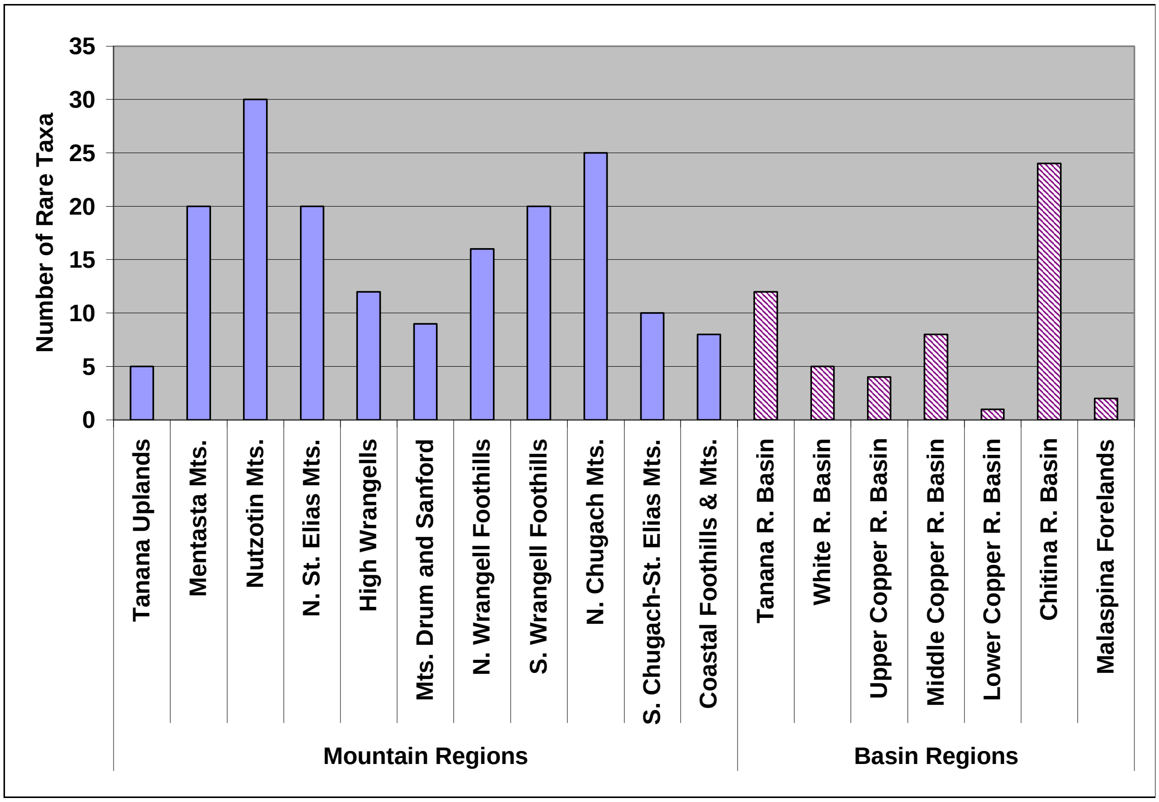
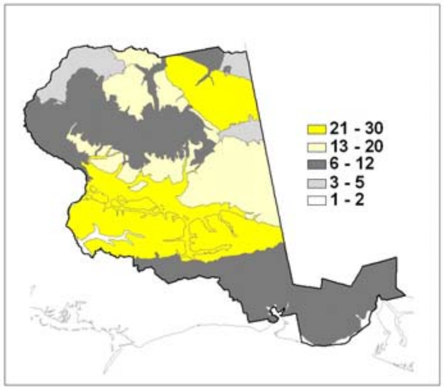
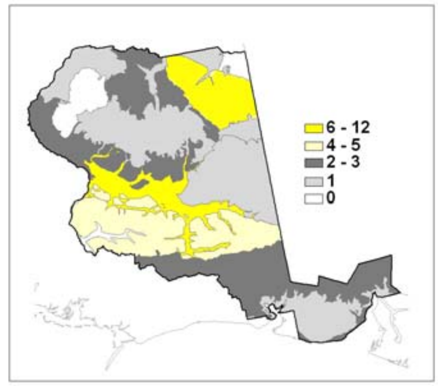


Figure 6.6. Distribution of rare taxa documented by vouchers within the mountain and basin regions of Wrangell-St. Elias National Park and Preserve, Alaska.

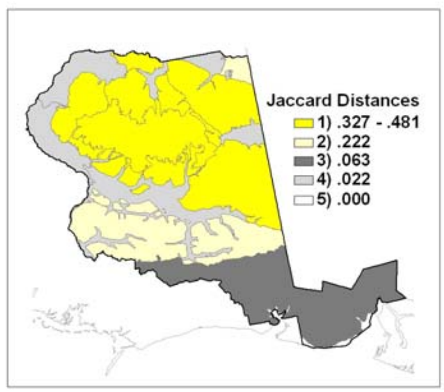
Distribution of Rare Flora by Park Region



A. Number of taxa by region.



B. Number of unique taxa by region



C. Similarity of flora between regions.

Figure 6.7A-C. Distribution of the rare flora documented by vouchers during the 1994-1997 & 2003 vascular plant inventory by regions within Wrangell-St. Elias National Park and Preserve, Alaska. Cluster group 1 (Figure C) represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

The average number of rare species per region is 12 and there are 45 rare species which occur in only one region indicating that the rare flora is broadly distributed (Figure 6.7B). The Chitina River basin has ten taxa unique to that region: (*Arabis lemmonii*, *Arnica diversifolia, Carex crawfordii, C. eburnea, C. interior, Cypripidium parviflorum, Eriophorum viridi-carinatum, Glyceria pulchella, Myriophyllum verticillatum and Najas flexilis*). The Nutzotin Mountains has seven taxa unique to that region (*Artemisia dracunculus*, *Botrychium alaskense*, *B. ascendens*, *B. lineare, Draba densifolia*, *Maianthemum stellatum, Puccinellia vahliana* and *Smelowskia calycina* var. *porsildii*). The Mentasta Mountains has four taxa unique to that region (*Carex atratiformis* subsp. *raymondii*, *Cryptantha shackletteana*, *Draba lonchocarpa* var. *thompsonii* and *Papaver walpolei*) as does the northern Chugach Mountains (*Agoseris glauca*, *Arabis codyi*, *Draba kananaskis*, and *Festuca minutiflora*).

The southern Wrangell foothills has three species unique to that region (*Arnica mollis, Thlaspi arcticum* and *Viola selkerkii*). The middle Copper River basin, northern Wrangell foothills, southern Chugach-St. Elias Mountains and Malaspina Forelands each have two species unique to those regions and the Coastal foothills and mountains, White River basin, high Wrangells, Tanana River basin, upper Copper River basin and northern St. Elias Mountains each have one unique rare species to those regions. The lower Copper River basin, Mt. Drum and Sanford region and the Tanana Uplands do not have any rare species unique to those regions. The rare taxa with the most widespread distribution are: *Oxytropis huddelsonii* occurring in 10 out of 18 regions, *Aphragmus eschscholtzianus* and *Minuartia biflora* occurring in eight regions and *Douglas gormanii, Draba ruaxes, Erigeron grandiflorus spp. arcticus, Montia bostockii, Papaver alboroseum and Stellaria alaskana* each occurring in seven regions.

Effect of Region Size and Survey Effort on the Distribution of the Rare Flora

There is a statistically significant linear relationship between the number of rare species in a region and the size of a region as tested with a simple linear regression (p=.001, r^2=0.481). There were also significant linear relationships between the number of survey sites per region and the number of rare plant species found in that region (p=0.000, r^2=0.534) and between the number of collections per region and the number of rare plant species found in a region (p=0.000, r^2=0.776). Region size and survey effort are therefore, influencing our knowledge of the distribution of rare plants across the park. Carl Roland (2004) also found a linear relationship between the number of rare plant species in a region and region size for Denali National Park and Preserve. More survey effort and larger regions are likely to produce more rare plants.

Table 6.7. Distribution of rare taxa, sites and collections documented during the 1994-1997 & 2003 vascular plant inventory within the basin and mountain regions of Wrangell-St. Elias National Park and Preserve, Alaska, by ice-free acres (IFA). Residuals are the difference between the observed and predicted values calculated in linear regression analyses.

	#/ Rare Taxa	#/Sites	#/Colls	Ice-free Acres (IFA)	#/Rare Taxa per 100,000 IFA	#/Sites per 100,000 IFA	#/Colls per 100,000 IFA	Std. Residual Acres/Rare	Std. Residual Sites/Rare	Std. Residual Colls/Rare
Mountain Regions										
Coastal Foothills & Mts.	8	23	633	177911.16	4.50	12.93	35.58	0.38	-1.24	-1.69
High Wrangells	12	5	462	874461.74	1.37	0.57	5.28	-0.67	0.77	0.23
Mentasta Mts.	20	22	561	161507.33	12.38	13.62	34.74	1.91	0.79	1.54
Mts. Drum and Sanford	9	13	296	425303.30	2.12	3.29	6.96	-0.28	-0.32	0.64
N. Chugach Mts.	25	44	1003	1921879.50	1.30	2.13	5.22	-0.66	-0.50	0.18
N. St. Elias Mts.	20	6	530	1144638.70	1.75	0.52	4.63	0.46	2.00	1.72
N. Wrangell Foothills	16	11	499	670345.58	2.39	1.64	7.44	0.33	0.97	0.96
Nutzotin Mts.	30	39	1109	979544.84	3.06	3.98	11.32	2.04	1.30	0.99
S. Chugach-St. Elias Mts.	10	8	289	984769.30	1.02	0.81	2.93	-1.18	0.22	0.75
S. Wrangell Foothills	20	19	1047	585527.54	3.42	3.24	17.88	1.10	1.02	-1.24
Tanana Uplands	5	3	353	151375.24	3.30	1.98	23.32	-0.37	-0.22	-0.79
Basin Regions										
Chitina R. Basin	24	45	1075	995940.01	2.41	4.52	10.79	0.94	-0.29	-0.46
Lower Copper R. Basin	1	4	94	110412.21	0.91	3.62	8.51	-0.91	-0.94	-0.25
Malaspina Forelands	2	10	256	76229.76	2.62	14.43	33.58	-0.69	-1.23	-0.94
Middle Copper R. Basin	8	9	296	472040.92	1.69	2.33	6.27	-0.52	-0.18	0.24
Tanana R. Basin	12	28	528	257006.76	4.67	12.06	20.54	0.50	-0.96	-0.15
Upper Copper R. Basin	4	16	301	525318.07	0.76	3.05	5.73	-1.23	-1.36	-0.73
White R. Basin	5	4	385	168561.45	2.97	2.37	22.84	-0.40	-0.29	-0.98

There were eight regions which had observed frequencies of rare taxa which did not fit the linear relationships (as indicated by the standardized residuals) for one or more variable (acreage, number of sites or number of collections). The distribution of rare taxa in these regions is less likely to be explained by these variables. The Mentasta, Nutzotin, southern Wrangell foothills and northern St. Elias Mountains all had standardized residuals greater than one for one or more variable indicating that more rare plants were collected in these regions than predicted by the linear relationships for acreage, number of collections or number of sites. The Coastal foothills and mountains, high Wrangells, Malaspina Forelands and upper Copper River basin had standardized residuals less than one for one or more variable indicating that fewer rare taxa were found in these regions than predicted by the linear relationships.

The Mentasta Mountains had 12 rare species per 100,000 ice free acres (1K IFA) and ranked fourth in actual number of rare plant taxa (20). The remaining regions had values ranging from less than one to six species per 1K IFA. The standardized residual for the number of rare plants predicted by acreage was 2.12 for the Mentasta Mountains and the standardized residual for the number of rare plants predicted by the number of collections was 1.54. This indicates that the number of rare plant taxa here is unusually high (not fitting the linear regression). The high number of rare plants in this region may be affected by the high number of sites (13.62) and collections (299) per 1K IFA as compared to the averages (4.84 and 121 respectively).

The Nutzotin Mountains ranked first in the number of rare plant taxa (31), had a residual value of 1.53 in the regression analysis of number of rare species by acreage and 1.30 for the number of rare species predicted by the number of sites. This indicates that the number of rare species in this region is also unusually high. The high number of rare plants in the Nutzotin Mountains does not appear to be a result of survey effort since the number of sites per 1K IFA (3.98) was less than average as were the number of collections (105).

The southern Wrangell foothills ranked fourth in the number of rare plant taxa (20) and had standardized residuals greater than one for the number of rare plants predicted by acres and sites. The number of sites (3.24) and collections (99) per 1K IFA were near the averages so it is likely that the high number of rare taxa here is not related to a higher survey effort and that the high number of rare plant taxa is meaningful.

The northern St. Elias Mountains had 20 rare plant taxa, a standardized residual of 2.00 for the number of rare plants predicted by the number of sites, and a standardized residual of 1.72 for the number of rare plant taxa predicted by the number collections. The low number of sites (0.52) and collections (47) per IFA when compared to the averages indicate the number of rare taxa in this region is also notable when compared to the other regions.

The high Wrangells had a standardized residual of -1.63 for the number of rare predicted by 1K IFA , indicating that for the large size of this region more rare plants are predicted to occur.

Survey effort was very low here (one site and 47 collections per 1K IFA, much below the average) and therefore likely to be affecting the low number of rare plants found here.

The Coastal foothills and mountains had standardized residuals of -1.24 for rare predicted by the number of sites and -1.69 for rare predicted by the number of collections. However, the numbers of sites (15) and collections (310) per 1K IFA were much greater than the averages so the lower number of rare taxa found here is not related to survey effort when compared to the other regions.

The Malaspina Forelands had a standardized residual of -1.23 for the number of rare taxa predicted by sites, but the number of sites (14.43) and collections (304) per 1K IFA were much greater than the averages so the low number of rare taxa found here is also not due to survey effort.

The upper Copper River basin had standardized residuals of -1.47 for the number of rare predicted by acres and -1.36 for the number of rare predicted by sites. But the numbers of sites (3.05) and collections (39) were also low, so survey effort could be affecting the low number of rare taxa here.

The remaining regions fit the predicted linear relationship for the number of rare plant taxa by acreage, number of sites and number of collections, so the actual values of rare taxa in these regions is most likely to be related to these factors. Of particular interest are the northern Chugach Mountains which ranked second in the number of rare plants (25 taxa) and the Chitina River basin which ranked third in the number of rare plants (24 taxa). These two regions ranked first and third in size, had more than twice the number of sites surveyed than other regions, and more than twice the number of collections. However, when evaluated per unit area, survey effort was either average or below average.

Similarity of the Rare Flora Among Regions

To determine which regions had the most similar rare floras, the rare plant species lists from each of the 18 park regions were compared with a nearest-neighbor, single linkage, hierarchical cluster analysis using Jaccard's coefficient for the distance measure. The species matrix and distance measures are in Appendices 5.5 and 5.6. The resulting dendogram is in Figure 6.8. The regions were then parsed into five groups based on the resulting clusters and distance coefficients and interpreted geospatially (Figure 6.7C).

The four Wrangell Mountain regions had the most similar rare plant species matrices, forming the first cluster. Mts. Drum and Sanford and the northern Wrangell foothills had a Jaccard distance of 0.588. The high Wrangells joined these regions at a distance of 0.538 and the southern Wrangell foothills joined the cluster at a distance of 0.476. The Nutzotin Mountains joined the Mentasta Mountains at a distance of 0.463 and along with the northern St. Elias Mountains joined group one at a distance of 0.379.

Rare Flora

Hierarchical Cluster Analysis, Single Linkage, Jaccard Distance Measure

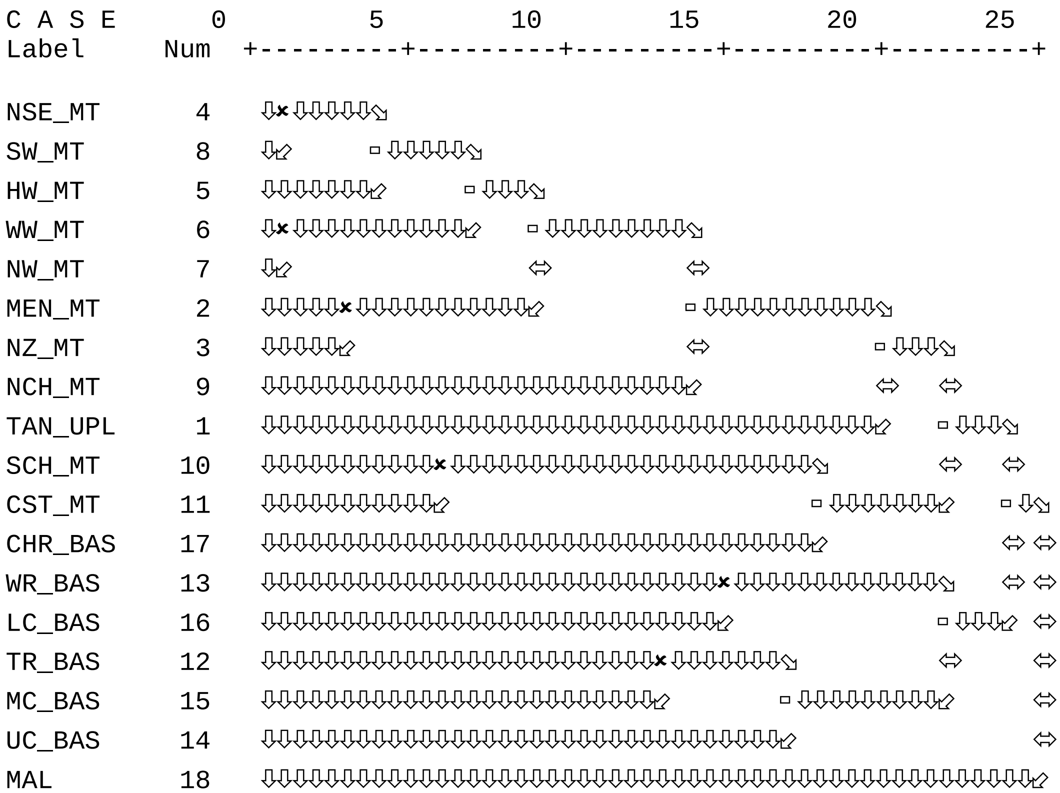


Figure 6.8. Dendrogram showing the results of cluster analysis of the vouchered rare species occurring in eighteen regions of Wrangell-St. Elias National Park and Preserve, Alaska. Species and proximity matrices are in Appendices 5.5 and 5.6.

Five regions with low similarity to group one and joining that group of regions at a Jaccard distance of 0.297 are: the northern Chugach Mountains, White River basin, Chitina River basin, southern Chugach-St. Elias Mountains and coastal mountains. The latter two regions were more similar to each other than to the rest of the regions joining each other at a Jaccard distance of 0.385.

There were five regions with very low similarity to the rest of the regions, joining the preceding regions at a Jaccard distance of 0.178. These regions are: the upper Copper River basin with only two rare species (*Lupinus kuschei* and *Potamogeton obtusifolius*) and the lower Copper River basin with one rare species (*Saxifraga adscendens* subsp. *oregonensis*), which join the Tanana River basin, middle Copper River basin and Tanana Uplands. The Malaspina Forelands, with two unique rare species (*Limosella aquatica* and *Salix hookeriana*) is an outlier with no similarity to the rest of the regions (Jaccard distance = .000).

Group one (Wrangell Mountains) accounts for 23% of the rare plant species in the park (Table 6.8). The Wrangell-St. Elias, Mentasta, Nutzotin and northern St. Elias Mountains account for 59% of the rare plant species. The mountains north of the Malaspina Forelands, the White River basin and the Chitina River basin include 97% of the rare plant species in the park.

The rare flora grouped by mountain or basin region except for the Chitina, White and Tanana River basins which were more similar to mountain regions in their associated cluster than to river basins in the cluster. The cluster analysis demonstrates that the rare flora is more similar in the interior mountain regions north of the Chitina River and that the rare flora is distributed broadly across the park.

Table 6.8. Number of endemic species accounted for in each group developed from Jaccard nearest neighbor cluster analysis. Groups are park regions within Wrangell-St. Elias National Park and Preserve, Alaska,-with the most similar species matrices Cnt=Count.

Group:		**1**		**2**	**1 & 2**		**3**	**1-3**		**4**	***1-4***	
	N	Cnt	%	Cnt	Cnt	%	Cnt	Cnt	%	Cnt	Cnt	*%*
Rare taxa	91	21	23.1	45	54	59.3	56	88	96.7	25	91	*100*
Endemic Species												
Alaska-Yukon	43	28	65.1	22	34	79.1	31	41	95.3	10	43	*100*
Amphiberingian	42	28	66.7	33	39	92.9	15	39	92.9	26	40	*95.2*
Cordilleran	43	33	76.7	24	38	88.4	24	43	100.	11	43	*100*
Pacific Coastal	42	18	42.9	33	38	90.5	5	40	95.2	1	40	95.2

The Endemic Flora

To determine if the distribution and compositional patterns of endemics in the park flora can provide insight into the origin and history of the flora, the frequency and ratio of endemic elements within each of the mountain and basin regions were evaluated and a cluster analysis as described for the rare flora was conducted for each element across the regions of the park. I also tested for correlations between the distribution of each endemic element with the other endemic elements and with the rare flora across the regions of the park. Finally, I determined if the variation in the number of endemic species per region was dependant upon the size of the region, the number of sites surveyed in that region or the number of collections made in a region. Endemic subspecies and varieties were excluded from this analysis.

The following endemic elements are recognized in the park: (1) Alaska-Yukon endemics – taxa limited to Alaska and the Yukon and sometimes radiating to northern British Columbia and Northwest Territories; (2) amphiberingian endemics: taxa restricted to Beringia and in North America found only in Alaska and the Yukon-Territory; (3) Cordilleran endemics: taxa restricted to the mountains of western North America, and (4) Pacific coastal endemics: taxa restricted to the Pacific coast of North America, sometimes radiating inland as far as the coastal states.

The Distribution of Endemic Elements in Mountain and Basin Regions

Each endemic element comprises approximately 25% of the endemic flora when evaluated over the entire park (Figure 6.9). However, amphiberingian and Cordilleran endemic taxa comprise a higher ratio of the endemic flora found in the mountains (27% and 26% respectively) and the Alaska-Yukon endemic element comprises 30% of the endemic flora found in the basins of the park.

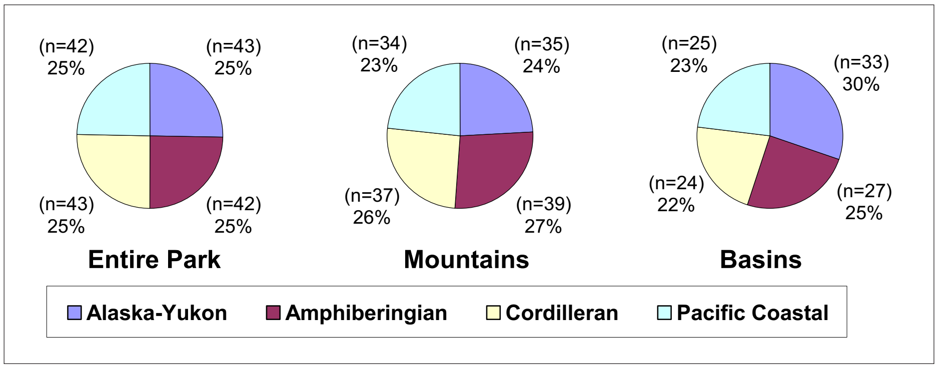


Figure 6.9. Ratio of endemic elements within the mountain and basin regions of Wrangell-St. Elias National Park and Preserve, Alaska.

The number of endemic species in mountain regions was greater than the number in basin regions for each endemic element (Figure 6.10). The difference was greatest for the Cordilleran endemic element which had 37 species in the mountain regions (61%) and 24 species in the basin regions (39%). The Alaska-Yukon endemic element had the least difference between the mountain regions (35 species – 52%) and the basin regions (33 species – 48%). There were 39 amphiberingian endemic species in mountain regions (59%), 27 amphiberingian endemic species in basin regions (41%), 34 Pacific coastal endemic species in mountains regions (58%) and 25 Pacific coastal endemic species in basin regions (42%).

Effects of Acreage and Survey Effort on the Distribution of Endemics

There were linear relationships between region size and the number of amphiberingian endemic species (p=0.008, r^2=0.315) and between region size and the number of Cordilleran endemic species (p=0.000, r^2=0.650) as tested with a simple linear regression. There was not a significant relationship between region size and the number of endemic species for the Alaska-Yukon or Pacific coastal elements. This indicates that there are factors other than region size that are contributing to the number of Alaska-Yukon endemic species and Pacific coastal endemic species found within the park.

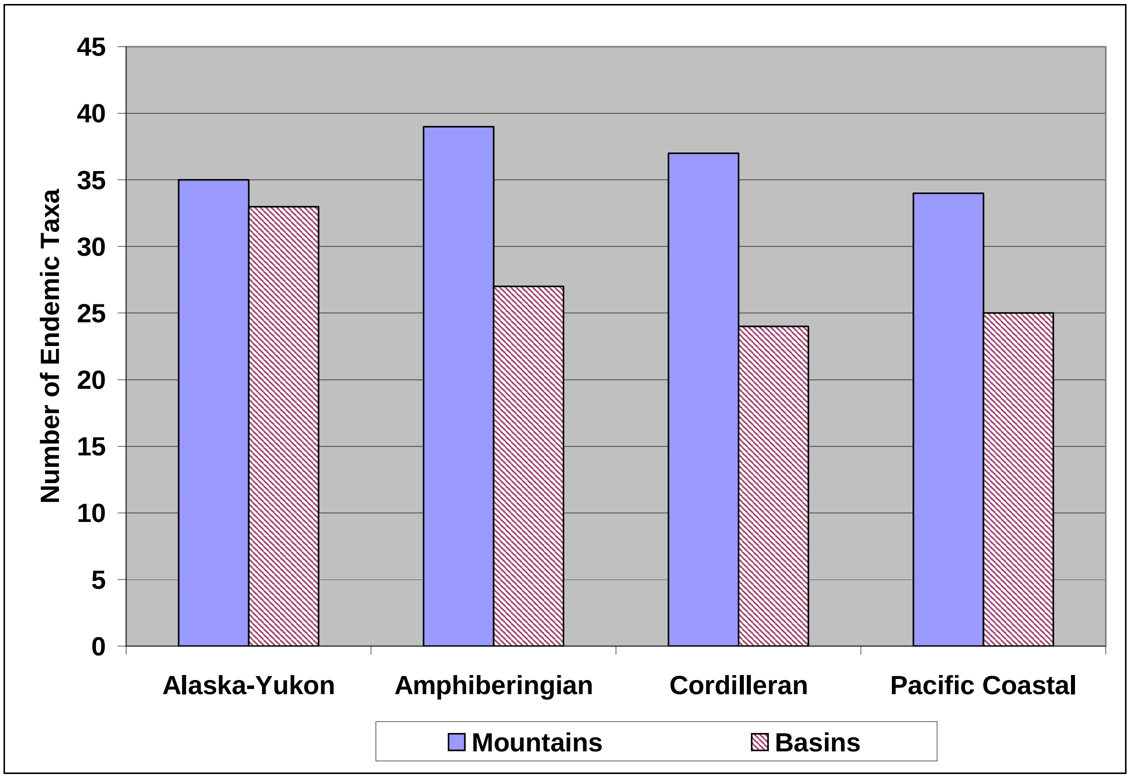


Figure 6.10. Frequency of endemic species within mountain and basin regions of Wrangell-St. Elias National Park and Preserve, Alaska.

There were weak but significant linear relationships between the number of collections per region and the number of Alaska-Yukon endemic species (p=0.045, r^2=.169), the number of amphiberingian endemic species (p=0.020, r^2=0.237) and the number of Cordilleran endemic species (p=0.039, r^2=0.181). There was also a linear relationship between the number of sites per region and the number of Cordilleran species per region (p=0.001, r^2=0.473). There was not a significant relationship between the number of sites per region and the number of other endemic species in each region (Alaska-Yukon, amphiberingian and Pacific Coastal). This indicates that survey effort may be effecting the number of endemic species found in a region.

Correlations between the Distribution of Endemic and Rare Species

Twenty-four (63%) of the Cordilleran endemic species are state level rare plants, 20 (46%) of the Alaska-Yukon endemics are rare plants, six (14%) of the amphiberingian endemics are rare plants and only one (2%) of the Pacific coastal endemics is a rare plant. There were significant positive correlations at the 0.01 level between the distribution of rare species across park regions and the distribution of Cordilleran endemic species (r=0.855), the distribution of Alaska-Yukon endemic species (r=0.759) and the distribution of amphiberingian endemic species (r=0.673) as tested with a non-parametric correlation analysis using Spearman's rank correlation coefficient. This indicates that the variation in the distribution of the rare flora across

the park is correlated to the distribution of the endemic flora except for the Pacific coastal endemics.

There were significant positive correlations between the number of Alaska-Yukon and amphiberingian endemic species across regions (r=0.800, significant at the 0.01 level); between the Alaska-Yukon and Cordilleran endemic elements (r=0.560, significant at the 0.05 level) and between the amphiberingian and Cordilleran elements (r=0.602, significant at the 0.01 level). There was a significant negative correlation between the number of Alaska-Yukon and Pacific coastal endemic elements across park regions (r=-0.609, significant at the 0.01 level). This indicates that the distribution of each endemic element is correlated to the distribution of the other endemic elements. There was also a strong correlation between the numbers of amphiberingian and Alaska-Yukon endemic species among floristic regions of Denali National Park and Preserve (r=0.96) as reported by Carl Roland (2004) indicating that the overlap of the distribution of these two endemic elements is a regional pattern extending beyond the boundaries of this park.

Alaska-Yukon Endemic Element

Distribution within Park Regions

Photographs of selected Alaska-Yukon endemics are in Plates 6.1a and 6.1 b. The 43 Alaska-Yukon endemic species exhibit a north to south latitudinal gradient within the park with a greater number of species and proportion of species occurring north of the Chitina River basin (Figures 6.11, 6.12A, 6.12B, 6.13). The greatest number of Alaska-Yukon endemics were in the Nutzotin and Mentasta Nutzotin Mountains, with 21 and 20 species respectively. The Malaspina Forelands and lower Copper River basin had the fewest number of Alaska-Yukon endemics, each with one species.

The greatest proportion of Alaska-Yukon endemics were in the Tanana River basin (60% - 19 species), Tanana Uplands (45% - 9 species), Mentasta Mountains (42%) and White River basin (47% - 14 species). The ratio of Alaska-Yukon endemics decreases substantially south of the Chitina River. The Chitina River basin had 22% of its endemic flora represented by Alaska-Yukon endemic species (11 species), the northern Chugach Mountains had 20% (14 species), the southern Chugach-St. Elias Mountains had 12% (4 species), the coastal foothills and mountains had 7% (3 species) and the Malaspina Forelands had 5% of its endemic flora represented by one Alaska-Yukon endemic (*Castilleja unalaschcensis*.).

The average number of Alaska-Yukon endemics per region was 11 and 11 species occurred in only one region. The northern Chugach Mountains had two unique rare species (*Arabis codyi* and *Melandrium macrocarpum*) as did the southern Wrangell foothills (*Saxifraga spicata* and *Thlaspi arcticum*). The following regions each had one unique rare species: Tanana River basin (*Erigeron pallens*), Mentasta Mountains (*Cryptantha shackletteana),* northern St. Elias Mountains*(Douglasia arctica),* White River basin *(Botrychium yaaxudakeit), middle* Copper

Plate 6.1a. Selected Alaska-Yukon endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

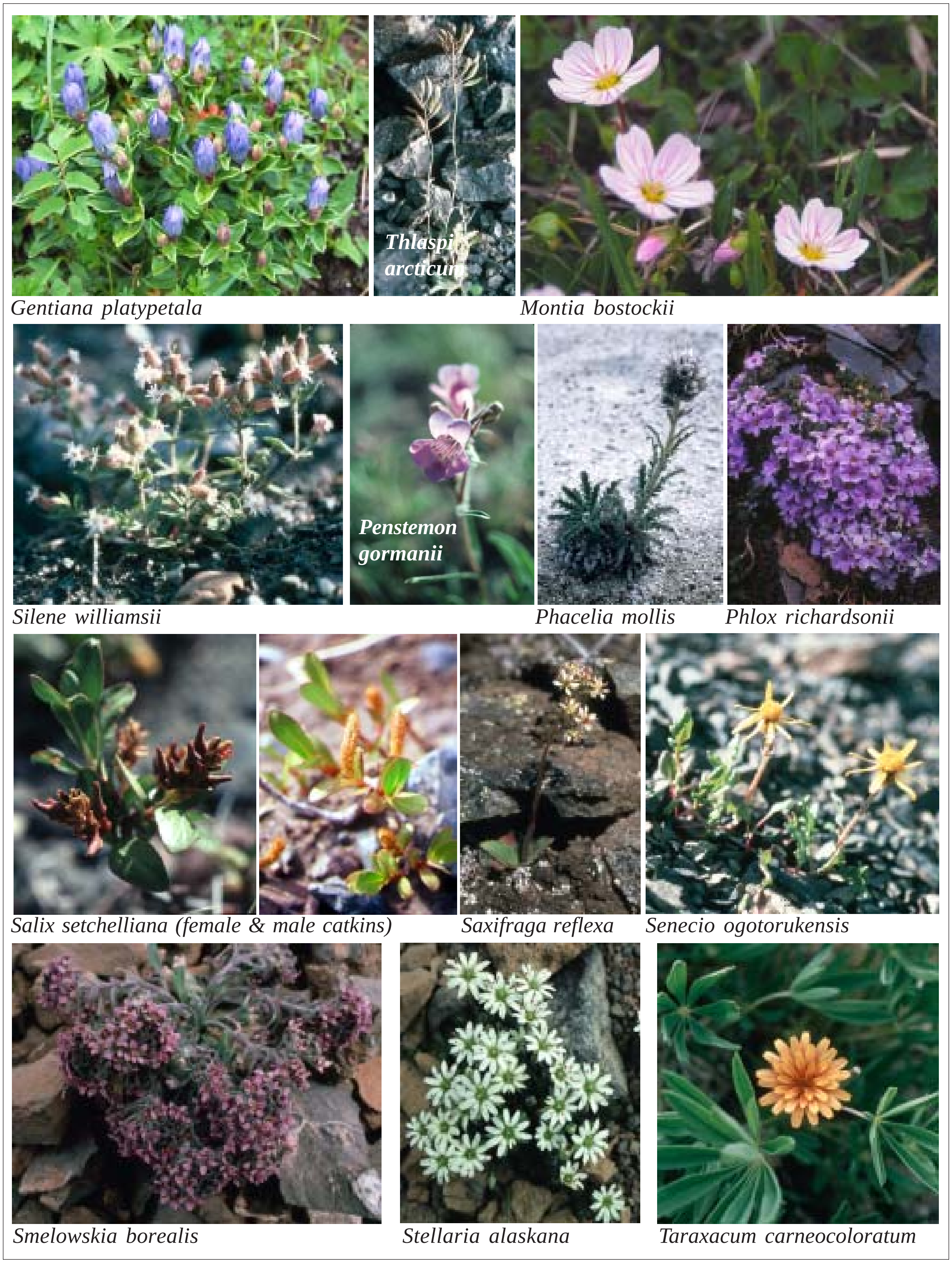


Plate 6.1b. Selected Alaska-Yukon endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

River basin *(Elymus calderi)*, Chitina River basin *(Betula kenaica)* and the coastal mountains and foothills *(Gentiana platypetala)*. The most widespread Alaska-Yukon endemic species are *Saxifraga reflexa* which occurs in 12 out of the 18 regions, *Oxytropis huddelsonii* which occurs in 11 regions and *Senecio ogotoukensis* which occurs in 10 regions.

Similarity Among Regions

The regions with the most similar Alaska-Yukon endemic floras as determined by the cluster analysis were the Nutzotin Mountains, northern Wrangell foothills and Mentasta Mountains with a Jaccard distance of 0.667 (see Figure 6.14 for the dendogram, Appendix 5.6 for the species matrix, and Appendix 5.7 for distance measures). These regions were joined by the high Wrangell Mountains and Mt. Drums and Sanford at a Jaccard distance of 0.611 and by the northern St. Elias Mountains at a Jaccard distance of 0.609. The high Wrangells and Mt. Drums and Sanford joined each other at a Jaccard distance of 0.643. These six regions comprise group one in Figure 6.15D.

The southern Wrangell foothills and White River basin joined group one at Jaccard distances of 0.545 and 0.476 respectively. The northern Chugach Mountains, Chitina River basin, Tanana Uplands, Tanana River basin and southern Chugach-St. Elias joined the preceding regions at a Jaccard distance of 0.381. The Chitina River basin and northern Chugach Mountains were more similar to each other with a Jaccard distance of 0.533.

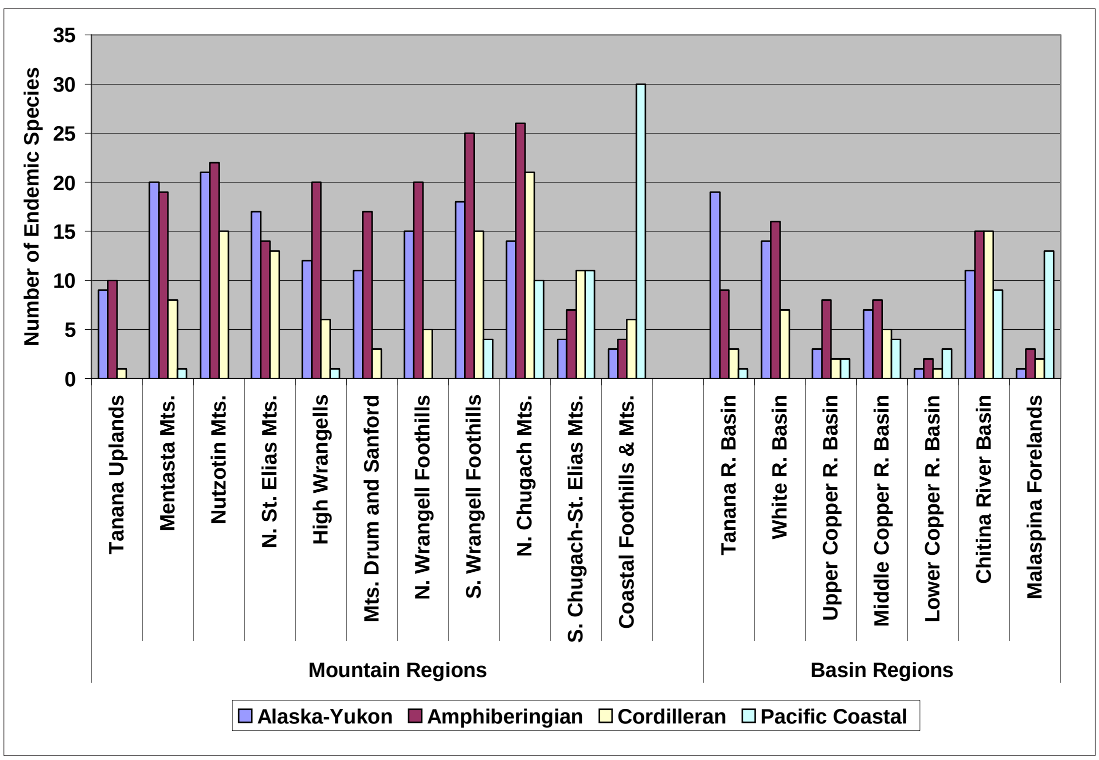


Figure 6.11. Frequency of endemic species documented within the regions of Wrangell-St. Elias National Park and Preserve, Alaska.

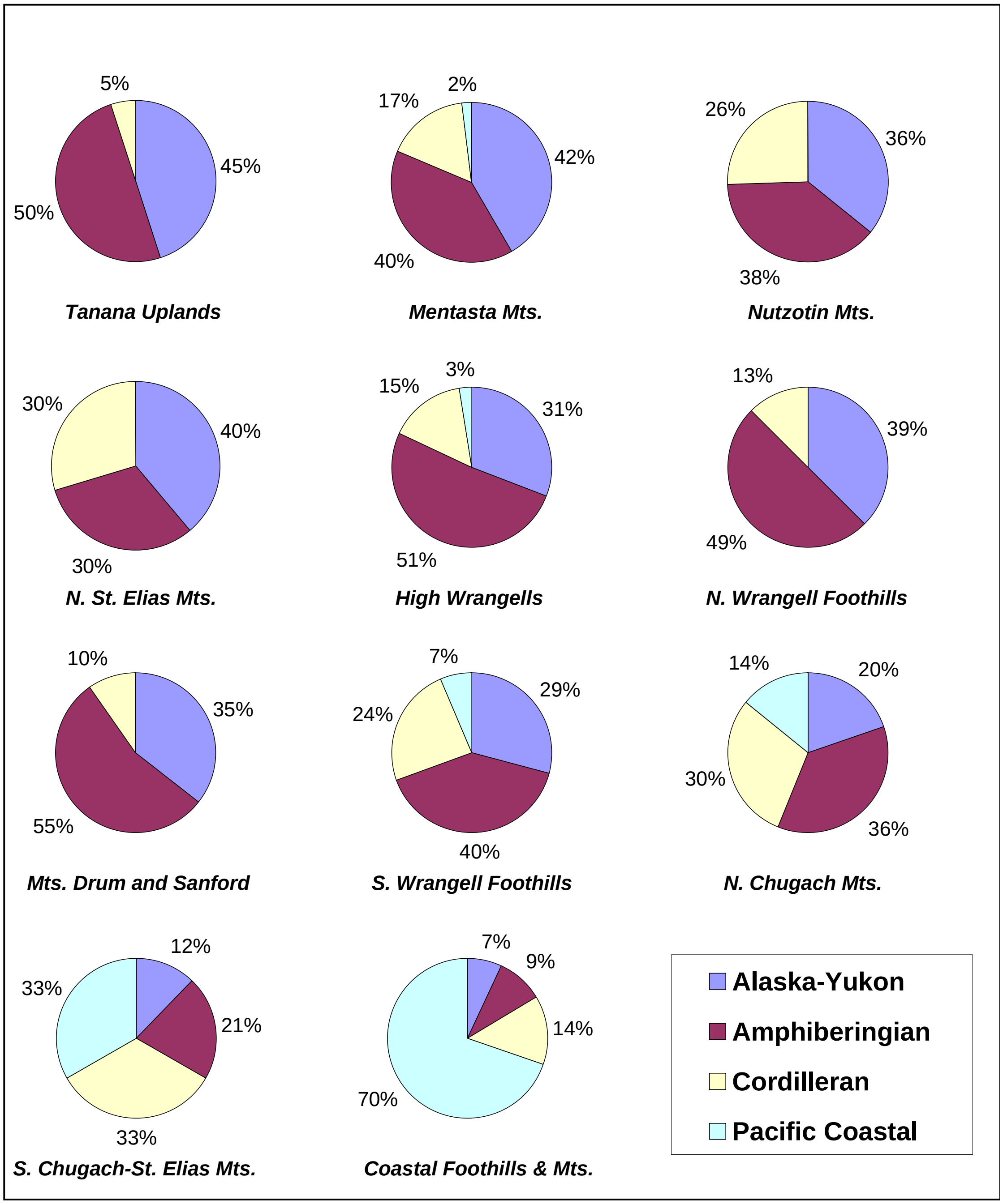


Figure 6.12A. Ratio of endemic species documented by vouchers within the mountain regions of Wrangell-St. Elias National Park and Preserve, Alaska.

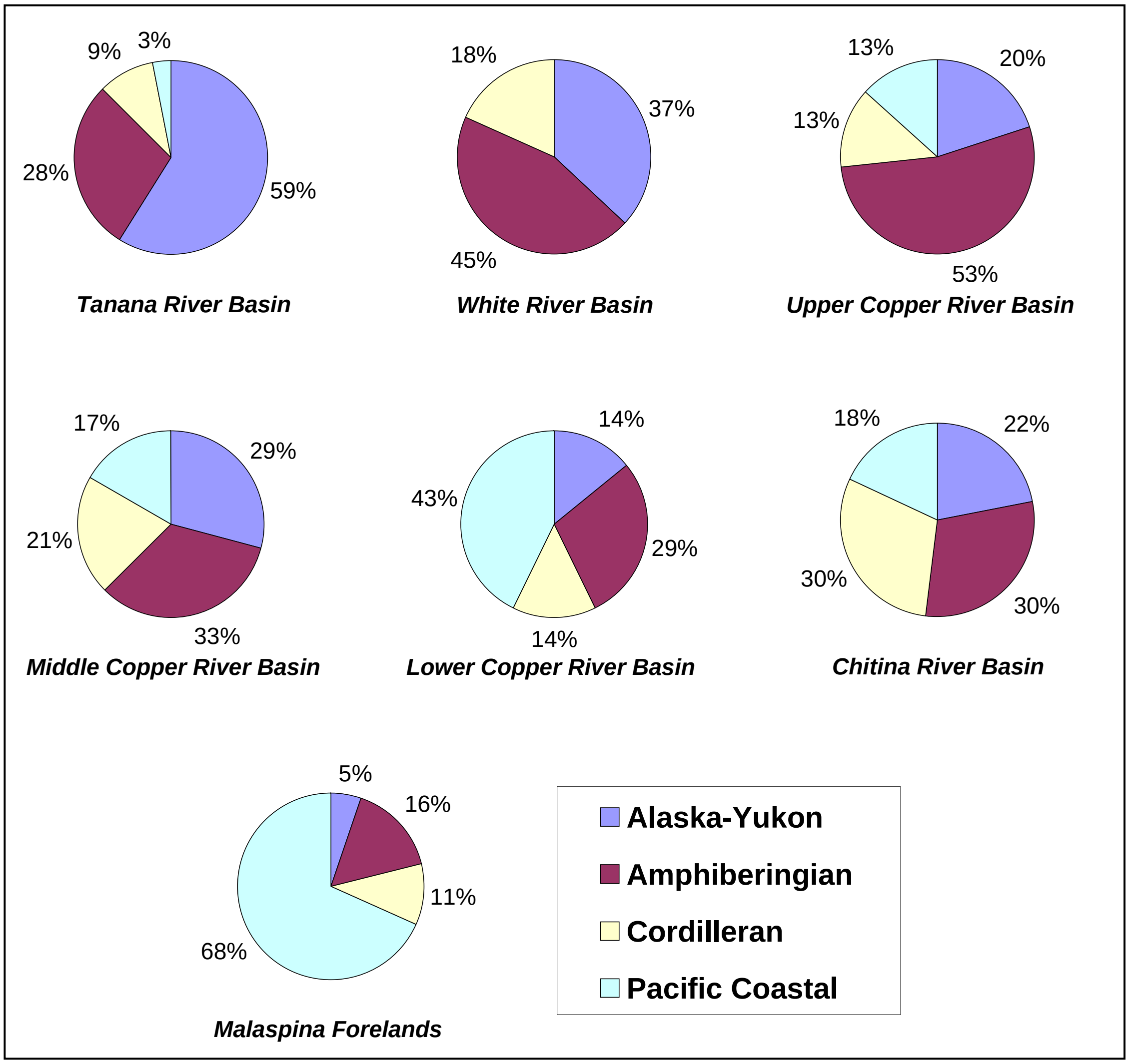
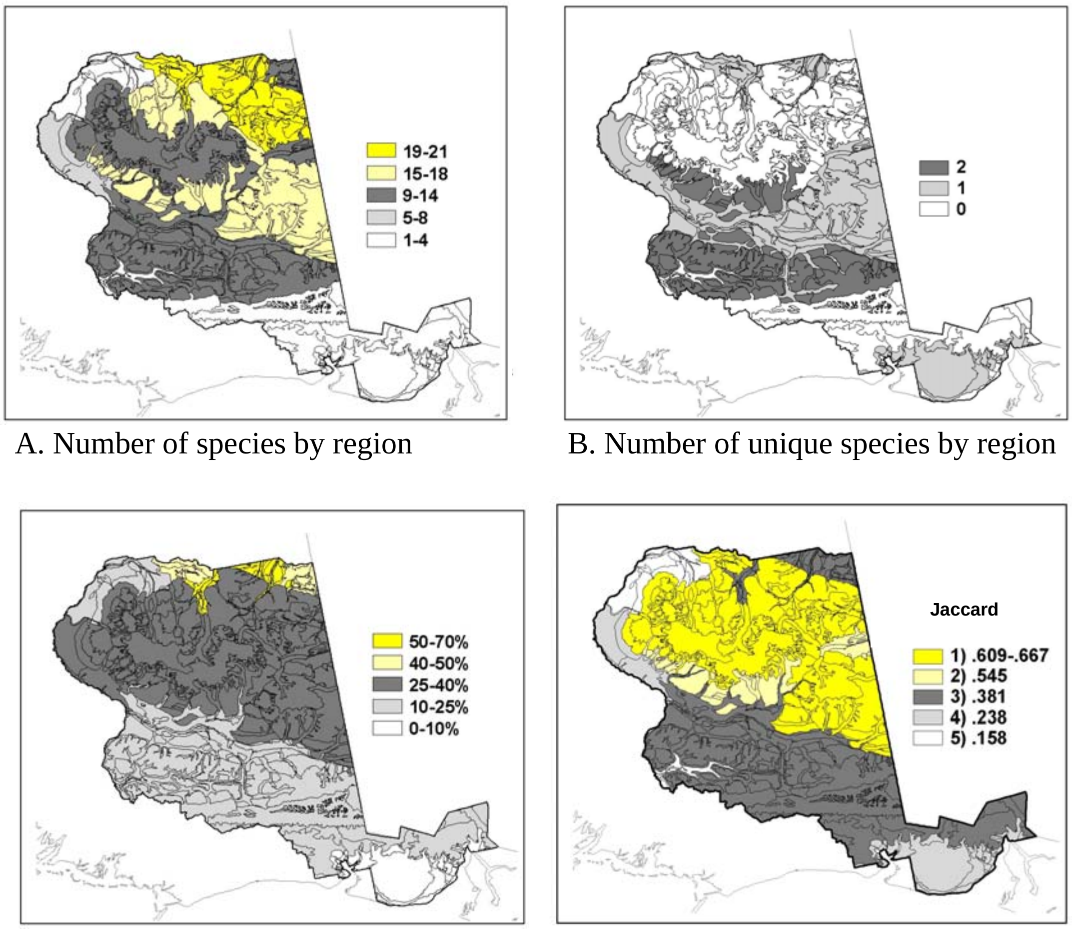


Figure 6.12B. Ratio of endemic species documented by vouchers within the river basins of Wrangell-St. Elias National Park and Preserve, Alaska.

Distribution of Alaska-Yukon Endemic Element by Park Region



A. Number of species by region

B. Number of unique species by region

C. Ratio of element within regions.

D. Similarity of element between regions

Figure 6.13A-D. Distribution of the Alaska-Yukon endemic element documented by vouchers within regions of Wrangell-St. Elias National Park and Preserve, Alaska. Ratio (Figure C) is the proportion of species in this element compared to the total number of endemic species in a region. Cluster group 1 (Figure D) represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

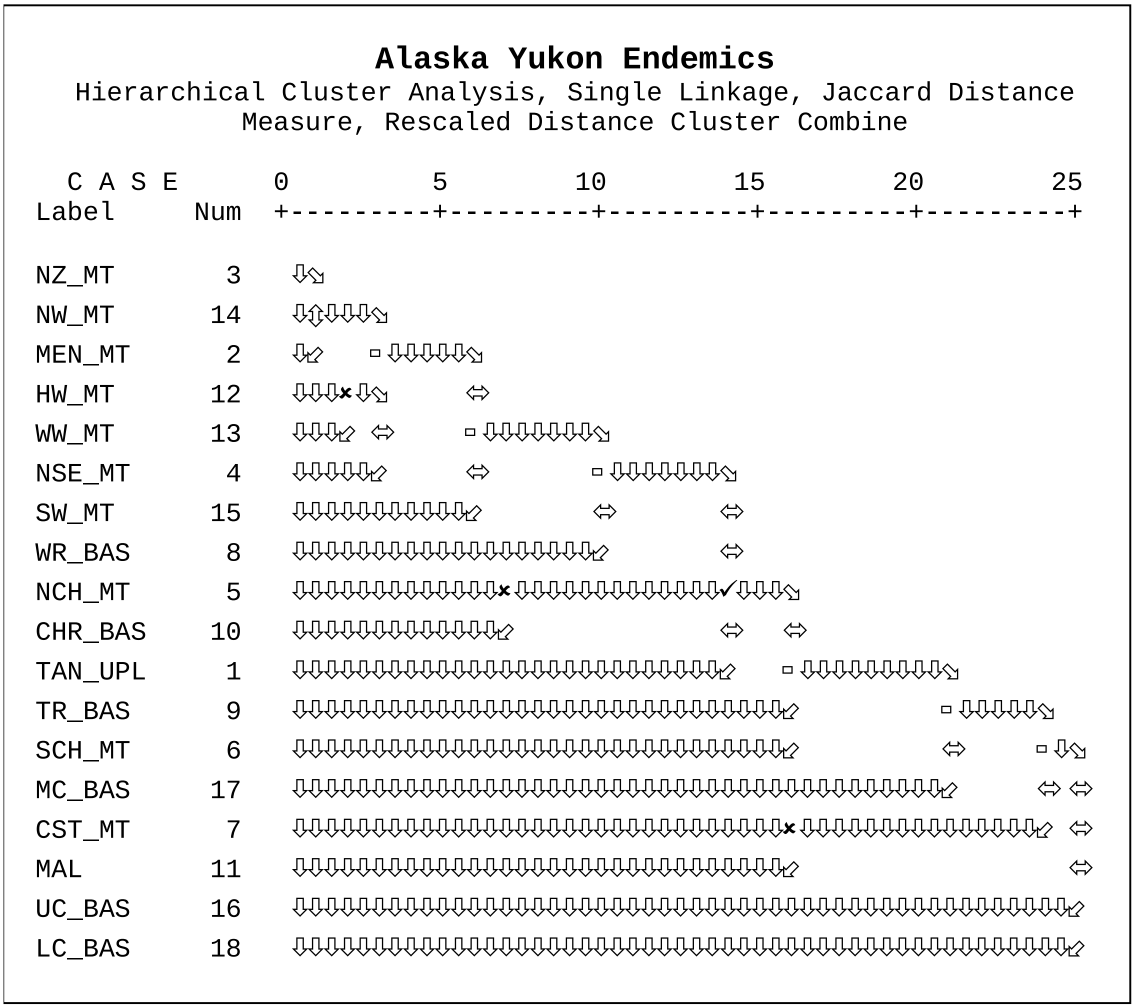


Figure 6.14. Dendrogram showing the results of cluster analysis of the Alaska-Yukon endemic species documented by vouchers within eighteen regions of Wrangell-St. Elias National Park and Preserve, Alaska. Species and proximity matrices are in appendices 5.7 and 5.8. Abbreviations for park regions are in Appendix 6.5.

The middle copper River basin (n=7), coastal Mountains and foothills (n=3) and Malaspina Forelands (n=1) joined the preceding regions at a Jaccard distance of 0.238 indicating low similarity to the rest of the regions. The upper Copper River basin (n=3) and lower Copper River basin (n=1) are the least similar to the other regions with respect to the Alaska-Yukon endemic flora joining group four at a Jaccard distance of 0.158.

Sixty-five percent of the Alaska-Yukon endemic species occurring in the park occur in the Alaska Range (Mentasta and Nutzotin Mountains) and the Wrangell-St. Elias Mountains (excluding the southern Wrangell foothills) and it is notable that these regions are all mountain regions (Table 6.8). Eighty percent of the Alaska-Yukon endemic species are found in the Alaska Range, Wrangell-St. Elias Mountains and the White River basin. Ninety-five percent of the Alaska-Yukon endemic species are found in the mountain and basin regions of the park north of the coastal mountains and excluding the Copper River basin.

Based on the similarity of their Alaska-Yukon endemic floras, the mountain regions were more similar to each other than to the basin regions except for the White River basin which was more similar to the mountain regions in group two, and the Chitina River basin which was more similar to the northern Chugach Mountains in group three.

Amphiberingian Endemic Element

Distribution Among Regions

Photographs of representave amphiberingian endemic species are in Plates 6.2a and 6.2b. The 42 amphiberingian endemic species are more widely distributed throughout the park than the Alaska-Yukon endemic species, and this element also exhibits a north to south latitudinal gradient (Figures 6.11, 6.12 and 6.15). The greatest numbers of amphiberingian endemic species were in the northern Chugach Mountains and southern Wrangell foothills (each with 25 species), the Nutzotin Mountains (22 species) and the high Wrangells (20 species).

The highest ratios of amphiberingian species were in the Mts. Drum and Sanford region (54% - 17 species), upper Copper River basin (53% - 8 species), high Wrangells (51%), Tanana Uplands (50% - 10 species), northern Wrangell foothills (49% - 19 species) and White River basin (45% - 17 species). The ratio of amphiberingian endemic species decreases south of the northern Chugach Mountains (36% - 25 species) to 21% of the southern Chugach-St. Elias Mountains endemic flora (7 species), 11% of the coastal foothills and mountains endemic flora (4 species) and 16% of the Malaspina endemic flora (3 species).

The average number of amphiberingian endemic species per region is 13.5, indicating that this element is more widespread than the Alaska-Yukon endemic element. There are only two amphiberingian endemic species unique to a region: one in the coastal foothills and mountains (*Carex macrocephala)*, and one from the Mentasta Mountains (*Papaver walpolei*). The most widespread amphiberingian species are *Salix pulchra* (found in 13 out of the 18 regions), *Claytonia sarmentosa* and *Astragalus umbellatus (*found in 11 regions*)*.

Plate 6.2a. Selected Amphiberingian endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

Festuca brevissima *Festuca lenensis* *Hieracium triste*

Papaver alboroseum *Papaver macounii* *Papaver walpolei* *Saussurea angustifolia* var. *yukonensis*

Rumex beringensis *Saxifraga serpyllifolia* *Taraxacum alaskanum* *Taraxacum kamtschaticum*

Tephroseris kjellmanii *Tephroseris kjellmanii* *Viola langsdorfii*

Plate 6.2b. Selected Amphiberingian endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

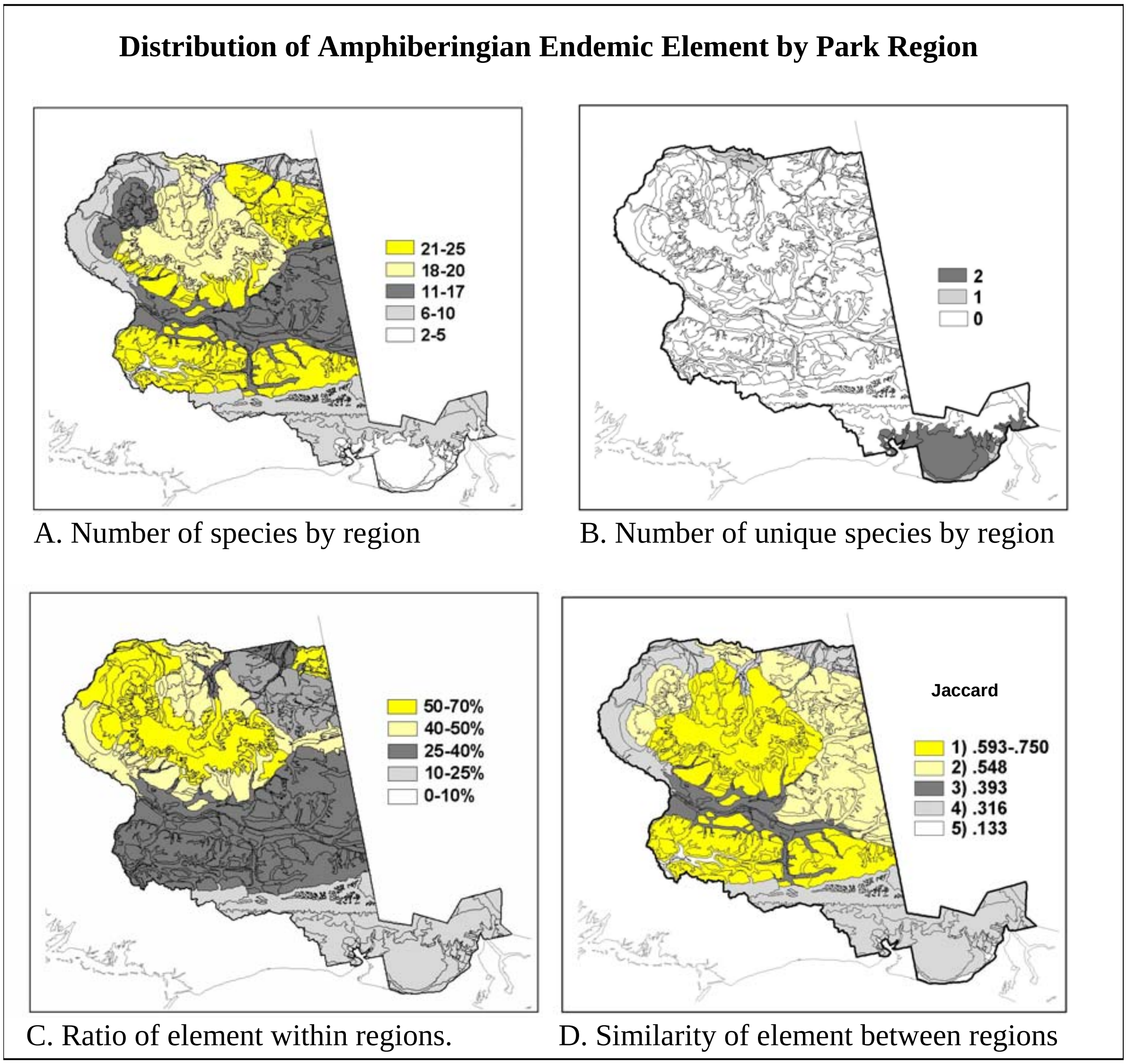


Figure 6.15A-D. Distribution of the amphiberingain endemic element by regions within Wrangell-St. Elias National Park and Preserve, Alaska. Ratio (Figure C) is the proportion of species in this element compared to the total number of endemic species in a region. Cluster group 1 (Figure D) represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

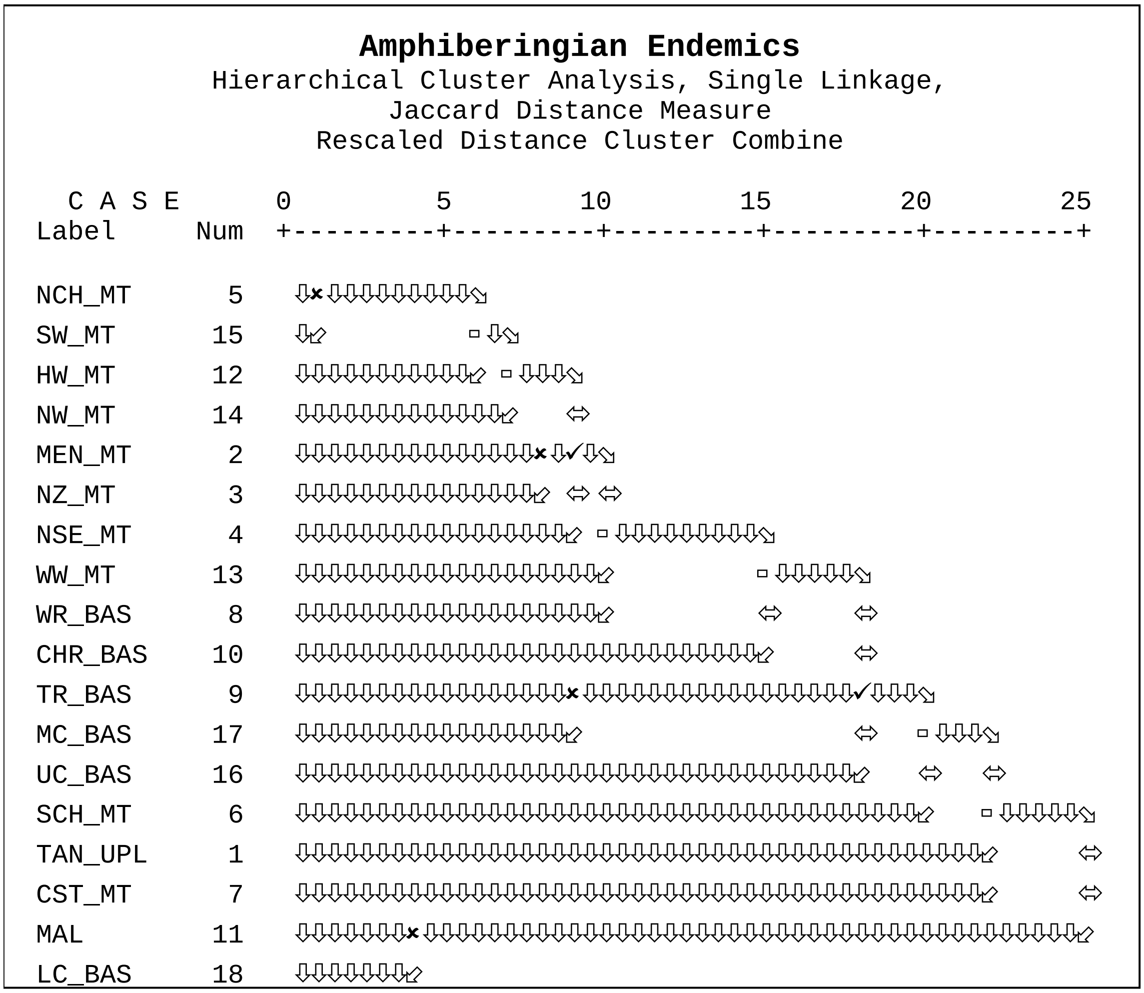


Figure 6.16. Dendrogram showing the results of cluster analysis of the amphiberingian endemic species occurring in eighteen regions of Wrangell-St. Elias National Park and Preserve, Alaska. Species and proximity matrices are in appendices 5.9 and 5.10. Abbreviations for park regions are in appendix 6.5.

Similarity Among Regions

The northern Chugach Mountains and southern Wrangell foothills had the most similar amphiberingian endemic floras (Jaccard distance of 0.750) and are joined by the high and northern Wrangell Foothill regions at a Jaccard distance 0.593 to form group one (see Appendix 6.8 for the species matrix, Appendix 6.9 for the distance measures, Figure 6.15D for the map interpretation and Figure 6.16 for the dendogram). There are five regions joining group one at a Jaccard distance of 0.548: the Mentasta and Nutzotin Mountains (joining each other at Jaccard distance = 0.548), northern St. Elias, Mts. Drum and Sanford and the White River basin. The Chitina River basin, with a Jaccard distance of 0.393, represents a large break in similarity with the former regions. The middle copper and Tanana River basins join each other at a Jaccard distance of 0.545 and with four other regions (the upper Copper River basin,

southern Chugach-St. Elias Mountains, Tanana Uplands and coastal mountains and foothills) join the preceding regions at a Jaccard distance of 0.316, showing low similarity to the first group of regions. The Malaspina Forelands (n=3) and lower Copper River basin (n=2) were the least similar to the rest of the regions with a Jaccard distances of 0.133, although they were more similar to each other with a Jaccard distance of 0.667 since they shared two out of three species (*Eriophorum chamissonis* and *Sanguisorba stipulata*).

Sixty-seven percent of all amphiberingian endemic species occur within group one (northern Chugach Mountains and southern Wrangell foothills, high Wrangells and northern Wrangell foothills). Ninety-three percent of the amphiberingian endemic species occur in the northern Chugach Mountains, Wrangell-St. Elias Mountains, Nutzotin Mountains, Mentasta Mountains and White River basin and 93% occur in the Mountains north of the Bagley Icefield excluding the Tanana Uplands but including the Chitina and White River basins. Based on the similarity of their amphiberingian endemic floras, the mountain regions were more similar to each other than to the basin regions except for the White River basin which was more similar to the mountain regions in group two.

Cordilleran Endemic Element

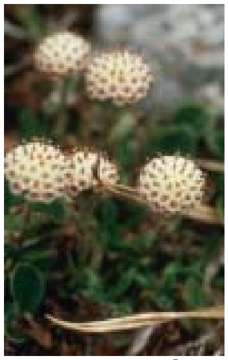
Distribution Within Regions

Photographs of representave Cordilleran endemic species are in Plate 6.4. The Cordilleran endemic element, represented by 43 species in the park, appears to be more broadly distributed across the regions of the park than the Alaska-Yukon endemic flora, and it is centered more in the mountain regions south of the high Wrangells and north of the coastal mountains (Figures 6.11, 6.12 and 6.17). The northern Chugach Mountains and Chitina River basin had the most Cordilleran endemic species (21 and 15 respectively). The lower Copper River basin and Tanana Uplands only had one Cordilleran endemic species and the upper Copper River basin and Malaspina Forelands each had two species.

The greatest ratios of the Cordilleran endemic element are in the southern Chugach-St. Elias Mountains (33% - 11 species), northern Chugach Mountains (30% - 21 species), the northern St. Elias Mountains (30% - 14 species) and the Chitina River basin (30% - 15 species). It has minimal representation in the Tanana Uplands (5%), Mts. Drum and Sanford region (10% - 3 species), the upper Copper River basin (13% - 2 species) and the Malaspina Forelands (11% - 2 species).

The average number of Cordilleran endemic species per region is 7.7. There are six species unique to a region: four from the northern Chugach Mountains (*Arabis drepanoloba, Draba kananaskis, D. lemmonii,* and *Festuca minutiflora)* and one each from the southern Chugach-St. Elias Mountains (*Botrychium montanum*) and the Nutzotin Mountains (*Draba densifolia)*. The most widespread species are *Delphinum glaucum* and *Oxytropis viscida* which both occur in 12 out of the 18 regions and *Crepis elegans* which occurs in 11 regions.

Agoseris



Antennaria media

Arabis calderi

Arnica mollis habitat (Mill Creek, Site

Arnica latifolia

Delphinium glaucum

Draba macounii

Draba oligosperma

Draba ruaxes

Potentilla drummondii

Salix barrattiana

Plate 6.4. Selected Cordilleran endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

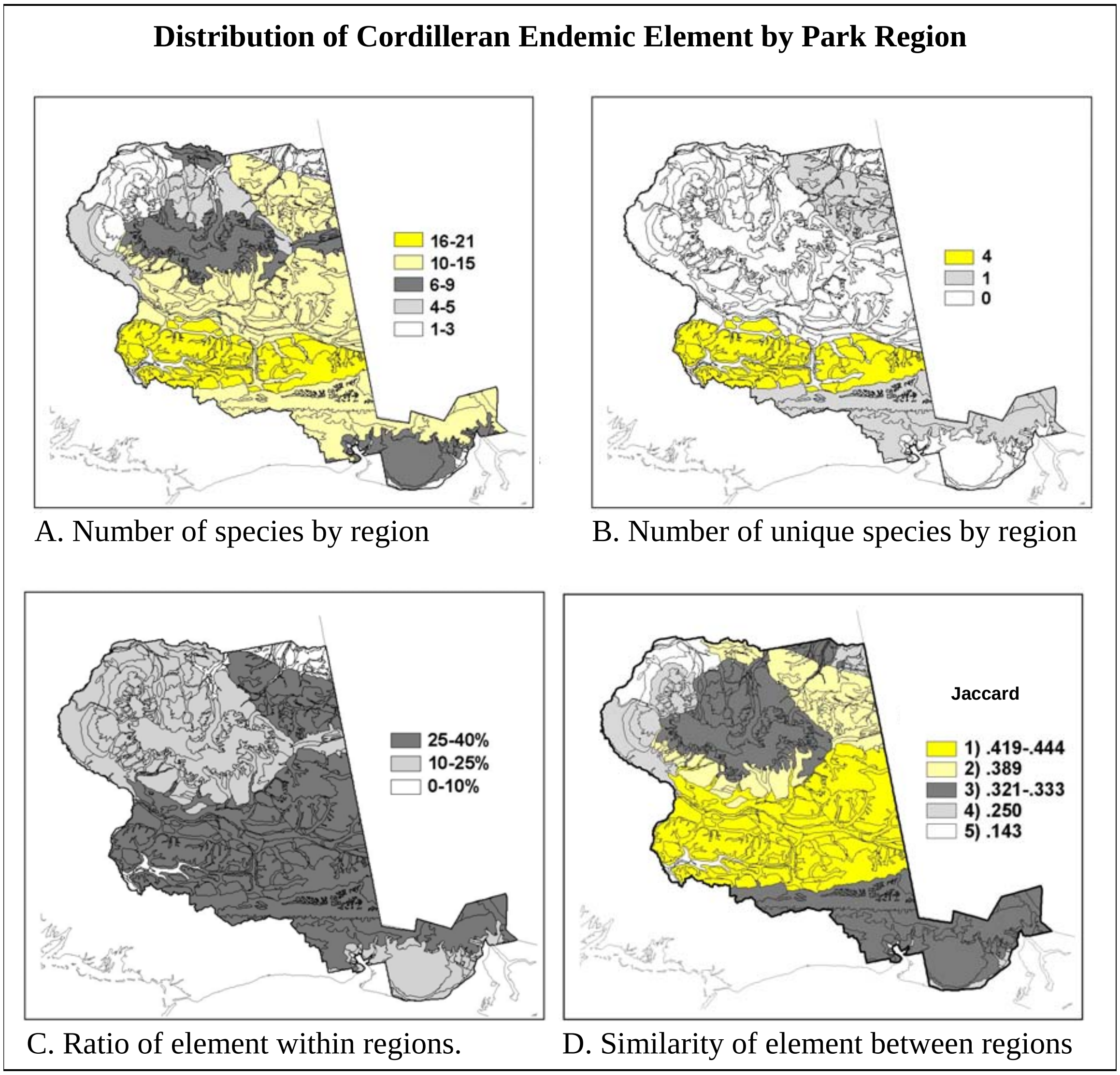


Figure 6.17A-D. Distribution of the Cordilleran endemic element by regions within Wrangell-St. Elias National Park and Preserve, Alaska. Ratio (Figure C) is the proportion of species in this element compared to the total number of endemic species in a region. Cluster group 1 (Figure D) represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

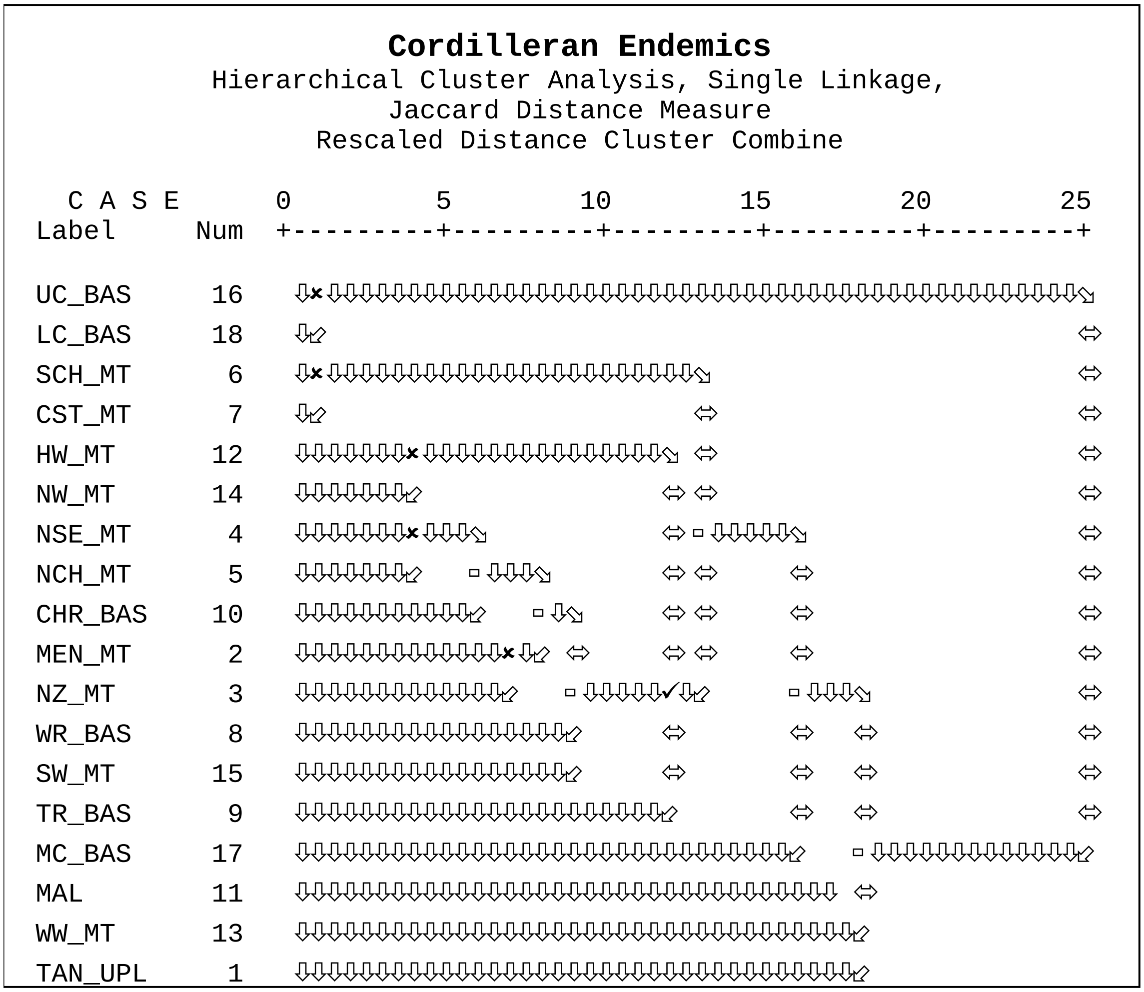


Figure 6.18. Dendrogram showing the results of cluster analysis of the Cordilleran endemic species occurring in eighteen regions of Wrangell-St. Elias National Park and Preserve, Alaska. Species and proximity matrices are in appendices 5.11 and 5.12. Abbreviations for park regions are in appendix 6.5.

Similarity Among Regions

The two regions with the most similar Cordilleran endemic species and which are the core cluster of group one are the northern St. Elias Mountains and the northern Chugach Mountains joined at a Jaccard distance of 0.444 and joined by the Chitina River basin at a Jaccard distance of 0.419 (see Appendix 6.10 for the species matrix, Appendix 6.11 for the distance measures, Figure 6.19D for the map interpretation and Figure 6.18 for the dendogram). Four regions join group one at a Jaccard distance of 0.389: the Mentasta and Nutzotin Mountains (joining each other at a Jaccard distance = 0.412), the White River basin and the Southwest Wrangell foothills.

The following five regions join the preceding regions at Jaccard distances of 0.321 to 0.333 (showing low similarity): the high Wrangells and Northwest Wrangell foothills (joining each other at a Jaccard distance of 0.444), the Tanana River basin, and the southern Chugach-St. Elias Mountains and coastal mountains and foothills (joining each other at a Jaccard distance of 0.500). The regions with the lowest similarity to group one were the middle copper River basin (Jaccard distance of 0.273), the Malaspina Forelands, Mt. Drum and Sanford and Tanana Uplands which joined the middle copper River basin at a Jaccard distance of 0.250, and the Upper and lower Copper River basins which were outliers at a Jaccard distance of 0.143 but joining each other at a distance of 0.500. The lower Copper River only had one Cordilleran endemic species (*Sorbus scopulina*) which it shared with the upper Copper River basin explaining both the similarity between the two regions and their outlier status.

Seventy-six percent of all Cordilleran endemic species occur in group one (northern St. Elias Mountains, northern Chugach Mountains and Chitina River basin). Eighty-eight percent of the Cordilleran endemic species occur in the northern St. Elias Mountains, northern Chugach Mountains, southern Wrangell foothills, Mentasta Mountains, Nutzotin Mountains and White River basin. All of the Cordilleran endemic species are found in the regions north of the Malaspina Forelands except for the Copper River basin and Tanana Uplands. The Cordilleran endemic floras of the mountain regions clustered together with the exception of the White and Chitina River basins which grouped with mountain regions in groups one and two.

Pacific Coastal Endemic Species

Distribution Within Regions

Photographs of representative Pacific coastal endemic species are in Plate 6.5. The 42 Pacific coastal endemic species are distributed along a south to north latitudinal gradient across the park (Figures 6.11, 6.12 and 6.19). This element is centered south of the Chitina River basin with outliers in the southern Wrangell foothills, Copper River basin and Tanana River basin. Pacific coastal endemic species were absent from the Nutzotin Mountains, the northern St. Elias Mountains, the northern Wrangell foothills, the Yukon-Tanana Uplands, Mts. Drum and Sanford region and the White River basin. The greatest number of Pacific coastal endemic species were in the coastal mountains and foothills (30 species), the Malaspina Forelands (13 species) and the southern Chugach-St. Elias Mountains (11 species).

The Pacific coastal endemic element comprises 2% of the Mentasta Mountain endemic flora (1 species), 3% of the high Wrangells (1 species), 7% of the southern Wrangell foothills (4 species), 14% of the northern Chugach Mountains (10 species), 33% of the southern Chugach-St. Elias Mountains and 70% of the Coastal foothills and Mountain endemic floras. This gradient is also apparent in the basin regions of the park. Pacific coast endemics are absent from the White River basin, they are 3% of the Tanana River basin endemic flora (1 species), 13-17% of the Upper and middle copper River basin endemic flora (2-4 species), 18% of the Chitina River basin endemic flora (8 species), 43% of the lower Copper River basin endemic flora (3 species) and 68% of the Malaspina Forelands endemic flora.

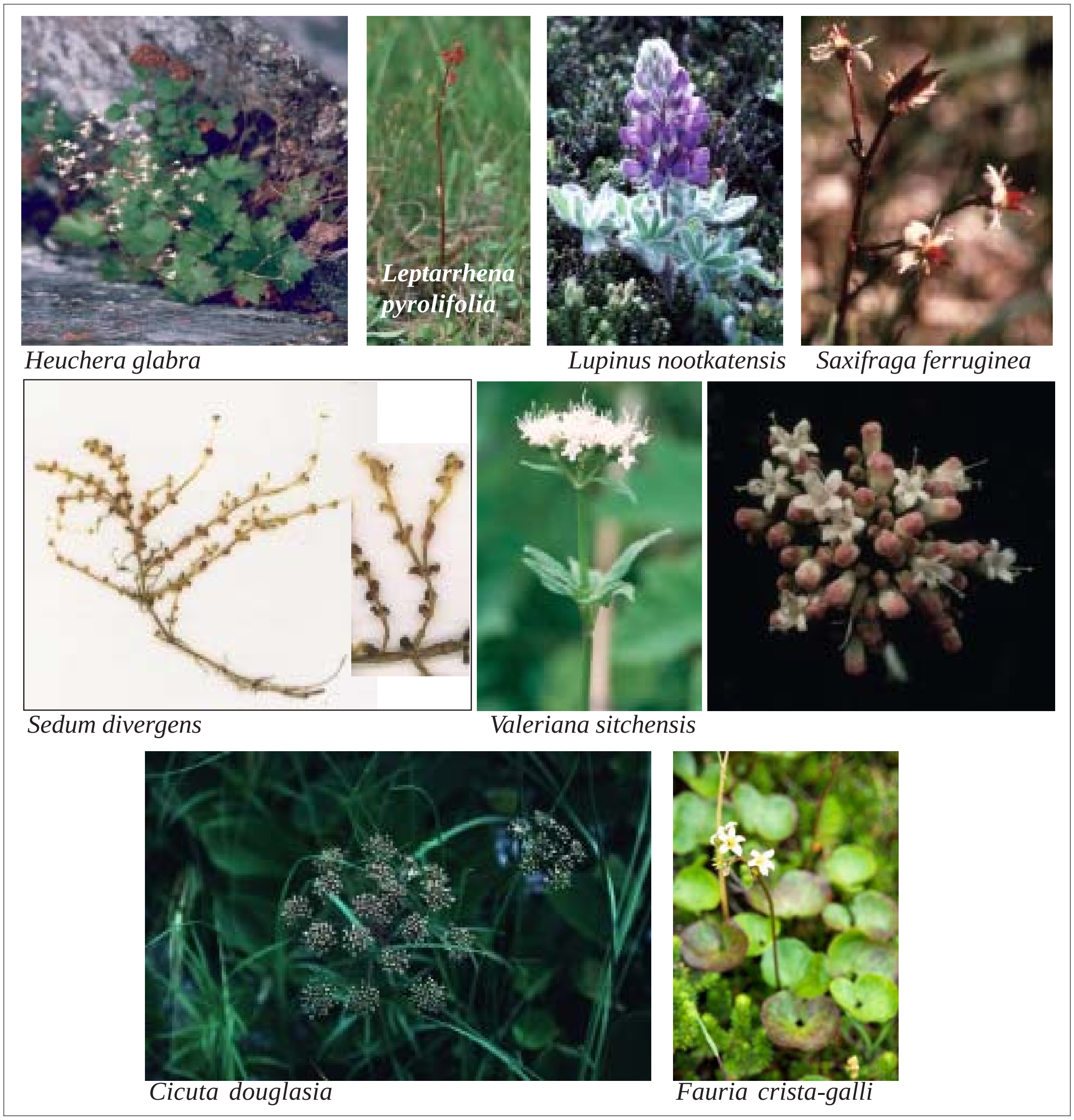


Plate 6.5. Selected Pacific coastal endemic species documented by vouchers during the 1994-1997 & 2003 vascular plant inventory in Wrangell-St. Elias National Park & Preserve, Alaska.

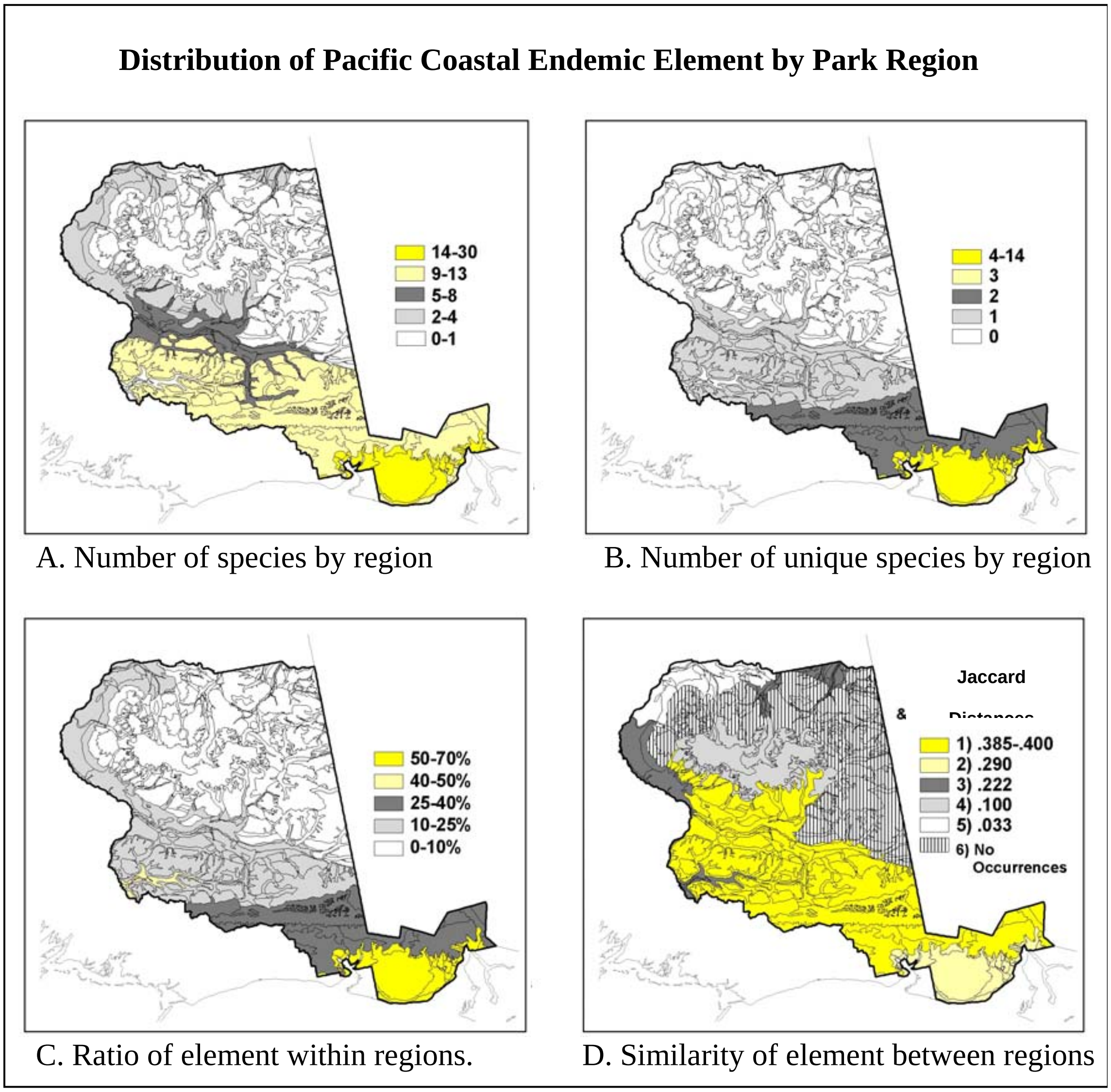


Figure 6.19A-D. Distribution of the Pacific coastal endemic element within regions of Wrangell-St. Elias National Park and Preserve, Alaska. Ratio (Figure C) is the proportion of species in this element compared to the total number of endemic species in a region. Cluster group 1 (Figure D) represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

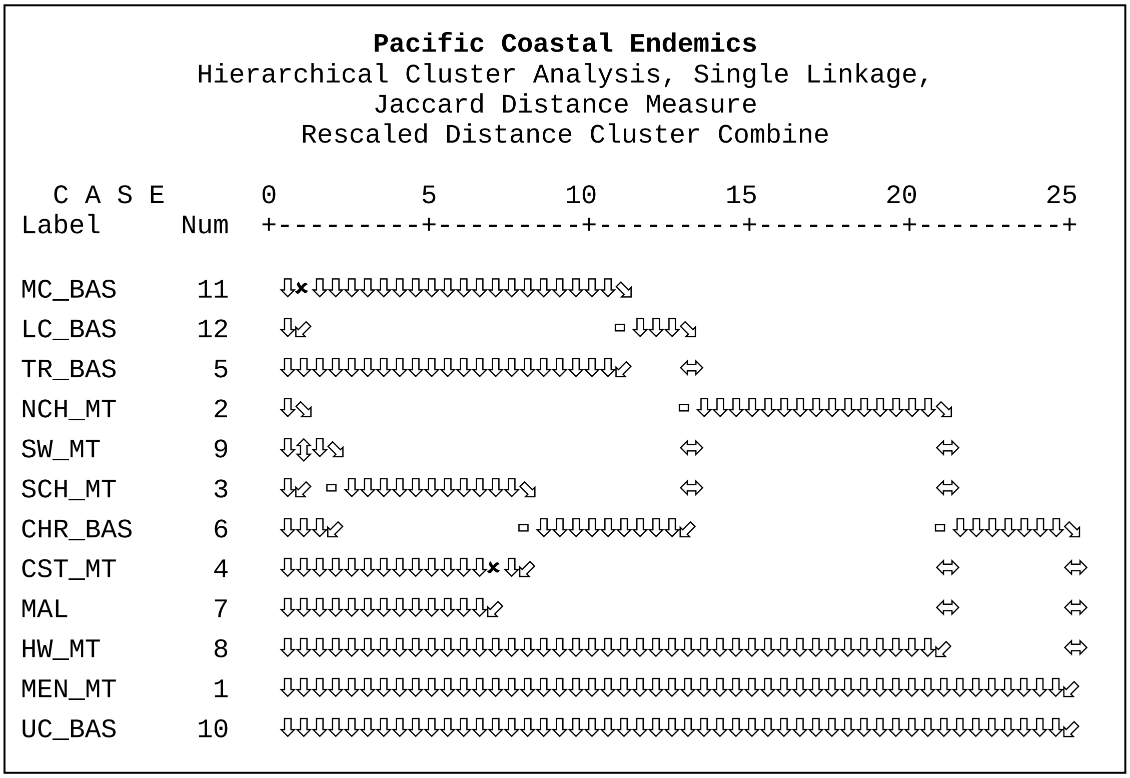


Figure 6.20. Dendrogram showing the results of cluster analysis of the Pacific Coastal endemic species occurring in twelve out of eighteen regions of Wrangell-St. Elias National Park and Preserve, Alaska. Species and proximity matrices are in appendices 5.13 and 5.14. Abbreviations for park regions are in appendix 6.5.

The mean number of Pacific coast endemic species per region was 4.8 indicating that this element is the least widespread across the park. There were 17 species found only in one region, 10 of these were in the Coastal foothills and Mountain region. Examples of species unique to the Coastal foothills and Mountain region are: *Carex mertensii*, *Cladothamnus pyrolaeflorus*, *Claytonia sibirica*, *Dodecatheon jeffreyi*, *Tellima grandiflora* and *Viola glabella*. There are three unique species from the Malaspina Forelands region (*Listera caurina*, *Picea sitchensis* and *Ranunculus uncinatus*), two from the southern Chugach-St. Elias Mountains (*Carex circinnata*, and *Sedum divergens*) and one each from the northern Chugach Mountains (*Cassiope mertensiana*) and Chitina River basin (*Carex laeviculmis*). The most widespread Pacific coastal endemic species are *Heuchera glabra*, *Lupinus nootkatensis*, *Salix sitchensis* and *Valeriana sitchensis* which occur in six out of 18 regions.

Similarity Among Regions

There were five regions without Pacific coastal endemics so these regions were excluded from the cluster analysis (see Appendix 6.12 for the species matrix, Appendix 6.13 for distance measures and Figure 6.20 for the dendogram). The most homogeneous group of regions (group one in Figure 6.21D) based on the Pacific coastal endemic flora included the northern

Chugach Mountains, the southern Wrangell foothills and the southern Chugach-St. Elias Mountains (Jaccard distances = 0.400) joined by the Chitina River basin with a Jaccard distance of 0.385 . The coastal mountains and foothills and the Malaspina Forelands joined the first group at a Jaccard distance of 0.290. The middle copper River basin, lower Copper River basin and Tanana River basin joined the preceding regions at a Jaccard distance of 0.222, although the Middle and lower Copper River basins were more similar at a distance of 0.400 (group three). The high Wrangell Mountains (n=1), Mentasta Mountains (n=1) and upper Copper River basin (n=2) with Jaccard distances of 0.100, 0.033 and 0.032 respectively, were outliers most likely due to low sample sizes.

Forty-three percent of the Pacific coastal endemic species occur within the first group of regions (northern Chugach Mountains, southern Wrangell foothills, southern Chugach-St. Elias Mountains and Chitina River basin). Ninety-one percent of the Pacific coastal endemics occur in the southern Wrangell foothills south to the Malaspina Forelands excluding the Copper River basin and 95% occur in the Tanana River basin, Middle and lower Copper River basins and regions south of the high Wrangells to the Malaspina Forelands. The mountains regions were more similar to each other than to the basin regions with respect to the Pacific coastal endemic flora except for the Chitina River basin which was more similar to the mountains regions in group one and the coastal mountains and foothills which was more similar to the Malaspina Forelands.

Identification of Floristic Regions and Components

Floristic Regions

To determine if there are regional floristic patterns, 10,262 voucher records with georeferences from the park were used to compile a species by region matrix and evaluated using a nearest neighbor cluster analysis. The dendogram resulting from the analysis is in Figure 6.21 and a map illustrating one interpretation of the analysis is in Figure 6.22. It is recognized that by using vouchers, common taxa or taxa within their range may be under represented in this analysis. This could have the effect of overstating similarity among regions.

The average number of species per region was 222, the greatest number of species was 394 in the Chitina River basin and the fewest number of species were in the lower Copper River basin with 64 species. The low number of species here is due to the few collections in this region (97 compared to an average of 620).

The most similar regions with respect to the entire flora were the Mentasta and Nutzotin Mountains, the southern Wrangell foothills and northern Chugach Mountains, and the Chitina River and middle copper River basins. The Mentasta and Nuztotin Mountains formed cluster group one with the White River basin and the Chitina River basin and the middle copper River basin formed cluster group two with the southern Wrangell Mountains and northern Chugach Mountains.

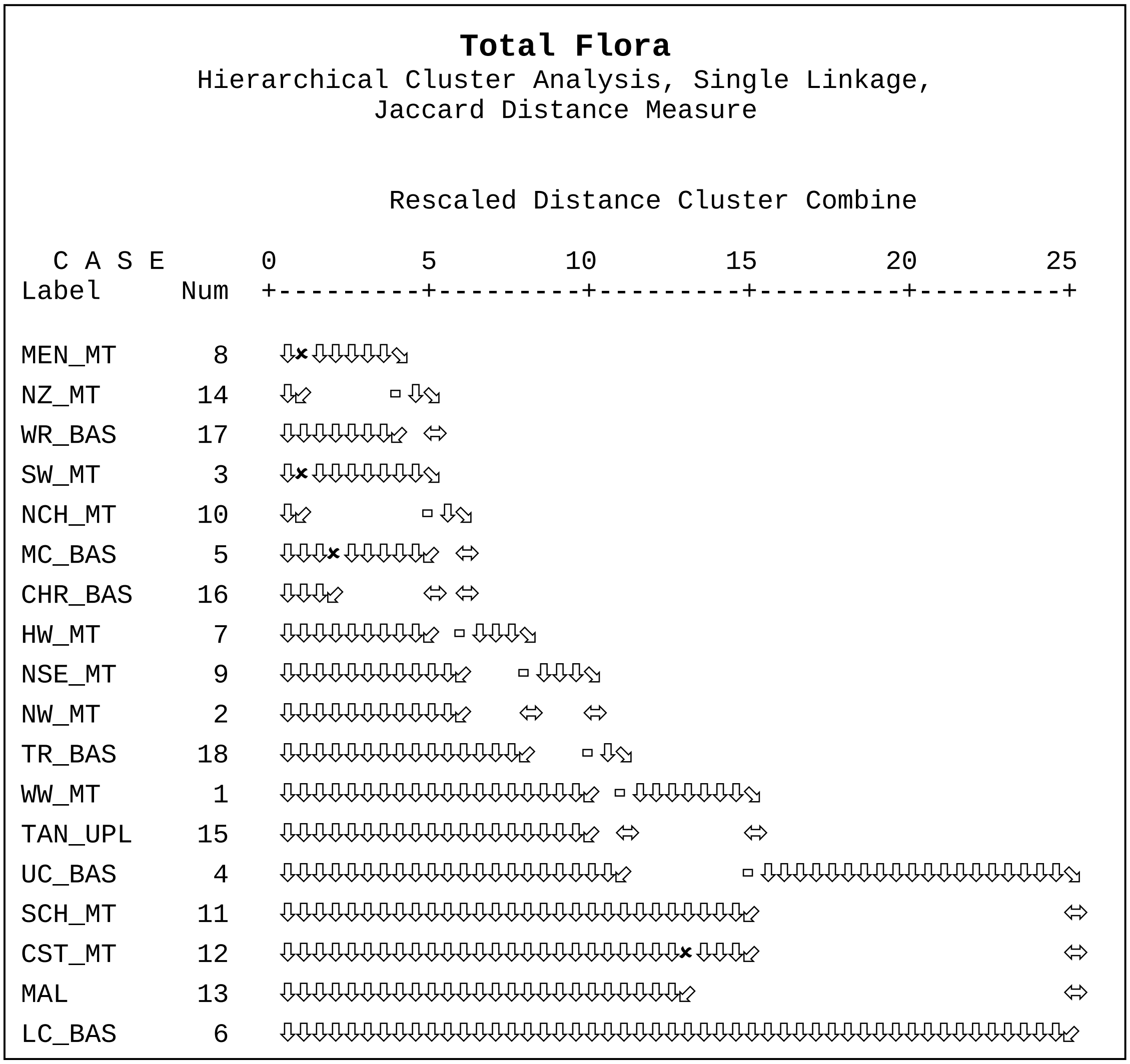


Figure 6.21. Dendrogram showing the results of cluster analysis of the entire flora indicating similarity between 18 regions of Wrangell-St. Elias National Park and Preserve, Alaska. Abbreviations for park regions are in appendix 6.5.

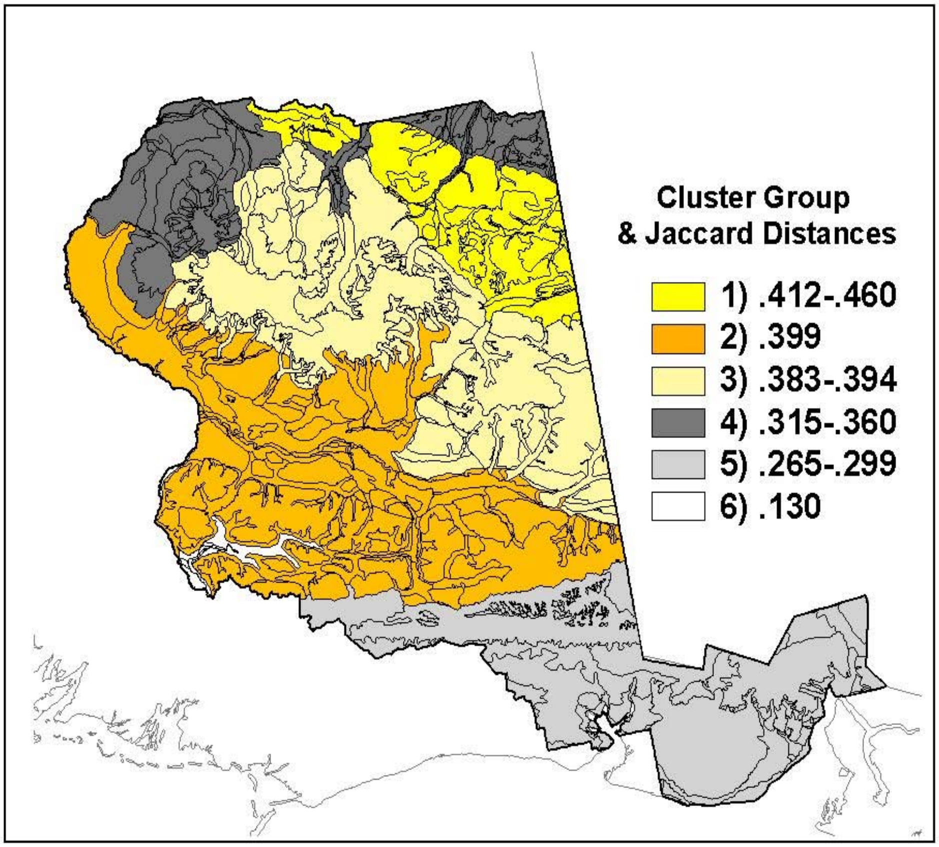


Figure 6.22. Interpretation of cluster analysis using the entire flora documented by vouchers, Wrangell-St. Elias National Park and Preserve, Alaska. Group 1 represents those regions which have the most similar species matrices as indicated by the Jaccard distance measures.

The high Wrangells, northern St. Elias and northern Wrangell foothills were the next most similar regions and are mapped as cluster group three. The Tanana River basin, Mt. Drums and Sanford, Tanana Upland and upper Copper River basin are mapped as cluster group four and the southern Chugach Mountains, coastal mountains and foothills and Malaspina Forelands as cluster group five. The lower Copper River basin was the least similar to any region. This is most likely due to the low number of number of collections and species with vouchers in this region.

The six regions resulting from this analysis primarily reflect the climatic and latitudinal gradients found within the park. However, the Copper River basin is not contiguous with the Tanana Lowland or Uplands, so I would retain this as a separate region with Mt. Drums and Sanford. This would result in six broad floristic regions based only on the similarity of the vascular floras: (1) The Tanana Region including the Tanana River basin and Tanana Upland; (2) the Alaska Range Region (Mentasta and Nutzotin Mountains and White River basin); (3) the Lake Ahtna Region (upper Copper River basin Region and Mts. Drum and Sanford); (3) the northern Wrangell-St. Elias Mountain Region; (4) the Transitional Region (southern Wrangell Mountain

foothills, northern Chugach Mountains, middle copper River basin and Chitina River basin; (5) the Coastal Region (southern St. Elias Mountains, coastal mountains and foothills and Malaspina Forelands); and (6) the lower Copper River basin Region.

Floristic Components

To determine if there are distinct components of the park's flora that are evident across regions that should be incorporated into a classification of the floristic regions, the species by region matrix used for the cluster analysis was interpreted using factor analysis. The numbers of species shared for each region were tabulated, a covariance matrix computed and factor loadings estimated using a maximum likelihood extraction method with oblique rotation. A factor is interpreted as a group of shared species or a floristic component. The factor loadings or eigen values indicate the similarity between the species in a region and the floristic component.

Three factors, accounting for 43% of the variation in the dataset were identified in this analysis. Factor score plots and maps of factor loadings for each factor are in Figures 6.23 and 6.23. Regions with the greatest factor loadings within factor one and between all three factors included the interior mountain ranges of the park and the White River basin. The high Wrangells had the greatest similarity to this element with a factor loading of 0.69. The northern Wrangell foothills, Mts. Drum and Sanford, southern Wrangell foothills, northern St.-Elias Mountains and Nutzotin Mountains had factor loadings of 0.62, 0.60, 0.58, 0.57 and 0.56 respectively. The Mentasta Mountains had a factor loading of 0.52 and the White River basin and northern Chugach Mountains had factor loadings of 0.48. The Yukon-Tanana Uplands had a factor loading of 0.36, very close to its value for factor two (0.35).

Regions with the greatest factor loadings within factor two and between all factors were the middle copper River basin with a factor loading of 0.65, and the Tanana, Chitina and upper Copper Basins with factor loadings of 0.51. The Yukon-Tanana Uplands and the White River basin had factor loadings of 0.35 and 0.39 respectively, and are intermediate between factors one and two in the bivariate plot. However, both regions had more similarity to factor one than to factor two.

Regions with the greatest factor loadings within factor three and between all factors are the coastal mountains with a factor loading of 0.58, the southern Chugach-St. Elias Mountains with a factor loading of 0.35, the Malaspina Forelands with a factor loading of 0.34 and the lower Copper River basin with a factor loading of 0.24. The northern Chugach Mountains and Chitina River basin had factor loadings of 0.20 and 0.29 respectively, but they were more similar to factors one and two.

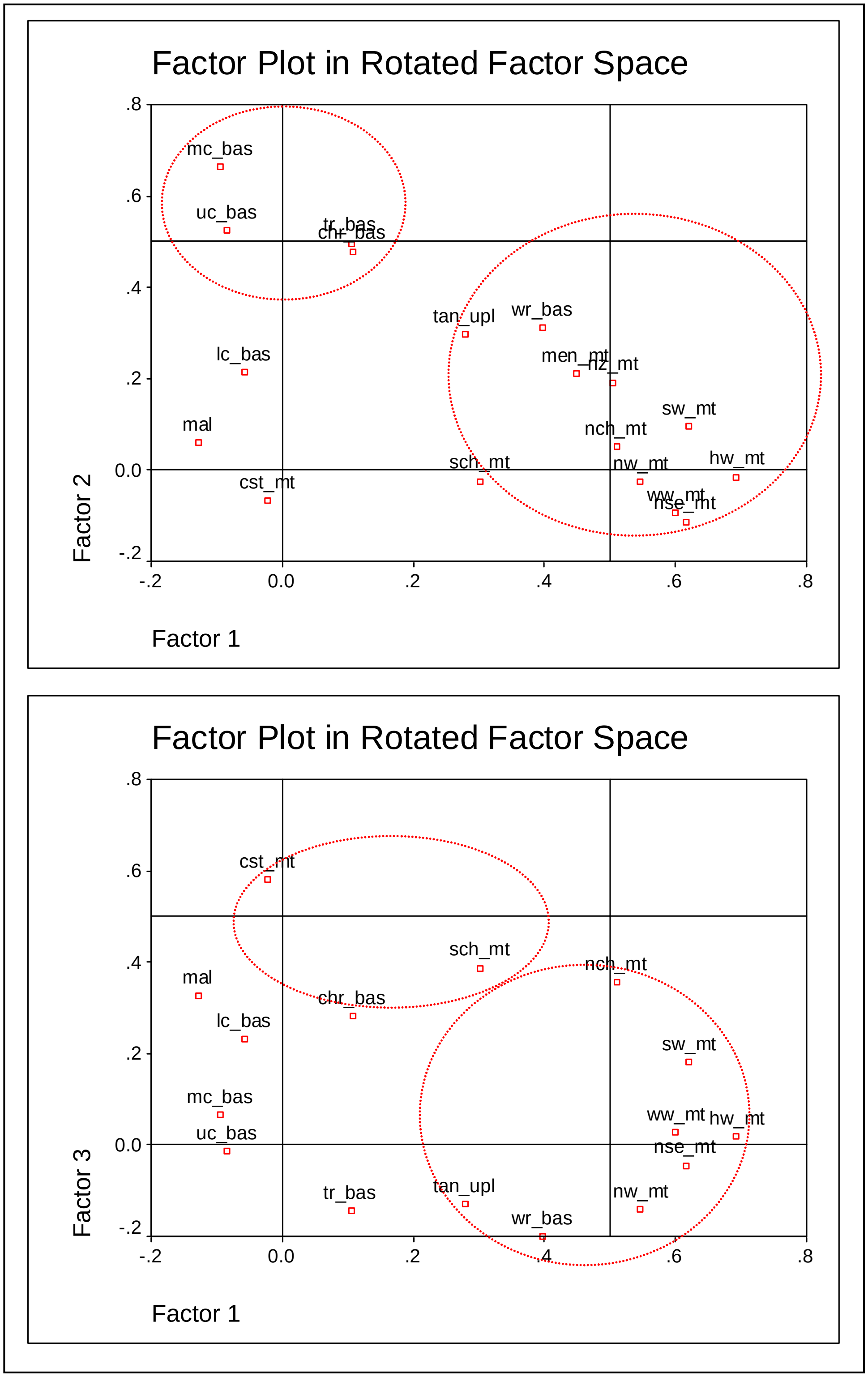


Figure 6.23. Factor score plots for analysis of total flora across regions of Wrangell-St. Elias National Park and Preserve, Alaska. Circles encompass regions with the highest factor scores between regions for each factor.

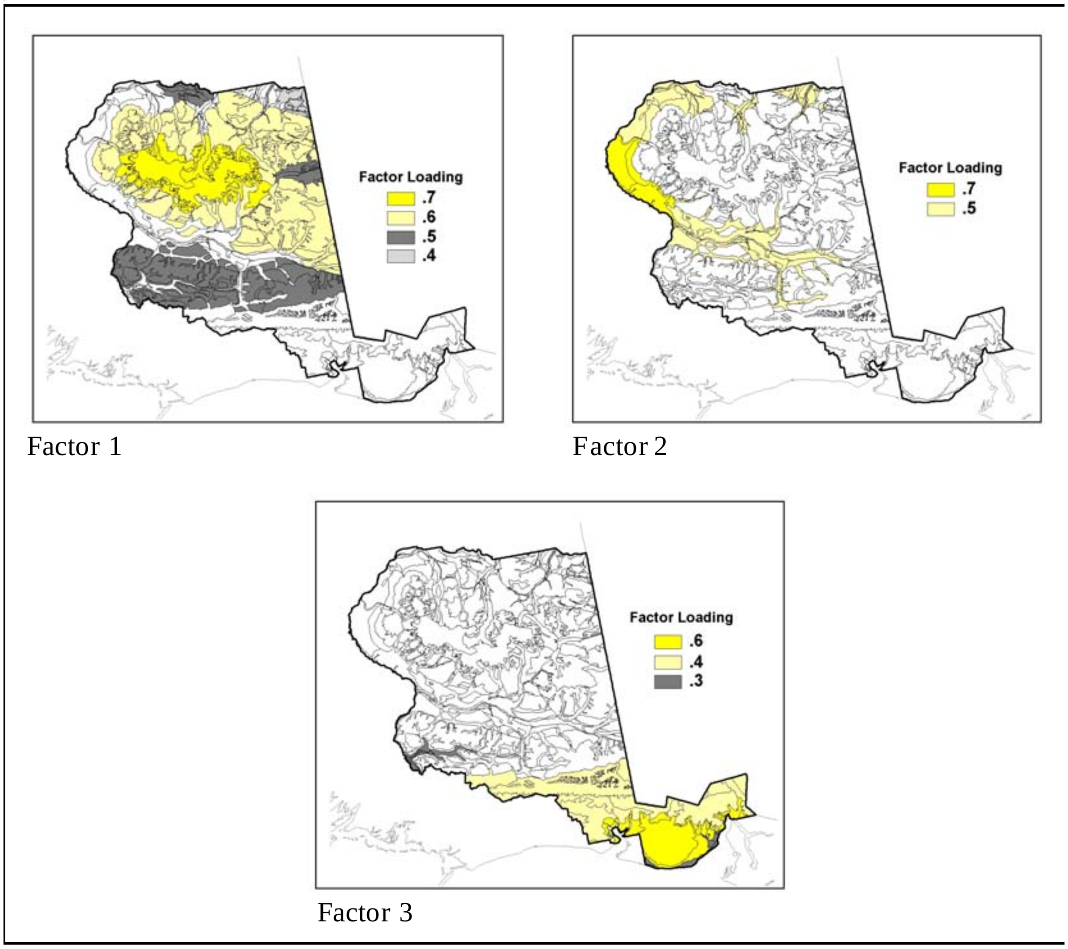


Figure 6.24. Maps of factor loadings for the three factors derived from factor analysis of the total flora of Wrangell-St. Elias National Park and Preserve, Alaska. The highest values between all three factors for each region are shown with the associated factor.

Three broad floristic components can be associated to the factors in this analysis using our voucher data. These are identified as: (1) the interior mountain component (including the White River basin and Tanana Uplands); (2) the interior river basin component, and (3) the coastal component. A floristic classification of regions should incorporate these components (which in the case of the first two regions is altitudinal separating the montane and alpine regions from the lowland regions). The following five floristic regions would therefore have montane and lowland components within each region: The Tanana, Alaska Range, Lake Ahtna, Transitional and Coastal Regions.

Patterns of Endemism and the Origins of the Flora

The composition and distribution of the park's flora is not only determined by ecological conditions but also by the dispersal patterns of plants since the end of the Wisconsin glaciation. Since the park was completely covered by ice when the Cordilleran ice sheet was at its

maximum, all plants occurring in the park are derived from sources that were not covered by ice during the Pleistocene (Figure 6.25). In the late Wisconsin, approximately 20,000 years ago, there were at least three areas within the park that were ice-free and were most likely the immediate sources of the park's modern day flora (Figure 1.9). These were: (1) unglaciated areas adjacent to pro-glacial lake Ahtna (Conner 1975, Hamilton and Thorson 1983, Pielou 1991); (2) an area in the Yukon-Tanana Lowlands and Uplands at the northern edge of the ice sheet in the northeast corner of the park (Manley and Kaufman 2002), and (3) nunataks in the Wrangell Mountains (Manley and Kaufman 2002, Hamilton and Thorson 1983). Based on plant distribution data, particularly the distribution of endemic species, there may have been additional nunataks in the coastal region and in the Nutzotin Mountains adjacent to the edge of the ice sheet. However, current paleoecological data has identified only the nunataks in the Wrangell Mountains.

Where did the plants come from that populated the ice-free areas within the park? The preceding analysis of the endemic elements in the park has been an attempt to clarify the distribution of these sources. The floristic regions of Hultén (1941-1950) hint at the origin of the park's flora, the park intersecting five of these regions (Western Pacific Coast, Eastern Pacific Coast, Alaska Range, Central Yukon and Upper Yukon). However, there has never been a comprehensive evaluation of the sources that contribute to this regional flora except for Scott (1974) who evaluated the flora of one area in the park, the southeastern Wrangell Mountains.

Our park-wide, georeferenced vouchered data set is a valuable tool for beginning to discern dispersal patterns of the flora. The distribution of endemic species is particularly useful for such an assessment since their distributions are narrower and reflect their origin. A high number of species of a particular endemic type in a flora for a region indicates closer proximity to the source of that endemic type. This was an exploratory assessment, illuminating only major patterns since our delineation of regions as the operational unit is coarse. It would be preferable to conduct this analysis using operational geographical units derived from a systematic grid across the park. Also, a more comprehensive interpretation could be completed after areas with poor representation are surveyed and a matrix used that includes all known species (not just collections).

Geographical Sources

The primary source of the park's flora from which the ice-free areas were populated at the end of the Wisconsin glaciation was Beringia, particularly the upper Yukon Valley which bordered the park's northeast corner. Beringia was that part of Alaska and Eastern Asia connected by the Bering Land Bridge that was not covered by the Cordilleran Ice Sheet during the Pleistocene. This area is referred to as a refugium and was a primary source of plants for all of North America during the interglacials and especially once the Cordilleran Ice Sheet melted and species migrated south along the Cordillera (Hultén 1972). The predominant community of Beringia was tundra steppe, a community with no extensive analog today except for remnants represented on south-facing bluffs dominated by *Artemisia* species. The species of the tundra

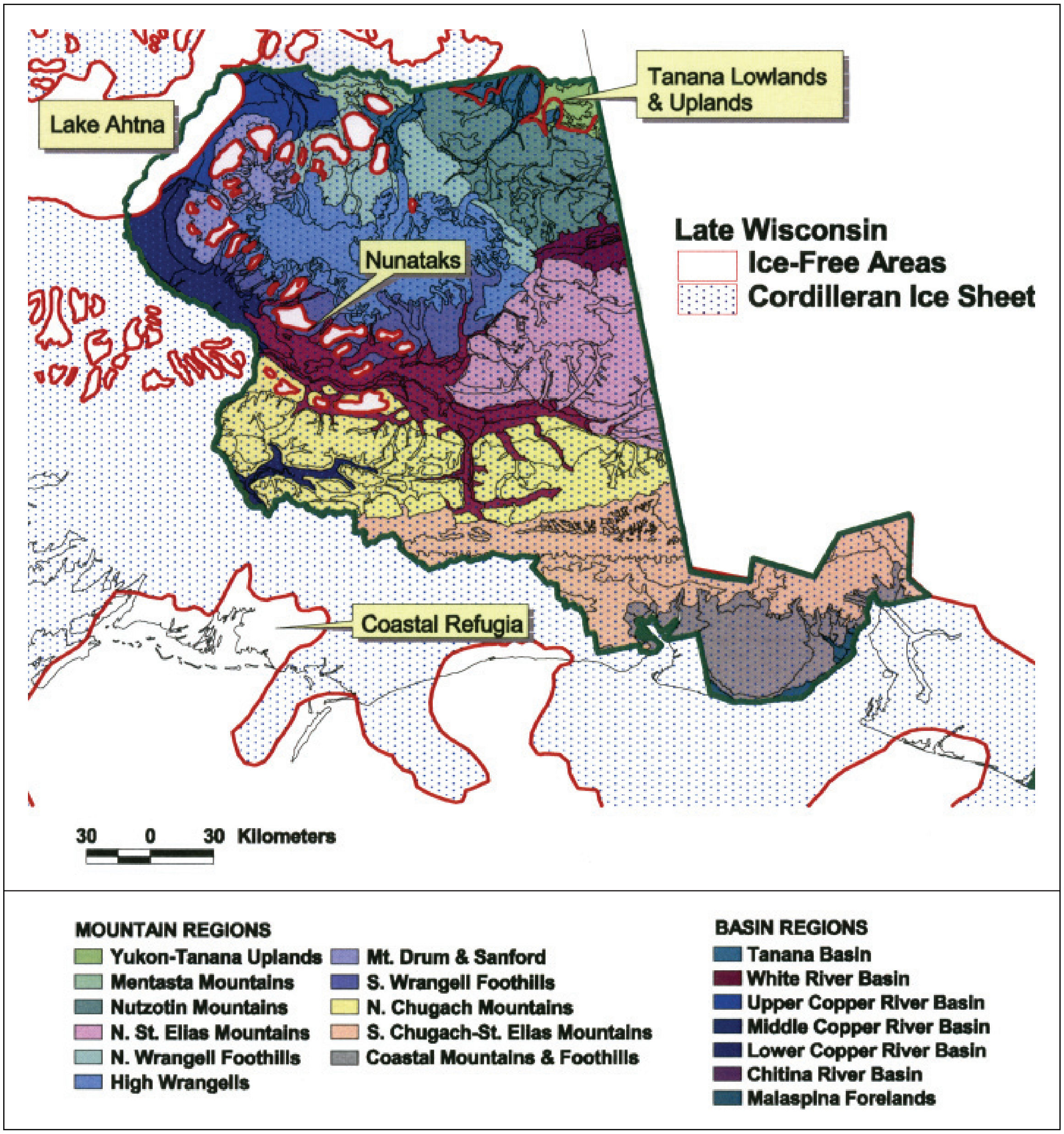


Figure 6.25. Extent of Wisconsin glaciation (approximately 20,000 years ago) showing ice-free areas and regions used for floristic analysis, Wrangell-St. Elias National Park and Preserve, Alaska (Mercator Projections NAD 1927).

steppe were pre-glacial relicts (species that were here prior to the Pleistocene including boreal and alpine species that could tolerate the cold and dry climate) and new species migrating from Eastern Asia. The Beringian refugium was also continuous with the high Arctic permitting arctic species to reach the eastern Beringian refugium in the Upper Yukon River Valley.

The second important source of the park's flora was the ice-free areas in the Alaska Range to the northwest and the Western North American Cordillera to the east. Although much of the Alaska Range was heavily glaciated during the Pleistocene, there were high mountainous areas which were not covered by ice which harbored alpine plants that could endure the harsh climatic conditions (Hultén 1946-1950). The Western North American Cordillera also had isolated unglaciated mountain peaks during the Pleistocene from which species migrated north and south during warming periods (Heusser 1954, Hultén 1972, Packer and Vitt 1974, Pielou 1991, Shoefield 1969).

The third significant source of the park's flora is the coastal region of Alaska. Although the park's coast was heavily glaciated even at the end of the Wisconsin glaciations, there were three unglaciated coastal refugia close to the park which served as sources as the continental ice shelf began to melt (Péwé 1975, Pielou 1991, Heusser, n.d., Heusser 1972, Figure 1.9).

The first of these refugia extended from Hinchbrook Island in Prince William Sound to Katella, covering 134 km of shoreline and reaching 53 km into the interior along the Copper River Delta as far as 2 km south of Miles Lake (Manley and Kaufmann 2002). This refugium was only 27 km from the park and 41 km from the Bremner River, a likely migration corridor.

The second refugium was on the Robinson Mountains forelands between the Tsiu River and Cape Yakataga covering 60 km of shoreline and extending 8 km into the foothills. This refugium was 45 km west of Icy Bay and 66 km south of the northern Chugach Mountains in the park. The third refugium was on the Yakutat Forelands between the Situk and Akwe Rivers covering 45 km of shoreline and extending 12 km into the interior. This refugium was 50 km east of the Malaspina Forelands.

Coastal refugia had both lowland and alpine species that were derived from Eastern Asia via the Aleutian chain, relict populations from the Tertiary, and migrants from coastal regions south of the Cordilleran Ice Sheet (Hultén 1972, Pielou 1991, Shoefield 1969). Additionally, there may have been nunataks in the coastal mountains, southern St. Elias and Chugach Mountains.

Patterns of Endemism

The numbers of species in each endemic element in the flora are similar indicating that each element has similar influence on the composition of the total flora. However, there are differences in their distribution on the landscape, and these differences can provide insight into the history of the park's flora.

The distribution patterns of Pacific coastal and Cordilleran endemics were as expected with a couple of noteworthy trends. The Pacific Coast endemics are most frequent in the coastal mountains (as would be expected) and radiate into the interior mountains of the park as far as the southern Wrangell foothills and into the interior basins except for the White River basin. They are the most restricted of all the endemic elements, not occurring in six of the northern park regions. Although the Bagley Icefield and southern St. Elias Mountains are functioning somewhat as a physical barrier to coastal plant migration (since there is a decrease into the interior), it appears that the high Wrangells are an even more effective barrier. The conditions on the north and west side of the Wrangell-St. Elias Mountains must also be too continental for the more temperate coastal flora.

It is also noteworthy that in the cluster analysis the regions with the most similar Pacific coastal floras did not include the coastal mountains but were centered on the northern Chugach and Chitina River basin. This may indicate that the park's coastal flora has been more influenced by the coastal refugium in Prince William Sound via the lower Copper River (which was ice-free much longer than the park's coastal area) than by the current flora on the coast of the park. The Pacific Coast endemics are predominately non-alpine species (67%) which supports an origin from a coastal refugium with lowland to sub-alpine species or from an extant coastal region rather than from a coastal nunatak which would be predominately alpine.

The Cordilleran endemics are most numerous in the Chugach Mountains (which is at the terminus of the Western North American Cordillera), and they radiate north and south into the mountain regions of the park. Cordilleran endemics are predominately alpine species (88%) which supports their origin from alpine nunataks within the Cordillera.

The high correlation between the distribution of Alaska-Yukon and amphiberingian endemics would be expected since their sources are similar, the main difference being that amphiberingian endemics are found on both sides of the Bering Strait. Both elements have arctic-alpine species preserved on unglaciated mountains during the Pleistocene, steppe-tundra species which evolved during the Pleistocene and relict species from pre-glacial times.

The greatest numbers of both elements are in the northeast corner of the park in the Nutzotin Mountains, the mountain region closest to the Upper Yukon portion of Beringia. The Upper Yukon has been identified by Hultén (1972) and Lausi and Nimis (1985) as a center of Alaska-Yukon endemism and it is evident how these species have radiated from the Upper Yukon south through the mountain and basin regions of the park. The paucity of Alaska-Yukon endemics in the southern St. Elias Mountains and coastal regions is most likely due to the barrier created by the Bagley Icefield and southern St. Elias Mountains. The climatic gradient between the Upper Yukon valley and coast of Alaska is significant as well, species evolving in the dry continental interior climate zone being less adapted to the moisture regime of the coast and transitional areas. Lausi and Nimis (1985) found that the Upper Yukon was the center of Alaska-Yukon endemics with an affinity to steppe environmental conditions, quite unlike conditions found in coastal Alaska.

There are three trends in the distribution of the amphiberingian endemic element. First, the amphiberingian endemic element is more widespread than the Alaska-Yukon endemic element, occurring in high numbers in the southern Wrangell foothills and northern Chugach Mountains. Additionally, the highest ratios of the amphiberingian endemics are in the high Wrangells, Mt. Sanford and Drum and upper Copper River basin regions. Finally, the amphiberingian floras are most similar for the southern Wrangell foothills and northern Chugach Mountains.

I attributed the high numbers of amphiberingian endemics in the northern Chugach and southern Wrangell foothills to the influence of the coastal refugia with species of amphiberingian origins. Viewing Hultén's maps of progressive areas for the various components of the arctic and boreal flora, the polygon with the highest numbers of southern Beringian radiants passes through the southern half of the park and the polygon with the highest numbers of northern Beringian radiants passes through the northern region of the park. This indicates the pervasiveness of the Beringian influence throughout Alaska and also in the composition of park's flora (Hultén 1972). Another factor contributing to the more widespread nature of the amphiberingian endemics is their ecological affinity: only 52% of the amphiberingian species are generally found in alpine habits whereas 70% of the Alaska-Yukon endemics are found in alpine habitats.

The Endemic Flora of the Late Wisconsin Ice-Free Regions

The ice free areas surrounding Lake Ahtna in the late Wisconsin, the nunataks in the Wrangell Mountains and the ice-free areas in the Tanana Lowlands and Uplands might be a significant source of amphiberingian endemics in the upper Copper River basin and Wrangell Mountains. To evaluate this, I summarized the endemic status and biogeographical categories for 637 collection records from within the areas which were ice-free at the end of the Wisconsin glaciation: Lake Ahtna, Wrangell and Chugach Mountain nunataks and the Tanana Lowland-Upland refugia. There were collections in 20 out of the 32 nunataks.

There were only four amphiberingian endemic species occurring in the identified nunataks within the park, representing 10% of the endemic flora and 2% of the 233 species collected in nunataks (3% less than the proportion of this element in the total flora). Alaska-Yukon endemics were predominant in the nunataks with 21 species (53% of the endemics and 9% of the species collected, 4% more than the proportion of Alaska-Yukon endemics in the total flora). Cordilleran endemics were also an important component of the nunatak flora with 12 species (30% of the endemics, but 3% less than the proportion in the total flora). The high ratio of Alaska-Yukon and Cordilleran endemic species in nunataks coincides with their origins and ecological affinity for alpine habitats.

There were no amphiberingian, Alaska-Yukon or Cordilleran endemic species in the Lake Ahtna ice-free region and only one Pacific Coast species. The broader distribution of the amphiberingian species must therefore have more to do with their greater ecological amplitude and more extensive distribution in Beringia as compared to the Alaska-Yukon endemic species,

than to the Lake Ahtna region being a significant source. The paucity of endemic species in the Lake Ahtna region may have to do with more recent disturbances, fewer collections, and the lowland environment where fewer endemics of all types are found.

The Tanana Lowland and Upland ice-free area had eight Alaska-Yukon endemics, two amphiberingian endemics, two Cordilleran endemic species and one Pacific Coast endemic species. The ratio of Alaska-Yukon endemics is similar for the entire flora but significantly less for the other three elements, supporting the predominance of this element of the flora in the northeast region of the park closest to areas that were ice-free at the end of the Pleistocene.

Summary

The Distribution of the Rare and Endemic Flora

1. Sixty-six percent of the rare plants were found at elevations over 4000 ft (1219 m), 54% were in the xeric moisture class and 37% were in the mesic moisture class. There were significant linear relationships between survey effort (number of rare plant collections and number of sites) and the distribution of rare plants by life zone, lithology and landcover type but not for elevation or moisture class. This indicates that elevation and moisture class may be more reliable landscape indicators of the distribution of the rare flora
2. The rare flora is comprised predominately of North American species (48%) and Alaska-Yukon endemics (22%).
3. Seventy percent of the rare species are found in mountain regions. They are most frequent in the Nutzotin Mountains, Chitina River Valley, the Mentasta Mountains, the northern St. Elias Mountains and the northern Chugach Mountains. However, every region had at least one rare species, with an average of 14 per region and 45 species occurring in only one region indicating that the rare flora is widespread throughout the park.
4. The number of rare species in a region is related to the size of a region, to the number of sites surveyed in a region and to the number of collections in a region. However, the high number of rare plants in the Nutzotin, northern St. Elias Mountains and southern Wrangell Mountains is most likely not due to survey effort. The high numbers of rare plant taxa in the Mentasta Mountains may be related to an increased survey effort. The low numbers of rare plant species in the high Wrangells and upper Copper River basin may be due to lower survey effort when compared to the rest of the regions. The lower number of rare plant species in the Malaspina Forelands and coastal mountains is most likely not due to lower survey effort.
5. The rare flora is most similar in the mountains north of the Chitina River Valley (the four Wrangell Mountain regions and the Mentasta, Nutzotin and St. Elias Mountains).

6. The distribution of the rare flora across park regions is correlated to the distribution of Alaska-Yukon, amphiberingian and Cordilleran endemic species.
7. The distribution of each endemic element across the park is correlated to the distribution of other endemic elements.
8. The number of amphiberingian and Cordilleran endemic species in a region is related to region size. The number of endemic species in a region (except for Pacific Coast endemics) is weakly related to survey effort measured either as number of collections or number of survey sites.
9. The greatest frequency of Alaska-Yukon endemic species are in the Tanana River Valley, Mentasta and Nutzotin Mountains. The greatest ratio of this element occurs in the Mentasta Mountains, Tanana River basin, Yukon-Tanana Uplands and White River Valley. The regions with the most similar Alaska-Yukon endemic floras are the Wrangell-St. Elias Mountains, the Nutzotin Mountains and the Mentasta Mountains.
10. The amphiberingain endemic element is most frequent in the northern Chugach Mountains, southern Wrangell foothills and Nutzotin Mountains. The greatest ratio of this element is in the upper Copper River basin, Mt. Sanford and Drum region and high Wrangells. The regions with the most similar Amphiberingain endemic floras are the Wrangell-St. Elias Mountains, Mentasta, Nutzotin and northern Chugach Mountains.
11. The Cordilleran endemic element is most frequent in the Chitina River Valley and northern Chugach Mountains. The greatest ratio of this element is in the Chitina River Valley, northern Chugach Mountains, northern St. Elias Mountains and southern Chugach-St. Elias Mountains. The regions with the most similar Cordilleran endemic floras are the Chitina River Valley, the northern St. Elias Mountains and the northern Chugach Mountains.
12. The Pacific coastal element is most frequent in the coastal mountains and foothills. The greatest ratio of this element is in the coastal mountains and foothills and the Malaspina Forelands. This element is the most restricted of all the endemic elements, not occurring in six northern regions. The regions with the most similar Pacific coastal endemic species are the southern-Chugach St. Elias Mountains, the northern Chugach Mountains and the southern Wrangell foothills.

A simple classification of the park's flora based solely on our voucher data and the analysis described above is as follows:

1) Tanana Region
    - i. Montane component (Tanana River basin)
    - ii. Lowland component (Tanana Upland)
2) Alaska Range Region (including the Mentasta and Nutzotin Mountains and White River basin)
    - i. Montane component
    - ii. Lowland component

3) Lake Ahtna Region (upper Copper River basin and Mts. Drum and Sanford)
    i. Montane component
    ii. Lowland component
4) Transitional Region (southern Wrangell Mountain foothills, northern Chugach Mountains, middle copper River basin and Chitina River basin)
    i. Montane component
    ii. Lowland component
5) Coastal Region (southern St. Elias Mountains, coastal mountains and foothills and Malaspina Forelands)
    i. Montane component
    ii. Lowland component
6) Lower Copper River basin Region

Origins of the Flora

There were at least three areas within the park that were ice-free in the late Wisconsin (approximately 20,000 years ago), and were most likely the immediate sources of the park's modern day flora: (1) unglaciated areas adjacent to pro-glacial lake Ahtna; (2) an area in the Yukon-Tanana lowlands and uplands at the northern edge of the ice sheet in the northeast corner of the park; and (3) nunataks in the Wrangell Mountains. The sources for these ice-free areas were: (1) Beringia, particularly the upper Yukon Valley which bordered the park's northeast corner; (2) the ice-free areas in the Alaska Range to the northwest and the Western North American Cordillera to the east, and (3) coastal refugia.

Alaska-Yukon and Cordilleran endemics are the most important components of the nunatak floras in the park coinciding with their ecological affinity for alpine habitats. The Alaska-Yukon endemic element is dominant in the Tanana Lowland and Upland ice-free region. This influence is seen in the biogeographic composition of the adjacent regions in the northeast corners of the park. The predominance of amphiberingian endemic taxa in the upper Copper River basin and the Wrangell Mountains most likely has more to do with the pervasiveness of this element across Alaska as well as the ecological amplitude of taxa in this element, then to there being a significant source from the late Wisconsin in these regions.

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Chapter 7: Annotated List Noteworthy Taxa

Distribution maps and annotations for 115 notable taxa documented during this inventory are presented in this chapter. Annotations and distribution maps for an additional 137 notable taxa are in Cook and Roland 2002. Table 7.1 lists the taxa found in each document. The annotations presented in this chapter include the following:

- Eleven taxa new to the flora of Alaska;
- All Alaska Natural Heritage Program (AKNHP) taxa with a state rank of three or less, including: 34 taxa with a state rank of S1 (five or fewer occurrences in the state and vulnerable to extinction); 35 taxa with a state rank of S2 (6-20 occurrences and very vulnerable to extirpation within the state), and 22 taxa with a state rank of S3 (21-100 occurrences and uncommon in the state);
- Twenty-seven collections made in 2003 which extend the range of the species over 250 km into a new mountain or basin region, and
- Three collections made prior to 2003 which are range extensions as defined above but which were not previously reported.

Annotations are in alphabetical order by family. Collections within each annotation are grouped by park region and are in order by collection date. Distribution maps were prepared by assembling the following locality data into a Geographic Information System: all collections from this inventory and previous park collections, specimen records from the University of Alaska Fairbanks Museum Plant Documentation Center and published stations from regional floras and monographs (Aiken and Darbyshire 1990, Argus 1973, Argus 2000, Bayer 1993, Cody 1996, Cody et. al. 1998, Cody et. al. 2000, Hultén 1941-1950, Hultén 1968, Porsild and Cody 1980). The distribution maps are at two scales, one encompassing all of Alaska and the Yukon Territory, including adjacent parts of Canada and one focused on the park. Distances were measured using ArcGIS software. Nomenclature follows the Flora of North America (1993-2003), Cody (1996) and Hultén (1968) for scientific names and Kartesz and Meacham (1999) for common names. Specimens are housed at the park herbarium unless indicated otherwise. Nature Conservancy global ranks are from Nature Serve (2004) if not ranked by the AKNHP.

Table 7.1. List of notable taxa with annotations and maps prepared for the 1994 to 1997 inventory (which are found in Cook and Roland (2002)), and for the 2003 inventory (which are found in this chapter), indicating the map number for each document.

Taxon	**Map #**	
	1997	**2003**
Agoseris aurantiaca		1
Agoseris glauca	201	2
Agrostis mertensii	21	
Agrostis thurberiana	22	72
Alopecurus magellanicus	23	
Antennaria media	201	
Aphragmus eschscholtzianus	109	7
Arabis calderi	110	8
Arabis codyi	111	9
Arabis drepanoloba	112	10
Arabis lemmonii	113	11
Arabis media	114	
Arenaria capillaris	82	
Arenaria longipedunculata	83	24
Arnica amplexicaulis	200	
Arnica latifolia	203	
Arnica mollis	204	3
Artemisia dracunculus		4
Artemisia hyperborea	205	
Aster alpinus subsp. *vierhapperi*	206	
Aster junciformis	207	
Astragalus williamsii	155	
Astragalus adsurgens	151	
Astragalus eucosmus subsp. *sealei*	152	
Astragalus harringtonii	153	53
Astragalus nutzotinensis	154	
Astragalus williamsii	155	
Botrychium alaskense		62
Botrychium ascendens	3	63
Botrychium lanceolatum	4	
Botrychium lineare		64
Botrychium minganense	5	
Botrychium montanum		65
Botrychium pinnatum	6	
Botrychium tunux		66
Botrychium yaaxudakeit		67
Braya glabella	115	
Braya purpurascens	116	
Callitriche anceps	160	
Callitriche hermaphroditica	161	23
Caltha leptosepala	98	
Carex adelostoma	40	33
Carex albonigra	41	
Carex atratiformis		34
Carex buxbaumii	42	
Carex chordorrhiza	43	
Carex circinnata		35
Carex crawfordii	44	36
Carex duriuscula		37
Carex eburnea	45	38

Taxon	**Map #**	
	1997	**2003**
Carex filifolia	46	
Carex holostoma		39
Carex hoodii	47	40
Carex krausei	49	
Carex leptalea	53	
Carex lapponica		41
Carex lasiocarpa subsp. *americana*	50	
Carex laxa	51	42
Carex lenticularis var. *dolia*	52	43
Carex leptalea	53	
Carex mackenziei		44
Carex nardina	54	
Carex nigricans	55	
Carex obtusata	56	
Carex parryana	57	45
Carex pauciflora	58	
Carex petricosa	60	
Carex phaeocephala	61	46
Carex praticola	62	
Carex stylosa	63	
Carex tahoensis	59	47
Carex viridula subsp. *viridula*	64	
Carex williamsii	65	
Cassiope lycopodioides var. *cristapilosa*		52
Cassiope mertensiana	173	
Castilleja chrymactis	189	107
Castilleja elegans	193	108
Castilleja miniata		109
Castilleja pallida var. *yukonis*	194	110
Cerastium regelii	84	25
Ceratophyllum demersum	96	30
Chamaerhodos erecta subsp. *nuttallii*	144	95
Cicuta douglasii	170	
Cladothamnus pyroliflorus	174	
Claytonia tuberosa	80	
Collomia linearis	186	
Coptis trifolia	99	
Cryptantha shackletteana	191	6
Cryptogramma sitchensis	7	
Cryptogramma stelleri	8	94
Cypripedium parviflorum		68
Cystopteris montana	9	
Danthonia intermedia	25	
Delphinium brachycentrum	100	
Deschampsia brevifolia	26	
Douglasia alaskana	176	91
Douglasia arctica	177	92
Douglasia gormanii	178	93

Taxon	Map #	
	1997	2003
Draba cinerea	117	
Draba corymbosa	118	
Draba crassifolia	119	
Draba densifolia	120	12
Draba incerta	121	13
Draba kananaskis	122	14
Draba lactea	123	
Draba lonchocarpa var. *thompsonii*	124	15
Draba macounii	125	
Draba oligosperma	126	
Draba palanderiana	127	
Draba porsildii	128	16
Draba ruaxes	129	17
Draba stenoloba	130	
Draba stenopetala	131	18
Elymus calderi		73
Epilobium lactiflorum	166	
Epilobium luteum	167	
Erigeron caespitosus	208	
Erigeron grandiflorus subsp. *arcticus*	209	
Eriophorum callitrix	66	
Eriophorum viridicarinatum	67	48
Erysimum pallasii var. pallasii	132	
Euphrasia mollis	195	
Eutrema edwardsii	133	
Fauria crista-galli	181	
Festuca brevissima	27	
Festuca lenensis	28	74
Festuca minutiflora	29	75
Festuca richardsonii	30	
Festuca saximontana	31	
Galium brandegei		100
Gentiana douglasiana	182	
Gentiana platypetala	183	
Gentianella tenella	184	
Glyceria pulchella	32	76
Gymnocarpium jessoense subsp. *parvulum*	10	
Hackelia deflexa	192	
Halimolobos mollis	134	
Hippuris montana	168	
Impatiens noli-tangere	162	
Isoetes echinospora	2	
Isoetes maritima		58
Juncus filiformis	71	
Juncus mertensianus	72	
Juniperus horizontalis	12	32
Kobresia sibirica	68	
Kobresia simpliciuscula	69	
Lesquerella arctica	135	
Ligusticum scoticum subsp. *hultenii*	171	
Limosella aquatica		111
Lupinus kuschei	156	54

Taxon	Map #	
	1997	2003
Maianthemum stellatum	73	60
Melandrium apetalum	92	
Melandrium macrospermum		26
Minuartia biflora	85	27
Minuartia dawsonensis	86	
Minuartia stricta	87	
Mitella pentandra	140	
Montia bostockii	81	86
Myriophyllum verticillatum	169	56
Najas flexilis	20	61
Nymphaea tetragona	97	
Osmorhiza depauperata	172	
Oxytropis campestris subsp. *jordalii*	157	
Oxytropis huddelsonii	158	55
Oxytropis scammaniana	159	
Papaver alboroseum	107	69
Papaver radicatum subsp. *kluanense*	106	70
Papaver walpolei	108	71
Pedicularis pacifica		112
Penstemon gormanii	196	113
Phacelia mollis	190	57
Phippsia algida	33	
Phlox hoodii	187	82
Phlox richardsonii	188	83
Phyllodoce aleutica subsp. *glanduliflora*	175	
Plantago eriopoda	199	
Poa abbreviata subsp. *pattersonii*		77
Poa leptocoma		78
Poa secunda subsp. *secunda*		79
Podagrostis aequivalis	35	
Polystichum lonchitis	11	
Polystichum setigerum		51
Potamogeton foliosus		87
Potamogeton friesii	14	
Potamogeton obtusifolius		88
Potamogeton praelongus	16	
Potamogeton pusillus	17	
Potamogeton subsibiricus	18	89
Potamogeton zosteriformis	19	
Potentilla arguta subsp. *convallaria*	145	
Potentilla biflora	146	96
Potentilla diversifolia	147	
Potentilla drummondii	148	97
Potentilla litoralis	149	
Potentilla rubricaulis	150	98
Primula cuneifolia subsp. *saxifragifolia*	179	
Primula egaliksensis	180	
Puccinellia deschampsioides	36	
Puccinellia interior	37	

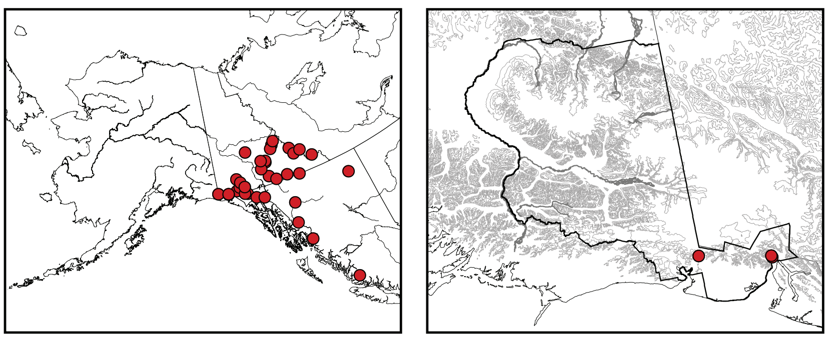
Taxon	Map # 1997	Map # 2003
Puccinellia vahliana	24	80
Ranunculus aquatilis var. *diffusus*	105	
Ranunculus gelidus subsp. *grayi*	101	
Ranunculus pacificus	102	
Ranunculus pedatifidus subsp. *affinis*	103	
Ranunculus sulphureus var. *sulphureus*	104	
Rumex acetosa subsp. *alpestris*	78	
Rumex beringensis	79	84
Rumex salicifolius var. *mexicanus*		85
Ruppia cirrhosa		90
Sagina saginoides	88	
Salix commutata	74	
Salix hookeriana		101
Salix rotundifolia subsp. *dodgeana*	75	
Salix setchelliana	76	102
Salix stolonifera	77	
Sanguisorba officinalis		99
Saussurea angustifolia subsp. *yukonensis*	210	
Saxifraga adscendens subsp. *oregonensis*	141	103
Saxifraga bracteata	142	105
Saxifraga eschscholtzii		106
Saxifraga foliolosa	143	
Saxifraga nelsoniana subsp. *porsildiana*		104
Schoenoplectus tabernaemontani		49
Scutellaria galericulata var. *pubescens*		59
Sedum divergens		31
Selaginella sibirica	1	
Silene involucrata subsp. *involucrata*	89	
Silene menziesii	90	
Silene repens	91	
Silene williamsii	93	
Smelowskia borealis	136	
Smelowskia calycina var. *integrifolia*	137	20
Smelowskia calycina var. *porsildii*	137	21
Sparganium natans	13	
Stellaria alaskana	94	28
Stellaria umbellata	95	29
Stuckenia pectinata	15	
Subularia aquatica	138	19
Swertia perennis	185	
Synthyris borealis	197	
Taraxacum carneocoloratum	211	5
Taraxacum phymatocarpum	212	
Thlaspi arcticum	139	22

Taxon	Map # 1997	Map # 2003
Trichophorum pumilum var. *rollandii*	70	50
Trisetum sibiricum subsp. *litorale*	38	81
Vahlodea atropurpurea subsp. *paramushirensis*	39	
Veronica serpyllifolia subsp. *humifusa*	198	
Viola adunca	163	
Viola biflora	164	
Viola renifolia var *brainerdii*		114
Viola selkirkii	165	115

ASTERACEAE

***Agoseris aurantiaca* (Hook.) Greene, Mountain Dandelion** -- This species was first documented in the park during the 2003 inventory, is known from only three other localities in the state (all of which are in southeast Alaska) and is extremely rare in Alaska (S1) although considered secure globally (G5). The three stations in the park on the coast extend its range 339 km to the west from a collection near Haines (Hultén 1968) and represent the western extent of its North American cordilleran distribution. It is found in the southern Yukon Territory, the southwestern District of Mackenzie, western Alberta, south to New Mexico and California and is disjunct in Quebec (Cody 1996). It occurs in alpine meadows, scree slopes, moist woodland and glacial till.

SOUTHERN ST. ELIAS MOUNTAINS: ► few on scree slope, Upper Tyndall Glacier, 1085 m, 60º 13.07' N 141º 03.21' W, *P. Loomis & A. Larsen 1368*, **20 July 2003**, det. A. Batten (ALA) 2003; ► patchy in shale with sparse vegetation cover, Haenke Glacier, 510 m, 60º 03.14' N 139º 34.38' W, *P. Loomis & A. Batten 1854 (ALA)*, **26 July 2003**, det. A. Batten (ALA) 2003; ► uncommon on unstable scree with moss, Upper Haenke Glacier, 766 m, 60º 04.23' N 139º 35.30' W, *P. Loomis & A. Batten 1844*, **26 July 2003**, det. A. Batten (ALA) 2003.

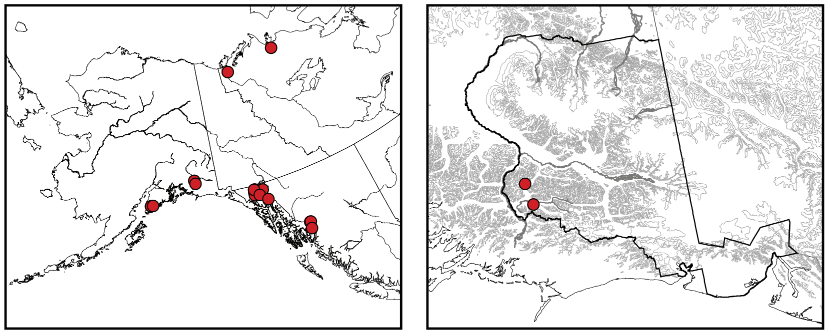


1. *Agoseris aurantiaca*

***Agoseris glauca* (Pursh) Raf., Pale Agoseris** --This North American boreal-montane species is extremely rare in Alaska (S1) where it reaches the western extent of its range, but it is globally secure (G5). The specimens cited below from the Chugach Mountains and lower Copper River basin connect its distribution with one locality 391 km to the west (Seldovia Quad: 59°40.0' N 151°09.0' W, *E. Berg 47*, 11 August 1988 (ALA)) with collections 478 km to the southeast near Skagway (Hultén 1968). It occurs in alpine meadows in Alaska and on mountain slopes, prairies and roadsides in the district of Mackenzie, Northwest Territories, British Columbia, east to southern Manitoba, and south to Minnesota and Arizona.

CHUGACH MOUNTAINS: ► mesic forb tundra, Upper Tebay Lake, 1219 m, 61º12.18' N 144º23.8' W, *M. Duffy 91113*, **12 August 1991**, conf. C. Parker (ALA) 1991.

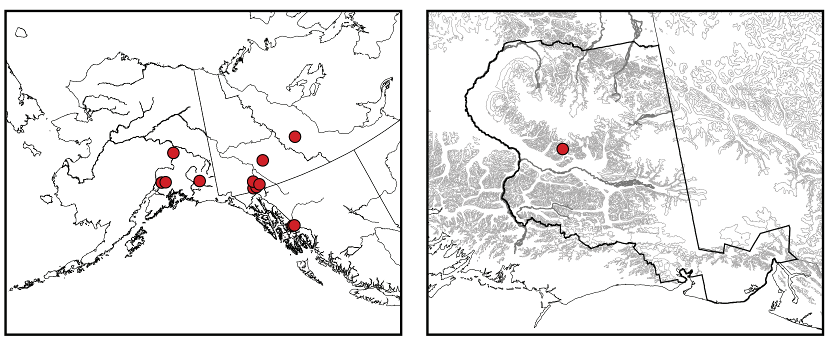
LOWER COPPER RIVER BASIN: meadow near the Bremner River, 396 m, 60º58.98' N 144º17.1' W, *M. Duffy 91146*, **19 August 1991**, conf. C. Parker (ALA) 1991.



2. *Agoseris glauca*

***Arnica mollis* Hook., Hairy Arnica** -- This arnica is known from only five other localities in Alaska and is considered extremely rare in the state (S1) but secure globally (G5). Our collection from the Wrangell Mountains connects its distribution 265 km to the west in the Anchorage Quad (Hatcher Pass, 61°46.0' N 149°18.0' W, *T. Ward 95*, 14 August 1976 (ALA)) with the distribution 445 km to the east in the Yukon Territory (Cody 1996). It is a North American cordilleran species found in moist to mesic meadows and open forests in the lowland to alpine zones. Hairy Arnica is common in southern British Columbia, is less frequent northward to the Yukon Territory, Northwest Territories and Alaska, is found east to Alberta, and south to Utah and California (Douglas et. al. 1998).

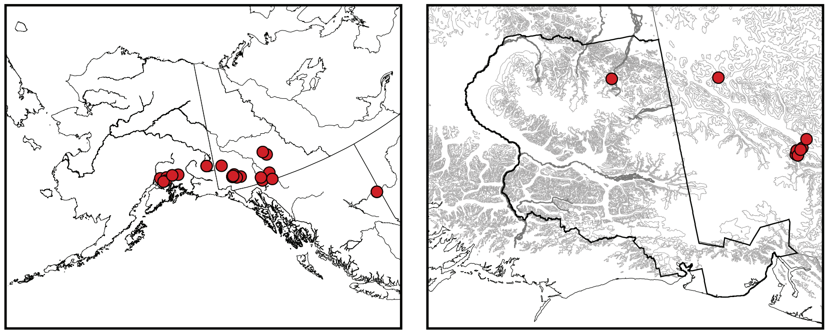
WRANGELL MOUNTAINS: ► forb herbaceous meadow, West Fork Mill Creek, 1241 m, 61º33.33' N 143º28.35' W, *C. Roland 96-659*, **24 July 1996**, conf. C. Parker (ALA) 1997.



3. *Arnica mollis*

***Artemisia dracunculus* L., Dragon Wormwood** – This species is known from only six other localities in Alaska and is rare in the state (S1S2) but considered secure globally (G5). Our collection from the Wrangell Mountains connects its distribution 246 km to the west in the Alaska Range with stations along the Alaska Highway in the Yukon Territory (Hultén 1968, Porsild 1980). Dragon Wormwood is found in North America and Eurasia primarily in prairie and foothill communities. It has a widespread distribution in the western and midwestern states and provinces of North America, and is disjunct in Ontario, New York, Maine, Connecticut and Mexico (Douglas et. al. 1998, Kartesz & Meecham, 1999).

WRANGELL MOUNTAINS: ► localized 15 m square patch of ~40 plants on silty sand drumlin, in and just above balsam poplar stand, Euchre Mountain, 1242 m, 62º 07.03' N 142º 11.15' W, *B. Bennett & P. Loomis 03-727(ALA)*, **19 June 2003**.



4. *Artemisia dracunculus*

Taraxacum carneocoloratum **Nels., Pink Dandelion** -- This Alaska-Yukon endemic with a cordilleran distribution is known from one locality in the Yukon Territory and sixteen localities in Alaska, ten of which are cited below from the park. These collections are 273 km east of a station in the Anchorage Quad (Campbell Lake, 61°07.17' N 149°29.75' W, Lichvar et al. 8082A, 19 July 1994 (ALA)) and 409 km south of the station in the Ogilvie Mountains, Yukon Territory (Murray and Lipkin 1987). Hultén (1973) indicated that this species may be the same as *T. soczavae* Tzvelev, whereas Welsh (1974) considered it to be a variant of *T. eriophorum* Rydberg (Murray and Lipkin 1987).

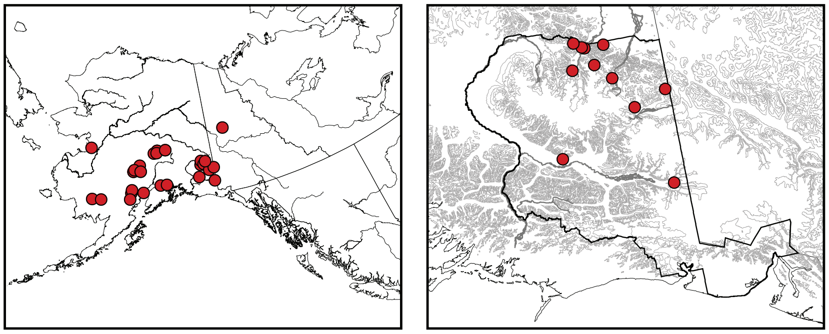
MENTASTA MOUNTAINS: ► rare on N-facing facing scree slope in Nikolai Greenstone and limestone units, Soda Lake, 1173 m, 62º32.36' N 142º53.98' W, *M. Cook 94301*, **21 July 1994**, conf. C. Parker (ALA) 1996; ► few in reddish gravel scree, SE-facing slope above Totschunda Creek, 1494 m, 62º28.28' N 142º40.5' W, *K. Shea 96287*, **7 July 1996**; ►ridge above Totschunda Creek, few 5 m below ridge in sparsely vegetated orange gravel scree, 1451 m, 62º29.02' N 142º43.94' W, *M. Cook 96293*, **7 July 1996**.

NORTHERN ST. ELIAS MOUNTAINS: ► Mt. Chitina, rare in steep, loose scree at contact between limestone and darker metamorphic rock, 2073 m, 60º57.74' N 141º17.33' W, *C. Roland 95-224*, **16 July 1995**, conf. C. Parker (ALA) 1996.

NORTHERN WRANGELL FOOTHILLS: ► alpine scree slope, Lime Creek, 1935 m, 61º47.35' N 141º49.06' W, *Duffy & Cook 92106*, **8 August 1992**, det. D.F. Murray (ALA) 1992; ► mesic rubble slope, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *Moran & Roland 95-45*, **8 August 1995**, conf. C. Parker (ALA) 1995.

NUTZOTIN MOUNTAINS: ► ridge 1.6 km W of Ptarmigan & Rocker Creek confluence, alpine tundra and rock slope, 1615 m, 61º54.81' N 141º5.51' W, *M. Duffy 92187*, **9 July 1992**, conf. C. Parker (ALA) 1995; ► rare in moist orange colored clay soil between gravel and thin bedded talus shale on N-facing slope, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *M. Cook 94357*, **24 July 1994**; ► ridge at headwaters of Alder Creek, occasional on S-facing boulder and rubble slopes, 1554 m, 62º28.44' N 142º15.06' W, *K.A. Beck 95-216*, **29 June 1995**; ► rare in sage brush scrub on drumlin ridge, Euchre Mountain, 1219 m, 62º 07.25' N 142º 11.18' W, *B. Bennett & P. Loomis* 03-801, **20 June 2003**.

SOUTHERN WRANGELL FOOTHILLS: ► rare in rocks and gravel on ridgeline, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *C. Roland 95-242*, **18 July 1995**, conf. C. Parker (ALA) 1996.



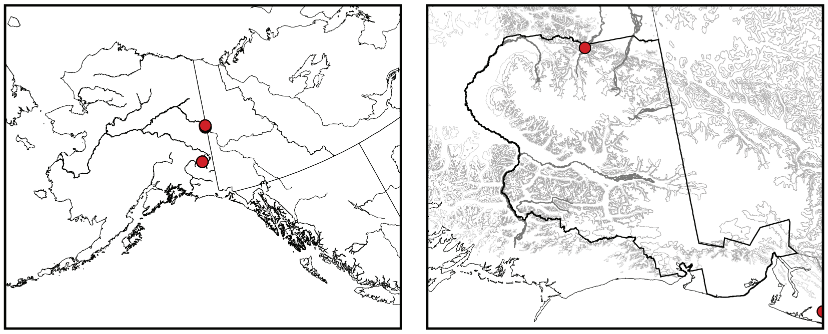
5. *Taraxacum carneocoloratum*

BORAGINACEAE

Cryptantha shackletteana **L.C. Higgins (=*Cryptantha spiculifera* (Piper) Payson), Shacklett's Catseye** -- This Alaska endemic is known from only three localities worldwide, all in Alaska: Calico and Eagle Bluffs along the Yukon River and our collections from the Nabesna River valley, 280 km to the south. *Cryptantha shackletteana* is on the AKNHP rare plant list (Lipkin and Murray 1997) with a rank of G1Q S1. Our collections are significant because they: (1) extend the distribution of this species into the Alaska Range, (2) broaden our concept of its ecological amplitude into the alpine zone, and (3) indicate that this plant was formerly more widespread (Roland and Cook 1998).

The taxonomic validity of *Cryptantha shackletteana* at the species level is unclear (Hultén 1968, Batten et al. 1979). It has been considered a vicariant of *Cryptantha spiculifera* (Payson) Piper, a species common over 2000 km to the south in the Great Basin states (Higgins 1969; Cronquist et. al. 1984). We examined specimens from the three Alaskan localities as well as a series of specimens of *C. spiculifera* from the Great Basin and observed consistent differences between plants from the two areas in the density and location of pustulate hairs on the leaves as was noted by Higgins (1969). Until further genetic and morphological studies can be completed, we agree with previous authors in accepting Higgins' (1969) treatment.

MENTASTA MOUNTAINS: ► scattered in red calcareous gravel on southeast to southwest-facing slopes, Totschunda Creek, 1280 m, 62º27.63' N 142º12.44' W, *C. Roland 96-284, 96-295 (ALA)* **24 June 1996;** ► barren calcareous gravel slopes above Totschunda Creek, 1494 m, 62º28.04' N 142º40.07' W, *C. Roland 96-369 (ALA)* **4 July 1996**.



6. *Cryptantha shackletteana*

BRASSICACEAE

***Aphragmus eschscholtzianus* Andrz., Aleutian Cress** -- This Alaska-Yukon endemic with a Pacific coastal distribution was known previously from only two localities in the park: Chitistone Pass (61º37' N 141º58' W, *D. F. Murray 1041* (CAN) (Murray 1968)) and Bonanza Ridge (61º30' N 142º51' W, *Nordell & Schmitt 163* (LD & ALA) (Nordell and Schmitt 1978)). As indicated by the below collections, this species is now known from throughout the mountain ranges in the park where it is locally common in alpine mesic sites. It is globally rare (G3) and rare within the state (S3). Collections from the western Wrangells and the Mentasta Mountains are up to 150 km distant from prior park collections, and the closest station to the specimens cited above is 78 km to the southwest at Thompson Pass (Valdez Quad: 61°08.0' N 145°45.0' W, *C.L. Parker 2415*, 22 July 1990 (ALA)).

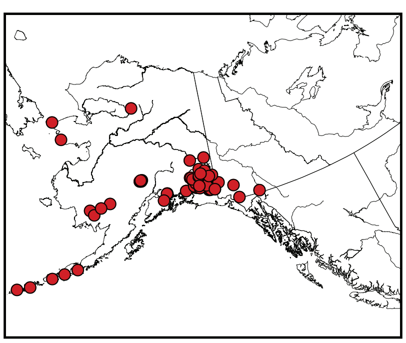
MENTASTA MOUNTAINS: ► occasional in mesic alpine tundra, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95161*, **7 July 1995**.

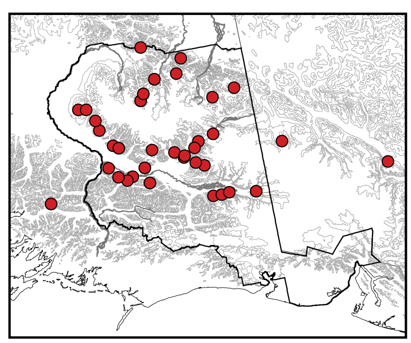
NORTHERN CHUGACH MOUNTAINS: ► moist sandy runnels on NE- facing stony slope, Verde Ridge, 1554 m, 61°14.03' N 143º28.52' W, *Roland & D'Auria* 96-471, 96-481, **10 July 1996**; ► occasional in moist calcareous gravel, Granite Creek, 1829 m, 61º0.22' N 141º51.1' W, *C. Roland* 96-739, **28 July 1996**; ► moist boulder solifluction slope, West Fork Goat Creek, 1487 m, 60º59.5' N 142º1' W, *Batten & Barker* 96-305, **29 July 1996**; ► scattered in granite gravel on ridge, East Fork Kiagna River, 1487 m, 60º59.8' N 142º11.8' W, M. Cook 96652, **31 July 1996**; ► few in wet mineral soil, Nelson Mountain, 1558 m, 61º19.37' N 143º48.83' W, *M. Cook* 96371, **7 July 1996**; ► few amongst unstable shale-gravel, Grant Creek plateau, 1250 m, 61º17.65' N 143º56.34' W, *M. Cook* 96410, **7 July 1996**; ► occasional in gravel stringers Bridge Creek plateau, 1871 m, 61º20.41' N 144º6.97' W, *M. Cook* 96492, **7 July 1996**; ► common in mesic tundra, Nerelna Creek plateau, 1372 m, 61º26.66' N 144º17.69' W, *Roland & D'Auria* 96-402, **8 July 1996**.

NUTZOTIN MOUNTAINS: ► scattered in wet moss and bare organic soil, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, M. Cook 94345, **24 July 1994**; ► moist bare mineral soil on NE-facing boulder slope, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *M. Cook* 95015, **15 June 1995**; ► occasional in wet mossy seep, volcanic plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, C. Roland 95-050, **18 June 1995**; ► wet moss seep, Antler Creek, 1585 m, 62º25.78' N 142º22.11' W, K.A. Beck 95-200, **27 June 1995**.

NORTHERN ST. ELIAS MOUNTAINS: ► rare in moist bare organic soil of solifluction lobes, limestone ridge between Dan & Copper Creeks, 1554 m, 61º21.56' N 142º26.43' W, M. Cook 94292, **14 July 1994**; ► scattered in wet seep, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, M. Cook 95225, **14 July 1995**; ► scattered in alpine herb community, head of Canyon Creek, 1637 m, 61º19.12' N 142º16.01' W, M. Cook & J. Eklund 4892, **19 July 2003**.

WRANGELL MOUNTAINS: ► alpine basin, northwest flank of Mt. Drum, 1615 m, 62º4.5' N 144º45.91' W, C.R. Meyers 84-29, **4 July 1984**; conf. C. Parker (ALA) 1991; ► sedge tundra frost boil, Cheshnina Plateau, 1640 m, 61º50.33' N 144º22.5' W, M. Duffy 91088, **21 July 1991**; ► common in mesic situations, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, C. Roland 94-306, M. Cook 94362, **25 July 1994**; ► occasional in bare sandy gravel, Chetaslina Plateau, 1615 m, 61º56.51' N 144º25.93' W, M. Cook 94475, **15 August 1994**; ► common in stony streambed, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, C. Roland 95-107, **30 June 1995**; ► common in seeps and snowbed areas, Jaegar Mesa, 1892 m, C. Roland and V. Moran 95-27, **6 June 1995**, conf. C. Parker (ALA) 1996; ► patchy in wet moss, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, M. Cook 95263, **17 July 1995**, C. Roland 95-243, **18 July 1995**; ► alluvial fan of seep, streambed & sorted rocks, Lakes Plateau, 1890 m, 62º4.4' N 143º23.5' W, A. Leggett 95-092, 95-091, 95-079, 95-085, 95-103, **28 & 30 July 1995**; ► scattered in loose, moist limestone gravel on N-facing slopes, Iron Mountain, 1868 m, 61º37.85' N 144º1.01' W, C. Roland 96-578, M. Cook 96455, **16 July 1996**; ► scattered in clay soil on east facing slope, Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, C. Roland 96-649A, **23 July 1996**; ► moist muddy scree, Nikolai Mine, 1695 m, 61º27' N 142º39' W, Batten & Barker 96-095, **27 July 1996** (ALA); rare in snowbed areas, upper Dadina River, 1646 m, 62º3.88' N 144º35.76' W, C. Roland 96-371, **5 July 1996**; ► occasional in protected chute, limestone ridge southwest of Alice Peak, 1628 m, 61º39.82' N 144º7.76' W, C. Roland 96-388, **5 July 1996**; ► occasional in mesic volcanic gravel stringers, Hasen Creek, 1835 m, 61º34.06' N 142º18.33' W, M. Cook 96494, **7 July 1996**; ► occasional in moss on limestone outcrops, Lakina Glacier, 1219 m, 61º33.64' N 143º19.01' W, M. Cook 96538, **7 July 1996**; ► moist silt adjacent to creek, Nikolai Pass, 1280 m, 61º26' N 142º40' W, Batten & Barker 96-045, **7 July 1996** (ALA).



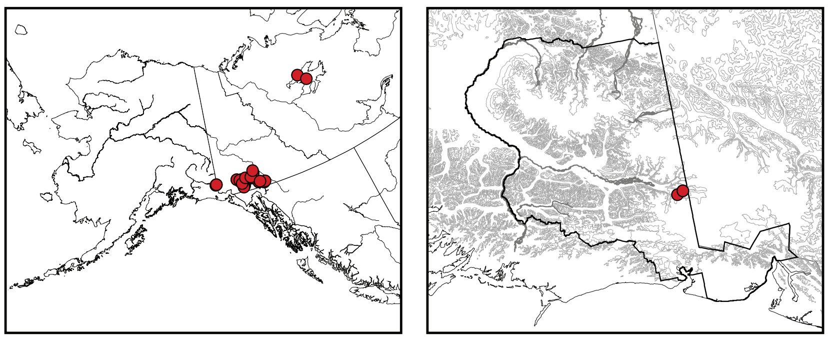


7. *Aphragmus eschscholtzianus*

***Arabis calderi* G. A. Mulligan (=*Arabis lyallii* sensu Hultén (1968) pro parte), Calder's Rockcress** -- This rockress was new to the flora of Alaska in 1996 and is extremely rare in the state (S1) known only from our two collections. The 2003

collection is only 8 km south of the 1996 collection (across the Logan Glacier) and is the western extent of its distribution. The closest station is 172 km to the east in the Yukon Territory (Cody 1996). The distribution of Calder's Rockcress to the south and east of the Yukon Territory is spotty, ranging from Great Bear Lake of the Mackenzie District in the Northwest Territories (1108 km distant), to the southwest corner of Alberta and British Columbia (1654 km distant), south to Washington, California and Montana (Mulligan 1995, Cody 1996). It has a global rank of G3G4. It is found in grassy clearings, meadows and openings in thickets in sub-alpine and alpine communities.

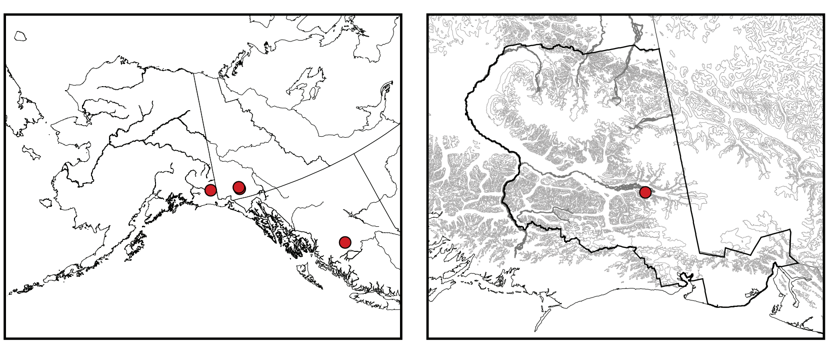
NORTHERN ST. ELIAS MOUNTAINS: ► scattered in meadow adjacent to sheep trail and in open soil on S-facing slopes, ridge between Logan and Walsh Glaciers, 1951 m, 60º53.94' N 141º6.75' W, *C. Roland 95-169, M. Cook 95215*, **12 & 13 July 1995**, det. G.A. Mulligan (DAO) 1996; ► rare in open low willow scrub on S-facing bluff, ridge at confluence of Baldwin Glacier with Logan Glacier, 1259 m, 60º52.23' N 141º14.50' W, *M. Cook & J. Eklund 4857 (ALA)*, **17 July 2004**, conf. C. Parker (ALA) 2003.



8. *Arabis calderi*

***Arabis codyi* G.A. Mulligan, Cody's Rockcress** -- This Rockcress is new to the flora of Alaska and is known from only two other localities worldwide: the holotype 230 km to the east in the St. Elias Mountains, Yukon Territory (*D.F. & B. Murray 72*, 1 July 1965 (DAO)) and a specimen from British Columbia 1174 km to the southeast (Perow, 54 30'N, 126 26'W, *Taylor & Levis 468* (UBC) (Mulligan, 1995)). It is rare throughout its range (G1G2 S1) and is found on unstable alpine scree slopes.

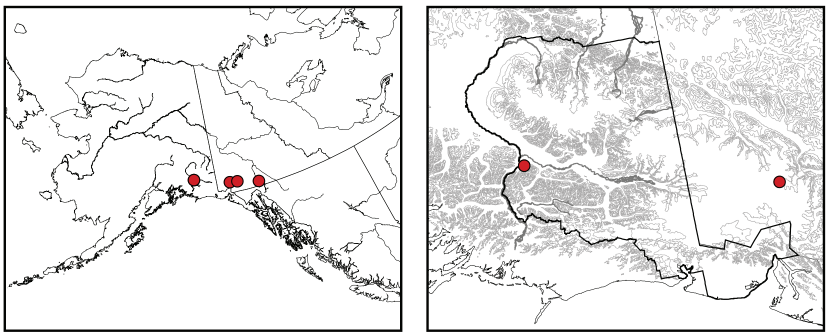
CHUGACH MOUNTAINS: ► rare on W-facing unstable limestone scree slope, Granite Range, 1798 m, 61º1' N 141º53.18' W, *M. Cook 94441*, **5 August 1994**, det. G.A. Mulligan (DAO) 1997.



9. *Arabis codyi*

***Arabis drepanoloba* Greene (=*Arabis lemmonii* S. Wats. var. *drepanoloba* (E.L. Greene) Rollins), Rockcress** -- This rockcress is also new to the flora of Alaska and considered extremely rare in the state (S1) although globally it is considered secure (G5). Our collection, 290 km east of a station in the Yukon Territory represents the western limit of its distribution (Cody, 1996). The Alaska-Yukon populations are disjunct from its main range in southeast British Columbia, Alberta, Colorado, Wyoming and Montana (Cody 1996, Mulligan 1995). *A. drepanoloba* is found on talus slopes, rock fields, ridge crests and outwash gravels in the high mountains.

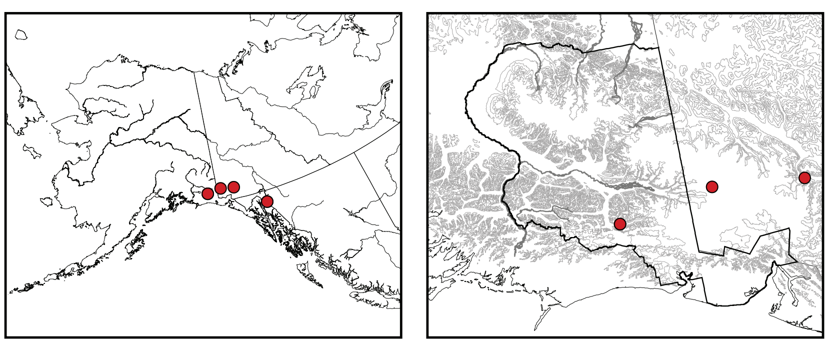
CHUGACH MOUNTAINS: ► few in gravel scree between limestone outcrops, ridge above Canyon Creek, 1682 m, 61º24.28' N 144º21.61' W, *M. Cook & M. Losso 96325 (ALA)* **7 July 1996**, conf. G.A. Mulligan (DAO) 1998.



10. *Arabis drepanoloba*

***Arabis lemmonii* S. Wats., Lemmon's Rockcress** -- This species is new to the flora of Alaska where it is considered extremely rare (S1) although secure globally (G5). Our collection delineates the western limit of this North America cordilleran species. The closest collection is 116 km to the east near Kluane Lake (Cody 1996). These stations are disjunct from the species' main range in southwestern Alberta, southern British Columbia, Montana, Idaho, Washington, Wyoming, Colorado, Utah, Nevada, Oregon and California (Mulligan 1995). It is found on rocky ridges, rock fields and outwash gravels in the high mountains.

CHUGACH MOUNTAINS: ► mesic shrub birch-ericaceous scrub on glacial moraine, Granite Creek, Granite Range, 701 m, 60º43.78' N 142º31.4' W, *M. Duffy & J. Barnes 96-064 (ALA)* **8 August 1996**, conf. G.A. Mulligan (DAO) 1998.

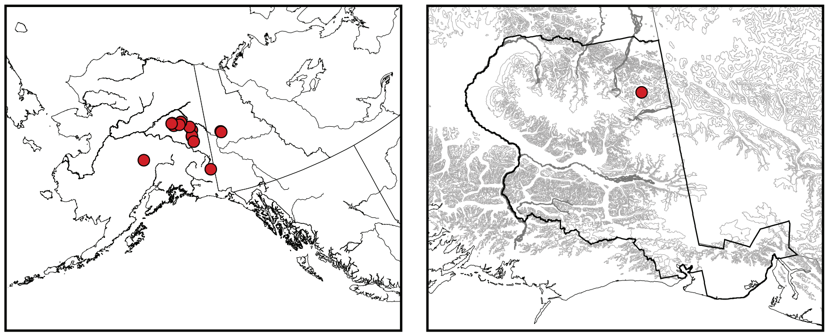


11. *Arabis lemmonii.*

***Draba densifolia* Nutt. ex Torrey & A. Gray, Denseleaf Whitlowgrass** -- This North American cordilleran mustard is disjunct in Alaska and the Yukon from southern

British Columbia, California, Oregon, Idaho, Montana, Wyoming and Utah. Our collection from the Nutzotin Mountains is one of thirteen localities in Alaska. The closest station is 266 km to the north in Yukon-Charley National Preserve. It is considered extremely rare in the state (S1), but is globally secure (G5). It is found on scree slopes, stony exposed ridges, talus, disintegrating rhyolite, granitic sand and gravel, chip-rock, shaded rock crevices and rocky knolls (Mulligan 1976, Rollins 1993).

NUTZOTIN MOUNTAINS: ► rockfield, Ophir Creek, 1966 m, 61°56.1' N 141°35.68' W, *M. Duffy 92172*, **8 July 1992**, det. C. Parker (ALA) 1992.



12. *Draba densifolia*

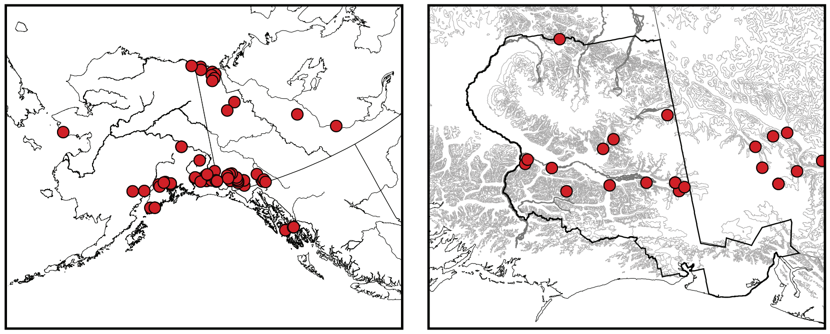
Draba incerta **Payson, Yellowstone Whitlowgrass** -- This North American cordilleran mustard is rare in Alaska (S2S3) but considered globally secure. Our collections connect its range 204 km to the west in the Anchorage Quad (Mi 119 Seward Highway, 61°07.0' N 149°52.0' W, *C. L. Parker 6953*, 20 May 1997 (ALA)) with its distribution 88 km to the east in the Yukon Territory (Cody 1996).

CHUGACH MOUNTAINS: ► graminoid forb herbaceous meadow, Iron Creek, 1798 m, 61º1' N 141º53.18' W, *M. Cook 94442*, **5 August 1994**; ► rare in old slide debris, Amy Creek, 1164 m, 61º4.01' N 143º34.83' W, *C. Roland 96-531*, **13 July 1996**; ► few in unstable limestone scree, Canyon Creek, 1682 m, 61º24.28' N 144º21.61' W, *Cook & Losso 96326*, **7 July 1996**; few in bare mineral soil, Nelson Mountain, 1558 m, 61º19.37' N 143º48.83' W, *M. Cook 96377*, **7 July 1996**; ► scattered in granitic rubble on S-facing slope, Nerelna Creek Plateau, 1372 m, 61º26.66' N 144º17.69' W, *Roland & D'Auria 96-410*, **8 July 1996**; ► rock outcrops, Towhead Mountain, 1433 m, 61º3.21' N 142º39.8' W, *Duffy & Barnes 96-156*, **8 August 1996**.

MENTASTA MOUNTAINS: ► *Dryas*-rock tundra, Lost Basin, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95170*, **7 July 1995**.

ST. ELIAS MOUNTAINS: ► rare in mesic area on small rock outcrop, ridge between Logan and Walsh Glaciers, 1951 m, 60º53.94' N 141º6.75' W, *C. Roland 95-159*, **12 July 1995**; ► rock crevices of S-facing outcrop, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *M. Cook 95235*, *C. Roland 95-201*, *95-202*, *95-206*, **15 July 1995**; ► N-facing scree, Nikolai Pass, 1280 m, 61º26' N 142º40' W, *Batten & Barker 96-016B*, 23 July 1996.

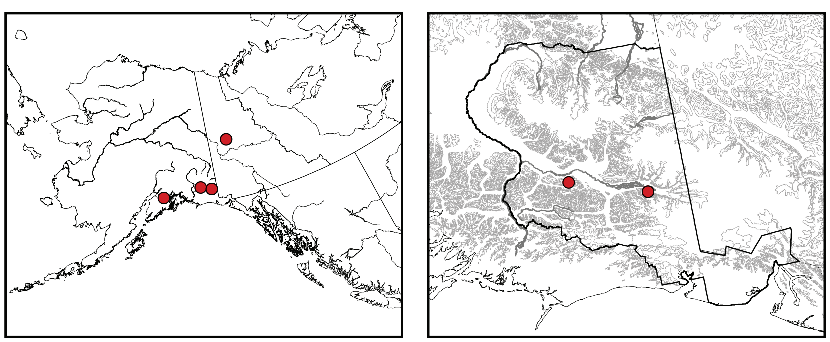
WRANGELL MOUNTAINS: ► scattered on barren slope, Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, *C. Roland 96-651*, 23 July 1996.



13. *Draba incerta*

***Draba kananaskis* G.A. Mulligan (=*Draba longipes* Raup), Longstalk Whitlowgrass** -- This North American cordilleran mustard is known from the east slopes of the Kananaskis Range in southern Alberta (Mulligan 1970), the Yukon Territory (Fish Creek, 64°18.0' N 138°00.0' W, *W. J. Cody & J. H. Ginns 33149*, 4 July 1984 (ALA)) the vicinity of Hope on the Kenai Peninsula (Hultén 1968) and the two localities cited below from the Chugach Mountains which are 318 km east of the Kenai Peninsula locality and 439 km south of the Yukon Territory locality. *D. kananaskis* is on the AKNHP rare plant list (Lipkin and Murray 1997) with a state rank of S1 and is considered rare throughout its range (G1Q) in Alberta and the Yukon Territory. The taxonomic validity of this taxon is questionable. Rollins (1993) treats it as a synonym within *D. longipes* Raup whereas Mulligan (1970) distinguishes it from *D. longipes* by its yellow flower color and short stalked leaf hairs. *D. kananskis* is found on rocky alpine slopes, ledges, shale and limestone talus (Rollins 1993).

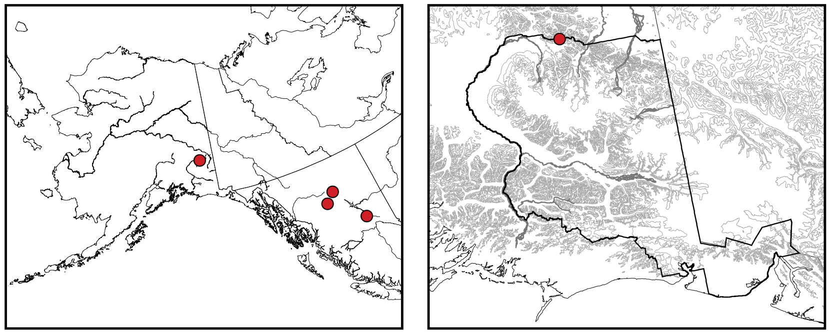
CHUGACH MOUNTAINS: ►scattered in seeps on E-facing slope, Verde Ridge, 1554 m, 61º14.03' N 143º28.52' W, *C. Roland & J. D'Auria 96-479*, **11 July 1996**, determined by G.A. Mulligan (DAO) 1996; ►occasional in moist calcareous gravel, Granite Creek, 1829 m, 61º0.22' N 141º51.1' W, *C. Roland 96-740*, *96-741A*, **28 July 1996**, det. G.A. Mulligan (DAO) 1996.



14. *Draba kananaskis*

***Draba lonchocarpa* Rydb. var. *thompsonii* (C.L. Hitchc.) Rollins, Lance-Pod Whitlowgrass** – Our collection of this Whitlowgrass documents the northern and western limit of the range of this North American cordilleran mustard, the only known locality of this variety in Alaska. It has a state rank of S1 and a global rank of G4T3T4. It is 1100 km disjunct from the mountains of British Columbia and western Washington where it is found on alpine ledges and rocky slopes (Rollins 1993 and Mulligan 1974).

Mentasta Mountains: ► scattered at base of scree slope below limestone ridge, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95184*, **11 July 1995**, det. G.A. Mulligan (DAO) **1996**.



15. *Draba lonchocarpa var. thompsonii*

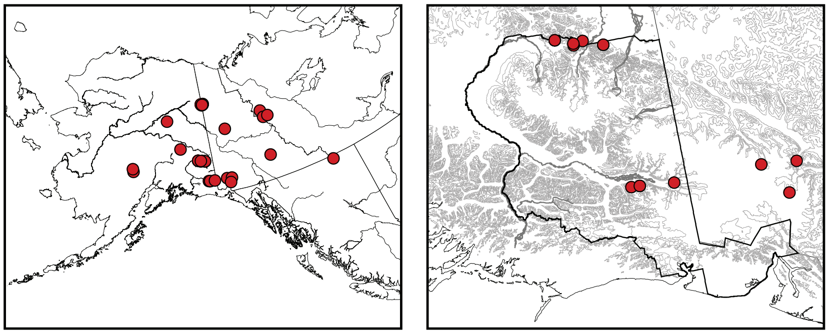
***Draba porsildii* G. A. Mulligan, Porsild's Whitlowgrass** -- The seven localities in the Chugach, Mentasta, Northern St. Elias and Nutzotin Mountains cited below are the only other stations in Alaska besides those in the Black River Quad 458 km to the north (66°35.0' N 141°10.0' W, *R. Lipkin 91-46*, 10 June 1991; 66°36.0' N 141°11.0', *R. Lipkin 91-96*, 11 June 1991; 66°36.0' N 141°11.0' W, *R. Lipkin 91-141*, 14 June 1991; 66°32.0' N 141°04.0' W, *R. Lipkin 91-153*, 15 June 1991 (ALA)). Our collections are 101 km west of stations in the Yukon Territory (Cody 1996). *D. porsildii* is rare in Alaska (S1S2) and throughout its range (G3). It is a North American cordilleran endemic known from Colorado (S1), Montana (S1), Wyoming (S2), Alberta (S2), British Columbia (S2S3), Northwest Territories and Yukon Territories. It is found on alpine scree, gravel and open shale slopes and in meadows.

Chugach Mountains: ► scree, Goat Creek, Granite Range, 1487 m, 60º59.5' N 142º1' W, *A.R. Batten & M. Barker 96-327B*, **29 July 1996** (ALA), det. by G. A. Mulligan (DAO); ► few in granite gravel, ridge above W. Fork Goat Creek, 1487 m, 60º59.8' N 142º11.8' W, *M. Cook 96661*, **31 July 1996**, conf. G.A. Mulligan (DAO) 1997.

Mentasta Mountains: ► rare in bare mineral soil on S-facing talus slope, Soda Lake, 1173 m, 62º32.36' N 142º53.98' W, *M. Cook 94312B*, **22 July 1994**, det. by G.A. Mulligan (DAO) 1995; ► occasional in gravel areas on limestone outcrop, Trail Creek, 1615 m, 62º36.05' N 143º17.63' W, *C. Roland 95-004, 95-015*, **6 & 7 June 1995** (ALA) determined by C. Parker (ALA) 1997, conf. G.A. Mulligan (DAO)) 1995; ► upper Trail Creek, 1341 m, 62º37.09' N 143º16.06' W, *M. Potkin 95-037A*, **27 July 1995**, det. G.A. Mulligan (DAO) 1996; ► scattered in limestone gravel, Soda Lake ridge, 1494 m, 62º31.2' N 142º54.03' W, *C. Roland 95-144 (ALA)* **7 July 1995** (ALA), conf. G.A. Mulligan (DAO) 1997.

Northern St. Elias Mountains: ► rare in disturbed area, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *C. Roland 95-203*, **15 July 1995**, det. G.A. Mulligan (DAO) 1998.

Nutzotin Mountains: ► few in bare mineral soil, ridge at headwaters of Alder Creek, 1554 m, 62º28.44' N 142º15.06' W, *M. Cook 95131 (ALA)* **26 June 1997** det. C. Parker (ALA) 1997, conf. G.A. Mulligan (DAO) 1997.

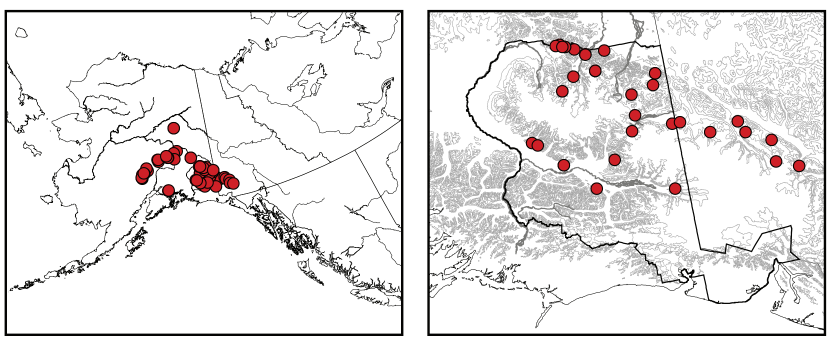


16. *Draba porsildii*

Draba ruaxes **Payson & H. (*D. exalata* Ekman, *D. ventosa* A.Gray var. *ruaxes* (Payson & H. St. John)), Rainier Whitlowgrass –** This mustard was known from two localities in the Wrangell Mountains prior to our inventory: Guerin Glacier (61º 36.82' 141º 4.98', *D. F. Murray 2103*, 4 August 1968 (ALA) (Murray 1971)) and Chitistone Pass (61º37' N 141º58' W, *D. F. Murray 865, 1218, 1343, 1541, 1817* (CAN)). Our collections throughout the mountain ranges in the park connect its distribution in the Alaska Range 107 km to the northwest (Mt. Hayes Quad: Rainbow Mountain, 63°20.0' N 145°35.0' W, *G. Smith 2604*, 7 July 1955 (ALA)) with stations 40 km to the east in the St. Elias Mountains, Yukon Territory (Cody 1996). This North America cordilleran species is rare in Alaska (GS S3) and in the Yukon Territory (Douglas et al. 1981).

CHUGACH MOUNTAINS: ► rare in gravel scree, serpentinized ultramafic unit, Granitic Creek ridge, 1768 m, 61º6.19' N 142º55.03' W, *M. Cook 94220*, **8 July 1994,** conf. C. Parker (ALA) 1995. **MENTASTA MOUNTAINS**: ► rare in moist bare soil on ledge between limestone gravel scree, Soda Lake, 1173 m, 62º32.36' N 142º53.98' W, *M. Cook 94311A*, **21 July 1994**, det. G.A. Mulligan (DAO) 1998; ► occasional on barren gravel scree, Lost Creek, 1646 m, 62º34.58' N 143º5.58' W, *M. Cook 94331*, **23 July 1994**, conf. C. Parker (ALA) 1995; ► scattered in runnels of fine limestone scree near ridge, Trail Creek, 1615 m, 62º36.05' N 143º17.63' W, *C. Roland 95-009*, **6 June 1995**, conf. C. Parker (ALA) 1996; ► occasional in moss between limestone rubble on N-facing slope, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *K.A. Beck 95-225*, *95-231*, *95-241*, *M. Cook 95175*, *95185*, **7 July 1995** conf. C. Parker (ALA) 1996; ► common in fine, red calcareous gravel on E-facing slope slopes above Totschunda Creek, 1280 m, 62º27.63' N 142º12.44' W, *C. Roland 96-289*, **24 June 1996**; few in basalt scree, ridge N of Totschunda Creek mouth, 1494 m, 62º28.28' N 142º40.5' W, *Cook & Shea 96285*, **7 July 1996**; ► scattered in unconsolidated limestone and greenstone rubble, Lost Creek, 1189 m, 62º35' N 143º9.1' W, *Roland & D'Auria 97-055*, **26 June 1997**. **NUTZOTIN MOUNTAINS**: gravel soil on ridgetop, Copper Pass, 1943 m, 62º17.16' N 142º31.44' W, *J. Bolivar 84-71*, **28 June 1984**, det. D.F. Murray (ALA) 1992; ► occasional in sterile limestone scree, Baultoff Creek, 1707 m, 62º9.13' N 141º14.51' W, *C. Roland 94-144A*, **27 June 1994** conf. C. Parker (ALA) 1995; ► scattered in exposed NW-facing area of ridge, Baultoff Creek, 1707 m, 62º9.13' N 141º14.51' W, *C. Roland 94-161*, **28 June 1994**; ► scattered on limestone ridge in bare mineral soil, Copper Pass, 1942 m, 62º17.16' N 142º31.44' W, *M. Cook 94344*, **24 July 1994** conf. C. Parker (ALA) 1995; ► scattered on ridge in *Rhacomitrium*, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *M. Cook 95018*, **15 June 1995** conf. C. Parker (ALA)

1995; ► scattered in volcanic rubble, plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, *M. Cook 95086*, **21 June 1995** conf. C. Parker (ALA) 1996; ► occasional on steep N-facing slope in fine scree, ridge at headwaters of Alder Creek, 1554 m, 62º28.44' N 142º15.06' W, *K.A. Beck 95-215*, **30 June 1995**, conf. C. Parker (ALA) 1996. **ST. ELIAS MOUNTAINS**: ► scattered in steep limestone gravel, butte between Dan and Copper Creeks, 1554 m, 61º21.56' N 142º26.43' W, *C. Roland 94-230B*, **14 July 1994,** conf. C. Parker (ALA) 1996; ► scattered on S-facing rock slope Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *M. Cook 95231*, **14 July 1995**, conf. C. Parker (ALA) 1996. **WRANGELL MOUNTAINS**: ► N-facing limestone talus slope, Lime Creek, 1646 m, 61º46.25' N 141º50.36' W, *M. Cook 94118*, **21 June 1994** conf. C. Parker (ALA) 1995; scattered in frost shattered rocks on limestone ridge, Copper Pass, 1942 m, 62º17.16' N 142º31.44' W, *C. Roland 94-283*, **24 July 1994** conf. C. Parker (ALA) 1995; ► occasional in moist organic soil between basalt tuff fragments, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94371*, **25 July 1994**, conf. C. Parker (ALA) 1996; ► common in stony areas, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *C. Roland 94-311*, **26 July 1994** conf. C. Parker (ALA) 1995; ► scattered in moss on stony slopes, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *Moran & Roland 95-27*, **30 June 1995** conf. C. Parker (ALA) 1996; ► rare in moss-lichen dwarf willow tundra, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *M. Cook 95273, C. Roland 95-245A*, **18 July 1995** conf. C. Parker (ALA) 1996; ► scattered in barren calcareous gravel, Iron Mountain, 1868 m, 61º37.85' N 144º1.01' W, *C. Roland 96-568*, **16 July 1996**; ► occasional in gravel and rubble on SE-facing limestone slopes, southwest of Alice Peak, 1628 m, 61º39.82' N 144º7.76' W, *C. Roland 96-387*, **5 July 1996**.



17. *Draba ruaxes*

***Draba stenopetala* Trautv., Anadyr Whitlowgrass** -- This amphiberingean arctic-alpine species, unknown previously from the park, is now known from 25 localities in the Western and northern Wrangells, Mentasta and Nutzotin Mountains. Our collections connect its distribution in the Alaska Range 147 km to the northwest (Hultén 1968) with the distribution in the Yukon Territory 105 km to the east (Cody 1996). The number of localities in the Western Wrangell Mountains may indicate that there was a local refugium from which these populations are derived. Hamilton and Thorson (1983) have suggested that the mountain slopes adjacent to Lake Ahtna in the Copper River basin could have been ice free at the end of the Wisconsin glaciation. Likewise, the populations in the Mentasta and Nutzotin Mountains, being close to the ice-free corridor, may represent areas source areas. This mustard is considered rare in Alaska (G3 S3S4) and in the Yukon Territory (Douglas et al. 1981).

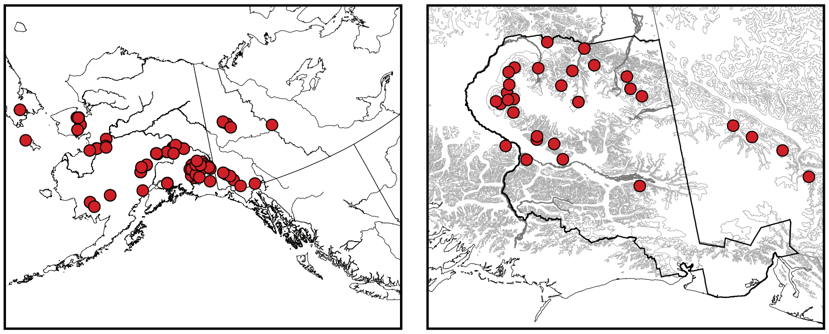
CHUGACH MOUNTAINS: ► occasional on talus slope and *Dryas* tundra, Hundell Creek, 1585 m, 61º36.75' N 144º42.2' W, *M. Cook 93466*, **28 August 1993**; ► rocky tundra knoll on ridge crest, vic. East Fork Kiagna River, Granite Range, 1487 m, 60º59.5' N 142º1' W, *Batten & Barker 96-278*, **29 July 1996**; ► occasional in gravel patches, Nerelna Creek plateau, 1372 m, 61º26.66' N 144º17.69' W, *M. Cook 96307*, **8 July 1996**.

MENTASTA MOUNTAINS: ► scattered in red gravel scree, SE-facing slope above Totschunda Creek, 1494 m, 62º28.28' N 142º40.5' W, *Cook & Shea 96286*, **3 July 1996**; ► common in gravel on orange-colored rubble slope, Caribou Creek, 1158 m, 62º35.7' N 143º27.87' W, *Roland & D'Auria 97-017*, **26 June 1997**.

NUTZOTIN MOUNTAINS: ► NW-facing steep, exposed talus slope, Gold Hill, 1585 m, 62º6.73' N 141º51.82' W, *M. Cook 9270*, **27 June 1992**; ► *Dryas* tundra ridge between Fogenbera Pass & Shotgold Creek, 1783 m, 61º53.28' N 141º37.1' W, *M. Cook 92457*, **8 July 1992**; ► occasional on S-facing slope in *Dryas-Rhacomitrium* tundra, volcanic plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, *M. Cook 95058*, **18 June 1995**; ► rare in gravel of dry *Salix*-lichen tundra, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *C. Roland 94-290*, **24 July 1994**, conf. C. Parker (ALA) 1995.

WRANGELL MOUNTAINS: ► alpine fellfield, on ridgetop east of Mt. Drum, 1768 m, 62º4.5' N 144º22.8' W, *K.A. Teare 1683*, **4 July 1984**, C. Parker (ALA) 1991; ► alpine tundra, slope above Nabesna Glacier moraine, 1768 m, 61º56.6' N 143º W, *M. Duffy 92113*, *M. Cook 9262*, 26 **June 1992,** conf. C. Parker (ALA) 1995; ► *Dryas*-sedge tundra, NW slope Mt. Sanford, 1295 m, 62º21.17' N 144º24.52' W, *M. Cook 93109*, **9 June 1993**; ► rare on E-facing gravel slope, northeast slope of Mt. Drum, 1433 m, 62º8.83' N 144º30.18' W, *Cook & Roland 94054A*, **11 June 1994**, conf. C. Parker (ALA) 1995; ► scattered on stony alluvium of cinder cone, N slope Mt. Sanford, 1722 m, 62º23.4' N 144º15.9' W, *C. Roland 94-004*, **6 June 1994,** conf. C. Parker (ALA) 1995; ► scattered on steep S-facing rubble, W slope Mt. Sanford, 1615 m, 62º13.59' N 144º26.06' W, *C. Roland 94-042*, **9 June 1994**, conf. C. Parker (ALA) 1995; ► scattered clumps on basalt tuff, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94393*, **26 July 1994,** conf. C. Parker (ALA) 1995; ► rare in bare mineral soil, Chetaslina plateau, 1615 m, 61º56.51' N 144º25.93' W, *M. Cook 94467A*, **15 August 1994**, conf. C. Parker (ALA) 1995; ► occasional in bare mineral soil of volcanic avalanche deposits, Nadina Glacier, 1768 m, 62º2.85' N 144º41' W, *M. Cook 94413*, **30 August 1994**, conf. C. Parker (ALA) 1995; ► rare in gravel on moderate S-facing slope in sandy sites, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *C. Roland 95-118*, **1 July 1995**; ► patchy on unstable gravel and cobble scree slope, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *M. Cook 95274*, *C. Roland 95-234*, **18 July 1995**; ► occasional in gravel frost scars, Black Mountain, 1481 m, 62º20.85' N 143º44.9' W, *Cook & Beck 95147*, **7 July 1995**; ► scattered in moist, barren limestone gravel on gentle, NW-facing slope, 1868 m, 61º37.85' N 144º1.01' W, *C. Roland 96-585A*, **16 July 1996**; ► occasional in limestone gravel, ridge between headwaters of Pass and East Fork of Copper Creeks, 1792 m, 61º39.82' N 144º0.18' W, *C. Roland 96-591*, **16 July 1996**; ► occasional in morainal deposits, valley between Ruddy Mountain and Mt. Drum, 1615 m, 62º4.61' N 144º46.39' W, *C. Roland 96-325*, **2 July 1996**; ► few in limestone gravel talus, Kuskulana Pass, 1545 m, 61º33.72' N 143º39.7' W, *M. Cook 96550*, **26 July 1996**; ► rare in loose gravel

on barren SW-facing slope of Snyder Peak, 1524 m, 62º4.47' N 144º30.51' W, *C. Roland 96-382*, **5 July 1996**.



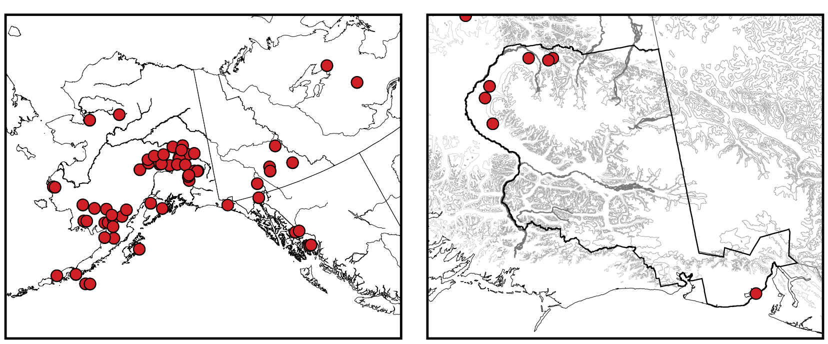
18. *Draba stenopetala*

***Subularia aquatica* L., Awlwort** -- This circumpolar boreal-montane aquatic was not known in the park prior to our inventory. The 2003 collection from the Malaspina Forelands extends it range south in the park 358 km from the Copper River basin and connects its coastal distribution 519 km to the west on the Kenai Peninsula (Hultén 1968) with a station 254 km to the east in the vicinity of Skagway (Hultén, 1968).

GULF OF ALASKA: ► abundant in pond and in stream flowing into pond, W of Kame Stream, vicinity of Malaspina Lake, 1.5 m, 59º 47.01' N 140º 02.00' W, *P. Loomis & A. Larsen 1633*, **23 July 2003**.

MIDDLE COPPER RIVER BASIN: ► gravel bottom, Chelle Lake, 930 m, 62°11.56'N, 144°51.97'W, *Cook 3606*, **1 September 2000**; ► patchy in mud on margin of small pond, vicinity of Nadina River, 766 m, 61º 57.02' N 144º 52.52' W, *P. Loomis 2070 (ALA)*, *2061*, **7 August 2003**, det. C. Parker (ALA) 2003; ► patchy in sparsely vegetated mud on margin of pond, 6 km NW of Chelle Lake, 749 m, 62º 13.35' N 144º 58.16' W, *P. Loomis 2196 (ALA)*, *2185*, **9 August 2003**.

UPPER COPPER RIVER BASIN: ► common along muddy shoreline, Fox Farm Lake, 727 m, 62º19.98' N 144º50.02' W, *M. Cook 95311*, *95303*, *C. Roland 95-252*, **25 July 1995**; . ► locally abundant in mud, pond adjacent to Tanada Lake trail, 940 m, 62º 31.25' N 143º 21.14' W, *P. Loomis 2495 (ALA)*, **14 August 2003**; ► scattered in silty mud at pond edge, NW arm of Boomerang Lake, 838 m, 62º 33.59' N 143º 53.04' W, *M. Cook & M. Reid 5125*, **9 August 2003**; ► common in shallow water (5-24" deep), rooted in red colored muck, Lake 2415', 7 km W of Boulder Creek, 736 m, 61º 30.41' N 143º 27.82' W, *M. Cook & M. Reid 5147*, **9 August 2003**.



19. *Subularia aquatica*

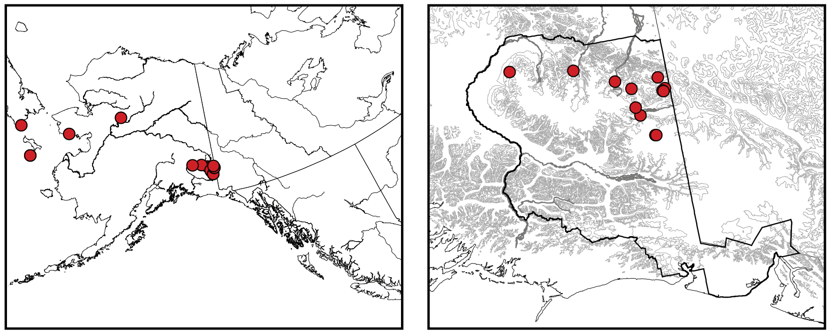
***Smelowskia calycina* (Steph. ex Willd.) C.A. Meyer s.l., False Candytuft** -- *Smelowskia calycina* var. *porsildii* Drury & Rollins is an arctic-alpine Alaska endemic. *S. calycina* var. *integrifolia* (Seem.) Rollins occurs in Alaska, the Northwest Territories and the Russian Far East. Taxonomists at the University of Alaska, Fairbanks Herbarium (ALA) treat the later taxon at the subspecific level (*S. calycina* subsp. *integrifolia* (Seem.) Hultén). *S. calycina* var. *porsildii* was collected from four localities in the Nutzotin Mountains and one site in the northern Wrangell Mountains. This variety has simple leaves, whereas *S. calycina* var. *integrifolia* has lobed leaves and is more widely distributed in the mountains of the park and in Alaska. At four of these localities in the park, both varieties occurred. Hultén suggested that *S. calycina* var. *porsildii* survived maximum glaciation in situ, while *S. calycina* var.. *integrifolia* was derived from the simple leaved variety (Hultén 1940-1950). Our collections of *S. calycina* var. *porsildii* are 794 km disjunct from the arctic distribution.

***S. calycina* var. *integrifolia* - NUTZOTIN MOUNTAINS**: ► rare on N facing scree slope**,** Lime Creek ridge, 1707 m, *M. Cook 92109*, **7 July 1992**, det. C. Parker (ALA) 1992**;** ► S-facing scree slope, knob 2.4 km W of Ptarmigan Creek, 1494 m, 61º55.55' N 141º6.72' W, *M. Cook 92467,* **9 July 1992**, det. C. Parker (ALA) 1992**;** ► rare on N facing scree slope**,** Lime Creek ridge, 1707 m, M. Cook 92109, **7 July 1992;** ► few in loose rhyolite gravels at edge of *Dryas*/graminoid tundra stringers on W-facing slope, Wiki Creek, 1433 m, 61º53.9' N 141º9.51' W, *C. Roland 94-109*, **22 June 1994*;*►** sparsely vegetated SW-facing scree slope, Horsfeld Creek, 1768 m, 62º2.88' N 141º13.18' W, *C. Roland 94-130*, **24 June 1994** (ALA); ► scattered on rhyolite talus, plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, *M. Cook 95043*, **17 June 1995**, det. C. Parker (ALA) 1996**;** ► very rare in gravels on dry tundra knob, Wiki Creek , 1411 m, 61º54.46' N 141º10.68' W, *C. Roland 96-059, 96-076*, **8 June 1996;** ► gravel talus slope, Euchre Mountain, 1414 m 62º05.08'N 142º09.59'W, *B. Bennett & P. Loomis* 03-890, **21 June 2003.**

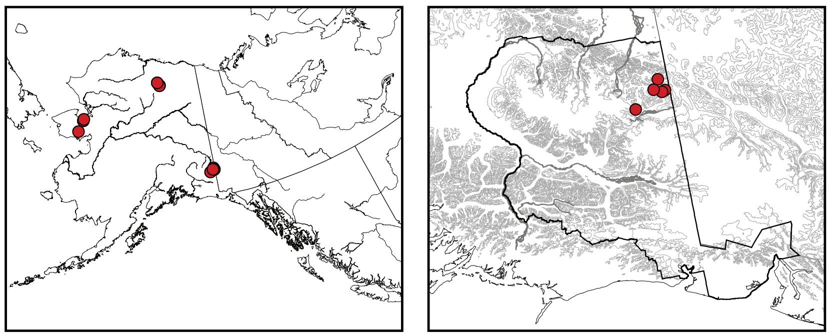
WRANGELL MOUNTAINS: ► N-facing scree slope, Lime Creek, 1707 m, 61º47.2' N 141º49.06' W, *M. Cook 92507, 92512*, **7 July 1992**; ► *Dryas* sedge tundra, NW slope of Mt. Sanford between Sanford and Boulder Creeks, 395 m, 62º21.17' N 144º24.52' W, *M. Cook 93121*, **9 June 1993**; ► rare in rocks on moderate S-facing slope, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *C. Roland 95-117A*, **1 July 1995**, conf. C. Parker (ALA) 1996.

***S. calycina* var. *porsildii* - NUTZOTIN MOUNTAINS**: ► S-facing scree slope, knob 2.4 km W of Ptarmigan Creek, 1494 m, 61º55.55' N 141º6.72' W, *M. Duffy 92185,* **9 July 1992,** det. C. Parker (ALA) 1992; ► sparsely vegetated SW-facing scree slope, Horsfeld Creek, 1768 m, 62º2.88' N 141º13.18' W, *M. Cook 94156*, **24 June 1994** (ALA); ► few scattered in scree, Wiki Basin, 1524 m, 61º54.77' N 141º11.05' W, *M. Cook 3185*, **15 July 1998** (ALA); ► scattered in scree, Sonja Creek, 1494 m, 61º57.14' N 141º21.43' W, *M. Cook 3193*, **16 July 1998** (ALA).

WRANGELL MOUNTAINS: ► N-facing scree slope, Lime Creek, 1707 m, 61º47.2' N 141º49.06' W, *M. Duffy 92145*, **7 July 1992**, det. C. Parker (ALA) 1992**.**



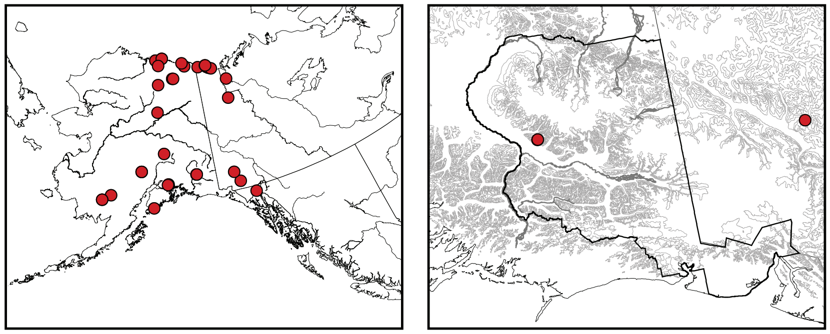
20. *Smelowskia calycina var. integrifolia*



21. *Smelowskia calycina* var. *porsildii*

Thlaspi arcticum **Pors., Arctic Pennycress** -- This Alaska-Yukon endemic with an arctic-alpine distribution is one of the rarest plants in the park, known only from one locality even though similar habitat has been surveyed throughout the park. It occurs only in Alaska, the Northwest Territories and the Yukon Territories. It is uncommon in Alaska (S3), extremely rare in the Northwest Territories and rare in the Yukon Territory (S2) with a global rank of G3. Most localities are widely disjunct in Alaska and the Yukon and are represented by very few individuals (Murray and Lipkin 1987). The collection in the southwest Wrangells connects its distribution 252 km to the west in the Anchorage Quad (North Campbell Creek Canyon, 61°07.17' N 149°29.75' W, *Lichvar et al. 8085*, 19 July 1994 (ALA)) with a station 303 km to the east in the Yukon Territory (Cody 1996).

WRANGELL MOUNTAINS: NE-facing scree slopes, Iron Mountain, 1676 m, 61º37.64' N 144º1.42' W, *M. Duffy 91150*, **27 August 1991**, *C. Roland 96-590*, *M. Cook 96465*, **16 July 1996**.



22. *Thlaspi arcticum*

CALLITRICHACEAE

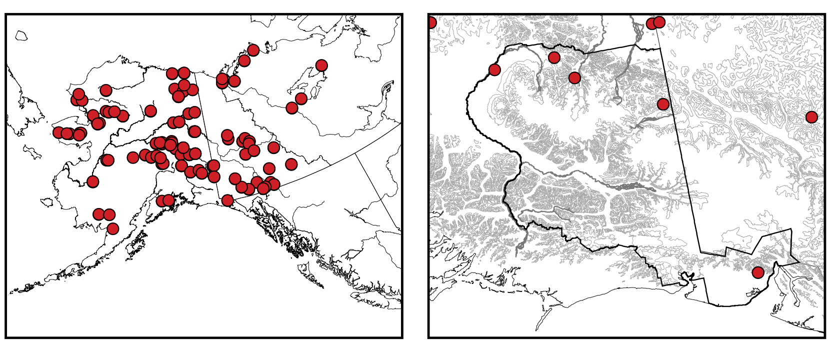
***Callitriche hermaphroditica* L., Northern Waterstarwort** -- The specimen collected at Floral Pass in 2003 extends the range of this species 217 km south in the park into the southern St. Elias Mountains from the Nutzotin Mountains and connects its coastal distribution 465 km to the west near Whittier (Hultén 1968) with a station 159 km to the east near Haines (Cody 1996). Northern Waterstarwort has a circumpolar boreal montane distribution and occurs in slow-moving streams, lakes and sloughs.

NUTZOTIN MOUNTAINS: ► lake margin, 0.5 m deep, mixed freshwater herbaceous, Ptarmigan Lake, 1079 m, 61º51.51' N 141º10.78' W, *J. Barnes 96-252*, **8 August 1996**, conf. C. Parker (ALA) 1996.

SOUTHERN ST. ELIAS MOUNTAINS: ► few in small, 40 cm deep pools of water, in sub-alpine wet herb meadow, flat bench on NE end of Floral Pass, 449 m, 59º 59.11' N 139º 56.33' W, *P. Loomis & A. Larsen 1700 (ALA)*, **23 July 2003**, det. C. Parker (ALA) 2003.

UPPER COPPER RIVER BASIN: ► common in 0.25- 1 m deep tannic water, Billy Lake, 606 m, 62º 29.29' N 144º 42.13' W, *P. Loomis 2153*, **9 August 2003**, det. C. Parker (ALA) 2003; ► patchy in 0.25 m deep water, pond adjacent to Tanada Lake trail, 940 m, 62º 31.25' N 143º 21.14' W, *P. Loomis 2510*, **14 August 2003**, det. C. Parker (ALA) 2003.

WRANGELL MOUNTAINS: ► scattered in 50 cm of water, rooted in rocky floor of small, shallow pond, Fish Creek, 1067 m, 62º16.92' N 142º58.99' W, *C. Roland 95-284*, **29 July 1995**, conf. C. Parker (ALA) 1996.

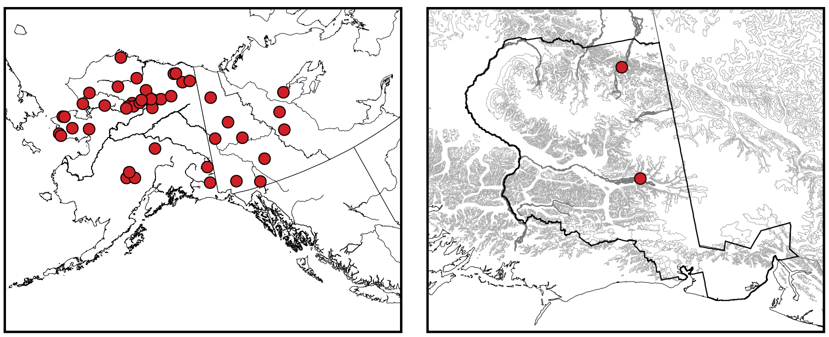


23. *Callitriche hermaphroditica*

CARYOPHYLLACEAE

***Arenaria longipedunculata* Hult., Longstem Sandwort --** This North American cordilleran species is uncommon in Alaska (S3) and rare throughout its range (G3Q). It occurs in Alberta (S1), British Columbia (S1S3) and the Yukon Territory where it is found in moist, calcareous or serpentine gravels in the mountains (Porsild and Cody 1980). It is known from only two localities in the park. Our collections extend its range southeast 453 km into the Chisana River basin and 536 km into the Chitina River basin from a locality in the Alaska Range near Healy (*A.E. Porsild 339*, 1926 (CAN), Hultén 1941-1950) and connect its distribution 212 km to the southeast in the Yukon Territory (Cody 1996).

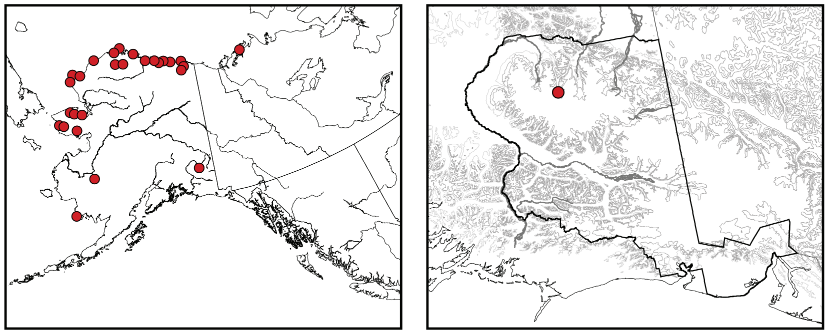
CHITINA RIVER BASIN: ► wet alluvium of gravel bar, Barnard Glacier terminus, Chitina River, 488 m, 61º5.82' N 141º57.92' W, *Duffy & Barnes 96-028*, **8 August 1996**, conf. C. Parker (ALA) 1996; ► rare on mossy bank of slough on river terrace, 864 m, 62º 14.6468' N 141º 55.2383' W, *Roland and Batten 5791 (ALA)*, **18 June 2003**, conf. A. Batten (ALA) 2003.



24. *Arenaria longipedunculata*

***Cerastium regelii* Ostenf., Regel's Chickweed –** This species is known from one highly disjunct locality in the park and is one of the rarest species in the park's flora. Our collection is 1071 km to the east of a collection made by Eric Hultén at Cape Newenham in western Alaska and 417 km south of a station in the Steese-White Mountains (Hultén 1968). It has a circumpolar arctic-alpine distribution, is rare in the state (S2S3) but apparently secure globally (G4). In North America it also occurs in the Northwest Territories and Nunavut. Our distribution map reflects the combination of *C. jenisejense* with *C. regelii* by Heide et. al. (1990).

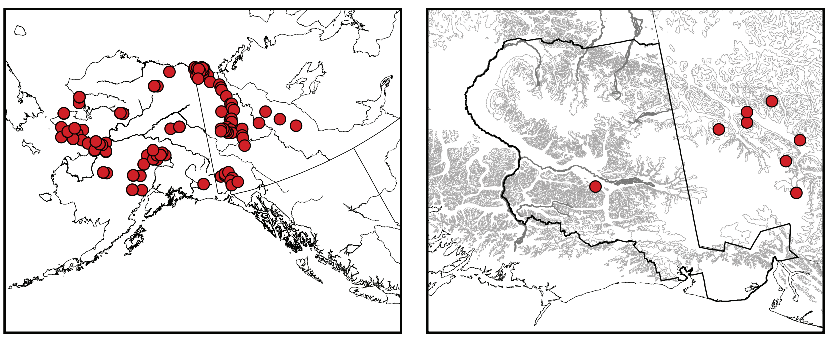
WRANGELL MOUNTAINS: ► mesic sedge grass meadow tundra, Lakes Plateau, 1890 m, 62º4.4' N 143º23.5' W, *Potkin & Leggett 95-085 (ALA)* **29 July 1995** conf. D.F. Murray (ALA) 1997.



25. *Cerastium regelii*

Melandrium macrospermum **Pors. (=*Silene uralensis* (Rupr.) Bocquet subsp. *uralensis, S. macrosperma* (Porsild) Hultén), Largefruit Catchfly** -- This species is circumpolar with an arctic-alpine distribution. The specimen cited above extends its range 410 km to the southeast into the Chugach Mountains from a station in the Healy Quad (Sable Pass, 63°34.0' N 149°40.0' W, *A. Murie s.n.*, 19 July 1964 (ALA)) and connects the range 148 km to the east in the Yukon Territory (Cody 1996).

CHUGACH MOUNTAINS: ► SE-facing ridge-top, lichen tundra, vic. Chakina River, 1768 m, 61º6.19' N 142º55.03' W, *C. Roland 94-184C*, **8 July 1994**, det. C. Parker (ALA) 1996.



26. *Melandrium macrospermum*

Minuartia biflora **(L.) Schinzl. & Thell., Mountain Stitchwort** -- This circumpolar arctic-alpine species is thought to be rare in Alaska (S2) but is secure globally (G5). It is now known from 22 localities in the interior mountain ranges of the park. It was previously known from three localities in the Wrangell Mountains: Chitistone Pass (61º37' N 142º3' W, *R. Scott 1630*, *1867*, *2214* (MICH), Scott 1968), Skolai valley (61º37' N 141º58' W, *D. F. Murray 719* (CAN), Murray 1968) and Bonanza Ridge (61º30' N 142º51' W, *O. Nordell & A. Schmitt 95, 416b, 450*, (LD & ALA), Nordell and Schmitt 1968).

The new collections cited below extend its range 124 km north into the Mentasta Mountains, 64 km north into the Nutzotin Mountains, 123 km southwest into the Chugach Mountains, 75 km northwest in the Wrangell Mountains and 105 km southeast into the northern St. Elias Mountains. These collections connect the distribution 152 km to the northeast in the Mt. Hayes Quad (Tangle Lakes, 63°03.0' N 146°01.0' W, *G. Smith, 2033*, 20 August 1953 (ALA)) with the distribution 204 km to the east in the Yukon Territory (Cody 1996).

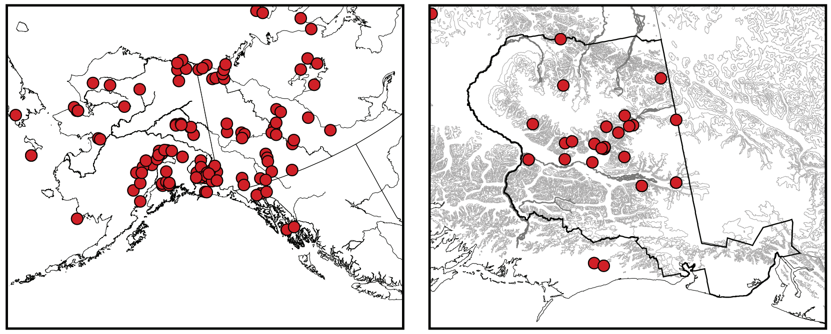
CHUGACH MOUNTAINS: ► moist bouldery solifluction lobe, East Fork Kiagna River, 1487 m, 60º59.5' N 142º1' W, *A.R. Batten & M. Barker 96-311 (ALA)* **29 July 1996**; ► scattered in *Rhacomitrium* on dry tundra, Nerelna Creek plateau, 1372 m, 61º26.66' N 144º17.69' W, *M. Cook 96309, C. Roland & J. D'Auria 96-411*, **8 July 1996**.

MENTASTA MOUNTAINS: ► scattered in mesic dwarf willow-*Dryas*-moss community, Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95169*, **7 July 1995**, conf. C. Parker (ALA) 1996.

NORTHERN ST. ELIAS MOUNTAINS: ► occasional in lush, steep, S-facing meadow, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *C. Roland 95-068*, **20 June 1995**, det. C. Parker (ALA) 1996; ► few in bare organic soil on rock moraine, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *M. Cook 95224, C. Roland 95-195*, **14 July 1995**. ► occasional on cobble-moss slope, head of Canyon Creek, 1682 m, 61º 18.97' N 142º 16.19' W, *M. Cook & J. Eklund 4898 (ALA)*, **19 July 2003**, conf. C. Parker (ALA) 2003; ► scattered in sedge meadow, head of Canyon Creek, 1682 m, 61º 19.01' N 142º 57.73' W, *M. Cook & J. Eklund 4940*, **19 July 2003**, conf. C. Parker (ALA) 2003; ► few in forb herbaceous-dwarf scrub in open bare sandy basalt scree, Cheshnina Plateau, 1311 m, 61º 47.82' N 144º 05.89' W, *M. Cook & J. Baker 4723 (ALA)*, **3 July 2003**, conf. C. Parker (ALA) 2003.

NUTZOTIN MOUNTAINS: ► occasional in bare organic soil between boulders at base of scree slope, 1585 m, 62º25.78' N 142º22.11' W, *M. Cook 95107*, **28 June 1995**, det. C. Parker (ALA) 1996; ► moist sandy grus with seral herbs on well-vegetated SE-facing alpine colluvium, Horsfeld Creek, 1128 m, 62º2' N 141º11' W, *C.L. Parker & M. Gracz 6subsp.*, **13 August 1996**.

WRANGELL MOUNTAINS: ► moist gravel, sparsely vegetated, SE slope of Fredrika Mountain, 1859 m, 61º43.8' N 142º6.46' W, *M. Duffy 91092*, 2 July 1991, conf. C. Parker (ALA) 1991; ► rare in mesic stony area, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *C. Roland 94-299*, **25 July 1994**, det. C. Parker (ALA) 1996; ► rare in mesic, mossy area of N-facing gravel slope, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *C. Roland 95-249*, **18 July 1995**, det. C. Parker (ALA) 1996; ► dry tundra on ridge Nikolai Pass, 1280 m, 61º26' N 142º40' W, *A.R. Batten & M. Barker 96-002 (ALA)* **23 July 1996**; ► rare in mossy, stony saturated soil of seep, Hasen Creek, 1835 m, 61º34.06' N 142º18.33' W, *C. Roland 96-643*, **23 July 1996**; ► scattered in sedimentary gravel scree on lower third of slope, West Fork Mill Creek, 1241 m, 61º33.33' N 143º28.35' W, *M. Cook 96519*, **24 July 1996**; ► occasional in moss between gravel at base of slope, Lakina Glacier, 1219 m, 61º33.64' N 143º19.01' W, *M. Cook 96545*, **24 July 1996**; ► moist muddy scree, Nikolai Mine, 1695 m, 61º27' N 142º39' W, *A.R. Batten & M. Barker 96-089B (ALA)* **24 July 1996**; ► moist gravelly clay, VABM Sentinel west of Nizina Glacier, 1829 m, 61º39' N 142º32' W, *A.R. Batten & M. Barker 96-110A (ALA)* **24 July 1996**; ► scree, ridge W of Nikolai Pass, 1372 m, 61º26.5' N 142º43' W, *A.R. Batten & M. Barker 96-161A*, **26 July 1996**.



27. *Minuartia biflora*

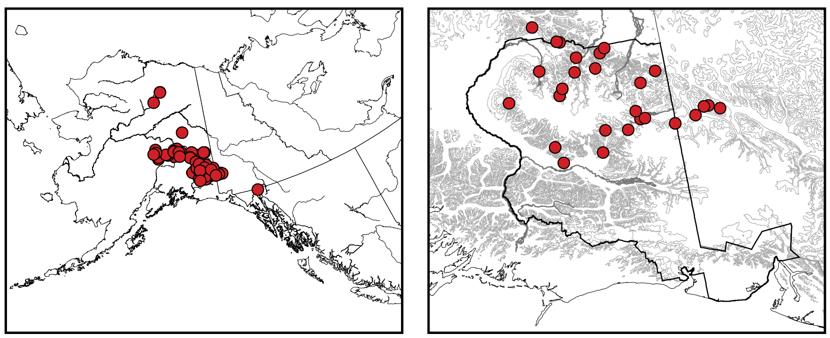
Stellaria alaskana **Hult., Alaska Starwort –** This Alaska-Yukon endemic is rare in Alaska (GS S3) and in the Yukon Territory (Douglas et al. 1981). Its distribution is centered on the Alaska Range and Wrangell-St. Elias Mountains. It was known previously from three localities in the park: Russell Glacier (61°42.0' N 141°45.0' W, D. F. Murray 2170, 11 August 1968 (ALA)), Sheep Glacier (61°42.0' N 141°39.0' W, D.F. Murray 2251, 15 August 1968 (ALA)) and Chitistone Pass (61º37' N 142º3' W, R. Scott 1761 (MICH), Scott 1968) and from a station near Mentasta Pass (Hultén 1968). Our collections extend the range 139 km west into the Wrangell Mountains, 85 km north into the Nutzotin Mountains and connect the distribution to the northwest in the Alaska Range with collections 40 km to the east in the Yukon Territory.

MENTASTA MOUNTAINS: ► limestone slope, upper Trail Creek, 1341 m, 62º37.09' N 143º16.06' W, *M. Potkin 95-042*, **26 July 1995**; ► scattered at base of NE-facing limestone scree slope, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95176*, **7 July 1995**; ► limestone slope, upper Trail Creek, 1341 m, 62º37.09' N 143º16.06' W, *A. Leggett 95-052*, **7 July 1995**; ► rare on rock outcrops, Devils's Mountain, 1530 m, 62º25.62' N 142º53.93' W, *C. Roland 96-351*, **3 July 1996**. **NUTZOTIN MOUNTAINS**: ► scattered in steep, unstable granitic rubble, Carl Creek, 1920 m, 62º3.52' N 141º36.27' W, *C. Roland 95-022*, **13 June 1994**; ► moist scree on N-facing slope, Baultoff Creek, 1707 m, 62º9.13' N 141º14.51' W, *M. Cook 94177A*, **27 June 1994**; ► scattered underneath rocks in moist loamy sand, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *M. Cook 95012*, **15 June 1995**; ► scattered at base of scree slope, alpine basin at headwaters of Stone Creek., 1585 m, 62º25.78' N 142º22.11' W, *M. Cook 95104*, **27 June 1995**; ► scattered at base of rock outcrops, headwaters of Alder Creek, 1554 m, 62º28.44' N 142º15.06' W, *M. Cook 95138*, **30 June 1995**.

ST. ELIAS MOUNTAINS: ► scattered on NE-facing unstable volcanic scree slope, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *M. Cook 95075, C. Roland 95-071*, **20 June 1995**.

WRANGELL MOUNTAINS: ► N-facing scree slope, Lime Creek ridge, 1707 m, 61º47.2' N 141º49.06' W, *M. Cook 92498*, **7 July 1992**; ► S-facing granite boulder slope, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *C. Roland 94-285B*, **24 July 1994**; ► scattered on upper slope of cinder cone, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94378, C. Roland 94-315*, **25 July 1994**; ► rare in tundra, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *C. Roland 95-251*, **18 July 1995**; ► scattered on E-facing boulder slope, Fish Creek, 1067 m, 62º16.92' N 142º58.99' W, *M. Cook 95318*, **27 July 1995**; ► Lakes Plateau, 1890 m, 62º4.4' N 143º23.5' W, *Leggett &*

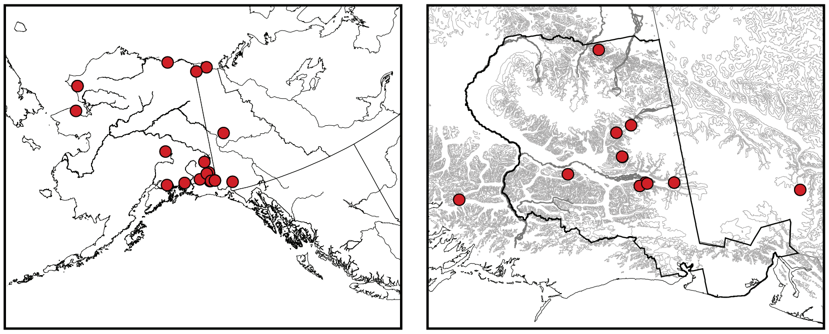
Potkin 95-073, 95-084, **28 July 1995**, conf. C. Parker (ALA) 1991; ► scattered on scree slope, Black Mountain, 1481 m, 62º20.85' N 143º44.9' W, *M. Cook 95145*, **7 July 1995**; ► steep N-facing scree, Nikolai Pass, 1280 m, 61º26' N 142º40' W, *Batten & Barker 96-028*, **23 July 1996**; ► scree near rocky ridge, VABM Sentinel, west of Nizina Glacier, 1829 m, 61º39' N 142º32' W, *Batten & Barker 96-124*, 25 July 1996 (ALA); ► scattered in rhyolite scree on SE-facing slope Kuskulana Pass, 1545 m, 61º33.72' N 143º39.7' W, *C. Roland 96-708*, **26 July 1996**; ► occasional in sandy soil on S-facing slope, 6 km east of Snyder Peak, 1524 m, 62º4.47' N 144º30.51' W, *C. Roland 96-376*, **5 July 1996**; ► occasional in *Rhacomitrium* at head of scree slope, Kuskulana Pass, 1545 m, 61º33.72' N 143º39.7' W, *M. Cook 96549*, **7 July 1996**; ► rare along gravel creekbed, upper Skookum trail, 1563 m, 62º25.83'N 143º6.91'W, 1572 m, *M. Cook 3533*, **7 July 1999**; ► scattered on scree slope, Grizzly Lake, 1312 m, 62º14.05'N 143º20.98'W, *J. Allen s.n.*, **27 July 2000**.



28. *Stellaria alaskana*

***Stellaria umbellata* Turcz., Umbrella Starwort** -- This amphiberingean arctic-alpine species is rare in Alaska (G4 S2S3) and the Yukon Territory (Douglas et al. 1981). It was known from Chitistone Pass in the Wrangell Mountains (61º37' N 141º58' W, D. F. Murray 1044, (CAN) (Murray 1968)). The specimens cited above extend its range 90 km south into the Chugach Mountains, 93 km north into the Nutzotin Mountains and connect its distribution 125 km to the west in the Valdez Quad (Valdez Glacier, 61°08.0' N 146°10.0' W, L. A. & E.G. Viereck 2229, 10 August 1957 (ALA)) with a station 151 km to the east in the Yukon Territory (Cody 1996).

CHUGACH MOUNTAINS: ► occasional in mesic tundra in limestone unit between Iron & Lime Creeks, 1798 m, 61º1' N 141º53.18' W, *M. Cook 94430A*, **8 August 1994,** conf. C. Parker (ALA) 1995; ► scattered in mud seeps, Verde Ridge, 1554 m, 61º14.03' N 143º28.52' W, *Roland & D'Auria 96-478*, **11 July 1996**; ► occasional in moist calcareous gravel, Granite Creek, 1829 m, 61º0.22' N 141º51.1' W, *C. Roland 96-737*, **28 July 1996**; ► moist N-facing scree, West Fork Goat Creek, 1487 m, 60º59.5' N 142º1' W, *Batten & Barker 96-312A*, **29 July 1996** (ALA). **NUTZOTIN MOUNTAINS**: ► patchy in sheep bed at base of talus slope, Stone Creek, 1585 m, 62º25.78' N 142º22.11' W, *M. Cook 95101*, **27 June 1995**. **ST. ELIAS MOUNTAINS**: ► rare in wet gravel, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *C. Roland 95-194*, **14 July 1995**; *M.Cook 95248*, **16 July 1995;** ► scattered in wet clay mineral soil and in moss seep, head of Canyon Creek, 1682 m, 61º19.12' N 142º16.30' W, *M. Cook & J. Eklund 4899, 4933*, **19 July 2003**. **WRANGELL MOUNTAINS**: ► common in saturated soil of seep, Hasen Creek, 1835 m, 61º34.06' N 142º18.33' W, *C. Roland 96-638*, **23 July 1996**.

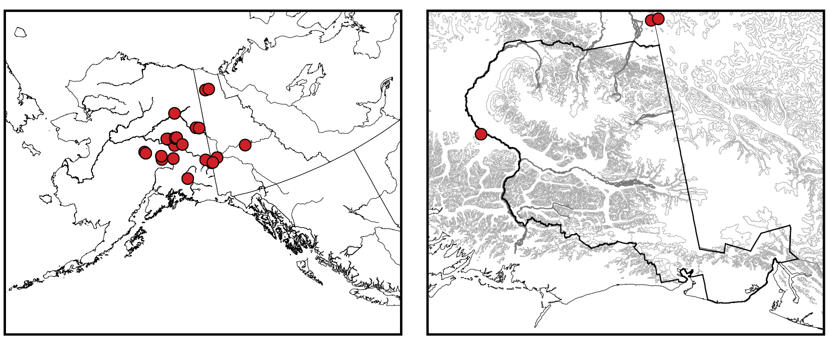


29. *Stellaria umbellata*

CERATOPHYLLACEAE

Ceratophyllum demersum **L., Coon's Tail** –Our collection extends the range of this incompletely circumpolar widespread species 201 km south from the Healy Quad (vic. Cantwell, 63°24.0' N 148°56.0' W, *G. Smith 2243*, 6 September 1953 (ALA)) into the Copper River basin. It is rare in Alaska (S2) but secure throughout its range (G5) where it occurs in quiet, fresh water pools and streams.

COPPER RIVER BASIN: ► dominant, submerged in shallow water next to shore, pond at 2 km, Old Edgerton Highway, 415 m, 61°49.3' N 145°10.7' W, *M. Cook 95371*, **8 August 1995**, conf. C. Parker (ALA) 1996.

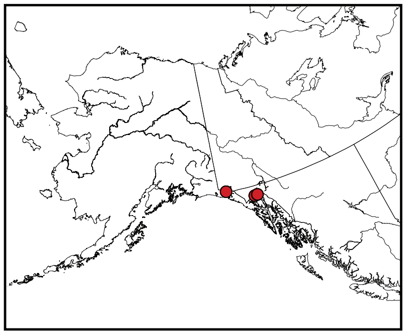


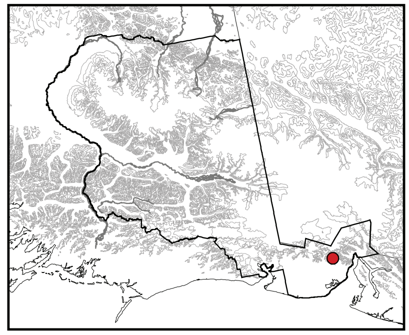
30. *Ceratophyllum demersum*

CRASSULACEAE

Sedum divergens **S. Watt, Spreading Stonecrop --** Our collection of *Sedum divergens* is one of the most notable finds from the 2003 inventory. It documents the third locality in Alaska and extends its range 260 km to the west from the Takhini River valley, 40 km west of Haines (Parker, Batten & Bennett 9698, 18 July 2000). The first collections of *Sedum divergens* in Alaska were from mile 10 on the Haines Highway (Murray 1980). The collections from the vicinity of Haines are disjunct from its main range along the Pacific Coast in central British Columbia by 700 km (Murray 1980). *Sedum divergens* is infrequent from British Columbia south to Oregon and California (Douglas et. al. 1998, Murray 1980). It is extremely rare in Alaska (S1) but may be secure globally (G5?). It has not been ranked in Washington or Oregon where it occurs, has a state rank of S1S3 in California, S2 in Alberta and S4 in British Columbia. It occurs on dry rocky cliffs and talus slopes.

SOUTHERN ST. ELIAS MOUNTAINS: ► uncommon in moss and organic soil at base of solifluction mound, ridge between Hayden Glacier and upper Lucia Glacier, 999 m, 60º 03.12' N 140º 00.05' W, *P. Loomis & A. Larsen 1658 (ALA)*, **22 July 2003**, conf. C. Parker (ALA) 2003.





31. *Sedum divergens*

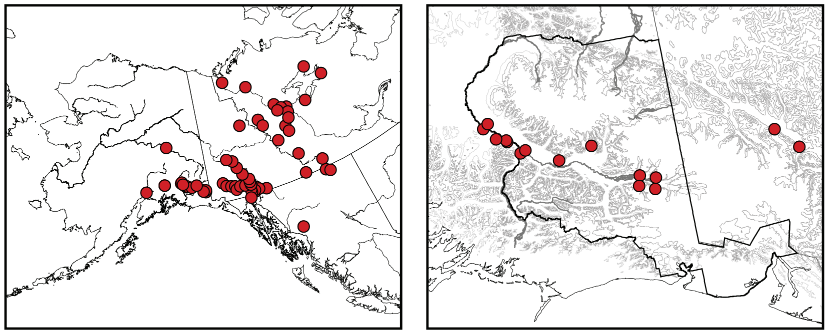
CUPRESSACEAE

***Juniperus horizontalis* Moench, Creeping Savin –** The distribution of this juniper in Alaska is centered in the middle Copper and Chitina River valleys where it is found on bluffs, often with *Juniperus communis*. There are only three other localities of this species in the state which are not from the vicinity of the park. It is rare in Alaska (S1S2) but secure globally (G5). It has a North American boreal-montane distribution extending to the east coast and south to Nebraska. Prior to our inventory it was known from two localities in the park: Bonanza Ridge in the Wrangell Mountains (61º30' N 142º51' W, *O. Nordell & A. Schmitt s.n.*, 1976 (LD & ALA), Nordell & Schmitt 1978) and at the head of the Chitina River (*H. M. Laing 10, 11* (CAN), Hultén 1941and Porsild 1939).

CHUGACH MOUNTAINS: ► S-facing bank of lake, vic. East Fork Kiagna River, Granite Range, 1487 m, 60º59.5' N 142º1' W, *A.R. Batten & M. Barker 96-202*, **27 July 1996**.

CHITINA RIVER BASIN: ► sandy hillside, Hubert's Landing, Chitina River, 671 m, 61º2.7' N 141º38' W, *D. Miquelle 84-38*, **15 July 1984**, conf. C. Parker (ALA) 1991; ► alluvial floodplain of Clear Stream, Chitina River, 488 m, 61º5.82' N 141º57.92' W, *M. Duffy & J. Barnes 96-005*, **8 August 1996**, conf. C. Parker (ALA) 1996; ► scattered on S-facing bluff in aspen woodland, Crystalline Hills, 602 m, 61º23.12' N 143º36.16' W, *M. Cook 3129*, **15 June 1998** (ALA).

MIDDLE COPPER RIVER BASIN: ► small patch in gully within steppe, Dadina River bluff, Copper River, 393 m, 61º51.49' N 145º0.72' W, *C. Roland 96-304*, **1 July 1996**.



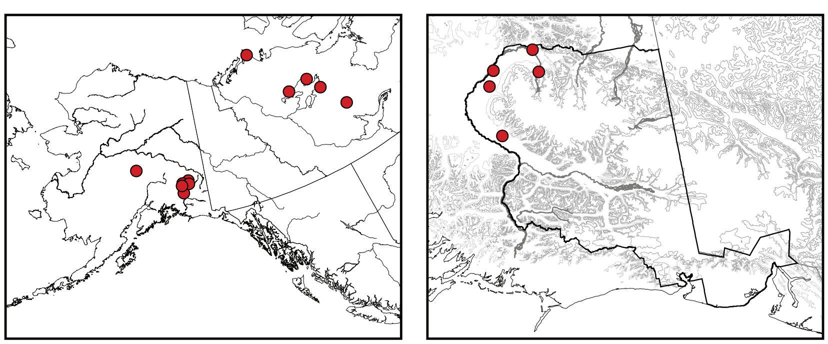
32. *Juniperus horizontalis*

CYPERACEAE

***Carex adelostoma* Krecz., Circumpolar Sedge** -- This sedge is known from only six localities in Alaska, five of which are in the park, four documented during this inventory. It had been collected in the park in 1947 by A. Dutilly, E. Lepage and O'Neil near Long Lake on the Nabesna Road (Lepage 1959, Hultén 1967). This was the only known collection from Alaska until our 1995 collection. Our distribution map for *C. adelostoma* includes the stations for *Carex morrisseyi* A. E. Porsild (Porsild and Cody 1980) following the current treatment in the Flora of North America (2002). Its Alaskan distribution is disjunct by 988 km from collections at Great Bear Lake in the Northwest Territories. It has a spotty distribution throughout its range occurring also in boreal Russia, northern Europe, Manitoba, Newfoundland, Labrador, Nunavut and Quebec. It occurs in subarctic bogs and forests and has most likely been overlooked throughout its range. It is extremely rare in Alaska (S1) but apparently secure globally (G4).

MIDDLE COPPER RIVER BASIN: ► patchy in sub-arctic lowland sedge wet meadow, vic. of Chetaslina River, 665 m, 61° 49.04' N 144° 42.23' W, *P. Loomis 2031 (ALA)*, **7 August 2003**, det. D.F. Murray (ALA) 2003.

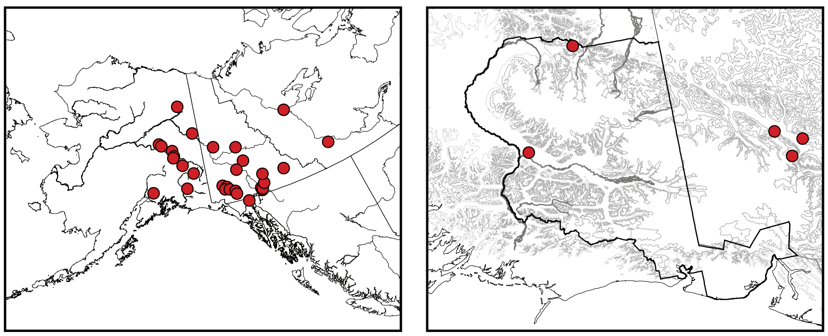
UPPER COPPER RIVER BASIN: ► Fox Farm Lakes, 727 m, 62º19.98' N 144º50.02' W, M. Potkin 95-008, **26 July 1995**, conf. D.F. Murray (ALA) 2000; ► patchy in mesic graminoid herbaceous vegetation, vic. Copper Lake, 911 m, 62º24.53' N 143º42.68' W, *M. Cook 96732*, **8 August 1996**, conf. D.F. Murray (ALA) 2000; ► common in sub-arctic lowland sedge wet meadow, Billy Lake, 606 m, 62º 29.29' N 144º 42.13' W, *P. Loomis 2172A*, *2174*, **8 August 2003**, det. D.F. Murray (ALA) 2003.



33. *Carex adelostoma*

Carex atratiformis **Britt., Black Sedge** -- This North American boreal-montane sedge is known from ten localities in Alaska, two of which are in the park. It is rare in the state (S2) but secure globally (G5). It occurs in forest margins, open woodlands, calcareous ledges, stream banks and high elevation seeps across Canada, south to Michigan, Maine, New Hampshire, New York and Vermont (Flora of North America 2002). Our collection extends its range 103 km to the southeast into the Mentasta Mountains from the Alaska Range (Mile 200 Richardson Highway, 63°12.0' N 145°36.0' W, *B. Rausch, s.n.*, July 1964 (ALA)) and connects its distribution 176 km to the east in the Yukon Territory (Cody 1996). It was previously known from one locality in the park near Chitina (Hultén 1968).

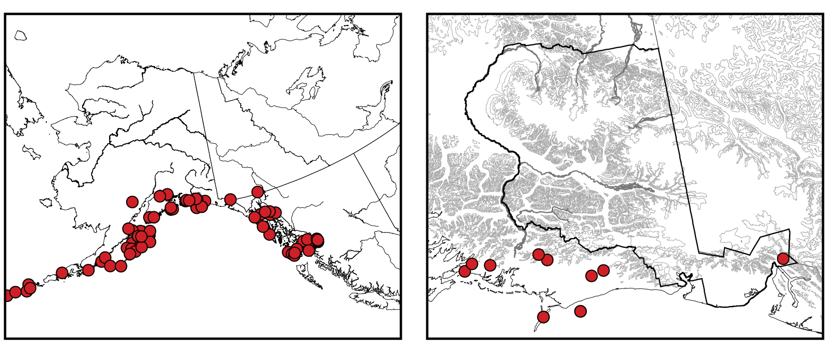
MENTASTA MOUNTAINS: ► common in small fen on Lost Creek floodplain, 1006 m, 62º32' N 143º9.6' W, *C. Roland & J. D'Auria 97-066*, **26 June 1997**, det. C. Parker (ALA) 1995.



34. *Carex atratiformis*

Carex circinnata **C.A. Mey, Coiled sedge –** Our collection of this North American Pacific coastal sedge connects its distribution 203 km to the west near Cape Yakataga (McIntosh Peak, 60º 18.28' N 143º 10.16' W, *Barker & Pratt, s.n.*, 13 August 2001 (ALA) with its distribution 233 km to the east near Haines (Hultén 1968, Cody 1996). It was new to the flora of the park in 2003.

SOUTHERN ST. ELIAS MOUNTAINS: ► in *Vaccinium* tundra on rock outcrop, Mount Foresta, 796 m, 60º 04.30' N 139º 20.23' W, *P. Loomis & A. Batten 1884*, **26 July 2003**.

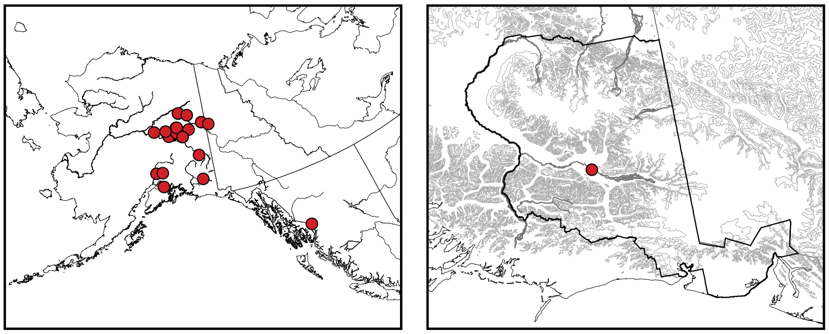


35. *Carex circinnata*

Carex crawfordii **Fern., Crawford's Sedge** -- This sedge is rare or uncommon in Alaska (S2S3) but secure globally (G5). It occurs across boreal North America reaching its southern extent in Missouri (Kartesz 1999). Our collection extends it range 141 km

south into the Chitina River drainage from the Tanana River valley (Hultén 1968). *C. crawfordii* is found in well drained lake and river meadows.

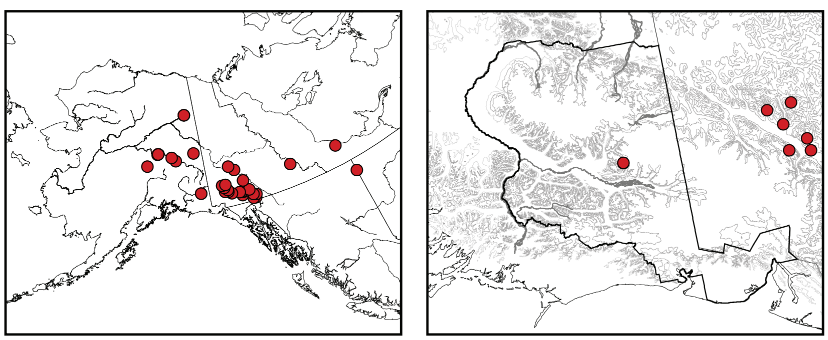
CHITINA RIVER BASIN: ► dry pond meadow, Tana River flats, 442 m, 61º14.45' N 142º57.21' W, *Duffy & Barnes 96-140*, **8 August 1996**, det. C. Parker (ALA) 1996.



36. *Carex crawfordii*

***Carex duriuscula* C.A. Mey (=*C. stenophylla* Wahlberg subsp. *eleocharis* (L.H. Bailey) Hultén), Spike-Rush Sedge** -- Our collections extend the range of this sedge 328 km south from the Alaska Range into the St. Elias Mountains of Alaska and connect its distribution 173 km to the east in the Yukon Territory. *C. duriuscula* has an amphiberingian distribution and occurs in dry prairies, sagebrush grasslands and openings in dry forests.

ST. ELIAS MOUNTAINS: ► patchy in *Sphagnum* of sedge bog and in dwarf willow/forb herbaceous meadow tundra, head of Canyon Creek, 1359 m, 61º 18.62' N 142º 14.37'W, 61º 18.68' N 142º 14.35' W, *M. Cook & J. Eklund 4976 (ALA), 4978*, **20 July 2003**, det. C. Parker (ALA) 2004.

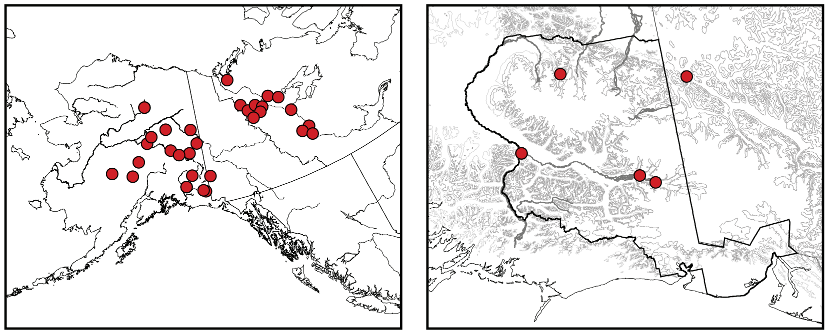


37. *Carex duriuscula*

***Carex eburnea* Boott., Bristleleaf Sedge** -- This North American boreal-montane sedge is rare or uncommon in Alaska (S2S3) but secure globally (G5). It is known from only four localities in the park. It had been collected previously in the park near Chitina (Hultén 1968) and at the head of the Chitina River (*H.M. Laing s.n.*, 18 June 1925 (CAN), Hultén 1941-1950, Porsild 1939). *Carex eburnea* is found in moist calcareous woodlands.

CHITINA RIVER BASIN: White Spruce woodland, Clear Stream, 488 m, 61º5.82' N 141º57.92' W, *Duffy & Barnes 96-001*, **8 August 1996**, conf. C. Parker (ALA) 1996.

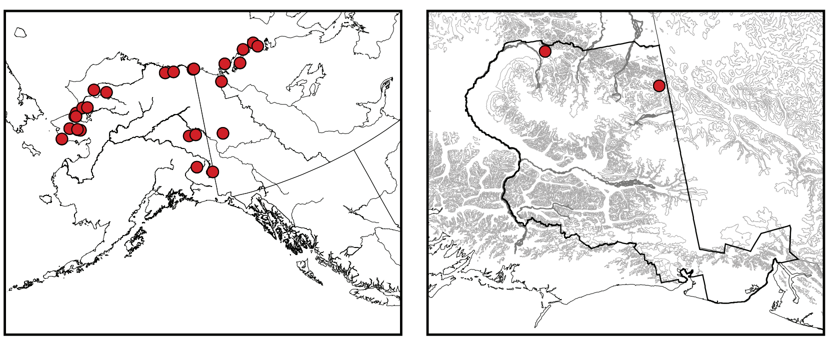
WRANGELL MOUNTAINS: patchy in sedge meadow, Grizzly Lake, 1000 m, 62°19.51'N 143°9.24'W, *Cook & Allen 3551*, **26 July 2000**.



38.   *Carex eburnea*

***Carex holostoma* Drej., Arctic Marsh Sedge –** This circumpolar arctic-alpine sedge is rare in Alaska (S2) but apparently secure globally (G4). In Alaska, it is known from nine localities in the northwest arctic, three localities on the northeast arctic coast, two localities in Yukon-Charley National Preserve and two localities in the park. It was first collected in the park by A. Dutilly, E. Lepage and O'Neil near Long Lake on the Nabesna Road in 1947 (Lepage 1951, Hultén 1967). Our collection is 344 km south of collections from Yukon- Charley Rivers National Preserve (64°51.15' N 144°20.28' W, M. Cook & C. Roland 02-304, 2002 (ALA)) and documents the southern extent of its range in Alaska. Carex holostoma is a calciphile found in turfy places in the tundra and by the edge of small ponds.

NUTZOTIN MOUNTAINS: ► occasional in open low mixed shrub sedge tundra bog, Horsfeld Creek, 1097 m, 62º1' N 141º11' W, *C.L. Parker & M. Gracz 6857A*, **10 August 1996**, conf. D.F. Murray (ALA) 2000.

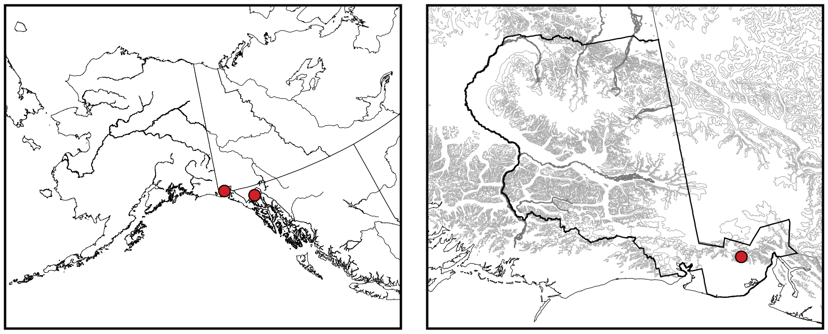


39.   *Carex holostoma*

***Carex hoodii* W. Boott, Hood's Sedge –** Our collection of this North American boreal-montane sedge is the second record for Alaska and one of the most notable finds from the 2003 inventory. This station extends its range 250 km west from the first state collection near Haines (Takhin Ridge, 59º17.00' N 136º07.00' W, *C. Parker, A. Batten & B. Bennett 9730*, 18 July 2000 (ALA)). These coastal Alaskan localities are 900 km disjunct from the main range of the species in British Columbia south of 56º latitude and the western United States (Douglas et al., 2001). It is absent from the Yukon Territory. *Carex hoodii* is extremely rare in Alaska but apparently secure globally (G4G5). It is found in Alberta (S3), British Columbia (S5), Saskatchewan (S2), California, Colorado, Idaho, Montana, Nevada, Oregon, South Dakota (S4), Utah, Washington and Wyoming

(S5) in dry to mesic grasslands, rocky slopes, screes, and forest openings (Flora of North America 2002, NatureServe 2004).

SOUTHERN ST. ELIAS MOUNTAINS: ► few in mixed forb meadow influenced by solifluction, ridge at fork in upper Marvine Glacier, 912 m, 60º 05.07' N 60º 05.07' W, *P. Loomis & A. Batten 1776 (ALA)*, **25 July 2003**, det. C. Parker (ALA) 2003.

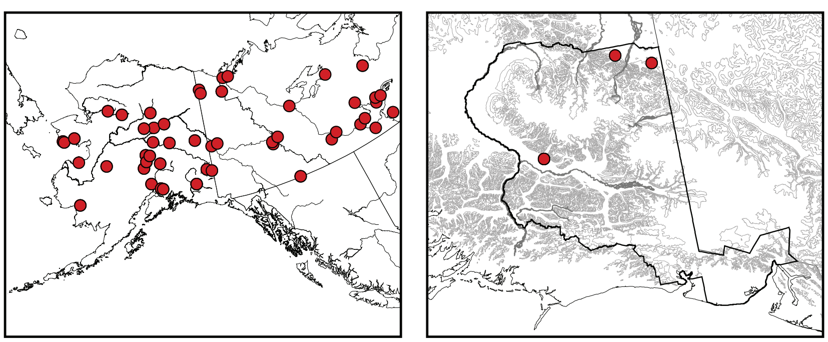


40. *Carex hoodii*

***Carex lapponica* O. Lang, Lapland Sedge --** This sedge is rare in Alaska (S2) and apparently secure globally but with taxonomic uncertainty (G4G5Q). It is known from only three localities in the park. Our collections extend its range 277 km east into the Chitina River basin from the Eklutna Valley (61º 21.35' N 149º 06.28' W, *Marvin 2165*, 24 August 1985 (ALA)) and 195 km south into the Tanana River basin from the Yukon River (Hultén 1968). *C. lapponica* occurs in sphagnum bogs and in nutrient poor wet areas in lowlands (Flora of North America 2002).

TANANA RIVER BASIN: ► rare in fen dominated by *Eriophorum angustifolium*, Stuver Creek, 945 m, 62º 25.11' N 141º 59.33' W, *P. Loomis & B. Bennett 03-437*, **9 June 2003**, det. C. Parker (ALA) 2003; ► patchy in mud between tussocks in open black spruce forest, Carden Lake, *P. Loomis & K. Beattie 1101*, **10 July 2003**, det. C. Parker (ALA) 2003.

CHITINA RIVER BASIN: ► common in sub-arctic lowland sedge- moss bog meadow, pond 4 km E of Strelna Pt., vic. Kuskulana River, 542 m, 61º 30.05' N 143º 53.29' W, *P. Loomis 2113 (ALA), 2114*, **8 August 2003**, det. C. Parker (ALA) 2003.

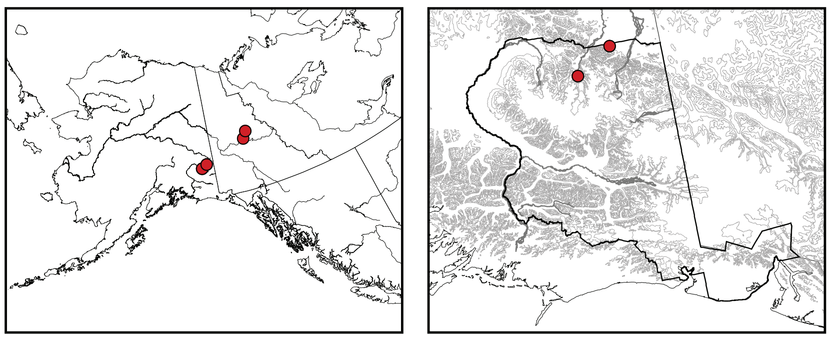


41. *Carex lapponica*

***Carex laxa* Wahlenb., Weak Sedge** -- Our collections of this incompletely circumpolar boreal-montane sedge are the only verified stations in Alaska. David F. Murray reviewed a collection of *Carex laxa* from Mile 172-174 on the Richardson Highway (*J.P. Anderson 2712B* (S), Hultén 1941-1950) but could not confirm the

original determination (Murray, pers. com.). It is known from Europe, Asia and in North America only from the collections in the park, the Mackenzie Delta in the Northwest Territories and a few localities in the central Yukon Territory. It occurs in woods, swamps and muskeg. It resembles *C. limosa* which is more common, so may be overlooked throughout its range. The park collections extend its range 368 km to the west from the Yukon Territory into Alaska. It is extremely rare in Alaska (S1) but apparently secure globally (G4).

TANANA RIVER BASIN: ► scattered in marsh vic. Lick Creek, 914 m, 62º28.89' N 142º7.56' W, *M. Cook & K.A. Beck 95112A (ALA)* **29 June 1995**, det. M.J. Waterway (WTU) 1997. **WRANGELL MOUNTAINS**: ► graminoid meadow, lakes at confluence of Monte Cristo Creek and Nabesna River, 1067 m, 62º14.27' N 142º55.81' W, *C. Roland 96-134 (ALA)* **18 June 1996**, det. M.J. Waterway (WTU) 1997.



42. *Carex laxa*

Carex lenticularis **Michx. var. *dolia* (M.E. Jones) L.A. Standley. Lakeshore Sedge** -- This North American cordilleran sedge is rare in Alaska (G5T3Q S3). The specimens cited above extend its range 188 km to the east of a collection in the Valdez Quad (Thompson Pass, 61°08.0' N 145°45.0' W, C.L. Parker *2451*, 23 July 1990 (ALA)) and connect the range 423 km to the southeast near Skagway (Hultén 1968).

CHITINA RIVER BASIN: ► edges of pools, marshy area of alluvial fan, tributary stream., Granite River, 823 m , *A. Batten & M. Barker* 96-343, **30 July 1996.**

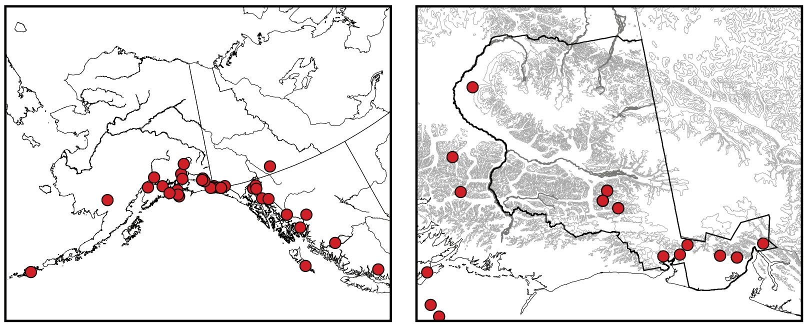
COASTAL MOUNTAINS AND FOOTHILLS: ► patchy in mixed herb meadow and along wet seep, Guyot Hills, 658 m, 60º09.09' N 141º27.28' W, *P. Loomis & A. Larsen 1207*, **19 July 2003**, det. Carolyn Parker (ALA) 2003; ► occasional in patches of organic soil on slope of unstable washout gravel, Mid-Tyndall Glacier, 749 m, 60º08.23' N 141º06.36' W, *P. Loomis & A. Larsen 1405*, **20 July 2003**, det. Carolyn Parker (ALA) 2003: ► common throughout moist subalpine heath, Floral Pass, 449 m, 59º59.11' N 139º56.33' W, *P. Loomis & A.Larsen1694, 1699, 2004*, **23 July 2003**, det. Carolyn Parker (ALA) 2003; ► abundant in fen, Hitchcock Hills, 568 m, 60º02.51' N 140º16.48' W, *P. Loomis & A. Batten 1801*, **25 July 2003**, det. C. Parker (ALA) 2003.

MIDDLE COPPER RIVER BASIN: ► common in silt and cobble on sparsely vegetated margin of pond, Sanford River, 749 m, 62º13.35' N 144º58.16' W, *P. Loomis & S. Backensto 2181,* **9 August 2003**, det. C. Parker (ALA).

NORTHERN CHUGACH MOUNTAINS: ► flooded silt bar of tributary stream, Martin Creek, 1097 m, 60º56' N 142º23' W, *Batten & Barker 96-266*, **28 July 1996**; ► scattered in snowmelt rivulet, west fork of 12-mile Creek, 1326 m, 60º50.21' N 142º30.85' W, *C. Roland 96-787,* **29 July 1996,** conf. C. Parker (ALA) 1996; ► marsh

on alluvial fan, Granite Creek, 823 m, 60º44' N 142º13' W, *Batten & Barker 96-343*, **30 July 1996**; ► moist meadow, west fork of 12-mile Creek, 1326 m, 60º50.21' N 142º30.85' W, *M. Cook 96593*, 29 **July 1996** (ALA), conf. C. Parker (ALA) 1997.

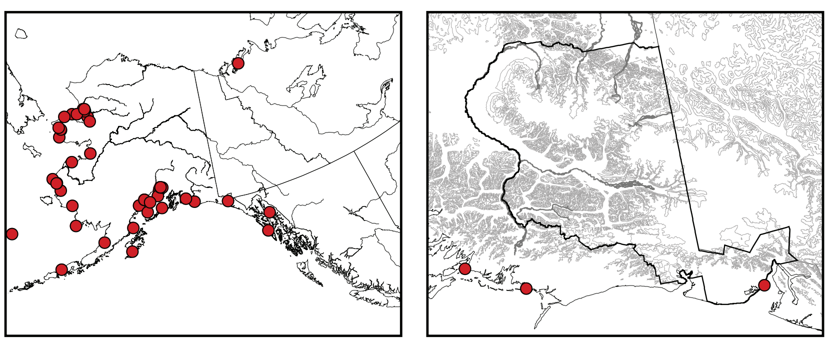
SOUTHERN CHUGACH-ST. ELIAS MOUNTAINS: ► common in moist organic soil surrounding alpine fen, Mount Haydon Nunatak, 924 m, 60º13.20' N 140º54.58' W, *P. Loomis & A. Larsen 1340*, **14 July 2003**, det. C. Parker (ALA); ► in *Vaccinium* tundra amongst quartz rock outcrops, Mount Foresta, 796 m, 60º04.30' N 139º20.23' W, *P. Loomis & A. Batten 1885*, **26 July 2003**, det. C. Parker (ALA) 2003.



43. *Carex lenticularis* var. *dolia*

***Carex mackenziei* Krecz., Mackenzie's Sedge –** Our collection of this sedge from the coast connects its distribution 271 km to the west near the mouth of the Copper River (Softuk Bar, 60º13' N 144º40' W, *Batten & Murphy 77-363*, 23 July 1977 (ALA) with a station 355 km to the east near Juneau. *C. mackenziei* has a boreal montane distribution in Europe, Asia and in North American where it occurs in coastal and estuarine marshes with brackish soils (Flora of North America 2003).

GULF OF ALASKA: ► occasional in fresh sedge marsh in 5-10 cm deep water, Strawberry Island, 0 m elev., 59º 49.36' N 139º 50.17' W, *P. Loomis & A. Batten 1722 (ALA)*, **24 July 2003**, det. A. Batten (ALA) 2003.



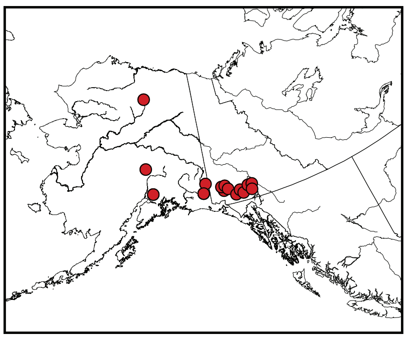
44. *Carex mackenziei*

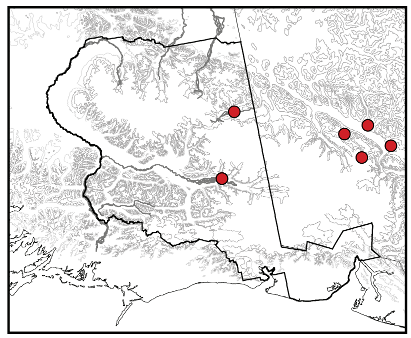
***Carex parryana* Dew., Parry's Sedge** -- This western North American boreal-montane sedge is rare in Alaska (S1) but apparently secure globally (G4). In Alaska, it is known only from three other localities besides the two collections in the park. The collections outside the park, made prior to the publication of Hultén's 1968 flora, are disjunct near Wiseman at the head of the Koyukuk River, in Denali National Park and near Anchorage. Our collections extend its range into the White and Chitina River basins and connect the collections in the Anchorage Quad 348 km to the east (Eklutna, 61°28.0'

N 149°22.0' W, *P.A. Dutilly, E.L. LePage & O'Neill 20709*, 7 July 1947 (ALA)) with its distribution in the Yukon Territory 162 km to the west (Cody 1996). It occurs east as far as Ontario in Canada, and Colorado in the United States in muddy shores, sheltered ponds, alkaline meadows, lake margins, roadsides and ditches (Flora of North America 2002, Cody 1996).

CHITINA RIVER BASIN: ► open low willow scrub, Clear Stream, terminus of Barnard Glacier, 488 m, 61º5.82' N 141º57.92' W, M. Duffy & J. Barnes 96-012, **8 August 1996**, conf. D.F. Murray (ALA) 1996.

WHITE RIVER BASIN: ► moist patch on open river bar, Pingpong Mountain, 1001 m, 61º 44.37' N 141º 26.41' W, *B. Bennett & P. Loomis 03-228 (ALA)*, **5 June 2003**.





45. *Carex parryana*

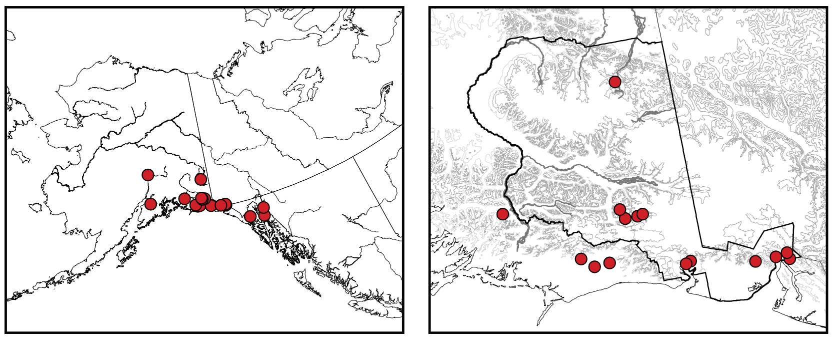
***Carex phaeocephala* Piper, Dunhead Sedge** -- This western North American cordilleran sedge is rare in Alaska (S1S2) but apparently secure globally (G4). Prior to our inventory, it was known from one locality in Alaska near Hope and one locality near the Schwan Glacier by Cordova. We documented four localities in the Chugach Mountains, one in the Nutzotin Mountains and six in the coastal St. Elias Mountains from 1996 to 2003. It has also been collected at three localities from 2001-2003 in the Bering Glacier Quad adjacent to the park. Outside of Alaska it is known from British Columbia, Alberta, as far south as California, and as far east as Wyoming. Reports of *C. phaeocephala* in the Yukon and Northwest Territories are based on other species, mostly *C. tahoensis* (Porsild and Cody 1979, Cody 1996, Flora of North America 2002). It occurs in high-montane to alpine areas, usually in rocky soils (Flora of North America 2002).

CHUGACH MOUNTAINS: ► scattered in loose, talus on S-facing slope, vic. 12-mile Creek, 1335 m, 60º49.71' N 142º33.34' W, *C. Roland 96-815*, **30 July 1996**; ► tufted on slope of moraine in *Arctostaphylos uva-ursi* patches, Granite River, 884 m, 60º44.63' N 142º6.05' W, *M. Cook 96602*, **7 July 1996**; ► mesic shrub birch-ericaceous, Granite Creek, near Ross Green Lake, 701 m, 60º43.83' N 142º28.78' W, *M. Duffy & J. Barnes* 96-056, 96-057, **8 August 1996**, conf. C. Parker (ALA) 1996.

SOUTHERN ST. ELIAS MOUNTAINS: ► Patchy in silt on solifluction slope, Karr Hills, 1070 m, 60º 11.16' N 141º 18.27' W, *P. Loomis & A. Larsen 1297*, **19 July 2003**, det. C. Parker (ALA) 2003 ; ► patchy in mountain heath meadow, Guyot Hills, 933 m, 60º 10.12' N 141º 24.36' W, *P. Loomis & A. Larsen 1266*, **19 July 2003**, det. C. Parker (ALA) 2003; ► occasional in thin organic soil, ridge between Hayden Glacier and upper Lucia Glacier, 999 m, 60º 03.12' N 140º 00.05' W, *P. Loomis & A. Larsen 1663*, **23 July**

2003, conf. A. Batten (ALA) 2003; ► patchy in open, shale with sparse vegetation cover, ridge 2.5 km N of confluence with Disenchantment Bay in vic. Haenke Glacier, 510 m, 60º 03.14' N 139º 34.38' W, *P. Loomis & A.. Batten 1862*, **26 July 2003**, det. C. Parker (ALA) 2003; ► *Vaccinium* tundra amongst rocky outcrops of smooth, dark grey rock and quartz, Mount Foresta, 796 m, 60º 04.30' N 139º 20.23' W, *P. Loomis & A.. Batten 1888,* **26 July 2003**, det. C. Parker (ALA) 2003; ► patchy on unstable scree slope near small rivulet, vic. Variegated Glacier, 387 m, 60º 00.30' N 139º 18.43' W, *P. Loomis & A. Batten 1999 (ALA)*, **28 July 2003**, det. C. Parker (ALA) 2003.

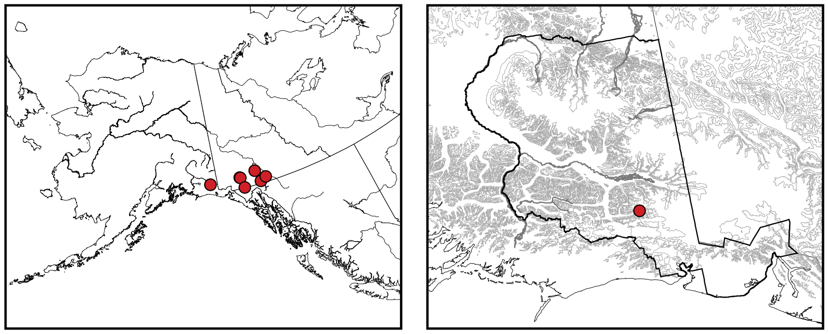
WRANGELL MOUNTAINS: ► drumlin ridges, well drained silty gravels, and *Dryas* heath, Euchre Mountain, 1248 m, 62º 06.54' N 142º 11.10' W, *B. Bennett & P. Loomis 03-891 (ALA)*, **20 June 2003**, det. C. Parker (ALA) 2003.



46. *Carex phaeocephala*

***Carex tahoensis* Smiley, Liddon Sedge –** We initially reported this collection as *Carex petasata* Dew. (Cook and Roland 2002). It was reviewed by Anton Reznicek in 2003 and determined to be *Carex tahoensis*, which is new to the flora of Alaska. Our collection extends its range 250 km to the west into Alaska from two collections in the Dezadeash Quad of the Yukon Territory (Alsek River Valley, Raup & Raup 11958, 26 June 1944, 60 47.06 137 36.09; Pine Creek vicinity, Raup & Raup 11761, 16 June 1944, 60 45.85 137 31.08 (ALA)). *C. tahoensis* resembles *C. petasata* and *C. phaeocephala* and hence its distribution is still unclear (Flora of North America 2002). It is extremely rare in Alaska (S1) and rare throughout its range (G3). It has a western North American cordilleran distribution extending south from Alaska to the Yukon Territory, Alberta, British Columbia, Arizona, California (S3), Colorado, Idaho, Montana, New Mexico, Oregon, Utah, Washington and Wyoming (Flora of North America 2002, NatureServe 2004). It occurs in grasslands, sagebrush slopes, open rocky and sandy slopes, subalpine and alpine meadows.

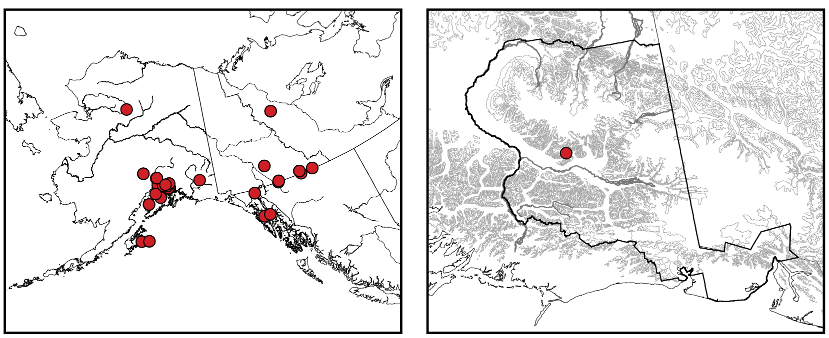
CHUGACH MOUNTAINS: ► locally common in a dry meadow on lateral moraine, Granite Creek, 884 m, 60º44.63' N 142º6.05' W, *C. Roland 96-791 (ALA)* **29 July 1996**, det. A.A. Reznicek (MICH) 2003.



47. *Carex tahoensis Smiley*

***Eriophorum viridi-carinatum* (Engelm.) Fern., Tassel Cotton-grass** -- This North American boreal-montane cotton-grass is rare in Alaska (S2) but secure globally (G5). Our collection connects its distribution 259 km to the west in the Anchorage Quad (Muldoon bog, 61°12.22' N 149°42.97' W, *M. Duffy & J. Tande 923*, 26 July 1994 (ALA)) with a station 458 km to the southeast near Haines (Hultén 1968).

WRANGELL MOUNTAINS: ► occasional in *Sphagnum* bog, Lakina River, Chitina River Basin, 792 m, 61º29.49' N 143º25.6' W, *C. Roland 96-672*, **24 July 1996**.

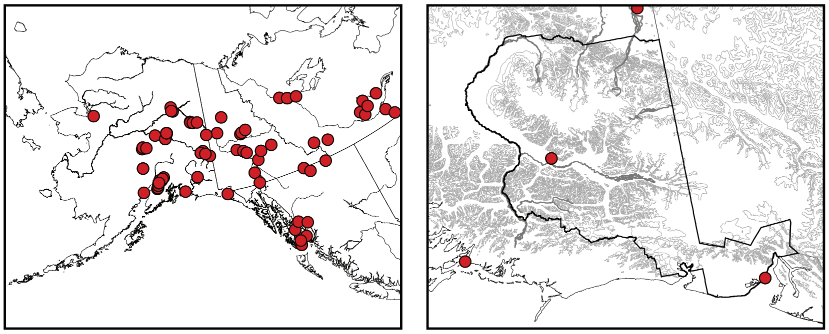


48. *Eriophorum viridi-carinatum*

***Schoenoplectus tabernaemontani (*G.C. Gmelin) Pall*, (=Scirpus validus* Vahl*),* Soft-Stem Club-Rush –** This rush was collected for the first time in the park in 2003 in the Chitina River drainage and along the coast. The coastal collection connects the range 338 km to the west near Cordova (Hartney Bay, Batten & Murray 77-291, 11 July 1997) with a station 278 km to the east near Haines (Hultén 1968). The Chitina River collection connects the interior distribution of this rush in the upper Tanana Valley with its coastal distribution.

MALASPINA FORELANDS: ► locally abundant in 0.5-1 m deep water around pools, Strawberry Island, 59º 49.36' N 13º 50.17' W, *P. Loomis & A. Batten 1721;* **24 July 2003.**

CHITINA RIVER BASIN: ► small patch on margin of pond in fresh sedge marsh, vic. Rock Lake, S of McCarthy Road, 396 m, 61º 25.11' N 143º 46.04' W, *M. Cook & J. Wilder 5110 (ALA)*, **8 August 2003**, conf. C. Parker (ALA) 2004.

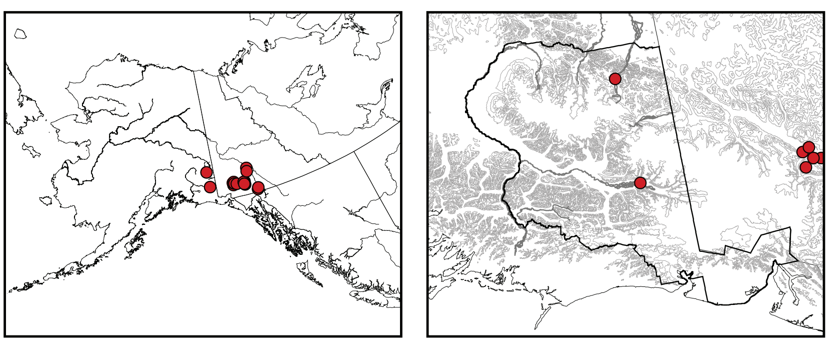


49. *Schoenoplectus tabernaemontani*

***Trichophorum pumilum* (M. Vahl.) Schinz. & Thell. (=*Scirpus rollandii* Fern., *Scirpus pumilus* - Vahl., *Trichophorum pumilum* (M. Vahl.) Schinz. & Thell. var. *rollandii* (Fern.) Hult.), Rolland's Leafless-Bulrush** -- This incompletely circumpolar boreal montane bulrush has only been documented twice in Alaska and both localities are in the park. These collections are 191 km west of localities in the Yukon Territory (Cody 1996). The collection from the Chisana River in 2003 extends its range120 km northwest in the park to its westernmost extant in North America. It is extremely rare in Alaska but globally secure (G5). It is also found in central Asia, Europe, British Columbia (S2S3), Alberta (S2), Quebec (S2), Yukon Territory, California (S1S2), Colorado (S2) and Wyoming (S1) (Flora of North America 2002, NatureServe 2004). It is a calciphile and occurs in moist to wet coniferous swamps, bogs and riverbanks (Flora of North America 2002).

TANANA RIVER BASIN: ► growing in dense patches in depressions within freshwater slough meadow in old channel on river terrace, Chisana River, Medicine Man Cr. river bar meadow, 937 m, 62º 10.98' N 142º 05.63' W, *C. Roland & A. Batten 5773 (ALA)*, **17 June 2003**, det. A. Batten (ALA) 2003.

CHITINA RIVER BASIN: ► wet alluvium at terminus of Barnard Glacier, 488 m, 61º5.82' N 141º57.92' W, *M. Duffy & J. Barnes 96-036*, **5 August 1996**, conf. C. Parker (ALA) 1996.



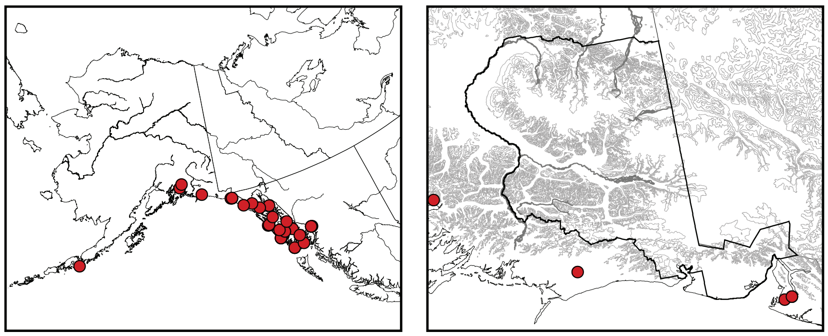
50. *Trichophorum pumilum* var. *rollandii*

DRYOPTERIDACEAE

***Polystichum setigerum* (C. Presl) C. Presl, Alaska Holly-Fern –** Our collection of *Polystichum setigerum*, from just outside the park border on the coast, connects its main range 249 km to the east near Yakutat (M. Stensvold 5618, 16 July 1991 (ALA))

with a station 185 km to the west near Valdez (Hultén 1968). This fern is endemic to Alaska and British Columbia where it is found on forest floors in lowland coastal forests (Flora of North America 2002). Its distribution in Alaska is primarily in the southeast except for disjunct populations on Attu Island at the western end of the Aleutians, the station near Valdez and our collection from the Robinson Mountains.

COASTAL CHUGACH MOUNTAINS: ► dwarf scrub/forb herbaceous tundra, ridge between Canyon and Clear Creeks, Robinson Mountains, 540 m, 60 ° 15.17"N 143 ° 34.58"W, M. Duffy 92112, **14 June 1992**.

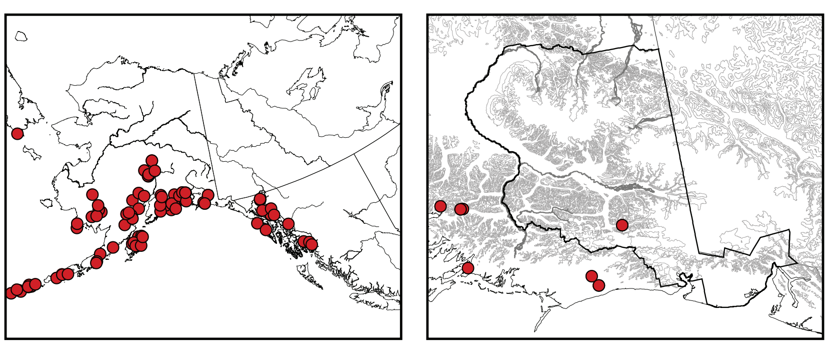


51. *Polystichum setigerum*

ERICACEAE

***Cassiope lycopodioides* (Pall.) D. Don var. *cristapilosa* (Calder & Taylor) Boivin, Clubmoss Mountain-Heather --** Our collections of this fern connect its coastal distribution 156 km to the west near Cordova with its range 454 km to the southeast near Haines (Hultén 1968). A second collection near our 1992 collection in the Grindle Hills was made in 2001 by Barker and Pratt (s.n., 7 August 2001 (ALA)) *C. lycopodioides var. cristapilosa* has an amphiberingian distribution occurring in northeast Asia, Alaska, and northwest British Columbia. It occurs on mesic to dry slopes, heath, and meadows in the subalpine and alpine zones (Douglas et. Al. 1999).

CHUGACH MOUNTAINS: ► ericaceous dwarf scrub tundra, nunatak between peaks 2710 & 2425, Grindle Hills Nunatak, 636 m. elev., 60° 09.9' N 143° 10'W, *M. Duffy, s.n.* **13 June 1992**; ► gravel moraine, Granite Creek, 690 m elev., 60° 43.83' N 142° 28.78' W, *M. Duffy & J. Barnes 96-060,* **8 August 1996**, conf. C. Parker (ALA) 1996.



52. *Cassiope lycopodioides* var. *cristapilosa*

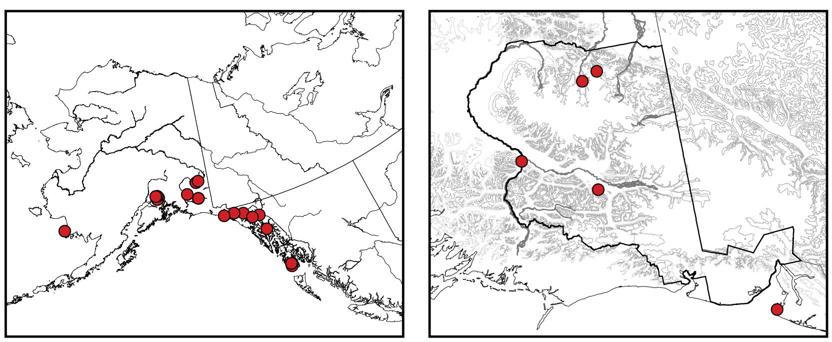
FABACEAE

***Astragalus harringtonii* (Rydb.) Hultén *(=Astragalus robbinsii* (Oakes) Gray var. *harringtonii* (Rydb.) Barneby), Harrington Milk-Vetch** -- This species is endemic to Alaska with a Pacific coastal distribution, is uncommon in the state (S3), secure globally (G5T3) and known from only three localities in the park . There were two stations adjacent to the park mapped in Hultén 1968, one at Chitina and one at Yakutat Bay (59°47.35'N 139°33.69'W, *E.P. Walker 2416*, 1subsp. (US)). Our collections extend its range into the Tanana River Basin and Nutzotin Mountains and connect the distribution 250 km to the west in the Anchorage Quad with its distribution 251 km to the southeast near Yakutat (Hultén 1968). This taxon is not accepted at the specific level by Kartesz (1999) who treats it as a variety, nor by Hultén who treated it at the subspecific level in his 1968 flora. We follow recommendations of D.F. Murray (ALA) and Welsh (1974) in accepting the specific epitaph until further research is completed on this group.

CHITINA RIVER BASIN: ► occasional near edge of forest in eroding soils, Tana Dunes, 488 m, 61º6.19' N 142º55.03' W, *C. Roland 94-180*, 7 July 1994, det. C. Parker (ALA) 1995.

TANANA RIVER BASIN: ► few in poplar woodland, Nabesna River, 884 m, 62º12.63' N 142º52.28' W, *M. Cook 96173B*, **6 June 1996**.

NUTZOTIN MOUNTAINS: ► rare on N-facing limestone talus slope in moist red silt clay, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *M. Cook 94353*, **24 July 1994**, det. C. Parker (ALA) 1995.



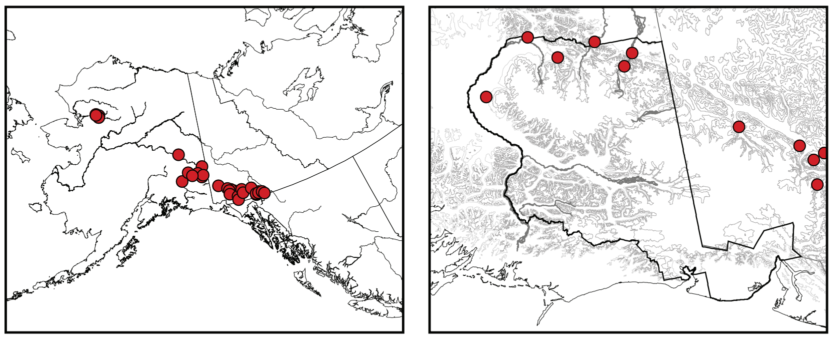
53. *Astragalus harringtonii*

***Lupinus kuschei* Eastw., Yukon Lupine** -- This Alaska-Yukon endemic with a boreal- montane distribution is rare in Alaska (S2) and throughout its range (G3) in the Yukon Territory and British Columbia (S2S3). It is now known from eight localities in the Tanana and Upper Copper River basins. Prior to our collections beginning in 1991, it was known only from the Kobuk Dunes in northwest Alaska (Ambler River Quad: Melchior 801, 16 September 1973 (ALA)) and a locality near Delta Junction (Hultén 1968). Our collections indicate that its current distribution is centered on the northern section of the park in Alaska following the northern edge of the Wisconsin ice sheet into the Yukon. Populations in Northwest Alaska are now seen as disjunct from this distribution. It grows in sandy alluvium, sand dunes and open woods.

TANANA RIVER BASIN: ► occasional in sandy areas of gravel bar, Totschunda Creek floodplain, 725 m, 62º26.94' N 42 º40.8' W, *C. Roland 96-255*, 23 June 1996, conf. C. Parker (ALA) 1996; ► common on windswept active and established river bars, Nabesna River, 632 m, 62º 32.44' N 142º 28.30' W, *B. Bennett & P. Loomis 03-299, 03-*

308, **7 June 2003**; ► scattered on river terrace, Chisana River, 864 m, 62º 14.64' N 141º 55.23' W, *C. Roland & A. Batten 5778(ALA)*, **18 June 2003**, conf. A. Batten, (ALA) 2003; ► growing in large patches in open floodplain deposits, river terraces between Brian Creek and Chisana River, 746 m, 62º 21.69' N 141º 42.24' W, *C. Roland & A. Batten 5837 (ALA)*, **22 June 2003**, conf. A. Batten (ALA) 2003.

UPPER COPPER RIVER BASIN: ► gravel roadside, km 2.4 Nabesna Road, 655 m, 62º41.84' N 143º55.1' W, *M. Duffy 91014*, **22 June 1991**, conf. C. Parker (ALA) 1992; ► sparsely vegetated dry forb-graminoid herbaceous meadow, Sanford Dunes, 686 m, 62º1.59' N 145º0.12' W, M. *Duffy 92200*, **10 July 1992**, conf. C. Parker (ALA) 1992.



54. *Lupinus kuschei*

***Oxytropis huddelsonii* Pors., Huddelson's Locoweed** -- This Alaska-Yukon endemic with a cordilleran distribution is rare in Alaska (G3 S2S3). It had been collected at four localities in the Wrangell-St. Elias Mountains: Russell Glacier (61°41.93'N 141°45.36'W, *D. F. Murray 2168*, 11 August 1968 (ALA)), Guerin Glacier (61°37.42'N 141°4.38'W, *D. F. Murray 2037*, 3 August 1968 (ALA)); Chitistone Pass (61°37' N 141º58' W, *D. F. Murray 712* (CAN) (Murray 1968)), and Chetaslina River headwaters (61°59.36'N 144°20.24'W, *R. Saltmarch PA21*, 11 July 1978 (ALA)). Our collections extend its range 114 km south into the Bagley Icefield, 71 km south into the Chugach Mountains, 96 km north into the Mentasta Mountains and 89 km north into the Nutzotin Mountains.

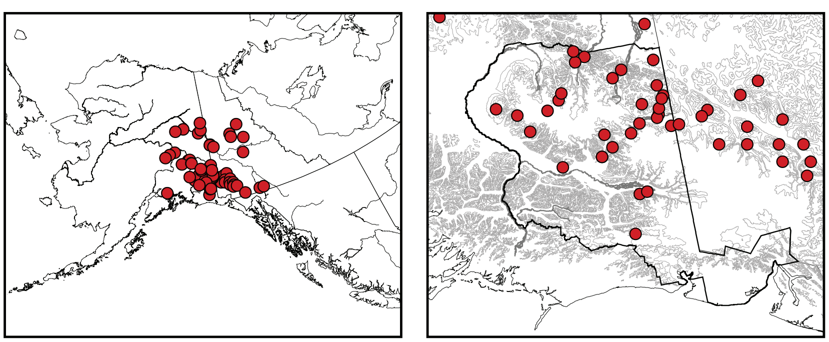
CHUGACH MOUNTAINS: ► solifluction soil, mesic tundra, Juniper Island, Granite Range, 1346 m, 60º36.17' N 142º14.96' W, *C. Roland 94-216*, **12 July 1994**. C. Parker (ALA), 1996; ► scattered in gravel, SW-facing slope, Granite Creek, 1829 m, 61º0.22' N 141º51.1' W, *C. Roland 96-744*, **28 July 1996**, conf. C. Parker (ALA), 1996; ► boulder field, in mat of *Rhacomitrium*, E. Fork Kiagna River, Granite Range, 1487 m, 60º59.5' N 142º1' W, *Batten & Barker 96-321*, **29 July 1996** (ALA).

MENTASTA MOUNTAINS: ► Soda Lake, 1173 m, 62º32.36' N 142º53.98' W, *C. Roland 94-259C*, **22 July 1994**; ► scattered in calcareous gravel, Totschunda Creek, 1280 m, 62º27.63' N 142º12.44' W, *C. Roland 96-287*, **24 June 1996**; ► rare in dry, gravelly tundra, Devil's Mountain, 1530 m, 62º25.62' N 142º53.93' W, *C. Roland 96-360D*, **3 July 1996**, conf. C. Parker (ALA) 1996.

NUTZOTIN MOUNTAINS: ► moist tundra, NW-facing slope, 4 km E of Wiki Peak, 1585 m, 61º55.98' N 141º8.02' W, *C. Roland 94-119B*, **23 June 1994**. det. C. Parker (ALA), 1996, ; ► occasional on steep S-facing scree slope, Horsfeld Creek, 1768 m, 62º2.88' N 141º13.18' W, *M. Cook 94146*, **24 June 1994,** conf. C. Parker (ALA),

1995 ; ► scattered in gravel areas, S-facing alpine meadow, Carden Hills, 1311 m, 62º18.44' N 141º11.55' W, *C. Roland 94-140B*, **26 June 1994**; ► common in dry graminoid tundra, W-facing slope, Rock Lake, 1119 m, 61º48.7' N 141º16.57' W, *C. Roland 96-032*, **6 June 1996,** det. C. Parker (ALA) 1996; ► occasional in tundra and dry gravels, Wiki Creek, 1411 m, 61º54.46' N 141º10.68' W, *C. Roland 96-061*, **6 June 1996,** det, C. Parker (ALA) 1996; ► patchy in windswept *Dryas* tundra at summit, White River Valley, 1494 m, 61º45.15' N 141º18.16' W, *B. Bennett & P. Loomis* 03-295, **6 June 2003**, conf. Carolyn Parker (ALA) 2004; ► common in shallow pockets of soil in outcrops and along basalt columns, White River Valley, 1109 m, 61º43.53' N 141º21.15' W, *B. Bennett & P. Loomis 03-892*, **4 June 2003**, det. Carolyn Parker (ALA) 2004.

WRANGELL MOUNTAINS: ► N-facing scree slope, Lime Creek, 1707 m, 61º53.27' N 141º37.05' W, *M. Cook 92112*, **7 July 1992,** det. C. Parker (ALA) 1996; ► basalt rubble, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94401*, **25 July 1994**, conf. C. Parker (ALA) 1995; ► common in mesic tundra, Crystalline Hills, 1585 m, 61º23.59' N 143º31.85' W, *C. Roland 95-233*, 18 July 1995; *Dryas* dwarf scrub tundra, Lakes Plateau, 1890 m, 62º4.4' N 143º23.5' W, *Potkin & Leggett 95-113*, **30 July 1995**, det. C. Parker (ALA) 1996; ► occasional in morainal deposits, Ruddy Mountain, 1615 m, 62º4.61' N 144º46.39' W, *C. Roland 96-329*, **2 July 1996**, conf. C. Parker (ALA) 1996; ► dry tundra, Nikolai Pass, 1280 m, 61º26' N 142º40' W, *Batten & Barker 96-013*, **23 July 1996** (ALA); ► dry tundra, Nikolai Pass, 1280 m, 61º26' N 142º40' W, *Batten & Barker 96-049*, **23 July 1996**; ► common in tundra, Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, *C. Roland 96-647*, **23 July 1996**, conf. C. Parker (ALA) 1996; ► moist scree, VABM Sentinel, W of Nizina Glacier, 1829 m, 61º39' N 142º32' W, *Batten & Barker 96-117*, **24 July 1996** (ALA); ► scattered in volcanic sand, Cheshnina Plateau, 1399 m, 61º48.04' N 144º6.27' W, *M. Cook 96712*, **5 August 1996**.

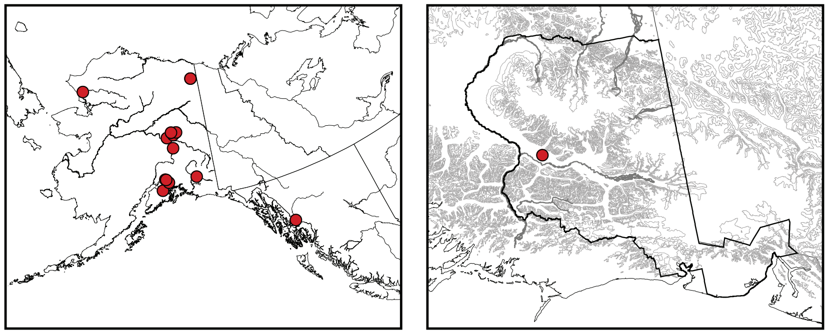


55. *Oxytropis huddelsonii*

HALORAGACEAE

***Myriophyllum verticillatum* L., Whorlleaf Watermilfoil –** This species is uncommon in Alaska (S3) but secure globally (G5) and known from only one locality in the park. Its distribution is incompletely circumpolar and disjunct from temperate zones. The specimen cited above extends its range 238 km east from the Anchorage Quad (Otter, 61°17.53' N 149°44.17' W, *Duffy & Tande 1019*, 3 August 1994 (ALA)) and connects the range 363 km to the east near Haines Junction in the Yukon Territory (Cody 1996).

WRANGELL MOUNTAINS: 1 m deep water, bog 2.5 km NW of Billy Lake, 614 m, 61°27.99' N 143°56.38' W, *C. Roland 94-323*, **10 August 1994**.



56. *Myriophyllum verticillatum*

HYDROPHYLLACEAE

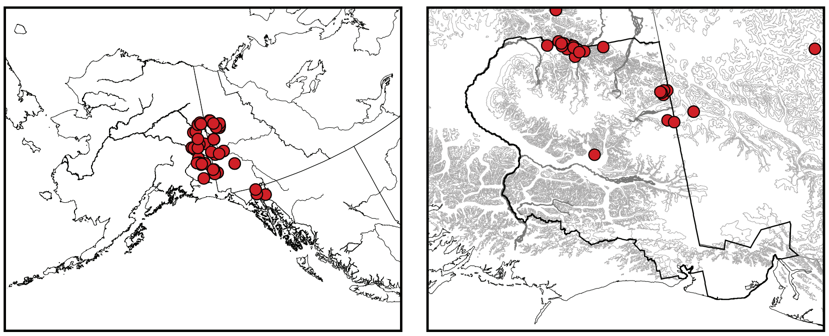
***Phacelia mollis* Macbr., Soft Phacelia** -- first collected in the park in 1989 at Jack Creek, then at Ptarmigan Creek in the Nutzotin Mountains in 1992, our inventory documented an additional 17 localities, ten of these in the Mentasta Mountains. It is an Alaska-Yukon endemic with a narrow distribution centered on the park north to the Charley River Quad and only as far east as the Mt Hayes Quad. It is rare in Alaska (G2 S2S3) and in the Yukon Territory (Douglas et al. 1981). It has a wide ecological tolerance being found on disturbed roadside margins and within varied sub-alpine and alpine communities from mesic tundra to steppe bluffs. The collections cited above extend its range 129 km south into the St. Elias Mountains (with intermediate stations in the Wrangell and Mentasta Mountains) from a station at Mile 1257 on the Alaska Highway (62°58.0' N 141°38.0' W, *M. Williams 2137*, 17 June 1968 (ALA)).

MENTASTA MOUNTAINS: ► disturbed roadside margin, mile 34 Nabesna Road, 884 m, 62º21.18' N 143º6.79' W, *K.A. Beck s.n.*, **1989**; ► large population in rubble slope and tundra, ridge S of Soda Creek, 1173 m, 62º32.36' N 142º53.98' W, *C. Roland 94-256*, **22 July 1994**; ► *Dryas*-forb tundra & limestone scree, Lost Creek, 1646 m, 62º34.58' N 143º5.58' W, *M. Cook 94337*, *C. Roland 94-269*, **23 July 1994**, conf. C. Parker (ALA) 1995; ► scattered in tundra, Boyden Hills, 1442 m, 62º30.97' N 143º2.98' W, *C. Roland 95-088*, **27 June 1995**; ► occasional in greenstone rubble, Soda Lake, 1494 m, 62º31.2' N 142º54.03' W, *C. Roland 95-141*, **5 July 1995**; ► *Dryas* tundra, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *K.A. Beck 95-223*, **7 July 1995**; ► scattered in dry tundra, Totschunda Creek, 1280 m, 62º27.63' N 142º12.44' W, *C. Roland 96-271*, **24 June 1996**; ► occasional in ericaceous tundra, Devils's Mountain, 1530 m, 62º25.62' N 142º53.93' W, *Cook & Shea 96278*, **7 July 1996** (ALA); ► scattered in *Arctostaphylos uva-ursi-Betula* scrub, Lost Creek bluff, 1097 m, 62º33.3' N 143º9' W, *Roland & D'Auria 97-040*, **26 June 1997**; ► occasional in rocky tundra, Lost Creek , 1189 m, 62º35' N 143º9.1' W, *Roland & D'Auria 97-060*, **26 June 1997**; occasional in rocky *Dryas*-heath-forb tundra, Lost Creek , 1646 m, 62º35' N 143º9.1' W, *Roland & D'Auria s.n.*, **26 June 1997**; ► patchy in low scrub, ridge between Platinum and Totschunda Creeks, 1494 m, 62º27.89' N 142º47.38' W, *Cook & Batten 3163*, **9 July 1998** (ALA).

NUTZOTIN MOUNTAINS: ► N-facing graminoid forb tundra, 2.4 km W of Ptarmigan Creek, 1494 m, 61º55.55' N 141º6.72' W, *M. Cook 92465*, **9 July 1992**; ► N-facing graminoid forb tundra, 2.4 km W of Ptarmigan Creek, 1494 m, 61º55.55' N

141º6.72' W, *M. Duffy 92180*, **9 July 1992**; ► rare on S-facing scree slope, Wiki Basin, 1433 m, 61º55.22' N 141º2.75' W, *M. Cook 94142*, **23 June 1994**, conf. C. Parker (ALA) 1995; *Dryas* tundra slopes, headwaters of Alder Creek, 1554 m, 62º28.44' N 142º15.06' W, *K.A. Beck 95-205*, *95212*, *M. Cook 95132*, **29 June 1995**; ► few in bare mineral soil, Wiki Creek, 1411 m, 61º54.46' N 141º10.68' W, *M. Cook 96100*, *C. Roland 96-072*, **11 June 1996**; ► bluff E of lodge, Ptarmigan Lake, 1079 m, 61º53' N 141º8.8' W, *Duffy & Barnes 96-253*, **10 August 1996**, conf. C. Parker (ALA) 1996; ► few in ericaceous heath, Wiki Creek, 1615 m, 61º55.11' N 141º11.81' W, *M. Cook 3176*, (ALA). **15 July 1998.**

ST. ELIAS MOUNTAINS: ► occasional in ash deposit, Cub Creek, 1280 m, 61º37.27' N 141º9.75' W, *M. Cook 94186*, **28 June 1994**, conf. C. Parker (ALA) 1995; ► scattered over ash deposit, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *M. Cook 95077*, **20 June 1995**.

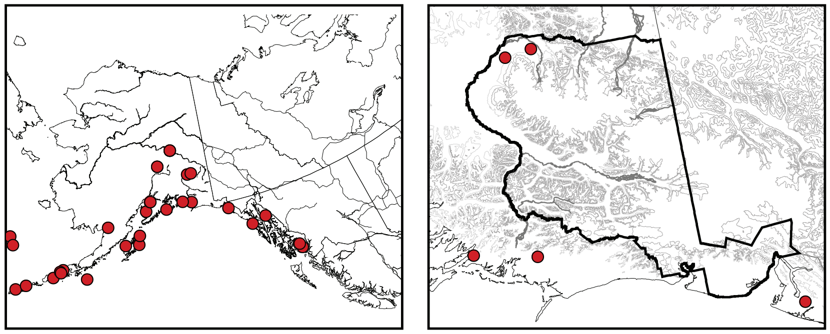


57. *Phacelia mollis*

ISOETACEAE

***Isoëtes maritima* L. Underwood, Maritime quillwort –** Our collections of this quillwort extend its range 228 km north into the upper Copper River basin from the coast (Cordova Quad, Martin River, A. Leggett 9730-31, 6 August 1997 (ALA)). The closest interior collection is 260 km to the northwest near Broad Pass in the Alaska Range (63º19' N, 149º09' W, *Smith 2205*, 4 September 1953 (ALA)). *Isoetes maritima* occurs in coastal regions of Alaska, British Columbia and Washington.

UPPER COPPER RIVER BASIN: ► submerged, in organic soil near margin of lake, Lake 2415', 736 m, 62º 30.41' N, 144º 27.82' W, *M. Cook & M. Reid 5148*, **9 August 2003**, det. C. Parker (ALA) 2003; ► submerged and rooted in organic soil near margin of rocky shore, Boomerang Lake, 838 m, 62º 33.22' N 143º 51.88' W, *M. Cook & M. Reid 5115 (ALA)*, **9 August 2003**, det. C. Parker (ALA) 2003.



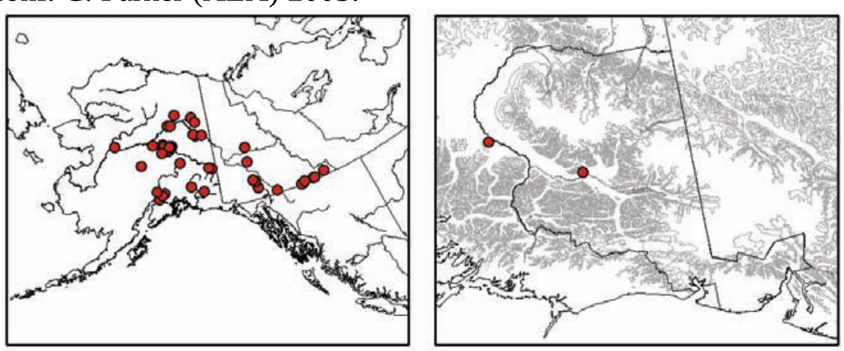
58. *Isoetes maritima*

Lamiaceae

***Scutellaria galericulata* L. var. *pubescens* Benth., Marsh Skullcap --** Our collections of this species of skullcap extend its range 195 km south into the Chitina River basin from the Tanana River valley (Northway, 62º 58' N 141º 56' W, *Rose 88*, 19 July 1957 (ALA)) and 239 km east of the Susitina drainage (Hultén 1968). It has a circumpolar boreal-montane distribution occurring at edges of lakes and streams, roadside ditches and open wet forests in the lowland, steppe and montane zones (Douglas et. al. 2002).

Chitina River basin: ► Long Lake spawning grounds, 518 m, *J. Wilder s.n.*, **26 August 2001**, conf. C. Parker (ALA) 2003.

Middle Copper River Basin: ► patchy in gravel between lake margin and road, Old Edgerton Highway, 427 m, 61º 49.07' N 145º 10.83' W, *M. Cook 4718 (ALA)*, **2 July 2003**, conf. C. Parker (ALA) 2003.



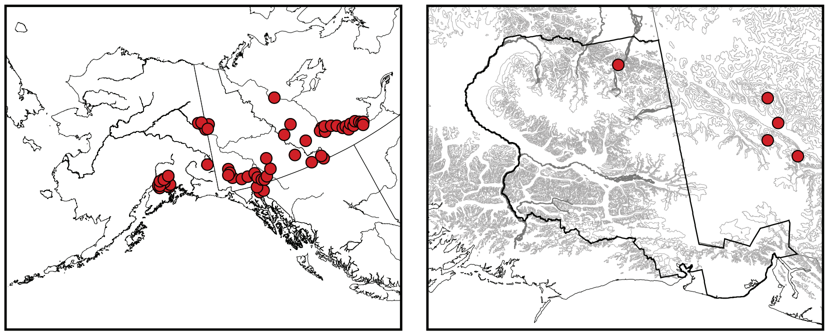
59. *Scutellaria galericulata* var. *pubescens*

Liliaceae

***Maianthemum stellatum* (L.) Link., Star-flowered Solomon's Seal** -- This lily is rare in Alaska (S2), secure globally (G5) and known from only one locality in the park. Our collection extends its range into the Tanana River valley and connects its distribution 328 km to the west in the Anchorage Quad (Long Lake, 61°48.55' N 148°14.56' W, *M.B. Cook 3114*, 2 June 1998 (ALA)) with collections 170 km to the east in the Yukon Territory (Cody 1996). *Maianthemum stellatum* is broadly distributed throughout boreal-montane regions of North America, reaching its northern extent in Alaska. It occurs in sand dunes and marginal woodlands. It is puzzling that only one population has been

found in the park. Adjacent drainages to Sheep Creek with similar site characteristics should be surveyed.

TANANA RIVER BASIN: ► *Populus balsamifera* forest on steep slope, between Sheep and Notch Creeks, 488 m, 62º15.09' N 141º59.17' W, *D. Morrison 84-41*, **19 June 1984**.

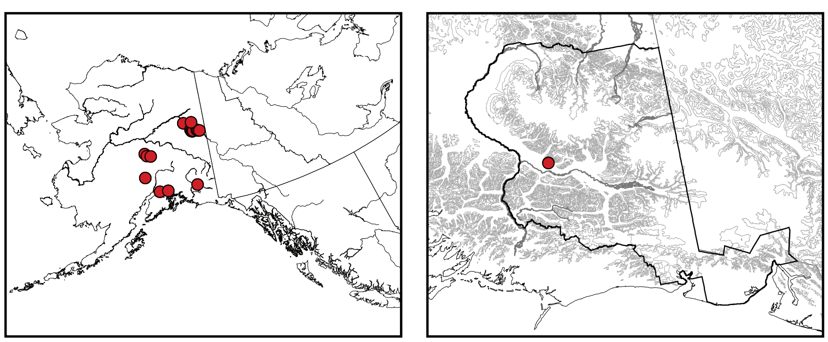


60. *Maianthemum stellatum*

NAJADACEAE

***Najas flexilis* (Willdenow) Rostkov. & Schmidt, Wavy Waternymph** -- This species was not known to the flora of Alaska when we first collected it in 1994. Although it was collected in 1986 in the Fort Yukon Quad (Heglun Plot Lake 23, & Lake 522 near Preacher Creek, 66º 01'N 144º 42'W, *P. Heglund 86-351 & 86-363*, 16 & 17 July 1986 (ALA)), it was not reported until 1994. It is rare in Alaska but secure globally (G5) and is now known from seven additional localities in the Yukon River drainage in Yukon National Preserve, four localities in the Alaska Range in Denali National Park and Preserve and one locality in the Anchorage Quad (Little Kiowa Lake, 61º 15.48'N 149º 39.38'W, *M. Duffy & J. Tande 1030*, 4 August 1994). Our collection is 243 km northeast of the Anchorage Quad collection. *Najas flexilis* has an amphiatlantic distribution, being widespread across North America and Europe.

WRANGELL MOUNTAINS: ► shallow water, Chokosna Lake, 619 m, 61º27.45' N 143º49' W, *C. Roland 94-325*, **10 August 1994**, conf. C. Parker (ALA) 1995.



61. *Najas flexilis*

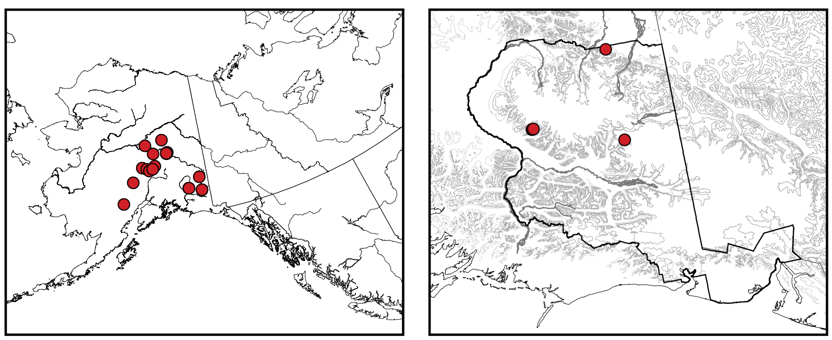
OPHIOGLOSSACEAE

***Botrychium alaskense* W.H. Wagner & J.R. Grant, Alaska Moonwort** -- This moonwort was recently described (Wagner and Grant 2002). It is endemic and rare in Alaska (G2G3 S2S3). Enzyme electrophoresis indicates that *B. alaskense* is an

allotetraploid of Eurasian *B. lunaria* x *B. lanceolatum* (Wagner and Grant 2002). Our collections extend its range 324 km southeast into the Nutzotin and Wrangell Mountains from the vicinity of Salcha (Wagner and Grant 2002) and 316 km east of the Alaska Range (Healy Quad, Carlo Creek, Mike Duffy 02-236, 17 August 2002).

NUTZOTIN MOUNTAINS: ► few in *Dryas*-graminoid tundra, Lick Ridge, 1554 m, 62º28.44' N 142º15.06' W, *M. Cook 95121 (ISC)* **29 June 1995**, det. D. Farrar (ISC) 2000.

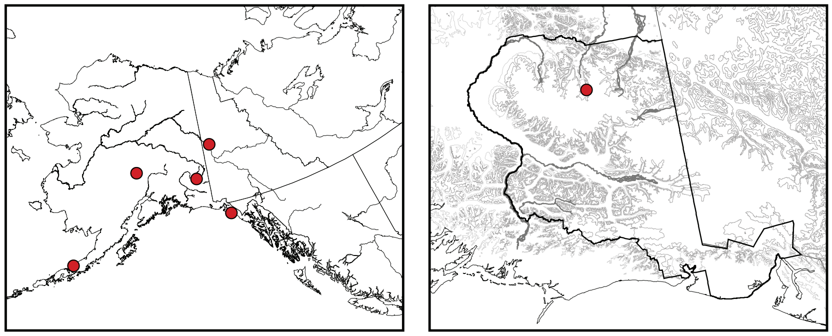
WRANGELL MOUNTAINS: ► scattered in turfy meadow in swale on SE-facing slope, vic. Chitistone Falls, 1177 m, 61º32.27' N 142º11.49' W, *C. Roland 96-632 (ISC)* **22 July 1996**, det. D. Farrar (ISC) 2000; ► few at edge of sloughing ridge in bare organic soil of dryas dwarf scrub, Cheshnina Plateau, 1200 m, 61º47.63'N 144º07.14'W, *M. Cook & J. Baker 4724 (ISC), 4726*, **3 July 2003**, det. D. Farrar (ISC) 2004; ► few on cutbank bluff in sagebrush juniper/ericaceous dwarf scrub, with *Botrychium lanceolatum*, Cheshnina Plateau, 1290 m, 61º47.82'N 144º05.89'W, *M. Cook & J. Baker 4722B (ISC)* **3 July 2003**, det. D. Farrar (ISC) 2004; ► small patch in ericaceous heath, with *Botrychium minganense* and an unknown *Botrychium* hybrid, Cheshnina Plateau, 1200 m, 61º47.57'N 144º07.45'W, *M. Cook & J. Baker 4728B (ISC)* **3 July 2003**, det. D. Farrar (ISC) 2004.



62. *Botrychium alaskense*

***Botrychium ascendens* W.H. Wagner, Triangle-Lobe Moonwort –** This moonwort is rare in Alaska (S2) known from only four widely disjunct localities in the state: our collection from the Nutzotin Mountains, the Alaska Peninsula, the Alaska Range and the vicinity of Yakutat. It is known from one locality in the Yukon Territory in the Yukon River drainage. It has a North American cordilleran distribution where it is rare throughout its range (G2G3) in California (S1), Idaho (S1), Montana (S1), Nevada (S1), Oregon (S2), Washington (S2), Wyoming (S1), Alberta (S1), British Columbia (S2S3), Quebec (S1), Saskatchewan (S1) and the Yukon (S1). It has been extirpated from Ontario.

NUTZOTIN MOUNTAINS: ► few on S-facing scree slope, with *Botrychium minganense* and *B.* cf. *lunaria* (related to *B. tunux* as determined by enzyme electrophoresis), Gold Hill, 1434 m, *M. Cook 3520B*, **18 July 1999**, det. D. Farrar 2000 (ISC).

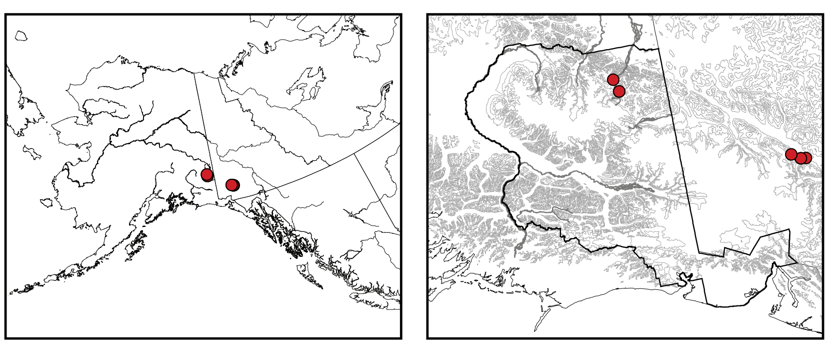


63. *Botrychium ascendens*

Botrychium lineare **Wagner, Slender Moonwort --** This North American boreal-montane moonwort is new to the flora of Alaska, rare throughout its range (G1), rare in Alaska (S1) and a U.S. Fish and Wildlife Service candidate species for protection under the Endangered & Threatened Species Act as of 13 June 2002. Our collections from the Nutzotin Mountains are the western and northern extent of its distribution. The closest collection is 230 km to the east at Soldiers Summit Trail in Kluane National park (61º01.53' N 138º30.41' W, *P. Caswell PPC-2003-077B*, *PPC-2003-097B*, 22 June 2003). The Alaska-Yukon populations are disjunct from the main range of *B. lineare* by 2,214 km. It also occurs in New Brunswick, Quebec, California (S1S3), Colorado (S1), Idaho, Montana (S1), Nevada, Oregon (S1), Utah (S1) and Washington (S1) (Kartesz & Meecham 1999, NatureServe 2004).

B. lineare is known from widely separated and extremely small populations and appears to be a habitat generalist also occurring in disturbed habitats. It has most likely been overlooked since its identity must be confirmed by electrophoresis, it occurs in mixed populations and it is difficult to survey for since most of its life cycle is below ground (NatureServe 2004).

NUTZOTIN MOUNTAINS: ►rare in pockets of open soil in dry graminoid-forb steppe vegetation on steep, treeless SE-facing slope at base of Mt. Allen, N of Medicine Creek, 1140 m, *Carl Roland & Alan Batten 5738B (ALA)* **16 June 2003**, det. D. Farrar (ISC) 2004; ► patchy on level ground in trail adjacent to Chisana airstrip, 941 m, *P. Loomis & B. Bennett 03-900 (ISC)*, **22 June 2003**, determined by D. Farrar (ISC) 2004.

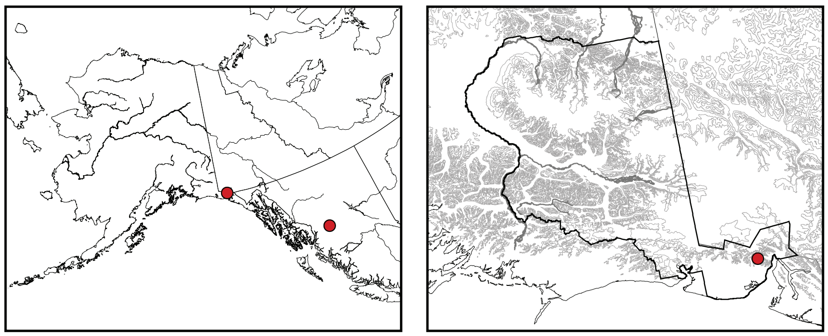


64. *Botrychium lineare*

Botrychium montanum **W.H. Wagner, Mountain Moonwort --**This North American cordilleran moonwort is new to the flora of Alaska, rare in Alaska (S1) and throughout its range (G3). It also occurs in British Columbia (S1), California (S1S2),

Idaho (S2), Montana (S3), Oregon (S2) and Washington (S3). Our collection from the coast is disjunct from central British Columbia by 870 km. It was collected in an alpine meadow on a precipitous ridge, differing from the typical habitat of *B. montanum* which is dark coniferous forests, usually near swamps and streams (Morin 1993). As survey intensity increases between British Columbia and Alaska it is expected that more populations will be found (D. Farrar, pers. comm.).

SOUTHERN ST. ELIAS MOUNTAINS: ► occasional in gravel on sparsely vegetated herbaceous slope, recently deglaciated, ridge on northeast side of upper Lucia Glacier, 967 m, 60º 03.02' N 139º 52.52' W, *P. Loomis & A. Batten 1161 (ISC)* **28 July 2003**, confirmed by D. Farrar (ISC) 2004.

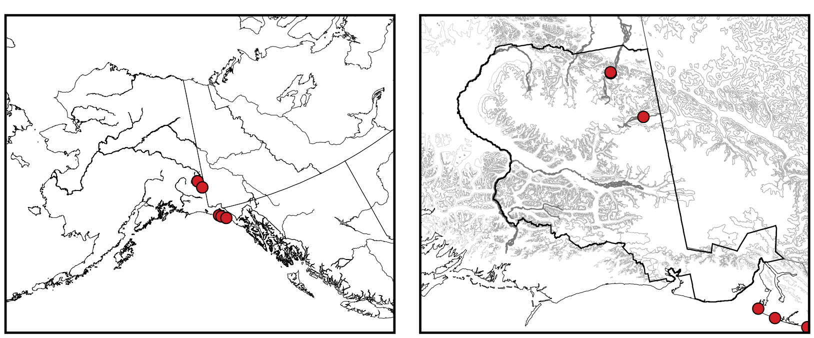


65. *Botrychium montanum*

Botrychium tunux **Stensvold & Farrar –**This moonwort was recently described from four populations in the vicinity of Yakutat in open dunes, upper beaches and beach meadows (Stensvold et. al. 2002). It is endemic to Alaska and rare (G1 S1). Our collections from three localities in the White and Chisana River valleys extend its range 260 km north from the coast into the interior of Alaska.

CHISANA RIVER VALLEY: ► scattered in grassy areas of floodplain with early seral herbs, shrubs and poplars, growing with a *Botrychium* hybrid (*Roland & Batten 5777B*), river bar on W bank of Chisana R., 10.5 km NW of Chavolda Cr., 864 m, 62º 14.65'N 141º 55.24'W, *C. Roland & A. Batten 5777A, 5822A (ISC)* **18 & 21 June 2003**, det. D. Farrar (ISC) 2003; ► rare in areas of newly disturbed open soil on bluff with rocky substrate, 10.5 km NW of Chavolda Cr., 960 m, 62º 15.23'N 141º 55.59'W, *C. Roland & A. Batten 5799 (ISC)* **20 June 2003**, det. D. Farrar (ISC) 2004.

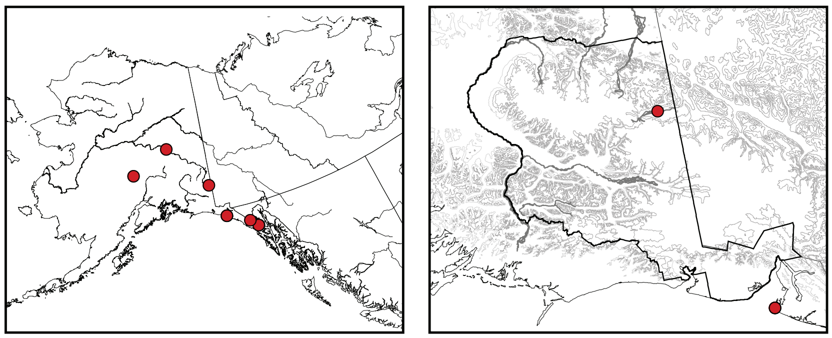
WHITE RIVER VALLEY: ► few in silt and unstable scree on disturbed slope, 975 m, 61º 44.25'N 141º 23.59'W, *B. Bennett & P. Loomis 03-222C, 03-222D (ISC)* **5 June 2003**, det. D. Farrar (ISC) 2004.



66. *Botrychium tunux*

***Botrychium yaaxudakeit* Stensvold & Farrar –** This moonwort was recently described from four localities near Yakutat, three localities in Glacier Bay and one near Fairbanks (Stensvold et. al. 2002). It has also been collected in Denali National Park (M. Duffy *MD01-260*, 20 August 2001, Chedotlathna Glacier (ALA)). It is endemic to Alaska and rare (G2 S2) Our collection in the White River basin is 263 km north of the coastal collections.

WHITE RIVER BASIN: ► Few in silt and unstable scree on disturbed slope, White River near Pingpong Mountain, 991 m, 61º 44.25' N 141º 23.59' W, *B. Bennett & P. Loomis 03-222(ISC)* **5 June 2003**, determined by D. Farrar (ISC) 2004.

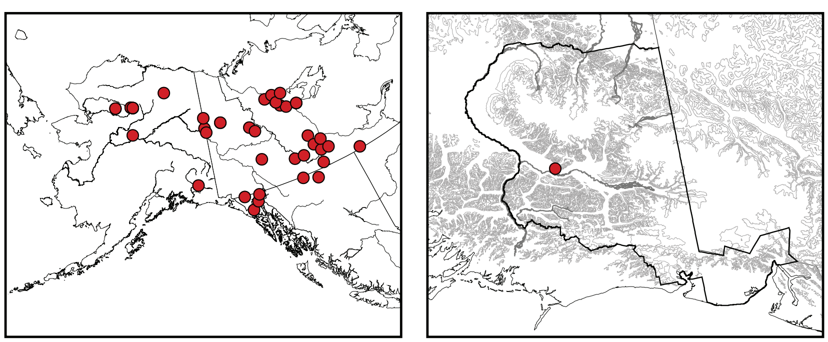


67. *Botrychium yaaxudakeit*

ORCHIDACEAE

***Cypripedium parviflorum* L., Lesser Yellow Lady's Slipper --** This circumpolar orchid is rare in Alaska (S2S3) but globally secure (G5). It is known from one locality in the park which is 389 km northwest of a station near the Alsek River and 433 km south of a station near Eagle (Porsild and Cody 1980).

CHITINA RIVER BASIN: ► patchy in narrow strip of sub-arctic lowland wet sedge meadow on margin of lake, Tooth Lake, 392 m, 61º 23.45' N 143º 41.14' W, *P. Loomis 2086 (ALA)* **8 August 2003**, det. C. Parker (ALA) 2003.



68. *Cypripedium parviflorum*

PAPAVERACEAE

***Papaver alboroseum* Hult., Pale Poppy** -- This amphiberingian arctic-alpine poppy is rare in Alaska (G3G4 S3) with a distribution known now to be centered on the park and the coastal mountains near Anchorage. Prior to our inventory, it was known from only three localities in the Wrangell-St. Elias Mountains: Flood Creek (61°42.88'N

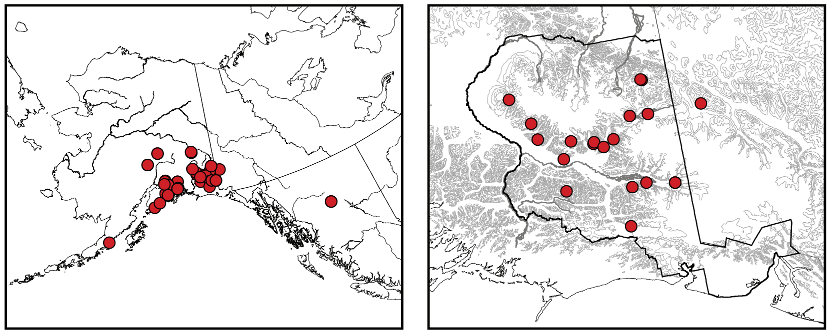
141°58.65'W, *M. Duffy 91059*, 16 July 1991), Sheep Glacier (61°42.48'N 141°38.59'W, *D. F. Murray 2212*, 14 August 1968 (ALA) (Murray 1971)) and Bonanza Ridge (61º30' N 142º51' W, *Nordell & Schmitt 1, 101, 160, 166, 171, 301, 464* (LD & ALA) (Nordell & Schmitt)). It is now known from 17 additional localities in the park including the Nutzotin and Chugach Mountains up to 108 km distant from the earlier collections. These collections are 161 km disjunct from the range of this species to the west in the Anchorage Quad (Eklutna Glacier, 61°17.0' N 148°58.0' W, *S.L. Welsh 4178*, 18 June 1965 (ALA)) and 135 km south of the range to the north in the Mt. Hayes Quad (Rainbow Ridge, 63°15.0' N 145°40.0' W, *C. Parker 1710*, 2 August 1985 (ALA)).

CHUGACH MOUNTAINS: ► talus slope, Flood Creek, 1829 m, 61º42.88' N 141º58.65' W, *M. Duffy 91059*, **16 July 1991**; ► rare on S-facing boulder slope, Juniper Island, 1291 m, 60º36.24' N 142º21.69' W, *M. Cook 94259*, **11 July 1994**; ► rare on W-facing limestone scree, ridge between Iron & Lime Creeks, 1798 m, 61º1' N 141º53.18' W, *M. Cook 94439*, **8 August 1994**; ► occasional in old slide debris, pass between Amy Creek and Klu River, 1164 m, 61º4.01' N 143º34.83' W, *C. Roland 96-530*, **13 July 1996**; ► few in loose rubble and sand, E Fork Kiagna River, 1487 m, 60º59.8' N 142º11.8' W, *C. Roland 96-844*, **31 July 1996**.

NUTZOTIN MOUNTAINS: ► rare on S-facing talus slope, Carl Creek, 1920 m, 62º3.52' N 141º36.27' W, *M. Cook 94112A*, **20 June 1994**; ► rare on barren S facing granodiorite slope, Carl Creek, 1859 m, 62º3.07' N 141º35.01' W, *M. Cook 94128*, **22 June 1994**.

ST. ELIAS MOUNTAINS: ► scattered on scree slopes, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *M. Cook 95237*, *C. Roland 95-198B, 95-208*, **15 July 1995**.

WRANGELL MOUNTAINS: ► rare in granitic scree, Crystalline Hills , 1585 m, 61º23.59' N 143º31.85' W, *C. Roland 95-241*, **18 July 1995**; ► few in gravel scree, Iron Mountain, 1868 m, 61º37.85' N 144º1.01' W, *M. Cook 96464*, **16 July 1996**; ► rubble and talus slope, Bonanza Ridge, 1768 m, 61º30.7' N 142º49.85' W, *G. Dodge s.n.*, **10 August 1993**; ► patchy on barren slope, Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, *M. Cook 96502*, **23 July 1996,** conf. D.F. Murray (ALA) 1997; ► few in gravel scree, alpine lake basin E side of Lakina Glacier, 1219 m, 61º33.64' N 143º19.01' W, *M. Cook 96548*, **24 July 1996**, conf. D.F. Murray (ALA) 1997; ► gently sloping gravel barrens, Nikolai Mine, 1695 m, 61º27' N 142º39' W, *Batten & Barker 96-081*, **24 July 1996**; ► rare in moist gravel, volcanic ridge 1 km east of Snyder Peak, 1524 m, 62º4.47' N 144º30.51' W, *C. Roland 96-384*, **5 July 1996**; ► few in moist gravel, Cheshnina Plateau, 1399 m, 61º48.04' N 144º6.27' W, *M. Cook 96711*, **5 August 1996,** conf. D.F. Murray (ALA) 1997.



69. *Papaver alboroseum*

Papaver radicatum **Rottball subsp. *kluanense* (D. Löve) D.F. Murray (=*P. kluanensis* D. Löve, *P. freedmanianum* D. Löve), Arctic Poppy** -- When this was first collected from Carl Creek in the Nutzotin Mountains, David F. Murray, the authority on the genus for North America, thought that this might be an undescribed taxon. Additional collections made during our inventory provided the material for Dr. Murray to develop the current treatment of the species in the Flora of North America. The specimens from Carl Creek had deep orange petals, which Dr. Murray now recognizes as a color variant of *P. radicatum* subsp. *kluanensis*. This taxon is an Alaska-Yukon endemic with a narrow distribution centered on the park (the Nuztotin and northern St. Elias Mountains). Prior to our inventory it was known from the St. Elias Mountains of Alaska and the Yukon, vicinity of Mayo Lake in the Yukon and Eklutna Valley near Anchorage. Our collections extend the range of this taxon into the Mentasta, Nutzotin and Wrangell Mountains as far as 126 km from the earlier collections. Except for the locality disjunct 338 km to the west in the Anchorage Quad (Eklutna Valley, 61°26.0' N 149°08.0' W, *L. C. Marvin 2114*, 19 Jul 1985 (ALA)), these collections represent the western extension of the range of this subspecies.

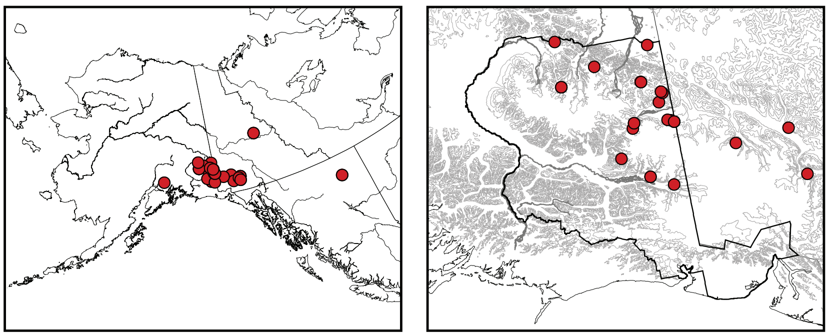
MENTASTA MOUNTAINS: ► rare in runnels of soil in fine limestone scree with alpine herbs, ridge between Little Jack and Trail Creeks, 1615 m, 62º36.05' N 143º17.63' W, *C. Roland 95-010*, **6 June 1995.**

NUTZOTIN MOUNTAINS: ► few on rhyolite talus slope with sparse *Dryas*-lichen-alpine herbs, vic. Wiki Peak, 1433 m, 61º53.9' N 141º9.51' W, *M. Cook 94126*, **16 June 1994**, det. D.F. Murray (ALA) 1995; ► few in unstable, granodiorite scree, S-facing slope with sparse alpine herbs, Carl Creek, 1859 m, 62º3.07' N 141º35.01' W, *M. Cook 94127A*, **22 June 1994**, det. D.F. Murray (ALA) 1995; ► few localized on barren, unstable, granodiorite cobble and boulder scree S-facing slope, 1585 m, 62º2.87' N 141º34.46' W, *M. Cook 95002, C. Roland 95-029*, **13 June 1995**; ► occasional in crevices and in gravel scree of boulder field, sparsely vegetated with sagebrush-herbs, Rock Lake, 1119 m, 61º48.7' N 141º16.57' W, *M. Cook 96029*, **4 June 1996**, conf. D.F. Murray (ALA) 1997; ► few scattered on unstable steep S-facing rhyolite scree knob, Wiki Basin, 1524 m, 61º54.77' N 141º11.05' W, *M. Cook 3186*, **15 July 1998**.

ST. ELIAS MOUNTAINS: ► few in exposed ash, sparsely vegetated with seral herbs, Cub Creek, 1280 m, 61º37.27' N 141º9.75' W, *M. Cook 94185*, **16 June 1994**, det. D.F. Murray (ALA) 1995; ► scattered at base of limestone knob in ash with seral herbs and *Dryas*, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *M. Cook 95070, 95078, C. Roland 95-064, 95-072*, **16 June 1995**, det. C. Roland 1998; ► occasional on barren N-

facing gravel slope, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *C. Roland 95-221*, **16 July 1995**.

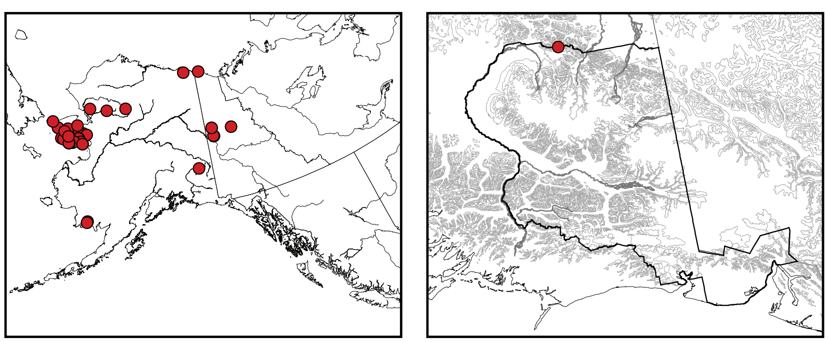
WRANGELL MOUNTAINS: ► scattered in frost-boils on high elevation ridge of limestone, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *C. Roland 94-278*, **24 July 1994**; ► scattered in bare mineral soil on S-facing slope, volcanic ridge between Jacksina River & Mesa Creek, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94374*, **25 July 1994**, det. D.F. Murray (ALA) 1995; ► volcanic ridge between Jacksina River & Mesa Creek, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94374*, **25 July 1994,** det. D.F. Murray (ALA) 1995; ► large population in volcanic tuff, ridge between upper Jacksina River & Mesa Creek, 2073 m, 62º8.21' N 143º18.47' W, *M. Cook 94407*, *C. Roland 94-312*, *94-313*, **26 July 1994**, det. D.F. Murray (ALA) 1997.



70. *Papaver radicatum* subsp. *kluanensis.*

Papaver walpolei **A.E. Porsild, Walpole's Poppy --** This poppy is rare in Alaska (S3), the Yukon Territory (S1) and globally (G3). It is amphiberingean with an arctic-alpine distribution and known only from Alaska and the Yukon in North America. Our collection in the Mentasta Mountains is the southern extent of its distribution in North America. This collection is 970 km disjunct from populations on the Seward Peninsula in northwestern Alaska (Solomon Quad: 64°34.0' N 163°43.0' W, *S.D. Kildaw s.n.*, July 1987 (ALA)) and 325 km southwest of collections near Dawson in the Yukon Territory (Cody 1996).

MENTASTA MOUNTAINS: ► scattered on rubble slope, headwaters of Lost Creek, 1722 m, 62°36.45' N 143°12.03' W, *M. Cook 95172 (ALA)* **4 July 1995**, det. D.F. Murray (ALA) 1996.



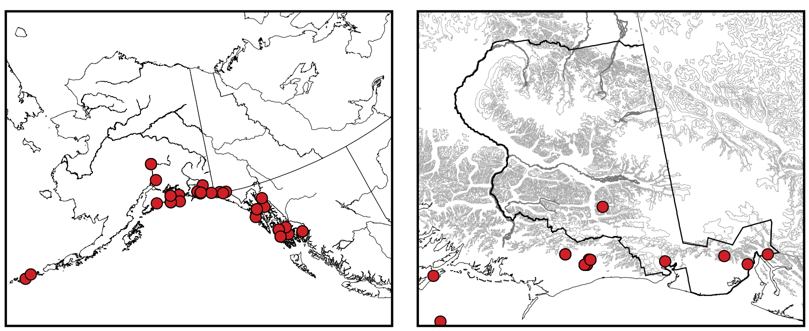
71. *Papaver walpolei*

POACEAE

***Agrostis thurberiana* A. S. Hitchc. (=*Podagrostis thurberiana* (Hitchc.) Hult.), Thurber's Bentgrass** -- This Bentgrass has a western North American distribution. It is rare in Alaska (S2) but secure globally (G5). Our collections connect its range 212 km to the southwest in the Seward Quad (Iron Mountain, 60°22.00' N 147°39.0' W, *M. Duffy 93-1095*, 17 August 1993 (ALA)) with a station near Pelican 345 km to the southeast (Hultén 1968). In Alaska and British Columbia is occurs primarily along the coast. It is also known from Alberta, Northwest Territories, south to California and east to Colorado. It is rare in Alberta (S2) and in Wyoming (S3).

CHUGACH MOUNTAINS: ► herbaceous meadow, under *Salix barclayi*, vic. 12-mile Creek, 1335 m, 60º49.71' N 142º33.34' W, *C. Roland 96-833*, **7 July 1996**, conf. C. Parker (ALA) 1997.

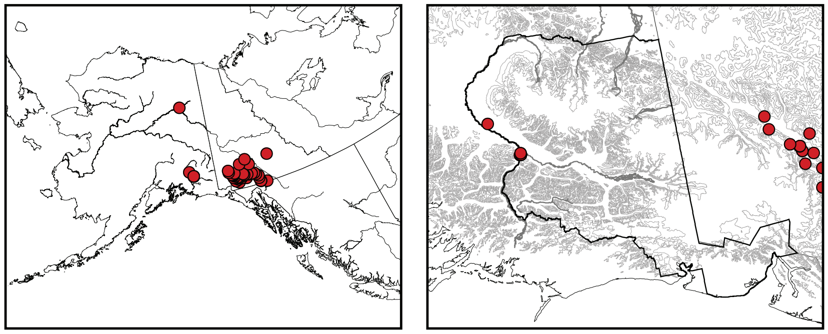
SOUTHERN ST. ELIAS MOUNTAINS: ► tall forb herbaceous slope, Amphitheater Knob, 427 m, 59º57' N 139º46' W, *M. Cook 87-165*, **19 August 1987**, conf. C. Parker (ALA) 1991; ► patchy in mesic mixed herb meadow, Guyot Hills, 658 m, 60º 09.09' N 141º 27.28' W, *P. Loomis & A. Larsen 1248 (ALA)* **19 July 2003**, det. C. Parker (ALA) 2003; ► common in mixed herb meadow and along wet seep, Guyot Hills, 658 m, 60º 09.09' N 141º 27.28' W, *P. Loomis & A. Larsen 1202*, **19 July 2003**, det. C. Parker (ALA) 2003; ► patchy in un-vegetated, unstable scree, vic. Marvine Glacier, 912 m, 60º 05.07' N 140º 12.39' W, *P. Loomis & A. Batten 1777*, **25 July 2003**, det. C. Parker (ALA) 2003; ► on unstable scree slope near small rivulet, vic. Variegated Glacier, 387 m, 60º 00.30' N 139º 18.43' W, *P. Loomis & A. Batten 2003 (ALA)* **28 July 2003**, det. C. Parker (ALA) 2003.



72. *Agrostis thurberiana*

***Elymus calderi* Barkw.(=Agropyron yukonense Scribn. & Merr), Calder's Wild Rye –** This grass is endemic to Alaska, the Yukon Territory and British Columbia. It is rare in Alaska (S2S3) and British Columbia (S1S3) with a global rank of G3G4. It is common in the southwest Yukon Territory. In Alaska it is known only from the confluence of the Chitina and Copper Rivers just outside the park (Valdez Quad, *Khokhryakov, Yurtsev and Murray 6196, 6234, 6099, 6177*, 8 August 1981 (ALA)), our collection from the Dadina River and a collection near Fort Yukon (Hultén 1968). The collections in the Chitina and Copper River drainages are 304 west of the Yukon Territory distribution and 529 km S of the Fort Yukon station. It occurs on dunes, sandy and gravelly hillsides, benches and roadsides (Cody 1996)

Middle Copper River Basin: ►scattered in steppe vegetation on steep, S-facing slope, Dadina River bluff, 387 m, 61 51.49'N 145 00.72'W, *C. Roland 96-302*, **1 July 1996**, conf. C. Parker (ALA) 1996.



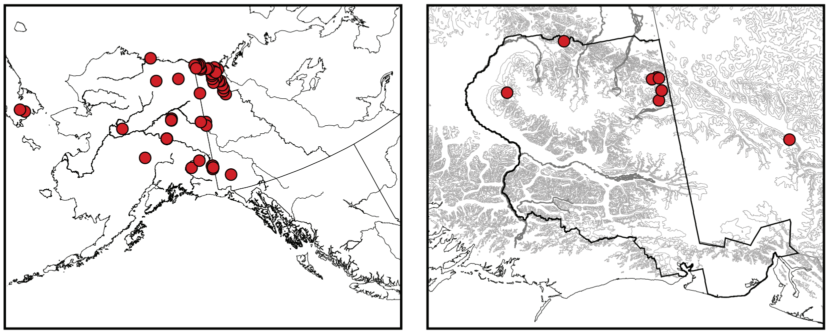
73. *Elymus calderi*

Festuca lenensis **Drobov (*F. ovina* L. subsp. *alaskensis* Holmen), Tundra Fescue** -- This amphiberingean arctic-alpine fescue is rare in Alaska (G4 S2S3) where it grows in dry, rocky places in the subalpine and alpine zones of northern and central Alaska. Our collections extend its range southeast 310 km into the Wrangell Mountains, 320 km into the Mentasta Mountains and 450 km into the Nutzotin Mountains from collections in the Fairbanks Quad (Wood River Buttes, 64°28.35' N 148°05.97' W, *Duffy et al. 95-80*, *95-68*, *95-26 & 95-57*, 16 June 1995 (ALA)). These collections also connect the range to the northwest in Alaska with the range 155 km to the east in the Yukon Territory (Cody 1996).

Mentasta Mountains: ► common in gravelly sites on limestone ridge in dry *Dryas octopetala* tundra, Lost Creek, 1646 m, 62º34.58' N 143º5.58' W, *C. Roland 94-268B*, **23 July 1994**, conf. C. Parker (ALA) 1996.

Nutzotin Mountains: ► scattered on unstable S-facing scree slope, Horsfeld Creek, 1768 m, 62º2.88' N 141º13.18' W, *M. Cook 94152*, *C. Roland 94-129C*, **24 June 1994**, conf. C. Parker (ALA) 1995; ► dense population in protected, turfy tundra, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *C. Roland 95-034*, **15 June 1995**, det. C. Parker (ALA) 1996; ► scattered in fine, dry reddish soil with gravel, Wiki Creek, 1411 m, 61º54.46' N 141º10.68' W, *M. Cook 96041*, *96099*, *C. Roland 96-057*, **11 June 1996** (ALA); ► abundant in dry facies around outcrops, Rock Lake, 1119 m, 61º48.7' N 141º16.57' W, *C. Roland 96-038*, **6 June 1996**; ► moist, sandy grus with seral herbs on well-vegetated SE-facing alpine colluvium, Horsfeld Creek valley, 1128 m, 62º2' N 141º11' W, *Parker & Gracz 6913*, **13 August 1996**.

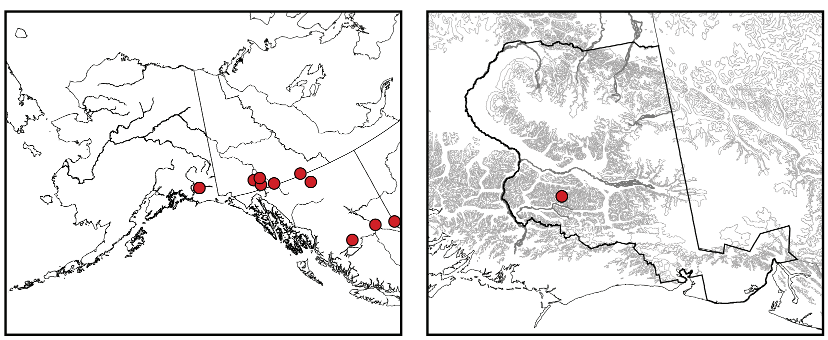
Wrangell Mountains: ► scattered in loose gravel on steep, SE-facing slope, NE slope of Mt. Drum, 1433 m, 62º8.83' N 144º30.18' W, *C. Roland 94-051*, **11 June 1994**, det. C. Parker (ALA) 1996.



74. *Festuca lenensis*

Festuca minutiflora **Rydb., Small-Flower Fescue –** Our collection of this North American cordilleran fescue was new to the flora of Alaska in 1996 and marks the western extent of its distribution, the closest collection being 445 km to the east in the Yukon Territory where it is rare (S1) (Cody 1996). It has not been collected elsewhere in the state since 1996 and is therefore extremely rare in Alaska (S1) although it is apparently secure globally (G4). It is also known from British Columbia (S2S3), Alberta (S2), Arizona, California (S1S3) Colorado, Idaho, Montana, New Mexico, Utah and Wyoming (S2) where it grows in alpine tundra and meadows and subalpine openings (Aiken and Darbyshire 1990). F. minutiflora may be more continuously distributed in the northern Rocky Mountains since is very similar to *F. brachyphylla* and it typically grows in remote habitats (Aiken and Darbyshire 1990). The main feature distinguishing it from *F. brachyphylla* is the pubescent ovary.

CHUGACH MOUNTAINS: ► scattered in dry mineral soil of gravel slope, alpine valley near Hanagita Peak, 1186 m, 61º4.91' N 143º38.86' W, *M. Cook 96418 (ALA)* **7 July 1996**, det. C. Parker (ALA) 1997, conf. S. Frederickson (C) 1998.

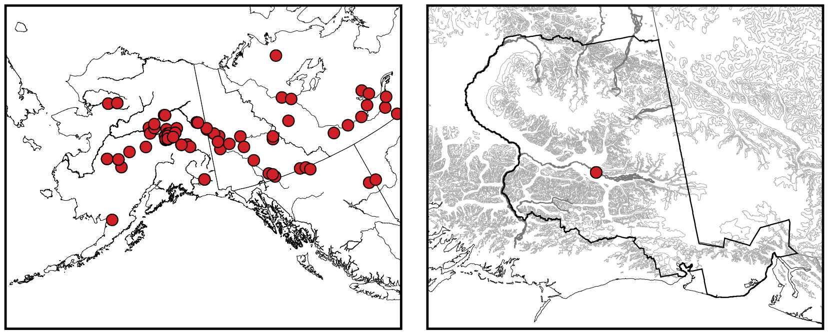


75. *Festuca minutiflora*

Glyceria pulchella **(Nash) K. Schum., MacKenzie Valley Mannagrass –** This mannagrass is uncommon in Alaska (S2S3) and known from only one locality in the park. Our collection extends it range 337 km south into the Chugach Mountains from the Tanana Valley (Hultén 1968) and connects the range 526 km to the east in the Yukon Territory near Carcross (Cody 1996). *G. pulchella* has a North American boreal montane distribution, known only from Canada and Alaska. However, it is considered to be secure globally (G5). It is also known from Alberta (S3), British Columbia (S2S3), Manitoba (S2), Northwest Territories, Saskatchewan and the Yukon Territory where it is

found in streamsides, marshes, lakeshores and ponds in the montane zone (Douglas et. al. 2001).

CHUGACH MOUNTAINS: ►margin of meadow on river terrace wetlands, Tana River flats, 351 m, 61º12.35' N 142º51.87' W, *Duffy & Barnes 96-188*, **8 August 1996**.

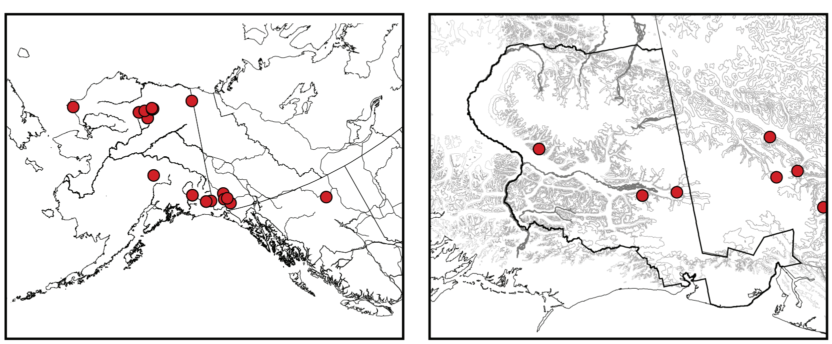


76. *Glyceria pulchella*

Poa abbreviata **R. Br. subsp. *pattersonii* (Vasey) A. Löve et. al., Northern Blue Grass --** This amphiberingian arctic-alpine grass is of limited distribution in Alaska, known from the Brooks Range, one station in the Alaska Range and the three collections in the park. Our collections connect the station in the Alaska Range 372 km to the east (Healy Quad, *Cook & Roland 3724 (ALA)*, 28 June 2001) with collections in the southwest Yukon (Cody 1996). This grass occurs in alpine turf, mesic fellfields and rocky slopes, often in limestone in Greenland, Eastern Asia, east to Northwest Territories in Canada and Colorado in the U.S. and south to Arizona (Cody 1996, Douglas et. al. 2001). It is rare in California (S1S3), Utah (S2), Wyoming (S3), Alberta (S3) and British Columbia (S1S3).

CHUGACH MOUNTAINS: ► few in gravel and cobble in swale at ridge, Mt. Chitina, 2040 m, 60º 57.74' N 141º 17.33' W, *M. Cook 95234*, **14 July 1995**, conf. Robert Soreng (US) 2001; ► dry soil on exposed bench at top of cliff on W-facing slope, Goat Creek, 1460 m, 60º 59.5' N 142º 01' W, *A. Batten & M. Barker 96-307 (ALA)*, **29 July 1996**.

SOUTHERN WRANGELL MOUNTAINS: ► common in moist, clayey soil in barren limestone gravel on NE-facing slope, Iron Mountain, 1840 m, 61º 37.85' N 144º 01.01' W, *C. Roland 96-587A, 96-587B*, **16 July 1996**, conf. Robert Soreng (US) 2001.

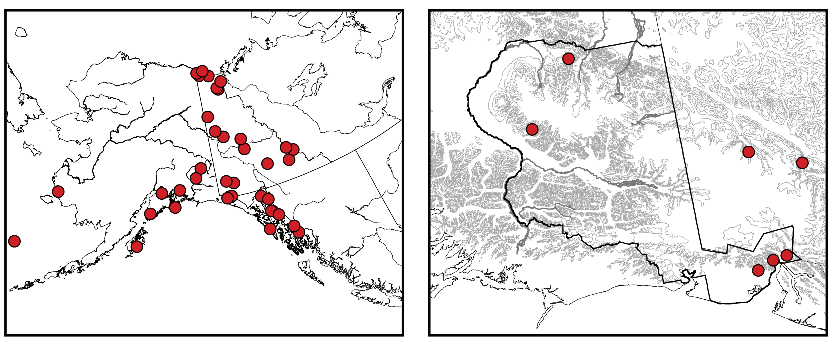


77. *Poa abbreviata* subsp. *pattersonii*

***Poa leptocoma* Trin., Marsh Blue Grass --** This amphiberingian arctic-alpine grass is rare in Alaska (S2) although secure globally (G5). Our collections from the Wrangell Mountains connect its range 165 km to the southwest in the Valdez Quad (Sawmill Bay, 61º 05.31' N 146º 49.12' W, *A. Batten & Murphy 77-429*, 31 July 1977 (ALA)) with its range 244 km to the east in the Yukon Territory (Cody 1996). *Poa leptocoma* is known from eastern Asia and in North America east to Northwest Territories and south to New Mexico in wet to moist meadows, streams and bogs in the subalpine and alpine zones (Douglas et. al. 1998 - 2002). It is rare in Wyoming (S3) and Alberta (S3).

SOUTHERN ST. ELIAS MOUNTAINS: ► patchy in tall herbaceous vegetation, ridge between lower Turner Glacier and Haenke Glacier, 668 m, 60º 03.16' N 139º 37.58' W, *P. Loomis & A. Batten 1834 (ALA)* **26 July 2003**, det. C. Parker (ALA) 2003; ► in *Vaccinium* tundra amongst rock outcrops, Mount Foresta, 796 m, 60º 04.30' N 139º 20.23' W, *P. Loomis & A. Batten 1874*, **26 July 2003**, det. C. Parker (ALA) 2003; ► occasional in loose cobble on unstable slope, Floral Pass, 880 m, 59º 59.10' N 139º 58.28' W, *P. Loomis & A. Larsen 1664 (ALA)* **23 July 2003**, det. C. Parker (ALA) 2003.

WRANGELL MOUNTAINS: ► scattered in mossy seep areas around rivulet, Cheshnina Plateau, 1399 m, 61º 48.04' N 144º 06.27' W, *C. Roland 96-878*, **8 August 1996**, det. R. Soreng (US) 2001; ► patchy on margin of trail and mixed spruce-alder forest, and in ashy creek bed, Skookum Volcano Trail, 892 m, 62º 27.09' N 143º 05.11' W, *P. Loomis 2403 (ALA)* **12 August 2003**, det. C. Parker (ALA) 2003.

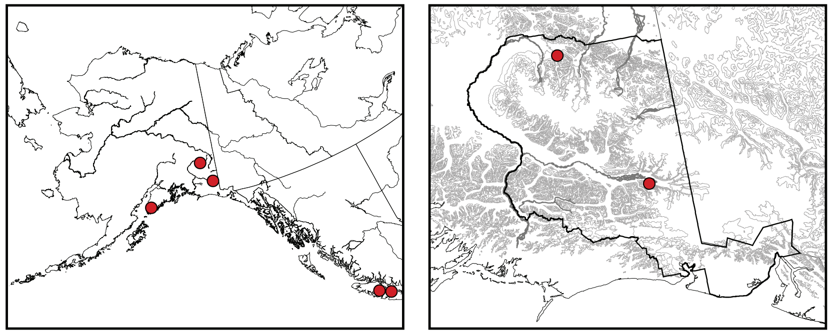


78. *Poa leptocoma*

***Poa secunda* J. Presl subsp. *secunda*, Curly Blue Grass --** This grass occurs in North, Central and South America. It is currently considered rare in Alaska (S1) but secure throughout the rest of its range (G5). It is known from two localities in the park, one of these was collected during the inventory. Only one other collection has been verified from Alaska, 549 km northeast of a collection at Kachemak Bay on the Kenai Peninsula.

CHITINA RIVER BASIN: ► dry open benchland meadow, Pease Grazing Lease, *D. Miquelle 84-03*, **18 June 1984**, det. Robert Soreng (US) 2001.

TANANA RIVER BASIN: ► scattered in sandy areas of gravel bar Nabesna River floodplain, 2380 m, *C. Roland 96-259*, **23 June 1996**, det. Robert Soreng (US) 2001.

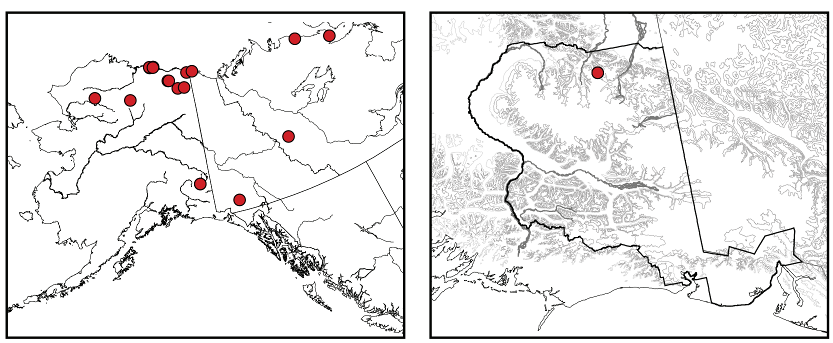


79. *Poa secunda* subsp. *secunda*

***Puccinellia vahliana* (Liebm.) Scribn. & Merr. (=*Colpodium vahlianum* (Liebm.) Nevski), Vahl's Alkalai Grass** -- This circumpolar high arctic grass is uncommon in Alaska (S2S3) where it is known only from the arctic coast except for our collection in the Wrangell Mountains. This collection is disjunct in Alaska by 719 km from a station in the Table Mountain Quad (Double Mt., 68°44.00' N 143°35.0' W, *A.R. Batten 75-514a*, 22 July 1975 (ALA)) and is 318 km west of another disjunct station in the Yukon Territory near Haines Junction (Cody 1996).

Puccinellia vahliana is apparently secure globally (G4) occurring in arctic east Asia, Europe, Greenland and in North America from Alaska, Labrador, Northwest Territories, Nunavut, Quebec and Yukon Territory. It occurs in wet seepage areas on mountains slopes, in stony tundra, in moist clay by brooks and on snowbeds (Hultén 1968, Cody 1996, Porsild and Cody 1980).

WRANGELL MOUNTAINS: scattered in wet frost boils on limestone ridge, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *C. Roland 94-279*, **24 July 1994** (ALA), conf. C. Parker (ALA) 1995.

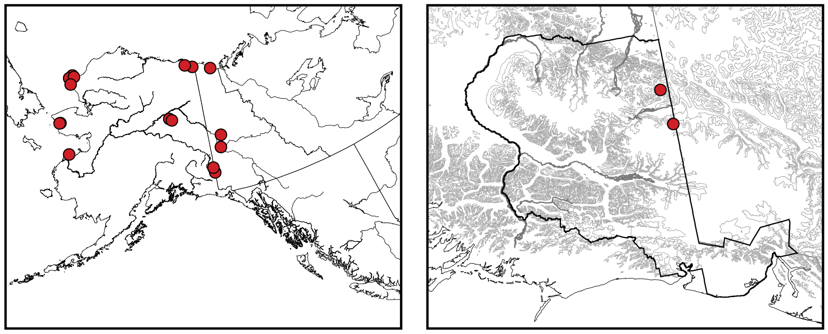


80. *Puccinellia vahliana*

***Trisetum sibiricum* Rupr. subsp. *litorale* (Rupr.) Roshev., Siberian Oatgrass** -- This arctic-alpine amphiberingian grass is rare in Alaska (S2) and in the Yukon (S1). In North American, this grass only occurs in Alaska and in the Yukon. Our collections from the Nutzotin Mountains are 533 km south of a station in the Livengood Quad of Alaska (Mt. Schwatka, *Parker, Murray, Lipkin & Emers 5079*, 19 June 1994), 147 km southwest of a station near Dawson in the Yukon, and represent the southern extent of this species in North America. The Mt. Schwatka collection is also 454 km south of the primarily arctic coastal distribution in Alaska. This species is apparently secure globally but there is a question as to whether *Trisetum sibiricum* subsp. *litorale* can be distinguished from

T. sibiricum subsp. *sibiricum*. The arctic collections occur on moist grassy slopes, tundra and in willow and alder thickets, whereas our collections were form scree slopes.

NUTZOTIN MOUNTAINS: ► s-facing scree slope, 2.4 km west of Ptarmigan Creek, 1494 m, 61º32.89' N 141º3.28' W, *M. Cook 92482*, **9 August 1992**, det. D.F. Murray (ALA) 1992; ► steep S-facing rhyolite scree knob, west side of Wiki Creek, 1524 m, 61º54.77' N 141º11.05' W, *M. Cook 3190 (ALA)* **15 July 1998**, conf. D.F. Murray (ALA) 1999.



81. *Trisetum sibiricum Rupr* subsp. *litorale*

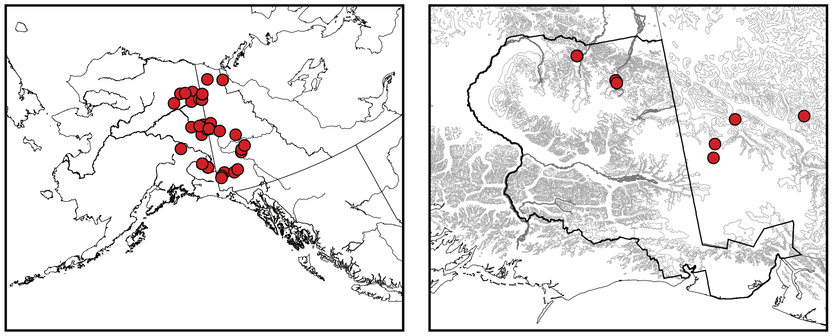
POLEMONIACEAE

***Phlox hoodii* Richards., Spiny Phlox** -- This North America species is rare in Alaska (S1S2). Prior to our inventory, it was known in Alaska only from the Yukon River drainage and the Porcupine and Sheenjek Rivers in the Brooks Range. Our collections in the Mentasta and Wrangell Mountains extend its range 290 km south from collections at Eagle Bluff (64°48.0' N 141°12.0' W, *A. R. Batten & J.C. Dawe 78-253,* 14 July 1978 (ALA)) and connect the distribution 194 km to the east in the Yukon Territory (Cody 1996). A collection has also recently been made 206 km to the northwest in the Alaska Range (Mt Hayes Quad, Buffalo Hills, *Roth, Pullman & Jorgenson ABR13*, 19 August 1998).

Phlox hoodii is secure globally (G5). It occurs east to Manitoba where it is vulnerable (S3), east to Nebraska in the United States and south to New Mexico. It is absent from British Columbia. Throughout most of its range, *P. hoodii* is found in dry prairies and foothills. It is found on dry south-facing river bluffs and alpine scree slopes in Alaska and the Yukon.

MENTASTA MOUNTAINS: ► locally abundant in silty soil on steep, S- facing slopes, Devil's Mountain, 942 m, 62º24.95' N 142º54.86' W, *C. Roland 96-235, M. Cook 96239*, **22 June 1996**, det. D. F. Murray (ALA) 1996.

WRANGELL MOUNTAINS: ► in loose sand and gravel talus slope, Euchre Mountain, 1414 m, 62º 05.08' N 142º 09.59' W, *B. Bennett & P. Loomis 03-832 (ALA)* **21 June 2003**; ► growing on drumlin ridge in shallow sand and gravel soil slope, Euchre Mountain, 1285 m, 62º 06.34' N 142º 10.35' W, *B. Bennett & P. Loomis 03-837*, **21 June 2003**; ► windswept ridges dominated by *Dryas* heath tundra, Euchre Mountain, 1600 m, 62º 04.48' N 142º 09.35' W, *B. Bennett & P. Loomis 03-886*, **21 June 2003**.



82. *Phlox hoodii*

***Phlox richardsonii* Hook. (=*Phlox sibirica* L. subsp. *richardsonii* (Hook.) Hult.), Siberian Phlox** – Prior to our inventory, this Alaska-Yukon endemic with an arctic-alpine distribution was known only from two localities in Alaska: in the Steese White Mountains and in the Brooks Range (Hultén 1968). Its distribution now appears to be centered in Alaska in the northern mountains of the park where it is known from nineteen localities in the Mentasta, Wrangell and Nutzotin Mountains. It is also now known from five localities in the Alaska Range, the closest of which is 162 km to the northwest.

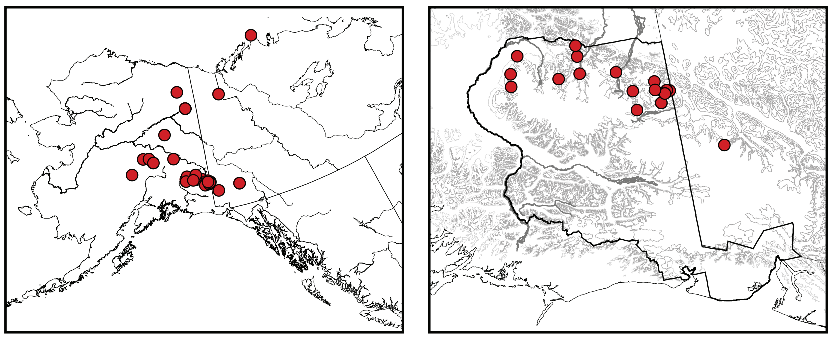
Phlox richardsonii is rare in Alaska (S2?) and known from only a few localities in the Yukon Territory, the arctic coast of the District of Mackenzie and Banks Island (Porsild 1980). It is therefore considered globally rare (G4T2T3Q) but there are taxonomic questions about its validity. D.F. Murray considers it to be a drought form of *P. sibirica*, whereas W.J. Cody considers it to be morphologically distinct. None of the material from the park has been identified as *P. sibirica* subsp. *sibirica*.

MENTASTA MOUNTAINS: ► localized on S-facing greenstone outcrop, above Soda Creek, 1173 m, 62º32.36' N 142º53.98' W, *C. Roland 94-260*, **22 July 1994**; ► occasional in rock crevices, SE-facing slope, Devil's Mountain, 1530 m, 62º25.62' N 142º53.93' W, *C. Roland 96-355*, **3 July 1996.**

NUTZOTIN MOUNTAINS: ► S-facing scree, 2 km W of Ptarmigan Creek, 1707 m, 61º55.65' N 141º6.5' W, *M. Duffy 92179*, **7 July 1992**, det. C. Parker (ALA) 1992; ► S-facing scree slope, 2.4 km w of Ptarmigan Creek, 1494 m, 61º55.65' N 141º6.5' W, *M. Cook 92478*, **9 July 1992**, det. D.F. Murray (ALA) 1992; ► locally abundant in gravel on southwest-facing slope, Upper Wiki Creek, 1433 m, 61º53.9' N 141º9.51' W, *C. Roland 94-116A*, **22 June 1994**; ► S-facing talus slope, ridge 1.6 km E of Rocker & Ptarmigan Creek confluence, 1433 m, 61º55.22' N 141º2.75' W, *M. Cook & C. Roland 94143*, **23 June 1994**, conf. C. Parker (ALA) 1995; ► locally common in rock crevices, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *C. Roland 95-031*, **15 June 1995**; ► scattered in orange rhyolite, volcanic plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, *M. Cook 95051*, **18 June 1995**, conf. C. Parker (ALA) 1996,; ► scattered in gravel on S-facing slopes, Rock Lake, 1119 m, 61º48.7' N 141º16.57' W, *M. Cook 96040 & C. Roland 96-052*, **6 June 1996**; ► common in barren, sand and gravel, Wiki Creek, 1411 m, 61º54.46' N 141º10.68' W, *C. Roland 96-068*, **6 June 1996**; ► scattered in basalt scree, Sonja Creek, 1494 m, 61º57.29' N 141º21.29' W, *M. Cook 3192*, 16 July 1998 (ALA); ► occasional on S-facing scree slope in moist bare sandy soil, Carl Creek , 1920 m, 62º3.52' N 141º36.27' W, *M. Cook 95004*, **14 June 1994**. ►

scattered in windswept, stony *Dryas*- graminoid tundra on hillocks in subalpine saddle, Chisana River-Medicine Man Creek Saddle, 1220 m, 62º 12.16' N 142º 07.40' W, *C. Roland & A. Batten 5747 (ALA)* **16 June 2003.**

WRANGELL MOUNTAINS: ► N-facing scree slope, Lime Creek, 1707 m, 61º47.2' N 141º49.06' W, *M. Cook 92108*, **9 July 1992**, det. D.F. Murray (ALA) 1992; ► *Dryas* sedge tundra, NW slope of Mt. Sanford, 1295 m, 62º21.17' N 144º24.52' W, *M. Cook 93119,* **9 June 1993**; ► S-facing volcanic slope, Capital Mountain, 1052 m, 62º31.61' N 144º12.38' W, *C. Roland 94-015*, **7 June 1994**; ► scattered on S-facing slope, Mt. Sanford, 1615 m, 62º13.59' N 144º26.06' W, *C. Roland 94-041*, **9 June 1994**; ► scattered in rock outcrop crevices on bluff, Nabesna River, 1106 m, 62º15.05' N 142º54.68' W, *M. Cook 96195*, **6 June 1996**; ► rare on rock outcrop ledges above Grizzly Lake, 1350 m, M. Cook & J. Allen 3564, **26 June 2000**.



83. *Phlox sibirica* subsp. *richardsonii*

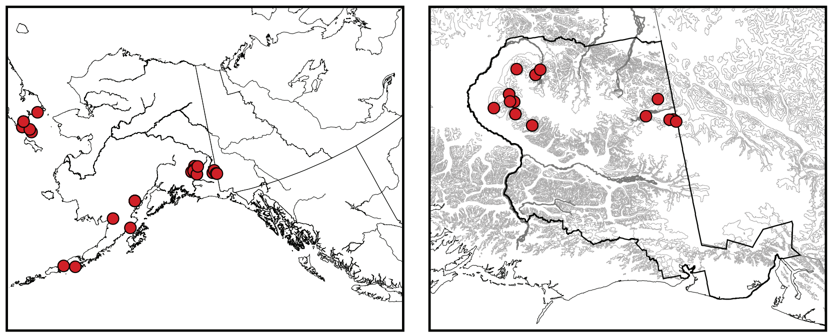
POLYGONACEAE

***Rumex beringensis* Yurtsev & Petrovsky (*R. graminifolius* DC), Bering Sea Dock** -- This amphiberingain species with a Pacific coastal distribution, is rare in Alaska (G3 S3). It had been collected by David F. Murray at Sheep and Guerin Glaciers in the St. Elias Mountains (Murray 1971). The specimens cited above extend its range 201 km into the western Wrangell Mountains. These collections document the eastern limit of its range and are disjunct from the closest locality 507 km to the southwest at Lake Clark (Tanalian Point, 60°12.0' N 154°19.0' W, *D.R. Hunt 44*, 11 June 1993 (ALA)).

ST. ELIAS MOUNTAINS: ► scattered in volcanic ash deposit, Cub Creek, 1280 m, 61º37.27' N 141º9.75' W, *M. Cook 94182A*, **28 June 1994**; ► occasional in bare soil on knoll in dry tundra, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *C. Roland 95-065*, **19 June 1995**.

WRANGELL MOUNTAINS: ► bare area under boulder, West Glacier, 1524 m, 62º18.31' N 143º52.37' W, *M. Duffy 92021*, **23 June 1991**, *M. Duffy 92267*; ► patchy on S-facing scree slope, NE slope of Mt. Drum, 1433 m, 62º8.83' N 144º30.18' W, *M. Cook 94058*, *C. Roland 94-075*, **11 June 1994**; ► rare on alluvium below cinder cone, north slope of Mt. Sanford, 1722 m, 62º23.4' N 144º15.9' W, *C. Roland 94-009*, **6 June 1994**; ► scattered in bare sandy mineral soil, Chetaslina plateau, 1615 m, 61º56.51' N 144º25.93' W, *C. Roland 94-343*, **15 August 1994**; *M. Cook 94479*, **16 August 1994**; ► occasional in moist bare soil of solifluction lobes, Black Mountain, 1481 m, 62º20.85' N 143º44.9' W, *Cook & Beck 95140*, **7 July 1995**; ► abundant in slumping lobes of organic-rich soil around rodent dens, volcanic ridge 6.4 km east of Snyder Peak, 1524 m, 62º4.47' N 144º30.51' W, *C. Roland 96-379*, **5 July 1996**; ► scattered throughout alpine

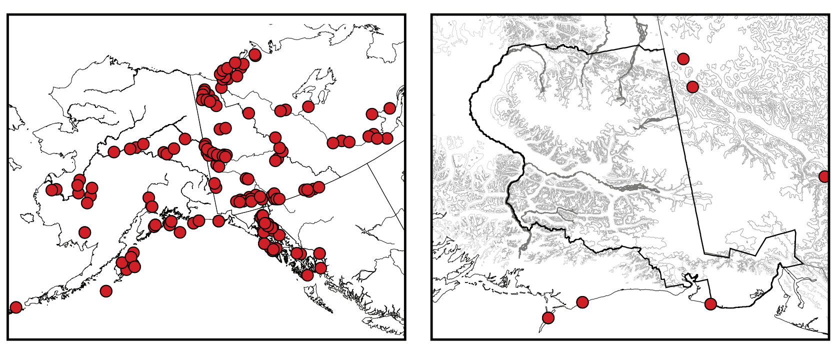
basin, upper Dadina River, 1344 m, 62º3.95' N 144º25.18' W, *M. Cook 96267*, **7 July 1996**; ► scattered in moist gravel of alpine lake shore, between Klawasi and Nadina Rivers, 1042 m, 62º1.95' N 144º52.49' W, *M. Cook 96273*, **7 July 1996**; ► patchy in bare sandy areas along edge of cliff, Cheshnina Plateau, 1399 m, 61º48.04' N 144º6.27' W, *C. Roland 96-850*, 6 August 1996; *M. Cook 96700*, **8 August 1996**.



84. *Rumex beringensis*

***Rumex salicifolius* Weinm. var. *mexicanus* (Meisn.) C.L. Hitchc., Willow Dock --** . Our collection of this North American widespread species connects its range in Alaska 314 km to the east in the vicinity of Haines (Hultén 1968) with a collection 154 to the west in the Bering Glacier quad (Tasalich River, 60º 04.08' N 143º43.27' W, *M. Barker, A. Batten & Lynch BG03-94*, 03 August 2003(ALA)). This Willow Dock is highly variable and poorly understood. We follow the treatment of Douglas et al. (1999), who include several epithets under *R. salicifolius* var. *mexicanus* including: *R. mexicanus* Meisn., *R. triangulivalvis* (Danser) Rech f., *R. salicifolius* subsp. *triangulivalvis* Danser var. *angustivalvis* Danser, *R. salicifolius* subsp. *triangulivalvis* var. *mexicanus* (Meisn.) C.L. Hitchc., and *R. salicifolius* subsp. *triangulivalvis* var. *montigentitus* Jeps.

GULF OF ALASKA: ► common in silty sand and moss near stream outlet on sandy beach and on floodplain, Yana Stream, 0 m, 59º 47.58' N 141º 05.12' W, *P. Loomis & A. Batten 1937(ALA)* **27 July 2003**, det. C. Parker (ALA) 2003.



85. *Rumex salicifolius* var. *mexicanus*

PORTULACACEAE

***Montia bostockii* (A.E. Porsild) Welsh (*Claytonia bostockii* Pors.), Bostock's Minerslettuce** -- This arctic-alpine Alaska-Yukon endemic was the only rare plant noted in the park's General Management plan. It was a USFWS Category 2 species in 1985, a category 3C in 1987, is globally rare (G3) and rare in the state (S2S3 prior to our

inventory, currently S3). Prior to our inventory it was known from seven localities in the park. Our inventory documented an additional 14 localities. As a result of our inventory, its distribution is now known to be centered on the Wrangell-St. Elias Mountains in Alaska and in the Yukon.

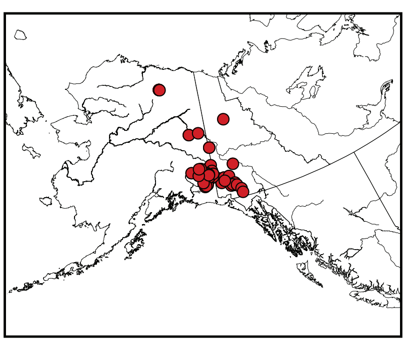
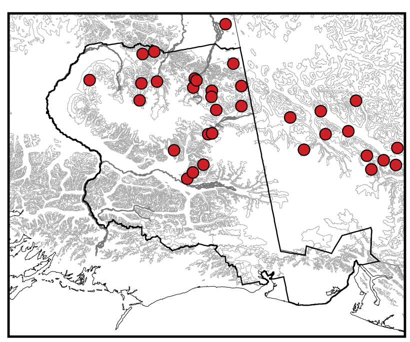
CHUGACH MOUNTAINS: ► sedge-*Dryas* tundra, Virgin Gulch, 1539 m, 61º15.52' N 142º31.09' W, *M. Protti 9104*, **17 July 1991**.

MENTASTA MOUNTAINS: ► numerous in moist sedge/birch meadow, Big Grayling Lake, 1036 m, 62º32.93' N 143º143.08' W, *G. Dodge s.n.* **June 1993**; ► scattered in mesic *Dryas* tundra, ridge E of Soda Lake, 1173 m, 62º32.36' N 142º53.98' W, *M. Cook 94307*, **21 July 1994**; ► occasional in open *Picea mariana* muskeg, Lost Creek floodplain, 1006 m, 62º32' N 143º9.6' W, *Roland & D'Auria 97-074*, **26 June 1997**.

NUTZOTIN MOUNTAINS: ► open shrub thicket, confluence of Notch Creek and Chisana River, 1097 m, 62º10.5' N 142º5.5' W, *J. Bolivar 84-48*, **25 June 1984**, conf. C. Parker (ALA) 1991; ► moist sedge meadow, Solo Flats, 1402 m, 61º50.67' N 141º47.05' W, *M. Duffy 92153*, **7 July 1992**, conf. C. Parker (1992); ► rare in low areas between dunes, Beaver Lake, 1341 m, 62º2.61' N 141º48.39' W, *M. Cook 94198*, **29 June 1994**; ► scattered in moss along stream bank, volcanic plateau between Bryan and Willow Creeks, 1829 m, 61º58.97' N 141º50.03' W, *M. Cook 95055B*, **18 June 1995**; ► few in saturated moss, Braye Lakes, 1097 m, 62º2' N 141º9' W, *Parker & Gracz 6870*, **11 August 1996**; ► saturated moss, open birch-willow scrub, Ptarmigan Lake, 1097 m, 61º50.03' N 141º13.75' W, *Duffy & Barnes 96-211*, **8 August 1996**, conf. C. Parker (ALA) 1996; ► scattered in open, mesic white spruce forest on bench below steep bluff, Chisana River, 2874 m, C. Roland & A. Batten 5734, 16 June 2003, conf. Alan Batten (ALA) 2003.

ST. ELIAS MOUNTAINS: ► open tundra muskeg, McColl Ridge, 1341 m, 61º12.36' N 142º39.64' W, *J. Bolivar 84-106*, 15 July 1984**,** conf. C. Parker (ALA) 1996.

WRANGELL MOUNTAINS: ► tussock muskeg ridgetop, between Grizzly Lake and Jacksina Creek, 1890 m, 62º14.51' N 143º17.46' W, *J. Bolivar 84-115*, **23 July 1984,** conf. C. Parker (ALA) 1991; *Dryas*-sedge tundra, NW slope of Mt. Sanford, 1296 m, 62º21.17' N 144º24.52' W, *M. Cook 93125*, **9 June 1993**; ► Lakes Plateau, 1890 m, 62º4.4' N 143º23.5' W, *M. Potkin 95-067*, **28 July 1995**; ► occasional in wet swale, bench between Monte Cristo Creek and Nabesna River, 1021 m, 62º14.07' N 142º56.85' W, *C. Roland 96-139*, **18 June 1996**.

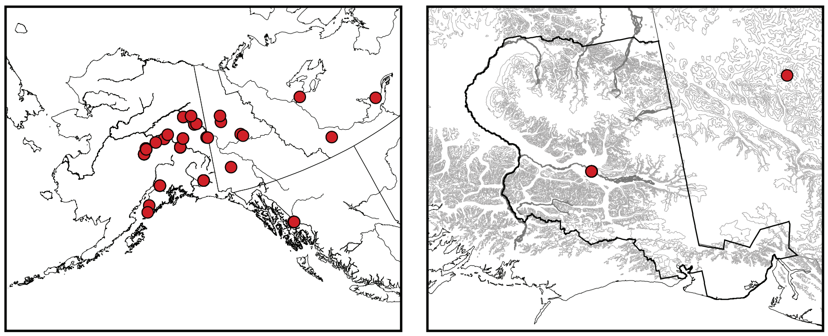



86. *Montia bostockii*

POTAMOGETONACEAE

Potamogeton foliosus **Rafinesque subsp. *foliosus*, Leafy Pondweed –** This pondweed has a widespread distribution in North America but was known from only five localities in Alaska prior to our inventory. Our collection extends its range into the Chitina River basin 330 km south from the Alaska Range (Mt. Hayes quad, Mark Lake, 63º 54.24' N 145º 55.03' W, *M. Duffy 98-450*, 14 August 1998 (ALA)) and 358 km east of Anchorage (Little Kowa Lake, *M. Duffy & J. Tande* 1031, 4 August 1994 (ALA)

CHITINA RIVER BASIN: ► mixed freshwater herbaceous in 1 m deep water and in mud at bottom of dried pond, Tana Flats, 442 m, 61º 14.45' N 142º 57.21' W, *M. Duffy & J. Barnes 96-122A*, *96-130A*, **7 August 1996**, det. C. Parker (ALA) 1996.

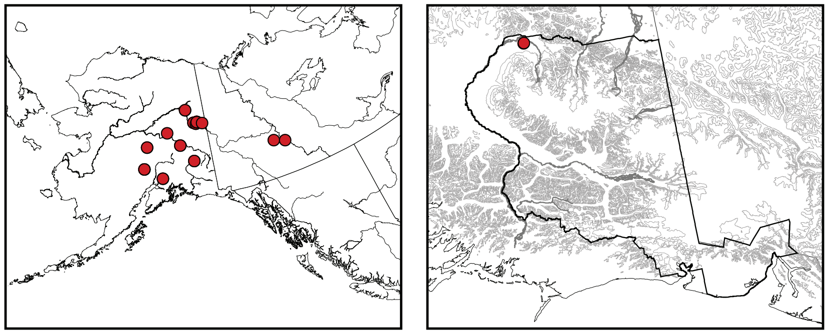


87. *Potamogeton foliosus* subsp. *foliosus*

Potamogeton obtusifolius **Mertens & Koch, Blunt-Leaf Pondweed –** This pondweed is rare in Alaska (S1). It was not known in Alaska prior to 1965 but is now known from 13 localities in interior Alaska, seven of these are along the Yukon River, the rest are disjunct but at least 150 km. Our collection from the upper Copper River valley is 298 km from a collection near Palmer (61º 36.39' N 149º 14.33' W, *L. Fuller s.n.*, 22 July 1991 (ALA)) and 172 km south of a collection from the Mt. Hayes quad (Mark Lake, 63º 54.24' N 145º55.03' W, *M. Duffy 98-446*, 14 August 1998 (ALA)).

Potamogeton obtusifolius Mertens & Koch is globally secure (G5) occurring in Europe, Asia and in North America in the boreal-montane zone. In North America it occurs across the continent and as far south as Kansas (but is absent from North and South Dakota). It is rare in Alberta (S2), British Columbia (S3S4), Labrador (S1?), Manitoba (S3?), Newfoundland Island (S1), Nova Scotia (S2), Ontario (S4S5), Quebec (S3), Saskatchewan (S2), Kansas (S2?), Montana (S2), New Jersey (S1), Pennsylvania (S1), Vermont (S3), Washington (S1), and Wyoming (S1).

UPPER COPPER RIVER VALLEY: ► aquatic forb herbaceous, vic. of Duck Lake, 686 m, 62º 37.40' N 143º 58.24' W, *M. Cook & M. Reid 5138 (ALA)* **9 August 2003**, conf. C. Parker (ALA) 2003.



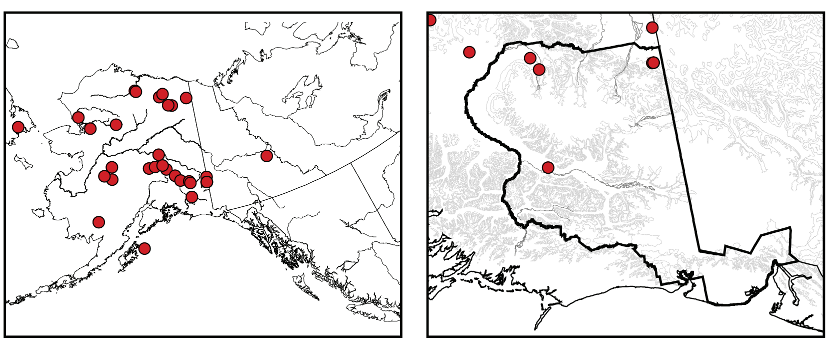
88. *Potamogeton obtusifolius*

Potamogeton subsibiricus **Hagstr., Yenisei River Pondweed** -- This amphiberingean species occurs in widely separated localities in boreal regions of Alaska and the Yukon. It is considered rare in Alaska (G3 S3) and the Yukon Territory (Douglas et al. 1981). The Chitina River locality extends its range 160 km southeast from a station along the Richardson Highway between Gakona and Paxson (Hultén 1968).

CHITINA RIVER BASIN: ► freshwater aquatic herbaceous, Muskrat Lake, 366 m, 61º24.56' N 143º50.66' W, *M. Cook & J. Wilder* 5049**, 8 August 2003**; ► freshwater aquatic herbaceous, Boomerang Lake, 838 m 61º 33.22' N 143º 51.88' W, *M. Cook & M. Reid 5112*, **9 August 2003**.

COPPER RIVER BASIN: ► rare in shallow water, Lake 2990', upper Copper River Basin, 911 m, 62º24.53' N 143º42.68' W, *C. Roland 96-919*, **11 August 1996**, det. Carolyn Parker (ALA) February 1997.

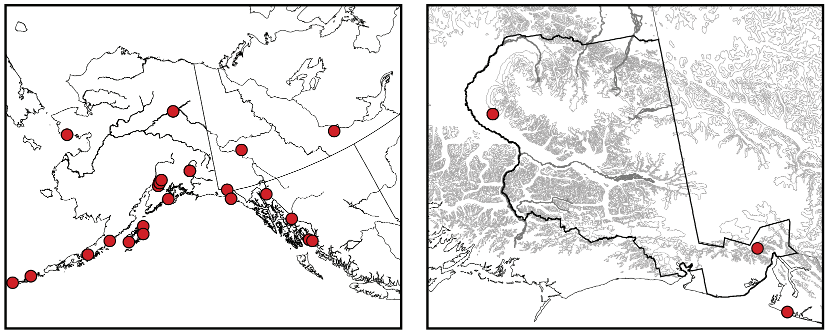
TANANA RIVER BASIN: ► patchy in shallow water in subarctic lowland sedge bog meadow, Carden Lake , 824 m, 62º16.55' N 141º12.02' W, *P. Loomis & K. Beattie 1129, 1030, 1033*, **9 July 2003**, det. Alan Batten (ALA) 2003►



89. *Potamogeton subsibiricus*

Ruppia cirrhosa **(Petagna) Grande, Ditch grass --** Our collection of this species in the Copper River basin is one of two non-coastal collections in Alaska. It connects the coastal range 238 km to the southwest near Anchorage (Coffee Point, 61º 30.10' N 149º 26.24' W, *A. Batten & Reed 80-166*, 08 July 1980 (ALA)) with a collection near 407 km to the southeast near Yakutat (Hultén 1968). *Ruppia cirrhosa* occurs in the West Indies, Central America, South America, Europe and is widespread in North America. It is found in shallow to deep fresh waters of lakes with high concentrations of sulphur or calcium (Flora of North America 2000).

Middle Copper River Basin: ► patchy in pond with rocky bottom and clear water, pond east of Nadina River, 763 m, 61° 57.02' N 144º 52.52' W, *P. Loomis & S. Backensto 2060 (ALA), 2051*, **7 August 2003**, det. C. Parker (ALA) 2003.



90. *Ruppia cirrhosa*

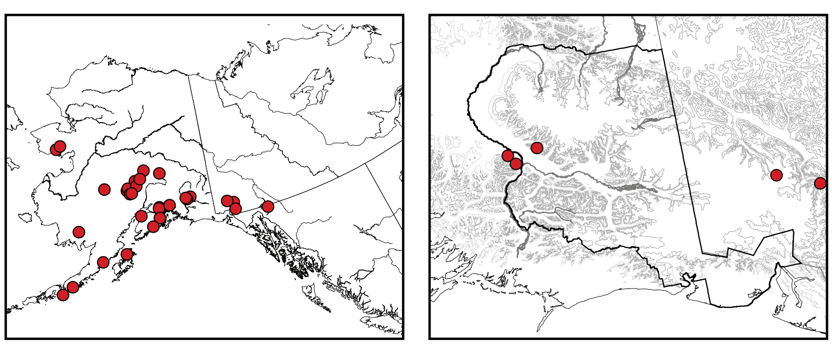
Primulaceae

Douglasia alaskana **(Coville & Standley ex Hultén) S. Kelso, Alaska Douglasia** -- This primrose is globally rare (G2G3), known from a restricted geographic range in southern Alaska (S2S3), southwestern Yukon Territories (S1) and northern British Columbia (S1). It is also one of the rarest plants in the park. Although extensive potential habitat has been surveyed in the park, only one location in the southwest Wrangell Mountains has been found. Two populations in the Chugach Mountains, just outside the park boundary have also been located and are reported here. It is never abundant at any site, usually less than ten scattered individuals. It is found in rocky alpine sites, rock crevices and scree slopes.

Our collections from the Wrangell and Chugach Mountains connect the range 203 km to the west in the Anchorage Quad (Lower Snowhawk, 61°11.75' N 149°33.25' W, *M. Duffy 795*, 19 July 1994 (ALA)) with collections 275 km to the east in the Yukon Territory (Cody 1996).

Chugach Mountains: few on old mining road, Five Mile Creek, 1463 m, 61º32.58' N 143º58' W, *M. Cook 93463*, 27 August 1993; few on talus slope and in *Dryas* tundra, Hundell Creek, 1585 m, 61º36.75' N 144º42.2' W, *M. Cook 93467*, **28 August 1993**.

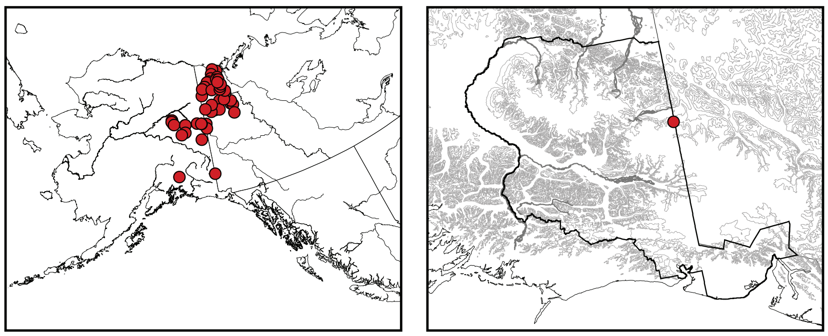
Wrangell Mountains: few along ridge at head of Elliot Creek, 1926 m, 61º38.99' N 144º3.51' W, *M. Cook 96468*, **16 July 1996**.



91. *Douglasia alaskana*

***Douglasia arctica* Hook., Mackenzie River Dwarf Primrose --** This primrose is globally rare (G3) known only from Alaska (S2S3), where it is uncommon, and the Yukon and Northwest Territories. Our collection is disjunct from the main distribution to the north in the Steese, White and Ogilvie Mountains in Alaska by 297 km. There is one other disjunct locality 296 km to the east in the Chugach Mountains near Nelchina (Hultén 1968). It is interesting that we have surveyed extensive habitat and have only found this one population, whereas we have found 34 localities of the closely related *Douglasia gormanii* in the northern Wrangell-St. Elias, Mentasta and Nutzotin Mountains (Cook and Roland 2002).

NORTHERN ST. ELIAS MOUNTAINS: rare in rocky sites on steep, N-facing slopes, Mt. Natazhat, 1716 m, 61º35.38' N 141º1.83' W, *C. Roland 95-066*, **19 June 1995**, conf. C. Parker (ALA) 1995.



92. *Douglasia arctica*

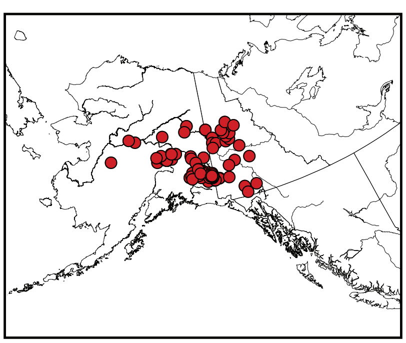
***Douglasia gormanii* Const., Gorman's Dwarf Primrose** -- This species, an Alaska-Yukon endemic with a cordilleran distribution, is rare in Alaska (G3 S3). Prior to inventory, it was known from four localities in the Wrangell-St. Elias Mountains of the park. We documented an additional 29 localities which extend its range 151 km into the northern and western Wrangells, 128 km northwest into the Mentasta Mountains and 90 km north into the Nuzotin Mountains. Our collections indicate that its distribution in Alaska and the Yukon is centered in the park.

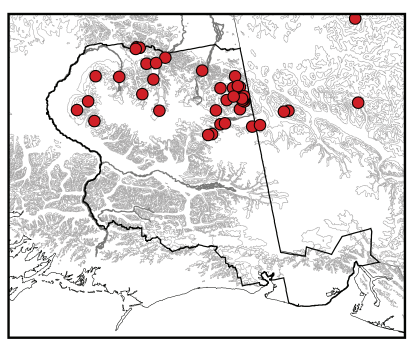
MENTASTA MOUNTAINS: ► occasional in moist soil and rubble on NE-facing debris flow, Trail Creek, 1615 m, 62º36.05' N 143º17.63' W, *C. Roland 95-014B*, **6 June 1995**; Upper Trail Creek, 1341 m, 62º37.09' N 143º16.06' W, *Potkin & Leggett 95-054*, **28 July 1995**, det. C. Parker (ALA) 1995; ► rare near top of steep talus slope, occasional on N-facing facing limestone rubble slope, headwaters of Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *K.A. Beck 95-222*, **4 July 1995**; *M. Cook 95171*, 7 July 1995; ► occasional in fine gravel, ridge above Totschunda Creek, 1280 m, 62º27.63' N 142º12.44' W, *C. Roland 96-293*, **24 June 1996**; ► scattered in rubble chute on NE-facing slope, Devil's Mountain, 1530 m, 62º25.62' N 142º53.93' W, *C. Roland 96-350*, **3 July 1996**.

NUTZOTIN MOUNTAINS: ► rare on upper slope, Carl Creek, 1920 m, 62º3.52' N 141º36.27' W, *M. Cook 94095*, **20 June 1994**; ► patchy on rock outcrops on northwest side of ridge, Wiki Peak, 1433 m, 61º53.9' N 141º9.51' W, *M. Cook 94123*, **22 June 1994**; ► occasional in moist tundra vegetation among cobble-sized rocks, slope 4 km east of Wiki Peak, 1585 m, 61º55.98' N 141º8.02' W, *C. Roland 94-118B*, **23 June 1994**; ► occasional on SW-facing scree slope, Horsfeld Creek, 1768 m, 62º2.88' N 141º13.18' W, *C. Roland 94-129B*, **24 June 1994**; ► rare on southeast trending

limestone ridge, Baultoff Creek, 1707 m, 62º9.13' N 141º14.51' W, *M. Cook 94190*, **28 June 1994**, conf. C. Parker (ALA) 1995; ► occasional on ridge growing in *Rhacomitrium*, Klein Creek, 1747 m, 62º2.29' N 141º19.88' W, *M. Cook 95017*, **15 June 1995**; ► few on ridge in rocky dwarf scrub tundra, Rock Lake, 1119 m, 61º48.7' N 141º16.57' W, *M. Cook 96028*, **6 June 1996**; ► common but scattered on gravel slope, Wiki Basin, 1411 m, 61º54.46' N 141º10.68' W, *C. Roland 96-067*, *M. Cook 96060*, **6 June 1996**; ► rare on well vegetated SE-facing alpine colluvium, Horsfeld Creek valley, 1128 m, 62º2' N 141º11' W, *Parker & Gracz 6914*, **13 August 1996**; ► bluff east of lodge, Ptarmigan Lake, 1079 m, 61º53' N 141º8.8' W, *Duffy & Barnes 96-259*, **8 August 1996**, conf. C. Parker (ALA) 1996; ► scattered on NW-SE trending ridge amongst *Dryas* stripes, pass between Cabin and Wiki Creeks, 1585 m, 61º53.64' N 141º11.4' W, *M. Cook 3172*, **14 June 1998** (ALA); ► steep S-facing rhyolite scree knob, W side of Wiki Creek, 1524 m, 61º54.77' N 141º11.05' W, *M. Cook 3181*, **15 July 1998** (ALA); ► scattered in gravel patches amongst *Dryas* stringers, Ophir Creek, 1463 m, 61º55.7' N 141º31.07' W, *M. Cook 3191*, **16 July 1998** (ALA); ► scattered in sparsely vegetated basalt scree, ridge S of Sonja Creek, 1494 m, 61º57.14' N 141º21.43' W, *M. Cook 3194*, **16 July 1998** (ALA); ► rare - growing in protected rock crevices on alpine spur ridge, Chisana River, 4482 m , *C. Roland & A. Batten* 5817A, **20 June 2003**, conf. Alan Batten (ALA) 2003.

WRANGELL MOUNTAINS: ► alpine tundra, Nabesna Glacier, 1768 m, 61º56.6' N 143º W, *M. Duffy 92115*, **26 June 1992,** conf. C. Parker (ALA) 1992; N-facing scree slope, ridge between Lime Creek and Solo Flats, 1707 m, 61º50.85' N 141º47.12' W, *M. Cook 92110*, **7 July 1992**, conf. C. Parker (ALA) 1992; ► occasional on steep gravel slope, northeast slope of Mt. Drum, 1433 m, 62º8.83' N 144º30.18' W, *C. Roland 94-055*, **11 June 1994**; ► occasional on slope of exposed, stony alluvium, Mt. Sanford cinder cone, 1722 m, 62º23.4' N 144º15.9' W, *C. Roland 94-002*, **6 June 1994**; ► rare on steep W-facing gravel slopes, Cone Ridge, 2073 m, 62º8.21' N 143º18.47' W, *C. Roland 94-318B*, **27 July 1994**; ► sparsely vegetated disturbed S-facing rubble, Chetaslina Plateau, 1615 m, 61º56.51' N 144º25.93' W, *C. Roland 94-351*, **17 August 1994**; ► occasional in stony, frost boiled polygon tundra, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *C. Roland 95-115*, **1 July 1995**; ► occasional in crevices of basalt rock ledges on ridge, Black Mountain, 1481 m, 62º20.85' N 143º44.9' W, *M. Cook 95153*, **7 July 1995**, det. C. Parker (ALA) 1996; ► southwest slope of Mt. Drum, between Nadina Glacier and Klawasi River, occasional in stony areas in sparse tundra, 1615 m, 62º4.61' N 144º46.39' W, *C. Roland 96-328*, **2 July 1996;** ► patchy in unstable scree, Skookum Volcano Trail, 1524 m 62º26.17' N 143º06.58' W, *P. Loomis & S. Backensto 2465*, **13 August 2003**, det. C. Parker (ALA) 2003.





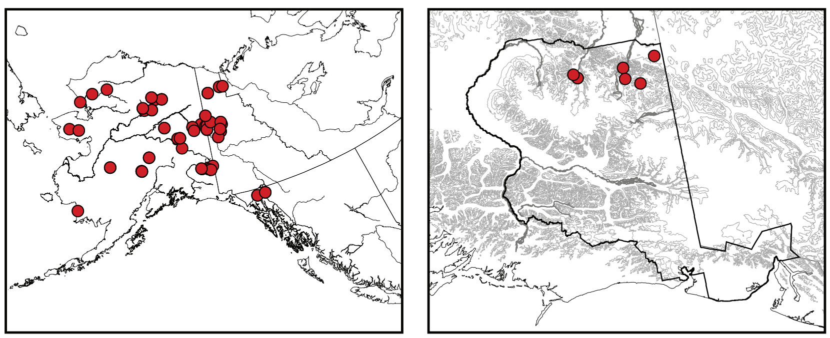
93. *Douglasia gormanii*

PTERIDACEAE

***Cryptogramma stelleri* (S.G. Gmel.) Prantl., Fragile Rock-Brake** -- This fern is circumpolar and widespread but rare throughout its range. It is considered rare in both Alaska (G5 S2S3) and the Yukon Territory (Douglas et al. 1981). Our collections extend its range 312 km south into the Nutzotin and Wrangell Mountains from a collection in the Big Delta Quad (Brigadier Road, 64°40.75' N 146°12.38' W, *Duffy & Lipkin 95-654*, 12 July 1995 (ALA)).

NUTZOTIN MOUNTAINS: ► head of Sheep Creek, 6 km above confluence with Chisana River, 1067 m, 62º7.95' N 141º54.9' W, *J. Bolivar 84-82*, **26 June 1984**; ► rare under boulders on SW-facing slope, Carl Creek, 1920 m, 62º3.52' N 141º36.27' W, *M.Cook 95006*, **14 June 1994**; ► rare in rock crevices, Carden Hills, 1311 m, 62º18.44' N 141º11.55' W, *M. Cook 94166*, **25 June 1994**.

WRANGELL MOUNTAINS: ► rare in rock crevices, Monte Cristo Creek, 975 m, 62º13.66' N 142º56.35' W, *C. Roland 96-147, 96-149*, **18 June 1996**; ► rare under boulders, Jaegar Mesa, 1893 m, 62º15.9' N 143º1.24' W, *C. Roland 95-133A*, **4 July 1995**.



94. *Cryptogramma stelleri*

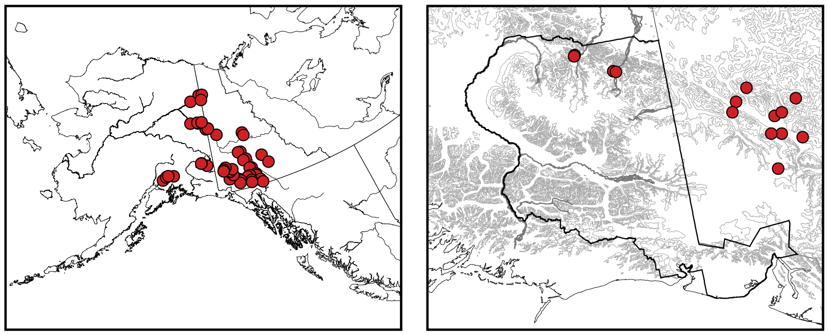
ROSACEAE

***Chamaerhodos erecta* (L.) Bunge subsp. *nuttallii* (Torr. & Gray) Hult., Little Rose** -- This amphiberingean species is rare in Alaska (S1S2) and in British Columbia (S2) although globally secure (G5T5). It occurs in Asia and in North America across Canada east to Ontario, in Montana, North Dakota, South Dakota, Wyoming, Utah, Colorado, Minnesota, and Michigan. It occurs in dry, open, sandy or gravelly hillsides and terraces in the steppe and montane zones (Douglas et. al. 1998 – 2002).

Our collections from the Mentasta and Nutzotin Mountains connect stations in the Anchorage Quad, 242 km to the southwest (Mile 74 Glenn Highway, 61°46.0' N 148°33.0' W, *S.L. Welsh 5001*, 30 July 1965 (ALA)) with its distribution 194 km to the east near Kluane Lake. Two additional populations of this species have been observed: one 7 km up the Nabesna River from the Devil's Mountain locality at the confluence with the Jacksina River (62°21.51'N 142°52.87'W) and one 8 km east and across the Nabesna River on a river terrace at Cabin Creek (62°23.57'N 142°46.74'W).

MENTASTA MOUNTAINS: ► locally abundant in bare soil on steep, S-facing slopes, Devil's Mountain, 942 m, 62º24.95' N 142º54.86' W, *C. Roland 96-225, M. Cook 96237*, **22 June 1996**; ► occasional on gravel scree slope, NE slopes of Devils Mountain, 1530 m, 62º25.62' N 142º53.93' W, *M. Cook 96284*, **3 July 1996**.

NUTZOTIN MOUNTAINS: ► rare in pockets of open soil in dry graminoid-forb steppe vegetation on steep, treeless S-facing slope, Chisana River #2: Medicine Man Creek Bluff, 1140 m, 62º 11.90' N 142º 07.255' W, *C. Roland & A. Batten 5737 (ALA)* **16 June 2003**; ► scattered in open soil within treeless graminoid-forb steppe on steep, S-facing slope, Warrick Peak on Chisana River, 970 m, 62º 11.10' N 142º 03.87' W, *C. Roland & A. Batten 5756*, **17 June 2003**.



95. *Chamaerhodos erecta* subsp. *nuttallii*

Potentilla biflora **Willd., Two-Flower Cinquefoil** -- This amphiberingian arctic-alpine species was previously known from only two localities in the Wrangell Mountains: between the Sanford River and Slana on the Copper River trail (62°24.70 144°5.68, 1372 m, *W.L. Poto s.n.*, 30 July 1902 (US) (Poto 1902, Hultén 1941-1950)) and Frederika Glacier (61°41.95 142°12.59, 1128 m, *R. Scott 2651*, 7 July 1968 (ALA) (Scott 1968)). It is now known throughout the mountains of the park. Our collections extend its range 114 km south into the Chugach Mountains and 72 km north into the Nutzotin Mountains.

CHUGACH MOUNTAINS: ► rare in dwarf scrub tundra, Chakina River , 1768 m, 61º6.19' N 142º55.03' W, *M. Cook 94227*, **8 July 1994**; ► locally common in *Dryas*-graminoid tundra, Verde Ridge, 1554 m, 61º14.03' N 143º28.52' W, *Roland & D'Auria 96-483*, **11 July 1996**; ► occasional in *Dryas*-lichen tundra, Nerelna Creek plateau, 1372 m, 61º26.66' N 144º17.69' W, *M. Cook 96306*, **7 July 1996**; ► occasional in Dryas-lichen tundra, Nelson Mountain, 1558 m, 61º19.37' N 143º48.83' W, *M. Cook 96375*, **7 July 1996**.

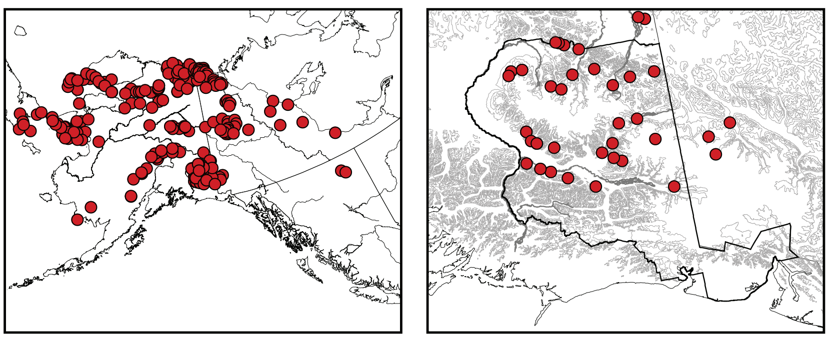
MENTASTA MOUNTAINS: ► *Dryas* forb tundra, limestone ridge between Lost and Platinum Creeks, 1646 m, 62º34.58' N 143º5.58' W, *M. Cook 94339*, **23 July 1994**; ► upper Trail Creek, 1341 m, 62º37.09' N 143º16.06' W, *M. Potkin 95-042*, **26 July 1995**; ► scattered in *Dryas*-lichen-moss stringers, ► Lost Creek, 1722 m, 62º36.45' N 143º12.03' W, *M. Cook 95179*, **5 July 1995**; ► locally abundant in argillite scree, Totschunda Creek, 1561 m, 62º30.62' N 142º47.21' W, *C. Roland 96-365*, **4 July 1996**.

NUTZOTIN MOUNTAINS: ► alpine tundra, Sheep Creek, 1554 m, 62º8.61' N 141º46.93' W, *J. Bolivar 84-61*, **26 June 1984**; ► dwarf scrub sedge tundra, Solo Mt., 1620 m, 62º11' N 143º31.42' W, *M. Cook 92052*, **8 July 1992**; ► scattered in SE-facing limestone, Baultoff Creek, 1707 m, 62º9.13' N 141º14.51' W, *Cook & Roland 94191*, **28 June 1994**; ► scattered in bare mineral soil, Cooper Pass, 1942 m, 62º17.16' N 142º31.44' W, *M. Cook 94342*, **24 July 1994**.

ST. ELIAS MOUNTAINS: ► common on N & S facing slopes in *Dryas* tundra & on ledges and crevices of limestone, ridge between Dan & Copper Creeks, 1554 m, 61º21.56' N 142º26.43' W, *M. Cook 94285*, **13 July 1994**; ► occasional in *Dryas*-sedge-

lichen tundra, Mt. Chitina, 2073 m, 60º57.74' N 141º17.33' W, *M. Cook 95256*, **16 July 1995**.

WRANGELL MOUNTAINS: ► moist silt and humus, ridge SW of Long Glacier, 1372 m, 61º45.83' N 144º12.12' W, *K.A. Teare 84-77B*, **18 July 1984**; ► N-facing scree slope, Lime Peak, 1707 m, 61º28.41' N 141º29.44' W, *M. Duffy 92208*, **11 July 1992**; ► *Dryas*-sedge tundra, Iron Mountain, 1676 m, 61º22.15' N 144º1.4' W, *M. Cook 92516*, **11 July 1992**; ► *Dryas*-sedge tundra, NW slope of Mt. Sanford between Sanford and Boulder Creeks, 395 m, 62º21.17' N 144º24.52' W, *M. Cook 93117*, **9 June 1993**; ► W-facing slope, volcanic ridge between upper Jacksina River and Mesa Creek, 2073 m, 62º8.21' N 143º18.47' W, *C. Roland 94-318A*, **27 July 1994**; ► tundra, Jaegar Mesa , 1893 m, 62º15.9' N 143º1.24' W, *Moran & Roland 95-57*, **3 July 1995**; ► dry tundra near ridge crest, Nikolai Pass, 1280 m, 61º26' N 142º40' W, *Batten & Barker 96-046*, **23 July 1996**; ► occasional in gravel on of limestone ridge, Alice Peak, 1628 m, 61º39.82' N 144º7.76' W, *C. Roland 96-389*, **5 July 1996**; ► few at edge of *Dryas*-graminoid heath adjacent to limestone cliff, headwaters of Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, *M. Cook 96511*, **7 July 1996**; ► scattered in limestone gravel talus, Kuskulana Pass, 1545 m, 61º33.72' N 143º39.7' W, *M. Cook 96551*, **7 July 1996**.



96. *Potentilla biflora*

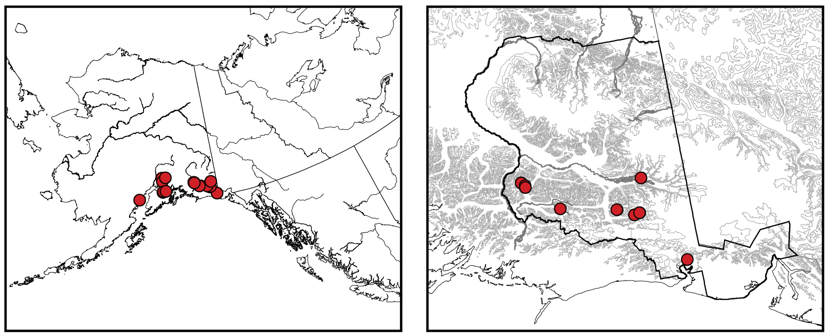
***Potentilla drummondii* Lehm., Drummond's Cinquefoil** -- This North American cordilleran species is rare in Alaska (S2) but globally secure (G5). Prior to our inventory, it had not been reported as occurring in the state. When our material from the Chugach Mountains was identified by Barbara Ertter (UCB), two older collections from the Anchorage Quad (234 km to the east of our collections) and two from the Seward Quad were discovered. It is also now known from Tuxedni Bay in the Kenai Quad.

Potentilla drummondii is disjunct in Alaska from southern British Columbia, southwest Alberta where it is rare (S2), the Cascade Mountains of Oregon, Washington and Northern California (Hitchcock and Cronquist 1961). It also occurs in Idaho, Montana and Nevada. It is found in moist to wet, open rocky slopes, meadows and open forests in the montane to alpine zones (Douglas et. al. 2001).

CHUGACH MOUNTAINS: ► mesic forb tundra, Upper Tebay Lake, 1219 m, 61º12.18' N 144º23.8' W, *M. Duffy 91109*, **12 August 1991**, det. C. Parker (ALA) 1996; ► occasional in dry graminoid meadow, Granite River, Granite Range, 884 m, 60º44.63' N 142º6.05' W, *M. Cook 96607*, **7 July 1996**, det. C. Parker (ALA) 1997; ► scattered in ericaceous-graminoid meadow, vic. 12-mile Creek, Granite Range, 1271 m, 60º48.85' N 142º33.52' W, *M. Cook 96632*, **7 July 1996**, det. C. Parker (ALA) 1997; ► scattered between willow, Upper Falls Creek, 655 m, 61º14.17' N 144º28.24' W, *L.A. Viereck &*

E.G. Viereck 11038, **7 July 1996**, det. Barbara Ertter (UCB) 1997; ► mixed mesic forb herbaceous snow beds, Middle Fork of the Bremner River, 869 m, 60º55.05' N 143º43.86' W, *M. Duffy & J. Barnes 96-083*, **6 August 1996**, det. Barbara Ertter (UCB) 1997; ► few at margin of bluejoint herb meadow, Upper Tebay Lake, 579 m, 61º11' N 144º24' W, *C.L. Parker & M. Gracz 6739*, 8 August 1996, det. Barbara Ertter (UCB) 1997.

ST. ELIAS MOUNTAINS: ► moist herbaceous patches among birch shrubs, upper Chitina River, 503 m, 61º5.35' N 141º56.3' W, *C.L. Parker & M. Duffy 6704*, **6 August 1996**, det. Barbara Ertter (UCB) 1997; ► occasional on slope of silty cobble, Upper Karr Hills, 1070 m, 60º 11.16' N 141º 18.27' W, *P. Loomis & A. Larsen 1292 (ALA)* **19 July 2003**, det. C. Parker (ALA) 2003.

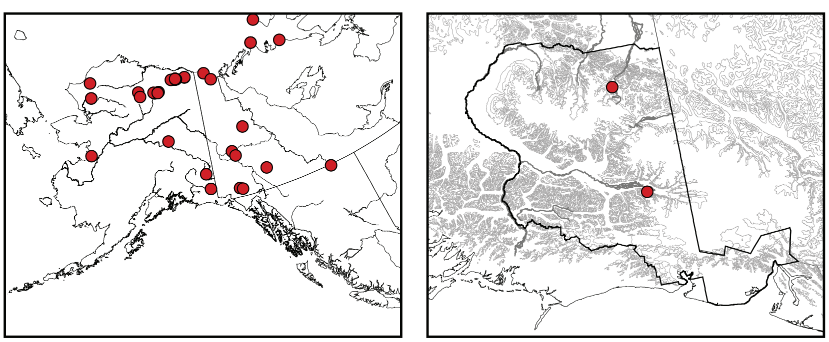


97. *Potentilla drummondii*

***Potentilla rubricaulis* Lehmann (*P. hookeriana* Lehm. subsp. *hookeriana* var. *furcata* (Pors.) Hult.), Rocky Mountain Cinquefoil** -- This North American arctic-alpine species is rare in Alaska (S2S3) but globally secure (G4). Our collection in the Chugach Mountains is 520 km south of a collection near Fairbanks and 235 km east of collections in the Yukon Territory (Cody 1996).

CHUGACH MOUNTAINS: ► rare in *Dryas*-graminoid tundra, between Granite and Lime Creeks, 1829 m, 61º0.22' N 141º51.1' W, *C. Roland 96-751*, 28 July 1996.

NUTZOTIN MOUNTAINS: ► common on dry, well drained slope, Euchre Mountain, 1241 m, 62º07.03' N 142º11.15' W, *B. Bennett & P. Loomis 03-726*, **19 June 2003**.



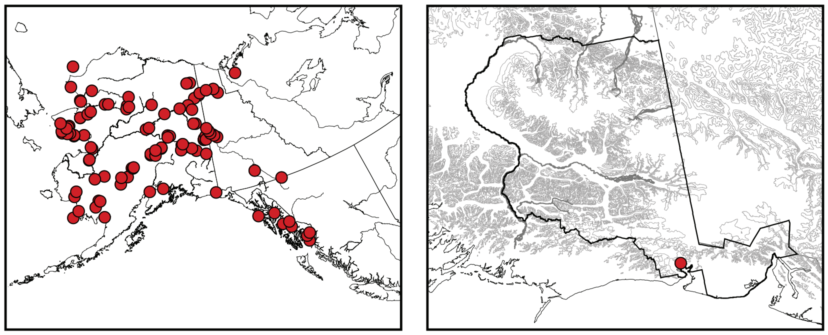
98. *Potentilla rubricaulis*

***Sanguisorba officinalis* L., Great Burnet –** Our collection of this circumpolar species connects its coastal distribution in Alaska 426 km to the west at Girdwood (60º57.04' N 149º13.19' W, *Schaeffer 40*, 9 June 1961 (ALA)) with its distribution 395

km to the southeast in the Sitka Quad (White Sulfur Springs, 57º46.06' N 136º21.48' W, *Muller 3237*, 22 August 1979 (ALA)).

It is found in bogs and fens in the lowland and montane zones (Douglas et. al. 1999). In North America it also occurs in the Yukon Territory, British Columbia (S4), Northwest Territories, Nova Scotia, California (S2), Maine, Michigan, Minnesota, Oregon, Pennsylvania and Washington.

SOUTHERN ST. ELIAS MOUNTAINS: ► patchy in tall herbaceous meadow, west Guyot Hills, 658 m, 60º 09.09' N 141º 27.28' W, *P. Loomis & A. Larsen 1230 (ALA)* **19 July 2003**.

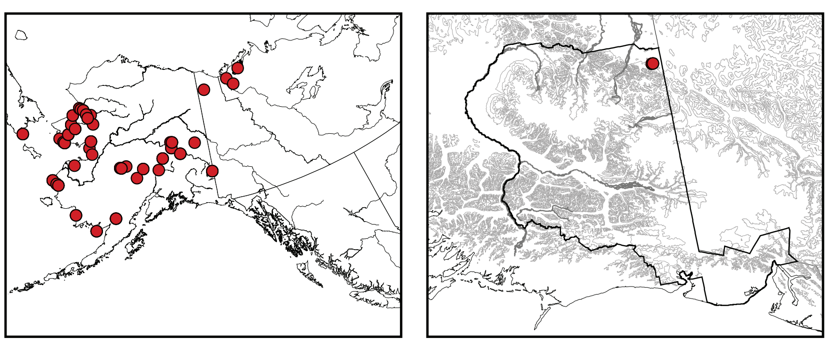


99. *Sanguisorba officinalis*

RUBIACEAE

***Galium brandegei* Gray, Three-Petal Bedstraw –** Our collections of this North American boreal-montane bedstraw extend its range in Alaska 289 km southeast into the Yukon-Tanana uplands from its distribution in the Alaska Range (Mt Hayes Quad, Tanana Valley).

TANANA RIVER LOWLANDS: ► occasional in muddy gaps between tussocks in open black spruce forest, ponds west of Carden Lake, 876 m, 62º 16.42' N 141º 13.59' W, *P. Loomis & K. Beattie 1088 (ALA)* **10 July 2003**, conf. C. Parker (ALA) 2003; ► occasional throughout sub-arctic sedge wet meadow along lake margin, Carden Lake, 62º 16.55' N 141º 12.02' W, *P. Loomis & K. Beattie 1011*, **10 July 2003**, conf. C. Parker (ALA) 2003.



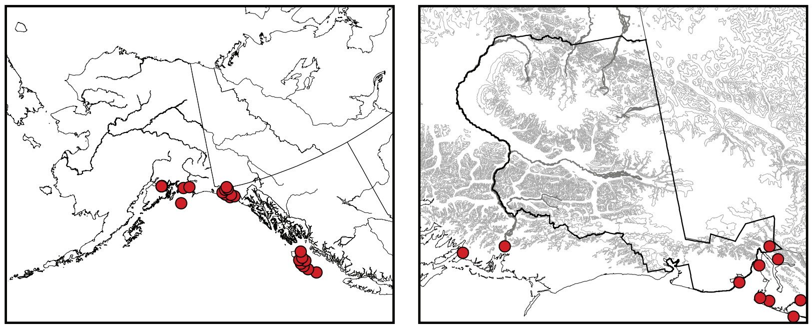
100. *Galium brandegei*

SALICACEAE

***Salix hookeriana* Barr., Hooker Willow –** This amphiberingean willow with a Pacific coastal distribution is rare in Alaska (S2) but secure globally (G5). It was known

only from the type locality at Yakutat until 1967 when George Argus found it to be abundant on stabilized coastal sand dunes on the Malaspina Forelands. It is thought to be more common along the coast in the park than our one collection indicates and is to be looked for in the interior Chugach Mountains.

GULF OF ALASKA: ► common on margin of open Sitka spruce forest and beach, Schooner Beach 4 km E of Osar estuary, 0 m, 59º 45.20' N 140º 05.20' W, *P. Loomis & A. Batten 1770 (ALA)* **25 July 2003**, det. C. Parker (ALA) 2003.



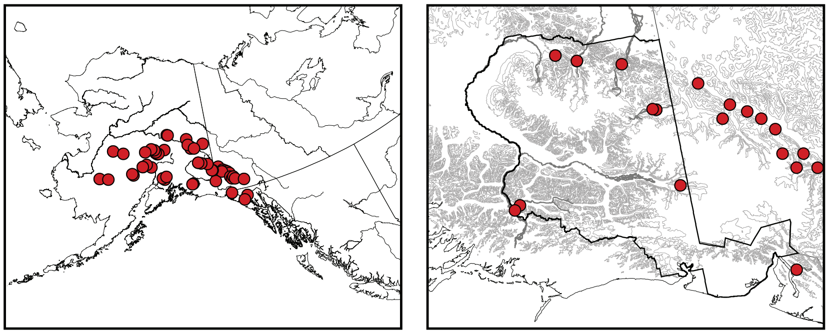
101. *Salix hookeriana*

***Salix setchelliana* Ball, Setchell's Willow** -- This Alaska-Yukon endemic willow is rare in Alaska (G3G4 S3) and in the Yukon Territory (Douglas et al. 1981). It had been collected in the park at the head of the Chitina River in 1925 by H.M. Laing (Porsild 1939, Hultén 1941-1950)). Our collections extend its range 183 km west into the Copper River basin and 184 km northwest into the Tanana River basin. These stations connect its range 198 km to the west in the Anchorage Quad (Matanuska, 61°32.0' N 149°14.0' W, *J.P. Anderson 884*, 10 July 1931 (ALA)) and 139 km to the north on the Delta River (63°33.0' N 145°50.0' W, *G.W. Argus 13398*, 15 August 1989 (ALA)) with its range 92 km to the east in the Yukon Territory (Cody 1996).

COPPER RIVER BASIN: ► rare in wet silt on floodplain, Bremner River, 152 m, 60º56.95' N 144º41.79' W, *C. Roland 96-611*, **17 July 1996**; ► dunes at mouth of Bremner River, 69 m, 60º59.67' N 144º34.63' W, *L. A. & E. G. Viereck 11050,* **7 July 1996**, conf. G.W. Argus (CAN) 2000.

TANANA RIVER BASIN: ► common in sandy areas of gravel bar, Totschunda Creek, 725 m, 62º26.94' N 42 º40.8' W, *C. Roland 96-252*, *M. Cook 96250*, **23 June 1996**, conf. G.W. Argus (CAN) 2000**;** ► scattered on sandy river bar, Bond Creek, 783 m, 62º19.42' N 142º51.82' W, *C. Roland 96-176*, **19 June 1996**, conf. G.W. Argus (CAN) 2000; ► scattered on stabilized river terrace, confluence of Jacksina and Nabesna Rivers, 759 m, 62º21.51' N 142º52.87' W, *C. Roland 96-198*, *M. Cook 96222*, **21 June 1996;** ► common to abundant on windswept active and established riverbars, Nabesna River, 632 m 62º 32.44' N 142º 28.30' W, *B. Bennett & P. Loomis* 03-306, **7 June 2003;** ► **p**atchy in open, stabilized gravels on river terrace, Chisana River, 2592 m , *C. Roland & A. Batten 5779*, **18 June 2003**, conf. Alan Batten (ALA) 2003.

WHITE RIVER BASIN: ► **c**ommon to abundant on open, active river bars, White River Valley, 983 m, 61º43.49'N 141º22.11'W, *B. Bennett & P. Loomis 03-118*, **2 June 2003,** *B. Bennett & P. Loomis***, 5 June 2003;** ► **a**bundant throughout river flats, White River Valley, 1001 m, 61º44.37' N 141º26.41' W, *B. Bennett & P. Loomis* 03-235, 5 June 2003.



102. *Salix setchelliana*

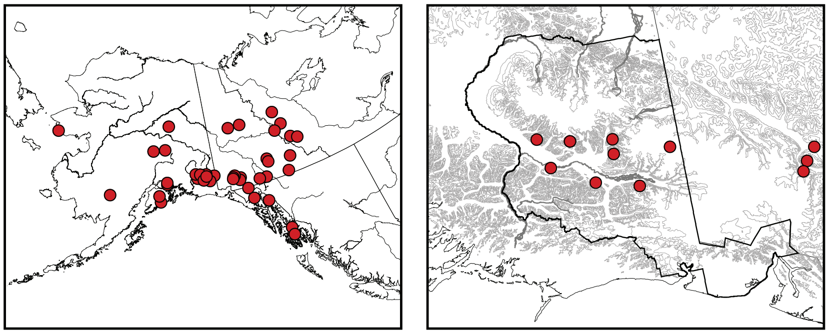
SAXIFRAGACEAE

Saxifraga adscendens **L. subsp.** ***oregonensis*** **(Raf.) Baciagalupi, Small Saxifrage** -- This North American cordilleran saxifrage is rare in Alaska (S2S3) but globally secure with some taxonomic uncertainty (G5T4T5). It was known from only one locality in the Wrangell Mountains prior to our inventory (Chitistone Pass, 61º37' N 141º58' W, 1979 m, *D. F. Murray 683*, *1064* (CAN)). Our collections extend its range 107 km into the Western Wrangells and 103 km south into the Chugach Range. These collections join the cordilleran range 240 km to the southwest in the Anchorage Quad (Nike Site, 61°15.70' N 149°32.25' W, *Duffy et al. 381*, 29 June 1994 (ALA)) with the distribution 161 km to the east in the Yukon Territory (Cody 1996).

CHUGACH MOUNTAINS: ► occasional in serpentinized ultramafic unit on ridge S of Chakina River, 1768 m, 61º6.19' N 142º55.03' W, *M. Cook 94229*, **8 July 1994**; ► rocky ridge crest and W- facing slide rock, West Fork Goat Creek, 1487 m, 60º59.5' N 142º1' W, *Batten & Barker 96-294*, **29 July 1996** (ALA); ► scattered on moist gravel slope, Nelson Mountain, 1558 m, 61°19.37' N 143º48.83' W, *M. Cook 96370*, **7 July 1996**.

ST. ELIAS MOUNTAINS: ► rare in solifluction lobes, limestone ridge between Dan & Copper Creeks, 1554 m, 61º21.56' N 142º26.43' W, *M. Cook 94293*, **14 July 1994**.

WRANGELL MOUNTAINS: ► scattered in dry, rocky limestone talus, Lakina Glacier, 1219 m, 61º33.64' N 143º19.01' W, *M. Cook 96537*, *C. Roland 96-705*, **25 July 1996**; ► few in fine gravels, in greenstone unit, Iron Mountain, 1868 m, 61º37.85' N 144º1.01' W, *M. Cook 96467*, **7 July 1996**; ► bare organic soil and moss, Grotto Creek, 1847 m, 61º30.56' N 142º24.79' W, *M. Cook 96510*, **7 July 1996**; ► scattered in moss and organic soil of limestone outcrops, Lakina Glacier, 1219 m, 61º33.64' N 143º19.01' W, **7 July 1996**.



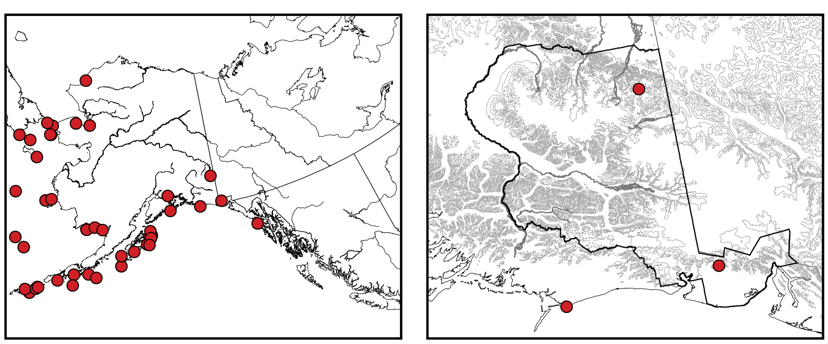
103. *Saxifraga adscendens* subsp. *oregonensis*

***Saxifraga bracteata* D. Don (*S. sibirica* L.), Siberian Saxifrage –** Our collection of this saxifrage in the Nutzotin Mountains in the interior of Alaska is unusual since *Saxifraga bracteata* is known only from rocky slopes along the coast throughout its range. It is an amphiberingian species occurring in Russia along the coast of Kamtschatka and in north Pacific coastal Alaska. Prior to our inventory, it was known from only four disjunct localities west of latitude 152, two on the Kenai Peninsula, one at Cape St. Elias and one near Pelican. Our collection in the Nutzotin Mountains is 259 km north of the closest coastal collection at Cape St. Elias (59°56.0' N 144°23.0' W, Cunningham et al. 124-78, 1 June 1978 (ALA)). Our collection in the Samovar Hills on the coast connects its distribution 188 km to the west at Cape St. Elias with a station 352 km to the southeast near Pelican (Hultén 1968).

This species is closely related to *S. rivularis* (Hultén 1940-1950, 1968, Welsh 1974) and is treated as *S. sibirica* L. by Kartesz (1999). Kartesz includes *S. exilis* Steph., *S. radiata* Small and *S. rivularis* var. *laurentiana* (Ser.) Engl within *S. sibirica*. *S. sibirica* has a broader distribution than *S. bracteata* occurring in Asia, Alaska, Yukon Territory, Northwest Territory and Alberta. We choose to follow the authorities at ALA who retain Hultén's 1968 nomenclature although our interior collection of this plant fits the broader and more interior distribution pattern of *S. sibirica*.

NUTZOTIN MOUNTAINS: ►occasional on rock-*Dryas-Rhacomitrium* SW-facing slope, Carl Creek, 1920 m, 62º3.52' N 141º36.27' W, *Cook & Roland 94091A*, **20 June 1994**, conf. C. Parker (ALA) 1995.

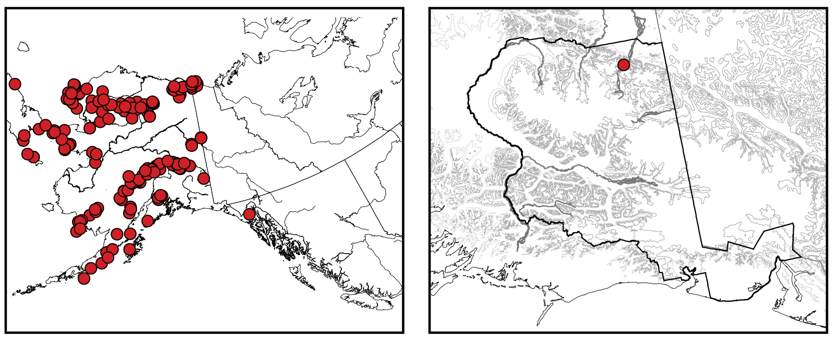
SOUTHERN ST. ELIAS MOUNTAINS: ►dry forb alpine herbaceous talus, Samovar Hills, 610 m, 60º8.35' N 140º39.6' W, *M. Cook 87-77*, **24 August 1987**, conf. C. Parker (ALA) 1991.



104. *Saxifraga bracteata*

Saxifraga eschscholtzii **Sternb., Cushion Saxifrage --** This arctic-alpine amphiberingean saxifrage occurs in Alaska, the Yukon Territory and Nunavut within North America and the Anadyr Range and Chukotka Peninsula in Russia. Although it is apparently secure globally (G4), it is extremely rare in the Yukon Territory (S1) and Nunavut (S1) and uncommon in Alaska (S3S4). Our collection of *Saxifraga eschscholtzii* extends its range 160 km to the southeast into the Nutzotin Mountains from the Alaska Range (Tanacross Quad, Sheep Creek, *Winters 287*, 24 May 1978 (ALA)). The collection in the Nutzotin Mountains is the only locality of this species in the park and it is not known from the adjacent mountains in the Yukon Territory. The closest station to the west is 487 km in the vicinity of Haines (Hultén 1968). It occurs on rocky outcrops, shale, and calcareous gravel slopes (Cody 1996).

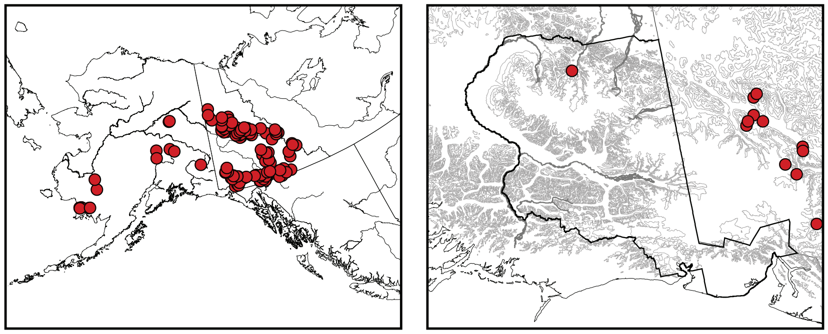
NUTZOTIN MOUNTAINS: ► rare in protected rock crevices in lee of large boulder on alpine spur ridge dividing Edge Creek and Chisana River, 1494 m, 62º16.23' N 141º55.62' W, *C. Roland & A. Batten 5820 (ALA)* **20 June 2003**.



105. *Saxifraga eschscholtzii*

Saxifraga nelsoniana **D. Don subsp.** ***porsildiana*** **(Calder & Savile) Hult., Porsild's Saxifrage –** This subspecies is amphiberingian with an arctic-alpine distribution. It occurs in northeast Asia, Alaska, Yukon Territory, Alberta, British Columbia, Northwest Territory and Nunavut. *Saxifraga nelsoniana* subsp. *porsildiana* is apparently secure globally (G5T3T4), but rare in Alaska (S2) and Alberta (S2). It is known from only one locality in the park in the northern Wrangell Mountains, but because it is so similar to the other subspecies all of which are quite variable, it is probably overlooked. Our collection connects its range 237 km to the west at the headwaters of the Susitna River (Hultén 1968) with its distribution 209 km to the west in Kluane National park (Cody 1996). It is found in moist rock outcrops, scree, meadows and streambanks from the montane to alpine zones (Douglas et. al. 2000).

WRANGELL MOUNTAINS: ► along stream, Jaeger Mesa, 1893 m, 62º15.90' N 143º01.24' W, *V. Moran & C. Roland 95-58*, **7 July 1995**, conf. C. Parker (ALA) 1996.



106. *Saxifraga nelsoniana* subsp. *porsildiana*

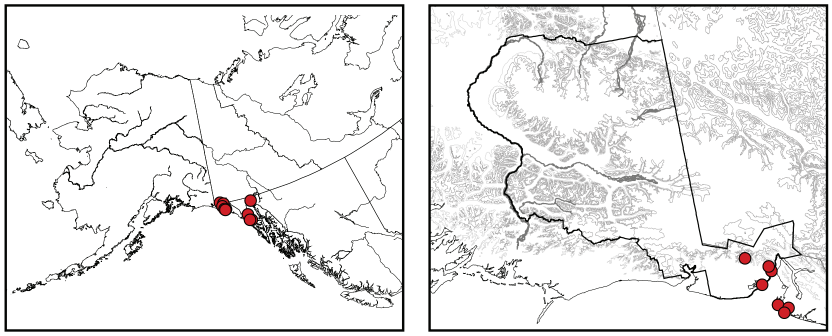
SCROPHULARIACEAE

***Castilleja chrymactis* Pennell, Green Indian Paintbrush** -- This Alaska endemic with a Pacific coastal distribution is globally rare (G1Q) occurring only from the Point Gustavus area northward to the Malaspina Forelands. *Castilleja chrymactis* is taxonomically questionable, being closely related to *C. hyetophila*. Both species are subsumed by Welsh (1974) and by Douglas et. al. (1998 - 2002) into *C. miniata*. Kartesz (1999) considers *C. chyrmactis* to be a valild taxon endemic to Alaska whereas Mark Egger (pers.comm. 2000) considers it to be a consolidated hybrid between *C. miniata* Doug. ex Hook. and *C. unalaschensis* (Cham. & Schhlecht.) Malte. The AKNHP ranked *C. chrymactis* as extremely rare in 1998 (S1), but thereafter treated it as a synonym with *C. miniata*. ALA recognizes it as a valid taxon, and we have followed this treatment.

Our collections from the Malaspina Forelands are in the vicinity of collections from Disenchantment Bay (*F. Funston 82*, 1892 (US) (Hultén 1949)) and Yakutat Bay (*Coville & Kearney 1147*, 1899 (US) (Hultén 1949)) but they extend the distribution west to the Malaspina Forelands and into the alpine zone.

GULF OF ALASKA: ► occasional in beach strand forb herbaceous vegetation, Sudden Stream, Malaspina Forelands, 30 m, 59º47.08' N 139º58.8' W, *M. Cook 8858*, **20 July 1988**, det. M. Egger (WTU) 2003; ► patchy throughout coastal herbaceous meadow, Strawberry Island, 0 m, 59 º54.08'N 139 44.25'W, *P. Loomis & A. Larsen 1499*, **21 July 2003**, det. A. Batten (ALA) 2003.

SOUTHERN ST. ELIAS MOUNTAINS: ► occasional in mesic tall forb meadow, Amphitheater Knob, 10 km east of Disenchantment Bay, 503 m, 59º57.1' N 139º46.4' W, *M. Cook 87-95*, **19 August 1987**, det. M. Egger (WTU) 2000; ► common along solifluction slope in tall mixed forb herbaceous meadow, 900 m, 60º 05.07'N 140º12.39'W *P. Loomis & A. Batten 1788 (ALA)* **25 July 2003**, det. A. Batten (ALA) 2003.



107. *Castilleja chrymactis*

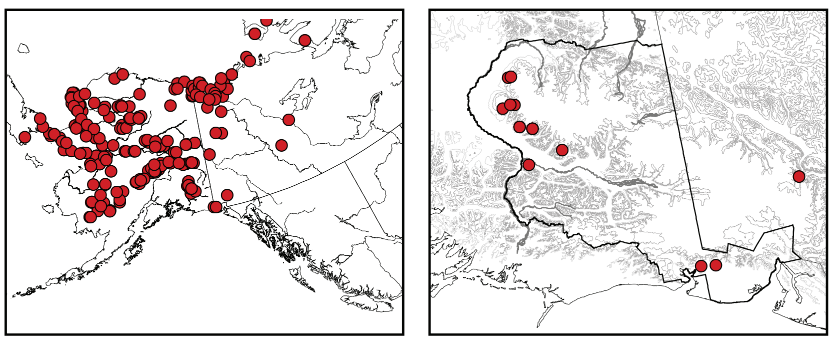
Castilleja elegans **Malte, Elegant Indian Paintbrush –** Our collections of this paintbrush on the coast in 2003 extend it range 243 km south into the southern St. Elias Mountains from our collections in the Wrangell Mountains which are 160 km south of its distribution in the Alaska Range (Mt. Hayes Quad: 63°40.0' N 144°54.0' W, L.A. Spetzman 86, 20 June 1957 (ALA)). It is an amphiberingean species with an arctic-alpine distribution occurring in North America in Alaska, Northwest Territories, Nunavat and Yukon Territory in moist calcareous tundra, moraines, talus slopes, fell fields and rocky or sandy lakeshores (Cody 1996, Welsh 1974).

Prior to our inventory, Castilleja elegans had not been documented in the Wrangell-St. Elias Mountains although there may have been two collections in the Wrangell Mountains (Jacksina River, F.C. Schrader & G.H. Hartman 49, 1902 (US) and Sanford River, W.L. Poto 100, 1902 (US) (Hultén 1948)). Hultén listed these specimens as *C. pallida* (L.) Kunth subsp. *mexiae* Pennell in the Flora of Alaska and the Yukon (1949). Hultén followed the treatments of J.R. Boivin (1952) and O.V. Rebristaja (1964) in his 1968 flora in which *C. elegans* is regarded as a distinct species and *C. pallida* subsp. *mexiae* is united with *C. elegans* (Hultén 1967, 1968). However, the distribution map in the 1968 flora for C. elegans does not include the specimens from the Wrangell Mountains or other specimens of *C. pallida* subsp. *mexiae* as cited in the Flora of Alaska and the Yukon (1949) nor do they appear to be included on the map of *C. caudata* (Pennell) Rebr. If these stations were included in the current distribution of *C. elegans*, it would extend south to Keystone Canyon on the Richardson Highway (J.P. Anderson 1884 (S)), west to Matanuska (J.P. Anderson 1908 (NY)) and include a locality near Willow Creek along the Richardson Highway adjacent to the park (J.P. Anderson 2003 (S) (Hultén 1949)).

CHUGACH MOUNTAINS: ► scattered throughout ericaceous heath, plateau NW of Nerelna Creek, 1372 m, 61º26.66' N 144º17.69' W, *M. Cook 96297*, **7 July 1996**, conf. M. Egger (WTU) 1999.

SOUTHERN ST. ELIAS MOUNTAINS: ► common on slope of unstable washout gravel, Slope on east side of Mid- Tyndall Glacier, 1 km S of Hoof Hill, 749 m, 60º 08.23' N 141º 06.36' W, *P. Loomis & A. Larsen 1398*, **20 July 2003**; ► common on densely vegetated ridge, Samovar Hills, 721 m, 60º 07.03' N 140º 48.06' W, *P. Loomis & A. Larsen 1445 (ALA)* **20 July 2003. WRANGELL MOUTAINS**: ► occasional in *Cassiope*/*Dryas*-lichen tundra, Cheshnina Plateau, 1338 m, 61º 49.16' N 144º 04.46' W, *M. Cook & J. Baker 4732*, 4 July 2003, conf. C. Parker (ALA) 2004.

Wrangell Mountains: ► sedge tundra, Cheshnina Plateau, 500 m, 61º 50.33' N 144º 22.50' W, *M. Protti 9105 & M. Duffy 91086*, **21 July 1991**, conf. M. Egger (WTU) 1999; ► mesic herbaceous/dwarf scrub tundra, ridge between Chichokna and Chetaslina Rivers, 1463 m, 61º 56.51' N 144º 25.93' W, *M. Cook 94471*, **15 August 1994**, det. M. Egger (WTU) 1999; ► top of small ridgetop, Chokosna River, 1097 m, 61º32.46' N 143º32.88' W, J. Bolivar 84-101, 13 July 1994, det. M. Egger (WTU) 1999; ► *Dryas* sedge tundra, NW slope of Mt. Sanford between Sanford and Boulder Creeks, 395 m, 62º21.17' N 144º24.52' W, *M. Cook 93122*, **9 June 1993**, conf. M. Egger (WTU) 1999; ► scattered in *Dryas*-graminoid tundra, NW slopes of Mt. Sanford, 1387 m, 62º20.98' N 144º28.18' W, *M. Cook 94411*, **30 July 1994**, conf. M. Egger (WTU) 1999; ► occasional in forb herbaceous meadow, vic. Nadina Glacier, 1768 m, 62º2.85' N 144º41' W, *M. Cook 94422*, **30 August 1994**, conf. M. Egger (WTU) 1999; ► common in heath snowbed tundra, volcanic ridge 6 km east of Snyder Peak, 1524 m, 62º4.47' N 144º30.51' W, *C. Roland 96-377*, **5 July 1996**, conf. M. Egger (WTU) 1999; ► scattered in sparse, lichen-dominated heath tundra, Cheshnina Plateau, 1399 m, 61º48.04' N 144º6.27' W, *C. Roland 96-871*, *96-877*, **5 August 1996**, conf. M. Egger (WTU) 1999; ► *Cassiope-Dryas* heath, plateau between Long Glacier and the Cheshnina River, 1399 m, 61º48.04' N 144º6.27' W, *M. Cook 96718*, **8 August 1996**, det. M. Egger (WTU) 1999.



108. *Castilleja elegans*

***Castilleja miniata* Dougl., Scarlet Indian Paintbrush –** Our collection of this paintbrush in the Chugach Mountains represents the northern extent of its North American cordilleran distribution and is the most interior collection in Alaska. In Alaska *Castilleja miniata* occurs primarily along the southeast coast. Our collections in the southern St. Elias Mountains on the coast connect its range 220 km to the west on the Copper River Delta (*Mickelson, s.n.*, 19 July 1973 (ALA)) with its distribution which is mostly continuous along the coast east of Yakutat (Disenchantment Bay, *F. Funston 82, 1892* (US), Situk River Estuary, 59º28.56' N 139º38.38' W, *C. Parker s.n.*, 28 June 1991 (ALA)).

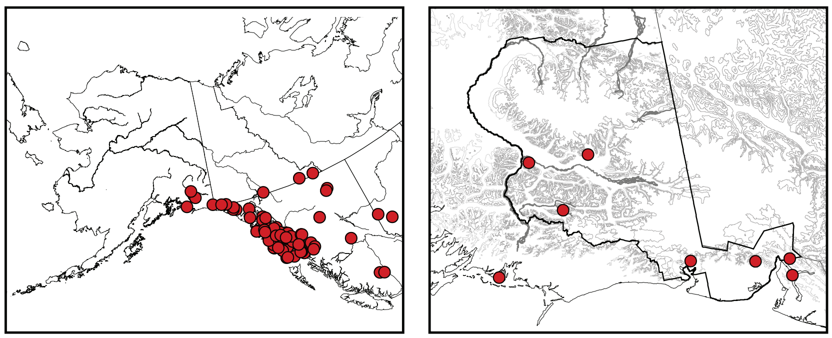
Castilleja miniata is uncommon in Alaska (S3) but secure globally (G5) occurring in the Yukon Territory, British Columbia east in Canada to Ontario and south to New Mexico. It is found in wet to dry meadows, grassy slopes, fens, tidal marshes, clearings, roadsides, thickets and open forests from the lowland to subalpine zones (Douglas et. al. 2001).

Chugach Mountains: ► mixed mesic forb herbaceous snow bed community, middle fork of the Bremner River, 869 m, 60º 55.05' N 143º 43.86' W, *M. Duffy & J. Barnes 96-084*, **8 August 1996**, det. M. Egger (WTU) 2001; common in mesic meadow

in swale on tundra, Nerelna Creek Plateau, 1372 m, 61º 26.66' N 144º 17.69' W, *C. Roland & J. D'Auria 96-404 (ALA)* **8 July 1996**, det. C. Parker (ALA) 1996.

SOUTHERN ST. ELIAS MOUNTAINS: ► patchy in silt and cobble on disturbed, mixed herb slope, Upper Karr Hills, 1070 m, 60º 11.16' N 141º 18.27' W, *P. Loomis & A. Larsen 1300*, **19 July 2003**, det. A. Batten (ALA) 2003; ► abundant in organic soil on unstable slope, ridge between Hayden and upper Lucia glaciers, 999 m, 60º 03.12' N 140º 00.05' W, *P. Loomis & A. Larsen 1659*, **23 July 2003**, det. A. Batten (ALA) 2003; ► common on unstable scree slope near small rivulet, Variegated Glacier vic. Hubbard Glacier, 387 m, 60º 00.30' N 139º 18.43' W, *P. Loomis & A. Batten 1995 (ALA)* **28 July 2003**.

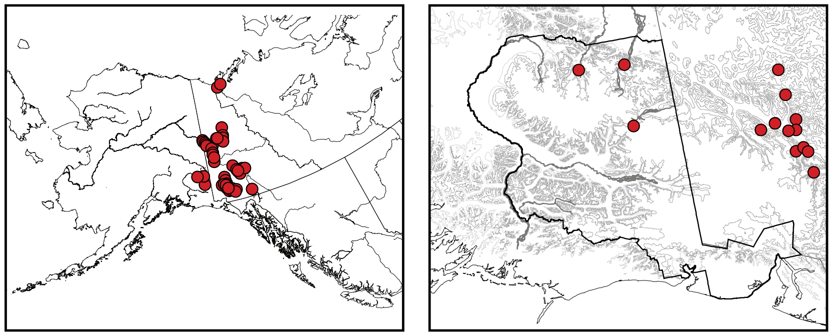
WRANGELL MOUNTAINS: Fireweed Mountain, *J. Wilder*, s.n., **26 July 2001**, conf. M. Egger (WTU) 2001



109. *Castilleja miniata*

***Castilleja yukonis* Pennell (=*C. pallida* (Linné) Sprengel var. *yukonis* Pennell), Yukon Indian-Paintbrush –** *Castilleja yukonis* is known only in Alaska from three localities in this park: our collections from the Wrangell Mountains and a collection by D.F. Murray at Skolai Pass in 1967 (61°37.25'N 141°58.77'W, *D. F. Murray 1025* (CAN) (Murray 1968)). It's primary distribution is 160 km to the east in the Yukon and Northwest Territories. Mark Egger, from the University of Washington herbarium, has been studying this genus for inclusion in the Flora of North America. He considers the *C. pallida* complex quite difficult with a large number of morphologically poorly defined and intergrading geographical varieties. According to Egger, *C. yukonis* should be considered a variety of *C. pallida* and it is not found much west of the Canadian border (Mark Egger pers. comm. 2000). ALA follows Egger's treatment, however Kartesz (1998) considers *C. yukonis* a valid taxon. It is considered globally rare (G3) but is not ranked by the AKNHP.

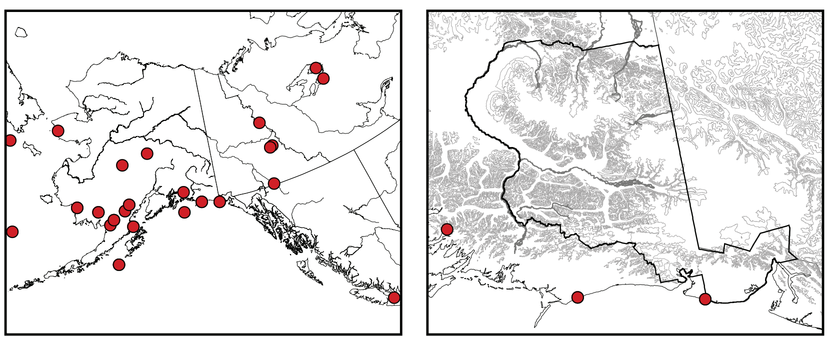
WRANGELL MOUNTAINS: ► scattered on rocky W-facing bluff in open alder scrub, between Nabesna River and Ellis Lake, 1310 m, 62º 16.22' 142º 55.70', *M. Cook 3026*, **21 June 1997**, det. M. Egger (WTU) 2000; ► scattered on river terrace with seral herbs, Chisana River, 864 m, 62°14.64'N 141°55.24'W, *C. Roland & A. Batten 5796 (ALA)* **18 June 2003** det. A. Batten (ALA) 2003.



110. *Castilleja pallida* var. *yukonis*

Limosella aquatica **L., Mudwort --**This circumpolar boreal montane aquatic is uncommon in Alaska but globally secure and known only from one locality in the park. It is also uncommon (S3) in Minnesota, Wyoming, Alberta, British Columbia and rare in Ontario (S2). Our collection from Yana Stream connects its distribution 144 km to the west in the Bering Glacier Quad (Tasalich River mouth, 60º 00.45' N 143º44.31' W, *M. Barker, A. Batten & Lynch BG03-97*, 3 August 2003 (ALA)) with a station 467 km to the east near Teslin, Yukon Territory (Cody 1996) w. 1968), and 302 km to the west to a locality near Valdez (Porsild 1980).

SOUTHERN ST. ELIAS MOUNTAINS: ► occasional, growing in silt under 5 cm water in small pool on sandy back beach, Yana Stream, 0 m, 59º 47.58' N 141º 05.12' W, *P. Loomis & A. Batten 1929 (ALA)* **27 July 2003**, det. A. Batten (ALA) 2003.



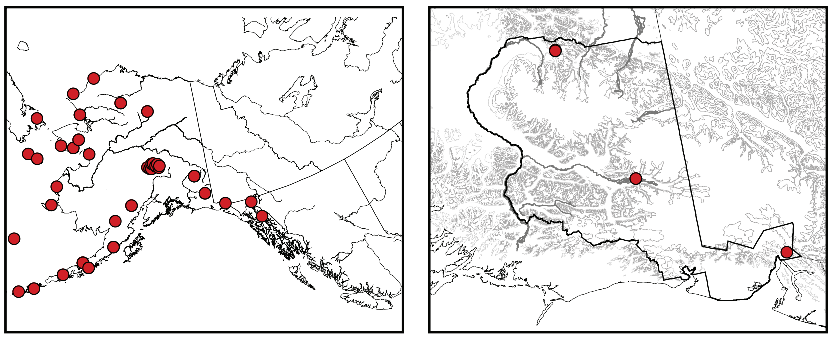
111. *Limosella aquatica*

Pedicularis pacifica **(Hult.) Kozh., (=** ***P. sudetica*** **Willd. subsp.** ***pacifica*** **Hultén) Sudetic Lousewort --** This species is restricted to the Russian Far East and Alaska (Hultén 1968, Molau and Murray 1996) and is considered to be rare globally (G5T3T4). It is found in moist arctic coastal habitats, meadows and stream banks of arctic mountains and in sub-alpine and alpine meadows of the taiga. It has most likely been overlooked throughout the park and Alaska, since many botanists do not identify specimens of the *P. sudetica* complex to subspecies and have not been familiar with the taxonomic revision by Molau and Murray (1996) in which the taxa treated as subspecies by Hultén (1968) are treated at the specific level and *P. sudetica* s. str. occurs only in the Sudeten Mountains of central Europe. Our collections of *P. pacifica* extend its range in Alaska 297 km to the SE into the northern Wrangell Mountains and 467 km into the southern St. Elias Mountains on the coast from its distribution in the Alaska Range (Healey Quad, Riley Creek, 63º35.59' N 148º55.13' W, *C. Roland 3843*, 18 June 1999

(ALA)), and connect the distribution represented by two stations in the vicinity of Haines 224 km to the southeast (Hultén 1968).

NORTHERN WRANGELL MOUNTAINS: ► patchy throughout sub-arctic lowland sedge wet meadow, Tanada Lake Trail, 959 m, 62º 31.50' N 143º 21.28' W, *P. Loomis 2523*, 14 August 2003, det. C. Parker (ALA) 2003; ► patchy in mixed shrub- sedge tussock tundra, pond adjacent to Tanada Lake Trail, 940 m, 62º 31.25' N 143º 21.14' W, *P. Loomis 2501 (ALA)* **14 August 2003**, det. C. Parker (ALA) 2003.

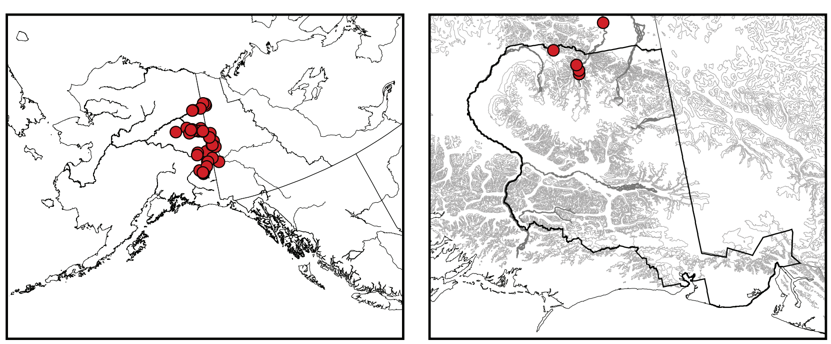
SOUTHERN ST. ELIAS MOUNTAINS: ► in *Vaccinium* tundra amongst rocky outcrops of smooth, dark grey rock and quartz, Mount Foresta, 796 m, 60º 04.30' N 139º 20.23' W, *P. Loomis & A. Batten 1882 (ALA)* **26 July 2003**, det. C. Parker (ALA) 2003.



112. *Pedicularis pacifica*

***Penstemon gormanii* Greene, Gorman's Beardt**ongue -- This is an Alaska-Yukon endemic with a narrow distribution in the boreal-montane zone. The southern limit of its distribution is from the Nabesna River valley in the park. It was not known to the park prior to our inventory.

TANANA RIVER BASIN: ► small population in limestone rubble at base of hill 3070', 1.2 km SE of Whitham Lake, 936 m, 62º19.33' N 142º53.28' W, *C. Roland 96-177*, *M. Cook 96198*, **20 June 1996**; ► abundant on small knob undercut by the Nabesna River downstream of Virginia lake, 759 m, 62º21.51' N 142º52.87' W, *C. Roland 96-215*, *M. Cook 96230*, **21 June 1996**; ► abundant in bare soil on steep, S-facing slopes, SW end of Devil's Mountain, 942 m, 62º24.95' N 142º54.86' W, *C. Roland 96-227*, *M. Cook 96234*, **22 June 1996**; ► scattered in moss on limestone ledges and in crevices, Nabesna River at Cheslina River, 677 m, 62º47.49' N 142º10.4' W, *M. Cook 96260*, **25 June 1996**.

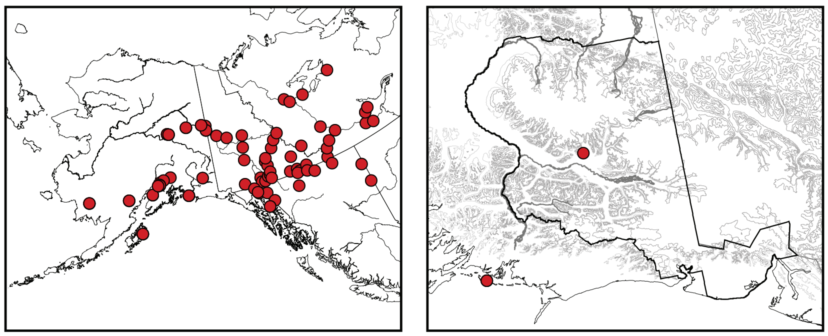


113. *Penstemon gormanii*

VIOLACEAE

***Viola renifolia* Gray (=*Viola renifolia* Gray var. *brainerdii* (Greene) Fern, Kidney-Leaf White Violet –** Our collection of this North American boreal-montane violet extends its range into the southern Wrangell Mountains and connects its distribution 178 km to the southwest on the Copper River Delta (*Parker 1974*, 15 August 1986 (ALA)) with its distribution 349 km to the east in the southwest Yukon (Hultén 1968). Prior to 1968, it was known in Alaska from only two stations in the vicinity of Anchorage and three stations in southeast Alaska (Hultén 1968).

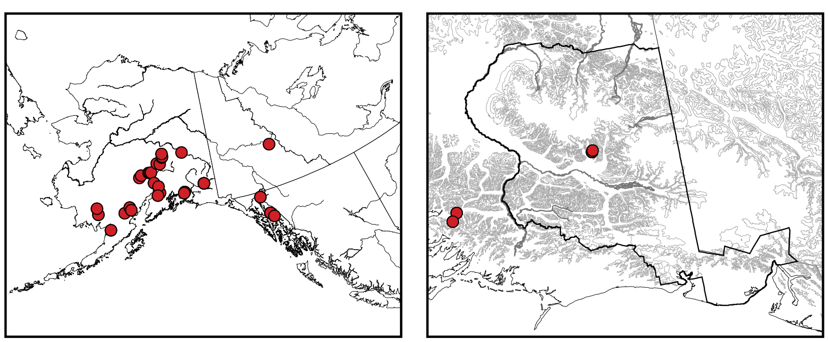
SOUTHERN WRANGELL MOUNTAINS: patchy in woods behind Terry & Dee Frady's house, vicinity of Fireweed Mountain, 61º 25.99'N 143º 01.40'W, *Jim Wilder, s.n.* **6 June 2002**, conf. C. Parker (ALA) 2003.



114. *Viola renifolia* var. *brainerdii*

***Viola selkirkii* Pursh, Great-spurred Violet –** This boreal-montane violet is uncommon in Alaska (S3) but globally secure (G5?). It has a circumpolar range with large gaps occurring in the boreal montane zone in mesic to moist rock outcrops, thickets, swamps and open forests (Douglas et. al. 1998 - 2002). The collection in the Wrangell Mountains connects its range 180 km to the southwest in the Valdez Quad (Mile 14 Richardson Highway, *I.W. Ailes 17* (ALA)) with collections 473 km to the southeast near Skagway (Hultén 1968)

WRANGELL MOUNTAINS: near Angle Station, 975 m, growing in alder-spruce stand, Bonanza Ridge, 61º 30.70' 142º 49.85', *G. Frost s.n.*, **1 June 1998** (ALA).



115. *Viola selkirkii*

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Conclusions and Recommendations

The National Park Service recognized as early as 1929 (with the ecological perspective of George Wright) that knowledge about the occurrence, distribution, condition and trends of its ecological resources was necessary to protect its lands for future generations (Sellars 1997). However, progress towards obtaining adequate information on these ecological resources has been slow (1997 General Accounting Office, 1991 National Park Foundation). Obtaining baseline information is particularly challenging in Alaska since most of the parks are relatively young (26 years old) and they encompass large areas that are difficult to access. Sixty-four percent of the 84.4 million acres of National Park land occur in Alaska, 25% are in the Central Area Network and 16% are in Wrangell-St. Elias National Park and Preserve. This park covers an area slightly larger than the following parks combined: Yellowstone, Everglades, Olympic, North Cascades, Great Smokey, Yosemite, Death Valley, Glenn Canyon, Big Bend and Lassen Volcanic National Parks.

The National Park Service National Resource Initiative was funded in 1997 to accelerate the inventorying and monitoring of National Park Service ecological resources and the National Parks Omnibus Management Act (NPOMA) of 1998 gave superintendents and managers specific legal authority to conduct and support science in National Parks. Knowledge of the diversity, abundance and distribution of 12 basic natural resource datasets was identified as the first step in protecting the parks from degradation and in developing the science program. The vascular flora was one of the basic datasets that was considered a high priority for this park.

Fulfillment of Inventory Purpose

This inventory has succeeded in significantly increasing the knowledge of the diversity, abundance and distribution of the vascular plant flora in Alaska and in this park and has made this data available to researchers and the National Park Service. This information is being used to fulfill the primary purpose of the study identified in the Final Environmental Statement for the Park: to acquire baseline information about the park's flora in order to "Ensure retention of the magnificent Wrangell-St. Elias landscapes and living systems in a natural state", and to "…allow the natural fluctuations and equilibrium of self-regulating ecosystems to continue unimpeded" (Alaska Planning Group 1973). If the founding legislation of this park were written today with the knowledge that we now possess about the diversity of the flora and the high number of rare and endemic species that occur here, these resources would most likely have been specifically identified in the park's founding legislation along with the protection of wildlife habitat and "…landscapes in their natural state" (National Park Service 1985).

The information from the inventory is being used to protect the park's biodiversity by:

- *Contributing to North American and Alaskan floristics and biodiversity assessments*- Data from the inventory was provided to John Kartesz for the inclusion in his PLANTS database and Synthesis of North America Flora (Kartesz and Meacham 1999). Vouchers of *Papaver*, *Poa*, *Carex*, *Potentilla*, *Draba* and *Salix* from the inventory have been used by the specialists who

wrote these treatments for the Flora of North America (1993-2005). Every species that occurs in the park is represented by at least one specimen at the University of Alaska Fairbanks Herbarium and data associated with these specimens is maintained by the herbarium's Northern Plant Documentation Center available online (http://arctos.database.museum). This data and park publications on its flora have provided context and inspiration for researchers studying the systematics and biogeography of the Alaskan flora. Rare plant data for 524 occurrences was provided to the Alaska Natural Heritage Program and has been a significant source of distribution data for the ranking of Alaska's rare plants. Providing the public and researchers access to our specimens and specimen data will increase the awareness and appreciation of the park's tremendous natural resources and will hopefully engender more support from the public for the protection and understanding of these resources.

- *Contributing to long term ecological monitoring*. Alaska's National Parks are in the gifted and challenging position of trying to protect relatively intact ecosystems represented within their boundaries. An understanding of baseline conditions is necessary to conduct long term monitoring. We estimate that 77% of the 1,198 vascular plant species that are expected to occur in the park have been documented, an increase of 19% from prior to the inventory. Although this baseline value is incomplete, it is all we will have in the near future. With continued field work in the park in unsurveyed areas and communities we would expect the species diversity to increase. If it does not, and if we are losing rare and endemic populations or populations at the edge of their range, these are indicators that the health of our ecosystems is altered and may require management action. The following information gained from the inventory has been key in supporting a park-wide sampling design for long term monitoring of vegetation, a design which would represent a good portion of the species and landscape diversity found within the park: (1) varied species composition across the various regions of the park, (2) varied distributions of endemic and rare plants across ecological regions and by landscape variables, and (3) an enhanced understanding of the origins of the park's flora and those elements that are most unique.
- *Facilitating environmental reviews* - Data from the inventory has been used in the review of 234 compliance projects. This includes 16 environmental assessments such as the assessments done for the Kennecott National Historic Landmark, the building of the Crystalline and Skookum trails and the development of campgrounds at McCarthy and at Twin Lakes (on the Nabesna Road).
- *Contributing to park planning* - Understanding the distributions of the rare and endemic floras of the park, and of the locations of unique plant communities acquired during the inventory has contributed to planning efforts for visitor use, backcountry recreation, trail management, grazing management and Nabesna and McCarthy Road development.
- *Contributing to cultural resource studies* - Endemic plant distribution data from this inventory was used to help select sites to inventory for the

archeological survey in the Wiki Basin (Patterson 1998). Community descriptions and species lists from the 1996 inventory were used for the vegetation description in the Bremner Cultural Landscape Study (White 2000) and historic data gathered during this inventory and inventory collection data from surrounding areas was used for the Kennecott Mill Town Cultural Landscape Report (Gilbert, White and Worthington 2001).

COMPLETION OF OBJECTIVES

1994-1997 Inventory Objectives

- *Establish a database of all plants known to occur in the park and maintain information on the rarity, distribution, synonymy, taxonomy and collections of these plants.*

The history of botanical collecting was researched thoroughly using published literature, collections at national herbaria, and secondary literature (such as USGS field reports and field notes of other collectors). Prior to this inventory, data for park collections was not digital. A set of relational databases was developed to track voucher collection data, taxonomic, biogeographic and ecological data. This database was populated with all species known to occur in the park and records added as new taxa were discovered during the inventory.

- *Conduct inventories of the vascular flora of selected areas within the park.*

Inventories of 233 sites north of the Bagley Icefield were conducted. Site selection focused on representing the spatial extent of the area, unique lithologies, and a range of elevations, aspects and communities across the park regions. Nine species new to Alaska and 160 taxa new to the park were documented during the 1994-1997 inventory.

- *Identify populations of rare taxa, unique floristic associations and areas of phytogeographic interest which the park may need to protect.*

Forty-six new rare taxa and 331 new rare occurrences were documented in the 1994-1997 inventory (14 new taxa in 2003 and 99 new occurrences) for a total of 91 taxa and 524 occurrences. Prior to 1994, 36 rare plant species were known from the park. Our voucher data clarified the distribution of many Alaska-Yukon rare taxa. Thirty-one taxa occurring in the park (such as *Draba stenopetala*, *Festuca brevissima* and *Minuartia dawsonensis*) were down listed by the Alaska Natural Heritage Program in large part due to our occurrence data (Chapter 4). There are ninety-nine taxa which reach their North American distribution limits in the park and we now know that the Alaska-Yukon distributions of many taxa are centered on the region of the park (such as *Carex adelostoma*, *Montia bostockii*, *Oxytropis huddelsonii* and *Papaver radicatum* subsp. *kluanensis*). Analysis of collection and site data indicated a trend for rare plants to occur in the alpine zone, above 4000 ft., in xeric sites, on southerly aspects and in the alpine-herb talus slope plant community. The Nutzotin and Mentasta Mountains and Tanana River Valley have a high number of Alaska-Yukon endemic and rare plant populations and therefore should be considered in park conservation planning.

- *Prepare a voucher collection of all plants known to occur in the park.*

4,278 vouchers were accessioned into the park herbarium from 1994-1997 (2,522 were vouchered in 2003 for a total of 8045 total specimens, 1893 of which are at the University of Alaska Fairbanks Herbarium). All species known to occur in the park are represented by a specimen. Vouchers of *Papaver*, *Poa*, *Carex*, *Potentilla*, *Draba* and *Salix* have been used by the specialists who wrote the treatments for the Flora of North America. Making our specimens and data available to researchers and the public will help increase the awareness and appreciation of this park's tremendous resources and will hopefully engender more support from the public for the park's protection and towards understanding its resources.

- *Enhance our understanding of the history, genetic diversity and biogeography of the park's flora*.

The biogeography, composition and sources of the park's flora were described in Cook and Roland (2002) and in this document (Chapter 6). Some of the highlights of our increased understanding of the phytogeographical patterns in the park (based on the voucher data from the inventory) are:

- The composition of the park's flora is more similar to the flora of the Yukon Territory than it is to the flora of Alaska.
- The floristic similarity between regions is described by six broad floristic regions which reflect the climatic and latitudinal gradients found within the park.
- The documented vascular flora is most similar in the Mentasta and Nutzotin Mountains and the coastal regions (including the lower Copper River basin) are least similar to the rest of the flora.
- The composition of the park's flora is predominately North American (33%), circumpolar (26%) and amphiberingian (22%).
- The composition of the rare flora is comprised predominately of North American species (49%) and Alaska-Yukon endemic species (22%).
- The distribution of the rare flora is uneven across the regions of the park with the greatest numbers in the Nutzotin Mountains, Mentasta Mountains, northern Chugach Mountains and Chitina River basin.
- Most (66%) of the rare plant collections were made over 4000 ft (1219 m) and were in the xeric moisture class (54%) and both of these variables were independent of sampling effort.
- The endemic flora is distributed evenly between four types (amphiberingian, Alaska-Yukon, Cordilleran and Pacific coastal) and there are more endemics in mountain regions than in basin regions.
- The primary sources of the park's flora are the ice-free areas of the Upper Yukon Valley, the ice-free areas in the Alaska Range to the northwest and the western North American Cordillera to the east, and unglaciated coastal refugia.

- *Provide the structure for a continued assessment of the park's flora.*

The methodology used in this inventory was applied to the subsequent state-wide plant inventories conducted through the National Resource Initiative. The relational databases were used for the Central Alaska Network inventories. Geographic and ecological gaps were identified for the 2003 and future inventories.

2003 Inventory Objectives

- *Document 90% of the plants expected to occur in the park by surveying targeted habitats and communities within unsurveyed regions.*

After the 2003 inventory, 917 taxa were documented by vouchers in the park. The 2003 expected list comprised 353 taxa. Therefore, 1198 taxa are expected to occur in the park, and we have documented 77% of these. However, the reliability of an expected species list as a predictor of inventory adequacy is questionable, particularly in Alaska where the park units are so large and where so little collecting had been done adjacent to and within most parks. It is notable that only 33% (72) of the 217 taxa new to the park were on the expected list and that none of the eleven species new to the state were on the expected list. A more reliable indicator of inventory adequacy is the rate of accumulation of new species. There has not been a consistent reduction in the rate of accumulation of new or rare species to the park's vascular flora, therefore it is likely the vascular flora is still inadequately documented. The number of new species per site was greater in 2003 than in 1996; the number of new species was greater in 2003 than in 1994 and 1995, and the number of new rare taxa was greater in 2003 than in 1996. The lower number of species per unit area compared to Denali National Park and Preserve and Yukon-Charley Rivers National Preserve also indicates inadequate documentation of this park's vascular flora.

- *Significantly improve current knowledge of the distribution of the plant species that occur in the Central Alaska Network.*

Data on the diversity, taxonomic composition, and biogeographic composition of the total and rare floras of the three parks in the Central Alaska Network was synthesized and compared (Chapter 6). The life form and taxonomic composition (by plant division) were similar for the three parks. The diversity per unit area was greater in the smaller parks (as would be expected by the species-area relationship). The biogeographic composition was similar for all three parks with a notable (10%) increase in North America taxa and a 2% increase in Alaska-Yukon endemics in this park.

- *Describe the taxonomic, ecological and geographic characteristics of selected species of special management concern.*

The distributions of the rare and endemic floras of the park were presented by landscape variables, by ecological regions and by biogeographic categories and the geographical sources of the endemic flora were described (Chapter 6). Distribution data for 252 notable taxa was compiled, digitized, state and park distribution maps prepared and annotations written (Chapter 7). Data for all taxa occurring in the park was reviewed and a rare plant watch list was compiled for the park which includes the 91 species on the Alaska Natural Heritage Program tracking list with a state rank of three or less and 98 additional taxa. The additional taxa are either: a) known from five or fewer localities

(and appear to be rare not just under collected); b) at the limits of their global distribution in the park; c) disjunct populations; or d) narrowly distributed endemics.

- *Acquire more information about the relative abundance of selected species within the park.*

New occurrences of 57 taxa, 14 which are rare were documented in 2003. As described above, distribution data for all vouchers was reviewed to determine relative abundance and to compile the park's rare plant watch list. The relative abundance of many species was clarified. Some species are more abundant and broadly distributed than previously documented, and other species continue to appear restricted in their ecological and/or spatial distribution.

- *Gather a vouchered set of specimens of each species for research and park uses and populate national and local databases with taxonomic and accompanying data*.

Two thousand five hundred twenty-two specimens were vouchered in 2003 for a total of 8045 specimens for the inventory effort. As mentioned above, specimens from five genera were provided to specialists who wrote the treatments for the Flora of North America. The park's data was also provided to John Kartesz and incorporated into his Synthesis of the North American Flora (Kartesz and Meacham 1999). Data was provided to NPSpecies, the University of Alaska Fairbanks Herbarium, the Alaska Natural Heritage Program and is maintained in the park's collection and taxonomic databases.

- *Acquire new inventory information in a format compatible with ongoing plant inventory efforts*.

Data is compatible with National Park Service standards, University of Alaska Fairbanks Herbarium and Alaska Natural Heritage Program data reporting requirements. However, maintenance will be a challenge with dwindling staff resources. See comment below under recommendations (data management).

Recommendations

This inventory made a significant contribution in the assessment of the park's vascular flora. However, the assessment is far from complete. Additional inventory, research, data management, management and monitoring needs are identified below.

Inventory

Geographic & Ecological Gaps: Geographic and ecological gaps in our knowledge of the vascular plant distribution in the park were identified in Chapter 5, for each of the eighteen regions in the park. It is unlikely that a comprehensive inventory will occur again in the near future of the park. Therefore, additional surveys will need to be conducted in conjunction with other projects (as was done the first 12 years of the park's history). Opportunities should be sought to send a qualified botanist into areas that have not been surveyed. The upcoming monitoring program will be valuable for documenting the flora, but since these sites are likely to be close to access points, they may not represent ecological and geographic gaps. The following information should help

determine when it would be useful to have a botanist join another project or to help develop proposals for targeted surveys.

The communities most likely to harbor new and notable taxa throughout the park include wetlands, south-facing steppe bluffs, calcareous lithologies, south-facing alpine communities, nunataks in the Mentasta, Wrangell and northern Chugach and St. Elias Mountains (see Figure 5.25), and coastal old growth forests. The most significant geographic gaps in the park are the lowlands and uplands north of the Nutzotin Mountains (Tanana Lowlands and Yukon-Tanana Uplands), the nunataks in the high Wrangells and the St. Elias Mountains. Specific areas and communities to survey within the regions of the park are:

1. The Yukon-Tanana Uplands - wetland and lowland areas.
2. Mentasta Mountains - wetlands, steppe communities, *Cryptantha shackletteana* and *Papaver walpolei* habitat.
3. Nutzotin Mountains - (a) the mountains in the northwest corner of the region between the Nabesna and Chisana Rivers, north of Notch Creek; (b) the mountains between the Chisana River and Baultoff Creek north of Gold Hill, and (c) the southeast corner of the region between Rock Lake near the White River and Chisana.
4. Northern St. Elias Mountains - one of the most poorly surveyed regions (one site per 100,000 ice-free acres (IFA).
5. Northern Wrangell Foothills - the region between the Upper Nabesna and Chisana Rivers and the ridge west of Beaver Peak, particularly calcareous lithologies.
6. High Wrangells - was poorly surveyed with only one site per 100,000 IFA. Inventory focus should be the nunataks.
7. Northern Chugach Mountains - the mountains between the Copper and Tana Rivers and south of the Bremner River and the Granite Range, east of Goat Creek.
8. Southern Chugach-St. Elias Mountain nunataks.
9. Coastal foothills and mountains - Malaspina Glacier and Karr, Chaix and Samovar Hills.
10. Tanana River basin - lowlands and wetlands north of the Nutzotin Mountains.
11. White River - wetland, floodplain and bluff communities.
12. Copper River basin wetlands.
13. Chitina River basin - Upper Kotsina and Kuskulana Rivers, Tebay River, Lake Creek and the lowlands between the Nizina and Chitina Rivers and south of the Chitina River between Steamboat Creek and the Chakina River.
14. Malaspina Forelands - forests and wetlands.

***Botrychium* Surveys:** Two populations of *Botrychium lineare,* a USFWS candidate species, were found in the Nutzotin Mountains in 2003. The extent of these populations should be determined and surveys conducted for additional populations.

Populations of *Botrychium* cf. *hesperium* at Chetaslina Ridge in the southern Wrangell foothills, should be re-surveyed and the identification determined by sending specimens

to Donald Farrar at Iowa State University. This would be a new record for Alaska and a population disjunct from British Colombia.

When inventories are conducted, the other rare *Botrychium* species that occur in the park should be looked for (*B. alaskense, B. ascendens*, *B. montanum*, *B. tunux* and *B. yaaxudakeit*). More material and localities of these species will help clarify their taxonomy and distribution in North America.

***Cryptantha shackletteana* Surveys:** *Cryptantha shackletteana* is one of the rarest species in the state and in the world. It is known only from three localities, two along the Yukon River and the populations above the Nabesna River near Totschunda Creek in the park. Suitable habitat in the Nutzotin and Mentasta Mountains should be surveyed to try to locate additional populations. Sufficient material should be collected and status surveys conducted of known populations. This information would be used to evaluate the status of this species, and would help clarify the ecological history of the areas where it has been found.

Bonanza Ridge Rare Plant Survey: Nordell and Schmitt (1978) documented six rare plants on Bonanza Ridge in 1976 and the ridge has not been surveyed since. This is one of the most heavily used areas in the park and has an encroaching population of *Taraxacum officinale*. A comprehensive survey of the area by a qualified botanist needs to be conducted to determine if the populations documented by Nordell and Schmitt still exist and if park activities are having an impact on the health of these species.

Other Rare Plant Surveys: Surveys for rare plants should be conducted on other established trails and high visitor use areas within the park. The park rare plant watch list should be used for these surveys. Data from the 1994-1997 and 2003 inventories can be used to develop predictive models for the distribution of rare species in these areas.

Assessment of Bryophyte and Lichen Biodiversity: Bryophytes and lichens comprise a significant portion of the biomass in the subarctic and alpine communities found in the park. There has never been a comprehensive effort to assimilate our knowledge of bryophytes and lichens or to assess their diversity within the park. Barbara Murray collected lichens in the Chitistone Valley within the park while surveying the vascular flora with David F. Murray in 1968. Richard Scott (1974) recorded bryophytes and lichens occurring in his plots in Skolai Pass in his study of alpine communities.

Park staff have collected, curated and verified the determinations of 562 bryophyte and lichen specimens. The data for these specimens has not been entered in the NP Species or NP Lichen databases. The park vouchers, along with specimens collected by Barbara Murray and cited by Richard Scott, document 109 lichen species, 153 moss and 34 liverwort species occurring in the park.

Worldwide there are 8,000 to 9,000 species of mosses, 6000 species of liverworts and 14,000 species of lichens (Vitt et. al. 1988; Brodo et. al 2001). Ireland et. al. (1980) documented 996 species of mosses in Canada, Steere (1978) documented 415 arctic moss

species and Lawton (1971) documented 600 species in the Pacific Northwest. The diversity of mosses in the park is likely to be between the arctic and Pacific Northwest values, possibly near 500 species.

Twelve hundred seventy-four lichen species are known to occur in Alaska (Thomson 1984 and 1997, University of Alaska Fairbanks, 1995). Approximately 56% of Alaska's vascular flora is known to occur in the park. If this ratio is used for lichen diversity in the park, we would expect 713 species to occur here. Using these estimates for moss and lichen diversity, we have documented only 31% of the moss flora and 15% of the lichen flora. A large portion of the park's biodiversity has therefore been undocumented.

Non-Native Invasive Plant Surveys: The 25 non-native invasive plants that occur in the park are currently restricted to disturbed lands at McCarthy, Kennicott, May Creek, Chisana and Peavine landing strip. There is a threat of these species spreading along river corridors and on aircraft into the backcountry with the potential that they could alter the native plant communities. Continuing road work along the McCarthy Road (most of which is not on park land) has the potential for introducing invasive plants into the park. Three highly invasive plants (*Melilotus alba*, *M. officinalis* and *Crepis tectorum*) have been spreading rapidly throughout the Copper River basin in the last five years and are likely to invade the two roads into the park. New inventories for invasive plant species should be conducted at backcountry access points, fixed wing landing sites and river crossings along the two roads into the park. Eradication of some populations and monitoring of the most invasive species was initiated in the park in 2003 in coordination with the Alaska Region Exotic Plant Management Team. Inventory, monitoring and eradication efforts are going to need to intensify in order to prevent the spread of non-native invasive plants into the native communities of the park.

Research

The occurrence in the park of high numbers of vascular plants, rare and endemic species, and species at the edge of their distribution, combined with the great landscape diversity found here, contribute to the potential for numerous research questions involving species distribution, biogeography, and plant systematics. One question involves the biogeographic composition of the nunatak floras in the park, particularly in the Western Wrangell Mountains. Is this flora composed primarily of Alaska-Yukon and Cordilleran endemic species as our descriptive analysis indicated? This would require a systematic inventory and analysis of the species that occur on the nunataks.

The most common research questions that were revealed during the inventory concerned the taxonomic relationships of difficult species. Biosystematic studies, including electrophoretic analysis and comparisons of a large number of specimens is usually required to resolved these questions Some of the species that need to be studied are:

- *Botrychium lineare* and other rare *Botrychium* (*B. alaskense*, *B. ascendens*, *B. montanum*, *B.* cf. *hesperium*, *B. tunux* and *B. yaaxudakeit*) that occur in the park. Donald Farrar at the University of Iowa is the authority on this genus in North America. Collections should be sent to him for analysis.

- *Phlox richardsonii* - should this be considered a subspecies of *P. sibirica?* Populations in the park of *P. richardsonii* seem very distinct from *P. sibirica*.
- *Smelowskia calycina* - what is the relationship between *S. calycina* var. *integrifolia* and *S. calycina* var. *porsild*ii? Taxonomists at the University of Alaska, Fairbanks treat *S. calycina* var. *integrifolia* at the subspecific level. Most documented populations in the park had occurrences of both taxa.
- *Cryptantha shackletteana* - is this distinct from *Cryptantha spiculifera*?
- *Draba kananaskis* - a mustard on the Alaska rare plant list (G1Q/S1). Is it distinct from *Draba longipes*?

Data Management & Curation

The data acquired in this inventory on the distribution of plant species in the park has been invaluable. However, this data and the associated specimens need to be maintained to be useful to park managers and researchers. Some of the ongoing tasks that need to be accomplished include the following.

1. All studies (research or monitoring, non-NPS or NPS) being conducted in the park involving plants need to be tracked. Data for specimens collected and species cited needs to be entered into NPSpecies and park databases (taxonomy and collection databases and Rediscovery if specimens are collected).
2. Changes in nomenclature need to be updated in NPSpecies and park databases.
3. Data for re-determinations of specimens housed at the University of Alaska Fairbanks Museum needs to be updated in NPSpecies and park databases.
4. Enter bryophyte and lichen data into NPSpecies and NPLichen.
5. Approximately 3000 specimens from the 2003 inventory remain at ALA to be mounted. Specimens housed at the park need to be properly maintained and easily available to researchers for them to be of value.

Products

Some of the pending products related to this inventory are:

1. The rare plant field guide. A draft of the rare plant field guide was completed in 1999. It included 71 of the park's rare plants with species descriptions, distribution maps and drawings. The guide needs to be updated with current data, the introduction and glossary written, and it needs to be printed.
2. The vascular plant species list that is sold in the visitor center is based on the pre-2003 flora. This list needs to be updated and made available to the public. It would be valuable to add the bryophytes and lichens to this list.
3. There is a backlog of taxonomic and ecological literature that needs to be entered into NPBib.
4. There are approximately 500 specimens collected in association with other projects that need review and preparation (data entry into NPSpecies and the park's curatorial database, labels printed, mounted and filed in the park

herbarium). This is an ongoing need and should be budgeted for within each project.

Monitoring

Monitoring plans should be developed for *Botrychium lineare*, a USFWS candidate species and *Cryptantha shackletteana*, an Alaska rare plant (G1Q/S1). The rare plant watch list for the park should be evaluated and monitoring plans developed for the species of the greatest concern.

Global warming models for the subarctic predict that boreal forest communities will expand and there will be a loss of sub-alpine and alpine habitats. This trend could reduce species diversity as well as rare plant habitat since the alpine zone harbors the highest ratio of rare plants and non-forested communities appear to have higher diversity. In addition, there will be more habitat for non-native invasive species as man made disturbances increase. To detect these changes, long term vegetation monitoring should include ecotones between forested and non-forested communities and between disturbed and undisturbed communities.

Although it appears that the park may be losing diversity with global warming, if migration corridors are protected, the potential for adding genetic material to our flora is increased. This is one reason why understanding the evolution of our flora is important. Population level monitoring should focus on species at the edge of their range (ecological and biogeographic) and on key migratory corridors and habitats. Some of the key migratory corridors for plants may be the Mentasta Mountains, the Upper Chitina River, northern Chugach Mountains and nunataks in the Wrangell Mountains. River corridors, areas of natural disturbances and alpine communities within these regions are more likely to function as migratory habitats.

Management Issues

The key management issues for protecting the park's flora include:

- Manage the data and specimens used to document the flora so that the data is available, synthesized and used.
- Monitor areas of high visitor use for changes in rare plant species populations, species composition and spread of exotic species.
- Continue to inventory unsurveyed regions of the park to document the flora (both vascular and non-vascular) and develop monitoring plans for species of management concern.
- Conduct thorough evaluations of the cumulative impacts of park projects to species composition, sensitive communities, rare plant populations and exotic species distribution.
- Protect plant migration corridors.

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Carl Roland assisted with the 1994-1997 inventory. He helped develop our databases, populated much of the biogeography data for the 1994-1997 inventory, developed the first expected species list for the park, conducted surveys from 1994 to1997, entered data for 1700 specimens, identified these specimens, prepared them for the park's herbarium, helped manage verification and curation of an additional 3000 specimens at the University of Alaska Fairbanks Herbarium, and wrote the first draft of the introduction to a rare plant document (which became the main text of Chapter 3 in this document). Carl was co-principal investigator for the Central Alaska Area Network plant inventory and conducted inventories at this park in 2003. He reviewed portions of this document and contributed valuable advice. Carl has provided continued inspiration with his commitment to understanding the flora of Alaska and with his exceptional skills as a botanist and ecologist.

The success of the 2003 inventory was due to the expertise and enthusiasm of Patricia Loomis. She managed the logistics of the inventory, conducted inventories of 57 sites, collected 1400 specimens, managed the verification of 2600 specimens collected that year, entered data for these specimens, prepared the specimens for the herbarium, digitized locality data for 115 notable taxa and wrote the first draft of the notables annotated species list (Chapter 7 of this document).

This project could not have succeeded without the support of the staff at the University of Alaska Fairbanks Herbarium: Dr. David F. Murray (past curator of the herbarium, and professor of botany), Carolyn Parker (assistant curator), and Alan Batten (assistant curator and data manager). Dr. Murray, Ms. Parker and Mr. Batten reviewed all specimens that were questionable and arranged for further verification by specialists. Mr. Batten provided data for specimens at the herbarium collected in the vicinity of the park prior to the inventory, data that was invaluable in constructing the history of botanical collecting in the park. The data from the University of Alaska Northern Plant Documentation Center has also been significant in developing distribution maps for many of the notable species. Dr. Murray, Ms. Parker and Mr. Batten provided advice and support throughout the inventory and reminded me of the importance of this work when progress was slow. Rob Lipkin, botanist with the Alaska Natural Heritage Program provided advice and encouragement during the 1994 to1997 inventory and shared data on the distribution and taxonomy of rare plants.

The following botanists were contracted by the National Park Service to conduct inventories: Alan Batten (1996 and 2003), Bruce Bennett (2003), Mike Duffy (1996), Carolyn Parker (1996), and Drs. Leslie and Teri Viereck (1996). Seven botanists volunteered ten days of their precious summers to conduct inventories. These included: Stacia Backensto (2003), Marilyn Barker (1996), Katherine Beattie (2003), Katy Beck (1996), Anne Leggett (1996), Mike Loso (1996) and Michele Potkin (1996). Jim Baker (1994-1997 and 2003), Jacqueline D'Auria (1996 and 1997) and Janelle Eklund (1997 and 2003) volunteered at least ten days each year to assist with the inventories:

The following specialists examined our specimens and provided determinations: George Argus, Canadian Museum of Nature (*Salix*), Mark Egger, University of Washington (*Castilleja*), Reidar Elven, Botanical Museum, Oslo, (*Draba lactea* and *Cerastium regelii*), Barbara Ertter, University of California, Berkeley (*Potentilla*), Donald Farrar, University of Iowa (*Botrychium*), Signe Frederickson, University of Copenhagen, Denmark (*Festuca*), G.A. Mulligan, Agriculture and Agri-Food Canada, Ottawa, Ontario (*Brassicaceae*), David F. Murray, University of Alaska, Fairbanks (*Papaver* and *Carex* section Atratae), Robert Soreng, Smithsonian Institution, Washington D.C. (*Poa*), and Marcia Waterway, McGill University, Macdonald Campus, Montreal, Quebec (*Carex laxa*).

A number of National Park Service staff assisted with the field inventories. Jennifer Allen, Alaska Region Fire Ecologist, took time away from her management of the spruce bark beetle project to conduct a ten day inventory in 1996. Besides her keen eye for notable species, Jennifer facilitated the logistics of surveying from helicopter in the Chugach Mountains and from horse in the Ptarmigan Lake area. Amy Larsen, Aquatic Ecologist for Yukon-Charley National Preserve, took time away from her duties at that park to conduct the 2003 coastal survey with Patricia Loomis. Her field experience, knowledge of wetland communities and good nature were much appreciated by the other botanists. Mason Reid, Wildlife Biologist for this park, assisted with an inventory of wetlands in the Ahtna Basin in 2003, provided excellent photo documentation of those sites and reviewed a portion of this document. Margie Steigerwald, Chief of Interpretation at this park during the 1994-1997 survey, assisted with an inventory in the upper Chitina Valley in 1996. Jim Wilder, Wildlife Biologist for the Alaska Region at the time, assisted with wetland inventories in the middle Copper River basin in 2003. Mr. Wilder also contributed his plant collections from the McCarthy area while conducting research there.

The Anchorage Support Office Geographic Information System group have provided tremendous services over the years. I would like to recognize the work of Sue Huse who wrote a program to automate the preparation of distribution maps in 1998; Joni Piercey who provided day to day trouble shooting assistance, and Greg Daniels who wrote a program to prepare the Alaska Natural Heritage Program rare plant locality maps. Doug Wilder, Data Manager for the Alaska Central Area Network also provided assistance in certifying our data for NPSpecies.

Numerous individuals at this park assisted me with this project over the years. Vicki Ables, biological technician, mounted herbarium specimens from 1994-1998, organized the herbarium, entered specimen data into the curatorial database, and prepared graphics for and edited the rare plant field guide. Geoff Bleakley, park historian, provided invaluable discussions on the history of the park, assisted in tracking down historical references and reviewed Chapter 2, the History of Botanical Collecting. Weston Davey, computer specialist, formatted the 2003 distribution maps and edited the document that contained these graphics. Bob Jones, information technology specialist, kept my computer updated and running through many software and hardware versions. Danny Rosenkrans, park geologist, provided valuable resources on the unique lithologies in the park, helped to identify areas to inventory in the 1994-1997 inventory, found the first locality of the ‘orange poppy’ (*Papaver radicatum* ssp. *kluanensis*) in the park, was always alert to new and unusual plant communities and populations, and reviewed Chapter 1, Description of the Study Area. Dani Shearer, computer specialist, scanned 35 mm slides from the 1994-1997 inventory. Susan Sura, curatorial specialist, curated the 1994 to1997 plant inventory project. Anne Worthington and Michele Jesperson, cultural resource managers, assisted with the curation of the specimens.

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Appendix 2.1 Historical botanical collections made within the vicinity of Wrangell-St. Elias National Park & Preserve, Alaska.

COLLECTOR	YEAR	LOCALITIES[1]	#/COLL	HERB DEPOS[2]	REFERENCES
Alaska Boundary Survey	1912	Mt. Wrangell at very high elevations	1	US	Green, Lewis. 1982 Hultén, E. 1941-1950.
Anderson, Jacob Peter	1935 1944	Chitina (30), Copper Center (10), Gakona (64), Gulkana (10), Liberty Falls (1), Slana-Tok Highway (35), Slana (4) Richardson Highway (33), Willow Creek (16), Tonsina (10)	235 4 in the Park	H, L, NY, US, ALA (8 in 1944), S	Hultén, E. 1940, 1941-1950. Welsh, Stanley. 1974.
Bayne-Beauchamp Expedition	1932	Gulkana	2	UC	Hultén, E. 1940, 1941-1950.
Beardsley	1901	Yakutat	1	US	Hultén, E. 1941-1950.
Blaschke, E. Leontjevitch	1820-1842	Mt. St. Elias	1	LECB	Hultén, E. 1945, p. 1110; 1940, p. 300
Cairnes, Donaldson delorme	1911 1912 1913 1916	Horsfeld Creek vic. at border (2) -NY White River (1) - CAN Upper White River (1) - CAN, NY Beaver Creek (1) - CAN between Rocker & Cache Creeks (1) -NY Klotassin area - 3 colls (CAN).	6	CAN, NY	Hultén, E. 1940, 1941-1950.
Collier, Arthur James	1902	Trout Creek, Tonsina	1	US	Hultén, E. 1941-1950
Coville, Frederick Vernon, Thomas H. Kearney, W.H. Brewer, Wesley Roswell Coe, William Trelease, Trevor Kincaid & de Alton Saunders (Harriman Expedition)	1899	Disenchantment Bay (5) Hubbard Glacier (4) Yakutat Bay (13) numerous other colls from Yakutat and other locations in Yakutat Bay that are not in the Park, Yakutat Bay & Disenchantment Bay colls could be in the Park, but have not been included on Park species list unless they were cited elswhere in the Park.	22 - potentially in the Park	US, G, CAN, H	Hultén, E. 1940, 1941-1950.
Diehl, I.E.	1908	Copper River	5	UC, NY	Hultén, E. 1940, 1941-1950

[1]Numbers in parenthesis indicate the number of collections
[2] Refer to Apendix 2.12 for a list of herbaria acronymns

Appendix 2.1, continued. Historical botanical collections made within the vicinity of Wrangell-St. Elias National Park & Preserve, Alaska.

COLLECTOR	YEAR	LOCALITIES[1]	#/COLL	HERB DEPOS[2]	REFERENCES
Dutilly, Artheme-Antoine, Ernest LePage and O'Neill	1947	Upper Copper River (1), Nabesna Mine (1), Gulkana (1), Nabesna Road (7), Slana-Tok Highway (2), Slana (1), Valdez Road, mile 90 (1), Glennallen (1)	15	LCU, QFA, S, CAN, H, ALA (2)	Hultén, E. 1941-1950 Pringle, J. S. 1995. Packer, J. G. 1972
Eaton, David W.	1909 1912 1913	White River valley near border (37) 141st meridian N of Mt. St. Elias (44) Chitina Valley (14)	98	US	Hultén, E. 1941-1950. Green, L.. 1982.
Emmons, George Thornton	1901	Yakutat & Yakutat Bay	2	US	Hultén, E. 1940, 1941-1950.
Evans, Walter Harrison	1909	White River near boundary	1	US	Hultén,, E. 1940, 1941-1950 Evans, W.H. 1897, 1899, 1900 .
Funston, Frederick	1892	Point Manby (1), Dalton's Landing (7), Disenchantment Bay (17), Yakutat Bay (30), Mt. St. Elias (1), numerous colls with general locality of 'Yakutat' and other localities in the vicintiy of Yakutat which are not in the Park.	8 in the Park, 66 potential, 3000 specimens collected representing 154 species	US, UC, G, NY	Funston, F. and F.V. Coville. 1899. Hultén, E. 1941-1950.
Glenn, Edwin F.	1899	Chistochina River, Slana River	2	US	Glenn, E.F. & W.A. Abercrombie. 1898. Hultén, E. 1940, 1941-1950 .
Gorman, Martin Woodlock	1898 1899	White River (6) Upper White River (2)	8	US, CAN, NY	Gorman. 1896. Hultén, E. 1940, 1941-1950
Greeley, Adolphus Washington	1905	Tonsina	1	US	Hultén, E. 1940, 1941-1950
Gustafson, J.A.	?	Chistochina	1	US	Hultén, E. 1940, p. 81
Ham, P.	1984	Lower Chitina Glacier	1	ALA	
Heideman, Charles W.H.	1908	Copper Center	71	US	Hultén, E. 1940, 1941-1950
Hultén, Eric	1961	Copper Center (1), Nabsna Road (2), 60 potentialy along Richardson Highway	2 in the Park	ALA, S	Hultén, E. 1940, 1941-1950, 1968
Kol, Elizabeth	1936	Chitina to Kennicott (1), Kennicott (1), Fox Farm & Tiekel (1), Gulkana (1)	4 in the Park	U of Szeged	Hultén, E. 1940, p. 342 Gombocz, E. 1940

[1]Numbers in parenthesis indicate the number of collections
[2] Refer to appendix 2.12 for a list of herbaria acronymns

Appendix 2.1, continued. Historical botanical collections made within the vicinity of Wrangell-St. Elias National Park & Preserve, Alaska.

COLLECTOR	YEAR	LOCALITIES[1]	#/COLL	HERB DEPOS[2]	REFERENCES
Laing, Hamilton L.	1925	Head of Chitina River	156 (found in Hultén 1940-1950 and Porsild 1939) 243 supposedly at CAN (acc. to Hultén 1940)	CAN, US, H, S	Hitchcock & Maguire. 1947. Hultén, E. 1940. 1941-1950 Lambart, H.F. 1926A, 1926B Packer, J.G. 1972. Porsild, A.E. 1938, 1939 Rollins, Reed C. & Elizabeth A. Shaw. 1973
Lambart, H.F.	1913	Head of White River, Klutlan Glacier	2	CAN	Hultén, E. 1940, 1941-1950
Lohbrunner	1936	Sheep Creek, near Alaska-Yukon boundary	1	CAN	Hultén 1942, p. 1779 Porsild, A.E. 1950.
Major, Jack	1980	Chitina	3	ALA	
Murray, David F.	1966 1967 1968 1981	May Creek (27), Nizina (5) Chitistone Pass (54), Chiitisotne/Skolai (37) Guerin Glacier (112), Russell Glacier (45), Sheep Glacier (57); 1981: Chitina (55), Gakona (6), Liberty Falls (11), Old Edgerton Highway (1)	406	ALA (331) CAN (74)	Hultén, E. 1968 Murray, D.F. 1968, 1971.
Nordell, Olle & Alf Schmitt	1902	Bonanza Ridge	207	ALA (23) L	Hultén, E. 1968 Nordell, O. & A. Schmitt. 1978.
Pegau, R.	1968, 1970	Tanada Lake, Gulkana	5	ALA	
Piper, Charles Vancouver	1913	Yakutat Bay, Ankow River.	22	US	Hultén, E. 1940, 1941-1950

[1]Numbers in parenthesis indicate the number of collections
[2] Refer to appendix 2.12 for a list of herbaria acronymns

Appendix 2.1, continued. Historical botanical collections made within the vicinity of Wrangell-St. Elias National Park & Preserve, Alaska.

COLLECTOR	YEAR	LOCALITIES[1]	#/COLL	HERB DEPOS[2]	REFERENCES
Poto, William L.	1883	Between Slana & Nabesna River (1), Cheshnina River (5), Chetalsina River (39), Chistochina (4), Chistonchina R. (1), Chistochina/Eagle Creek (1), Copper Center (1), Copper River (2), Copper River Region (3), Dadina (4), Slate Creek (1), Eagle Creek (7), Nadina River (4), Klutina R. (7), Kotsina River (5), Long Glaicer (1), Mt. Drum Trail (6), Mitchell Creek -(1), Mt. Sanford (1), Slana River (3), Mt. Wrangell (1), Indian River (11), Sanford River (9)	116 in Hultén 1941-1950; 176 numbers appear in Poto's collection notes	US	Hultén, E. 1940, 1941-1950 Poto, William L. 1902.
Raup, H.M.	1944	N. slope of the Nutzotins	1	ALA	
Rigg, George Burton	1978	Yakutat	1	WTU	Hultén 1941, p.385
Rudkin, J.A.	1902	Juneau to Mt. St. Elias	16	NY	Britton, N.L. 1884 Hultén, E. 1940, 1941-1950
Saltmarch, Ransom	1967, 1968	S and W slopes of Mt. Wrangell between Chetaslina River and Long Glacier.	76	ALA (1)	Saltmarch, Ransom. 1978
Schrader, Frank Charles & G.H. Hartman,	1910	Upper Copper River (8), Jacksina River (13), Batzulnetas Village (6), Nabesna River (17), Drop Creek (5), Mentasta Pass (3), Gordon Creek (1)	54	US	Hultén 1940, 1941-1950 Mendenhall. 1905. Schrader. 1903.
Scott, Richard W.	1932	Skolai, Frederika Glacier, Chitisotne Pass, Snag Glacier	214	ALA (24) MICH	Scott, R.W. 1968.
Scribner, F.L. & E.D. Merrill	1910	Yakutat Bay	1		Hultén, E. 1941-1950, 1968
Sharrock, M.	1962	Twin Lakes, Mile 29 Nabesna Road	13	ALA	
Spetzman, Lloyd A.	?	Chitina, Chistochina	2	CAN	Hultén, E 1941-1950 Rollins. 1973
Stair, L.D. and F.W. Pennell	1945	Yakutat Bay. Numerous other colls at Yakutat and colls not wihtin park.	16	PH	16
Walker, Enest Pilsbury	1914	Yakutat Bay	3	US, RM	Hultén, E. 1940, 1941-1950
Williams, M.	1965	Copper Center, Glennallen, Gakona	3	ALA	
Went, Frits Warmolt	1934	Copper Center (47), Chitina (12)	59	L, UC	Hultén, E. 1940, 1941-1950

[1]Numbers in parenthesis indicate the number of collections
[2] Refer to appendix 2.12 for a list of herbaria acronymns

Appendix 2.2. Collections of Frank Charles Schrader and G.H. Hartman in the vicinity of the Wrangell-St. Elias National Park and Preserve, Alaska in 1902. Specimens are deposited at the U.S. National Herbarium Collection data from is from Hultén 1941-1950.

TAXON	COLL#	LOCALITY
ACHILLEA BOREALIS Bong.	80	Nabesna River
ACHILLEA BOREALIS Bong.	50	Jacksina River
ALNUS INCANCA (L.) Monech subsp. TENUIFOLIA (Nutt.) Breitung	83	Mentasta Pass
ALNUS INCANCA (L.) Monech subsp. TENUIFOLIA (Nutt.) Breitung	78	N. side of Nabesna River
ALNUS RUBRA Bong.	78	Nabesna River
ANDROMEDA POLIFOLIA L.		Upper Copper River
ARCTOSTAPHYLOS RUBRA (Rehd. & Wilson) Fern.	69	Nabesna River
BETULA NANA L.	25	Upper Copper River
BETULA NANA L.		Batzulnetas village
CALAMAGROSTIS PURPURASCENS R. Br.	52	Jacksina River
CAMPANULA LASIOCARPA Cham.		Jacksina River
CAREX BIGELOWII Torr.	25a	Upper Copper River
CASSIOPE TETRAGONA (L.) D. Don	15	Drop Creek
CASTILLEJA ELEGANS Malte	49	Jacksina River
CASTILLEJA RAUPII Pennell		Nabesna River
DODECATHEON FRIGIDUM Cham. & Schlecht.	20	Drop Creek
DRYAS INTEGRIFOLIA M. Vahl	76	Nabesna River
DRYAS INTEGRIFOLIA M. Vahl	27	Upper Copper river
EMPETRUM NIGRUM L.	88	Mentasta Pass
EPILOBIUM ANGUSTIFOLIUM L.	66	Nabesna River
EPILOBIUM LATIFOLIUM L.		Jacksina River
EPILOBIUM LATIFOLIUM L.		N side of the Nabesna River
EQUISETUM VARIEGATUM Schleich. subsp. ALASKANUM (A. A. Eat.) Hult.	71	Nabesna River
ERIGERON CAESPITOSUS Nutt.	65	Nabesna River
LEDUM GROENLANDICUM Oeder	33	Jacksina River
LEDUM GROENLANDICUM Oeder	83	Mentasta Pass
LEDUM GROENLANDICUM Oeder	11	Batzulnetas Village
LEDUM PALUSTRE L. subsp. DECUMBENS (Ait.) Hult.		Upper Copper River
LEDUM PALUSTRE L. subsp. DECUMBENS (Ait.) Hult.		Drop Creek
LUPINUS ARCTICUS S. Wats.		Batzulnetas
PARNASSIA PALUSTRIS L.	72	Nabesna River
PARRYA NUDICAULIS (L.) Regel subsp. INTERIOR Hult.		Drop Creek
PEDICULARIS LABRADORICA Wirsing	34	Jacksina River
PEDICULARIS LANGSDORFII Fisch.		Drop Creek
PEDICULARIS SUDETICA Willd.		Upper Copper River
PEDICULARIS SUDETICA Willd.		Balzunetas village

Appendix 2.2, continued. Collections of Frank Charles Schrader and G.H. Hartman in the vicinity of the Wrangell-St. Elias National Park and Preserve, Alaska in 1902. Specimens are deposited at the U.S. National Herbarium Collection data from is from Hultén 1941-1950.

TAXON	COLL#	LOCALITY
POLEMONIUMACUTIFLORUM Willd.	30	Jacksina River
POLEMONIUM ACUTIFLORUM Willd.	6	Batzulnetas Village
POLYGONUM BISTORTA L.	44	Jacksina River
POLYGONUM BISTORTA L.	19	Headwaters of Copper and Tanana River
POPULUS TREMULOIDES Michx.		Batzulnetas village
POTENTILLA FRUTICOSA L.		Jacksina River
ROSA ACICULARIS Lindl.		Jacksina River
ROSAACICULARIS Lindl.	5	Batzulnetas Village
SAXIFRAGA TRICUSPIDATA Rottb.	47	Jacksina River
SENECIO ATROPURPUREUS (Ledeb.) Fedtsch.		Gordon Creek
SILENE REPENS Patrin	61	Nabesna River
SOLIDAGO MULTIRADIATA Ait.	60	Nabesna River
SOLIDAGO MULTIRADIATA Ait.	48	Jacksina River
TOFIELDIA PUSILLA (Michx.) Pers.		Upper Copper River
TOFIELDIA PUSILLA (Michx.) Pers.	73	Nabesna River
VACCINIUM ULIGINOSUM L. subsp. MICROPHYLLUM Lange	74	Nabesna River
ZYGADENUS ELEGANS Pursh	62	Nabesna River

Appendix 2.3. Collections of William L. Poto made in the vicinity of the Park and Preserve in 1902. Specimens are deposited at U.S. National Herbarium. Collection data is from Hultén 1941-1950 and Poto 1902.

TAXON	COLL#	COLL DATE	LOCALITY
ACONITUM DELPHINIFOLIUM DC. subsp. DELPHINIFOLIUM		07/24/1902	Sanford River
AGROSTIS SCABRA Willd.	88		Long Glacier
ANDROSACE SEPTENTRIONALIS L.	8	05/28/1902	Klutina River
ANEMONE PARVIFLORA Michx.			Near forks of Nadina River
ANEMONE RICHARDSONII Hook.			Vicinity of Dadina River
ANGELICA LUCIDA L.		07/24/1902	Sanford River
ARABIS KAMCHATICA (Fisch.) Ledeb.			Chetaslina
ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. var. ARUNDINACEA (Trin.) Griseb.	94	07/10/1902	Cheshnina R.
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	20	06/06/1902	Mt. Drum trail
ARNICA DIVERSIFOLIA Greene	165	08/28/1902	Copper River Region (between Slate Creek and Chisna River)
ARNICA GRISCOMII C. A. Mey.	46	06/19/1902	Chetaslina Glacier
ARTEMISIA TILESII Ledeb.			Chetaslina Glacier
BETULA GLANDULOSA Michx.		06/06/1902	Mt. Drum trail
BETULA OCCIDENTALIS Hook.	118	08/05/1902	Slana River mouth
BOSCHNIAKIA ROSSICA (Cham. & Schlecht.) Fedtsch.			Dadina River
BOYKINIA RICHARDSONII (Hook.) Gray	163	08/23/1902	W Fork Eagle Creek
CAMPANULA LASIOCARPA Cham.	93	07/10/1902	Cheshnina River
CARDAMINE UMBELLATA Greene			East Fork Chetaslina
CAREX AQUATILIS Wahlenb.			Sanford River
CASSIOPE TETRAGONA (L.) D. Don			Near forks of Nadina
CASTILLEJA ELEGANS Malte	100	07/19/1902	Sanford River
CHENOPODIUM CAPITATUM (L.) Aschers.	150	08/12/1902	Between Slana and Chistochina River
CLAYTONIA SARMENTOSA C.A. Mey			Vic. of Chistochina
CORNUS CANADENSIS L.	96	07/10/1902	Cheshnina River
CORNUS CANADENSIS L.			Ridge between Slana and Tetelna (Indian Creek)
CORYDALIS AUREA Willd.			Copper Center
CORYDALIS SEMPERVIRENS (L.) Pers.		06/06/1902	Mitchell Creek
CREPIS NANA Richards.	158	08/22/1902	W fork of Eagle Creek
CYSTOPTERIS FRAGILIS (L.) Bernh.	137	08/09/1902	Chetaslina River
DELPHINIUM GLAUCUM S. Wats.	92	07/10/1902	Cheshnina River
DIAPENSIA LAPPONICA L. subsp. OBOVATA (F. Schm.) Hult.		06/09/1902	Mt. Drum trail, vicinity Nadina River
DODECATHEON FRIGIDUM Cham. & Schlecht.			Chetaslina Glacier
DRABA AUREA M. Vahl ex Hornem	66	06/25/1902	East Fork of the Chetaslina
DRYAS HOOKERIANA Juz.	47	06/19/1902	Chetaslina Glacier
DRYOPTERIS FRAGRANS (L.) Schott	108	07/30/1902	Mt. Sanford
EPILOBIUM ANGUSTIFOLIUM L.	84	07/06/1902	Kotsina River
EPILOBIUM LATIFOLIUM L.	44	06/19/1902	Chetaslina River
EQUISETUM ARVENSE L.	73	07/10/1902	Chetaslina Rriver

Appendix 2.3, continued. Collections of William L. Poto made in the vicinity of the Park and Preserve in 1902. Specimens are deposited at U.S. National Herbarium. Collection data is from Hultén 1941-1950 and Poto 1902.

TAXON	COLL#	COLL DATE	LOCALITY
ERIGERON ACRIS L.			East fork of Chetaslina River
GEUM ROSSII (R. Br.) Ser.	113	08/01/1902	Vic. of Sanford River
HALIMOLOBOS MOLLIS (Hook.) Rollins			Copper River bank
HEDYSARUM ALPINUM L.	48	06/23/1902	Chetaslina Glacier
JUNCUS CASTANEUS Sm.	83	07/07/1902	Kotsina River/Copper Creek
JUNIPERUS COMMUNIS L.		08/18/1902	Copper River Region
LEDUM PALUSTRE L. subsp. DECUMBENS (Ait.) Hult.	45	06/19/1902	Chetaslina Glacier
LINNAEA BOREALIS L.			Sanford River
LOISELEURIA PROCUMBENS (L.) Desv.			Mt. Drum trail
LOMATOGONIUM ROTATUM (L.) E. Fries	149	08/12/1902	Chistochina
LUPINUS ARCTICUS S. Wats.	32	06/11/1902	Forks of Nadina River
MERTENSIA PANICULATA (Ait.) G. Don	64	06/25/1902	East Fork of the Chetaslina River
MOEHRINGIA LATERIFLORA (L.) Fenzl			Cheshnina River
MONESES UNIFLORA (L.) Gray	86	07/06/1902	Kotsina River
NUPHAR POLYSEPALUM Engelm.	114	08/01/1902	Vicinity of Sanford River
OXYRIA DIGYNA (L.) Hill	162	08/22/1902	Eagle Creek
PEDICULARIS CAPITATA Adams	71	06/26/1902	East fork of Chetaslina River
PEDICULARIS LABRADORICA Wirsing			Chetaslina Glacier
PEDICULARIS SUDETICA Willd.	112	07/30/1902	Vic. Sanford River
PHLEUM COMMUTATUM Gandoger var. AMERICANUM (Fourn.) Hult.	164	08/28/1902	Divide between Slate Creek and Chisana River
PICEA GLAUCA (Moench) Voss	173	09/06/1902	Chistochina
PICEA MARIANA (Mill.) B.S.P.		06/30/1902	Chetaslina River
PLANTAGO CANESCENS Adams	10	05/28/1902	Klutina River
POLEMONIUM ACUTIFLORUM Willd.	65	06/25/1902	East fork of Chetaslina River
POLEMONIUM PULCHERRIMUM Hook.	11	05/28/1902	Klutina River
POPULUS TREMULOIDES Michx.			Klutina River, one mile abovemouth
POTENTILLA BIFLORA Willd.		07/30/1902	Vic. Sanford River
POTENTILLA FRUTICOSA L.			Chetaslina Glacier
POTENTILLA HOOKERIANA Lehm.			Klutina River
POTENTILLA PALUSTRIS (L.) Scop.			Ridge between Slana and Tetlna (Indian River)
PULSATILLA PATENS (L.) Mill.	1		Vic of Klutina River
PYROLA GRANDIFLORA Radius	63	06/23/1902	Chetaslina Glacier
RIBES HUDSONIANUM Richards.			Near mouth of Slana River
RIBES TRISTE Pall.	21	06/07/1902	Mt. Drum Trail, vic. Little River
ROSA ACICULARIS Lindl.	53	06/23/1902	Chetaslina Glaicer
RUBUS CHAMAEMORUS L.	40	06/15/1902	Chetaslina
RUBUS IDAEUS L.	136	08/09/1902	Ridge between Slana & Tetelna (Indian River)
SALIX ALAXENSIS (Anderss.) Cov.	57	06/23/1902	Chetaslina River
SALIX ALAXENSIS (Anderss.) Cov.	157	08/17/1902	Chistochina/Eagle Creeks
SALIX ARBUSCULOIDES Anderss.	141, 176	08/10/1902	Forks of Dadina Rivers

Appendix 2.3, continued. Collections of William L. Poto made in the vicinity of the Park and Preserve in 1902. Specimens are deposited at U.S. National Herbarium. Collection data is from Hultén 1941-1950 and Poto 1902.

TAXON	COLL#	COLL DATE	LOCALITY
SALIX ARCTICA Pall. subsp. TORULOSA (Trautv.) Hult.	128	08/08/1902	Tetelna (Indian River)
SALIX BARCLAYI Anderss.		06/24/1902	Chetaslina Glacier
SALIX BEBBIANA Sarg.	138	08/10/1902	Chistochina
SALIX BEBBIANA Sarg.	49	06/23/1902	Chetaslina River
SALIX PLANIFOLIA Pursh subsp. PULCHRA Cham.			Chetaslina drainage
SALIX POLARIS Wahlenb.	161	08/22/1902	West for of Eagle Creek
SALIX PSEUDOMONTICOLA Ball	76	06/30/1902	E. Fork of Chetaslina
SALIX RETICULATA L.	160	08/22/1902	W Fork Eagle Creek
SANGUISORBA CANADENSIS L. subsp. LATIFOLIA (Hook.) Calder & Taylor	152	08/18/1902	Chetaslina R.
SAXIFRAGA HIRCULUS L.			Near snowline of Mt. Wrangell
SAXIFRAGA OPPOSITIFOLIA L.			Chetaslina Glacier
SAXIFRAGA SERPYLLIFOLIA Pursh	29	06/09/1902	Nadina R.
SAXIFRAGA TRICUSPIDATA Rottb.			Chetaslina Glacier
SENECIO ATROPURPUREUS (Ledeb.) Fedtsch. subsp. FRIGIDUS (Richards.) Hult.	37	06/14/1902	Dadina River
SENECIO CONGESTUS (R. Br.) DC.			Upper Kotsina River
SILENE REPENS Patrin	103	07/19/1902	Sanford River
SMELOWSKIA BOREALIS (E. L. Greene) Drury & Rollins var. BOREALIS	157	08/22/1902	Ridge between forks of Eagle Creek
SOLIDAGO MULTIRADIATA Ait.			Chetaslina Glacier
SPIRAEA BEAUVERDIANA Schneid.	135	08/09/1902	Ridge between Slana and Indian River
SPIRANTHES ROMANZOFFIANA Cham.			Copper River
SWERTIA PERENNIS L.	151	8/0/1902	Tetelna Creek
VACCINIUM ULIGINOSUM L. subsp. MICROPHYLLUM Lange	38	06/15/1902	Chetaslina Glacier
VACCINIUM VITIS-IDAEA L. subsp. MINUS (Lodd.) Hult.			Chetaslina Glacier
VALERIANA CAPITATA Pall.			East fork of the Chetaslina River
VIBURNUM EDULE (Michx.) Raf.			Vic. of (Tetelna) Indian Creek
WILHELMSIA PHYSODES (Fisch.) McNeill	156	08/18/1902	Chetaslina R.
ZYGADENUS ELEGANS Pursh		08/08/1902	Tetelna (Indian River)

Appendix 2.4. Collections of Charles W.H. Heideman at Copper Center in 1908. Specimens are deposited at the U.S. National Herbarium. Collection data is from Hultén 1941-1950.

TAXON	COLL#	TAXON	COLL#
ACHILLEA BOREALIS Bong.	20	JUNCUS ARCTICUS Willd. var. ALASKANUS Hult.	103
ANDROMEDA POLIFOLIA L.	s.n.	LAPPULA OCCIDENTALIS (Wats.)	16
ANEMONE PARVIFLORA Michx.	50	LEDUM GROENLANDICUM Oeder	s.n.
ANEMONE RICHARDSONII Hook.	65	LOMATOGONIUM ROTATUM (L.) E. Fries	25
AQUILEGIA BREVISTYLA Hook.	25	LUPINUS ARCTICUS S. Wats.	33
ARABIS DIVARICARPA Nels.	92	MERTENSIA PANICULATA (Ait.) G. Don	74
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	61	MONESES UNIFLORA (L.) Gray	89
ARENARIA CAPILLARIS Poir.	106	OXYTROPIS CAMPESTRIS (L.) DC. subsp. VARIANS (Rydb.) Cody	85
ASTRAGALUS AMERICANUS (Hook.) M.E. Jones	14	PARNASSIA PALUSTRIS L.	29
CALYPSO BULBOSA (L.) Rchb. f.	24,80	PETASITES SAGITTATUS (Banks) Gray	54
CARDAMINE PRATENSIS L.	76	PLATANTHERA HYPERBOREA (L.) Lindl.	43
CASSIOPE TETRAGONA (L.) D. Don	71	PLATANTHERA OBTUSATA (Pursh) Lindl.	s.n.
CASTILLEJA CAUDATA (Pennell) Rebr.	15	POLEMONIUM PULCHERRIMUM Hook.	27,34
CORALLORRHIZA TRIFIDA Chatelain	82	POTENTILLA FRUTICOSA L.	11
CORYDALIS AUREA Willd.	68	POTENTILLA HOOKERIANA Lehm.	57,63
DRYAS DRUMMONDII Richards.	36	POTENTILLA PALUSTRIS (L.) Scop.	18
DRYAS INTEGRIFOLIA M. Vahl	104	PULSATILLA PATENS (L.) Mill.	53
ELAEAGNUS COMMUTATA Bernh.	37	PYROLA GRANDIFLORA Radius	38
EPILOBIUM ANGUSTIFOLIUM L.	12	RANUNCULUS GMELINI DC.	73
EPILOBIUM LATIFOLIUM L.	22	RIBES HUDSONIANUM Richards.	51
EPILOBIUM PALUSTRE L.	17	ROSA ACICULARIS Lindl.	s.n.
QUISETUM ARVENSE L.	60, 91	RUBUS CHAMAEMORUS L.	87
EQUISETUM SCIRPOIDES Michx.	64	SAXIFRAGA TRICUSPIDATA Rottb.	83
ERIGERON COMPOSITUS Pursh.	32, 67	SENECIO LUGENS Richards.	94
ERIGERON LONCHOPHYLLUS Hook.	44	SHERPERDIA CANADENSIS (L.) Nutt.	55
GALIUM BOREALE L.	23, 90	TARAXACUM LACERUM Greene	78
GERANIUM ERIANTHUM DC.	105	VALERIANA CAPITATA Pall.	84
HEDYSARUM MACKENZII Richards.	48	VIBURNUM EDULE (Michx.) Raf.	86

Appendix 2.5. Collections of David W. Eaton in 1909, 1912 and 1913 along the US-Canadian border. Specimens are deposited at the U.S. National Herbarium. Collection data is from Hultén 1941-1950.

TAXON	COLL#	COLL DATE	LOCALITY
ACHILLEA BOREALIS Bong.	21		141st meridian N. of Mt. St. Elias
ACONITUM DELPHINIFOLIUM DC.			White River valley
ANDROMEDA POLIFOLIA L.	47		141st meridian N. of Mt. St. Elias
ANDROSACE SEPTENTRIONALIS L.	62		Copper Center
ANEMONE PARVIFLORA Michx.			Chitina valley
ANEMONE PARVIFLORA Michx.			White River near the boundary
ANEMONE RICHARDSONII Hook.			Chitina River Valley
ANEMONE RICHARDSONII Hook.			White River near boundary
ANTENNARIA PULCHERRIMA (Hook.) Greene			141st meridian N. of Mt. St. Elias
ARCTOSTAPHYLOS RUBRA (Rehd. & Wilson) Fern.	48		141st meridian N. of Mt. St. Elias
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	55		141st meridian N. of Mt. St. Elias
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.			White River near the boundary
ARUNCUS DIOICUS (Walt.) Fern.	7		N of Mt. St. Elias
ASTRAGALUS UMBELLATUS Bunge	30		141st meridian N of Mt. St. elias
ASTRAGALUS UMBELLATUS Bunge	30		White River near the boundary
CAMPANULA UNIFLORA L.			White River near the boundary
CASSIOPE TETRAGONA (L.) D. Don	46		141st Meridian N of Mt. St. Elias
CASSIOPE TETRAGONA (L.) D. Don			White River
CASTILLEJA CAUDATA (Pennell) Rebr.			White River near the boundary
CHRYSOSPLENIUM WRIGHTII Fr. & Sav.			White River valley near the boundary
CORYDALIS AUREA Willd.		1913	Chitina Valley
CORYDALIS PAUCIFLORA (Steph.) Pers.			White River near the boundary
CREPIS ELEGANS Hook.	35		141st meridian N. of Mt. St. Elias
CYPRIPEDIUM PASSERINUM Richards.	24		141st Meridian N. of Mt. St. Elias
DELPHINIUM GLAUCUM S. Wats.			White River near boundary
DESCHAMPSIA CAESPITOSA (L.) Beauv. subsp. CAESPITOSA var. CAESPITOSA	62, 63		141st Meridian N of Mt. St. Elias
DRYAS DRUMMONDII Richards.	22		141st meridian N of Mt. St. Elias
DRYAS DRUMMONDII Richards.			White River near the boundary
DRYAS INTEGRIFOLIA M. Vahl			White River near the boundary
ELAEAGNUS COMMUTATA Bernh.	6		141st meridian N of Mt. St. Elias
EPILOBIUM ANGUSTIFOLIUM L.	61		141st meridian N of Mt. St. Elias
EPILOBIUM ANGUSTIFOLIUM L.			Chitina Valley
EPILOBIUM LATIFOLIUM L.	52		141st meridian n of Mt. St. Elias
EPILOBIUM LATIFOLIUM L.			Chitina River Valley
ERIGERON ACRIS L.	38		141st meridian N. of Mt. St. Elias
ERIGERON PEREGRINUS (Pursh) Greene	20		141st meridian N. of Mt. St. Elias
ERIGERON PURPURATUS Greene			White River near the boundary
FAURIA CRISTA-GALLI (Menzies) Makino	42		141st meridian N. of Mt. St. Elias
GALIUM BOREALE L.	59		141st meridian N. of Mt. St. Elias
GEOCAULON LIVIDUM (Richards.) Fern.	53		141st Meridian N of Mt. St. Elias
GEUM CALTHIFOLIUM Menzies	14		141 meridian N of Mt. St. Elias

Appendix 2.5, continued. Collections of David W. Eaton in 1909, 1912 and 1913 along the US-Canadian border. Specimens are deposited at the U.S. National Herbarium. Collection data is from Hultén 1941-1950.

TAXON	COLL#	LOCALITY
HEDYSARUM ALPINUM L.		Chitina Valley
HEDYSARUM ALPINUM L.		White River near boundary
HERACLEUM LANATUM Michx.		141st meridian N of Mt. St. Elias
JUNCUS ALPINUS Vill. subsp. NODULOSUS (Wahlenb.) Lindm.	51	141st meridian, N. of Mt. St. Elias
JUNCUS CASTANEUS Sm.	50	141st Meridian N of Mt. St. Elias
LEDUM GROENLANDICUM Oeder	13	Chitina River Valley
LEDUM GROENLANDICUM Oeder		White River near the boundary
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.		Whiter River valley near the border
LOMATOGONIUM ROTATUM (L.) E. Fries	34	141st meridian N. of Mt. St. Elias
LUPINUS ARCTICUS S. Wats.		Chitina Valley N. of Mt. St. Elias
LUPINUS ARCTICUS S. Wats.		White River near boundary
MERTENSIA PANICULATA (Ait.) G. Don		Chitina Valley N of Mt. St. Elias
MERTENSIA PANICULATA (Ait.) G. Don		White River valley near the boundary
MONESES UNIFLORA (L.) Gray	56	141st Meridian N of Mt. St Elias
NUPHAR POLYSEPALUM Engelm.	60	141 meridian N. of Mt. St. Elias
PAPAVER RHOEAS L.		Chitina Valley
PARNASSIA PALUSTRIS L.	31	141st meridian of Mt. St. Elias
PARNASSIA PALUSTRIS L.		White River valley
PARRYA NUDICAULIS (L.) Regel subsp. INTERIOR Hult.		Chitina Valley N of Mt. St. Elias
PARRYA NUDICAULIS (L.) Regel subsp. INTERIOR Hult.		White River near the boundary
PEDICULARIS CAPITATA Adams		White River valley
PLATANTHERA DILATATA (Pursh) Lindl.	25	141st Meridian N. of Mt. St. Elias
PLATANTHERA HYPERBOREA (L.) Lindl.	27	141st Meridian N. of Mt. St. Elias
POA ALPINA L.	65	141st Meridian N of Mt St. Elias
POLEMONIUM ACUTIFLORUM Willd.	41	141st meridian N. of Mt. St. Elias
POLEMONIUM PULCHERRIMUM Hook.		Chitina River valley N of Mt. St. Elias
POTENTILLA FRUTICOSA L.	54	N. of Mt. St. Elias
POTENTILLA FRUTICOSA L.		White River near the boundary
PULSATILLA PATENS (L.) Mill.		White River near boundary
PYROLA SECUNDA L.	57	141st meridan N. of Mt. St. Elias
ROSA ACICULARIS Lindl.		Chitina Valley
ROSA ACICULARIS Lindl.		White River Valley
RUBUS CHAMAEMORUS L.		White River near boundary
SALIX RETICULATA L.		White River Valley
SANGUISORBA CANADENSIS L. subsp. LATIFOLIA (Hook.) Calder & Taylor	23	141st meridian N of Mt. St. Elias
SAXIFRAGA OPPOSITIFOLIA L.		White River near the boundary
SAXIFRAGA TRICUSPIDATA Rottb.		White River near boundary
SENECIO FUSCATUS (Jord. & Fourr.) Hayek		White River near the boundary
SENECIO LUGENS Richards.		White River near the boundary
SENECIO PAUPERCULUS Michx.	16	141st meridian N. of Mt. St. Elias
SHERPERDIA CANADENSIS (L.) Nutt.		Whiter River near boundary
SILENE ACAULIS L.		White River near boundary
SOLIDAGO MULTIRADIATA Ait.		Chitina Valley
SORBUS SITCHENSIS Roem.	2	141st meridian N. of Mt. St. Elias

Appendix 2.5, continued. Collections of David W. Eaton in 1909, 1912 and 1913 along the US-Canadian border. Specimens are deposited at the U.S. National Herbarium. Collection data is from Hultén 1941-1950.

TAXON	COLL#	LOCALITY
STREPTOPUS AMPLEXIFOLIUS (L.) DC.	44	141st Meridian N. of Mt. St. Elias
SWERTIA PERENNIS L.	11	141 meridian N of Mt. St. Elias
TIARELLA TRIFOLIATA L.	13	141st meridian N. of Mt. St. Elias
VACCINIUM ULIGINOSUM L.	49	141st meridian N. of Mt. St Elias
VALERIANA CAPITATA Pall.	40	141st meridian N. of Mt. St. Elias
VALERIANA CAPITATA Pall.		White River valley
VIOLA LANGSDORFII Fisch.		141st meridian N of Mt. St. Elias
WILHELMSIA PHYSODES (Fisch.) McNeill		White River near boundary
ZYGADENUS ELEGANS Pursh	s.n.	White River near the boundary

Appendix 2.6. Collections of Hamilton L. Laing in 1925 at the head of the Chitina River. Collection data is from Hultén 1941-1950, Porsild 1939, Hitchcock and Maguire 1947, Porsild 1938, Packer 1972 and Rollins 1973.

TAXON	COLL#	COLL DATE	HERB_DEPOS[1]
ACHILLEA BOREALIS Bong.	199, 240		CAN
ACONITUM DELPHINIFOLIUM DC.	78		CAN
ACONITUM DELPHINIFOLIUM DC. subsp. PARADOXUM (Rchb.) Hult.	725		CAN
AMELANCHIER ALNIFOLIA (Nutt.) Nutt.	121		CAN
AMERORCHIS ROTUNDIFOLIA (Banks) Hult.	36, 37		CAN
ANDROMEDA POLIFOLIA L.	165		CAN, H
ANDROSACE SEPTENTRIONALIS L.	170, 171, 172		CAN
ANEMONE MULTIFIDA Poir.	508, 730		CAN
ANEMONE PARVIFLORA Michx.	67 - 69		CAN
ANEMONE RICHARDSONII Hook.	70		CAN, H
ANTENNARIA MONOCEPHALA DC.	239		CAN
ANTENNARIA ROSEA E.L. Greene subsp. CONFINIS (E.L. Greene) Bayer	210, 238		CAN
AQUILEGIA BREVISTYLA Hook.	73-76		CAN
ARABIS HOLBOELLII Hornem. var. PINETORUM (Tidestrom) Rollins	93, 94		CAN
ARCTOSTAPHYLOS RUBRA (Rehd. & Wilson) Fern.	158, 159		CAN
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	162		CAN
ARNICA LESSINGII (Torr. & Gray) Greene	203		CAN
ARTEMISIA FRIGIDA Willd.	127, 128		CAN
ASTRAGALUS ALPINUS L.	129		CAN
ASTRAGALUS UMBELLATUS Bunge	127, 128		CAN
BETULA NANA L.	52		CAN
BOSCHNIAKIA ROSSICA (Cham. & Schlecht.) Fedtsch.	180		CAN
BRAYA HUMILIS (C.A. Mey.) Robins.	89, 90		CAN
CALAMAGROSTIS PURPURASCENS R. Br.	12	06/12/1925	CAN
CALYPSO BULBOSA (L.) Rchb. f.	30		CAN
CAREX CONCINNA R. Br.			CAN
CAREX EBURNEA Boott		06/18/1925	CAN
CAREX GARBERI Fern.	16, 18		CAN
CAREX KRAUSEI Boeck.	21		CAN
CAREX SCIRPOIDEA Michx.	20		CAN
CASSIOPE TETRAGONA (L.) D. Don	163		CAN
CASTILLEJA HYPERBOREA Pennell	183		CAN
CERASTIUM BEERINGIANUM Cham. & Schlecht.	57		CAN
CHENOPODIUM CAPITATUM (L.) Aschers.	56		CAN
CLAYTONIA SARMENTOSA C.A. Mey	227		CAN
CORALLORRHIZA TRIFIDA Chatelain	29		CAN
CORNUS CANADENSIS L.	149		CAN
CREPIS ELEGANS Hook.	215		CAN
CREPIS NANA Richards.	214		CAN

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.6, continued. Collections of Hamilton L. Laing in 1925 at the head of the Chitina River. Collection data is from Hultén 1941-1950, Porsild 1939, Hitchcock and Maguire 1947, Porsild 1938, Packer 1972 and Rollins 1973.

TAXON	COLL#	HERB DEPOS[1]
CYPRIPEDIUM PASSERINUM Richards.	28	CAN
CYSTOPTERIS FRAGILIS (L.) Bernh.	1,2	CAN
DELPHINIUM GLAUCUM S. Wats.	77	CAN
DODECATHEON FRIGIDUM Cham. & Schlecht.	169	CAN
DRABA AUREA M. Vahl ex Hornem	81, 82, 85-87	CAN
DRABA GLABELLA Pursh	83	CAN
DRABA LONGIPES Raup	84	CAN
DRABA OLIGOSPERMA Hook.	79, 80	CAN
DRYAS DRUMMONDII Richards.	118, 119	CAN
DRYAS INTEGRIFOLIA M. Vahl	120	CAN
ELAEAGNUS COMMUTATA Bernh.	146	CAN, H
EMPETRUM NIGRUM L.	144	CAN
EPILOBIUM ANGUSTIFOLIUM L.	148	CAN
EPILOBIUM LATIFOLIUM L.	147	CAN
EQUISETUM ARVENSE L.	3	CAN
EQUISETUM PRATENSE L.	4	CAN
EQUISETUM SCIRPOIDES Michx.	5, 6	CAN
EQUISETUM VARIEGATUM Schleich. subsp. ALASKANUM (A. A. Eat.) Hult.	7	CAN, H
ERIGERON COMPOSITUS Pursh.	197	CAN, H
ERIGERON ERIOCEPHALUS J. Vahl	241	CAN
ERIOPHORUM ANGUSTIFOLIUM Honck.	15	CAN
ERIOPHORUM BRACHYANTHERUM Trautv.	14	CAN
ERYSIMUM CHEIRANTHOIDES L.	95-98	CAN
ERYSIMUM INCONSPICUUM (S. Wats.) MacM.	95, 96, 97	CAN
EUPHRASIA SUBARCTICA Raup.	237	CAN
GENTIANA PROPINQUA Richards subsp. ARCTOPHILA (Griseb.) Hultén	175	CAN
GENTIANA PROPINQUA Richards subsp. PROPINQUA	174, 176, 234	CAN
GENTIANA PROSTRATA Haenke	235	CAN
GEOCAULON LIVIDUM (Richards.) Fern.	53	CAN
GERANIUM ERIANTHUM DC.	142	CAN
GOODYERA REPENS (L.) R. Br. Var. OPHIOIDES Fern	38A	CAN
HEDYSARUM ALPINUM L.	138, 339	CAN
HEDYSARUM MACKENZII Richards.	140, 231, 141	CAN
JUNCUS TRIGLUMIS L. subsp. ALBESCENS (Lange) Hult.	22	CAN
JUNIPERUS COMMUNIS L.	9	CAN
JUNIPERUS HORIZONTALIS Moench	10, 11	CAN
LAPPULA OCCIDENTALIS (Wats.)	182	CAN
LEDUM GROENLANDICUM Oeder	156	H
LEDUM PALUSTRE L.	157	CAN

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.6, continued. Collections of Hamilton L. Laing in 1925 at the head of the Chitina River. Collection data is from Hultén 1941-1950, Porsild 1939, Hitchcock and Maguire 1947, Porsild 1938, Packer 1972 and Rollins 1973.

TAXON	**COLL#**	**HERB DEPOS**[1]
LESQUERELLA ARCTICA (Wormsk.) S. Wats. subsp. ARCTICA	91,92	CAN
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.	143	CAN
LISTERA BOREALIS Morong	38	CAN
LLOYDIA SEROTINA (L.) Rchb.	27	CAN
LUPINUS ARCTICUS S. Wats.	122, 125, 126, 128, 233	CAN
MELANDRIUM AFFINE J. Vahl	228	CAN
MENYANTHES TRIFOLIATA L.	173	CAN
MERTENSIA PANICULATA (Ait.) G. Don	178, 179, 180	CAN
MONESES UNIFLORA (L.) Gray	150	H
NUPHAR POLYSEPALUM Engelm.	63	CAN
OXYRIA DIGYNA (L.) Hill	54	CAN
OXYTROPIS CAMPESTRIS (L.) DC. subsp. VARIANS (Rydb.) Cody	134, 135	CAN
OXYTROPIS DEFLEXA (Pall.) DC. var. FOLIOLOSA (Hook.) Barneby	131, 132	CAN
OXYTROPIS NIGRESCENS (Pall.) Fisch. subsp. BRYOPHILA (Greene) Hult.	130	CAN
OXYTROPIS SPLENDENS Dougl.	133	CAN
OXYTROPIS VISCIDA Nutt.	136, 137	CAN
PAPAVER RADICATUM Rottb.	229	CAN
PARNASSIA PALUSTRIS L.	230	CAN, H
PEDICULARIS CAPITATA Adams	186	CAN
PEDICULARIS LABRADORICA Wirsing	194	H
PICEA GLAUCA (Moench) Voss	8	CAN
PLATANTHERA HYPERBOREA (L.) Lindl.	34, 35	CAN
PLATANTHERA OBTUSATA (Pursh) Lindl.	31, 32, 33	CAN
POLEMONIUM PULCHERRIMUM Hook.	117	CAN
POLYGONUM BISTORTA L.	55	CAN
POLYGONUM VIVPARUM L.		CAN
POPULUS BALSAMIFERA L.	49 - 51	CAN
POTENTILLA FRUTICOSA L.	110	CAN
POTENTILLA HOOKERIANA Lehm.	115, 116, 117	CAN
POTENTILLA NORVEGICA L.	111	CAN
POTENTILLA PALUSTRIS (L.) Scop.	109	CAN
POTENTILLA UNIFLORA Ledeb.	112	CAN
POTENTILLA VIRGULATA Nels.	113	CAN
PYROLA ASARIFOLIA Michx.	155	CAN
PYROLA CHLORANTHA Sw.	154	CAN
PYROLA GRANDIFLORA Radius	152	CAN
PYROLA SECUNDA L.	151	H
RANUNCULUS PEDATIFIDUS Sm. subsp. AFFINIS (R. Br.) Hult.	71, 72	CAN, H
ROSA ACICULARIS Lindl.	106, 107, 108	CAN

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.6, continued. Collections of Hamilton L. Laing in 1925 at the head of the Chitina River. Collection data is from Hultén 1941-1950, Porsild 1939, Hitchcock and Maguire 1947, Porsild 1938, Packer 1972 and Rollins 1973.

TAXON	COLL#	HERB_DEPOS[1]
RUBUS CHAMAEMORUS L.	104	CAN
RUBUS IDAEUS L.	105	CAN
SALIX ALAXENSIS (Anderss.) Cov.	41, 46, 48	CAN
SALIX ARBUSCULOIDES Anderss.		CAN
SALIX BARCLAYI Anderss.	223	CAN
SALIX BARRATTIANA Hook.	216, 222	CAN, H
SALIX BEBBIANA Sarg.	43, 45, 218	CAN
SALIX GLAUCA L. subsp. DESERTORUM (Richards.) Ands.	226	H
SALIX LANATA L. subsp. RICHARDSONII (Hook.) A. Skvortz.	42	CAN
SALIX MYRTILLIFOLIA Anders.	221	CAN
SALIX POLARIS Wahlenb.	39	CAN
SALIX RETICULATA L.	44, 47	CAN
SALIX SETCHELLIANA Ball	224	CAN
SALIX SITCHENSIS Sanson	40	CAN
SAXIFRAGA OPPOSITIFOLIA L.	99, 100, 101	CAN
SAXIFRAGA TRICUSPIDATA Rottb.	102,103	CAN
SENECIO KJELLMANII Porsild	206	CAN
SENECIO LUGENS Richards.	209	CAN
SENECIO OGOTORUKENSIS Packer	207.208	CAN
SHERPERDIA CANADENSIS (L.) Nutt.	27	CAN
SILENE ACAULIS L.	60	CAN
SILENE MENZIESII Hook. (Britt.) Hult. comb. nov.	61, 62	CAN
SOLIDAGO MULTIRADIATA Ait.	195	H
STELLARIA LAETA Richards	58, 59	CAN
TARAXACUM CERATOPHORUM (Ledeb.) DC.	212	S
TARAXACUM LACERUM Greene	212	CAN
TARAXACUM LACERUM Greene	244	CAN
TOFIELDIA PUSILLA (Michx.) Pers.	s.n.	NY
VACCINIUM ULIGINOSUM L.	167	CAN, H
VACCINIUM VITIS-IDAEA L. subsp. MINUS (Lodd.) Hult.	166	CAN
VIBURNUM EDULE (Michx.) Raf.	191, 192, 193	CAN
ZYGADENUS ELEGANS Pursh	24, 25, 26	CAN

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.7. Collection of Frits Warmolt Went in 1934 at Copper Center and Chitina.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
ALLIUM SCHOENOPRASUM (L.) Hartm.		Copper Center	L
AMERORCHIS ROTUNDIFOLIA (Banks) Hult.		Copper Center	L
ANTENNARIA ROSEA E.L. Greene	223	Copper Center	L
ARCTOPHILA FULVA (Trin.) Anderss.	206	Copper Center	Cal U,L
ARCTOSTAPHYLOS RUBRA (Rehd. & Wilson) Fern.		Chitina	L
BECKMANNIA ERUCAEFORMIS (L.) Host subsp. BAICALENSIS (Kuzn.) Hult	235	Copper Center	Cal U
BROMUS PUMPELLIANUS Scribn. var. ARCTICUS (Shear) Pors.	245	Copper Center	L. Cal U
CALAMAGROSTIS INEXPANSA Gray	216	Copper Center	Cal U L
CAREX AQUATILIS Wahlenb.	219	Copper Center	Cal U
CAREX AUREA Nutt.	231	Copper Center	L
CAREX MARITIMA Gunn.	211	Copper Center	Cal U, L
CAREX MEDIA R. Br.	225	Copper Center	Cal U, L
CAREX SUPINA Willd. subsp. SPANIOCARPA (Steud.) Hult.	248	Copper Center	Cal U, L
CYPRIPEDIUM PASSERINUM Richards.		Copper Center	L
DESCHAMPSIA CAESPITOSA (L.) Beauv. subsp. CAESPITOSA var. CAESPITOSA	214	Copper Center	Cal u, L
ELAEAGNUS COMMUTATA Bernh.	203	Copper Center	Cal U, L
EPILOBIUM LATIFOLIUM L.		Chitina	L
EQUISETUM ARVENSE L.	230	Copper Center	L, Cal U
EQUISETUM HYEMALE L.	204	Copper Center	Cal U, L
EQUISETUM SCIRPOIDES Michx.		Chitina	L
ERIGERON ACRIS L.		Copper Center	L
ERIGERON LONCHOPHYLLUS Hook.	200, 210	Copper Center	US
ERYSIMUM CHEIRANTHOIDES L.	236	Copper Center	L
EUPHRASIA SUBARCTICA Raup.	239	Copper Center	L
FESTUCA ALTAICA Trin.	217	Copper Center	Cal U
FESTUCA RUBRA L.	217	Copper Center	L
GALIUM BOREALE L.		Chitina	L
GEOCAULON LIVIDUM (Richards.) Fern.		Chitina	L
HEDYSARUM ALPINUM L.	201	Copper Center	L
JUNCUS ALPINUS Vill. subsp. NODULOSUS (Wahlenb.) Lindm.	213	Copper Center	L
JUNCUS ARCTICUS Willd. var. ALASKANUS Hult.	212,233	Copper Center	US
JUNIPERUS HORIZONTALIS Moench		Copper Center	L
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.		Copper Center	L
MONESES UNIFLORA (L.) Gray		Chitina	L
OXYTROPIS CAMPESTRIS (L.) DC. subsp. VARIANS (Rydb.) Cody	200	Copper Center	L
PARNASSIA PALUSTRIS L.	240	Copper Center	L
PEDICULARIS LABRADORICA Wirsing		Chitina	L
PLATANTHERA HYPERBOREA (L.) Lindl.		Copper Center	L
POA GLAUCA M. Vahl.		Copper Center	L, Cal U
POLYGONUM BISTORTA L.		Copper Center	L
POLYGONUM VIVPARUM L.		Copper Center	L

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.7, continued. Collection of Frits Warmolt Went in 1934 at Copper Center and Chitina.

TAXON	COLL #	LOCALITY	HERB DEPOS[1]
POTENTILLA FRUTICOSA L.		Chitina	L
POTENTILLA HOOKERIANA Lehm.	247	Copper Center	L
POTENTILLA NORVEGICA L.		Copper Center	L
POTENTILLA PALUSTRIS (L.) Scop.		Chitina	L
POTENTILLA VILLOSA Pall.		Copper Center	L
PYROLA CHLORANTHA Sw.		Chitina	L
RANUNCULUS GMELINI DC.	73	Copper Center	L
SALIX BRACHYCARPA Nutt.		Copper Center	L
SALIX BRACHYCARPA Nutt. subsp. NIPHOCLADA (Rydb.) Argus	251	Copper Center	L
SALIX MYRTILLIFOLIA Anders. var. PSEUDO-MYRSINITES (Ands.) Ball	223	Chitina	L
SENECIO CONGESTUS (R. Br.) DC.		Copper Center	Cal U, L
SENECIO LUGENS Richards.		Copper Center	L
SILENE WILLIAMSII Britt. (Britt.) Hult. comb. nov.	205	Copper Center	L
TRIGLOCHIN PALUSTRIS L.		Copper Center	L, Cal U
VIBURNUM EDULE (Michx.) Raf.		Chitina	L

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
ACONITUM DELPHINIFOLIUM DC.	2086	Meyer's Roadhouse	L,H
ALNUS INCANCA (L.) Monech subsp. TENUIFOLIA (Nutt.) Breitung	2014	Chitina	H
ALNUS INCANCA (L.) Monech subsp. TENUIFOLIA (Nutt.) Breitung	2737	Gulkana	L, H
ALNUS RUBRA Bong.	2737	Gulkana	H
ALNUS RUBRA Bong.		Between Chitina and Kennicott	H
ALNUS RUBRA Bong.	2014	Chitina	H
ALOPECURUS AEQUALIS Sobol.	2746	Near Tonsina	
AMELANCHIER ALNIFOLIA (Nutt.) Nutt.	8514	Gakona	H
AMELANCHIER ALNIFOLIA (Nutt.) Nutt.	10787	Copper Center	H
AMSINCKIA MENZIESII (Lehm.) Nels. & Macbr.	1987	Tonsina Lodge	H
ANEMONE MULTIFIDA Poir.	2016	Chitina	H
ANEMONE MULTIFIDA Poir.	2048	Copper Center	H
AQUILEGIA BREVISTYLA Hook.	8669	Mentasta	H
ARABIS DIVARICARPA Nels.	1972	Richardson Highway, mile 52-65	H
ARABIS HIRSUTA (L.) Scop. subsp. PYCNOCARPA (M. Hopkins) Hult.	9158	Gakona	H
ARABIS HOLBOELLII Hornem. var. RETROFRACTA (Graham) Rydb.	8531	Gakona	H
ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. var. ARUNDINACEA (Trin.) Griseb.	2760	Tiekel	H
ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. var. ARUNDINACEA (Trin.) Griseb.	2745	Willow Creek	L
ARCTOPHILA FULVA (Trin.) Anderss.	8667	Mentasta	
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	1907	Tiekel	L.H.
ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.	8557	Gakona	H
ARENARIA CAPILLARIS Poir.	8679, 10133	Slana-Tok Highway	H
ARNICA GRISCOMII C. A. Mey.	8752	Slana-Tok Highway mile 4	
ARTEMISIA FRIGIDA Willd.	2023	Chitina	H
ASTRAGALUS ALPINUS L.	8536	Gakona	ALA
ASTRAGALUS ALPINUS L.	8649	Gakona	
ASTRAGALUS ALPINUS L.	2019	Chitina	
ASTRAGALUS AMERICANUS (Hook.) M.E. Jones	8610	Gakona	H
ASTRAGALUS BODINII Sheld.	2488	Alaska Highway at White River	H
ASTRAGALUS BODINII Sheld.	8779	Tanana Crossing	H
ASTRAGALUS EUCOSMUS Robins.	8537	Gakona	ALA
ASTRAGALUS ROBBINSII (Oakes) Gray (Hook.) Barneby	9223	Slana-Tok Highway	H
ASTRAGALUS WILLIAMSII Rydb.	9224	Slana-Tok Highway, Clearwater Creek	H
BETULA GLANDULOSA Michx.	197	Richardson Highway, between miles 52 and 65	L, H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
BOSCHNIAKIA ROSSICA (Cham. & Schlecht.) Fedtsch.	2181	Richardson Highway mile 119 (near Glennallen)	H
BROMUS CILATUS L.	8544	Gakona	H
BROMUS PUMPELLIANUS Scribn. var. ARCTICUS (Shear) Pors.	2009	Chitina	L,H
BROMUS PUMPELLIANUS Scribn. var. ARCTICUS (Shear) Pors.	2046	Copper Center	H
CALAMAGROSTIS CANADENSIS (Michx.) Beauv.	2744	Willow Creek	H
CALAMAGROSTIS INEXPANSA Gray	2732	Gulkana	H
CALAMAGROSTIS PURPURASCENS R. Br.	2054	Copper Center	H
CALAMAGROSTIS PURPURASCENS R. Br.	8543	Gakona	H
CALLA PALUSTRIS L.	2725	Richardson Highway mile 150 (near Gakona)	H
CARDAMINE UMBELLATA Greene	2079	Meyer's Roadhouse	H
CAREX ADELOSTOMA Krecz.	9140	Mi 172-174 Richardson Highway	H
CAREX AQUATILIS Wahlenb.	2722	Richardson Highway mile 50 (near Gakona)	H
CAREX BONANZENSIS Britt.	8653	Gakona	H
CAREX BUXBAUMII Wahlenb.	2719	Richardson Highway, Mile 172-174 (near Meyers Lake)	H
CAREX CANESCENS L.		Slana-Tok highway	H
CAREX CAPILLARIS L.	8597	Gakona	
CAREX CAPITATA Soland. In L.	8654	Gakona	H
CAREX CHORDORRHIZA Ehrh. Ex. L. f.	8638	Gakona	
CAREX DEFLEXA Hornem.	8703	Slana-Tok Highway mile 20	
CAREX DIANDRA Schrank	2721	Richardson Highway, Mile 150 (near Gakona)	H
CAREX DISPERMA Dewey	8526	Gakona	H
CAREX EBURNEA Boott	9276	Alaska Highway at White River	H
CAREX GARBERI Fern.	8596	Gakona	H
CAREX LAXA Wahlenb.	2712b	Richardson Highway mile 172-174 (near Meyers Lake)	H
CAREX LEPTALEA Wahlenb.	2713	Mile 172-174 Richardson Highway (Near Meyers Roadhouse)	H
CAREX LIMOSA L.	2716	Richardson Highway mile 172-174 (near Meyers Lake)	H
CAREX LIMOSA L.	8633	Gakona	
CAREX LIVIDA Willd.	2719b	Richardson Highway mile 172-174 (near Meyers Lake)	H
CAREX MEDIA R. Br.	2730	Gulkana	H
CAREX PRATICOLA Rydb.	1927	Tiekel	L H
CAREX PRATICOLA Rydb.	8527	Gakona	H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
CAREX ROTUNDATA Wahlenb.	2749b	Richardson highway, mile 92 (near Willow Creek)	H
CASTILLEJA CAUDATA (Pennell) Rebr.	8559	Gakona	H
CERASTIUM ARVENSE L.	2759	Tiekel	H
CERASTIUM BEERINGIANUM Cham. & Schlecht.	8745	Slana-Tok Highway	H
CHAMAEDAPHNE CALYCULATA (L.) Moench	8636	Gkona	H
CICUTA VIROSA L.	10147	Edgerton Highway	H
CICUTA VIROSA L.		Willow Creek	H
CORALLORRHIZA TRIFIDA Chatelain	8547	Gakona	ALA
CORNUS CANADENSIS L.	8766	Mile 12 Slana-Tok HIghway	H
CORNUS STOLONIFERA Michx.	2056	Gulkana	L,H
DELPHINIUM GLAUCUM S. Wats.	1936	Tiekel	L, H.
DESCURAINIA RICHARDSONII (Sweet) O.E. Schulz	1999	Willow Creek	H
DESCURAINIA RICHARDSONII (Sweet) O.E. Schulz	2739	Copper Center	H
ELEOCHARIS PALUSTRIS (L.) Roem. & Schult.	2749	Mile 92 (near Willow Creek)	L, H
ELYMUS MACROURUS (Turcz.) Drobov	2731	Gulkana	H
ELYMUS MACROURUS (Turcz.) Drobov	2731b	Slana	H
EMPETRUM NIGRUM L.	8578	Gakona	H
EPILOBIUM LATIFOLIUM L.	8518	Gakona	H
EQUISETUM FLUVIATILE L. ampl. Ehrh.	2027	Chitina	H
EQUISETUM FLUVIATILE L. ampl. Ehrh.	8696	Slana-Tok highway	H
EQUISETUM PALUSTRE L.	8672	Mentasta	H
EQUISETUM PALUSTRE L.	9301	Alaska Highway at White River	H
EQUISETUM SCIRPOIDES Michx.		Alaska Highway at White River	US
EQUISETUM VARIEGATUM Schleich. subsp. ALASKANUM (A. A. Eat.) Hult.	8494	Gakona	H
EQUISETUM VARIEGATUM Schleich. subsp. ALASKANUM (A. A. Eat.) Hult.	9266	Alaska Highway at White River	H
EQUISETUM VARIEGATUM Schleich. subsp. ALASKANUM (A. A. Eat.) Hult.	8697	Slana-Tok highway	H
ERIGERON COMPOSITUS Pursh.	2026	Chitina	L, H
ERIGERON ELATUS Greene	1956	Tiekel	H
ERIOPHORUM BRACHYANTHERUM Trautv.	8706	Slana-Tok highway mile 20	H
ERYSIMUM CHEIRANTHOIDES L.	2018	Chitina	US
ERYSIMUM INCONSPICUUM (S. Wats.) MacM.	8549	Gakona	H
FRAGARIA VIRGINIANA Duchesne	9108	Between Slana and Nabesna	H
FRAGARIA VIRGINIANA Duchesne	9185	Between Slana and Nabesna	H
GALIUM BOREALE L.	1952	Tiekel	L, H
GEOCAULON LIVIDUM (Richards.) Fern.	8539	Gakona	H
GEUM MACROPHYLLUM Willd. subsp. PERINCISUM (Rydlb.) Hult.	1939	Tiekel	H
GLYCERIA BOREALIS (Nash) Batchelder	10789	Gakona	H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
HALIMOLOBOS MOLLIS (Hook.) Rollins	2017	Chitina	H
HEDYSARUM ALPINUM L.	2004	Edgerton cutoff	H
HEDYSARUM MACKENZII Richards.	8515	Gakona	ALA
HERACLEUM LANATUM Michx.	2085	Meyer's Roadhouse	L, H
HIPPURIS VULGARIS L.	2034	Chitina	H
HIPPURIS VULGARIS L.	2000B	Richardson Highway, mile 92, near Willow Creek	H
JUNCUS ARCTICUS Willd. subsp. ATER (Rydb.) Hult.	2728	Mile 150 Richardson Highway (near Gakona)	H
LEDUM GROENLANDICUM Oeder	8583	Gakona	H
LEDUM PALUSTRE L. subsp. DECUMBENS (Ait.) Hult.	2097	Meyer's Roadhouse	H
LEMNA MINOR L.	9242	Edgerton Highway mile 9	H
LEMNA TRISULCA L.	9243	Edgerton Highway mile 9	H
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.	8517	Gakona	ALA
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.	2021	Chitina	L, H
LINUM PERENNE L. subsp. LEWISII (Pursh) Hult.	8688	Slana-Tok Highway	H
LLOYDIA SEROTINA (L.) Rchb.	1892	Thompson Pass	H
LUPINUS ARCTICUS S. Wats.	8532	Gakona	H
LUPINUS ARCTICUS S. Wats.	2044	Richardson Highway Mile 92 (near Willow Creek)	H
MELANDRIUM TAIMYRENSE Tolm.	2047	Copper Center	L, H
MENYANTHES TRIFOLIATA L.	2035	Chitina	H
MENYANTHES TRIFOLIATA L.	2035	Richardson Highway mile 173 (vic. Meyer's Roadhouse)	H
MERTENSIA PANICULATA (Ait.) G. Don	1950	Tiekel	L, H
MERTENSIA PANICULATA (Ait.) G. Don	8585	Gakona	H
MERTENSIA PANICULATA (Ait.) G. Don	2092	Meyer's Road House	H
MONESES UNIFLORA (L.) Gray	8667	Mile 12 Slana-Tok Highway	H
MONOLEPIS NUTTALLIANA (Schult.) Greene		Tiekel	H
MONOLEPIS NUTTALLIANA (Schult.) Greene	6031	Gulkana	H
MONOLEPIS NUTTALLIANA (Schult.) Greene	8751	Slana	H
MYRICA GALE L. var. TOMENTOSA L. DC.	2038	9 miles from Chitina	L,H
MYRIOPHYLLUM ALTERNIFLORUM DC.	10792	Gakona	H
MYRIOPHYLLUM SPICATUM L.	8612	Gakona	H
NUPHAR POLYSEPALUM Engelm.	2037	9 miles from Chitina	L, H
NUPHAR POLYSEPALUM Engelm.	2726, 2706	Richardson Highway mile 150 & mile 173	L. H
OXYTROPIS CAMPESTRIS (L.) DC. subsp. VARIANS (Rydb.) Cody	2020	Chitina	H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
OXYTROPIS DEFLEXA (Pall.) DC.	8535	Gakona	H
OXYTROPIS VISCIDA Nutt.	8533	Gakona	H
OXYTROPIS VISCIDA Nutt.	8686a	Slana-Tok Highway	H
PEDICULARIS LABRADORICA Wirsing	2084	Meyer's Road House	L, H
PEDICULARIS LABRADORICA Wirsing	1951	Tiekel	H
PEDICULARIS SUDETICA Willd.	8728	Slana-Tok Highway, mile 20	H
PETASITES SAGITTATUS (Banks) Gray	8619	Gakona	H
PETASITES SAGITTATUS (Banks) Gray	2002	Willow Creek	H
PINGUICULA VILLOSA L.	2186	Richardson Highway mile 119 (near Glennallen)	H
PLAGIOBOTHRYS COGNATUS (Greene) Johnston	1948	Tiekel	L, H
PLATANTHERA OBTUSATA (Pursh) Lindl.	1993	Richardson Highway, Mile 86 (near upper Tonsina)	H
PLATANTHERA OBTUSATA (Pursh) Lindl.	8760	Slana-Tok Highway	H
POA ALPIGENA (E. Fries) Lindm.	2733	Gulkana	L,H
POA ALPINA L.	8662	Slana	H
POA ALPINA L.	8662	Slana	H
POA ARCTICA R. Br. subsp. LONGICULMIS Hult.	8665	Mentasta	NY, LUND, US
POA GLAUCA M. Vahl.	2748	Willow Creek	NY, LUND, US
POA GLAUCA M. Vahl.	2045	Copper Center	NY, LD, US
POA PRATENSIS L.	8545	Gakona	H
POA PRATENSIS L.	8545	Gakona	H
POLEMONIUM PULCHERRIMUM Hook.	8540	Gakona	H
POLYGONUM ALASKANUM (Small) Wight	8736	Slana-Tok Highway	H
POLYGONUM CAURIANUM Robins.	1991	Richardson Highway mile 86	L, H
POLYGONUM CAURIANUM Robins.	2740	Copper Center	L, H
POLYGONUM CAURIANUM Robins.	10129	Slana-Tok Highway	H
POPULUS TREMULOIDES Michx.	8716	Slana-Tok Highway	H
POTAMOGETON GRAMINEUS L.	9762	Northway	NY, LD, US
POTAMOGETON PERFOLIATUS L. subsp. RICHARDSONII (Bennett) Hult.	10152	Chitina Lake	H
POTENTILLA ARGUTA Pursh subsp. CONVALLARIA (Rydb.) Keck	9109	Alaska Highway, mile 1016	H
POTENTILLA DIVERSIFOLIA Lehm.	1974	Richardson Highway mile 52-65, vic Tiekel	H
POTENTILLA HOOKERIANA Lehm.	2050	Copper Center	L,H
POTENTILLA NORVEGICA L.	1984	Tonsina Lodge	H
POTENTILLA PALUSTRIS (L.) Scop.	2032	Chitina	L, H
PRIMULA EGALIKSENSIS Wormsk.	9226	Northway airbase	H
PUCCINELLIA ARCTICA (Hook.) Fern. & Weatherby	2747	Richardson Highway, Mile 92	H
PUCCINELLIA BOREALIS Swallen	2008	Chitina	
PUCCINELLIA DISTANS (Jacq.) Parl.	2008. 2028	Chitina	H
PUCCINELLIA INTERIOR Sorens.	2734	Copper Center	H
PUCCINELLIA INTERIOR Sorens.	2028	Chitina	H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
PUCCINELLIA NUTTALLIANA (Schult.) Hitchc.	2747	Richardson Highway, mile 92, vic. Willow Creek	
PULSATILLA PATENS (L.) Mill.	2015	Chitina	H
PYROLA ASARIFOLIA Michx.	1946	Tiekel	H
PYROLA ASARIFOLIA Michx.	8582	Gakona	H
PYROLA CHLORANTHA Sw.	8555	Gakona	ALA
PYROLA GRANDIFLORA Radius	8581	Gakona	H
PYROLA GRANDIFLORA Radius	8769	Mile 12 Slana-Tok Highway	H
PYROLA SECUNDA L.	1945	Tiekel	L, H
PYROLA SECUNDA L.	8556	Gakona	H
PYROLA SECUNDA L.	10125	Slana-Tok Highway	H
RANUNCULUS CYMBALARIA Pursh	1998	Willow Creek	H
RANUNCULUS CYMBALARIA Pursh	2736	Gulkana	L, H
RANUNCULUS GMELINI DC.	2030	Chitina	L, H
RANUNCULUS GMELINI DC.	2742	Willow Creek	H
RIBES TRISTE Pall.	2040	Liberty Falls	H
ROSA ACICULARIS Lindl.	1938	Tiekel	L, H
RUMEX ARCTICUS Trautv.	1997	Richardson Highway mile 92, near willow Creek	H
RUMEX ARCTICUS Trautv.	8717	Slana-Tok Highway	H
SALIX ARBUSCULOIDES Anderss.	8506	Gakona	H
SALIX BEBBIANA Sarg.	2013	Chitina	H
SALIX GLAUCA L.	2060	Mile 146 Richardson Highway (near Gakona)	H
SALIX MYRTILLIFOLIA Anders.	8710	Slana-Tok Highway	H
SALIX MYRTILLIFOLIA Anders.	9344	Alaska Highway at White River	H
SALIX MYRTILLIFOLIA Anders.	8710	Slana-Tok Highway	H
SALIX PSEUDOMONTICOLA Ball	8504	Gakona	H
SAXIFRAGA LYALLII Engler	2103	Mayer's Roadhouse	L, H
SELAGINELLA SIBIRICA (Milde) Hieron	8676, 10131	Slana-Tok highway	H
SENECIO CONGESTUS (R. Br.) DC.	8617	Gakona	H
SENECIO LUGENS Richards.	1254	Tiekel	H
SENECIO LUGENS Richards.	8758	Slana-Tok Highway mile 20	H
SENECIO OGOTORUKENSIS Packer	2024	Chitina	H
SENECIO PAUCIFLORUS Pursh	2039	Chitina	L, H
SHERPERDIA CANADENSIS (L.) Nutt.	8554	Gakona	H
SOLIDAGO MULTIRADIATA Ait.	1955	Tiekel	S
SOLIDAGO MULTIRADIATA Ait.	2025	Chitina	L, H
SOLIDAGO MULTIRADIATA Ait.	10137	Gakona	H
SORBUS SCOPULINA Greene	9236	Slana-Tok Highway	H
SPIRAEA BEAUVERDIANA Schneid.	2063	Richardson Highway, milw 146, vic. of Gakona	L, H
STELLARIA CALYCANTHA (Ledeb.) Bong.	8567	Gakona	H
STELLARIA CALYCANTHA (Ledeb.) Bong.	8761	Slana-Tok Highway	H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.8, continued. Collections of J.P. Anderson in the vicinity of the Park in 1935 and 1944.

TAXON	COLL#	LOCALITY	HERB DEPOS[1]
STELLARIA LONGIPES Goldie	199	Tiekel	G. H
TARAXACUM CERATOPHORUM (Ledeb.) DC.	1935	Upper Tonsina	S
TARAXACUM CERATOPHORUM (Ledeb.) DC.	1935	Tonsina Lodge	L
TARAXACUM CERATOPHORUM (Ledeb.) DC.	1935	Tonsina Lodge	S
TARAXACUM CERATOPHORUM (Ledeb.) DC.	8523	Gakona	H
TARAXACUM LACERUM Greene	1990	Tonsina Lodge	H
TARAXACUM LACERUM Greene	1990	Tonsina Lodge	H
TARAXACUM OFFICINALE Weber		Chitina	S
TARAXACUM OFFICINALE Weber		Willow Creek	S
TRIGLOCHIN PALUSTRIS L.	1996	Richardson Highway, Mile 92	H
VACCINIUM CAESPITOSUM Michx.	10155	Edgerton Highway, mile 10	H
VACCINIUM VITIS-IDAEA L. subsp. MINUS (Lodd.) Hult.	8558	Gakona	H
VACCINIUM VITIS-IDAEA L. subsp. MINUS (Lodd.) Hult.	2065	Richardson Highway mile 146 (vic. Gakona)	L,H
VALERIANA CAPITATA Pall.	8741	Slana-Tok Highway, mile 24	H
VIBURNUM EDULE (Michx.) Raf.	8520	Gakona	H
WOODSIA ALPINA (Bolton) S. F. Gray	1871b	Keystone Canyon	NY, LUND, US
WOODSIA ALPINA (Bolton) S. F. Gray	10130	Slana-Tok highway	H
WOODSIA GLABELLA R. Br.	1877	Keystone Canyon	H
WOODSIA ILVENSIS (L.) R. Br.	1871	Keystone Canyon	H
ZYGADENUS ELEGANS Pursh	2010	Chitina	L,H

[1] Refer to Appendix 2.12 for a list of herbaria acronymns.

Appendix 2.9. Stations in Hultén 1968 which may represent his collections. Voucher data could not be located for these localities.

TAXON	LOCALITY
ARABIS HIRSUTA (L.) Scop. subsp. PYCNOCARPA (M. Hopkins) Hult.	Chitina
ARABIS HOLBOELLII Hornem. var. PINETORUM (Tidestrom) Rollins	Chitina
ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. var. ARUNDINACEA (Trin.) Griseb.	Slana
ARCTAGROSTIS POAEOIDES Nash	Nabesna
ARCTOPHILA FULVA (Trin.) Anderss.	Slana
ARCTOPHILA FULVA (Trin.) Anderss.	Nabesna
ASTRAGALUS EUCOSMUS Robins. subsp. SEALEI (Lepage) Hultén	Nabesna
ASTRAGALUS HARRINGTONII (Rydb.) Hultén	Chitina
ASTRAGALUS NUTZOTINENSIS Rousseau	Nabesna
CALAMAGROSTIS CANADENSIS (Michx.) Beauv. subsp. CANADENSIS	Gakona
CALAMAGROSTIS LAPPONICA (Wahlenb.) Hartm.	Upper Copper River/Nabesna
CALAMAGROSTIS NEGLECTA (Ehrh.) Gaertn., Mey & Schreb.	Upper Copper River/Nabesna
CAREX LACHENALII Schkuhr.	Chistochina
CAREX NARDINA E. Fries	Gakona
CAREX SYNCHNOCEPHALA Carey	Slana
DIPHASIASTRUM COMPLANATUM (L.) Holub	Chitina
ELEOCHARIS ACICULARIS (L.) Roem. & Schult.	Gakona
ELYMUS TRACHYCAULUS (Link) Gould ex Shinners subsp. TRACHYCAULUS	Slana
LYCOPODIUM ANNOTINUM L. subsp. ANNOTINUM	Chitina
MINUARTIA STRICTA (Sw.) Hiern	Nabesna
POA ALPIGENA (E. Fries) Lindm.	Upper Copper
POA ALPINA L.	Chitina
POA ARCTICA R. Br. subsp. LANATA (Scribn. & Merr.) R.J. Soreng	Nabesna
POA ARCTICA R. Br. subsp. LONGICULMIS Hult.	Chistochina
POA GLAUCA M. Vahl.	Slana
POLEMONIUM BOREALE Adams subsp. BOREALE	Copper Center
POTAMOGETON PERFOLIATUS L. subsp. RICHARDSONII (Bennett) Hult.	Gakona
POTENTILLA ARGUTA Pursh subsp. CONVALLARIA (Rydb.) Keck	Slana
RANUNCULUS PYGMAEUS Wahlenb. subsp. PYGMAEUS	Nabesna
RUMEX OCCIDENTALIS Wats.	Slana
SAXIFRAGA NIVALIS L.	Nabesna
SELAGINELLA SELAGINOIDES (L.) Link	Upper Copper River
TRISETUM SPICATUM (L.) Richter subsp. MOLLE (Michx.) Hult.	Slana
TURRITIS GLABRA L.	Slana

Appendix 2.10. Stations mapped in Hultén 1968 lacking specimen data.

TAXON	LOCALITY
ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. var. ARUNDINACEA (Trin.) Griseb.	White River
ARNICA DIVERSIFOLIA Greene	Upper Chitina
ASTRAGALUS EUCOSMUS Robins. subsp. SEALEI (Lepage) Hultén	N Wrangells
ASTRAGALUS NUTZOTINENSIS Rousseau	Upper Chitina
CALAMAGROSTIS CANADENSIS (Michx.) Beauv.	Icy Bay
CAREX FULIGINOSA Schkuhr subsp. MISANDRA (R. Br.) Nyman	Mentastas
CHRYSANTHEMUM ARCTICUM L. subsp. ARCTICUM Hult.	Yakutat
DIAPENSIA LAPPONICA L. subsp. OBOVATA (F. Schm.) Hult.	N Wrangells
JUNIPERUS COMMUNIS L.	Tana R. vicinity
LUPINUS POLYPHYLLUS Lindl.	Yakutat
LYCOPODIUM ANNOTINUM L. subsp. ANNOTINUM	Upper Chitina
LYCOPODIUM LAGOPUS Laestadius ex C. Hartman	Chisana River
MALUS FUSCA (Raf.) Schneid.	Yakutat
MONTIA CHAMISSOI (Ledeb.) Robins. & Fern	Yakutat
MONTIA FONTANA L.	Yakutat
PINUS CONTORTA Dougl. ex Loud. var. CONTORTA	Yakutat
POLEMONIUM BOREALE Adams subsp. BOREALE	Yakutat
POTAMOGETON NATANS L.	Yakutat
POTAMOGETON PECTINATUS L.	Yakutat
POTAMOGETON VAGINATUS Turczaninow	Yakutat
RANUNCULUS PACIFICUS (Hult.) Benson	Yakutat
SALIX PHLEBOPHYLLA Anderss.	Central Wrangells
SAUSSUREA AMERICANA DC.	Yakutat
SAXIFRAGA NIVALIS L.	NE Wrangells

Appendix 2.11. Park collections that were accessioned into the herbarium prior to the floristic inventory.

Year	#/Colls	Collectors	General Localities
1984	414	John Bolivar & Ken Hobson (FIREPRO)	Park-wide
		Carl Acuna (Yakutat seasonal ranger)	Yakutat district
			Central Wrangells & N
		Kathleen Teare, Cynthia R. (Randy) Meyers & Dean W. Taylor	Chugach
		Dale Miquelle (Bison study)	Upper Chitina River
1986	29	Martos & Diane Hoffman (FIREPRO)	Park-wide
1987	169	Katy Beck, Mary Beth Cook & Bruce Haller (FIREPRO)	Coast
			Sudden Stream (Malaspina
			Forelands) and McCarthy
1988	21	K. Beck and M. Cook (environmental Compliance)	Creek
			Gold Hill, Rex Creek,
			McCarthy Creek, Jack
			Creek, Rambler Mine,
1989	49	M. Cook (environmental compliance)	Chitina
			Gold Hill, Rex Creek, Dan
			Creek, Independence Creek
			(Icy Bay), Silver Star
1990	11	M. Cook (environmental compliance)	Pandora (Upper Kotsina)
1991	154	Mike Duffy, Mark Protti (FIREPRO)	Park-wide
			Tanada, Ptarmigan &
			Copper Lakes; Dan Creek,
		M. Cook (Lake Survey, environmental compliance)	Klawasi Warm Spring
		M. Duffy, K. Beck, M. Cook (FIREPRO & Guyot Glacier	
1992	274	successional study)	Park-wide, coastal
			Vic. Chelle Lake, upper
			Sanford River, slopes of
			Sanford, Drop Creek, Upper
1993	24	M. Cook (Caribou exclosure study, environmental compliance)	Klawasi Creek, Gold Hill
		Gary Dodge (raptor surveys)	Bonanza Ridge, Lost Creek

Appendix 2.12. List of herbaria and acronyms used in this document.

ALA - University of Alaska, Fairbanks, Alaska
CAN - Canadian Museum of Nature, Ottawa, Ontario, Canada
GH - Gray Herbarium, Harvard University, Cambridge, Massachusetts.
H - Hultén's Herbarium (now mostly at Swedish Museum of Natural History, Stockholm, Sweden)
ISC – Iowa State University, Ames, Iowa
LCU - Catholic University of America, District of Columbia, Washington
L, LD - Botanical Museum, Lund, Sweden
LECB- Saint Petersburg University, Saint Petersburg, Russia
MICH - University of Michigan, Ann Arbor, Michigan
NY - New York Botanical Garden, New York, New York
PH - Academy of Natural Sciences, Philadelphia, Pennsylvania.
PR - National Museum in Prague, Czech Republic.
QFA - Université Laval, Sainte-Foy, Québec, Canada
RM - University of Wyoming, Laramie, Wyoming.
S - Swedish Museum of Natural History, Stockholm, Sweden
U of Szeged - Hungary
UC - University of California, Berkeley, California
US - Smithsonian Institution, U.S. National Herbarium, Washington, D.C.
WTU - University of Washington, Seattle, Washington

Appendix 3.1. List of species expected to occur in Wrangell-St. Elias National Park & Preserve. Prepared June 2003.

TAXON
ABIES LASIOCARPA (Hook.) Nutt.
ACHNATHERUM NELSONII (Scribn.) Barkworth
ADIANTUM ALEUTICUM (Ruprecht) Paris
AGOSERIS AURANTIACA (Hook.) Greene
AIRA CARYOPHYLLEA L.
ALNUS VIRIDIS (Villars) de Candolle subsp. FRUTICOSA (Ruprecht) Nyman
ALOPECURUS PRATENSIS L.
AMBROSIA CHAMISSONIS (Less.) Greene
AMELANCHIER FLORIDA Lindl.
AMSINCKIA LYCOPOSOIDES Lehm.
AMSINCKIA MENZIESII (Lehm.) Nels. & Macbr.
ANEMONE NARCISSIFLORA L. subsp. ALASKANA Hult.
ANGELICA ARGUTA Nutt.
ANTENNARIA DENSIFOLIA A.E. Porsild
APARGIDIUM BOREALE (Bong.) Torr. & Gray
ARABIDOPSIS SALSUGINEA (Pall.) N. Busch
ARABIS GLABRA (L.) Bernh.
ARABIS HIRSUTA (L.) Scop. subsp. PYCNOCARPA (M. Hopkins) Hult.
ARABIS LYALLII S. Wats.
ARNICA ANGUSTIFOLIA Vahl subsp. TOMENTOSA (J.M. Macoun) Douglas & Ruyle-Douglas
ARNICA CORDIFOLIA Hook.
ARNICA DIVERSIFOLIA Greene
ARNICA LESSINGII Greene subsp. NORBERGII Hult. & Maguire
ARNICA LONCHOPHYLLA Greene
ARTEMISIA DRACUNCULUS L.
ARTEMISIA FURCATA Bieb.
ARTEMISIA RUPESTRIS L. subsp. WOODII
ARTEMISIA TILESII Ledeb. subsp. UNALASCHCENSIS (Bess.) Hult.
ASPLENIUM TRICHOMANES L.
ASPLENIUM TRICHOMANES-RAMOSUM L.
ASTER BRACHYACTIS Blake
ASTER COMMUTATUS (T. & G.) A. Gray
ASTER MODESTUS Lindl. in DC.
ASTER YUKONENSIS Cronquist
ASTRAGALUS AGRESTIS Douglas. ex G. Don
ASTRAGALUS AMERICANUS (Hook.) M.E. Jones
ASTRAGALUS ROBBINSII (Oakes) Gray (Hook.) Barneby
ATHYRIUM ALPESTRE (Hoppe) Clairville var. AMERICANUM Butters
ATRIPLEX GMELINI C.A. Mey
ATRIPLEX PATULA L.
AVENULA HOOKERI (Scribn.) Holub
BETULA NEOALASKANA Sargent
BETULA OCCIDENTALIS Hooker
BLECHNUM SPICANT (L.) Roth
BLYSMOPSIS RUFA (Hudson) Oteng-Yeboah

TAXON
BOLBOSCHOENUS MARITIMUS (L.) Palla subsp. PALUDOSUS (A. Nelson) T. Koyama
BOTRYCHIUM MULTIFIDUM (S.G. Gmelin) Ruprecht
BOTRYCHIUM SPATHULATUM W.H. Wagner
BOTRYCHIUM YAAXUDAKEIT Stensvold & Farrar
BOYKINIA RICHARDSONII (Hook.) Gray
BRASSICA JUNCEA (L.) Czern.
BRASSICA RAPA L.
BROMUS CARINATUS Hook. & Arn.
BROMUS CILIATUS L.
BROMUS COMMUTATUS Schrad.
BROMUS HORDEACEUS L.
BROMUS SECALINUS L.
BROMUS SITCHENSIS Trin
BROMUS TECTORUM L.
CALAMAGROSTIS NUTKAENSIS (Presl) Steud.
CALYPSO BULBOSA (L.) Oakes var. AMERICANA (R.BR.) LUER
CALYPSO BULBOSA (L.) Oakes var. OCCIDENTALIS (HOLZINGER) BOIVIN
CALYPTRIDIUM UMBELLATA Greene
CAPSELLA BURSA-PASTORIS (L.) Medic.
CAREX AQUATILIS Wahlenberg var. DIVES (T. Holm.)
CAREX BONANZENSIS Britt.
CAREX CIRCINNATA C.A. Mey
CAREX DEFLEXA Hornem. var. DEFLEXA
CAREX DEWEYANA Schweinitz var. DEWEYANA
CAREX DURIUSCULA C.A. meyer
CAREX ELEUSINOIDES Turcz.
CAREX FLAVA L.
CAREX GLAREOSA Wahlenb. subsp. GLAREOSA
CAREX GMELINI Hook. & Arn.
CAREX HELEONASTES Ehrh.
CAREX LAPPONICA O. Lang
CAREX LENTICULARIS Michaux var. LIMNOPHILA (T. Holm) Cronquist
CAREX LOLIACEA L.
CAREX MARINA Dewey
CAREX PECKII Howe
CAREX PELLITA Willdenow
CAREX PETASATA Dew.
CAREX PRAEGRACILIS W. Boott
CAREX RARIFLORA (Wahlenberg) Smith
CAREX SABULOSA Turcz.
CAREX SCIRPOIDEA Michx. subsp. STENOCHLAENA
CAREX STIPATA Muhl. var. STIPATA
CAREX SYCHNOCEPHALA Carey
CERASTIUM FISCHERIANUM Ser.
CERASTIUM MAXIMUM L.
CHAMAECYPARIS NOOTKATENSIS (D. Don) Sudworth
CHENOPODIUM ALBUM L.
CHENOPODIUM BERLANDIERI Moq. subsp. ZSCHACKEI (Murr.) Zobel

TAXON
CHENOPODIUM RUBRUM L.
CHENOPODIUM SALINUM Standely
CHIMAPHILA UMBELLATA (L.) Barton subsp. OCCIDENTALIS (Rydb.) Hult.
CHRYSANTHEMUM ARCTICUM L. subsp. ARCTICUM Hult.
CICUTA DOUGLASII (DC.) Coult. & Rose
CIRSIUM FOLIOSUM (Hook.) DC.
CLAYTONIA CHAMISSOI Esch.
CLAYTONIA PERFOLIATA Donn
CLAYTONIA SCAMMANIANA Hult.
COCHLEARIA OFFICINALIS L. subsp. OBLONGIFOLIA (DC.) Hult.
COMANDRA UMBELLATA (L.) Nutt. subsp. PALLIDA (A.DC.) Piehl
CONYZA CANADENSIS (L.) Cronq.
CORALLORRHIZA MACULATA Raf. subsp. MERTENSIANA (Bong.) Calder & TAylor
CORISPERMUM OCHOTENSE Ignatov var. ALASKANUM Mosyakin
CORYDALIS SEMPERVIRENS (L.) Pers.
CRASSULA AQUATICA (L.) Schönl.
CRATAEGUS DOUGLASII Lindl.
CYPRIPEDIUM GUTTATUM Sw.
CYPRIPEDIUM MONTANUM Dougl
CYPRIPEDIUM PARVIFLORUM L.
DACTYLIS GLOMERATA L.
DESCHAMPSIA DANTHONIOIDES (Trin.) Munro
DESCURAINIA PINNATA (Walt.) Britt. subsp. NELSONII (Rydb.) Detling
DESCURAINIA SOPHIA (L.) Prantl
DODECATHEON PULCHELLUM (Raf.) Merr. subsp. ALASKANUM (Hult.) Hult.
DODECATHEON PULCHELLUM (Raf.) Merr. subsp. SUPERBUM (Pennell & Stair) Hult.
DRABA KLUANEI G. Mulligan
DRABA LASIOCARPA R.Br.
DRABA LONCHOCARPA Rydb. var. VESTITA O.E. Schulz
DRABA OGILVIENSIS Hultén
DRABA PAYSONII Macbride
DRABA YUKONENSIS A.E. Porsild
DRACOCEPHALUM PARVIFLORUM Nutt.
DRYAS INTEGRIFOLIA Juz. subsp. CHAMISSONIS (Spreng.) Scoggan
DRYAS INTEGRIFOLIA Juz. subsp. CRENULATA (Juz.) J. Kozhevn
DRYAS INTEGRIFOLIA M. Vahl subsp. SYLVATICA (Hultén) Hultén
ELEOCHARIS ERYTHROPODA Steudel
ELEOCHARIS KAMTSCHATICA (C.A. Mey) Kom.
ELEOCHARIS MACROSTACHYA Britton
ELEOCHARIS MAMILLATA (H. Lindberg) H. Lindgerg subsp. MAMILLATA
ELEOCHARIS NITIDA Fern.
ELEOCHARIS QUINQUEFLORA (F. X. Hartm.) O. Schwarz
ELEOCHARIS UNIGLUMIS (Link) Schult.
ELYMUS GLAUCUS Buckl.
ELYMUS HIRSUTUS Presl
EPILOBIUM ARCTICUM Samuelss.
EPILOBIUM DAVURICUM Fisch. ex Hornem.
EPILOBIUM LEPTOPHYLLUM Raf

TAXON
ERIGERON GLABELLUS Nutt. subsp. PUBESCENS (Hook.) Cronq.
ERIGERON LONCHOPHYLLUS Hook.
ERIGERON PEREGRINUS (Pursh) Greene subsp. CALLIANTHEMUS (Greene) Cronq.
ERIGERON PUMILUS Nutt.
ERIGERON YUKONENSIS Rydb.
ERITRICHIUM SPLENDENS Kearney
EUROTIA LANATA (Pursh) Moq
EURYBIA PYGMAEA (Lindl.) Nelsom
GAILLARDIA ARISTATA Pursh
GALIUM APARINE L.
GALIUM KAMTSCHATICUM Stellar
GENTIANA ALGIDA Pall.
GENTIANA DOUGLASIANA Bong.
GENTIANOPSIS DETONSA (Rottb.) Ma subsp. YUKONENSIS J.M. Gillett
GERANIUM BICKNELLII Britt.
GEUM ALEPPICUM Jacq. subsp. STRICTUM (Ait.) Clausen
GEUM MACROPHYLLUM Willd. subsp. MACROPHYLLUM
GLAUX MARITIMA L.
GLEHNIA LITTORALIS F. Schm. subsp. LEIOCARPA (Math.) Hult.
GLYCERIA GRANDIS S. Wats.
GLYCERIA STRIATA (Lam.) Hitchc. subsp. STRICTA (Scribn.) Hult.
GOODYERA OBLONGIFOLIA Raf.
HESPEROSTIPA COMATA (Trin. & Rupr.) Rupr.
HIERACIUM GRACILE Hook. var. ALASKANUM Zahn
HIPPURIS TETRAPHYLLA L. f.
HUPERZIA MIYOSHIANA (Makino) Ching
HUPERZIA SELAGO (L.) Bernhardi ex Schrank & Martius
HYMENOPHYLLUM WRIGHTII Bosch.
IRIS SETOSA Pall.
ISOETES MARITIMA L. Underwood
ISOETES OCCIDENTALIS L.F. Henderson
ISOETES X TRUNCATA (A.A. Eaton) Clute
JUNCUS ARCTICUS Willd. var. BALTICUS (Wildenow) Trautvetter
JUNCUS ENSIFOLIUS Wikström var ENSIFOLIUS
JUNCUS MACRANDRUS Coville
JUNCUS NODOSUS L.
JUNCUS STYGIUS L. var. AMERICANUS Buchenau
JUNCUS SUPINIFORMIS Englemann
JUNCUS TENUIS Willdenow
JUNCUS TRIGLUMIS L. var. TRIGLUMIS Lange
KALMIA POLIFOLIA Wang.
KOELERIA ASIATICA Domin
KOELERIA MACRANTHA (Ledeb.)
LAPPULA OCCIDENTALIS (Wats.) var. CUPULATA (A. Gray) Higgins
LATHYRUS MARITIMUS L. subsp. MARITIMUS
LATHYRUS PALUSTRIS L. subsp. PILOSUS (Cham.) Hult.
LEMNA TRISULCA L.
LEPIDIUM DENSIFLORUM Schrad.

TAXON
LEWISIA PYGMAEA (Gray) robins.
LEYMUS INNOVATUS (Beal) Pilger
LIMOSELLA AQUATICA L.
LISTERA CAURINA Piper
LUPINUS POLYPHYLLUS Lindl.
LUZULA GROENLANDICA Böcher
LUZULA MULTIFLORA (Ehrhart) Lejeune subsp. KOBAYASII (Satake) Hult.
LUZULA PIPERI (Coville) M.E. Jones
LYSICHITON AMERICANUM Hult. & St. John
LYSIMACHIA THYRSIFLORA L.
MALAXIS MONOPHYLLA (L.) Sw.
MALAXIS PALUDOSA (L.) Sw.
MALUS FUSCA (Raf.) Schneid.
MATRICARIA MATRICARIOIDES (Less.) Porter
MENZIESIA FERRUGINEA J.E. Smith
MERTENSIA PANICULATA G. Don var. ALASKANA (Britt.) Williams
MERTENSIA PANICULATA (Ait.) G. Don var. EASTWOODAE (Macbr.) Hult.
MINUARTIA YUKONENSIS Hult.
MONTIA CHAMISSOI (Ledeb.) Robins. & Fern
MONTIA FONTANA L.
MONTIA PARVIFOLIA Greene
MUHLENBERGIA RICHARDSONIS (Trin.) Rydb.
MYOSOTIS SCORPIOIDES L.
MYRIOPHYLLUM ALTERNIFLORUM DC.
NUPHAR VARIEGATUM Engelm.
OPLOPANAX HORRIDUS (Sm.) Miq
OROBANCHE FASCICULATA Nutt.
OSMORHIZA CHILENSIS Hook. & Arn.
OXYTROPIS SERICEA Nutt. subsp. SPICATA (Hook.) Cody
PEDICULARIS LANGSDORFII Fisch. subsp. LANGSDORFII
PEDICULARIS MACRODONTA Richards
PEDICULARIS PACIFICA (Hult.) Kozh.
PENSTEMON PROCERUS Dougl.
PETASITES FRIGIDUS (L.) Fries var. PALMATUS (Ait.) Cronq.
PETASITES SAGITTATUS (Banks) Gray
PHALARIS ARUNDINACEA L.
PHLEUM PRATENSE L.
PHYLLODOCE EMPETRIFORMIS (Sm.) D. Don
PINUS CONTORTA Dougl. ex Loud.
PIPERIA UNALASCENSIS (Spreng.) Rydb.
PLAGIOBOTHRYS COGNATUS (Greene) Johnston
PLANTAGO MAJOR L.
PLATANTHERA CHORISIANA (Cham.) Rchb.
PLATANTHERA CONVALLARIIFOLIA Fischer ex Lindley
PLATANTHERA HURONENSIS (Nutt.) Lindl.
PLATANTHERA ORBICULATA (Pursh) Lindl.
PLATANTHERA SACCATA (Greene) Hult.
PLATANTHERA STRICTA Lindl.

TAXON
POA ANNUA L.
POA COMPRESSA L.
POA CUSICKII Vasey
POA EMINENS Presl
POA LAXIFLORA Buckl.
POA MACRANTHA Vasey
POA OCCIDENTALIS Vasey
POA SECUNDA subsp. JUNCIFOLIA (Scribn.) Soreng
PODISTERA MACOUNII (Coult. & Rose) Mathias & Const.
POLYGONUM ARENASTRUM Jordal ex Bor.
POLYPODIUM GLYCYRRHIZA D.C. Eaton subsp. OCCIDENTALE (Hook.) Hult.
POLYPODIUM SIBIRICUM Siplivinsky
POLYSTICHUM BRAUNII (Spenn.) Fee
POLYSTICHUM SETIGERUM (C. Presl) C. Presl
POTAMOGETON EPIHYDRUS Rafinesque
POTAMOGETON OBTUSIFOLIUS
POTENTILLA EGEDII Wormsk. subsp. YUKONENSIS (Hult.) Hult.
POTENTILLA ELEGANS Cham. & Schlecht.
POTENTILLA GRACILIS Dougl.
POTENTILLA HIPPIANA Lehm.
POTENTILLA VAHLIANA Lehm.
PRIMULA EXIMIA Greene
PRIMULA INCANA M.E. Jones
PRIMULA MISTASSINICA Michx.
PRUNELLA VULGARIS L. subsp. LANCEOLATA (Carton) Hult.
PSEUDOROEGNERIA SPICATA (Pursh) A. Löve
PUCCINELLIA BOREALIS Swallen
PUCCINELLIA DISTANS (Jacq.) Parl.
PUCCINELLIA HAUPTIANA (Krecz.) Kitagawa
PUCCINELLIA NUTKAENSIS (Presl) Fern & Weath.
PUCCINELLIA NUTTALLIANA (Schult.) Hitchc.
PUCCINELLIA PUMILA (Vasey) Hitchc.
PUCCINELLIA TENUIFLORA (Turcz.) Scribn. & Merr.
RANUNCULUS ACRIS L.
RANUNCULUS AQUATILIS L. var. AQUATILIS
RANUNCULUS PALLASII
RANUNCULUS REPENS L.
RIBES GLANDULOSUM Grauer
RIBES LACUSTRE (Pers.) Poir
RIBES OXYACANTHOIDES L. subsp. OXYACANTHOIDES
ROMANZOFFIA SITCHENSIS Bong.
RORIPPA CURVISILIQUA (Hook.) Bess.
ROSA WOODSII Lindl.
RUMEX ACETOSELLA L. subsp. ACETOSELLA
RUMEX FENESTRATUS Greene
RUMEX LONGIFOLIUS DC.
RUMEX MARITIMUS L. subsp. MARITIMUS
RUMEX SALICIFOLIUS Weinm. var. MEXICANUS (Meisn.) C.L. Hitchc.

TAXON
RUMEX TRANSITORIUS Rech.f.
SAGINA CRASSICAULIS S. Wats.
SAGITTARIA CUNEATA Sheld.
SALICORNIA EUROPAEA L. s. lat.
SALIX ATHABASCENSIS Raup.
SALIX CANDIDA Flügge ex Willd.
SALIX EXIGUA Nuttall subsp. INTERIOR (Rowlee) Cronquist
SALIX INTERIOR Rowlee
SALIX LASIANDRA Benth.
SALIX PEDICELLARIS Pursh
SALIX PLANIFOLIA Pursh subsp. PLANIFOLIA
SANGUISORBA MENZIESII Rydb.
SANGUISORBA OFFICINALIS L.
SAUSSUREA AMERICANA DC.
SAXIFRAGA CALYCINA Sternb. subsp. UNALASCHCENSIS (Sternb) Hult., comb. nov.
SAXIFRAGA NELSONIANA L. subsp. PACIFICA Hult., comb.nov.
SAXIFRAGA RADIATA Small
SCHEUCHZERIA PALUSTRIS L. subsp. AMERICANA (Fern.) Hultén
SCHOENOPLECTUS ACUTUS (Muhlengerg ex Bigelow) A. Löve & Löve var. ACTUS
SCHOENOPLECTUS PUNGENS (Vahl) Palla
SCHOENOPLECTUS TABERNAEMONTANI (G.C. Gmelin) Palla
SCIRPUS MICROCARPUS Presl
SCUTELLARIA GALERICULATA L.
SEDUM LANCEOLATUM Torr.
SENECIO MORESBIENSIS (Calder & Taylor) G.W. Douglas & G. Ruyle-Douglas
SENECIO VULGARIS L.
SILENE DOUGLASII Hook.
SILENE INVOLUCRATA (Cham. & Schlecht.)Bocquet subsp. TENELLA (Tolm.) Bocquet
SINAPIS ARVENSIS L.
SISYRINCHIUM MONTANUM Greene
SOLIDAGO CANADENIS L. var. SALEBROSA (Piper) Jones
SPARGANIUM EMERSUM Rehmann
SPARGANIUM MULTIPEDUNCULATUM (Morong) Rydb.
STELLARIA BOREALIS Bigelow subsp. SITCHANA (Steud.) Piper
STELLARIA DICRANOIDES (Cham. & Schlecht.) Fenzl
STELLARIA HUMIFUSA Rottb.
STELLARIA MEDIA (L.) Vill.
STELLARIA RUSCIFOLIA Pall. subsp. ALEUTICA Hult.
STREPTOPUS ROSEUS Michx. subsp. CURVIPES (Vail) Hult.
STREPTOPUS STREPTOPOIDES (Ledeb.) Frye & Rigg subsp. BREVIPES (Baker) Calder & Taylor
STUCKENIA FILIFORMIS (Persoon) Börner subsp. FILIFORMIS
STUKENIA FILIFORMIS (Persoon) Börner subsp. ALPINA (Blytt) R.R. Haynes
STUKENIA FILIFORMIS subsp. OCCIDENTALIS
SUAEDA CALCEOLIFORMIS (Hook.) Moq.
TARAXACUM ERYTHROSPERMUM Andrz. ex Bess.
TEPHROSERIS YUKONENSIS (A.E.Porsild) Holub
THALICTRUM OCCIDENTALE Gray

TAXON
THLASPI ARVENSE L.
TIARELLA UNIFOLIATA Hook.
TOWNSENDIA HOOKERI Beaman
TRIFOLIUM HYBRIDUM L.
TRIFOLIUM PRATENSE L.
TRIFOLIUM REPENS L.
TRISETUM SPICATUM (L.) Richter subsp. MOLLE (Michx.) Hult.
TURRITIS GLABRA L.
TYPHA LATIFOLIA L.
URTICA DIOICA L. subsp. GRACILIS (Ait.) Selander
URTICA LYALLII S. Wats.
UTRICULARIA OCHROLEUCA R. Hartm.
VACCINIUM CAESPITOSUM Michx. var. PALUDICOLA (Camp) Hult.
VACCINIUM PARVIFOLIUM Sm.
VALERIANA DIOICA L. subsp. SYLVATICA (richards.) F.G. Meyer
VERONICA ARVENSIS L.
VERONICA PEREGRINA L. subsp. XALAPENSIS (HBK.) Penell
VERONICA SCUTELLATA L.
WOODSIA SCOPULINA D.C. Eat subsp. SCOPULINA
XELYHORDEUM MACOUNII (Vasey) Barkworth & Dewey
ZANNICHELLIA PALUSTRIS L.

Appendix 3.2. The amount of existing plant inventory information for regions within Wrangell-St. Elias National Park & Preserve, Alaska. Rare plants are those with an Alaska Natural Heritage Program state rank <= 3.

Regions	Acres	#/Sites	Acres per site	#/Pre-inventory collections	#/New Taxa	#/New Species per Site	#/Rare Plant Localities	Survey Areas/Habitats	Survey Priority
MT. REGIONS									
Nutzotin	847,441	31	27,337	16	50	1.61	26	Rare/endemic habitat in 2 areas	9
Mentasta	122,138	18	6,785	2	30	1.67	22	Rare/endemic habitat	10
N. Wrangells	1,613,873	10	161,397	15	24	2.40	20	High elevation plateaus, scree slopes and river bluffs	6
W. Wrangells	706,301	18	39,239	12	17	0.94	14		
S. Wrangells	682,153	15	45,477	13	16	1.07	24	Alpine slopes between Long & Kuskulana Glaciers	11
N. St. Elias	1,215,056	3	405,019	17	6	2.00	12	Alpine slopes between Chitistone Pass and Anderson Glacier	5
S. St. Elias	1,093,375	2	546,688	1	12	6.00	13	Alpine slopes and nunataks	2
Chugach	1,186,709	32	37,085	16	27	0.84	20	All communities S of Bremner R & between Tebay and Hanagita Peak	8
Granite	669,296	12	55,775	5	27	0.44	18	All communities, eastern half of range	8
Bagley Icefield	993,756	2	466,878	0	6	3.00	2	Nunataks	2
BASIN REGIONS									
White R.	167,923	1	167,923	4	3	3.00	6	Lowlands and bluffs	4
Tanana R.	566,648	23	24,637	10	29	1.26	11	Wetlands	3
Upper Copper R.	435,507	15	29,034	10	31	2.07	5	Wetlands	7
Middle Copper R.	899,986	11	81,817	10	26	2.36	7	Wetlands, bluffs	7
Lower Copper R.	436,121	5	87,224	13	7	1.40	3	Wetlands, bluffs	7
Chitina R.	1,450,548	36	40,293	15	59	1.64	17	Wetlands, bluffs	7
Gulf of Alaska	1,080,231	0	n/a	32	n/a	n/a	0	All communities	1

Appendix 3.3. Description of targeted survey areas and communities from Alaska Central Area Network inventory proposal (Swanson 2000).

Targeted survey areas

1. *Gulf of Alaska Basin between Yakutat and Icy Bays.* This region has one of the highest unsurveyed acreages in the park (1,080,231 acres) and includes the coastal forests, the Malaspina Foreland uplands, coastal nunataks and extensive wetlands between the forested region and uplands. No comprehensive inventories have been conducted in this region. The FIREPRO collections that have been made from this region almost always represent significant range extensions (>200 km) from prior stations. Coastal nunataks that may have been ice free since the Wisconsin glaciation (Samovar Hills, Floral Island and Blossom Hills) and other unnamed hills at the head of the Malaspina Glacier may be refugia for disjuncts, rare or endemic species.

2. *Southern St. Elias Mountains and Bagley Icefield.* These two mountain regions have the highest average acreage by site for the park (545,588 and 466,878 respectively) and the highest average number of new species to the park's flora in the 1994-1997 inventory. One species from this region was new to the state (*Arabis calderi*). A rare Yukon endemic, *Artemisia rupestris* was observed by a Kluane ranger on Mt. Chitina in the park, but has not been verified. This would be a new species to the state if it were verified. This is extremely rugged terrain with numerous nunataks that could have unique communities and species new to the flora. Oral history documents the nunataks in the Bagley Icefield as a travel route to the coast (Russell 1891, deLaguna 1922). We will be seeking additional funding to conduct an interdisciplinary survey of the nunataks for archeological sites, vascular plants and small mammals in coordination with David Hik from the Univeristy of Alberta, Edmonton.

3. *Tanana Lowlands.* There are extensive un-inventoried wetlands in this region which extends up the Chisana River drainage. Only one site was inventoried in this region and it was an upland site in the Carden Hills. The hygric and mesic moisture classes have the highest number of expected species in the interior lowlands.

4. *White River Basin*. Only one site has been surveyed in the White River basin an area of 167,923 acres which ranked third in average number of new species to the park in the 1994-1997 survey. River bluffs with steppe communities may have Alaska-Yukon endemic species new to the flora such as *Townsendia hookeri* and *Penstemon procerus*.

5. *Northern St. Elias Mountains between Chitistone Pass and Anderson Glacier.* This is extremely rugged inaccessible terrain that has only had three survey sites for an average of 405,019 acres, third highest for the mountain ranges in the park. Alpine species comprise 16% of the total expected species for the interior, and these are primarily in the xeric and mesic moisture classes.

6. *Northern Wrangells.* High elevation plateaus, scree slopes and river bluffs in this region have been very productive for new, rare species and major disjuncts in our previous inventory (i.e., *Erysimum asperum* var. *angustatum*, *Phlox hoodii*, *Colpodium vahlianum* and *Cerastium regelii*). This region ranked fourth in the average number of new species by region, and it has the fourth highest average acreage by site (161,387 acres).

7. *Wetlands and uplands in the Copper and Chitina River basins.* Wetlands have been poorly surveyed throughout the park. The highest absolute number of species new to the park (59) was from the Chitina River basin, one of these being new to the state (*Tricophorum pumilum* var. *rollandii*). The uplands on the northwest slopes of Mt Sanford bordering pre-historic Lake Ahtna may have been ice free during the late Wisconsin glaciation and should be surveyed for endemics and disjuncts.

8. *Chugach Mountains and Granite Range***.** Only a few sites south of the Bremner River and between Tebay Lakes and Hanagita Peak have been surveyed. Also, five of the nine species new to the state were from the Granite Range and Chugach Mountains (*Arabis lemmonii, Arabis codyi, Arabis drepanoloba, Carex petasata* and *Festuca minutiflora*).

9. *Nutzotin Mountains.* Only two sites have been inventoried in the area between the Chisana and Nabesna River and north of Cooper Pass in the western Nutzotin Mountains and only four sites between upper Baultoff Creek, the Chisana River and Nelson Creek in the eastern Nutzotins. Ten of the 24 Alaska-Yukon endemics and 29 of the 72 rare plant species occur in the Nutzotin Mountains.

10. *Mentasta Mountains.* Although our survey effort for this region has been high considering the acreage (18 sites for 122,138 acres), this region continues to produce species new to the park as well as rare species to the state, one of these is a USFWS Species of Concern (*Cryptantha shackletteana*). Twenty-six of the 72 rare plant species occur in the Mentasta Mountains, four of these being unique to this region.

11. *Southwest slopes of Wrangell Mountains between Long & Kuskulana Glaciers:* There are two rare species known only in the park from two sites adjacent to this area (*Thlaspi arctium* and *Douglasia alaskana*) indicating that there may be a unique floristic influence in this region that we have not surveyed.

Targeted survey communities.

1. *Wetlands & aquatics:* Many of the new species to the park came from these communities that are still poorly surveyed. Wetlands to survey include both freshwater and tidally influenced communities such as swamps, bogs, fens, marshes, coastal shores, lakes and ponds.

2. *Rare plant habitat:* Thirty-six of the species new to the park's flora (21%) were rare plants. Results from the 1994-1997 inventory of selected areas within the park indicate the following trends in rare plant habitat: 82% of the 423 rare plant collections were made in the alpine vegetation zone; 79% were made over 4000 ft elevation (35% between 5000 and 6000 ft); 42% were in the barren vegetation type and 41% were in the graminoid-forb herbaceous vegetation type; 75% were in volcanic or calcareous substrates; 57% were in alpine herb-talus slope communities; 60% were in a xeric moisture regime; 45% were on a southerly aspect and 60% were on 20 - 40 degree slopes. Most of these trends are not reflected in the selection of site, i.e., similar ratios of sites by parameter.

3. *Other azonal communities:* steppe (along river corridors), high elevation plateaus, scree slopes, unusual lithologies (calcareous, ultramafic zones) and unusual landforms (nunataks, sand dunes, monadnocks and springs).

Appendix 3.4. Geofererences for potential 2003 inventory survey sites (Mercator Projection NAD 1927).

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
1	Edge Creek 1	Non-coastal upland	-141.8403000	62.3157400
2	Edge Creek 2	Non-coastal upland	-141.9895000	62.3421000
3	Edge Creek 3	Non-coastal upland	-141.9249000	62.2883500
4	Mt. Gordon	Non-coastal upland	-143.1297800	62.1504700
5	Sheep Creek 1	Non-coastal upland	-141.7507300	62.2738800
6	Sheep Creek 2	Non-coastal upland	-141.7184300	62.2622300
7	Sheep Creek 3	Non-coastal upland	-141.7155100	62.2390900
8	Sheep Creek 4	Non-coastal upland	-141.6864800	62.2352000
9	Bruin Creek 1	Non-coastal upland	-141.6625500	62.3007300
10	Bruin Creek 2	Non-coastal upland	-141.5934300	62.2836100
11	Snag Creek	Non-coastal upland	-141.5562200	62.1811100
12	East Snag Creek 1	Non-coastal upland	-141.4380900	62.2260600
13	Crescent Creek 1	Non-coastal upland	-141.3953600	62.1694500
14	East Snag Creek 2	Non-coastal upland	-141.4254000	62.1789700
15	East Snag Creek 3	Non-coastal upland	-141.2975400	62.1640800
16	Wellesley Mountain	Non-coastal upland	-141.3135900	62.4335900
17	Copper Creek	Non-coastal upland	-142.6475400	62.3661200
18	Bond Creek	Non-coastal upland	-142.7627100	62.2570600
19	William Creek	Non-coastal upland	-142.4198900	62.2148600
20	Cross Creek Plateau	Non-coastal upland	-142.3266000	62.1650400
21	Euchre Mountain	Non-coastal upland	-142.2056200	62.0800100
22	Nabesna Glacier 1	Non-coastal upland	-143.1365400	61.8600600
23	Nabesna Glacier 2	Non-coastal upland	-143.2285700	61.9068800
24	Nabesna Glacier 3	Non-coastal upland	-142.8582500	62.0130800
25	Middle Fork Ridge	Non-coastal upland	-141.9104800	61.7665600
26	Bow Pass Ridge	Non-coastal upland	-142.1167700	61.9395400
27	Frederika Mountain	Non-coastal upland	-142.1653800	61.7514700
28	Shelter Valley	Non-coastal upland	-142.4406400	61.7639800
29	Chimney Mountain	Non-coastal upland	-142.5011800	61.6981500
30	East Russell Glacier	Non-coastal upland	-141.7524800	61.5551400
31	Klutlan Glaicer	Non-coastal upland	-141.1472300	61.4632700
32	Mt. George	Non-coastal upland	-141.1164200	61.0532200
33	Barnard Glacier	Non-coastal upland	-141.6541900	61.1662800
34	Hawkins Glacier	Non-coastal upland	-141.8619000	61.2493300
35	Erickson Creek Plate	Non-coastal upland	-142.1299000	61.1790100
36	Canyon Creek	Non-coastal upland	-142.2499400	61.3322400
37	Upper Young Creek	Non-coastal upland	-142.3064400	61.2597500
38	Pyrmaid Peak Valley	Non-coastal upland	-142.3727800	61.2923100
39	Chititu Ridge	Non-coastal upland	-142.5932400	61.2656900
40	Gilahina Butte	Non-coastal upland	-143.8256700	61.4420100
41	Chokosna Mountain	Non-coastal upland	-143.5394500	61.4866600
42	Scotty Peak	Non-coastal upland	-143.9825800	61.7724200
43	Granite Peak	Non-coastal upland	-143.8245500	61.7551900
44	Fohlin Creek	Non-coastal upland	-143.2975000	61.5178500
45	Pyramid Peak	Non-coastal upland	-143.7322500	61.6895200
46	East Fork Chetaslina	Non-coastal upland	-144.2460400	61.8568600
47	Baldwin Glacer	Non-coastal upland	-141.2287700	60.8570500
48	Unnamed Creek - Loga	Non-coastal upland	-141.4035300	60.8866100
49	Quintina Sella Glaci	Non-coastal upland	-141.1647800	60.5463000
50	East Juniper Island	Non-coastal upland	-141.8605800	60.5596300

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
51	Nunatak 9020	Non-coastal upland	-141.6236200	60.5321500
51	Bagley Nuntak	Non-coastal upland	-142.7088700	60.6012300
52	Coast 1	Coastal	-141.4367000	60.1411500
53	Coast 2	Coastal	-141.4533600	60.1484700
54	Coast 3	Coastal	-141.4319800	60.1546300
55	Coast 4	Coastal	-141.3489600	60.0915300
56	Coast 5	Coastal	-141.3107800	60.0965500
57	Coast 6	Coastal	-141.3008400	60.1100100
58	Coast 7	Coastal	-141.2733300	60.1034600
59	Coast 8	Coastal	-141.2667600	60.1479000
60	Coast 9	Coastal	-141.3285100	60.1591900
61	Coast 10	Coastal	-141.1987800	60.1656600
62	Coast 11	Coastal	-141.1961100	60.1805600
63	Coast 12	Coastal	-141.1799000	60.1978100
64	Coast 13	Coastal	-141.1477500	60.2140000
65	Coast 14	Coastal	-141.1496100	60.2018400
66	Coast 15	Coastal	-141.1353300	60.2209900
67	Coast 16	Coastal	-141.0591300	60.2233600
68	Coast 17	Coastal	-141.1117700	60.1744700
69	Coast 18	Coastal	-141.1514400	60.1086600
70	Coast 19	Coastal	-141.0686700	60.1294500
71	Coast 20	Coastal	-141.1038900	60.1551200
72	Coast 21	Coastal	-141.0888300	60.1563500
73	Coast 22	Coastal	-141.0037400	60.1442400
74	Coast 23	Coastal	-140.9952900	60.1456100
75	Coast 24	Coastal	-141.0187600	60.1579400
76	Coast 25	Coastal	-140.9092400	60.1745500
77	Coast 26	Coastal	-140.9363100	60.2147600
78	Coast 27	Coastal	-140.8874100	60.2144600
79	Coast 28	Coastal	-140.9917000	60.1841300
80	Coast 29	Coastal	-140.8132100	60.1327400
81	Coast 30	Coastal	-140.8141800	60.1242800
82	Coast 31	Coastal	-140.7728800	60.1201500
83	Coast 32	Coastal	-140.7509700	60.1254200
84	Coast 33	Coastal	-140.7086200	60.1135900
85	Coast 34	Coastal	-140.7033100	60.1295800
86	Coast 35	Coastal	-140.6776900	60.1317700
87	Coast 36	Coastal	-140.7015600	60.1440800
88	Coast 37	Coastal	-140.5854900	60.1574600
89	Coast 38	Coastal	-140.5920400	60.1380500
90	Coast 39	Coastal	-140.4913500	60.1078500
91	Coast 40	Coastal	-140.3967500	60.0534500
92	Coast 41	Coastal	-140.4061600	60.0616400
93	Coast 42	Coastal	-140.3695000	60.1107700
94	Coast 43	Coastal	-140.3561000	60.0497400
95	Coast 44	Coastal	-140.3128800	60.0392600
96	Coast 45	Coastal	-140.2735000	60.0501100
97	Coast 46	Coastal	-140.2933000	60.0663800
98	Coast 47	Coastal	-140.2350400	60.0494100
99	Coast 48	Coastal	-140.2124600	60.0921500
100	Coast 49	Coastal	-140.1667100	60.0643200
101	Coast 50	Coastal	-140.1446600	60.0395800

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
102	Coast 51	Coastal	-140.1263000	60.0264900
103	Coast 52	Coastal	-140.1313800	60.0157500
104	Coast 53	Coastal	-140.1135700	60.0060300
105	Coast 54	Coastal	-140.1003100	59.9868500
106	Coast 55	Coastal	-140.0724500	59.9926100
107	Coast 56	Coastal	-140.1444500	59.9798600
108	Coast 57	Coastal	-139.9962000	60.0534400
109	Coast 58	Coastal	-139.9255300	60.0374500
110	Coast 59	Coastal	-139.9036800	59.9745100
111	Coast 60	Coastal	-139.9159700	59.9683500
112	Coast 61	Coastal	-139.9466500	59.9829100
113	Coast 62	Coastal	-139.9425400	59.9992800
114	Coast 63	Coastal	-139.9143900	60.0090200
115	Coast 64	Coastal	-140.0025600	59.9773500
116	Coast 65	Coastal	-139.9788700	59.9550800
117	Coast 66	Coastal	-140.0341600	59.9514000
118	Coast 67	Coastal	-140.0197700	59.9453300
119	Coast 68	Coastal	-140.0273200	59.9438000
120	Coast 69	Coastal	-140.0544000	59.9449600
121	Coast 70	Coastal	-140.0076700	59.9402400
122	Coast 71	Coastal	-139.8806500	60.0241800
123	Coast 72	Coastal	-139.8510500	60.0076300
124	Coast 73	Coastal	-139.8312600	59.9726200
125	Coast 74	Coastal	-139.8503100	59.9532000
126	Coast 75	Coastal	-139.7780000	59.9522600
127	Coast 76	Coastal	-139.7536600	60.0703900
128	Coast 77	Coastal	-139.6562800	60.0471800
129	Coast 78	Coastal	-139.6723800	60.0986500
130	Coast 79	Coastal	-139.6267400	60.0686400
131	Coast 80	Coastal	-139.6012400	60.0368800
132	Coast 81	Coastal	-139.5809600	60.0368700
133	Coast 82	Coastal	-139.5570500	60.0400200
134	Coast 83	Coastal	-139.5753700	60.0500100
135	Coast 84	Coastal	-139.5439400	60.0500000
136	Coast 85	Coastal	-139.5719000	60.0845100
137	Coast 86	Coastal	-139.5487100	60.0854000
138	Coast 87	Coastal	-139.5122200	60.0606400
139	Coast 88	Coastal	-139.4944600	60.0826400
140	Coast 89	Coastal	-139.4222300	60.1021900
141	Coast 90	Coastal	-139.3781000	60.0802200
142	Coast 91	Coastal	-139.3424800	60.0800700
143	Coast 92	Coastal	-139.3516800	60.0131400
144	Coast 93	Coastal	-139.3169800	60.0111100
145	Coast 94	Coastal	-139.2129500	60.0217000
146	Coast 95	Coastal	-139.6109700	59.9876000
147	Coast 96	Coastal	-139.6108500	59.9772700
148	Coast 97	Coastal	-139.6101900	59.9636900
149	Coast 98	Coastal	-139.6205600	59.9497200
150	Coast 99	Coastal	-139.6355600	59.9442400
151	Coast 100	Coastal	-139.6619400	59.9347300
152	Coast 101	Coastal	-139.6683700	59.9458700
153	Coast 102	Coastal	-139.6510900	59.9380900

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
154	Coast 103	Coastal	-139.6757300	59.9437200
155	Coast 104	Coastal	-139.6728900	59.9322400
156	Coast 105	Coastal	-139.7010400	59.9321200
157	Coast 106	Coastal	-139.6992300	59.9429700
158	Coast 107	Coastal	-139.7155900	59.9253600
159	Coast 108	Coastal	-139.7355400	59.9220000
160	Coast 109	Coastal	-139.7379100	59.9379700
161	Coast 110	Coastal	-139.7286900	59.9111900
162	Coast 111	Coastal	-139.7593200	59.9222500
163	Coast 112	Coastal	-139.7863500	59.9258000
164	Coast 113	Coastal	-139.8150700	59.9311100
165	Coast 114	Coastal	-139.8063600	59.9030500
166	Coast 115	Coastal	-139.7958700	59.9033900
167	Coast 116	Coastal	-139.7854900	59.8950200
168	Coast 117	Coastal	-139.7632200	59.8840200
169	Coast 118	Coastal	-139.7495000	59.8934500
170	Coast 119	Coastal	-139.8736300	59.9125200
171	Coast 120	Coastal	-139.7846900	59.8680600
172	Coast 121	Coastal	-139.8026200	59.8517200
173	Coast 122	Coastal	-139.8254200	59.8529600
174	Coast 123	Coastal	-139.8619900	59.8678300
175	Coast 124	Coastal	-139.9390100	59.9001600
176	Coast 125	Coastal	-139.9232600	59.9241100
177	Coast 126	Coastal	-139.9234000	59.9323400
178	Coast 127	Coastal	-139.9106600	59.8809300
179	Coast 128	Coastal	-139.9620700	59.8820200
180	Coast 129	Coastal	-140.0140100	59.8629200
181	Coast 130	Coastal	-140.0355400	59.8723300
182	Coast 131	Coastal	-140.0600800	59.9201900
183	Coast 132	Coastal	-140.1522400	59.8491600
184	Coast 133	Coastal	-140.0879600	59.8623300
185	Coast 134	Coastal	-140.0367300	59.8500200
186	Coast 135	Coastal	-139.8193500	59.8296000
187	Coast 136	Coastal	-139.7906900	59.8322600
188	Coast 137	Coastal	-139.8639600	59.8087900
189	Coast 138	Coastal	-139.8675400	59.8254900
190	Coast 139	Coastal	-139.8458100	59.8444900
191	Coast 140	Coastal	-139.9526900	59.8152800
192	Coast 141	Coastal	-139.9843100	59.8239400
193	Coast 142	Coastal	-139.9801700	59.8307300
194	Coast 143	Coastal	-139.9041200	59.8141000
195	Coast 144	Coastal	-139.9009200	59.8061500
196	Coast 145	Coastal	-139.8901600	59.8026600
197	Coast 146	Coastal	-139.9148600	59.7994300
198	Coast 147	Coastal	-139.9402500	59.8390900
199	Coast 148	Coastal	-140.0099900	59.7748100
200	Coast 149	Coastal	-140.0229300	59.7726400
201	Coast 150	Coastal	-140.0291000	59.7828600
202	Coast 151	Coastal	-140.0564800	59.7876300
203	Coast 152	Coastal	-140.0432000	59.7957700
204	Coast 153	Coastal	-140.0945100	59.7546500
205	Coast 154	Coastal	-140.1446400	59.7455100

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
206	Coast 155	Coastal	-140.1503100	59.7604500
207	Coast 156	Coastal	-140.0975500	59.7844000
208	Coast 157	Coastal	-140.1434300	59.7969900
209	Coast 158	Coastal	-140.1672900	59.7399400
210	Coast 159	Coastal	-140.1828500	59.7390100
211	Coast 160	Coastal	-140.1909600	59.7464900
212	Coast 161	Coastal	-140.3059800	59.7715800
213	Coast 162	Coastal	-140.2488000	59.7759900
214	Coast 163	Coastal	-140.2552100	59.7998300
215	Coast 164	Coastal	-140.3683500	59.7763800
216	Coast 165	Coastal	-140.2141600	59.7233200
217	Coast 166	Coastal	-140.1934000	59.7261600
218	Coast 167	Coastal	-140.2472700	59.7481400
219	Coast 168	Coastal	-140.2098200	59.7493400
220	Coast 169	Coastal	-140.2782400	59.7109600
221	Coast 170	Coastal	-140.2470000	59.7062000
222	Coast 171	Coastal	-140.4126700	59.7007600
223	Coast 172	Coastal	-140.3738900	59.6983100
224	Coast 173	Coastal	-140.3381700	59.6978800
225	Coast 174	Coastal	-140.3208000	59.7290200
226	Coast 175	Coastal	-140.3617200	59.7352600
227	Coast 176	Coastal	-140.4148700	59.7373700
228	Coast 177	Coastal	-140.3318900	59.7505200
229	Coast 178	Coastal	-140.4437100	59.7326500
230	Coast 179	Coastal	-140.4734100	59.7103800
231	Coast 180	Coastal	-140.4532400	59.7036300
232	Coast 181	Coastal	-140.5090200	59.7092800
233	Coast 182	Coastal	-140.5188100	59.7068700
234	Coast 183	Coastal	-140.5656300	59.7099800
235	Coast 184	Coastal	-140.7867900	59.7468400
236	Coast 185	Coastal	-140.7920000	59.7296200
237	Coast 186	Coastal	-140.8420200	59.7339300
238	Coast 187	Coastal	-140.8301100	59.7532800
239	Coast 188	Coastal	-140.9882000	59.7739800
240	Coast 189	Coastal	-140.8852400	59.7687300
241	Coast 190	Coastal	-140.9260100	59.7553200
242	Coast 191	Coastal	-140.9613400	59.7825600
243	Coast 192	Coastal	-140.9490000	59.7662900
244	Coast 193	Coastal	-140.9925400	59.7808900
245	Coast 194	Coastal	-140.9625900	59.7732700
246	Coast 195	Coastal	-140.9799200	59.7893000
247	Coast 196	Coastal	-140.9508700	59.7886100
248	Coast 197	Coastal	-140.9482600	59.8013100
249	Coast 198	Coastal	-140.9566800	59.8274600
250	Coast 199	Coastal	-140.9921500	59.8367300
251	Coast 200	Coastal	-140.9938800	59.8638000
252	Coast 201	Coastal	-141.0284400	59.9144000
253	Coast 202	Coastal	-140.9756600	59.8886500
254	Wetland 1	Wetland	-144.4175360	61.7178700
255	Wetland 2	Wetland	-144.4014146	61.7066400
256	Wetland 3	Wetland	-144.3786240	61.7037400
257	Wetland 4	Wetland	-144.3373909	61.7378200

SITE#	SITE_NAME	TYPE	X_COORD	Y_COORD
258	Wetland 5	Wetland	-144.0072228	61.4309200
259	Wetland 6	Wetland	-143.8758096	61.4486500
260	Wetland 7	Wetland	-143.8591024	61.4140400
261	Wetland 8	Wetland	-143.9247156	61.4243500
262	Wetland 9	Wetland	-143.8529586	61.4891700
263	Wetland 10	Wetland	-143.7349475	61.4104100
264	Wetland 11	Wetland	-143.6832895	61.3912100
265	Wetland 12	Wetland	-143.7433343	61.3962700
266	Wetland 13	Wetland	-143.6651222	61.3655500
267	Wetland 14	Wetland	-143.5903755	61.3700800
268	Wetland 15	Wetland	-143.6545078	61.3531200
269	Wetland 16	Wetland	-143.9437802	61.5202200
270	Wetland 17	Wetland	-143.8938224	61.5016900
271	Wetland 18	Wetland	-145.4562746	62.1481200
272	Wetland 19	Wetland	-144.7428026	61.8024600
273	Wetland 20	Wetland	-144.7130867	61.8171500
274	Wetland 21	Wetland	-144.6709740	61.8320400
275	Wetland 22	Wetland	-144.8583979	61.9279500
276	Wetland 23	Wetland	-144.8850433	61.9483600
277	Wetland 24	Wetland	-145.0788671	62.3600900
278	Wetland 25	Wetland	-145.0280181	62.3536900
279	Wetland 26	Wetland	-145.0489444	62.2153800
280	Wetland 27	Wetland	-144.9697613	62.2329700
281	Wetland 28	Wetland	-144.7407452	62.4877000
282	Wetland 29	Wetland	-144.4515090	62.5057400
283	Wetland 30	Wetland	-144.5076603	62.5999200
284	Wetland 31	Wetland	-144.1812917	62.6391600
285	Wetland 32	Wetland	-144.1122026	62.6441300
286	Wetland 33	Wetland	-144.0277347	62.6333100
287	Wetland 34	Wetland	-143.9263900	62.6500800
288	Wetland 35	Wetland	-143.8785463	62.5570200
289	Tanana Lowlands 1	Tanana Lowlands	-141.7018032	61.7420855
290	Tanana Lowlands 2	Tanana Lowlands	-141.4104211	61.7636065
291	Tanana Lowlands 3	Tanana Lowlands	-142.1569965	62.4941007
292	Tanana Lowlands 4	Tanana Lowlands	-141.7372687	62.4881389
293	Tanana Lowlands 5	Tanana Lowlands	-141.6201687	62.4931474
294	Tanana Lowlands 6	Tanana Lowlands	-141.7522783	62.4025507
295	Tanana Lowlands 7	Tanana Lowlands	-141.8976008	62.4119498
296	Tanana Lowlands 8	Tanana Lowlands	-141.6572137	62.3784734
297	Tanana Lowlands 9	Tanana Lowlands	-141.3784784	62.4379453
298	Tanana Lowlands 10	Tanana Lowlands	-141.5143593	62.4786407
299	Tanana Lowlands 11	Tanana Lowlands	-141.4839438	62.4291025
300	Tanana Lowlands 12	Tanana Lowlands	-141.4177424	62.3121183
301	Tanana Lowlands 13	Tanana Lowlands	-141.4804200	62.2791063
302	Tanana Lowlands 14	Tanana Lowlands	-141.2183002	62.2768858
303	Tanana Lowlands 15	Tanana Lowlands	-141.2580206	62.2834887
304	Tanana Lowlands 16	Tanana Lowlands	-141.1312674	62.3318161
305	Tanana Lowlands 17	Tanana Lowlands	-141.2900378	62.2772866
306	Tanana Lowlands 18	Tanana Lowlands	-141.1185069	62.2311154
307	Tanana Lowlands 19	Tanana Lowlands	-141.3937994	62.2649583

Appendix 3.5. Collection database structure.

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
WRST Collections Database									
	Code	Text		RANGEL	6 to 8 letter acronymn, linked to taxon database	Taxon			
	Taxon	Calculation					X	X	X
X	Coll_fst1	Text		Carl	Collector #1, first name				
X	Coll_lst1	Text		Roland	Collector #1, last name				
X	Coll_fst2	Text		Mary Beth	Collector #2, first name				
X	Coll_lst2	Text		Cook	Collector #2, last name				
X	Coll_fst3	Text		Jennifer	Collector #3, first name				
X	Coll_lst3	Text		Allen	Collector #3, last name				
X	Coll_nmbr	Numeric		2003-096	Collection number		X	X	X
X	Coll_month	Numeric		6	Collection month				
X	Coll_day	Numeric		3	Collection day				
X	Coll_year	Numeric		2003	Collection year				
	Acc_no	Numeric		25	Park accession number				
	Cat_no	Numeric		5000	Park catalog number				
	No_sheets	Numeric		2	Number of sheet				
	ALA_VER	Y,N		Y	To ala for verification				
X	Herb_depos	Text		WRST	Herbarium of deposition		X		
X	cf	List	cf.	cf.	genus uncertain				
X	Genus	Lookup		Ranunculus	If using codes, the fields for the scientific name will be auto-filled	Taxon			
X	cf1	List	cf.						
X	Species	Lookup				Taxon			
X	s_lat	List	s. lat.		sensu lat.				
X	author	Lookup		Karel. & Kiril		Taxon			
X	v_s1	Lookup				Taxon			
X	vname1	Lookup				Taxon			
X	vauth1	Lookup				Taxon			
X	v_s2	Lookup				Taxon			
X	vname2	Lookup				Taxon			

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
X	vauth2	Lookup				Taxon			
X	Park	Text		WRST	park of collection, acronymn		X	X	X
	Site_no	Text		2003-02	site number, linked to site file	Site			
X	Locality	Lookup		Towhead Mt.	if using site numbers and linked database, site database will be autofilled with site number	Site	X	X	X
X	Spec_loc	Lookup		bluff at confluence of Chitina and Tana Rivers		Site	X	X	X
X	Quad	Lookup		McCarthy		Site	X	X	X
X	Quad_no	Lookup		B5		Site	X	X	X
X	Township	Lookup		T5N		Site	X	X	X
X	Range	Lookup		R6E		Site	X	X	X
X	Quarter1	Lookup		NE4		Site	X	X	X
X	Quarter2	Lookup		SE4		Site	X	X	X
X	Sec	Lookup		January 5, 1900		Site	X	X	X
X	Y_deg_coll	Numeric		March 2, 1900	Latitude degrees of collection				
X	Y_dmin_coll	Numeric		January 31, 1900	Latitude decimal minutes of collection				
X	X_deg	Numeric		May 20, 1900	Longitude degress of collection				
X	X_dmin_coll	Numeric		January 21, 1900	Longitude decimal minutes of collection				
X	Error	Numeric		January 10, 1900	GPS read-out of error				
X	Error_units	Text		m	units for GPS error				
	Latitude	Calculation		62 21 31.25 N	Latitude, deg min dec. sec				X
	Longitude	Calculation		141 15 21.23 W	Longitude, deg min dec. sec				
X	Datum	List	NAD27/NAS-D or NAD83/WGS84	NAD 27	Datum used to record gps		X	X	

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
X	Precision	List	0.25 mi radius (400 m); 1 mi radius (2 km); 5 mi radius (8 km); 5-15 mi radius (8-24 km); > 15 mi radius (24 km)	2 km radius	Precision of data		X	X	
	Latdecdeg	Calculation			Latitude decimal degrees for Arcview		X		
	Londecdeg	Calculation			Longitude decimal degrees for Arcview		X		
	Latdecmin	Calculation			Latitude decimal minutes				
	Londecmin	Calculation			Longitude decimal minutes				
X	Habitat	Text		Scree slope	Brief description of habitat		X	X	X
X	Assoc_spec	Text		Synthyris borealis, Polemonium boreale	Dominate associates, no codes		X	X	
X	Descr	Text			Description of phenology, flower color, etc.		x	x	x
X	Viereck	Text		alpine herb talus slope	Viereck vegetation classifcation to level three or four				
X	Lithology	List	Granite, greenstone, limestone, marble, non date, other, calcareous, saline, sedimentary, serpentine, surficial deposits, ultramafic, unconsolidated deposits, volcanic	sedimentary	Lithology of collection site if known				

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
X	Land_pos	List	alpine, subalpine, montane, lowland	subalpine	Landscape position of collection				
X	Moisture	List	xeric, mesic, hydric, hygric	xeric	Moisture of collection site				
X	Aspect	Numeric		June 28, 1900	aspect in degrees		x	x	x
X	Slope	Numeric		February 4, 1900	slope in degrees		x	x	x
X	Elevation	Numeric		November 4, 1906	elevation		x	x	x
X	Elev_unit	List	ft, m	elevation_unit	unit of elevation		x	x	x
X	Daub_class	List	1 (0-5), 2 (5-25_, 3 (25-50), 4 (50-75), 5 (75-95), 6 (95-100)	January 1, 1900	Daubenmire cover class				
X	Freq_class	List	1 (1 individual, solitary), 2 (<5 individuals, rare, few), 3 (5-25, occassional, scattered, patchy), 4 (25-100, numerous), 5 (>100, abundant)	January 3, 1900	Frequency class for rare species				
X	Pop_size	Numeric		January 10, 1900	For rare species, species of concern or exotics, estimate the number of individuals				
X	Pop_area	Text		10 sq m	For rare species, species of concern or exotics, the area over which the estimate was made				
X	det_ver	List	det., conf.	conf.	Determined or confirmed, other than collector				
X	det_first	Text		Carolyn	First name of determiner				
X	det_last	Text		Parker	Last name of determiner				
X	det_herb	Text		ALA	Herbarium associated with				

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
					specialist				
X	det_date	Text		March 2003	Date of determination, Month and year				
	det_hist1	Text			Previous determination, name, determiner and year				
	det_hist2	Text			Previous determination, name, determiner and year				
	det_hist3	Text			Previous determination, name, determiner and year				
	det_hist4	Text			Previous determination, name, determiner and year				
X	Project	Text		FIREPRO	Project associated with collection				
NPSpecies Database Fields									
	EXP_NPS	List	Y,N		Whether or not to export to NPSpecies				
	Herb_depos	Text		WRST	Herbarium of deposition		x		
	Date	Calculation		July 25, 1994					
	Collectors	Calculation			collectors listed, last name first		X		
	coll_nmbr	text							
	spec_ed2	Calculation		ACC_NMBR: WRST-60/CAT_NMBR: WRST-2378	accession number and catalog number		X		
	Location	Calculation		Nabesna A5 Quad: T4N R10E NW4 NW4 Sec 13. Cone Ridge, volcanic plateau between Jacksina River and Mesa Creek, Wrangell Mts.	quad, quad_no, TRS, locality, spec_loc		X		
	Habitat	Text		Common in basalt tuff in moist bare organic soil			X		

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
	Latdecdeg	Calculation							
	Londecdeg	Calculation							
	datum	List							
	precision	List							
	elevation	Numeric							
	elev_unit	List							
	comments	Calculation			Data that doesn't fit elsewhere was lumped into this field. Fields: in_ park, det, det_hits, research notes, curation notes, reference, project name, site, associated species, descr.		X		
ANCI+ Regristration Layout Fields									
	EXP_ANCI	List			Export to ANCI+				
	Ctrl_prop	List						REQ	
	Class1	Lookup				Taxon		REQ	
	Kingdom (Class 2)	Lookup				Taxon		REQ	
	Division (Class 3)	Lookup				Taxon		REQ	
	Family (Class 4)	Lookup				Taxon		REQ	
	Sci_name	Lookup				Taxon		REQ	
	Com_name	Lookup				Taxon			
	Cat_nmbr	Calculation						REQ	
	Acc_nmbr	Calculation						REQ	
	Location	Calculation						REQ	
	Obj_status	List						REQ	
	Satus_date	List						REQ	
	Item_cnt	List						REQ	
	Storage_unit	List						REQ	
	Condition	List						REQ	
	Con_prop	List						REQ	
ANCI+ Catalog Layout Fields									
	Collector	Calculation						REQ	
	Coll_nmbr	Text						REQ	

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
	coll_date	Calculation						REQ	
	Ident_by	Calculation						REQ	
	Cataloger	Text						REQ	
	Catalog _date	Date							
ANCI+ Collection Site Layout Fields									
	Park	Text						REQ	
	Locality	Text						REQ	
	y	Calculation		Nabesna A1	Quad & quad_no			REQ	
	State	Text						REQ	
	TRS	Calculation						REQ	
	Lat_lng	Calculation						REQ	
	Elevation	Calculation						REQ	
ANCI+ Biology Layout Fields									
	Habitat	Text						REQ	
	Slope	Calculation							
	Aspect	Calculation							
	Assoc_spec	Text							
	Rare	Text							
	USESA	Text							
ANCI+ Park User Layout Fields									
	MapType (User1)	List							
	Precision (User2)	List							
	Datum (User3)	List							
	Proj_site(User4)	Calculation							
	Spec_loc (User5)	Text							
	Synonyms (User8)	Lookup				Taxon			
ANCI+ Supplemental Fields									
X	Research Notes	Text			Researchers notes on significance of collection if applicable				

Required Field	Field Name	Field Type	Values	Example	Comments	Links	NPSpecies	ANCI+	ALA
	Loan_ID	Alpha-numeric			Loan number				
	Start_date	Date							
	End_date	Date							
	Loan_status	List							
	Loan_notes	Text							
	Scientific Name	Calculation			documents name changes due to redeterminations or nomenclature				

Appendix 3.6. Example of Alaska Rare Plant sighting form and associated map.

RARE PLANT SIGHTING FORM

Page 1

Alaska Natural Heritage Program
University of Alaska
707 A. St.
Anchorage, AK 99501

Species name: SEDUM DIVERGENS S.Wats. **Park EO number:** 1

Date observed/collected: 22 July 2003

Collector(s): Patricia Loomis & Amy Larsen

Collection Number: 1658 Catalog Number: Acc. 194/Cat. 11921

Determined or verified:

Herbarium of Deposition: ALA

USGS Quad map: Mt. St. Elias A-6 **TRS** T21S R32E NW4 SW4 Sec. 31

Latitude (99 99 99N) 60° 3' 7.2" Longitude (999 99 99W) 140° 0' 3"

Coordinate determined using: GPS

Location accurate to within: ☒ 0.25 mi ☐ 5 mi ☐ > 15 mi ☐ 1 mi ☐ 5-15 mi

Landowner: Wrangell- St. Elias National Park and Preserve

Directions to Site:

Hayden Glacier and upper Lucia Glacier
Narrow ridge between glaciers
Access is extremely difficult or even impossible without a helicopter.

Site Description:

Elevation: 3276 ft Aspect: 10 (degrees) Slope: 15°

Substrate:

Landform:

Other:

RARE PLANT SIGHTING FORM
Page 2
Alaska Natural Heritage Program
University of Alaska
707 A. St.
Anchorage, AK 99501

Species name: SEDUM DIVERGENS S.Wats. **Park EO Number:** 1

Population Description:

No. Individulas: <30 Area Covered: 20 m squared

Phenology: Not in flower, but some with small buds

Distribution Pattern: Scattered

Comments: Growing both in moss and under herbaceous vegetation on solifluction humps.

Plant Community:

Mixed herbs

Associated Species:

Epilobium latifolium, Fragaria chiloensis, Gentiana propinqua, Veronica wormskjoldii

Threats and Disturbances:

None

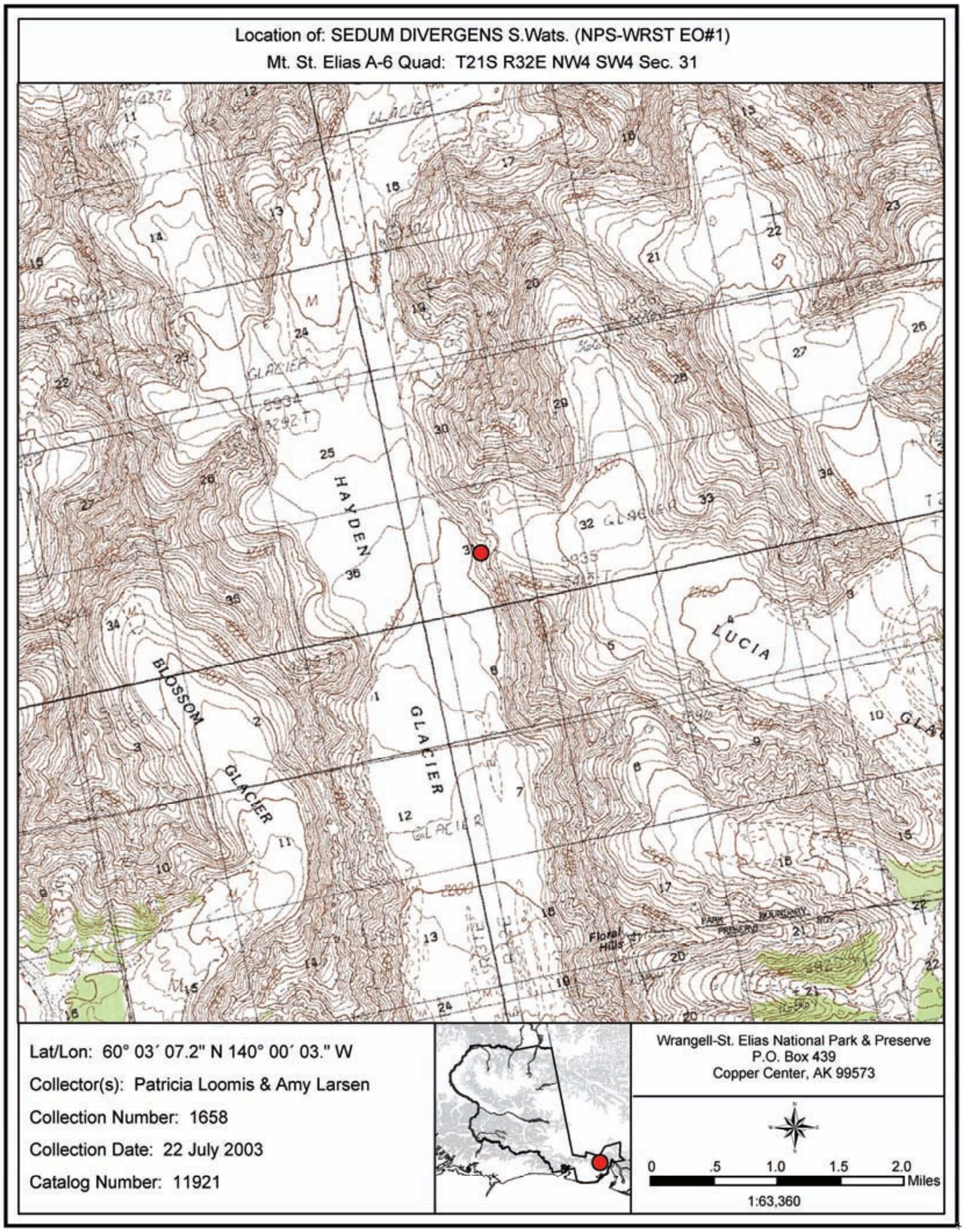
Reported by: Patricia Loomis

Address: WRST NP/P PO Box 435 Copper Center, AK 99573

Date: 3/2004

Phone: 907.822.7418

Please Include a Map with a Scale


Location of: SEDUM DIVERGENS S.Wats. (NPS-WRST EO#1)
Mt. St. Elias A-6 Quad: T21S R32E NW4 SW4 Sec. 31
HAYDEN
GLACIER
BLOSSOM
GLACIER
LUCIA
Floral Hills
Lat/Lon: 60° 03´ 07.2" N 140° 00´ 03." W
Collector(s): Patricia Loomis & Amy Larsen
Collection Number: 1658
Collection Date: 22 July 2003
Catalog Number: 11921
Wrangell-St. Elias National Park & Preserve
P.O. Box 439
Copper Center, AK 99573
0 .5 1.0 1.5 2.0 Miles
1:63,360

Appendix 4.1 Additions to the vascular flora of Wrangell-St. Elias National Park and Preserve, Alaska documented during this inventory.

1994 to 1997	**2003**	**TAXON**	**FAMILY**
x		ACHILLEA SIBIRICA	Asteraceae
	x	AGOSERIS AURANTIACA	Asteraceae
x		ALOPECURUS AEQUALIS	Poaceae
x		ALOPECURUS MAGELLANICUS	Poaceae
	x	ANEMONE MULTICEPS	Ranunculaceae
x		ANTENNARIA FRIESIANA subsp. ALASKANA	Asteraceae
x		ANTENNARIA FRIESIANA subsp. FRIESIANA	Asteraceae
x		ANTENNARIA MEDIA	Asteraceae
x		ANTENNARIA ROSEA subsp. ARIDA	Asteraceae
x		ANTENNARIA ROSEA subsp. CONFINIS	Asteraceae
x		ARABIS CALDERI	Brassicaceae
x		ARABIS CODYI	Brassicaceae
x		ARABIS DIVARICARPA var. DACOTICA	Brassicaceae
x		ARABIS DREPANOLOBA	Brassicaceae
x		ARABIS HOLBOELLII var. RETROFRACTA	Brassicaceae
x		ARABIS LEMMONII	Brassicaceae
x		ARENARIA CAPILLARIS	Caryophyllaceae
x		ARENARIA LONGIPEDUNCULATA	Caryophyllaceae
x		ARNICA ANGUSTIFOLIA subsp. ATTENUATA	Asteraceae
x		ARNICA MOLLIS	Asteraceae
	x	ARTEMISIA DRACUNCULUS	Asteraceae
x		ASTER BOREALIS	Asteraceae
x		ASTRAGALUS ABORIGINUM	Fabaceae
x		ASTRAGALUS HARRINGTONII	Fabaceae
x		ASTRAGALUS WILLIAMSII	Fabaceae
x		BOTRYCHIUM ALASKENSE	Ophioglossaceae
x		BOTRYCHIUM ASCENDENS	Ophioglossaceae
x		BOTRYCHIUM HESPERIUM	
x		BOTRYCHIUM LANCEOLATUM	Ophioglossaceae
	x	BOTRYCHIUM LINEARE	Ophioglossaceae
x		BOTRYCHIUM MINGANENSE	Ophioglossaceae
	x	BOTRYCHIUM MONTANUM	Ophioglossaceae
	x	BOTRYCHIUM TUNUX	Ophioglossaceae
	x	BOTRYCHIUM YAAXUDAKEIT	Ophioglossaceae
x		BRAYA GLABELLA subsp. GLABELLA	Brassicaceae
x		CALLA PALUSTRIS	Araceae
x		CALLITRICHE HERMAPHRODITICA	Callitrichaceae
x		CALLITRICHE PALUSTRIS	Callitrichaceae
x		CALTHA NATANS	Ranunculaceae
x		CAREX ADELOSTOMA	Cyperaceae
x		CAREX ALBONIGRA	Cyperaceae
x		CAREX ATHERODES	Cyperaceae
x		CAREX ATROFUSCA	Cyperaceae
x		CAREX BUXBAUMII	Cyperaceae

1994 to 1997	2003	TAXON	FAMILY
x		CAREX CHORDORRHIZA	Cyperaceae
	x	CAREX CIRCINNATA	Cyperaceae
x		CAREX CRAWFORDII	Cyperaceae
x		CAREX DIANDRA	Cyperaceae
x		CAREX DISPERMA	Cyperaceae
	x	CAREX DURIUSCULA	Cyperaceae
	x	CAREX HOODII	Cyperaceae
x		CAREX INTERIOR	Cyperaceae
x		CAREX LAEVICULMIS	Cyperaceae
	x	CAREX LAPPONICA	Cyperaceae
x		CAREX LASIOCARPA subsp. AMERICANA	Cyperaceae
x		CAREX LAXA	Cyperaceae
x		CAREX LENTICULARIS var. DOLIA	Cyperaceae
x		CAREX LIVIDA	Cyperaceae
	x	CAREX LOLIACEA	Cyperaceae
	x	CAREX MACKENZIEI	Cyperaceae
	x	CAREX MARINA	Cyperaceae
x		CAREX OBTUSATA	Cyperaceae
x		CAREX PARRYANA	Cyperaceae
x		CAREX PHAEOCEPHALA	Cyperaceae
x		CAREX PRATICOLA	Cyperaceae
x		CAREX ROSSII	Cyperaceae
x		CAREX ROSTRATA	Cyperaceae
x		CAREX ROTUNDATA	Cyperaceae
x		CAREX STYLOSA	Cyperaceae
x		CAREX SUPINA subsp. SPANIOCARPA	Cyperaceae
x		CAREX TAHOENSIS	Cyperaceae
x		CAREX WILLIAMSII	Cyperaceae
x		CERASTIUM ARVENSE	Caryophyllaceae
x		CERASTIUM REGELII	Caryophyllaceae
x		CERATOPHYLLUM DEMERSUM	Ceratophyllaceae
x		CHAMAEDAPHNE CALYCULATA	Ericaceae
	x	CICUTA DOUGLASII	Apiaceae
x		COEOGLOSSUM VIRIDE subsp. VIRIDE	Orchidaceae
x		CRYPTANTHA SHACKLETTEANA	Boraginaceae
	x	CYPRIPEDIUM PARVIFLORUM	Orchidaceae
x		DANTHONIA INTERMEDIA	Poaceae
x		DELPHINIUM BRACHYCENTRUM	Ranunculaceae
x		DESCHAMPSIA BREVIFOLIA	Poaceae
x		DESCURAINIA SOPHIOIDES	Brassicaceae
x		DOUGLASIA ARCTICA	Primulaceae
x		DRABA BOREALIS	Brassicaceae
x		DRABA INCERTA	Brassicaceae
x		DRABA LONCHOCARPA var. THOMPSONII	Brassicaceae
x		DRABA NEMOROSA	Brassicaceae
x		DRABA PALANDERIANA	Brassicaceae
x		DRABA PORSILDII	Brassicaceae

1994 to 1997	2003	TAXON	FAMILY
x		DROSERA ANGLICA	Droseraceae
x		ELEOCHARIS ACICULARIS	Cyperaceae
	x	ELEOCHARIS MACROSTACHYA	Cyperaceae
x		ELYMUS CALDERI	Poaceae
x		ELYMUS TRACHYCAULUS subsp. NOVAE-ANGLIAE	Poaceae
x		ELYMUS TRACHYCAULUS subsp. SUBSECUNDUS	Poaceae
	x	EPILOBIUM DAVURICUM	Onagraceae
	x	ERIGERON LONCHOPHYLLUS	Asteraceae
	x	ERIGERON PALLENS	Asteraceae
x		ERIOPHORUM GRACILE	Cyperaceae
x		ERIOPHORUM VIRIDICARINATUM	Cyperaceae
x		FESTUCA BREVISSIMA	Poaceae
x		FESTUCA LENENSIS	Poaceae
x		FESTUCA MINUTIFLORA	Poaceae
x		FESTUCA RUBRA subsp. ARCTICA	Poaceae
	x	GALIUM APARINE	Rubiaceae
	x	GALIUM BRANDEGEI	Rubiaceae
x		GASTROLYCHNIS TAIMYRENSIS	Caryophyllaceae
	x	GENTIANELLA AMARELLA subsp. ACUTA var. ACUTA	Gentianaceae
x		GLYCERIA BOREALIS	Poaceae
x		GYMNOCARPIUM JESSONENSE subsp. PARVULUM	Dryopteridaceae
x		IMPATIENS NOLI-TANGERE	Balsaminaceae
	x	IRIS SETOSA	Iridaceae
x		ISOETES ECHINOSPORA	Isoetaceae
	x	ISOETES MARITIMA	Isoetaceae
	x	JUNCUS ARCTICUS var. BALTICUS	Juncaceae
	x	JUNCUS FALCATUS var. SITCHENSIS	Juncaceae
x		JUNCUS FILIFORMIS	Juncaceae
x		KOBRESIA SIBIRICA	Cyperaceae
	x	LATHYRUS PALUSTRIS subsp. PILOSUS	Fabaceae
x		LEMNA MINOR	Lemnaceae
	x	LEMNA TRISULCA	Lemnaceae
x		LESQUERELLA ARCTICA subsp. PURSHII	Brassicaceae
	x	LIMOSELLA AQUATICA	Scrophulariaceae
	x	LISTERA CAURINA	Orchidaceae
x		LUZULA ARCUATA subsp. UNALASCHKENSIS	Juncaceae
	x	LUZULA MULTIFLORA subsp. KOBAYASII	Juncaceae
x		LUZULA RUFESCENS	Juncaceae
x		MELANDRIUM MACROSPERMUM	Caryophyllaceae
x		MENTHA ARVENSIS	Lamiaceae
x		MIMULUS GUTTATUS	Scrophulariaceae
x		MYRIOPHYLLUM VERTICILLATUM	Haloragaceae
x		NAJAS FLEXILIS	Najadaceae
	x	OSMORHIZA CHILENSIS	Apiaceae
x		OXYTROPIS CAMPESTRIS subsp. JORDALII	Fabaceae
x		PAPAVER MACOUNII subsp. DISCOLOR	Papaveraceae
x		PAPAVER RADICATUM subsp. KLUANENSE	Papaveraceae

1994 to 1997	2003	TAXON	FAMILY
x		PAPAVER WALPOLEI	Papaveraceae
	x	PEDICULARIS MACRODONTA	Scrophulariaceae
	x	PEDICULARIS PACIFICA	Scrophulariaceae
x		PENSTEMON GORMANII	Scrophulariaceae
x		PHLOX HOODII	Polemoniaceae
	x	PLATANTHERA STRICTA	Orchidaceae
x		POA ABBREVIATA subsp. PATTERSONII	Poaceae
	x	POA ALPIGENA	Poaceae
x		POA LEPTOCOMA	Poaceae
x		POA PRATENSIS subsp. ALPIGENA	Poaceae
x		PODAGROSTIS AEQUIVALIS	Poaceae
x		POLYGONUM AMPHIBIUM subsp. LAEVIMARGINATUM	Polygonaceae
x		POLYGONUM AVICULARE	Polygonaceae
x		POLYGONUM CAURIANUM	Polygonaceae
x		POLYGONUM PENNSYLVANICUM subsp. ONEILLII	Polygonaceae
x		POTAMOGETON FOLIOSUS subsp. FOLIOSUS	Potamogetonaceae
x		POTAMOGETON FRIESII	Potamogetonaceae
x		POTAMOGETON GRAMINEUS	Potamogetonaceae
	x	POTAMOGETON OBTUSIFOLIUS	Potamogetonaceae
x		POTAMOGETON PRAELONGUS	Potamogetonaceae
x		POTAMOGETON RICHARDSONII	Potamogetonaceae
x		POTAMOGETON SUBSIBIRICUS	Potamogetonaceae
x		POTAMOGETON ZOSTERIFORMIS	Potamogetonaceae
	x	POTENTILLA FURCATA	Rosaceae
x		POTENTILLA RUBRICAULIS	Rosaceae
x		PRIMULA EGALIKSENSIS	Primulaceae
	x	PRUNELLA VULGARIS subsp. LANCEOLATA	Lamiaceae
	x	PUCCINELLIA NUTKAENSIS	Poaceae
x		PUCCINELLIA VAHLIANA	Poaceae
x		RANUNCULUS AQUATILIS var. DIFFUSUS	Ranunculaceae
x		RANUNCULUS MACOUNII	Ranunculaceae
x		RANUNCULUS SCELERATUS subsp. MULTIFIDUS	Ranunculaceae
	x	RIBES LACUSTRE	Saxifragaceae
	x	ROMANZOFFIA SITCHENSIS	Saxifragaceae
x		RORIPPA PALUSTRIS var. FERNALDIANA	Brassicaceae
x		RUBUS SPECTABILIS	Rosaceae
x		RUMEX ACETOSA subsp. ALPESTRIS	Polygonaceae
	x	RUMEX FENESTRATUS	Polygonaceae
	x	RUMEX SALICIFOLIUS var. MEXICANUS	Polygonaceae
	x	RUPPIA CIRRHOSA	Potamogetonaceae
x		SALIX HASTATA	Salicaceae
x		SALIX STOLONIFERA	Salicaceae
	x	SANGUISORBA OFFICINALIS	Rosaceae
	x	SAXIFRAGA ESCHSCHOLTZII	Saxifragaceae
	x	SAXIFRAGA NELSONIANA subsp. PACIFICA	Saxifragaceae
	x	SCHOENOPLECTUS TABERNAEMONTANI	Cyperaceae
	x	SCUTELLARIA GALERICULATA var. PUBESCENS	Lamiaceae

1994 to 1997	2003	TAXON	FAMILY
	x	SEDUM DIVERGENS	Crassulaceae
x		SELAGINELLA SIBIRICA	Selaginellaceae
	x	SILENE INVOLUCRATA subsp. TENELLA	Caryophyllaceae
x		SILENE WILLIAMSII	Caryophyllaceae
x		SPARGANIUM NATANS	Sparganiaceae
x		STUCKENIA FILIFORMIS	Potamogetonaceae
x		STUCKENIA PECTINATA	Potamogetonaceae
x		STUCKENIA VAGINATA	Potamogetonaceae
x		SUBULARIA AQUATICA	Brassicaceae
x		TARAXACUM PHYMATOCARPUM	Asteraceae
x		TRICHOPHORUM PUMILUM var. ROLLANDII	Cyperaceae
x		UTRICULARIA MINOR	Lentibulariaceae
x		VAHLODEA ATROPURPUREA subsp. PARAMUSHIRENSIS	Poaceae
x		VIOLA BIFLORA	Violaceae
	x	VIOLA RENIFOLIA var BRAINERDII	Violaceae
x		VIOLA SELKIRKII	Violaceae

Appendix 4.2. Vascular plant taxa occurring in Wrangell-St. Elias National Park and Preserve, Alaska, with an Alaska Natural Heritage Program (AKNHP) state rank of three or less. AKNHP ranks as of April 2004 are listed with with the number of park localities, habitats and park distribution. An explanation of the Nature Conservancy global ranks and AKNHP state ranks follows this table. ☼ Indicates that these taxa have been downlisted since the inventory began.

Asteraceae (Sunflower Family)

AGOSERIS AURANTIACA (Hook.) Greene — Mountain Dandelion
AKNHP rank: G5 S1.
Three Park localities.
Alpine meadows.
Maritime St. Elias Mts.

AGOSERIS GLAUCA (Pursh) Raf. — Pale Agoseris
AKNHP rank: G5 S1.
Two Park localities.
Alpine meadows.
Chugach Mts.

ARNICA DIVERSIFOLIA Greene — Snow Leopardbane
AKNHP rank: G5 S1.
One Park locality.
Moist open woodland.
Upper Chitina River (Hultén 1968) or Upper Chistochina R., outside park (Hultén 1940-50; Poto 1902). Questionable locality.

ARNICA MOLLIS Hook. — Hairy Arnica
AKNHP rank: G5 S1.
One Park locality.
Alpine meadows.
Southern Wrangell Mts.

ARTEMISIA DRACUNCULUS L. — Dragon Wormwood
AKNHP rank: G5 S1S2.
One Park locality.
Open dry slopes.
Nutzotin Mts.

ERIGERON GRANDIFLORUS Hook. subsp. **ARCTICUS** A.E. Porsild
AKNHP rank: G4T3T4 S3.
14 Park localities.
Alpine herbaceous slopes.
Mentasta Mts.

TARAXACUM CARNEOCOLORATUM Nels. ☼ — Flesh-Colored Dandelion
AKNHP rank: G3Q S3 (S2 in 1994), USFWS Category 2 in 1987.
10 Park localities.
Alpine slopes and coarse, well-drained substrates.
Nutzotin, Mentasta, Wrangell and St Elias Mts.

Boraginaceae (Borage Family)

CRYPTANTHA SHACKLETTEANA L.C. Higgins — Shacklett's Catseye
AKNHP rank: G1Q S1, USFWS Category 2 in 1993.
Two Park localities.
Dry gravels on open, calcareous slopes.
Mentasta Mts.

Brassicaceae (Mustard Family)

APHRAGMUS ESCHSCHOLTZIANUS Andrz. ☼ — Aleutian Cress
AKNHP rank: G3 S3 (S2S3 in 1992).
33 Park localities.
Solifluction soil.
Park-wide in the mountains.

ARABIS CALDERI G. A. Mulligan — Calder's Rock-cress
AKNHP rank: G3?Q S1.
Two Park localities.
Grassy clearings, meadows and openings in thickets in sub-alpine and alpine areas.
St. Elias Mts.

ARABIS CODYI G.A. Mulligan — Cody's Rock-cress
AKNHP rank: G1G2 S1.
One Park locality.
Unstable alpine slopes.
Granite Range.

ARABIS DREPANOLOBA Greene — Rockcress
AKNHP rank: G5T4? S1?.
One Park locality.
Talus, rock fields, ridge crests and outwash gravels in the high mountains.
Chugach Mts.

ARABIS LEMMONII S. Wats. — Lemmon's Rock-cress
AKNHP rank: G5 S1.
One Park locality.
Rocky ridges, rock fields, outwash gravels in the high mountains.
Granite Range of Chugach Mts.

DRABA DENSIFOLIA Nutt. ex Torrey & A. Gray — Denseleaf Whitlow-Grass
AKNHP rank: G5 S1.
One Park locality.
Scree slopes, stony exposed ridges, talus, disintegrating rhyolite, granitic sand & gravel, chip-rock, shaded rock crevices & rocky knolls.
Nutzotin Mts.

DRABA INCERTA Payson — Yellowstone Whitlow-Grass
AKNHP rank: G5 S2S3.
12 Park localities.
Calcareous screes.
Granite Range, S Wrangell Mts.

DRABA KANANASKIS G.A. Mulligan — Longstalk Whitlow-Grass
AKNHP rank: G1Q S1.
Two Park localities.
Alpine communities, rocky alpine slopes, rocky ledges, bare shale, and limestone slopes with large blocky talus.
Granite Range, Chugach Mountains.

DRABA LONCHOCARPA Rydb. var. **THOMPSONII** (C.L. Hitchc.) Rollins — Lance-Pod Whitlow-Grass
AKNHP rank: G4T3T4 S1.
One Park locality.
Alpine ledges and rocky slopes.
Mentasta Mts.

DRABA PORSILDII G. A. Mulligan — Posild's Whitlow-Grass
AKNHP rank: G3G4 S1S2.
Nine Park localities.
Alpine scree, gravel, open shale slopes and meadows.
Mentasta, Nutzotin and St. Elias Mts. and Granite Range.

DRABA PRAEALTA E.L. Greene ☼ — Tall Whitlow-Grass
AKNHP rank: G5 S1S3 (S2S3 in 1996).
One Park locality.
Alpine shale cliffs, moist banks and slopes, rocky embankments, steep hillsides, limestone talus, damp rocks and sub-alpine slopes.
St. Elias Mts.

DRABA RUAXES Payson & H. ☼ — Rainier Whitlow-Grass
AKNHP rank: G3 S3 (S2 in 1994, S2S3 in 1996), USFWS Category 3C in 1987.
24 Park localities.
Crevices of disintegrating andesite, windy ridges, summits, scree slopes, and cliffs.
Wrangell-St. Elias, Mentasta and Nutzotin Mts.

SMELOWSKIA CALYCINA (Stephan) C.A. Meyer var. **PORSILDII** Drury & Rollins — Porsild's False Candytuft
AKNHP rank: G5T2T3Q S2S3.
Five Park localities.
Alluvial fans, gravel & talus alpine slopes.
Nutzotin Mts.

THLASPI ARCTICUM Pors. ☼ — Arctic Pennycress
AKNHP rank: G3 S3 (S2S3 in 1992), USFWS Category 2 in 1987, vulnerable endemic (Murray &Lipkin 1987).
Two Park localities.
Scree and gravel slopes and turfy places in alpine tundra.
Southwest Wrangell Mts.

Caryophyllaceae (Pink Family)

ARENARIA LONGIPEDUNCULATA Hult. — Longstem Sandwort
AKNHP rank: G3Q S3.
Two Park localities.
Moist, calcareous or serpentine gravels and rock crevices.
Chitina River.

CERASTIUM REGELII Ostenf. — Regel's Chickweed
AKNHP rank: G4Q S2S3.
One Park locality.
Wet swales of low, calcareous tundra, lake shores, solifluction soil.
Northern Wrangell Mts.

MINUARTIA BIFLORA (L.) Schinzl. & Thell. — Mountain Stitchwort
AKNHP rank: G5 S2.
23 Park localities.
Exposed, calcareous, grassy slopes and herbmats having abundant snow cover in winter.
Park-wide in the mountains.

STELLARIA ALASKANA Hult. ☼ — Alaska Starwort
AKNHP rank: G3 S3 (S2 in 1992).
23 Park localities.
Rock outcrops, talus slopes and moraines in alpine tundra.
Wrangell, St. Elias, Nutzotin and Mentasta Mts.

STELLARIA UMBELLATA Turcz. ☼ — Umbrella Starwort
AKNHP rank: G5 S2S3 (S1S2 in 1992).
Nine Park localities.
Alpine tundra.
Wrangell-St. Elias, Nutzotin and Chugach Mts.

Ceratophyllaceae (Hornwort Family)

CERATOPHYLLUM DEMERSUM L. Coon's Tail
AKNHP rank: G5 S2.
One Park locality.
Quiet, fresh water pools and streams.
Copper River basin.

Crassulaceae (Stonecrop Family)

SEDUM DIVERGENS S.Wats. Pacific Stonecrop
AKNHP rank: G5? S1.
One Park locality.
Steep rocky slopes, sub-alpine to alpine meadows to ridges.
Maritime St. Elias Mts.

Cupressaceae (Cypress Family)

JUNIPERUS HORIZONTALIS Moench Creeping Savin
AKNHP rank: G5 S1S2.
Eight Park localities.
Rocky and sandy places, bluffs, alluvial fans, woods, and terraces.
Southern Wrangell Mts. and Granite Range.

Cyperaceae (Sedge Family)

CAREX ADELOSTOMA Krecz. Circumpolar Sedge
AKNHP rank: G4 S1.
Six Park localities.
Wet places, moist sites and fens.
Upper and Middle Copper River Basin.

CAREX ATRATIFORMIS Britt. Black Sedge
AKNHP rank: G5T5 S2.
One Park locality.
Open coniferous woods and meadows and floodplains.
Mentasta Mountains, Lost Creek floodplain.

CAREX CRAWFORDII Fern. Crawford's Sedge
AKNHP rank: G5 S2S3.
One Park locality.
Well drained lake and river meadows.
Tana River.

CAREX EBURNEA Boott Bristleleaf Sedge
AKNHP rank: G5 S2S3.
Two Park localities.
Dry sand or rocky places, preferably on calcareous soil.
Upper Chitina River.

CAREX HOLOSTOMA Drej. Arctic Marsh Sedge
AKNHP rank: G4? S2.
Two Park localities.
Turfy places in tundra and by the edge of small ponds. A calciphile.
Nutzotin Mts.

CAREX HOODII W. Boott Hood's Sedge
AKNHP rank: G4G5 S1.
One Park locality.
Dry to mesic grasslands, rocky slopes, screes and forest openings.
Maritime St. Elias Mts.

CAREX LAPPONICA O. Lang Lapland Sedge
AKNHP rank: G4G5Q S2.
Three Park localities.
Lowlands, *Sphagnum* bogs, wet, nutrient poor areas.
Tanana & Ahtna basin lowlands.

CAREX LAXA Wahlenb. — Weak Sedge
AKNHP rank: G4 S1.
Two Park localities.
Wet places, mostly in woods, swamps and muskeg.
Tanana lowlands, Nabesna River.

CAREX LENTICULARIS Michx. var. **DOLIA** (M.E. Jones) L.A. Standley ☼ — Tufted Sedge
AKNHP rank: G5T3Q S3 (S2 in 1992), USFWS Category 2 in 1985, Category 3C in 1987.
10 Park localities.
Muddy shores, sheltered ponds, lakes and river flats.
Granite Range, St. Elias Mts, Ahtna basin lowlands.

CAREX PARRYANA Dew. — Parry's Sedge
AKNHP rank: G4 S1.
Two Park localities.
Wet places, gravel bars.
Upper Chitina River, Upper White River.

CAREX PHAEOCEPHALA Piper — Dunhead Sedge
AKNHP rank: G4 S1S2.
10 Park localities.
Alpine herbaceous and low shrub.
Granite Range, Maritime St. Elias Mts, Nutzotin Mts.

CAREX TAHOENSIS Smiley — Tahoe Sedge
AKNHP rank: G3? S1.
One Park locality.
Sagebrush slopes, open rocky and sandy slopes, sub-alpine and alpine meadows.
Granite Range.

ERIOPHORUM VIRIDICARINATUM (Engelm.) Fern. — Large-Flower Fleabane
AKNHP rank: G5 S2.
One Park locality.
Sub-alpine and lowland peat meadows.
Southern Wrangell Mts.

TRICHOPHORUM PUMILUM (M. Vahl.) Schinz. & Thell. var. **ROLLANDII** (Fern.) Hult. — Rolland's Leafless-Bulrush
AKNHP rank: G5 S1.
Two Park localities.
Bogs, damp, marly lake shores, alkaline seepages, and moist calcareous ground.
Upper Chitina River.

Fabaceae (Pea Family)

ASTRAGALUS HARRINGTONII (Rydb.) Hultén ☼ — Harrington Milk-vetch
AKNHP rank: G5T3 S3 (S2S3 in 1996).
Three Park localities.
Meadows, stream banks and scree slopes.
Nutzotin Mts., Tana and Nabesna Rivers.

LUPINUS KUSCHEI Eastw. ☼ — Yukon Lupine
AKNHP rank: G3 S2 (S1S2 in 1993).
Seven Park localities.
Sandy alluvium, sand dunes, open woods.
Sanford, Nabesna and Chisana Rivers.

OXYTROPIS HUDDELSONII Pors. — Huddelson's Locoweed
AKNHP rank: G3 S2S3.
28 Park localities.
Ridge tops, frost boils, alpine tundra, heath, and less commonly in woods.
Park-wide in the mountains.

Haloragaceae (Watermilfoil Farmily)

MYRIOPHYLLUM VERTICILLATUM L. — Whorlleaf Watermilfoil
AKNHP rank: G5 S3.
One Park locality.
Small pond.
Chitina River basin.

Hydrophyllaceae (Waterleaf Family)

PHACELIA MOLLIS Macbr. ☼ — Soft Phacelia
AKNHP rank: G3 S2S3 (S2 1994), vulnerable endemic (Murray & Lipkin 1987).
19 Park localities
Dry slopes, roadsides, sandy or gravelly soils, rock outcrops and in open woods.
Nutzotin, Wrangell, Granite and Chugach Mts.

Lilaceae (Lily Family)

MAIANTHEMUM STELLATUM (L.) Link — Star-flowered Solomon's Seal
AKNHP rank: G5 S2.
One Park locality.
Common locally in dry open woodlands, on calcareous river banks or lake shores, tidal flats, open woods, and meadows.
Nutzotin Mts.

Najadaceae (Naid Family)

NAJAS FLEXILIS (Willdenow) Rostkov. & Schmidt — Naiad
AKNHP rank: G5 S1S2.
One Park locality.
Shallow fresh or brackish water.
Lower Chitina River basin.

Ophiolossaceae (Adder's Tongue Family)

BOTRYCHIUM ALASKENSE W.H. Wagner & J.R. Grant — Alaska Moonwort
AKNHP rank: G2G3 S2S3.
Two Park localities.
Ericaceous heath, sandy basalt, turfy tundra, disturbed situations in the alpine.
Wrangell and Nutzotin Mts.

BOTRYCHIUM ASCENDENS W.H. Wagner ☼ — Triange-Lobe Moonwort
AKNHP rank: G2G3 S2 (S1 in 1996).
One Park locality.
Open mountain slopes and steep screes, from 4,500 - 5,300 ft. elevation.
Nutzotin Mts.

BOTRYCHIUM LINEARE W.H. Wagner — Narrow-Leaf Grape Fern
AKNHP rank: G1 S1, USFWS Candidate species (June 13, 2002).
Two Park localities.
Open silty areas, disturbed situations, meadows, variable.
Nutzotin Mts.

BOTRYCHIUM MONTANUM W.H. Wagner — Mountain Moonwort
AKNHP rank: G3 S1.
One Park locality.
Alpine forb herbaceous scree slopes, wet fens & cedar forests.
Maritime St. Elias Mts.

BOTRYCHIUM TUNUX Stensvold & Farrar
AKNHP rank: G1 S1.
One Park locality.
Floodplains, river bluffs, open sand dunes & upper beaches on the coast.
Nutzotin Mts.

BOTRYCHIUM YAAXUDAKEIT Stensvold & Farrar
AKNHP rank: G2 S2.
One Park locality.
Silty slopes.
White River.

Orchidaceae (Orchid Family)

CYPRIPEDIUM PARVIFLORUM L. — Lesser Yellow Lady's Slipper
AKNHP rank: G5 S2S3.
One Park locality.
Woods and swamps.
Chitina River valley.

Papaveraceae (Poppy Family)

PAPAVER ALBOROSEUM Hult. ☼ — Pale Poppy
AKNHP rank: G3G4 S3 (S2S3 1994), USFWS Category 3C in 1987, vulnerable endemic (Murray and Lipkin 1987).
19 Park localities.
Sandy, gravelly soil and alpine scree slopes.
Park-wide in the mountains.

PAPAVER WALPOLEI A.E. Porsild ☼ — Walpole's Poppy
AKNHP rank: G3 S3 (S2 in 1993), USFWS Category 3C in 1987
One Park locality.
Exposed tundra uplands, expecially calcareous fellfield and river gravels.
Mentasta Mts.

Poaceae (Grass Family)

AGROSTIS THURBERIANA A. S. Hitchc. — Thurber's Bentgrass
AKNHP rank: G5Q S2.
6 Park localities.
Mesic alpine meadows.
Malaspina Forelands & Granite Range.

ELYMUS CALDERI Barkw. — Calder's Wild Rye
AKNHP rank: G3G4 S2S3.
One Park locality.
Dunes, sandy and gravelly hillsides, benches, and roadsides.
Dadina River bluff.

FESTUCA LENENSIS Drobov ☼ — Tundra Fescue
AKNHP rank: G4 S3 (S2S3 in 1996).
Nine Park localities.
Gravel and scree slopes.
Nutzotin, Mentasta and northern Wrangell Mts.

FESTUCA MINUTIFLORA Rydb. Small-Flower Fescue
AKNHP rank: G5 S1.
One Park locality.
Alpine tundra, meadows and scree slopes.
Chugach Mts.

GLYCERIA PULCHELLA (Nash) K. Schum. MacKenzie Valley Mannagrass
AKNHP rank: G5 S2S3.
One Park locality.
Subarctic lowland sedge wet meadow.
Tana River.

POA LEPTOCOMA Trin. Marsh Blue Grass
AKNHP rank: G5 S2.
Five Park localities.
Damp places, *Vaccinium* heaths, moist woods, in loose scree.
St. Elias, Nutzotin and Wrangell Mts.

POA SECUNDA Presl subsp. **SECUNDA** Curly Blue Grass
AKNHP rank: G? S1.
Five Park localities.
Alpine graminoid herbaceous and floodplain meadows.
Granite Mountains, Nabesna River.

PUCCINELLIA VAHLIANA (Liebm.) Scribn. & Merr. Val's Alkali Grass
AKNHP rank: G4 S2S3.
One Park locality.
Non-littoral species, in moist clay by brooks and on snowbeds, stony tundra and alpine seeps.
Northern Wrangell Mts.

TRISETUM SIBIRICUM Rupr. subsp. **LITORALE** (Rupr.) Roshev. Siberian Oatgrass
AKNHP rank: G5T4Q S2.
Two Park localities.
Moist grassy slopes and tundra, willow and alder thickets, meadows and along creeks.
Alpine and subalpine. Nutzotin Mts.

Polemoniaceae (Polemonium Family)

PHLOX HOODII Richards. Spiny Phlox
AKNHP rank: G5 S1S2
Four Park localities
South facing bluffs and scree slopes.
Mentasta and Nutzotin Mts.

PHLOX SIBIRICA L. subsp. **RICHARDSONII** (Hook.) Hult. ☼ Siberian Phlox
AKNHP rank: G4T2T3Q S2? (S1S2 in 1994)
17 Park localities
Sandy or gravelly hilltops and barrens, rock outcrops, scree slopes.
Mentasta, Nutzotin and northern Wrangell Mts.

Polygonaceae (Buckwheat Family)

RUMEX BERINGENSIS Yurtsev & Petrovsky ☼ Bering Sea Dock
AKNHP rank: G3 S3 (S1S2 in 1994, S2 in 1996), vulnerable endemic (Murray and Lipkin 1987).
17 Park localities.
Sandy places on tundra, solifluction lobes, frost boils, broken soil of *Dryas* tundra.
Wrangell and St. Elias Mts.

Portulacaceae (Purslane Family)

MONTIA BOSTOCKII (A.E. Porsild) Welsh ☼ — Bostock's Minerslettuce

AKNHP rank: G3 S3 (S2S3 1994), USFS Category 2 in 1985, Category 3C in 1987.
21 Park localities.
Moist places near springs, mesic alpine tundra slopes.
Northern and central Wrangell Mts., Mentasta & Nutzotin Mts.

Potamogetonaceae (Pondweed Family)

POTAMOGETON OBTUSIFOLIUS Merten & Koch — Blunt-Leaf Pondweed

AKNHP rank: G5 S1.
One Park locality.
Shallow ponds and lakes.
Ahtna basin.

POTAMOGETON SUBSIBIRICUS Hagstr. ☼ — Yenisei River Pondweed

AKNHP rank: G3 S3 (S2 in 1992).
Five Park localities.
Shallow ponds and lakes.
Upper Copper River.

Primulaceae (Primrose Family)

DOUGLASIA ALASKANA (Coville & Standley ex Hultén) S. Kelso ☼ — Alaskan Douglasia

AKNHP rank: G2G3 S2S3 (S2 in 1994).
One Park locality.
Sandy soil, gravel, scree slopes and rocky alpine sites.
Southern Wrangell and Chugach Mts.

DOUGLASIA ARCTICA Hook. — Mackenzie River Dwarf Primrose

AKNHP rank: G3 S2S3.
One Park locality.
Rocky, mossy slopes in the mountains.
Northern St. Elias Mts.

DOUGLASIA GORMANII Const. ☼ — Gorman's Dwarf Primrose

AKNHP rank: G3 S3 (S2S3 in 1992).
33 Park localities.
Rock outcrops, gravel scree slopes, alpine tundra and moist alpine slopes.
Mentasta, Nutzotin and Northern Wrangell Mts.

Pteridaceae (Maidenhair Fern Family)

CRYPTOGRAMMA STELLERI (S.G. Gmel.) Prantl. — Fragile Rock-brake

AKNHP rank: G5 S2S3
Six Park localities
Crevices in calcareous rocks in shaded localities with dripping water, usually very rare and scattered.
Nutzotin and northern Wrangell Mts.

Rosaceae (Rose Family)

CHAMAERHODOS ERECTA (L.) Bunge subsp. **NUTTALLII** (Torr. & Gray) Hult. — Little-Rose

AKNHP rank: G5T5 S1S2.
Five Park localities.
S-facing bluffs and river terraces. Nabesna River.

POTENTILLA DRUMMONDII Lehm. ☼ — Drummond's Cinquefoil
AKNHP rank: G5 S2 (S1 in 1995, S1S2 in 2003).
Eight Park localities.
Meadows to ridges, subalpine to alpine.
Chugach Mts. and Granite Range.

POTENTILLA RUBRICAULIS Lehmann — Rocky Mountain Cinquefoil
AKNHP rank: G4 S2S3.
Two Park localities.
Dryas graminoid tundra.
Granite Range.

Salicaceae (Willow Family)

SALIX HOOKERIANA Barr. — Hooker Willow
AKNHP rank: G5 S2.
Two Park localities.
Coastal spruce forests and stabilized sand dunes.
Malaspina Forelands.

SALIX SETCHELLIANA Ball — Setchell's Willow
AKNHP rank: G4 S3.
11 Park localities.
Gravel bars, shores and sandy slopes. Pioneer on sandy beaches, margins of glacial rivers and on glacial moraines.
Nabesna, White, Chisana and Bremner Rivers.

Saxifragaceae (Saxifrage Family)

SAXIFRAGA ADSCENDENS L. subsp. **OREGONENSIS** (Raf.) Baciagalupi — Small Saxifrage
AKNHP rank: G5T4T5 S2S3.
Eight Park localities.
Moist gravelly and rocky alpine situations.
Chugach, southern Wrangells, St. Elias and Granite Range.

SAXIFRAGA NELSONIANA D. Don subsp. **PORSILDIANA** (Calder & Savile) Hult. — Porsild's Saxifrage
AKNHP rank: G5T3T4 S2.
One Park locality.
Hillsides and along streams, subalpine to alpine.
Northern Wrangell Mts.

Scrophulariaceae (Figwort Family)

CASTILLEJA MINIATA Dougl. — Scarlet Indian Paintbrush
AKNHP rank: G3 S3.
Six Park localities.
Alpine and subalpine meadows.
Malaspina Forelands and Southern Wrangell Mts.

LIMOSELLA AQUATICA L. — Mudwort
AKNHP rank: G5 S3.
One Park locality.
Wet, muddy or sandy pond margins.
Malaspina Forelands.

PEDICULARIS MACRODONTA Richards — Muskeg lousewort
AKNHP rank: G4Q S3.
One Park locality.
Swamps, wet meadows and muskeg.
Malaspina Forelands.

Violaceae (Violet Family)

VIOLA SELKIRKII Pursh — Great-spurred Violet

AKNHP rank: G5? S3.
One Park locality.
Moist woodlands.
Southern Wrangell Mts.

G1: Critically imperiled globally, 5 or less occurrences
G2: Imperiled globally, 6 to 20 occurrences
G3: Either very rare and local throughout its range or found locally in a restricted range, 21 to 100 occurrences, threatened throughout its range.
G4: Widespread and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5: Demonstrably secure globally, though it may be quite rare in parts of its range.
T#: Global rank of the described subspecies or variety.
G#G#: Global rank of species uncertain, best described as a range between the two ranks
G#Q: Indicates some uncertainty about taxonomic status that might affect global rank

S1 = Critically imperiled in the state, 5 or fewer occurrences.
S2 = Imperiled in the state, 6 - 20 ocurrences.
S3 = Rare or uncommon in the state, 21 - 100 occurrences.

Appendix 4.3. Species collected in Wrangell-St. Elias National Park and Preserve, Alaska, during the 1994-1997 and 2003 inventory that document range extensions of greater than 250 km, indicating when the extension was first documented. Annotations and distribution maps for collections made from 1994 to 1997 are in Cook and Roland (2002) and those made in 2003 are in Chapter 7 of this document.

1994 to 1997	**2003**	**Taxon**
	x	AGOSERIS AURANTIACA
x		AGOSERIS GLAUCA
x		AGROSTIS THURBERIANA
x		ALOPECURUS ALPINUS
x		ARENARIA LONGIPEDUNCULATA
x		ARNICA MOLLIS
	x	ARTEMISIA DRACUNCULUS
x		ASTER BOREALIS
x		BOTRYCHIUM ASCENDENS
x		BOTRYCHIUM MINGANENSE
x		BOTRYCHIUM PINNATUM
	x	BOTRYCHIUM YAAXUDAKEIT
x		BRAYA GLABELLA
x		BRAYA PURPURASCENS
x		CALLITRICHE ANCEPS
	x	CALLITRICHE HERMAPHRODITICA
x		CALTHA LEPTOSEPALA
		CAREX ADELOSTOMA
x		CAREX ALBONIGRA
x		CAREX CHORDORRHIZA
	x	CAREX CIRCINNATA
	x	CAREX DURIUSCULA
x		CAREX FILIFOLIA
x		CAREX HOLOSTOMA
	x	CAREX HOODII
x		CAREX INTERIOR
x		CAREX LASIOCARPA subsp. AMERICANA
x		CAREX LAXA
x		CAREX LEPTALEA
	x	CAREX MACKENZIEI
x		CAREX MICROGLOCHIN subsp. MICROGLOCHIN
x		CAREX NIGRICANS
x		CAREX OBTUSATA
x		CAREX PARRYANA
x		CAREX PAUCIFLORA
x		CAREX PETRICOSA var. PETRICOSA
x		CAREX PRATICOLA
x		CAREX STYLOSA
x		CAREX VIRIDULA var. VIRIDULA
x		CAREX WILLIAMSII
x		CASSIOPE MERTENSIANA
	x	CASTILLEJA ELEGANS

1994 to 1997	2003	Taxon
	x	CASTILLEJA MINIATA
x		CERASTIUM REGELII
x		CERATOPHYLLUM DEMERSUM
x		CLADOTHAMNUS PYROLAEFLORUS
x		COLLOMIA LINEARIS
x		COLPODIUM VAHLIANUM
x		CRYPTANTHA SHACKLETTEANA
x		CRYPTOGRAMMA SITCHENSIS
x		CRYPTOGRAMMA STELLERI
	x	CYPRIPEDIUM PARVIFLORUM
x		DANTHONIA INTERMEDIA
x		DELPHINIUM BRACHYCENTRUM
x		DOUGLASIA ARCTICA
x		DRABA CORYMBOSA
x		DRABA DENSIFOLIA
x		DRABA INCERTA
x		DRABA KANANASKIS
x		DRABA LONCHOCARPA var. THOMPSONII
x		DRABA MACOUNII
x		DRABA PORSILDII
	x	ELEOCHARIS MACROSTACHYA
x		EPILOBIUM LACTIFLORUM
x		EPILOBIUM LUTEUM
x		ERIOPHORUM VIRIDICARINATUM
x		EUPHRASIA MOLLIS
x		FAURIA CRISTA-GALLI
x		FESTUCA BREVISSIMA
x		FESTUCA LENENSIS
x		FESTUCA SAXIMONTANA
	x	GALIUM BRANDEGEI
x		GENTIANA PLATYPETALA
x		GLYCERIA PULCHELLA
x		HACKELIA DEFLEXA
x		HIPPURIS MONTANA
x		IMPATIENS NOLI-TANGERE
	x	ISOETES MARITIMA
x		JUNCUS FILIFORMIS
x		JUNCUS MERTENSIANUS
x		KOBRESIA SIMPLICIUSCULA
x		LIGUSTICUM SCOTICUM subsp. HULTENII
	x	LIMOSELLA AQUATICA
x		MAIANTHEMUM STELLATUM
x		MINUARTIA DAWSONENSIS
x		MITELLA PENTANDRA
x		MYRIOPHYLLUM VERTICILLATUM
x		NAJAS FLEXILIS
x		NYMPHAEA TETRAGONA

1994 to 1997	2003	Taxon
x		OSMORHIZA DEPAUPERATA
x		OXYTROPIS CAMPESTRIS subsp. JORDALII
x		PAPAVER WALPOLEI
	x	PEDICULARIS PACIFICA
x		PHLOX SIBIRICA subsp. RICHARDSONII
x		PHYLLODOCE ALEUTICA subsp. GLANDULIFLORA
x		PLANTAGO ERIOPODA
x	x	POA LEPTOCOMA
x		PODAGROSTIS AEQUIVALIS
x		POLYSTICHUM LONCHITIS
	x	POTAMOGETON FOLIOSUS subsp. FOLIOSUS
	x	POTAMOGETON OBTUSIFOLIUS
x		POTAMOGETON PUSILLUS subsp. TENUISSIMUS
x		POTENTILLA ARGUTA subsp. CONVALLARIA
	x	POTENTILLA DRUMMONDII
x		POTENTILLA RUBRICAULIS
x		PUCCINELLIA DESCHAMPSIOIDES
x		PUCCINELLIA VAHLIANA
x		RUMEX ACETOSA subsp. ALPESTRIS
x		RUMEX BERINGENSIS
	x	RUMEX FENESTRATUS
	x	RUMEX SALICIFOLIUS var. MEXICANUS
	x	RUPPIA CIRRHOSA
x		SAGINA SAGINOIDES
x		SALIX COMMUTATA
x		SALIX STOLONIFERA
	x	SANGUISORBA OFFICINALIS
x		SAXIFRAGA BRACTEATA
	x	SAXIFRAGA ESCHSCHOLTZII
	x	SCHOENOPLECTUS TABERNAEMONTANI
	x	SCUTELLARIA GALERICULATA var. PUBESCENS
	x	SEDUM DIVERGENS
x		SELAGINELLA SIBIRICA
x		SILENE MENZIESII
x		SMELOWSKIA CALYCINA var. INTEGRIFOLIA
x		SMELOWSKIA CALYCINA var. PORSILDII
x		STELLARIA ALASKANA
x	x	SUBULARIA AQUATICA
x		TARAXACUM CARNEOCOLORATUM
x		TARAXACUM PHYMATOCARPUM
x		THLASPI ARCTICUM
x	x	TRIGLOCHIN PALUSTRIS
x		TRISETUM SIBIRICUM subsp. LITORALE
x		VAHLODEA ATROPURPUREA subsp. PARAMUSHIRENSIS

1994 to 1997	2003	Taxon
x		VERONICA SERPYLLIFOLIA subsp. HUMIFUSA
x		VIOLA ADUNCA
x		VIOLA SELKIRKII

Appendix 4.4. List of taxa which reach their North American distributon limit within Wrangell-St. Elias National Park & Preserve, Alaska, indicating state (AKNHP) and park rarity.

Taxon	**AKNHP Rare**	**Park Watch List**	**Limits of North American Distribution**			
			North	**South**	**East**	***West***
AGOSERIS AURANTIACA	X					X
AGOSERIS GLAUCA	X		X			
ARABIS CALDERI	X					X
ARABIS CODYI	X		X			X
ARABIS DREPANOLOBA	X					X
ARABIS LEMMONII	X		X			X
ARNICA DIVERSIFOLIA	X		X			X
ARTEMISIA HYPERBOREA						X
ASTRAGALUS EUCOSMUS subsp. SEALEI		X			X	
ASTRAGALUS HARRINGTONII	X		X			
BETULA KENAICA					X	
BOTRYCHIUM LINEARE	X		X			X
BOTRYCHIUM MONTANUM	X		X			X
BOTRYCHIUM TUNUX	X		X			X
BOTRYCHIUM YAAXUDAKEIT	X		X			
BRAYA GLABELLA		X		X		
BRAYA PURPURASCENS		X		X		
CAREX HOLOSTOMA	X			X		
CAREX HOODII	X		X			X
CASSIOPE MERTENSIANA		X	X			X
CASTILLEJA ELEGANS				X		
CASTILLEJA MINIATA	X		X			
CASTILLEJA PARVIFLORA			X			
CASTILLEJA YUKONIS		X				X
CERASTIUM REGELII	X			X		
CRYPTANTHA SHACKLETTEANA	X			X		
DESCHAMPSIA BREVIFOLIA				X		
DOUGLASIA ARCTICA	X			X		
DOUGLASIA GORMANII	X			X		
DRABA LONCHOCARPA var. THOMPSONII	X					X
DRABA OLIGOSPERMA		X				X
ELYMUS ALASKANUS subsp. ALASKANUS				X		
ELYMUS ALASKANUS subsp. BOREALIS				X		
ELYMUS ALASKANUS subsp. HYPERARCTICUS				X		
ELYMUS CALDERI	X					X
FESTUCA MINUTIFLORA	X		X			X
HACKELIA DEFLEXA			X			
LISTERA CAURINA		X				X
PAPAVER WALPOLEI	X			x	x	
PHLOX RICHARDSONII	X			X		
POTENTILLA RUBRICAULIS	X			X		X
PRENANTHES ALATA			X			

Taxon	**AKNHP Rare**	**Park Watch List**	**Limits of North American Distribution**			
			North	**South**	**East**	***West***
RANUNCULUS COOLEYAE		X	X			
RUMEX BERINGENSIS	X				X	
SALIX SITCHENSIS			X			
SAXIFRAGA SPICATA		X		X		
SEDUM DIVERGENS	X		X			
SMELOWSKIA BOREALIS var. BOREALIS				X		
SMELOWSKIA CALYCINAvar. INTEGRIFOLIA				X	X	
SMELOWSKIA CALYCINA var. PORSILDII	X			X	X	
SORBUS SITCHENSIS			X			
SYNTHYRIS BOREALIS				X		
TORREYOCHLOA PALLIDA var. PAUCIFLORA		X	X			
TRICHOPHORUM PUMILUM	X					X
TRISETUM SIBIRICUM subsp. LITORALE	X			X		

Appendix 4.5. Additions to rare plant watch list for Wrangell-St. Elias National Park and Preserve, Alaska, with plant family, the number of localities in the park (EO's), notes on global Nature Conservancy ranks, Alaska Natural Heritage Program (AKNHP) state ranks, North American distribution limits, and map numbers for the distribution maps in Cook and Roland (2002) or in this document (Chapter 7). An explanation of codes used under the notes column is at the end of Appendix 4.2. The rare plant watch list for the park is comprised of the AKNHP list (Appendix 4.2) and this list of additions.

Taxon	**Family**	**EO's**	**Notes**	**2002 Maps**	**2007 Maps**
ALLIUM SCHOENOPRASUM	Liliaceae	2			
ANEMONE MULTICEPS	Ranunculaceae	2	G3G4 S3S4, Alaska-Yukon endemic		
ANTENNARIA MEDIA	Asteraceae	5		201	
ARENARIA CAPILLARIS	Caryophyllaceae	4		82	
ARTEMISIA CAMPESTRIS	Asteraceae	2			
ASTER BOREALIS	Asteraceae	3		207	
ASTRAGALUS ADSURGENS subsp. VICIIFOLIUS	Fabaceae	2	G5T4 SNR, Alaska-Yukon endemic	151	
ASTRAGALUS BODINII	Fabaceae	5			
ASTRAGALUS EUCOSMUS subsp. SEALEI	Fabaceae	2		152	
ASTRAGALUS WILLIAMSII	Fabaceae	2		155	
BRAYA GLABELLA	Brassicaceae	3	S limit		
BRAYA PURPURASCENS	Brassicaceae	2	S limit	116	
BUPLEURUM AMERICANUM	Apiaceae	6			
CALLITRICHE ANCEPS	Callitrichaceae	3		160	
CALLITRICHE HERMAPHRODITICA	Callitrichaceae	5		161	18
CAREX ATHERODES	Cyperaceae	1			
CAREX BICOLOR	Cyperaceae	2			
CAREX BRUNNESCENS subsp. BRUNNESCENS	Cyperaceae	4			
CAREX CIRCINNATA	Cyperaceae	1	G3G4 S3S4, Pacific Coast endemic		21
CAREX DISPERMA	Cyperaceae	4			
CAREX DURIUSCULA	Cyperaceae	1			23
CAREX ECHINATA subsp. PHYLLOMANICA	Cyperaceae	1			
CAREX FOENEA	Cyperaceae	1			
CAREX GLACIALIS	Cyperaceae	2			
CAREX LAEVICULMIS	Cyperaceae	1			
CAREX LOLIACEA	Cyperaceae	1	G5 and S1, S2 or S3 in four Canadian Provinces		
CAREX MACKENZIEI	Cyperaceae	1	G4? and S1,S2 or S3 in five Canadian Provinces		30
CAREX MACROCEPHALA	Cyperaceae	1			
CAREX MARINA	Cyperaceae	1			

Taxon	Family	EO's	Notes	2002 Maps	2007 Maps
CAREX PACHYSTACHYA	Cyperaceae	5			
CAREX PAUCIFLORA	Cyperaceae	4		58	
CAREX SPECTABILIS	Cyperaceae	2			
CAREX WILLIAMSII	Cyperaceae	1		65	
CASSIOPE LYCOPODIOIDES	Ericaceae	1			
CASSIOPE MERTENSIANA	Ericaceae	1	W & N limit	173	
CASTILLEJA RAUPII	Scrophulariaceae	1			
CASTILLEJA YUKONIS	Scrophulariaceae	2	W limit	194	
CLADOTHAMNUS PYROLAEFLORUS	Ericaceae	4		174	
CLAYTONIA TUBEROSA	Portulacaceae	4		80	
CORYDALIS AUREA subsp. AUREA	Fumariaceae	1			
CRYPTOGRAMMA SITCHENSIS	Pteridaceae	7		7	
DELPHINIUM BRACHYCENTRUM	Ranunculaceae	3		100	
DESCHAMPSIA BREVIFOLIA	Poaceae	4		26	
DODECATHEON JEFFREYI	Primulaceae	1			
DRABA BOREALIS	Brassicaceae	4			
DRABA CINEREA	Brassicaceae	3		117	
DRABA OLIGOSPERMA	Brassicaceae	4	W limit	126	
EPILOBIUM LUTEUM	Onagraceae	2		167	
ERIGERON LONCHOPHYLLUS	Asteraceae	1			
ERIOPHORUM GRACILE	Cyperaceae	1			
GALIUM APARINE	Rubiaceae	2			
GALIUM BRANDEGEI	Rubiaceae	1			51
GENTIANA PLATYPETALA	Gentianaceae	3	G3G4 S3S4, Alaska-Yukon endemic	183	
GENTIANELLA TENELLA	Gentianaceae	2		184	
GOODYERA REPENS var. OPHIOIDES	Orchidaceae	2			
GYMNOCARPIUM JESSONENSE subsp. PARVULUM	Dryopteridaceae	1		10	
IMPATIENS NOLI-TANGERE	Balsaminaceae	1		162	
IRIS SETOSA	Iridaceae	2			
ISOETES ECHINOSPORA	Isoetaceae	6		2	
ISOETES MARITIMA	Isoetaceae	1			53
JUNCUS FALCATUS var. SITCHENSIS	Juncaceae	3			
KOBRESIA SIBIRICA	Cyperaceae	1		68	
LESQUERELLA ARCTICA subsp. PURSHII	Brassicaceae	1			
LIMOSELLA AQUATICA	Scrophulariaceae	1			55
LISTERA CAURINA	Orchidaceae	1	N limit		
MAIANTHEMUM DILATATUM	Liliaceae	1			
MINUARTIA STRICTA	Caryophyllaceae	2		87	
PARNASSIA FIMBRIATA	Saxifragaceae	3			
PEDICULARIS MACRODONTA	Scrophulariaceae	1			

Taxon	**Family**	**EO's**	**Notes**	**2002 Maps**	**2007 Maps**
PENSTEMON GORMANII	Scrophulariaceae	4		196	
PHEGOPTERIS CONNECTILIS	Thelypteridaceae	3			
PLATANTHERA STRICTA	Orchidaceae	1			
POA ABBREVIATA subsp. PATTERSONII	Poaceae	4			66
PODAGROSTIS AEQUIVALIS	Poaceae	1		35	
POTAMOGETON ZOSTERIFORMIS	Potamogetonaceae	2		19	
POTENTILLA FURCATA	Rosaceae	1			
PRIMULA CUNEIFOLIA subsp. SAXIFRAGIFOLIA	Primulaceae	4		179	
PRIMULA EGALIKSENSIS	Primulaceae	3		180	
PRUNELLA VULGARIS subsp. LANCEOLATA	Lamiaceae	1			
RANUNCULUS COOLEYAE	Ranunculaceae	2	N limit		
RANUNCULUS PEDATIFIDUS var. AFFINIS	Ranunculaceae	5		103	
ROMANZOFFIA SITCHENSIS	Saxifragaceae	1			
RUPPIA CIRRHOSA	Potamogetonaceae	1			74
SALIX HASTATA	Salicaceae	1			
SAXIFRAGA BRACTEATA	Saxifragaceae	2		142	77
SAXIFRAGA ESCHSCHOLTZII	Saxifragaceae	1			78
SAXIFRAGA SPICATA	Saxifragaceae	1			
SCHOENOPLECTUS TABERNAEMONTANI	Cyperaceae	2			80
SCUTELLARIA GALERICULATA var. PUBESCENS	Lamiaceae	2			81
SILENE WILLIAMSII	Caryophyllaceae	4	S limit	93	
SISYRINCHIUM LITORALE	Iridaceae	1			
SWERTIA PERENNIS	Gentianaceae	3	G5 S3S4	185	
TELLIMA GRANDIFLORA	Saxifragaceae	2			
TORREYOCHLOA PALLIDA var. PAUCIFLORA	Poaceae	2	N limit		
UTRICULARIA MINOR	Lentibulariaceae	2			
VIOLA BIFLORA	Violaceae	5		164	
VIOLA GLABELLA	Violaceae	2			
WILHELMSIA PHYSODES	Caryophyllaceae	1			

Appendix 4.6. List of non-native plant species documented along state roads in Wrangell-St. Elias National Park and Preserve, private land in the park and on park lands. AKEPIC = Alaska Exotic Plant Information Clearinghouse.

Taxon	**Common Name**	**AKEPIC Rank* 4/17/07**	**USFWS List of Noxious Weeds**	**State List of Noxious Weed Seed**	**Not Vouchered from Park Land**
Allium schoenoprasum	wild chive	53			
Arabis glabra	tower rockcress	59			x
Beckmannia syzigacene	slough-grass				
Bromus inermis subsp. *inermis*	smooth brome grass	62			
Capsella bursa-pastoris	shepherd's purse	40			
Caragana arborescens	Siberian peashrub	66			x
Cerastium fontanum	mouse-ear chickweed	36			
Chenopodium album	common lambsquarters	35			
Collomia linearis	narrowleaf-mountain trumpet				
Crepis tectorum	narrowleaf hawksbeard	54			
Descurainia sophia	flixweed	41			
Elymus repens	quackgrass	59			
Erysimum cheiranthoides subsp. *cheiranthoides*	wormseed mustard				
Eschscholzia californica	California poppy				x
Galeopsis tetrahit	hempnettle				x
Hordeum jubatum	foxtail barley	63			
Impatiens glandulifera	ornamental jewelweed	82			x
Lappula squarrosa	European stickseed	44			
Lepidium densiflorum	common pepperweed	25			
Leucanthemum vulgare	oxeye daisy	61	x		
Linaria vulgaris	yellow toadflax	69			
Lolium perenne subsp. *perenne*	perennial ryegrass	41			x
Matricaria discoidea	pineapple weed	32			
Medicago lupulina	black medic	48			x
Melilotus alba	white sweetclover	80	x		x
Melilotus officinalis	yellow sweetclover	65	x		x
Papaver rhoes	corn poppy				
Papaver somniferum	opium poppy				x
Phleum pratense	common timothy	56			x
Plantago major	common plantain	44			
Poa pratensis subsp. pratensis	Kentucky bluegrass	52			
Polygonum aviculare	prostrate knotweed	45			
Polygonum convolvulus	black bindweed			x	
Secale cerale	wild rye				x
Silene latifolia	bladder campion	45			x
Stellaria media	common chickweed	42			x
Taraxacum officinale subsp. officinale	common dandelion	58			
Thlaspi arvense	field pennycress				x
Trifolium hybridum	alsike clover	57	x		x
Trifolium pratense	red clover	53			
Trifolium repens	white clover	59			x
Tripleurospermum perforata	scentless false mayweed	48			x

Taxon	**Common Name**	**AKEPIC Rank* 4/17/07**	**USFWS List of Noxious Weeds**	**State List of Noxious Weed Seed**	**Not Vouchered from Park Land**
Veronica serpyllifolia subsp serpyllifolia	thyme-leaf speedwell				
Vicia cracca	bird vetch	73			x
Vicia sativa	common vetch				x

Appendix 6.1. Vascular plants documented by vouchers within Wrangell-St. Elias National Park and Preserve, June 2006.

Adoxaceae

Adoxa moschatellina L.

Apiaceae

Angelica genuflexa Nutt.

Angelica lucida L.

Bupleurum americanum Coult. & Rose

Cicuta douglasii (DC.) Coult. & Rose

Cicuta virosa L.

Cnidium cnidiifolium (Turcz.) Schischkin

Conioselinum gmelinii (Cham. & Schlecht.) Steud.

Heracleum lanatum Michx.

Ligusticum scoticum L. subsp. *hultenii* (Fern.) Calder & Taylor

Osmorhiza chilensis Hook. & Arn.

Osmorhiza depauperata Phil.

Osmorhiza purpurea (Coult. & Rose) Suksdorf

Araceae

Calla palustris L.

Araliaceae

Oplopanax horridus (Sm.) Miq

Asteraceae

Achillea borealis Bong.

Achillea lanulosa Nutt.

Achillea millefolium L.

Achillea sibirica Ledeb.

Agoseris aurantiaca (Hook.) Greene

Agoseris glauca (Pursh) Raf.

Anaphalis margaritacea (L.) Benth. & Hook.

Antennaria alpina (L.) Gaertn.

Antennaria friesiana (Trautv.) Ekman subsp. *alaskana* (Malte) Hult.

Antennaria friesiana (Trautv.) Ekman subsp. *friesiana* Trautv.

Antennaria media Greene

Antennaria monocephala DC. subsp. *angustata* (Greene) Hult.

Antennaria monocephala DC. subsp. *monocephala* (Greene) Hult.

Antennaria pulcherrima (Hook.) Greene

Antennaria rosea E.L. Greene subsp. *arida* (E. Nels.) Bayer

Antennaria rosea E.L. Greene subsp. *confinis* (E.L. Greene) Bayer

Antennaria rosea E.L. Greene subsp. *pulvinata* (E.L. Greene) Bayer

Antennaria rosea E.L. Greene subsp. *rosea*

Arnica amplexicaulis Nutt.

Arnica angustifolia Vahl in Hornem. subsp. *angustifolia* Vahl

Arnica angustifolia Vahl in Hornem. subsp. *attenuata* (Greene) Douglas & Royle-Douglas

Arnica chamissonis Less. subsp. *chamissonis*

Arnica cordifolia Hook.

Arnica diversifolia Greene

Arnica frigida C. A. Mey. ex Iljin subsp. *frigida*

Arnica latifolia Bong.

Arnica lessingii (Torr. & Gray) Greene

Arnica mollis Hook.

Artemisia alaskana Rydb.

Artemisia arctica Less.

Artemisia campestris L.

Artemisia dracunculus L.

Artemisia frigida Willd.

Artemisia hyperborea Rydb.

Artemisia tilesii Ledeb.

Aster alpinus L. subsp. *vierhapperi* Onno

Aster junciformis Rydb.

Aster sibiricus L.

Aster subspicatus Nees

Crepis elegans Hook.

Crepis nana var. *nana* Richards

Crepis tectorum L.

Erigeron acris L. subsp. *kamtschaticus* Ledeb.

Erigeron caespitosus Nutt.

Erigeron compositus Pursh.

Erigeron denalii A. Nelson

Erigeron elatus Greene

Erigeron eriocephalus J. Vahl.

Erigeron humilis Graham

Erigeron lonchophyllus Hook.

Erigeron nivalis Nutt.

Erigeron peregrinus (Pursh) Greene

Erigeron porsildii G.L. Nesom & D.F. Murray

Erigeron purpuratus Greene

Hieracium triste Willd.

Leucanthemum vulgare Lam.

Matricaria matricarioides (Less.) Porter

Packera cymbalaria (Pursh) W.A. Weber & A. Löve

Petasites frigidus (L.) Fries var. *frigidus*

Petasites frigidus (L.) Fries var. *nivalis* (Greene) Cronq.

Prenanthes alata (Hook.) D. Dietr.

Saussurea angustifolia (Willd.) DC. subsp. *angustifolia*

Saussurea angustifolia (Willd.) DC. subsp. *yukonensis* (Porsild) Cody

Senecio congestus (R. Br.) DC.

Senecio lugens Richards.

Senecio ogotorukensis Packer

Senecio pauciflorus Pursh

Senecio pauperculus Michx.

Senecio pseudo-arnica Less.

Senecio triangularis Hook.

Solidago decumbens Greene var. *oreophila* (Rydb.) Fern.

Solidago lepida DC.

Solidago multiradiata Ait.

Taraxacum alaskanum Rydb.

Taraxacum carneocoloratum Nels.

Taraxacum ceratophorum (Ledeb.) DC.

Taraxacum kamtschaticum Dahlstedt

Taraxacum lacerum Greene

Taraxacum officinale Weber

Taraxacum phymatocarpum J. Vahl

Tephroseris atropurpurea (Ledeb.) Holub subsp. *frigidus* (Richardson) D. Löve

Tephroseris kjellmanii (Porsild) Holub

Tephroseris lindstroemii (Ostenf.) A. & D. Löve

Tripleurospermum perforata Merat (M. Lainz)

Balsaminaceae

Impatiens noli-tangere L.

Betulaceae

Alnus incana (L.) Moench subsp. *tenuifolia* (Nutt.) Breitung

Alnus rubra Bong.

Alnus viridis (Vill.) DC. subsp. *fruticosa* (Aiton) Turrill

Alnus viridis (Vill.) DC. subsp. *sinuata* (Regel) A. Löve & D. Löve

Betula glandulosa Michx.

Betula kenaica W.H. Evans

Betula nana L. subsp. *exilis* (Sukaczev) Hult.

Betula neoalaskana Sargent

Betula occidentalis Hook.

Betula papyrifera Marsh.

Boraginaceae

Cryptantha shackletteana L.C. Higgins

Hackelia deflexa (Wahl.) Opiz

Lappula occidentalis (Wats.) var. *occidentalis*

Lappula squarrosa (Retz.) Dumort

Mertensia maritima (L.) S.F. Gray

Mertensia paniculata (Ait.) G. Don var. *paniculata*

Myosotis alpestris F. W. Schmidt subsp. *asiatica* Vestergr.

Brassicaceae

Aphragmus eschscholtzianus Andrz.

Arabis calderi G. A. Mulligan

Arabis codyi G.A. Mulligan

Arabis divaricarpa Nels. var. *dacotica* (Greene) B. Boivin

Arabis divaricarpa Nels. var. *divaricarpa*

Arabis drepanoloba Greene

Arabis drummondii Gray

Arabis eschscholtziana (L.) Scop.

Arabis hirsuta (L.) Scop. var. *pycnocarpa* (M. Hopkins) Rollins

Arabis holboellii Hornem. var. *pinetorum* (Tidestrom) Rollins

Arabis holboellii Hornem. var. *retrofracta* (Graham) Rydb.

Arabis kamchatica (Fisch.) Ledeb.

Arabis lemmonii S. Wats.

Arabis media N. Busch

Barbarea orthoceras Ledeb.

Braya glabella Richardson

Braya humilis (C.A. Mey.) Robins.

Braya purpurascens (R. Br.) Bunge

Capsella bursa-pastoris (L.) Medic.

Cardamine bellidifolia L.

Cardamine oligosperma Nutt. var. *kamtschatica* (Regel) Detling

Cardamine pratensis L. subsp. *angustifolia* (Hook.) O.E. Schulz

Cardamine purpurea Cham. & Schlect.

Descurainia richardsonii (Sweet) O.E. Schulz

Descurainia sophia (L.) Prantl

Descurainia sophioides (Fisch.) O.E. Schulz

Draba alpina L.

Draba aurea M. Vahl ex Hornem

Draba borealis DC.

Draba breweri S. Wats. var. *cana* (Rydb.) Rollins

Draba cinerea Adams

Draba corymbosa R. Br. ex DC.

Draba crassifolia Graham

Draba densifolia Nutt. ex Torrey & A. Gray

Draba fladnizensis Wulfen var. *fladnizensis*

Draba glabella Pursh

Draba incerta Payson

Draba kananaskis G.A. Mulligan

Draba lactea Adams

Draba lonchocarpa Rydb. var. *lonchocarpa*

Draba lonchocarpa Rydb. var. *thompsonii* (C.L. Hitchc.) Rollins

Draba longipes Raup

Draba macounii O.E. Schulz

Draba nemorosa L.

Draba nivalis Liljebl.

Draba oligosperma Hook.

Draba palanderiana Kjellman

Draba porsildii G. A. Mulligan

Draba praealta E.L. Greene

Draba ruaxes Payson & H.

Draba stenoloba Ledeb.

Draba stenopetala Trautv.

Erysimum cheiranthoides L.

Erysimum inconspicuum (S. Wats.) MacMillan var. *inconspicuum*

Erysimum pallasii (Pursh) Fern. var. *pallasii*

Eutrema edwardsii R. Br.

Halimolobos mollis (Hook.) Rollins

Lepidium densiflorum Schrad.

Lesquerella arctica (Wormsk.) S. Wats.

Lesquerella arctica (Wormsk.) S. Wats. subsp. *arctica*

Lesquerella arctica (Wormsk.) S. Wats. subsp. *purshii* (S. Wats.) Porsild

Parrya nudicaulis (L.) Regel subsp. *interior* Hult.

Parrya nudicaulis (L.) Regel subsp. *nudicaulis*

Rorippa palustris (L.) Besser var. (Butters & Abbe) Stuckey

Rorippa palustris (L.) Besser var. *hispida* (Desvaux) Jonsell

Rorippa palustris (L.) Besser var. *palustris*

Smelowskia borealis (E. L. Greene) Drury & Rollins var. *borealis*

Smelowskia borealis (E. L. Greene) Drury & Rollins var. *villosa* Drury & Rollins

Smelowskia calycina (Steph.) C.A. Mey var. *integrifolia* (Seem.) Rollins

Smelowskia calycina (Stephan) C.A. Meyer var. *porsildii* Drury & Rollins

Subularia aquatica L.

Thlaspi arcticum Pors.

Turritis glabra L.

Callitrichaceae

Callitriche anceps Fern.

Callitriche hermaphroditica L.

Callitriche palustris L.

Campanulaceae

Campanula lasiocarpa Cham. subsp. *lasiocarpa*

Campanula latisepala Hult.

Campanula rotundifolia L.

Campanula uniflora L.

Caprifoliaceae

Linnaea borealis L.

Sambucus racemosa L. subsp. *pubens* (Michx.) House

Viburnum edule (Michx.) Raf.

Caryophyllaceae

Arenaria capillaris Poir.

Arenaria longipedunculata Hult.

Cerastium arvense L.

Cerastium beeringianum Cham. & Schlecht. var. *beeringianum*

Cerastium beeringianum Cham. & Schlecht. var. *grandiflorum* (Fenzl) Hult.

Cerastium fontanum Baumg.

Cerastium regelii Ostenf.

Gastrolychnis taimyrensis (Tolm.) Czern.

Honckenya peploides (L.) Ehrh. subsp. *major* (Hook.) Hult.

Melandrium affine J. Vahl
Melandrium apetalum (L.) Fenzl subsp. *arcticum* (E. Fries) Hult

Melandrium macrospermum Pors.

Minuartia arctica (Stev.) Aschers. & Graebn

Minuartia biflora (L.) Schinzl. & Thell.

Minuartia dawsonensis (Britt.) Mattf.

Minuartia elegans (Cham. & Schlecht.) Schischk.

Minuartia macrocarpa (Pursh) Ostenf.

Minuartia obtusiloba (Rydb.) House

Minuartia rossii (R. Br.) Graebn.

Minuartia rubella (Wahlenb.) Graebn.

Minuartia stricta (Sw.) Hiern

Moehringia lateriflora (L.) Fenzl

Sagina nivalis (Lindbl.) Fries

Sagina saginoides (L.) Karst.

Silene acaulis L.

Silene involucrata (Cham. & Schlecht.)Bocquet subsp. *tenella* (Tolm.) Bocquet

Silene menziesii Hook.

Silene repens Patrin

Silene williamsii Britt.

Stellaria alaskana Hult.

Stellaria borealis Bigelow subsp. *borealis*

Stellaria calycantha (Ledeb.) Bong.

Stellaria crassifolia Ehrh.

Stellaria crispa Cham. & Schlecht.

Stellaria edwardsii R. Br.

Stellaria laeta Richards

Stellaria longifolia Muhl.

Stellaria longipes Goldie

Stellaria longipes Hult. var. *monantha* (Hult.) Emery & Chinnapappa

Stellaria sitchana Steud. var. *bongardiana* (Fern.) Hult.

Stellaria umbellata Turcz.

Wilhelmsia physodes (Fisch.) McNeill

Ceratophyllaceae

Ceratophyllum demersum L.

Chenopodiaceae

Chenopodium album L.

Chenopodium capitatum (L.) Aschers.

Monolepis nuttalliana (Schult.) Greene

Cornaceae

Cornus canadensis L.

Cornus stolonifera Michx.

Cornus suecica L.

Crassulaceae

Rhodiola integrifolia Raf.

Sedum divergens S.Wats.

Cupressaceae

Juniperus communis L. var. *depressa* Pursh.

Juniperus horizontalis Moench

Cyperaceae

Carex adelostoma Krecz.

Carex albonigra Mack.

Carex anthoxanthea J. & C. Presl

Carex aquatilis Wahlenb. var. *aquatilis*

Carex aquatilis Wahlenb. var. *minor* Boott

Carex aquatilis Wahlenberg var. *dives* (T. Holm) Küenthal

Carex atherodes Spreng.

Carex atratiformis Britt.

Carex atrofusca Schkuhr

Carex atrosquama Mack.

Carex aurea Nuttall

Carex bicolor All.

Carex bigelowii Torrey ex Schweinitz subsp.
lugens
(T. Holm) T.V. Egorova

Carex brunnescens (Pers.) Poir subsp.
brunnescens

Carex brunnescens (Pers.) Poir subsp. *pacificus*

Carex buxbaumii Wahlenb.

Carex canescens L.

Carex capillaris L.

Carex capitata Soland. in L.

Carex chordorrhiza Ehrhart ex. Linnaeus f.

Carex circinnata C.A. Mey

Carex concinna R. Br.

Carex crawfordii Fern.

Carex diandra Schrank

Carex disperma Dewey

Carex duriuscula C.A. Mey

Carex eburnea Boott

Carex echinata Murray subsp. *phyllomanica* (W. Boott) Reznicek

Carex filifolia Nutt.

Carex foenea Fern.

Carex fuliginosa Schkuhr

Carex garberi Fern.

Carex glacialis Mack.

Carex gynocrates Wormskj. ex Drejer

Carex holostoma Drej.

Carex hoodii W. Boott

Carex interior Bailey

Carex krausei Boeck.

Carex lachenalii Schkuhr

Carex laeviculmis Meinsh.

Carex lapponica O. Lang

Carex lasiocarpa Ehrh. subsp. americana (Fern.) Hult.

Carex laxa Wahlenb.

Carex lenticularis Michx. var. dolia (M.E. Jones) L.A. Standley

Carex lenticularis Michx. var. lipocarpa (Holm) L.A. Standley

Carex leptalea Wahlenb.

Carex limosa L.

Carex livida (Wahl.) Willd.

Carex loliacea L.

Carex lyngbyaei Hornem.

Carex mackenziei Krecz.

Carex macloviana d'Urville

Carex macrocephala Willd. ex Spreng.

Carex macrochaeta C.A. Mey.

Carex magellanica Lam. subsp. irrigua (Wahlenb.) Hult.

Carex marina Dewey

Carex maritima Gunn.

Carex media R. Br.

Carex membranacea Hook.

Carex mertensii Prescott ex Bong.

Carex microchaeta T. Holm subsp. microchaeta

Carex microchaeta T. Holm subsp. nesophila (T. Holm.) D.F. Murray

Carex microglochin Wahlenb. subsp. microglochin

Carex micropoda C.A. Meyer

Carex nardina E. Fries

Carex nigricans C.A. Mey

Carex obtusata Liljeb.

Carex pachystachya Cham. ex. Steud.

Carex parryana Dew.

Carex pauciflora Lightf.

Carex petricosa Dewey var. petricosa

Carex phaeocephala Piper

Carex pluriflora Hult.

Carex podocarpa R. Brown ex Richardson

Carex praticola Rydb.

Carex rossii Boott

Carex rostrata Stokes

Carex rotundata Wahlenb.

Carex rupestris All.

Carex saxatilis L.

Carex scirpoidea Michx. subsp. *scirpoidea*

Carex spectabilis Dew.

Carex stylosa C.A. Mey.

Carex supina Willd. subsp. *spaniocarpa* (Steud.) Hult.

Carex tahoensis Smiley

Carex tenuiflora Wahlenb.

Carex utriculata F. Boott

Carex vaginata Tausch

Carex viridula Michaux subsp. *viridula*

Carex williamsii Britt.

Eleocharis acicularis (L.) Roem. & Schult.

Eleocharis macrostachya Britton

Eleocharis palustris (L.) Roem. & Schult.

Eleocharis quinqueflora (F. X. Hartm.) O. Schwarz

Eriophorum angustifolium Honck. subsp. *angustifolium*

Eriophorum angustifolium Honck. subsp. *subarcticum* (Vassiljev) Hult.

Eriophorum angustifolium Honckeny subsp. *triste* (Th. Fries) Hult.

Eriophorum angustifolium Honk. subsp. *scabriusculum* (Vassiljev) Hult.

Eriophorum brachyantherum Trautv.

Eriophorum callitrix Cham.

Eriophorum chamissonis C.A. Meyer

Eriophorum gracile W.D.J. ex Koch

Eriophorum scheuchzeri Hoppe

Eriophorum vaginatum L.

Eriophorum viridicarinatum (Engelm.) Fern.

Kobresia myosuroides (Vill.) Fiori & Paol.

Kobresia sibirica Turcz.

Kobresia simpliciuscula (Wahlenb.) Mack.

Schoenoplectus tabernaemontani (G.C. Gmelin) Palla

Trichophorum alpinum (L.) Pers.

Trichophorum cespitosum (L.) Schur

Trichophorum pumilum (M. Vahl.) Schinz. & Thell. var. *rollandii* (Fern.) Hult.

Diapensiaceae

Diapensia lapponica L. subsp. *obovata* (F. Schm.) Hult.

Droseraceae

Drosera anglica Huds.

Droseraceae

Drosera rotundifolia L.

Dryopteridaceae

Athyrium filix-femina (L.) Roth subsp. *cyclosorum* (Rupr.) Christens.

Cystopteris fragilis (L.) Bernh.

Cystopteris montana (Lam.) Bernh.

Dryopteris expansa (K. Presl) Fraser-Jenkins & Jermy

Dryopteris fragrans (L.) Schott

Gymnocarpium dryopteris (L.) Newm.

Gymnocarpium jessoense (Koidz.) Koidz. subsp. *parvulum* Sarvela

Polystichum lonchitis (L.) Roth

Woodsia alpina (Bolton) S. F. Gray

Woodsia glabella R. Br.

Woodsia ilvensis (L.) R. Br.

Elaeagnaceae

Elaeagnus commutata Bernh.

Sherperdia canadensis (L.) Nutt.

Empetraceae

Empetrum nigrum L. subsp. *hermaphroditum* (Lange ex Hagerup) Böcher

Equisetaceae

Equisetum arvense L.

Equisetum fluviatile L. ampl. Ehrh.

Equisetum hyemale L.

Equisetum palustre L.

Equisetum pratense L.

*Equisetum scirp*oides Michx.

Equisetum sylvaticum L.

Equisetum variegatum Schleich. subsp. *alaskanum* (A. A. Eat.) Hult.
Equisetum variegatum Schleich. subsp. *variegatum*

Ericaceae

Andromeda polifolia L.

Ericaceae

Arctostaphylos alpina (L.) Spreng.

Arctostaphylos rubra (Rehd. & Wilson) Fern.

Arctostaphylos uva-ursi (L.) Spreng.

Cassiope lycopodioides (Pall.) D. Don

Cassiope mertensiana (Bong.) D. Don

Cassiope stelleriana (Pall.) DC.

Cassiope tetragona (L.) D. Don

Chamaedaphne calyculata (L.) Moench

Cladothamnus pyroliflorus Bong.

Ledum groenlandicum Oeder

Ledum palustre L. subsp. *decumbens* (Ait.) Hult.

Loiseleuria procumbens (L.) Desv.

Oxycoccus microcarpus Turcz.

Phyllodoce aleutica (Spreng.) Heller subsp. *glanduliflora*

Rhododendron lapponicum (L.) Wahlenb.

Vaccinium alaskensis How.

Vaccinium caespitosum Michx.

Vaccinium ovalifolium Sm.

Vaccinium uliginosum L. subsp. *alpinum* (Bigel) Hult.

Vaccinium uliginosum L. subsp. microphyllum Lange

Vaccinium vitis-idaea L. subsp. *minus* (Lodd.) Hult.

Fabaceae

Astragalus aboriginorum Richards.

Astragalus adsurgens Pall. subsp. *viciifolius*

(Hult.)
Welsh

Astragalus alpinus L. subsp. *alpinus*

Astragalus bodinii Sheld.

Astragalus eucosmus Robins. subsp. *euscosmus*

Astragalus eucosmus Robins. subsp. *sealei* (Lepage) Hult.

Astragalus harringtonii (Rydb.) Hult.

Astragalus nutzotinensis Rousseau

Astragalus umbellatus Bunge

Astragalus williamsii Rydb.

Hedysarum alpinum L. subsp. *americanum* (Michx.) Fedtsch.

Hedysarum boreale Nutt. subsp. *mackenziei* (Richards.) Welsh

Hedysarum hedysaroides (L.) Schinz & Thell.

Lathyrus maritimus L. subsp. *maritimus*

Lathyrus palustris L. subsp. *pilosus* (Cham.) Hult.

Lupinus arcticus S. Wats.

Lupinus kuschei Eastw.

Lupinus nootkatensis Donn.

Oxytropis borealis DC.

Oxytropis campestris (L.) DC. subsp. *jordalii* (Pors.) Hult.

Oxytropis campestris (L.) DC. subsp. *varians* (Rydb.) Cody

Oxytropis deflexa (Pall.) DC. var. *foliolosa* (Hook.) Barneby

Oxytropis deflexa (Pall.) DC. var. *sericea* Torr. & Gray

Oxytropis huddelsonii Pors.

Oxytropis maydelliana Trautv.

Oxytropis nigrescens (Pall.) Fisch. subsp.*bryophila* (Greene) Hult.

Oxytropis scammaniana Hult.

Oxytropis splendens Dougl.

Oxytropis viscida Nutt.

Trifolium hybridum L.

Trifolium pratense L.

Trifolium repens L.

Fumariaceae

Corydalis aurea Willd. subsp. aurea

Corydalis pauciflora (Steph.) Pers.

Gentianaceae

Fauria crista-galli (Menzies) Makino

Gentiana glauca Pall.

Gentiana platypetala Griseb.

Gentiana prostrata Haenke

Gentianella amarella (L.) Borner subsp. *acuta* (Michx) J.M. Gillett

Gentianella propinqua (Richards.) J.M. Gillett

Gentianella propinqua (Richards.) J.M. Gillett subsp. *arctophila* (Griseb.) Hult.

Gentianella propinqua (Richards.) J.M. Gillett subsp. *propinqua*

Gentianella tenella (Rottb.) Borner

Lomatogonium rotatum (L.) E. Fries

Swertia perennis L.

Geraniaceae

Geranium erianthum DC.

Haloragaceae

Hippuris montana Ledeb.

Hippuris vulgaris L.

Myriophyllum sibiricum Komarov

Myriophyllum verticillatum L.

Hydrophyllaceae

Phacelia mollis Macbr.

Iridaceae

Iris setosa Pall.

Sisyrinchium litorale Greene

Isoetaceae

Isoetes echinospora Durieu

Isoetes maritima L. Underwood

Juncaceae

Juncus alpinoarticulatus Chaix

Juncus arcticus Willd. var. *alaskanus* Hult.

Juncus arcticus Willd. var. *balticus* (Wildenow) Trautvetter

Juncus biglumis L.

Juncus bufonius L.

Juncus castaneus Sm.

Juncus drummondii E. Mey.

Juncus falcatus E. Mey. subsp. *sitchensis* (Buchenau) Hult.

Juncus filiformis L.

Juncus mertensianus Bong.

Juncus triglumis L. subsp. *albescens* Lange

Luzula arctica Blytt

Luzula arcuata (Wahlenb.) Sw. subsp. *unalaschcensis* (Buchenau) Hult.

Luzula confusa Lindeb.

Luzula kjellmaniana Miyabe & Kudo

Luzula multiflora (Ehrhart) Lejeune subsp. *frigida*

Luzula multiflora (Ehrhart) Lejeune subsp.

kobayasii
(Satake) Hult.

Luzula parviflora (Ehrh.) Desv.

Luzula rufescens Fisch. ex E. Meyer

Luzula spicata (L.) DC.

Luzula wahlenbergii Rupr.

Lamiaceae

Mentha arvensis L.

Prunella vulgaris L. subsp. *lanceolata* (Carton) Hult.

Scutellaria galericulata L. var. *pubescens* Benth.

Lemnaceae

Lemna minor L.

Lemna trisulca L.

Lentibulariaceae

Pinguicula villosa L.

Pinguicula vulgaris L.

Utricularia intermedia Hayne

Utricularia minor L.

Utricularia vulgaris L. subsp. *macrorhiza* (Le Conte) Clausen

Liliaceae

Allium schoenoprasum (L.) Hartm.

Fritillaria camschatcensis (L.) Ker-Gawl.

Lloydia serotina (L.) Rchb.

Maianthemum dilatatum (How.) Nels. & Macbr.

Maianthemum stellatum (L.) Link

Streptopus amplexifolius (L.) DC.

Tofieldia coccinea Richards.

Tofieldia glutinosa (Michx.) Pers. subsp. *brevistyla* Hitchc.

Tofieldia pusilla (Michx.) Pers.

Veratrum viride Ait subsp. *eschscholtzii* (Gray) Löve & Löve

Zigadenus elegans Pursh

Linaceae

Linum perenne L. subsp. *lewisii* (Pursh) Hult.

Lycopodiaceae

Diphasiastrum alpinum (L.) Holub

Diphasiastrum complanatum (L.) Holub

Diphasiastrum sitchense (Ruprecht) Holub

Huperzia haleakalae (Brackenridge) Holub

Lycopodium annotinum L. subsp. *annotinum*

Lycopodium lagopus Laestadius ex C. Hartman

Menyanthaceae

Menyanthes trifoliata L.

Myricaceae

Myrica gale L. var. *tomentosa* L. DC.

Najadaceae

Najas flexilis (Willdenow) Rostkov. & Schmidt

Nymphaceae

Nuphar polysepala Engelm.

Nymphaea tetragona Georgi

Onagraceae

Circaea alpina L.

Epilobium anagallidifolium Lam.

Epilobium angustifolium L.

Epilobium ciliatum Raf. subsp. *ciliatum*

Epilobium ciliatum Raf. subsp. *glandulosum* (Lehm.) Hock & Raven

Epilobium davuricum Fisch. ex Hornem.

Epilobium hornemannii Rchb. subsp. *hornemannii*

Epilobium hornemannii Reichenb. subsp. *behringianum* (Hausskn.) Hoch & Raven

Epilobium lactiflorum Haussk.

Epilobium latifolium L.

Epilobium leptocarpum Haussk.

Epilobium luteum Pursh

Epilobium palustre L.

Ophioglossaceae

Botrychium alaskense W.H. Wagner & J.R. Grant

Botrychium ascendens W.H. Wagner

Botrychium hesperium (Maxon & R.T. Clausen) W.H. Wagner & Lellinger

Botrychium lanceolatum (Gmel.) Angstr.

Botrychium lineare W.H. Wagner

Botrychium lunaria (Linneaus) Swartz

Botrychium minganense Victorin

Botrychium montanum W.H. Wagner

Botrychium pinnatum H. St. John

Botrychium tunux Stensvold & Farrar

Botrychium yaaxudakeit Stensvold & Farrar

Orchidaceae

Amerorchis rotundifolia (Banks) Hult.

Calypso bulbosa (L.) Oakes

Coeloglossum viride (L.) Hartm. subsp. *bracteatum* (Muhl.) Hult.

Coeoglossum viride (L.) Hartm. subsp. *viride* L.

Corallorrhiza trifida Chatelain

Cypripedium parviflorum L.

Cypripedium passerinum Richards.

Goodyera repens (L.) R. Br. var. *ophioides* Fern

Listera borealis Morong

Listera caurina Piper

Listera cordata (L.) R. Br.

Platanthera dilatata (Pursh) Lindl.

Platanthera hyperborea auct. non (L.) Lindl.

Platanthera obtusata (Pursh) Lindl.

Platanthera stricta Lindl.

Spiranthes romanzoffiana Cham.

Orobanchaceae

Boschniakia rossica (Cham. & Schlecht.) Fedtsch.

Papaveraceae

Papaver alboroseum Hult.

Papaver lapponicum (Tolm.) Nordh.

Papaver macounii Greene subsp. *discolor* (Hult.) Randel ex D.F. Murray

Papaver radicatum Hult. subsp. *alaskanum*

Papaver radicatum Rottball subsp. *kluanense* (D. Löve) D.F. Murray

Papaver rhoeas L.

Papaver walpolei A.E. Porsild

Pinaceae

Picea glauca (Moench) Voss

Picea mariana (Mill.) B.S.P.

Picea sitchensis (Bong.) Carr.

Plantaginaceae

Plantago canescens Adams

Plantago eriopoda Torr.

Plantago macrocarpa Cham. & Schlect.

Poaceae

Agrostis exarata Trin.

Agrostis mertensii Trin.

Agrostis scabra Willd.

Agrostis thurberiana A. S. Hitchc.

Alopecurus aequalis Sobol.

Alopecurus magellanicus Lam.

Anthoxanthum monticola (Bigelow) Y. Schouten & Veldkamp

Anthoxanthum nitens (Weber) Y. Schoulen & Veldkamp

Arctagrostis latifolia (R. Br.) Griseb. var. *arundinacea* (Trin.) Griseb.

Arctagrostis latifolia (R. Br.) Griseb. var. *latifolia*

Arctophila fulva (Trin.) Anderss.

Avena sativa L.

Beckmannia syzigachne (Steud.) Fernald

Bromus inermis Leyss. subsp. *inermis*

Bromus pumpellianus Scribn. var. *arcticus* (Shear) Pors.

Calamagrostis canadensis (Michx.) Beauv. subsp. *langsdorffi* (Link) Hult.

Calamagrostis canadensis (Michx.) P. Beauv. var. *canadensis*

Calamagrostis lapponica (Wahlenb.) Hartm.

Calamagrostis purpurascens R. Br.

Calamagrostis stricta (Timm) Koeler subsp. *inexpansa* (A. Gray) C.W. Greene

Calamagrostis stricta (Timm) Koeler subsp. *stricta*

Cinna latifolia (Trev.) Griseb.

Danthonia intermedia Vasey

Deschampsia brevifolia R. Br.

Deschampsia cespitosa (L.) Beauv. subsp. *glauca* (C. Hartm.) C. Hartm.

Deschampsia cespitosa (L.) P. Beauv. subsp. *beringensis* (Hult.) W.E. Lawr.

Deschampsia cespitosa (L.) P. Beauv. subsp. *cespitosa*

Elymus alaskanus (Scribner & Merr.) A. Löve

Elymus calderi Barkw.

Elymus macrourus (Turcz.) Drobov

Elymus repens (L.) Gould

Elymus trachycaulus (Link) Gould ex Shinners subsp. *novae-angliae* (Scribn.) Tzvelev.

Elymus trachycaulus (Link) Gould ex Shinners subsp. *subsecundus* (Link) Gould

Elymus trachycaulus (Link) Gould ex Shinners subsp. *trachycaulus*

Elymus trachycaulus (Link) Gould ex Shinners subsp. *violaceus* (Hornem.) A. & D. Love

Festuca altaica Trin.

Festuca baffinensis Polunin

Festuca brachyphylla Schultes et. Schultes fil.

Festuca brevissima Jurtzev

Festuca lenensis Drobov

Festuca minutiflora Rydb.

Festuca rubra L.

Festuca rubra L. subsp. *arctica* (Hack.) Govor.

Festuca saximontana Rydberg

Festuca vivipara (L.) Smith

Glyceria borealis (Nash) Batchelder

Glyceria pulchella (Nash) K. Schum.

Hordeum brachyantherum Nevski

Hordeum jubatum L.

Leymus mollis (Trin.) Pilger subsp. *mollis*

Phippsia algida (Soland.) R. Br.

Phleum alpinum L.

Poa abbreviata R. Br. subsp. *pattersonii* (Vasey) A. Löve et. al.

Poa alpigena (E. Fries) Lindm.

Poa alpina L.

Poa arctica R. Br. subsp. *arctica*

Poa arctica R. Br. subsp. *lanata* (Scribn. & Merr.) R.J. Soreng

Poa glauca M. Vahl. subsp. *glauca*

Poa glauca M. Vahl. subsp. *rupicola* (Nash) W.A. Weber

Poa interior Rydb.

Poa leptocoma Trin.

Poa palustris L.

Poa paucispicula Scribn. & Merr.

Poa pratensis L. subsp. *alpigena* (Lindm.)

Hiitonen

Poa pratensis L. subsp. *pratensis*

Poa pratensis L. var. *colpodea* (Th.Fr.) Soreng

Poa pseudoabbreviata Roshev.

Poa secunda Presl subsp. *secunda*

Poa stenantha Trin.

Podagrostis aequivalis (Trin.) Scribn. & Merr.

Puccinellia nutkaensis (Presl) Fern & Weath.

Puccinellia nuttalliana (Schult.) Hitchc.

Puccinellia vahliana (Liebm.) Scribn. & Merr.

Torreyochloa pallida (Torr.) G.L. Church var. *pauciflora* (J. Presl) J.I Davis

Trisetum cernuum Trin.

Trisetum sibiricum Rupr. subsp. *litorale* (Rupr.) Roshev.

Trisetum spicatum (L.) Richter subsp. *spicatum*

Vahlodea atropurpurea (Wahlenb.) E. Fries subsp. *atropurpurea*

Vahlodea atropurpurea (Wahlenb.) E. Fries subsp. *paramushirensis* (Kudo) Hult.

Polemoniaceae

Collomia linearis Nutt.

Phlox hoodii Richards.

Phlox sibirica L. subsp. *richardsonii* (Hook.) Hult.

Polemonium acutiflorum Willd.

Polemonium boreale Adams subsp. *boreale*

Polemonium boreale Adams subsp. *villosissimum* Hult.

Polemonium pulcherrimum Hook. var. *pulcherrimum*

Polygonaceae

Bistorta plumosa (Small) Greene

Koenigia islandica L.

Oxyria digyna (L.) Hill

Polygonum alaskanum (Small) Wight

Polygonum amphibium L. subsp. *laevimarginatum* Hult.

Polygonum aviculare L.

Polygonum caurianum Robins.

Polygonum convolvulus L.

Polygonum pennsylvanicum L. subsp. *oneillii* (Brenckle) Hult.

Polygonum vivipara L

Rumex acetosa L. subsp. *alpestris* (Scop.) Love

Rumex arcticus Trautv.

Rumex beringensis Yurtsev & Petrovsky

Rumex fenestratus Greene

Rumex salicifolius Weinm. var. *mexicanus* (Meisn.) C.L. Hitchc.

Portulacaceae

Claytonia sarmentosa C.A. Mey

Claytonia sibirica L.

Claytonia tuberosa Pall.

Montia bostockii (A.E. Porsild) Welsh

Potamogetonaceae

Potamogeton alpinus Balbis

Potamogeton foliosus Rafinesque subsp. *foliosus*

Potamogeton friesii Rupr.

Potamogeton gramineus L.

Potamogeton natans L.

Potamogeton obtusifolius Merten & Koch

Potamogeton praelongus Wulf.

Potamogeton pusillus L. subsp. *pusillus*

Potamogeton pusillus L. subsp. *tenuissimus* (Mert. & Koch) Haynes & C.B. Hellquist

Potamogeton richardsonii (Benn.) Rydb.

Potamogeton subsibiricus Hagstr.

Potamogeton zosteriformis Fern.

Ruppia cirrhosa (Petagna) Grande

Stuckenia filiformis (Persoon) Börner

Stuckenia pectinata L. Börner

Stuckenia vaginata (L.) Börner

Primulaceae

Androsace chamaejasme Host subsp.

Lehmanniana
(Spreng.) Hult.

Androsace septentrionalis L.

Dodecatheon frigidum Cham. & Schlecht.

Dodecatheon jeffreyi Van Houtte

Douglasia alaskana (Coville & Standley ex Hult.) S. Kelso

Douglasia arctica Hook.

Douglasia gormanii Const.

Primula cuneifolia Ledeb. subsp. *saxifragifolia* (Lehm.) Sm. & Forrest

Primula egaliksensis Wormsk.

Primula nutans Georgi

Trientalis europaea L.

Pteridaceae

Cryptogramma acrostichoides R. Br.

Cryptogramma sitchensis (Ruprecht) T. Moore

Cryptogramma stelleri (S.G. Gmel.) Prantl.

Pyrolaceae

Moneses uniflora (L.) Gray

Orthilia secunda (L.) House

Pyrola asarifolia Michx.

Pyrola chlorantha Sw.

Pyrola grandiflora Radius

Pyrola minor L.

Ranunculaceae

Aconitum delphinifolium DC.

Actaea rubra (Ait.) Willd.

Anemone multiceps (Greene) Standley

Anemone multifida Poir.

Anemone narcissiflora L. var. *monantha* de Candolle

Anemone parviflora Michx.

Anemone patens L. var. *multifida* Pritz.

Anemone richardsonii Hook.

Aquilegia brevistyla Hook.

Aquilegia formosa Fisch. var. *formosa*

Caltha leptosepala DC.

Caltha natans Pall.

Caltha palustris L. subsp. *arctica* (R. Br.) Hult.

Caltha palustris L. subsp. *arctica* (R. Br.) Hult.

Coptis aspleniifolia Salisb.

Coptis trifolia (L.) Salisb.

Delphinium brachycentrum Ledeb.

Delphinium glaucum S. Wats.

Ranunculus aquatilis L. var. *diffusus* Withering

Ranunculus cooleyae Vasey & Rose

Ranunculus cymbalaria Pursh

Ranunculus eschscholtzii Schlecht.

Ranunculus flammula L. var. *reptans* (L.) E. Mey.

Ranunculus gelidus Karel. & Kiril. subsp. *grayi* (Britt.) Hult.

Ranunculus gmelini DC.

Ranunculus hyperboreus Rottb.

Ranunculus lapponicus L.

Ranunculus macounii Britt.

Ranunculus nivalis L.

Ranunculus occidentalis Nutt. var. *brevistylis* Greene

Ranunculus pedatifidus Sm. subsp. *affinis* (R. Br.) L.D. Benson

Ranunculus pygmaeus Wahlenb.

Ranunculus sceleratus L. subsp. *multifidus* (Nutt.) Hult.

Ranunculus sulphureus Soland.

Ranunculus uncinatus D. Don

Thalictrum alpinum L.

Thalictrum sparsiflorum Turcz.

Rosaceae

Amelanchier alnifolia (Nutt.) Nutt.

Aruncus dioicus (Walt.) Fern.

Chamaerhodos erecta (L.) Bunge subsp. *nuttallii* (Torr. & Gray) Hult.

Comarum palustre L.

Dryas alaskensis Pors.

Dryas drummondii Richards.

Dryas hookeriana Juz.

Dryas integrifolia M. Vahl subsp. *integrifolia*

Dryas octopetala L.

Fragaria chiloensis (L.) Duchesne subsp. *pacifica* Staudt

Fragaria virginiana Duchesne subsp. *glauca* (S. Wats.) Staudt

*Geum calthi*folium Menzies

Geum macrophyllum Willd. subsp. *perincisum* (Rydlb.) Hult.

Geum rossii (R. Br.) Ser.

Luetkea pectinata (Pursh) Ktze.

Potentilla arguta Pursh subsp. *convallaria* (Rydb.) Keck

Potentilla biflora Willd.

Potentilla diversifolia Lehm.

Potentilla drummondii Lehm.

Potentilla egedii Wormsk. subsp. *grandis* (Torr. & Gray) Hult.

Potentilla flabelliformis Lehm.

Potentilla fruticosa L.

Potentilla furcata A.E. Porsild

Potentilla hookeriana Lehm.

Potentilla hyparctica Malte.

Potentilla multifida L.

Potentilla nivea L.

Potentilla norvegica L. subsp. *monspeliensis* (L.) Aschers. & Graebn.

Potentilla pensylvanica L.

Potentilla rubricaulis Lehmann

Potentilla uniflora Ledeb.

Potentilla villosa Pall.

Potentilla virgulata Nels.

Rosa acicularis Lindl.

Rubus arcticus L. subsp. *acaulis* (Michx.) Focke

Rubus arcticus L. subsp. *arcticus*

Rubus arcticus L. subsp. *stellatus* (Sm.) Boiv. emend Hult.

Rubus chamaemorus L.

Rubus idaeus L.

Rubus pedatus Sm.

Rubus spectabilis Pursh

Sanguisorba canadensis L. subsp. *latifolia* (Hook.) Calder & Taylor

Sanguisorba officinalis L.

Sibbaldia procumbens L.

Sorbus scopulina Greene

*Sorbus sitch*ensis Roem.

Spiraea beauverdiana Schneid.

Rubiaceae

Galium aparine L.

Galium boreale L.

Galium brandegei Gray

Galium trifidum L. subsp. *columbianum* (Rydlb.) Hult.

Galium trifidum L. subsp. *trifidum*

Galium triflorum Michx.

Salicaceae

Populus balsamifera L.

Populus tremuloides Michx.

Populus trichocarpa Torr. & Gray ex Hook.

Salix alaxensis (Anderss.) Cov.

Salix arbusculoides Anderss.

Salix arctica Pall.

Salix barclayi Anderss.

Salix barrattiana Hook.

Salix bebbiana Sarg.

Salix brachycarpa Nutt.

Salix commutata Bebb

Salix glauca L. var. *acutifolia* (Hook.) C.K. Schneider

Salix glauca L. var. *stipulata* Flod. in Lindem.

Salix hastata L.

Salix hookeriana Barr.

Salix myrtillifolia Anders.

Salix niphoclada Rydb.

Salix phlebophylla Anderss.

Salix polaris Wahlenb.

Salix pseudomonticola C.R. Ball

Salix pseudomyrsinites Andersson

Salix pulchra Cham.

Salix reticulata L. subsp. *reticulata*

Salix richardsonii Hook.

Salix rotundifolia Trautv. subsp. *dodgeana* Rydb.

Salix rotundifolia Trautv. subsp. *rotundifolia*

Salix scouleriana Barratt

Salix setchelliana Ball

Salix sitchensis Sanson

Salix stolonifera Cov.

Santalaceae

Geocaulon lividum (Richards.) Fern.

Saxifragaceae

Chrysosplenium tetrandrum (Lund) T. Fries

Chrysosplenium wrightii Fr. & Sav.

Heuchera glabra Willd.

Leptarrhena pyrolifolia (D. Don) Ser.

Mitella pentandra Hook.

Parnassia fimbriata Konig.

Parnassia kotzebuei Cham. & Schlecht.

Parnassia palustris L.

Ribes bracteosum Dougl.

Ribes hudsonianum Richards.

Ribes lacustre (Pers.) Poir

Ribes laxiflorum Pursh

Ribes triste Pall.

Romanzoffia sitchensis Bong.

Saxifraga adscendens L. subsp. *oregonensis* (Raf.) Baciagalupi

Saxifraga bracteata D. Don

Saxifraga bronchialis L. subsp. *funstonii* (Small) Hult.

Saxifraga caespitosa L.

Saxifraga cernua L.

Saxifraga eschscholtzii Sternb.

Saxifraga ferruginea Graham

Saxifraga flagellaris Willd. subsp. *setigera* (Pursh) Tolm.

Saxifraga foliolosa R. Br.

Saxifraga hieracifolia Waldst. & Kit.

Saxifraga hirculus L.

Saxifraga lyallii Engler subsp. *hultenii* (Calder & Savile) Calder & Savile

Saxifraga nelsoniana D. Don. subsp. *carlottae* Calder & Savile

Saxifraga nelsoniana D. Don subsp. *nelsoniana*

Saxifraga nelsoniana D. Don subsp. *porsildiana* (Calder & Savile) Hult., comb. nov.

Saxifraga nelsoniana L. subsp. *pacifica* (Hult.) Hult.

Saxifraga nivalis Hult. var. *rufopilosa* Hult.

Saxifraga nivalis L. var. *nivalis*

Saxifraga nivalis L. var. *tenuis* (Wahlenb.) H. Sm.

Saxifraga oppositifolia L. subsp. *oppositifolia*

Saxifraga razshivinii Zhmylev

Saxifraga reflexa Hook.

Saxifraga rivularis L. var. *flexuosa* (Sternb.) Engler & Irmsch.

Saxifraga serpyllifolia Pursh

Saxifraga spicata D. Don

Saxifraga tricuspidata Rottb.

Tellima grandiflora (Pursh) Dougl.

Tiarella trifoliata L.

Scheuchzeriaceae

Triglochin maritimum L.

Triglochin palustris L.

Scrophulariaceae

Castilleja chrymactis Pennell

Castilleja elegans Malte

Castilleja hyperborea Pennell

Castilleja miniata Dougl.

Castilleja pallida (Linne) Sprengel var. *caudata* Pennell

Castilleja pallida (Linne) Sprengel var. *yukonis* Pennell

Castilleja parviflora Bong.

Castilleja raupii Pennell

Castilleja unalaschcensis (Cham. & Schlecht.) Malte

Euphrasia mollis (Ledeb.) Wettst.

Euphrasia subarctica Raup.

Lagotis glauca Gaertn.

Limosella aquatica L.

Mimulus guttatus DC.

Pedicularis capitata Adams

Pedicularis labradorica Wirsing

Pedicularis lanata Cham. & Schlecht.

Pedicularis langsdorfii Fisch. subsp. *arctica* (R. Br.) Pennell

Pedicularis macrodonta Richards

Pedicularis oederi M. Vahl.

Pedicularis pacifica (Hult.) Kozh.

Pedicularis parviflora J. E. Sm. subsp. *parviflora*

Pedicularis sudetica Willd. sensu lat.

Pedicularis verticillata L.

Penstemon gormanii Greene

Rhinanthus minor L. subsp. *borealis* (Sterneck) Löve

Synthyris borealis Pennell

Veronica americana Schwien.

Veronica serpyllifolia L. subsp. *humifusa* (Dickson) Syme

Veronica serpyllifolia L. subsp. serpyllifolia

Veronica wormskjoldii Roem. & Schult. subsp. *wormskjoldii*

Selaginellaceae

Selaginella selaginoides (L.) Link

Selaginella sibirica (Milde) Hieron

Sparganiaceae

Sparganium angustifolium Michx.

Sparganium hyperboreum Laestadius

Sparganium natans L.

Thelypteridaceae

Phegopteris connectilis (Michaux) Watt

Valerianaceae

Valeriana capitata Pall.

Valeriana sitchensis Bong.

Violaceae

Viola adunca Sm.

Viola biflora L.

Viola epipsila Ledeb. subsp. *repens* (Turcz.) Becker

Viola glabella Nutt.

Viola langsdorfii Fisch.

Viola renifolia Gray var. *brainerdii* (Greene) Fern

Viola selkirkii Pursh

Appendix 6.2. Species previously included in the flora of the park (Cook and Roland 2002), now excluded due to changes in nomenclature.

Taxon	**Accepted Name**	**Treatment**
AGROSTIS ALASKANA Hult.	AGROSTIS EXARATA Trin.	Soreng et. al. 2004
AGROSTIS GEMINATA Trin.	AGROSTIS SCABRA Willd.	Soreng et. al. 2004
ARCTAGROSTIS POAEOIDES Nash	ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb.	Soreng et. al. 2004
CASTILLEJA HYETOPHILA Pennell	CASTILLEJA MINIATA Dougl.	Douglas et. al 2000
EPILOBIUM ADENOCAULON Haussk.	EPILOBIUM CILIATUM Raf. subsp. CILIATUM	Douglas et. al 2000
POA HISPIDULA Vasey	POA MACROCALYX Trautv. & C.A. Mey	Soreng et. al. 2004
POA MALACANTHA Kom.	POA ARCTICA R. Br. subsp. LANATA (Scribn. & Merr.) R.J. Soreng	Soreng et. al. 2004
PUCCINELLIA DESCHAMPSIOIDES Sorens.	PUCCINELLIA NUTTALLIANA (Schult.) Hitchc.	Soreng et. al. 2004
RHINANTHUS ARCTICUS (Sterneck) Pennell	RHINANTHUS MINOR L.	Kartesz 1999
SENECIO RESEDIFOLIUS Less.	PACKERA CYMBALARIA (Pursh) W.A. Weber & A. Löve	Kartesz 1999

Appendix 6.3. Taxa previously included in the flora of the park, now excluded due to changes in nomenclature. These infraspecific taxa are no longer accepted.

Taxon	**Accepted Name**	**Treatment**
ACONITUM DELPHINIFOLIUM DC. subsp. DELPHINIFOLIUM	ACONITUM DELPHINIFOLIUM DC.	FNA*
ACONITUM DELPHINIFOLIUM DC. subsp. PARADOXUM (Rchb.) Hult.	ACONITUM DELPHINIFOLIUM DC.	FNA
ACTAEA RUBRA (Ait.) Willd. subsp. ARGUTA (Nutt.) Hult.	ACTAEA RUBRA (Ait.) Willd.	FNA
CAREX ATRATIFORMIS Britt. subsp. RAYMONDII (Calder) Pors.	CAREX ATRATIFORMIS Britt.	FNA
CAREX GARBERI Fern. subsp. BIFARIA	CAREX GARBERI Fern.	FNA
DESCHAMPSIA CAESPITOSA (L.) Beauv. subsp. ORIENTALIS Hult.	DESCHAMPSIA CESPITOSA (L.) P. Beauv.	Soreng et. al. 2004
ELYMUS ALASKANUS subsp. LATIGLUMIS	ELYMUS ALASKANUS (Scribner & Merr.) A. Löve	Soreng et. al. 2004
ERIOPHORUM ANGUSTIFOLIUM Honck. subsp. SUBARCTICUM (Vassiljev) Hult.	ERIOPHORUM ANGUSTIFOLIUM Honck.	FNA
ERIOPHORUM ANGUSTIFOLIUM Honk. subsp. SCABRIUSCULUM (Vassiljev) Hult.	ERIOPHORUM ANGUSTIFOLIUM Honck.	FNA
ERIOPHORUM VAGINATUM L. subsp. SPISSUM (Fern.) Hult.	ERIOPHORUM VAGINATUM L.	FNA
POA ARCTICA R. Br. subsp. LONGICULMIS Hult.	POA ARCTICA R. Br.	Soreng et. al. 2004
POA ARCTICA R. Br. subsp. WILLIAMSII (Nash) Hult.	POA ARCTICA R. Br.	Soreng et. al. 2004
RANUNCULUS AQUATILIS L. var. SUBRIGIDUS (W.B. Drew) Breitung	RANUNCULUS AQUATILIS L.	FNA
RANUNCULUS GMELNII DC. subsp. PURSHII (Richards.) Hult	RANUNCULUS GMELINI DC.	FNA
RHINANTHUS MINOR L. subsp. BOREALIS (Sterneck) Love	RHINANTHUS MINOR L.	Kartesz 1999
SAXIFRAGA DAVURICA Willd. subsp. GRANDIPETALA (Engler & Irmsch.) Hult.	SAXIFRAGA RAZSHIVINII Zhmylev	Kartesz 1999
TRISETUM SPICATUM (L.) Richter subsp. ALASKANUM (Nash) Hult.	TRISETUM SPICATUM (L.) Richter	Soreng et. al. 2004
VAHLODEA ATROPURPUREA (Wahlenb.) E. Fries subsp. LATIFOLIA (Hook.) Pors.	VAHLODEA ATROPURPUREA (Wahlenb.) E. Fries	Soreng et. al. 2004

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Appendix 6.4. Number of taxa by family for the Wrangell-St. Elias National Park & Preserve flora.

Family	**# of Taxa**	**Family**	**#/Taxa**
Cyperaceae	107	Pinaceae	3
Asteraceae	82	Callitrichaceae	3
Poaceae	82	Caprifoliaceae	3
Brassicaceae	71	Chenopodiaceae	3
Rosaceae	47	Cornaceae	3
Saxifragaceae	42	Iridaceae	3
Caryophyllaceae	41	Lamiaceae	3
Ranunculaceae	35	Plantaginaceae	3
Fabaceae	33	Pteridaceae	3
Scrophulariaceae	30	Sparganiaceae	3
Salicaceae	30	Valerianaceae	3
Ericaceae	22	Crassulaceae	2
Juncaceae	20	Cupressaceae	2
Potamogetonaceae	16	Droseraceae	2
Orchidaceae	16	Elaeagnaceae	2
Polygonaceae	14	Fumariaceae	2
Onagraceae	13	Isoetaceae	2
Apiaceae	12	Lemnaceae	2
Liliaceae	11	Nymphaceae	2
Ophioglossaceae	11	Scheuchzeriaceae	2
Primulaceae	11	Selaginellaceae	2
Dryopteridaceae	11	Adoxaceae	1
Betulaceae	9	Araceae	1
Equisetaceae	9	Araliaceae	1
Gentianaceae	9	Balsaminaceae	1
Boraginaceae	7	Diapensiaceae	1
Lycopodiaceae	7	Empetraceae	1
Papaveraceae	7	Geraniaceae	1
Polemoniaceae	7	Hydrophyllaceae	1
Violaceae	7	Linaceae	1
Pyrolaceae	6	Menyanthaceae	1
Rubiaceae	6	Myricaceae	1
Lentibulariaceae	5	Najadaceae	1
Campanulaceae	4	Orobanchaceae	1
Haloragaceae	4	Santalaceae	1
Portulacaceae	4	Thelypteridaceae	1
		Total	917

Appendix 6.5. Abbreviations used for park regions in cluster analysis.

Region	Abbreviation
Tanana Uplands	TAN_UPL
Mentasta Mountains	MEN_MT
Nutzotin Mountains	NZ_MT
N. St. Elias Mountains	NSE_MET
High Wrangells	HW_MT
Mts. Drum and Sanford	WW_MT
N. Wrangell Foothills	NW_MT
S. Wrangell Foothills	SW_MT
N. Chugach Mountains	NCH_MT
S. Chugach-St. Elias Mountains	SCH_MT
Coastal Foothills	CST_MT
Tanana River Basin	TR_BAS
White River Basin	WR_BAS
Upper Copper River Basin	UC_BAS
Middle Copper River Basin	MC_BAS
Lower Copper River Basin	LC_BAS
Chitina River Basin	CHR_BAS
Malaspina Forelands	MAL

Appendix 6.6. Rare plant species matrix used for cluster analysis. Region codes are in Appendix 6.5

RARE PLANT TAXON	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**NSE_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**WR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Region for Species**
AGOSERIS AURANTIACA	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**2**
AGOSERIS GLAUCA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
AGROSTIS THURBERIANA	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	**2**
APHRAGMUS ESCHSCHOLTZIANUS	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	**8**
ARABIS CALDERI	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
ARABIS CODYI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
ARABIS DREPANOLOBA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
ARABIS LEMMONII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
ARENARIA LONGIPEDUNCULATA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	**2**
ARNICA DIVERSIFOLIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
ARNICA MOLLIS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
ARTEMISIA DRACUNCULUS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
ASTRAGALUS HARRINGTONII	0	0	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	**4**
BOTRYCHIUM ALASKENSE	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	**3**
BOTRYCHIUM ASCENDENS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
BOTRYCHIUM LINEARE	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
BOTRYCHIUM MONTANUM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
BOTRYCHIUM TUNUX	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	**2**
BOTRYCHIUM YAAXUDAKEIT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**1**
CAREX ADELOSTOMA	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	**3**
CAREX ATRATIFORMIS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
CAREX CRAWFORDII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
CAREX EBURNEA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
CAREX HOLOSTOMA	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**2**
CAREX HOODII	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
CAREX INTERIOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
CAREX LAPPONICA	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	**3**
CAREX LAXA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
CAREX LENTICULARIS var. DOLIA	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	**5**
CAREX PARRYANA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**

Appendix 6.6 (continued). Rare plant species matrix used for cluster analysis. Region codes are in Appendix 6.5

RARE PLANT TAXON	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**NSE_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**WR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Region for Species**
CAREX PHAEOCEPHALA	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	**5**
CAREX TAHOENSIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
CASTILLEJA MINIATA	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	0	**5**
CERASTIUM REGELII	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
CERATOPHYLLUM DEMERSUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
CHAMAERHODOS ERECTA subsp. NUTTALLII	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
CRYPTANTHA SHACKLETTEANA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
CRYPTOGRAMMA STELLERI	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	**4**
CYPRIPEDIUM PARVIFLORUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
DOUGLASIA ALASKANA	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**2**
DOUGLASIA ARCTICA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
DOUGLASIA GORMANII	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	**7**
DRABA DENSIFOLIA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
DRABA INCERTA	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**4**
DRABA KANANASKIS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
DRABA LONCHOCARPA var. THOMPSONII	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
DRABA PORSILDII	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**4**
DRABA PRAEALTA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
DRABA RUAXES	0	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	**7**
ELYMUS CALDERI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
ERIGERON GRANDIFLORUS subsp. ARCTICUS	0	1	1	1	0	0	0	1	1	0	0	0	1	0	0	0	1	0	**7**
ERIOPHORUM VIRIDICARINATUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
FESTUCA LENENSIS	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**3**
FESTUCA MINUTIFLORA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
GLYCERIA PULCHELLA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
JUNIPERUS HORIZONTALIS	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	1	0	**5**
LIMOSELLA AQUATICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
LUPINUS KUSCHEI	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	**3**
MAIANTHEMUM STELLATUM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**

Appendix 6.6 (continued). Rare plant species matrix used for cluster analysis. Region codes are in Appendix 6.4

RARE PLANT TAXON	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**NSE_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**WR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Region for Species**
MINUARTIA BIFLORA	0	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	1	0	**8**
MONTIA BOSTOCKII	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	**7**
MYRIOPHYLLUM VERTICILLATUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
NAJAS FLEXILIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
OXYTROPIS HUDDELSONII	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	**10**
PAPAVER ALBOROSEUM	0	0	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	**7**
PAPAVER WALPOLEI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
PEDICULARIS MACRODONTA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
PHACELIA MOLLIS	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**4**
PHLOX HOODII	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
PHLOX SIBIRICA subsp. RICHARDSONII	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	**4**
POA LEPTOCOMA	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	0	**5**
POA SECUNDA subsp. SECUNDA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	**2**
POTAMOGETON OBTUSIFOLIUS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
POTAMOGETON SUBSIBIRICUS	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	**3**
POTENTILLA DRUMMONDII	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	**3**
POTENTILLA RUBRICAULIS	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
PUCCINELLIA VAHLIANA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
RUMEX BERINGENSIS	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	**5**
SALIX HOOKERIANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
SALIX SETCHELLIANA	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	**4**
SAXIFRAGA ADSCENDENS subsp. OREGONENSIS	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	**4**
SAXIFRAGA NELSONIANA subsp. PORSILDIANA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
SEDUM DIVERGENS	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
SMELOWSKIA CALYCINA var. PORSILDII	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**2**
STELLARIA ALASKANA	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	**7**
STELLARIA UMBELLATA	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**4**
TARAXACUM CARNEOCOLORATUM	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	**5**
THLASPI ARCTICUM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**

Appendix 6.6 (continued). Rare plant species matrix used for cluster analysis. Region codes are in Appendix 6.4

RARE PLANT TAXON	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**NSE_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**WR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Region for Species**
TRICHOPHORUM PUMILUM var. ROLLANDII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
TRISETUM SIBIRICUM subsp. LITORALE	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
VIOLA SELKIRKII	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Sum of Species for Region	**5**	**20**	**31**	**20**	**12**	**9**	**16**	**20**	**25**	**10**	**8**	**12**	**5**	**4**	**8**	**1**	**25**	**2**	

Appendix 6.7 Proximity matrix for cluster analysis of the rare species occurring in eighteen regions of the park using Jaccard distance measure.

Proximity Matrix

	Matrix File Input																	
Case	TAN_UPL	MEN_MT	NZ_MT	NSE_MT	HW_MT	WW_MT	NW_MT	SW_MT	NCH_MT	SCH_MT	CST_MT	TR_BAS	WR_BAS	UC_BAS	MC_BAS	LC_BAS	CHR_BAS	MAL
TAN_UPL		.087	.094	.087	.133	.167	.167	.042	.034	.071	.000	.133	.000	.125	.000	.000	.071	.000
MEN_MT	.087		.429	.429	.280	.318	.385	.290	.184	.034	.000	.000	.042	.000	.000	.000	.047	.000
NZ_MT	.094	.429		.389	.273	.258	.394	.250	.250	.081	.027	.077	.029	.000	.027	.000	.058	.000
NSE_MT	.087	.429	.389		.455	.318	.440	.481	.364	.071	.000	.000	.042	.000	.037	.000	.071	.000
HW_MT	.133	.280	.273	.455		.400	.400	.391	.194	.048	.000	.000	.000	.000	.000	.000	.028	.000
WW_MT	.167	.318	.258	.318	.400		.471	.261	.097	.118	.000	.000	.000	.000	.000	.000	.000	.000
NW_MT	.167	.385	.394	.440	.400	.471		.333	.139	.083	.000	.037	.000	.000	.000	.000	.025	.000
SW_MT	.042	.290	.250	.481	.391	.261	.333		.324	.154	.077	.032	.042	.000	.037	.000	.125	.000
NCH_MT	.034	.184	.250	.364	.194	.097	.139	.324		.207	.138	.028	.034	.000	.100	.000	.163	.000
SCH_MT	.071	.034	.081	.071	.048	.118	.083	.154	.207		.385	.048	.000	.000	.059	.000	.167	.000
CST_MT	.000	.000	.027	.000	.000	.000	.000	.077	.138	.385		.053	.000	.000	.067	.000	.138	.000
TR_BAS	.133	.000	.077	.000	.000	.000	.037	.032	.028	.048	.053		.133	.143	.250	.083	.121	.000
WR_BAS	.000	.042	.029	.042	.000	.000	.000	.042	.034	.000	.000	.133		.000	.083	.200	.071	.000
UC_BAS	.125	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.143	.000		.200	.000	.036	.000
MC_BAS	.000	.000	.027	.037	.000	.000	.000	.037	.100	.059	.067	.250	.083	.200		.125	.065	.000
LC_BAS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.083	.200	.000	.125		.000	.000
CHR_BAS	.071	.047	.058	.071	.028	.000	.025	.125	.163	.167	.138	.121	.071	.036	.065	.000		.000
MAL	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

Appendix 6.8. Alaska-Yukon endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

ALASKA-YUKON ENDEMIC SPECIES	TAN_ UPL	MEN_ MT	NZ_ MT	HW_ MT	WW_ MT	NW_ MT	SW_ MT	NSE_ MT	NCH_ MT	SCH_ MT	CST_ MT	WR_ BAS	TR_ BAS	UC_ BAS	MC_ BAS	LC_ BAS	CHR_ BAS	MAL	Sum of Regions for Species
ANEMONE MULTICEPS	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
APHRAGMUS ESCHSCHOLTZIANUS	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	9
ARABIS CODYI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
ARTEMISIA ALASKANA	0	1	1	1	0	1	0	1	0	0	0	1	1	0	0	0	0	0	7
ARTEMISIA HYPERBOREA	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	5
ASTRAGALUS HARRINGTONII	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	4
ASTRAGALUS NUTZOTINENSIS	0	1	0	1	1	0	1	1	1	0	0	1	1	0	0	0	1	0	9
ASTRAGALUS WILLIAMSII	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3
BETULA KENAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
BOTRYCHIUM ALASKANUM	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
BOTRYCHIUM TUNUX	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
BOTRYCHIUM YAAXUDAKEIT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
CASTILLEJA UNALASCHCENSIS	0	0	0	0	0	0	1	1	1	0	1	0	1	0	0	0	1	1	7
CASTILLEJA YUKONIS	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
CRYPTANTHA SHACKLETTEANA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CRYPTOGRAMMA SITCHENSIS	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	4
DOUGLASIA ALASKANA	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	3
DOUGLASIA ARCTICA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
DOUGLASIA GORMANII	0	1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	8
DRABA PALANDERIANA	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
DRYAS ALASKENSIS	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	6
ELYMUS CALDERI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
ERIGERON PALLENS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
ERIGERON PURPURATUS	0	1	1	1	0	1	1	1	1	1	0	1	1	0	0	0	0	0	10
GENTIANA PLATYPETALA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
LUPINUS KUSCHEI	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3
MELANDRIUM MACROCARPUM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
MONTIA BOSTOCKII	1	1	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	8
OXYTROPIS HUDDELSONII	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	11
OXYTROPIS SCAMMANIANA	1	0	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	8
PENSTEMON GORMANII	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
PHACELIA MOLLIS	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	5

Appendix 6.8 (continued). Alaska-Yukon endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

GNAME	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NSE_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**WR_ BAS**	**TR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Regions for Species**
PHLOX RICHARDSONII	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	5
POLYGONUM ALASKANUM	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3
SALIX SETCHELLIANA	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	5
SALIX STOLONIFERA	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	3
SAXIFRAGA REFLEXA	1	1	1	1	1	1	1	1	1	0	0	1	0	0	1	0	1	0	12
SAXIFRAGA SPICATA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
SENECIO OGOTORUKENSIS	1	1	1	0	0	0	1	1	1	0	0	1	1	0	1	0	1	0	10
SILENE WILLIAMSII	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	3
SMELOWSKIA BOREALIS	0	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	7
STELLARIA ALASKANA	0	1	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	7
SYNTHYRIS BOREALIS	1	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	6
TARAXACUM CARNEOCOLORATUM	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	5
THLASPI ARCTICUM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Sum of Species per Region	**9**	**20**	**21**	**12**	**11**	**15**	**18**	**17**	**14**	**4**	**3**	**14**	**19**	**3**	**7**	**1**	**11**	**1**	

Appendix 6.9. Proximity matrix for cluster analysis of the Alaska-Yukon endemic species occurring in eighteen regions of the park using Jaccard distance measure.

Proximity Matrix

	Matrix File Input																	
Case	TAN_UPL	MEN_MT	NZ_MT	NSE_MT	NCH_MT	SCH_MT	CST_MT	WR_BAS	TR_BAS	CHR_BAS	MAL	HW_MT	WW_MT	NW_MT	SW_MT	UC_BAS	MC_BAS	LC_BAS
TAN_UPL		.261	.381	.300	.167	.083	.000	.353	.120	.176	.000	.235	.250	.263	.238	.091	.143	.000
MEN_MT	.261		.667	.609	.231	.091	.000	.417	.345	.192	.000	.455	.476	.591	.423	.045	.080	.000
NZ_MT	.381	.667		.609	.231	.091	.000	.417	.258	.148	.000	.455	.476	.667	.480	.000	.125	.000
NSE_MT	.300	.609	.609		.318	.105	.053	.476	.241	.217	.059	.611	.474	.600	.545	.000	.091	.000
NCH_MT	.167	.231	.231	.318		.333	.154	.238	.192	.533	.083	.263	.211	.174	.381	.000	.188	.000
SCH_MT	.083	.091	.091	.105	.333		.167	.125	.045	.154	.000	.143	.071	.118	.105	.000	.000	.000
CST_MT	.000	.000	.000	.053	.154	.167		.000	.048	.167	.333	.000	.000	.000	.053	.000	.000	.000
WR_BAS	.353	.417	.417	.476	.238	.125	.000		.222	.250	.000	.444	.316	.318	.409	.000	.167	.071
TR_BAS	.120	.345	.258	.241	.192	.045	.048	.222		.154	.053	.240	.200	.259	.161	.158	.238	.053
CHR_BAS	.176	.192	.148	.217	.533	.154	.167	.250	.154		.091	.150	.158	.083	.333	.000	.200	.091
MAL	.000	.000	.000	.059	.083	.000	.333	.000	.053	.091		.000	.000	.000	.059	.000	.000	.000
HW_MT	.235	.455	.455	.611	.263	.143	.000	.444	.240	.150	.000		.643	.500	.450	.000	.056	.000
WW_MT	.250	.476	.476	.474	.211	.071	.000	.316	.200	.158	.000	.643		.529	.400	.000	.059	.000
NW_MT	.263	.591	.667	.600	.174	.118	.000	.318	.259	.083	.000	.500	.529		.333	.000	.100	.000
SW_MT	.238	.423	.480	.545	.381	.105	.053	.409	.161	.333	.059	.450	.400	.333		.000	.091	.000
UC_BAS	.091	.045	.000	.000	.000	.000	.000	.000	.158	.000	.000	.000	.000	.000	.000		.111	.000
MC_BAS	.143	.080	.125	.091	.188	.000	.000	.167	.238	.200	.000	.056	.059	.100	.091	.111		.143
LC_BAS	.000	.000	.000	.000	.000	.000	.000	.071	.053	.091	.000	.000	.000	.000	.000	.000	.143	

Appendix 6.10. Amphiberingian endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

AMPHIBERINGIAN ENDEMIC SPECIES	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NSE_ MT**	**NCH_ MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**WR_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Regions for Species**
ACONITUM DELPHINIFOLIUM	0	1	1	1	0	1	1	1	1	0	1	0	0	0	0	1	1	0	**10**
ARNICA FRIGIDA	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	**7**
ARNICA LESSINGII	0	1	0	1	0	1	1	1	1	0	0	0	0	0	0	1	1	0	**8**
ASTRAGALUS UMBELLATUS	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	1	0	**11**
CARDAMINE PURPUREA	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
CAREX MACROCEPHALA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
CASTILLEJA CAUDATA	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	**4**
CASTILLEJA HYPERBOREA	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	**10**
CHRYSOSPLENIUM WRIGHTII	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	**9**
CLAYTONIA SARMENTOSA	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0	1	1	0	**11**
CLAYTONIA TUBEROSA	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
CNIDIUM CNIDIIFOLIUM	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**3**
DELPHINIUM BRACHYCENTRUM	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
DODECATHEON FRIGIDUM	0	1	1	1	1	0	1	0	1	0	0	0	1	0	0	1	1	0	**9**
DRABA BOREALIS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	**2**
DRABA STENOPETALA	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	**8**
ELYMUS MACROURUS	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	**3**
ERIOPHORUM CHAMISSONIS	0	0	1	1	0	1	0	0	1	0	0	1	1	1	1	0	1	1	**10**
FESTUCA BREVISSIMA	0	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	**6**
FESTUCA LENENSIS	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
GASTROLYCHNIS TAIMYRENSIS	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	**5**
HIERACIUM TRISTE	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	**4**
IRIS SETOSA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
LAGOTIS GLAUCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
OXYTROPIS BOREALIS	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	**5**
PAPAVER ALBOROSEUM	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	**7**
PAPAVER MACOUNII	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	**4**
PAPAVER WALPOLEI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
POA PSEUDOABBREVIATA	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	**7**
PRIMULA CUNEIFOLIA	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	**3**
RUMEX BERINGENSIS	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	**6**
SALIX PHLEBOPHYLLA	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**2**

Appendix 6.10 (continued). Amphiberingian endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

AMPHIBERINGIAN ENDEMIC SPECIES	TAN_ UPL	MEN_ MT	NZ_ MT	HW_ MT	WW_ MT	NW_ MT	SW_ MT	NSE_ MT	NCH_ MT	SCH_ MT	CST_ MT	TR_ BAS	UC_ BAS	MC_ BAS	LC_ BAS	WR_ BAS	CHR_ BAS	MAL	Sum of Regions for Species
SALIX PULCHRA	1	1	1	0	1	1	1	1	1	0	0	1	1	1	0	1	1	0	**13**
SANGUISORBA STIPULATA	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1	1	**6**
SAUSSUREA ANGUSTIFOLIA	1	0	0	1	1	1	1	1	1	0	0	0	1	0	0	1	0	0	**9**
SAXIFRAGA CALYCINA	0	1	1	1	0	1	1	0	1	0	0	1	0	1	0	1	0	0	**9**
SAXIFRAGA SERPYLLIFOLIA	0	1	0	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	**10**
SELAGINELLA SIBIRICA	1	0	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	**6**
TARAXACUM ALASKANUM	1	0	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	**8**
TARAXACUM KAMTSCHATICUM	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	**6**
TEPHROSERIS KJELLMANII	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	**3**
VIOLA LANGSDORFII	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	**5**
WILHELMSIA PHYSODES	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	**2**
Sum of Species per Region	**10**	**19**	**22**	**20**	**17**	**19**	**25**	**13**	**25**	**7**	**4**	**9**	**8**	**8**	**2**	**17**	**15**	**3**	

Appendix 6.11. Proximity matrix for cluster analysis of the Amphiberingian endemic species occurring in eighteen regions of the park using Jaccard distance measure.

Proximity Matrix

	Matrix File Input																	
Case	TAN_UPL	MEN_MT	NZ_MT	NSE_MT	NCH_MT	SCH_MT	CST_MT	WR_BAS	TR_BAS	CHR_BAS	MAL	HW_MT	WW_MT	NW_MT	SW_MT	UC_BAS	MC_BAS	LC_BAS
TAN_UPL		.120	.231	.222	.214	.143	.000	.182	.200	.143	.000	.208	.136	.167	.222	.214	.133	.000
MEN_MT	.120		.556	.391	.517	.040	.045	.500	.217	.360	.000	.500	.458	.462	.536	.080	.227	.000
NZ_MT	.231	.556		.333	.548	.111	.038	.333	.280	.310	.040	.387	.393	.448	.469	.192	.192	.042
NSE_MT	.222	.391	.333		.462	.176	.063	.500	.100	.273	.000	.500	.450	.524	.542	.105	.167	.000
NCH_MT	.214	.517	.548	.462		.280	.115	.400	.172	.379	.077	.607	.464	.571	.750	.179	.179	.080
SCH_MT	.143	.040	.111	.176	.280		.222	.043	.000	.158	.111	.125	.150	.083	.192	.000	.000	.125
CST_MT	.000	.045	.038	.063	.115	.222		.050	.000	.118	.000	.043	.053	.045	.077	.000	.000	.000
WR_BAS	.182	.500	.333	.500	.400	.043	.050		.238	.333	.000	.480	.375	.500	.519	.250	.316	.000
TR_BAS	.200	.217	.280	.100	.172	.000	.000	.238		.200	.091	.160	.087	.217	.138	.308	.545	.100
CHR_BAS	.143	.360	.310	.273	.379	.158	.118	.333	.200		.125	.346	.292	.308	.393	.150	.278	.133
MAL	.000	.000	.040	.000	.077	.111	.000	.000	.091	.125		.045	.000	.048	.038	.100	.100	.667
HW_MT	.208	.500	.387	.500	.607	.125	.043	.480	.160	.346	.045		.385	.560	.571	.167	.217	.048
WW_MT	.136	.458	.393	.450	.464	.150	.053	.375	.087	.292	.000	.385		.522	.481	.143	.143	.000
NW_MT	.167	.462	.448	.524	.571	.083	.045	.500	.217	.308	.048	.560	.522		.593	.174	.227	.050
SW_MT	.222	.536	.469	.542	.750	.192	.077	.519	.138	.393	.038	.571	.481	.593		.143	.143	.040
UC_BAS	.214	.080	.192	.105	.179	.000	.000	.250	.308	.150	.100	.167	.143	.174	.143		.231	.111
MC_BAS	.133	.227	.192	.167	.179	.000	.000	.316	.545	.278	.100	.217	.143	.227	.143	.231		.111
LC_BAS	.000	.000	.042	.000	.080	.125	.000	.000	.100	.133	.667	.048	.000	.050	.040	.111	.111	

Appendix 6.12. Cordilleran endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

CORDILLERAN ENDEMIC SPECIES	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NSE_ MT**	**NCH _MT**	**SCH_ MT**	**CST_ MT**	**WR_ BAS**	**TR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Regions for Species**
AGOSERIS AURANTIACA	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**2**
ANTENNARIA MEDIA	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**3**
ARABIS CALDERI	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**2**
ARABIS DREPANOLOBA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
ARABIS LEMMONII	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	01	0	**1**
ARENARIA LONGIPEDUNCULATA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
ARNICA AMPLEXICAULIS	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	**3**
ARNICA DIVERSIFOLIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	**3**
ARNICA LATIFOLIA	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	1	**7**
ARNICA MOLLIS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**2**
BOTRYCHIUM ASCENDENS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
BOTRYCHIUM MONTANUM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
CAREX ALBONIGRA	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	**5**
CAREX ATROSQUAMA	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	**6**
CAREX PHAEOCEPHALA	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	**5**
CAREX TAHOENSIS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	**2**
CREPIS ELEGANS	0	0	1	0	0	0	1	1	1	1	0	1	1	0	1	0	1	0	**11**
DELPHINIUM GLAUCUM	0	1	1	1	0	0	1	1	1	0	0	1	1	0	1	0	1	0	**12**
DRABA DENSIFOLIA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
DRABA INCERTA	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	**5**
DRABA KANANASKIS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
DRABA LONCHOCARPA	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	**6**
DRABA MACOUNII	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	**7**
DRABA OLIGOSPERMA	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	**3**
DRABA PORSILDII	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**4**
DRABA PRAEALTA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
DRABA RUAXES	0	1	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	**9**
DRABA STENOLOBA	0	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	**5**
FESTUCA MINUTIFLORA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
JUNCUS DRUMMONDII	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0	1	0	**7**

Appendix 6.12 (continued). Cordilleran endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

CORDILLERAN ENDEMIC SPECIES	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NSE_ MT**	**NCH _MT**	**SCH_ MT**	**CST_ MT**	**WR_ BAS**	**TR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**CHR_ BAS**	**MAL**	**Sum of Regions for Species**
OXYTROPIS VISCIDA	0	1	1	1	0	1	0	1	1	0	0	1	0	1	1	0	1	0	**12**
POTENTILLA DIVERSIFOLIA	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	**9**
POTENTILLA DRUMMONDII	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	**3**
RIBES LAXIFLORUM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**2**
SALIX BARRATTIANA	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	**4**
SALIX COMMUTATA	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	1	**6**
SORBUS SCOPULINA	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	**6**
Sum of Species per Region	**1**	**8**	**15**	**6**	**3**	**5**	**15**	**13**	**21**	**11**	**6**	**7**	**3**	**2**	**5**	**1**	**15**	**2**	

Appendix 6.13. Proximity matrix for cluster analysis of the Cordilleran endemic species occurring in eighteen regions of the park using Jaccard distance measure.

Proximity Matrix

	Matrix File Input																	
Case	TAN_UPL	MEN_MT	NZ_MT	NSE_MT	NCH_MT	SCH_MT	CST_MT	WR_BAS	TR_BAS	CHR_BAS	MAL	HW_MT	WW_MT	NW_MT	SW_MT	UC_BAS	MC_BAS	LC_BAS
TAN_UPL		.091	.067	.063	.040	.000	.000	.250	.200	.048	.000	.000	.000	.000	.063	.000	.000	.000
MEN_MT	.091		.412	.389	.214	.045	.000	.385	.167	.154	.000	.333	.000	.214	.250	.091	.143	.000
NZ_MT	.067	.412		.381	.310	.174	.048	.375	.125	.259	.000	.250	.000	.235	.381	.067	.176	.000
NSE_MT	.063	.389	.381		.444	.120	.045	.353	.188	.207	.000	.313	.059	.294	.304	.063	.167	.000
NCH_MT	.040	.214	.310	.444		.321	.231	.185	.120	.419	.083	.154	.125	.148	.345	.083	.200	.042
SCH_MT	.000	.045	.174	.120	.321		.500	.050	.063	.320	.071	.056	.143	.053	.217	.000	.188	.000
CST_MT	.000	.000	.048	.045	.231	.500		.000	.000	.217	.250	.000	.222	.000	.095	.000	.167	.000
WR_BAS	.250	.385	.375	.353	.185	.050	.000		.333	.273	.000	.273	.000	.154	.211	.111	.273	.000
TR_BAS	.200	.167	.125	.188	.120	.063	.000	.333		.143	.000	.111	.000	.000	.118	.000	.250	.000
CHR_BAS	.048	.154	.259	.207	.419	.320	.217	.273	.143		.048	.130	.150	.080	.296	.048	.238	.000
MAL	.000	.000	.000	.000	.083	.071	.250	.000	.000	.048		.000	.250	.000	.063	.000	.143	.000
HW_MT	.000	.333	.250	.313	.154	.056	.000	.273	.111	.130	.000		.125	.444	.235	.143	.200	.000
WW_MT	.000	.000	.000	.059	.125	.143	.222	.000	.000	.150	.250	.125		.111	.200	.000	.000	.000
NW_MT	.000	.214	.235	.294	.148	.053	.000	.154	.000	.080	.000	.444	.111		.222	.125	.083	.000
SW_MT	.063	.250	.381	.304	.345	.217	.095	.211	.118	.296	.063	.235	.200	.222		.063	.105	.067
UC_BAS	.000	.091	.067	.063	.083	.000	.000	.111	.000	.048	.000	.143	.000	.125	.063		.143	.500
MC_BAS	.000	.143	.176	.167	.200	.188	.167	.273	.250	.238	.143	.200	.000	.083	.105	.143		.000
LC_BAS	.000	.000	.000	.000	.042	.000	.000	.000	.000	.000	.000	.000	.000	.000	.067	.500	.000	

Appendix 6.14. Pacific coastal endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

PACIFIC COAST ENDEMIC SPECIES	**TAN_ UPL**	**MEN_ MT**	**NZ_ MT**	**HW_ MT**	**WW_ MT**	**NW_ MT**	**SW_ MT**	**NSE_ MT**	**NCH _MT**	**SCH_ MT**	**CST_ MT**	**TR_ BAS**	**UC_ BAS**	**MC_ BAS**	**LC_ BAS**	**WR_ BAS**	**CHR _BAS**	**MAL**	**Sum of Regions for Species**
ALNUS RUBRA	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	**4**
CAMPANULA LATISEPALA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
CAREX CIRCINNATA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
CAREX LAEVICULMIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
CAREX MERTENSII	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	**4**
CAREX PLURIFLORA	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	**5**
CASSIOPE MERTENSIANA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
CASTILLEJA PARVIFLORA	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**2**
CICUTA DOUGLASII	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
CLADOTHAMNUS PYROLAEFLORUS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
CLAYTONIA SIBIRICA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
DODECATHEON JEFFREYI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
EPILOBIUM LEPTOCARPUM	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	**5**
EPILOBIUM LUTEUM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
FAURIA CRISTA-GALLI	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**2**
HEUCHERA GLABRA	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	**6**
HIPPURIS MONTANA	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	**3**
ISOETES MARITIMA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**2**
LEPTARRHENA PYROLIFOLIA	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	**6**
LISTERA CAURINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
LUPINUS NOOTKATENSIS	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	1	**6**
OSMORHIZA PURPUREA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
PICEA SITCHENSIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
PLANTAGO MACROCARPA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**2**
PLATANTHERA STRICTA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
PRENANTHES ALATA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
RANUNCULUS COOLEYAE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
RANUNCULUS UNCINATUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
RIBES BRACTEOSUM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
SALIX SITCHENSIS	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	**6**
SAXIFRAGA FERRUGINEA	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	**2**
SEDUM DIVERGENS	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**

Appendix 6.14 (continued). Pacific coastal endemic species matrix for park regions used in cluster analysis. Region codes are in Appendix 6.4

PACIFIC COAST ENDEMIC SPECIES	TAN_ UPL	MEN_ MT	NZ_ MT	HW_ MT	WW_ MT	NW_ MT	SW_ MT	NSE_ MT	NCH _MT	SCH_ MT	CST_ MT	TR_ BAS	UC_ BAS	MC_ BAS	LC_ BAS	WR_ BAS	CHR _BAS	MAL	Sum of Regions for Species
SORBUS SITCHENSIS	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	**4**
STELLARIA CRISPA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
TELLIMA GRANDIFLORA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
TIARELLA TRIFOLIATA	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	**3**
TRISETUM CERNUUM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
VACCINIUM ALASKENSIS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	**3**
VACCINIUM OVALIFOLIUM	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**2**
VALERIANA SITCHENSIS	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	**6**
VIOLA GLABELLA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Sum of Species per Region	**0**	**1**	**0**	**1**	**0**	**0**	**4**	**0**	**10**	**11**	**30**	**1**	**2**	**4**	**3**	**0**	**8**	**13**	

Appendix 6.15. Proximity matrix for cluster analysis of the Pacific Coast endemic species occurring in twelve out of eighteen regions of the park using Jaccard distance measure.

Proximity Matrix

	Matrix File Input											
Case	MEN_MT	NCH_MT	SCH_MT	CST_MT	TR_BAS	CHR_BAS	MAL	HW_MT	SW_MT	UC_BAS	MC_BAS	LC_BAS
MEN_MT		.000	.000	.033	.000	.000	.000	.000	.000	.000	.000	.000
NCH_MT	.000		.400	.290	.000	.385	.150	.100	.400	.000	.000	.083
SCH_MT	.000	.400		.281	.000	.267	.143	.091	.154	.000	.000	.077
CST_MT	.033	.290	.281		.000	.188	.303	.033	.133	.032	.030	.065
TR_BAS	.000	.000	.000	.000		.125	.000	.000	.000	.000	.250	.000
CHR_BAS	.000	.385	.267	.188	.125		.050	.000	.333	.000	.200	.222
MAL	.000	.150	.143	.303	.000	.050		.077	.063	.000	.063	.067
HW_MT	.000	.100	.091	.033	.000	.000	.077		.000	.000	.000	.000
SW_MT	.000	.400	.154	.133	.000	.333	.063	.000		.000	.000	.000
UC_BAS	.000	.000	.000	.032	.000	.000	.000	.000	.000		.000	.000
MC_BAS	.000	.000	.000	.030	.250	.200	.063	.000	.000	.000		.400
LC_BAS	.000	.083	.077	.065	.000	.222	.067	.000	.000	.000	.400	

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Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

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