

New and Important Vascular Plant Collections from South-Central and Southwestern Alaska: A Region of Floristic Convergence

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Source: *Rhodora*, 115(961):61-95. 2013.

Published By: The New England Botanical Club, Inc.

DOI: <http://dx.doi.org/10.3119/11-20>

URL: <http://www.bioone.org/doi/full/10.3119/11-20>

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NEW AND IMPORTANT VASCULAR PLANT
COLLECTIONS FROM SOUTH-CENTRAL AND
SOUTHWESTERN ALASKA: A REGION OF
FLORISTIC CONVERGENCE

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ABSTRACT. We conducted a vascular plant inventory of six National Park Service units in southwestern and south-central Alaska to establish baseline floristic information and identify species of conservation concern. Between 1998 and 2005, we collected 815 taxa, the majority of which were new records for one or more park units. We present descriptions of the rare taxa (Alaska Natural Heritage Program S1–S3 ranks) collected as part of the National Park Service inventories, as well as new collections that represent significant range extensions. Of the 45 taxa reported here, all but one are considered globally rare or rare within Alaska. Collections of six taxa, including the common species, represent range extensions of greater than 450 km, and collections of an additional 16 taxa were minor range extensions (> 150 km, < 450 km). We include brief synopses of the vouchers, including general notes on the biogeography and rarity of these taxa. These and previous collections support the demarcation of southwestern Alaska as an important zone of floristic convergence. The central Alaska Range also represents a unique assemblage of boreal and maritime-associated taxa.

Key Words: Alaska, Aleutian Range, Arctic, alpine, biogeography, endemic, National Parks, relict flora, range extension

Southwest Alaska is a floristically rich area, recognized as early as 1937 as a region of exceptionally high endemism and source of species radiations (Hultén 1937). The area encompassing the Alaska

and Kenai peninsulas and west to the Bering Sea includes pronounced latitudinal, elevation, and climatic gradients. Thus, a diversity of ecosystems ranging from coastal to alpine, Arctic, Canadian, and Vancouverian floristic provinces (*sensu* Cronquist 1982) converge in southwest Alaska, disproportionately augmenting the floristic diversity of the region relative to others. Yet, in spite of its floristic and biogeographic importance, it is a region characterized by relatively few collections.

Baseline floristic inventories are essential for management of vegetation and floristic resources on public lands, as outlined by Cook and Roland (2002) and Talbot et al. (2006). Identification of areas of high species richness, particularly those that have seen few collections historically, has been of foremost concern for the National Park Service (NPS) and other land management agencies (Araújo 1999; Cabeza et al. 2004; Prendergast et al. 1993). Between 1998 and 2005, in an effort to establish baseline information on species' occurrence and diversity, the NPS conducted vascular plant inventories in six park units in southwest and south-central Alaska (Alagnak National Wild River, Aniakchak National Monument and Preserve, Denali National Park and Preserve, Katmai National Park and Preserve, Kenai Fjords National Park, and Lake Clark National Park and Preserve; Figure 1). Collections from Denali included in this paper are limited to those found on the south side of the Alaska Range (Figure 1).

Previous collections from most of the NPS units in the region are limited. Many of the earliest botanical collections were taken from what is now Katmai between 1915 and 1930 (Griggs 1936), followed by Cahalane (1959), and by Young and Racine (1978). Prior to 2001, approximately 400 vascular plant taxa had been documented from Katmai, the majority from only a few locations. Large areas of the park had no botanical collecting, and virtually no floristic data were available for the adjoining Alagnak Wild River. In Lake Clark, the majority of collections were made by Racine and Young (1978) and by Caswell in 1996–2001 (unpublished data). In the mid-1990s, Bennett and Tande (1996) inventoried a number of marshes along Cook Inlet. Collections from Aniakchak came from Bosworth (1987), Sowl (1988; unpublished data), and Hasselbach (1995), with the majority of collections from the Aniakchak Caldera. Collections from Kenai Fjords consisted primarily of those by Rice (unpublished data) made in the 1980s from a few low-elevation areas. Historical collections from the south side of the

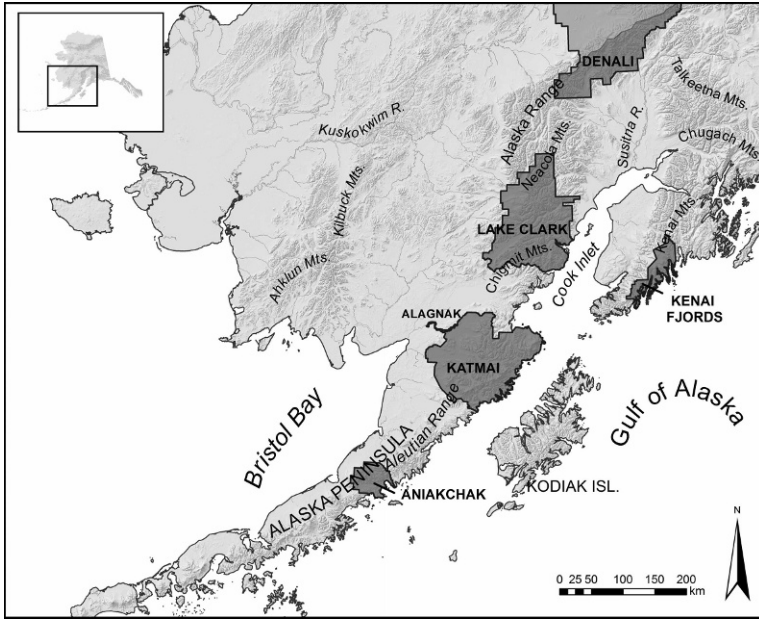


Figure 1. Map of study area showing national parks included in the inventories (shaded). Collections described here are limited to the south side of the Alaska Range, including those from the southern half of Denali National Park and Preserve.

Alaska Range, within Denali, were likewise limited. A few collections were made at the base of the Kahiltna Glacier by Viereck in 1956 (Viereck 1962), with additional, scattered collections from near Windy Pass in 1902 (Brooks and Prindle 1911) and 1968 (S. Jones, unpublished data), and along the Petersville Road, immediately south of the park boundary, in 1968 (V. Siplivinsky, independent botanist, unpublished data).

Here, we present brief descriptions of the rare taxa [Alaska Natural Heritage Program S1–S3 ranks; Alaska Natural Heritage Program (AKNHP) 2008] collected as part of the NPS inventories, as well as new collections that represent significant range extensions. For all species, we include taxonomic synonyms, a synopsis of the collection locations and habitats, and biogeographic affinities, as well as a brief summary of their conservation status (Appendix).

STUDY SITE

Floristic sampling was restricted to the National Park lands within the southwestern and south-central Alaska region, which encompasses approximately 15% of the land area in Alaska. This broader region includes mainland southwest Alaska south of the Kuskokwim River and the crest of the Central Alaska Range, south along the crest of the Talkeetna Mountains, and east to the Kenai Peninsula. Floristic inventories were conducted between 2001–2005 at Alagnak National Wild River (WR), Aniakchak National Monument and Preserve (NM), Katmai National Park and Preserve (NPP), Lake Clark National Park and Preserve, and Kenai Fjords National Park (NP), and between 1998–2001 at Denali National Park and Preserve (Figure 1). Because our focus is on southwest and south-central Alaska, only collections from south of the Alaska Range crest are treated in this discussion.

Lake Clark NPP, Katmai NPP, Alagnak WR, and Aniakchak NM are located from the southern Alaska Range to the central Alaska Peninsula, between approximately 63°45'N and 56°40'N. Kenai Fjords NP is located on the southeastern edge of the Kenai Peninsula. Permanent ice occupies most areas above 2300 m in the Alaska Range. Summer temperatures across much of the region are moderated by the Bering Sea and Gulf of Alaska, and most of the precipitation falls as rain between July and October, with the highest mean rainfall in August. Mean annual precipitation ranges from 378 mm on the northern Alaska Peninsula to as much as 1520 mm on the eastern Kenai Peninsula (Western Regional Climate Center 2011). Mean annual temperature varies across the region from approximately –12°C to +5°C (PRISM Climate Group and NPS 2009).

The region is characterized by diverse physiography and underlying parent material, ranging from glaciated alpine peaks to productive coastal lowlands. Most of southwest Alaska was covered by ice during the Last Glacial Maximum (LGM), estimated at approximately 19–23 ka BP. Glacial refugia have been identified from a number of locations in the region and nearby on Kodiak Island (Manley and Kaufman 2002), where willow macrofossils were found in strata dated at 23 ka BP (Mann and Peteet 1994). At the time when the glaciers likely began retreating at 13 ka BP, the vegetation appears to have been composed of plants present in modern wet and mesic meadows and *Empetrum* heathlands (Peteet

and Mann 1994). Between roughly 7 and 1.1 ka BP, ice sheets extended east into the Gulf of Alaska (Karlstrom 1964). More recently, Little Ice Age advances occurred in coastal southern Alaska, culminating in two advance phases from the 1540s–1710s AD and from the 1810s–1880s (Barclay et al. 2009). The Harding Icefield on the Kenai Peninsula, and the Kahiltna, Ruth, and Tokositna glaciers in the Alaska Range remain as prominent features on the landscape. Large, glacially-formed lakes, including Iliamna, Naknek, Nonvianuk, Kukaklek, and Lake Clark span the central portion of the Alaska Peninsula. Major river basins in the region include the Nushagak, Kuskokwim, Chakachamna, Kvichak, Naknek, and King Salmon in Lake Clark NPP and Katmai NPP; the Nuka River in Kenai Fjords NP; and the Aniakchak and Meshik rivers in Aniakchak NM. The headwaters of the Yentna, Kahiltna, Tokositna, and Chulitna rivers occur in the southern portion of Denali NPP.

The Alaska Range, which extends through the southern end of Denali NPP into northern Lake Clark NPP, was formed by granitic intrusions along the Denali Fault into Mesozoic sedimentary and meta-sedimentary rock (Csejtev et al. 1992; Jones et al. 1983; Reed and Nelson 1980). The northern section of Lake Clark NPP (Neacola Mountains) is likewise dominated by Tertiary and Mesozoic intrusive rocks, and the southern portion (Chigmit Mountains) by a complex of Triassic granitic stocks and batholiths intruded into Paleozoic and Cenozoic bedrock (Beikman 1980). To the south of the Chigmit Mountains and Lake Iliamna, the Aleutian Range includes Jurassic intrusions of crystalline quartz diorite, diorites, and granodiorite (Beikman 1980). To the east of Cook Inlet, in Kenai Fjords NP, the Kenai Mountains consist of a mixture of faulted metamorphics and intruded volcanics, primarily Cretaceous–Upper Jurassic greywacke, slate, argillite, conglomerates, and interbedded mafic rocks (Beikman 1980). Several granite and granodiorite intrusions occur along the coast. From Katmai NPP south, Pleistocene to Quaternary pyroclastic and debris-flow deposits are interspersed with glacial deposits and Jurassic and Cretaceous sandstones, shales, conglomerate, and limestone (Beikman 1980). Active volcanoes in the region include Mt. Redoubt, Mt. Iliamna, Mt. Augustine, and Mt. Spurr. The 1912 eruption of Novarupta and subsequent caldera-forming collapse of Mt. Katmai resulted in deep ash deposits in the Valley of Ten Thousand Smokes. The last major eruption in Aniakchak NM occurred in 1931 (Neal et al. 2001).

The park units are located within the following ecoregions (Gallant et al. 1995): 1) the Alaska Peninsula; 2) Bristol Bay Lowlands; 3) Alaska Range; 4) Lime Hills; 5) Cook Inlet Lowlands; 6) Chugach-St. Elias Mountains; and 7) Gulf of Alaska Coast. White spruce [*Picea glauca* (Moench) Voss] and resin birch (*Betula neolaskana* Sarg.) form widespread stands in well-drained uplands on the Alaska Peninsula and north into the Alaska Range, grading into Sitka (*Picea sitchensis* (Bong.) Carrière) and Lutz spruce [*P. × lutzii* Little (*glauca* × *sitchensis*)] along the central portion of the Cook Inlet coast. Black spruce [*Picea mariana* (Mill.) Britton, Sterns & Poggenb.] occurs in the Stony River basin and localized areas around Lake Clark. Latitudinal treeline occurs at approximately 58°21'N in southern Katmai. Sitka spruce and mountain hemlock [*Tsuga mertensiana* (Bong.) Sarg.] are dominants in the coastal forests of the eastern Kenai Peninsula. Sitka alder [*Alnus viridis* (Chaix) DC. subsp. *sinuata* (Regel) A. Löve & D. Löve] is dominant on young, volcanic substrates, glacial outwash, and steep slopes along the Gulf of Alaska and Cook Inlet coastlines, and north into the steep, rocky slopes on the south side of the Alaska Range. Dwarf birch (*Betula nana* L.) and willows (*Salix* L. spp.) are common in the interior portions of the northern Alaska Peninsula. Ericaceous dwarf shrub tundra and fellfield communities dominate at higher elevations across the region.

MATERIALS AND METHODS

Within each park unit, collection efforts from 1998 to 2005 were directed toward areas that had 1) high topographic, surficial geologic, and habitat richness, 2) few historical collections, and 3) were accessible by helicopter, fixed-wing aircraft, or boat. Sites ranged in elevation from 0 to 1420 m. On average, two senior botanists and three botany technicians collected vouchers from each park unit. The numbers of senior person-hours collecting were roughly proportional to the park unit size, ranging from 80 in the Alagnak WR to approximately 480 person-hours in Lake Clark NPP, and 593 person-hours for southern Denali NPP. Site locations and habitat descriptions are included in detail in Carlson et al. (2003, 2005a, b), Lipkin (2002), and Roland (2004).

Plant collections from the University of Alaska, Museum of the North Herbarium (ALA), the herbaria of the various park units in Alaska, selected collections from other herbaria, and observations

and floristic lists from published and unpublished literature were compiled into a database prior to field inventories. These data provided information on taxa previously collected and regions of low sampling intensity. While in the field, we visited all accessible habitats and made collections of species not yet documented for the park units, rare taxa, and plants that were not readily identifiable in the field (see Carlson et al. 2005a).

Species determinations were completed by the authors (M.C., R.L., and C.R.), Carolyn Parker and David Murray (ALA), Don Farrar (Iowa State Univ.; *Botrychium*), Bruce Bennett (Environment Yukon), and Tony Reznicek (Univ. Michigan; *Carex*). All collections are housed at ALA unless otherwise noted. We used Elven and Murray's Checklist of the Panarctic Flora (Elven and Murray 2011) and Flora of North America (1993+) taxonomies to develop the species lists, and included commonly encountered synonyms (e.g., from Hultén 1968). Additionally, we report NatureServe (2010) global and subnational (Alaska) Conservation Status Ranks for relevant species (see NatureServe 2010 for definitions). Range extensions were estimated as direct (straight line) distances to the nearest documented collections in a GIS environment (ArcGIS 10, ESRI, Redlands, CA).

RESULTS

We collected 815 taxa between 1998 and 2005, approximately two-thirds of which were new records for one or more of the park units. These collections, and others from the park areas treated here, total 1074 taxa and thus represent approximately 50% of the vascular flora of Alaska (Hultén 1968). Forty-two of the taxa reported here are considered globally rare, or rare within Alaska (AKNHP 2008). In addition, 32 taxa were identified as minor, moderate, or major range extensions [150–449 km, 450–999 km, and > 999 km from previously reported collections, respectively (see Talbot et al. 2006)]. Complete reviews of vouchered specimens and floristic summaries are presented in Carlson et al. (2005a, b), Carlson and Lipkin (2003), and Lipkin (2002, 2005). Appendix 1 presents the annotated list of rare taxa and taxa that represent significant range extensions in this region. New collections are shown relative to existing distribution data in Figure 2.

We collected one regional endemic (*Cochlearia sessilifolia*) and six Beringian-Alaskan endemics (*Aphragmus eschscholtzianus*,

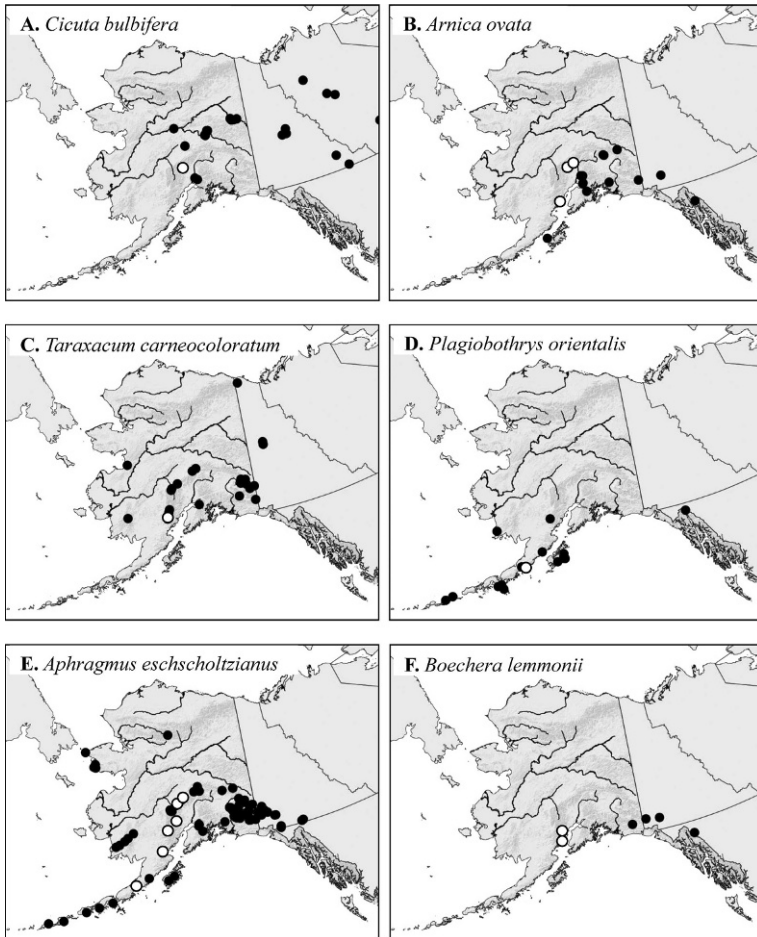


Figure 2. Species occurrences from vouchered collections in Alaska and the Yukon Territory. Open circles indicate collections recorded as part of the NPS inventories (1998–2005). Earlier collections are indicated in black (see Appendix for data sources).

Douglasia alaskana, *Noccaea arctica*, *Primula tschuktschorum*, *Rumex beringensis*, and *Taraxacum carneocoloratum*) from the region. In addition, we found a rare North American moonwort (*Botrychium pedunculosum*) that represents the first collection of this species for Alaska. As with *B. pedunculosum*, several of the other rare taxa also constituted moderate to major (> 450 km) range extensions.

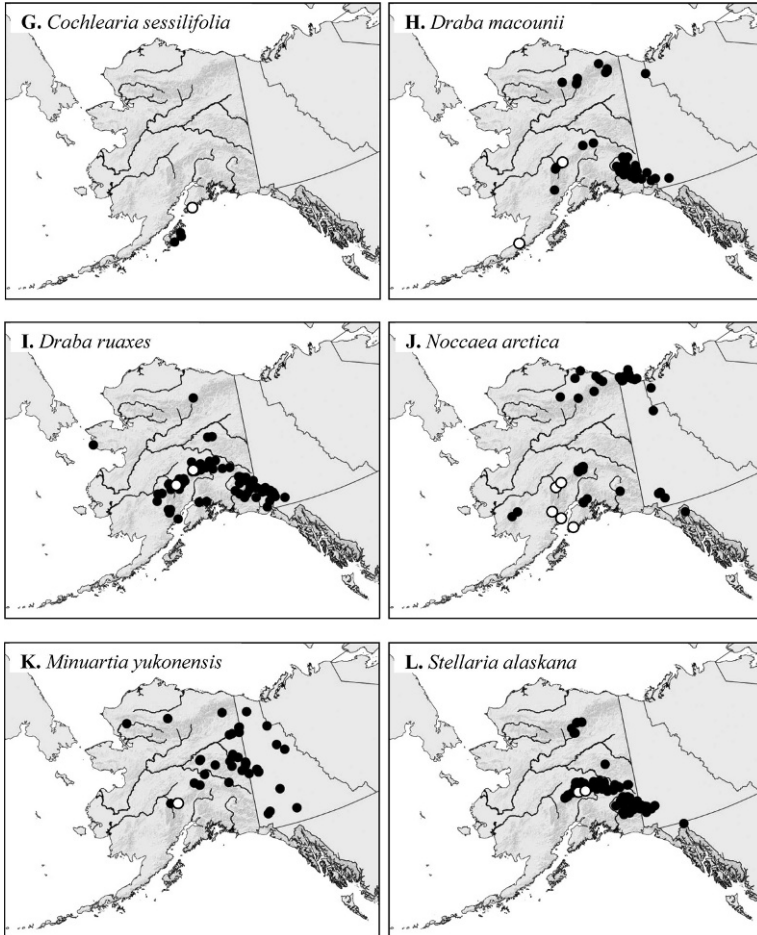


Figure 2. Continued.

DISCUSSION

The center of distribution for many of the rare species we encountered in our surveys is southwestern Alaska, consistent with Hultén's (1937) hypothesis that the region, particularly the ice-free land bridge west of the study area, served as an important refugium in the Quaternary and the area from which plants radiated in the Holocene. Because much of the Alaska Peninsula and Alaska Range was overlain by extensive glaciers, populations of these

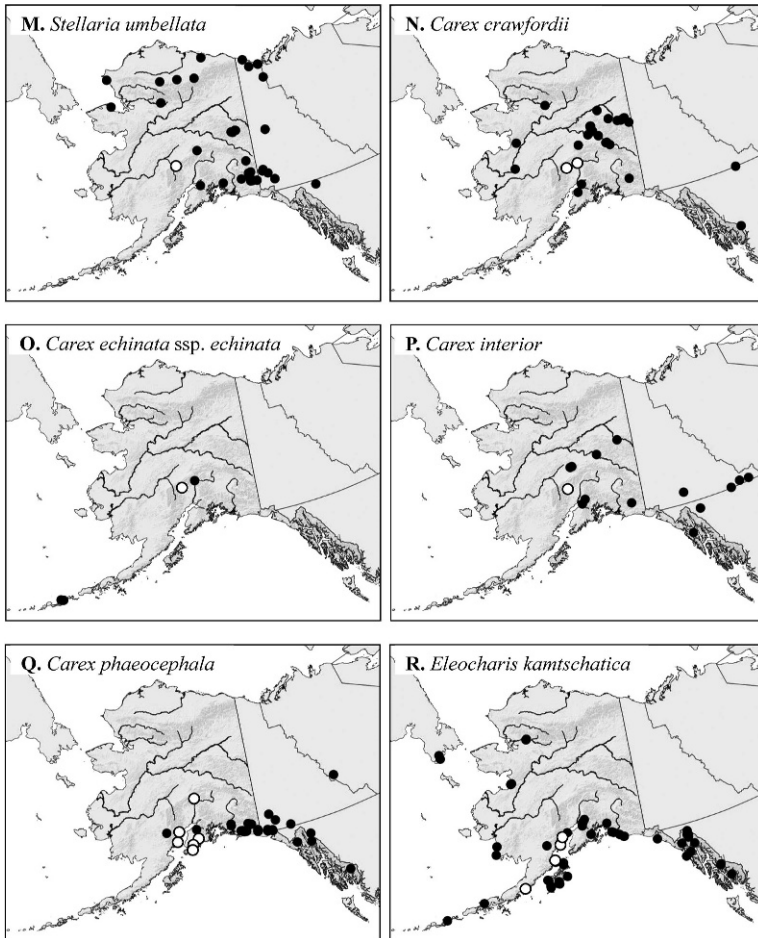


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species presumably are more recent migrants from the nearby and formerly ice-free areas to the north and west. Repeated ice advances and retreats in southwestern Alaska are believed to have acted as a fluctuating barrier between the unglaciated lowlands of eastern and central Beringia and the Gulf of Alaska coastline (Mann and Hamilton 1995); the movement of plants to and from the Aleutian Islands likely occurred during warmer interglacial periods (Hultén 1937), including the Holocene.

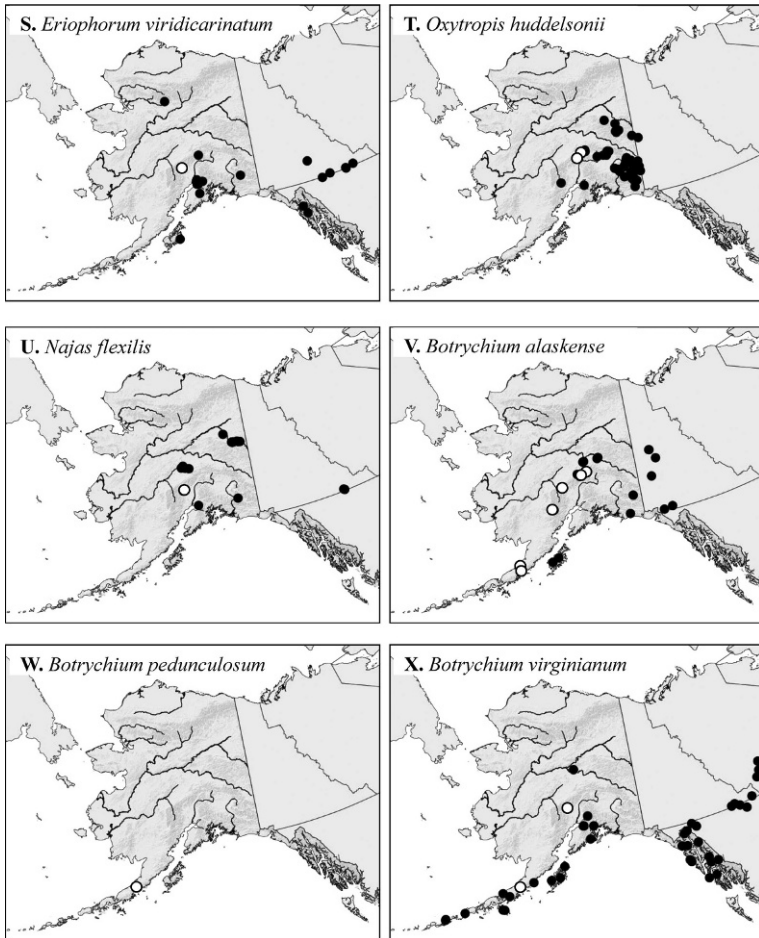


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Several of the major range extensions in the region were collected from sites believed to have been ice-free during the LGM. Our collections of *Boechnera lemmonii* and *Potentilla drummondii* came from a nunatak in the Chigmit Mountains that supported several other disjuncts, and from nearby coastal ridges that were mapped as refugia by Manley and Kaufman (2002). Cook and Roland (2002) likewise report these taxa from one or more sites in the Granite Range and St. Elias Mountains east of our study region that appear

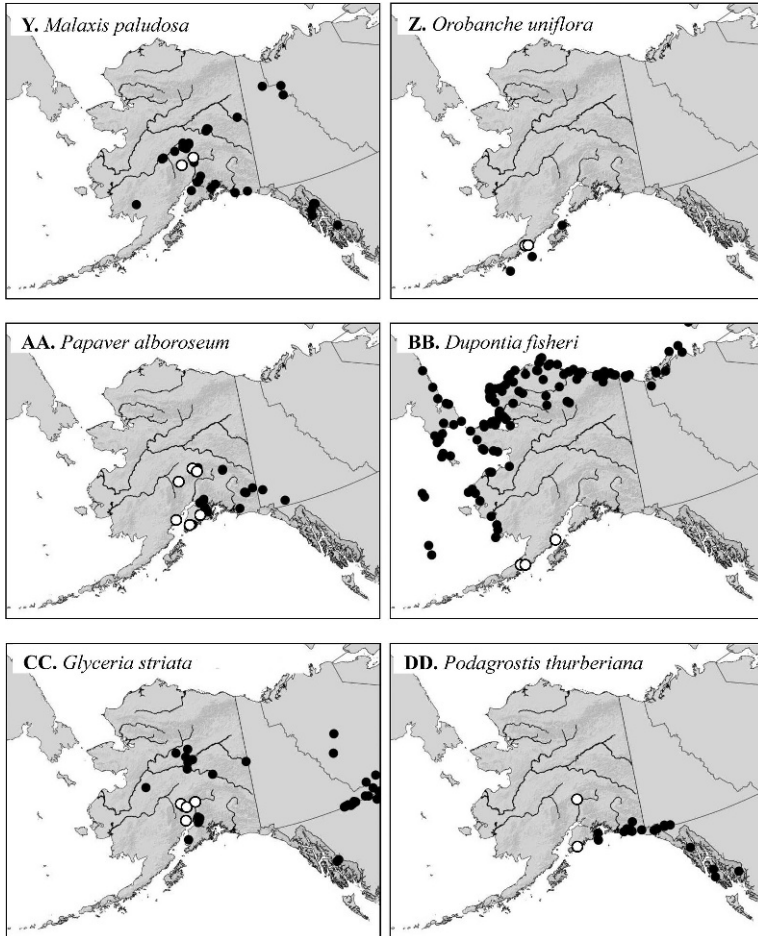


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to have been ice-free during the LGM. Our collection of *Arnica ovata* from an unglaciated coastal ridge in the Chigmits coincides with a more recent report by C. Parker from a site on southwestern Kodiak (unpublished data; UAM 2011), also believed to have been a glacial refugium throughout the mid- to late-Wisconsin Glaciation (Karlstrom and Ball 1969; Manley and Kaufman 2002). It is unclear if populations found in these presumed refugia in fact represent older vicariance events, or are the result of more recent,

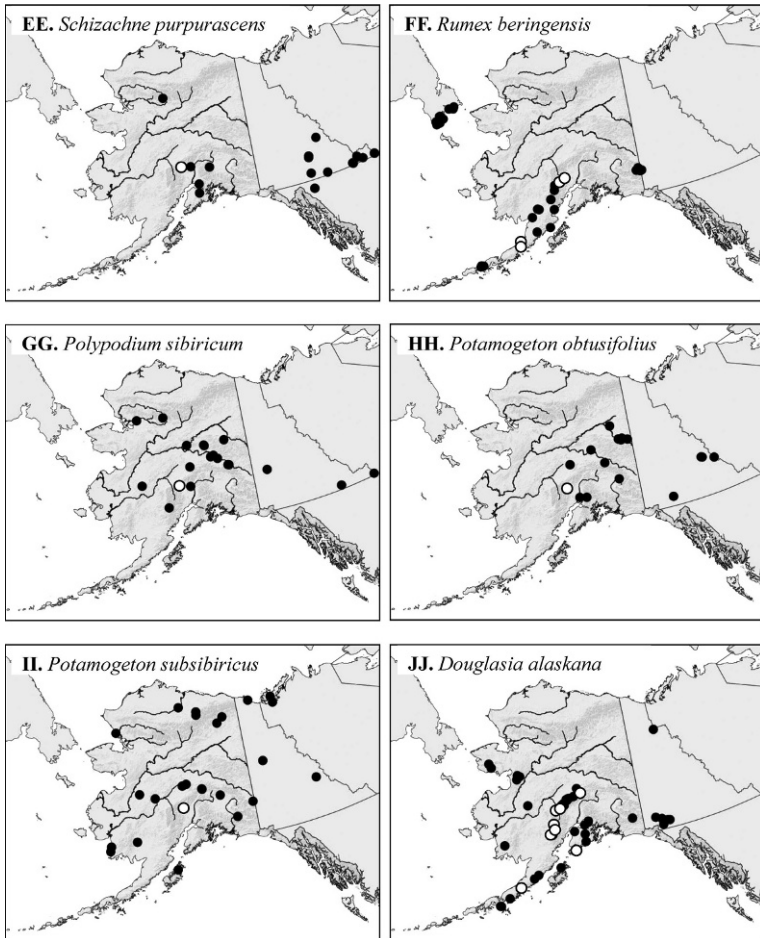


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even post-glacial, long-distance dispersal. Fossil records from refugia in western Kodiak Island suggest that at least some of the vegetation persisted in these ice-free regions through the LGM. In general, the region is characterized by dramatic transitions in plant composition over the last 12 ka BP (Brubaker et al. 2001). Population genetic analyses would assist in disentangling vicariance or post-glacial dispersal and establishment of the species. Regardless of their history, these areas appear to support a disproportionate

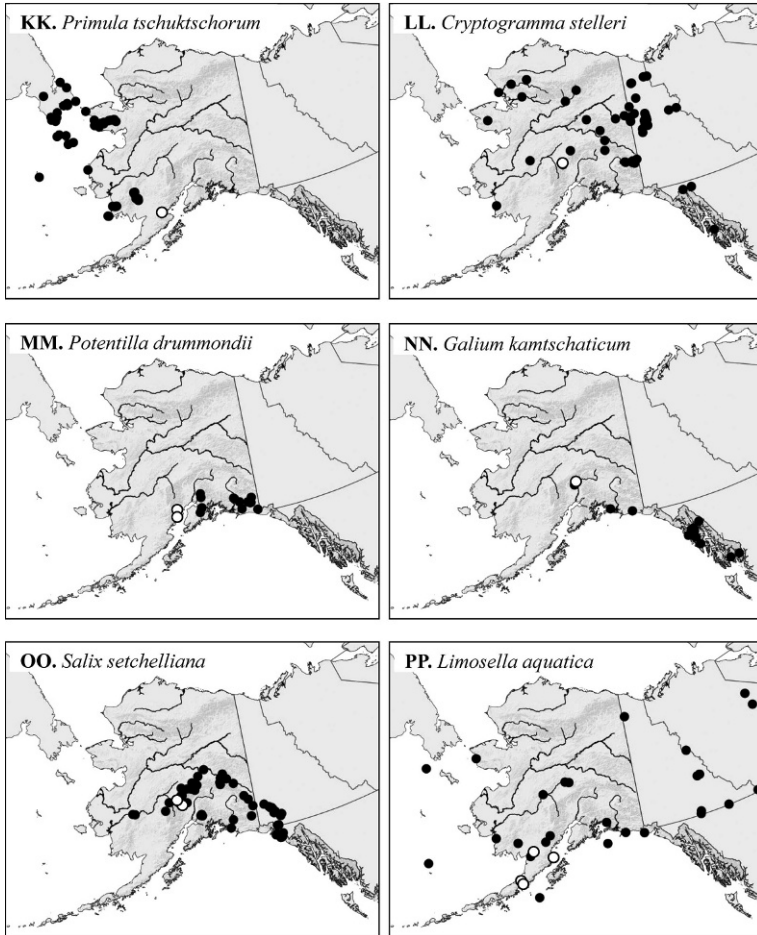


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number of uncommon North American cordilleran and Pacific-coastal taxa, contributing significantly to the biodiversity of the region.

The flora of the upper Cook Inlet basin region in the southern half of Denali contains a unique mixture of biogeographic affinities. It is the northern range limit for numerous taxa with maritime and Pacific-coastal distributions such as *Carex echinata* subsp. *echinata*, *Galium kamtschaticum*, and *Podagrostis thurberiana*, among others. In addition, a variety of taxa that occur primarily in interior and

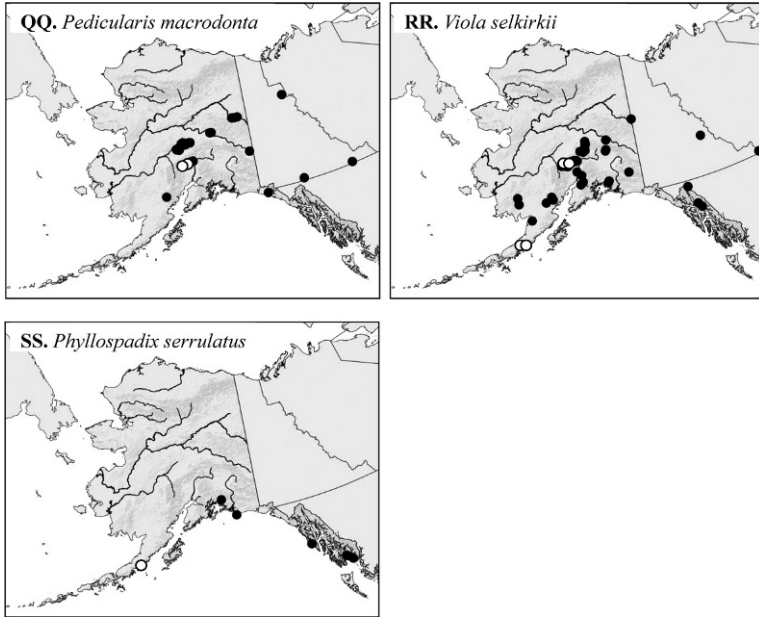


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northern regions of the state reach their southern limit in the immediate vicinity of two low passes over the Alaska Range (Broad Pass and Mystic Pass), including several species treated here such as *Cryptogramma stelleri*, *Minuartia yukonensis*, *Polypodium sibiricum*, and *Stellaria alaskana*.

Vascular plant species in the region represent a convergence of floras where many of the species are at their range limits. Numerous Pacific-coastal (Vancouverian, *sensu* Cronquist 1982) species encountered in this study, such as *Ranunculus cooleyae* Vasey & Rose, reach their western range limits on the Alaska Peninsula. A few arctic-associated species such as *Dupontia fisheri* R. Br. and *Primula tschuktschorum*, reach their southern range limit on the Peninsula. The Alaska Peninsula also marks the eastern termini of some Aleutian and amphi-beringian taxa such as *Aconitum maximum* Pall. *ex* DC. subsp. *maximum* and *Cerastium aleuticum* Hultén, and the western termini of many boreal-associated (Canadian *sensu* Cronquist 1982) taxa such as *Populus tremuloides* Michx. and *Salix pseudomyrsinites* Andersson. The expansion of

Pacific-coastal species on the Alaska and Kenai peninsulas is readily observed today (e.g., *Picea sitchensis* and *Tsuga mertensiana*; Ager et al. 2010; Jones et al. 2009; Mimura and Aitken 2007).

ACKNOWLEDGMENTS. Alan Batten, Bruce Bennett, Keith Boggs, Koren Bosworth, Phil Caswell, Mary Beth Cook, Mike Duffy, Lucretia Fairchild, Eric Groth, Anna Jansen, Eve Laeger, Amy Larsen, Penny Knuckles, Evelyn Martin, Ian Pierce, Bud Rice, Page Spencer, Michelle Sturdy, and numerous others collected and assisted in collecting many of the specimens. The National Park Service, Central Alaska and Southwest Alaska Networks provided logistical and financial support. The University of Alaska Museum and Yukon Conservation Data Centre graciously shared collection data. Carolyn Parker, David Murray, and Alan Batten assisted with determinations. We are grateful to David Murray, Carolyn Parker, Bruce Bennett, Alan Batten, and two anonymous reviewers for their numerous helpful comments on this manuscript.

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APPENDIX

ANNOTATED LIST OF RARE TAXA AND TAXA WITH RANGE EXTENSIONS IN
SOUTH-CENTRAL AND SOUTHWESTERN ALASKA

All collections are housed at ALA or the Alaska National Park Service (NPS). Elven and Murray's Checklist of the Panarctic Flora (Elven and Murray 2011) and Flora of North America (1993+) taxonomies were used to develop the species lists. Following the taxonomic authors we have included NatureServe (2010) global and subnational (Alaska) Conservation Status Ranks for the taxa. Ranks range from critically imperiled globally (G1) and in the state (S1) to secure globally and in the state (G5S5); taxonomically questionable species are identified with a "Q" following the global rank (see NatureServe 2010 for definitions and AKNHP 2008 for subnational ranks). Subnational ranks for Yukon are included for relevant taxa. Brief habitat and distribution information is included. For rare species, we include the number of known collections from the region; in almost all cases the collections are > 1 km apart and, when they are not (e.g., *Cochlearia sessilifolia*), we describe the number of locations where populations are known from. Distribution maps showing new and existing collections in Alaska are included in Figure 2. Range extensions were estimated as the shortest (straight line) distances to the nearest documented collections in a GIS environment (ArcGIS 10, ESRI, Redlands, CA; Figure 2).

APIACEAE

Cicuta bulbifera L. G5S2 – ALASKA RANGE: rare in wet sedge meadow around small pond, East Fork of Yentna River, 73 m, 62°18.00'N 151°48.11'W, C. Roland & C. Parker 4274, 17 August 1999. *Cicuta bulbifera* is a North American boreal wetland species, with disjunct populations as far south as Florida (Kartesz and Meecham 1999). It is also imperiled in Yukon (YCDC 2011). In Alaska, it is now known from 16 collections in interior Alaska (Talbot et al. 1988) and the Yukon River Valley, Tanana Lowlands, and from the Susitna Valley (UAM 2011; Figure 2A).

ASTERACEAE

Arnica ovata Greene (syn. *Arnica diversifolia* Greene; *A. latifolia* Bongard var. *viscidula* A. Gray) G5S1 – CHIGMIT MOUNTAINS: rare on eroding mudstone, Lenore Hill, 850 m, 60°0.00'N 152°48.00'W, M. Carlson, A. Miller & P. Spencer V156311, 29 July 2005. ALASKA RANGE: occasional in lush herbaceous vegetation on well-drained SW-slope, east of Chelatna Lake, 732 m, 62°29.52'N 151°21.86'W, C. Roland 3938, V133595, 30 June 1999; scattered in lush meadow, upper Wildhorse Creek, 930 m, 62°39.19'N 150°57.64'W, M.B. Cook & A. Larsen 3765, V150477, 3 July 2001. This is a North American species with a cordilleran distribution, found in high elevation meadows, coniferous forests, stream banks, and snowbeds (Wolf 2006). It is reported from 15 sites in the Alaska Range, Coast Mountains,

Chugach Mountains, Talkeetna Mountains, and Kodiak Island (AKNHP 2011; UAM 2011; Figure 2B).

Taraxacum carneocoloratum A. Nelson G3QS3 – CHIGMIT MOUNTAINS: scattered on scree, west of Kasma Creek, 1372 m, 60°10.58'N 154°4.35'W, P. Caswell & E. Laeger V136589, 21 June 2001. This Alaska-Yukon endemic is found on high alpine, barren areas, and scree slopes (Brouillet 2006). It is known from 21 locations in the Wrangell Mountains, Chugach Mountains, Kilbuck Mountains, Alaska Range, and Nulato Hills (AKNHP 2011; UAM 2011; Figure 2C).

BORAGINACEAE

Plagiobothrys orientalis (L.) I.M. Johnston G3G4S3 – ALASKA PENINSULA: occasional on intermittently-flooded sandbars, Aniakchak River, 5 m, 56°46.01'N 157°31.60'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156050, 20 July 2004. *Plagiobothrys orientalis* is an amphi-beringean species known from scattered freshwater wetland sites along the southern coast of Alaska, Kamchatka, and the Commander Islands in the Russian Far East. It is known from 10 records from the Alaska Peninsula and Kuskokwim Bay, Aleutian Range, Kodiak Archipelago, and Skagway (AKNHP 2011; UAM 2011; Figure 2D).

BRASSICACEAE

Aphragmus eschscholtzianus Andrzejowski ex de Candolle G3S3 – NEACOLA MOUNTAINS: rare on scree above Turquoise Lake, 1310 m, 6042.10'N 153°54.99'W, R. Lipkin & P. Caswell V136264, 25 June 2001. CHIGMIT MOUNTAINS: Kasma Creek, 1220 m, 60°10.44'N 154°4.80'W, P. Caswell & E. Laeger LACL 1733 (NPS), 21 June 2001. ALASKA PENINSULA: scattered in talus, Mirror Lake, 700 m, 59°13.01'N 154°47.07'W, A. Jansen, M. Carlson & I. Pierce V143360, 17 July 2002. ALEUTIAN RANGE: rare on limestone scree, Aniakchak caldera, 400 m, 56°54.19'N 158°4.69'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156015, 16 July 2004. ALASKA RANGE: scattered in stony area, rivulet draining limestone knoll, Shellabarger Pass, 1097 m, 62°31.86'N 152°46.81'W, C. Roland & A. Batten V141149, 16 August 2000; in alpine *Dryas* tundra, headwaters of West Fork Yentna River, 838 m, 62°37.91'N 152°33.79'W, A. Larsen & M. Duffy V138619, 16 August 2001; rare in moist clayey areas of east-facing alpine slope, headwaters of West Fork Yentna River, 1177 m, 62°37.38'N 152°36.61'W, C. Roland & A. Batten V141148, 27 June 2000. This is primarily an Alaska-Yukon endemic, though it is known from a single locality on Chukotka (Katenin and Petrovsky 1995). It is typically found on moist calcareous rocky slopes, wet cliffs, and fine gravels (Al-Shehbaz 2010). It is known from 47 records from the Aleutian Islands, southwest Alaskan mainland, Chukchi, Alaska, and Seward peninsulas, Chugach and Wrangell mountains, Kodiak Island, and Alaska and Brooks ranges (AKNHP 2011; UAM 2011; Figure 2E).

Boechera lemmonii (S. Watson) W.A. Weber (syn. *Arabis lemmonii* S. Watson) G5S1 – CHIGMIT MOUNTAINS: rare on crumbling diorite at base of cliff, Double Glacier Nunatak, 1115 m, 60°42.72'N 152°39.59'W, M. Carlson, A. Miller & P. Spencer V156288, 28 July 2005; rare on eroded mudstone gravels,

Saddle Mountain, 850 m, 60°0.00'N 152°48.00'W, *M. Carlson, A. Miller & P. Spencer V156310*, 29 July 2005. *Boechea lemmonii* is a North American cordilleran species found on high elevation cliffs, talus slopes, and gravelly soils (Al-Shehbaz and Windham 2010). It is known from 12 collections from the Chigmit Mountains, Chugach Mountains, and two populations in neighboring Yukon and British Columbia (AKNHP 2011, Cody 1996; UAM 2011; Figure 2F). The Chigmit populations were found approximately 555 km west of the nearest known collection from the Granite Range (Cook and Roland 2002). The Chigmit Mountain specimens show weakly clasping stem leaves, not typically associated with *B. lemmonii* (Hultén 1968; Rollins 1993), and warrant further taxonomic work.

Cochlearia sessilifolia Rollins [syn. *Cochlearia officinalis* var. *sessilifolia* (Rollins) Hultén] G1G2QS1S2 – KENAI PENINSULA: abundant on mud flats and shingle beach in upper intertidal zone, Beauty Bay, 10 m, 59°32.54'N 150°39.71'W, *R. Lipkin & A. Miller V157122*, 10 August 2005. *Cochlearia sessilifolia*, an Alaska endemic, occurs on low-energy mudflats and gravel bars submerged at high tide in south-central Alaska, where it is known only from four general locations along the Gulf of Alaska and Kodiak Archipelago (AKNHP 2011; UAM 2011; Figure 2G); recent collections from Prince of Wales Island are awaiting determinations (Meridian Environmental 2011). *Cochlearia sessilifolia* has been reduced to a variety of the European *C. officinalis*, but appears to be morphologically distinct from the other North American species (Al-Shehbaz and Koch 2010).

Draba macounii O.E. Schulz G3G4S3 – ALEUTIAN RANGE: rare on limestone scree, Aniakchak caldera, 400 m, 56°54.19'N 158°4.69'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156016*, 16 July 2004. ALASKA RANGE: on alpine-dwarf scrub, gravelly colluvial slope, Shellabarger Pass, 1354 m, 62°32.37'N 152°45.21'W, *M. Duffy V148086*, August 2001. This northern North American cordilleran species is found on rocky outcrops, talus, and tundra at mid to high elevations in Montana, western Canada, and Alaska. The collection from Aniakchak occurs approximately 495 km south of the nearest known collection in the Neacola Mountains (Figure 2H).

Draba ruaxes Payson & H. St. John [syn. *D. ventosa* A. Gray var. *ruaxes* (Payson & H. St. John) C.L. Hitchcock] G3S3 – ALASKA RANGE: scattered in scree on SW-facing slope, W. Fork of Chulitna R., 63°17.790'N 149°49.342'W, 1400 m, *C. Roland & M.B. Cook 3491, V127579*, 14 August 1998; occasional in scree on SE-facing slope, vic. Mystic Pass, 62°37.271'N 152°35.628'W, 1100 m, *C. Roland & A. Batten 4346, V141260*, 27 June 2000. *Draba ruaxes* is a North American cordilleran species that occurs in barren, calcareous alpine rubble and scree. In Alaska-Yukon, it is known mainly from the Alaska and St. Elias ranges. This species is known from only a handful of sites south of the Alaska Range crest, including the localities in the upper Chulitna and Yentna drainages cited above (Figure 2I).

Noccaea arctica (A.E. Porsild) Holub [syn. *Thlaspi arcticum* A.E. Porsild; *Noccaea montana* (L.) F.K. Mey. subsp. *arctica* (A.E. Porsild) A. Löve & D. Löve] G3S3 – CHIGMIT MOUNTAINS: occasional on fine scree and barren ridges, Barren Hills, 782 m, 60°1.75'N 152°54.34'W, *P. Caswell, P. Knuckles & A. Jansen V136598*, 31 July 2001; rare on eroding mudstone and small cliffs, Lenore Hill, 850 m, 60°0.00'N, 152°48.00'W, *M. Carlson, A. Miller &*

P. Spencer V156331, 29 July 2005. KENAI MOUNTAINS: rare on fractured metasediments in herbaceous meadow, Wosnesenski Glacier Nunatak, 1050 m, 59°26.75'N, 150°56.60'W, *R. Lipkin & A. Miller V157087*, 8 August 2005. ALASKA RANGE: on south-facing scree, West Fork Yentna River, Shadows Glacier vicinity, 1021 m, 62°31.84'N 152°34.41'W, *A. Larsen & A. Batten V139328*, 1 August 2001; on talus, scree and rock outcrops, headwaters of West Fork Yentna River, 1064 m, 62°35.19'N 152°43.38'W, *M. Duffy V148496*, 7 August 2002; large scree slope, 1433 m, 62°32.60'N 152°45.59'W, Shellabarger Pass, *A. Larsen & A. Batten V139329*, 1 August 2001. *Noccaea arctica* is an Alaska-Yukon endemic found on barren scree, gravels, and tundra. It is known from 41 collections in mountainous areas of the state (Cook and Roland 2002; AKNHP 2011; UAM 2011; Figure 2J).

CARYOPHYLLACEAE

Minuartia yukonensis Hultén [syn. *Lidia yukonensis* (Hultén) Á. Löve & D. Löve] G4?S3 – ALASKA RANGE: growing in crevice of granitic rock outcrop, facing south, Upper W. Fork of Yentna R., 62°31.212'N 152°25.150'W, *C. Roland and S. Burson 4072, V133779*, 27 July 1999. *Minuartia yukonensis* is a Beringian endemic species that occurs in dry, south-exposed, open sites from the lowlands into the lower alpine zone. It occurs most abundantly in xeric river bluff communities along the upper Yukon River and its tributaries. Our collection in the upper Yentna River extends the range of this species into the Cook Inlet lowlands; it is known from only one other site south of the Alaska Range crest (UAM 2011; Figure 2K).

Stellaria alaskana Hultén G3S3 – ALASKA RANGE: rare in loose rubble and patchy tundra on S-facing slope, Windy Cr. Valley, 63°27.057'N 149°02.780'W, 1220 m, *C. Roland 3236, V127415*, 9 July 1998; scattered in scree on SW-facing slope, W. Fork of Chulitna R., 63°17.790'N 149°49.342'W, 1219 m, *C. Roland & M.B. Cook 3499B, V127585*, 14 August 1998. A rare Alaska-Yukon endemic species, *S. alaskana* occurs in alpine scree and fellfield situations in the Alaska Range, with a handful of disjunct localities in the Brooks Range (UAM 2011; Figure 2L). Prior to our collections in the Chulitna River drainage, this taxon was not known to occur in the Cook Inlet drainage, or in other maritime or transitional areas of Alaska.

Stellaria umbellata Turczaninow (syn. *Alsine baicalensis* Coville; *Stellaria gonomischa* B. Boivin; *S. weberi* B. Boivin) G5S2S3 – ALASKA RANGE: rare in stony area in wet alpine rivulet draining limestone knoll, Shellabarger Pass, 1097 m, 62°31.89'N 152°146.67'W, *C. Roland & A. Batten NPS-4727, V141534*, 16 August 2000. *Stellaria umbellata* is found in moist meadows, rocky summits, and wet gravelly areas in mountainous areas of western North America and northern Eurasia (Hultén 1968; Morton 2005). In Alaska, Yukon, and Chukotka, it is known from 32 records from the Alaska Range, Chugach Mountains, Yukon-Tanana Uplands, Arctic Foothills, Angayucham Mountains, Seward Peninsula, and Arctic Coastal Plain (UAM 2011; Figure 2M).

CYPERACEAE

Carex crawfordii Fernald G5S3 – ALASKA RANGE: scattered in large, open *Carex utriculata* marsh below large beaver dam, vic. Ruth Glacier terminus,

62°42.045' N 150°19.697'W, 220 m, *C. Roland* 3531 & 3544, V127604 & V127608, 18 August 1998; occasional in meadow around small beaver pond, upper W. Fork Yentna River valley, 62°24.527'N 152°06.569'W, 134 m, *C. Roland* & *W. Mahovlic* 4184, V133633, 2 August 1999. *Carex crawfordii* occurs across boreal North America, reaching as far south as Missouri (Kartesz and Meecham 1999). It occurs most commonly in the central interior of Alaska, with a few isolated stations known from maritime areas of the state (UAM 2011; Figure 2N). This sedge occurs in wet to moist open areas of the lowlands, including sedge meadows and open soil around ponds and river terraces. Our collections add to the few stations in the Cook Inlet basin, including our collection localities in the Yentna and Chulitna River drainages, and are the first localities for the species in Denali.

Carex echinata Murray subsp. *echinata* G5T5S1S2 – ALASKA RANGE: rare in pond within fen, Cascade Creek, 329 m, 62°25.75'N 152°01.52'W, *C. Roland* & *C. Parker* NPS-4255B, V133638, 16 August 1999. *Carex echinata* subsp. *echinata* occurs across boreal North America from the Aleutian Islands to Newfoundland, and south to California and Nevada in the west and North Carolina in the east (Reznicek 2002). The species occurs in low-elevation wet meadows and peatlands. The subspecies was known previously from a single locality near Unalaska in the Aleutian Islands (UAM 2011; Figure 2O). The collection from south of the Alaska Range represents a range extension of almost 1400 km to the northeast from the Unalaska collection.

Carex interior L.H. Bailey G5S1 – ALASKA RANGE: co-dominant in saturated, *Sphagnum*-rich bog, vic. Midway Lakes, Yentna River valley, 62°18.854'N 151°49.494'W, 207 m, *C. Roland* & *A. Batten* 4870, V141199, 18 August 2000. *Carex interior* is a widespread North American species found in wetlands and wooded lowlands in northern temperate areas across the continent (Hultén 1968; Kartesz and Meecham 1999). It is known from five localities in Alaska (Bennett, Environment Yukon, pers. comm.). These northern populations appear to be disjunct from the temperate range of the species. In Alaska, it is known from roughly 20 collections in interior and south-central Alaska (UAM 2011), and the Tana River in the Wrangell Mountains (Cook and Roland 2002), and from several sites near Anchorage (Hultén 1968; UAM 2011; Figure 2P). Our collections extend its range 160 km to the NW in Cook Inlet lowlands from the stations near Anchorage.

Carex phaeocephala Piper G4S3 – KENAI MOUNTAINS: scattered on exposed scree mounds, Exit Glacier, 1080 m, 60°10.86'N 149°42.23'W, *M. Sturdy* & *E. Martin* V150771, 31 July 2003; occasional in sparsely vegetated dwarf shrub tundra, upper Nuka River, 550 m, 59°39.98'N 150°39.74'W, *R. Lipkin* & *M. Carlson* V152636, 29 July 2003; scattered to patchy on mesic herbaceous meadow, Petrof Glacier Nunatak, 760 m, 59°26.56'N 150°51.28'W, *R. Lipkin* & *A. Miller* V157098, 9 August 2005. CHIGMIT MOUNTAINS: scattered on steep herbaceous meadow, Double Glacier Nunatak, 1097 m, 60°42.72'N 152°39.59'W, *M. Carlson*, *A. Miller* & *P. Spencer* V156309, 28 July 2005; very rare in loose granitic rocks, Double Glacier Nunatak, 914 m, 60°41.29'N 152°35.01'W, *M. Carlson*, *A. Miller* & *P. Spencer* V156372, 28 July 2005; scattered on finely eroded mudstone gravels, Lenore Hill, 853 m, 60°0.00'N 152°48.00'W, *M. Carlson*, *A. Miller* & *P. Spencer* V156312, 29 July 2005; occasional on eroding mudstone and

weathered talus, Slope Mountain, 910 m, 60°4.94'N 152°37.36'W, *M. Carlson mlc2007-138*, 8 August 2007. ALASKA RANGE: on granitic bedrock, Hidden River vicinity, 1097 m, 62°52.82'W 150°8.52'N, *C. Roland NPS-3440*, 13 August 1998. This North American cordilleran species occurs on rocky soils in high-montane to alpine areas throughout western North America (Mastrogioseppe et al. 2002). It is known from 47 records from the Coast Mountains of southeastern Alaska, Wrangell Mountains, Chugach Mountains, Kenai Mountains, and western Alaska Range (AKNHP 2011; UAM 2011; Figure 2Q). The collection from the Alaska Range was found approximately 230 km north of the nearest known collection on the northern Kenai Peninsula.

Eleocharis kamschatrica (C.A. Meyer) Komarov G4S2S3 – ALASKA PENINSULA: dominant in tidal salt marsh, Tuxedni Bay, 0 m, 60°14.76'N 152°47.41'W, *P. Caswell, E. Laeger & A. Jansen V136392*, 7 July 2001; scattered in ponds at mouth of Johnson River, 7 m, 60°0.97'N 152°37.03'W, *P. Caswell, P. Knuckles & A. Jansen LACL 1848* (NPS), 30 July 2001; scattered in halophytic wet sedge meadow, Swikshak Lagoon, 1 m, 58°37.01'N 153°43.32'W, *A. Jansen, K. Boggs & J. Grunblatt V143466*, 15 August 2002; abundant in low herbaceous meadow in old pond bottom, Aniakchak Bay, 1 m, 56°46.06'N 157°32.23'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156057*, 20 July 2004; abundant on pond margins, Aniakchak Bay, 18 m, 56°45.47'N 157°27.55'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156101*, 22 July 2004; occasional on margin of small pond, Aniakchak Bay, 1 m, 56°43.64'N 157°35.35'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156116*, 23 July 2004. This circumboreal species occurs in brackish marshes, meadows, and ponds in China, Japan, Korea, Russia, and northern North America (Smith et al. 2002). It is known from 60 records from the Kobuk River, Norton Sound, Kuskokwim Bay, Alaska Peninsula, Kodiak Archipelago, Cook Inlet, Prince William Sound, and Gulf of Alaska (AKNHP 2011; UAM 2011; Figure 2R).

Eriophorum viridicarinatum (Engelmann) Fernald (syn. *Eriophorum latifolium* Hoppe var. *viridicarinatum* Engelmann) G5S2 – ALASKA RANGE: scattered in wet *Trichophorum*–*Sphagnum* meadow on bench between lower Fourth of July Creek and West Fork of Yentna River, 305 m, 62°20.62'N 152°02.33'W, *C. Roland & C. Parker NPS-4278A, V133733*, 17 August 1999. This species of cotton-grass occurs only in North America, where its primary range is in the northeastern boreal region, including Ontario, Quebec, and New England (Hultén 1968). In Alaska, it is known from 20 records in the Brooks Range, the Kenai Peninsula, Anchorage and vicinity, Kodiak Island, and isolated locations in the southeast panhandle (Cook and Roland 2002; UAM 2011; Figure 2S).

FABACEAE

Oxytropis huddelsonii A.E. Porsild G3S2S3 – ALASKA RANGE: scattered in loose rubble and patchy tundra on south-facing slope; Windy Creek, 1219 m, 63°27.06'N 149°02.78'W, *C. Roland 3239*, 9 July 1998; scree slope, West Fork of Chulitna River, 1300 m, 63°17.79'N 149°49.34'W, *C. Parker NPS-8234B, V126224*, 14 August 1998. This alpine legume is endemic to mountainous areas of interior and central Alaska and the southwestern

Yukon Territory. In Alaska, it is known from 54 records from the Wrangell Mountains, Yukon-Tanana Uplands, Nutzotin Mountains, Chugach Mountains, and Alaska Range (Cook and Roland 2002; UAM 2011; Figure 2T).

NAJADACEAE

Najas flexilis (Willd.) Rostk. & Schmidt G5S1S2 – ALASKA RANGE: in shallow pond on mineral substrate, East Fork of Yentna River, 73 m, 62°18.00'N 151°48.11'W, C. Roland & C. Parker NPS-4272, V133782, 17 August 1999. *Najas flexilis* is a widespread species found in lakes and rivers in North America and Eurasia. The collection in the Yentna River was the first record for Denali. Prior to this work, the species was known from three localities in Alaska, near Fort Yukon in the interior, the Wrangell Mountains, and one station near Anchorage (Cook and Roland 2002; Figure 2U). This species has subsequently been collected from several localities in the northern part of Denali and upper Yukon River drainage (UAM 2011).

OPHIGLOSSACEAE

Botrychium alaskense W.H. Wagner & J.R. Grant G2G3S2S3 – ALEUTIAN RANGE: abundant on tephra slopes, Aniakchak caldera, 330 m, 56°56.24'N 158°5.03'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156013, 15 July 2004; abundant in herbaceous meadow, Aniakchak caldera, 330 m, 56°55.80'N 158°7.93'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156027, 18 July 2004; and 360 m, 56°56.02'N 158°6.50'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156003, 15 July 2004; abundant in herbaceous meadow near Rainbow Creek, 60 m, 56°46.06'N 158°5.04'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155982, 11 July 2004; and 60 m, 56°46.53'N 158°3.85'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155755, 2 July 2004. NEACOLA MOUNTAINS: unvegetated west-facing slope, Telquana Badlands, 860 m, 60°59.90'N 153°51.65'W, P. Caswell & L. Mullin V136288, 14 June 2001. ALASKA RANGE: mesic meadow in swale, West Fork of Chulitna River, 1219 m, 63°17.79'N 149°49.34'W, C. Roland & M.B. Cook NPS-3493B, V127582, 14 August 1998; West Fork of Chulitna River, 62°17.4'N 149°49'W, C. Roland NPS-9643, V133615, 14 July 1998. *Botrychium alaskense* is known only from 25 collections from the Alaska Peninsula and Aleutian Range, Kodiak Archipelago, Neacola Mountains, Alaska Range, Robinson Mountains, and four sites in Yukon (AKNHP 2011; Bennett et al. 2010; UAM 2011; Figure 2V). Our collections from the Aleutian Range were found 525 km south of the nearest known collection from the Neacola Mountains.

Botrychium pedunculosum W.H. Wagner G2G3S1 – New to Alaska. ALEUTIAN RANGE: rare beneath alder in an herbaceous meadow, Waterfall Creek area, 35 m, 56°46.00'N 158°7.00'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V152482, 8 July 2004 (determined by D. Farrar, Faculty, Dept. Ecology, Evolution, and Organismal Biology, Iowa State University). It is found in shrubby, secondary-growth habitats, particularly adjacent to streams and roadsides between 300 and 1000 m (Wagner and Wagner 1993). It is known from British Columbia, Alberta, Saskatchewan, and Oregon. A disjunct population is also known from northeastern Quebec (NatureServe 2010).

Only 56 populations are known globally for this taxon and most population sizes are fewer than ten plants (NatureServe 2010). Our collection from the Aleutian Range is the first for Alaska, and was found approximately 1850 km west of the nearest known population in central British Columbia (Figure 2W).

Botrychium virginianum (L.) Swartz G5S2 – ALEUTIAN RANGE: rare in herbaceous meadow, Waterfall Creek area, 35 m, 56°45.13'N 158°7.28'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155932, 8 July 2004. ALASKA RANGE: on large alluvial fan near confluence of East and West Fork of Yentna River, 134 m, 62°22.74'N 151°52.65'W, M. Duffy DENA-00609, 3 August 2001. This widespread temperate species occurs in shaded forests and brush at low to mid-elevations in the Americas and Eurasia (Wagner and Wagner 1993). Globally it is common, but it is known from just 18 records from the Alaska Peninsula, Kodiak Archipelago, Talkeetna Mountains, Alexander Archipelago, and Coast Mountains (AKNHP 2011; UAM 2011; Figure 2X).

ORCHIDACEAE

Malaxis paludosa (L.) Swartz [syn. *Ophrys paludosa* L.; *Epipactis paludosa* (L.) F.W. Schmidt; *Hammarbya paludosa* (L.) Kuntz; *Sturmia paludosa* (L.) Reichenbach] G4S3 – ALASKA RANGE: rare in wet *Trichophorum*–*Sphagnum* fen in valley bottom, Cascade Creek, 329 m, 62°25.75'N 152°01.52'W, C. Roland & C. Parker NPS-4250B, V133768, 16 August 1999; in alpine-sedge wet meadow terraces in valley bottom, lower Buckskin Glacier, 766 m, 62°55'N 150°11'W, M. Duffy MD00-186, V147823, 25 July 2000. *Malaxis paludosa* is a circumboreal species that occurs in wet sphagnum bogs and lowland wetlands. It is known from 38 records from the Alaska Range, Cook Inlet Lowlands, Agulupak River, Tanana Lowlands, Yukon River valley, and scattered locations around the Gulf of Alaska and in southeast Alaska (UAM 2011; Figure 2Y). This taxon is also known from Yukon (Cody et al. 2001). The collection in Cascade Creek was the first record for this species in Denali, followed a year later with a collection from nearby Buckskin Glacier; it is also known from several localities north of the Alaska Range.

OROBANCHACEAE

Orobanche uniflora L. G5S2 – ALASKA PENINSULA: abundant in tall forb meadow, Aniakchak Bay, 17 m, 56°45.85'N 157°29.47'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156078-V156079, 21 July 2004; scattered on meadow bluff above Aniakchak River, 46 m, 56°46.07'N 157°30.62'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156135, 25 July 2004. This widespread North American species is found in sandy meadows and prairies, thickets, moist woods, and along stream banks. It is known from eight records from the Alaska Peninsula, the Shumigan Islands, Semidi Islands, and the Kodiak Archipelago (AKNHP 2011; UAM 2011; Figure 2Z).

PAPAVERACEAE

Papaver alboroseum Hultén G3G4S3 – KENAI MOUNTAINS: rare to occasional on scree mounds, Exit Glacier, 1080 m, 60°10.88'N 149°42.09'W, M. Sturdy &

E. Martin V150819, 31 July 2003; rare in sparsely vegetated cobble and gravel, Nuka River, 375 m, 59°39.85'N 150°40.79'W, *R. Lipkin & M. Carlson* V152760, 30 July 2003. CHIGMIT MOUNTAINS: scattered on eroding mudstone and small outcrops, Lenore Hill, 732 m, 60°0.11'N, 152°48.31'W, *M. Carlson, A. Miller & P. Spencer* V156321, 29 July 2005. ALASKA RANGE: rare in fine gravelly scree on steep south-facing slope, West Fork Chulitna River 1466 m, 63°16.45'N 149°54.33'W, *C. Roland & S. Carwile* V141381, 18 July 2000; alpine gravel swales on scree slope, Dunkle Mine area, 1440 m, 63°17.33'N 149°37.13'W, *M. Duffy* V147743, 13 July 2000. *Papaver alboroseum* is found on weakly stabilized mineral substrates, rocky tundra and scree, glacial outwashes, and floodplains (Kiger and Murray 1997). It is known from British Columbia, Yukon, Alaska, and Kamchatka. It is known from 35 records from the Chugach Mountains, Wrangell Mountains, Kenai Mountains, Chigmit Mountains, and the Alaska Range (AKNHP 2011; UAM 2011; Figure 2AA).

POACEAE

Dupontia fisheri R. Br. [syn. *D. f.* subsp. *psilosantha* (Rupr.) Hultén *sensu* Hultén (1968)] G4S4 – ALASKA PENINSULA: scattered in wet sedge meadow, Swikshak Lagoon, 8 m, 58°37.12'N 153°41.44'W, *R. Lipkin & I. Pierce* V143487, 8 July 2002; abundant in wet sedge marsh, Meshik River drainage, 36 m, 56°45.44'N 158°5.16'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller* V155789, 3 July 2004; abundant in *Sphagnum* fen, Meshik River drainage, 30 m, 56°44.71'N 158°4.66'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller* V155808, 3 July 2004; occasional in wet sedge meadow, Aniakchak Bay, Black Creek Lagoon, 1 m, 56°43.64'N 157°35.35'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller* V156121, 23 July 2004. This circumpolar species occurs in wet, open habitats, including wet tundra, marshes, and stream, lagoon, and lake margins at low elevations (Cayouette and Darbyshire 2007). The collections from the Alaska Peninsula were found approximately 300–450 km to the east of the nearest known records from Cape Pierce, and are the only known records from the Gulf of Alaska (Figure 2BB).

Glyceria striata (Lam.) Hitchc. [syn. *G. striata* (Lam.) Hitchc. var. *stricta* (Scribn.) Fernald] G5T5QS2 – ALASKA RANGE: scattered in moist area on gravel bar, East Fork of Yentna River, 122 m, 62°21.76'N 151°55.34'W, *C. Roland & C. Parker* NPS-4265, 16 August 1999; rare in saturated soil in tall alder scrub, East Fork of Yentna River, Midway Lakes vicinity, 207 m, 62°21.35'N 151°52.67'W, *C. Roland & A. Batten* NPS-4906, V141318, 18 August 2000; scattered in wet sedge meadow on margins of beaver pond, upper West Fork of Yentna River, 259 m, 62°29.57'N 152°25.40'W, *C. Roland, M. Duffy & A. Blakesley* NPS-4141, V133744, 30 July 1999; growing in open moist silt of river bar, West Fork of Yentna River, 67 m, 62°18.21'N 151°53.80'W, *C. Roland & W. Mahovlic* NPS-4220, V133746, 3 August 1999; occasional in meadow silt around small beaver pond, upper West Fork of Yentna River, 134 m, 62°24.53'N 152°6.57'W, *C. Roland & W. Mahovlic* NPS-4185, V133745, 2 August 1999; cottonwood woodland, Ruth Glacier terminus, 202 m, 62°32.52'N 152°4.26'W, *M. Duffy* NPS-00-225, V147862, 31 July 2000; open black cottonwood–thinleaf alder forest, Lower West Fork of Yentna River, 134 m, 62°24.72'N 152°8.04'W, *M. Duffy* NPS-01-215,

V148174, 8 August 2001. This taxon occurs in floodplain meadows and marshes throughout North America (Kartesz and Meecham 1999). In Alaska, it is known from 18 records from the Stikine River, the Cook Inlet lowlands and Matanuska Valley, the Ray Mountains, and Kanuti Hot Springs (UAM 2011; Figure 2CC).

Podagrostis thurberiana (Hitche.) Hultén (syn. *Agrostis thurberiana* A. S. Hitchc.) G5S2 – ALASKA RANGE: alpine basin on west side of Coffee River, 808 m, 62°50.40'N 150°18.98'W, C. Roland & M.B. Cook NPS-3424a, V127533, 13 August 1998. KENAI MOUNTAINS: occasional in blocky talus in moist, late-melting snowbeds and seeps, north-facing slope, Quartz Bay, 350 m, 59°30.73'N 150°30.63'W, R. Lipkin, B. Rice & E. Groth V152792, 10 July 2003. This North American species occurs in scattered, moist alpine and subalpine localities along the southern coast of Alaska. In the state, it is known from 20 records from the Alaska Range, Robinson Mountains, St. Elias Mountains, Chugach Mountains, Coast Mountains, Prince William Sound, and the Alexander Archipelago. The collection from the Coffee River was found approximately 310 km north of the nearest known collection from Knight Island, western Prince William Sound, and represents the north-western extent of the species' known range (Cook and Roland 2002; UAM 2011; Figure 2DD).

Schizachne purpurascens (Torr.) Swallen [syn. *Avena torreyi* Nash; *Melica purpurascens* (Torr.) Hitchc.; *Schizachne purpurascens* (Torr.) Swallen var. *pubescens* Dore; *S. stricta* (Michx.) Hultén; *Trisetum purpurascens* Torr.] G5S2 – ALASKA RANGE: rare in open white spruce forest, valley of Cascade Cr., 62°25.748'N 152°01.515'W, 322 m, E. Groth 10-127, DENA-00609, 5 Aug. 2010. *Schizachne purpurascens* grows in spruce forest, woodlands, and shrub thickets. Our collection near the Ruth Glacier terminus is the first in Denali (UAM 2011; Figure 2EE). *Schizachne purpurascens* has a circumpolar distribution (with wide gaps) and, within Alaska and Yukon, is known from a few widely separated locations from the Schwatka Mountains to the Kenai Peninsula in Alaska and to the southern mountains of Yukon (Cody 1996).

POLYGONACEAE

Rumex beringensis Jurtzev & V.V. Petrovsky [syn. *Acetosella beringensis* (Jurtzev & V.V. Petrovsky) Á. Löve & D. Löve] G3S3 – ALASKA RANGE: rare on moist sand and gravels, ridges above Chilligan River, 1097 m, 61°22.85'N 153°2.27'W, R. Lipkin & A. Jansen V136546, 22 June 2001. REVELATION MOUNTAINS: scattered to dominant on sparsely-vegetated and wind-eroded substrates, ridge above Two Lakes, 1067 m, 61°11.31'N 153°44.88'W, P. Caswell & E. Laeger (NPS) 01-97-V136547, 23 June 2001. ALEUTIAN RANGE: occasional on eroding embankment, Waterfall Creek area, 248 m, 56°47.48'N 158°7.84'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155841, 4 July 2004; abundant on exposed ash flats, saturated gravels, and cinder ridge, Rainbow Creek area, 45–53 m, 56°46.09'N 158°3.69'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155782, V155977, 2–10 July 2004; occasional on cinder slopes of Vent Mountain, Aniakchak caldera, 628 m, 56°53.37'N 158°7.89'W, R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156035, 17 July 2004; abundant in moist graminoid

meadow, Cub Creek, 60 m, 56°46.60'N 158°3.84'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155782*, 2 July 2004. *Rumex beringensis* is an amphiberingean species with a Pacific coastal distribution and is found on sandy and gravelly substrates and outcrops at low elevations in the Yukon, Alaska, and the Russian Far East (Mosyakin 2005). In Alaska, it is known from 29 records from the Alaska Peninsula, Aleutian Range, Neacola Mountains, Revelation Mountains, and Wrangell Mountains (AKNHP 2011; UAM 2011; Figure 2FF).

POLYPODIACEAE

Polypodium sibiricum Sipliv. G5S2 – ALASKA RANGE: confined to mossy, protected site on rock outcrop, Upper W. Fork Yentna R. valley, 62°31.212'N 152°25.150'W, 305 m, *C. Roland & S. Burson 4071, V133810*, 27 July 1999. This small fern occurs across the boreal zones of Asia and North America, where it grows in and around rock outcrops, on a variety of substrates including both calcareous and acidic lithologies (Hauffer et al. 1993). Our collection from the upper west fork of the Yentna River is only the second locality for this species south of the Alaska Range (Figure 2GG).

POTAMOGETONACEAE

Potamogeton obtusifolius Mertens & W.D.J. Koch G5S2S3 – ALASKA RANGE: abundant in one meter of water in lower Midway Lake, Yentna River lowlands, 137 m, 62°21.03'N 151°56.88'W, *C. Roland & C. Parker 4287, V133817*, 17 August 1999. *Potamogeton obtusifolius* is found in semi-alkaline lakes and slow-flowing streams across northern North America and Eurasia (Haynes and Hellquist 2000). In Alaska, it is known from 14 records from the Copper River, Charley River, Alaska Range, and Fairbanks (UAM 2011; Figure 2HH).

Potamogeton subsibiricus Hagström G3S3 – ALASKA RANGE: abundant in one meter of water in beaver pond, vic. E. Fork of Yentna R., 62°19.530'N 151°47.260'W, 207 m, *C. Roland & A. Batten 4891, V141434*, 18 August 2000. This rare, amphiberingean pondweed occurs in scattered locations across Alaska, primarily in the central and northern parts of the state (UAM 2011; Figure 2II) in shallow water of boreal ponds and lakes. Our collection on the Yentna River extends the range of this species into the Cook Inlet basin.

PRIMULACACEAE

Douglasia alaskana (Coville & Standley ex Hultén) S. Kelso G3S3 – REVELATION MOUNTAINS: rare on well-drained fine shales, ridges above Stony River, Two Lakes area, 1402 m, 61°11.87'N 153°58.37'W, *R. Lipkin & A. Jansen V136368*, 24 June 2001. ALEUTIAN RANGE: rare on rock ledge, Waterfall Creek area, Meshik River drainage, 100 m, 56°44.83'N 158°7.29'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155945*, 8 July 2004. KENAI MOUNTAINS: fractured metasediments and well-drained gravels, Wosnesenski Glacier nunatak, 1050 m, 59°26.75'N 150°56.60'W, *R. Lipkin & A. Miller V157065*, 8 August 2005. ALASKA RANGE: scattered in scree, West Fork of Chulitna River, 1219 m, 63°17.79'N 149°49.34'W, *C. Roland & M.B. Cook NPS-3500, V127586*, 14 August 1998; scree on south-facing slope, West Fork

Yentna River, 1067 m, 62°31.97'N 152°34.26'W, *A. Larsen & A. Batten NPS-01-0819, V138835*, 1 August 2001; scree slope, Shellabarger Pass, 1433 m, 62°32.21'N 152°46.73'W, *C. Roland & A. Batten NPS-4749, V141249*, 16 August 2000. *Douglasia alaskana* is an Alaska-Yukon endemic found in rocky tundra and alpine scree between 0–2000 m (Kelso 2009a). It is rare in Alaska and Yukon (Douglas et al. 1981, YCDC 2011), where it is known from 40 records from the Kodiak Archipelago and Kenai Mountains, through the Aleutian and Alaska ranges, to isolated mountain ranges in western and northwestern Alaska (AKNHP 2011; Cody et al. 2004; UAM 2011; Figure 2JJ).

Primula tschuktschorum Kjellman G2G3S2S3 – ALASKA PENINSULA: patchy in wet *Sphagnum* site, upper Funnel Creek, 396 m, 59°14.70'N 154°48.31'W, *A. Jansen, M. Carlson & I. Pierce V143491*, 14 July 2002. *Primula tschuktschorum* is an amphi-beringean species that occurs on moist, frost-patterned ground, typically influenced by cryoturbation, gravelly stream banks, and around late-melting snowbanks, in western Alaska and the Russian Far East (Kelso 2009b). The Funnel Creek collection was found approximately 200 km east of an earlier collection from Tikchik Lake. The species is known from 40 records from the Ahklun Mountains, Wood-Tikchik Lakes, Alaska Peninsula, and Seward Peninsula (AKNHP 2011; UAM 2011; Figure 2KK).

PTERIDACEAE

Cryptogramma stelleri (S.G. Gmelin) Prantl. (syn. *Pteris stelleri* S.G. Gmelin) G5S2S3 – ALASKA RANGE: rare on mossy log in forest, upper West Fork of Yentna River, 293 m, 62°30.56'N 152°26.96'W, *C. Roland & S. Burson NPS-4103, V133685*, 27 July 1999; moist, organic soil in crevices on shaded rock outcrop, upper West Fork of Yentna River, 283 m, 62°29.25'N 152°23.99'W, *C. Roland, M. Duffy & A. Blakesley NPS-4150, V133686*, 29 July 1999. This fern is found in sheltered microsites, cliff crevices, and rock ledges from 0–3000 m (Alverson 1993). In Alaska, it is known from 32 records from the Seward Peninsula, Brooks Range, Ahklun Mountains, Alaska Range, and Yukon River valley (AKNHP 2011; UAM 2011; Figure 2LL).

ROSACEAE

Potentilla drummondii Lehm. G5S2 – CHIGMIT MOUNTAINS: rare in snowbed meadow beneath alder, Rusty Mountain vicinity, 762 m, 60°16.32'N 152°45.84'W, *P. Caswell, E. Laeger & A. Jansen V136519*, 7 July 2001; rare in steep herbaceous meadow below crumbling diorite cliffs, Double Glacier Nunatak, 1097 m, 60°42.72'N 152°39.59'W, *M. Carlson, A. Miller & P. Spencer V156291*, 28 July 2005. *Potentilla drummondii* is a widespread North American cordilleran species of montane and alpine areas, often in mesic or wet habitats. It is known from 10 collections from the Chugach, Talkeetna, Kenai, and St. Elias mountains (AKNHP 2011; Cook and Roland 2002; Roland 2004; UAM 2011; Figure 2MM).

RUBIACEAE

Galium kamtschaticum Steller ex Roem. & Schult. G5S2 – ALASKA RANGE: abundant in mossy understory of closed spruce–birch forest, E of Ruth

Glacier terminus, Chulitna R. valley, 62°42.045'N 150°19.697'W, 225 m, *E. Groth 10-167*, 19 August 2010. This small herb grows in damp areas and spruce forest. *Galium kamtschaticum* is a north Pacific coast endemic species, occurring from Oregon north to southeast Alaska and then disjunct to Aleutian Islands, Kamchatka, and north coastal Asia (Hultén 1968). The collection near the Ruth Glacier terminus is the first in the Cook Inlet basin and connects the species range from localities in southeast Alaska with locations on the western Alaska Peninsula and the Aleutian Islands (Figure 2NN).

SALICACEAE

Salix setchelliana C.R. Ball G4S3 – ALASKA RANGE: scattered in open poplar stands on stabilized river bar, upper W. Fork of Yentna R. valley, 62°30.589'N 152°26.083'W, 259 m, *C. Roland 4116A, V133845*, 28 July 1999; scattered among *Dryas drummondii* mats on gravel bar, East Fork of Yentna R., 62°21.760'N 151°55.341'W, 122 m, *C. Roland & C. Parker 4263, DENA 10406*, 16 Aug. 1999. *Salix setchelliana* is a rare (G4S3) Alaska-Yukon endemic species that occurs in gravel bars of large glacial rivers. The main range of this distinctive, decumbent willow in Alaska is in floodplains of rivers flowing north and west out of the Alaska Range, from the Canadian border in the St. Elias Mountains in the east to near Russian Mission in the Kuskokwim River valley in the west (Cook and Roland 2002; Figure 2OO). Our collections in the Yentna River drainage extend the range of this species into the Cook Inlet basin south of the Alaska Range, where it was previously known only from the Knik and Matanuska rivers near Anchorage (Argus 2004; Hultén 1968).

SCROPHULARIACEAE

Limosella aquatica L. G5S3 – ALASKA PENINSULA: rare in low shrub-graminoid meadow, Alagnak River, 15 m, 59°5.27'N 156°28.39'W, *A. Jansen & I. Pierce V143119*, 29 July 2002; rare in halophytic sedge meadow, Swikshak Lagoon, 1 m, 58°37.01'N 153°43.32'W, *A. Jansen, R. Lipkin, M. Carlson & I. Pierce V143131*, 3 July 2002. ALEUTIAN RANGE: abundant on sparsely vegetated sand bars near Surprise Lake, Aniakchak caldera 330 m, 56°55.93'N 158°7.22'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155996*, 13 July 2004; occasional on open sand in *Deschampsia* meadow, Aniakchak River, 4 m, 56°46.01'N 157°31.61'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156051*, 20 July 2004. *Limosella aquatica* is a widespread temperate species found in wet habitats across North America and Eurasia. It is known from 23 records from Kuskokwim Bay, the Alaska Range, Alaska Peninsula, Kodiak Archipelago, and the north Gulf coast (AKNHP 2011; UAM 2011; Figure 2PP). The collection from the Aniakchak River was found approximately 175 km west of Chirikof Island and 320 km south of the nearest known location on the Alaska Peninsula, at Swikshak Lagoon.

Pedicularis macrodonta Richardson G4QS3 – ALASKA RANGE: abundant in *Sphagnum* bog, vic. Ruth Glacier terminus, 62°39.099'N 150°18.616'W, 189 m, *C. Roland 3553, V127613*, 18 August 1998; rare in wet sedge meadow

around small pond, East Fork of Yentna River, 62°18.001'N 151°48.113'W, 73 m, *C. Roland & C. Parker 4275E, V133795*, 17 August 1999; scattered in saturated *Sphagnum*-rich bog, E. Fork of Yentna River, 62°18.854'N 151°49.494'W, 207 m, *C. Roland & A. Batten 4868, V141392*, 18 August 2000. *Pedicularis macrodonta* is a rare boreal North American species with a spotty distribution that stretches from Hudson Bay in the east to central Alaska (Hultén 1968). This species grows in wet meadows and muskeg, and our collections in Denali extend its range northward from stations in Hultén (1968) near Anchorage (Figure 2QQ).

VIOLACEAE

Viola selkirkii Pursh ex Goldie G5S3 – ALASKA PENINSULA: abundant under closed alder, Aniakchak Bay, 5 m, 56°45.86'N 157°29.34'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156130*, 24 July 2004; abundant in mesic herbaceous meadow, Garden Wall area, Aniakchak Caldera, 72 m, 56°46.93'N 158°3.70'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V155772*, 2 July 2004. ALASKA RANGE: occasional in shady, old poplar forest on river terrace, Yentna R., 259 m, 62°30.589'N 152°26.083'W, *C. Roland 4121A, V1338731*, July 1999; riparian vegetation; vic. of Granite Cr., 914 m, 62°40.080'N 151°03.090'W, *A. Larsen, M. Cook & M. Duffy NPS-01-342A, V139382*, 26 July 2001. *Viola selkirkii* is a circumpolar species with a boreal-montane distribution. It is known from 33 records from the Alaska Peninsula, Alaska Range, Chugach Mountains, Ogilvie Mountains, and the Coast Range (AKNHP 2011; UAM 2011; Figure 2RR). Our collection from Aniakchak Bay was found approximately 365 km south of the nearest known collection at the Newhalen River.

ZOSTERACEAE

Phyllospadix serrulatus Rupr. ex Asch. G4S2 – ALASKA PENINSULA: abundant in rocky tidepools, Aniakchak Bay, 0 m, 56°45.80'N 157°28.52'W, *R. Lipkin, M. Duffy, K. Bosworth & A. Miller V156077*, 21 July 2004. *Phyllospadix serrulatus* is a North American species occurring in the upper tidal to subtidal zone, typically attached to rocks; it is known from British Columbia and Alaska. It is known from 12 sites around the Gulf of Alaska (AKNHP 2011; UAM 2011; Figure 2SS). The Aniakchak collection was found approximately 200 km west of the nearest known unvouchered record from the Trinity Islands (AKNHP 2011).