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Rare Vascular Plants of the North Slope

A Review of the Taxonomy, Distribution, and Ecology of 31 Rare Plant Taxa That Occur in Alaska's North Slope Region

Helen Cortés-Burns, Matthew L. Carlson, Robert Lipkin, Lindsey Flagstad, and David Yokel

The Alaska Natural Heritage Program

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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Abstract

The taxonomy, distribution, and ecology of rare, imperiled, and critically imperiled vascular plants of Alaska's North Slope are summarized in this report. These data are synthesized to aid the Bureau of Land Management's Arctic Field Office in protecting the natural floristic resources of the region and the National Petroleum Reserve - Alaska in particular.

After discussions with local experts and reviewing the Alaska Natural Heritage Program rare plant database and the University of Alaska Museum database, it was determined that 31 rare plant taxa occur on the North Slope. Of this total, 8 taxa are globally rare to imperiled, while the remainder are more globally widespread, but with few populations in Alaska. Eight taxa are ranked as critically imperiled in the state and either occur, or are considered very likely to occur, within the boundaries of the National Petroleum Reserve - Alaska. None of the 31 taxa are listed by the U.S. Fish and Wildlife Service as Threatened or Endangered, and only 14 are included in the Bureau of Land Management - Alaska's sensitive species list.

Acknowledgments

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Alaska's North Slope Flora: Origins, Diversity, and Distribution

Effective natural resource management requires the best data and information available to protect the resources mandated by agency policy or law. This report synthesizes relevant botanical information on Alaska's North Slope flora, with special attention paid to the region's imperiled and rare species. This effort is largely prompted by current and expected oil exploration and development in the Bureau of Land Management's National Petroleum Reserve - Alaska (NPR-A). To better understand the patterns of plant rarity observed in this work, we first provide a brief review of the North Slope's climatic and physiographic properties, as well as the historic and current factors that have forged the current diversity of the arctic flora.

Biophysical characteristics of the North Slope

The arctic flora of Alaska is primarily restricted to the treeless tundra north of the Brooks Range and west along the Bering Strait as far south as the Pribilof Islands (Hultén 1968). Because floristic elements are strongly influenced by the abiotic environment, we briefly summarize climatic and geologic patterns of the region.

Geographical extent of our study area

In this work, we use the "Arctic Slope Boundary" GIS coverage (Alaska Geobotany Center, http://www.geobotany.uaf.edu/data/alaska/) to define our area of interest. The Arctic Slope region (hereafter synonymous with North Slope), as treated here, is delimited by Demarcation Bay to the east, Barrow to the north, Cape Lisburne to the west, and the spine of the Brooks Range to the south (**Figure 1**).

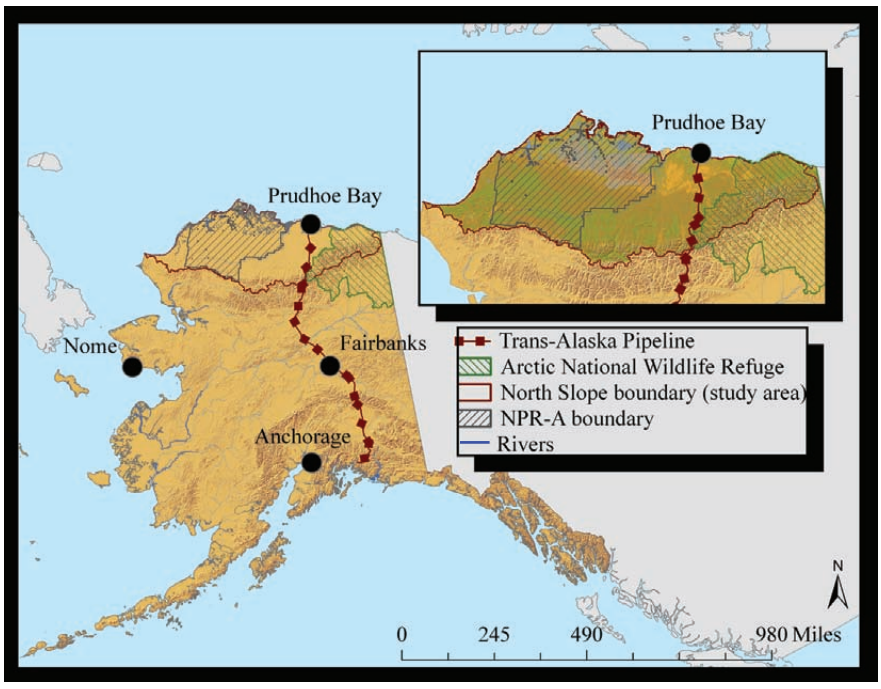

Figure 1. Demarcation of the Arctic or North Slope region as defined in this work.

Climate

Temperatures on the Arctic Coastal Plain average from –10 to –12 ºC annually. Mean July temperatures are 10 ºC north of the Brooks Range and 4 ºC north of 70º latitude. The period of growth is only 60 days, which is half that of interior Alaska and one-third that of southern maritime Alaska (Hultén 1968). Permafrost is continuous north of the northern portion of the Seward Peninsula and discontinuous south along the Bering Strait. Annual precipitation is relatively low (20–25 cm); however, soils are often saturated due to permafrost and low transpiration rates (Hultén 1968).

Physiography

The North Slope is comprised of 3 ecoregions. These are, from south to north, the Brooks Range, the Brooks Foothills, and the Arctic Coastal Plain (**Figures 2 and 3**).

The Arctic Coastal Plain is a broad, low basin covered with Quaternary deposits and scattered with lakes and ponds, tundra polygons, and ice wedges (Hultén 1968). It is separated from the Yukon basin by the Brooks Foothills and the Brooks Range, which extend westward from the Alaska–Yukon border almost to the Bering Sea. The Brooks mountain range has substantial elevation, with peaks over 2000 m and some passes over 800 m (Hultén 1968). The geology of the Arctic Coastal Plain and Brooks Range

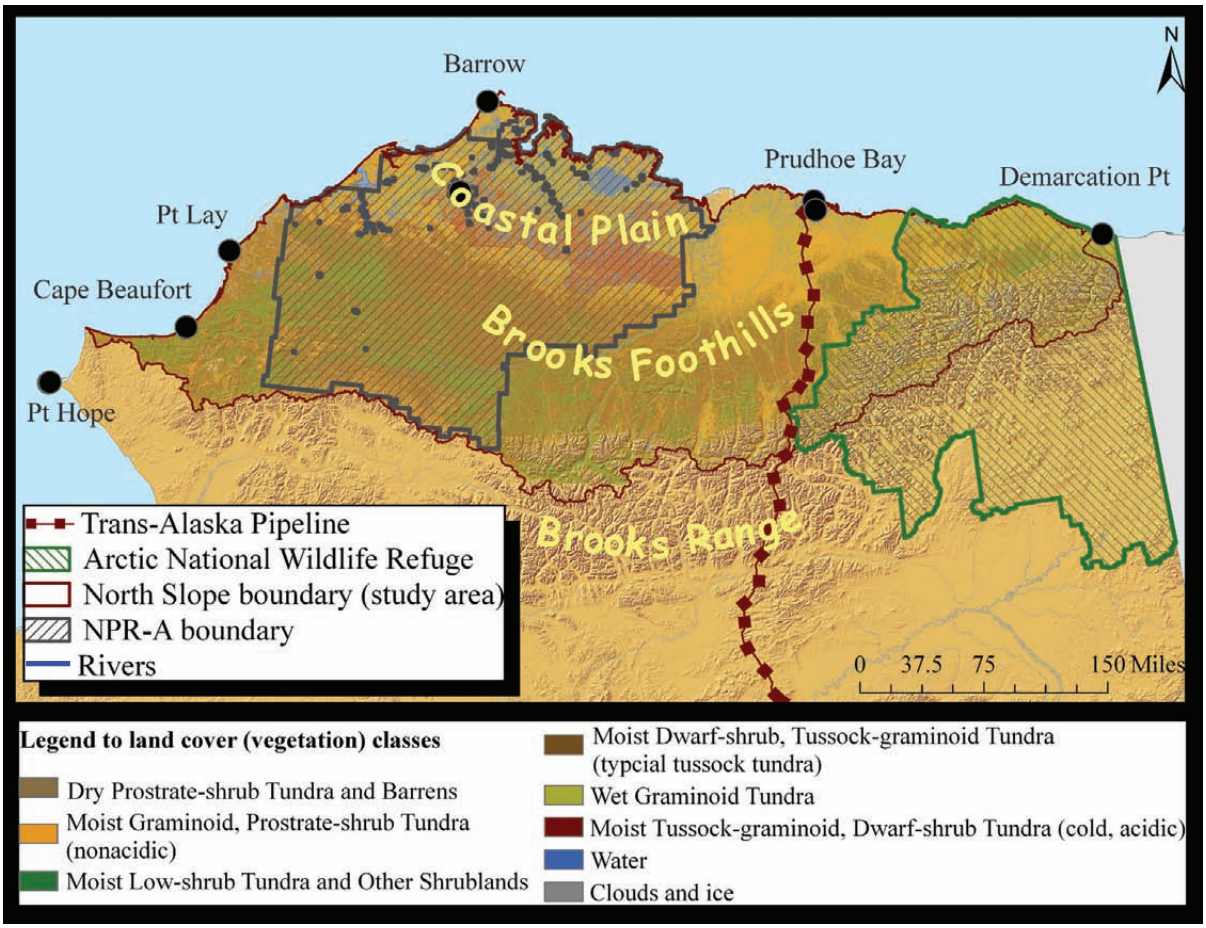

Figure 2. Map showing the boundaries of the North Slope region (brown line), the 3 physiographic regions that it comprises (Arctic Coastal Plain, Brooks Foothills, and Brooks Range), and the boundaries of the Arctic National Wildlife Refuge (green line fill) and the National Petroleum Reserve–Alaska (dark grey line fill).

Figure 3. Typical views of the Brooks Range, Brooks Foothills and Arctic Coastal Plain ecoregions (© Steve Beukema).

is diverse. The plain is primarily composed of Quaternary surficial deposits and Tertiary sedimentary rocks (sands, silts, and marine deposits), while the Brooks Range consists of Cretaceous sedimentary rocks on the northern slope, and Cretaceous to Upper Devonian sedimentary rocks (marine shale, sandstone, limestone, and chert) on the southern side (Moore et al. 1994).

At various times during the Pleistocene ice ages (1.5 Ma –10 ka), glaciation caused eustatic lowering of sea level, exposing an area of land that joined present-day Alaska with eastern Siberia (**Figure 4a**). This land bridge, called Beringia, extended from the present-day Aleutian Islands to just north of the Kamchatka Peninsula in Russia, and from the Mackenzie River delta in Canada to the Kolyma and Indigirka rivers in Siberia (Hopkins 1967).

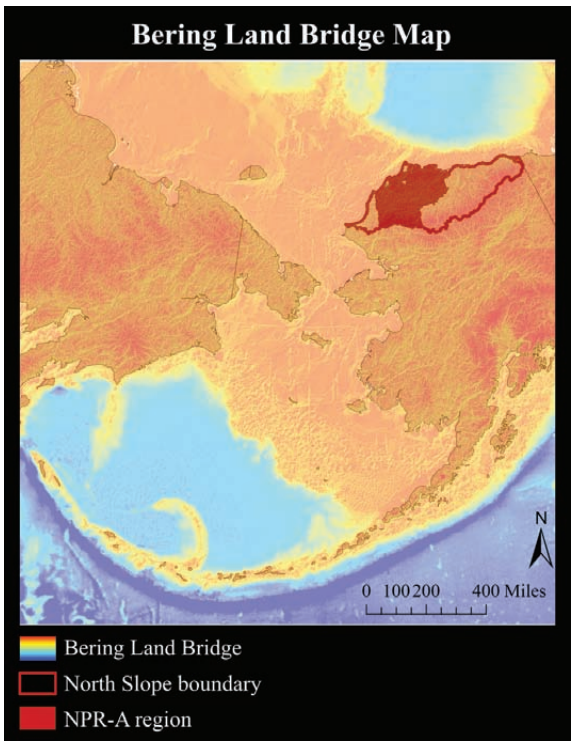

Figure 4a. Map showing the extent of Beringia during the ice ages generated using Manley's (2002) digital elevation model of the Bering Sea land bridge.

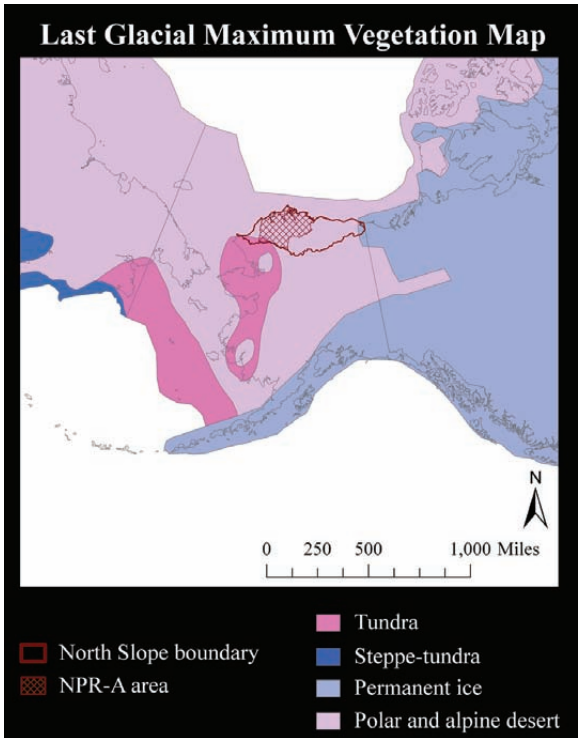

Figure 4b. Last Glacial Maximum vegetation map of the Bering Sea area modified from Ray and Adams (2001). Alaska consisted of a mosaic of steppe-tundra, tundra, and polar and alpine desert vegetation, while the ice sheets extended south and east of the state.

The land bridge itself remained largely ice-free during the Last Glacial Maximum (21 ka –18 ka), even though ice sheets extended to the south, east, and west of Beringia (**Figure 4a**). However, by separating the Pacific and Arctic oceans, the land bridge obstructed the warm air masses coming from the Pacific, causing them to lose most of their moisture as snowfall over the Aleutian and Alaska Ranges. In consequence, most of Alaska north of the Alaska Range had a predominantly cold and dry continental climate (Guthrie 1990) and consisted of a mosaic of steppe-tundra and polar and alpine desert vegetation (Ray and Adams 2001) (**Figure 4b**).

North Slope bioclimatic zones

The Circumpolar Arctic Vegetation (CAVM) Team describes 9 vegetation types and 3 bioclimatic subzones in the area that spans the North Slope of Alaska (CAVM Team 2003):

1. Middle Arctic Tundra (subzone C)
   a. Area: extreme north of Alaska, from Pt. Franklin west to Atigaru Pt., and north to Barrow
   b. Mean July temperatures: 5 to 7 ºC
   c. Dominant vegetation type: wetlands dominated by sedges, grasses, mosses, and tundra dominated by dwarf, semiprostrate shrubs (< 15 cm tall)
   d. Typical species richness: 75–150 vascular plants
   e. Examples of rare plant taxa studied in this work that are found primarily in the Middle Arctic Tundra subzone include: *Draba micropetala*, *Draba pauciflora*, *Poa hartzii* ssp. *alaskana*, *Pleuropogon sabinei*, and *Ranunculus sabinei*.
2. Southern Arctic Dwarf Shrub Tundra (subzone D)
   a. Area: abutting subzone C south to the Brooks Foothills
   b. Mean July temperatures: warmer than subzone C (7 to 9 ºC)
   c. Dominant vegetation type: tundra and wetlands dominated by mosses, sedges, herbaceous plants, and dwarf shrubs (< 40 cm tall)
   d. Typical species richness: 125–250 vascular plants
   e. Examples of rare plant taxa studied in this work that are found primarily in the Southern Arctic Dwarf Shrub Tundra subzone include: *Erigeron muirii*, *Koeleria asiatica*, *Oxygraphis glacialis*, and *Smelowskia media*.
3. Southern Arctic Shrub Tundra (subzone E):
   a. Area: from the Brooks Foothills to the southern limit of the Brooks Range mountains and along western Alaska
   b. Mean July temperatures: 9 to 12 ºC
   c. Dominant vegetation type: mosses, sedges, herbaceous plants, dwarf shrubs and tall shrubs
   d. Typical species richness: 200–500 vascular plants
   e. Examples of rare plant taxa studied in this work that are found primarily in the Southern Arctic Shrub Tundra subzone include: *Carex holostoma* and *Puccinellia wrightii*.

Origins of Alaska's arctic flora

Alaska's present-day arctic flora has been shaped by the following 4 biogeographical events: (1) the survival of late Tertiary species in ice-free refugia, (2) the migration of alpine species from more southerly latitudes during the Quaternary glaciations, (3) in-place (in situ)

speciation processes, and (4) recent long-distance dispersal events. Below we describe how each one of these factors has contributed to the development of Alaska's arctic flora.

1. Survival of species in ice-free refugia

During the late Tertiary (25 Ma –10 Ma), temperate-boreal forests covering much of the North Slope region of Alaska were dominated by species such as spruce, hemlock, hazelnut, and larch (based on fossils from the Seward Peninsula) (Murray 1995). Some of the shrubby and herbaceous plants that are now restricted to open bogs, riparian, and well-drained upland habitats (e.g., *Boykinia richardsonii*, **Figure 5**) are remnants of this late Tertiary forest, which extended from arctic North America to Asia prior to the Quaternary glaciations (Murray 1995). Genera such as *Draba* sp., *Papaver* sp., *Saxifraga* sp., and *Stellaria* sp., which are treated here, also have representatives that are relics from this late Tertiary, treed vegetation (Murray 1995).

Figure 5. *Boykinia richardsonii* is a remnant of arctic Alaska's Tertiary forest element. (Gerald and Buff Corsi © California Academy of Sciences).

Northern Quaternary refugia also played an important role in the formation of today's arctic flora by harboring species that would otherwise have been forced to migrate to lower latitudes or would have gone extinct (Hultén 1937, Abbott and Brochmann 2003). Beringia is a refugium of particular importance because it constituted a broad land-bridge connection between Asia and North America, extending from northeastern Russia, through Alaska, to the Yukon Territories (Hultén 1937). Although the Bering Sea land bridge disappeared following the late Tertiary flooding (5 Ma), it re-emerged during the Quaternary, for repeated intervals of roughly 1000 years each, at times when the sea level decreased approximately 100–130 m (Murray 1995, Abbott and Brochmann 2003). Because most of Beringia remained unglaciated during the Pleistocene ice ages, the region not only enabled transoceanic floristic exchanges but also acted as a refugium for Asian and North American species during periods of global cooling (**Figure 4a, b**). Consequently, this region can be regarded as a potential hotbed for plant evolution. In addition to acting as a refugium during the glaciations, the region has a very dynamic history involving appearance and disappearance of landscapes, shifting of habitats, and exchange of Asian and North American plant species (Murray 1992). The region's geographically restricted (rare) plants largely resulted from these glacial and interglacial events, which triggered range contractions/expansions, migrations, and population extinctions in the Bering Straits region (Murray and Lipkin 1987).

2. Plant migrations

A large part of the arctic flora has its origins in arctic and alpine tundra floristic elements that migrated from high mountains in both Asia and America as temperatures dropped during the mid-Miocene (Hultén 1937, Murray 1995, Abbott and Brochmann 2003). For instance, *Saxifraga oppositifolia* is believed to have originated in the central Asian highlands during the Tertiary and, in periods of global cooling, to have migrated north into Siberia and then

spread in both directions around the pole. Likewise, the genera *Primula* and *Androsace* (Mast et al. 2001, Schneeweiss et al. 2004) and the species *Aphragmus eschscholtzianus* and *Polystichum aleuticum* (Hultén 1937) are thought to have originated in the Himalayan highlands, from which they then radiated toward higher latitudes and into Alaska. The rare *Oxygraphis glacialis*, which is treated in this report, likely constitutes another Pleistocene migrant from Asia, as it occurs at high elevations from the Urals east through the Altai and the Himalayas into Russia/Chukotka, and then extends into Alaska's western mountain ranges.

Similarly, a number of species groups appear to have originated in the mountains of western North America and then migrated north. This is the case of *Sedum lanceolatum*, a widespread montane species throughout the Rocky Mountains, and one of only a few members of the Crassulaceae (a family with physiological adaptations to xeric conditions) to be found in Alaska. This taxon is believed to have persisted in the northern and southern Rocky Mountains throughout the Quaternary, tracking appropriate habitats up and down the mountains in response to the interglacial climate oscillations (DeChaine and Martin 2005).

Yet another arctic floristic element is derived from Old World and New World steppe plant communities. Asian steppe species such as *Carex duriuscula* and *Koeleria cristata* (a relative of rare *Koeleria asiatica*) migrated eastward across the Bering Sea land bridge into Alaska and formed what was once a more widespread, cold, steppe-like community in Beringia. Taxa from the grasslands of the western North America also migrated north during interglacials and now form distinctive elements in azonal habitats, such as xeric bluffs and old dune fields (e.g., rare *Erigeron ochroleucus*).

3. In situ speciation processes

In situ speciation is considered to be a central mechanism underlying the diversity of today's arctic flora. In particular, major forces driving speciation among arctic plant groups include (1) hybridization (through secondary contact of fragmented populations in interglacial periods), (2) the rapid accumulation of hybrid incompatibilities following isolation of lineages through selfing (considered to be frequent in arctic plants [Lloyd 1980]), and (3) allopolyploidy[1] (Brochmann and Steen 1999, Abbott and Brochmann 2003, Grundt et al. 2006). For example, studies indicate that hybridization between the circumpolar arctic *Saxifraga hyperborea* and amphi-Pacific (between 50°N and 70°N) *S. bracteata* in the Beringian region gave rise to the tetraploid *Saxifraga rivularis* lineage, which later, through vicariance and survival in separate refugia during the last glaciation, split into 2 allopatric subspecies: amphi-Atlantic *S. rivularis* ssp. *rivularis*, and amphi-Beringian *S. rivularis* ssp. *arctolitoralis* (the latter is included in this report) (Jørgensen et al. 2006). The relatively common arctic grass *Dupontia fisheri* is also believed to have evolved in the Arctic as a result of local speciation processes (Murray 1987, Lipkin 1983).

It should also be stressed that the process of speciation continues. Rapid speciation has occurred—and is likely occurring now—in many arctic plants that self-fertilize and are now reproductively isolated from other populations, even if the ecological, morphological, and significant genetic differences to distinguish these populations at the species level have not yet accumulated. If reproductive isolation (rather than morphological distinctions) is used

[1] Chromosome doubling from different parental species, providing fertility to hybrid offspring and thus ensuring their survival during periods of isolation from the parental genotypes.

to define a species, the diversity of the arctic flora is likely to be much greater (Grundt et al. 2006). The high levels of hybridization, polyploidy, and self-fertilization, coupled with the extensive fragmentation of habitats, have created multiple cases of sibling species that are morphologically undistinguishable but reproductively isolated (e.g., species of *Draba* [Brochmann et al. 1993, Grundt et al. 2006]). These factors also explain why the genetic richness of the arctic flora is high despite the comparatively small number of species that have been described on morphological grounds (Abbott and Brochmann 2003).

4. Recent trans-Atlantic long-distance dispersal events

Lastly, molecular studies have revealed yet another source of plant species for the Arctic: the trans-Atlantic, long-distance dispersal events that took place during the Holocene (Nordal 1987, Abbott and Brochmann 2003). These studies suggest that, following the last glaciation, drifting ice, icebergs, and birds could have acted as vectors for the dispersal of plants across the Atlantic Ocean. From there the plants could have spread across North America and reached Alaska. The dispersal events, which allowed for a very recent floristic exchange between Europe and North America, explain the origins and current distribution pattern of amphi-Atlantic disjunct taxa such as *Phippsia algida* (Aares et al. 2000), *Draba alpina* (Brochmann et al. 1992, 1996), and *Saxifraga oppositifolia* and *S. cernua* (Abbot et al. 2000, and Bronken 2001, respectively).

Current ecological determinants of Alaska's arctic flora diversity and distribution

In addition to the above cited historic events and processes, the diversity and distribution of plants on the North Slope are also determined by (1) the different climatic zones, (2) disturbance regimes, and (3) substrate types (Murray 1997). Even though arctic tundra landscapes may appear to be homogeneous, their smaller-scale topographic and spatial heterogeneity are well known to promote habitat diversity and thus plant species diversity (Murray 1997). Slope, magnitude, and aspect, even of small features, can influence moisture availability, solar radiation levels, and stability of the substrates. Moisture regime in the Arctic can be influenced by very minor topographic changes, such as tussocks and edges of ice-wedge polygons. Mesic species are often found along the highest margins of low-center polygons with wetland specialists dominating the lower half of the margins less than a meter away. Below we provide a brief description of how climate, disturbance, and soil type impact the diversity and distribution of Alaska's arctic plant species.

1. Climatic zones

As described in the *North Slope Bioclimatic Zones* section, the CAVM Team (2003) identifies 3 distinct bioclimatic zones in the North Slope region: Subzones C, D, and E. Each one of these subzones is primarily defined by summer temperatures (mean July temperature and summer warmth index), which in turn affect the size, horizontal cover, abundance, productivity and variety of plants.

In particular, Subzone C, which is restricted to the northernmost part of the Arctic Coastal Plain and has low mean temperatures in July (5–7 °C), is the least species-rich subzone of the 3 (75–150 species) and is dominated by semi-prostrate shrubs, sedges, and mosses. Subzone D, which extends from the southern part of the Arctic Coastal Plain to the Brooks Foothills, has slightly higher mean July temperatures (7–9 °C), greater species

diversity, and is dominated by erect, instead of prostrate, dwarf-shrubs, as well as sedges and mosses. Still farther to the south, in Subzone E, mean July temperatures increase again (9–12 °C), with a consequent increase in the richness (200–500 species) and size (low shrubs, tussock sedges, and mosses) of the flora. Therefore, on a broad scale, each one of the 3 subzones determines the diversity and distribution of plant species in arctic Alaska, with species richness and plant size increasing in response to higher summer temperatures along a north-to-south gradient.

2. Disturbance Regimes

Disturbance on large and small scales is another major determinant of plant diversity. Activities carried out over time spans both short (e.g., formation of burrows on pingos) and long (e.g., erosion) are correlated with higher species diversity because they create new microhabitats and can result in changes in soil composition (e.g., accumulation of nitrogen and phosphorus outside burrows) (Murray 1997). Freeze-thaw activities play a particularly important role along Alaska's Arctic Coastal Plain because they create geomorphic disturbances such as ice-wedge polygons, sorted-circles, gelifluction lobes, and frost boils. It should be noted that many rare species are poor competitors, unable to survive in closed communities, and hence restricted to the open, less competitive habitats that disturbance creates.

3. Soil types

Soil pH is one of the most important factors regulating species distributions and richness on the North Slope. The flora of arctic Alaska displays greater similarities with Chukotka's flora than that of the Yukon Territory. This is in part because of Alaska and Chukotka's shared historical phytogeographic ties (cf. Beringia) but also because of the two regions' widespread calcareous soils (Murray 1992, 1997). On a more local scale, differences in soil pH also account to a large extent for the lack of shared taxa between Prudhoe Bay and Barrow. The low acidity of the peaty soil at Prudhoe Bay derives from the calcareous alluvial deposits of the Sagavanirktok River, which originates in the limestone-rich Brooks Range. West of the Colville River, no rivers carry Brooks Range sediments north to the coast, so soils at Barrow are more acidic, as well as less topologically and edaphically diverse, than those at Prudhoe Bay (Murray 1992).

Summary of past and present factors driving plant diversity and rarity in arctic Alaska

As discussed above, Alaska's present-day arctic flora is mainly comprised of relics from the Late Tertiary forest element, of alpine species that migrated north from high mountains and steppes in Asia and North America during the Quaternary, and of species that arrived more recently, during the Holocene, as a result of trans-Atlantic dispersal events (Murray 1995, 1997; Abbott and Brochmann 2003). Moreover, because many of the taxa that constitute today's arctic flora originated and evolved in ice-free refugia (namely in Beringia) during the Pleistocene ice ages, arctic Alaska harbors a considerable number of species that are rare because they only occur within the confines of the Bering Sea land bridge area. These species include many amphi-Beringian[2] endemics.

[2] Amphi-Beringian endemics are species that occur on both sides of the North Pacific, Bering Sea, and/or the Chukchi Sea. They are restricted in their distribution to the area comprised by Beringia, a land bridge that connected Alaska to Siberia at various times during the Pleistocene ice ages.

Another important driver of diversity and rarity in arctic Alaska was the repeated fragmentation and subsequent hybridization (through secondary contact of the isolated populations) of taxa from all the above floristic elements during the Quaternary glaciations; this circumstance provided ample opportunity for in situ speciation (Abbott and Brochmann 2003, Grundt et al. 2006). Thus, even though the arctic flora is generally considered depauperate at the species level relative to more southerly floras, it is diverse at the population level, and it is probable that many more (cryptic) species are present than have previously been acknowledged (Grundt et al. 2006).

Furthermore, the distribution and diversity of Alaska's arctic flora is affected not only by past biogeographic events but also by present-day climate and ecological factors. For example, calciphilous species will likely have smaller ranges than habitat generalists, and taxa that reached Alaska following the Quaternary glaciations via trans-Atlantic dispersal may be restricted to the northwestern coast, while plants that migrated into this region from high mountain ranges in the Quaternary will often have a broader distribution.

These past and present constraints determine not only arctic plant diversity but also rarity. Thus, the rarity of the plant taxa listed in this work can be explained as a result of the biogeographic history of the taxon and/or its current ecological requirements. In particular, all of the 31 taxa treated in this work were selected for one or more of the following reasons: (1) their distribution is either globally or locally restricted; (2) they are habitat specialists; or (3) they have consistently small population sizes.

Finally, it must be noted that some of the taxa we include have broad, global geographic ranges but are considered rare because they have only one, or few, disjunct populations in Alaska (e.g., *Pedicularis hirsuta*, *Pleuropogon sabinei*). This and other patterns of plant distribution that explain the rarity of some of the 31 taxa selected are described in greater detail in the following section.

Patterns of plant distributions for the North Slope flora

Plants of the North Slope can be broadly classified as those that are widespread throughout Alaska, those that are typically interior Alaska species with populations disjunct north of the Brooks Range, and those that are endemic to the arctic region. Species that are rare on the North Slope are generally arctic endemics. Examples are presented here for each of these categories.

A portion of the North Slope flora is composed of widespread Alaskan species. These species typically occur in a number of habitat types and are often the most abundant species in an area. The majority of these species have holarctic distributions. Graminoids with these characteristics include *Carex aquatilis*, *C. scirpoidea*, *Eriophorum russeolum* s.l., *Festuca brachyphylla*, *Hierochloe alpina*, and *Poa arctica* and *P. glauca*. Examples of widespread woody species are *Betula nana*, *Salix alaxensis*, *S. glauca*, *S. pulchra*, and *S. reticulata*. Some species, however, are considered to be rare in Alaska, even though they are scattered throughout a wide area, because they are known from just a small number of populations. This is the case of *Carex heleonastes*: although broadly distributed, extending from south-central to northwestern Alaska, it is known from fewer than 6 populations, and therefore

considered rare to imperiled statewide (Lipkin 2007, http://aknhp.uaa.alaska.edu/botany/pdfs/RPWG07_alpha.pdf).

In another pattern observed among Alaskan taxa, species are restricted to mountain ranges. In this case, populations of the same species often occur in the Brooks Range as well as the Alaskan, Aleutian, and Coastal ranges. Populations disjunct on these mountain ranges are on different evolutionary paths because they are reproductively isolated from one another, undergoing genetic drift, and facing divergent natural selective pressures. Consequently, they are considered taxa of conservation concern because they represent separate (however recent) evolutionary lineages. *Oxygraphis glacialis*, *Erigeron porsildii*, and *Stellaria umbellata* are examples of this type of disjunction.

Species that are widespread in the Arctic outside of Alaska are sometimes disjunct to the Alaskan Arctic and are often the only representatives of these taxa in the United States. They may also be the only representatives in the western hemisphere. Some of these taxa may be restricted to high arctic regions in Canada or Asia and are found in the northernmost fringe of coastal Alaska. Examples include *Draba micopetala*, *D. pauciflora*, *D. subcapitata*, *Papaver gorodkovii*, *Pedicularis hirsuta*, *Pleuropogon sabinei*, and *Rumex graminifolius*.

Finally, the most distinct subset of North Slope taxa consists of species that are not found south of the Arctic. The majority of these species are widely distributed and often circumpolar. Examples of broadly distributed arctic taxa whose populations are also secure in Alaska include *Dendranthema arcticum* ssp. *polare*, *Carex ursina*, *Carex stans*, *Potentilla pulchella*, and *Tripleurospermum phaeocephalum*. However, in some cases these taxa have a much narrower distribution; they are either restricted to the North Slope region (e.g., *Cardamine microphylla* aff. *microphylla*, *Erigeron muirii*, *Mertensia drummondii*, *Poa hartzii* ssp. *alaskana*), or have a slightly broader range that extends into eastern Chukotka and/or into westernmost Yukon and Nunavut (e.g., *Ranunculus camissonis*, *Smelowskia media*).

Plant Rarity on the North Slope

List of rare vascular plant taxa on the North Slope

In this work we summarize information on the following 31 taxa:

	Species name	Family name
1.	*Erigeron muirii*	Asteraceae
2.	*Erigeron ochroleucus*	Asteraceae
3.	*Erigeron porsildii*	Asteraceae
4.	*Symphyotrichum pygmaeum*	Asteraceae
5.	*Mertensia drummondii*	Boraginaceae
6.	*Cardamine microphylla* aff. *microphylla*	Brassicaceae
7.	*Draba micropetala*	Brassicaceae
8.	*Draba pauciflora*	Brassicaceae
9.	*Draba subcapitata*	Brassicaceae
10.	*Smelowskia media*	Brassicaceae
11.	*Stellaria umbellata*	Caryophyllaceae
12.	*Carex atherodes*	Cyperaceae

13. *Carex heleonastes* ..... Cyperaceae
14. *Carex holostoma* ..... Cyperaceae
15. *Oxytropis tananensis* ..... Fabaceae
16. *Papaver gorodkovii* ..... Papaveraceae
17. *Festuca edlundiae* ..... Poaceae
18. *Koeleria asiatica* ..... Poaceae
19. *Pleuropogon sabinei* ..... Poaceae
20. *Poa hartzii* ssp. *alaskana* ..... Poaceae
21. *Puccinellia vahliana* ..... Poaceae
22. *Puccinellia wrightii* ..... Poaceae
23. *Trisetum sibiricum* var. *litorale* ..... Poaceae
24. *Rumex graminifolius* ..... Polygonaceae
25. *Oxygraphis glacialis* ..... Ranunculaceae
26. *Ranunculus camissonis* ..... Ranunculaceae
27. *Ranunculus sabinei* ..... Ranunculaceae
28. *Potentilla stipularis* ..... Rosaceae
29. *Saxifraga aizoides* ..... Saxifragaceae
30. *Saxifraga rivularis* ssp. *arctolitoralis* ..... Saxifragaceae
31. *Pedicularis hirsuta* ..... Scrophulariaceae

Rare plant taxa excluded from the list

Oxytropis arctica var. *barnebyana*, *Smelowskia johnsonii*, and *Rumex krausei* are rare taxa that have not yet been included in this report because either their taxonomic status was questionable or they are unlikely to occur within the boundaries of the North Slope region.

Oxytropis arctica var. *barnebyana* is an entity that may not represent a good taxon, and we therefore decided to omit this taxon from the list of rare plant taxa likely to be found in the NPR-A and North Slope regions. We briefly review its distribution and taxonomic history here.

Oxytropis arctica var. *barnebyana* is endemic to northwestern Alaska. Its distribution is limited to the area around Kotzebue and the western Brooks Range, and it is only known from about 7 localities. It is therefore listed in the Alaska rare plant field guide as a globally and statewide imperiled species (Lipkin and Murray 1997), and it is also treated as rare by the Conservation of Arctic Flora and Fauna Program (Talbot et al. 1999).

Taxonomically, var. *barnebyana* is considered part of one of the 2 polyloid complexes that occur in arctic and interior Alaska: *O. arctica s. lat.* and *O. campestris s. lat*. The identity of these 2 complexes, however, is called into question by the fact there is a certain amount of overlap among alternative states for the 4 "diagnostic" morphological traits that are used to separate them (flower color, flower size, number of flowers per inflorescence, and plant size and habit) (Jorgensen et al. 2003). Similarly, var. *barnebyana* has been included in *O. arctica*, in *O. campestris*, and in *O. sordida* by different authors (Welsh 1991, Yurtsev 1999, and Barneby 1952, respectively) depending on which set of characters the authors emphasized in their studies of this taxon (Jorgensen et al. 2003). Adding to this lack of morphological distinctiveness, a recent phylogenetic study of arctic oxytropes failed to support *O. arctica*

var. *barnebyana* as a distinct evolutionary lineage (Jorgensen et al. 2003). An extended revision of the 2 *Oxytropis* complexes is needed to clarify the distinctions between the taxa, determine their distributions, and subsequently reevaluate their conservation status.

Smelowskia johnsonii, listed globally and statewide as critically imperiled (Lipkin 2007), is known from 2 sites near the Kukpuk River, Lisburne Peninsula, and from a third site in the Lost River drainage area, near the west end of the Seward Peninsula (Mulligan 2001). Despite its endangered conservation status, we excluded it from this work because it is a narrow endemic restricted to northwesternmost Alaska, and therefore most likely does not extend further east into the North Slope region and the NPR-A.

A recent report by Al-Shehbaz and Warwick (2006) suggests that *S. johnsonii* is synonymous with *S. borealis* var. *jordalii*, which would extend its range to northeastern Alaska but would also result in its removal from the Alaska Natural Heritage Program Rare Vascular Plant Tracking List (Lipkin 2007). We have not yet been able to evaluate the specimens used in this analysis and therefore cannot comment on their treatment (Lipkin, pers. comm.).

Rumex krausei is ranked globally and statewide as imperiled (Lipkin 2007) and was excluded from this report for reasons similar to *S. johnsonii*: it is a narrow endemic restricted to northeasternmost Chukotka and the northwestern coastal area of Alaska (Mosyakin 2005, Lipkin and Murray 1997). It is therefore unlikely to occur further east in the North Slope region and in the NPR-A.

Types of rarity for the North Slope flora

We divide the 31 rare plant taxa into 8 different classes of rarity. This exercise aims to provide a classification of the main types of rarity for the Alaskan arctic flora, and it can also be used to compare patterns of plant rarity in the Alaskan Arctic with those of other floras (e.g., Oregon, Kaye et al. [1997]). Future botanical work should be used to refine this scheme.

Modifying Rabinowitz's (1981) plant rarity classification scheme, we identify 8 types of rarity for the North Slope flora (**Table 1**). Seven types follow Rabinowitz's (1981) model and are based on geographic range (large vs. small), habitat specificity (broad vs. restricted), and population size (large at least in one place vs. small everywhere). Species are classified as "endemic" when they are restricted geographically and are habitat specialists. Within the endemic taxa, we distinguish between "narrowly endemic" (e.g., *Cardamine microphylla* aff. *microphylla* and *Poa hartzii* ssp. *alaskana*, which are endemic to arctic Alaska) and "regionally endemic" (with populations in Eastern Chukotka and/or western Canada, such as *Erigeron porsildii*, *E. muirii*, *Mertensia drummondii*, and *Smelowskia media*). Species with broad distributions but high habitat specificity are referred to as "predictable" (e.g., *Draba micropetala*, *Oxygraphis glacialis*). Species with a narrow distribution range, found in a wide range of habitats, with either large or small populations, are often considered to be biologically "(very) unlikely" (e.g., *Papaver gorodkovii*) (Rabinowitz 1981, Kaye et al. 1997). "Sparse" species are those with consistently small population sizes, despite having large geographic ranges and being habitat generalists (e.g., *Stellaria umbellata*). The eighth form of rarity contains widely disjunct taxa that, though often being common in other areas, are rare in Alaska or restricted to the North Slope (e.g., *Carex atherodes*, *Pedicularis hirsuta*).

Table 1. Classification of the 31 rare vascular plant taxa for Alaska's North Slope region, using a modified version of Rabinowitz's (1981) scheme. Population size, habitat specificity, and distribution range for each taxon are assessed on a global scale.

		GEOGRAPHIC RANGE			
		Small		**Large**	
POPULATION SIZE	**Somewhere large**	**Unlikely** Locally abundant, restricted geographically, but found in several habitats – No representatives	**Endemic** Locally abundant, restricted geographically as well as to a specific habitat – **Cardamine microphylla* aff. *microphylla* – ‡ *Erigeron muirii* – ‡*Erigeron porsildii* – ‡ *Mertensia drummondii* – **Poa hartzii* ssp. *alaskana* – ‡*Smelowskia media*	**Predictable** Locally abundant over a large range, but restricted to a specific habitat – *Erigeron ochroleucus* – *Oxytropis tananensis* – *Potentilla stipularis* – *Pleuropogon sabinei* – *Ranunculus camissonis* – *Ranunculus sabinei* – *Saxifraga aizoides* – ‡*Symphyotrichum pygmaeum*	**"8th CLASS"** Widely disjunct taxa that are rare in Alaska or in the North Slope but are broadly distributed on a global scale – *Carex atherodes* – *Pedicularis hirsuta* **COMMON**
	Everywhere small	**Very unlikely** Constantly sparse, restricted geographically, but found in several habitats – *Papaver gorodkovii* – *Saxifraga rivularis* ssp. *arctolitoralis*	**Endemic** Constantly sparse, restricted geographically as well as to a specific habitat – ‡*Puccinellia wrightii*	**Predictable** Constantly sparse over a large range, and restricted to a specific habitat – *Carex heleonastes* – *Draba micropetala* – *Draba pauciflora* – *Draba subcapitata* – *Oxygraphis glacialis* – *Puccinellia vahliana* – *Rumex graminifolius*	**Sparse** Constantly sparse, over a large range and found in several habitats – *Carex holostoma* – *Festuca edlundiae* – *Koeleria asiatica* – *Stellaria umbellata* – *Trisetum sibiricum* var. *litorale*
		Broad	**Restricted**	**Restricted**	**Broad**
		HABITAT SPECIFICITY			

* Species endemic to arctic Alaska

‡ Species endemic to Alaska and to either the Russian Far East (Chukotka) or to northwestern Canada (Yukon Territory/Nunavut)

Representatives for 7 of the 8 types of rarity are found within the 31 North Slope rare plant taxa reviewed in this work.

Based on this classification, the most abundant type of rarity in Alaska's arctic flora is formed by taxa with high habitat specificity. Such species are often restricted to unusual substrates, such as sand dunes, beach ridges, and basic soils or to disturbed sites. Habitat specialists can be found over restricted or large geographic ranges and in small or large populations. Likewise, in Oregon rare plants are also mostly species of restricted habitats; however, the pattern differs dramatically, with nearly 30% of the 338 rare Oregon species reviewed by Kaye et al. (1997) also having small geographic ranges (i.e., "endemic") vs. just

6% (2 species) on the North Slope. Nine of the 31 taxa were not habitat specialists. Seven of these 9 taxa correspond to species that are constantly sparse over a large range and found in several habitats. Two species, *Carex atherodes* and *Pedicularis hirsuta*, exemplify the eighth class of rarity: they are actually broadly distributed on a global scale but are known from only a few Alaska populations, which are widely disjunct from the other populations. Lastly, *Papaver gorodkovii* and *Saxifraga rivularis* ssp. *arctolitoralis* illustrate Rabinowitz's (1981) "very unlikely" class, as they are geographically restricted with small population sizes but do not have specific habitat requirements. Species that are neoendemics are likely to fit this last category.

Despite the fact that habitat specificity seems to be a major factor underlying plant rarity in arctic Alaska, no single "class" of rarity dominates the North Slope flora. The apparent lack of a common cause for plant rarity on the North Slope is likely due, to some extent, to the paucity of information on the distribution, biology, and ecology for all of the species. This results in there being no across-the-board approach to conserving native and rare plant species in arctic Alaska. Therefore, in order to adequately manage and protect these species, we must first gain better insight into their biology, distribution, and potential threats. Although this work compiles all the information available for each of the 31 taxa that are currently considered rare in the North Slope region, it is a work in progress.

Priority species requiring legal protection

No plant species on Alaska's North Slope are listed as Threatened or Endangered by the U.S. Fish and Wildlife Service. *Draba micropetala*, *Erigeron muirii*, *Mertensia drummondii*, *Pedicularis hirsuta*, *Poa hartzii* ssp. *alaskana*, *Pleuropogon sabinei*, and *Potentilla stipularis* are all BLM Sensitive Species.

We recommend that the BLM treat the following North Slope narrowly restricted taxa as "Sensitive," in addition to those already included in the list:

1. *Cardamine microphylla* aff. *microphylla*
2. *Papaver gorodkovii*
3. *Puccinellia wrightii*
4. *Smelowskia media*
5. *Symphyotrichum pygmaeum*

Federal and State land managers should also protect species that are secure outside of Alaska but make particularly important additions to the biodiversity of Alaska and the United States (e.g., arctic Asian or European species only known in the United States from a few populations on the North Slope). These taxa are:

1. ‡*Draba micropetala*
2. *Draba pauciflora*
3. *Draba subcapitata*
4. *Erigeron ochroleucus*
5. *Erigeron porsildii*

6. *Festuca edlundiae*
7. *Koeleria asiatica*
8. *Oxygraphis glacialis*
9. ‡*Pedicularis hirsuta*
10. ‡*Pleuropogon sabinei*
11. ‡P*otentilla stipularis*
12. *Puccinellia vahliana*
13. *Ranunculus camissonis*
14. *Ranunculus sabinei*

‡ These species are already listed "Sensitive" by the BLM.

Given the paucity of biodiversity surveys in arctic Alaska and the lack of ecological data on the 31 taxa reviewed, it is impossible to draw strong conclusions on the underlying causes of plant rarity on the North Slope. We recognize 3 primary requirements for gaining a better understanding on this subject:

1. Increase the number of botanical inventories in arctic Alaska (**Figure 6**). Large regions of the North Slope have very few collections, and the spotty collection intensity across the region hampers the ability to determine if higher frequencies of rare plant populations are only due to sampling intensity. The 4 specific areas identified in Figure 4 as priorities for future rare plant collecting work are:

   a. Chukchi Sea coast from Wainwright to north of Point Hope
   b. Cape Simpson lowlands
   c. North side of the Brooks Range from the Chukchi Sea to the Dalton Highway
   d. Eastern Brooks Range and Beaufort Sea coastal plain

   Within each of these areas, surveys should focus on those habitats most likely to support rare species. These habitats will vary with the region surveyed, but may include perennial springs, carbonate or mineralized areas, relictual dune areas, and naturally disturbed areas such as screes, point bars, and eroding banks.

2. Study and acquire more data on the ecological requirements and population trends of rare vascular plants. We have no information on the population growth parameters, and without these baseline data, our ability to detect rates and causes of population decline due to natural or anthropogenic causes will be severely limited.

3. Carry out thorough taxonomic revisions for many of the rare species treated here (e.g., the *Cardamine microphylla* complex, *Oxytropis arctica-campestris* aggregate). Clearly, delineating taxa is one of the first steps in conservation. Only in this way can surveys and ecological studies target entities warranting greater conservation efforts.

Recommended changes in species conservation and taxonomic ranks

Following this effort we identified 3 rare plant taxa that are not currently included in the Alaska Natural Heritage Program Rare Vascular Plant List (Lipkin 2007). The first, *Carex atherodes*, is rare in Alaska but globally secure. Both of the other 2 taxa, *Cardamine*

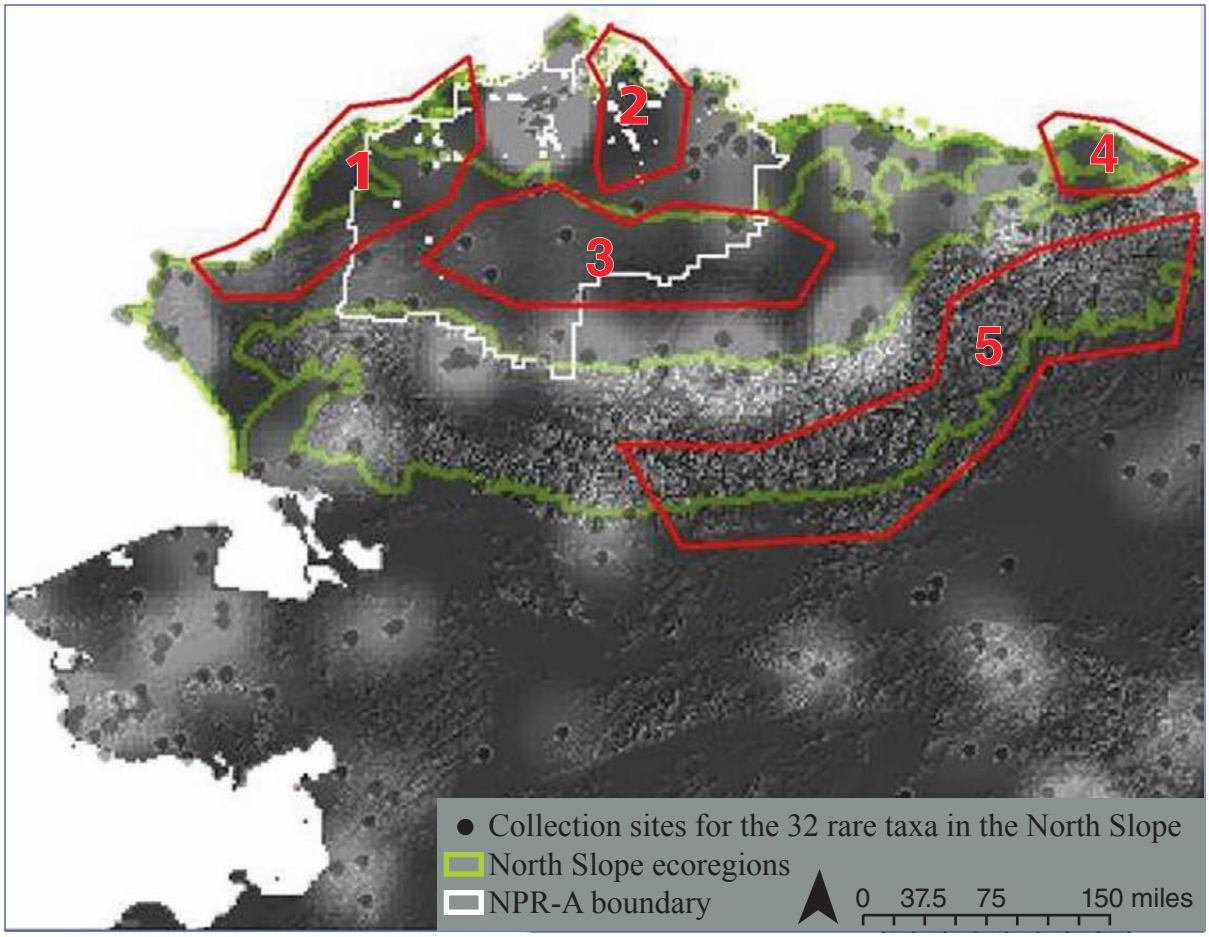

Figure 6. North Slope areas with high plant collection intensity (grey-white zones) and areas that require future botanical surveying work (red polygons 1–5). This map was created by plotting collection locality information for the 31 rare plant taxa studied in this work. The points were then analyzed to identify areas of high (grey-white) and low (black) collection density using ArcGIS Spatial Analyst. The priority areas highlighted in this map should be interpreted with caution for 2 reasons: (1) additional data points could change the extent and shape of the polygons; and (2) this only reflects collection intensity for the 31 rare taxa treated here, not for the North Slope plants in general. This is especially the case for polygons 4 and 5, as it is very likely that the Arctic National Wildlife Refuge has been more heavily sampled than what is shown here.

microphylla aff. *microphylla* and *Saxifraga rivularis* ssp. *arctolitoralis*, are statewide rare to imperiled and globally imperiled. Additionally, we assigned a 'G4' global conservation rank for *Draba micropetala*, as it was previously unranked ('G4' indicates that the taxon is apparently secure globally, but that there is cause for long-term concern. The list of Alaska Natural Heritage Program (AKNHP) ranks and definitions is provided in Appendix B).

Additionally, we recognize the need to treat *Cardamine microphylla* as 2 separate entities: *C. blaisdellii* and *C. microphylla* aff. *microphylla*, with the latter (the rare taxon) requiring a separate rank. Similarly, we treat *Smelowskia media* and *Ranunculus camissonis* at the species level, and change their global conservation ranks accordingly.

Summary of Methods and Resources Used for the Species Accounts

The 31 taxa that are reviewed in this work (Appendix A) were determined rare on Alaska's North Slope following a process that involved (a) data-mining the AKNHP rare plant database (Biotics), (b) acquiring information on potentially rare Alaskan arctic plant species from the University of Alaska Museum of the North Herbarium (ALA) through the Arctos database and herbarium specimens, and (c) having detailed discussions with experts on the region's flora.

The following information was compiled for each taxon:

a. Taxonomic/nomenclatural summary (scientific name, synonymy, and common names)
b. Global and state conservation ranking, based on AKNHP ranks (see Appendix B for an explanation of ranks)
c. ‡ Range and elevation of each taxon on a global and statewide level, as well its presence/absence on Alaska's Arctic Slope and in the NPR-A
d. § Ecological descriptors: landform, soil type, moisture regime, slope, aspect, vegetation type, and associated species
e. Biological descriptors: longevity, phenology, and reproductive biology of each taxon
f. Taxonomic notes (included when pertinent)
g. Sources of information used
h. Photographs of a representative herbarium sheet of the ALA specimens examined
i. * Distribution maps

‡ Presence of a species on the Arctic Slope is based on there being known occurrences of the species in the area shown in Figure 1, delimited by Demarcation Bay to the east, Barrow to the north, Cape Lisburne to the west, and the spine of the Brooks Range to the south. For the purposes of this revision, 'Arctic Slope' and 'North Slope' are used interchangeably.

§ The list of associated species refers only to collections made on the North Slope.

* The maps only show point locality information for those specimens included in the "ALA_BCD_collections_2006.xls" database that was generated for this project. This database primarily consists of records obtained from the Arctos and AKNHP's Biological Conservation Database (BCD) databases, as well as from herbarium specimens housed in ALA. Therefore, these maps do not necessarily reflect the species' entire distribution. A description of the complete range of each species is given under the "Distribution" notes section.

We summarized each taxon's phenology and reproductive ecology by examining herbarium specimens and reviewing reports in the literature. Clonal reproduction was noted for species producing rhizomes or stolons. Reliance on pollinators was determined by reports in the literature or estimated by flower morphology and the degree of fruit set for those species with sufficient specimens of the appropriate phenological stage. Pollination syndromes were estimated based on floral morphology (cf. Fægri and van der Pijl 1980).

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Appendix A. Species Accounts

Figure A-1. *Erigeron muirii* habitat: Ivishak River bluff. (© Amy Breen Carroll)

Note: The distribution maps included below only show point locality information for specimens housed in ALA or recorded in the Arctos and BCD databases. **Therefore, these maps do not necessarily reflect the entire range of the species treated.** A description of each species' known global and statewide distribution is given under the corresponding "Distribution" section.

Cardamine microphylla aff. *microphylla*

Species:

Scientific name:	*Cardamine microphylla* M. F. Adams aff. *microphylla*
Synonym(s):	None
Common name(s):	Small-leaf bittercress
Global rank:	G3T1?Q
State rank:	S2

Distribution:

Global:	*Cardamine microphylla* aff. *microphylla* is related to *Cardamine microphylla* ssp. *microphylla* (known from Siberia), but has yet to be named and is currently being phylogenetically investigated. This taxon has been collected in Alaska's North Slope region, between the Franklin Mountains and Camden Bay (northeastern Alaska).
State:	Northeast of the Franklin Mtns., Brooks Range, and vicinity of Camden Bay, Arctic Coastal Plain
North Slope:	Collinson Point and Marsh Creek, vicinity of Camden Bay, Mt. Michelson quad.
NPR-A:	Not documented
Likely to be found in the NPR-A?	Uncertain
Elevation:	Near sea level to at least 3000 m

Ecology:

Landform:	Floodplains, in alluvial sand, river bars, and terraces
Soil type:	Sand and cobbles on gravel, sandy clay with cobbles
Moisture regime:	Moist
Slope:	No information available
Aspect:	NE
Vegetation type:	*Dryas* river terraces
Co-occurring species:	*Cerastium beeringianum*, *Salix ovalifolia*, *Stellaria humifusa*, and mosses
Longevity:	Estimated to be relatively short lived – weak, herbaceous caudex
Phenology:	In flower in June; flowering and fruiting in July, with mature fruits from early-mid July on; mainly just fruits in August
Reproductive biology:	Probably bee- and fly-pollinated

Taxonomic notes:

The taxonomy of white-flowered arctic *Cardamine* is not well resolved (Murray and Kelso 1997). Systematists agree that two distinct groups can be defined using morphological traits:

Group I	plants with narrow, linear-lanceolate leaflets	*C. digitata* Richardson
Group II	plants with orbicular to elliptic leaflets that show a tendency for toothed or lobed forms in the Bering Strait region	*C. microphylla* M.F. Adams/ *C. hyperborea* O.E. Schulz/ *C. blaisdellii* Eastw.

Petrovsky (1975), Porsild (1938, 1974), and most recently Murray and Kelso (1997), note that a morphological discontinuity within Group II can help differentiate *C. microphylla* aff. *microphylla* (a northeastern Alaska taxon) from Bering Strait region cardamines (e.g., *C. blaisdellii*).

Taxon A	plants with the terminal leaflet equal to the lateral leaflets, leaflets generally not lobed or toothed	*C. microphylla* aff. *microphylla*
Taxon B	plants with the terminal leaflet greater than the lateral leaflets, leaflets generally lobed or toothed lobed, from the Bering Strait region	*C. blaisdellii*./*C. hyperborea*

Recent phylogenetic studies carried out in Reidar Elven's laboratory (unpubl. res.) have found that *C. microphylla* ssp. *blaisdellii* (from northwestern Alaska) is distinct from other cardamines and suggested elevating it to the species level (*C. blaisdellii*).

Regarding the *Cardamine microphylla* plants from northeasternmost Alaska, these are no longer considered identical to Siberian *C. microphylla* ssp. *microphylla*, but are rather a related and yet unnamed species or subspecies, and should be referred to as *C. microphylla* aff. *microphylla* until it too is phylogenetically investigated by R. Elven's group (Elven and Murray, pers. comms.)

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 516.

Murray, D.F. and Kelso, S. 1997. Chromosome number and notes on the taxonomy of selected Alaskan vascular plants. Rhodora 99(897):33–35.

Petrovsky, V.V. 1975. *Cardamine*. In: Tolmachev, A.I., editor. Arctic flora USSR (in Russian). Leningrad: Nauka. pp. 79–92.

Porsild, A.E. 1938. Flora of Little Diomede Island in Bering Strait. Proceedings and Transactions of the Royal Society of Canada 32:21–38.

Porsild, A.E. 1974. Materials for a flora of central Yukon Territory. Publications in Botany no. 4, National Museum of Canada:1–77.

Figure A-2. *Cardamine microphylla* aff. *microphylla* ALA specimen.

Figure A-3. *Cardamine microphylla* aff. *microphylla* closeup.

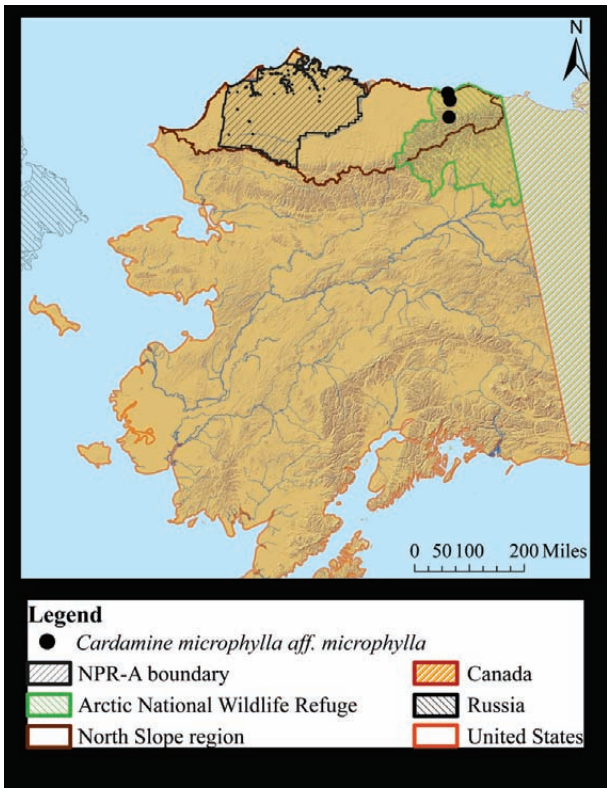

Figure A-4. Occurrences of *Cardamine microphylla* aff. *microphylla* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Carex atherodes

Species:

Scientific name:	*Carex atherodes* Spreng.
Synonym(s):	None
Common name(s):	Awned sedge, slough sedge, wheat sedge, carex épi-de-blé (French)
Global rank:	G5
State rank:	S3

Distribution:

Global:	Considered rare regionally, but not globally. Common in the western and midwestern US, but rare in eastern portions of its range (Ball and Reznicek 2002). Also found throughout Canada and in Eurasia.
State:	Primarily interior Alaska, collections widely separated: Tikchik Lakes and mouth of Koyukuk River in western Alaska, east along the southern side of the Brooks Range, and south to the Wrangell Mountains
North Slope:	Sadlerochit Spring in the Brooks Foothills
NPR-A:	Not documented (unlikely unless a comparable springs habitat is known)
Likely to be found in the NPR-A?	Unlikely
Elevation:	From approximately 50 m to at least 750 m (50–2800 m [Ball and Reznicek 2002]).

Ecology:

Landform:	No habitat information is available for the one specimen we found collected on the North Slope (Mt. Michelson quad., Sadlerochit Spring, 300 m, 8 Aug 1978, *Murray 6919* [ALA]); specimens from elsewhere in Alaska are described growing in glacial moraines, wet, open thickets and swamps, marshes, wet prairies and meadows, streams, ponds, beaver ponds, ditches and lakeshores, often in water (to 60–80 cm deep) (ALA; Ball and Reznicek 2002).
Soil type:	Silty soil with cobbles, organic soil, sand
Moisture regime:	Saturated-wet to moist soils; this species tolerates deeper water than most other *Carex* species, and has been found at 0.5 m depth in interior Alaska.
Slope:	No information available
Aspect:	No information available (aspect is probably not important, as it grows in gentle slopes in marshes)
Vegetation type:	Freshwater herbaceous marshes, adjacent to willows, in sedge meadows
Co-occurring species:	No information available (south of the Brooks Range, in interior Alaska, *C. atherodes* grows with *Beckmannia syzigachne*, *Carex aquatilis*, *Carex rostrata*, *Galium trifidum*,

Polygonum pennsylvanicum, and *Sparganium multipedunculatum*)

Longevity: Multi-year perennial; longevity is difficult to estimate.

Phenology: Fruiting June through August (Ball and Reznicek 2002)

Reproductive biology: Wind-pollinated

Sources of information used:

ALA specimens

BCD records

Literature:

Ball, P.W. and Reznicek, A.A. 2002. *Carex*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 23:498–500. Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=carex+atherodes

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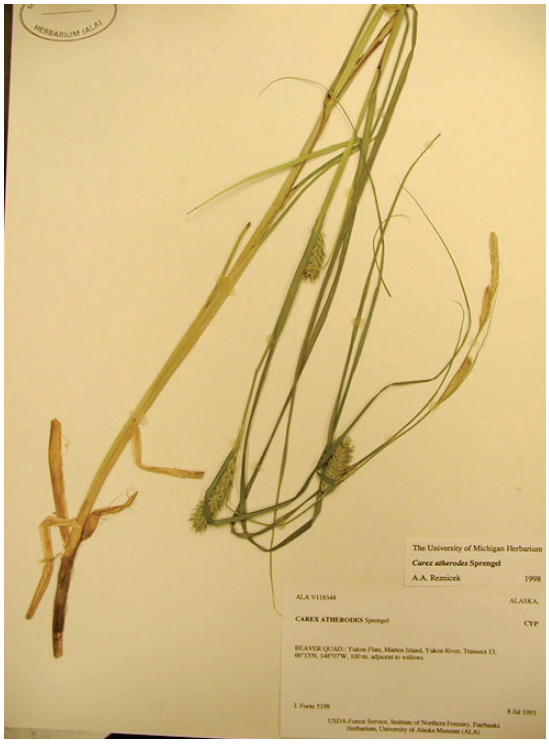

Figure A-5. *Carex atherodes* ALA specimen.

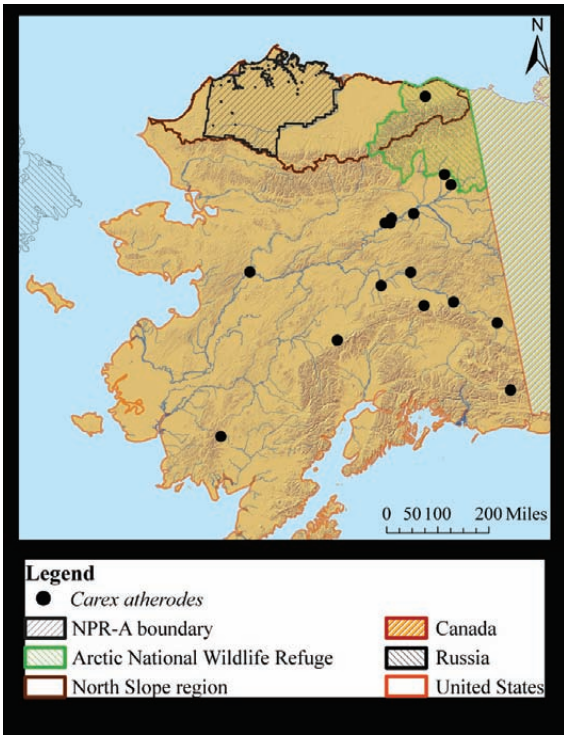

Figure A-6. Occurrences of *Carex atherodes* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Carex heleonastes

Species:

Scientific name:	*Carex heleonastes* L. f.
Synonym(s):	None
Common name(s):	Hudson Bay sedge
Global rank:	G4
State rank:	S2S3

Distribution:

Global:	Occurs scattered throughout Canada; also recorded from Alaska, Michigan, and Eurasia (Ball and Reznicek 2002).
State:	There are 7 known locations in Alaska over a fairly large geographic area (collections have been made near the Brooks Range, the Bendeleben Mountains, and the Alaska Range), and more are likely given that the species' habitat is undercollected.
North Slope:	Not documented (closest Alaska collection is from Old John Lake east of Arctic Village and Nutuvkti Lake in the Brooks Range)
NPR-A:	Not documented
Likely to be found in the NPR-A?	Unlikely
Elevation:	Between 0 and 760 m (0–1500 m in Ball and Reznicek [2002])

Ecology:

Landform:	Mires, damp meadows, lowlands (Ball and Reznicek 2002); south of the Brooks Range it has been collected in black spruce muskeg and bogs ("a minerotrophic mire/fen specialist," Elven and Murray, pers. comms.).
Soil type:	Organic soil, glacial till, sand, in mossy peat
Moisture regime:	Saturated to wet
Slope:	Gentle
Aspect:	SW
Vegetation type:	Black spruce muskeg, in pools in burned black spruce muskeg, tufted-bulrush sedge wet meadow, boreal-sedge bogs, forming tussocks by pond margins, in *Dryas* moss slough
Co-occurring species:	No information available (in the Brooks Range, *Carex heleonastes* is known to grow with *Carex limosa, C. livida*, *Eriophorum* spp., and *Trichophorum caespitosum* [Elven and Murray, pers. comms.])
Longevity:	Multi-year perennial
Phenology:	In northeastern and northern Alaska this species has been observed flowering in late June and early July, and fruiting late July, early August (Elven and Murray, pers. comms.).
Reproductive biology:	Wind-pollinated, clonal

Sources of information used:

ALA specimens

BCD records

Literature:

Ball, P.W. and Reznicek, A.A. (2002). *Carex*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 23:312–316. Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=carex+heleonastes.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 238.

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent Canada. Provo (UT): Brigham Young University Press. p. 509.

Figure A-7. *Carex heleonastes* ALA specimen.

Figure A-8. *Carex heleonastes* ALA specimen.

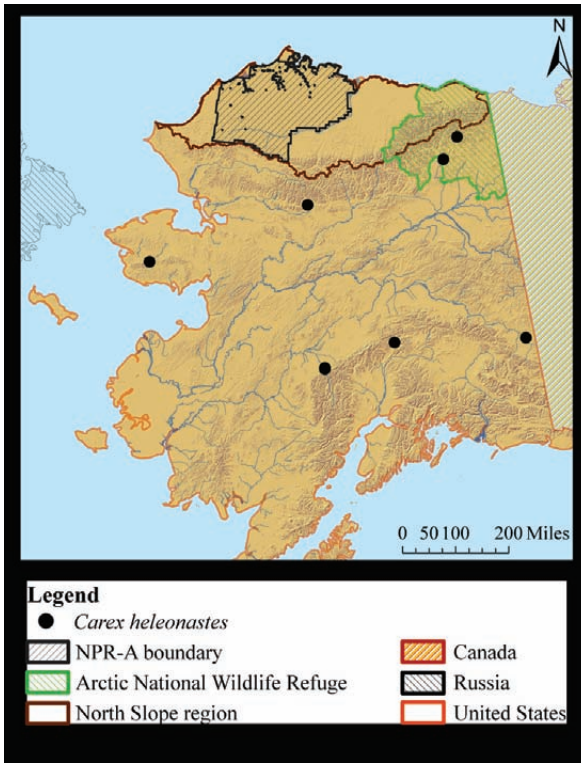

Figure A-9. Occurrences of *Carex heleonastes* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Carex holostoma

Species:

Scientific name:	*Carex holostoma* Drej.
Synonym(s):	None
Common name(s):	Arctic marsh sedge
Global rank:	G4?
State rank:	S2

Distribution:

Global:	Known from Greenland, eastern and northern Canada, Alaska, and arctic Eurasia (Ball and Reznicek 2002). *Carex holostoma* has most likely been overlooked and has a more continuous range than indicated (Ball and Reznicek 2002).
State:	Known from Demarcation Point and the Canning River area in northeastern Alaska, from the Bendeleben Mountains and Cape Espenberg (Seward Peninsula), Cape Krusenstern, and the De Long Mountains in northwestern Alaska, also from the Yukon-Tanana Uplands, in interior Alaska
North Slope:	East of Demarcation Bay and southwest of Kaktovik/east of Canning River
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	Known to grow between 0 and 430 m

Ecology:

Landform:	Low-centered polygons, retreating lake margins, alluvial fan and beach ridges, active and ancient dune ridges, alpine slopes
Soil type:	Mud, gravel, cobble
Moisture regime:	("Moist," from specimens collected in the Yukon-Tanana Uplands and Chukotka)
Slope:	No information available
Aspect:	Variable
Vegetation type:	Sedge-grass meadows, open herbaceous meadows
Co-occurring species:	*Carex aquatilis, C. chordorhiza, C. misandra, C. rariflora, C. saxatalis,* and *Eriophorum angustifolium*
Longevity:	Multi-year perennial
Phenology:	Flowering late June to early July, fruiting in August (Elven and Murray, pers. comms.)
Reproductive biology:	Wind-pollinated, very restricted clonal growth

Sources of information used:

ALA specimens

BCD records

Literature:

Ball, P.W. and Reznicek, A.A. 2002. *Carex*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 23:402–408. Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=carex+holostoma.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 255.

Figure A-10. *Carex holostoma* ALA specimen.

Figure A-11. *Carex holostoma* ALA specimen close-up.

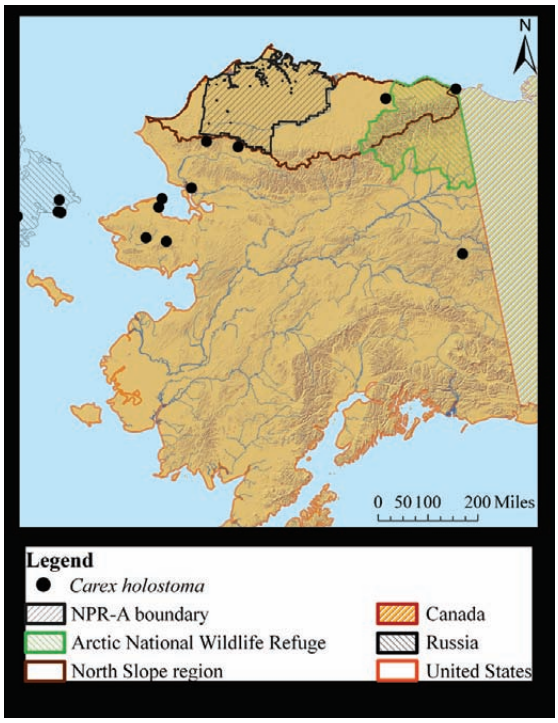

Figure A-12. Occurrences of *Carex holostoma* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

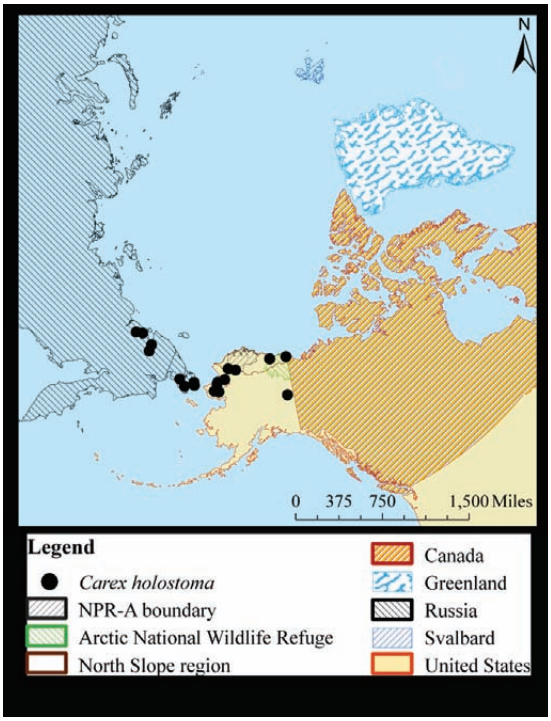

Figure A-13. Other circumpolar arctic collections of *Carex holostoma*.

Draba micropetala

Species:

Scientific name: *Draba micropetala* Hook.
Synonym(s): *D. adamsii* auct., non Ledeb
D. alpina L. s. lat., p.p.
Common name(s): None
Global rank: G4
State rank: S1S2

Distribution:

Global: Circumpolar high Arctic: Greenland, Svalbard, northern Russia (including Wrangel Island), Canadian Arctic Archipelago (Nunavut, NWT), and Alaska
State: Vicinity of Barrow
North Slope: Vicinity of Barrow
NPR-A: Not documented (nearest collections are from Barrow)
Likely to be found in the NPR-A? Yes
Elevation: From near sea level to less than 30 m

Ecology:

Landform: Creek and stream banks, beach ridges
Soil type: Pebbles and gravel, [clayey]
Moisture regime: Well-drained, dry, [moist]
Slope: Gentle to moderate
Aspect: No information available
Vegetation type: Grass-herbaceous meadows, *Carex* meadows, turf
Co-occurring species: *Carex* spp. and *Salix rotundifolia* (In Chukotka, *Draba micropetala* is known to grow with *Arctagrostis latifolia, Cochlearia officinalis, Dupontia fisheri, Papaver lapponicum, Poa arctica, Stellaria humifusa,* and mosses.)
Longevity: Most plants have only one or a few rosettes (some more). This taxon is assumed to be short-lived compared with many other *Draba* spp. (Elven and Murray, pers. comms.).
Phenology: In flower in June (and probably earlier); in fruit by early/mid-July
Reproductive biology: Nearly obligately self-pollinating (Brochmann and Elven 1992)

Taxonomic notes:

Taxonomic confusion arises because *Draba micropetala* shares a number of morphological characteristics with *D. alpina* L. s. lat. and has therefore sometimes been treated within it (e.g., National Plants Database, Integrated Taxonomic Information System).

Sources of information used:

ALA specimens

BCD records

Literature:

Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Gillespie, L.J., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Brysting A.K., and Solstad, H. 1999 onwards. Flora of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval. Version: 29 April 2003. Available from: http://www.mun.ca/biology/delta/arcticf/_ca/www/badrmc.htm.

Brochmann, C. and Elven, R. 1992. Ecological and genetic consequences of polyploidy in arctic *Draba* (Brassicaceae). Evolutionary Trends in Plants 6:111–124.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 528.

Mulligan, G.A. 1974. Confusion in the names of three *Draba* species of the Arctic: *D. adamsii*, *D. oblongata*, and *D. corymbosa*. Canadian Journal of Botany 52:791–793.

Figure A-14. *Draba micropetala* ALA specimen.

Figure A-15. *Draba micropetala* ALA specimen close-up.

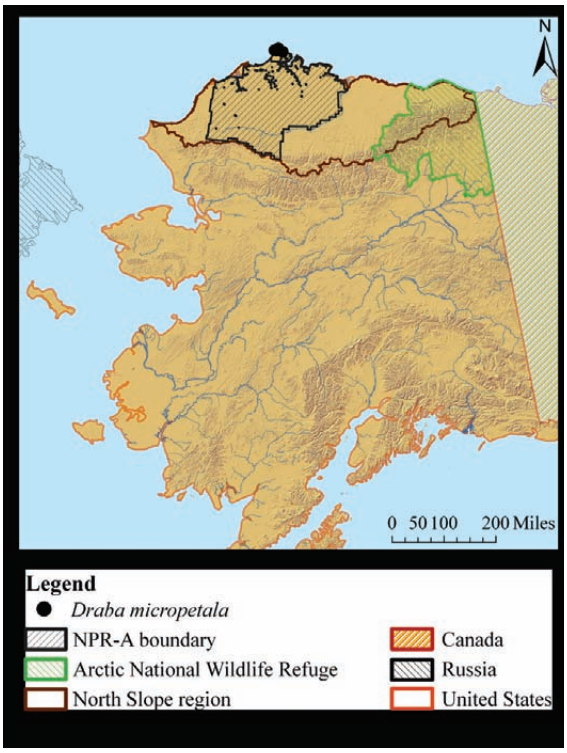

Figure A-16. Occurrences of *Draba micropetala* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

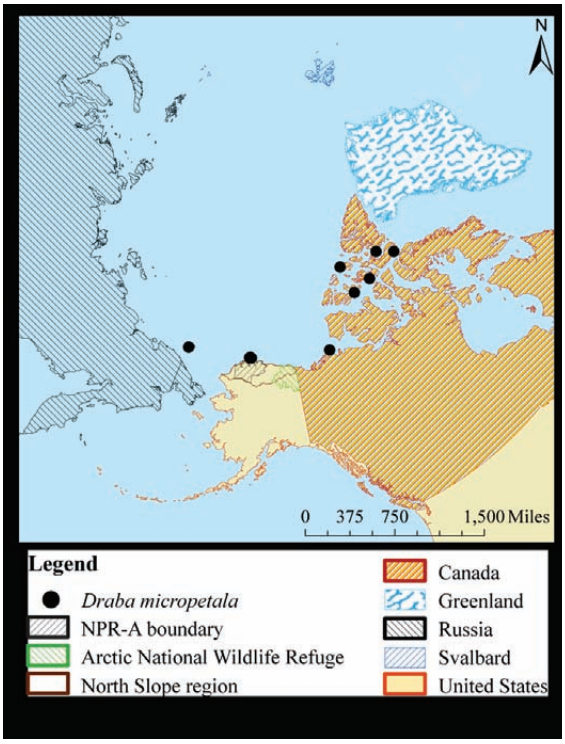

Figure A-17. Other circumpolar arctic collections of *Draba micropetala.*

Draba pauciflora

Species:

Scientific name:	*Draba pauciflora* R. Br.
Synonym(s):	*Draba adamsii* Ledeb. *Draba alpina* var. *adamsii* (Ledeb.) O.E. Schulz *Draba lasiocarpa* M.F. Adams *Draba micropetala* auct. non Hook.
Common name(s):	Fewflower draba
Global rank:	G4
State rank:	S1

Distribution:

Global:	Circumpolar high Arctic: occurs in the Canadian Arctic Archipelago, Greenland, northern Eurasia, and Alaska
State:	Northern Alaska, including Barrow, Lonely, and Pitt Point (Arctic Coastal Plain), and the Endicott Mountains (Brooks Range)
North Slope:	Arctic coast between Barrow and Pitt Point; and Endicott Mountains in central Brooks Range
NPR-A:	Between Barrow and Pitt Point
Likely to be found in the NPR-A?	Yes
Elevation:	Near sea level to over 300 m

Ecology:

Landform:	Beach ridges, boulder slopes, high-center polygons, broad troughs, seepage slopes
Soil type:	Acidic or blocky carboniferous substrate, boulders, sandy
Moisture regime:	Moist
Slope:	No information available
Aspect:	E, W
Vegetation type:	Grass-herb meadow, ericaceous heath, mossy patches
Co-occurring species:	No information available
Longevity:	Multi-year perennial – moderate to extensive caudex
Phenology:	The only specimen we saw with some flowers left was collected on 19 July 1978, so flowering most likely takes place in late June and early July; in fruit by early/mid-July.
Reproductive biology:	Nearly obligately self-pollinating (Brochmann and Elven 1992)

Sources of information used:

ALA specimens

BCD records

Literature:

Brochmann, C. and Elven, R. 1992. Ecological and genetic consequences of polyploidy in arctic *Draba* (Brassicaceae). Evolutionary Trends in Plants 6:111–124.

Mulligan, G.A. 1974. Confusion in the names of three *Draba* species of the arctic: *D. adamsii*, *D. oblongata*, and *D. corymbosa*. Canadian Journal of Botany 52:791–793.

Figure A-18. *Draba pauciflora* ALA specimen.

Figure A-19. *Draba pauciflora* ALA specimen close-up.

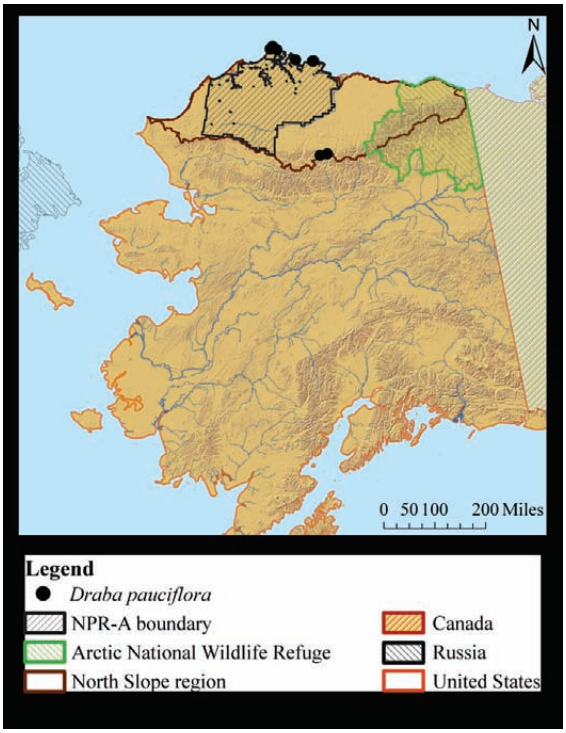

Figure A-20. Occurrences of *Draba pauciflora* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

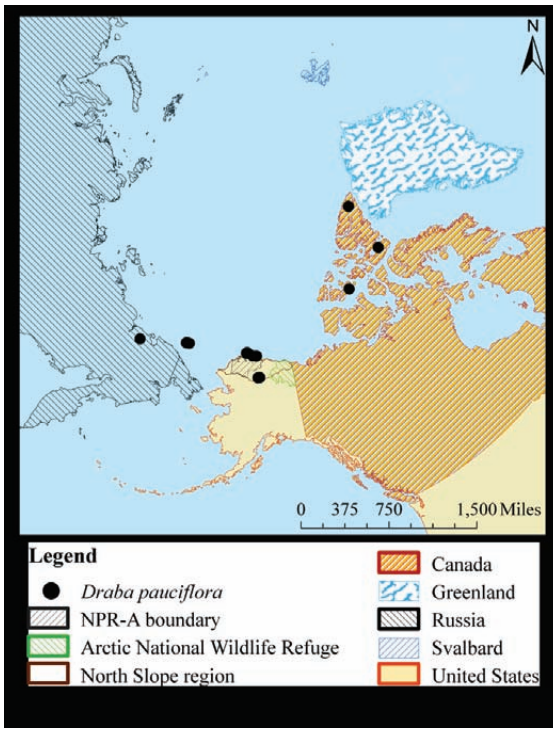

Figure A-21. Other circumpolar arctic collections of *Draba pauciflora*.

Draba subcapitata

Species:

Scientific name:	*Draba subcapitata* Simm.
Synonym(s):	None
Common name(s):	Ellesmereland whitlowgrass
Global rank:	G4
State rank:	S1

Distribution:

Global:	Circumpolar: well over 100 locations in the Canadian Arctic and Greenland, with additional locations in the Eurasian Arctic; disjunct in Alaska.
State:	Known from Konganevik Point in Camden Bay, from Barrow, and from 2 locations in the Prudhoe Bay oilfield activity area
North Slope:	Barrow to Prudhoe Bay, and Konganevik Point.
NPR-A:	Not documented (nearest collections are from Barrow and Prudhoe Bay)
Likely to be found in the NPR-A?	Yes
Elevation:	Found in sites at less than 30 m elevation

Ecology:

Landform:	Beach ridges, river bars, high-centered polygons and broad troughs.
Soil type:	Generally strongly calciphilic (but also found on acidic boulders); sand, gravel, carboniferous substrates
Moisture regime:	Variable (moist, dry)
Slope:	Gentle
Aspect:	S, E, W
Vegetation type:	Grass-herb meadows, ericaceous heath, dry hummocks, *Thlaspi* habitat
Co-occurring species:	*Artemisia comata*, *Cochlearia groenlandica*, *Thlaspi arcticum*
Longevity:	Probably very long lived – very extensive caudex
Phenology:	In fruit by early/mid-July
Reproductive biology:	Nearly obligately self-pollinating (Brochmann and Elven 1992)

Sources of information used:

ALA specimens

BCD records

Literature:

Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Gillespie, L.J., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Brysting, A.K., and Solstad, H. 1999 onwards. Flora of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval. Version:

29 April 2003. Available from: http://www.mun.ca/biology/delta/arcticf/_ca/www/badrsu.htm.

Brochmann, C. and Elven, R. 1992. Ecological and genetic consequences of polyploidy in arctic *Draba* (Brassicaceae). Evolutionary Trends in Plants 6:111–124.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 528.

Figure A-22. *Draba subcapitata* ALA specimen.

Figure A-23. *Draba subcapitata* ALA specimen close-up.

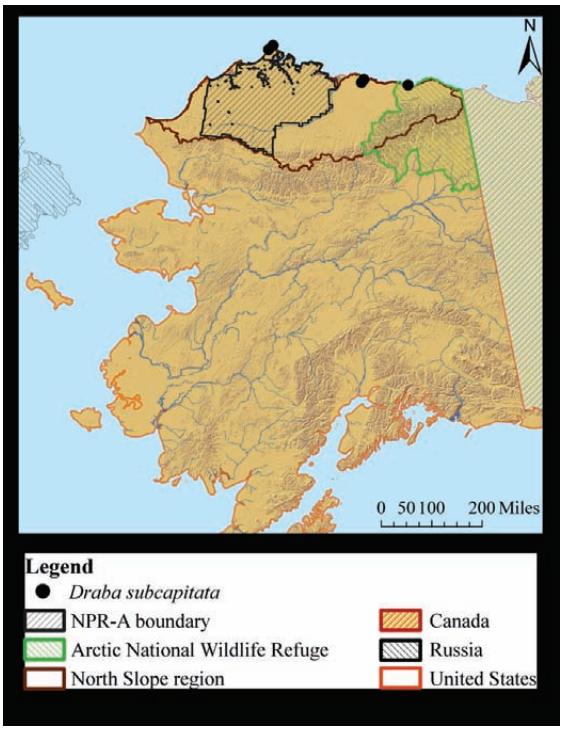

Figure A-24. Occurrences of *Draba subcapitata* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

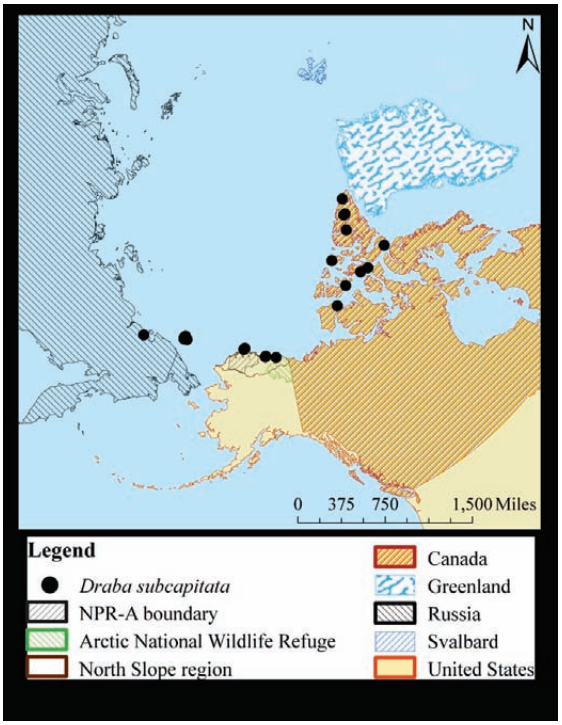

Figure A-25. Other circumpolar arctic collections of *Draba subcapitata*.

Erigeron muirii

Species:

Scientific name:	*Erigeron muirii* Gray
Synonym(s):	*Erigeron grandiflorus* ssp. *muirii* (Gray) Hultén
Common name(s):	Muir's fleabane
Global rank:	G2
State rank:	S2

Distribution:

Global:	This species is known from about 20 locations (although future surveys may reveal additional populations), extending across northern Alaska into northwesternmost Yukon (Herschel Island).
State:	Known from fewer than 20 locations in the east and central Brooks Range, as well as Cape Thompson in northwestern Alaska.
North Slope:	Along the Dalton Highway (Sagwon and Toolik Lake), in the Endicott Mountains, and between the Kavik and Canning rivers in the Brooks Range; north of the White Hills, in the Beaufort Sea coastal plain
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	Found at sites from 100 to 1200 m

Ecology:

Landform:	Alpine slopes, screes and outcrops; river terraces and bluffs; ridge crests, rocky tundra and meadows
Soil type:	Limestone and calcareous shale, rocky soil, sandstone outcrops, gravel
Moisture regime:	Dry
Slope:	No information available
Aspect:	S, SW
Vegetation type:	*Dryas* heath tundra, fellfield tundra
Co-occurring species:	*Anemone drummondii, Boykinia richardsonii, Cassiope tetragona, Castilleja hyperborea, Cetraria cuculata, Cetraria nivalis, Cornicularia divergens, Dryas octopetala, Eritrichium aretioides, Lupinus arcticus, Packera cymbalaria, Polygonum bistorta* ssp. *plumosum, Salix reticulata, Saxifraga bronchialis, Saxifraga tricuspidata, Silene acaulis, Thamnolia subuliformis, Vaccinium uliginosum,* and crustose lichens
Longevity:	Multi-year perennial
Phenology:	In flower July/early August; unable to determine fruiting time, as none of the specimens we studied had fruits.
Reproductive biology:	Unknown, probably pollinated by a range of insects (butterflies, solitary bees, and flies). *Erigeron glabellus* from

interior Alaska is known to be pollinated by 1 species of fritillary butterfly (*Boloria titania*) and males of 3 species of halictid bees (*Evylaeus comagenensis* and 2 species of *Dialictus* bees) (Armbruster and McGuire 1991).

Taxonomic notes:

Erigeron muirii is no longer considered to be endemic to northern Alaska. Specimens from Herschel Island, Canada were previously reported to be based on more pubescent forms of *E. porsildii* (Nesom and Murray 2004) but have now been confirmed as *E. muirii* (Murray pers. comm.), thus making this species a narrow endemic that occurs across northern Alaska and in the northwesternmost corner of the Yukon Territory (Herschel Island). Collections of this species from Wrangel Island, Russia, on the other hand, have later been re-determined as *E. komarovii*, and consequently *E. muirii* has been excluded from the revised vascular plant inventory for Wrangel Island (Yurtsev et al.1989).

Although *E. muirii* and *E. porsildii* occur sympatrically within Alaska, a series of ecological, morphological, and cytological traits distinguish them. *Erigeron muirii* generally grows in exposed, rocky sites, while *E. porsildii* is commonly found in meadows (Nesom and Murray 2004). Morphologically, *E. muirii* can be distinguished from *E. porsildii* by the following traits (Nesom and Murray 2004):

Erigeron muirii	– Stems, leaves and involucres lanate, eglandular – Cauline leaves narrowly elliptic-lanceolate, not subclasping
Erigeron porsildii	– Stems, leaves and involucres villose, glandular to stipitate-glandular – Leaves narrowly ovate to ovate-lanceolate or lanceolate, often subclasping

Sources of information used:

ALA specimens

BCD records

Literature:

Armbruster, W.S. and McGuire, A.D. 1991. Experimental assessment of reproductive interactions between sympatric *Aster* and *Erigeron* (Asteraceae) in interior Alaska. American Journal of Botany 78:1449–1457.

Hultén, E. 1950. Flora of Alaska and Yukon, vol. X. Lund, Sweden: C.W.K. Gleerup.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 866.

Nesom, G.L. and Murray, D.F. 2004. Notes on North American arctic and boreal species of *Erigeron* (Asteraceae: Astereae). Sida 21(1):41–57.

Walker, D. A., Binnian, E., Evans, B. M., Lederer, N. D., Nordstrand, E. and Webber, P. J. 1989. Terrain, vegetation and landscape evolution of the R4D research site, Brooks Range Foothills, Alaska. Holarctic Ecology 12:238–261.

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent Canada. Provo (UT): Brigham Young University Press. p. 145.

Yurtsev, B.A., Polozova, T.G. and Sekretareva, N.A. 1989. Additions and corrections to the list of vascular plants of Wrangel Island. Communication 2. Byulleten' Moskovskogo Obshchestva Ispytatelei Prirody., Otdel Biologicheskii 94:116–126.

Figure A-26. *Erigeron muirii* ALA specimen.

Figure A-27. *Erigeron muirii* ALA specimen close-up.

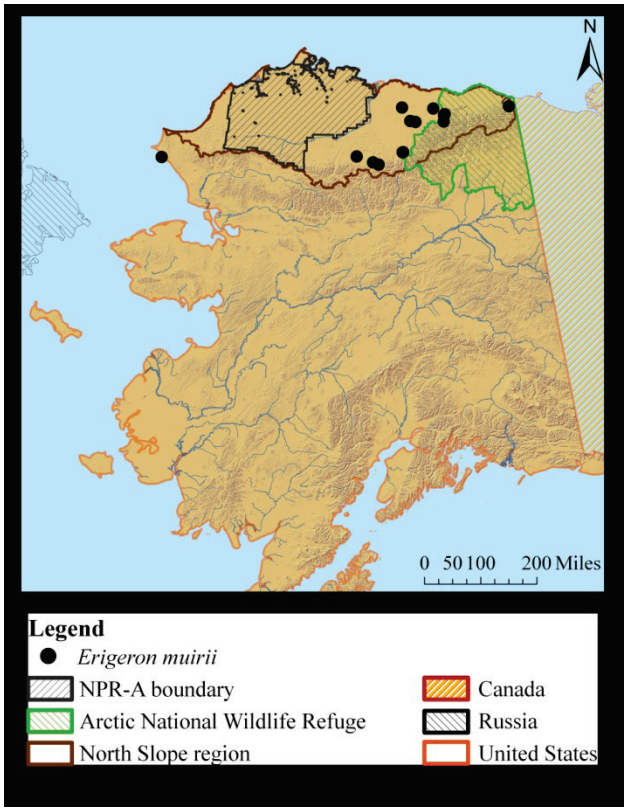

Figure A-28. Occurrences of *Erigeron muirii* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Erigeron ochroleucus

Species:

Scientific name:	*Erigeron ochroleucus* Nutt.
Synonym(s):	None
Common name(s):	Buff fleabane
Global rank:	G4G5
State rank:	S1S2

Distribution:

Global:	Occurs in Alberta and Saskatchewan, Canada; Montana, Wyoming, South Dakota, and North Dakota, US (Bry 1986). It has more recently been reported from British Columbia (Ceska 1996). USDA and NCRS (2005) also list this species as present in Nebraska. The arctic and boreal Alaska (and adjacent Yukon) populations are disjunct more than 2800 km from those in the contiguous US and southwestern Canada (Nesom and Murray 2004).
State:	Known from just a few locations in Alaska: near Meade River Camp (Atqasuk), close to the Kadleroshilik River, and in the Porcupine River area in northeastern Alaska, where it is reported common below the Lower Ramparts (Nesom and Murray 2004)
North Slope:	Close to Kadleroshilik and Shaviovik river mouths (southeast of Prudhoe Bay) near Foggy Island Bay; south of Meade River Camp (Atqasuk)
NPR-A:	South of Meade River Camp (Atqasuk)
Likely to be found in the NPR-A?	Yes
Elevation:	Known to grow from near sea level to 366 m

Ecology:

Landform:	Steppe bluffs; "base of arid slopes with an eastern to southern exposure, and adjacent terraces" (Nesom and Murray 2004)
Soil type:	Sand, gravel
Moisture regime:	Well-drained, dry
Slope:	Level to steep
Aspect:	S, SE, E
Vegetation type:	Discontinuous steppes (Nesom and Murray 2004)
Co-occurring species:	*Artemisia frigida*, *Bupleurum americanum*, *Calamagrostis purpurascens*, *Pseudoroegneria spicata*, *Phlox hoodii*, *Erigeron caespitosus*
Longevity:	Multi-year perennial
Phenology:	In flower July/early August; unable to determine fruiting time, as none of the specimens we studied had fruits.
Reproductive biology:	Unknown, probably pollinated by a range of insects, butterflies, solitary bees, and flies. *Erigeron glabellus* from interior Alaska is known to be pollinated by 1 species of

fritillary butterfly (*Boloria titania*) and males of 3 species of halictid bees (*Evylaeus comagenensis* and 2 species of *Dialictus* bees) (Armbruster and McGuire 1991).

Sources of information used:

ALA specimens

BCD records

Literature:

Armbruster, W.S. and McGuire, A.D. 1991. Experimental assessment of reproductive interactions between sympatric *Aster* and *Erigeron* (Asteraceae) in interior Alaska. American Journal of Botany 78:1449–1457.

Bry, E., editor. 1986. The rare ones. North Dakota Outdoors 49(2):2–33. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available from: http://www.npwrc.usgs.gov/resource/wildlife/rareone/grasslnd.htm.

Ceska. A. 1996. Two new plants to the flora of British Columbia. Botanical Electronic News (148). Available from: http://www.ou.edu/cas/botany-micro/ben/ben148.html.

Nesom, G. L. and Murray, D.F. 2004. Notes on North American arctic and boreal species of *Erigeron* (Asteraceae: Astereae). Sida 21(1):41–57.

[USDA and NRCS] U.S. Department of Agriculture and National Resource Conservation Service. 2005. The PLANTS Database, Version 3.5. Available from: http://plants.usda.gov. Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA.

Figure A-29. *Erigeron ochroleucus* ALA specimen.

Figure A-30. *Erigeron ochroleucus* ALA specimen close-up.

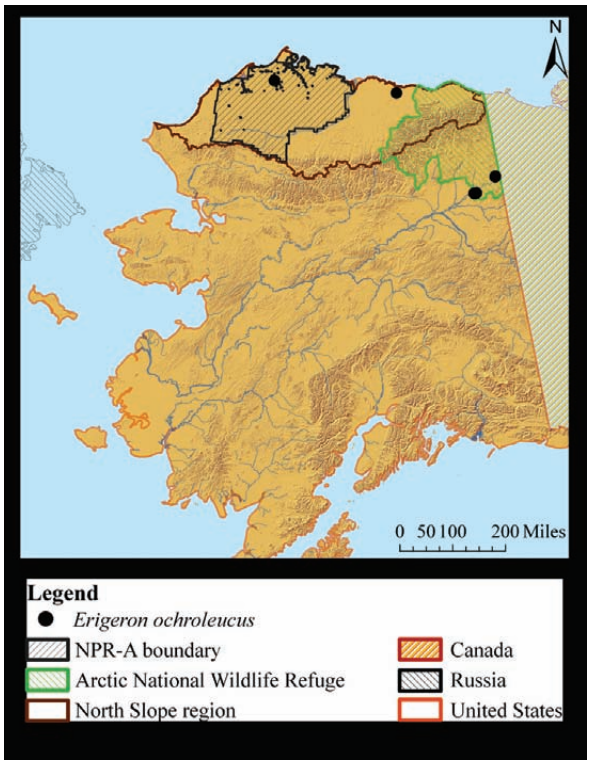

Figure A-31. Occurrences of *Erigeron ochroleucus* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Erigeron porsildii

Species:

Scientific name:	*Erigeron porsildii* Nesom and Murray
Synonym(s):	*Erigeron grandiflorus* Hooker ssp. *arcticus* Porsild
Common name(s):	Largeflower fleabane
Global rank:	G4T3T4
State rank:	S3

Distribution:

Global:	Approximately 40 sites documented; more sites have been seen, but no specimens collected. Known from western Canada (NWT: districts of Franklin, Mackenzie; YKT) and Alaska.
State:	More than 30 sites scattered in alpine and arctic Alaska. Recorded from interior Alaska mountains (Alaska Range, White Mountains, Wrangell-St. Elias Mountains), with disjunct populations in northern Alaska (collected from the Romanzof, Endicott, and Baird mountains)
North Slope:	Brooks Foothills: northeast of the Romanzof Mountains and foothills of the Endicott Mountains
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	(150–) 600–1600 (–2100) m

Ecology:

Landform:	Mountain ridges and slopes, rock outcrops, and screes, river bluffs and bars, and dune blowouts
Soil type:	(Often) calcareous substrates, shaley gravel (Nesom and Murray 2004); acidic bedrock, marble outcrops in micaschist bedrock; sandy silty soil, conglomerate outcrops, fine broken stones
Moisture regime:	Moist to dry
Slope:	Often moderate to steep
Aspect:	S, SE, [N]
Vegetation type:	Graminoid-forb tundra, open shrub-herbaceous meadows
Co-occurring species:	No information available (in the Alaska Range, *Erigeron porsildii* grows with *Oxytropis viscida, Dryas* sp., *Douglasia gormanii, Carex albonigra,* and *Calamagrostis purpurascens)*
Longevity:	No information available
Phenology:	In flower mid-June through August (September) (Nesom and Murray 2004)
Reproductive biology:	Unknown, probably pollinated by a range of insects, butterflies, solitary bees, and flies. *Erigeron glabellus* from interior Alaska is known to be pollinated by 1 species of fritillary butterfly (*Boloria titania*) and males of 3 species of

halictid bees (*Evylaeus comagenensis* and 2 species of *Dialictus* bees) (Armbruster and McGuire 1991).

Taxonomic notes:

Erigeron porsildii was previously included in the "*Erigeron grandiflorus*" complex (Porsild 1955), wherein *E. grandiflorus* was separated into 3 distinct "races": Rocky Mountain, Arctic, and Alaskan.

A subsequent revision of these taxa by Nesom and Murray (2004) indicates that the Alaskan and Arctic races are indistinguishable and consequently groups both these taxa under Porsild's (1955) *E. grandiflorus* ssp. *arcticus.* Additionally, the authors identify a set of non-overlapping features that separate *E. grandiflorus sensu stricto* from *E. grandiflorus* ssp. *arcticus*, thus allowing for these taxa to be treated independently and at the specific rank: *E. grandiflorus* Hook. *s.s.*, and *E. porsildii* Nesom and Murray *nom. nov*., respectively (Nesom and Murray 2004).

Lastly, we note that *E. porsildii* is not synonymous with *E. arcticus* Rouy, Fl. France 8:160 (1903). This precludes adoption of Porsild's (1955) name, *E. grandiflorus* ssp. *arcticus*, at the specific rank (i.e., *E. arcticus*) following the rule of name priority and explains the renaming of the taxon as *Erigeron porsildii*.

Sources of information used:

ALA specimens

BCD records

Literature:

Armbruster, W.S. and McGuire, A.D. 1991. Experimental assessment of reproductive interactions between sympatric *Aster* and *Erigeron* (Asteraceae) in interior Alaska. American Journal of Botany 78:1449–1457.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 865.

Nesom, G.L. and Murray, D.F. 2004. Notes on North American arctic and boreal species of *Erigeron* (Asteraceae: Asterae). Sida 21(1):41–57.

Porsild, A.E. 1955. The vascular plants of the western Canadian Arctic Archipelago. National Museum Canada Bulletin 135.

Figure A-32. *Erigeron porsildii* ALA specimen.

Figure A-33. *Erigeron porsildii* ALA specimen close-up.

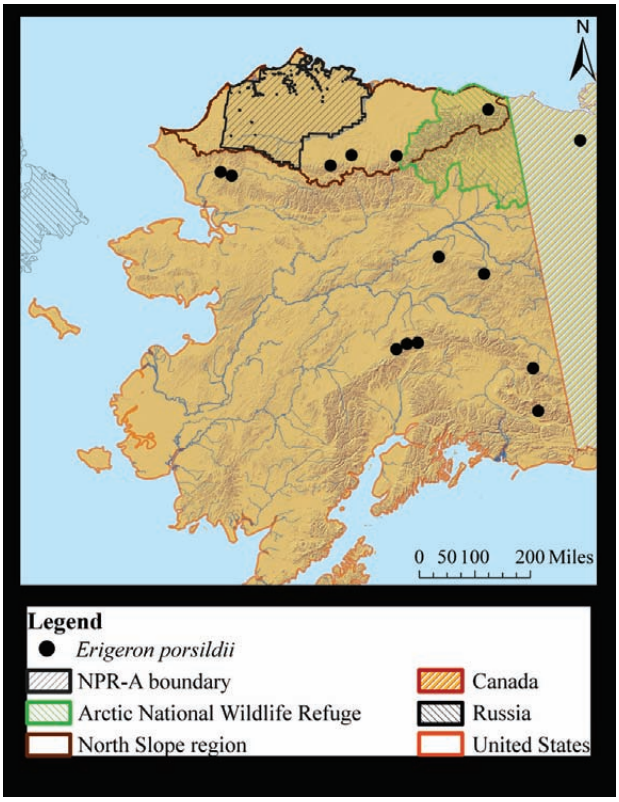

Figure A-34. Occurrences of *Erigeron porsildii* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Festuca edlundiae

Species:

Scientific name:	*Festuca edlundiae* S. Aiken, L. Consaul and L. Lefkovitch
Synonym(s):	None
Common name(s):	None
Global rank:	G3G4
State rank:	S1

Distribution:

Global:	Found in the Canadian high Arctic, Greenland, Svalbard, Russia (eastern Arctic). It is known from at least 25 sites in Canada, and is common in Svalbard, where it is known from hundreds of sites (Elven and Murray, pers. comms.).
State:	Only known from one site in Alaska, growing intermixed with *F. brachyphylla*. A recent revision of the *Festuca hyperborea*/*F. brachyphylla*/*Festuca edlundiae* material housed in ALA has revealed that there is one other possible *F. edlundiae* collection for Alaska. This specimen has not been annotated, as these species are notoriously more difficult to identify on herbarium specimens, where they lose many of their characteristics (not least the bloom on the leaves and stems) (Elven, pers. comm.).
North Slope:	Endicott Mountains
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	900–1200 m (100–200 m in the Canadian Arctic Archipelago, i.e., at higher latitudes)

Ecology:

Landform:	Gentle slopes, gravel bars, cliff ledges, and frost boils. (In Canada, it is found often in fine-grained calcareous substrates; when growing with *F. hyperborea*, *F. edlundiae* plants prefer a wetter microhabitat, sometimes even a solifluction slope. Plants may resemble *F. hyperborea* when they are growing stunted and isolated on mineral soil in a polar desert environment (Aiken et al. 1995).
Soil type:	Gravel, silt, acidic ledges
Moisture regime:	Not available
Slope:	Gentle
Aspect:	SW
Vegetation type:	Tundra and polar deserts, rich herbaceous slopes
Co-occurring species:	*Festuca brachyphylla*
Longevity:	Probably long lived – very highly tufted, with many old leaf-bases
Phenology:	No information available

Reproductive biology: Wind-pollinated, largely self-fertilized (autogamous) (Brochmann and Steen 1999)

Sources of information used:

ALA specimens

BCD records

* **DELTA-Intkey**

Literature:

Aiken, S.G., Consaul, L.L., and Lefkovitch, L.P. 1995. *Festuca edlundiae* (Poaceae), a high arctic, new species compared enzymatically and morphologically with similar *Festuca* species. Systematic Botany 20:374–392.

Aiken, S.G., Dallwitz, M.J., McJannet, C.L., and Consaul, L.L. 1996 onwards. *Festuca* of North America: descriptions, illustrations, identification, and information retrieval. Version: 19 October 2005. Available from: http://delta-intkey.com/.

Aiken, S.G., Dallwitz, M.J., McJannet, C.L., and Consaul, L.L. 1997. Biodiversity among *Festuca* (Poaceae) in North America: diagnostic evidence from DELTA and clustering programs, and an INTKEY package for interactive, illustrated identification and information retrieval. Canadian Journal Botany 75:1527–1555.

Brochmann, C. and Steen, S.W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

* A number of the *F. edlundiae* records from Canada (Nunavut and Northwest Territories), Norway (Svalbard), Russia (Chukotka), and Greenland cited in the database were obtained from DELTA-Intkey, available from http://delta-intkey.com.

Figure A-35. *Festuca edlundiae* ALA specimen.

Figure A-36. *Festuca edlundiae* ALA specimen close-up.

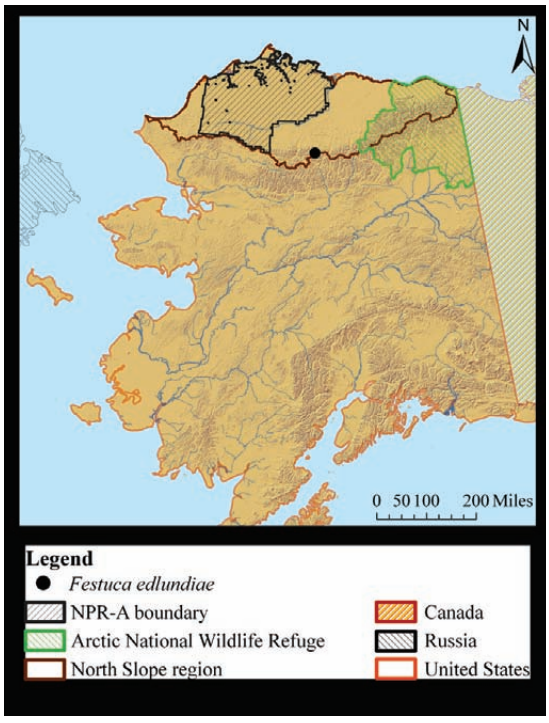

Figure A-37. Occurrences of *Festuca edlundiae* in Alaska based on the ALA, Arctos, BCD, and DELTA-Intkey records compiled for this project.

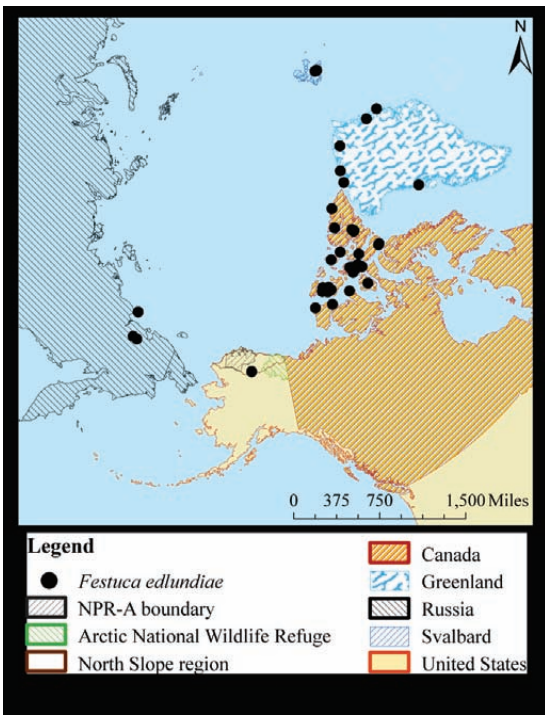

Figure A-38. Other circumpolar arctic collections of *Festuca edlundiae.*

Koeleria asiatica

Species:

Scientific name: *Koeleria asiatica* Domin
Synonym(s): None
Common name(s): Eurasian junegrass
Global rank: G4
State rank: S2S3

Distribution:

Global: Amphi-Beringian, from Siberia east to Alaska and the Yukon Territory. In addition to mainland Russia, it is also known from Wrangell Island (Kharkevicz 1985) (see **Figure A-42**).

State: From the Ketik River in the Brooks Foothills to Harrison Bay in the Arctic Coastal Plain; also occurs farther south, around Cape Beaufort, east of the Lisburne Hills, near Cape Thompson, and then disjunctly in the Nulato Hills range (vicinity of Unalakleet).

North Slope: From the Ketik River in the Brooks Foothills to Fish Creek (Harrison Bay) in the Arctic Coastal Plain, including sites in the Meade River Camp (Atqasuk) area, and near the confluence of the Ikpikpuk and Price rivers. Also collected around Cape Beaufort.

NPR-A: Meade River Camp (Atqasuk); near the confluence of the Ikpikpuk and Price rivers; Kalikpik River/Fish Creek near Harrison Bay

Likely to be found in the NPR-A? Yes

Elevation: From sea level to approximately 600 m

Ecology:

Landform: River banks and bluffs, lake shore areas, gravel bars, sand dunes, alpine slopes, ridge crests

Soil type: Sand, sandstone, gravel, silt, and cobbly limestone

Moisture regime: Well-drained, dry

Slope: No information available

Aspect: NE, S

Vegetation type: Tussock tundra, squirrel burrows

Co-occurring species: *Potentilla uniflora*, *Eritrichium chamissonis* (in the Brooks Foothills)

Longevity: Perennial; longevity is difficult to estimate

Phenology: No information available

Reproductive biology: Wind-pollinated

Sources of information used:

ALA specimens
BCD records

Literature cited:

Clayton, W.D., Harman, K.T., and Williamson, H. 2002 onwards. World grass species: descriptions, identification, and information retrieval [cited 09 June 2006]. Available from: http://www.kew.org/data/grasses-db.

Kharkevich, S.S., editor. 1985. Sosudistyje rastenija sovietskogo Dal'nego Vostoka [Vascular Plants of the Soviet Far East]. Nauka: Leningrad. Vol. 1, p. 165.

Figure A-39. *Koeleria asiatica* ALA specimen.

Figure A-40. *Koeleria asiatica* ALA specimen close-up.

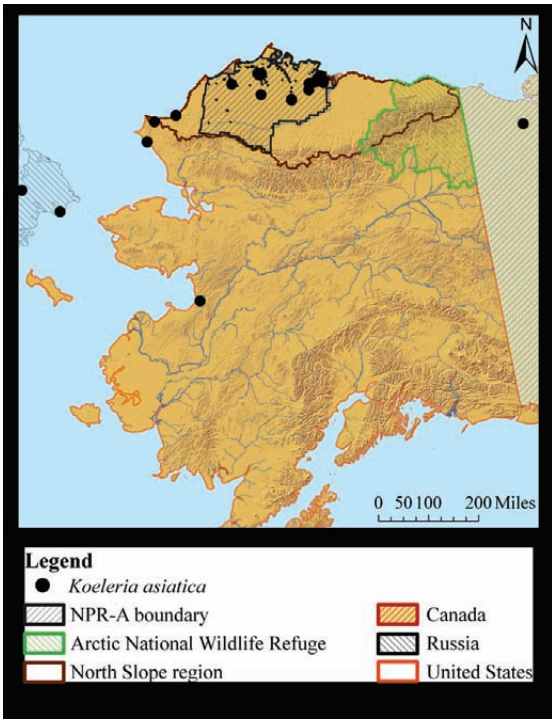

Figure A-41. Occurrences of *Koeleria asiatica* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

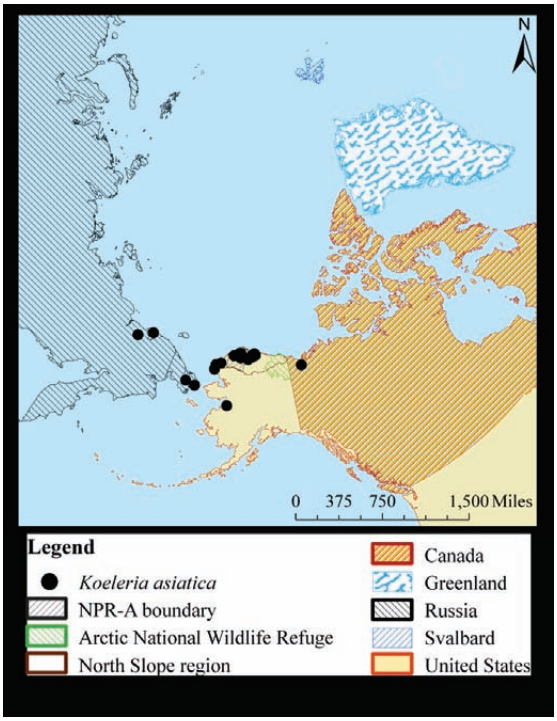

Figure A-42. Other circumpolar arctic collections of *Koeleria asiatica*.

Mertensia drummondii

Species:

Scientific name:	*Mertensia drummondii* (Lehm.) G. Don
Synonym(s):	*Lithospermum drummondii* Lehman, *Mertensia sibirica* var. *drummondii* (Lehm.) A. Gray, *Mertensia lanceolata* var. *drummondii* (Lehm.) Boivin
Common name(s):	Drummond's bluebells
Global rank:	G2Q
State rank:	S2

Distribution:

Global:	Known from fewer than 20 sites in 3 widely separated areas of arctic Alaska and Canada. Several sites are within areas that have been or are currently being considered for oil or gas exploration and development. In Alaska this species has been found in 2 areas: (1) a stretch of less than 55 km along the Meade River near Atqasuk (south of Barrow), and (2) approximately 250 km to the east on the Kogosukruk River near Umiat. The Meade River sites are all less than 11 miles (18 km) from each other. The sites on the Kogosukruk River are all less than 4 miles (6.4km) from each other. Four (or more?) sites are known from the arctic coast of western Nunavut and Victoria Island, all around Union Straits.
State:	Although only known from 2 general areas, each contains several sites with hundreds to thousands of ramets. There are potential threats from all-terrain vehicle use or sand extraction, but neither is a problem at present.
North Slope:	Meade and Kogosukruk Rivers
NPR-A:	Meade and Kogosukruk Rivers
Likely to be found in the NPR-A?	Yes
Elevation:	Between 2 and 75 m

Ecology:

Landform:	Sparsely vegetated, active sand dunes and blowouts near rivers; also on sandy banks near the coast in Canada; not a seashore species. The Alaska sites are all found well back from, or above, the active flood plain.
Soil type:	Sand to sandy gravel
Moisture regime:	Moist to dry
Slope:	Level to moderate
Aspect:	No particular aspect
Vegetation type:	Open mat and cushion tundra, willow-graminoid desert scrub, herbaceous/shrubby heath with high lichen cover
Co-occurring species:	*Bromus inermis* var. *pumpellianus, Carex obtusata, Festuca rubra, Leymus mollis, Dryas integrifolia, Eritrichium nanum*

var. *chamissonis,* and *Salix brachycarpa* (Lipkin and Murray 1997)

Longevity: Perennial

Phenology: In flower late June through late July; mostly gone to fruit (swollen fruit bulging through remains of corolla) by late July to early August

Reproductive biology: The genus *Mertensia* is primarily bee-pollinated, and bumblebee-pollinated (*Bombus* spp. and *Psithyrus* spp.) in particular. This is very likely the case with *M. drummondii*. It is unknown whether this species is self-compatible and able to set seed in the absence of insect visitation.

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 784.

Lipkin, R. 1995. Status survey update *Mertensia drummondii* (Lehm.) G. Don. Unpublished report to U.S. Fish and Wildlife Service. Alaska Natural Heritage Program, Anchorage, AK.

Lipkin, R. and Murray, D.F. 1997. Alaska rare plant field guide. U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Alaska Natural Heritage Program, and U.S. Forest Service. Available from: http://aknhp.uaa.alaska.edu/rareguide/.

Murray, D.F. 1980. Threatened and endangered plants of Alaska. U.S. Forest Service and Bureau of Land Management. p. 8.

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent Canada. Provo (UT): Brigham Young University Press. pp. 61–62.

Wiggins, I.L. and Thomas, J.H. 1962. A flora of the Alaskan Arctic Slope. Arctic Institute Special Publication 4. Toronto (ON): Univ. of Toronto Press. p. 306.

Williams, L.O. 1940. *Mertensia drummondii* (Lehm.) G. Don. Annals of the Missouri Botanical Garden 27:263–264.

Figure A-43. *Mertensia drummondii* ALA specimen.

Figure A-44. *Mertensia drummondii* ALA specimen close-up.

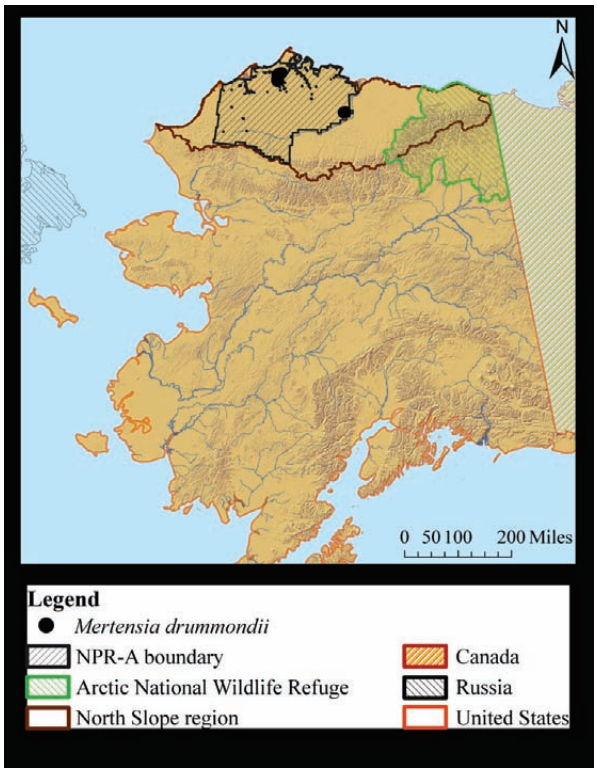

Figure A-45. Occurrences of *Mertensia drummondii* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Oxygraphis glacialis

Species:

Scientific name:	*Oxygraphis glacialis* (Fisch.) Bunge
Synonym(s):	*Ranunculus kamchaticus* DC. *Ranunculus kamtschaticus* de Candolle
Common name(s):	Kamchatka buttercup
Global rank:	G4G5
State rank:	S2S3

Distribution:

Global:	Asia, Alaska (Whittemore 1997): it is found isolated in the Urals and extends from the eastern mountain ranges in Tajikistan (Pamir) to the Altai in Kazakhstan, then through Mongolia and eastern Russia (along the lower Lena River north to the Chukchi Peninsula and northern Kamtchatka) into western Alaska. It has also been collected in the Himalayas (Kumaon and Sikkim) and in North China (T'ai Po Shan) and South China (Yunnan).
State:	Known from the Aleutian Islands, Ahklun Mountains near Goodnews Bay, Seward Peninsula, northern foothills of Brooks Range (Lookout and Archimedes Ridges), Cape Beaufort, central Brooks Range (Invalurak Mountain, Endicott Mountains), and also from near Healy, in the Alaska Range
North Slope:	Collected on the Archimedes and Lookout ridges (eastern Brooks Foothills) and near Cape Beaufort
NPR-A:	Archimedes and Lookout ridges
Likely to be found in the NPR-A?	Yes
Elevation:	Sea level to 1260 m in Alaska (known to grow to 5000 m in China and to 2400 m in Scandinavia)

Ecology:

Landform:	Polygon tundra, rock-mud seepage terraces, moist banks and rubble slopes; outcrops, screes, and ridgetop fellfields; open soils and sparsely vegetated barrens (In China it is found in alpine meadows, often on level, wet stony areas, grassy slopes, scrub, and by rivers [Wencai et al. 2001].)
Soil type:	Limestone/calcareous screes and outcrops, marbleized carbonate rock, serpentinite barrens, sandy, gravely, rocky, clay, gravel, silt, sand
Moisture regime:	Wet to moist
Slope:	Gentle
Aspect:	Variable
Vegetation type:	Tundra on moist slopes (Whittemore 1997), sparsely vegetated ridges
Co-occurring species:	No information available

Longevity: Multi-year perennial
Phenology: Flowering May through late July; fruiting from June onward
Reproductive biology: Likely fly-pollinated

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 486.

Wencai, W., Tamura, M., and Gilbert, M.G. 2001. *Oxygraphis*. In: Wu Zheng-yi and Raven, P., editors. Flora of China 6:434–435.

Whittemore, A.T. 1997. *Ranunculus*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 3:(page number not available). Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=Ranunculus+kamtschaticus.

Figure A-46. *Oxygraphis glacialis* ALA specimen.

Figure A-47. *Oxygraphis glacialis* ALA specimen close-up.

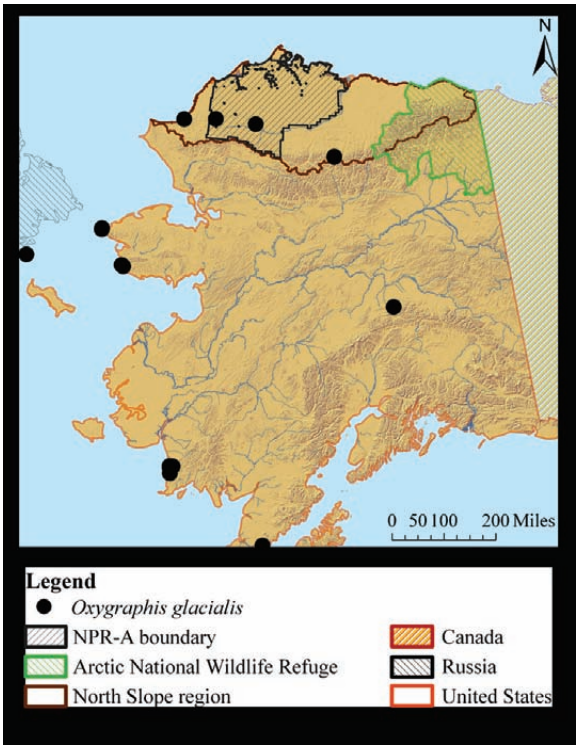

Figure A-48. Occurrences of *Oxygraphis glacialis* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

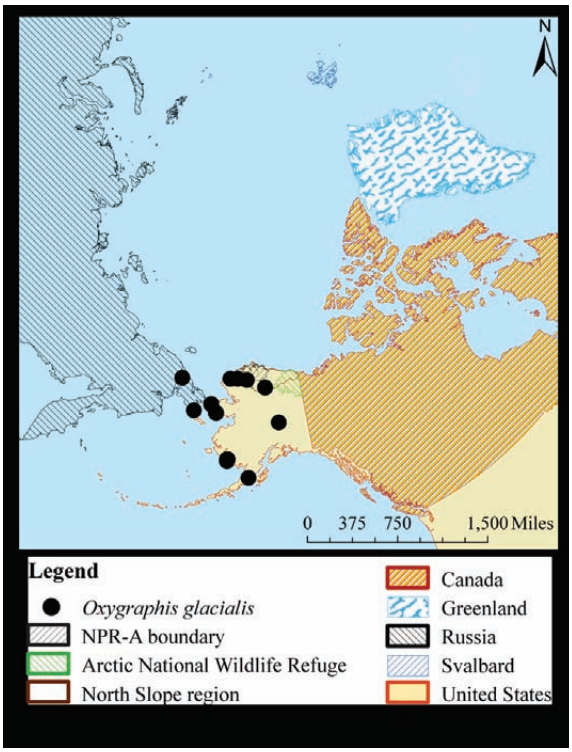

Figure A-49. Other circumpolar arctic collections of *Oxygraphis glacialis.*

Oxytropis tananensis

Species:

Scientific name:	*Oxytropis tananensis* Yurtzev
Synonym(s):	None
Common name(s):	Tanana locoweed
Global rank:	G2G3Q
State rank:	S2S3

Distribution:

Global:	Endemic to Alaska, primarily from the Tanana Basin, near the confluence with the Delta River and south to sites along the Chitina River. Outlying collections to the north are known from the upper Porcupine River and Anisak River (there is also one additional collection from the Jim Lake area, south-southeast of Palmer).
State:	See global range comments
North Slope:	Not documented (nearest collection is from the Anisak River valley, western Brooks Range)
NPR-A:	Not documented
Likely to be found in the NPR-A?	Unlikely
Elevation:	Known to grow between 135 m and 731 m

Ecology:

Landform:	River bluffs, limestone knobs above floodplains (Brooks Range collection); talus, outcrops, steep slopes, bluffs, ancient dune slopes, gravel railroad beds, open prairie slopes, steppe meadows
Soil type:	Limestone (Brooks Range collection); gravel, sand, sandy-silt loam and rocks with carbonate crust
Moisture regime:	Dry to moist
Slope:	Gentle, moderate, and steep
Aspect:	SE, SSE, W
Vegetation type:	Rocky, *Dryas* heath tundra with scattered shrubs and forbs (Brooks Range collection); spruce-poplar-aspen forest clearings, steppe meadows
Co-occurring species:	No information available within the study region
Longevity:	Apparently a long-lived perennial; a species in the related genus *Astragalus* with a very similar growth-form (*Astragalus tyghensis*) was estimated to live greater than 30 years in a demographic study (Carlson and Kaye 2001).
Phenology:	Flowering mid-June to early-July; fruiting mid-July on
Reproductive biology:	Bee-pollinated (likely *Bombus* spp. and *Psithrys* spp.)
Herbivory:	Pre-dispersal seed predation (likely bruchid beetles or weevils) was evident on roughly 10% of ALA specimens examined – these specimens were all from interior Alaska. Additionally, the genus *Oxytropis* is well-known forage in

the Arctic for muskoxen (Mulder and Harmsen 1995) and grizzly/brown bears.

Taxonomic notes:

This taxon was described by Yurtsev (1993) as distinct from *Oxytropis campestris* s. l., based on the presence of whorled leaflets for all individuals, a dark spot on the keel, and a lack of clavate appendages on its stipules.

Sources of information used:

ALA specimens

BCD records

Literature:

Carlson, M.L., and T.N. Kaye. 2001. *Astragalus tyghensis* population monitoring and viability models. Oregon Department of Agriculture and Bureau of Land Management, Prineville District, Prineville, OR.

Gillett, J.M, Consaul, J.J, Aiken S.G., and Dallwitz, M.J. 2000. Fabaceae of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval [cited 15 November 2000]. Available from: http://www.mun.ca/biology/delta/arcticf/fab/www/faoxcv.htm.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 664.

Mulder, C.P.H. and Harmsen, R. 1995. The effect of muskox herbivory on growth and reproduction in an Arctic legume. Arctic and Alpine Research 27:44–53.

Welsh, S.L. 1994. *Oxytropis* DC. Flora North America project. Manuscript completed.

Yurtsev, B.A. 1993. *Oxytropis tananensis*, a new species of section *Baicalia* (Fabaceae) from the interior of eastern Alaska. Ukrains'kii Botanichnii Zhurnal 78:59–65.

Figure A-50. *Oxytropis tananensis* ALA specimen.

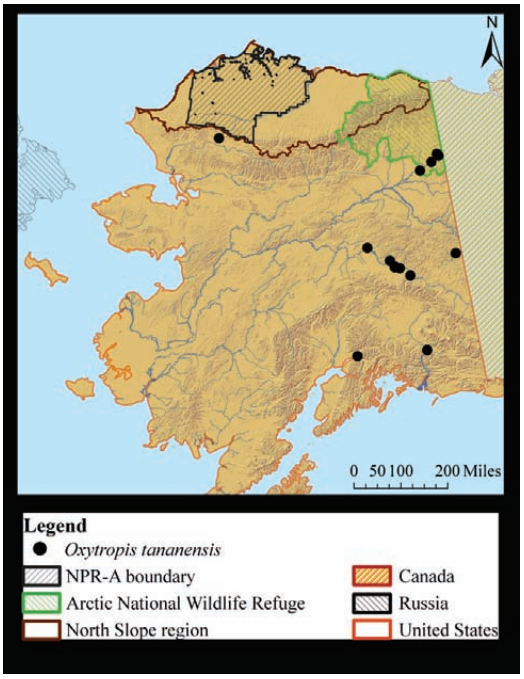

Figure A-51. Occurrences of *Oxytropis tananensis* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Papaver gorodkovii

Species:

Scientific name:	*Papaver gorodkovii* Tolm. & Petrovsky
Synonym(s):	None
Common name(s):	Arctic poppy
Global rank:	G3
State rank:	S2S3

Distribution:

Global:	There are at least 20 known occurrences of this species in the Russian Far East and northernmost Alaska, but it is unlikely that there are more than 100 separate locations. In Russia it is only known from Wrangel Island. In northern Alaska it has been recorded from several widely scattered sites along a narrow margin of coastal tundra. It has also been collected from the Canadian Arctic Archipelago (Banks and Victoria islands).
State:	Seemingly restricted to the coastal margin of arctic Alaska (Point Hope to Cape Lisburne, Barrow, and Camden Bay). It is apparently not very abundant at some of the known locations.
North Slope:	Barrow and Camden Bay
NPR-A:	Not documented (nearest collections are from Barrow)
Likely to be found in the NPR-A?	Yes
Elevation:	Usually near sea level, but known to grow up to 205 m

Ecology:

Landform:	Close to shore, in protected areas on outcrops, screes, high-center polygons, river gravel bars and alluviums; on well-drained gravels of floodplain terraces and coastal arctic screes (Kiger and Murray 1997)
Soil type:	Limestone, chert, sandy clay and gravel, silt
Moisture regime:	Well-drained to moist
Slope:	No information available
Aspect:	No information available
Vegetation type:	Tundra
Co-occurring species:	*Epilobium latifolium, Ranunculus nivalis, Poa arctica, Corydalis pauciflora*
Longevity:	Probably long-lived perennial – extensive caudex, with many leaf-bases (Carlson, per. obs.)
Phenology:	Flowering July to early August (Kiger and Murray 1997)
Reproductive biology:	Insect-pollinated

Sources of information used:

ALA specimens

BCD records

Literature:

Brochmann, C. and Steen, S.W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Kiger, R. and Murray, D.F. 1997. *Papaver gorodkovii.* In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 3:(page number not available). Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=papaver+gorodkovii&chkAllFloras=on\.

Figure A-52. *Papaver gorodkovii* ALA specimen.

Figure A-53. *Papaver gorodkovii* ALA specimen close-up.

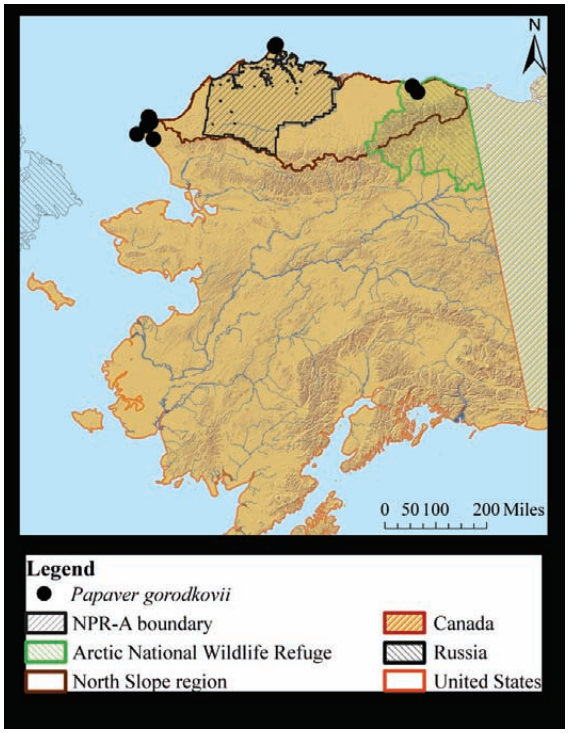

Figure A-54. Occurrences of *Papaver gorodkovii* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

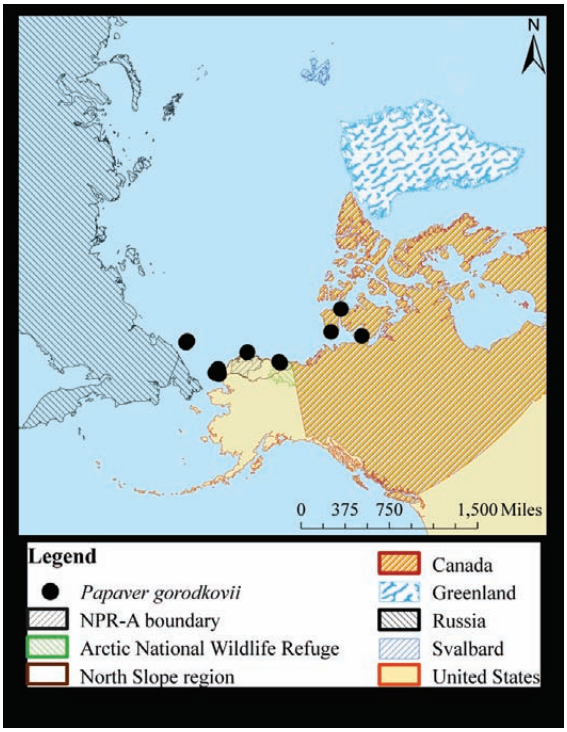

Figure A-55. Other circumpolar arctic collections of *Papaver gorodkovii.*

Pedicularis hirsuta

Species:

Scientific name:	*Pedicularis hirsuta* L.
Synonym(s):	None
Common name(s):	Hairy lousewort
Global rank:	G5?
State rank:	S1

Distribution:

Global:	Almost circumpolar distribution: Norway, European Russia, Siberia, the Far East, Alaska (Prudhoe Bay), Greenland, and Canada. In Canada it is found in the islands of the Northwest Territories, continental Northwest Territories, Nunavut Islands, continental Nunavut, and Northern Québec. Within the Canadian Arctic Archipelago, it is common (where it occurs), even though its range is limited to the following islands: Baffin, Devon, Ellesmere, Axel Heiberg, Southampton, and Coats (Aiken et al. 2003).
State:	Prudhoe Bay (Reports from the Seward Peninsula are based on misidentified collections of *P. langsdorfii*.)
North Slope:	Prudhoe Bay
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	In Alaska (Beechey Point collections) it is known to grow near sea level (2–20 m).

Ecology:

Landform:	Beach terraces, tundra; Russian and Canadian specimens were found growing in mossy snowbeds.
Soil type:	Sandy, stony, basic substrates in Scandinavian mountains, but not calciphilic in the Arctic
Moisture regime:	Damp, moist, saturated wet
Slope:	Gentle
Aspect:	No information available
Vegetation type:	*Carex-Eriophorum* tundra
Co-occurring species:	*Carex aquatilis* var. *stans, Eriophorum triste*
Longevity:	Multi-year perennial
Phenology:	Flowering in July, fruiting late July/August
Reproductive biology:	Insect-pollinated (bumblebees and *Psithyrus* spp.), able to autonomously set seed in the absence of pollinators, largely autogamous (Brochmann and Steen [1999] and references cited therein)

Sources of information used:

ALA specimens
BCD records

Literature:

Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Gillespie, L.J., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Brysting A.K., and Solstad, H. 2003. Flora of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval [cited 29 April 2003]. Available from: http://www.mun.ca/biology/delta/arcticf/_ca/www/scpehi.htm.

Brochmann, C. and Steen, S. W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Lid, J., and Lid, D.T. 1994. Norsk flora. Oslo: Det Norske Samlaget. p. 1014.

Figure A-56. *Pedicularis hirsuta* ALA specimen.

Figure A-57. *Pedicularis hirsuta* ALA specimen close-up.

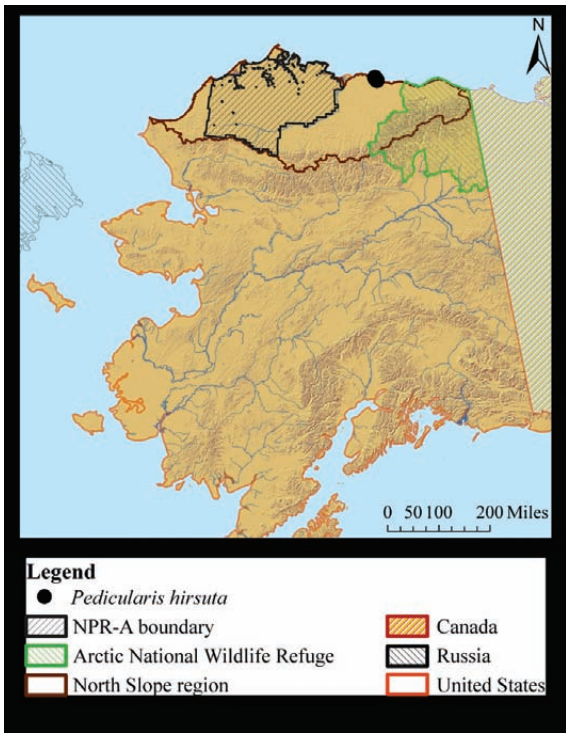

Figure A-58. Occurrences of *Pedicularis hirsuta* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

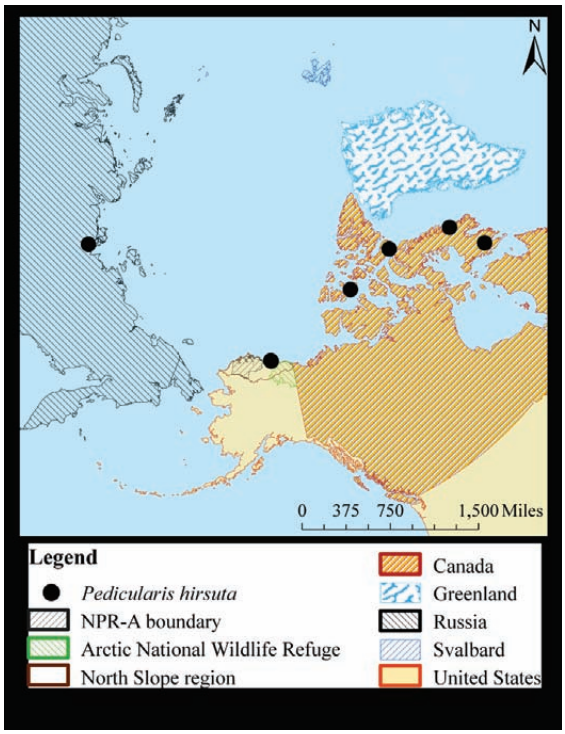

Figure A-59. Other circumpolar arctic collections of *Pedicularis hirsuta.*

Pleuropogon sabinei

Species:

Scientific name:	*Pleuropogon sabinei* R.Br.
Synonym(s):	None
Common name(s):	False semaphoregrass
Global rank:	G4G5
State rank:	S1

Distribution:

Global:	Arctic, amphi-Atlantic distribution, with occurrences in Alaska and Canada. Within the Canadian Arctic Archipelago it is widespread and found on some of the Queen Elizabeth Islands (Ellesmere, Devon, Axel Heiberg, Cornwallis, and Ellef Ringnes) and on the islands of Baffin, Banks, Victoria, Prince of Wales, Somerset, King William, Southampton, and Coats (Aiken et al. 2001).
State:	Prudhoe Bay and Cape Halkett, in the Arctic Coastal Plain (Collections from the Seward Peninsula have been re-examined and found to be of an unidentifiable grass, most likely not *Pleuropogon.*)
North Slope:	Between Kuparuk and Sagavanirktok rivers, Prudhoe Bay; near Garry Creek, south of Cape Halkett
NPR-A:	Near Garry Creek, south of Cape Halkett
Likely to be found in the NPR-A?	Yes
Elevation:	Beechey Point records are from near sea level; in the Canadian Arctic islands, it has generally been collected at 50–150 m, but one specimen was found growing at 690 m in Ellesmere Island [Nunavut, Ellesmere Island, east of Piper Pass, 690 m, meadow in mountain pass, 3 Aug 1990, *Murray and Yurtsev 10391* (ALA)]

Ecology:

Landform:	Close to lakes, streams, creeks, rivers, in floodplain habitats, marshes and ponds; always found close to water, pond specialist (Elven and Murray, pers. comms.)
Soil type:	Mud, silt, clay, pebbles, gravel
Moisture regime:	Moist to saturated wet
Slope:	Level to gentle
Aspect:	No information available
Vegetation type:	Tundra
Co-occurring species:	*Arctophila fulva, Caltha palustris*
Longevity:	Perennial
Phenology:	Flowering July, fruiting late August to September (Elven and Murray, pers. comms.)
Reproductive biology:	Wind-pollinated and clonal – subterranean runners (Brochmann and Steen 1999)

Sources of information used:

ALA specimens

BCD records

Literature:

Aiken, S.G., Consaul, L.L. and Dallwitz, M.J. 2001. Poaceae of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval [cited 10 December 2001]. Available from: htttp://www.mun.ca/biology/delta/arcticf/poa/www/poplsa.htm.

Brochmann, C. and Steen, S. W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Halliday, G. 1977. New and notable finds in the Alaskan vascular flora. Canadian Field-Naturalist 91(3):319–322.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 126.

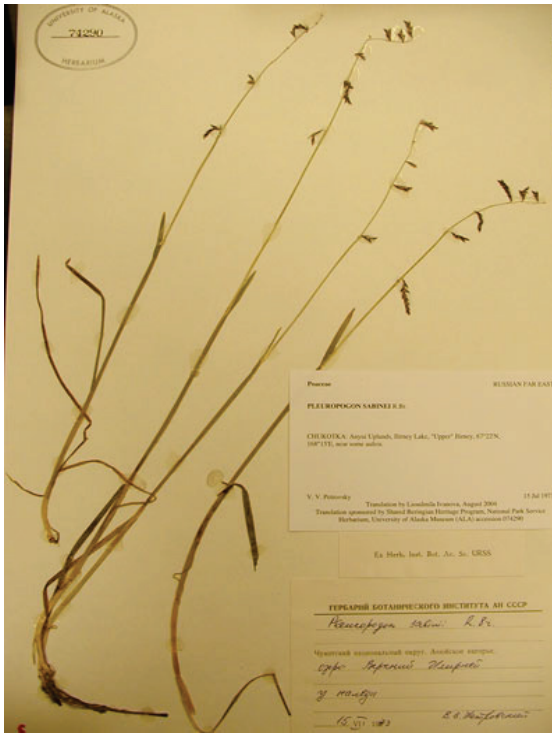

Figure A-60. *Pleuropogon sabinei* ALA specimen.

Figure A-61. *Pleuropogon sabinei* ALA specimen close-up.

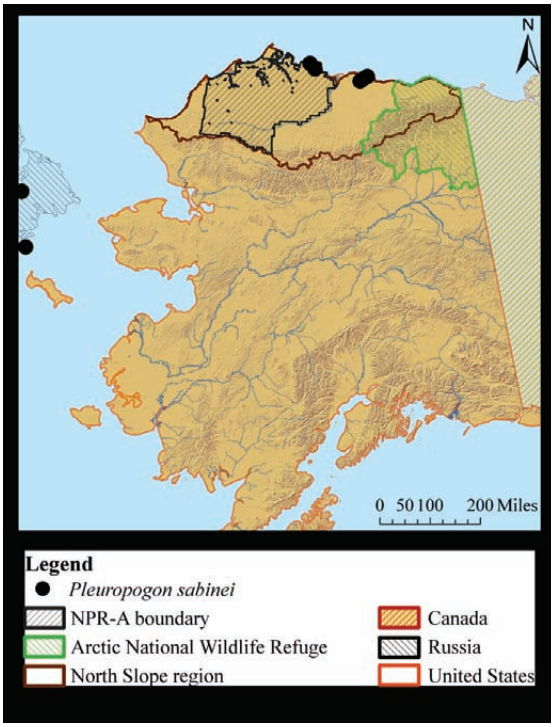

Figure A-62. Occurrences of *Pleuropogon sabinei* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

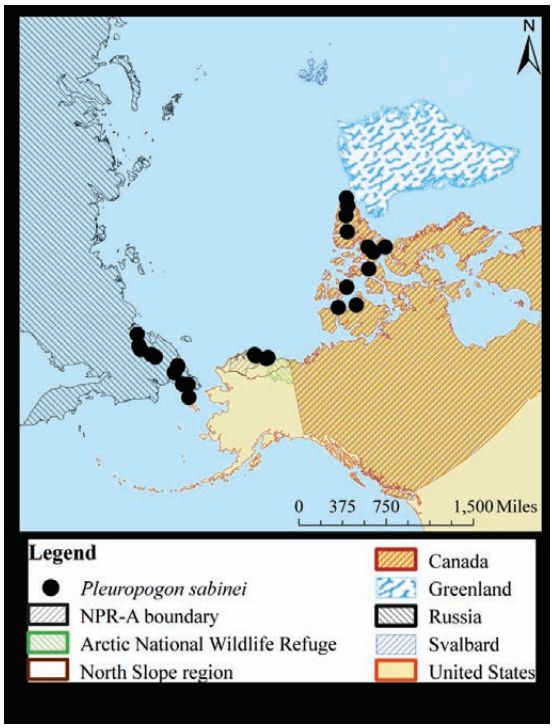

Figure A-63. Other circumpolar arctic collections of *Pleuropogon sabinei.*

Poa hartzii ssp. *alaskana*

Species:

Scientific name:	*Poa hartzii* ssp. *alaskana* Soreng
Synonym(s):	None
Common name(s):	Alaskan bluegrass
Global rank:	G3G4T1
State rank:	S1

Distribution:

Global:	Known from 5 locations in a very restricted range in arctic Alaska; potentially threatened by oil exploration activity
State:	This bluegrass is endemic to arctic Alaska, where it is known from the Meade River and from Lake Peters in the eastern Brooks Range. (Reports from Lake Peters, however, may be based on a mislabeled collection from the Meade River.)
North Slope:	Along Meade River; Fish Creek close to Harrison Bay
NPR-A:	Along Meade River; Fish Creek close to Harrison Bay
Likely to be found in the NPR-A?	Yes
Elevation:	Between sea level and 410 m

Ecology:

Landform:	Sparsely vegetated river bars and active dunes of point bars
Soil type:	Sand to silty-sand
Moisture regime:	Well-drained, dry to moist
Slope:	Gentle
Aspect:	No information available
Vegetation type:	Barren sand dunes, sparsely vegetated habitats
Co-occurring species:	Primarily on barren substrates (commonly associated species include *Artemisia borealis*, *Festuca rubra*, *Leymus mollis*, and *Rumex graminifolius* [Lipkin and Murray 1997])
Longevity:	Multi-year perennial
Phenology:	Flowering in July (Lipkin and Murray 1997)
Reproductive biology:	Not available (However, *Poa hartzii* ssp. *hartzii* is wind-pollinated and undergoes asexual seed production [Brochmann and Steen 1999].)

Taxonomic notes:

This is the only subspecies of *Poa hartzii* that has been collected in Alaska. *Poa glauca* Vahl lacks the distinctive reddish bases and has shorter anthers (1.8–2.2 mm). Other *Poa* species that can be found in sandy areas on the North Slope lack the distinctive reddish leaf and culm bases. Species of the genera *Deschampsia* and *Festuca* are found in similar habitats and can be of similar appearance, but have awned or awn-pointed lemmas (Lipkin & Murray 1997).

Sources of information used:

ALA specimens

BCD records

Literature:

Brochmann, C. and Steen, S. W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Lipkin, R. and Murray, D.F. 1997. Alaska rare plant field guide. U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Alaska Natural Heritage Program, and U.S. Forest Service. Available from: http://aknhp.uaa.alaska.edu/rareguide/.

Soreng, R. J. 1991a. New taxa and hybrids in North American *Poa*. Phytologia 71(5):404.

Soreng, R. J. 1991b. Notes on new infraspecific taxa and hybrids in North American *Poa* (Poaceae). Phytologia 71(5):390–413.

Figure A-64. *Poa hartzii* ssp. *alaskana* ALA specimen.

Figure A-65. *Poa hartzii* ssp. *alaskana* ALA specimen close-up.

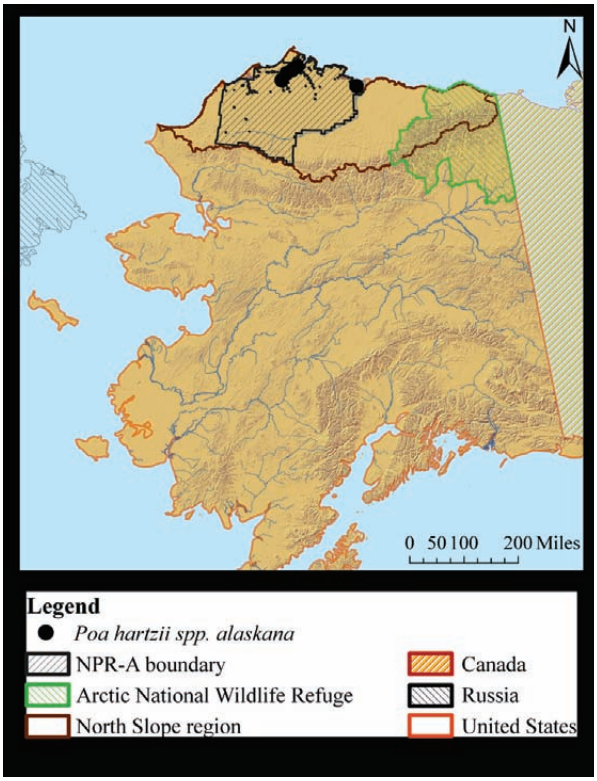

Figure A-66. Occurrences of *Poa hartzii* ssp. *alaskana* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Potentilla stipularis

Species:

Scientific name:	*Potentilla stipularis* L.
Synonym(s):	None
Common name(s):	Stipulated cinquefoil
Global rank:	G5
State rank:	S1S2

Distribution:

Global:	Widespread and abundant in northern Asia, extending into northwestern Alaska and along the Colville River; disjunctly to Greenland
State:	Known from only 6 locations in North America (excluding Greenland), all of which are in Alaska. The 3 general areas are the West Fork of the Buckland River (northeastern Seward Peninsula), Anisak River and Desperation Lake (both sites in the upper Noatak River area), and 2 sites on the Colville River (one near the confluence with the Etivluk River and one near Umiat).
North Slope:	Brooks Foothills (bluffs along the Colville River and vicinity of the upper Noatak River)
NPR-A:	Confluence of the Etivluk and Colville rivers, in the Brooks Range
Likely to be found in the NPR-A?	Yes
Elevation:	Collected between 15 m and 700 m

Ecology:

Landform:	Meadows, open areas, river and stream banks, river bars and terraces, vegetated river floodplains, bluffs, cutbank slopes, and draws
Soil type:	Silty loam, mud, sand, gravel, cobbles, chert
Moisture regime:	Wet to moist
Slope:	Moderate
Aspect:	S
Vegetation type:	Grassy meadow enclosed by tall willow and alder, moist graminoid-*Salix-Dryas* tundra, *Dryas* heath hummock tundra
Co-occurring species:	*Saxifraga tricuspidata, Trisetum spicatum, Salix* sp., *Alnus* sp.
Longevity:	Multi-year perennial
Phenology:	Mostly in flower through mid-July
Reproductive biology:	No information available

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 610.

Porsild, A.E. 1964. *Potentilla stipularis* L. and *Draba sibirica* (Pall.) Thell. new to North America. Canadian Field-Naturalist 78:92–96.

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent Canada. Provo (UT): Brigham Young University Press. p. 389.

Figure A-67. *Potentilla stipularis* ALA specimen.

Figure A-68. *Potentilla stipularis* ALA specimen close-up.

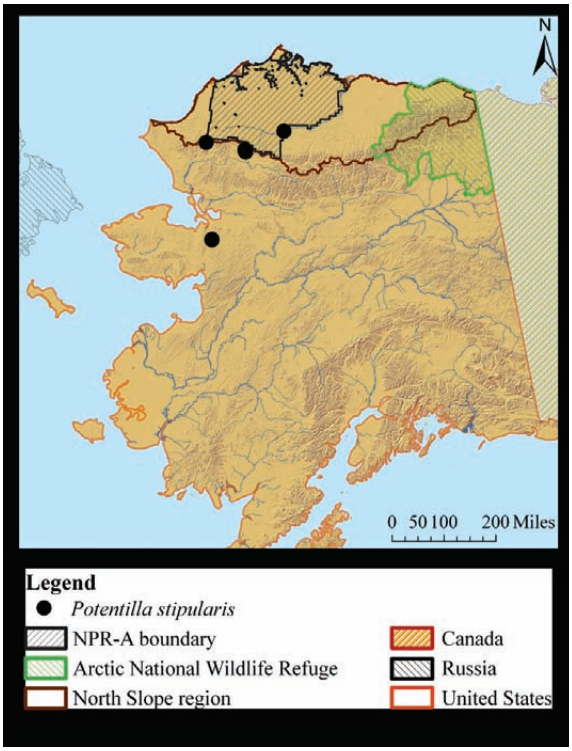

Figure A-69. Occurrences of *Potentilla stipularis* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

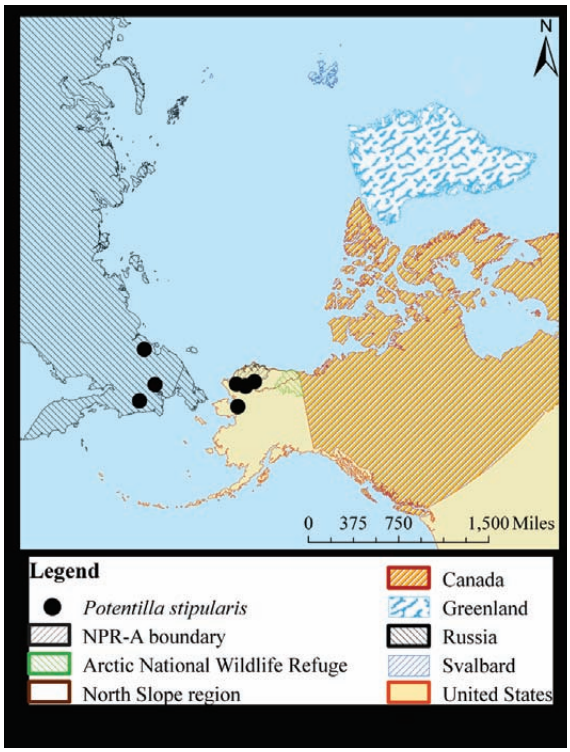

Figure A-70. Other circumpolar arctic collections of *Potentilla stipularis.*

Puccinellia vahliana

Species:

Scientific name:	*Puccinellia vahliana* (Liebm.) Scribn. and Merr.
Synonym(s):	*Colpodium vahlianum* (Liebm.) Nevski *Phippsia vahliana* (Liebm.) Á. and D. Löve
Common name(s):	Vahl's alkaligrass
Global rank:	G4
State rank:	S2S3

Distribution:

Global:	Amphi-Atlantic; northern Alaska, east across the Canadian Arctic, Greenland, and northern Europe to Novaya Zemlya. Other sites in north Asia need to be confirmed.
State:	In Alaska, *P. vahliana* is known from fewer than 20 sites, and though more sites are likely, few new sites have been identified in recent years. It is unlikely to prove widespread. This species is found on the coastal strip in the eastern Arctic, and in 2 to 3 scattered alpine sites in the Brooks Range, with a separate, disjunct occurrence in the Nutzotin Mountains.
North Slope:	Three sites along eastern Arctic Coastal plain: Prudhoe Bay, Camden Bay, and Pingokraluk Point; 3 sites in the Brooks Range: Endicott Mountains, De Long Mountains (near Desperation Lake), and between the Franklin and Sadlerochit mountains)
NPR-A:	Not documented (nearest collection is from Desperation Lake, De Long Mountains)
Likely to be found in the NPR-A?	Yes
Elevation:	Sea level to approximately 2000 m

Ecology:

Landform:	Disturbed areas, dunes, seepage meadows, steep sloping fens, pond margins, stream banks, brackish creeks, gently sloping ridges, boulder slopes, high-center polygons, pingos, in shale in mountain passes
Soil type:	Gravel, sand, silt, clay, peat; mainly on limestone/calcareous substrates
Moisture regime:	Moist
Slope:	Gentle to steep
Aspect:	W, NW
Vegetation type:	*Dryas* heath tundra, open herbaceous areas, fens
Co-occurring species:	The Katakturuk River delta specimens were growing with *Braya purpurascens, Cochlearia groenlandica, Deschampsia caespitosa, Puccinellia andersonii*, and *Salix ovalifolia.* (The set of species growing with *P. vahliana* in the Brooks Range

sites would be different, as most of the above taxa are typical of seashore habitats.)

Longevity: Multi-year perennial, long-lived

Phenology: Flowering in July; fruiting in very late August (Elven and Murray, pers. comms.)

Reproductive biology: Wind-pollinated, presumably largely autogamous, and no clonal reproduction (Brochmann and Steen 1999)

Sources of information used:

ALA specimens

BCD records

Literature:

Brochmann, C. and Steen, S. W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 148.

Figure A-71. *Puccinellia vahliana* ALA specimen.

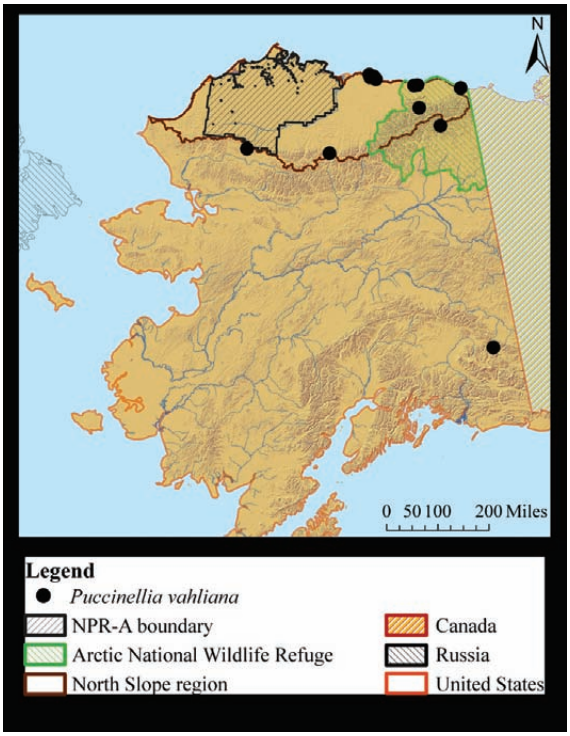

Figure A-72. Occurrences of *Puccinellia vahliana* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

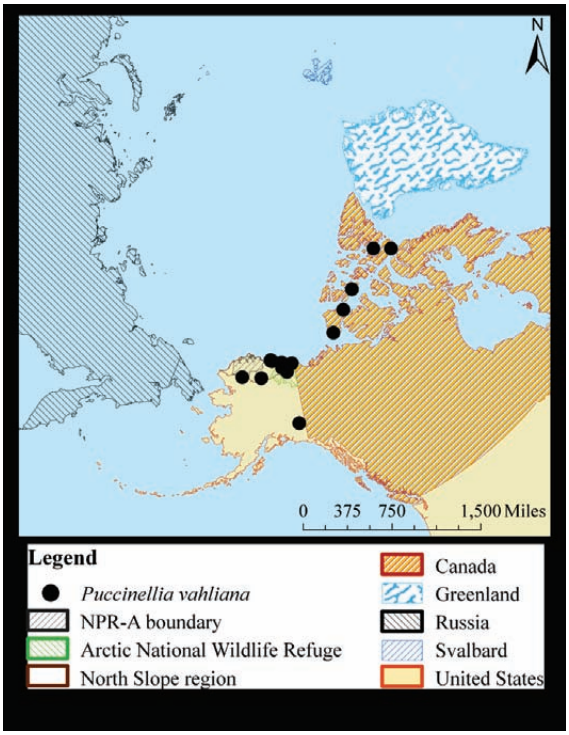

Figure A-73. Other circumpolar arctic collections of *Puccinellia vahliana.*

Puccinellia wrightii

Species:

Scientific name:	*Puccinellia wrightii* (Scribn. and Merr.) Tzvelev
Synonym(s):	*Colpodium wrightii* Scribn. and Merr. *Phippsia wrightii* (Scribn. and Merr.) A. and D. Löve
Common name(s):	Wright's alkaligrass
Global rank:	G3G4
State rank:	S2S3

Distribution:

Global:	Amphi-Beringian, known from the Russian Far East and northwestern Alaska. More than 20 locations worldwide, but it is unclear exactly how many.
State:	Known from the Seward Peninsula (foothills of the Continental Divide, the Kigluaik Mountains, and in the Bendeleben Mountains) and adjacent northwestern Alaska (Cape Beaufort and Igichuk Hills). It is almost certain that there are at least 20 locations, though fewer than 20 are currently documented.
North Slope:	Cape Beaufort
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	Collected between 140 m and 930 m

Ecology:

Landform:	Alpine seepage slopes and meadows
Soil type:	Limestone, marbleized carbonate rock, calcareous bedrock
Moisture regime:	Moist
Slope:	No information available
Aspect:	No information available
Vegetation type:	*Dryas* heath and tundra meadows
Co-occurring species:	No information available
Longevity:	Multi-year perennial, often with well-developed tuft
Phenology:	Flowering July; fruiting early to late August (Elven and Murray, pers. comms.)
Reproductive biology:	Wind-pollinated

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 148.

Figure A-74. *Puccinellia wrightii* ALA specimen.

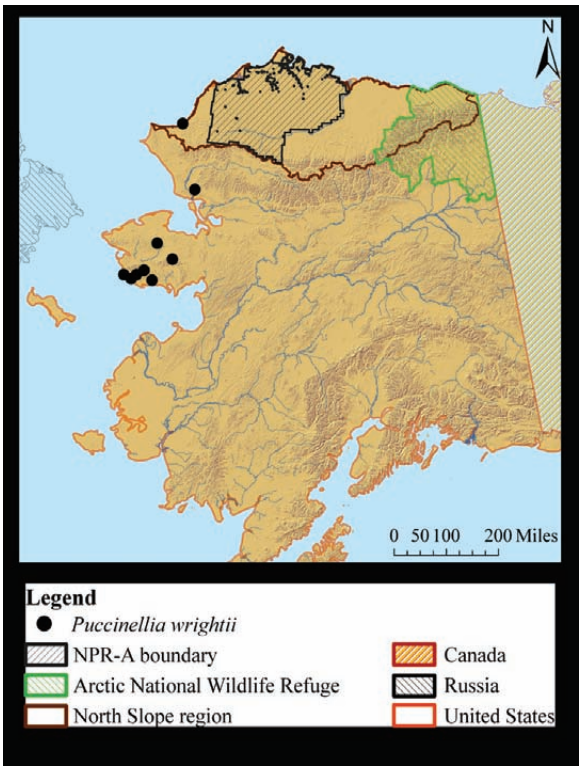

Figure A-75. Occurrences of *Puccinellia wrightii* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Ranunculus camissonis

Species:

Scientific name:	*Ranunculus camissonis* (Schlecht.) L. Benson
Synonym(s):	*Ranunculus glacialis* ssp. *chamissonis* (Schlecht.) Hultén *Beckwithia camissonis* (Schlecht.) Tolm**.**
Common name(s):	None
Global rank:	G3G4
State rank:	S2S3

Distribution:

Global:	Amphi-Beringian, known mostly from the Russian Far East, extending into Alaska and the Yukon Territory. It has been reported from Chukotka, islands of the Bering Sea, the Seward Peninsula, and then north to the Brooks Range and east to the White Mountains of central Alaska.
State:	Most collections are from westernmost Alaska: Seward Peninsula, St. Lawrence Island, along the western Brooks Range, Ray Mountains, White Mountains, and the Alaska Range (records for this area are not housed in the University of Alaska Museum of the North Herbarium, nor in its corresponding database). It has been described as abundant at 2 Alaskan sites. Other occurrences in east and central Alaska are possible, but the taxon's rarity in that part of the state is probably real and not an artifact.
North Slope:	Endicott Mountains (north-northeast of Inualurak Mountain) and De Long Mountains (near Desperation Lake, Brooks Range)
NPR-A:	Desperation Lake, De Long Mountains
Likely to be found in the NPR-A?	Yes
Elevation:	Between 150 m and 1500 m

Ecology:

Landform:	Snowmelt drainages, swales, alluvial fans, beach ridges, gently sloping seepage terraces, glacial circles, lower mountain slopes
Soil type:	Rocky-muddy, shale-mud; mainly calcareous (Elven & Murray, pers. comms.), carbonate (Seward Peninsula record), granite (White Mountains record)
Moisture regime:	Moist
Slope:	Gentle
Aspect:	No information available
Vegetation type:	Sedge-grass meadows, seepage meadows, marshlands
Co-occurring species:	No information available
Longevity:	Probably more or less short-lived (Elven and Murray, pers. comms.)

Phenology: In flower through early August; fruiting in August

Reproductive biology: No information available

Taxonomic notes:

We treat *Ranunculus camissonis* at the species level, as there are numerous characters separating it from *Ranunculus glacialis* (*R. glacialis* var. *glacialis*) and no morphological intermediates (Elven and Murray, pers. comms.). Key traits used to separate these two taxa are:

***Ranunculus camissonis**	***Ranunculus glacialis**
❑ stems distally brown-pilose	❑ stems glabrous
❑ caudices short	❑ caudices well-developed
❑ basal leaves deeply 3-parted or 3-foliolate	❑ basal leaves compound
❑ segments or leaflets 1–2x parted	❑ leaflets parted or lobed
❑ ultimate segments oblanceolate to almost linear	❑ ultimate segments elliptic to oblanceolate
❑ receptacle brown-pilose	❑ receptacle glabrous

* Dichotomous key from Whittemore (1993)

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 473.

Whittemore A. T. 1993. *Ranunculus*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 3:88–117.

Figure A-76. *Ranunculus camissonis* ALA specimen.

Figure A-77. *Ranunculus camissonis* ALA specimen close-up.

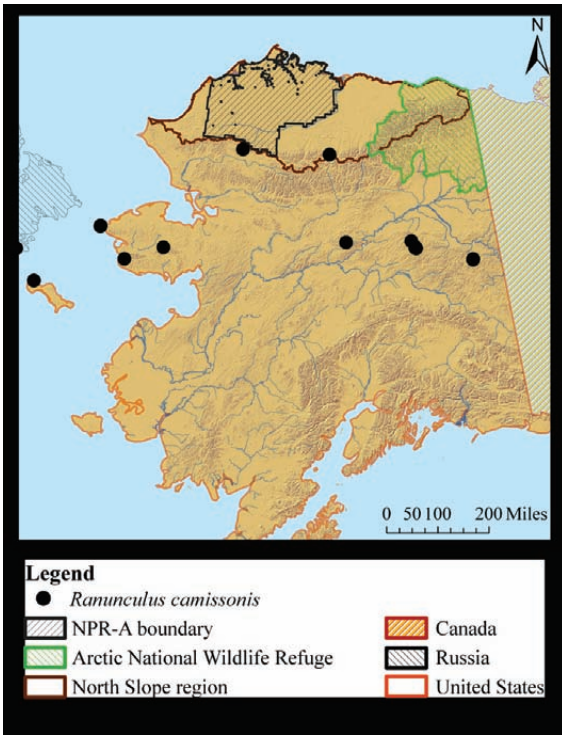

Figure A-78. Occurrences of *Ranunculus camissonis* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

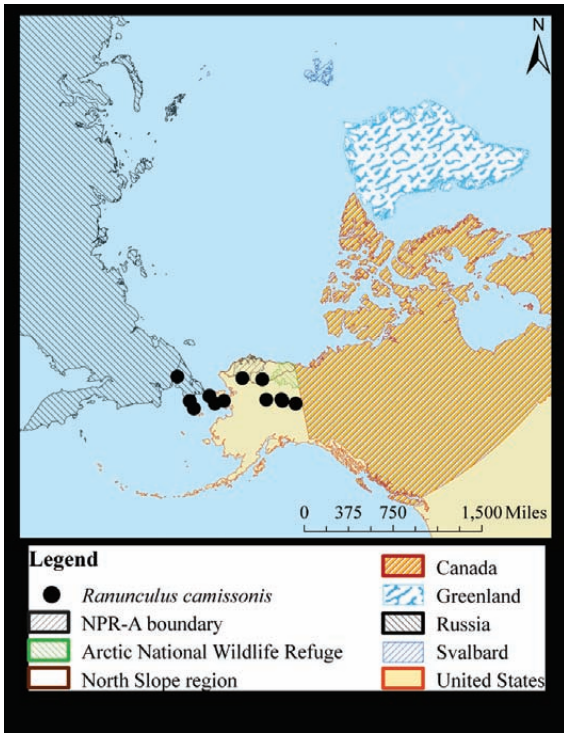

Figure A-79. Other circumpolar arctic collections of *Ranunculus camissonis.*

Ranunculus sabinei

Species:

Scientific name:	*Ranunculus sabinei* R.Br.
Synonym(s):	*Ranunculus pygmaeus* ssp. *sabinei* (R.Br.) Hultén
Common name(s):	Sardinian buttercup
Global rank:	G4
State rank:	S1

Distribution:

Global:	Circumpolar Arctic, but discontinuous. Seven sites are reported in Hultén (1968) for this species, but the range map suggests that many more could be found. It occurs in northern Alaska and the Siberian coast (spotty distribution), northern Canada, and Greenland.
State:	Vicinity of Barrow
North Slope:	Vicinity of Barrow (Arctic Coastal Plain)
NPR-A:	Not documented (nearest collections are from Barrow)
Likely to be found in the NPR-A?	Yes
Elevation:	No information available

Ecology:

Landform:	Snowbeds, base of ridges, tundra slopes and hummocks
Soil type:	Gravel, sand
Moisture regime:	Damp, moist
Slope:	No information available
Aspect:	No information available
Vegetation type:	Gravelly mossy areas, tundra
Co-occurring species:	No information available
Longevity:	Short-lived perennial
Phenology:	Flowers and young fruits by early July; late fruits in August
Reproductive biology:	Probably fly-pollinated, strictly seed-reproducing species (Elven, pers. comm.)

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 448.

Figure A-80. *Ranunculus sabinei* ALA specimen.

Figure A-81. *Ranunculus sabinei* ALA specimen close-up.

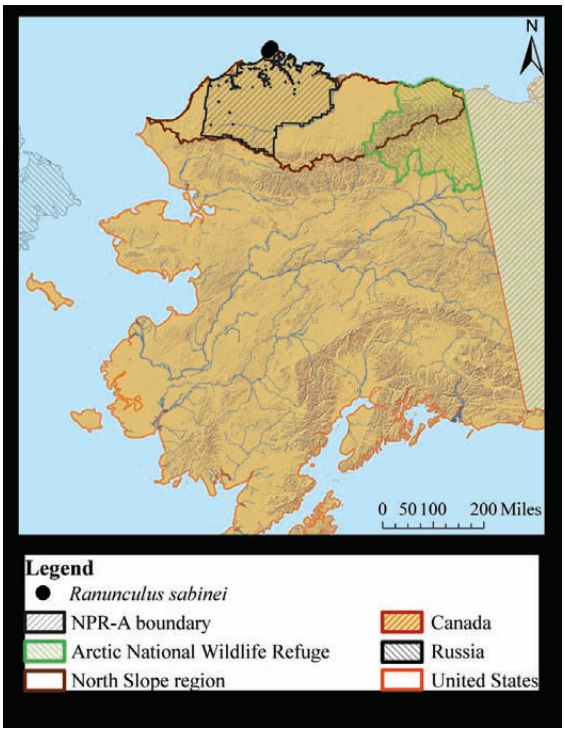

Figure A-82. Occurrences of *Ranunculus sabinei* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

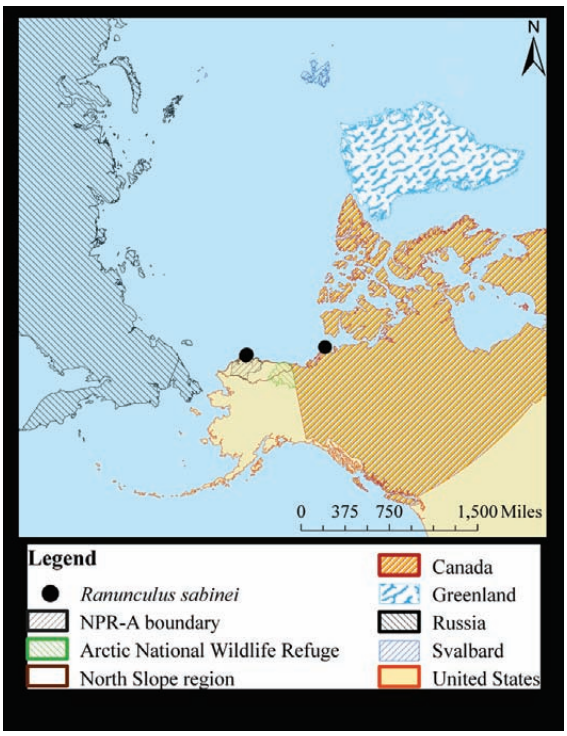

Figure A-83. Other circumpolar arctic collections of *Ranunculus sabinei.*

Rumex graminifolius

Species:

Scientific name:	*Rumex graminifolius* Rudolph ex Lambert
Synonym(s):	*Acetosella graminifolia* (Rudolph ex Lambert) Á. Löve *Rumex acetosella* Linnaeus var. *graminifolius* (Rudolph ex Lambert) Schrenk *R. angustissimus* Ledebour
Common name(s):	Grass-leaved or grassleaf sorrel
Global rank:	G4?
State rank:	S1

Distribution:

Global:	Northeastern Eurasia (northeastern Russian Far East and Northern Siberia), Greenland, and Alaska (Mosyakin 2005)
State:	Only known from 2 sites, both in the Beaufort coastal plain: vicinity of village of Atqasuk (Meade River) and the Kaolak River
North Slope:	Atqasuk and Kaolak River
NPR-A:	Atqasuk and Kaolak River
Likely to be found in the NPR-A?	Yes
Elevation:	Sea level to 30 m

Ecology:

Landform:	Sandy and gravelly slopes and shores (Mosyakin 2005); sandy river banks, sand dunes
Soil type:	Sand, gravel
Moisture regime:	Dry to moist
Slope:	Gentle
Aspect:	No information available
Vegetation type:	Sparsely vegetated sand dunes and shores, *Dryas* heath
Co-occurring species:	*Dryas integrifolia, Salix glauca, Festuca brachyphylla, Carex obtusata, Artemisia glomerata*
Longevity:	No information available
Phenology:	Flowering late spring to summer (Mosyakin 2005)
Reproductive biology:	No information available

Sources of information used:

ALA specimens

BCD records

Literature:

Mosyakin, S.L. 2005. *Rumex*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 5:(page number not available). Available from: http://www.efloras.org/browse.aspx?flora_id=1&name_str=Rumex+graminifolius.

Figure A-84. *Rumex graminifolius* ALA specimen.

Figure A-85. *Rumex graminifolius* ALA specimen close-up.

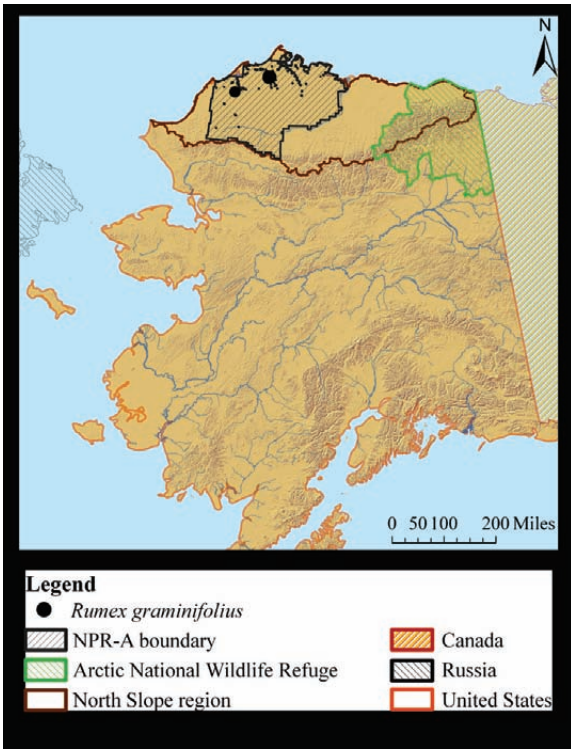

Figure A-86. Occurrences of *Rumex graminifolius* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

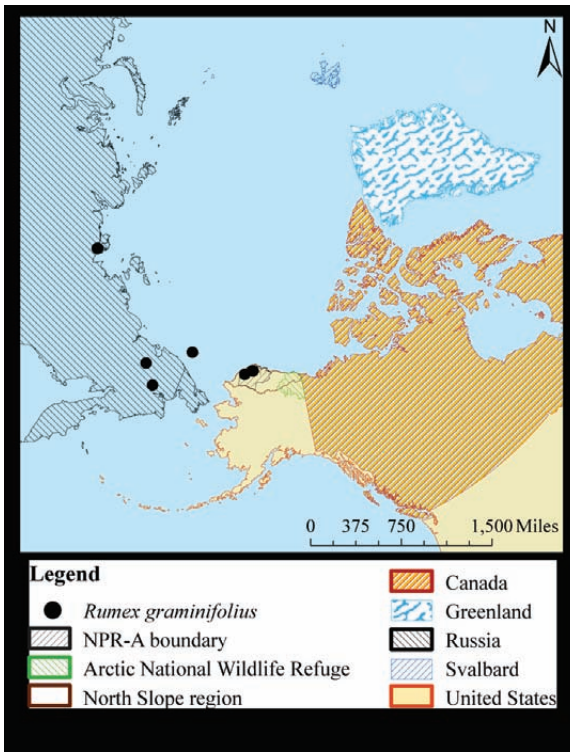

Figure A-87. Other circumpolar arctic collections of *Rumex graminifolius.*

Saxifraga aizoides

Species:

Scientific name: *Saxifraga aizoides* L.
Synonym(s): *Leptasea aizoides* (L.) Haw.
Common name(s): Yellow mountain saxifrage
Global rank: G5
State rank: S1

Distribution:

Global: Amphi-Atlantic distribution, extending from the Yukon Territory east to Europe. It is widespread, but relatively uncommon, in the Canadian Arctic Archipelago islands (Baffin, Ellesmere, Banks, and Victoria islands) (Aiken et al. 2003).
State: Only known from Prudhoe Bay
North Slope: Vicinity of Prudhoe Bay
NPR-A: Not documented
Likely to be found in the NPR-A? Yes
Elevation: Near sea level

Ecology:

Landform: River bank (Prudhoe Bay record); confined to the base of calcareous screes, seepages, and brook margins in the Ogilvie Mountains (Yukon); found on mires, seepages, and along brooks, always on more basic substrates, in Northern Europe (Elven, pers. comms.)
Soil type: Peat, calcareous screes and soils
Moisture regime: Moist
Slope: No information available
Aspect: No information available
Vegetation type: Partially barren peat
Co-occurring species: No information available
Longevity: Perennial, potentially short-lived
Phenology: Flowering from July onward
Reproductive biology: Insect-pollinated (probably fly-pollinated), no clonal reproduction (Brochmann and Steen 1999); this species is abundantly nectar producing, and the mats are full of insects on good days (Elven and Murray, pers. comms.).

Sources of information used:

ALA specimens
BCD records
Literature:

Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Gillespie, L.J., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Brysting A.K. and Solstad, H. 2003. Flora of the Canadian Arctic Archipelago:

descriptions, illustrations, identification, and information retrieval [cited 29 April 2003]. Available from: http://www.mun.ca/biology/delta/arcticf/_ca/www/sxsxaz.htm.

Brochmann, C. and Steen, S. W. 1999. Sex and genes in the flora of Svalbard – implications for conservation biology and climate change. Det Norske Vitenskaps-Akademi. I. Matematisk Naturvitenskapelig Klasse, Skrifter, Ny Serie 38:33–72.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 568.

Schick, C. T. 1992. Westward range extension for the yellow mountain saxifrage: *Saxifraga aizoides* (Saxifragaceae): a new vascular plant species to Alaska. Canadian Field-Naturalist 106(2):262–264.

Figure A-88. *Saxifraga aizoides* ALA specimen.

Figure A-89. *Saxifraga aizoides* ALA specimen close-up.

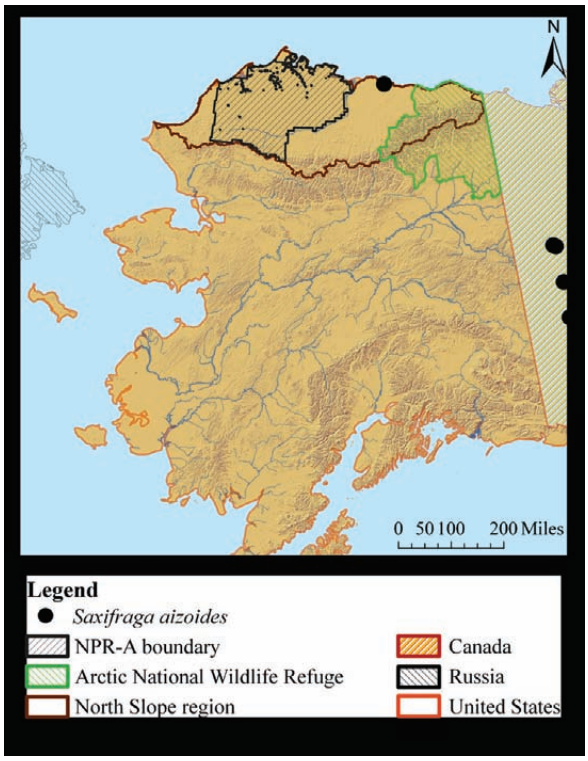

Figure A-90. Occurrences of *Saxifraga aizoides* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

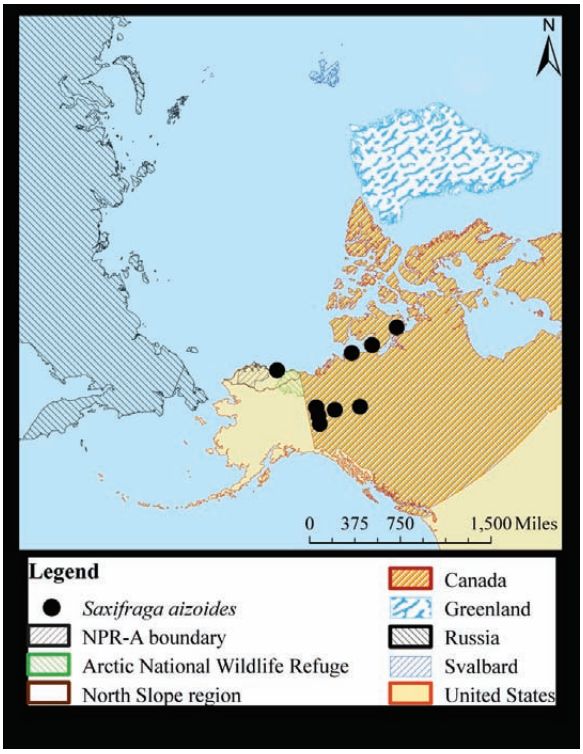

Figure A-91. Other circumpolar arctic collections of *Saxifraga aizoides.*

Saxifraga rivularis ssp. *arctolitoralis*

Species:

Scientific name:	*Saxifraga rivularis* ssp. *arctolitoralis* (Jurtz. and V.V. Petrovsky) Jørgensen and Elven
Synonym(s):	*Saxifraga arctolitoralis* Jurtz. & V.V. Petrovsky
Common name(s):	None
Global rank:	G4T2T3
State rank:	S2S3

Distribution:

Global:	Amphi-Beringian: known from the western arctic coast of Alaska (from Barrow south to the Seward Peninsula), from the eastern and northern coast of Chukotka, and from Wrangel Island (Jørgensen et al. 2006). We found one additional collection from Demarcation Point quad. at ALA [Demarcation Point quad., Icy Reef, 1–2 m, growing among collapsed buildings in moist peaty sand, 6 Aug 1980, *Meyers and Friedman 80-117* (ALA)]. Its taxonomic identity should be reinvestigated.
State:	Northwestern arctic coast (Barrow, Icy Cape, and Point Hope); Seward Peninsula (near Cape Espenberg)
North Slope:	Vicinity of Barrow and Icy Cape
NPR-A:	Not documented (nearest collections are from Barrow and Icy Cape)
Likely to be found in the NPR-A?	Yes
Elevation:	Sea level

Ecology:

Landform:	Arctic seashores, sloping soil banks (Jørgensen et al. 2006); polygonized ground, slumping mud banks along coast, dry gullies, gravel flats
Soil type:	Silt, clay (Jørgensen et al. 2006)
Moisture regime:	Moist, dry
Slope:	Gentle
Aspect:	No information available
Vegetation type:	Tundra, sandy banks
Co-occurring species:	No information available
Longevity:	No information available
Phenology:	No information available
Reproductive biology:	No information available

Sources of information used:

ALA specimens

BCD records

Literature:

Jørgensen, M.H., Elven, R., Tribsch, A., Gabrielsen, T.M., Stedje, B., and Brochmann, C. 2006. Taxonomy and evolutionary relationships in the *Saxifraga rivularis* complex. Systematic Botany 31(4):702–729.

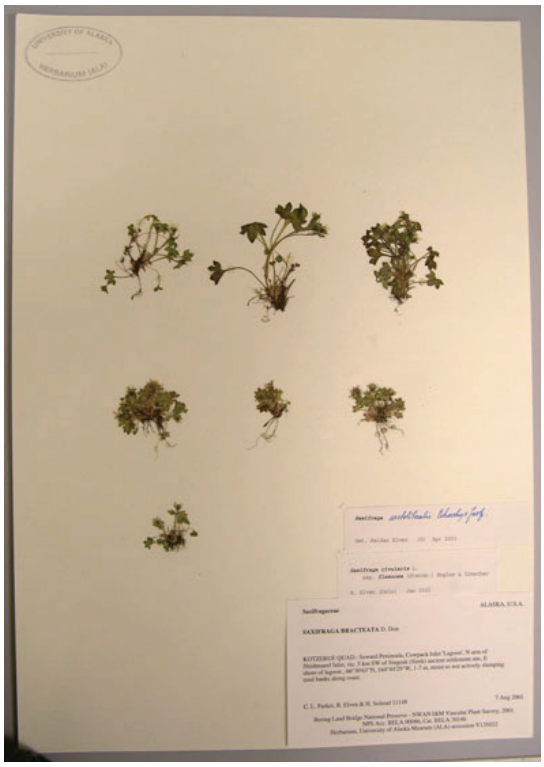

Figure A-92. *Saxifraga rivularis* ssp. *arctolitoralis* ALA specimen.

Figure A-93. *Saxifraga rivularis* ssp. *arctolitoralis* ALA specimen close-up.

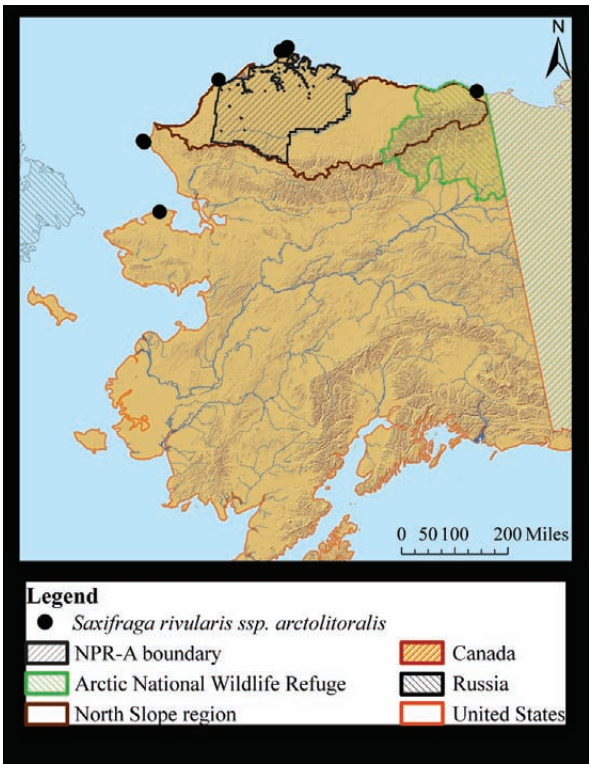

Figure A-94. Occurrences of *Saxifraga rivularis* ssp. *arctolitoralis* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Smelowskia media

Species:

Scientific name:	*Smelowskia media* (Drury and Rollins) G.A. Mulligan
Synonym(s):	*Smelowskia calycina* var. *media* Drury and Rollins
Common name(s):	Fernleaf false candytuft
Global rank:	G2G3
State rank:	S2S3

Distribution:

Global:	Endemic to northeastern Alaska and northern Yukon Territory (Murray and Kelso 1997, Mulligan 2001)
State:	See global range comments
North Slope:	Brooks Foothills: north of White Hills, at confluence of Kuparuk and Toolik rivers, and north of the Franklin Mountains
NPR-A:	Not documented
Likely to be found in the NPR-A?	Uncertain
Elevation:	Collected between 457 m and 1235 m

Ecology:

Landform:	Mountain bluffs and ridges, outcrops, and screes
Soil type:	Talus scree, calcareous substrates, coarse soil, Lisburne limestone gravel, shale. A collection from the Franklin Bluffs describes this species as growing in dry, gravelly, acidic soils [Sagavanirktok quad., Franklin Bluffs, top of bluffs, dry, gravelly, acidic soils, 12 Aug 1982, *Walker 82-10b* (ALA)]
Moisture regime:	Dry
Slope:	No information available
Aspect:	S
Vegetation type:	No information available
Co-occurring species:	No information available
Longevity:	Long-lived perennial – extensive caudex
Phenology:	Fruiting and flowering mid-June through July; late fruits by early August
Reproductive biology:	Insect-pollinated (likely small bee or fly) or self-pollinated – high levels of fruit set for an arctic/alpine species

Taxonomic notes:

We follow Mulligan (2001) and Al-Shehbaz and Warwick (2006) in recognizing *S. media* at the rank of species, distinct from the Asian *S. calycina*. When treated as a variety, its conservation rank is G5T2T3Q, while as a species it is G2G3, thus making it a globally rare to imperiled species.

Sources of information used:

ALA specimens

BCD records

Literature:

Al-Shehbaz, I.A. and Warwick, S.I. 2006. A synopsis of *Smelowskia* (Brassicaceae). Harvard Papers in Botany 11(1):91–99.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 539.

Mulligan, G.A. 2001. Three new taxa and a summary of the Mustard Family, Brassicaceae (Cruciferae), in Canada and Alaska. Canadian Field-Naturalist 115:341–342.

Murray, D.F. and Kelso, S. 1997. Chromosome number and notes on the taxonomy of selected Alaskan vascular plants. Rhodora 99(897):33–35.

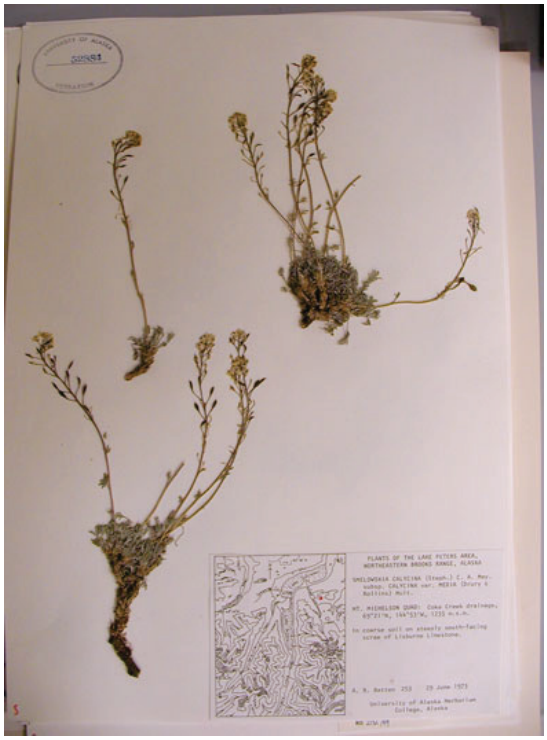

Figure A-95. *Smelowskia media* ALA specimen.

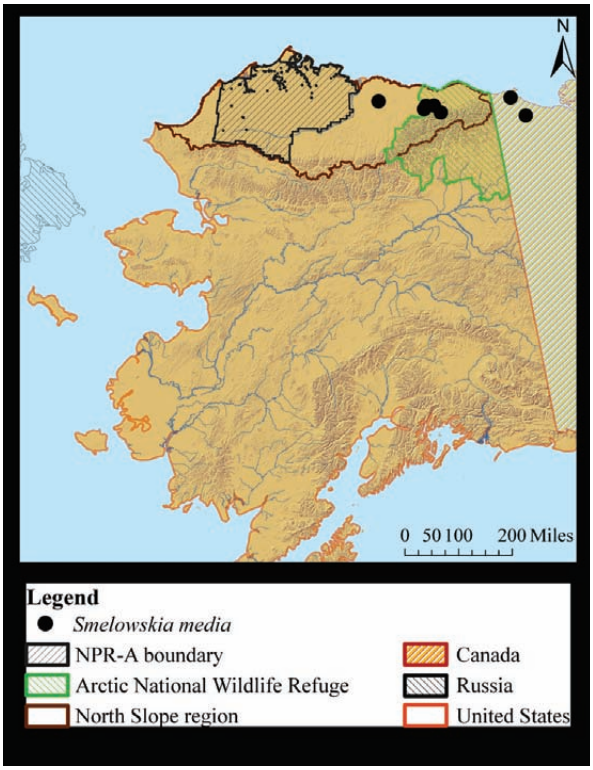

Figure A-96. Occurrences of *Smelowskia media* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Stellaria umbellata

Species:

Scientific name:	*Stellaria umbellata* Turcz. ex Kar. and Kir.
Synonym(s):	*Alsine baicalensis* Coville *Stellaria gonomischa* Boivin *Stellaria weberi* Boivin
Common name(s):	Umbellate chickweed Umbrella starwort
Global rank:	G5
State rank:	S3

Distribution:

Global:	Asia and North America; in North America it occurs in western Canada (Alberta, British Columbia, and Yukon Territory) and the US, where it grows in and west of the Rockies and in Alaska (USDA and NCRS 2005)
State:	At least 13 (scattered) locations are known from Alaska, but more are likely for this easily overlooked species.
North Slope:	Close to Kadleroshilik and Shaviovik river mouths, near Foggy Island Bay, and along the Brooks Foothills. (Also collected from Point Hope, just outside the Arctic Slope boundary)
NPR-A:	Not documented
Likely to be found in the NPR-A?	Yes
Elevation:	From sea level up to 1070 m

Ecology:

Landform:	Creek bars; stream margins; in meadows along drainages; adjacent to ponds; alpine cirque rocky knolls, snowbeds, and screes; deeply eroded gullies; gravel bars; snowbanks; snowbeds
Soil type:	Mud, gravel, igneous substrate
Moisture regime:	Very wet to moist
Slope:	No information available
Aspect:	N
Vegetation type:	Alpine *Dryas* heath; snowbed communities; meadows along creeks and drainages; mossy, wet meadows.
Co-occurring species:	*Festuca altaica, Poa* sp., mosses
Longevity:	Short-lived perennial, but some specimens have signs of multiple years of growth
Phenology:	Flowering until late July; young fruits in early August; ripe fruits in mid/late August
Reproductive biology:	Probably syrphid fly and/or self-pollinated – nearly 100% fruit set is suggestive of self-compatibility.

Sources of information used:

ALA specimens

BCD records

Literature:

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 417.

U.S. Department of Agriculture, National Resource Conservation Service. 2005. The PLANTS Database, Version 3.5 (http://plants.usda.gov). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA.

Figure A-95. *Stellaria umbellata* ALA specimen.

Figure A-96. *Stellaria umbellata* ALA specimen.

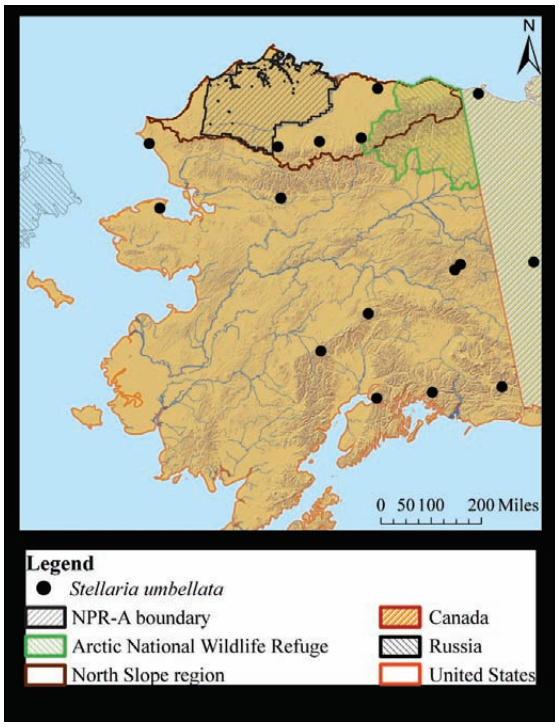

Figure A-97. Occurrences of *Stellaria umbellata* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

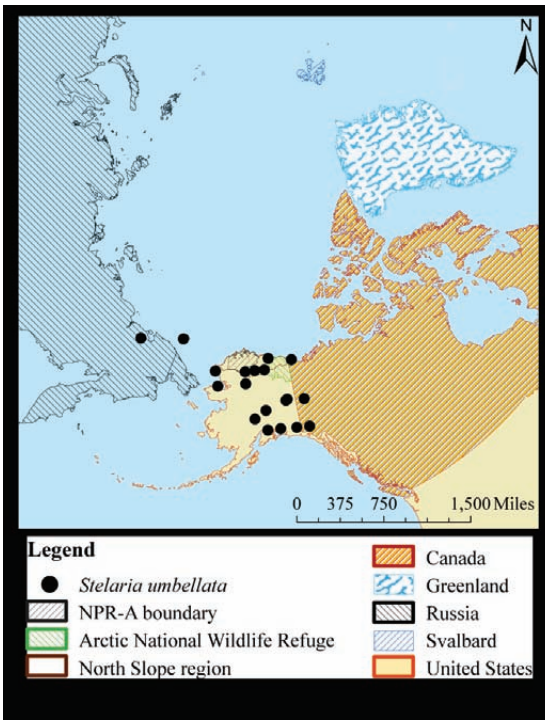

Figure A-98. Other circumpolar arctic collections of *Stellaria umbellata.*

Symphyotrichum pygmaeum

Species:

Scientific name: *Symphyotrichum pygmaeum* Brouillet and Sugirthini
Synonym(s): *Eurybia pygmaea* (Lindl.) Nesom
Aster pygmaeus Lindl.
Aster sibiricus Linnaeus subsp. *pygmaeus* (Lindl.) Á. Löve & D. Löve
Aster sibiricus var. *pygmaeus* (Lindl.) Cody
Common name(s): Pygmy aster
Global rank: G2G4
State rank: S2

Distribution:

Global: At least 22 locations documented, all from remote areas. Further exploration of these areas is likely to add additional locations. This taxon is known from the western Canadian Arctic (Nunavut and Northwest Territories) and the central and northeastern arctic coast of northern Alaska (Brouillet and Sugirthini 2005, Brouillet et al. 2006). Most sites are near the coast. Reports of this species from British Columbia are based on a misapplication of the name.
State: At least 5 to 6 discrete locations are known, with more very likely. Many of these, however, are in or near areas subject to disturbance from oil exploration and development (e.g., Prudhoe Bay sites).
North Slope: Prudhoe Bay, vicinity of Kongakut River delta
NPR-A: Not documented
Likely to be found in the NPR-A? Yes
Elevation: Most sites are near the coast, up to 200 m (Lipkin, pers. comm.); 0–200+ m (Brouillet et al. 2006)

Ecology:

Landform: Riverbanks and terraces, sand dunes, old river terraces, pingo slopes (open, active, moist sand dunes, sandy or silty stream banks and terraces, usually cyclically disturbed gravelly tundra and tundra slopes [Brouillet et al. 2006])
Soil type: Silt, sand
Moisture regime: Moist to dry
Slope: Level to moderate
Aspect: No information available
Vegetation type: Open *Dryas* tundra
Co-occurring species: *Dryas* spp.
Longevity: No information available

Phenology: Flowering July, fruiting mid- to late August (Elven and Murray, pers. comms.)

Reproductive biology: No information available

Taxonomic notes:

Symphyotrichum pygmaeum previously was grouped with *Eurybia sibirica*. However, it can be distinguished from the latter by the presence of glands on the distal leaves and phyllaries (Brouillet et al. 2006).

Sources of information used:

ALA specimens

BCD records

Literature:

Brouillet, L. and Sugirthini, S. 2005. *Symphyotrichum pygmaeum*: transfer of *Eurybia pygmaea* from the Eurybioid grade to the subtribe Symphyotrichinae (Asteraceae: Astereae). Sida 21(3):1633–1635.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 859.

Brouillet, L., Semple, J.C, Allen, G.A., Chambers, K., and Sundberg, S. 2006. *Symphyotrichum*. In: Flora of North America Editorial Committee, editors. Flora of North America north of Mexico. New York: Oxford University Press. Vol. 20:485. Available from: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250067679.

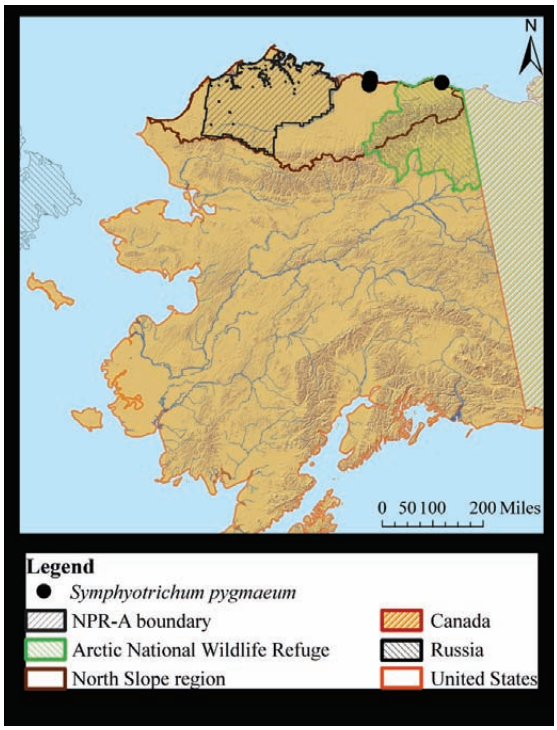

Figure A-99. Occurrences of *Symphyotrichum pygmaeum* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

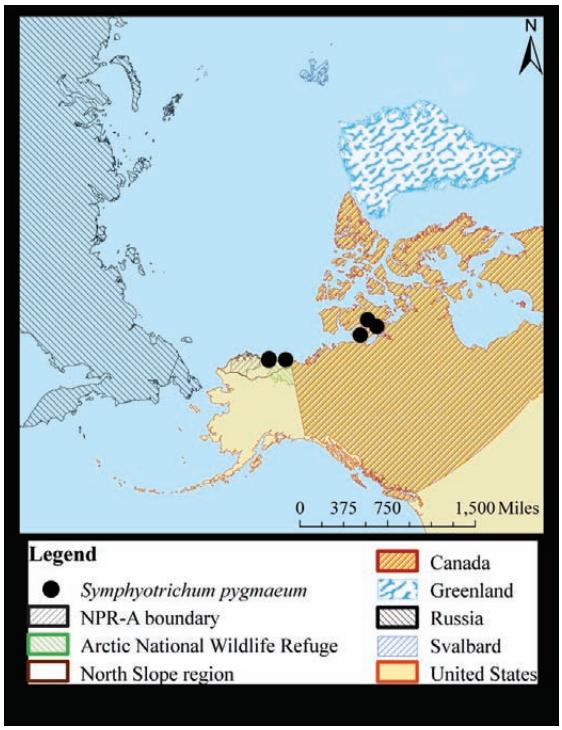

Figure A-100. Other circumpolar arctic collections of *Symphyotrichum pygmaeum.*

Trisetum sibiricum var. *litorale*

Species:

Scientific name:	*Trisetum sibiricum* var. *litorale* (Rupr. ex Rosh.) Rosh.
Synonym(s):	*Trisetum litorale* (Rupr. ex Rosh.) Czern.
Common name(s):	Siberian oatgrass
Global rank:	G5T4Q
State rank:	S2

Distribution:

Global:	Arctic Eurasia, from eastern arctic Europe across Siberia to Alaska and the Yukon Territory.
State:	Ten known sites, mostly in westernmost Alaska (including collections from the White Mountains, Ogoturok Creek, Teller area in the Seward Peninsula, and a collection from northeastern Alaska along the Kongakut River). Additional collections are unverified. No other representatives of *T. sibiricum* are known in North America. Gjærevoll (1958) cites a "doubtful" collection from Sitka ("extremely doubtful," Elven & Murray, pers. comms.).
North Slope:	Kongakut River (Ogoturuk Creek collections fall just outside the Arctic Slope boundaries)
NPR-A:	Not documented
Likely to be found in the NPR-A?	Uncertain
Elevation:	Collected from sea level up to 1070 m

Ecology:

Landform:	Riverbanks, brackish mires, slopes, meadows, beach terraces
Soil type:	Sand, silt, cobble
Moisture regime:	Moist
Slope:	No information available
Aspect:	No information available
Vegetation type:	Streamside willows; disturbed, mixed herbaceous/graminoid slopes
Co-occurring species:	*Artemisia arctica, Phleum alpinum, Polemonium pulcherrimum, Sibbaldia procumbens*
Longevity:	Multi-year perennial
Phenology:	No information available
Reproductive biology:	Wind-pollinated

Sources of information used:

ALA specimens

BCD records

Literature:

Gjærevoll, O. 1958. Botanical investigations in central Alaska, especially in the White Mountains. Part I. Pteridophytes and Monocotyledons. Det Kongelige Norske Videnskabers Selskabs Skrifter (Trondheim) 5. p. 36.

Hultén, E. 1968. Flora of Alaska and neighboring territories: a manual of the vascular plants. Stanford (CA): Stanford University Press. p. 119.

Figure A-101. *Trisetum sibiricum* var. *litorale* ALA specimen.

Figure A-102. *Trisetum sibiricum* var. *litorale* ALA specimen.

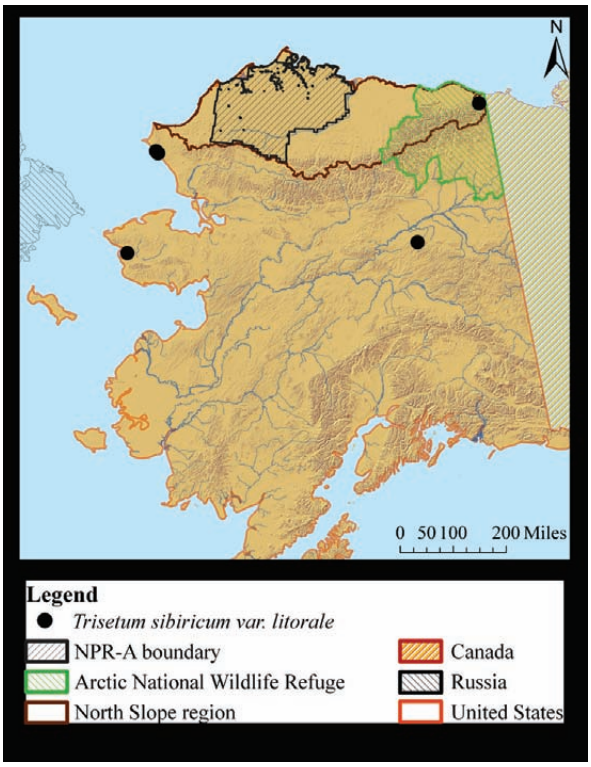

Figure A-103. Occurrences of *Trisetum sibiricum* var. *litorale* in Alaska based on the ALA, Arctos, and BCD records compiled for this project.

Appendix B. NatureServe and Natural Heritage Program Conservation Status Ranks

(NatureServe 2008)

Species Global Rankings	
G1	Critically imperiled globally
G2	Imperiled globally
G3	Rare or uncommon globally
G4	Apparently secure globally, but cause for long-term concern
G5	Demonstrably secure globally
G?	Unranked
G#G#	Global rank of species uncertain, best described as a range between the two ranks
G#Q	Taxonomically questionable
G#T#	Global rank of species and global rank of the described variety or subspecies of the species
GU	Unrankable
GH	Historical Occurrence
GX	Extinct
HYB	Hybrid

Species State Rankings	
S1	Critically imperiled in state
S2	Imperiled in state
S3	Rare or uncommon in state
S4	Apparently secure in state, but with cause for long-term concern
S5	Demonstrably secure in state
S#S#	State rank of species uncertain, best described as a range between the two ranks
S?	Unranked
SU	Unrankable
SA	Accidental
SR	Reported from the state, but not yet verified
SRF	Reported falsely
SP	Potential to occur in the state
HYP	Hybrid
SYN	Synonym

Qualifiers:	
B	Breeding status
N	Non-breeding status
?	Inexact
Q	Questionable taxonomy such that, depending on how it is resolved, could affect the final rank given to the species

Citation information:

NatureServe. 2008. NatureServe Explorer: an online encyclopedia of life [web application, cited 18 November 2008]. Version 7.0. NatureServe, Arlington, VA. Available from: http://www.natureserve.org/explorer/ranking.htm.