National Park Service

Arctic Network Inventory and Monitoring Program

Vascular Plant Inventory of Alaska's Arctic National Parklands

Bering Land Bridge National Preserve, Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve

Final Report

Arctic Network Inventory & Monitoring Program

National Park Service, Alaska Region

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Vascular plants, rare plants, floristics, Alaska flora, NPS Arctic Network, ARCN, Bering Land Bridge National Preserve, Cape Krusenstern National Monument, Kobuk Valley National Preserve, Gates of the Arctic National Park and Preserve, Noatak National Preserve.

Abbreviations

AKNHP: Alaska Natural Heritage Program, University of Alaska Anchorage
ALA: University of Alaska Museum of the North Herbarium, Fairbanks
ANCS: Automated National Cataloging System, NPS database
ANILCA: Alaska National Interest Lands Conservation Act
ARCN: Arctic Network, National Park Service Alaska Region
B: Herbarium, Botanical Garden and Museum, Berlin, Germany
BELA: Bering Land Bridge National Preserve
C: Herbarium, Botanical Museum, University of Copenhagen, Denmark
CAKR: Cape Krusenstern National Monument
CAN: Herbarium, Canadian Museum of Nature, Ontario
COCO: Herbarium, Colorado College, Colorado Springs
COLO: University of Colorado Herbarium, Boulder
DAO: Herbarium, Agriculture and Agri-food Canada, Ontario, Canada
DS: California Academy of Sciences, San Francisco
GAAR: Gates of the Arctic National Park and Preserve
GB: Herbarium, Botanical Institute, Götenborg, Sweden
GH: Harvard University Herbaria, Cambridge, Massachusetts
IAB: Institute of Arctic Biology, University of Alaska Fairbanks
ISC: Ada Hayden Herbarium, Iowa State University, Ames, Iowa
I&M: Inventory and Monitoring Program, NPS
K: Herbarium, Royal Botanic Gardens, Kew, England
KOVA: Kobuk Valley National Park
LE: Herbarium, Komarov Botanical Institute, St. Petersburg, Russia
LD: Herbarium, Botanical Museum, Lund, Sweden
MICH: University of Michigan Herbarium, Ann Arbor
MIN: University of Minnesota Herbarium, St. Paul
NPS: National Park Service
NOAT: Noatak National Preserve
NWR: National Wildlife Refuge

NY: New York Botanical Garden Herbarium
O: Herbarium, Natural History Museum, Oslo, Norway
OBI: California Polytechnic State University, San Luis Obispo
RE: Range extension
RM: Rocky Mountain Herbarium, University of Wyoming, Laramie
S: Herbarium, Swedish Museum of Natural History, Stockholm, Sweden
TRH: Herbarium, Norwegian University of Science and Technology, Trondheim
UAF: University of Alaska Fairbanks
US: Smithsonian Institution, U.S. National Herbarium, Washington, DC
USFS-Sitka: U.S. Forest Service Herbarium, Sitka, Alaska
USFWS: U.S. Fish and Wildlife Service
USGS: U.S. Geological Survey
VABM: Vertical angle benchmark
WRST: Wrangell-St. Elias National Park and Preserve
WS: Herbarium, Washington State University, Pullman

Rare Plant Ranking Abbreviations

Listed are the abbreviations used for indicating plant rarity that are used by the Nature Conservancy and a network of natural heritage programs and conservation data centers. In Alaska, the Alaska Natural Heritage Program, University of Alaska Anchorage (AKNHP), maintains a tracking list and rankings for the rare biota of Alaska.

G#: global rank, throughout the entire range of the species

S#: state rank, rarity as observed at the state level

1: species is critically imperiled due to extreme rarity (five or fewer occurrences) or due to some factor of its biology making it especially vulnerable to extinction

2: species is imperiled due to rarity (6 to 20 occurrences) or due to other factors making it very vulnerable to extinction

3: species is either very rare and local in distribution (21 to 100 occurrences) or found within a restricted range

4: species is widespread and apparently secure

5: species is clearly secure

?: a qualifier noting that the ranking is inexact; more information is needed to be certain if the rank shown is supportable

Q: questionable taxonomy, the taxonomy supporting this name is questioned by some botanists

S#S#: indicates rank is uncertain and best described as a range between two rankings

T: indicates ranking is for the listed subspecies or variety

TABLE OF CONTENTS

Recommended Citation ii
Keywords ii
Abbreviations ii
Rare Plant Ranking Abbreviations iii
List of Figures vi
List of Tables vii
Abstract ix
Executive Summary xi
Chapter 1: Introduction 1
Chapter 2: History of Early Botanical Investigations in the Arctic Network Region . . . 3
Chapter 3: Methods 5
Chapter 4: Description of ARCN Parklands and Results of I&M Vascular Plant Inventory 7
Bering Land Bridge National Preserve 8
Cape Krusenstern National Monument 15
Gates of the Arctic National Park and Preserve 25
Kobuk Valley National Park 37
Noatak National Preserve 44
Chapter 5: Discussion of Rare and Noteworthy Species 56
Chapter 6: Range Extensions 104
Chapter 7: Summary Discussion and Recommendations 108
Acknowledgements 111
Literature Cited 112
Appendix: List of Vascular Plant Species Documented for ARCN Parklands 119

LIST OF FIGURES

Figure 1.1. Physiographic map of the Arctic Network parklands 1
Figure 4.1. Overview map of the Arctic Network I&M inventory sites 7
Figure 4.2. Overview map of Bering Land Bridge National Preserve 10
Figure 4.3. Shishmaref Inlet lagoon, northeast arm 10
Figure 4.4. Shishmaref Inlet lagoon, northeast arm 11
Figure 4.5. Espenberg River, vicinity 2 km east of mouth 12
Figure 4.6. Espenberg River, vicinity 5 km upriver from mouth 12
Figure 4.7. Overview map of Cape Krusenstern National Monument 18
Figure 4.8. Kakagrak Hills, vicinity 2 km north of landing strip 19
Figure 4.9. Tasaychek Lagoon, on the coast at base of Kakagrak Hills 19
Figure 4.10. Igichuk Hills, north of Mt. Noak and upper Situkuyok River valley 20
Figure 4.11. Igichuk Hills, vicinity southeast of Mt. Noak 20
Figure 4.12. Overview map of Gates of the Arctic National Park and Preserve 29
Figure 4.13. Endicott Mountains, Upper Encampment Creek 30
Figure 4.14. Endicott Mountains, Killik River dunefield 30
Figure 4.15. Castle Mountain, Arctic Foothills 31
Figure 4.16. Angayucham Mountains, Lake Selby 31
Figure 4.17. Schwatka Mountains, Reed Hot Springs 32
Figure 4.18. Overview map of Kobuk Valley National Park 39
Figure 4.19. Baird Mountains, Salmon River headwaters 39
Figure 4.20. Baird Mountains, north side of Jade Mountain 41
Figure 4.21. Kobuk River lowlands in vicinity of Ahnewetut Lake 41
Figure 4.22. Waring Mountains, vicinity 1 km north of VABM Slam 42
Figure 4.23. Overview map of Noatak National Preserve 47
Figure 4.24. DeLong Mountains, Copter Peak, headwaters of Kugururok River 47
Figure 4.25. DeLong Mountains, Primus Creek, headwaters in Anisak River valley 48
Figure 4.26. Desperation Lake, Anisak River valley 48
Figure 4.27. Grand Canyon of the Noatak River, mouth of Porgo Creek 49
Figure 4.28. Grand Canyon of the Noatak River, Sisiak Creek and Lake Narvakrak 49
Figure 5.1. *Saussurea triangulata* 60
Figure 5.2. *Symphyotrichum yukonense* 62
Figure 5.3. *Draba pauciflora* 65
Figure 5.4. *Stellaria dicranoides* 71
Figure 5.5. *Carex holostoma* 75
Figure 5.6. *Oxytropis arctica* var. *barnebyana* 78
Figure 5.7. *Oxytropis kobukensis* 80
Figure 5.8. *Oxytropis tananensis* 82
Figure 5.9. *Gentianopsis detonsa* 83
Figure 5.10. *Rumex krausei* 91
Figure 5.11. *Oxygraphis glacialis* 94
Figure 5.12. *Ranunculus glacialis* ssp. *camissonis* 95
Figure 5.13. *Ranunculus monophyllus* 96
Figure 5.14. *Potentilla fragiformis* 98
Figure 5.15. *Potentilla stipularis* 99

LIST OF TABLES

Table 4.1. List of localities and major habitat types visited in BELA. 13
Table 4.2. List of localities and major habitat types visited in CAKR. 21
Table 4.3. List of localities and major habitat types visited in GAAR 33
Table 4.4. List of localities and major habitat types visited in KOVA 42
Table 4.5. List of localities and major habitat types visited in NOAT 50
Table 5.1. Rare species in the ARCN parks 56
Table 5.1. Summary list of the rare plant species documented or cited 101
Table 6.1. List of moderate and major range extensions documented. 105

ABSTRACT

This report summarizes the inventory of vascular plants of the five park units comprising the Arctic Network (ARCN) of the National Park Service, Alaska Region, undertaken from 2001 to 2003. This study was part of a cooperative effort between the University of Alaska Museum of the North Herbarium (ALA) and the Inventory and Monitoring Program (I&M) of the National Park Service in Alaska. The primary objective was to produce a baseline species list for each park unit based on voucher specimens. Additional objectives were (1) to identify places and habitats that support the region's rare or uncommon flora and (2) offer recommendations for future inventory work.

Our initial effort was to compile lists of the vascular plants previously documented in earlier inventories and to identify areas and habitats in each park unit that remained under-surveyed. In addition, "expected species" lists were generated by the Alaska Natural Heritage Program (AKNHP) based on known plant records from areas adjacent to each park unit. The selection of I&M inventory sites was made primarily by taking into account the information gained from both these earlier surveys and the lists of expected, but previously undocumented, species. Logistical concerns were also a strong factor in determining sites, because each park unit is remote and roadless and collectively they cover approximately 19 million acres.

Once in the field, plant samples were gathered, pressed, and dried in standard plant presses. Location, habitat, and tentative field identifications were recorded for each plant. At the end of each field season, all specimens were returned to the University of Alaska Museum of the North Herbarium for final identification, processing, electronic database entry, and permanent curated storage.

A total of 4,567 plant specimens were collected from the ARCN parklands during our three seasons of fieldwork. The currently documented species for each park unit and the number of species new as a result of this inventory are: Bering Land Bridge National Preserve (BELA) 485 species (46 new); Cape Krusenstern National Monument (CAKR) 380 species (343 new); Gates of the Arctic National Park and Preserve (GAAR) 556 species (173 new); Kobuk Valley National Preserve (KOVA) 393 species (127 new); and Noatak National Preserve (NOAT) 431 species (244 new). A total of 706 species, representing 68 families, are documented for the combined ARCN parklands.

A total of 54 species ranked rare to critically imperiled (S3–S1) in Alaska by the AKNHP are now documented for the ARCN parklands. As a result of this inventory, 20 of these rare species were newly documented for ARCN and 50 new occurrence (element) records are documented for individual park units. In addition, most of the 54 rare species were documented from new localities within ARCN. *Draba pauciflora* (in GAAR) and *Festuca edlundiae* (in GAAR) are new to Alaska. *Potentilla fragiformis* (in CAKR) is newly recognized for North America. A second population of *Saussurea triangulata* (in KOVA), recently new to North America, was located. X_*Dupoa labradorica* (in both CAKR and BELA), a generic hybrid grass not currently ranked by AKNHP, is also new to Alaska.

In addition, we documented moderate (100–250 km) or major (>250 km) range extensions for 43 species, including 13 plants ranked as rare to critically imperiled (S3–S1) for Alaska. The majority of these range extensions are to the north and northwest of the species' previously known distribution.

This inventory has contributed significantly to our baseline knowledge of the distribution and richness of the vascular flora in the ARCN region. It also offers a strong foundation for future monitoring activities and recommendations for future inventory efforts.

EXECUTIVE SUMMARY

Chapter 1. Introduction

The Arctic Network (ARCN) of the National Park Service includes five parklands lying almost entirely north of the Arctic Circle and covering approximately 19 million acres. These parklands are the most wild and undeveloped units under National Park Service stewardship. All of them are remote and lack both roads and established trails. Access in summer is by boat, aircraft, or overland hiking. Earlier plant surveys are few and widely scattered over time and area. Recognizing that the biological resources of most parklands are poorly known, the NPS Inventory and Monitoring Program (I&M) mandated and funded inventory efforts in all Alaska's parklands, including this vascular plant survey of the ARCN units.

Chapter 2. History of Early Botanical Investigations in the Arctic Network Region

The earliest plant collections (1816–1880s) from the general ARCN region were made by naturalists traveling by ship and having brief opportunities to collect along the northwestern Alaska coastline. In the mid 1880s, exploration up the Kobuk and Noatak rivers resulted in a few collections from the interior. USGS explorers reaching the central and northern Brooks Range made small collections from 1899 to 1901. Alaska's first resident botanist, Jacob Anderson, made trips to the Seward Peninsula and Wiseman in the 1930s. However, knowledge of the flora in the ARCN region remained poor when Eric Hultén published the first comprehensive flora for Alaska in 1951. Plant surveys undertaken during the last 50 years are described for each individual park unit in Chapter 4.

Chapter 3. Methods

Inventory sites were selected after reviewing (1) the reports and resulting collections of earlier plant surveys within each unit, (2) lists of "expected" species generated from known collections within a 50 km perimeter of each unit, and (3) the geologic, topographic, and any ecological maps for all regions. Our general goal was to reach the areas, landscapes, and habitats that had not been previously visited by botanists or that might support elements of the flora not yet documented for each unit. In the field, plants were collected, pressed, and dried. Habitats and locations were described for all collections. Specimens were returned to the University of Alaska Museum of the North Herbarium (ALA) for final identification, entry into a database, and filing into the main herbarium collection. Specimen information was made available online through the Museum internet database and NPSpecies.

Chapter 4. Description of ARCN Parklands and Results of I&M Vascular Plant Inventory

This chapter contains a separate section for each of the five park units in ARCN. Each section includes (1) a general description of the unit, (2) a brief history of recent botanical work undertaken, (3) a list of botanical field crew and dates the unit was visited, (4) a list

of the sites and habitats surveyed during the I&M inventory, (5) floristic results, and (6) recommendations for future work.

Chapter 5. Discussion of Rare and Noteworthy Species

A general introduction of the ARCN rare flora is followed by a discussion of each of the 54 rare or noteworthy species that have been documented and the three that have been cited from ARCN parklands. The specimen label data (location, habitat, etc.) for all rare plant occurrences in the network are listed and a summary table is included. Among the species covered are three new to Alaska based on our I&M inventory, three recently recognized as new to North America, and several major range extensions. The total rare species now documented for each unit are BELA 17 (1 new), CAKR 13 (11 new), GAAR 29 (19 new), KOVA 14 (4 new), and NOAT 21 (16 new).

Chapter 6. Range Extensions

A brief introduction describes how a range extension was determined and defined for this report. A summary table lists the 43 range extensions documented by the I&M inventory collections. The majority of range extensions were to the north or northwest and involved species having a boreal or continental distribution. Thirteen of the range extensions involved Alaska rare plants.

Chapter 7. Summary Discussion and Recommendations

A broad overview of our results and several suggestions for future inventory work are offered. Most of these recommendations are general and refer to the entire ARCN parklands.

CHAPTER 1
INTRODUCTION

The Arctic Network of National Park Service (ARCN) parklands includes 5 units in northcentral and northwestern Alaska. Collectively they cover approximately 19 million acres (Figure 1.1). The current boundaries of each of these units were created in 1980 under the Alaska National Interest Lands Conservation Act (ANILCA). Included within the ARCN parklands are the eastern (North American) portion of the unglaciated Bering Straits region of Beringia, the very rich archaeological region of northwest Alaska with its long history of occupation by the Inupiaq Eskimos, and the western half of the Brooks Range. All of the parklands lie within, and extend north or west of, the boreal forest-tundra ecotone zone. With the exception of Bering Land Bridge National Preserve (BELA) and a small segment of Gates of the Arctic National Park and Preserve (GAAR), all these parklands lie north of the geographic Arctic Circle.

The remoteness of this region makes access relatively difficult for visitors and researchers alike. There are no NPS visitor facilities, established trails, or public roads within any of the units. Access is by boat, foot, small plane, or helicopter in summer, and by skis, dog team, snowmobile, or ski plane in winter. Large portions of the ARCN parklands are now declared as wilderness areas, and they are, without doubt, the most wild and undeveloped regions under NPS stewardship nationwide.

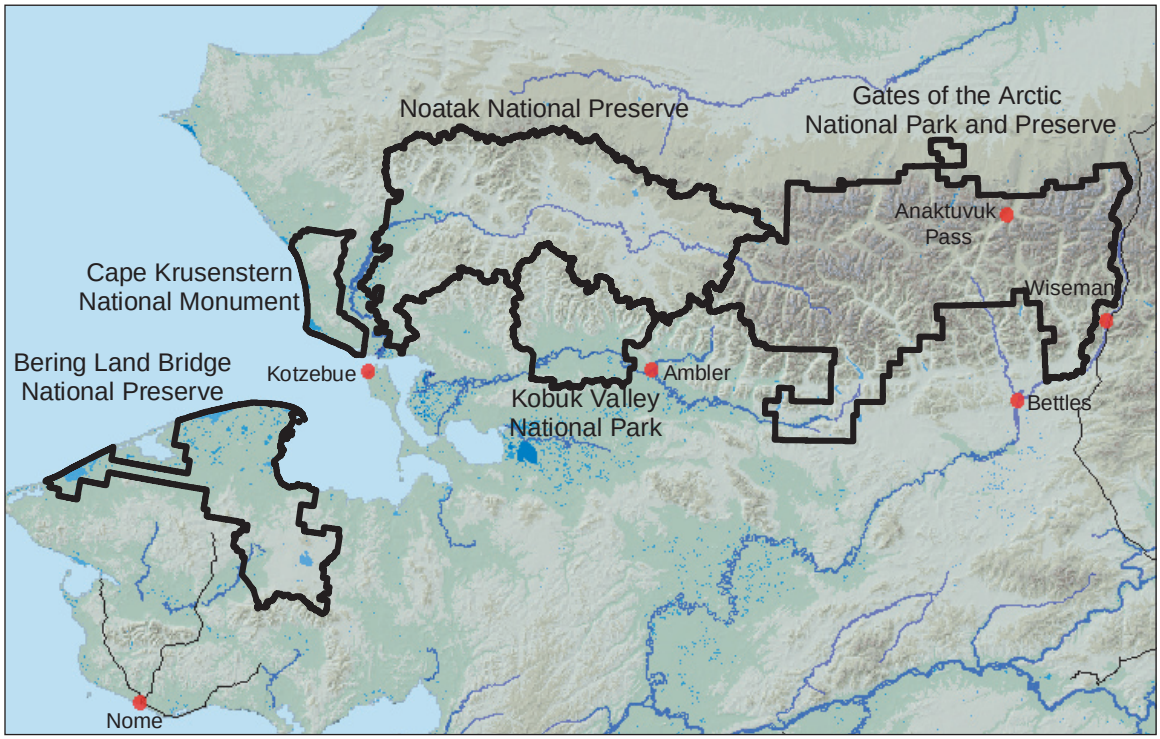

Figure 1.1. *Physiographic map of the Arctic Network parklands in northwestern Alaska. Map generated by NPS Alaska Region, I&M Program.*

Due to their remoteness and large size, studies of the natural and cultural history within the ARCN parklands have been widely scattered over time and over their total geographic area. Conducting any type of research in these regions involves a significant commitment of time, personnel, and logistical support. However, the rewards of investigating pristine and intact ecosystems are immeasurable.

The NPS Inventory and Monitoring Program (I&M) was established in 1992 with the mandate to create a database of the biological resources found in each park unit (species diversity, species distribution) and describe the current state of these resources and monitor them for any change over time. In 2000, funding was made available to begin conducting inventories of plants, mammals, birds, and amphibians within Alaska's NPS parklands. This funding provided the support for this vascular plant inventory of the ARCN parklands.

CHAPTER 2
HISTORY OF EARLY BOTANICAL INVESTIGATIONS IN THE ARCTIC NETWORK REGION

The earliest known plant collections from northwest Alaska were made in 1816 by the naturalist and poet Adalbert Chamisso and ship's surgeon Johann Eschscholtz. They sailed with Captain Otto von Kotzebue on the *Rurik* up the south and west coast of Alaska and in northwestern Alaska visited Shishmaref Inlet, Cape Espenberg, and Chamisso Island (at the head of Kotzebue Sound). Chamisso, who had also visited many Bering Sea islands and the Aleutian Islands, was a stellar collector who took detailed notes and processed and published all his collections. His report was the first published account of the Alaskan flora (Chamisso and Schlechtendal 1826–1836, Hultén 1940). His reports and collections are held at Berlin, Germany (B) and St. Petersburg, Russia (LE). Chamisso's and Eschscholtz's names are attached to many plant species today.

In 1826 and 1827, naturalist George Lay and ship's surgeon Alexander Collier sailed with Captain Beechy to Chamisso Island, Cape Krusenstern, and northward to Wainwright. Their collections were published (Hooker and Arnott 1841) and are held at Kew Gardens (K) in England.

During the next 50 years, various additional collecting efforts were made along the northwest coast. The best known may be those of John Muir, an American naturalist who sailed on the *Corwin* in 1881. He visited Kotzebue Sound, Cape Prince of Wales, and several other localities along the western coast of Alaska and the eastern coast of Chukotka, Russia. His collections were reviewed by botanist Asa Gray and published (Muir 1883, Hultén 1940). Muir's collections are held at the Gray Herbarium at Harvard University (GH), and are probably the first Alaska specimens to be both published and housed within the United States.

The first collections of plants from the interior of northwestern Alaska were made in 1884 and 1885. This inventory was conducted by S. B. McLenegan, a ship's engineer who sailed to the region on the *Corwin* in 1884. Leaving the ship at Kotzebue Sound, he traveled 185 miles up the Kobuk River and on to Selawik Lake. In 1885, he went inland again, this time going 250 miles up the Noatak River. His collections were eventually published, but their location is uncertain (McLenegan 1889, Hultén 1940).

Also in 1885 and 1886, small collections were made by Huff and Stoney who were attached to a U.S. Naval exploration envoy based out of Fort Cosmos, located at the confluence of the Kobuk River and Cosmos Creek near the modern village of Shungnak. Huff collected plants at both Fort Cosmos and in Hotham Inlet while Stoney explored the Kobuk, Noatak, Selawik, and upper Alatna river valleys (Stoney 1900, Hultén 1940). Their collections are housed at the United States National Herbarium (US), Smithsonian Institution, Washington, DC.

USGS geologist Frank Schrader was the first person to collect plants from the central Brooks Range region to the east of the Kobuk and Noatak river basins. In 1899 he explored the Chandalar, Koyukuk, and Alatna rivers (Schrader 1900), then in 1901 he

returned to the Koyukuk, John, and Anaktuvuk river valleys before heading north to the Colville River and Point Barrow (Schrader 1904). His collections are believed to be at US (Hultén 1940).

In 1901, two U.S. Geological Survey explorers, William L. Poto and W. C. Mendenhall, collected plants during a trip from Walker Lake through the Alatna and Kobuk river valleys and finally west to Kotzebue Sound (Mendenhall 1902). Their collections are held at US.

For several years after 1901 and up to the 1940 to 1960s, only small, scattered collection efforts were made in northern interior and northwestern Alaska. Most specimens were sent to US and GH, two of the largest active research collections in the United States at that time, where they could be reviewed by botanists interested in the northern floras (Fernald 1925, Hultén 1940).

The exception to this hiatus in collection efforts is that of Jacob Peter Anderson, who is considered by most to be Alaska's first resident botanist. Based at both Sitka and Juneau from 1914 to 1941, he traveled all over Alaska, including the Seward Peninsula, along the coast to Pt. Barrow, and to the Wiseman area in the central Brooks Range. He was a vigorous collector himself, and he actively recruited others to collect for him during their respective travels throughout Alaska. He amassed a large personal herbarium at Sitka and sent duplicate specimens to US, GH, and to herbaria in Sweden (LD and S) where Eric Hultén was working (Hultén 1940, Welsh 1974). A portion of Anderson's personal collection is now held at the Alaska State Museum in Juneau, but the bulk of his specimens returned with him to the Iowa State University Herbarium, Ames, Iowa (ISC). He eventually published an illustrated treatment dedicated to the Alaska flora (Anderson 1959). As a result of a recent agreement between ISC and ALA, his collection of several thousand specimens will be housed at the University of Alaska Museum of the North Herbarium, Fairbanks.

During the same period that Anderson and his colleagues were active, additional botanists and naturalists made small, scattered collections. Bob Marshall (unpublished) and Edith Scamman (Scamman 1940) made a few collections in the vicinity of Wiseman in the central Brooks Range. Canadian botanists A. Erling and Robert Porsild made collections along the northwest coast, including the Seward Peninsula (Porsild 1939).

Most plant inventories after the 1940s and early 1950s were linked with general geological, geomorphic, and biological inventories throughout the region as well as surveys made by botanists working on their own research projects. These more recent investigations are described in the section for each park unit in Chapter 4.

In 1950, Eric Hultén, from his home base in Sweden, completed the first truly comprehensive treatment for the Alaskan and Yukon flora (Hultén 1941–1950). This work included his taxonomic discussions, a full synonymy for each species, full citations for specimens he had reviewed, and maps based on specimens he had collected or reviewed at several herbaria. The flora of the ARCN region was poorly known at this time; however, many of the early collections noted above are cited by Hultén in this volume. Although published over 50 years ago, this publication remains a keystone reference for Alaska botanists.

CHAPTER 3
METHODS

The primary objective of this vascular plant inventory was to compile a baseline species list for each park unit that would be documented by herbarium voucher specimens. Additional objectives included identifying areas rich in rare or uncommon species and warranting additional concern, and making suggestions for future surveys.

Our initial step was to search the electronic database at the University of Alaska Museum of the North Herbarium and generate a species list for each unit that was based on collections currently held there. We also contacted knowledgeable people and searched the literature for references and information concerning earlier botanical work in the ARCN region. From these combined efforts it was determined for each unit (1) where previous inventory work had been done, (2) what types of habitats had been visited, (3) how thoroughly these localities and habitats had been surveyed, and (4) where the resulting collections were held.

The Alaska Natural Heritage Program, under contract with NPS Alaska Region, contributed further to this effort by generating lists for each park based on the ALA database, on the Automated National Cataloguing System (ANCS) maintained by NPS, and on selected holdings from several out-of-state herbaria (CAN, DAO, US, NY, GH). Using these same information sources, AKNHP also generated expected species lists for each unit, consisting of species documented within a 50 km perimeter of each respective park unit's boundary, but which had not been documented from within it.

Our considerations in the selection of potential inventory sites can be generalized and summarized as follows:

1. Previous collection history, including species lists and reports, was used to identify areas and habitats within each unit that appeared to be under-surveyed or were essentially unknown botanically. This same information often suggested potential floristic "hotspots," based on unusual species occurrences from otherwise poorly inventoried sites. Our effort was to identify sites that lay within these poorly known regions that had under-surveyed habitats or that seemed unique in some way based on the information we had gathered.
2. Bedrock, glacial history, and topographic maps were consulted for each park unit to identify the diversity of bedrock types and landscape forms present. The effort was made to select sites that optimized access to a diversity of bedrock type and landscape features. When available, vegetation maps were used to identify sites having access to the greatest diversity of plant cover types.
3. Local residents and pilots, NPS personnel, and others familiar with the region were consulted to determine which potential sites could be reasonably accessed given the short collecting season and limited inventory time and resources. Access to these remote and roadless regions is usually by small fixed-wing aircraft, helicopter, boat, or raft, and the final selection of sites had to take into consideration the availability of

landing sites, navigable waterways, and any opportunities to share logistic costs with other field projects.

The working definition of "site" used herein refers to a locality reached by boat, plane, or helicopter where plant collecting occurred. This concept of a site often included the surrounding area, within a 3–8 km radius, that was reached on foot from a base camp or "put-down" locality. Since collecting occurs continuously as a botanist moves across the landscape, our sense of the term site is broader than that generally used by those gathering plot or transect information.

After potential access and collecting sites were chosen, we gathered geologic and topographic maps (both 1:63,360 and 1:250,000 scale), aerial photographs, preexisting species lists and reports, and any additional information relevant to each site. These combined resources were taken to the field for reference while working in each area.

Once a collection site was reached, we noted a brief description of the landscape and vegetation, took a GPS waypoint, and marked the location on a topographic map and/or aerial photograph. Specimens were collected and carried in plastic (food storage) containers or plastic bags during the day. An effort was made to seek out and investigate the full diversity of habitats and microhabitats found at each site in order to maximize the diversity of plant species found. In the evening, each specimen was given a collector number, a tentative field identification, and placed in a standard plant press for drying. In addition, the habitat and any additional relevant information was recorded for each specimen. Plants were left in the press until dry and eventually packaged for transport back to ALA.

At ALA, each specimen was given a final identification by Carolyn Parker or Reidar Elven. Taxonomic specialists were consulted for final determinations of the more problematic species. Herbarium labels were generated for all specimens, noting scientific name, collection location, habitat, collectors, and date. All specimens were also assigned an ALA accession number and a NPS accession and catalog number. All of this label information was entered into our ALA database (4th Dimension-2003) and sent to both the University of Alaska Museum of the North internet database (http://arctos.database.museum/) and to NPSpecies (https://science1.nature.nps.gov/npspecies/web/main/start). Specimens were mounted on archival paper and systematically filed in the main herbarium at ALA, where they are held in the public domain.

CHAPTER 4
DESCRIPTION OF ARCN PARKLANDS AND RESULTS OF I&M VASCULAR PLANT INVENTORY

ARCN covers a very large area of northern and northwestern Alaska. As noted in Chapter 1, this region is very diverse with respect to its ancient glacial history, bedrock geology, landscape topography, vegetation, and climatic zones. Each parkland has its unique setting and features, yet all include a portion of the broad and complex transitional ecotone between the boreal forest and the northern and alpine tundra. In addition, with the exception of BELA and a small segment of GAAR, the entire region is north of the geographic Arctic Circle. Due to the immense size and remoteness of this region, earlier botanical work has occurred at scattered locations depending on the project focus and available access. Most of the areas and sites we visited had never been surveyed by botanists or at best had been visited only briefly. Our I&M effort in ARCN has truly been an exploratory effort in many respects. An overview map of our I&M inventory sites in ARCN is shown in Figure 4.1.

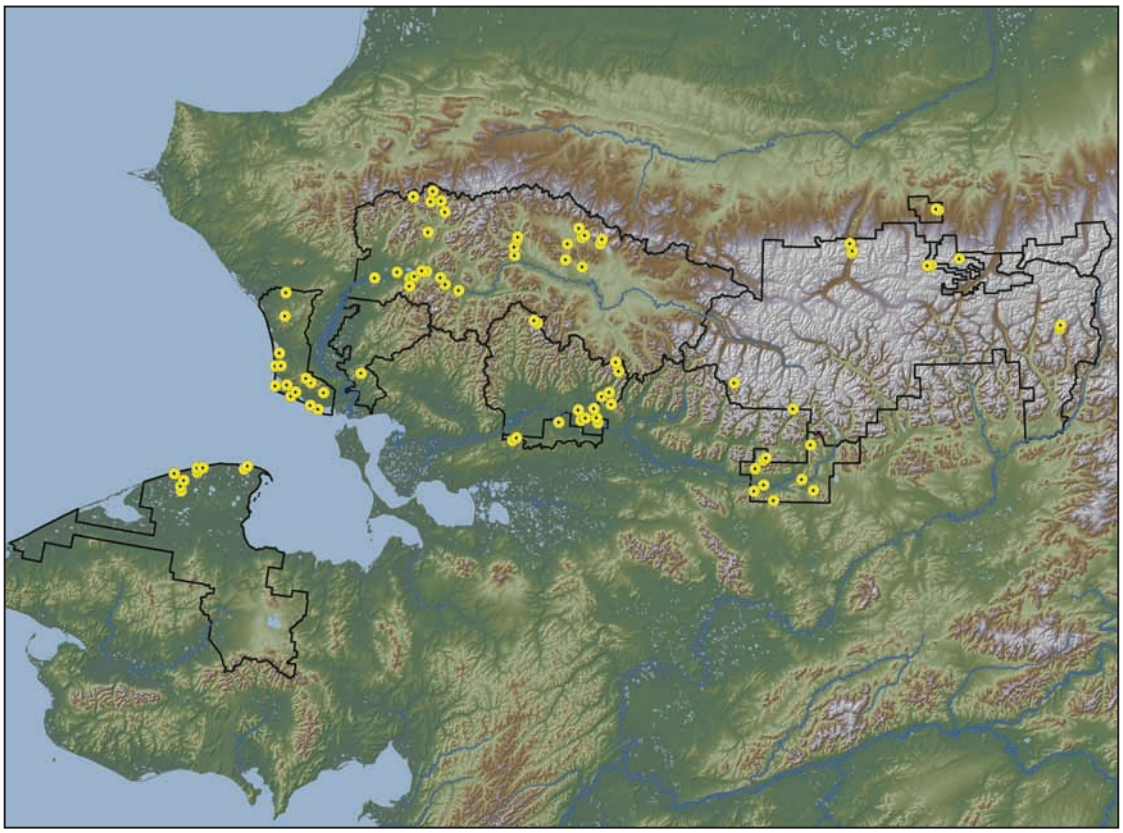

Figure 4.1. *Overview map of the Arctic Network parklands. Yellow dots indicate collection sites visited during the 2001–2003 I&M vascular plant inventory.*

Bering Land Bridge National Preserve

Introduction

Bering Land Bridge National Preserve (BELA) is centrally located within the ancient unglaciated Bering Land Bridge and covers approximately 2.5 million acres. It is renowned for its rich Beringian endemic vascular flora, significant paleo-ecological and paleo-sol deposits, and for having a rich and diverse migratory bird fauna. The Preserve was established for the primary purposes of (1) protecting diverse geologic and geomorphic landscapes (e.g., massive lava flows, dynamic coastlines, wetlands, marble knobs, alpine uplands) and the plant communities they support; (2) preserving critical habitats used by migratory birds in transit between Asia and North America; and (3) protecting archeological sites such as those at Serpentine Hot Springs and along the Chukchi Sea coast. Sustainable management of the reindeer grazing permit system was also a concern at the time the preserve was established.

General Description

Physiography

The Preserve spans much of the northern half of the Seward Peninsula. The irregular boundary encompasses a diversity of landscapes and vegetation representative of the entire peninsula, with the exception of the boreal forest found in the southeast portion of the peninsula. The southeast corner of BELA includes the rugged Bendeleben Mountains consisting primarily of acidic metamorphic bedrock with scattered carbonate intrusions. This is the only area within the preserve that experienced glaciation during the Quaternary, and the effects of local alpine glaciation are evident. Extensive Tertiary and Holocene lava flows fill a large portion of the Imuruk Basin north of the mountains. Weathered uplands of schistose bedrock with carbonate (including marble) intrusions span the central region, including the Good Hope and the Inmachuk mountains. The northern and western portions of the preserve are dominated by a broad, ancient coastal plain dotted with numerous lakes and bordered by a very dynamic coastline that includes active and stabilized dunes, shallow tidal lagoons, estuaries, rapidly eroding coastal plain slump banks, and stretches of outer barrier dunes. Widely scattered granitic intrusions have weathered to produce isolated tors such as those found at Serpentine Hot Springs.

Vegetation

Plant communities found within the preserve are equally diverse. The entire area is just beyond the regional treeline, and tall shrubs (*Salix* spp., *Alnus viridis* ssp. *fruticosa*) and balsam poplar (*Populus balsamifera*) are found in isolated sheltered sites in the southeastern portion of the preserve. The alpine and highest upland regions support ericaceous–*Dryas* tundra that is often rich in lichens. Some rare species, such as *Douglasia beringensis* and *Papaver walpolei*, are found on the outcrops of carbonate rock within these upland regions. Poorly drained slopes throughout the uplands support moist to wet sedge-*Dryas*

tundra and sedge-tussock tundra. The large lava flows near Imuruk Lake offer a barren appearance and support only widely scattered lichens, forbs, and dwarf shrubs. The extensive low coastal plain that dominates the north and western portions of the preserve are a mosaic of permafrost thaw lakes, wet graminoid meadows, tussock tundra, and acidic ericaceous-low shrub tundra. Willows and alder form patches along drainages. Active and stabilized dunes along the coast support *Leymus* meadows, *Empetrum* heath tundra on the well-drained dune summits, and peaty wet sedge meadows (mires) in the swales.

Recent Botanical Investigations

The southern and coastal areas of the Seward Peninsula, especially in the vicinity of Nome, Teller, and Wales, have been visited by many botanists since the early 1900s, because these areas are readily accessible by road or scheduled airlines. Some of the resulting collections are at ALA; others are scattered among other U.S. herbaria. Very few collections were made in the northern and interior regions until 1948 when Robert Sigafoos spent several summers studying the effect of soil frost action on vegetation patterns in the Imuruk Basin area (Hopkins and Sigafoos 1951). His collections are at US, and some duplicates are held at ALA.

UAF student Kathy Wright made a collection along the length of the Kitluk River to its mouth west of Cape Espenberg in 1977 (ALA). Charles Racine collected from several scattered localities as part of a general biological survey of the preserve (then a monument) in 1978 (Racine and Anderson 1979). A portion of his collections is at ALA.

During the early 1980s and through to 1993, Tass Kelso made collections from many Seward Peninsula localities including Wales, Serpentine Hot Springs, and Ear Mountain. Her work resulted in several range extension discoveries and in the naming of one new species within the genus *Primula* (Kelso 1983, 1987a, 1987b, 1989). Her collections are held at ALA and COLO. NPS personnel made collections from scattered localities within BELA and adjacent areas during the mid 1980s and early 1990s (NPSpecies). These are held at the NPS herbarium at Anchorage.

The NPS Shared Beringian Heritage Program funded botanists David Murray (ALA), Boris Yurtsev (LE), and Tass Kelso (ALA and COCO) to conduct a thorough botanical inventory of the southern and interior portions of the preserve in 1992 and 1993. The results of this inventory are to be compiled in 2006.

Field Activity and Personnel

The north and northwest coastal areas were the least botanically known areas within the preserve, therefore we focused our I&M inventory fieldwork there. A map of BELA indicating our collecting sites is shown in Figure 4.2.

In 2001, botanists Carolyn Parker (ALA), Reidar Elven, and Heidi Solstad (both from O), assisted by Alfred Weyowanna of Shishmaref, visited the northeast arm of Shishmaref Inlet (known locally as Cowpack Lagoon) from August 6–10 (Figures 4.3 and 4.4). Motorboat access allowed us to reach several sites from the northern tip of the lagoon to the lower reaches of the Cowpack River.

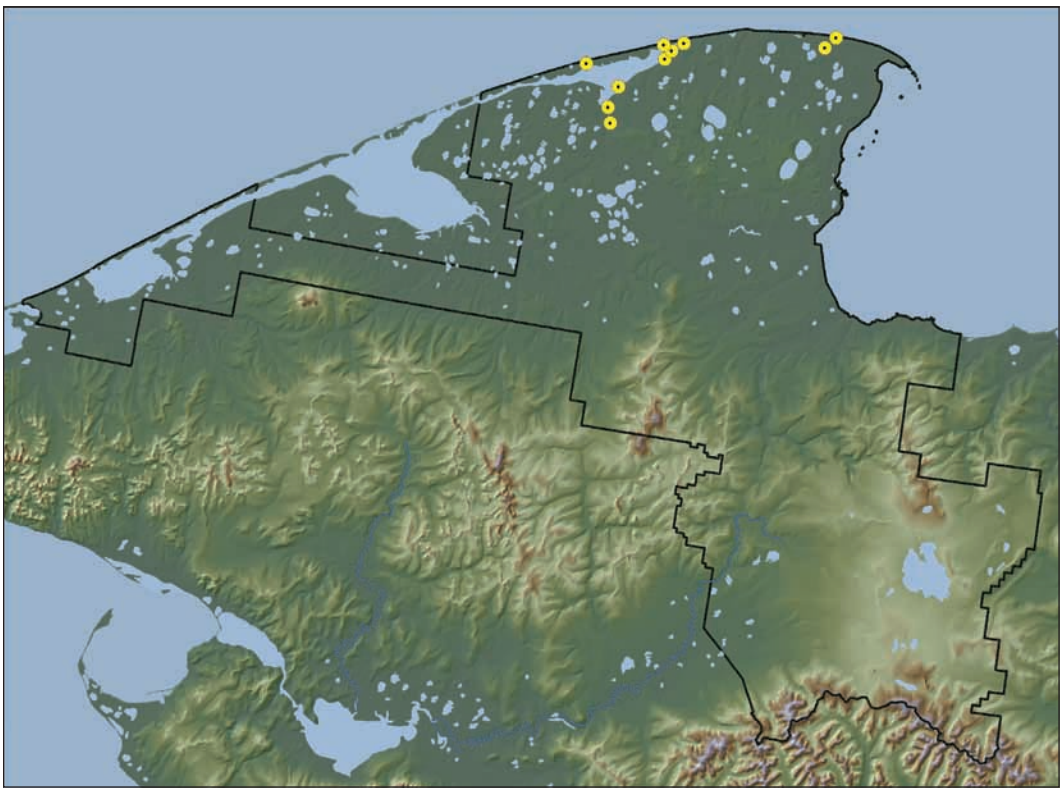

Figure 4.2. *Overview map of Bering Land Bridge National Preserve. I&M inventory sites in the northeast arm of Shishmaref Inlet lagoon were visited in August 2001. Sites near the mouth of the Espenberg River were visited in July 2003.*

Figure 4.3. *Shishmaref Inlet lagoon, northeast arm. View to southwest along the outer coastal beach. Active sand dunes with open* Leymus mollis *meadow in foreground. A brackish graminoid meadow, margined by dunes, is indicated by the darker, reddish color at upper left.*

Figure 4.4. *Shishmaref Inlet lagoon, northeast arm. View to northeast toward tip of lagoon along inner coast. The ancient coastal plain is eroding along the beach, creating peaty slump banks supporting seral herbs. Heath-shrub hummock tundra, seen in the foreground, dominates the top of the coastal plain.*

In 2003, Parker, Elven, and Solstad were joined by botanist Alan Batten (ALA) to survey the area around the mouth of the Espenberg River from July 2–7. From this base, canoe access allowed us to cover areas on both sides of the river and to go upriver to inland sections of the coastal plain (Figures 4.5 and 4.6). Localities and habitats visited during our inventory in BELA are listed in Table 4.1.

Results and Discussion

We collected 505 specimens during our two inventory trips to BELA and documented 46 new species for the preserve. The total of number of species now documented for BELA is 486.

In 2001, the rare species *Minuartia biflora* and *Puccinellia vaginata* were documented from the Shishmaref Inlet lagoon area. *Puccinellia vaginata* was a new record for BELA. *Minuartia biflora* had been collected previously by Murray et al. at Killeak Lake in 1993 (ALA). In 2003, we collected the rare species *Carex holostoma* near the Espenberg River mouth. This sedge had been previously collected in BELA at Killeak and Kuzitrin lakes by Murray et al. in 1993 (ALA).

A stabilized hybrid grass, X_*Dupoa labradorica*, the result of a cross between *Poa eminens* and *Dupontia fisheri*, was found at both of our BELA inventory sites. At Shishmaref Inlet lagoon, it was found in a wet marsh among dunes of the outer barrier island near the Singeak shelter cabin. Along the Espenberg River, it was found in brackish meadows approximately 3 km inland from the coast on both the east and west side of the river. This grass was recognized as new to Alaska when it was found at Sheshalik (CAKR) in 2001

Figure 4.5. *Espenberg River, vicinity 2 km east of mouth. Wet freshwater meadow lies in the foreground. Inland side of active and semiactive dunes, seen in background, support* Leymus *meadows on summits and upper slopes, and* Empetrum *heath tundra (appearing dark green) on lower slopes.*

Figure 4.6. *Espenberg River, vicinity approximately 5 km upriver from mouth. Late-lying snowbank slope at right supports an open* Salix *stand with lush forb meadow understory. Wet freshwater meadows are visible in the background.*

Table 4.1. *List of localities and major habitat types visited in BELA during the I&M inventory in 2001 and 2003*

Locality	Landscapes	Dominant Communities
2001		
Shishmaref Inlet Lagoon, Singeak shelter cabin and Kividlo archaeological site (base camp), 66°31'N, 164°47'W	• active and semistabilized barrier island dunes	• *Leymus* meadows • *Empetrum* heath tundra • wet freshwater graminoid meadows • brackish meadows
Shishmaref Inlet lagoon N end, Singeak archaeological site and south to Cowpack River mouth (4 sites), 66°32'N, 164°41'W	• active peat slump banks • ponds • low-energy sand beach	• heath-shrub hummock tundra • wet freshwater graminoid meadows • brackish meadows • *Leymus* meadows
Shishmaref Inlet lagoon, Cowpack River lower reaches (2 sites), 66°31'N, 164°44'W	• lowlands • late-lying snowmelt slopes	• wet freshwater graminoid meadows • wet brackish meadows • open *Salix* with herbaceous understory • open *Salix*-heath hummock tundra
Shishmaref Inlet lagoon, Ray's camp, across from Cowpack River (1 site), 66°28'N, 165°8'W	• open low-energy sand beach • areas of recent moderate human disturbance	• *Leymus* meadows • wet brackish meadows
2003		
Espenberg River mouth (base, includes few km both to E and W of mouth), 66°35'N, 163°59'W	• active and semistabilized dunes • dune blowouts • storm surge washouts • ponds • river bars	• *Leymus* meadows • *Empetrum* and dwarf *Salix* heath tundra • wet-sedge-dwarf *Salix* peat meadows (mires) • brackish meadows • mesic graminoid-forb meadows
Espenberg River lower reaches (4 sites), 66°34'N, 164°1'W	• sand bars • peat slump banks • late-lying snow bank slopes • reindeer corral site	• wet freshwater meadows • brackish meadows • heath-shrub hummock tundra • snowbed meadows

during our inventory, only one week before our trip to Shishmaref Inlet lagoon. Being a hybrid, it is not ranked for rarity. However, our collections from both BELA and CAKR represent a major westward range extension from Hudson Bay, Canada, where this grass was first described (Cayouette and Darbyshire 1993, Darbyshire et al. in prog). Since the completion of our ARCN inventory, X_*Dupoa labradorica* has also been found at Kotzebue, Goodnews Bay village, and in the lower Yukon River delta (ALA).

The single new rare species record for the preserve is *Puccinellia vaginata* G4S1.

The additional species ranked S1–S3 and currently documented from BELA as a result of earlier surveys are:

Artemesia senjavinensis G3S2S3

Cardamine microphylla ssp. *blaisdellii* G4S2S3

Carex holostoma G4S2

Douglasia beringensis G2S2

Draba exalata G3S3

Minuartia biflora G5S3S4

Oxytropis arctica var. *barnebyana* G4T2S2

Papaver walpolei G3S3

Potamogeton subsibiricus G3S3

Primula tschuktschorum G2G3S2S3

Puccinellia wrightii G3G4S2S3

Ranuculus glacialis ssp. *camissonis* G4S2

Ranunculus monophyllus G5S2

Saxifraga nudicaulis G3G4S2S3

Stellaria dicranoides G3S3

Stellaria umbellata G5S2S3

A new treatment for the circumpolar *Saxifraga rivularis* complex (Jørgensen et al., in press) has described *Saxifraga rivularis* ssp. *arctolitoralis*. Our collection from Shishmaref Inlet lagoon was the first record known from Alaska; however, a careful review of ALA collections found misidentified specimens of this taxon from other arctic coastal sites in Alaska. It is expected that it will soon be listed, and ranked for rarity, by AKNHP.

Although the flora of BELA is rich in endemic and rare species, the total number of documented species, 486, is only about 75% of the expected total. Probably most significant is the fact that the extensive alpine landscapes immediately south of the preserve are, by comparison, very limited within it. The alpine and rocky coastal areas south of BELA have been well inventoried by Kelso and others (ALA), and the flora is known to have a rich Beringian and Asian character. The expected species list for the preserve has certainly been enriched by the many records from these habitats and regions that lie outside the preserve, yet are not well represented within it. In addition, many of the "missing" taxa are plants usually associated with the boreal forest or found in human-disturbed habitats such as roads and mining areas. These habitats are rare, or lacking, within BELA, but are found within the 50 km perimeter of the preserve from which the expected species list was based. The boreal zone almost reaches the southeast boundary of BELA. The disturbed habitats that have been collected from in the past include a gravel road system and mining claims immediately south of the preserve boundary.

Recommendations

Despite the many collections from the preserve, a few areas remain poorly known botanically. These include:

Southeast Coast of Kotzebue Sound

Possibly the most potentially interesting area not yet surveyed within BELA is the active bird cliffs along the southern Kotzebue Sound coastline from Sullivan Bluffs to Clifford Point, west of the village of Deering. The combination of enhanced nutrients, increased opportunities for dispersal by birds, and the moderate disturbance associated with bird cliff activity often results in a rich flora, including many species not found in the adjacent

zonal vegetation. A plant inventory of the bluff bird cliffs on the southeast coast of the Seward Peninsula by ornithologist Dean Kildaw resulted in the documentation of several range extensions and rare species (ALA). An inventory of the similar setting on this segment of the Kotzebue Sound coastline could prove productive.

Goodhope River Basin

This basin has scattered outcroppings of carbonate rock, some of which have not been visited by botanists. These midelevation ridges and low hills are effectively alpine-like habitats, and the carbonate bedrock exposed on them is known to support rare and endemic taxa in other areas of the Seward Peninsula outside BELA. In addition, the well-developed and extensive Goodhope River estuary leading into Kotzebue Sound has not been surveyed.

Arctic and Ikpek Lagoons

The Arctic and Ikpek lagoons, southwest of Shishmaref village, lie on a distant western arm of BELA that reaches the Chukchi Sea coast. These areas offer similar landscapes to the north arm of Shishmaref Lagoon and lower Cowpack River visited briefly in 2001. However, the only known collections are those of David Mason, who visited the area briefly in 1976 (ALA).

Cape Krusenstern National Monument

Introduction

Cape Krusenstern National Monument (CAKR) is situated along the northern entrance to Kotzebue Sound and encompasses the coastline and adjacent uplands from west of the lower Noatak River northwest almost to the Wulik River. The primary purpose for the establishment of the monument was to preserve, study, and interpret the unique sequence of ancient gravel beach ridges and lowlands adjacent to Krusenstern Lagoon, which record over 6,000 years of continuous human occupation. In addition, the region supports seasonally rich populations of marine mammals, fish, caribou, and waterfowl. These resources need to be protected and kept available for local subsistence users.

Recent attention has been focused on the Red Dog Mine private access road that passes through the northern portion of the monument, linking a seaport within the monument to the mine on the Wulik River just north of the monument boundary. The concern is contamination by heavy metal-enriched dust that is released as trucks transport ore from the mine to the port. NPS is currently monitoring contamination in the streams and vegetation adjacent to the access road.

Several private subsistance camps are scattered along the coastline, and local residents, primarily Inupiaq Eskimos from Kotzebue and Noatak, continue to hunt, fish, and collect edible plants in the area.

General Description

Physiography

Cape Krusenstern National Monument follows the coastline of Kotzebue Sound from west of the Noatak delta northward to just south of the village of Kivalina. Landscapes include active gravel beaches, ancient beach ridges, extensive lagoon systems, inland lowlands, and rounded, barren uplands.

The most dynamic landscape feature found in CAKR is the active lagoon-spit system found along the coast. Most notable are Sheshalik (Sisualik) Spit, a long gravel spit that creates a large lagoon system within the Noatak River delta, and Krusenstern Lagoon, a very large lagoon lying between upland bluffs on the inland side and a band of ancient dune ridges extending to the coast. Smaller lagoon systems are also found along the coast including Tasaychek and Kotlik. Occasionally these lagoons become isolated from Kotzebue Sound when shifting ocean currents block their outlets with beach gravels in midsummer.

The Igichuk Hills, consisting of rounded summits and ridges of carbonate rock, extend through the southern portion of the monument and eastward across the Noatak Canyon into NOAT. The bedrock here consists of massive, coarsely weathered limestone and dolomite, lending much of the landscape above 200 m in elevation a gray, barren appearance.

The Tahinichok Mountains, within the Mulgrave Hills, are in the central northern portion of the monument. These are rounded hills of acidic sedimentary bedrock, including shales, conglomerates, and sandstones. Although screes and rubble slopes are common at the highest elevations, generally the alpine slopes are well vegetated.

The lowlands reaching into the interior, such as those along the Omikviorok River and Kilikmak Creek, consist of well-developed riparian landscapes of low-angled slopes, terraces, ponds, active floodplains, and incised beaded streams.

Vegetation

The coastal areas in CAKR support northern coastal strand communities, including *Leymus* meadows, scattered forbs on the younger gravel beaches, wet graminoid meadows, and mesic low shrub tundra.

The carbonate uplands of the Igichuk Hills support *Dryas* fellfield or plant assemblages consisting of scattered herbs and dwarf shrubs. Lower elevations, and sites at higher elevations where moisture is available, support low shrub tundra or a narrow zone of open riparian vegetation. At the southeastern corner of CAKR, patches of open white spruce boreal forest and woodland occur, representing the regional western treeline. In the Tahinichok Mountains, vegetation includes *Dryas* fellfield, dwarf heath-shrub tundra, and snowmelt meadows.

The lowlands along the major drainages support well-developed wetland meadows, medium to tall *Salix* thickets, and heath-sedge tussock tundra.

Recent Botanical Investigations

Before our inventory very little botanical work had been done within CAKR. Steve Young made approximately 30 plant collections in the southern portion of the monument during a comprehensive study of the entire Noatak Basin (Young 1973, ALA). In addition, NPS personnel and affiliates made a few collections in the 1980s, mainly from the Krusenstern Lagoon vicinity (NPSpecies).

Collections have been made in adjacent regions in the 1940s to 1960s. A large plant collection documenting botanical research undertaken in the Cape Thompson area, 70 km north of CAKR, is held at ALA. This research was part of the Project Chariot studies undertaken by the U.S. Department of Energy in the late 1950s to early 1960s (Johnson et al. 1966). In 1960, Anore Bucknell collected over 60 specimens from Kivalina, a village on the coast north of the monument (ALA).

Field Activity and Personnel

We conducted survey work in CAKR during a portion of each of the three years of the I&M inventory. An overview map of CAKR indicating our sites is shown in Figure 4.7.

In 2001, our base camps included the Kakagrak Hills at the "radio tower" airstrip from June 25–29 (Figures 4.8 and 4.9), and near the mouth of the Tukrok River at the coast from June 30–July 4. We also visited Sheshalik Spit, at the southeast tip of CAKR, from July 30–August 3. Collecting sites were accessed on foot from each of these camps. The only exception was on July 1 when we were offered boat transport by NPS personnel to travel up the Tukrok River and to the southern tip of Krusenstern Lagoon. Carolyn Parker and Alan Batten (both at ALA) were botanists for the first two trips. They were joined by Amy Denton (ALA) and Thomas Heinlein (NPS). During the Sheshalik Spit visit, botanists were Carolyn Parker, joined by Reidar Elven and Heidi Solstad (both at O).

In 2002, Carolyn Parker and Kate Beattie (both at ALA) based at Cape Krusenstern (Sealing Point) from July 11–14.

During 2003, base camp was again situated at the Kakagrak Hills "radio tower" airstrip from July 9–14. Inventory botanists included Carolyn Parker, Reidar Elven, and Heidi Solstad. Helicopter support offered access to several distant sites not previously visited in 2001 and 2002, including the vicinity of Mt. Noak (Figures 4.10 and 4.11) and the Tahinichok Mountains. This helicopter access was shared with a vegetation mapping team from Alaska Biological Resources (ABR), Fairbanks, under contract with NPS.

Since CAKR was essentially unknown botanically prior to this inventory, we attempted to reach as many localities and habitats as possible given the available access and time of each visit. In addition, collecting during our first season was extensive, as we attempted to document each species found and to document all but the most common and widespread species from more than a single locality. Localities and habitats visited during our inventory in CAKR are listed in Table 4.2.

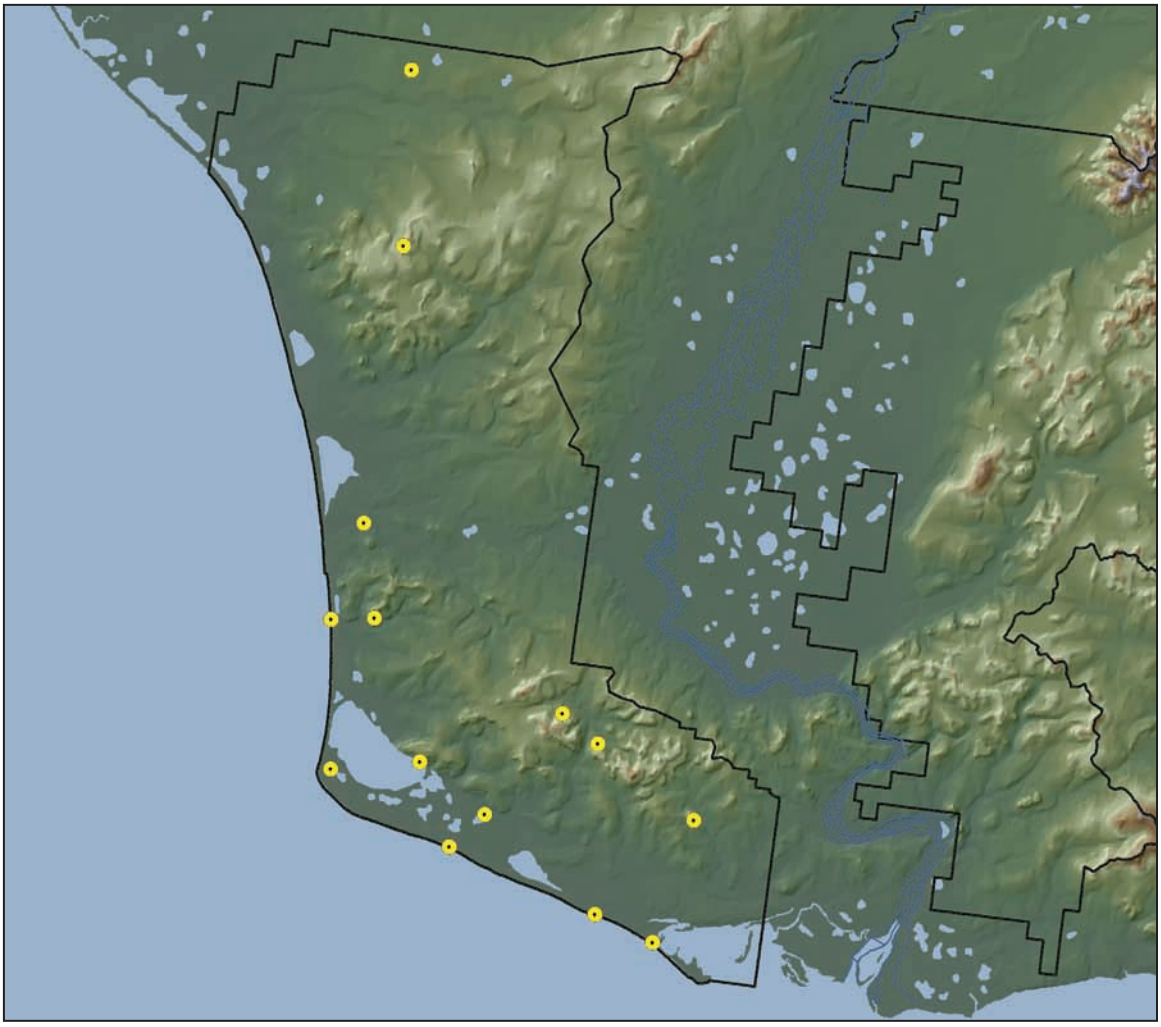

Figure 4.7. *Overview map of Cape Krusenstern National Monument. I&M inventory sites visited in 2001 include Sheshalik Spit, vicinity of Tulrok River, and vicinity of the Kakagrak Hills airstrip. Site along the southwestern margin of Krusenstern Lagoon and Cape Krusenstern was visited in 2002. Sites in the northern portion of the monument and in the Igichuk Mountains in the vicinity of Mt. Noak were visited in 2003.*

Figure 4.8. *Kakagrak Hills, vicinity 2 km north of airstrip. Barren limestone ridge with outcrops is seen along the skyline.* Dryas *fellfield covers the upper, drier slopes. Mesic heath-shrub tundra on the midslopes grades to open* Salix *shrub in foreground where it descends into a small drainage.*

Figure 4.9. *Tasaychek Lagoon, on the coast 3 km west of the Kakagrak Hills. Wet brackish graminoid meadows fill the lagoon basin. Open* Leymus *meadow covers a gravel beach ridge crest in foreground around hunting blind. Shrub tundra dominates the slopes in the background.*

Figure 4.10. *Igichuk Hills, vicinity north of Mt. Noak and upper Situkuyok River valley. Open* Dryas *fellfield covers the barren limestone ridges and slopes. Lower slopes support heath-shrub tundra. The narrow alpine riparian zone, seen in center left, has scattered* Salix *shrub with an herbaceous meadow understory.*

Figure 4.11. *Igichuk Hills, vicinity southeast of Mt. Noak. South-facing slope supporting an open white spruce stand with tall* Salix*-herbaceous understory. Slopes in the distant background are covered with heath-shrub hummock tundra with* Salix *thickets tracking the shallow drainages.*

Table 4.2. *List of localities and major habitat types visited in CAKR during the I&M inventory in 2001–2003.*

Locality	Landscapes	Dominant Communities
2001		
Kakagrak Hills airstrip (base camp 2001 and 2003) 67°16'N, 163°40'W	• limestone uplands, outcrops and rubble slopes	• *Dryas* fellfield • open willow-sedge shrub tundra • open riparian *Salix* thicket • alpine meadows
Sheshalik Spit, base of spit (base camp; ranged inland 5 km and north along coast 10 km) 67°1'N, 162°57'W	• beach ridges • lagoons	• *Leymus* beach meadows • brackish and freshwater wet graminoid meadows • open alkaline meadows • heath-shrub tundra • *Salix* thickets • *Empetrum* heath • open *Salix*-forb snowmelt slopes
Tasaychek Lagoon vicinity (1 site) 67°16'N, 163°46'W	• beach ridges • lagoon	• *Leymus* beach meadows • wet brackish meadows • wet sedge-grass freshwater meadows • *Dryas* fellfield-riparian margin
Tukrok River mouth (ranged N 10 km along coast to VABM First) 67°4'N, 163°46'W	• beach ridges	• *Leymus* beach meadows • wet sedge-grass meadows • *Empetrum* heath • open *Salix* thickets
Ingitkalik Mountain (base of hill at lagoon shore) 67°9'N, 163°31'W	• limestone rubble on S-facing slope	• mesic *Dryas*-heath tundra
Kimirok Hill, SE flank 67°7'N, 163°22'W	• base of uplands	• wet sedge-grass meadow • shrub-sedge tussock tundra • wet *Equisetum* snowmelt meadow
2002		
Cape Krusenstern, Sealing Point (base camp) 67°8'N, 163°43'W	• coastal plain • beach ridges	• *Leymus* beach meadow • wet brackish graminoid meadow • wet freshwater graminoid meadow
2003		
Kakagrak Hills airstrip (base camp 2001 and 2003) 67°16'N, 163°40'W	• limestone uplands, outcrops and rubble slopes	• *Dryas* fellfield • open willow-sedge shrub tundra • open riparian *Salix* thicket • alpine meadows
Igisukruk Mountain (1 site) 67°8'N, 162°54'W	• limestone uplands	• *Dryas* fellfield • mesic heath hummock tundra • open subalpine spruce krummholtz woodland • open white spruce forest
Mt. Noak and Kaksurok Mountain (upper Situkuyok River valley) (2 sites) 67°11'N, 163°8'W	• limestone screes and outcrops • active cobble-gravel floodplain	• *Dryas* fellfield • alpine heath tundra • open riparian *Salix* thickets • snowmelt meadow • mesic tussock tundra • wet freshwater graminoid meadow
Lower Kilikmak Creek valley (1 site) 67°21'N, 163°43'W	• lowlands	• open riparian thickets • tussock tundra • open gravel floodplain and terraces • mires, bogs • cutbank snowbed
Tahinichok Mountains, Mulgrave Hills (1 site), 67°36'N, 163°44'W	• acidic bedrock uplands, screes, and alpine slopes	• *Dryas* fellfield • dwarf heath-shrub tundra • snowmelt meadows
Omikviorok River valley lowlands (1 site) 67°45'N, 163°46'W	• lowlands	• wet freshwater graminoid meadows • *Salix* thickets • heath-sedge tussock tundra • freshwater pond margins

Results and Discussion

We collected a total of 835 specimens and added 343 new species records for a total of 380 species now documented for CAKR. Of these newly recorded species, approximately 140 were not on the expected species list described above, indicating that the flora of the adjacent region is also poorly known. The new species records include 11 species ranked S1–S3 by AKNHP:

Arenaria longipedunculata G3S3

Carex holostoma G4?S2

Cryptogramma stelleri G5S2S3

Festuca lenensis G4G5S3

Oxytropis arctica var. *barnebyana* GT2S2

Papaver walpolei G3S3

Potentilla fragiformis G4S1

Puccinellia vaginata G4S1

Rumex krausei G2S2

Stellaria dicranoides G3S3

Zannichellia palustris G5S3

Before our survey, the occurrence of two additional rare species had been recorded:

Gentianopsis detonsa G3G4S1

Potamogeton subsibiricus G3S3

Gentianopsis detonsa had been documented at Sheshalik Spit by summer resident and natural historian Bob Uhl. *Potamogeton subsibiricus* was collected from the Kilikmak Creek drainage in 1973 by Steve Young (ALA). The exact location of this latter collection is uncertain, but most of this drainage is within the boundaries of CAKR so it is reasonable to suggest this species occurs in the monument.

Our collection of X_*Dupoa labradorica* at Sheshalik Spit in 2001 was the first record for the plant in western North America. This plant is a stabilized hybrid between *Poa eminens* and *Dupontia fischeri*, and was previously known only from Hudson Bay, Canada (Cayouette & Darbyshire 1993). Since this first I&M collection in 2001, X_*Dupoa labradorica* has been documented from the Espenberg and Cowpack rivers in BELA, from Kotzebue, and from two localities in southwestern Alaska. Although this hybrid is not ranked for rarity by the AKNHP, our record for Alaska is notable as a range extension, and will be published (Darbyshire et al. in prog.).

Initially we believed that our collection of *Potentilla fragiformis,* found at both Sheshalik Spit and Krusenstern Lagoon, represented a new record for North America. Based on the publications of Eric Hultén (1941–1960 [vol. VI], 1967, 1968), *P. fragiformis* had been considered by both Alaskan and Russian botanists as being restricted to coastal areas of the Russian Far East. However, a review by the author of early herbarium collections from Alaska, loaned to ALA from CAN and NY, revealed that *P. fragiformis* had indeed been documented from Alaska but had been misidentified. A careful look at ALA

collections of two similar-looking species from western Alaska, *Potentilla villosa* and *P. hyparctica,* revealed that a few collections, including one from Sheshalik Spit collected by Steve Young, were indeed *P. fragiformis* and had been previously misidentified.

The rare plants found in CAKR offer a true floristic mixture, with the largest portion representative of the Beringian flora, as might be expected. Three rare species found at CAKR are generally associated with carbonate substrates (*Arenaria longipedunculata, Papaver walpolei, Cryptogamma stelleri*); three are strictly coastal species (*Potentilla fragiformis, Gentianopsis detonsa, Puccinellia vaginata*), and two are aquatic (*Potamogeton subsibiricus*, *Zannichellia palustris*). It is difficult to suggest any pattern or explanation for the mixture of rare species found here except that the landscape itself offers a mixture of habitats, augmented by the juxtaposition of carbonate rock, usually producing a very well-drained to xeric substrate with a moist coastal zone.

A notable anomaly to this trend is the rare species *Festuca lenensis,* which is generally considered a grass of dry, continental habitats. It was found growing at the base of a limestone slope just above the inland shore of Krusenstern Lagoon.

The documented species diversity (380 species) at CAKR seems very rich when compared to that now documented for other park units in ARCN. KOVA, which has more than three times the land area of CAKR, has 393 documented species. NOAT, which has almost 12 times the land area of CAKR, has 431 species. One reason for this may be that our inventory effort within each unit was not equally proportionate to the land area involved. We spent 22 days total collecting in CAKR, the smallest parkland in the network. This is three days less than was spent in NOAT, and the same time as spent in GAAR, both much larger park units. However, it is important to note that the flora of CAKR was essentially unknown before our survey, whereas previous collections had documented a good portion of the flora from each of the other parklands.

Unlike other ARCN park units, CAKR displays a high diversity of coastal habitats (lagoons, gravel beaches, bluffs). Yet only two of the species found are strictly coastal in habitat distribution, not a large proportion of the total species found. An additional 21 species were collected only near the coast, though not strictly coastal in habitat preference. Hence the unique coastal habitats found at CAKR contributed to only approximately 8% (50 species) of the total number of species found there. Several species having a narrow Beringian distribution are found in both BELA and CAKR but do not reach the other units.

The combination of all these factors—diverse habitats, landscapes, and bedrock; occurrence of the restricted Beringian flora; and the disproportionate amount of time spent in CAKR relative to land area—may all have contributed to our documenting this species richness.

Recommendations

Although our inventory at CAKR resulted in a much greater species diversity than was expected, we believe some sites and habitats remain under-surveyed. Examples include:

Tahinichok Mountains (Mulgrave Hills)

Most inland collecting during our inventory was done on the carbonate substrate that dominates the southern and central portions of the monument. In contrast, only one locality within the Tahinichok Mountains, which are underlain primarily by acidic bedrock, was visited for part of one day. This upland region should be revisited, with emphasis on sites at middle elevations and more inland (east) of our single alpine site.

Southeastern Corner of the Monument

Less than one full day was spent in the southeastern tip of CAKR, east of Mount Noak, where boreal forest, woodlands, and extensive dwarf shrub hummock tundra are found. This single visit yielded many new records, and more collecting in this region could offer additional boreal-associated species records, some of which have been found previously at sites within the boreal zone and immediately outside the monument boundary (Young 1973, Bob Uhl, pers. comm.).

Upper Kilikmak Creek Drainage

The extensive wetlands scattered with ponds at the headwaters of the Kilikmak Creek drainage were not visited during our inventory. Much of this lowland is actually part of the Noatak River drainage system and is the area where the rare pondweed, *Potamogeton subsibiricus*, was collected. A visit to this area in mid to late summer, when aquatic vegetation is best developed, could be productive.

Situkuyok River Headwaters

Only one day was spent in the Situkuyok River headwaters basin, yet this area offered several new and significant collections, including the first records in CAKR for the rare plants *Rumex krausei* and *Oxytropis arctica* ssp. *barnebyana*. The landscape here offers many alpine habitats, and elevations reach up to 1,000 m higher than those in the better-collected Kakagrak Hills.

Omikviorok River Valley Lowlands

This broad lowland lies at the northern boundary of the monument. The landscape is a mosaic of ponds, wet meadows, and *Salix* thickets. Several strictly wetland species were collected during a single visit by one botanist. This area, as well as the Kilikmak Creek drainage noted above, is a well-developed wetland, a habitat that remains under-surveyed within CAKR.

Ingitkalik Mountain and the "Palisades"

Due to the need to protect nesting peregrines and other raptors, we were not allowed to visit the base and summit area of Ingitkalik Mountain and the "Palisades" on the inland shore of Krusenstern Lagoon. However, our collections from a very short stop at nearby Talikoot settlement site, combined with a list of plants made by K. Sowl in 1991 (NPSpecies) at the Palisades, suggest the area is worth surveying if an opportunity arises.

Sowl's specimens have not been reviewed by the author, but the list includes several plants not found during our inventory.

Gates of the Arctic National Park and Preserve

Introduction

Gates of the Arctic National Park and Preserve (GAAR) is the largest of the ARCN parklands, covering over 8 million acres. This huge region reaches from interior Alaska northward to the Arctic Foothills, and spans more than 300 km east to west across the central Brooks Range. GAAR was established with the primary purposes of preserving the wild and undeveloped character of the entire region and protecting wildlife habitat over a very large area. A large preserved region assures the maintenance of healthy populations of grizzly bear, caribou, wolf, wolverine, and other wildlife species that require very large home ranges.

Often considered Alaska's true "wilderness park," GAAR offers opportunities for prime wilderness recreational activities. Motorized access has some restrictions, and there are no visitor facilities, roads, or established trails and campsites within the unit. Visitors have a genuine sense of being in a remote and unspoiled land within a spectacular alpine setting. The small Nunamiut Eskimo village of Anaktuvuk is located in the northeast portion of GAAR. Village residents have subsistence rights to travel and to harvest game and other resources within the unit.

General Description

Physiography

Centrally located in the Brooks Range, GAAR is dominated by the rugged alpine landscapes of the Endicott and Schwatka mountains. The region has been carved by repeated alpine glaciations, creating steep slopes, sharp ridgelines, and peaks up to 2,135 m (7,000 ft) in elevation. The very diverse bedrock geology and extensive, horizontally thrust-faulted bedding has resulted in many different rock types being exposed at the surface in relative proximity. As a result, a variety of weathered landforms, substrates, and habitats are often found within a small area within the alpine zone.

Two favorite destinations within GAAR are the Gates of the Arctic, where paired, spire-like granite massifs flank the North Fork Koyukuk River, and the Arrigetch Peaks, a very high and rugged alpine landscape of jagged peaks sitting on the Continental Divide and supporting several cirque glaciers.

The headwaters of several major drainages lie within GAAR. The Killik, Nigu, and Anaktuvuk rivers flow north to the Colville River and the Arctic Ocean. The Noatak and Kobuk rivers flow westward to the Chukchi Sea. On the south side of the range, the Alatna, North Fork Koyukuk, and John rivers flow to the Koyukuk River, eventually reaching the Yukon River and the Bering Sea. Each of these large and ancient valleys has offered routes into, and across, the mountainous regions for both early indigenous people and recent overland explorers.

Three exceptions to this domination by an alpine landscape are found within GAAR. The vicinity of Castle and Fortress mountains is a detached, northern parcel of the unit situated at the southern margin of the Arctic Slope. Although one summit reaches over 1,000 m in elevation, the overall landscape is relatively subdued and open. This site is truly a part of the Arctic Foothills. Toward the southwestern corner of the parkland, the "boot" extends southward, reaching the northern margin of unglaciated Beringia. The low, rounded Lockwood and Norutak hills and the broad upper Kobuk River valley found here are clearly linked to the continental interior Alaska landscape. At its southeast corner, the GAAR boundary extends to include the lower portion of the North Fork Koyukuk River, southward to its confluence with the Middle Fork Koyukuk River. The landscape included in this small "arm" includes a broad boreal forest valley and low, lake-filled wetlands.

Vegetation

Various types of alpine tundra dominate the vegetation in GAAR due to its highly mountainous landscape. Well-drained areas usually support dry tundra vegetation such as dwarf shrub tundra, *Dryas* fellfield, or an open vegetation of scattered forbs and dwarf shrubs. Valley bottoms, alpine basins, and similar poorly drained settings support mesic to moist shrub-herb tundra, tussock tundra, and in some circumstances, herbaceous meadows. Medium to tall willows track stream drainages. These shrub stands range from being open and sparse in more exposed or alpine settings to thick and well developed in more sheltered and lowland areas. Alder thickets are found on moist slopes, especially on the south slope of the range and in the Noatak River headwaters.

The boreal forest extends northward into GAAR as finger-like strands along the major south-flowing drainages. Along the south margin of the parkland, the boreal forest may be well developed and include both white and black spruce, paper birch, aspen, and balsam poplar. Farther into the mountains, the forest becomes restricted to valley bottoms and lower slopes, with white spruce and paper birch being dominant. The northern treeline within the Brooks Range is usually an open shrub tundra-woodland and is restricted to the south slope of the mountains. However, isolated balsam poplar stands may be found in moist sheltered sites well into the alpine zone and northward to the Arctic Foothills.

Recent Botanical Investigations

Botanists have been drawn to the heart of the Brooks Range, the area now known as Gates of the Arctic National Park and Preserve, long before the park unit was established in 1980. Lloyd Spetzman, a botanist with the U.S. Geological Survey, spent five summers, starting in 1946, traveling across the North Slope. He described the plant communities he found and made extensive collections (Spetzman 1951 and 1959). Sites he visited that are within or very near GAAR include Kurupa Lake, Easter Creek on the upper Killik River, Shainin (Kanayut) Lake, and the Anaktuvuk Pass and Tulikguk Lake areas. His main plant collection is retained at MIN, where he earned a doctorate degree for his North Slope work. A small subset of this collection is held at ALA. Louis Jordal spent two seasons (1949–1950) undertaking a floristic study in the south central Brooks Range. He visited

many sites, including Wild Lake, Old John Lake, and the Wiseman area (Jordal 1951 and 1952). His main collection is held at MICH, where he received a doctorate for his work. Among the new taxa he described is *Phlox alaskensis* Jordal, a strikingly dark pink dwarf phlox that is a favorite among northern trekkers. Unfortunately Jordal died just after finishing his Alaska fieldwork. In remembrance, Canadian botanist A. Erling Porsild applied the name *Oxytropis jordalii* Porsild to a new alpine oxytrope that Jordal had collected at Old John Lake in 1950 (Porsild 1951).

In 1955 and early 1956, Donald MacVicar, a student from Yale University, made a small collection of vascular and nonvascular plants from the northern and northeastern shores of Chandler Lake as part of his geomorphological research. His untimely death in the field in 1956 brought northern botanist Ira Wiggins to Chandler Lake. Wiggins continued to collect at Chandler Lake and eventually published their combined collections, now held at DS (Wiggins 1957, Wiggins and MacVicar 1958).

In 1963, botanist Stanwyn Shetler from the Smithsonian Institution visited two sites within GAAR, Walker Lake and Lake Omelaktavik, as part of a study of the entire Noatak River basin. This work was supported jointly by the Smithsonian Institution and the University of Alaska Fairbanks. He published a preliminary list of his collections that are now held at US (Shetler 1964).

David and Barbara Murray, botanists from ALA, spent the summer of 1973 in the upper Alatna and Killik river valleys. They collected from four sites: (1) "Headwaters Lake" at the headwaters of the Alatna River, (2) at the confluence of the Nahtuk and Alatna rivers, (3) Kaniksrak Lake in the upper Killik River valley, and (4) Imiaknikpak Lake, on the Killik River immediately north of the GAAR boundary. They published their combined findings of vascular and nonvascular plants (Murray 1974) and their collections are held at ALA.

Also in 1973, botanist Steve Young led an interdisciplinary study of the entire Noatak River basin. Sites he visited and collected from within GAAR include Kipmik Lake and the upper Noatak River valley just upstream of Omelaktivak Lake. Young made both vascular and nonvascular collections, and his findings have been published (Young 1974a and b). A subset of his collections are held at ALA.

David Cooper, a student at the University of Colorado, Boulder, spent the summers of 1979 and 1980 in the Arrigetch Valley doing field work on plant community classification, plant ecology, and the floristics of the region. His resulting doctoral thesis not only holds a wealth of information on his botanical work, but also addresses management concerns and includes observations and collection information on mammals, birds, insects, and fish in the area (Cooper 1983). His vascular and nonvascular plant collections are at COLO, with a duplicate set at ALA.

Ann Marie Odasz, also a student at the University of Colorado, spent the summers of 1978, 1981, and 1982 in the upper Alatna River valley investigating the ecology of the forest-tundra ecotone. She published several minor and moderate range extensions, primarily northward records of boreal species (Odasz 1983, 1986). Her collections are held at RM where the final determinations of her specimens were made by curator Ron Hartman.

Swedish botanist Jan Jörgensen made a large collection at Takahula Lake in 1979. He published a list of their extensive collections and a duplicate subset is held at ALA (Jörgensen 1980).

Reed Hot Springs, in the Reed River valley and on the south side of the Brooks Range, was visited for one day in 1981 by NPS personnel during a mining claims reconnaissance of the area. They made a listing of species observed, but no collections were made (National Park Service Denver Service Center 1982).

Numerous additional smaller collections or duplicate sets (less than 100 specimens each) exist at ALA from several sites within or very near GAAR. These collections were made by both private individuals and researchers associated with various projects. Notable among them are: Gil and Vivian Staender in the 1960s, from Loon Lake, Easter Creek, and the Unakserak River headwaters; G. L. Shaungnessy in 1972 and S. Galen Smith in 1954 from Walker Lake; JoAnn Flock and Fran Chauvin in 1963 from Ulo Lake; Alan Batten in 1974 from the John River; and Eric Hultén in 1960, Helen Schmuck in 1962, and Maxine Williams in 1962, all collecting in the vicinity of the village of Anaktuvuk Pass.

Since the establishment of GAAR in 1980, several NPS personnel and various other researchers have made small collections from several scattered localities. Notable are a collection of graminoids from Takahula Lake made in 1994 by Paul Peterson and Carol Annable (US, ALA) and a collection from Walker Lake made in 1996 by NPS botanists Linda Hasselbach and Peter Neitlich (Hasselbach and Neitlich 1996, collections at NPS Regional Office, Fairbanks). Other collectors associated with NPS include Nancy VanAlstine, Donna DiFolco, Janet (Christiansen) Jorgensen, Mike Emers, and Sheryl Stevens. These collections are held at the NPS Regional Office Herbarium at Fairbanks, Alaska, and most are listed in NPSpecies.

Field Activity and Personnel

Fieldwork in GAAR was undertaken from July 19 to August 9, 2002. I&M sites were selected based largely on our knowledge of the history of previous collection efforts. Areas such as Walker Lake and the Alatna River headwaters that had been extensively botanized were not considered. Instead, we attempted to select areas that had not been visited previously by botanists or that supported habitats or had unique bedrock or topographic settings that had not been represented in earlier inventory efforts. In addition, we tried to target areas from which there were only a few collections, but which seemed of floristic interest based on these collections, to the extent that we wished to do more extensive collecting from the same or a similar adjacent area. GAAR NPS personnel who had spent time in the field were also helpful in suggesting localities they had visited and thought to be botanically interesting or diverse. An overview map of GAAR indicating our sites is shown in Figure 4.12. The range of landscape settings visited in 2002 is illustrated in Figures 4.13 (Encampment Creek), 4.14 (Killik River dunes), 4.15 (Castle Mountain), 4.16 (Lake Selby), and 4.17 (Reed Hot Springs).

Crew consisted of Carolyn Parker (ALA), Reidar Elven and Heidi Solstad (O), Nikki Guldager (NPS), Bruce Bennett (Yukon NatureServe, July 19–August 9), and Tom Heinlein (NPS, 23 July–1 August). Base camps were reached by fixed-wing floatplane or

helicopter. While based at Selby Lake, helicopter access for five days allowed us to reach several distant areas in the general region. A planned final base camp in mid August at Lake Omelaktavik, in the upper Noatak River valley was canceled due to an early August report of a late plant phenology (i.e., full fall colors) and an early snowstorm in the area. We ranged on foot (aided by canoe at Chandler Lake and Killik River dunes) from 3 to 10 km from each base camp. Localities and habitats visited during our inventory in GAAR are listed in Table 4.3.

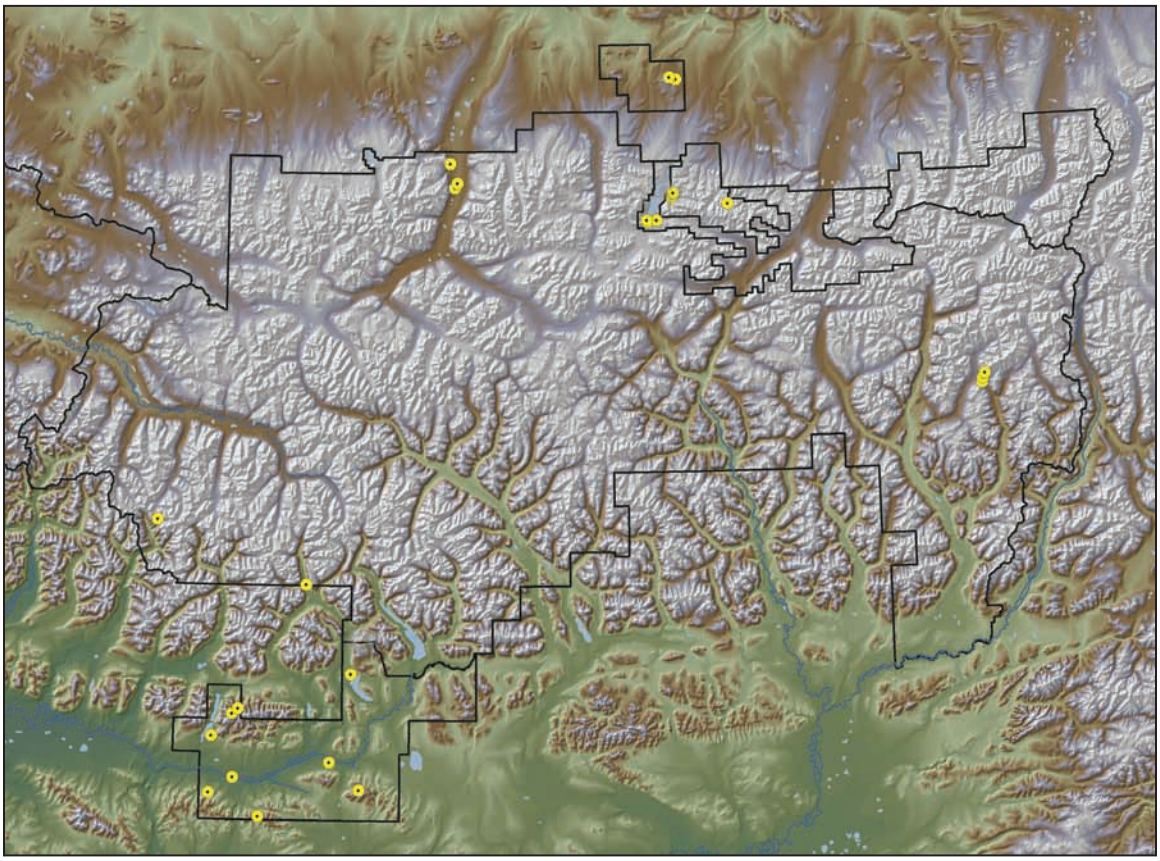

Figure 4.12. *Overview map of Gates of the Arctic National Park and Preserve. I&M inventory sites are indicated. All locations in GAAR were visited in July and August 2002.*

Figure 4.13. *Endicott Mountains, Upper Encampment Creek. View looking north toward the Arctic Foothills. Scattered forbs and open* Dryas *fellfield dominate the dry rocky slopes. Alpine heath tundra covers the lower slopes where more moisture is available. Rocky seepage slopes supporting open wet meadows were scattered throughout the valley.*

Figure 4.14. *Endicott Mountains, Killik River dunefield. View looking upriver to the south. Coarse sand-fine gravel dunes and gravel pavement terraces support scattered forbs, scattered* Salix *shrub, and dry meadows. The ancient valley-bottom terraces and lower slopes above the active floodplain are dominated by medium shrub tundra and wet meadows and are dotted by lakes and ponds.*

Figure 4.15. *Castle Mountain, Arctic Foothills. Open* Dryas *fellfield and forb meadows dominate the upper rocky slopes. Seepage areas and moist to wet meadows are found along the base of the massif.*

Figure 4.16. *Angayucham Mountains, Lake Selby. View to north along the east shore of lake. Inventory botanist Heidi Solstad is collecting aquatic plants. Vegetation surrounding the lake includes open boreal forest, open tall* Salix *shrub with medium shrub-herb understory, and dry open knolls.*

Figure 4.17. *Schwatka Mountains, Reed Hot Springs, central Reed River valley. Tall cottonwood and white spruce stands flank the hot springs. The main saturated area of the hot springs is barely visible as gray patches behind spruce trees, left of center. A dry graminoid meadow is in lower center of image. A moist streamside meadow, dominated by* Heracleum lanatum *and graminoids, spans the foreground.*

Table 4.3. *List of localities and major habitat types visited in GAAR during the I&M inventory in 2002.*

Locality	Landscapes	Dominant Communities
2002		
Chandler Lake, S end (4 sites), 68°12'N, 152°45'W	• beach ridges • alpine slopes and screes • valley bottom • acidic sedimentary bedrock	• scattered forbs • wet graminoid meadows • alpine heath tundra • snowmelt meadows • *Dryas* fellfield
Castle Mountain (entire summit area) 68°34'N, 152°37'W	• alpine summit, slopes, outcrops • acidic sedimentary bedrock	• scattered forbs • *Dryas* fellfield • wet sedge tundra • alpine seeps • forb meadow
Upper Encampment Creek (2 transects) 68°15'N, 152°12'W	• alpine ridges, slopes, screes • carbonate and acidic substrates	• open wet meadows • forb meadows • scattered forbs • alpine heath tundra • mesic *Dryas* tundra
Chimney Pass and Whiteface Mountain (2 sites) 67°46'N, 150°30'W	• alpine slopes, screes and outcrops • lakes • acidic metamorphic bedrock	• wet and moist graminoid meadows • scattered forbs • spruce forest • alpine heath • shrub thickets • *Dryas* fellfield
Killik River valley (2 transects) 68°17'N, 154°4'W	• active and semiactive sand dunes • lakes • alpine carbonate slopes • cobble-gravel "pavement"	• scattered forbs • open tall shrub • open dry forb meadow • shrub-heath tundra • wet sedge meadow
Nutuvukti Lake, N shore (1 site) 67°2'N, 154°45'W	• lowlands	• rich oligotrophic graminoid fen
Reed River Hot Springs (1 site), 67°16'N, 155°3'W	• rubble slope • hot springs • valley bottom	• open poplar stand • open white spruce stand • dry graminoid meadow • wet graminoid meadow • rocky seepage slopes
Fritts Mountain, Angayucham Mtns. (2 sites) 66°56'N, 155°29'W	• N-facing cirque basins • alpine slopes • acidic bedrock	• alpine snowbed meadows • scattered forbs • heath-lichen tundra • open shrub
Lake Selby, E shore (base camp), 66°52'N, 155°40'W	• lowlands, rocky knolls • gravel lake shore	• open spruce forest • open tall shrub thickets • dry open shrub tundra • *Sphagnum*-shrub bog • scattered forbs
Upper Igning River valley (transect), 67°25'N, 156°3'W	• alpine slopes and valley • carbonate and acidic bedrock	• mesic *Dryas*-heath tundra • open shrub • open wet meadows
Lockwood Hills (2 sites) "west" 66°43'N, 155°40'W "east" 66°40'N, 155°20'W	• rocky uplands, screes • acidic bedrock	• alder thickets • *Dryas* heath tundra • snowbed meadow
Norutak Hills (1 site) 66°44'N, 154°41'W	• rocky uplands • acidic bedrock	• *Dryas*-heath tundra • alder and willow thickets • snowbed meadows
Upper Kobuk River (2 sites): 66°46'N, 155°31'W and 66°48'N, 154°53'W	• active floodplain • elevated stable terraces	• scattered seral forbs • shrub thickets • spruce forest

Results and Discussion

We collected a total of 1,670 specimens and added 173 new species records, for a total of 556 species now documented for GAAR. Included among the new records are 19 plants ranked S1–S3 by AKNHP:

Cardamine microphylla ssp. *blaisdellii* G4S2S3

Carex deflexa G5S1S2

Carex heleonastes G4S2

Carex lapponica G4G5S2

Draba pauciflora G4S1

Erigeron porsildii G4S3

Eriophorum viridicarinatum G5S2

Festuca edlundiae G3G4S1

Glyceria striata ssp. *stricta* G5T5QS2

Minuartia biflora G5S2

Oxygraphis glacialis G4G5S2S3

Oxytropis kokrinensis G3S3

Potentilla rubricaulis G4S2S3

Puccinellia vahliana G3G4S2S3

Ranunculus glacialis ssp. *chamissonis* G4S2

Schizachne purpurascens G5S2

Stellaria alaskana G3S3

Stellaria umbellata G5S2S3

Thlaspi arcticum G3S3

We also documented new localities within GAAR for the following five rare species that had been collected during previous surveys:

Arenaria longipedunculata G3QS3

Erigeron muirii G2S2

Festuca lenensis G4G5S3

Oxytropis kokrinensis G3S3

Smelowskia porsildii G5S2S3

The total number of rare plants documented from GAAR is now 29. Five of these were not found during our inventory but had been documented by earlier surveys:

Aphragmus eschscholtzianus G3S3

Campanula aurita G3G4S3

Cypripedium parviflorum G5S2S3

Stellaria dicranoides G3S3

Symphyotrichum yukonense G2G3S2S3

The most extensive earlier collections from GAAR came mainly from sites centrally located within the Brooks Range. For our I&M inventory strategy, we selected most sites from either the northern or southernmost regions of the unit in an effort to cover areas, landscapes, and habitats that remained under-surveyed. Indeed, many of our new records for both rare and nonrare species are plants having either a northern-arctic distribution or a boreal-continental distribution.

Two locations that were especially rich in new records for GAAR were Castle Mountain (Figure 4.15) and Encampment Creek (Figure 4.13), both on the north margin of the Brooks Range. Having an exposure toward the North Slope and dominated by low, sparse vegetation, these sites seemed more "arctic" relative to the alpine landscape of the central portion of the range, and many species found only here reflected this (i.e., *Draba pilosa*, *Potentilla rubricaulis*).

Likewise, locations in the southwest "boot" of GAAR also yielded several new records. Selby Lake (Figure 4.16), the Noratuk Hills, Reed Hot Springs (Figure 4.17) and the Upper Kobuk River floodplain all offered many new records of plants characteristic of the boreal and southcentral regions of Alaska (i.e., *Carex lapponica, Equisetum silvaticum*).

Reed Hot Springs was in several ways the most interesting habitat we visited. Warm water irrigates the base of a steep boulder slope and intercepts a small cool stream just above the Reed River floodplain. The slope is moist to wet where water is flowing and supports lush herbaceous vegetation as well as a stand of tall balsam poplar. The exception to this cover is those areas where the water is the warmest; here plants are sparse and scattered and a covering of matted algae and fungi, wet mud, and the underlying cobbles dominates. However, the southwest exposure results in a small portion of this slope, elevated above the irrigated zone, being very dry and supporting a dry graminoid meadow. Rare species collected at Reed Hot Springs include *Carex deflexa* (S1S2) and *Schizachne purpurascens* (S2), both graminoids of dry, open, boreal woodlands. Their occurrences here represent major northward range extensions within Alaska. *Glyceria striata* ssp. *stricta* (S2), a grass of moist, open boreal habitats, was found here and its presence represents a moderate northward range extension. Other plants found at Reed Hot Springs that are new records for GAAR and represent northward range extensions include *Athyrium filix-femina* ssp. *cyclosorum, Heracleum lanatum, Carex brunnescens, Erigeron acris, Stellaria borealis, Circaea alpina*, and *Phegopteris connectilis*.

Recommendations

Although many botanical surveys have been undertaken within GAAR, this large parkland is very rich in landscape diversity and habitats. Some areas and habitats remain poorly known and should be considered of interest if future inventory work is supported. Our field list of species expected to be found within GAAR that are still not yet documented here includes a mixture of boreal, alpine, and arctic species, as well as a few plants more characteristic of naturally or artificially disturbed habitats. The following suggestions may help fill in some of these floristic gaps.

Upper Noatak River Valley

The Noatak River headwaters area within GAAR support extensive mesic and dry tundra vegetation unlike the mesic to moist tundra and tussock tundra that is so widespread further downstream within NOAT (Young 1974a). In 1973, Steve Young collected in the vicinity of Lake Omelaktavik in the upper Noatak River valley, and briefly at Lake Kipmik, 40 km to the northwest. However, his collections are few, and little survey work in this region has been done since, with the exception of a few incidental collections made by NPS personnel. Of special interest would be the Kugrak Springs on the lower Kugrak River (Donna DiFolico, NPS, pers. comm.).

North Fork Koyukuk River Lowlands

The entire North Fork Koyukuk River, to its confluence with the Middle Fork Koyukuk, is included within GAAR. The very lower reaches of the river leave the mountains and flow into a well-developed lowland boreal forest zone having numerous small lakes. This area has not been inventoried to our knowledge. This could be a promising area in which to find some of the yet-undocumented boreal, lowland riparian, and aquatic species expected to be in GAAR.

Itkillik River Valley

The Itkillik River flows north into a broadening glacially carved valley in the far northeast corner of GAAR. This north-exposed valley reaches the southern margin of the Arctic Slope at Itkillik Lake, and it could be a promising area for finding species that typically have an arctic distribution. A small collection (ca. 50 species), held at ALA, was made in 1963 by JoAnn Flock and Fran Chauvin at Ulo (Oolah) Lake. However, this cannot be considered a full inventory effort. The vicinity of Itkillik Lake is approximately 20 km west of the Galbraith Lake–Atigun River valley area along the Dalton Highway. This latter area is known to be rich in rare and uncommon species including *Claytoniella* (*Montia*) *bostockii*, *Potamogeton subsibiricus*, and *Cryptogramma stelleri*, plants which have not yet been documented from GAAR (Murray et al. 1979, Lipkin and Parker 1995).

Mining Sites in Southeastern GAAR

Scattered historical mining claims exist in the southeastern portion of GAAR along the Glacier River, directly west of the active Wiseman mining district. This area was visited in 2002 by a NPS invasive species botanist, but no truly invasive species were found, nor were collections made (Chris McKee, pers. comm.). However, a few native plants common to disturbed areas throughout interior and northern Alaska (native "weeds," or ruderal species) remain expected yet undocumented for GAAR.

Kobuk Valley National Park

Introduction

Kobuk Valley National Park (KOVA) was established with the primary concerns of preserving the unique landscape processes and vegetation of Great and Little Kobuk Sand Dunes and protecting and interpreting the several rich archaeological sites located along the Kobuk River. Onion Portage, a well-known site on the Kobuk River, records over 9,500 years of human activity and occupation. The region is also critical for the fall migration of the large western arctic caribou herd, and for the subsistence activities of residents, mostly Inupiaq Eskimos, living in the Kobuk River villages of Kobuk, Ambler, Shungnak, and Kiana.

General Description

Physiography

The park spans the drainage system of the lower central Kobuk River between the villages of Ambler and Kiana. The southern boundary follows the crest of the Waring Mountains, a low-elevation range of rounded ridges and peaks (400–600 m in elevation) that separate the Kobuk River from the Selawik Basin to the south. Several small streams flow north from the Waring Mountains to the Kobuk River. The northern park boundary is at the crest of the central Baird Mountains (1,000–1,400 m in elevation), a western component of the Brooks Range that separates the Kobuk River valley from the Noatak River to the north. Included in KOVA are the entire drainages of the Kallarichuk, Salmon, and Hunt rivers, which flow from the Baird Mountains south to the Kobuk River. A rugged alpine landscape, displaying evidence of past glaciations, dominates the headwaters of these rivers. Extensive lowlands span both sides of the Kobuk River through its broad central valley.

The most distinctive landscape features within KOVA are Great and Little Kobuk Sand Dunes. These patches of active and semiactive dunes lie within a larger ancient sand sheet that extends from the base of the Waring Mountains northward to the Kobuk River floodplain. Portions of this Quaternary-aged sand sheet are completely vegetated, and the underlying dune features are subdued or partially eroded. However, the active dunes and open sand sheets are conspicuous and stand in striking contrast to the surrounding boreal vegetation. A small active dune field, Hunt River dunes, lies on the south bank of the Kobuk River, across from the mouth of the Hunt River. The geomorphic processes that produced the original sand sheet, and help maintain the active dunes, have been described (Dijkmans and Koster 1990, Dijkmans et al. 1986, Mann et al. 2002).

Vegetation

The lowlands along the Kobuk River, much of it within the boundaries of the ancient sand sheet, display a mosaic of vegetation types ranging from boreal forest to open wetlands. Fire history and soil drainage probably exert the greatest influence on vegetation here. Poorly drained areas support tussock tundra, open bogs with scattered ponds and willow stands, or acidic heath tundra. Slightly raised dune ridges and other better-drained areas

support boreal forest, boreal woodland, and early successional tall shrubs. Lichens are often a dominant ground cover in the woodlands, especially on the vegetated, stabilized dune ridge systems.

Scattered along larger river floodplains are mature cottonwood stands, spruce forest, and tall willow thickets. Ascending upstream along smaller drainages, boreal spruce forest tracks the narrow valleys, while upland alder and willow patches grade into alpine *Dryas* or dwarf shrub tundra on the slopes. In areas where massive limestone dominates the substrate, the boundary between boreal forest and an open, alpine, *Dryas* tundra or scree with scattered forbs may be very abrupt.

The unique plant assemblages, distribution of rare plant species, and dune landscapes found at Great Kobuk Sand Dunes have been described (Hunt 1997a and b, Parker and Mann 1999, Racine 1976).

Recent Botanical Investigations

Botanical work in KOVA following the early 1940s focused on select aspects of the vegetation and did not result in large collections representing the entire flora (Jordal 1951, Racine 1976, Racine and Young 1977, Sigafoos 1958). A few of the specimens taken by Racine and Sigafoos are now held at ALA. One notable exception to this paucity of collections is one from Onion Portage, made in 1967 by Charles Schweger as part of his research on the reconstruction of the Holocene vegetation of the area (Schweger 1964). Collections from Great Kobuk Sand Dunes and adjacent areas made by Rob Lipkin, Diane Hunt, and Carolyn Parker since the mid 1980s offer an additional exception. These habitats have been extensively botanized, and specimens are held at ALA, with a subset at NPS in Kotzebue. Reports submitted to the U.S. Fish and Wildlife Service (Lipkin 1985) and to NPS (Hunt 1997a and b, Parker and Mann 1999) describe the areas covered and collections made.

Additional small but relevant collections from the region of KOVA include those of independent botanist Marko Lewis who collected from Great Kobuk Sand Dunes, the Cosmos Hills, and along the Ambler River in the 1970s (ALA). Randy Meyers (BLM-Kotzebue) has made several collecting trips to the Squirrel River valley, a major drainage adjacent to the western boundary of KOVA (ALA). In addition, a floristic inventory of the Waring Mountains, along the southern boundary of the park, was sponsored by the Selawik NWR in 2000 (Parker 2001).

Field Activity and Personnel

Fieldwork was undertaken in 2002 from June 23–30. Base camp was established at Onion Portage and access to sites was by helicopter each day. Crew consisted of botanists Carolyn Parker and Alan Batten (ALA), assisted by Sarah Fowell (UAF Geology and Geophysics) and Heather McIntyre (UAF-IAB). A crew of two visited one to three different sites each day. Sites were chosen to maximize the diversity of bedrock types, vegetation, and landforms found in the area that had not been collected from during previous inventories. An overview map of KOVA indicating our sites is shown in Figure 4.18. The range of landscape settings visited in KOVA is illustrated in Figure 4.19 (Salmon River

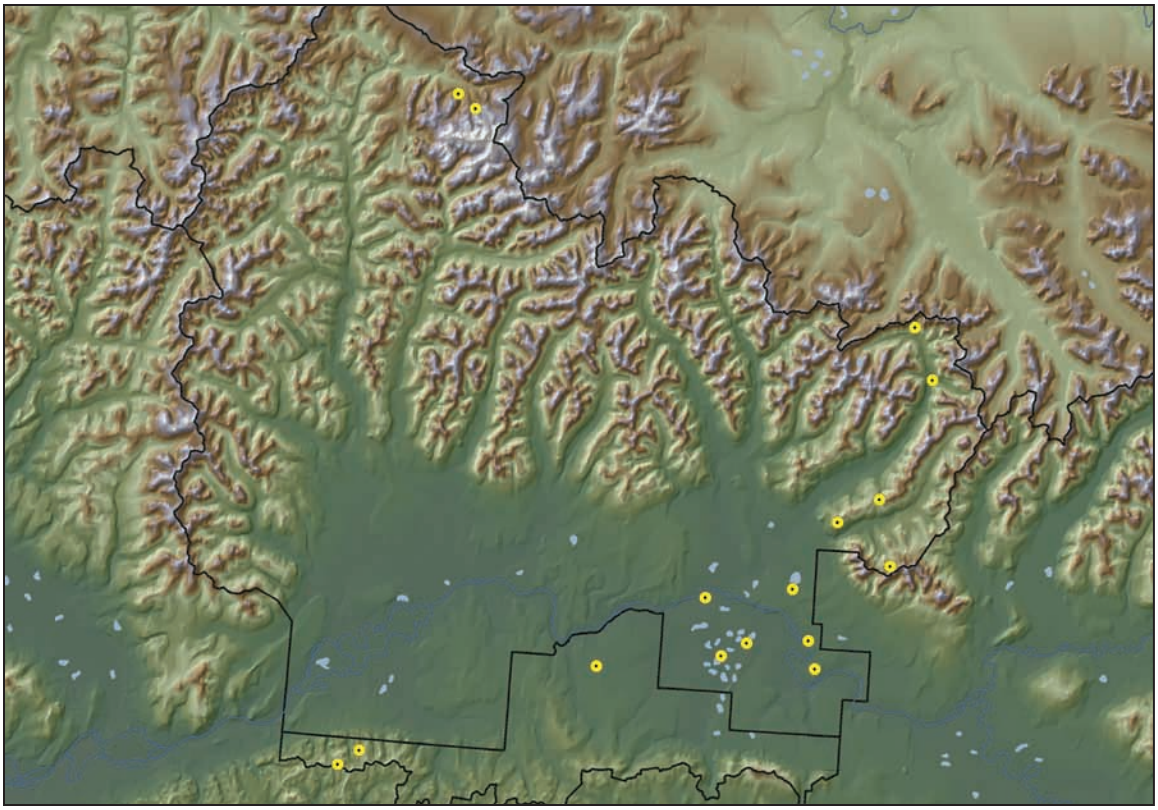

Figure 4.18. *Overview map of Kobuk Valley National Park. I&M inventory sites are indicated. All locations in KOVA were visited in June 2002.*

Figure 4.19. *Salmon River headwaters. Mt. Angayukaqsraq is in background. Barren ridges of light-colored carbonate bedrock are in foreground and in right half of image. Dark-colored acidic bedrock ridges are seen in the background. This barren landscape was dominated by open* Dryas *fellfield and scattered alpine forbs.*

headwaters), Figure 4.20 (Jade Mountain), Figure 4.21 (Kobuk River lowlands), and Figure 4.22 (Waring Mountains). Localities and habitats visited during our inventory in KOVA are listed in Table 4.4.

Results and Discussion

We collected a total of 468 specimens and added 127 new park species records for a total of 393 species now documented for KOVA and held at ALA. These new records include four additional species ranked S1–S3 by AKNHP:

Cardamine microphylla ssp. *blaisdellii* G4S2S3

Festuca lenensis G4G5S3

Oxytropis kokrinensis G3S3

Stellaria dicranoides G3S3

Species ranked S1–S3 that had been previously documented from KOVA are:

Arenaria longipedunculata G3S3

Carex lapponica G4G5S2

Corispermum ochotense var. *alaskanum* G3G4T2?S2?

Cryptogramma stelleri G5S2S3

Eleocharis kamtschatica G4S2S3

Lupinus kuschei G3S2

Oxytropis kobukensis G2S2

Papaver walpolei G3S3

Saussurea triangulata G5?S1

Symphyotrichum yukonense G3S3

Our additions to the total species list for KOVA reflect, in part, the many habitats that had not been well surveyed previously. Examples include *Carex chordorrhiza* and *Polygonum ampibium* from the wetlands, *Poa paucispicula* and *Carex lachenalii* from the subalpine, and several *Draba* spp. from the alpine. Some of our new additions had been cited previously by Charles Racine (1976) but had not been documented with collections.

The area of Great Kobuk Sand Dunes was not surveyed during our I&M inventory because the unique flora and vegetation there had been described and documented previously as noted above. Four of KOVA's rare plants are found here. The occurrence of *Lupinus kuschei* and *Symphyotrichum yukonense* in the active dunes is a significant disjunction from central and eastern Alaska where they are also found in open sandy habitats. *Oxytropis kobukensis* is a very narrowly restricted endemic, known only from open sandy habitats in the central Kobuk valley, and *Eleocharis kamtschatica*, a spike rush, is characteristically found scattered throughout coastal Alaska and the Russian Far East.

During our inventory, a second population of *Saussurea triangulata* was located in the Waring Mountains, approximately 5 km from the original population found in 2000 during an inventory of the Selawik NWR (Parker 2001). Both populations are located just inside the KOVA boundary along the crest of the Waring Mountains, and live plants are

Figure 4.20. *Baird Mountains, north side of Jade Mountain. Rocky slopes at the base of the peak support scattered alpine forbs and open* Dryas *fellfield. Open* Salix *thickets with a meadow understory and widely scattered white spruce and alder patches cover the lower slopes in foreground.*

Figure 4.21. *Kobuk River lowlands in the vicinity of Ahnewetut Lake. Wetlands and lowlands south of the Kobuk River. Wet graminoid meadows dominate the landscape. Narrow patches of open shrub and boreal woodland are found along the slightly elevated ancient dune crests as seen on left.*

Figure 4.22. *Waring Mountains, vicinity 1 km north of VABM Slam. Subalpine ridges in the foreground are dominated by* Dryas *fellfield and scattered alpine forbs. The far slope in this view shows the zone of alder shrub and open white spruce that defines treeline in the region. The Baird Mountains, located north of the Kobuk River and across the Kobuk River lowlands, are seen along the skyline.*

Table 4.4. *List of localities and major habitat types visited in KOVA during the I&M inventory in 2002.*

Locality	Landscapes	Dominant Communities
2002		
Upper Salmon River drainage, NW of Mt. Angayukaqsraq (2 sites) 67°45'N, 159°30'W	• alpine slopes, ridges, and screes • carbonate and acidic substrates	• *Dryas* fellfield • open alpine forbs
N side of Jade Mountain (1 site) 67°15'N, 158°6'W	• outcrops, screes, alpine slopes • phyllite and other metamorphic acidic bedrock	• forb snowpatch meadows • willow thickets • *Dryas* fellfield • open alpine forbs
Upper Akillik River valley (2 sites) 67°31'N, 158°4'W	• S-facing limestone slopes and screes	• *Dryas* fellfield • boreal forest • seeps
Nuna Creek valley, ridges NW of lower valley (2 sites) 67°17'N, 158°16'W	• alpine ridge with outcrops, screes • acidic bedrock	• shrub hummock tundra • open alpine forbs
Waring Mountains, western portion (2 sites), 66°59'N, 159°38'W	• alpine and subalpine ridges • metamorphic bedrock	• *Dryas* fellfield • open alpine forbs • alder patches • boreal forest treeline
S of the Kobuk River, vicinity Hunt River dunes (2 sites) 67°11'N, 158°38'W	• poorly drained lowlands	• graminoid wetlands • open shrub • open woodland
SE of Ahnewetut Lake (2 sites) 67°8'N, 158°30'W	• poorly drained dunefield lowlands	• lakes • graminoid wetlands • dwarf heath tundra • open shrub • open boreal woodland
Onion Portage vicinity (6 sites) 67°7'N, 158°18'W	• lowlands • floodplain • bedrock benches above active floodplain	• open river bars • riparian cottonwood and spruce forest • tussock tundra • shrub hummock tundra • aspen stands • lake margins • drained lake basins

now maintained at the UAF-IAB greenhouse from rootstock collected in 2002. The name attached to this collection remains tentative until a better understanding of the taxonomy of the genus *Saussurea* in eastern Asia is available (David Keil, OBI, pers. comm.). Because these two sites are the only known North American localities for the taxon, the state ranking will remain S1 (critically imperiled), regardless if it is eventually considered to be a species new to science or remains as *S. triangulata* in a greatly disjunct occurrence in KOVA from Kamchatka, in the southern Russian Far East.

A specimen at ALA of the shield fern *Polystichum lonchitis*, collected previously by Max Britten in the upper Akillik River valley in a limestone seep, is very notable as it represents a major range extension of over 700 km northward from its general range in southern coastal Alaska. This fern has a circumpolar midlatitude distribution. It has been found at a few inland sites close to treeline in Yukon and eastern Canada and is often associated with moist limestone slopes (Cody and Britton 1989). This collection of *P. lonchitis* from KOVA alerts us to watch carefully for this species in similar moist limestone habitats within ARCN.

Recommendations

Kobuk Valley National Park remains under-surveyed relative to the I&M effort made for the other ARCN park units. We spent only one week at KOVA, and the early summer visit meant many graminoid and wetland species were not mature yet and possibly inconspicuous. Most of our I&M sites centered near the eastern portion of the park due to helicopter fuel constraints, with the exception of a single day (two sites) in the upper Salmon River headwaters. As noted above, earlier collecting focused on Great Kobuk Sand Dunes and Onion Portage. A few areas and habitats are suggested for inclusion in future inventories.

Salmon River Basin, Western Portion

The alpine, subalpine, and boreal zones within the tributaries of this basin and west of the Salmon River have not been surveyed with the exception of approximately 20 collections made by Charles Racine (ALA). The bedrock here is dominated by marble and quartz-rich rocks, and also differs from that in the areas we accessed to the east. In addition, collections at ALA from the upper Squirrel River basin, adjacent and to the west of the park, have included a few rare and uncommon taxa not yet found in KOVA.

Wetlands along Kobuk River, Western Portion of Park

There are no known collections from the extensive wetland system along the Kobuk River located downstream of Kavet Creek and onward to the park boundary. Relevant to this concern, it has been noted that our visit to KOVA, in mid to late June, was too early for finding mature flowering plants of many aquatic and wetland species. A future inventory effort focused on these habitats anywhere in the park should be scheduled for midsummer or later.

Stabilized Sand Dunes

The ancient stabilized and vegetated sand dunes immediately adjacent to the modern active dunes have been visited by the author briefly during previous surveys. Open white spruce–paper birch woodland with a *Dryas*-lichen ground cover and scattered ponds or moist depressions covers these low-lying dune ridges. Although this landscape seems relatively species-poor, within it there are numerous game trails, small waterfowl-enriched ponds, mammal burrows, blowouts, and windthrows that offer unique, widely-spaced microhabitats that warrant further inventory attention.

Miscellaneous Comments

A review of the list of species we had not collected during our inventory in KOVA that were on the expected list for the park, and are usually common where found, suggests that several habitats remain under-collected. Examples from this expected list include *Cornus canadensis* and *Ledum groenlandicum* from the boreal forest, *Carex rupestris* and *Saxifraga hyperborea* from the alpine, *Myriophyllum* spp. and *Isoetes* spp. from wetlands, and *Tephroseris congestus* and *Hordeum jubatum* from natural or human-disturbed sites. Future inventories in KOVA could survey these habitats.

Noatak National Preserve

Introduction

Noatak National Preserve (NOAT) is the second largest park unit within ARCN, encompassing over 6,460,000 acres (GAAR is largest at 8,212,000 acres). It was established with the primary objective of conserving a pristine and essentially intact drainage basin: the Noatak River valley, its tributaries, and adjacent uplands. This intact basin would remain undisturbed by human activity and offers a large, natural laboratory in which biological, hydrological, and geomorphic processes could be studied. An additional purpose in the establishment of NOAT was for the protection of, and opportunities for investigation of, the rich archaeological sites found throughout the preserve that record over 10,000 years of human activity and occupation by different cultural groups.

The uppermost headwaters of the Noatak River lie entirely within GAAR. Only the lowermost portion of the entire river, from approximately 12 km below the Kelly River mouth to the delta at Kotzebue Sound, lie outside park stewardship.

Description

Physiography

Noatak National Preserve spans over 400 km of the Noatak River and includes the entire drainage systems entering the river along this length. Major rivers with headwaters in the DeLong Mountains and flowing south include the Kelly, Kugururok, Nimiuktuk, and Anisak rivers. The Cutler River and several smaller streams flow north from the Baird Mountains. The crest region of both ranges within the preserve includes rugged alpine

landscapes. Two large rivers, the Eli and the Agashashok, drain westward from the Baird Mountains and reach the lower Noatak River outside the preserve.

Although the Noatak River effectively transects the Brooks Range from east to west, its main valley, and those of its major tributaries, includes extensive lowlands and broad ancient alluvial terraces dotted with lakes, ponds, and isolated bedrock knolls. The central portion of the river cuts through a few small canyon regions, with Noatak Canyon and Sekuiak Bluff being the most spectacular.

Vegetation

The boreal forest zone reaches its northwestern treeline within NOAT. White spruce (*Picea glauca*) forest and woodlands are widespread and reach the uplands in the Agashashok and Eli river basins but are restricted to the floodplains and adjacent slopes along the lower and central valleys of the Noatak River and its major tributaries downstream of Grand Canyon. The farthest upstream white spruce is found near the mouth of Sisiak Creek. Scattered mixed stands of white spruce, paper birch, and tall shrubs are found on the more sheltered and well-drained slopes within this area and westward. Isolated cottonwood (*Populus balsamifera*) stands are also found along major river floodplains. Tall willow shrub is common along all floodplains and follows some drainages up to the alpine.

However, tundra vegetation dominates almost the entire preserve. Most widespread is moist to wet tundra, including wet graminoid meadows, moist dwarf shrub-heath, and sedge tussock tundra. The latter is often very extensive at lower elevations from the subalpine to the valley bottom. Different forms of alpine tundra such as *Dryas* fellfield, mesic dwarf and medium shrub-heath, and mesic forb-graminoid meadows are found on better-drained sites from lowlands to the alpine. Willows (*Salix* spp.) and dwarf birch (*Betula glandulosa* and *B. nana*) are the dominant shrubs in all these forms of tundra. Barrens, outcrops, taluses, and similar rock-dominated habitats support scattered forbs or scattered fragments of tundra vegetation.

Recent Botanical Investigations

A few collections were made in 1961 at the mouth of the Kelly River by Max Thompson (ALA). Otherwise the flora and vegetation of Noatak National Preserve was essentially unknown until 1963 when botanist Stanwyn Shetler visited a few sites as part of an inclusive biological inventory sponsored jointly by the Smithsonian Institution and the University of Alaska. Collectors on the trip included Shetler, assisted by his wife Elaine, David and Janice Chesemore, and Fred Dean. Only two of their five sites were within NOAT, both along the Noatak River. Shetler published a list of the species collected, and these specimens are held at US (Shetler 1964).

In 1973, a biological survey of the entire Noatak River drainage was undertaken by the Center for Northern Studies (Wolcott, VT) that included several sites within NOAT. Steve Young, botanist and director of the center, documented almost 200 species within NOAT from Feniak Lake, Kikitaliorak Lake, and a few sites along the river further downstream. He noted an abundance of rare and widely disjunct species found on the serpentine

barrens near Feniak Lake and within the canyons along the middle Noatak River valley. Young reported their survey results, and a set of his collections are held at ALA (Young 1974a & b).

Most recently, Alison Arians compiled a species list as part of her study of the floodplain dynamics along a section of the Noatak River within the boreal forest treeline zone (Arians 1997). Michael Duffy, a botanist working with Alaska Biological Research, Inc. (ABR) in 2005, made a small collection from the western portion of NOAT, which will be processed and held at ALA.

Field Activity and Personnel

A portion of three summers were spent in NOAT for our I&M survey. In 2001, Carolyn Parker (ALA) and Randy Meyers (BLM-Kotzebue) shared base camp and helicopter access with Bob Gal's NPS archaeology field crew on Primus Creek in the DeLong Mountains from July 7–18. Several sites and habitats were surveyed, from Siniktanneyak Mountain westward to the Kugururok River, all north of the Noatak River.

In 2002, Carolyn Parker and Kate Beattie (ALA) shared base camp and helicopter logistics with Bob Gal's field camp in the headwaters of the Kugururok River from July 3–7. Alpine and subalpine habitats within this headwaters area were visited.

In 2003, Carolyn Parker, accompanied by botanists Heidi Solstad and Reidar Elven (O), floated the central portion of the Noatak River from July 19–30. Starting approximately 6 km upstream of Mukachiak Creek, above the Noatak Grand Canyon, we finished our float at the mouth of the Kelly River. Collections were made at several locations along this section of the river. Also in 2003, Elven, Solstad, and Randy Meyers spent part of one day, July 17, in the headwaters of Hugo Creek in the western Igichuk Hills, situated in the southwest corner of NOAT. An overview map of NOAT indicating our sites is shown in Figure 4.23.

Because NOAT was poorly known botanically and is very large and remote, our strategy in 2001 and 2002 included taking advantage of the opportunity to share logistics resources with other NPS projects and using helicopter support to access a large diversity of localities and habitats from a remote base camp. Steve Young's floristically interesting collections from the xeric, south-facing bluffs along the Noatak River (Young 1974a & b) was the major motivation for our 2003 float trip. Traveling this portion of the Noatak River would allow us to spend more time on these unique sites as well as collect from a diversity of lowland and boreal habitats and localities not previously surveyed in NOAT. The range of landscape settings visited in NOAT is illustrated in Figure 4.24 (Copter Peak), Figure 4.25 (Primus Creek headwaters), Figure 4.26 (Desperation Lake), Figure 4.27 (Grand Canyon of the Noatak River), and Figure 4.28 (Noatak River at Sisiak Creek). Localities and habitats visited are listed in Table 4.5.

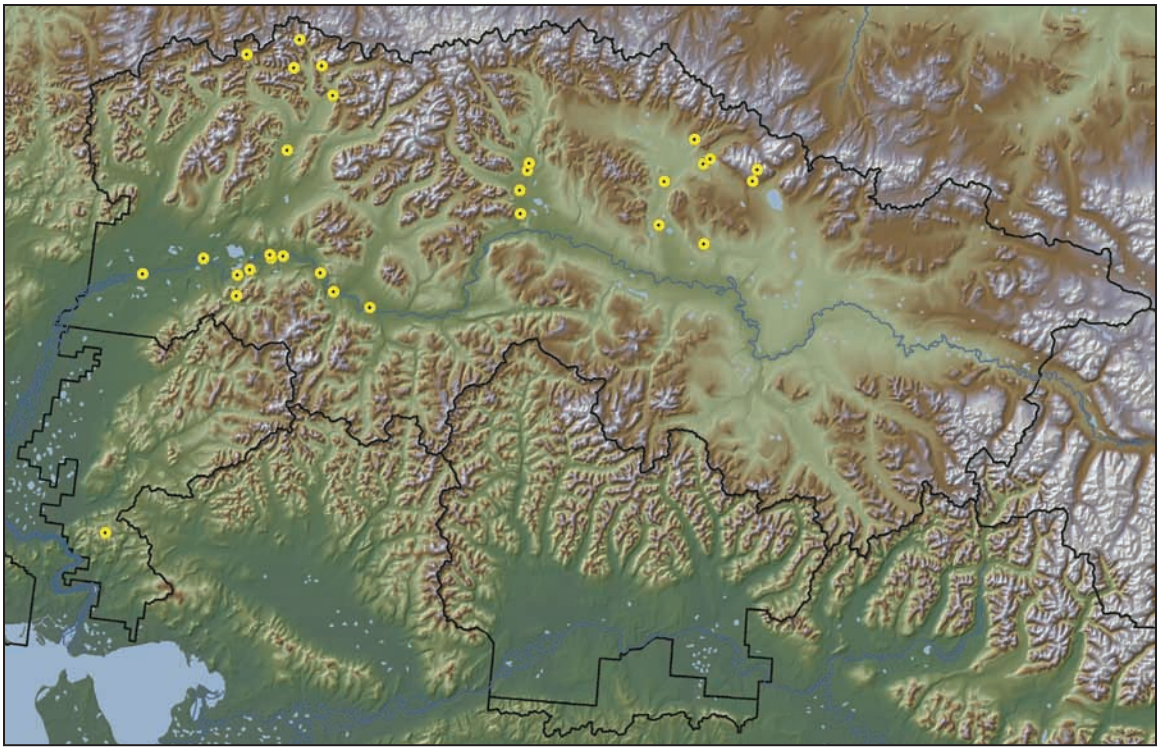

Figure 4.23. *Overview map of Noatak National Preserve. I&M inventory sites are indicated. Sites visited in 2001 span the central northern portion of the preserve from near Feniak Lake westward to the Kugururok River. Sites clustered near the headwaters of the Kugururok River were visited in 2002. Sites along the central Noatak River valley and the single site in the lower southwest corner were visited in 2003.*

Figure 4.24. *DeLong Mountains, Copter Peak, headwaters of Kugururok River. The screes and upper slopes support scattered forbs and* Dryas *fellfield. Lower slope in foreground is covered with heath tundra and open willow shrub.*

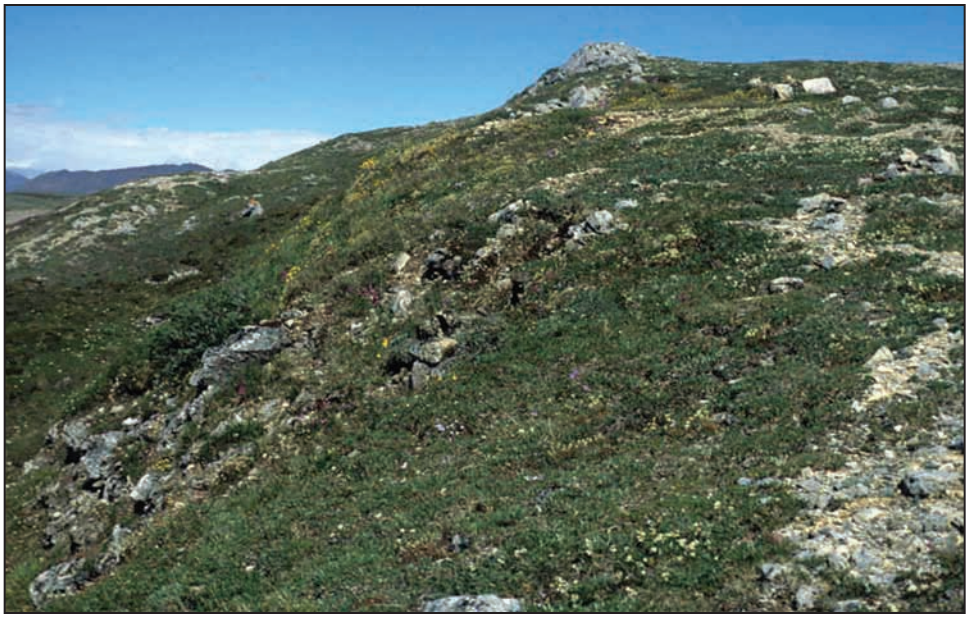

Figure 4.25. *DeLong Mountains, Primus Creek headwaters in upper Anisak River valley. South-facing limestone rubble slopes, having sheltered, moist microsites, supported a lush* Dryas *hummock tundra with high species diversity.*

Figure 4.26. *Desperation Lake, Anisak River valley. Moist to wet meadows and forb-rich tundra, with widely scattered alder and willow shrubs, surrounded the lake. The gravel beach ridges along the shore supported scattered forbs. The DeLong Mountains are in the background.*

Figure 4.27. *Grand Canyon of the Noatak River, mouth of Porgo Creek. View looking north across the Noatak River. Visible on the bluffs are outcrops, xeric,* Artemisia *slopes, and open, tall shrub thickets. Moist hummock tundra and tussock tundra covered the top of the slope just out of view.*

Figure 4.28. *Grand Canyon of the Noatak River, vicinity of Sisiak Creek and Lake Narvakrak. View is looking up river across the ancient floodplain to the ancient cutbank bluff that spans background. The ancient floodplain supports a diversity of wetland vegetation types and scattered open patches of white spruce and alders. The bluffs beyond it and in foreground support open and closed tall shrubs and hummock tundra.*

Table 4.5. *List of sites and major habitat types visited in NOAT during the I&M inventory in 2001–2003.*

Locality	Landscapes	Dominant Communities
2001		
Desperation Lake and vicinity, N and S shore of lake (2 sites) 68°20'N, 158°44'W (N shore)	• ancient alluvial fan • gravel lake shore • gravel beach ridges • ancient house sites	• moist to wet graminoid meadows • forb-graminoid meadows • open scattered forbs
Siniktanneyak Mountain, 5 km NW of Feniak Lake, from summit to lower slopes at base and on SW flanks (2 transects) 68°18'N, 158°27'W	• serpentine barrens • alpine to subalpine boulder slopes • cobble seepage slopes	• talus with patches of moist to dry *Dryas*-heath vegetation • open scattered forbs • open wet graminoid meadows
Primus and Buccaneer creeks confluence and vicinity, upper Anisak River valley (base camp) 68°22'N, 158°51'W	• limestone, dolostone, and igneous bedrock slopes • active floodplains • gravel ridge tops and terraces • outcrops	• *Dryas*-lichen fellfield • moist to dry graminoid-forb meadows • seepage meadows • alder and willow thickets • snowbeds • open willow-heath tundra • open scattered forbs
Middle Kugururok River valley, 12 km N of Lake Kaiyak (1 site) 68°16'N, 161°28'W	• active and semiactive gravel-sand floodplain bars	• medium-aged balsam poplar stands • open scattered forbs
Central Anisak River valley, NW of Avingyak Hills (1 transect) 68°17'N, 159°2'W	• limestone talus and slopes • active river floodplain	• herbaceous-shrub tundra • open willow thickets • open scattered forbs
Lower Anisak River valley, 3 km NW of Sidik Lake (1 site) 68°10'N, 159°2'W	• gravelly knoll • active river floodplain	• *Dryas* fellfield • rocky shrub heath tundra • open tall willow shrub • closed tall willow shrub
Lower Mapik Creek drainage (1 transect) 68°08'N, 158°44'W	• poorly drained lowlands • beaded streams	• sedge tussock tundra • wet sedge meadows • willow thickets
Nimiuktuk River valley (4 sites) 68°10'N, 159°56'W upstream to 68°18'N, 159°54'W	• active river floodplain • open gravel-sand bars	• alder and willow thickets • medium-aged to mature balsam poplar stands • tall open willow shrub • open scattered forbs
2002		
Inaccessible Ridge and Kagvik Creek headwaters (2 transects, to N and E) 68°29'N, 161°48'W	• active gravel bars • limestone rubble slopes • chert scree	• *Dryas* fellfield • open scattered forbs • heath hummock tundra • open medium willow shrub • snowbed meadows
Copter Peak area (1 transect) 68°28'N, 161°18'W	• acidic bedrock rubble • alpine slopes	• open scattered forbs • *Dryas* hummock heath • open willow-forb meadows
Upper Nunaviksak Creek valley (1 site) 68°32'N, 161°28'W	• rocky alpine slopes and stream bed • outcrops and cutbanks	• *Dryas* fellfield • wet sedge-forb meadow • hummock heath tundra • open scattered forbs
Upper Kugururok River Valley (1 transect to S) 68°25'N, 161°13'W	• kettle lakes • broad valley bottom	• open herb-forb meadows • wet sedge meadows • open willow-birch shrub
Central Nunaviksak Creek tributary (base camp) 68°28'N, 161°29'W	• active floodplain • ancient terraces • alpine slopes and knolls	• open willow-birch shrub • *Dryas* fellfield • open scattered forbs • snowbed meadows

2003		
Igichuk Hills, Hugo Creek headwaters (1 site) 67°18'N, 162°19'W	• alpine limestone slopes and drainages • active stream gravel bars	• snowbed meadows and seeps • mossy hummock tundra
Noatak River, 7 km above Mukachiak Creek, vicinity of "wolf control" cabin (1 site) 67°54'N, 160°50'W	• acidic bedrock outcrops, slopes, and screes • active floodplains	• tall willow thickets • open scattered forbs • dry shrub-herb meadow
Noatak River, 2 km above Akikukchiak Creek (1 site) 67°57'N, 161°4'W	• outcrops and screes • active gravel floodplain	• open shrub • young balsam poplar • scattered forbs
Noatak River, Porgo Creek mouth and vicinity (1 transect) 67°59'N, 161°10'W	• active gravel-sand floodplain • acidic bedrock outcrops • screes and rocky slopes	• open and closed tall willow thickets • xeric, S-facing *Artemisia*-forb slope • moist heath hummocky tundra • wet graminoid meadow • bogs • wet tussock tundra
Noatak River, Sisiak Creek mouth to 4 km downstream (base camp) 68°00'N, 161°24'W	• active gravel-sand floodplain • ancient gravel terraces • low foothills • small ponds	• steep herb-medium shrub slopes • heath-*Dryas* hummock tundra • open forb meadows • open willow thickets • open white spruce woodland • tall shrub thickets • *Kobresia* meadows • bogs
Noatak River, Sekuiak Bluff area (1 site) 67°59'N, 161°37'W	• gabbro and limestone outcrops and screes • active gravel-sand floodplain • dry, rocky knolls	• open white spruce woodland • mixed white spruce-birch-alder forest • moist calcareous hummock fen • peaty heath hummock tundra • willow thickets • steep, xeric *Artemisia*-forb slopes
Noatak River, Kugururok River mouth (1 site) 67°59'N, 161°55'W	• active gravel bars • ancient river terraces	• closed balsam poplar forest • closed white spruce forest • tall alder-willow thickets • open flood channels • disturbed, open herbaceous seral vegetation
Noatak River, Kelly River mouth (1 site) 67°56'N, 162°18'W	• active gravel-sand floodplain • lower foothill slopes	• mature open white spruce forest • tall shrub thickets • open willow-forb vegetation

Results and Discussion

During a portion of three summers we collected 1090 specimens and added 244 new species records, for a total of 447 species now documented for NOAT. Although Young (1974b) states 413 vascular species were identified during his 1973 survey of the entire Noatak River valley (which included 3 sites outside NOAT boundaries), only approximately 200 species were actually documented within NOAT before our I&M inventory.

The new records include 16 species ranked S1–S3 by AKNHP:

Arenaria longipedunculata G3S3

Carex holostoma G4?S2

Erigeron porsildii G4S3

Festuca lenensis G4S3

Minuartia biflora G5S2

Minuartia yukonensis G3G4S3

Oxytropis tananensis G2G3S2S3

Potentilla rubricaulis G4S2S3

Potentilla stipularis G5S1

Puccinellia vahliana G4S2S3

Puccinellia wrightii G3G4S2S3

Ranunculus glacialis ssp. *camissonis* G4T3T4S2

Ranunculus monophyllus G5S1S2

Rumex krausei G2S2

Smelowskia porsildii G5S2S3

Symphyotrichum yukonense G2G3S2S3

In addition, new localities were found for five species ranked S1–S3 that had previously been documented within NOAT:

Oxytropis arctica var. *barnebyana* G2G3?S2S3

Oxytropis kokrinensis G3S3

Papaver walpolei G3S3

Stellaria dicranoides G3S3

Cryptogramma stelleri G5S2S3

The majority of these ranked species have a Beringian or northern North American distribution. Their occurrence in NOAT is to be expected, and some represent minor or moderate range extensions. However, a major range extension is recorded by the collection of *Oxytropis tananensis* on the Anisak River, approximately 600 km northwest of the nearest known locality near Fairbanks, Alaska.

The 244 new species records for NOAT come from a broad diversity of habitats, as might be expected since the preserve was poorly known before our inventory. Among these records are many species best known from the boreal forest (i.e., *Moneses uniflora*, *Rosa acicularis*), the subarctic lowlands (i.e., *Hierochloe pauciflora*, *Eleocharis palustris*), and the alpine zone (i.e., several *Draba* spp., *Saxifraga oppositifolia*). In addition, several taxa often associated with azonal or uncommon habitats were newly collected. Examples include limestone substrates (i.e., *Carex glacialis*, *Astragalus aboriginum*) and open xeric slopes (i.e., *Minuartia yukonensis*, *Arabidopsis mollis*).

During his 1973 survey, Young (1974b) collected a showy spring beauty, *Claytonia* sp., on the serpentine barrens north of Feniak Lake. He suspected this plant might be a species new to science and undescribed. We visited this general area (Young's exact locality is uncertain) and collected additional specimens of this same *Claytonia* at the base of a moist, seepage serpentine slope 5 km north of Feniak Lake. Leaf tissue samples and herbarium specimens were shared with researchers investigating the systematics of the tribe Montieae (Family Portulacaceae), to which this plant is suspected to belong. However, in their molecular analyses, they labeled the Feniak Lake plants as *C. scammaniana*, and did not include samples of *C. scammaniana* from other sites in Alaska, including from the

type locality, so the taxonomic relationships of these morphologically varied populations were not resolved in their analyses (O'Quinn and Hufford 2005).

In 2006, David Murray (ALA) and Reidar Elven (O) examined all the ALA material of *Claytonia scammaniana,* and all other very similar-looking specimens, including the Feniak Lake material and specimens from northern Alaska labeled as *Claytonia porsildii.* They found very broad morphological variation among all specimens from Alaska and Yukon Territory, Canada, but no clear discontinuity. They concluded that only one species, *Claytonia scammaniana*, can be recognized at present (Elven and Murray, pers. comm.).

The expected species list for NOAT lists 567 species, considerably more than are documented as a result of our I&M inventory combined with previous collections. A careful look at the expected species list reveals that several species noted are generally restricted to coastal habitats (i.e., *Carex glareosa, Primula nutans*) or moderately disturbed sites (i.e., *Beckmannia syzigachne*, *Matricaria matricariodes*), habitats that are included within a 50 km perimeter of the preserve boundary but are not found within it. However, the expected list also includes several species from boreal (i.e., *Geocaulon lividum, Salix bebbiana*), alpine (i.e., *Potentilla elegans, Draba nivalis*), and lowland-wetland (i.e., *Carex utriculata, Stuckenia pectinata*) habitats that are found within NOAT. It seems reasonable that these latter species certainly could be here, and because they are missing from our collections, these may reflect areas or habitats that remain under-surveyed.

Recommendations

Although we covered different areas of NOAT during each of the three summers of the I&M inventory, some areas of this huge preserve remain poorly known. The areas discussed below have not been visited by botanists or only briefly visited with few, if any, collections. They should be considered in future inventory work.

Lower Noatak River Valley

The southwestern margin of NOAT includes well-developed wetlands lying east of the Noatak River from the vicinity of the Kelly River mouth and southward. Although we did access lowlands along the central Noatak valley, we are not aware of any collections from the extensive wetlands in this area, which may be richer in aquatic and wetland species than the smaller wetlands to the north and east.

In addition, the lower reaches of the Agashashok and Eli rivers support a zone of boreal forest and boreal woodlands that is more extensive than that found upstream along the Noatak River. This seems a likely area to search for the several boreal species not yet documented for NOAT.

Maiyumerak Mountains and Agashashok and Eli Rivers Headwaters

The alpine and upland landscapes in the southwestern portion of NOAT include the Maiyumerak Mountains and the headwaters of the Agashashok and Eli rivers. The bedrock in this area includes a great diversity of volcanic, intrusive (i.e., noncarbonate), and sedimentary (including carbonates) bedrock that have been highly faulted,

metamorphosed, and recrystalized (Karl et al. 1989). This area is botanically unknown and offers a diversity of substrates and topographic features to explore.

Hugo Creek Drainage

The bedrock at this site, located in the eastern part of the Igichuk Hills, is the same massive dolomite and limestone found in the Igichuk Hills within CAKR. The brief field day spent in the headwaters of Hugo Creek resulted in the documentation of several uncommon species, including two very rare plants, *Ranunculus monophyllus* (S1S2) and *Rumex krausei* (S2). This lush alpine area may be worth revisiting. In addition, the lowlands to the south and within the Hugo Creek basin offer boreal and lowland habitats influenced by the limestone substrate draining into it from the north and by the coastal weather arriving from the south. This combination of features is unique within the preserve. This setting may be similar in some respects to the floristically productive I&M inventory site near Igisukruk Mountain in southeastern CAKR. Steve Young made a small collection at Mulik Hills, on the preserve boundary and just north of the Noatak River delta, that documented a mixture of boreal and alpine species (ALA).

Kelly River Headwaters

The alpine area of the Kelly River headwaters is a part of the same highly faulted and metamorphosed bedrock system as found in the Agashashok River headwaters and the Maiyumerak Mountains, although it consists of different bedrock units, including ultramafics, partially serpentinized volcanics, and marine shale-carbonate sections (Curtis et al. 1984). This area is botanically unknown, although it was visited briefly during an ABR mapping project in 2005. The few collections from this area include the rare plant *Thlaspi arcticum* (Michael Duffy, pers. comm.). Our NOAT I&M site at Inaccessible Ridge in the Kugururok River headwaters is immediately northeast of the Kelly River headwaters but is dominated by carbonate bedrock. The Kelly River headwaters region remains of botanical interest due to its mixed bedrock geology and the fact that it is botanically unknown.

Cutler and Imelyak River Basins

This region is located south of the central Noatak River valley. Steve Young made a few collections at the mouth of the Cutler River (ALA); however, no collections are otherwise known from the entire basin areas of both rivers. The valleys are broad and well vegetated with numerous small lakes. The upland and alpine region (up to 1,200 m in elevation) includes the northern slope of the Baird Mountains and the northern tip of the Schwatka Mountains. Limestone, dolomite, and other basic bedrock types dominate most of this upland and alpine region (Mayfield and Tailleur 1978). Because calcareous substrates typically support unique plant assemblages and uncommon species, inventory work in this totally unknown region could be productive.

Upper Portion of Noatak River, Upstream of Atongarak Creek

Above Atongarak Creek, the upper Noatak River cuts through ancient glacial tills, and the valley bottom supports relatively well-drained, open, nonpeaty vegetation, unlike the

well-developed tussock tundra downstream (Tom Hamilton, pers. comm.). This upper river basin region has calcareous bedrock along the lowlands and underlying the numerous small lakes on both sides of the valley (Mayfield and Tailleur 1978). It is also linked to the Arctic Slope vegetation through Howard Pass and the Aniuk and Etivluk river valleys. These combined factors could contribute to species richness and support the occurrence of both characteristically Arctic Slope species and species commonly associated with calcareous substrates.

CHAPTER 5
DISCUSSION OF RARE AND NOTEWORTHY SPECIES

Knowledge of the occurrence of rare plants on public lands is fundamental to sound management decisions. Public land stewardship demands that we protect rare or noteworthy species, unique plant assemblages, and the habitats that support them. A significant portion of our inventory focused on those habitats and areas in ARCN where we suspected rare plants might be, based on both the results of previous surveys and the known habitat preferences for rare species that could occur in the region. A part of our daily field strategy was to check carefully any unusual setting or landscape feature, no matter how small or unfavorable for plants it appeared, for it is just such sites that often harbor the rarest species in our flora.

A total of 54 species ranked S1, S2, and S3 (respectively critically imperiled, imperiled, and rare) by the Alaska Natural Heritage Program (AKNHP) are now documented for the entire ARCN parklands. (For a complete list of ranking abbreviations, see the Abbreviations on page *iii*). Two additional species have been cited in the literature, but have not been documented. Twenty of these rare species are new records for the entire ARCN parklands. We found a total of 51 new records for a ranked species in at least one of the five park units. The currently known rare plant occurrences for each park unit are summarized in Table 5.1:

Table 5.1. *Rare species in the ARCN parks*

Park Unit	New rare species from 2001–2003 I&M survey	Total rare species
BELA	1	17
CAKR	11	13
GAAR	19	29
KOVA	4	14
NOAT	16	21

Previous inventories in BELA had already documented several ranked species from the interior of the park. Our inventory focused entirely on the coastal regions, and our single new rare plant record, *Puccinellia vaginata,* is a coastal species. In KOVA, four rare plants are known from, and seem to be restricted to, the active sand sheets of Great and Little Kobuk Sand Dunes and the immediate vicinity, a landscape that has been botanized extensively during previous studies (Hunt 1997b, Lipkin 1985, Parker and Mann 1999). In contrast, the four new rare taxa we documented from KOVA were growing in rocky or herbaceous alpine habitats in which they are typically found. For each of the remaining three park units, we made a significant contribution toward the knowledge and documentation of their respective rare floras from diverse landscapes and habitats.

Among the new finds is one species recognized as new to North America, found in CAKR (*Potentilla fragiformis*), and two species recognized as new to Alaska, found in GAAR (*Draba pauciflora* and *Festuca edlundiae*). An additional noteworthy record, X_*Dupoa labradorica*, is a new generic hybrid grass for Alaska and highly disjunct from Hudson Bay, Canada. It was found in both BELA and CAKR. However, being a stabilized hybrid, it is not currently ranked for rarity. A population of *Saussurea triangulata*, a species new to North America when it was found in KOVA in 2000 (Parker 2001), was relocated, and a second population within KOVA was found.

The knowledge of the rare plant flora of an area may also offer insight, or support speculation, concerning the origins and history of the flora. Approximately one half of the rare species currently known to be in ARCN parklands display a Beringian or east Beringian distribution (i.e., *Primula tschuktschorum*, *Aphragmus eschscholtzianus*). This is interpreted by many botanists as reflecting the geologically recent repeated opening and closing of the Quaternary Bering Land Bridge and the opportunity it offered for plant migrations between Asia and North America and for repeated periods of isolation enforced by these cycles. Hence there is increased potential for genetic divergence, speciation, and/or extinctions within the Bering Land Bridge region (Hultén 1937 and 1968, Kelso 1989, Young 1982).

Another distinctive group of rare species within ARCN have a definite North American distribution (e.g., *Minuartia yukonensis*, *Carex deflexa*). The majority of these taxa are from open, dry to xeric habitats, and their presence in northwestern Alaska often represents a widely disjunct occurrence from their more southern range. This could reflect the very early or very late periods within the full glacials when dry open habitats were more widespread and contiguous within Alaska and extended southward through the Rocky Mountain Cordilleran system. These circumstances would have facilitated northward migration of plants characteristic of these habitats.

In the northern regions of NOAT and GAAR, a few rare circumpolar arctic species are found that are generally restricted to the coastal arctic regions (i.e., *Draba pauciflora*, *Festuca edlundiae*, *Puccinellia vahliana*). The appearance of these species in ARCN represents small southward range extensions of a true arctic floristic zone that has been nearly contiguous, and open to plant migrations, throughout most of the Quaternary era.

A few rare species that display a circumpolar boreal distribution are found as disjuncts and/or northward range extensions in the southern portions of some ARCN parklands (i.e., *Carex lapponica*, *Carex heleonastes*). Their occurrence here could reflect either a biologically recent migration northward or the persistence of relict populations established during a slightly warmer interglacial period when a well-developed boreal vegetation was more contiguous and reached these regions, which now lie at, or beyond, the northern margin of the boreal forest.

The presence of a few species that are widespread in the northeastern Russian flora but barely reach western Alaska (i.e., *Ranunculus monophyllus*, *Potentilla stipularis*, *Saxifraga rivularis* ssp. *arctolitoralis*) simply emphasizes to North American botanists the rich Asian heritage found in our Alaska flora.

However, although our inventory has significantly improved our knowledge of the flora in this extensive region, it is far from complete. Many areas and habitats within each park unit remain poorly known, as mentioned in the recommendation sections for each unit and in the summary of this report.

Following is a brief discussion of each of the rare (S1–S3) and noteworthy taxa that have been documented or cited for the ARCN parklands. Current AKNHP global and state rankings are given. Range extension categories noted in the text are:

- minor (50–100 km)
- moderate (>100–250 km)
- major (> 250 km)

Listed for each species is the label information from the herbarium specimens held at ALA. The abbreviation "s.n." stands for *sans numbre*, meaning no collection number exists. These specimens are the result of both this I&M inventory collection and of previous surveys within the current boundaries of ARCN. This information is also included in our ALA database, which is accessible at http://arctos.database.museum/. The scientific names printed in bold are those currently used at ALA; the synonyms included are those that are also commonly found in the regional floras and in taxonomic literature. Coordinates are rounded to the nearest minute. For more exact locations, consult NPSpecies or the ALA database website listed above. A summary table of the rare plant occurrences in ARCN can be found in Table 5.1.

Aspleniaceae

Asplenium viride Hudson G4S3

= *A. trichomanes-ramosum* L. nom. rejic.

This small, dark-green fern is known from scattered circumboreal sites, including southern and central Alaska. It grows on cliffs and in rock crevices or grottos and is often associated with carbonate rock. Due to its small size and cryptic habitats, it is easily overlooked and may be more common than known occurrences suggest.

Asplenium viride was recorded in the literature from KOVA (Racine 1976) and from BELA (Racine and Anderson 1979) but no specimens have been located. It has been documented from Anvil Mountain on the southern Seward Peninsula (ALA; Hultén 1941) and could occur in ARCN.

Asteraceae

Artemisia senjavinensis Besser G3S2S3

This tightly cespitose wormwood is narrowly endemic to the Bering Strait region. It is found only on the Seward Peninsula, Alaska, and the southeastern portion of the Chukotka Peninsula, Russia. *A. senjavinensis* grows on screes, outcrops, and open rocky sites at all elevations and is often associated with carbonate rock.

Alaska specimens held at ALA are all from the southern half of the Seward Peninsula with the exception of one from the headwaters of Eldorado Creek, a locality that is believed to be within BELA. *Artemisia senjavinensis* was not collected during this inventory.

BELA

Bendeleben Quad: Seward Peninsula, head of Eldorado Cr., 65°41'N, 164°18'W., D. Kaufman s.n., 20 July 1984.

Erigeron muirii **A. Gray G2S2**

= *E. grandiflorus* Hook. ssp. *muirii* (A. Gray) Hultén

This pale lavender fleabane displays a fine white floccose pubescence that covers the entire plant. It is endemic to the North Slope of Alaska and western Canada. Alaska localities documented at ALA range from Cape Thompson eastward to the Arctic National Wildlife Refuge.

Erigeron muirii was first collected at Cape Thompson by John Muir in 1881 and subsequently named for him by botanist Asa Gray (Muir 1883). Lloyd Spetzman collected *E. muirii* at Kanayut (Shainin) Lake just north of GAAR and from the Anaktuvuk Pass area within GAAR (Wiggins and Thomas 1962, collections at MIN and ISC). Our collection from Castle Mountain is a second record for GAAR.

GAAR

Chandler Lake Quad: Arctic Foothills, Castle Mtn., middle ridge and summit area, 68°34'N, 152°32'W, 700–1,070 msm, alpine slopes, screes and outcrops, growing on dry *Dryas* heath and scree, Parker et al. 12690, 28 July 2002.

Erigeron porsildii **Nesom & D. F. Murray G4S3**

= *E. grandiflorus* Hook. ssp. *arcticus* Porsild

This whitish to purple fleabane is similar in appearance to *E. grandiflorus* but is generally a taller and more robust plant with broader leaves and colorless involucral hairs (Nesom and Murray 2004). *E. porsildii* is an east Beringian endemic found in Alaska and Yukon, Canada. Documented localities within Alaska include the eastern arctic coastal plain, Yukon-Tanana uplands, Alaska Range, and the Wrangell Mountains.

Our collections from the central Noatak River valley in NOAT and Castle Mountain in GAAR represent moderate western range extensions from a previously known locality at Galbraith Lake in the east central Brooks Range (ALA) and are first records for both units and for ARCN.

GAAR

Chandler Lake Quad: Arctic Foothills, Castle Mountain, northern ridge of summit area, 68°34'N, 152°35'W, 700–1,070 msm, alpine *Dryas* heath cliffs, scree and meadows along drainages, growing in a lush herbaceous, N-facing meadow, Parker et al. 12891, 30 July 2002.

NOAT

Baird Mountains Quad: Central Noatak River valley, Grand Canyon, vicinity of Wolf Control cabin, ca. 7 km upriver from Mulachiak Cr., 67°54'N, 160°50'W, 140 msm, S-facing acidic bedrock bluffs above floodplain, dry to mesic shrub and open shrub-herbaceous vegetation, growing on open grassy slope, Parker et al. 14959, 19 July 2003.

Baird Mountains Quad: Central Noatak River valley, Sekuiak Bluff, upstream end of bluff, vicinity E of VABM Windy, 58°00'N, 161°37'W, 100 msm, cobble-gravel river bars and gabbro outcrops, growing in turf on outcrops, Parker et al. 15185, 26 July 2003.

Baird Mountains Quad: Central Noatak River valley, Sekuiak Bluff, vicinity of upstream end of bluff and VABM Windy, N bank of river, 58°00'N, 161°37'W, 100 msm, S-facing outcrops and scree, limestone-acidic rock contact zone, Parker et al. 15264, 27 July 2003.

Saussurea triangulata Trautv. & C. A. Mey. G1?S1

This *Saussurea* sp. was immediately recognized as new to North America, although its identity was uncertain, when it was collected in the Waring Mountains as part of a vascular plant survey of Selawik NWR sponsored by USFWS in 2000 (Parker 2001). Our specimen was reviewed by botanists Boris Yurtsev and Alexander Korobkov of the Komarov Botanical Institute, St. Petersburg, Russia (LE), who believed it to be a new, undescribed species, not known from the Russian Far East where the genus *Saussurea* is very species rich. However, David Keil, author of the treatment for the genus for the *Flora of North America* (FNA, volume in prog., pers. comm.) is provisionally calling our Waring Mountains plants *Saussurea triangulata*, a species known from the southern Russian Far East and Korea (Lipschitz 1979, Schischkin and Bobrov 1998). Under this provisional

Figure 5.1. Saussurea triangulata *growing in the Waring Mountains (KOVA). The triangular leaves, extending upright among other plants, are distinctive. Dark-colored flower buds are visible in upper center of photograph.*

taxonomic view, the 2000 collection represents a species new to North America and a significant major range extension northeastward from Kamchatka, Russia (Figure 5.1).

In 2002, we returned to the 2000 collection site, which is just inside the KOVA boundary, to collect more material and obtain live plants. This population is situated on a gentle north-facing slope just below a ridgeline, approximately 3 km southwest of VABM Slam in the western Waring Mountains. Plants formed a large but open and fragmented patch approximately 10 m by 20 m within a narrow zone of herbaceous vegetation in subalpine shrub tundra and adjacent to the upper margin of an alder belt. The delayed phenology of the associated species, and the deep humus layer here, suggest the site holds a late-lying snow patch. Also in 2002, we located a second small population of *Saussurea triangulata* in a similar habitat 1 km north of VABM Slam. This second locality supported only a small clump of plants approximately 0.5 m in diameter and was not vouchered.

KOVA

Selawik Quad: Waring Mtns., vicinity 3 km W of VABM Slam, 66°58'N, 159°41'W, 425 msm, gentle N-facing slope just below ridgeline, herbaceous-heath meadow zone along margin of alder thicket at shrub line, Parker & McIntyre 11522, 26 June 2002.

Selawik Quad: Waring Mtns., vicinity 3 km W of VABM Slam, 66°58'N, 159°41'W, cobbley ridgetops and heath slopes, meadow at margin of alders, Parker et al. 9323, 25 June 2000.

Symphyotrichum yukonense **(Cronq.) Nesom G3S3**

= *Aster yukonensis* Cronq.

This east Beringian endemic is a slender purple aster that favors open sandy-gravelly habitats subject to moderate to infrequent disturbance, such as semistabilized dune fields and the more stable bars within an active river floodplain. It was first described in 1945 from the Slims River, Yukon, Canada, where it grows on saline flats on the floodplain (Cronquist 1945). It was collected near Bettles, Alaska, in 1960 (Stone 602, ALA), a locality that is disjunct by over 1,000 km from the Yukon site and south of GAAR. A 1965 collection noted below from the Oolah Valley, ca. 80 km north of Wiseman, Alaska, is believed to be within, or immediately adjacent to, the GAAR boundary.

In 1976, Marko Lewis collected *Symphyotrichum yukonense* at Great Kobuk Sand Dunes (ALA). This new occurrence represented a major northwestward range extension of 350 km from the Bettles area. Since these earlier records, *S. yukonense* has been documented from several sites within Great Kobuk Sand Dunes in KOVA, from the Squirrel River valley north of the Kobuk River and northwest of KOVA, and from additional sites along the Koyukok River between Bettles and Wiseman (ALA). This southern Yukon to northwest Alaska disjunction in its range invites speculation that it may have had a more contiguous distribution during a drier period of the late Quaternary when open, moderately disturbed habitats such as sand dunes and active floodplains were more common throughout East Beringia (Lea and Waythomas 1990).

During our 2003 inventory season, we documented *S. yukonense* for the first time in NOAT from several sites along the central Noatak River floodplain between Porgo Creek

and the Kelly River. These new NOAT collections represent a minor range extension northward from the Kobuk River valley (Figure 5.2).

GAAR

Chandler Lake Quad: Oolah Valley, 68°7'N, 150°7'W, dry portion of stream bed, sandy silt, W. L. Cheney s.n., 22 August 1965.

Note: *Symphyotrichum yukonense* has also been documented from along the Hunt Fork John River and the North Fork Koyukuk River by NPS personnel. These specimens, held at the GAAR herbarium in Fairbanks, have been reviewed by the author, but are not recorded in NPSpecies.

KOVA

Ambler River Quad: Great Kobuk Sand Dunes, 67°4'N, 158°59'W, 76 msm, barely damp sand flats at base of transverse dune system with low mounds of *Dryas integrifolia* and scattered clumps of *Lupinus arcticus, Arctostaphylos rubra*, and *Salix niphoclada*, Meyers and Hunt DRH-9413, 2 August 1994.

Baird Mountains Quad: Great Kobuk Sand Dunes, Kavet Creek, 67°6'N, 159°1'W, 92 msm, on creek floodplain, damp sandy soil at NW base of 100 ft. barchan dune edge, associated with shrub *Salix* spp., *Castilleja* spp., *Arctostaphylos rubra, Chrysanthemum* spp., *Aster sibiricus, Picea* spp. seedlings, *Sanguisorba* spp., mushrooms, Hunt DRH-943, 9 August 1994.

Note: Twelve additional specimens of *S. yukonense* from KOVA are also held at ALA. All are from Great Kobuk Sand Dunes and were found in similar habitats of semistablized sandy areas within the dune complex and along the dune field margin.

Figure 5.2. Symphyotrichum yukonense *(at right) and the similar looking* Eurybia sibirica *(at left) growing together on the Noatak River floodplain (NOAT). The narrow, clasping leaves help distinguish the rare* S. yukonense *from the more common and widespread* E. sibirica.

NOAT

Baird Mountains Quad: Central Noatak valley, mouth of Porgo Cr., S side of river, 67°59'N, 161°10'W, 120 msm, sand-gravel bars and willow thickets on floodplain, in *Salix alaxensis* thicket, Parker et al. 14992, 21 July 2003.

Baird Mountains Quad: Central Noatak valley, mouth of Porgo Cr., N side of river, 67°59'N, 161°10'W, 120 msm, gravel river bar, Parker et al. 15014, 21 July 2003.

Misheguk Mountain Quad: Central Noatak River valley, mouth of Sisiak Cr., N side of river, 68°00'N, 161°25'W, 100 msm, sandy-muddy river bars on floodplain, open *Salix alaxensis* thicket, Parker et al. 15057, 22 July 2003.

Misheguk Mountain Quad: Central Noatak River valley, 5 km downstream from Sisiak Cr., N side of river, 68°00'N, 161°30'W, 100 msm, floodplain and ancient terraces, growing in gravelly-sandy bar, willow-herb open shrub, Parker et al. 15151, 24 July 2003.

Baird Mountains Quad: Central Noatak River valley, Sekuiak Bluff, upstream end of bluff, vicinity E of VABM Windy, 67°58'N, 161°37'W, 100 msm, sandy river terrace, open shrubs and herbs, Parker et al. 15204, 26 July 2003.

Baird Mountains Quad: Central Noatak River valley, mouth of Kugururok R., upstream side of mouth of river, 67°59'N, 161°55'W, 85 msm, sand bars, open *Salix-Equisetum* vegetation, Parker et al. 15283, 28 July 2003.

Noatak Quad: Central Noatak River valley, vicinity mouth of Kelly R., 2–5 km upstream of mouth, vicinity of NPS cabin, 67°55'N, 162°18'W, 80 msm, open gravel-sand bar, Parker et al. 15325, 30 July 2003.

Brassicaceae

Aphragmus eschscholtzianus Andrz. G3S3

This tiny purple mustard is a Beringian endemic found throughout southern and interior Alaska in moist to wet alpine sites. It is easily overlooked as it often grows among rocks or in moss. Several widely scattered populations are documented throughout central and southern Alaska.

A single specimen of *Aphragmus eschscholtzianus* has been collected from the Arrigetch Creek valley in GAAR, and it represents a major northward range extension within Alaska. Based on collections from the Seward Peninsula near Cape Rodney and Cape Prince of Wales (ALA), and the Kigluiak Mountains (Hultén 194–1950 [vol. V]), it could eventually be found in BELA.

GAAR

Survey Pass Quad: Arrigetch Cr. valley, 67°26'N, 154°5'W, 1067 msm, wet area with *Carex membranacea*, D. J. Cooper 1053, 17 July 1980.

***Cardamine microphylla* J. E. Adams**

ssp. ***blaisdellii*** (Eastw.) D. F. Murray & T. Kelso G4S2S3

= *C. blaisdellii* Eastw.

This Beringian endemic has erect stems that arise from a creeping, prostrate stem and support a raceme of white flowers. It is distinguished from *C. microphylla* ssp. *microphylla* in having a terminal leaflet that is larger than the lateral leaflets and which has two or more shallow teeth or lobes (Murray and Kelso 1997). It is usually found in moist, herbaceous, low-growing vegetation. *C. microphylla* ssp. *blaisdellii* is known from several localities in northwestern Alaska and eastern Chukotka, Russia. It was reported from Walker Lake in GAAR, but a specimen has not been located (Hasselbach and Neitlich 1996).

At KOVA we collected *C. microphylla* ssp. *blaisdellii* on the north side of Jade Mountain. Our collections from GAAR came from a north-facing cirque on Fritts Mountain in the Angayucham Mountains and from the Igning River valley in the Schwatka Mountains. These were the first documented records for both parks and represent moderate north and eastward range extensions. Previous collections had documented *C. microphylla* ssp. *blaisdellii* from the Lake Kuzitrin area and the headwaters of Ella and Minnie creeks, both in BELA.

BELA

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, lower slopes, 65°20'N, 163°14'W, moist to wet tundra meadows, Murray et al. 11118, 28 July 1992.

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, N side of Mt. Boyan, 65°20'N, 163°14'W, valley, Murray et al. 11227, 31 July 1992.

Bendeleben Quad: Mt. Boyan, 2 miles S of Kuzitrin Lake, upper slopes, 65°21'N, 163°14'W, 732 msm, in wet, late snowbank area on upper slope, Racine 344, 21 July 1973.

Bendeleben Quad: ridge between Ella and Minnie creeks, 65°18'N, 163°44'W, moist to mesic soil at front edge of solifluction lobe, Murray et al. 11529, 15 July 1993.

GAAR

Hughes Quad: Angayucham Mts., Fritts Mt., N-facing alpine cirque N of summit, 66°55'N, 155°31'W, 700 msm, snowbeds, screes and rocky heath, igneous substrate, growing in soil bank at lake margin, Parker et al. 13497, 4 August 2002.

Hughes Quad: Angayucham Mts., Fritts Mt., N-facing alpine cirque NE of summit, 66°56'N, 155°29'W, 550 msm, mesic creek bank meadows, heath, and rocky knolls, igneous substrate, growing in lush meadows along creek, Parker & Guldager 13882, 7 August 2002.

Ambler River Quad: Schwatka Mts., Igning R. headwaters, broad N-NW trending valley, 67°25'N, 156°3'W, 850 msm, SW-facing gelifluction lobes with mesic heath-herbaceous tundra, heavily grazed by caribou, Parker and Solstad 13739, 5 August 2002.

KOVA

Ambler River Quad: Baird Mts., Jade Mt., N side, NW shoulder, 67°14'N, 158°6'W, 450 msm, N-facing cliffs and ledges above cirque, acidic (phyllite) bedrock, Parker and Fowell 11315, 25 June 2002.

Draba exalata E. Ekman G3S3

This small yellow mustard of rocky habitats belongs to a taxonomically and nomenclaturely confusing complex of species requiring further study (Elven et al. 2005, Hultén 1968 and 1973, Mulligan 1971). In addition to the BELA specimens noted below, a few collections are known from the southern half of the Seward Peninsula where it usually grows on calcareous outcrops and screes.

Regardless of future taxonomic resolution within the group to which this plant belongs, any resulting species will probably remain rare for our region, because the entire species complex is uncommon in the northern and arctic floras.

BELA

Bendeleben Quad: Trail Cr. caves, 65°49'N, 163°25'W, 488 msm, summit outcrop, in loose rubble, on shallow soil, Murray and Kelso 11301B, 5 July 1993.

Bendeleben Quad: Minnie Cr. headwaters, Minnie-Boston Cr. divide, 65°20'N, 163°38'W, limestone marble outcrops and ledges, Murray et al. 11580, 16 July 1993.

Figure 5.3. Draba pauciflora *growing near Chandler Lake (GAAR). The 6 to 8 cm tall plants were found in small moss patches within taller heath-*Dryas *tundra on a moderately steep slope.* D. pauciflora *was also found at Encampment Creek (GAAR), approximately 90 km east of Chandler Lake.*

Draba pauciflora R. Br. G4S1

= *D. adamsii* Ledeb.

= *D. micropetala* auct., non Hook.

= *D. oblongata* auct., non R. Br.

Draba pauciflora is a high arctic circumpolar species that is poorly understood taxonomically but is currently recognized within the Alaska flora. The yellow petals and coarse hairs suggest it belongs to the *D. alpina* species complex. However, the small narrow petals suggest linkage to *D. micropetala* Hook. Collections reviewed at ALA seem distinctive in having very long ciliate hairs on the leaves, relatively broad leaves compared to other regional *Draba* spp., and obovate siliques that are glabrous or have a sparse pubescence of short hairs.

At GAAR, we collected *D. pauciflora* from the south shore of Chandler Lake and from the Encampment Creek

headwaters. Both collections are from north-trending valleys in the Endicott Mountains of the Brooks Range (Figure 5.3).

Our collections were thought to be the first records for the species in Alaska. However, a subsequent careful review of ALA specimens of similar-looking *Draba* species undertaken by Reidar Elven (O) and David Murray (ALA) in 2002 resulted in three previously unidentified or misidentified *Draba* specimens also being determined as *D. pauciflora*. These collections were all from from the Beaufort Sea arctic coast (Barrow, Cape Simpson, and Pitt Point). Our collections therefore represent a minor range extension southward from the arctic coast and a new record for both GAAR and ARCN.

GAAR

Chandler Lake Quad: Endicott Mts., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W, 1260–1400 msm, E-facing seepage slope on blocky, carboniferous substrate, moist to wet open herbaceous vegetation, Parker and Solstad 13358, 28 July 2002.

Chandler Lake Quad: Endicott Mts., Chandler Lake, S shore, 68°12'N, 152°45'W, 900–950 msm, W-facing slope, ericaceous heath on acidic boulder slope, growing in deep, moist moss patches in more open microsites, Parker et al. 12308, 20 July 2002.

Smelowskia porsildii **(Drury & Rollins) Jurtsev G5S2S3**

= *Smelowskia calycina* (Stephan) C. A. Mey.

var. *porsildii* W. H. Drury & Rollins

Narrow to almost linear leaves, very long petioles, and ascending fruiting pedicels distinguish this Alaska endemic within the *Smelowskia calycina* species aggregate. Recent molecular analysis supports its recognition at the species level (Warwick et al. 2004). It is documented at ALA from several localities in northern and western Alaska as well as from the Kokrines Hills, the western Alaska Range, and the Nutzotin Mountains in east-central Alaska. *Smelowskia porsildii* is usually found growing in rock-dominated habitats such as scree, outcrops, and fellfields.

Previous ALA records from GAAR include Kurupa Lake and the Alatna River headwaters. During our inventory, we collected the first NOAT record for *Smelowskia porsildii* at Desperation Lake and at Sekuiak Bluff along the central Noatak River. In southern GAAR, we documented *S. porsildii* from the Lockwood Hills, south of the upper Kobuk River valley.

GAAR

Hughs Quad: Upper Kobuk R. valley, Lockwood Hills, 66°40'N, 155°20'W, 620–730 msm, exposed ridges, S and W-facing *Dryas* heath slopes, screes and shrub thickets, growing on acidic rock scree, Parker et al. 13782, 6 August 2002.

Killik River Quad: Kurupa Lake, 68°22'N, 154°39'W, lithosol of ridge crest, Murray 4336, 27 July 1973.

Survey Pass Quad: Alatna R., Headwaters Lake, 67°53'N, 155°5'W, S-facing mountain slopes and summits, Murray 4063, 13 July 1973.

NOAT

Howard Pass Quad: DeLong Mts., Desperation Lake, S shore, E of outlet of Uivaksak Cr., 68°20'N, 158°47'W, 400 msm, lake shore gravel beach ridges, active beach gravels and adjacent ancient, sparsely vegetated ridges, Parker & Meyers 10553, 7 July 2001.

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, vicinity of upstream end of bluff and VABM Windy, N bank of river, 67°58'N, 161°37'W, 100–150 msm, N-facing gabbro outcrops and scree, Parker et al. 15273, 27 July 2003.

Thlaspi arcticum A. E. Porsild G3S3

This small mustard is distinctive among all other Alaska crucifers in being completely glabrous and in having horizontally spreading clavate fruits held in a ladder-like raceme. An amphi-Beringian species, it is known in Alaska from the Chugach Mountains, Alaska Range, southern Kuskokwim Mountains, and eastern Brooks Range northward to Prudhoe Bay. *Thlaspi arcticum* usually grows on alpine slopes with an open to a very sparse vegetation cover.

Thlaspi arcticum has been documented from the Atigun River valley, just outside the east boundary of GAAR. Our collection from Castle Mountain in GAAR represents a minor westward range extension within Alaska and a first record for both GAAR and ARCN.

GAAR

Chandler Lake Quad: Arctic Foothills, Castle Mtn., southern ridge of massif, 68°34'N, 152°32'W, 700–1,070 msm, alpine slopes, valleys, and screes, growing in moist *Dryas* heath, Parker et al. 12757, 29 July 2002.

Note: In 2005, *Thlaspi arcticum* was collected in the headwaters of the Avan River in the northwestern portion of NOAT by Mike Duffy, a botanist working for a private consulting company. This collection has yet to be processed but will eventually be held at ALA.

Campanulaceae

Campanula aurita Greene G4S3

This slender blue harebell, an east Beringian endemic, is best known from dry, midelevation slopes in the upper Yukon and Porcupine river valleys, the Ogilvie Mts., and eastern Brooks Range in Alaska. It is also found in northwestern Canada.

The central Brooks Range collections listed below from GAAR represent the western edge of its range.

GAAR

Survey Pass Quad: Takahula Lake, 67°21'N, 153°40'W, 300 msm, dry cliff, Jörgensen T153, 2 August 1979.

Wiseman Quad: vicinity John R. and Tangleblue Cr., 67°33'N, 152°12'W, 365 msm, in thin dry rocky soil on steeply NW-sloping ridge of Skajit limestone, alpine tundra dominated by *Dryas* spp., Batten 74–85, 13 July 1974.

Caryophyllaceae

Arenaria longipedunculata Hultén G3S3

This loosely matted sandwort is an east Beringian endemic. Its distinctly erect flowering stems and long erect pedicel (10–20 mm) below the single flower help distinguish it from other *Arenaria* species in Alaska. *A. longipedunculata* grows in open, moist microsites at all elevations and frequently is associated with carbonate substrates.

Arenaria longipedunculata is documented from several widely scattered sites within Alaska. Previous records in GAAR are known from Walker Lake and the middle Alatna River valley. A single record from KOVA is from the central Kobuk River valley. We documented it from Whiteface Mountain, from Chimney Pass in GAAR, from near Igisukruk Mountain in CAKR, and from the central Noatak River valley in NOAT. We also collected *A. longipedunculata* at Shainin Lake, north of Anaktuvak Pass and just outside the GAAR boundary. Our collections from CAKR and NOAT are first records for these park units.

Although it has yet to be found in BELA, it has been found at Ear Mountain immediately south of the BELA boundary (ALA).

CAKR

Noatak Quad: Igisukruk Mtn., vicinity of peak, 67°08'N, 162°54'W, 140–262 msm, scattered forbs on unstable limestone scree, Parker and Solstad, 14567, 11 July 2003.

GAAR

Survey Pass Quad: Nahtuk R., confluence with Alatna R., 67°25'N, 153°43'W, 325 msm, gravel spit bars of Nahtuk Cr., Murray 3755, 24 June 1973.

Survey Pass Quad: N end of Walker Lake, 67°10'N, 154°30'W, 458 msm, damp sand on steep bank of lake, Smith 2450, 14 July 1954.

Wiseman Quad: Endicott Mts., Whiteface Mtn., SW flanks, 67°47'N, 150°29'W, 730 msm, steep alpine slopes, *Dryas* heath, schist screes and fines, mica-rich acidic bedrock, growing on mud flow, rare, Parker et al. 12639, 25 July 2002.

KOVA

Ambler River Quad: Kobuk R., below Ahnewetut Cr. mouth, S bank of river, 67°10'N, 158°50'W, 35 msm, sand-silt-gravel bar, moist bank under willows and herbs, Parker 8164, 24 July 1998.

NOAT

Baird Mountains Quad: Central Noatak R. valley, mouth of Kugururok R., 1 km downstream of mouth, 67°59'N, 161°55'W, 85 msm, mature white spruce forest, old meander, open shrub-herbaceous vegetation, Parker et al. 15322, 29 July 2003.

Minuartia biflora (L.) Schinz & Thell. G5S3S4

Individual plants of this tiny sandwort are very small and may be growing separately, or collectively form small mats. The flat leaves, smooth-coated seeds, and one to two flowered stems help distinguish this species from other small *Minuartia* spp. *Minuartia biflora* has a northern circumpolar distribution and is found throughout Alaska in widely spaced localities, frequently growing in open microsites in the alpine and occasionally at low elevations.

Previous collections exist from the Killeak Lakes in BELA. In GAAR, we documented *M. biflora* at Chandler Lake on the north side of the Brooks Range and at Fritts Mountain in the Angayucham Mountains. In NOAT, we collected it at Inaccessible Ridge in the DeLong Mountains. In BELA, we found it along the north arm of Shishmaref Inlet. Our collections from GAAR and NOAT are first records for those park units.

After our last I&M field season, the ranking for *Minuartia biflora* in Alaska has gone from S2 to S3–S4 due to the large number of new localities recently documented.

BELA

Kotzebue Quad: Killeak Lakes, southernmost lake, 66°20'N, 164°7'W, beneath shrubs, Murray et al. 11036, 24 July 1992.

Kotzebue Quad: Killeak Lakes, southernmost lake, along outlet creek, 66°20'N, 164°7'W, gravel slope, Murray et al. 11060, 25 July 1992.

Kotzebue Quad: Cowpack Inlet lagoon, N arm of Shishmaref Inlet, vicinity of Singeak (Sinik) settlement site, 66°32'N, 164°41'W, 1 msm, low energy beach and brackish marsh, growing in small cut bank above beach near animal burrow, Parker et al. 11177, 7 August 2001.

GAAR

Hughes Quad: Angayucham Mts., Fritts Mtn., N-facing alpine cirque N of summit, 66°55'N, 155°31'W, 700 msm, snowbeds, screes and rocky heath, igneous substrate, growing in snowbed, Parker et al. 13490, 4 August 2002.

Chandler Lake Quad: Chandler Lake, E shore, 68°12'N, 152°41'W, 900–1,200 msm, silt-gravel bars and cutbanks of older terraces, growing in late-lying snowbed sites, Parker et al. 12511, 22 July 2002.

NOAT

Misheguk Mountain Quad: DeLong Mts., Inaccessible Ridge, Kagvik Cr. headwaters, vicinity of gap, 68°29'N, 161°48'W, 480–700 msm, braided floodplain of small stream,

growing on older terrace with open *Dryas*-shrub *Salix* vegetation, on game trail, Parker & Beattie 11855, 4 July 2002.

Minuartia yukonensis **Hultén G4S3**

= *Arenaria laricifolia* sensu Hultén

This sandwort is distinguished from two similar appearing species in the northern flora, *M. arctica* and *M. obtusiloba*, by having very sharp, pointed leaf tips. Under the current treatments (Rabeler et al. 2005), it has an east Beringian distribution, extending southward to British Columbia, Canada. In Alaska, *M. yukonensis* is found on dry, open, rocky slopes and ridges at all elevations in the Yukon-Tanana uplands and the north slope of the Alaska Range.

Previously documented northern localities at ALA include the upper Sheenjek River valley, southeast of GAAR, and Imiaknikpak Lake on the Killik River, just north of the GAAR boundary. We documented *Minuartia yukonensis* at 2 sites along Seluiak Bluff in the central Noatak River valley in NOAT. Our collections represent a minor northwestward range extension for the species and a new record for NOAT and for ARCN.

NOAT

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, upstream end of bluff, vicinity E of VABM Windy, 67°58'N, 161°37'W, 100–150 msm, cobble-gravel river bars and gabbro outcrops, growing on turf on outcrops, Parker et al. 15186, 26 July 2003.

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, upstream end of bluff and VABM Windy, N bank of river, 67°58'N, 161°37'W, 100–150 msm, dry limestone knoll, scattered open vegetation of forbs and shrubs growing on rubble slope, Parker et al. 15218, 27 July 2003.

Stellaria alaskana **Hultén G3S3**

This small chickweed is slightly fleshy in texture and has flat, dull leaves that are often clustered near the stem base. The plant usually bears a single flower at the tip of an elongated pedicel. *Stellaria alaskana* is endemic to east Beringia and is found on screes, moraines, and other rock-dominated alpine habitats. Most known localities are from the Alaska Range and southwestern Yukon, Canada.

Our collection of *S. alaskana* was growing on Chimney Mountain in the Endicott Mountains within GAAR and is the first record for both the park unit and ARCN. It represents a minor range extension westward of the only other documented Brooks Range localities at Wiseman and in Atigun Pass along the Dalton Highway (ALA).

GAAR

Wiseman Quad: Endicott Mts., Chimney Mt., N flank, 67°45'N, 150°31'W, 730–1,134 msm, alpine heath, schist screes, and exposed ridges, mica-rich acidic rock, growing in scree, Parker et al. 12572, 24 July 2002.

***Stellaria dicranoides* (Cham. & Schltdl.) Fenzl G3S3**

= *Arenaria chamissonis* Maguire

= *Arenaria dicranoides* (Cham. & Schltdl.) Hultén

= *Cherieria dicranoides* Cham. & Schltdl.

This amphi-Beringian endemic forms pulvinate cushions in open rocky habitats. The tiny pale flowers are barely visible, but the dense, yellow-green cushions are conspicuous (Figure 5.4). *Stellaria dicranoides* is known from many scattered localities, ranging from the Alaska Peninsula and Alaska Range northward to the Arctic Foothills. It is also known from the eastern tip of Chukotka, Russia.

Previous collections from NOAT are from Feniak Lake and the Mulik Hills. A single GAAR record exists from Kipmik Lake in the upper Noatak River valley. A collection is known from just east of GAAR near Grayling Lake (ALA). *S. dicranoides* is also documented from the Minnie Creek headwaters in BELA.

We documented *S. dicranoides* from CAKR in both the Kakagrak Hills and the Igichuk Hills. In KOVA, we collected it from the headwaters of the Salmon and the Akillik rivers. Both of these collections represent new records for their respective park units. In NOAT it was found in the Hugo Creek headwaters, near Inaccessible Ridge, and on the south shore of Desperation Lake.

Figure 5.4. Stellaria dicranoides *forms a tiny dense cushion with inconspicuous pale green flowers covering the surface. It is usually found growing in rocky alpine habitats.* S. dicranoides *was collected from each ARCN park unit. Photo taken in the Nulato Hills of western Alaska.*

BELA

Bendeleben Quad: Minnie Cr. headwaters, Minnie Cr.-Boston Cr. divide, 65°20'N, 163°38'W, marble rubble, Murray et al. 11563, 16 July 1993.

CAKR

Noatak Quad: Kakagrak Hills, vicinity "radio tower" airstrip, 67°16'N, 163°40'W, 100–262 msm, *Dryas* fellfield ridgetops and slopes, poorly developed frost circles and stripes, limestone substrate, Parker et al. 10225, 26 June 2001.

Noatak Quad: Igichuk Hills, Kaksurok Mtn., N side of mountain, 67°13'N, 163°13'W, 200–240 msm, small N-facing limestone valley, growing in *Dryas* heath, Parker et al. 14828, 14 July 2003.

GAAR

Ambler River Quad: Kipmik Lake, 67°57'N, 156°9'W, mountain to S of lake, Young 4784, 22 July 1973.

KOVA

Baird Mountains Quad: Baird Mts., Salmon R. headwaters, ca. 6 km NW of Mt. Angayukaqsraq, 67°45'N, 159°30'W, 610–900 msm, *Dryas* fellfield on carbonate bedrock, shallowly N-facing alpine slope, Parker and Fowell 11330, 24 June 2002.

Ambler River Quad: Baird Mts., upper Akillik R. valley, 67°31'N, 158°3'W, 450–556 msm, S-facing carbonate screes with scattered *Dryas* stripe vegetation, Parker et al. 11453, 25 June 2002.

NOAT

Noatak Quad: Mulik Hills, lower Noatak valley, 67°10'N, 162°19'W, limestone barrens, Young 4001, 17 June 1973.

Howard Pass Quad: Noatak R. valley, Feniak Lake, 68°15'N, 158°20'W, fellfield, serpentines, Murray 6894, 26 July 1978.

Howard Pass Quad: Noatak R. valley, Feniak Lake, near outlet of Makpik Cr., 68°15'N, 158°20'W, beach ridges near outlet, Young 4588, 9 July 1973.

Howard Pass Quad: DeLong Mts., Desperation Lake, S shore, E of outlet of Uivaksak Cr., 68°20'N, 158°47'W, 400 msm, lake shore gravel beach ridges, active beach gravels and adjacent ancient, sparsely vegetated ridges, growing among small *Dryas* patches on older beach surface, Parker & Meyers 10568, 7 July 2001.

Misheguk Mountain Quad: DeLong Mts., Inaccessible Ridge, Kagvik Cr. headwaters, 68°29'N, 161°48'W, 480–760 msm, rocky *Dryas* fellfield on SE-facing limestone and shale scree, Parker & Beattie 11770, 3 July 2002.

Noatak Quad: Hugo Cr. headwaters, 67°18'N, 162°19'W, 230–360 msm, alpine limestone slopes, *Dryas* heath and meadows, growing in snowbed meadow, Parker et al. 14928, 16 July 2003.

Stellaria umbellata **Turcz. G5S2S3**

This delicate chickweed is often low growing and entangled with other plants, hence easily overlooked. It is distinctive from similar *Stellaria* spp. in having a subumbellate inflorescence subtended by several basal bracts. *S. umbellata* is found in widely scattered localities across western North American and eastern Asia, including Russia. It usually grows in moist, sheltered, herbaceous microsites.

S. umbellata has been documented previously from the Killeak Lakes in BELA. Additional locations known within Alaska include the Wrangell Mountains, Chugach Mountains, Alaska Range, Yukon-Tanana uplands, Arctic Foothills, and Ogotoruk Creek near Point Hope (ALA). During this inventory, the first GAAR records for *S. umbellata* were collected on Fritts Mountain in the Angayucham Mountains and on Castle Mountain in the Arctic Foothills.

BELA

Kotzebue Quad: Killeak Lakes, southernmost lake, 66°20'N, 164°7'W, gully, Murray et al. 11038, 24 July 1992.

GAAR

Hughes Quad: Angayucham Mts., Fritts Mt., N-facing alpine cirque N of summit, 66°55'N, 155°31'W, 700 msm, snowbeds, screes and rocky heath, igneous substrate, growing in snowbed, Parker et al. 13510, 4 August 2002.

Hughes Quad: Angayucham Mts., Fritts Mt., N-facing alpine cirque NE of summit, 66°56'N, 155°29'W, 550–600 msm, mesic creek bank meadows, heath, and rocky knolls, igneous substrate, growing in lush meadows along creek, Parker and Guldager 13884, 7 August 2002.

Chandler Lake Quad: Arctic Foothills, Castle Mtn., northern ridge of summit area, 68°34'N, 152°35'W, 700–1070 msm, alpine *Dryas* heath, cliffs, scree and meadows along drainages, growing on moist soil along creek, Parker et al. 12923, 30 July 2002.

Chenopodiaceae

Corispermum ochotense **Ignatov**

var. *alaskanum* Mosyakin G3G4T?QS2?

This small chenopod is known best from the type locality vicinity along the Kobuk River in KOVA where it was first collected by C. Schweger in 1967 (ALA). It is distinguished from var. *ochotense* based on its having larger fruits (Mosyakin 1995). The exact type locality is uncertain; the label reads "Onion Portage, Upper Kobuk River . . . in sand dunes," yet there are no active dunes at Onion Portage. The collector may have been downstream of Onion Portage, on any of the small active dunes between there and the Hunt River mouth. Since this first type collection, *C. ochotense* var. *alaskanum* has been found only in KOVA at additional sites along the Kobuk River, and from a single site near Fairbanks, Alaska.

KOVA

Ambler River Quad: Kobuk R. valley, Onion Portage, 67°7'N, 158°18'W, in sand dunes, open site, deep root, annual, Schweger 196, 10 August 1967. [Holotype, annotated as ssp. *alaskanum* even though this taxon was published as var. *alaskanum*].

Ambler River Quad: Hunt R. dunes, Kobuk R. valley, S side of Kobuk R., opposite mouth of Hunt R., 67°12'N, 158°37'W, weedy annual, low abundant plant covering sand surface of dunes, Racine 731, 12 August 1974. [Paratype, annotated as ssp. *alaskanum* even though this taxon was published as var. *alaskanum*].

Baird Mountains Quad: Pt. Goldie, Kobuk R., 67°6'N, 159°44'W, weedy annual, forming dense stands on sandy river bar, Racine 732, 2 August 1974. [Paratype, annotated as ssp. *alaskanum* even though this taxon was published as var. *alaskanum*].

Ambler River Quad: Hunt R. dunes, Kobuk R. valley, 67°12'N, 158°37'W, growing on sand dunes, Lipkin 84–49, 21 July 1984.

Baird Mountains Quad: Kallarichuk R. mouth, Kobuk R. valley, 67°5'N, 159°47'W, sparsely vegetated gravel bar, scattered in fine sand with cobbles, Lipkin 84–77, 27 July 1984.

Ambler River Quad: Kobuk R., above Kavet Cr. mouth, N bank of river, 67°9'N, 158°58'W, 35 msm, sand-silt-gravel bar, growing on dry, exposed gravel, Parker 8166, 24 July 1998.

Cyperaceae

Carex deflexa Hornem. G5S1S2

This small sedge is similar in appearance and closely related to *Carex rossii,* which has the same North American distribution and habitat preferences: mesic to dry open vegetation. However, *C. deflexa* is readily distinguished from *C. rossii* by its longer perigynia beak, longer curved culms, and more slender rhizome.

Previous known localities include the Tok area in Alaska, and several sites in central and southern Yukon Territory, Canada (ALA). *C. deflexa* is also reported from Sourdough Creek in the central western Yukon-Tanana uplands (Gjærevoll 1958, collections at TRH). Our collection of *C. deflexa* from Reed River Hot Springs in GAAR represents a major northward range extension from the southwestern Yukon-Tanana uplands and is a first record for both GAAR and ARCN.

GAAR

Survey Pass Quad: Schwatka Mts., Reed Hot Springs, Reed R. valley, 67°16'N, 155°3'W, 245 msm, dry herbaceous meadows adjacent to hot springs, Parker et al. 13637, 5 August 2002.

Carex heleonastes Ehrh. G4S2

This tall slender wetland sedge has a broad boreal circumpolar distribution but remains rare in Alaska. It may be easily overlooked, being similar in overall appearance to several other wetland *Carex* species having small sessile spikes clustered toward the top of the culm.

A few specimens are documented from the central Alaska Range. Our collection of *Carex heleonastes* from Nutuvukti Lake in southern GAAR is a first record for both the park unit and for ARCN.

GAAR

Survey Pass Quad: Nutuvukti Lake, NW end of lake, 67°2'N, 154°45'W, 210 msm, well-developed oligotrophic bog and small lake, low tussocks, Parker et al. 13584, 5 August 2002.

Carex holostoma Drejer G4?S2

This stiff, angle-stemmed sedge is superficially similar to a few other northern species, so could be easily missed. Its most distinguishing feature is the positioning of the terminal staminate spike which is essentially hidden within a cluster of two to three larger, erect pistillate spikes. *Carex holostoma* grows in mesic to moist sites in open vegetation such as bogs, retreating lake shores, frost boil tundra, and sedge meadows. It has a circumpolar northern boreal distribution with several widely scattered known localities.

Previous inventories have recorded *C. holostoma* from Killeak Lakes and Kuzitrin Lake in BELA. Additional known sites in Alaska include Quartz Creek on the Seward Peninsula (south of BELA), and the Kavik River airstrip and Demarcation Bay in northeastern Alaska (ALA). We documented *C. holostoma* west of Espenberg Spit in BELA, at Desperation Lake and the upper Kugururok River valley in NOAT, and at Sheshalik Spit in CAKR. Our collections from NOAT and CAKR are first records for these park units (Figure 5.5).

BELA

Kotzebue Quad: Killeak Lakes, southernmost lake, 66°20'N, 164°7'W, bog, Murray et al. 11063, 25 July 1992.

Bendeleben Quad: Kuzitrin Lake, W end of lake, 65°23'N, 163°14'W, bog, Murray et al. 11159, 29 July 1992.

Kotzebue Quad: Cape Espenberg, mouth of Espenberg R., E side of river, 66°36'N, 163°54'W, 2–8 msm, active and ancient dune ridges and swales, mesotrophic peaty marsh on older dunes, Parker et al. 14396, 4 July 2003.

CAKR

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing in freshwater sedge meadow, Parker et al. 10936, 31 July 2001.

Figure 5.5. Carex holostoma *growing near the Espenberg River (BELA) in moist turf that is slightly elevated above a wet meadow. The pale narrow male spike is tucked in among the two to three darker female spikes, a trait distinguishing it from similar looking sedges.*

NOAT

Howard Pass Quad: DeLong Mts., Desperation Lake, N shore, E of outlet of Uivaksak Cr., 68°20'N, 158°44'W, 417 msm, ancient alluvial fan and beach ridges, growing in moist to wet sedge-grass meadow with scattered gravel frost boils, Parker & Meyers 10748, 13 July 2001.

Misheguk Mountain Quad: DeLong Mts., upper Kugururok R. valley, lakes 4 km SE of Kingavaksak Mt., 68°25'N, 161°13'W, 325 msm, retreating lake margin, open herb-sedge meadow, mud and cobble substrate, Parker & Beattie 11993, 7 July 2002.

Carex lapponica Lang. G4G5S2

This slender wetland sedge has a broad northern circumpolar distribution but is known from only a few widely scattered localities across central Alaska to the Seward Peninsula.

Carex lapponica could easily be overlooked among other wetland sedges having small sessile spikes and may be under-collected.

A single previous collection exists from Onion Portage in KOVA. Our collection from Lake Selby is a new record for GAAR and a minor range extension northeast of the KOVA record.

GAAR

Hughes Quad: Anagaycham Mtns., Lake Selby, NE shore of lake, 66°52'N, 155°39'W, 155 msm, open mixed boreal forest and shrub thickets, growing in wet *Spagnum*-sedge-shrub bog, Parker et al. 13983A, 8 August 2002.

KOVA

Ambler River Quad: Kobuk R. valley, Onion Portage, 67°6'N, 158°15'W, tundra, wet lake margin, organic soils, Schweger 149, 24 July 1967.

Eleocharis kamtschatica (C. A. Mey.) Kom. G4S2S3

This spike-rush is found in northern North America and the Russian Far East. *Eleocharis kamtschatica* commonly grows in tidal marshes and mud flats along the coast from southeastern Alaska to Unalakleet. It is distinguished from similar-appearing *Eleocharis* species by its bright wine-red stem bases and, in mature plants, a large tubercle positioned on the summit of the achene (fruit). Mature plants are needed for confident identification.

Two specimens have been collected from wet semistabilized sand at Great Kobuk Sand Dunes in KOVA. Given the annotation comment noted below, and the fact that both specimens are located far inland, in contrast to the more typical coastal habitat observed for the species, we should be cautious in declaring we have *E. kamtschatica* occurring in KOVA, equivalent to the species as otherwise recognized in Alaska.

KOVA

Ambler River Quad: Kobuk R. lowlands, Great Kobuk Sand Dunes, 67°4'N, 158°54'W, wet, semistablized sandy flat, Racine 800, 20 August 1974.

Ambler River Quad: Kobuk R. lowlands, Great Kobuk Sand Dunes, 67°4'N, 158°54'W, wet areas near spring, Lewis s.n., 6 August 1976.

Note: The specimen collected by Lewis has been reviewed by S. Galen Smith (U. of Wisconsin) who describes this material as being "possibly intermediate with *E. uniglumis?* … having intermediate [-sized] tubercles" (annotations on ALA specimens, 1997, 2000).

Eriophorum viridicarinatum (Engelm.) Fern. G5S2

This slender, multiheaded cotton grass has a central to northern North American distribution. *Eriophorum viridicarinatum* grows in wet peat bogs and meadows, often together with *E. angustifolium* and *E. gracile*, which have a similar overall appearance. A prominent midvein that extends to the tip of infloresence scales and a relatively slender appearance are the best characters distinguishing *E. viridicarinatum* from other multiheaded cotton grasses.

Previously documented locations in Alaska include the Anchorage area, Kenai Peninsula, Kodiak Island, and southeastern Alaska (ALA). It is also reported from southern Yukon Territory, Canada (Cody 1996). Our specimen of *E. viridicarinatum* from Nutuvukti Lake in GAAR represents a major northward range extension from the Cook Inlet lowlands at the south side of the Alaska Range. It is also a first record for both GAAR and ARCN.

GAAR

Survey Pass Quad: Nutuvukti Lake, NW end of lake, 67°2'N, 154°45'W, 210 msm, well-developed oligotrophic bog and small lake, growing in wet hollows, Parker et al. 13615, 5 August 2002.

Fabaceae

Lupinus kuschei Eastw. G3S2

= *Lupinus jacob-andersonii* C. P. Sm.

This east Beringian endemic has a fragmented distribution, ranging from the northwestern corner of British Columbia to Great Kobuk Sand Dunes in KOVA. It is also known from the sand dunes at Carcross, Yukon, where it was first described. It is distinguished from *Lupinus arcticus*, which is found throughout Alaska, by having silvery-pilose hairs on both leaflet surfaces, having a semidecumbent growth form, and occasionally branched flowering stems. In Alaska, *L. kuschei* is known from the Sanford River in the Wrangell Mountains (WRST), Nogahabara Dunes in the Koyukuk River Lowlands (Koyukuk NWR), the Kugarak River headwaters east of the Waring Mountains (Selawik NWR), and from both Great and Little Kobuk Sand Dunes in the Kobuk River valley (KOVA). At all these localities, it grows in semistable to active aeolian sand deposits, dunes, and dune blowouts.

L. kuschei was first collected, but misidentified as *L. arcticus*, at Great Kobuk Sand Dunes (KOVA) in 1973 (Racine 1976, ALA). During a later survey it was correctly identified (Parker and Mann 1999).

It has been suggested that *L. kuschei* originated as a hybrid between *L. arcticus* and *L. sericeus* in northern British Columbia where both species are found (Dunn and Gillett 1966). Some specimens from northwestern Alaska show traits intermediate between *L. kuschei* and *L. arcticus*. However, other specimens in this same region seem to fit the full description for *L. kuschei*. This suggests that some introgression may be occurring between the two species wherever they overlap.

Our I&M inventory did not visit the dunes, nor did we locate any additional localities for the species in KOVA.

KOVA

Ambler River Quad: Great Kobuk Sand Dunes, vicinity Ahnewetut Cr., 67°6'N, 158°50'W, 65 msm, moist open sand sheet at edge of active dunes, Parker and Lipkin 8100, 14 July 1998.

Ambler River Quad: Little Kobuk Sand Dunes, 67°1'N, 158°18'W, 65 msm, growing in open, active sand sheets, infrequent, Parker and Batten 8199, 30 July 1998.

Ambler River Quad: Great Kobuk Sand Dunes, 67°1'N, 158°54'W, sandy interdune area, Lewis s.n., 6 August 1976.

Ambler River Quad: Great Kobuk Sand Dunes, Ahnewetut Cr., 67°2'N, 158°52'W, large dune, gentle windward slope, Melchior 801, 16 September 1973.

Oxytropis arctica R. Br. var. *barnebyana* Welsh G4TS2

= *O. sordida* (Willd.) Pers. ssp. *barnebyana* (Welsh) Yurtsev

This creamy white oxytrope is endemic to northern Alaska and was first described from Kotzebue (Welsh 1968). It grows on rocky or gravelly substrates in open vegetation such as screes and alluvial floodplains. A recent phylogenetic study was not able to resolve the taxonomic relationship among *Oxytropis arctica* var. *barnebyana* and its suspected close relatives in the *O. campestris* and *O. arctica* species complexes (Jorgensen et al. 2003). When encountered in the field, however, this taxon seems clearly distinctive with its large creamy white flowers, purple-dotted keel, and relatively robust appearance (Figure 5.6).

O. arctica var. *barnebyana* had been previously collected on older floodplain terraces in the North Fork Squirrel River valley and from the Kotzebue area. In NOAT, it has been collected from two sites in the central Kugururok River valley (ALA). A single specimen has been collected along the Kitluk River in BELA.

Our I&M inventory collections of *O. arctica* var. *barnebyana* extend its known range approximately 40 km northwest in CAKR where it was growing in the Igichuk Hills along the Situkuyok River. This was a first record for CAKR. In NOAT, we found *O. arctica* var. *barnebyana* at Inaccessible Ridge and at two localities along the upper Anisak River, representing a moderate range extension of 120 km to the northeast.

Figure 5.6. Oxytropis arctica *var.* barnebyana *growing above Primus Creek, west of Desperation Lake, in the DeLong Mountains (NOAT). Large creamy white flowers with purple dots on their keels make this plant very attractive and conspicuous in the vegetation.*

BELA

Kotzebue Quad: Kitluk R., 66°34'N, 164°25'W, 3 msm, dry sandy river floodplain, Wright 51, 12 July 1977.

CAKR

Noatak Quad: Igichuk Hills, Mt. Noak, western flanks above middle Situkoyok R. valley, 67°11'N, 163°8'W, 65 msm, older gravel bars along river, scattered forbs in open vegetation, Parker et al. 14766, 14 July 2003.

NOAT

Misheguk Mountain Quad: Kugururok R., 68°8'N, 161°42'W, 244 msm, growing on S-facing slope of old stream terrace at margin of white spruce woodland, rocky silt loam with *Dryas integrifolia*, *Arnica alpina*, petals creamy white, Meyers 93–2, 20 June 1993.

Misheguk Mountain Quad: Kugururok R., 68°9'N, 161°46'W, 640 msm, growing at summit of small alpine meadow, SE-facing slope, in steep scree with stripes, in rocky silt loam, Meyers 93–1, 19 June 1993.

Howard Pass Quad: Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, hills and alluvial terraces N of confluence, 68°23'N, 158°51'W, 400–670 msm, S-facing limestone outcrops, lush heath-herbaceous vegetation growing on and surrounding outcrops, Parker & Meyers 10662, 10 July 2001.

Misheguk Mountain Quad: Anisak R. valley, central area, NW of Avingyak Hills, 68°17'N, 159°2'W, 275–425 msm, prominent limestone knob above floodplain, rocky *Dryas*-heath tundra with scattered shrubs, growing on SE-facing limestone talus, Parker & Meyers 10714, 12 July 2001.

Misheguk Mountain Quad: Inaccessible Ridge, Kagvik Cr. headwaters, 68°29'N, 161°48'W, 480–760 msm, rocky *Dryas* fellfield on SE-facing limestone and shale scree, Parker and Beattie 11768, 3 July 2002.

Oxytropis kobukensis Welsh G2S2

This purple-flowered oxytrope is endemic to the immediate vicinity of the Kobuk Valley sand dune complex. It was first described from a specimen collected in 1938 from the Hunt River Dunes, a small dune field along the Kobuk River directly opposite the Hunt River mouth (Welsh 1967). It is readily distinguished from other oxytropes with its dark purple, pilose stipules, a character that persists in cultivated plants (H. McIntyre, IAB, pers. comm.). It grows in active to stabilized sand dunes in association with other widely scattered herbs. *Oxytropis kobukensis* is frequently very abundant, forming large patches in these habitats (Figure 5.7).

In addition to the first known locality at Hunt River dunes, *O. kobukensis* is also documented from both Great and Little Kobuk Sand Dunes, from along the Kobuk River at VABM Bluff, and from the mouth of Niaktuvik Creek, approximately 6 km upstream of Hunt River Dunes.

Figure 5.7. Oxytropis kobukensis *is known only from the active and semiactive dunes in the Kobuk River valley (KOVA). The purple pubescent stipules, evident at lower right, are distinctive for the species.*

O. kobukensis was not collected during our inventory, although it was watched for on the gravel bars in the immediate vicinity of Onion Portage along the Kobuk River. Listed below is the label information from five of the 23 specimens now held at ALA. These represent the known range and habitats of *O. kobukensis*, which currently is only known from the Kobuk River valley within KOVA.

KOVA

Ambler River Quad: Great Kobuk Sand Dunes, E of Ahnewetut Cr., 67°6'N, 158°50'W, 65 msm, growing in sparsely vegetated dry sand slack between dunes, with *Calamagrostis purpurascens, Festuca rubra*, common, Parker 7689, 20 August 1997.

Ambler River Quad: Hunt R. dunes, Kobuk R. valley, 67°12'N, 158°37'W, 60 msm, sparsely vegetated active sand dunes, Hunt 43A, 5 July 1994.

Baird Mountains Quad: Kobuk R. valley, Great Kobuk Sand Dunes, NW portion of dunefield, 67°6'N, 159°1'W, 60 msm, sparsely vegetated active sand dunes, inner dune area, Hunt 46B, 5 July 1994.

Ambler River Quad: Kobuk R. valley, Paungaq Taugruk (VABM Bluff), across river from bluffs, 67°11'N, 158°30'W, growing in *Dryas*-heath on stabilized sand dune, lavender to light pink flowers, Lipkin 84–47, 19 July 1984.

Ambler River Quad: Kobuk R. valley, Niaktuvik Cr., just N of mouth of creek, 67°10'N, 158°24'W, growing on semivegetated sand dunes with cottonwood, shrub willow, forbs, Lipkin 84–43, 19 July 1984.

Ambler River Quad: Kobuk R. valley, Little Kobuk Sand Dunes, 67°1'N, 158°18'W, 65 msm, growing on active sand sheet, frequent to common, Parker and Batten 8196, 30 July 1998.

Oxytropis kokrinensis A. E. Porsild G3S3

An Alaska endemic, this oxytrope was first described in 1939 from the Kokrines Hills in central interior Alaska (Porsild 1939). Additional localities now documented include the Ray Mountains, the Buckland River, the Selawik Hills, and scattered sites in the central to western Arctic Foothills and Brooks Range. *Oxytropis kokrinensis* is identified from other oxytropes by having the combined traits of a dwarf, cushion growth form, very broad mature pods, and deep reddish-brown stipules.

Previous records of *O. kokrinensis* are reported from the Jade Mountain area in KOVA (M. Britten, 1984, NPSpecies database) and from the Kugururok River and Howard Pass area in NOAT (Wiggins and Thomas 1962). Steve Young cites it from Lake Kipmik in GAAR, although no specimen has been located (Young 1974b). Our single specimen from GAAR was collected in the Lockwood Hills and represents both a new documented record for the park unit and a minor eastward range extension. In NOAT, we collected *O. kokrinensis* in the upper Anisak River valley. Our three collections from KOVA came from the Salmon River headwaters, the Nuna Creek valley, and the Akillik River valley.

GAAR

Hughes Quad: upper Kobuk R. valley, Lockwood Hills, 66°40'N, 155°21'W, 620–730 msm, exposed ridges, S and W-facing *Dryas* heath slopes, screes and shrub thickets, growing on exposed *Dryas* heath, Parker et al. 13772, 6 August 2002.

KOVA

Baird Mountains Quad: Baird Mts., Salmon R. headwaters, ca. 5 km N of Mt. Angayukaqsraq, 67°44'N, 159°26'W, 640–730 msm, rocky *Dryas* tundra with scattered outcrops and screes, acidic bedrock, Parker et al. 11397, 24 June 2002.

Ambler River Quad: Baird Mts., lower Nuna Cr. valley, ridge crest N of lower Nuna Cr., 67°17'N, 158°16'W, 500 msm, gentle S-facing slope, *Dryas* fellfield, Parker et al. 11712, 29 June 2002.

Ambler River Quad: Baird Mts., Akillik R. valley, ridge crest SE of valley, vicinity VABM Nuna, 67°19'N, 158°8'W, 550–610 msm, S-facing platey phyllite scree with scattered forbs, Parker & Fowell 11764, 29 June 2002.

NOAT

Howard Pass Quad: DeLong Mts., Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, hills and alluvial terraces N of confluence, 68°23'N, 158°51'W, 400–670 msm, S-facing, moist, snowmelt meadow on limestone-igneous rock contact, Parker & Meyers 10674, 10 July 2001.

Oxytropis tananensis Yurtzev G2G3QS2S3

This bright yellow oxytrope was first described from a xeric steppe bluff above the Tanana River in interior Alaska (Yurtsev 1993). It is distinguished from other closely related oxytropes in having highly verticillate leaflets. A subsequent review of herbarium speci-

mens at ALA by Boris Yurtsev revealed additional occurrences for the species near Shaw Creek, Fairbanks, the Gerstle River, and the Porcupine River, all in eastern interior Alaska; and at Carmacks in Yukon, Canada. At all localities it was found growing in dry, open habitats such as steppe bluffs, gravel floodplains, and sand dunes. *Oxytropis tananensis* belongs to the poorly understood *O. campestris* species complex, and future study could modify the taxonomy of the entire group.

Our specimen of *O. tananensis* was reviewed and annotated by Boris Yurtsev (LE) in 2002. This first ACRN record was found in the central Anisak River valley in NOAT and represents a major range extension of approximately 600 km to the northwest (Figure 5.8).

Figure 5.8. Oxytropis tananensis *growing on a southeast-facing limestone rubble slope along the Anisak River (NOAT). Bright yellow flowers and verticillate leaflets separate this species from other oxytropes in the region. Its occurrence here represents a major range extension from central interior Alaska.*

NOAT

Misheguk Mountain Quad: Anisak R. valley, central area, NW of Avingyak Hills, 68°17'N, 159°2'W, 275–425 msm, prominent limestone knob above floodplain, rocky *Dryas*-heath tundra with scattered shrubs, growing on SE-facing limestone talus with scattered forbs, Parker & Meyers 10717, 12 July 2001.

Gentianaceae

Gentianopsis detonsa (Rottb.) Ma G3G4T?S1

= *Gentiana detonsa* Rottb.

This handsome deep blue gentian is known from a few widely scattered circumpolar arctic localities, including Scandinavia, Russia, Greenland, and Canada. In Alaska, it is only known from the Kotzebue Sound area.

The population we visited in CAKR was growing in a low-energy inner lagoon on the inside of Sheshalik Spit. Here *Gentianopsis detonsa* was restricted to a shallow depression that is infrequently flooded and usually sheltered by outer lagoon channels from all but the strongest and highest storm surges. This habitat supported a open, sparse, but diverse assemblage of scattered forbs growing in mud and gravels topped by a thin saline crust. Bob Uhl, local summer resident at Sheshalik (Sisualik), has been observing this population of *G. detonsa* for over 30 years. He suggests the highly fluctuating population size and age structure he has recorded over this time correlates with the occurrence of huge winter or spring storms causing flooding of these inner lagoon depressions. Years with

high flooding in the inner lagoon system generally result in fewer plants appearing the following summer. However, the occasional disturbance probably helps maintain the open habitat that this species seems to require (Figure 5.9).

The taxonomic relationship of *Gentianopsis detonsa* of the circumpolar arctic coast with *G. barbata* (sensu Hultén) of interior boreal habitats of northwestern North America and Asia is not fully resolved and needs further study (Gillett 1963, Hultén 1967). These species are similar in appearance and both occur in open, infrequently disturbed habits.

G. detonsa had previously been documented at ALA or recorded from both the tip and the base of Sheshalik Spit in CAKR, the delta of the Noatak River, southward along the Baldwin Peninsula, and at Kiwalik Spit east of Deering (B. Uhl, pers. comm., R. Meyers, pers. comm., ALA). Our collection from CAKR was taken from the same site as an earlier ALA specimen taken by Uhl in 1982.

CAKR

Kotzebue Quad: Sheshalik (Sisualik), mouth of Noatak R., 66°59'N, 162°50'W, Uhl s.n., 25 July 1982.

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162° 57'W, 1 msm, gravel beaches, inner lagoons, and old beach ridges, growing in open, semi-brackish back beach meadow, Parker et al. 10890, 31 July 2001.

Figure 5.9. Gentianopsis detonsa *is found in low-energy lagoons in the Kotzebue Sound area. Plants may range from 3 to 35 cm tall. Long-time Sheshalik resident Bob Uhl, at right, has been monitoring the fluctuations in population size and plant size for many years near his home within CAKR.*

Orchidaceae

Cypripedium parviflorum (Salisb.) Hultén G5S2S3

= *Cypripedium calceolus* L. ssp. *parviflorum* (Salisb.) Hultén

This showy yellow lady slipper orchid inhabits open boreal forests throughout the circumboreal region but is not common in Alaska. Collections at ALA are from the Wiseman area, and within GAAR from Arrigetch Creek and the Alatna River headwaters.

GAAR

Survey Pass Quad: Arrigetch Creek Valley, 67°26'N, 154°5'N, open *Picea glauca* woods, Cooper 1041, 28 June 1980.

Survey Pass Quad: Nahtuk River, confluence with Alatna R., 67°25'N, 153°43'W, dry open spruce forest, edge of S-facing slope, Murray 3762, 24 June 1973.

Survey Pass Quad: Nahtuk River, confluence with Alatna R., 67°25'N, 153°43'W, hill above black spruce area, Murphy & Murray 26, 25 July 1973.

Survey Pass Quad: Nahtuk River, confluence with Alatna R., 67°25'N, 153°43'W, slopes, bedrock knolls, moist herb mats, Murray 3727, 22 June 1973.

Papaveraceae

Papaver walpolei A. E. Porsild G3S3

This small poppy is distinctive among northern *Papaver* species in having white (occasionally yellow) flowers and glabrous leaves with revolute margins and only three (rarely two) terminal lobes. A Beringian endemic, it is known from eastern Chukotka, Russia, and western Alaska. In addition, *Papaver walpolei* is curiously disjunct to northeastern Alaska and northern Yukon, Canada (ALA, Porsild 1972). *P. walpolei*, like many *Papaver* species, is usually found growing in rocky, sparsely vegetated habitats, often on limestone substrate.

Several localities for *P. walpolei* had been previously documented in the southern portion of BELA, in the Mulik Hills in NOAT, and along the Salmon River in KOVA. Our inventory collected it at three localities in CAKR: the Kakagrak Hills, Kaksurok Mountain and Mt. Noak. These were the first records for CAKR. We also collected *P. walpolei* in the Hugo Creek headwaters in western NOAT and from the Salmon River headwaters in northern KOVA.

BELA

Bendeleben Quad: Eldorado Cr., 65°42'N, 164°23'W, dry calcareous slope, Murray et al. 10657, 11 July 1992.

Bendeleben Quad: Minnie Cr. headwaters, 65°20'N, 163°38'W, SW-facing slope, patchy *Dryas* tundra, near tor, Murray et al. 11569, 16 July 1993.

CAKR

Noatak Quad: Kakagrak Hills, vicinity "radio tower" airstrip, 67°16'N, 163°40'W, 100–262 msm, *Dryas* fellfield ridgetops and slopes, poorly developed frost circles and stripes, limestone substrate, Parker et al. 10223, 26 June 2001.

Noatak Quad: Igichuk Hills, Kaksurok Mtn., N side of mountain, 67°13'N, 163°13'W, 200–240 msm, small N-facing limestone valley, growing in *Dryas* heath, Parker et al. 14832, 14 July 2003.

Noatak Quad: Igichuk Hills, Kaksurok Mtn., western flanks of mountain, 67°11'N, 163°8'W, alpine limestone slopes above middle Situkuyok R. valley, Parker et al. 14833, 14 July 2003.

KOVA

Baird Mountains Quad: Salmon R., near headwaters, 67°9'N, 159°27'W, 200 msm, Racine 772, 1 August 1974.

Baird Mountains Quad: Baird Mts., Salmon R. headwaters, ca. 6 km NW of Mt. Angayukaqsraq, 67°45'N, 159°30'W, 610–900 msm, *Dryas* fellfield on carbonate bedrock, shallowly N-facing alpine slope, Parker & Fowell 11331, 24 June 2002.

Ambler River Quad: Baird Mts., upper Akillik R. valley, 67°31'N, 158°4'W, 450–556 msm, *Dryas* fellfield on S-facing carbonate slopes, Parker et al. 11481, 25 June 2002.

NOAT

Noatak Quad: Mulik Hills, Lower Noatak R. valley, 67°10'N, 162°19'W, Young 3977, 17 June 1973.

Noatak Quad: Igichuk Hills, Hugo Cr. headwaters, 67°18'N, 162°19'W, 230–360 msm, alpine limestone slopes, *Dryas* heath and meadows, growing in dry *Dryas*-gravel heath, Parker et al. 14896, 16 July 2003.

Poaceae

X_*Dupoa labradorica* (Steud.) J. Cay. & Darbysh. no ranking

This grass was first described from Hudson Bay and the northeast coast of Labrador, Canada. It is a stabilized hybrid, the result of a hybrid cross between *Poa eminens* and *Dupontia fisheri*, and clearly displays an intermediate morphology and anatomy between these two parent species (Cayouette & Darbyshire 1993). It is restricted to the coastal strand zone where both parent species are found. The spreading rhizomatous growth habit of X_*Dupoa labradorica* helps assure that an individual (genet) resulting from a local, possibly single, hybridization event will persist and effectively spread.

In 2001, we collected X_*Dupoa labradorica* from Sheshalik Spit in CAKR and from the north arm of Shismaref Lagoon in BELA. These were the first records of the hybrid from western North America. In 2003, we documented additional populations from the lower Espenberg River in BELA and near the village of Kotzebue. Additional recently collected Alaska specimens are now known from the head of Goodnews Bay (ALA) and from Hock

Slough in the lower Yukon Delta (ALA). All the Alaska specimens have been reviewed by the original authors of the taxon, and this western range extension will eventually be published (Darbyshire et al. in prog.).

BELA

Kotzebue Quad: Cowpack Inlet lagoon, N arm of Shishmaref Inlet, vicinity Singeak shelter cabin and Kividlo site, 66°32'N, 164°47'W, 1 msm, marshy site in stabilized dunes, growing with *Poa eminens*, Parker et al. 11221, 8 August 2001.

Kotzebue Quad: Cape Espenberg, mouth of Espenberg R., ca. 3 km upriver from mouth E bank, 66°36'N, 163°58'W, 2 msm, inland margin of dune ridges, brackish meadow along drainage from small lake, Parker and Batten 14365, 4 July 2003.

Kotzebue Quad: Espenberg R., ca. 5 km inland from coast, vicinity of channel between river and lagoon to E, 66°34'N, 164°1'W, 2 msm, brackish marsh, small stand, parental species not close by, Parker et al. 14430, 5 July 2003.

Kotzebue Quad: Espenberg R., ca. 5 km inland from coast, W side of river, 66°34'N, 164°1'W, 2 msm, margin of dune system and coastal plain, brackish marsh, growing in vicinity of *Dupontia fisheri* and *Poa eminens*, Parker et al. 14463, 6 July 2003.

CAKR

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing in *Leymus* meadow, Parker et al. 10912, 31 July 2001.

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing in brackish meadow, Parker et al. 10953, 1 August 2001.

Festuca edlundiae S. Aiken, Consaul, & Lefkovitch G3G4S1

This small tufted arctic fescue was described recently from Bathurst Island in the Canadian Arctic Archipelago (Aiken et al. 1995). An extensive review by Susan Aiken of herbarium holdings from the Arctic held at Ottawa, Canada (CAN), Copenhagen, Denmark (C) and St. Petersburg, Russia (LE) has shown the species also occurs (but herbarium specimens had been previously misidentified) from Svalbard, Greenland, and the north coast of the Russian Far East.

Our collections from Chandler Lake in GAAR are the first known records of *Festuca edlundiae* in Alaska and represent a major range "connection" between arctic Canada and northern Russia. These specimens have been reviewed by Reidar Elven (O), who is familiar with the species from Svalbard and Canada. Alerted to watch for this species in Alaska, field botanists will probably find more localities in the future.

GAAR

Chandler Lake Quad: Endicott Mts., Chandler Lake, E shore, 68°12'N, 152°41'W, 900–1200 msm, gentle SW-facing slopes NE of mouth, growing in frost boils, Parker et al. 12485, 22 July 2002.

Chandler Lake Quad: Endicott Mts., Chandler Lake, E shore, 68°12'N, 152°41'W, 900 msm, silt-gravel bars and cutbanks of older terraces, growing on gravel bars, growing with *F. brachyphylla*, Parker et al. 12523, 22 July 2002.

Festuca lenensis Drobov G4G5S3

= *Festuca ovina* L. ssp. *alaskensis* Holmen pro parte

= *Festuca auriculata* Drobov pro parte

This fescue was originally described from the Lena River in Russia and was not recognized as being part of the Alaska flora until the late 1980s (Aiken and Darbyshire 1990). Previously, many herbarium specimens existed but had been misidentified. Blue-green glaucous leaves that are finely hairy is the primary morphological feature distinguishing this grass from other tufted fescues in our flora. *Festuca lenensis* is usually found in dry open habitats, such as S-facing slopes in the subalpine and alpine from the Wrangell Mountains north to the Arctic Foothills in Alaska.

F. lenensis had previously been collected at Lake Kaniksrak in the Killik River valley in GAAR. We collected *F. lenensis* on Castle Mountain, in the Norutak Hills, and in the Lockwood Hills, all in GAAR. *F. lenensis* was also found growing at the base of Ingitkalik Mountain on Krusenstern Lagoon and in the Kakagrak Hills in CAKR. We also found it in the Waring Mountains along the southern border of KOVA. In NOAT, *F. lenensis* was found at Sekuiak Bluff on the Noatak River and in the upper Anisak River valley. These are first records for the species in CAKR, KOVA, and NOAT.

CAKR

Noatak Quad: Krusenstern Lagoon, NE shore, base of Ingitkalik Mt., near Talikoot village site, 67°9'N, 163°31'W, 2–50 msm, scattered forbs on unstable limestone scree, Parker et al. 10461, 1 July 2001.

Noatak Quad: Kakagrak Hills, vicinity "radio tower" airstrip, 67°16'N, 163°40'W, 135–165 msm, limestone barren uplands, *Dryas* heath, Parker et al. 14503, 9 July 2003.

GAAR

Killik River Quad: Kaniksrak, Killik R. valley, 68°11'N, 154°9'W, 600–750 msm, mountain slopes, Murray 4207, 18 July 1973.

Hughes Quad: upper Kobuk R. valley, Lockwood Hills, headwaters of Kokumpat Cr., 66°41'N, 155°50'W, 620–760 msm, alpine ridges with tors and rocky *Dryas*-shrub tundra, growing on drier, rockier sites, Parker and Guldager 13539, 4 August 2002.

Hughes Quad: Upper Kobuk R. valley, Lockwood Hills, 66°40'N, 155°20'W, 620–730 msm, exposed ridges, S and W-facing *Dryas* heath slopes, screes and shrub thickets, growing on acidic rock scree, Parker et al. 13775, 6 August 2002.

Hughes Quad: Norutak Hills, summits and ridges S of lower Kobuk canyon, 66°44'N, 155°41'W, 730–850 msm, *Dryas* heath, meadows, and shrub thickets on acidic bedrock, growing on small screes and gravelly patches, Parker et al. 13902, 7 August 2002.

Chandler Lake Quad: Arctic Foothills, Castle Mtn., middle ridge and summit area, 68°34'N , 152°32'W, 700–1070 msm, alpine slopes, screes, and outcrops, growing on *Dryas* heath and screes, Parker et al. 12698, 28 July 2002.

Chandler Lake Quad: Arctic Foothills, Castle Mtn., southern ridge of massif, 68°34'N , 152°32'W, 700–1070 msm, alpine slopes, valleys, and screes, growing on scree, Parker et al. 12802, 29 July 2002.

Chandler Lake Quad: Arctic Foothills, Castle Mtn., northern ridge of summit area, 68°34'N, 152°35'W, 700–1070 msm, alpine *Dryas* heath, cliffs, scree and meadows along drainages, growing on shale scree, abundant, Parker et al. 12920, 30 July 2002.

NOAT

Howard Pass Quad: DeLong Mts., Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, hills and alluvial terraces N of confluence, 68°23'N, 158°51'W, 400–670 msm, dry, open heath on terrace, growing on small, S-facing ancient cutbank in terrace, Parker & Meyers 10641, 10 July 2001.

Howard Pass Quad: DeLong Mts., Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, 68°23'N, 158°51'W, 400 msm, *Dryas* fellfield slope, growing on nutrient-enriched knob at top of E-facing cutbank, Parker and Meyers 10773, 14 July 2001.

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, vicinity of upstream end of bluff and VABM Windy, N bank of river, 67°58'N, 161°3'W, 100–150 msm, dry limestone knoll, scattered open vegetation of forbs and shrubs growing on rubble slope, Parker et al. 15219, 27 July 2003.

Glyceria pulchella (Nash) Schumach. G5S2S3

This tall wetland grass has a large open panicle and is often found growing at the margins of ponds and small lakes. The range of *Glyceria pulchella* spans across northwestern North America. Within Alaska, it has been found primarily in the interior and southcentral regions (ALA).

The KOVA collections from the Hunt River dunes and Onion Portage represent a moderate northwestern range extension for the species.

KOVA

Ambler River Quad: Kobuk R. valley, Onion Portage, vicinity of archaeological site and Giddings cabin, 67°7'N, 158°18'W, 40 msm, meadow, growing in moist to wet fines of old lake bed, Parker 8184, 28 July 1998.

Ambler River Quad: Kobuk R. valley, vicinity Hunt R. dunes, 67°11'N, 158°38'W, 60 msm, wetlands complex within semistabilized dune complex, dominated by *Equisetum fluviatile* and *Carex utriculata*, Parker et al. 11556, 26 June 2002.

Glyceria striata (Lam.) Hitchc. ssp. *stricta* (Scribn.) Hultén G5T5QS2

This tall manna grass is found throughout boreal North America, but there are only a few records from southern and central Alaska. It was collected as a moderate northern range extension from Kanuti Hot Springs in 1987 (Lipkin and Parker 1995). Our collection at Reed Hot Springs represents an additional moderate range extension to the northwest from the Kanuti area and is a first record for both GAAR and ARCN.

GAAR

Survey Pass Quad: Schwatka Mountains, Reed Hot Springs, Reed R. valley, 67°16'N, 155°3'W, 245 msm, wet herb meadow, associated with hot springs, Parker et al. 13646, 5 August 2002.

Puccinellia vaginata (Lange) Fernald & Weath. G4S1

This low-growing alkali grass is found in brackish and freshwater marshes along the arctic coast of Alaska, Canada, Greenland, and the Russian Far East.

Our specimen from BELA was growing upstream of the Cowpack River mouth in Shismaref Inlet lagoon. In CAKR, we found *Puccinellia vaginata* at the northwest end of Sheshalik Spit. This grass was also found by inventory botanists in the lagoon system south of the village of Kotzebue. These combined collections represent a minor southward range extension within Alaska and are first records for both park units and for ARCN.

BELA

Kotzebue Quad: Cowpack Inlet, lower Cowpack R., E bank of river, ca. 7 km upriver from mouth, 66°22'N, 164°58'W, 2 msm, graminoid meadow at edge of river, growing in mud, Parker et al. 11235, 9 August 2001.

CAKR

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing in brackish gravel beach, Parker et al. 10910, 31 July 2001.

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing on a sandy lagoon beach, Parker et al. 10941, 31 July 2001.

Puccinellia vahliana (Liebm.) Scribn. & Merr. G4S2S3

= *Colpodium vahlianum* (Liebm.) Nevski

This grass is found across most of the circumpolar Arctic, although it is almost absent from Russia. There are southward outlying localities known from southcentral Alaska

and southern Yukon, Canada. It grows in wet, open rocky habitats from the coast up to the alpine. The majority of Alaska specimens held at ALA are from the Beaufort Sea coast. Additional inland collections are from the upper Sheenjek River and Peters Lake, both within the Arctic NWR. *Puccinellia vahliana* has also been documented from the Nutzotin Mountains in northern WRST.

We collected *P. vahliana* at the base of Siniktanneyak Mountain, northwest of Lake Feniak in NOAT. In GAAR, we found *P. vahliana* at the headwaters of Encampment Creek. These are first records for both park units and for ARCN. They also represent minor range extensions southward from the arctic coast within northern Alaska.

GAAR

Chandler Lake Quad: Endicott Mtns., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W, 1,260–1,500 msm, NW-facing gentle seepage slope with open herbaceous vegetation, Parker and Solstad 13393, 29 July 2002.

NOAT

Howard Pass Quad: DeLong Mts., Siniktanneyak Mtn., area just below summit to base of SE flank, 68°19'N, 158°26'W, 540–1,020 msm, boulder slopes, wet seepage meadows, and moist *Dryas* heath, growing in wet rocky meadow, Parker & Meyers 10624, 9 July 2001.

Puccinellia wrightii **(Scribn. & Merr.) Tzvel.** **G3G4S2S3**

= *Colpodium wrightii* Scribn. & Merr.

This grass is a Beringian endemic, known only from Chukotka, Russia, and northwestern Alaska. It grows in moist to wet open alpine meadows.

Previous collections of *Puccinellia wrightii* have been from Kuzitrin Lake and Eldorado Creek within BELA. Additional localities documented at ALA include several sites in the southern portion of the Seward Peninsula. Our collection from the headwaters of Hugo Creek in the Igichuk Hills is a first record for NOAT.

BELA

Bendeleben Quad: Eldorado Creek, 65°42'N, 164°23'W, mesic tundra meadow, Murray et al. 10670, 11 July 1992.

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, N side of mountain, 65°20'N, 163°14'W, valley, Murray et al. 11214, 31 July 1992.

NOAT

Noatak Quad: Igichuk Hills, Hugo Cr. headwaters, 67°18'N, 162°19'W, 230–260 msm, alpine limestone slopes, *Dryas* heath and meadows, growing in lush meadow, seepage, Parker et al. 14862, 16 July 2003.

Schizachne purpurascens (Torr.) Swallen G5S2

This tall showy grass with long-awned spikelets has a North American–East Asian boreal distribution. Within Alaska it is known from a few locations in Southcentral and Southeast where it grows in open habitats.

Our collection of *Schizachne purpurascens* from Reed Hot Springs represents a new record for GAAR, for ARCN, and a major northward range extension for the species.

GAAR

Survey Pass Quad: Schwatka Mtns., Reed Hot Springs, Reed R. valley, 67°16'N, 155°3'W, 245 msm, dry herbaceous meadow slope adjacent to springs, Parker and Solstad 13841, 6 August 2002.

Polygonaceae

Rumex krausei Jurtzev & V.V. Petrovsky G2S2

This small dioecious sorrel was only recently described as being a part of the Beringian flora (Yurtsev et al. 1973) and is now known from a few scattered localities from the Seward Peninsula, northward to Cape Thompson and inland to the Squirrel River valley in northwestern Alaska. In Russia, it has only been found in easternmost Chukotka. *Rumex krausei* is usually found in moist open habitats such as seeps and moist meadows (Figure 5.10).

R. krausei has been found at Tin City and "Moon Mountains" on the south coast of the Seward Peninsula (ALA) but has not yet been found within BELA. It has been collected in the North Fork Squirrel River, north of the lower Kobuk River, and should be watched for in adjacent areas of northwestern KOVA. Our collections from CAKR and NOAT are new records for both park units and for ARCN.

Figure 5.10. Rumex krausei *was found growing in a wet, sloping meadow above the Situkoyok River near Mt. Noak (CAKR). Bright red stems and very narrow stiff leaves help distinguish it from other small docks in the region. Shown here is a female plant.*

CAKR

Noatak Quad: Igichuk Hills, Mt. Noak, western flanks above middle Situkoyok R. valley, 67°11'N, 163°8'W, 65–300 msm, rocky alpine limestone slopes, *Dryas* fellfield, outcrops, and herbaceous snowmelt meadows, growing in open wet meadow with mineral soil exposed, Parker et al. 14799, 14 July 2003.

NOAT

Noatak Quad: Igichuk Hills, Hugo Cr. headwaters, 67°18'N, 162°19'W, 230–360 msm, alpine limestone slopes, *Dryas* heath and meadows, growing in lush meadow, seepage, Parker et al. 14861, 16 July 2003.

Potamogetonaceae

Potamogeton subsibiricus Hagstr. G3S3

This slender pondweed is known from several localities in Alaska, Canada, and a few sites in northern Russia.

Potamogeton subsibiricus was collected during a previous survey from the Kilikmak Creek drainage west of the lower Noatak River valley. Although the exact location of this collection is uncertain, most of this drainage is within CAKR, so we can suspect this species to occur there. *P. subsibiricus* was also collected from Kuzitrin Lake (BELA) in 1988 by NPS personnel (NPSpecies). This specimen was reviewed by the author and is held at the NPS Herbarium in Anchorage.

CAKR

Noatak Quad: Kilikmak drainage, W of lower Noatak R., 67°19'N, 163°30'W, aquatic in shallow lake, Young 5528, 13 August 1973.

Primulaceae

Douglasia beringensis S. Kelso, Jurtsev, & D. F. Murray G2S2

This small cushion plant was described for the first time following its discovery during a previous plant inventory in BELA (Kelso et al. 1994). *Douglasia beringensis* can be distinguished from *D. alaskana* and *D. ochotensis*, both also known from the Seward Peninsula, by the occurrence of stellate hairs on the calyx lobes. The first population was found in 1992 in the Trail Creek uplands, 44 km southwest of Deering. A second population was located in 1993 at Crossfox Butte, 8 km east of the first locality and within BELA. At both sites the species was growing on marble outcrops and associated with scattered alpine forbs.

Since these initial discoveries, *D. beringensis* has been documented from the Nulato Hills east of Norton Sound (Parker 1999), from the vicinity of Cape Rodney in southwestern Seward Peninsula (Parker 2006), and from the Lime Hills in southwestern Alaska (Parker 2000). In addition, a small depauperate specimen from Conglomerate Mountain in the Kokrines Hills of central Alaska (ALA) was determined to be *D. beringensis* by Kelso in 1994 (ALA).

BELA

Bendeleben Quad: Crossfox Butte, 65°48'N, 163°19'W, 600 msm, locally common on areas of sheltered, moist soil on SE to S slope, in more open polsters growing with pleurocarpous moss, Murray and Kelso 11302 (Paratype), 5 July 1993.

Primula tschuktschorum Kjellm. G2G3S2S3

= *Primula tschuktschorum* Kjellm. var. *tschuktschorum* sensu Hultén

This showy, deep purple primrose is distinguished from *Primula tschukstchorum* Kjellm. var. *arctica* (Koidz.) Fern. (= *P. eximia* Greene., = *P. pumila* Ledeb.) by being distylous (having an outcrossing breeding system), by lacking farina on the foliage, and by usually having narrower leaves. Both species are Beringian endemics; however, *P. tschukstchorum* has a narrower range within Beringia that includes easternmost Chukotka, Russia, and southwestern Alaska from the Seward Peninsula to the Alaska Peninsula. Both species grow in moist, open herbaceous habitats such as snow beds and stream margins.

Previous inventories have documented *P. tschukstchorum* in BELA from the Kuzitrin Lake area and the headwaters of Ella and Minnie creeks in the Bendeleben Mountains, both along the south boundary of the preserve (ALA).

BELA

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, lower slopes, 65°20'N, 163°14'W, wet solifluction terrace, Murray et al. 11123, 28 July 1992.

Bendeleben Quad: Sturgeon Ridge, Kuzitrin Lake, E end of lake and ridge, 65°23'N, 163°7'W, Murray et al. 11193, 30 July 1992.

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, N side of Mt. Boyan, 65°20'N, 163°14'W, valley, Murray et al. 11215, 31 July 1992.

Bendeleben Quad: Ella and Minnie creeks, ridge between creeks, 65°18'N, 163°44'W, in moss along runoff from late snowbed, Murray et al. 11528, 15 July 1993.

Bendeleben Quad: Kuzitrin Lake, E shore of lake, 64°23'N, 163°13'W, sandy wet drainage area, Racine 310, 20 July 1973.

Pteridaceae

Cryptogramma stelleri (S. G. Gmelin) Prantl G5S2S3

This tiny fragile parsley fern has a northern circumpolar distribution. It is known from several widely scattered sites across northcentral Alaska. Previously *Cryptogramma stelleri* had been collected from along the Pilgrim River in central Seward Peninsula, just south of BELA (ALA). It has also been documented from Wiehl Mountain (ALA) and from Coldfoot (Hultén 1941), both located just outside the east boundary of GAAR. Collections also exist from the Salmon River in KOVA and the Noatak Canyon in NOAT. *C. stelleri* is usually found growing on shaded or sheltered limestone outcrops in moist crevices or seepage faces.

We documented *C. stelleri* from Sekuiak Bluff in the central Noatak River valley and in the upper Anisak River valley, both in NOAT. In CAKR, we collected a first record of *C. stelleri* in the Kakagrak Hills.

CAKR

Noatak Quad: Kakagrak Hills, vicinity "radio tower" airstrip, 67°16'N, 163°40'W, 100–262 msm, *Dryas* fellfield ridgetops and slopes, poorly developed frost circles and stripes, limestone outcrops and adjacent sheltered heath-*Dryas* patches, in *Dryas* hummocks, Parker et al. 10287, 27 June 2001.

KOVA

Baird Mountains Quad: Salmon R., N of Kobuk R., 67°9'N, 159°27'W, Racine s.n., 30 July 1974. Racine's report to NPS (1976) notes "growing on phyllite rocks" for this collection, although this information is not on the herbarium label.

NOAT

Howard Pass Quad: DeLong Mts., Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, 68°23'N, 158°51'W, 400–670 msm, growing on moist, shaded limestone face under alders, Parker 10793, 16 July 2001.

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, vicinity of upstream end of bluff and VABM Windy, N bank of river, 67°58'N, 161°37'W, 100–150 msm, N-facing gabbro outcrops and screes, moist, Parker et al. 15251, 27 July 2003.

Baird Mountains Quad: Noatak Canyon, 67°57'N, 161°39'W, Young 5497, 11 August 1973.

Ranunculaceae

Oxygraphis glacialis (Fisch.) Bunge G4G5S2S3

= *Ranunculus kamchaticus* DC.

This very small plant grows right at ground level, with flowers and leaves almost flush with the ground surface, hence it is easily overlooked. Its distribution ranges from western Alaska through eastern Asia, including Russia, China, and the Himalaya Mountains. *Oxygraphis glacialis* grows in moist to wet open habitats such as frost boils, fine scree, and fellfields (Figure 5.11).

Our collection came from upper Encampment Creek in the Endicott Mountains in GAAR and represents a moderate western range extension within Alaska and the first record for both the park unit and for ARCN.

Figure 5.11. Oxygraphis glacialis *grows at ground level and is easily overlooked. This tiny plant was growing in a wet, rocky, seepage slope in upper Encampment Creek (GAAR).*

GAAR

Chandler Lake Quad: Endicott Mtns., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W,

1,260 msm, drying rock-mud seepage pavement on gently sloping terrace, Parker and Solstad 13440, 31 July 2002.

Ranunculus glacialis L. ssp. *camissonis* (Schlecht.) Hultén G4T3T4S2

= *Beckwithia camissonis* (Schlecht.) Tolm.

= *Ranunculus camissonis* Schlecht.

= *Ranunculus glacialis* L. var. *camissonis* (Schlecht.) L. D. Benson

This Beringian buttercup is strikingly different from all other Alaska buttercups in having a single white flower that becomes reddish with age and bearing dense, rust-colored pubescence on the sepals. *Ranunculus glacialis* ssp. *camissonis* is documented at ALA from several widely scattered localities in northern and western Alaska including the Yukon-Tanana Uplands, the Ray Mountains, Seward Peninsula, and St. Lawrence Island. It is also found in Chukotka, Russia (Figure 5.12).

Some Alaska specimens collected from the southern Seward Peninsula have leaf traits that are more similar to those characteristic of *R. glacialis* ssp. *glacialis* known from Greenland and Europe, such as spreading versus erect leaves, broader and more round-tipped leaf lobe tips, and leaves being twice ternate (vs. once ternate in spp. *chamissonis*). A careful taxonomic review is needed to determine if these specimens represent a taxon distinct from *R. glacialis* ssp. *camissonis*, and if so, if it is conspecific with *R. glacialis* ssp. *glacialis* as recognized in Europe and Greenland, or if it is a distinctly separate and undescribed taxon (D. Murray, pers. comm.).

Lloyd Spetzman had previously collected *R. glacialis* ssp. *camissonis* at Thunder Mountain on the north boundary of NOAT in 1950 (Wiggins and Thomas 1962, collection not seen). We collected first records for *R. glacialis* ssp. *camissonis* at Desperation Lake in NOAT, and at the Encampment Creek headwaters in GAAR.

Figure 5.12. Ranunculus glacialis *ssp.* camissonis *growing in an open seepage meadow near the north shore of Desperation Lake (NOAT). The purple-pink petals and fleshy leaves are unique among northern buttercups.*

BELA

Bendeleben Quad: Minnie Cr. headwaters, Minnie–Boston Cr. divide, 65°20'N, 163°38'W, mesic to moist meadow below outcrops, in mosses, at junction of carbonate and acid bedrock, Murray et al. 11597, 16 July 1993.

GAAR

Chandler Lake, Endicott Mtns., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W, 1,260–1,500 msm, gently sloped seepage meadow, open patchy vegetation in shale-mud substrate, Parker and Solstad 13377, 29 July 2002.

Chandler Lake, Endicott Mtns., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W, 1,260 msm, drying rock-mud seepage pavement on gently sloping terrace, Parker and Solstad 13442, 31 July 2002.

NOAT

Howard Pass Quad: De Long Mts., Desperation Lake, N shore, E of outlet of Uivaksak Cr., 68°20'N, 158°44'W, 417 msm, ancient alluvial fan and beach ridges, growing in moist to wet sedge-grass meadow with scattered gravel frost boils, Parker & Meyers 10751, 13 July 2001.

***Ranunculus monophyllus* Ovcz. G5S1S2**

= *Ranunculus auricomus* L. aggregate

This bright yellow buttercup was first recognized as part of the North American flora when it was collected in the Nulato Hills in western Alaska (Parker 1999). It belongs to a widespread species aggregate that is found across northern Russia (including Chukotka), northern Europe, and Greenland. Fruiting characters help distinguish *Ranunculus monophyllus* from *R. pedatifidus* ssp. *affinis* when the basal leaves, which are strongly diagnostic for separating these two species, are lacking from specimens. The author reviewed all ALA specimens of *R. pedatifidus* ssp. *affinis* and as a result additional collections of *R. monophyllus* that had been previously misidentified were found from Bluff, on the southeast coast of the Seward Peninsula, and from Serpentine Hot Springs within BELA. Recently specimens of *R. monophyllus* received at ALA have come from the vicinity immediately north and west of Nome (Figure 5.13).

Figure 5.13. Ranunculus monophyllus *was collected from Serpentine Hot Springs (BELA) in 1987 but had been misidentified until recently. It was found in the Hugo Creek headwaters in NOAT in 2003. The round-outlined, toothed basal leaves help distinguish* R. monophyllus *from similar northern buttercups.*

Our collection of *R. monophyllus* from the headwaters of Hugo Creek in NOAT is

a moderate northward range extension for the species within Alaska and a new record for NOAT.

BELA

Bendeleben Quad: Serpentine Hot Springs, 65°52'N, 164°26'W, 150 msm, moist areas in meadow among fescues, Kelso 87–223, 30 June 1987.

NOAT

Noatak Quad: Igichuk Hills, Hugo Cr. headwaters, 67°18'N, 162°19'W, 230–360 msm, alpine limestone slopes, *Dryas* heath and meadows, growing in lush meadow, Parker et al. 14863, 16 July 2003.

Rosaceae

Potentilla fragiformis Willd. G4S1

= *Potentilla grandiflora* L. var. *fragiformis* (Willd.) Ser.

This showy cinquefoil of coastal habitats was "rediscovered" as being a part of the North American flora following our first collection in 2001 at Sheshalik Spit in CAKR. It was noted in the early literature as being found in the Bering Sea area of North America (Rydberg 1908) based on collections made in 1891 on St. Paul Island by J. M. Macoun (CAN,NY) and C. H. Merriam (US), and by J. T. White (US) in 1894 in the "Bering Straits area'. Hultén was certainly familiar with this species from his work in Kamchatka, Russia, yet curiously he stated that it was unknown from North America (Hultén 1941–1950 [vol. VI], 1967, 1968) even though he had reviewed Macoun's Alaska collections (Hultén 1941–1950 [vol. VI]). His range map (Hultén 1968) shows *Potentilla fragiformis* to be limited to the eastern and southern coasts of the Russian Far East.

Although *P. fragiformis* is very similar in appearance to *P. villosa*, which grows in the same habitat, it lacks the white tomentose pubescence on the underside of the leaves. Instead, *P. fragiformis* has a sparse, hirsute pubescence similar to that seen in *P. hyparctica*. However, it can be separated from *P. hyparctica* by its longer (to 2 mm), more slender styles and by being a coarser, more robust plant. A subsequent review of ALA specimens of both *P. villosa* and *P. hyparctica* revealed misidentified collections of *P. fragiformis* from Kivalina, St. Lawrence Island, and Sheshalik Spit, the latter in CAKR.

A subsequent review of specimens borrowed from the New York Botanical Garden Herbarium (NY) and the Canadian Museum of Nature Museum Herbarium (CAN) uncovered Alaska specimens from St. Lawrence and St. Paul islands in the Bering Sea. Some of these specimens were misidentified or were on mixed-species herbarium sheets. This might help explain why Hultén originally overlooked the occurrence of *P. fragiformis* in Alaska.

In 2002, we located a second population of *P. fragiformis* on the northwest shore of Krusenstern Lagoon in CAKR. An additional population was reported in 2003 at

the head of Kotzebue Sound (C. Meyers, pers. comm.). At each of these documented or reported localities, the species was growing on inland beach gravels or sand within the coastal *Leymus* meadow zone (Figure 5.14).

CAKR

Noatak Quad: Sheshalik Spit, NW end, vicinity Uhl summer camp, 67°1'N, 162°57'W, 1–2 msm, gravel beaches, inner lagoons, and old beach ridges, growing at edge of *Leymus* beach meadow, Parker et al. 1948, 1 August 2001.

Noatak Quad: Cape Krusenstern (Sealing Pt.), vicinity 2–8 km N of VABM Krusenstern, 67°8'N, 163°43'W. 1 msm, growing in *Leymus*-forb back beach meadow, widely scattered plants, growing with *Potentilla villosa*, Parker and Beattie 12030, 12 July 2002.

Noatak Quad: Sheshalik Spit, 67°N, 162°51'W, Young 4032, 18 June 1973. This specimen originally determined as *P. hyparctica*.

Figure 5.14. Potentilla fragiformis *(on left) was collected from Sheshalik (CAKR) in 1973 but misidentified. It is very similar in appearance to* P. villosa *(on right) and found in the same habitats, but lacks the thick tomentose pubescence on the underside of the leaves. Botanist Kate Beattie holds both species, found growing together along the northwest shore of Krusenstern Lagoon (CAKR).*

Potentilla rubricaulis Lehm. aggregate G4S2S3

The name *Potentilla rubricaulis* is currently used by some botanists to recognize those plants that have traits morphologically intermediate between the taxonomic sections Niveae and Multifidae (Elven et al. 2005). The suggestion that this species has a hybrid origin with a parent from each section (Soják 1986) is based on morphology and has yet to be supported with genetic or chromosomal analysis. Traits used to distinguish *P. rubricaulis* from among the most similar appearing species in our region (including *P. hookeriana*, *P. uniflora*, *P. nivea*) are the occurrence of a fourth or fifth leaflet on some basal leaves and having a pubescence similar to that found in *P. uniflora* yet being many-flowered and having more deeply incised leaflet teeth. Under this provisional treatment, the distribution of *P. rubricaulis* is northwestern North America.

The taxonomy and subsequent nomenclature for these morphologically variable but possibly related species remains unclear and is in serious need of further study.

We collected *P. rubricaulis* from Sekuiak Bluff, central Noatak River valley in NOAT, and from Castle Mountain and upper Encampment Creek in GAAR. Both records are new for these park units and for ARCN.

GAAR

Chandler Lake Quad: Endicott Mtns., upper Encampment Cr., 3 km NNE of Inualurak Mt., 68°14'N, 152°12'W, 1260–1500 msm, steep, E-facing gully with lush mesic, herbaceous vegetation, growing on patch of cobbley scree, carbonate substrate, Parker and Solstad 13428, 30 July 2002.

Chandler Lake Quad: Arctic Foothills, Castle Mtn., middle ridge and summit area, 68°34'N, 152°32'W, 700–1070 msm, alpine slopes, screes, and outcrops, growing on S-facing conglomerate outcrops and ledges, Parker et al. 12696, 28 July 2002.

NOAT

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, upstream end of bluff, vicinity E of VABM Windy, 67°58'N, 161°37'W, 100–150 msm, cobble-gravel river bars and gabbro outcrops, growing on turf on gabbro outcrops, Parker et al. 15194, 26 July 2003.

Baird Mountains Quad: Central Noatak R. valley, Sekuiak Bluff, vicinity of upstream end of bluff and VABM Windy, N bank of river, 67°58'N, 161°37'W, 100–150 msm, S-facing outcrops and scree, acidic-limestone contact zone, Parker et al. 15234, 27 July 2003.

Potentilla stipularis L. G5S1

This slender cinquefoil is widespread in northeastern Russia yet just barely reaches into northwestern Alaska. Unlike other Alaska cinquefoils, it has distinctive palmately compound basal leaves and inflated cauline stipules (Figure 5.15). *Potentilla stipularis* is usually found in herbaceous vegetation, often in open, moderately disturbed settings.

P. stipularis had previously been documented from the western Seward Peninsula and the Arctic Coastal Plain (ALA, Porsild 1964), hence may eventually be found in BELA and in the northern areas of GAAR. Our collections are from Desperation Lake, the upper Anisak River valley, and Inaccessible Ridge and represent new records for both NOAT and ARCN.

Figure 5.15. Potentilla stipularis *was found in open herbaceous and tundra habitats at three localities in NOAT. The palmately compound basal leaves and inflated stipules along the stem separate it from other similar cinquefoils. Colville River, northern Alaska. Photo by Robert Lipkin.*

NOAT

Howard Pass Quad: DeLong Mts., Desperation Lake, S shore, E of outlet of Uivaksak Cr., 68°20'N, 158°47'W, 400 msm, moist graminoid-*Salix-Dryas* tundra with scattered sedge tussocks, Parker & Meyers 10537, 7 July 2001.

Howard Pass Quad: DeLong Mts., Anisak R. valley, vicinity confluence Primus and Buccaneer creeks, 68°23'N, 158°51'W, 380 msm, S-facing cobble slope of cutbank above creek, scattered forbs and shrubs, Parker 10840, 18 July 2001.

Misheguk Mountain Quad: DeLong Mts., Inaccessible Ridge, Kagik Cr. headwaters, vicinity of gap, 68°29'N, 161°48'W, 480–700 msm, mesic *Dryas*-heath hummock tundra on chert substrate, growing in herbaceous, S-facing draw, Parker & Beattie 11892, 4 July 2002.

Saxifragaceae

Saxifraga nudicaulis D. Don. G3G4QS2S3

This small red-stemmed saxifrage is a narrow Beringian endemic, restricted to the Russian Far East, Seward Peninsula, the Bering Sea Islands, and a few coastal localities along the Yukon-Kuskokwim delta. *Saxifraga nudicaulis* can be found in moist to wet open habitats such as along streams, meadows, snow beds, and lake shores.

Previous collections exist for *S. nudicaulis* in BELA from Kuzitrin Lake and the Ellie and Minnie creeks headwaters. It was not found during our I&M inventory.

BELA

Bendeleben Quad: Mt. Boyan, Kuzitrin Lake, 65°20'N, 163°14'W, wet gravel along stream, Murray et al. 11190, 30 July 1992.

Bendeleben Quad: Ella and Minnie Cr., ridge between creeks, 65°18'N, 163°44'W, 732 msm, wet mossy terrace of solifluction lobe, Murray et al. 11512, 15 July 1993.

Bendeleben Quad: Kuzitrin Lake, E shore of lake, 65°23'N, 163°13'W, 427 msm, wet sandy beach of lake, Racine 351, 23 July 1973.

Violaceae

Viola selkirkii Pursh G5S3

This rare dark blue violet has been reported from Reed Hot Springs but no collection seemed to have been made (Swanson 1993, NPSpecies). Its occurrence must be considered undocumented at this time.

Zannichelliaceae

Zannichellia palutris L. G5S3

This delicate submerged horned pondweed has a cosmopolitan distribution and is found in both fresh and brackish slow-moving water. It has slender verticillate branches and

a whorl of three to four sausage-shaped, beaked fruits. In Alaska it is documented from scattered localities along the southcentral coast from the Copper River delta to Kotzebue Sound (ALA).

During a 1973 survey, it was collected from the vicinity of the Seetakuyuk River mouth (= Situkuyok River) in CAKR. Our collection of *Zannichellia palustris* from CAKR was found southeast of Aukulak Lagoon at the base of Sheshalik Spit. These combined collections represent a very minor northwestern range extension within Alaska.

CAKR

Noatak Quad: Situkuyuk R. mouth, near Noatak Delta, 67°4'N, 163°23'W, marshland, Young 5581, 19 August 1973.

Noatak Quad: Sheshalik Spit, NW end, vicinity S of Aukulak Lagoon, 67°2'N, 163°5'W, 1–10 msm, beach meadows, *Empetrum* heath, and willow thickets on S-facing slopes, growing in freshwater ponds, Parker et al. 11016, 2 August 2001.

Table 5.2. *Summary list of the rare plant species documented or cited from ARCN parklands. Included are current AKNHP rankings and comments with respect to distribution. For localities, collection records, and Latinized (scientific) synonyms and authorities, see text. Rankings are those of the Alaska Natural Heritage Program (2005). Range extensions (RE) are based on ALA holdings and other documented and reviewed specimens.*

Species/Rankings		BELA	CAKR	GAAR	KOVA	NOAT	Comments
Aspleniaceae							
Asplenium viride	G4S3	?			?		Circumpolar, cited for BELA and KOVA, but lacking specimens
Asteraceae							
Artemisia senjavinensis	G3S2S3	X					Bering Strait
Erigeron muirii	G2S2			X			East Beringian
Erigeron porsildii	G4S3			X		X	East Beringian, new to GAAR and NOAT, moderate RE to W
Saussurea triangulata	G1?S1				X		East Asian, new to KOVA and to North America, major RE from Russia
Symphyotrichum yukonense	G3S3			X	X	X	East Beringian, new to NOAT, minor RE to N
Brassicaceae							
Aphragmus eschscholtzianus	G3S3			X			Beringian
Cardamine microphylla ssp. *blaisdellii*	G4S2S3	X		X	X		Beringian, new to GAAR and KOVA
Draba exalata	G3S3	X					Beringian
Draba pauciflora	G4S1			X			Arctic circumpolar, new to GAAR and Alaska
Smelowskia porsildii	G5S2S3			X		X	Alaska, new to NOAT
Thlaspi arcticum	G3S3			X			Beringian, new to GAAR, RE to W
Campanulaceae							
Campanula aurita	G4S3			X			East Beringian

(continued on next page)

Species/Rankings	BELA	CAKR	GAAR	KOVA	NOAT	Comments
Caryophyllaceae						
Arenaria longipedunculata G3S3		X	X	X	X	East Beringian, new to CAKR and NOAT
Minuartia biflora G5S3S4	X		X		X	Northern circumpolar, new to GAAR and NOAT
Minuartia yukonensis G4S3					X	East Beringian, new to NOAT, minor RE to NW
Stellaria alaskana G3S3			X			East Beringian, new to GAAR, minor RE to W
Stellaria dicranoides G3S3	X	X	X	X	X	Beringian, new to CAKR and KOVA
Stellaria umbellata G5S2S3	X		X			Amphi-Beringian, new to GAAR
Chenopodiaceae						
Corispermum ochotense var. *alaskanum* G3G4T?QS2				X		Alaska, taxonomy poorly resolved
Cyperaceae						
Carex deflexa G5S1S2			X			North American, new to GAAR, major RE to N
Carex heleonastes G4S2			X			Boreal circumpolar, new to GAAR, major RE to N
Carex holostoma G4?S2	X	X			X	Northern circumpolar, new to CAKR and NOAT
Carex lapponica G4G5S2			X	X		Northern circumpolar, new to GAAR, minor RE to NE
Eleocharis kamtschatica G4S2S3				X		Northern Asia, Alaska
Eriophorum viridicarinatum G5S2			X			North American, new to GAAR, major RE to N
Fabaceae						
Lupinus kuschei G3S2				X		East Beringian
Oxytropis arctica var. barnebyana G4TS2	X	X			X	Northwestern Alaska, new to CAKR and NOAT, moderate RE to NE
Oxytropis kobukensis G2S2				X		Restricted to central Kobuk Valley
Oxytropis kokrinensis G3S3			X	X	X	East Beringian, new to GAAR and KOVA, minor RE to E
Oxytropis tananensis G2G3QS2S3					X	East Beringian, new to NOAT, major RE to NW
Gentianaceae						
Gentianopsis detonsa ssp. *detonsa* G3G4T?S1		X				Arctic circumpolar
Orchidaceae						
Cypripedium parviflorum G5S2S3			X			Boreal North American
Papaveraceae						
Papaver walpolei G3S3	X	X		X	X	Beringian, new to CAKR
Poaceae						
X_Dupoa labradorica	X	X				Northern North America, new to Alaska, major RE to W
Festuca edlundiae G3G4S1			X			Arctic North America, new to GAAR and Alaska
Festuca lenensis G4G5S3		X	X	X	X	Beringian, new to KOVA and NOAT

Species/Rankings		BELA	CAKR	GAAR	KOVA	NOAT	Comments
Glyceria pulchella	G5S2S3				X		Northern North America, moderate RE to NW
Glyceria striata ssp. *stricta*	G5S2			X			North American, new to GAAR
Puccinellia vaginata	G4S1	X	X				Arctic circumpolar, new to BELA and CAKR
Puccinellia vahliana	G4S2S3			X		X	Arctic circumpolar, new to GAAR and NOAT
Puccinellia wrightii	G3G4S2S3	X				X	Beringian, new to NOAT
Schizachne purpurascens	G5S2			X			Norhern North America and Eastern Asia, new to GAAR, major RE to N
Polygonaceae							
Rumex krausei	G2S2		X			X	Beringian, new to CAKR and NOAT
Potamogetonaceae							
Potamogeton subsibiricus	G3S3		X				Beringian
Primulaceae							
Douglasia beringensis	G3S3	X					East Beringian
Primula tschuktschorum	G2G3S2S3	X					Beringian, minor RE to NW
Pteridaceae							
Cryptogramma stelleri	G5S2S3		X		X	X	Circumpolar, new to CAKR and NOAT
Ranunculaceae							
Oxygraphis glacialis	G4G5S2S3			X			Amphi-Beringian, new to GAAR, moderate RE to W in Alaska
Ranunculus glacialis ssp. *camissonis*	G4T3T4S2	X		X		X	Beringian, new to GAAR
Ranunculus monophyllus	G5S1S2	X				X	Northern Asia, Europe, Greenland and NW Alaska, new to NOAT, moderate RE to N
Rosaceae							
Potentilla fragiformis	G4S1		X				Beringian, recognized new to Alaska
Potentilla rubricaulis	G4S2S3			X		X	Northern North American, new to GAAR and NOAT
Potentilla stipularis	G5S1					X	Beringian, new to NOAT
Saxifragaceae							
Saxifraga nudicaulis	G3G4QS2S3	X					Beringian
Violaceae							
Viola selkirkii	G5S3			?			Boreal circumpolar, cited but lacking specimen
Zannichelliaceae							
Zannichellia palutris L.	G5S3		X				Cosmopolitan

CHAPTER 6
RANGE EXTENSIONS

Botanical inventories in Alaska remain truly exploratory because so many areas of the state remain poorly known. Inevitably, the results of major plant surveys include several species range extensions within the state and often document species that are new to the state from another region. We assume that these new records are clear evidence of our limited knowledge of the Alaska flora (filling in the gaps) and do not represent recent plant migrations into an area.

As a result of the ARCN I&M inventory, we documented 13 moderate range extensions (100–250 km) and 30 major range extensions (>250 km) (Table 6.1). Thirteen of these total 43 records are species ranked critically imperiled (S1) to rare (S3) within Alaska. In recognizing a species as representing a range extension, we used the following baselines:

1. ALA collections. Several range extensions were documented by earlier collections from the ARCN region (including those of Steve Young, Charles Racine, David Murray, Tass Kelso, Marko Lewis, David Cooper, Carolyn Parker, and Randy Meyers). Most of these collections are held at ALA, hence are part of this baseline. The range extensions they represent are not included here, although several are noted in the respective reports submitted by some of these collectors.
2. Select literature sources on the flora of Alaska that cite author-reviewed specimens, along with their locality, collector, and the herbarium where each is held (Hultén 1941–1950, 1967, and 1973; Wiggins and Thomas 1962). The NPS-held specimens that could be reviewed by this author were also considered in the range extensions noted below.

The majority (29 species, 67%) of these new records represent range extensions to the north or northwest for species characteristic of continental and boreal habitats. Nine of these records were collected from the Noatak Canyon (NOAT), where we focused on both the xeric slopes along the river and on the scattered boreal forest stands. An additional nine records came from Reed Hot Springs in the southcentral Brooks Range (GAAR). As discussed in Chapter 4 in the section on GAAR, this unique site offered boreal, moist to wet, and xeric habitats all in a sheltered valley setting. Among these new records are some relatively "common" and conspicuous species (i.e., *Athyrium filix-femina* ssp. *cyclosorum*, *Potentilla pensylvanica*) that would not have been easily overlooked during earlier surveys. Possible explanations why these "boreal-continental" plants were not collected previously include (1) earlier surveys were focused on more alpine and subarctic landscapes and habitats in the region, or (2) these plants are very uncommon within ARCN, and the chance of encountering them is rare.

Twelve species (28% of total records) listed are generally found in wet lowlands, including five that are aquatic plants. This can be expected given these habitats are frequently overlooked by botanists and are sometimes more difficult (even risky) to collect from (requiring waders, small boat or raft, pails, etc.). In addition, aquatic plant species often become conspicuous relatively late in the season, after surveys are completed.

Table 6.1. *List of moderate (100–250 km) and major (>250 km) range extensions (RE) documented for ARCN during the I&M inventory. Range extensions are based on ALA collections and the references noted above. Species are listed alphabetically by family and genus. Rankings are noted for those species listed as critically imperiled to rare in Alaska by AKNHP.*

Family/Species		New Locations and Range Extension Description
Apiaceae		
Heracleum lanatum		Iguichuk Hills (CAKR), Reed Hot Springs (GAAR); moderate RE to NW from Interior Alaska
Asteraceae		
Erigeron porsildii	G4S3	Central Noatak River (NOAT), Castle Mtn. (GAAR); major RE to W from Galbraith Lake
Brassicaceae		
Arabidopsis mollis		Central Noatak River (NOAT); major RE to N from Bluff, Seward Peninsula, and W from Porcupine River
Arabis hirsuta ssp. *pycnocarpa*		Central Noatak River (NOAT); major RE to NW from Innoko River basin
Cardamine microphylla ssp. *blaisdellii*	G4S2S3	Jade Mtn. (KOVA), Igning River and Fritts Mtn. (GAAR); major RE to E from Noluck Lake
Draba cana		Central Noatak River (NOAT), Kakagrak Hills (CAKR); moderate RE to N from Seward Peninsula, major RE to W from Porcupine River
Draba macounii		Encampment Creek (GAAR); moderate RE to W from Atigun Pass area
Draba pauciflora	G4S1	Encampment Creek and Chandler Lake (GAAR); moderate RE to S from Teshekpuk Lake
Subularia aquatica		Lake Selby (GAAR); major RE to N from interior Alaska, moderate RE to E from Selawik River basin
Caryophyllaceae		
Stellaria longifolia		Lake Selby (GAAR); major RE to WNW from Yukon River Flats
Cyperaceae		
Carex concinna		Igisukruk Mt. (CAKR), Noatak Canyon (NOAT); major RE to W from Arrigetch Peaks (GAAR)
Carex crawfordii		Upper Kobuk River (GAAR); major RE to NW from Yukon River Flats
Carex deflexa	G5S1S2	Reed Hot Springs (GAAR); major RE to NW from Yukon-Tanana uplands
Carex heleonastes	G4S2	Nutuvukti Lake (GAAR); moderate RE to NW from eastern Brooks Range
Carex livida		Espenberg River (BELA), Nutuvukti Lake (GAAR); major RE to N and NW from Innoko River basin
Carex petricosa		Kakagrak Hills (CAKR), Noatak Canyon, Primus Creek (NOAT); major RE to W from Atigun Valley, moderate RE to N from Seward Peninsula
Eriophorum viridicarinatum	G5S2	Nutuvukti Lake (GAAR); major RE to N from Alaska Range
Dryopteridaceae		
Athyrium filix-femina ssp. *cyclosorum*		Reed Hot Springs (GAAR); major RE to N from Tanana River Valley
Gymnocarpium dryopteris		Reed Hot Springs (GAAR); moderate RE to E from upper Ambler River
Ericaceae		
Arctostaphylos uva-ursi		Igisukruk Mtn. (CAKR); moderate RE to W from Great Kobuk Sand Dunes
Fabaceae		
Oxytropis arctica ssp. *barnebyana*	G4S2	Anisak River (NOAT); moderate RE to NE from Kugururok River (NOAT)
Oxytropis tananensis	G2G3S2S3	Anisak River (NOAT); major RE to NW from interior Alaska
Juncaceae		
Juncus filiformis		Reed Hot Springs (GAAR); moderate RE to N from Huslia River
Juncus stygius		Nutuvukti Lake (GAAR); major RE to N from upper Tanana River and central Alaska Range

Family/Species	New Locations and Range Extension Description
Onagraceae	
Circaea alpina	Reed Hot Springs (GAAR); moderate RE to NW from Kanuti Hot Springs
Ophiolossaceae	
Botrychium minganense	Igisukruk Mtn. (CAKR), Castle Mtn., Killik R. (GAAR); major RE to NW from Yukon-Tanana uplands
Poaceae	
Bromopsis ciliata	Central Noatak River (NOAT); major RE to NW from Kanuti Hot Springs
X_Dupoa labradorica	Espenberg River (BELA) and Sheshalik (CAKR); major RE to W from Hudson Bay, Canada
Festuca edlundiae G3G4S1	Chandler Lake (GAAR), major RE to W from Banks Island, Canada, and E from Wrangel Island, Chukotka
Glyceria striata ssp. *stricta* G5T5S2	Reed Hot Springs (GAAR), moderate RE to NW from Kanuti Hot Springs
Leymus innovatus	Noatak Canyon (NOAT); major RE to W from Umiat and Arrigetch valley (GAAR)
Schizachne purpurascens G5S2	Reed Hot Springs (GAAR); major RE to N from Talkeetna Mtns.
Polygonaceae	
Polygonum amphibium	Hunt River dunes (KOVA); major RE to N and W from Yukon River Flats
Potamogetonaceae	
Potamogeton friesii	Killik River (GAAR); major RE to NW from interior Alaska
Potamogeton praelongus	Killik River and Selby Lake (GAAR); major RE to W from Sheenjek R. and to N from Seward Peninsula
Potamogeton pusillus ssp. *tenuissimus*	Noatak Canyon (NOAT); major RE to W from Yukon Flats and N from central Seward Peninsula
Pyrolaceae	
Pyrola minor	Mulgrave Hills (CAKR) and Chimney Pass and Reed Hot Springs (GAAR); moderate RE to N from interior Alaska and central Seward Peninsula
Ranunculaceae	
Oxygraphis glacialis GG5S2S3	Encampment Creek (GAAR); major RE to E from Seward Peninsula and to N from Alaska Range
Ranunculus monophyllus G5S1S2	Hugo Creek (NOAT); moderate RE to N from central Seward Peninsula
Rosaceae	
Potentilla pensylvanica	Noatak Canyon (NOAT); major RE to NW from Kanuti River basin
Selaginellaceae	
Selaginella selaginoides	Hugo Creek (NOAT) and Kakagrak Hills (CAKR); major RE to W from central Brooks Range
Thelypteridaceae	
Phegopteris connectilis	Reed Hot Springs (GAAR); major RE to N from Interior Alaska
Violaceae	
Viola biflora	Igisukruk Mtn. (CAKR); moderate RE to W from central Kobuk River

Among some of the most floristically interesting range extensions we have "recognized" during this survey are not expressed in this list, or omitted from it entirely for some reason; but each is discussed in Chapter 5. These include:

Draba pauciflora (G4S1) was first recognized as being in our Alaska flora based on our I&M collections from Chandler Lake and Encampment Creek (both in GAAR). However, careful review of ALA collections revealed that it had been collected previously along the Beaufort Sea coast near Barrow but had not been correctly identified. Hence, our I&M collections are designated here as simply a moderate range extension to the south.

Potentilla fragiformis (G4S1) was thought to be new to North America when we collected it at Sheshalik and Cape Krusenstern (both in CAKR). A search through the ALA collections of similar looking species revealed it had been collected at Sheshalik by Steve Young in 1973 and misidentified. Additional Alaska collections of *Potentilla fragiformis*, also misidentified, were eventually found from Kivalina, St. Lawrence Island, and St. Paul Island. Our I&M collections alerted us to look at the earlier collections more carefully.

Saussurea triangulata (G1S1) was first collected in the Waring Mountains, just inside the KOVA boundary, in 2000. It was recognized as new to North America, disjunct from Kamchatka, Russia. During the I&M inventory, we revisited this original population and found a second population a few kilometers away, also within KOVA. Regardless of whether the Alaska plants continue to be called *S. triangulata* or are eventually considered a species new to science, the acquisition of live plants and location of a second population is notable.

X_*Dupoa labradorica,* a generic hybrid grass is noted as a range extension from Hudson Bay, Canada, and new to Alaska based on our first I&M collections from Sheshalik (CAKR) in 2001. Afterwards, we found it at two distant localities in BELA and near the village of Kotzebue. Additional new Alaska localities now include Goodnews Bay and the lower Yukon River Delta. One can only speculate whether X_*Dupoa labradorica* has only recently been arising (as a stable, persistent hybrid) in our area, or if Alaska botanists are just learning to watch for it.

CHAPTER 7
SUMMARY DISCUSSION AND RECOMMENDATIONS

The combined Arctic Network parklands include a broad diversity of landscapes, bedrock substrates, habitats, and climatic and vegetation zones. Although most of the parklands lie north of the geographic Arctic Circle, they collectively support a vascular flora that includes almost one half of the total number of vascular plants (≈1,500 species) known from throughout Alaska (Hultén 1968). In the ARCN flora, the greatest contributions to this diversity comes from the floristic elements botanists commonly refer to as (1) Beringian (plants having a distribution reflecting the unglaciated Quaternary Bering Land Bridge area, (2) alpine-cordilleran (referring to the alpine flora that is widespread through at least a portion of the alpine system running from Alaska to the southern Rocky Mountains), and (3) continental-boreal (plants of the broad boreal forest zone, including dry uplands and other habitats associated with it).

This I&M inventory has significantly increased our knowledge of the vascular flora of the parklands in northwestern Alaska. Earlier plant inventories in each of the ARCN parklands varied greatly, both in the areas covered and in the amount of time spent documenting the flora. For example, the interior regions of Bering Land Bridge National Preserve had been inventoried by a team of botanists in the early 1990s (D. Murray, pers. comm.). We therefore focused solely on the coastal landscapes while there and only added 46 new species to the BELA list. In contrast, earlier plant survey work in Cape Krusenstern National Monument had been sparse, and here our I&M efforts increased the known vascular flora tenfold from 37 to 380 species. The number of vascular plant species now documented for GAAR, KOVA, and NOAT increased by 45%, 48%, and 130%, respectively. These increases reflect both the limited extent to which the flora in each unit was known previously, and the success of our I&M inventory strategy to reach areas, landscapes, and habitats that had been poorly surveyed or not surveyed at all.

In addition, we added 20 new critically imperiled to rare (S1–S3) species to the list for the entire ARCN region, for a total of 54. Two species are new to Alaska (*Festuca edlundiae* and *Draba pauciflora*). One species is newly recognized for North America (*Potentilla fragiformis*). The unranked hybrid grass, X_*Dupoa labradorica*, is new to Alaska from Hudson Bay, Canada, and a second population of *Saussurea triangulata*, recently new to North America from Kamchatka, Russia, was located. Forty-three moderate to major range extensions are also recorded.

The caveat often repeated is "a botanical survey is never done." This is certainly true for these extensive and diverse ARCN parklands. In this report, recommendations have been offered for future inventory work within each of the park units in their respective sections. These are both conservative and speculative suggestions, given the relatively limited experience the author has gained for this large region during a brief time.

A lifetime could be dedicated to understanding the flora of any one of these five park units, although clearly this is unrealistic. However, as a result of our field work in ARCN,

certain localities and landscape settings encountered seemed particularly "special" in some way and warrant additional attention when the opportunity arises or concern if they are seemingly threatened.

1. The coastal areas of BELA and CAKR are quite different from each other in several ways, but both support an incredible seasonal diversity of bird life and seasonal use by other wildlife, and combined, they display a variety of dynamic geomorphic landscapes. The floristic diversity seen along and near the coast at CAKR seems exceptionally rich. The limited amount of subsistence activity occurring on these coasts today has minimal or only very localized impact. Park managers should be alert to any development that affects the active coastal geomorphic processes that make these coastlines unique, such as coastal road or seaport building. Currently, climate change may be the greatest factor affecting these areas.
2. Hot springs, warm springs, and any site that has perennial freshwater flow supporting lush growth could be floristically interesting. These sites may be conspicuous on the landscape by the presence of cottonwood, tall shrubs, tall herbs, and late spring aufeis and often offer habitat for birds and small mammals not otherwise commonly found in the adjacent areas. If a salt lick is available, such springs may be critical for large mammals in the surrounding area. Springs may have their own natural fluctuations in flow volume but are often very sensitive to any disturbance affecting flow patterns, such as carelessly placed roads and trails.
3. Carbonate rock is common throughout the ARCN parklands. Areas underlain by a calcareous substrate typically support species and species assemblages that are distinctively different from surrounding vegetation. Several of our sites were on calcareous substrates, and these sites were the setting for several of our rare species records and range extensions. However, we did not exhaust this habitat setting within ARCN. Especially rich in diversity and unique floristic finds were sites that included perennial seepage, late-lying snow banks, or some source of moisture throughout the growing season (Hugo Creek headwaters in NOAT, vicinity of Mt. Noak in CAKR, Encampment Creek headwaters in GAAR). These sites are usually too small to reveal themselves on most vegetation and soil maps. However, they are evident to workers on the ground who may see a lush growth of herbs or just a different-looking patch of vegetation at the base of a slope or in a sheltered setting.
4. Northward-facing valleys along the north slope of Brooks Range are the settings in which we found species typically considered "arctic" in distribution, such as *Draba pauciflora* and *Potentilla rubricaulis,* found at Chandler Lake and Encampment Creek (GAAR). Additional sites in a similar setting include Kurupa Lake and the Oolah (Ulo) valley in northern GAAR, both of which have been only briefly surveyed, and along the northern margin of NOAT. A stronger survey effort in such settings could be productive and contribute to the arctic floristic element representation in the park unit.
5. Scattered boreal-continental sites, as defined above, are found throughout the ARCN area. Botanists headed to northern Alaska may, somewhat understandably, focus on the alpine and northern tundra habitats in the region. However, attention to these

diverse and scattered boreal habitats could certainly contribute to the species diversity recorded for the network. Areas within ARCN that remain poorly surveyed include the southernmost regions of GAAR, the lower Noatak River valley within NOAT, along the Salmon River in KOVA, and the southeastern corner of CAKR.

6. Wetlands and aquatic habitats remain under-surveyed throughout Alaska. Effective botany inventory work in these habitats often requires a boat, a visit in mid-to-late summer, after flowering in the drier uplands has passed, and pails, waders, and even a wetsuit and snorkel face mask. Hence most botanical work, by design or default, overlooks these habitats or the plants in them that are hardest to reach. Potentially rich wetlands within ARCN include the lower Koyukuk River valley (GAAR), the lower Noatak River valley (NOAT), the central Kobuk River valley (KOVA), and the scattered wetlands in CAKR. These habitats are not only under-surveyed, but they often provide critical wildlife, waterfowl, and fisheries habitat, as well as a local flood control system. Wetlands are typically sensitive to development such as roads or greatly increased motorized boat traffic.
7. Although the active sand dunes in the Kobuk River valley (KOVA) were not visited during this I&M inventory, they are a unique habitat. They have been visited previously by botanical, geomorphic, and paleoenvironmental researchers as noted in the KOVA section of Chapter 4. Climate change toward warmer, wetter summers and few forest fires may be the greatest "threat" to the active dunes, as suggested by some researchers to date. However, the unique processes and plant assemblages here could also be adversely affected by increased visitation, including both large groups and more frequent visits. Currently, the relative remoteness of the active dune field seems to restrict visitation or limit most activity to the Kavet Creek area.

These suggestions are not meant to be inclusive; there were many areas of ARCN the author has not seen at all and so cannot comment on. We hope our I&M inventory work will be useful for future inventory planners, for future monitoring programs, and to offer some insight into the more floristically diverse, interesting, and potentially fragile areas within the network.

As a final note, one of the surprises that emerged from our total effort was in the comparison between the expected species list described in Chapter 3 with our actual list of newly documented species. For each unit, we found many species that were not expected (and many that were, of course). The indisputable and challenging message that must be drawn is that the flora of all of northwestern Alaska was and probably remains poorly known.

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APPENDIX
LIST OF VASCULAR PLANT SPECIES DOCUMENTED FOR THE ARCTIC NETWORK PARKLANDS

This appendix is a list of the 706 species of vascular plants documented for the entire Arctic Network parklands by collections held at the University of Alaska Museum of the North Herbarium, Fairbanks (ALA). This list includes species collected as a result of this I&M inventory as well as those documented by earlier collections that are held at ALA. An X in the right-hand column indicates in which of the five park units each species is found. A check may represent a single, or several, collections from within the indicated park unit for that species. Plant families are listed alphabetically and species names follow alphabetically within each family. Names in larger type are those currently used at ALA. The indented names in smaller type are nomenclatural or taxonomic synonyms: other names for the same species used in the literature of the Alaska and northern flora.

A few Latinized abbreviations are used here. They are:

- s. lat.: *sensu lato*, the broad sense of the species is being used
- s. str.: *sensu stricto*, the narrow sense of the species is being used
- aggr.: an aggregate, or complex, of several, possibly closely related species is included under this name, and their taxonomic relationships remain poorly understood
- pro parte: indicates the plants once considered under this synonym have been split into more than one taxon, and the name listed above applies to only one of the newly defined taxa
- auct., non: indicates name has been misapplied for the Alaskan flora but still commonly appears in the literature

Exact location, habitat, and other information for each record can be found on the ALA database website at http://arctos.database.museum/. The same ALA information, in addition to that for the collections held at NPS-Alaska herbaria, can be found on the NPSpecies website at https://science1.nature.nps.gov/npspecies/web/main/start.

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Adoxaceae					
Adoxa moschatellina L.	X	X	X	X	X
Apiaceae					
Angelica lucida L. *Angelica gmelinii* (DC.) Pimenov	X	X	X	X	
Bupleurum americanum J. M. Coult. & Rose *Bupleurum triradiatum* auct., non J. E. Adams *B. arcticum* (Regel) Krasnob.	X	X	X	X	X
Cicuta virosa L. *Cicuta mackenzieana* Raup.				X	
Cnidium cnidiifolium (Turcz.) Schischk.	X	X	X	X	X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Conioselinum pacificum (S.Watson) J. M. Coult. & Rose *Conioselinum chinense* auct., non (L.) BSP.	X	X			
Heracleum lanatum Michx.	X	X	X		
Ligusticum scoticum L. ssp. *hulténii* (Fernald) Calder & Taylor	X	X			
Podistera macounii (J. M. Coult. & Rose) Mathias & Constance *Ligusticum mutellinoides* auct., non (Crantz) Willar	X				
Asteraceae					
Achillea sibirica Ledeb. *Achillea multiflora* Hook.	X				
Antennaria alpina (L.) G. Gaertn.	X	X			
Antennaria friesiana (Trautv.) E. Ekman	X		X	X	X
Antennaria friesiana (Trautv.) E. Ekman ssp. *alaskana* (Malte) Hultén	X	X	X	X	X
Antennaria friesiana (Trautv.) E. Ekman ssp. *friesiana*	X	X	X		X
Antennaria monocephala DC.		X	X	X	X
Antennaria monocephala DC. ssp. *angustata* (Greene) Hultén	X				
Antennaria monocephala DC. ssp. *monocephala*	X		X		
Antennaria pulcherrima (Hook.) Greene			X		
Arctanthemum arcticum (L.) Tzvelev s. lat. *Chrysanthemum arcticum* L. *Dendranthema arctica* (L.) Tzvelev	X	X			
Arnica angustifolia Vahl ssp. *angustifolia* *Arnica alpina* auct., non (L.) Olin		X	X		X
Arnica griscomii Fernald ssp. *frigida* (C. A. Mey. ex Iljin) S. J. Wolf *Arnica frigida* C. A. Mey.	X	X	X	X	X
Arnica lessingii Greene	X		X		X
Artemisia alaskana Rydb.			X		
Artemisia arctica Less.	X	X	X	X	X
Artemisia borealis Pall.	X		X	X	X
Artemisia comata Rydb.			X		X
Artemisia frigida Willd.			X		X
Artemisia furcata M. Bieb.	X	X	X	X	X
Artemisia globularia Cham. ex Besser	X				X
Artemisia glomerata Ledeb.	X		X		X
Artemisia tilesii Ledeb.	X	X	X	X	X
Chrysanthemum bipinnatum L. *Tanacetum bipinnatum* (L.) Sch. Bip.	X			X	
Chrysanthemum integrifolium Richardson *Hulténiella integrifolia* (Richardson) Tzvelev		X	X	X	X
Crepis elegans Hook.			X		
Crepis nana Richardson			X	X	X
Erigeron acris L. ssp. *politus* (Fr.) Schinz & R. Keller			X	X	
Erigeron denalii A. Nelson *Erigeron purpuratus* pro parte			X		

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Erigeron elatus Greene			X	X	X
Erigeron eriocephalus J. Vahl			X		X
Erigeron humilis Graham	X	X	X	X	X
Erigeron hyperboreus Greene	X	X	X	X	X
Erigeron muirii A. Gray *Erigeron grandiflorus* Hook. ssp. *muirii* (A. Gray) Hultén			X		
Erigeron pallens Cronquist *Erigeron purpuratus* pro parte			X		X
Erigeron porsildii Nesom & Murray *Erigeron grandiflorus* Hook. ssp. *arcticus* A. E. Porsild					X
Erigeron purpuratus Greene		X	X		X
Eurybia sibirica (L.) G. L. Nesom *Aster sibiricus* L.	X	X	X	X	X
Packera cymbalaria (Pursh) W. A. Weber & A. Löve *Senecio resedifolius* Less.	X	X	X	X	X
Packera hyperborealis (Greenm.) A. Löve & D. Löve *Senecio hyperborealis* Greenm.			X	X	
Packera ogotorukensis (Packer) A. Löve & D. Löve *Senecio ogotorukensis* Packer	X	X	X	X	X
Petasites frigidus (L.) Fr. ssp. *frigidus*	X	X	X	X	X
Petasites frigidus (L.) Fr. ssp. *nivalis* (Greene) Cody *Petasites hyperboreus* Rydb.			X		X
Saussurea angustifolia (Willd.) DC. includes *Saussurea angustifolia* (Willd.) DC. ssp. *yukonensis* (A. E. Porsild) Cody	X	X	X	X	X
Saussurea nuda Ledeb.	X	X			
Saussurea triangulata Trautv. & C. A.Mey.				X	
Senecio lugens Richardson	X	X	X	X	X
Senecio pseudoarnica Less.		X			
Solidago multiradiata Aiton s. lat.	X	X	X	X	X
Symphyotrichum yukonense (Cronquist) G. L. Nesom *Aster yukonensis* Cronq.			X	X	X
Taraxacum alaskanum Rydb.	X	X	X		X
Taraxacum ceratophorum (Ledeb.) DC.	X	X	X	X	X
Taraxacum hyparcticum Dahlst.		X	X		
Taraxacum kamtschaticum Dahlst.	X		X		
Taraxacum lacerum Greene			X		
Taraxacum phymatocarpum J. Vahl	X	X	X	X	X
Tephroseris frigida (Richardson) Holub *Senecio atropurpureus* (Ledeb.) B. Fedtsch. spp. *frigidus* (Richards.) Hultén	X	X	X	X	X
Tephroseris kjellmanii (A. E. Porsild) Holub *Senecio atropurpureus* (Ledeb.) B. Fedtsch. ssp. *tomentosus* (Kjellm.) Hultén	X		X		X
Tephroseris lindstroemii (Ostenf.) A. Löve & D. Löve *Senecio fuscatus* auct., non (Jord. & Fourr.) Hayek		X	X	X	X
Tephroseris palustris (L.) Fourr. ssp. *congesta* (R. Br.) Holub *Senecio congestus* (R. Br.) DC.	X	X	X		X

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Tephroseris yukonensis (A. E. Porsild) Holub *Senecio yukonensis* A. E. Porsild	X				
Tripleurospermum phaeocephalum (Rupr.) Pobed.	X	X			
Betulaceae					
Alnus incana (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung *Alnus tenuifolia* Nutt.			X		
Alnus viridis (Vill.) DC. ssp. *fruticosa* (Rupr.) Nyman *Alnus crispa* auct., non (Aiton) Pursh ssp. *crispa*	X	X	X	X	X
Betula glandulosa Michx.	X	X	X	X	X
Betula hybrids	X		X	X	
Betula nana L. ssp. *exilis* (Sukaczev) Hultén	X	X	X	X	X
Betula neoalaskana Sarg. *Betula papyrifera* auct., non Marshall			X	X	X
Betula occidentalis Hook.	X		X		X
Boraginaceae					
Amsinckia lycopsoides Lehm.	X				
Eritrichium aretioides (Cham.) DC.	X	X	X	X	X
Eritrichium chamissonis DC.	X		X		X
Eritrichium splendens Kearney	X	X		X	X
Mertensia maritima (L.) A. Gray	X	X			
Mertensia paniculata (Aiton) G. Don s. lat.	X	X	X	X	X
Myosotis alpestris F. W. Schmidt ssp. *asiatica* Vestergr.	X	X	X	X	X
Brassicaceae					
Aphragmus eschscholtzianus Andrz.			X		
Arabidopsis mollis (Hook.) O. E. Schulz *Halimolobus mollis* (Hook.) Rollins *Transberingia bursifolia* (DC.) Al-Shehbaz & O'Kane					X
Arabis hirsuta (L.) Scop. ssp. *pycnocarpa* (M. Hopkins) Hultén					X
Arabis kamchatica Fisch. *Arabis lyrata* L. ssp. *kamchatica* (Fisch.) Hultén	X	X	X	X	X
Barbarea orthoceras Ledeb.	X	X	X		X
Braya glabella Richardson *Braya bartlettiana* Jordal	X	X	X	X	X
Cardamine bellidifolia L.	X	X	X	X	X
Cardamine digitata Richardson *Cardamine hyperborea* O. E. Schulz	X	X	X	X	X
Cardamine microphylla J. E. Adams ssp. *blaisdellii* (Eastw.) D. F. Murray & S. Kelso *Cardamine microphylla* auct., non J. E. Adams	X		X	X	
Cardamine pratensis L. ssp. *angustifolia* (Hook.) O. E. Schulz	X	X	X	X	X
Cardamine purpurea Cham. & Schltdl.	X	X		X	X
Cochlearia officinalis L. ssp. *arctica* (Schltdl.) Hultén	X				
Cochlearia officinalis L. ssp. *oblongifolia* (DC.) Hultén	X	X			
Descurainia sophioides (Fisch.) O. E. Schulz	X	X	X		X
Draba alpina L.			X	X	X

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Draba borealis DC.	X				
Draba cana Rydb. *Draba lanceolata* auct., non Royle	X	X			X
Draba cinerea J. E. Adams	X	X	X	X	X
Draba corymbosa R. Br. ex DC. *Draba macrocarpa* Adams	X	X	X	X	X
Draba exalata E. Ekman *Draba ruaxes* Payson & St. John	X				
Draba fladnizensis Wulfen	X	X	X		X
Draba glabella Pursh *Draba hirta* L.	X	X	X	X	X
Draba juvenilis Kom. *Draba longipes* Raup	X	X	X	X	X
Draba lactea J. E. Adams			X		
Draba lonchocarpa Rydb.			X		
Draba macounii O. E. Schulz			X		
Draba nivalis Lilj.	X	X	X	X	
Draba palanderiana Kjellman *Draba caesia* auct., non Hultén	X	X	X	X	X
Draba pauciflora R. Br.			X		
Draba pilosa Adams		X	X		X
Draba stenoloba Ledeb.	X				
Draba stenopetala Trautv.	X		X	X	
Erysimum cheiranthoides L.	X			X	
Erysimum inconspicuum (S. Watson) MacMill. *Erysimum coarctatum* Fernald					X
Erysimum pallasii (Pursh) Fernald	X	X	X	X	X
Eutrema edwardsii R. Br.	X	X	X	X	X
Lesquerella arctica (Wormsk.) S. Watson	X	X	X	X	X
Parrya nudicaulis (L.) Regel s. lat.	X	X	X	X	X
Parrya nudicaulis (L.) Regel ssp. *interior* Hultén	X		X	X	X
Parrya nudicaulis (L.) Regel ssp. *nudicaulis*	X				X
Parrya nudicaulis (L.) Regel ssp. *septentrionalis* Hultén	X		X	X	
Rorippa palustris (L.) Besser *Rorippa islandica* auct., non (Oeder) Borb.				X	
Rorippa palustris (L.) Besser ssp. *hispida* (Desv.) Jonsell *Rorippa hispida* (Desv.) Britt.			X		
Rorippa palustris (L.) Besser ssp. *palustris* *Rorippa islandica* auct., non (Oeder) Borb. pro parte	X		X		X
Smelowskia borealis (Greene) W. H. Drury & Rollins			X		X
Smelowskia porsildii (W. H. Drury & Rollins) Jurtzev *Smelowskia calycina* (Stephan) C. A. Mey. var. *porsildii* (W. H. Drury & Rollins) Hultén			X	X	X
Smelowskia spathulafolia Velichkin *Smelowskia calycina* (Stephan) C. A. Mey. var. *integrifolia* (Seemann) Rollins	X		X	X	
Subularia aquatica L.			X		

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Thlaspi arcticum A. E. Porsild *Noccaea arctica* (A. E. Porsild) Holub.			X		
Torularia humilis (C. A. Mey.) O. E. Schulz s. lat. *Braya humilis* (C. A. Mey.) Robins.	X	X	X	X	X
Torularia humilis (C. A. Mey.) O. E. Schulz ssp. *arctica* Böcher *Braya humilis* (C. A. Mey.) Robins. ssp. *arctica* (Böcher) Rollins	X				
Torularia humilis (C. A. Mey.) O. E. Schulz ssp. *richardsonii* (Rydb.) comb. nov. *Braya humilis* (C. A. Mey.) Robins. ssp. *richardsonii* (Rydb.) Hultén					X
Callitrichaceae					
Callitriche hermaphroditica L.	X		X	X	
Callitriche palustris L. *Callitriche verna* L. emend Lonnr.	X		X		
Campanulaceae					
Campanula aurita Greene			X		
Campanula lasiocarpa Cham.	X	X	X	X	X
Campanula uniflora L.	X	X	X	X	X
Caprifoliaceae					
Linnaea borealis L. s. lat.	X	X	X	X	X
Linnaea borealis L. ssp. *americana* (J. Forbes) Hultén		X			X
Viburnum edule (Michx.) Raf.			X	X	X
Caryophyllaceae					
Arenaria capillaris Poir. *Eremogone capillaris* (Poir.) Fenzl var. *capillaris*			X		X
Arenaria longipedunculata Hultén		X	X	X	X
Cerastium beeringianum Cham. & Schltdl.	X	X	X	X	X
Cerastium beeringianum Cham. & Schltdl. var. *grandiflorum* Hultén	X		X		X
Cerastium jenisejense Hultén	X				
Dianthus repens Willd.			X	X	X
Gastrolychnis affinis (J. Vahl) Tolm. & Kozhanch. *Melandrium affine* J. Vahl *Silene involucrata* (Cham. & Schlecht.) Bocquet ssp. *involucrata*	X	X	X		X
Gastrolychnis apetala (L.) Tolm. & Kozhanch. *Melandrium apetalum* (L.) Fenzl *Silene uralensis* (Rupr.) Bocquet. ssp. *uralensis*	X	X	X	X	X
Gastrolychnis macrosperma (A. E. Porsild) Tolm. & Kozhanch. *Melandrium macrospermum* A. E. Porsild *Silene soczaviana* (Schischk.) Bocquet var. *macrosperma* (A. E. Porsild) V. V. Petrovsky	X	X	X		
Gastrolychnis ostenfeldii (A. E. Porsild) V. V. Petrovsky *Melandrium taimyrense* Tolm. *Silene ostenfeldii* (A. E. Porsild) V. V. Petrovsky			X		X

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Gastrolychnis taylorae (B. L. Rob.) D. F. Murray *Melandrium taylorae* (Robins.) Tolm. *Silene involucrata* (Cham. & Schlecht.) Bocquet ssp. *tenella* (Tolm.) Bocquet	X			X	X
Honckenya peploides (L.) Ehrh. s. lat.	X	X			
Minuartia arctica (Steven) Böcher	X	X	X	X	X
Minuartia biflora (L.) Schinz & Thell.	X		X		X
Minuartia elegans (Cham. & Schltdl.) Schischk.	X	X	X	X	X
Minuartia macrocarpa (Pursh) Ostenf.	X	X	X	X	X
Minuartia obtusiloba (Rydb.) House	X		X	X	X
Minuartia rossii (R. Br.) Graebn.	X	X	X	X	X
Minuartia rubella (Wahlenb.) Graebn.	X	X	X	X	X
Minuartia stricta (Sw.) Hiern					X
Minuartia yukonensis Hultén					X
Moehringia lateriflora (L.) Fenzl	X	X	X	X	X
Sagina nivalis (Lindblom) Fr. *Sagina intermedia* Fenzl	X		X		X
Sagina saginoides (L.) H. Karst.	X				
Silene acaulis L.		X	X	X	X
Silene repens Patrin	X				X
Stellaria alaskana Hultén			X		
Stellaria borealis Bigelow ssp. *borealis*	X		X		
Stellaria calycantha (Ledeb.) Bong.	X		X	X	X
Stellaria crassifolia Ehrh.	X	X	X		X
Stellaria dicranoides (Cham. & Schltdl.) Fenzl *Arenaria chamissonis* Maguire *Cherleria dicranoides* Cham. & Schltdl	X	X		X	X
Stellaria edwardsii R. Br.	X	X	X		X
Stellaria humifusa Rottb.	X	X			
Stellaria laeta Richardson	X	X	X	X	X
Stellaria longifolia Muhl. ex Willd.			X		
Stellaria longipes Goldie	X	X	X	X	X
Stellaria monantha Hultén	X		X		X
Stellaria umbellata Turcz.	X		X		
Wilhelmsia physodes (Fisch.) McNeill	X	X	X	X	X
Chenopodicaceae					
Atriplex gmelinii C. A. Mey. ex Bong.	X	X			
Chenopodium glaucum L. *Chenopodium salinum* Standl.	X				
Corispermum ochotense Ignatov var. *alaskanum* Mosyakin *Corispermum hyssopifolium* auct., non L.				X	
Cornaceae					
Cornus suecica L.	X		X	X	
Cornus unalaschkensis Ledeb.			X		

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Crassulaceae					
Rhodiola integrifolia Raf. *Sedum rosea* (L.) Scop. ssp. *integrifolium* (Raf.) Hultén	X	X	X	X	X
Cupressaceae					
Juniperus communis L. ssp. *depressa* Pursh		X	X	X	X
Cyperaceae					
Carex albonigra Mack.			X		
Carex aquatilis Wahlenb.	X	X	X	X	X
Carex atrofusca Schkuhr	X	X	X	X	X
Carex aurea Nutt.			X	X	X
Carex bicolor All.	X	X	X	X	X
Carex bigelowii Torr. ssp. *lugens* (Holm) T. V. Egorova includes *C. bigelowii* s. lat., (in AK)	X	X	X	X	X
Carex brunnescens (Pers.) Poir.			X	X	
Carex canescens L.	X		X	X	
Carex capillaris L. includes *Carex fuscidula* V. I. Krecz.	X	X	X	X	X
Carex capitata L.	X	X	X		X
Carex chordorrhiza Ehrh.	X	X	X	X	X
Carex concinna R. Br.		X	X	X	X
Carex crawfordii Fernald			X		
Carex deflexa Hornem.			X		
Carex diandra Schrank			X	X	
Carex eleusinoides Turcz.	X		X		
Carex filifolia Nutt.				X	
Carex fuliginosa Schkuhr ssp. *misandra* (R. Br.) Nyman *Carex misandra* R. Br.	X	X	X	X	X
Carex garberi Fernald *Carex garberi* Fernald ssp. *bifaria* (Fernald) Hultén			X	X	X
Carex glacialis Mack.	X	X	X	X	X
Carex glareosa Wahlenb.	X	X			
Carex gmelinii Hook. & Arn.	X	X			
Carex gynocrates Wormsk. ex Drej. *Carex dioica* L. ssp. *gynocrates* (Wormsk.) Hultén	X		X	X	
Carex heleonastes Ehrh.			X		
Carex holostoma Drejer	X	X			X
Carex krausei Boeck.		X	X	X	X
Carex lachenalii Schkuhr	X	X	X	X	X
Carex lapponica O.Lang			X	X	
Carex lenticularis Michx. var. *lipocarpa* (T. Holm) L. A. Standley *Carex kelloggii* W. Boott				X	
Carex leptalea Wahlenb.			X		
Carex limosa L.			X	X	
Carex livida (Wahlenb.) Willd.	X		X		

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Carex lyngbyei Hornem.	X	X			
Carex mackenziei V. I. Krecz.	X	X			
Carex marina Dewey *Carex amblyorhyncha* V. I. Krecz.	X	X	X		X
Carex maritima Gunnerus		X	X		X
Carex media R. Br.	X	X	X		X
Carex membranacea Hook.	X	X	X	X	X
Carex microchaeta Holm ssp. *microchaeta*	X		X		X
Carex microchaeta Holm ssp. *nesophila* (Holm) D. F. Murray	X				
Carex microglochin Wahlenb.				X	
Carex micropoda C. A. Mey. *Carex pyrenaica* Wahl. ssp. *micropoda* (C. A. Mey.) Hultén	X				
Carex nardina Fr. *Carex hepburnii* Boott	X		X	X	X
Carex obtusata Lilj.	X	X	X	X	X
Carex petricosa Dewey	X	X	X	X	X
Carex podocarpa R. Br.	X	X	X	X	X
Carex praticola Rydb.	X				
Carex ramenskii Kom.	X	X			
Carex rariflora (Wahlenb.) Sm.	X	X	X	X	X
Carex rostrata Stokes				X	
Carex rotundata Wahlenb.	X	X	X	X	X
Carex rupestris All.		X	X		X
Carex saxatilis L.	X	X	X	X	X
Carex scirpoidea Michx.	X	X	X	X	X
Carex stylosa C. A. Mey.	X	X			
Carex subspathacea Wormsk.	X				
Carex supina Willd. ssp. *spaniocarpa* (Steud.) Hultén				X	X
Carex tenuiflora Wahlenb.			X	X	X
Carex utriculata Boott	X		X	X	
Carex vaginata Tausch	X	X	X	X	X
Carex viridula Michx. *Carex oederi* Retz.				X	
Carex williamsii Britton	X	X	X		X
Eleocharis acicularis (L.) Roem. & Schult.	X		X	X	
Eleocharis erythropoda Steud.				X	
Eleocharis kamtschatica (C. A. Mey.) Kom.				X	
Eleocharis palustris (L.) Roem. & Schult.	X		X	X	X
Eriophorum angustifolium Honck.	X	X	X	X	X
Eriophorum angustifolium Honck. ssp. *triste* (Th. Fr.) Hultén *Eriophorum triste* (Th. Fr.) Hadac & A. Löve			X		
Eriophorum brachyantherum Trautv.	X		X		

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Eriophorum callitrix Cham.	X	X	X	X	X
Eriophorum chamissonis C. A. Mey. *Eriophorum russeolum* Fr.	X	X	X	X	X
Eriophorum gracile W. D. J. Koch			X		
Eriophorum scheuchzeri Hoppe	X	X	X	X	X
Eriophorum vaginatum L.	X	X	X	X	X
Eriophorum viridicarinatum (Engelm.) Fernald			X		
Kobresia myosuroides (Vill.) Fiori & Paol.	X	X	X		X
Kobresia sibirica Turcz.	X	X	X		X
Kobresia simpliciuscula (Wahlenb.) Mack. s. lat.		X	X	X	X
Trichophorum alpinum (L.) Pers.			X	X	
Trichophorum cespitosum (L.) C. Hartm.	X		X	X	
Diapensiaceae					
Diapensia lapponica L. ssp. *obovata* (F. Schmidt) Hultén	X	X	X	X	X
Droseraceae					
Drosera anglica Huds.			X	X	
Drosera rotundifolia L.			X	X	
Dryopteridaceae					
Athyrium filix-femina (L.) Roth ssp. *cyclosòrum* (Rupr.) Christens.			X		
Cystopteris fragilis (L.) Bernh. includes *Cystopteris fragilis* (L.) Bernh. ssp. *dickieana* (R. Sim) Hyl.	X	X	X	X	X
Cystopteris montana (Lam.) Bernh.	X	X			
Dryopteris expansa (C. Presl) Fraser-Jenk. & Jermy *Dryopteris dilatata* auct., non (Hoffman) A. Gray			X	X	
Dryopteris fragrans (L.) Schott	X	X	X	X	X
Gymnocarpium dryopteris (L.) Newman			X		
Gymnocarpium jessoense (Koidz.) Koidz. ssp. *parvulum* Sarvela *Gymnocarpium robertianum* auct., non (Hoff.) Newm.	X				
Polystichum lonchitis (L.) Roth				X	
Woodsia alpina (Bolton) Gray	X			X	
Woodsia glabella R. Br.	X	X	X	X	X
Woodsia ilvensis (L.) R. Br.		X	X	X	X
Elaeagnaceae					
Shepherdia canadensis (L.) Nutt.		X	X	X	X
Empetraceae					
Empetrum nigrum L. s. lat. includes *Empetrum nigrum* L. ssp. *hermaphroditum* (Lange) Böcher	X	X	X	X	X
Equisetaceae					
Equisetum arvense L.	X	X	X	X	X
Equisetum fluviatile L.	X	X	X	X	X
Equisetum palustre L.		X	X	X	X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Equisetum pratense Ehrh.	X	X	X		X
Equisetum scirpoides Michx.	X	X	X	X	X
Equisetum silvaticum L.			X	X	
Equisetum variegatum Schleich.	X	X	X	X	X
Ericaceae					
Andromeda polifolia L.	X	X	X	X	X
Arctostaphylos uva-ursi (L.) Sprengel		X	X	X	
Arctous alpina (L.) Nied. *Arctostaphylos alpina* (L.) Spreng.	X	X	X	X	X
Arctous rubra (Rehder & E. H. Wilson) Nakai *Arctostaphylos rubra* (Rehder & E. H. Wilson) Fernald	X	X	X	X	X
Cassiope tetragona (L.) D. Don ssp. *tetragona*	X	X	X	X	X
Chamaedaphne calyculata (L.) Moench			X	X	X
Ledum groenlandicum Oeder			X		
Ledum palustre L. ssp. *decumbens* (Aiton) Hultén	X	X	X	X	X
Loiseleuria procumbens (L.) Desv.	X	X	X	X	X
Oxycoccus microcarpus Turcz. ex Rupr.	X	X	X	X	X
Rhododendron camtschaticum Pall. ssp. *glandulosum* (Standl.) Hultén	X				
Rhododendron lapponicum (L.) Wahlenb.	X	X	X	X	X
Vaccinium uliginosum L.	X	X	X	X	X
Vaccinium vitis-idaea L. ssp. *minus* (Lodd.) Hultén	X	X	X	X	X
Fabaceae					
Astragalus aboriginum Richardson s. lat. includes *Astragalus lepagei* Hultén	X		X	X	X
Astragalus alpinus L.	X	X	X	X	X
Astragalus alpinus L. ssp. *alaskanus* Hultén	X				
Astragalus alpinus L. ssp. *arcticus* (Bunge) Hultén					X
Astragalus nutzotinensis J. Rousseau			X		
Astragalus polaris Benth.	X		X		X
Astragalus robbinsii A. Gray					X
Astragalus sealei Lepage *Astragalus eucosmus* Hornem. ssp. *sealei* (Lepage) Hultén		X	X		X
Astragalus umbellatus Bunge	X	X	X	X	X
Astragalus williamsii Rydb.			X		
Hedysarum alpinum L. ssp. *americanum* (Michx.) B. Fedtsch.	X	X	X	X	X
Hedysarum hedysaroides (L.) Schinz & Thell.	X				X
Hedysarum mackenzii Richardson	X	X	X	X	X
Lathyrus japonicus Willd. *Lathyrus maritimus* L.	X	X			
Lupinus arcticus S. Watson	X	X	X	X	X
Lupinus kuschei Eastw.				X	
Oxytropis arctica R. Br. var. *arctica*	X		X		
Oxytropis arctica R. Br. var. *barnebyana* S. L. Welsh	X	X			X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Oxytropis borealis DC.	X	X	X	X	X
Oxytropis bryophila (Greene) Jurtzev *Oxytropis nigrescens* (Pall.) Fisch. ssp. *bryophila* (Greene) Hultén includes *O. nigrescens* ssp. *pygmaea* (Pall.) Hultén includes *O. gorodkovi* Jurtsev	X	X	X	X	X
Oxytropis deflexa (Pall.) DC. ssp. *foliolosa* (Hook.) Barneby			X		X
Oxytropis jordalii A. E. Porsild *Oxytropis campestris* (L.) DC. ssp. *jordalii* (A. E. Porsild) Hultén		X	X	X	X
Oxytropis kobukensis S. L. Welsh				X	
Oxytropis kokrinensis A. E. Porsild			X	X	X
Oxytropis koyukukensis A. E. Porsild	?		X		
Oxytropis maydelliana Trautv.	X	X	X	X	X
Oxytropis mertensiana Turcz.	X		X	X	X
Oxytropis scammaniana Hultén			X		X
Oxytropis tananensis Jurtzev					X
Oxytropis varians (Rydb.) K. Schum. *Oxytropis campestris* (L.) DC. ssp. *gracilis* (Nels.) Hultén					X
Oxytropis viscida Nutt.					X
Fumariaceae					
Corydalis pauciflora (Stephan) Pers. *Corydalis arctica* Popov.	X	X	X	X	X
Corydalis sempervirens (L.) Pers.				X	
Gentianaceae					
Gentiana glauca Pall.	X	X	X	X	X
Gentiana prostrata Haenke	X	X	X		X
Gentianella propinqua (Richardson) J. M. Gillett *Gentiana propinqua* Richardson	X	X	X	X	X
Gentianella tenella (Rottb.) Börner *Gentiana tenella* Rottb. *Comastoma tenella* (Rottb.) Toyok.	X	X			
Gentianopsis detonsa (Rottb.) Malte *Gentiana detonsa* Rottb.		X			
Lomatogonium rotatum (L.) Fr. ssp. *rotatum*	X	X			
Lomatogonium rotatum (L.) Fr. ssp. *tenuifolium* (Griseb.) A. E. Porsild			X	X	X
Menyanthes trifoliata L.	X	X	X	X	
Grossulariaceae					
Ribes triste Pall.			X	X	X
Haloragaceae					
Hippuris tetraphylla L.f. *Hippuris lanceolata* Retz.	X	X			
Hippuris vulgaris L.	X	X	X	X	X
Myriophyllum sibiricum Kom. *Myriophyllum spicatum* auct., non L.			X		X
Iridaceae					
Iris setosa Pall.	X	X	X	X	

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Isoetaceae					
Isoetes echinospora Durieu			X		
Junaceae					
Juncus alpinoarticulatus Chaix *Juncus alpinus* Villars				X	
Juncus arcticus Willd. ssp. *alaskanus* Hultén	X	X	X	X	X
Juncus biglumis L.	X	X	X	X	X
Juncus bufonius L. ssp. *ranarius* (Nees ex Song. & Perrier) Hiit.	X	X			
Juncus castaneus Sm.	X	X	X	X	X
Juncus filiformis L.			X		
Juncus stygius L.			X		
Juncus triglumis L. includes *Juncus triglumis* L. ssp. *albescens* (Lange) Hultén	X	X	X	X	X
Luzula arctica Blytt *Luzula nivalis* (Laest.) Beurl.		X	X	X	X
Luzula arcuata (Wahlenb.) Sw. ssp. *unalaschcensis* (Buchenau) Hultén includes *Luzula arcuata* (Wahlenb.) Sw. ssp. *arcuata* sensu Hultén	X	X	X	X	X
Luzula confusa Lindeb.	X	X	X	X	X
Luzula kjellmaniana Miyabe & Kudo *Luzula tundricola* Gorodk.	X	X	X	X	X
Luzula multiflora (Ehrh.) Lej. ssp. *frigida* (Buchenau) V. I. Krecz.	X	X	X	X	X
Luzula parviflora (Ehrh.) Desv.	X	X	X	X	
Luzula rufescens Fisch.	X				X
Luzula wahlenbergii Rupr.	X	X		X	X
Juncaginaceae					
Triglochin maritima L.	X	X	X	X	
Triglochin palustris L.		X	X	X	X
Lentibulariceae					
Pinguicula villosa L.	X				
Pinguicula vulgaris L.	X	X	X	X	X
Utricularia intermedia Hayne	X		X	X	X
Utricularia minor L.		X	X	X	X
Utricularia vulgaris L. ssp. *macrorhiza* (Leconte) R. T. Clausen	X	X	X	X	X
Liliaceae					
Allium schoenoprasum L. ssp. *sibiricum* (L.) Hartm.	X	X	X	X	X
Lloydia serotina (L.) Rchb.		X	X	X	X
Tofieldia coccinea Richardson	X	X	X	X	X
Tofieldia pusilla (Michx.) Pers.	X	X	X	X	X
Veratrum album L. var. *oxysepalum* (Turcz.) B. Boivin *Veratrum oxysepalum* Turcz.	X		X	X	X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Zigadenus elegans Pursh *Anticlea eleagans* (Pursh) Rydb.	X	X	X	X	X
Linaceae					
Linum lewisii Pursh *Linum perenne* L. ssp. *lewisii* (Pursh) Hultén			X		
Lycopodiaceae					
Diphasiastrum alpinum (L.) Holub *Lycopodium alpinum* L.	X	X	X	X	
Diphasiastrum complanatum (L.) Holub *Lycopodium complanatum* (L.) Holub			X	X	X
Huperzia selago (L.) Bernh. ex Schrank & Mart. *Lycopodium selago* L.	X	X	X	X	X
Lycopodium annotinum L. includes *Lycopodium annotinum* L. ssp. *pungens* (Bach. Pyl.) Hultén includes *L. annotinum* L. var. *alpestre* (C. Hartm.) A. Löve & D. Löve	X	X	X	X	X
Lycopodium clavatum L. ssp. *monostachyon* (Grev. & Hook.) Sel. *Lycopodium lagopus* (Laest. ex C. Hartm.) G. Zinserl. ex Kuzen.	X	X	X	X	X
Lycopodium dendroideum Michx. *Lycopodium obscurum* L. var. *dendroideum* (Michx.) D.C. Eaton			X		
Myricaceae					
Myrica gale L.			X	X	
Nymphaeaceae					
Nuphar polysepala Engelm.			X	X	
Onagraceae					
Circaea alpina L.			X		
Epilobium anagallidifolium Lam.	X		X		X
Epilobium angustifolium L. *Chamerion angustifolium* (L.) Holub	X	X	X	X	X
Epilobium ciliatum Raf. ssp. *ciliatum* *Epilobium adenocaulon* Haussk. pro parte			X		
Epilobium ciliatum Raf. ssp. *glandulosum* (Lehm.) Hoch & P. H. Raven *Epilobium glandulosum* Lehm.	X				
Epilobium davuricum Fisch.	X	X	X		X
Epilobium hornemannii Rchb. ssp. *behringianum* (Hausskn.) Hoch & P. H. Raven *Epilobium behringianum* Haussk.			X		
Epilobium hornemannii Rchb. ssp. *hornemannii*	X		X		
Epilobium latifolium L. *Chamerion latifolium* (L.) Holub	X	X	X	X	X
Epilobium palustre L.	X	X	X	X	X
Ophioglossaceae					
Botrychium lunaria (L.) Sw.	X	X	X	X	
Botrychium minganense Vict.		X	X		

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Orchidaceae					
Amerorchis rotundifolia (Banks) Hultén			X	X	
Coeloglossum viride (L.) C. Hartm.	X	X	X		X
Corallorrhiza trifida Chatel.	X	X	X	X	X
Cypripedium guttatum Sw.			X		
Cypripedium parviflorum Salisb. *Cypripedium calceolus* L. ssp. *parviflorum* (Salisb.) Hultén			X		
Cypripedium passerinum Richardson		X	X	X	X
Goodyera repens (L.) R. Br.				X	
Listera borealis Morong		X		X	X
Platanthera aquilonis Sheviak *Platanthera hyperborea* (L.) Lindl.	X		X	X	
Platanthera obtusata (Banks ex Pursh) Lindl.	X	X	X	X	X
Spiranthes romanzoffiana Cham.			X	X	
Orobanchaceae					
Boschniakia rossica (Cham. & Schltdl.) B. Fedtsch.	X		X	X	X
Papaveraceae					
Papaver hultenii Knaben var. *salmonicolor* Hultén			X		
Papaver lapponicum (Tolm.) Nordh. s. lat.	X	X	X		X
Papaver macounii Greene ssp. *discolor* (Hultén) Rändel ex D. F. Murray	X	X	X	X	X
Papaver mcconnellii Hultén *Papaver denalii* Gjærevoll *P. alaskanum* Hultén pro parte			X		
Papaver radicatum Rottb. s. lat.			X		X
Papaver radicatum Rottb. ssp. *alaskanum* (Hultén) J. P. Anderson *Papaver alaskanum* Hultén pro parte			X		X
Papaver walpolei A. E. Porsild	X	X		X	X
Pinaceae					
Picea glauca (Moench) Voss	X	X	X	X	X
Picea mariana (Mill.) Britton, Sterns, Poggenb.			X	X	
Plantaginaceae					
Plantago canescens J. E. Adams			X	X	X
Plumbaginaceae					
Armeria maritima (Mill.) Willd. *Armeria scabra* Pall. ex Roem. & Schult.	X	X	X	X	X
Poaceae					
Agrostis scabra Willd.	X		X	X	
Agrostis trinii Turcz.			X		
Alopecurus aequalis Sobol.	X			X	
Alopecurus alpinus Sm. *Alopecurus borealis* Trin.	X	X	X		
Arctagrostis arundinacea (Trin.) Beal *Arctagrostis latifolia* (R. Br.) Griseb. var. *arundinacea* (Trin.) Griseb.	X		X		

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Arctagrostis latifolia (R. Br.) Griseb. var. *latifolia*	X	X	X	X	X
Arctophila fulva (Trin.) Andersson	X	X	X	X	X
Beckmannia syzigachne (Steud.) Fernald *Beckmannia erucaeformis* auct., non (L.) Host				X	
Bromopsis ciliata (L.) Holub *Bromus ciliatus* L.					X
Bromopsis pumpelliana (Scribn.) Holub *Bromus pumpellianus* Scribn.			X	X	X
Bromopsis pumpelliana (Scribn.) Holub ssp. *arctica* (Shear) A. Löve & D. Löve *Bromus pumpellianus* Scribn. var. *arcticus* (Shear) Porsild	X	X			X
Bromopsis pumpelliana (Scribn.) Holub ssp. *pumpelliana* *Bromus pumpellianus* Scribn. var. *pumpellianus*		X	X		X
Calamagrostis canadensis (Michx.) P. Beauv.	X	X	X	X	X
Calamagrostis canadensis (Michx.) P. Beauv. ssp. *canadensis*	X				
Calamagrostis canadensis (Michx.) P. Beauv. ssp. *langsdorffii* (Link) Hultén	X	X	X		X
Calamagrostis deschampsioides Trin.	X	X			
Calamagrostis lapponica (Wahlenb.) C. Hartm.	X	X	X	X	X
Calamagrostis purpurascens R. Br.	X	X	X	X	X
Calamagrostis stricta (Timm) Koeler *Calamagrostis neglecta* (Ehrh.) G. Gaertn, E. Mey. & Scherb.	X	X	X	X	X
Calamagrostis stricta (Timm) Koeler ssp. *inexpansa* (A. Gray) C. W. Greene *Calamagrostis inexpansa* A. Gray	X		X	X	
Deschampsia brevifolia R. Br.		X	X		X
Deschampsia cespitosa (L.) P. Beauv. ssp. *cespitosa*	X		X	X	X
Deschampsia cespitosa (L.) P. Beauv. ssp. *orientalis* Hultén *Deschampsia sukatschewii* (Popl.) Roshev ssp. *orientalis* (Hultén) Tzvelev in Tolm.	X	X	X		
Deschampsia cespitosa (L.) P. Beauv. var. *glauca* (C. Hartm.) Sam. *Deschampsia* '*glauca*' auct.	X				X
Dupontia fisheri R. Br. s. lat.	X	X	X		X
Elymus alaskanus (Scribn. & Merr.) A. Löve *Agropyron boreale (*Turcz.) Drobov ssp. *alaskanum* (Scribn. & Merr.) Melderis	X	X	X	X	X
Elymus alaskanus (Scribn. & Merr.) A. Löve ssp. *alaskanus*					X
Elymus alaskanus (Scribn. & Merr.) A. Löve ssp. *borealis* (Turcz.) A. Löve & D. Löve *Agropyron boreale* (Turcz.) Drobov ssp. *boreale*		X	X		X
Elymus alaskanus (Scribn. & Merr.) A. Löve ssp. *hyperarcticus* (Polunin) A. Löve & D. Löve *Agropyron boreale* (Turcz.) Drobov ssp. *hyperarcticum* (Polunin) Melderis	X		X		X
Elymus alaskanus (Scribn. & Merr.) A. Löve ssp. *latiglumis* (Scribn. & Sm.) A. Löve *Agropyron boreale* s.lat.			X	X	X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Elymus macrourus (Turcz.) Tzvelev *Agropyron macrourum* (Turcz.) Drobov			X	X	X
Elymus trachycaulus (Link) Gould ex Shinners *Agropyron violaceum* s.lat.		X	X		X
Elymus trachycaulus (Link) Gould ex Shinners ssp. *andinus* (Scribn. & Sm.) A. Löve & D. Löve *Agropyron violaceum* (Hornem.) Lange ssp. *andinum* (Scribn. & Sm.) Melderis		X			X
Elymus trachycaulus (Link) Gould ex Shinners ssp. *trachycaulus* *Agropyron violaceum* s.lat.			X		X
Elymus trachycaulus (Link) Gould ex Shinners ssp. *violaceus* (Hornem.) A. Löve & D. Löve *Agropyron violaceum* (Hornem.) Lange ssp. *violaceum*		X	X	X	X
Festuca altaica Trin.	X	X	X	X	X
Festuca baffinensis Polunin	X	X	X	X	X
Festuca brachyphylla Schult. & Schult.f.	X	X	X	X	X
Festuca brevissima Jurtzev	X	X	X		X
Festuca edlundiae S. G. Aiken, Consaul & Lefk.			X		
Festuca lenensis Drobow		X	X	X	X
Festuca rubra L. ssp. *richardsonii* (R.Br.) Hultén	X	X	X	X	X
Festuca rubra L. ssp. *rubra*	X		X		X
Festuca vivipara (L.) Sm. *Festuca viviparoidea* Krajina ex L. E. Pavlick			X		
Glyceria pulchella (Nash) Schumach.				X	
Glyceria striata (Lam.) Hitchc.			X		
Hierochloe alpina (Sw.) Roem. & Schult.	X	X	X	X	X
Hierochloe odorata (L.) P. Beauv. ssp. *arctica* (C. Presl) Tzvelev *Hierochloe hirta* (Schrank) Borbás ssp. *arctica* (J. Presl) G. Weim.	X	X	X	X	X
Hierochloe pauciflora R. Br.	X	X	X		X
Leymus innovatus (Beal) Pilg. *Elymus innovatus* Beal			X	X	X
Leymus mollis (Trin.) Pilg. *Elymus arenarius* L. ssp. *mollis* (Trin.) Hultén	X	X		X	
Leymus mollis (Trin.) Pilg. ssp. *villosissimus* (Scribn.) A. Löve & D. Löve *Elymus arenarius* L. ssp. *mollis* (Trin.) Hultén var. *villosissimus* (Scribn.) Hultén	X	X		X	
Phippsia algida (Sol.) R. Br.	X		X		
Poa abbreviata R. Br. ssp. *pattersonii* (Vasey) A. Löve, D. Löve & B. M. Kapoor			X		
Poa alpina L.	X	X	X	X	X
Poa arctica R. Br.	X	X	X	X	X
Poa arctica R. Br. ssp. *arctica*			X		
Poa arctica R. Br. ssp. *lanata* (Scribn. & Merr.) Soreng *Poa lanata* Scribn. & Merr.	X		X		
Poa arctica R. Br. var. *vivipara* Hook.			X		

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Poa eminens J. Presl	X	X			
Poa glauca Vahl	X	X	X	X	X
Poa palustris L.				X	X
Poa paucispicula Scribn. & Merr.	X	X	X	X	
Poa pratensis L. ssp. *alpigena* (Lindm.) Hiitonen	X	X	X	X	X
Poa pseudoabbreviata Roshev.			X		X
Puccinellia borealis Swallen		X			
Puccinellia hauptiana (V. I. Krecz.) Kitag.	X				
Puccinellia phryganodes (Trin.) Scribn. & Merr. ssp. *phryganodes*	X	X			
Puccinellia vaginata (Lange) Fernald & Weath.	X	X			
Puccinellia vahliana (Liebm.) Scribn. & Merr. *Colpodium vahlianum* (Liebm.) Nevski			X		X
Puccinellia wrightii (Scribn. & Merr.) Tsvel. *Colpodium wrightii* Scribn. & Merr.	X				X
Schizachne purpurascens (Torr.) Swallen			X		
Trisetum spicatum (L.) K. Richt.	X		X	X	X
Trisetum spicatum (L.) K. Richt. ssp. *molle* (Michx.) Hultén	X	X	X		X
Trisetum spicatum (L.) K. Richt. ssp. *spicatum*	X	X	X		X
X_Dupoa labradorica (Steud.) J. Cay. & Darbysh.	X	X			
Polemoniaceae					
Phlox alaskensis Jordal *Phlox sibirica* auct., non L.	X	X	X	X	X
Polemonium acutiflorum Willd.	X	X	X	X	X
Polemonium boreale J. E. Adams	X		X		X
Polemonium pulcherrimum Hook. spp. *lindleyi* (Wherry) V. E. Grant	X				
Polygonaceae					
Bistorta plumosa (Small) Greene *Polygonum bistorta* L. ssp. *plumosum* (Small) Hultén	X	X	X	X	X
Bistorta vivipara (L.) Gray *Polygonum viviparum* L.	X	X	X	X	X
Koenigia islandica L.	X		X		X
Oxyria digyna (L.) Hill	X		X	X	X
Polygonum alaskanum (Small) W. Wight *Aconogonon alaskanum* W. Wight ex Harshb.	X		X	X	
Polygonum amphibium L. *Persicaria amphibia* (L.) Gray				X	
Polygonum caurianum B. L. Rob.			X	X	
Rumex acetosa L. includes *Rumex acetosa* L. ssp. *alpestris* (Scop.) A. Löve includes *Rumex acetosa* L. ssp. *lapponicus* Hiitonen	X		X	X	X
Rumex arcticus Trautv.	X	X	X	X	X
Rumex crispus L.	X				
Rumex krausei Jurtzev & V. V. Petrovsky		X			X

Family/Species	BELA	CAKR	GAAR	KOVA	NOAT
Polypodiaceae					
Polypodium sibiricum Sipliv. *Polypodium vulgare* auct., non L.			X		
Portulaceae					
Claytonia eschscholtzii Cham. *Claytonia acutifolia* auct., non Pall. ex Willd.	X	X	X	X	X
Claytonia sarmentosa C. A. Mey.	X		X	X	X
Claytonia scammaniana Hultén			X		X
Claytonia tuberosa Pall.		X			
Montia fontana L. *Montia lamprosperma* Cham.	X	X		X	
Potamogetonaceae					
Potamogeton alpinus Balb. ssp. *tenuifolius* (Raf.) Hultén		X	X	X	X
Potamogeton foliosus Raf.				X	
Potamogeton friesii Rupr.			X		
Potamogeton gramineus L.		X	X	X	X
Potamogeton praelongus Wulfen			X		
Potamogeton pusillus L. ssp. *tenuissimus* (Mert. & W. D. J. Koch) R. R. Haynes & Hellq. *Potamogeton berchtoldii* Fieb.					X
Potamogeton richardsonii (A. Bennett) Rydb. *Potamogeton perfoliatus* L. ssp. *richardsonii* (Bennett) Hultén			X	X	
Potamogeton subsibiricus Hagstr.		X			
Potamogeton zosteriformis Fernald				X	
Stuckenia filiformis (Pers.) Börner *Potamogeton filiformis* Pers.	X	X	X		X
Stuckenia pectinata (L.) Börner *Potamogeton pectinatus* L.		X	X	X	
Stuckenia vaginata (Turcz.) Holub *Potamogeton vaginatus* Turcz.				X	X
Primulaceae					
Androsace chamaejasme Host	X	X	X	X	X
Androsace septentrionalis L.	X	X	X	X	X
Dodecatheon frigidum Cham. & Schltdl.	X	X	X	X	X
Douglasia beringensis S. Kelso, Jurtzev & D. F. Murray	X				
Douglasia ochotensis (Willd.) Hultén			X		X
Primula anvilensis S. Kelso	X	X			X
Primula borealis Duby	X	X			
Primula egaliksensis Wormsk.		X	X		X
Primula eximia Greene *Primula tschuktschorum* Kjellm. var. *arctica* (Koidz.) Fern. *Primula pumila* (Ledeb.) Pax	X				
Primula mistassinica Michx.				X	X
Primula nutans Georgi *Primula sibirica* auct., non		X			

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Primula tschuktschorum Kjellman *Primula tschuktschorum* Kjellm. var. *tschuktschorum*	X				
Trientalis europaea L.	X		X	X	
Pteridaceae					
Cryptogramma stelleri (S. G. Gmel.) Prantl		X		X	X
Pyrolaceae					
Moneses uniflora (L.) A. Gray		X	X	X	X
Orthilia secunda (L.) House ssp. *obtusata* (Turcz.) Böcher *Pyrola secunda* House ssp. *obtusata* (Turcz.) Hultén	X	X	X	X	X
Pyrola asarifolia Michx. var. *purpurea* (Bunge) Fernald *Pyrola asarifolia* Michx. var. *incarnata* (Fisch.) Fernald	X	X	X	X	X
Pyrola chlorantha Sw.				X	
Pyrola grandiflora Radius	X	X	X	X	X
Pyrola minor L.	X	X	X		
Ranunculaceae					
Aconitum delphinifolium DC. includes *Aconitum delphinifolium* DC. ssp. *paradoxum* (Rchb.) Hultén	X	X	X	X	X
Anemone drummondii S. Watson var. *lithophila* (Rydb.) C. L. Hitchc.			X	X	X
Anemone multiceps (Greene) Standl.	X	X	X	X	X
Anemone narcissiflora L. s. lat.	X	X	X	X	X
Anemone parviflora Michx.	X	X	X	X	X
Anemone patens L. var. *multifida* Pritzel *Pulsatilla patens* (L.) Mill. ssp. *multifida* (Pritzel) Zamels	X		X	X	
Anemone richardsonii Hook.	X	X	X	X	X
Caltha natans Pall.	X	X			
Caltha palustris L. s. lat. includes *Caltha palustris* L. ssp. *arctica* (R. Br.) Hultén	X	X	X	X	X
Delphinium brachycentrum Ledeb. *Delphinium chamissonis* Pritz.	X	X	X		X
Delphinium glaucum S. Watson			X	X	
Oxygraphis glacialis (Fisch.) Bunge *Ranunculus kamtschaticus* DC.			X		
Ranunculus aquatilis L. s. lat. *Batrachium aquatile* (L.) Dumort. s. lat.		X	X		X
Ranunculus gelidus Kar. & Kir. ssp. *grayi* (Britton) Hultén	X		X		X
Ranunculus glacialis L. ssp. *camissonis* (Schltdl.) Hultén *Ranunculus camissonis* Schltdl. *Beckwithia camissonis* (Schltdl.) Tolm. *Ranunculus glacialis* L. var. *camissonis* (Schltdl.) L. D. Benson			X		X
Ranunculus gmelinii DC.	X		X	X	X
Ranunculus hyperboreus Rottb.	X	X	X		X
Ranunculus lapponicus L.	X	X	X	X	X
Ranunculus monophyllus Ovczinn. aggr. *Ranunculus auricomus* L. s. lat.	X				X

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Ranunculus nivalis L.	X	X	X	X	X
Ranunculus pallasii Schltdl.	X	X	X		X
Ranunculus pedatifidus Sm. ssp. *affinis* (R. Br.) Hultén *Ranunculus arcticus* Richardson	X	X	X		X
Ranunculus pygmaeus Wahlenb.	X		X		X
Ranunculus reptans L.			X	X	
Ranunculus sulphureus Sol.	X		X		X
Thalictrum alpinum L.	X	X	X	X	X
Thalictrum sparsiflorum Turcz.			X	X	
Rosaceae					
Acomastylis rossii (R. Br.) Greene *Geum rossii* (R. Br.) Ser.	X		X	X	X
Comarum palustre L. *Potentilla palustris* (L.) Scop.	X	X	X	X	X
Dryas alaskensis A. E. Porsild *Dryas octopetala* L. ssp. *alaskensis* (A. E. Porsild) Hultén	X	X	X	X	X
Dryas drummondii Richardson			X		
Dryas integrifolia Vahl ssp. *integrifolia*	X	X	X	X	X
Dryas integrifolia Vahl ssp. *sylvatica* (Hultén) Hultén *Dryas sylvatica* (Hultén) A. E. Porsild	X	X	X		X
Dryas octopetala L s. lat. includes *Dryas ajanensis* Jurtsev includes *Dryas incisa* Jurtsev	X	X	X	X	X
Novosieversia glacialis (J. E. Adams) F. Bolle *Geum glaciale* Adams	X		X	X	X
Pentaphylloides floribunda (Pursh) A. Löve *Potentilla fruticosa* L. *Dasiphora fruticosa* (L.) Rydb.	X	X	X	X	X
Potentilla arenosa (Turcz.) Jurtsev					X
Potentilla biflora Willd. ex Schltdl.	X	X	X	X	X
Potentilla egedii Wormsk.	X	X			
Potentilla elegans Cham. & Schltdl.	X		X		
Potentilla fragiformis Willd.		X			
Potentilla hookeriana Lehm. s. lat.	X	X	X	X	X
Potentilla hyparctica Malte s. lat.	X		X		X
Potentilla nivea L.	X		X		X
Potentilla norvegica L.			X	X	
Potentilla pensylvanica L.			X		X
Potentilla rubricaulis Lehm.			X		X
Potentilla stipularis L.					X
Potentilla uniflora Ledeb.	X	X	X	X	X
Potentilla villosa Pall. ex Pursh	X	X			
Potentilla virgulata A. Nelson		X	X		X
Rosa acicularis Lindl. s. lat.	X		X	X	X
Rubus arcticus L. s. lat.	X		X	X	X
Rubus arcticus L. ssp. *acaulis* (Michx.) Focke		X			X

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Rubus arcticus L. ssp. *arcticus*	X	X	X		
Rubus arcticus L. ssp. *stellatus* (Sm.) Boiv. *Rubus stellatus* Sm.	X				
Rubus chamaemorus L.	X	X	X	X	X
Rubus idaeus L. ssp. *melanolasius* (Dieck) Focke			X		
Sanguisorba officinalis L.		X	X	X	X
Sibbaldia procumbens L.	X		X		
Spiraea stevenii (C. K. Schneid.) Rydb. *Spiraea beauverdiana* auct., non C. K. Schneid.	X	X	X	X	X
Rubiaceae					
Galium boreale L.	X	X	X	X	X
Galium brandegei A. Gray	X	X			
Galium trifidum L. ssp. *trifidum*	X	X	X	X	
Salicaceae					
Populus balsamifera L. ssp. *balsamifera*	X	X	X	X	X
Populus tremuloides Michx.			X	X	
Salix alaxensis (Andersson) Coville	X	X	X	X	X
Salix alaxensis (Andersson) Coville var. *alaxensis*	X	X	X	X	
Salix alaxensis (Andersson) Coville var. *longistylis* (Rydb.) C. K. Schneid.			X	X	
Salix arbusculoides Andersson		X	X		X
Salix arctica Pall.	X	X	X	X	X
Salix barclayi Andersson			X		
Salix bebbiana Sarg.			X	X	
Salix chamissonis Andersson	X	X	X	X	X
Salix fuscescens Andersson	X	X	X	X	X
Salix glauca L.	X	X	X	X	X
Salix glauca L. ssp. *acutifolia* (Hook.) Hultén	X	X	X	X	X
Salix glauca L. ssp. *stipulifera* (Flod. ex Hayren) Hiitonen	X	X	X		
Salix hastata L.	X	X	X	X	X
Salix niphoclada Rydb. *Salix brachycarpa* Nutt. ssp. *niphoclada* (Rydb.) Argus	X	X	X	X	X
Salix ovalifolia Trautv. s. lat.	X				
Salix ovalifolia Trautv. var. *arctolitoralis* (Hultén) Argus	X	X			
Salix ovalifolia Trautv. var. *ovalifolia*	X	X		X	
Salix phlebophylla Andersson	X	X	X	X	X
Salix polaris Wahlenb.	X		X	X	X
Salix pseudomonticola C. R. Ball			X		
Salix pseudomyrsinites Andersson			X		
Salix pulchra Cham. *Salix planifolia* Pursh ssp. *pulchra* (Cham.) Argus	X	X	X	X	X
Salix reticulata L.	X	X	X	X	X
Salix richardsonii Hook. *Salix lanata* L. ssp. *richardsonii* (Hook.) A. K. Skvortsov	X	X	X	X	X
Salix rotundifolia Trautv.	X	X	X	X	X

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Salix sphenophylla A. K. Skvortsov				X	X
Santalaceae					
Geocaulon lividum (Richardson) Fernald			X	X	
Saxifragaceae					
Boykinia richardsonii (Hook.) A. Gray	X	X	X	X	X
Chrysosplenium tetrandrum (N. Lund) Th. Fr.	X	X	X	X	X
Chrysosplenium wrightii Franch. & Sav.			X		
Parnassia kotzebuei Cham. & Schltdl.	X	X	X	X	X
Parnassia palustris L.	X	X	X	X	X
Saxifraga arctolitoralis Jurtz. & Petrovsky *Saxifraga rivularis* L. pro parte	X				
Saxifraga bronchialis L. ssp. *funstonii* (Small) Hultén *Saxifraga funstonii* (Small) Fed.	X	X	X	X	X
Saxifraga caespitosa L.	X	X	X		X
Saxifraga calycina Sternb.	X		X		X
Saxifraga cernua L.	X	X	X		X
Saxifraga eschscholtzii Sternb.			X	X	X
Saxifraga flagellaris Willd. ssp. *setigera* (Pursh) Tolm.	X	X	X	X	X
Saxifraga foliolosa R. Br.	X	X	X		X
Saxifraga hieracifolia Waldst. & Kit. includes *Saxifraga hieracifolia* Waldst. & Kit. ssp. *longifolia* (Engl. & Irmsch.) Jurtz. & V. V. Petrovsky	X	X	X	X	X
Saxifraga hirculus L.	X	X	X	X	X
Saxifraga hyperborea R. Br. *Saxifraga rivularis* L. pro parte		X	X		X
Saxifraga nelsoniana D. Don *Saxifraga punctata* L. ssp. *nelsoniana* (D. Don) Hultén	X	X	X	X	X
Saxifraga nivalis L.	X		X	X	X
Saxifraga nudicaulis D. Don	X				
Saxifraga oppositifolia L. includes *Saxifraga oppositifolia* L. ssp. *smalliana* (Engl. & Irmsch.) Hultén	X	X	X	X	X
Saxifraga radiata Small *Saxifraga exilis* Stephan	X	X			
Saxifraga razshivinii Zhmylev			X		
Saxifraga reflexa Hook.	X	X	X	X	X
Saxifraga serpyllifolia Pursh	X		X		X
Saxifraga spicata D. Don	X	X	X	X	X
Saxifraga tenuis (Wahlenb.) Harry Sm.	X		X		X
Saxifraga tricuspidata Rottb.		X	X		X
Scrophulariaceae					
Castilleja annua Pennell			X		
Castilleja elegans Malte	X		X	X	X
Castilleja hyperborea Pennell	X	X	X	X	X

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Castilleja pallida (L.) Sprengel var. *caudata* (Pennell) B. Boivin *Castilleja caudata* (Pennell) Rebrist. sensu Hultén	X	X	X	X	X
Lagotis glauca G. Gaertn. ssp. *minor* (Willd.) Hultén	X	X	X	X	X
Pedicularis albolabiata (Hultén) Kozhevn. *Pedicularis sudetica* Willd. ssp. *albolabiata* Hultén	X	X	X	X	X
Pedicularis arctoeuropaea (Hultén) Molau & D. F. Murray *Pedicularis sudetica* Willd. ssp. *arctoeuropaea* Hultén			X		X
Pedicularis capitata J. E. Adams	X	X	X	X	X
Pedicularis interior (Hultén) Molau & D. F. Murray *Pedicularis sudetica* Willd. ssp. *interior* Hultén	X		X	X	X
Pedicularis labradorica Wirsing	X	X	X	X	X
Pedicularis lanata Cham. & Schltdl. *Pedicularis kanei* Durand *Pedicularis alopecuroides* Adams ex Stev.	X	X	X	X	X
Pedicularis langsdorffii Fisch. ex Steven	X	X	X	X	X
Pedicularis lapponica L.					X
Pedicularis oederi Vahl		X	X	X	X
Pedicularis pacifica (Hultén) Kozhevn. *Pedicularis sudetica* Willd. ssp. *pacifica* Hultén	X	X	X		
Pedicularis parviflora Sm. ssp. *pennellii* (Hultén) Hultén *Pediculuaris pennellii* Hultén	X	X			X
Pedicularis sudetica Willd. s. lat.	X		X	X	X
Pedicularis verticillata L.		X	X	X	X
Veronica wormskjoldii Roem. & Schult.			X		
Selaginellaceae					
Selaginella selaginoides (L.) Link		X	X		X
Selaginella sibirica (Milde) Hieron.	X	X	X	X	X
Sparganiaceae					
Sparganium angustifolium Michx.			X		
Sparganium hyperboreum Laest.	X	X	X	X	X
Thelypteridaceae					
Phegopteris connectilis (Michx.) Watt *Thelypteris phegopteris* (L.) Sloss.			X		
Valerianaceae					
Valeriana capitata Pall.	X	X	X	X	X
Violaceae					
Viola biflora L.	X	X		X	
Viola epipsila Ledeb. ssp. *repens* (Turcz.) W. Becker	X	X	X	X	X
Zannichelliaceae					
Zannichellia palustris L.		X			
Zosteraceae					
Zostera angustifolia Rchb. *Zostera marina* auct., non L.	X				