

# Floristic survey of the Delta National Wild and Scenic River



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## Introduction

The Bureau of Land Management is entrusted with the management of recreational activities, energy and minerals, cultural resources, and habitat and wildlife on its lands. To meet the management objective of documenting the floristic resources and preserving the biological integrity of the region, BLM entered into an assistance agreement with AKNHP aimed at identifying and collecting rare and non-native plants and noting the location, distribution, and abundance of populations. The proposed work has been conducted in three phases. Phase I focused on diverse habitat types and areas proposed for construction of off-road vehicle trails in the Tangle Lakes Archeological District or TLAD ([Carlson 2007](#)), Phase II was directed at the Gulkana National Wild and Scenic River corridor ([Duffy and Cortés-Burns 2010](#)), while Phase III focused on the flora of the Delta National Wild and Scenic River (herein referred to as DNWSR), including the Tangle Lakes network and the first 29 miles of the Delta River. This report summarizes the main findings from the floristic inventories conducted by AKNHP in the last of the three phases.

## Objectives

The objective of the rare plant survey was to assess the occurrence of rare plant populations within the river corridor. Additional beneficial work associated with this agreement included recording new non-native plant populations that had not been recorded in 2008 ([Cortés-Burns et al. 2010](#)) and updating the Alaska-statewide rare plant (BIOTICS) and non-native plant (AKEPIC) databases. The overarching goal of this project was to increase knowledge on the flora of the Tangle Lakes Archeological District and two associated National Wild and Scenic Corridors. With the data gathered, resource managers can have a better understanding of the condition of public lands and will be better able to address rare plant population concerns for new management actions within the realm of NEPA.

## Physiography, climate and vegetation

The DNWSR is located in the Alaska Range in the southern interior of Alaska. It encompasses the Upper and Lower Tangle lakes, the Tangle River, and the upper Delta River. The DNWSR abuts the Gulkana National Wild and Scenic River in the south (Fig. 1). The Delta River flows out of Lower Tangle Lake, through the Alaska Range, and into the Tanana River.

Floristic elements are strongly influenced by the abiotic environment. Therefore, here we briefly summarize the climatic and geologic patterns of the region. The climate of the Alaska Range is characterized by long, cold, dry winters and short, cool to warm summers. The mean annual temperature is 25.2° F, with an average July temperature of 53.4° F and an average January temperature of -1.8° F. While there is only a mild temperature gradient between the southern and northern end of the river, there are marked differences in precipitation: average annual precipitation varies from 127 inches in Paxson to 55 inches in Big Delta (although in both cases, approximately 80 percent of the precipitation is snow). The growing period is similar to other subarctic locations, with a few growing degree days in mid-late May, increasing in June, climaxing in July and August, and tapering off in September to the beginning of October ([Western Region Climate Center](#)).

The region is a mosaic of rugged mountains, hills, valleys, with many lakes, streams, and rivers. Likewise, the geology is complex, including Precambrian metamorphic, as well as recent volcanic and alluvial deposits. Rich mineral deposits are clustered north of Eureka Creek and south of the Alaska Range spine. These deposits include unusual substrates, such as ultramafics (Bittenbender et al. 2007), which often host rare vascular plants, at least at lower latitudes (Kruckeberg 1987, Kruckeberg 1991). The Wrangellia composite terrane dominates most of the area; the terrane is a complex assembly of accreted material, primarily of oceanic affinity (Bittenbender et al. 2007). The Wrangellia terrane includes a mixture of basalts, carbonate layers, and mafic-ultramafic intrusives. Much of TLAD and the DNWSR corridor is Quaternary aged unconsolidated glacial deposits. Eskers, moraines, kettles and kames, and pitted outwash plains are common glacial features (Clark 2005). The diversity of landforms as well as acidic, basic, and ultramafic parent materials suggests a capacity for the region to harbor a high diversity of rare vascular plants.

The landscape, however, was largely overrun by glaciers during the Illinoian and Wisconsin Glaciations and therefore the flora is likely more depauperate than unglaciated regions to the north. Glaciers shaped mountains and valleys during maximum glaciations, ca. 150,000 ybp, and were discontinuous during the height of the Wisconsin, 20,000 ybp. Some ridges such as the Amphitheater Mountains and Whistle Ridge appear to have remained unglaciated during the Wisconsin (see Manley and Kaufman 2002).

The water of the Delta River is clear from its source at Tangle Lakes to the confluence with Eureka Creek, where it becomes silty, glacial, fast moving water with numerous braided channels. The dominant vegetation and surficial geology classes also change from the river's southern headwaters to its northern mouth. Tangle Lakes is a glaciated intermontane basin characterized by rolling hills and alpine tundra with numerous small, generally isolated kettle lakes and eskers, steep alluvial slopes, and rock cliffs. The area around the upper most reaches of DNWSR also includes steep alluvial slopes and rock cliffs, as well the highest elevation points in the study area (e.g. Sugarloaf Mountain, 5,347 feet). Shrub birch and willow scrub are the dominant vegetation types from the lakes to the canyon. After the canyon, the steep slopes give way to a corridor of flood plains, terraces, and mountain slopes, and the vegetation changes from alpine tundra to riparian scrub communities. Occasional spruce woodlands are interspersed with scrub on alluvial fans and mountain slopes adjacent to the river.



### **Land use and management objectives**

The BLM-managed Wild and Scenic portion of the Delta River is a popular recreation destination. The area provides excellent remote and backcountry recreational opportunities, including flat water and white water boating, camping, moose and caribou hunting, fishing, wildlife viewing, and hiking. It has limited commercial facilities along the Denali Highway and a BLM campground at Round Tangle Lake; the rest of the Wild and Scenic portion of this river only has primitive campgrounds dotting the riverbanks, with minimal signs of human presence in the lower reaches of the river (Krebs' cabin and a few ATV trails).

BLM is tasked with managing this portion of the river corridor so as to protect and enhance any identified outstandingly remarkable river values. However, it must also manage the area to allow its use by the public. It is also involved in decisions that relate to the development of mining operations in lands adjacent to the river (there are a number of prospect sites and mining claims for sale along the river at the mouths of Garret, Phelan, and Rainy Creeks). These often competing management goals necessitate that the area's rare and outstanding natural resources be inventoried and assessed on a regular basis. This report aims to partially fulfill that objective.

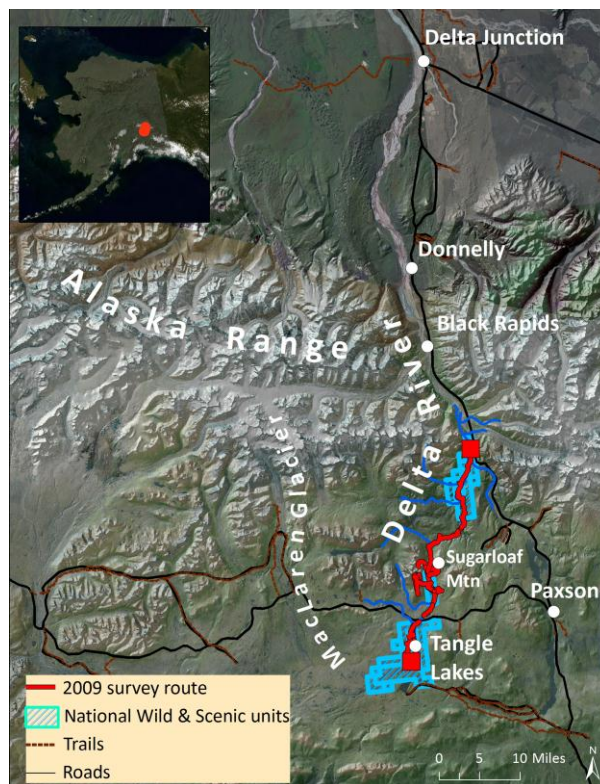


Figure 1. Overview of the study area

### **Previous botanical work in the Delta River watershed**

The plant collection history of the region was initiated by Alf Erling Porsild and his brother Robert Thorbjørn in 1926 from along the Delta River at Black Rapids. Danish born A. E. Porsild was a botanist who worked in Greenland prior to being hired by the Canadian government in 1926 to study reindeer/caribou grazing in arctic Canada and Alaska. He later was made the chief botanist of the National Museum of Canada. L. J. Palmer of the Bureau of Biological Survey, U.S. Department of Agriculture, made numerous collections in the Alaska Range north of TLAD in 1941. Upon the completion of the Denali Highway in 1953, significant collections were made by S. Galen Smith, and in the late 1970's Janice Dawe collected extensively from around Tangle Lakes and Paxson. Intermittent collecting has occurred since this time, primarily restricted to the immediate road corridor.

Of noteworthy importance are the collections made by Mike Duffy during the USDA-Natural Resources Conservation Service soil survey for the Delta River corridor (Clark 2005). This project resulted in the documentation of new populations for the following five species of conservation interest:

1. *Viola selkirkii* was found both on a forested slope north of Wildhorse Creek and in a riparian woodland downriver of Rainy Creek. This species is globally secure but used to be ranked as rare or uncommon in Alaska (G5? S3<sup>1</sup>, AKNHP 2008).
2. The mountain bladder fern, *Cystopteris montana*, was also collected in the vicinity of Rainy Creek. This species is ranked as secure globally (G5). It is imperiled in most of the western provinces in Canada and yet apparently secure but a cause for long-term concern (S4, AKNHP 2011<sup>2</sup>) in Alaska.
3. Mike Duffy also made a collection of the rare *Cryptogramma stelleri* (G5 S2S3, AKNHP 2008), a fern that grows in wet crevices in calcareous rocks.
4. *Carex deflexa* var. *deflexa* is a globally secure sedge that used to be considered critically imperiled in Alaska (G5 S1S2, AKNHP 2008). Although new collections have reduced the conservation concern for this species, it is still being tracked as rare by AKNHP (S3S4, AKNHP 2011). This sedge was collected at the confluence of Miller's Creek and the Delta River; although this site is located two miles downriver from our take out point, other populations might be found within the confines of our study area.
5. *Salix setchelliana* currently ranks as being apparently secure globally and statewide, but of long term conservation concern (G4 S4<sup>2</sup>). This willow is associated with moist to mesic, sandy to gravelly glacial riversides and glacial moraines. It was collected in three separate locations along the Delta River, all three downstream of Black Rapids [two collections by George Argus (1989) from Darling Creek and one from near Donnelly by Mike Duffy (1998)]. As with *Carex deflexa* var. *deflexa*, this species was included in our target list as it is likely to occur on gravel bars upstream from these known locations.

A similar soil survey from the Gulkana River corridor (Clark & Kautz 1999) reported three plants that were on the [AKNHP tracking list](#) (2008): *Cypripedium montanum* G4 S1, *Galium kamtschaticum* G5 S2, and *Melica subulata* G5 S1. However, these reports are likely erroneous and were not vouchered by herbarium specimens or photographs. As far as we know, these species are restricted to coastal areas in southern Alaska. It is therefore highly unlikely for them to occur in this region.

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<sup>1</sup> Ranks correspond to those assigned by AKNHP in 2008. "G" denotes the global rank for a species, while "S" denotes the statewide rank. Smaller rank values indicate greater conservation concern (for instance, a G3 or S3 species is more common or less threatened than a species ranked G1 or S1). See Appendix 3 for a description of each of the rank categories used by NatureServe and the Heritage Programs across North and South America.

<sup>2</sup> AKNHP is in the process of reviewing the taxonomy and rank of all vascular plant species that were considered of conservation concern in 2008 (see <http://aknhp.uaa.alaska.edu/botany/rare-plants-species-lists/>). As a result of this effort, a number of species that were being tracked as rare by AKNHP in 2009 have now been de-listed or down-graded with regard to their conservation status. The preliminary new ranks for each of the species target in the DNWSR survey are listed and discussed in greater detail in [Appendix 2](#).



## Rare vascular plant species targeted in 2009

Target species for the current survey included rare plant taxa on the BLM sensitive species list and on the AKNHP tracking list that are likely to occur in the DNWSR, as well as those previously reported or documented from the area (see Table 1 for target species names, conservation status, and likelihood of occurrence in the DNWSR). A list of species of conservation concern that are known to occur within 50 km of the DNWSR boundary and could possibly occur inside it are presented in [Appendix 2](#). To develop these lists, we downloaded collection data from ARCTOS (The University of Alaska Fairbanks herbarium database) and from BIOTICS (a database that specifically tracks rare plant and animal species and is maintained by AKNHP) and plotted their distribution (Fig. 2). We also looked for range extensions of more common plant species.

Many of the species in [Appendix 2](#) are known from higher elevations (e.g. *Aphragmus eschscholtzianus*, *Draba ruaxes*, *Arnica mollis*, and *Oxytropis huddelsonii*) and only could have occurred along the western edge of the DNWSR corridor near Landmark Gap. Some typically alpine species such as the pink poppy (*Papaver alboroseum*), can sometimes be found in isolated populations in naturally disturbed areas such as river bars.

The species we considered were most likely for us to encounter were those that might occur in wetlands and aquatic habitats (*Potamogeton subsibiricus*, *Carex laxa*), along early successional riparian gravel bars (*Salix setchelliana*), or in riparian scrub and herbaceous meadows (*Viola selkirkii*). Other habitats especially suitable for rare plants included seeps, alluvial forests and scrubs, black spruce muskegs, rocky outcrops, bluffs, and scree. Candidate species for these types of habitats include *Carex deflexa* var. *deflexa*, which grows in mesic meadows, forest openings and talus, *Stellaria alaskana*, which could be found both in the more alpine Tangle Lakes area and in scree slopes and meadows along the river corridor, *Arnica ovata*, in forests in the upper Delta River), and *Cryptogramma stelleri*, a fern that is restricted to wet crevices in calcareous rocks and has been recorded from the upper Delta growing in limestone cliff crevices in closed tall green alder-Richardson willow scrub.

**Table 1.** List of target species for the DNWSR survey\*

Family name	2011 accepted name with authority <sup>3</sup>	2008 SRANK	2011 SRANK	Tracked at present	nearest collection to DNWSR	likelihood of presence in the DNWSR
Adiantaceae	<i>Cryptogramma stelleri</i> (S.G. Gmel.) Prantl	S2S3	S4	No	1 mi	high
Asteraceae	<i>Arnica mollis</i> Hooker	S1	S2Q	Yes	50 km	high
Asteraceae	<i>Arnica ovata</i> Greene (previously, <i>Arnica x diversifolia</i> )	S1	S3S4Q	Yes	1 mi	medium
Brassicaceae	<i>Aphragmus eschscholtzianus</i> Andrzejowski ex de Candolle	S3	S3S4	Yes†*	5 mi	medium
Brassicaceae	<i>Draba porsildii</i> G. A. Mulligan	S1S2	S3Q	Yes†	50 km	low
Brassicaceae	<i>Draba ruaxes</i> Payson & H. St. John	S3	S4	No	5 mi	low
Caryophyllaceae	<i>Stellaria alaskana</i> Hultén	S3	S4	No†	1 mi	medium
Cyperaceae	<i>Carex atratifformis</i> Britton	S2	S3	Yes	50 km	low
Cyperaceae	<i>Carex deflexa</i> Hornemann var. <i>deflexa</i>	S1S2	S3	Yes	1 mi	high
Cyperaceae	<i>Carex laxa</i> Wahlenberg	S1S2	S2	Yes†	50 km	medium
Fabaceae	<i>Oxytropis huddelsonii</i> A.E. Porsild	S2S3	S4?	No‡	1 mi	high
Papaveraceae	<i>Papaver alboroseum</i> Hultén	S3	S4	No‡*	1 mi	high
Polemoniaceae	<i>Phlox hoodii</i> Richardson (previously <i>Phlox richardsonii</i> ssp. <i>richardsonii</i> )	S2?	S3	Yes†	50 km	medium
Potamogetonaceae	<i>Potamogeton subsibiricus</i> Hagstr.	S3	S4	No†	1 mi	high
Primulaceae	<i>Douglasia gormanii</i> Constance	S3	S4	No†	50 km	medium
Ranunculaceae	<i>Ranunculus grayi</i> Britton (previously <i>Ranunculus gelidus</i> var. <i>shumaginensis</i> )	S1	S4	No	5 mi	low
Salicaceae	<i>Salix setchelliana</i> C. R. Ball	S3	S4	No†	50 km	high
Violaceae	<i>Viola selkirkii</i> Pursh ex Goldie	S3	S4	No	1 mi	high

\* This list was developed by selecting all documented rare plant populations that occur within a 50km radius from the DNWSR

N.B.: Lighter font indicate species that are no longer included in AKNHP's rare vascular plant tracking list.

N.B.: A collection of the rare *Potentilla hippiana* in the area is now considered taxa misidentification of a more common species. See [Appendix 2](#) for more information.

(†) 2011 BLM "Watch List" species (species that warrant consideration during the development of NEPA compliance documents and permitting); (‡) 2011 BLM "Sensitive Species List, Tier 2" (species that are experiencing significant declines throughout their range with a high likelihood of being listed in the foreseeable future; includes species ranked by AKNHP as G1–G3 or T1–T3); (\*) 2009 USFS Sensitive Species List.

<sup>3</sup> AKNHP follows three sources of botanical expertise to track changes in the nomenclature and taxonomy of Alaska's flora. When available, we adhere to [Panarctic Flora Checklist](#) (Elven et al. 2010) treatments. If a species has not been revised by the latter, we follow [Flora of North America](#) (Flora North America Ed. Comm. 1993+) in combination with expert input from Alaskan botanists (primarily Dr. Dave Murray at the University of Alaska Fairbanks, Rob Lipkin and Mike Duffy).

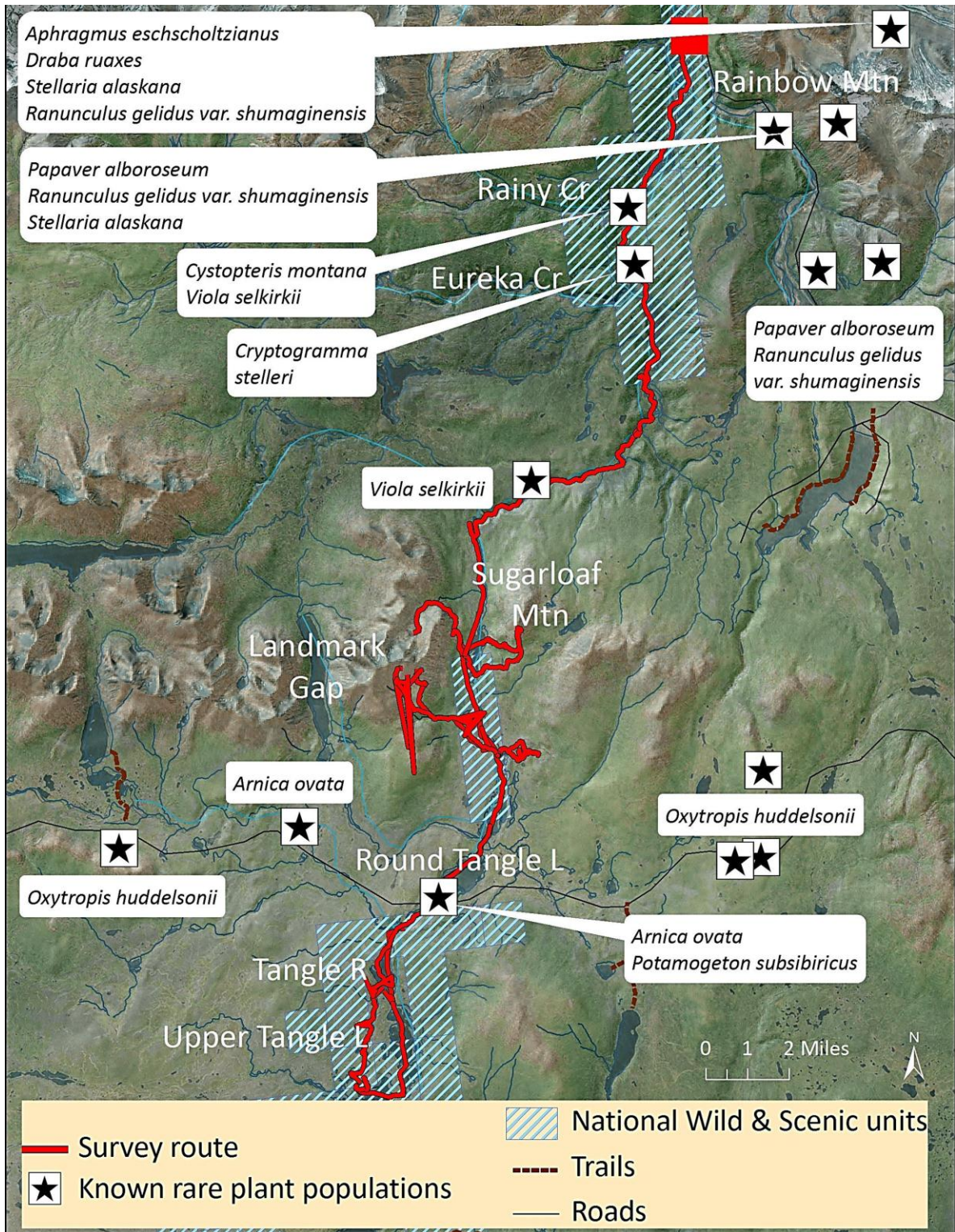


Figure 2. Locations of all rare plant populations recorded along the DNWSR corridor



## Methods

Access in the survey area was by foot, canoe, and raft. In order to attain the goal of determining the presence of species of conservation concern in the unit, we used the reconnaissance method of floristic survey. The reconnaissance method has been recommended as the best approach for plant inventories by the wide group of botanists at the Alaska Plant Inventory Working Group; the general methodology is also supported by Catling and Reznicek (2003). Further, the level of botanical training is well accepted to be the primary factor explaining the number of plant species of conservation concern recorded (see Ahrends et al. 2011). This methodology has been widely used in Alaska for other rare plant surveys in the state (Carlson and Lipkin 2003; Carlson *et al.* 2004a, b; Parker 2006a, b; Carlson 2007). The reconnaissance method includes identifying survey areas within landscape units via spatial analysis and uses the following criteria:

- Unique geological or geomorphologic features
- Unusual communities or habitats of biological concern
- Likely habitats that house expected species, as indicated by regional floras and other collections
- Under-represented plant communities in existing inventories
- Logistical feasibility (e.g., access, cost)
- Potential of certain types of sites to maximize species and communities encountered (e.g., ecotones, high environmental gradient areas)

We selected survey sites to represent a range in variability of landcover types, wetlands, plant associations, and the geographic scope of the upper reaches of the Delta River watershed (from Tangle Lakes to the take out point at mile 212.5 on the Richardson Highway). These sites were largely pinpointed during the course of the fieldwork, guided by geologic maps, coordinates from prior rare plant collections in the area, and on-the-site identification of habitats that looked suitable for rare plants. Survey sites were explored by covering the area on foot and by carefully examining all plant species. Species of interest or those not previously encountered were collected. Greater effort was spent in areas with high diversity and high environmental gradients. At each survey site (hereafter also referred to as site) we made a general survey of all the microhabitats present and inventoried all vascular plants in a roughly 30 x 30 m area. Notes were made on the landscape, vegetation communities, natural and human-derived disturbance (if any), and dominant plant species observed. GPS coordinates and photographs were taken. Each species of plant was identified to determine if notable species were present. If a rare plant was encountered, the site would have been described in more detail with soil/substrate, associated plant species and number of plants. Specimens of interest were collected when population size permitted, according to the protocol set forth by Murray and Parker (1990) and Parker and Murray (1992). All vouchers have been curated and catalogued at the University of Alaska Anchorage Herbarium (UAAH).

To maximize our chances of finding and recording any rare plant populations along the area, AKNHP developed a list of species of conservation concern that are likely to occur in the region by researching (1) BIOTICS, the rare species database that is administered by AKNHP, (2)

ARCTOS (University of Alaska Fairbanks Herbarium collections' database), (3) previous vegetation surveys that have been conducted in the area (Clark 2005).

The resulting list of species and associated habitats was then adjusted following discussions with Alaska botanists Robert Lipkin, who co-authored the [Alaska Rare Plant Field Guide](#) (Lipkin and Murray 1997) and managed the rare plant information in BIOTICS through 2008, and Mike Duffy, who has been the lead botanist on numerous rare plant field surveys in the area, including the Delta soil surveys (Clark 2005).

Surveys were carried out in two phases. Phase one was directed by AKNHP botanist Matthew Carlson and focused on the Tangle Lakes network. Phase two was conducted by AKNHP botanist Helen Cortés-Burns and ecologist Tina Boucher, and consisted on surveying the upper reaches of the Delta River (the 29 miles that are Wild and Scenic), from Round Lake to milepost 212.5 of the Richardson Highway. We used canoes as the primary means of transportation (Fig. 3).



Figure 3. The 2009 BLM river crew at the end of the portage trail

## Results and Discussion

We did not collect or observe any rare plants on the 2008 [AKNHP tracking list](#) or on the BLM sensitive species and watch lists within these boundaries. However, the regionally rare *Arnica mollis* was collected from the western side of the Maclaren River, just outside of the western TLAD boundary on a separate trip by an AKNHP botanist. Additionally, earlier collections indicate that four plant species of conservation concern are, or were, within a one mile buffer zone of the DNWSR (these are, from south to north: *Potamogeton subsibiricus*, *Arnica ovata*, *Viola selkirkii*, *Cryptogramma stelleri*, and, two miles downriver from the take out point, *Carex deflexa* var. *deflexa*<sup>4</sup>).

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<sup>4</sup> See Appendix 2 for recent nomenclatural and rank changes to these species.

A total of 34 sites were thoroughly surveyed in 2009 (Fig. 4). Fieldwork was conducted in two phases. Phase I focused on the upper reaches of the DNWSR (Tangle Lakes, Landmark Gap): a circular route including 11 survey sites from Upper Tangle Lake boat launch to Mud Lake and returning along the Tangle River was surveyed in one leg; we also surveyed the variety of wetland, upland, and alpine habitats adjacent to Round and Long Tangle Lakes in 2009, where 53 collections were made from nine sites. The sites we surveyed covered a wide range of habitat types. We collected aquatic plants from lakes, rivers, and ponds. Riparian shrub communities and wetlands were surveyed intensively. We surveyed mesic shrublands and open gravel barrens, as well as higher elevation forb-graminoid tundra and scree slopes. Last, we surveyed the small spruce and aspen stands.

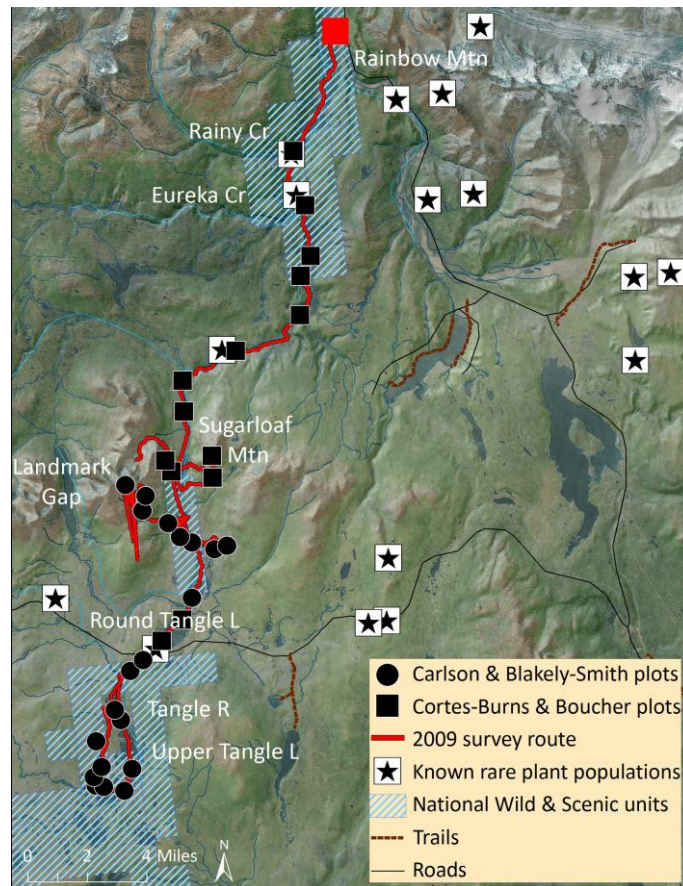


Figure 4. Sites surveyed by AKNHP botanists in 2009

The second phase of the trip consisted of surveying habitats likely to harbor rare plant species from Round Tangle Lake to the northern end of the Wild and Scenic portion of the river, at mile 212.5 of the Richardson Highway. We targeted habitats that looked likely to harbor the targeted rare plants (e.g. rocky, alpine tundra, talus slopes, alpine fens, riparian shrub and gravel bars), areas with unique geologies (e.g. limestone outcrops), and sites at which rare plants had previously been recorded (Mike Duffy's 1999 collection sites for *Viola selkirkii* and *Cryptogramma stelleri*; Galen Smith's 1953 collection locality for *Potamogeton subsibiricus*, see



Fig. 4). We sampled 15 sites and documented 110 plant records, 43 of which were curated and are now housed at UAAH.

In addition to looking for rare plant populations, we also inventoried stretches of riverbank that had been under water during the 2008 Delta River non-native plant surveys ([Cortés-Burns et al. 2010](#)). In all, 10 non-native plant populations were reported from a total of five sites in 2009 (Table 2), two of which (*Plantago major* at the end of the portage trail, and *Hordeum jubatum* at the take out point at mile 212.5 of the Richardson Highway) had not been detected in 2008<sup>5</sup>.

**Table 2.** Non-native plant infestations recorded in 2009.

Family	Scientific name	Specific locality	UAAH accession number
Poaceae	<i>Poa annua</i>	Upper Tangle Lake Portage	2609
Asteraceae	<i>Matricaria discoidea</i>	Upper Tangle Lake Portage	2585
Caryophyllaceae	<i>Stellaria media</i>	Upper Tangle boat launch	2646
Poaceae	<i>Poa annua</i>	Upper Tangle boat launch	2608
Plantaginaceae	<i>Plantago major</i>	Upper Tangle boat launch	2603
Asteraceae	<i>Matricaria discoidea</i>	Upper Tangle boat launch	2584
Asteraceae	<i>Taraxacum officinale</i>	Kreb's Cabin	not collected
Plantaginaceae	<i>Plantago major</i>	Kreb's Cabin	2602
Plantaginaceae	<i>Plantago major</i>	End of portage trail	not collected
Chenopodiaceae	<i>Chenopodium album</i>	abandoned boat, along ATV trail riverbank	not collected

A total of 130 collections were made during the 2009 DNWSR inventory, all of which are now housed at UAAH (and listed in [Appendix 4](#)). Most of these collections represent relatively common boreal species with widespread distributions. Below we briefly discuss the vascular plants associated with the Upper and Lower Tangle lakes network and the Delta River itself.

#### *Aquatic and wetland habitats*

Much of the DNWSR corridor is dominated by shallow lakes, rivers, ponds, and wetlands. We collected from nine wetland habitats that included lakes, kettle pond margins, drying ponds, wet sedge meadows, and saturated peatlands (Fig. 5). A total of 36 species were collected from these habitats and an additional 17 species were documented but not collected. We paid particular attention to species of *Potamogeton* and *Carex* in these habitats in an attempt to locate species of conservation concern. The species we collected, however, were relatively common throughout boreal Alaska. Interestingly, Sphagnum-tussock tundra peatlands were uncommon in DNWSR and restricted to small areas. While these habitats supported a number of species that were unique to the local areas, these species are common to acidic wet boreal tundra more broadly.

<sup>5</sup> The 2008 non-native-plant survey focused on surveying high-use areas, including boat ramps, trails connecting and surrounding the Upper Tangle lakes, and campsites both at Tangle Lakes and along the DNWSR. However, summer of 2008 was markedly rainy and cold and the water levels of the Delta at the time of the survey were very high. This prevented us from surveying many of the gravel bars and pullouts along the river corridor. This was further compounded by an unexpected snowfall that blanketed the area while we surveyed the lower reaches of the Wild and Scenic corridor.



Figure 5. Mud Lake (left), associated sedge marsh (center), and small peatland (right)

### **Lake margins and lowland barren habitats**

Many of the deeper lakes and rivers had large exposed gravel bars that supported native and non-native ruderal species (Fig. 6). [Appendix 4](#) shows the species collected and documented from these habitats. The non-native *Stellaria media*, *Plantago major*, *Matricaria discoidea*, and *Poa annua* were relatively common on compacted soils in the parking lot down to the water's edge along and in the ramp; *M. discoidea* and *P. annua* were also found at the Upper Tangle Lakes Portage. These non-native plants are not regarded as particularly threatening to the natural ecology of Alaska (see Carlson et al. 2008 for Invasiveness Ranks of these species) and they are very widespread in the state. Control of these species at roadsides and boat launches will require continued efforts as new seeds will continually be imported. The small non-native plant infestation found at the Upper Tangle Lakes Portage represents an incipient population in a more remote area that could result in additional populations that are difficult to find and control.

The great majority of the exposed mineral soils, however, were dominated by common native species such as *Agrostis scabra*, *Erigeron acris*, *Chamerion angustifolium*, *Chamerion latifolium*, and *Arabidopsis kamtschatica*.



Figure 6. Upper Tangle Lake boat launch, portage, southern-most Upper Tangle Lake beach, and Mud Lake moraine (left to right).

In Phase 2 we surveyed the Round Tangle Lake campground and boat ramp area, which had not been surveyed in 2008. The most noteworthy collections from this site are the ones we made of *Polygonum aviculare* ssp. *buxiforme* (growing in unvegetated gravel by the water pump and the boat ramp, Fig. 7). This subspecies has been found to intergrade with the non-native *P. aviculare* ssp. *aviculare*, which it strongly resembles, but is otherwise native to North America. We also made collections of amphibious *Ranunculus confervoides* and aquatic *Stuckenia pectinata* (previously *Potamogeton pectinatus*).



Figure 7. *Polygonum aviculare* ssp. *buxiforme* at Round Tangle Lake campground

### *Shrublands and woodlands*

Willow, birch, and alder shrublands were commonly encountered from lake and river margins to mid-elevations (Fig. 8). During Phase 1, we inventoried eight sites; 48 species were recorded from these habitats; 16 species were collected (Appendix 4). All species encountered in these habitats were common boreal taxa. One *Delphinium* collection had characteristics of both *D. glaucum* and *D. brachycentrum*. This plant may be simply a larger-flowered *D. glaucum*, with more densely pubescent pedicels and capsules than typical. Previous collections from Denali are suggestive of a hybrid (Hultén 1968) and these specimens at Tangle Lakes may represent some degree of introgression.



Figure 8. Willow forb-graminoid mosaic (Upper Tangle Lake); open aspen woodland (Tangle River); mid elevation alder-willow shrubland

During Phase 2 we surveyed two sites located in open, spruce forests (Krebs Cabin and a section of ATV trail). Although no noteworthy native plants were observed at these locations, we were able to better document populations of two weakly non-native species (*Plantago major* and *Taraxacum officinale*) that had been covered by snow during the 2008 survey ([Cortés-Burns et al. 2010](#)), as well as a single stem of *Chenopodium album* (another weakly invasive non-native plant) that was found growing in sand at the bottom of an abandoned boat (Fig. 9). The latter exemplifies the ease with which human traffic through the Delta River corridor can inadvertently result in the introduction of non-native plants into the area (*C. album* had not been recorded in the DNWSR prior to this).





Figure 9. ATV trail (left); *Chenopodium album* growing in an abandoned boat (right)

We also tried to relocate a previous population of *Viola selkirkii*, which had been documented at the top of a ridge, growing in alpine shrub tundra and interspersed white spruce trees (Fig. 10). However, once we were on the ridge the GPS seemed to indicate the collection might have been made one or two ridges further west, in an area that would have to be accessed by helicopter. Although we surveyed the area extensively, we did not find any *V. selkirkii* plants.



Figure 10. Approximate location of Mike Duffy's 1999 *Viola selkirkii* collection

### ***Upland tundra and alpine habitats***

Upland rocky outcrops, exposed mineral soils, and alpine habitats are restricted in the DNWSR, these habitats therefore were expected to represent an important component of the total vascular plant diversity. During Phase 1 we concentrated collection efforts on ultramafic outcrops east of Lower Tangle Lake and alpine slopes near Landmark Gap (Fig. 11). 40 taxa were documented, 23 of which were collected from these habitats (Appendix 4).



Figure 11. Dwarf shrub-forb alpine habitat near Landmark Gap; ultramafic outcrop; steep talus slope Landmark Gap (left to right)

The ultramafic rocky substrates in other regions often harbor numerous narrowly endemic taxa. These species have evolved tolerance to the generally toxic levels of magnesium and often nickel and are often poor competitors in other soil types. Areas that have recently been glaciated, however, apparently have not had the time necessary for species to evolve such soil toxicity tolerances (Kruckeberg 2002). The areas we surveyed followed this pattern of having, low species richness and having widespread species that are encountered in a diversity of rocky substrates.

The diversity of species in the alpine tundra, scree, and outcrops on the peak west of Lower Tangle Lake was likewise depauperate.



Figure 12. Talus lobe and alpine fen surveyed by Long Tangle Lake

During Phase 2 of the DNWSR survey we focused our efforts in Long Tangle lake area. We surveyed a talus lobe on river left, a spring depression and associated alpine fen at the top of the lobe (Fig. 12), as well as a variety of alpine habitats on our way to the summit of Sugarloaf Mountain (forb meadows, talus slopes, and rocky, alpine tundra) (Fig. 13). None of the rare plants that are often associated with these upland and alpine habitats (e.g. *Papaver alboroseum*, *Aphragmus eschscholtzianus*, *Draba ruaxes*, *Arnica mollis*, *Oxytropis huddelsonii*) were found. A total of 63 species were documented in this leg of the trip; 25 have been vouchered at the University of Alaska Anchorage herbarium (UAAH).



Figure 13. Sugarloaf Mountain survey: mesic forb meadow, *Taraxacum alaskanum* and rocky alpine tundra (left to right)

### ***Riparian forest/shrub habitats and associated gravel bars***

Three of the rare plants we were targeting have either been collected or are likely to be found in riparian habitats along the DNWSR corridor. *Cryptogramma stelleri* was recorded in limestone cliffs among riparian willow scrub in the lower section of the study area. A second population of *Viola selkirkii* was documented from the same area, and is often associated with riparian scrub and herbaceous meadows. *Salix setchelliana*, which has been found further north along the Delta, grows on gravel bars.

We made two stops in areas that seemed likely to harbor one or more of these species: one was in the open spruce forest that surrounds campsites 54-56, and another was selected using the coordinates provided in the *Viola selkirkii* and *Cryptogramma stelleri* specimens. Three voucher specimens were collected at the latter site (Fig. 14), but no rare plants were found, even though the habitat seemed very suitable for at least *Salix setchelliana*.



Figure 14. These gravel bars offer good potential habitat for rare *Salix setchelliana*

We also recorded *Hordeum jubatum*, a species of questionable nativity, at the take point at mile 212.5 on the Richardson Highway. This area was completely covered in snow in 2008 and had therefore not been adequately surveyed. No other non-natives were documented here



(neither in 2008 nor 2009), which highlights the need for proactive management to keep the entire DNWSR corridor (relatively) weed-free.

### ***Rocky outcrops and bluffs***

During Phase 2 we were especially interested in finding and surveying bluffs and limestone outcrops, as these often harbor a diversity of rare and interesting plants, including species such as *Cryptogramma stelleri*. We made a stop at the one limestone outcrop we saw, just opposite the mouth of Eureka Creek (Fig. 15). Nine collections were made, but none were rare or of conservation interest.



Figure 15. Many of Alaska's rare plants are calciphilous. Limestone outcrops like this one by Eureka Creek provide suitable habitat for these species

### ***Ancillary collections***

In September 2010, on a separate trip, AKNHP botanist Matthew Carlson collected a specimen in an alpine snowbed just west of the TLAD boundary near Maclaren Glacier of the rare species, *Arnica mollis* (Fig. 16). This is the same general area that Shacklette collected what he called *A. mollis* in 1967. The specimens we collected had few cauline leaves, tawny-colored pappus with amberlike deposits and fit the recent treatment of the genus in the Flora of North America. We sent a specimen to the University of Alaska Museum to compare to recently annotated sheets of *A. mollis*, where it was confirmed to be a reasonable match (C. Parker pers. comm.). It seems possible for this species to be found in similar habitats to the east in TLAD and DNSWR, such as between Seven Mile, Glacier, and Landmark Gap Lakes and alpine margins along the lower DNSWR.



Figure 16. Alpine snowbed habitat near MaLaren Glacier (left), *Arnica mollis* plant (right)

## Conclusions

Previous studies and collections in the Wild and Scenic River corridor indicate the presence of several rare species in DNWSR. While we did not document *Arnica ovata*, *Potamogeton subsibiricus*, *Cryptogramma stelleri*, *Salix setchelliana*, and *Viola selkirkii*, these taxa have been collected in DNWSR in the past. It is not clear if these populations are no-longer present or if they were overlooked, although we did revisit the locations given for the *Viola selkirkii*, *Potamogeton subsibiricus*, *Cryptogramma stelleri* and *Salix setchelliana* collections, as well as other sites that had suitable habitat for each one of the rare plant species targeted in this survey. We did not encounter any rare plants and no plants on the BLM sensitive species list were observed. We did record a new non-native plant species for the DNWSR area: *Chenopodium album*, a weakly invasive species, was found growing in the sandy bottom of an abandoned boat in the lower reaches of the Wild and Scenic section of the river. [Appendix 1](#) gives a review of species that are included in the 2011 provisional tracking list and are likely to occur in the DNWSR. [Appendix 2](#) provides a list of rare plants that have been collected within a 50 km buffer zone of the DNWSR, together with the 2011 provisional ranks and reasons for changes to their ranks.

We did identify a series of sites with suitable habitat for some of the area's species of conservation concern (alpine rocky tundra and talus slopes in the Tangle Lakes area, gravel bars and limestone rocky slopes in the lower reaches of the study area, etc.), and located one regionally rare taxon (*Arnica mollis*) just outside of TLAD and DNWSR. Additional work carried out in the area could reveal new rare plant populations.

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## Appendix 1. Rare plants that occur or are likely to occur in the DNWSR corridor.

### *Aphragmus eschscholtzianus* Andrzejowski ex de Candolle



Figure 17. *Aphragmus eschscholtzianus* and typical steep limestone scree slope habitat (Aniakchak Caldera).

Conservation status: AKNHP G3, S3. Updated rank of S4 is proposed. BLM watch listed.

Range:

This small, white-flowered mustard is endemic to Alaska, Yukon, and the Russian Far East (Chukotka). In Alaska, it has been documented from approximately 51 sites, mainly in the Aleutian and Alaska Ranges, but also from the Seward Peninsula and from one site in the Brooks Range (Fig. 18). It is the only North American representative of the genus, whose other six species are found in the Himalayas and Siberia.

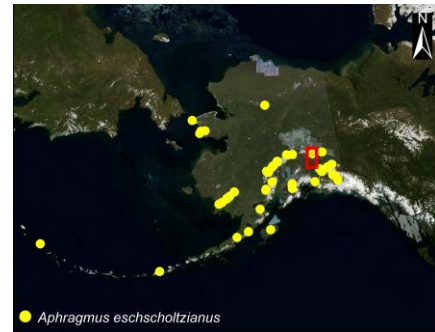


Figure 18. Known occurrences of *Aphragmus eschscholtzianus* in Alaska

Habitat:

In Alaska it is principally found on moist to wet alpine screes and cliffs saturated with snow melt and along streams in the alpine, typically on limestone (Fig. 17). Carolyn Parker of the University of Alaska Museum collected this species from Rainbow Ridge in a snowmelt area along the Richardson Highway to the north of Gulkana NWSR.

Local distribution:

Known from Rainbow Mountain (vic. Delta River).

Likely in survey area?

It is possible that this species could be found at high elevation sites in/near the survey area.

***Arnica mollis* Hooker**

Conservation status: AKNHP G5, S1. Updated rank of S2Q is proposed.

Range: Rocky Mountain states and provinces, extending north into Alaska, Yukon and the Northwest Territories. Recorded in Southeast Alaska (Stikine River), Kodiak, and from the Maclaren Glacier (vic. Delta River) (Fig. 19).

Habitat: Moist meadows and conifer forests, (gravelly sites along) stream banks, late snow-melt areas, montane to subalpine; 1000–4000 m; low forb meadow on terminal moraine.

Local distribution: There are now two collections of this yellow-flowered composite adjacent to the study area. H. T. Shacklette collected the species from 1967 near the Maclaren Glacier, northwest of the Gulkana NWSR and we collected the species in the same general location in 2010 in an alpine snowbed (Fig. 16).

Likely in survey area? Mountain meadows south of the Alaska Range spine and adjacent to the upper Delta River may provide suitable habitat for this plant. It is therefore likely that this species will be found within the survey area.



Figure 19. Known occurrences of *Arnica mollis* in Alaska

***Carex deflexa* var. *deflexa* Hornemann**

Conservation status: AKNHP G5, S1S2. Updated rank of S3 is proposed.

Range: This species can be found in arctic and boreal ecosystems throughout much of North America as well as Greenland. In Alaska, it has been documented in the boreal-interior and arctic regions. Although only six distinct populations have been documented in Alaska, this species' distribution is broad (Brooks Range, White Mountains, Alaska Range and Wrangells). This suggests that there is quite a lot of potential habitat, and/or that this species might be undercollected.

Habitat: Moist meadows and forest openings, gravelly sites along stream banks, late snow-melt areas, montane to subalpine; disturbed roadsides and adjacent cleared areas; 1000–4000 m.



Figure 20. Known occurrences of *Carex deflexa* var. *deflexa* in Alaska



Local distribution: Mike Duffy (1999) collected this species from an open white spruce river terrace in the upper reaches of the Delta River.

Likely in survey area? It is likely that this species will be found within the survey area.

***Carex laxa* Wahlenberg**

Conservation status: AKNHP G5?, S1S2. Updated rank of S2 is proposed. BLM watch listed.

Range: This sedge is globally common, but it is known from only 3 sites in eastern Alaska.

Habitat: Moist meadows and conifer forests, (gravelly sites along) stream banks, late snow-melt areas, montane to subalpine; 1000–4000 m; low forb meadow on terminal moraine.



Figure 21. Known occurrences of *Carex laxa* in Alaska

Local distribution: There is a report of this species for the area between Mile 172-174 along the Richardson Highway in the vicinity of Paxson Lake.

Habitat: pond edges and marshes, in wet graminoid or graminoid herbaceous meadows (for instance, surrounded by black spruce woodland, 25-50% cover of standing water)

Likely in survey area? It is possible for this species to show up in wet habitats adjacent to woodlands along the Delta NWSR. (N.B.: This species looks quite similar to *C. limosa*, *C. magellanica*, *C. pluriflora*, and *C. rariflora*, but differs in having a long, tubiform sheath of the upper bract.)

***Cryptogramma stelleri* (S.G. Gmelin) Prantl**

Conservation status: AKNHP G5, S2S3. Updated rank of S4 is proposed.

Range: This species has been reported from most of the northwestern and northeastern states and provinces in North America, as well as Greenland. Roughly 25 populations have been documented in Alaska, ranging from the Seward Peninsula and the Brooks Range, into the Yukon-Tanana uplands, across the Alaska Range and extending into western Alaska, where there is one record from the Ahklun Mountains.

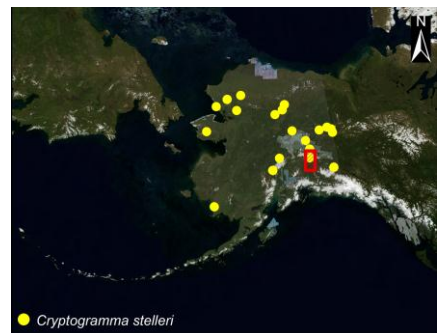


Figure 22. Known occurrences of *Cryptogramma stelleri* in Alaska

Habitat: Growing in moist to wet sites in calcareous rocky crevices on shaded outcrops above floodplain, along wet stream banks and in river terrace forests, especially under dense alder and spruce rush along the shores, in seepage areas on unstable scree and fellfields on ridgetops and slopes, on wet sites on limestone cliffs; 0—3000.

Local distribution: Mike Duffy recorded this species from limestone cliffs in willow-alder scrub along the upper Delta River.

Likely in survey area? It is likely that this species will be found on limestone cliffs or outcrops within the survey area.

***Oxytropis huddelsonii* A. E. Porsild**

Conservation status: AKNHP G3, S2S3. Updated rank of S4(?) is proposed. BLM Sensitive Species.

Range: This species’ distribution is restricted to northwest British Columbia, where it is infrequent, Alaska and the Yukon. A total of 34 populations have been documented in Alaska, primarily along the Alaska Range and in mountainous sites in eastern interior.

Habitat: This tufted, pinkish-purple flowered pea occurs in moist to dry ridgecrests, meadows, heath, tundra and solifluction slopes in the alpine zone

Local distribution: Multiple populations have been recorded near the study area. Of greatest relevance are the three collections that have been made off of the Denali Highway (at miles 13 and 30) and the one population documented on Rainbow Mountain.

Likely in survey area? It is likely that this species could be found in the southern end of the study area (vic. Tangle Lakes).



Figure 23. Known occurrences of *Oxytropis huddelsonii* in Alaska

***Phlox hoodii* Richardson (previously *Phlox richardsonii* ssp. *richardsonii*)**

Conservation status: AKNHP G5, S2. Updated rank of

S3 is proposed. BLM watch listed.

Range:

This species is distributed across the mid-western and western states and Canadian provinces, reaching Alaska and the Yukon in the north. Statewide, it has been documented from roughly 20 locations in mountainous areas of eastern arctic and interior Alaska.

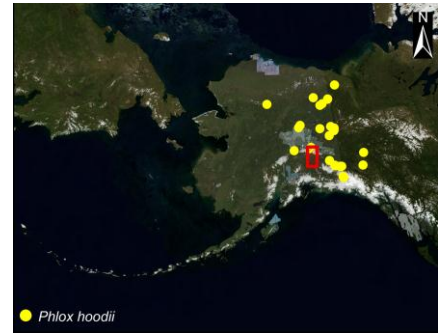


Figure 24. Known occurrences of *Phlox hoodii* in Alaska

Habitat:

This white flowered *Phlox* is generally restricted to south-facing bluffs and slopes.

Local distribution:

Two populations have been recorded in the area, approximately 15 miles downriver from the take out point for our survey (mile 212.5 Richardson Highway). One collection was made on a steep south-facing slope on Buffalo Hill and the other is from Donelly Dome.

Likely in survey area?

It is possible that this species will be found within the survey area.

**Other species of conservation interest**

We exclude *Papaver alboroseum*, *Potamogeton subsibiricus*, *Salix setchelliana* and *Viola selkirkii* from this section because they have proposed new statewide ranks of S4. However, because this designation means that they are apparently secure but cause for long term concern, we recommend that they be included on target lists for future floristic work in the area.

## Appendix 2. Species of conservation concern recorded within 50 km of the DNWSR corridor with notes on changes to their taxonomy or rank

Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Pteridaceae	<i>Cryptogramma stelleri</i> (S.G. Gmel.) Prantl	S2S3	<u>S4</u>	No		<b>Rank justification:</b> Additional collections of this species have increased the number of EOs for the state to 25, and broadened its range (over 100,000 square kilometers). Over 40 percent of the populations have good ecological integrity. Its conservation status is lowered to an S4, which removes it from the tracking list.	1 mi
Asteraceae	<i>Arnica mollis</i> Hooker	S1	S2Q	Yes		<b>Rank justification:</b> This species has a narrow distribution in Alaska, with two collections from the Alaska Range and one from southeast Alaska. Despite its small range and that there are only 3 EOs, the EOs are well dispersed within the range, have moderate to broad habitat requirements and has few to no threats. It has therefore been ranked as imperiled statewide (S2). Further studies are needed to better delineate this species (Carolyn Parker, pers. comms.); we therefore add a “questionable taxonomy” qualifier.	50 km
Asteraceae	<i>Arnica ovata</i> Greene (previously, <i>Arnica</i> x <i>diversifolia</i> )	S1	S3S4Q	Yes		<b>Rank justification:</b> This species grows in alpine and subalpine meadows, and has been recorded from naturally and human disturbed areas. There are 18 EOs in Alaska distributed across the Alaska Range and south-coastal mountain ranges. Its relatively broad distribution, the good ecological of at least 40 percent of its populations, and the fact that it is able to grow in a diversity of habitats, including roadside areas, have dropped this species from an S1 to an S3S4 rank. Further studies are needed to better delineate this species (Carolyn Parker, pers. comms.); we therefore add a “questionable taxonomy” qualifier.	1 mi

<sup>6</sup> AKNHP follows three sources of botanical expertise to track changes in the nomenclature and taxonomy of Alaska’s flora. First and foremost, we observe recommendations and changes made by Panarctic Flora Checklist authors. If a species has not been treated or revised by the latter, we follow Flora of North America treatments in combination with expert input from Alaskan botanists (primarily Dr. Dave Murray at the University of Alaska Fairbanks).

Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Brassicaceae	<i>Aphragmus eschscholtzianus</i> Andrzejowski ex de Candolle	S3	<u>S4</u>	No	BLM - Tier 4*, USFS	<b>Rank justification:</b> an increase in the number of known populations (up to 51 elements of occurrence, EOs), where more than 40 percent have good ecological integrity, and few to no impending threats reduces the conservation status of this little mustard of wet mossy seeps in alpine meadows and fellfields to an S4, which removes it from the tracking list.	5 mi
Brassicaceae	<i>Draba porsildii</i> G. A. Mulligan	S1S2	S3Q	Yes	BLM - Tier 4*	<b>Rank justification:</b> we re-assessed this species' rank using NatureServe's rank calculator. With a total of 7 EOs, primarily located in the Brooks and Alaska ranges, this alpine draba remains rare to the state. Some of the Alaska material may correspond to a different taxon; we therefore add a "questionable taxonomy" qualifier, pending identification by an expert.	50 km
Brassicaceae	<i>Draba ruaxes</i> Payson & H. St. John	S3	<u>S4</u>	No		<b>Rank justification:</b> This alpine draba has at least 71 EOS, most of them concentrated in the Alaska Range and Wrangells, but with at least some populations in the arctic (north to the White Mountains, Seward Peninsula, and the Brooks Range foothills). Most of its populations occur in areas of good ecological integrity. Despite its moderate habitat specificity, the increase in EOs and its broad distribution give it an S4 rank, which removes it from the tracking list.	5 mi
Caryophyllaceae	<i>Arenaria longipedunculata</i> Hultén	S3	S3S4	Yes	BLM - Tier 4*	<b>Rank justification:</b> this species' populations are broadly distributed across the Brooks and Alaska ranges. There are approximately 18 EOs with excellent to good ecological integrity and no impending threats. We increased rank by a half step because the range in Alaska is very large, including both the Brooks Range and the Alaska Range, but the number of occurrences and moderate habitat specificity (calcareous and limestone rocks and outcrops) does not support an S4 rank.	50 km

Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Caryophyllaceae	<i>Stellaria alaskana</i> Hultén	S3	<u>S4</u>	No	BLM - Tier 4*	<b>Rank justification:</b> With at least 50 EOs in the state, primarily concentrated in the Alaska Range, but also occurring in the Endicott Mountains (Brooks Range) and the Wrangells, the long-stalked starwort has been removed from the tracking list, but will be monitored by AKNHP.	1 mi
Cyperaceae	<i>Carex atratiformis</i> Britton	S2	S3	Yes		<b>Rank justification:</b> this sedge is mainly confined to eastern interior Alaska (with one record from southeast Alaska). There are 9 EOs recorded for the state. Given that this sedge is known to have few habitat requirements (and has been collected along roadsides), the taxon has been reclassified as an S3.	50 km
Cyperaceae	<i>Carex deflexa</i> Hornemann var. <i>deflexa</i>	S1S2	S3	Yes		<b>Rank justification:</b> Although there are only 6 EOs in Alaska, the relative broad distribution of these occurrences (Endicott Mountains, White Mountains, Alaska Range and the Wrangells) combined with the lack of habitat specificity and of impending threats result in a change in its rank, from an S1S2 to an S3.	1 mi
Cyperaceae	<i>Carex laxa</i> Wahlenberg	S1S2	S2	Yes	BLM - Tier 4*	<b>Rank justification:</b> this sedge is still considered very rare given its narrow distribution range and paucity of known populations (3 EOs). However, this species does not have specific habitat requirements (it grows around ponds and in fens and marshes, all of which are abundant in Alaska) and no impending threats have been identified for the existing populations. Therefore, the rank changes from S1S2 to S2.	50 km
Fabaceae	<i>Oxytropis huddelsonii</i> A.E. Porsild	S2S3	<u>S4?</u>	No	BLM - Tier 2†	<b>Rank justification:</b> the increase in range and total number of EOs (34 at present), combined with the overall good ecological integrity of more than 40 percent of its populations results in a change of rank from S2S3 to an S4 (with some uncertainty on the new rank). Although we do not consider it rare, AKNHP will continue to monitor this species.	1 mi



Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Fabaceae	<i>Oxytropis tananensis</i> Jurtz.	S2S3	<u>S4Q</u>	No	BLM - Tier 4*	<b>Rank justification:</b> The taxonomy of this species is highly questionable. It is likely that it will eventually be merged with <i>Oxytropis varians</i> . Furthermore, a revision of its distribution (previously known from eastern interior Alaska, but recently found in borderline arctic Alaska), and increase in the number of EOs (28) result in this entity being ranked as an S4 now. AKNHP will stop tracking it as rare, but will continue to gather information on new and existing populations, as well as on taxonomic and nomenclatural changes to this taxon.	50 km
Papaveraceae	<i>Papaver alboroseum</i> Hultén	S3	<u>S4</u>	No	BLM - Tier 2†, USFS	<b>Rank justification:</b> with over 45 EOs for the state (most in the Alaska Range, but also known from south coastal mountainous areas), and having few habitat requirements (it has been found in both naturally and anthropologically disturbed sites, including roadsides), this poppy is considered secure in the state for now, and will be removed from the AKNHP tracking list.	1 mi
Plantaginaceae	<i>Plantago major</i> ssp. <i>major</i> L. (previously <i>Plantago major</i> var. <i>pilgeri</i> )	S2S3	<u>Non-native</u>	No		<i>Plantago major</i> var. <i>pilgeri</i> is now considered a synonym of the adventive, non-native <i>P. major</i> ssp. <i>major</i> , and will therefore no longer be tracked	50 km
Polemoniaceae	<i>Phlox hoodii</i> Richardson (previously <i>Phlox richardsonii</i> ssp. <i>richardsonii</i> )	S2?	S3, now synonymous w <i>P. hoodii</i>	Yes	BLM - Tier 4*	<b>Rank justification:</b> this white flowered Phlox is generally restricted to south-facing bluffs and slopes. It has been collected from mountainous areas in the eastern arctic and eastern interior. Most populations occur in remote sites with good ecological integrity. In synonymizing <i>Phlox richardsonii</i> ssp. <i>richardsonii</i> with <i>P. hoodii</i> the number of EOs for the state increases to approximately 20. It is now ranked as rare to the state (S3).	50 km

Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Polemoniaceae	<i>Polemonium villosissimum</i> <sup>7</sup> (Hultén) D.F. Murray & Elven	Not listed	<u>S4</u>	No		<b>Rank justification:</b> This species was recently described as new to Alaska (Murray & Elven 2011). Because it has been collected from near the project area we ran it through the rank calculator. Although it is limited in its distribution to the Alaska Range, the Chugach and the Wrangell mountains, <i>Polemonium villosissimum</i> has a large number of EOs in Alaska (approx. 50), most of which are in areas with good ecological integrity, and is considered secure statewide.	100 km
Potamogetonaceae	<i>Potamogeton subsibiricus</i> Hagstr.	S3	<u>S4</u>	No	BLM - Tier 4*	There are over 25 EOs in the state, recorded from the arctic, interior, western and south-coastal Alaska. Given its current broad range, and the abundance of key habitat requirements in Alaska (shallow water in ponds and lakes) this species is no longer tracked as rare by AKNHP.	1 mi
Primulaceae	<i>Douglasia gormanii</i> Constance	S3	<u>S4</u>	No	BLM - Tier 4*	<b>Rank justification:</b> With over 70 EOs distributed in moist, rocky slopes in the alpine zone throughout the Alaska Range, and smaller mountainous areas in south-coastal and eastern-interior Alaska, this member of the primrose family is no longer tracked as rare by AKNHP.	50 km
Ranunculaceae	<i>Ranunculus grayi</i> Britton (previously <i>Ranunculus gelidus</i> var. <i>shumaginensis</i> )	S1	<u>S4</u>	No		<b>Rank justification:</b> This species is broadly distributed along hills and mountain ranges throughout AK (from the Brooks Range south to the Nulato Hills, Kuskwokim Mountains, present in the Aleutian and Alaska ranges, as well as in the Chugach and Wrangell mountains). With approximately 45 EOs, and more than half of these being in sites of good to excellent ecological integrity, this alpine buttercup that grows in moist meadows, gravelly seepage sites, scree and talus slopes has been reclassified as an S4. AKNHP will remove this species from the tracking list, but will continue to gather information on existing and new populations.	5 mi

<sup>7</sup> We assessed the rank and distribution of newly described *Polemonium villosissimum* just to make sure this was not a species that could occur in the Delta River watershed. Given that its newly calculated rank indicates it is secure in the state, it is not of conservation importance at this point.

Family name	2011 accepted name with authority <sup>6</sup>	2008 SRANK	2011 SRANK	Tracked at present	Other listings	Notes	nearest collection to DNWSR
Rosaceae	<i>Potentilla pennsylvanica</i> (previously <i>Potentilla hippiana</i> )	S1	<u>common</u>	No		The one record in Alaska for <i>P. hippiana</i> was a mis-identification. The record actually corresponded to <i>P. pennsylvanica</i> , which is common (S5).	50 km
Salicaceae	<i>Salix setchelliana</i> C. R. Ball	S3	<u>S4</u>	No	BLM - Tier 4*	<b>Rank justification:</b> This willow has now been recorded from a total of 50 unique sites (EOs), mainly along river gravel bars in south coastal and southeast Alaska. Although there are threats to this species, such as the advance of invasive <i>Melilotus alba</i> along glacial river bars, this species is more common than previously thought (S4), and is no longer tracked as rare by AKNHP.	50 km
Violaceae	<i>Viola selkirkii</i> Pursh ex Goldie	S3	<u>S4</u>	No		<b>Rank justification:</b> This violet has over 25 EOs that are broadly dispersed within its range (south-coastal to south central Alaska, extending to south-east and eastern-interior Alaska). More than 40 percent of the populations occur in areas with good to excellent ecological integrity, and this species has few key habitat requirements. Our new rank calculations change its conservation status to an S4, thus taking it off the tracking list.	1 mi
Woodsiaceae	<i>Cystopteris montana</i> (Lam.) Desv.		<u>common</u>	No		<b>Rank justification:</b> This species was not on the 2008 tracking list but had previously been considered of conservation value by some Alaskan botanists. A cursory overview of its distribution and number of EOs (at least 100), with many of these in areas with good ecological integrity, confirm that this species is common and secure, and should not be added to the tracking list.	1 mi

\*BLM Tier 4 species (“Watch list Species”) are not considered sensitive species, but warrant additional consideration during the development of NEPA compliance documents and permitting. These species have an increased probability of being added to future updates of the Alaska BLM sensitive species list as new information materializes. The Watch List include species with insufficient data on population or habitat trends, regionally adapted variations potentially important for overall conservation, or have potential threats that are poorly understood. The Watch List also includes rare species that do not occur with several kilometers of BLM managed land, although potential habitat may occur. BLM Sensitive Species designation may be warranted in the future for these species; therefore, appropriate inventory or research efforts should be emphasized.

† BLM Tier 2 species are Sensitive Species that are experiencing significant declines throughout their range with a high likelihood of being listed in the foreseeable future due to their rarity and/or significant endangerment factors (includes species ranked by AKNHP as G1–G3 or T1–T3).

### Appendix 3. Definitions of ranks used by NatureServe and AKNHP

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.
GNR:	Unranked--Global rank not yet assessed.
GU:	Unrankable.
GH:	Historical Occurrence.
GX:	Extinct.
HYB:	Hybrid.

Qualifiers:	
B:	Breeding status.
N:	Non-breeding status.
?:	Inexact.
Q:	Questionable taxonomy.

Species State Rankings	
S1:	Critically imperiled in state.
S2:	Imperiled in state.
S3:	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
SE:	Exotic--Some, or all, populations are introduced within state.
HYP:	Hybrid.
SSYN:	Synonym.

#### Appendix 4. List of specimens collected during the 2009 DNWSR survey, including UAAH vouchers

Date	Locality Name	Scientific name	UAAH #	Locality Remarks	Latitude	Longitude
07/23/2009	Long Tangle L.	<i>Saxifraga hirculus</i> ssp. <i>hirculus</i>	2641	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Gentianella propinqua</i> ssp. <i>propinqua</i>	2579	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Carex membranacea</i>	2542	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Carex saxatilis</i> ssp. <i>laxa</i>	2548	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Carex capillaris</i>	2538	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Deschampsia cespitosa</i>	2562	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Arctagrostis latifolia</i>	2517	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Carex scirpoidea</i> ssp. <i>scirpoidea</i>	2550	Margin of kettle pond, adjacent to shrub birch-willow and ericaceous shrublands; mesic humus over glacial till; N10 degree slope	63.093935	-145.936552
07/23/2009	Long Tangle L.	<i>Woodsia ilvensis</i>	2657	Rocky ultramafic outcrop; thin organic layer over sand, pebbles, and rock - ultramafic; 0-5 slope	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Packera cymbalaria</i>	2596	Thin organic layer over sand, pebbles, and rock - ultramafic	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Arnica griscomii</i> ssp. <i>frigida</i>	2521	Rocky ultramafic outcrop; thin organic layer over sand, pebbles, and rock - ultramafic; 0-5 slope	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Tofieldia pusilla</i>	2651	Rocky ultramafic outcrop; thin organic layer over sand, pebbles, and rock - ultramafic; 0-5 slope	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Potentilla gorodkovii</i>	2619	Thin organic layer over sand, pebbles, and rock - ultramafic	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Calamagrostis purpurascens</i> ssp. <i>purpurascens</i>	2529	Rocky ultramafic outcrop; thin organic layer over sand, pebbles, and rock - ultramafic; 0-5 slope	63.094887	-145.922833
07/23/2009	Long Tangle L.	<i>Parnassia palustris</i>	2597	Lake margin: willow-scrub, forb, graminoid mosaic; saturated thick organic layer and mud; 35 degree S facing slope	63.098403	-145.959645
07/23/2009	Long Tangle L.	<i>Eriophorum angustifolium</i> ssp. <i>angustifolium</i>	2570	Lake margin: willow-scrub, forb, graminoid mosaic; saturated thick organic layer and mud; 35 degree S facing slope	63.098403	-145.959645
07/23/2009	Long Tangle L.	<i>Gentiana glauca</i>	2577	Willow-scrub, forb, graminoid mosaic; eroding sandy moraine edge; 0-5 slope	63.098403	-145.959645
07/23/2009	Long Tangle L.	<i>Carex podocarpa</i>	2545	Willow-scrub, forb, graminoid mosaic; eroding sandy moraine edge; 0-5 slope	63.098403	-145.959645

Date	Locality Name	Scientific name	UAAH #	Locality Remarks	Latitude	Longitude
07/23/2009	Long Tangle L.	<i>Carex canescens</i> ssp. <i>canescens</i>	2537	Lake margin: willow-scrub, forb, graminoid mosaic; saturated thick organic layer and mud; 0-5 degree slope	63.098403	-145.959645
07/23/2009	Long Tangle L.	<i>Rorippa palustris</i>	2630	Drained pond; drying mud; 0-5 degree slope	63.101746	-145.971558
07/24/2009	Long Tangle L.	<i>Eriophorum scheuchzeri</i>	2571	Drained pond; drying mud; 0-5 degree slope	63.101746	-145.971558
07/24/2009	Long Tangle L.	<i>Carex saxatilis</i>	2549	Drained pond; drying mud	63.101746	-145.971558
07/24/2009	Long Tangle L.	<i>Carex lenticularis</i>	2540	Drained pond; drying mud	63.101746	-145.971558
07/24/2009	Long Tangle L.	<i>Mertensia paniculata</i> var. <i>paniculata</i>	2589	Tall shrub tundra; thick lichen-moss layer over glacial till; 0-5 slope	63.101746	-145.971558
07/24/2009	Long Tangle L.	<i>Delphinium x nutans</i>	2560	Willow-open spruce scrub, streamside; thick moist organic layer and moss over rocks; 5 degree S facing slope	63.109052	-145.982430
07/24/2009	Long Tangle L.	<i>Delphinium x nutans</i>	2561	Willow-open spruce scrub, streamside; thick moist organic layer and moss over rocks; 5 degree S facing slope	63.109052	-145.982430
07/24/2009	Long Tangle L.	<i>Micranthes porsildiana</i>	2591	Willow-open spruce scrub, streamside; thick moist organic layer and moss over rocks; 5 degree S facing slope	63.109052	-145.982430
07/24/2009	Landmark Gap Mtn.	<i>Campanula lasiocarpa</i> ssp. <i>lasiocarpa</i>	2533	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Castilleja caudata</i>	2551	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Salix polaris</i>	2635	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Veronica wormskjoldii</i> ssp. <i>alterniflora</i>	2655	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Arnica latifolia</i>	2522	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Arnica lessingii</i>	2524	Low ericaceous-shrub, graminoid-forb tundra; thick organic layer over large rocks and loamy soil; 40 degree SE facing slope	63.116654	-146.008301
07/24/2009	Landmark Gap Mtn.	<i>Saxifraga eschscholtzii</i>	2640	Barren alpine tundra; rocky gabbro outcrops, thin soils in cracks; 50-70 degree E facing slope	63.123570	-146.003008
07/24/2009	Landmark Gap Mtn.	<i>Carex rupestris</i>	2547	Barren alpine tundra; rocky gabbro outcrops, thin soils in cracks; 50-70 degree E facing slope	63.123570	-146.003008
07/24/2009	Landmark Gap Mtn.	<i>Minuartia macrocarpa</i>	2593	Barren alpine tundra; rocky gabbro outcrops, thin soils in cracks; 50-70 degree E facing slope	63.123570	-146.003008
07/24/2009	Landmark Gap Mtn.	<i>Festuca brevissima</i>	2574	Barren alpine tundra; rocky gabbro outcrops, thin soils in cracks; 50-70 degree E facing slope	63.123570	-146.003008
07/24/2009	Landmark Gap Mtn.	<i>Luzula arcuata</i>	2586	Barren alpine tundra; rocky gabbro outcrops, thin soils in cracks; 50-70 degree E facing slope	63.123570	-146.003008
07/24/2009	Landmark Gap Mtn.	<i>Claytonia sarmentosa</i>	2557	Barren talus slope, moist drainage; moist rocky gabbro outcrop and talus; 40 degree S facing slope	63.129944	-146.023242
07/24/2009	Landmark Gap Mtn.	<i>Carex lachenalii</i>	2539	Barren talus slope, moist drainage; moist rocky gabbro outcrop and talus; 40 degree S facing slope	63.129944	-146.023242

Date	Locality Name	Scientific name	UAAH #	Locality Remarks	Latitude	Longitude
07/24/2009	Landmark Gap Mtn.	<i>Micranthes porsildiana</i>	2590	Barren talus slope, moist drainage; moist rocky gabbro outcrop and talus; 40 degree S facing slope	63.129944	-146.023242
07/24/2009	Landmark Gap Mtn.	<i>Poa cf. arctica</i>	2610	Barren talus slope, moist drainage; moist rocky gabbro outcrop and talus; 40 degree S facing slope	63.129944	-146.023242
07/25/2009	Round Tangle L.	<i>Ranunculus flammula</i>	2628	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Epilobium palustre</i>	2568	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Stellaria crassifolia</i>	2645	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Luzula multiflora</i> ssp. <i>frigida</i>	2587	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Swertia perennis</i>	2649	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Caltha palustris</i>	2532	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Ranunculus trichophyllus</i>	2627	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Hippuris vulgaris</i>	2582	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Callitriche palustris</i>	2531	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Potamogeton praelongus</i>	2616	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Potamogeton gramineus</i>	2615	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Round Tangle L.	<i>Stuckenia cf. filiformis</i>	2647	Muddy lake margin; 25 cm fine mud over rocks	63.071845	-145.966814
07/25/2009	Upper Tangle L.	<i>Potamogeton praelongus</i>	2617	Lake bottom; 2m depth	63.040145	-146.041983
07/25/2009	Upper Tangle L. portage	<i>Angelica lucida</i>	2698	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Bistorta vivipara</i>	2527	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Eurybia sibirica</i>	2573	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Poa annua</i>	2609	Trail; compacted glacial till; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Matricaria discoidea</i>	2585	Trail; compacted glacial till; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Agrostis scabra</i>	2514	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Phleum alpinum</i> ssp. <i>alpinum</i>	2601	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Carex macloviana</i>	2541	Shrub birch-willow scrub and graminoid mosaic; loamy soil on moraine; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Elymus trachycaulus</i>	2566	Sandy lake margin; 10 degree slope	63.017157	-146.058332
07/25/2009	Upper Tangle L. portage	<i>Erigeron acris</i> ssp. <i>politus</i>	2569	Gravel-sandy lakeshore; 5-10 degree slope	62.992905	-146.052573
07/25/2009	Upper Tangle L. portage	<i>Astragalus alpinus</i>	2525	Gravel-sandy lakeshore; 5-10 degree slope	62.992905	-146.052573



Date	Locality Name	Scientific name	UAAH #	Locality Remarks	Latitude	Longitude
07/25/2009	Upper Tangle L. portage	<i>Arabidopsis kamchatica</i>	2699	Gravel-sandy lakeshore; associated with <i>Epilobium latifolium</i> , <i>Salix pulchra</i> , <i>Equisetum arvense</i> , <i>Calamagrostis canadensis</i>	62.992905	-146.052573
07/25/2009	Upper Tangle L. portage	<i>Potentilla norvegica</i> ssp. <i>hirsuta</i>	2622	Gravel-sandy lakeshore; 5-10 degree slope	62.992905	-146.052573
07/25/2009	Upper Tangle L. portage	<i>Juncus filiformis</i>	2583	Gravel-sandy lakeshore; 5-10 degree slope	62.992905	-146.052573
07/25/2009	Upper Tangle L. portage	<i>Carex bigelowii</i> ssp. <i>lugens</i>	2536	Gravel-sandy lakeshore; 5-10 degree slope	62.992905	-146.052573
07/25/2009	Mud Lake	<i>Oxycoccus palustris</i>	2595	Sphagnum-tussock tundra peatland; 0-5 degree slope	62.982965	-146.063343
07/25/2009	Mud Lake	<i>Eriophorum vaginatum</i> ssp. <i>vaginatum</i>	2572	Sphagnum-tussock tundra peatland; 0-5 degree slope	62.982965	-146.063343
07/25/2009	Mud Lake	<i>Rubus chamaemorus</i>	2631	Sphagnum-tussock tundra peatland; 0-5 degree slope	62.982965	-146.063343
07/25/2009	Mud Lake	<i>Polemonium acutiflorum</i>	2612	Sedge marsh; saturated organic layer; 0-5 degree slope	62.987035	-146.093243
07/25/2009	Mud Lake	<i>Comarum palustre</i>	2558	Sedge marsh; saturated organic layer; 0-5 degree slope	62.987035	-146.093243
07/25/2009	Mud Lake	<i>Chrysosplenium tetrandrum</i>	2555	Sedge marsh; saturated organic layer; 0-5 degree slope	62.987035	-146.093243
07/25/2009	Mud Lake	<i>Epilobium palustre</i>	2567	Sedge marsh; saturated organic layer; 0-5 degree slope	62.987035	-146.093243
07/25/2009	Mud Lake	<i>Stellaria borealis</i> ssp. <i>borealis</i>	2644	Sedge marsh; saturated organic layer; 0-5 degree slope	62.987035	-146.093243
07/26/2009	Mud Lake	<i>Poa glauca</i>	2611	Open gravelly moraine in willow-scrub mosaic; lichens, moss, thin soil over glacial till; west facing, 0-20 degree slope	62.985976	-146.085015
07/26/2009	Mud Lake	<i>Hierochloa alpina</i>	2581	Open gravelly moraine in willow-scrub mosaic; lichens, moss, thin soil over glacial till; west facing, 0-20 degree slope	62.985976	-146.085015
07/26/2009	Mud Lake	<i>Carex bigelowii</i> ssp. <i>lugens</i>	2535	Open gravelly moraine in willow-scrub mosaic; lichens, moss, thin soil over glacial till; west facing, 0-20 degree slope	62.985976	-146.085015
07/26/2009	Mud Lake	<i>Pedicularis labradorica</i>	2599	Open gravelly moraine in willow-scrub mosaic; lichens, moss, thin soil over glacial till; west facing, 0-20 degree slope	62.985976	-146.085015
07/26/2009	Mud Lake	<i>Salix pulchra</i>	2637	Open gravelly moraine in willow-scrub mosaic; lichens, moss, thin soil over glacial till; west facing, 0-20 degree slope	62.985976	-146.085015
07/26/2009	Mud Lake	<i>Myriophyllum sibiricum</i>	2594	Muddy lake bottom; thick fine mud; 0.25 depth	62.991123	-146.094103
07/26/2009	Mud Lake - Tangle R.	<i>Potamogeton zosteriformis</i>	2618	Muddy slow river bottom; thin mud over cobbles; 0.5m depth	62.995681	-146.084761
07/26/2009	Tangle R.	<i>Salix glauca</i>	2634	Open willow shrub birch scrub-dwarf ericaceous shrub mosaic; lichens, moss, soil over glacial till; S facing slope at 10-40 degrees	63.008377	-146.087220
07/26/2009	Upper Tangle L.	<i>Geum macrophyllum</i>	2580	Open shrub birch-willow scrub and forb-graminoid mosaic; thick moist organic layer; 0-5 degree slope	63.022331	-146.063528
07/26/2009	Upper Tangle L.	<i>Senecio lugens</i>	2643	Open shrub birch-willow scrub and forb-graminoid mosaic; thick moist organic layer; 0-5 degree slope	63.022331	-146.063528
07/26/2009	Upper Tangle L.	<i>Luzula parviflora</i>	2588	Open shrub birch-willow scrub and forb-graminoid mosaic; thick moist organic layer; 0-5 degree slope	63.022331	-146.063528

Date	Locality Name	Scientific name	UAAH #	Locality Remarks	Latitude	Longitude
07/26/2009	Upper Tangle L. boat launch	<i>Stellaria media</i>	2646	Roadside; compacted gravel; 0-10 degree slope	63.044740	-146.026938
07/26/2009	Upper Tangle L. boat launch	<i>Matricaria discoidea</i>	2584	Roadside; compacted gravel; 0-10 degree slope	63.044740	-146.026938
07/26/2009	Upper Tangle L. boat launch	<i>Poa annua</i>	2608	Roadside; compacted gravel; 0-10 degree slope	63.044740	-146.026938
07/26/2009	Upper Tangle L. boat launch	<i>Plantago major</i>	2603	Roadside; compacted gravel; 0-10 degree slope	63.044740	-146.026938
08/03/2009	Long Tangle L.	<i>Valeriana capitata</i>	2653	scree slope on river left opposite campsite	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Carex parryana</i>	2544	Spring in depression on top of talus lobe, surrounded by moss	63.139533	-145.977404
08/03/2009	Long Tangle L.	<i>Saxifraga hyperborea</i>	2642	talus lobe above the drainage area	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Cystopteris fragilis</i>	2559	talus lobe on river left; in alder willow dominated drainage among Salix pulchra and Betula glandulosa scrub	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Chrysosplenium tetrandrum</i>	2556	scree slope on river left opposite campsite; seep, in alder willow dominated drainage among Salix pulchra and Betula glandulosa scrub	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Rumex arcticus</i>	2632	scree slope on river left opposite campsite; seep, in alder willow dominated drainage among Salix pulchra and Betula glandulosa scrub	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Cardamine bellidifolia</i> ssp. <i>bellidifolia</i>	2534	talus lobe above the drainage area	63.133857	-145.972230
08/03/2009	Long Tangle L.	<i>Salix rotundifolia</i>	2638	talus lobe on river left; above the drainage area	63.133857	-145.972230
08/03/2009	Round Tangle L. boat ramp	<i>Ranunculus confervoides</i>	2624	low shrub tundra; dominant sps are S. bebbiana, S. pulchra, and B. nana	63.053108	-146.004401
08/03/2009	Round Tangle L. boat ramp	<i>Ranunculus confervoides</i>	2625	low shrub tundra; dominant sps are S. bebbiana, S. pulchra, and B. nana	63.053108	-146.004401
08/03/2009	Round Tangle L. boat ramp	<i>Stuckenia pectinata</i>	2648	low shrub tundra; dominant sps are S. bebbiana, S. pulchra, and B. nana	63.053108	-146.004401
08/03/2009	Round Tangle L. campground, by water pump at boat put in	<i>Polygonum aviculare</i> ssp. <i>buxiforme</i>	2614		63.053108	-146.004401
08/04/2009	Sugarloaf Mtn.	<i>Minuartia macrocarpa</i>	2592		63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Arnica lessingii</i>	2523	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Bistorta plumosa</i>	2526	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Castilleja caudata</i> s.l.	2553	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Castilleja caudata</i> s.l.	2554	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330

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08/04/2009	Sugarloaf Mtn.	<i>Gentiana glauca</i>	2576	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Pedicularis capitata</i>	2598	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Ranunculus eschscholtzii</i> var. <i>eschscholtzii</i>	2626	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Rhodiola integrifolia</i> ssp. <i>integrifolia</i>	2629	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Salix polaris</i>	2636	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Sanguisorba canadensis</i> ssp. <i>latifolia</i>	2639	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Taraxacum alaskanum</i>	2650	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Vahlodea atropurpurea</i>	2652	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Veronica wormskjoldii</i> ssp. <i>alterniflora</i>	2654	midway point, approaching from the SW side of the mountain, mesic forb meadow	63.128624	-145.929330
08/04/2009	Sugarloaf Mtn.	<i>Antennaria monocephala</i>	2516	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Carex microchaeta</i>	2543	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Carex podocarpa</i>	2546	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Castilleja caudata</i> s.l.	2552	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Potentilla hyparctica</i>	2621	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/04/2009	Sugarloaf Mtn.	<i>Sagina saginoides</i>	2633	Rocky talus on slope at Sugarloaf Mtn summit	63.139069	-145.927132
08/05/2009	Upper Delta R., at end of portage trail	<i>Poa annua</i>	2606	100-200 stems, collected some on cobble and sand (this infestation was submerged in 2008)	63.176995	-145.948684
08/05/2009	Upper Delta R., campsite 50	<i>Poa alpina</i>	2605	~500 stems at camp, ~100 stems on cobbly beach	63.188204	-145.888083
08/05/2009	Upper Delta R., campsite 54-56	<i>Galearis rotundifolia</i>	2575		63.201568	-145.814573
08/05/2009	Upper Delta R., campsite 54-56	<i>Gentianella propinqua</i>	2578	surveyed mixed spruce forest behind camp; found one vegetative stem, potentially <i>Poa annua</i> at nearby campsite 55	63.201568	-145.814573
08/06/2009	Upper Delta R.	<i>Androsace septentrionalis</i>	2515	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Arnica angustifolia</i>	2518	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Arnica angustifolia</i>	2519	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Arnica angustifolia</i>	2520	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Draba aurea</i>	2563	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Draba aurea</i>	2564	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Draba glabella</i>	2565	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396

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08/06/2009	Upper Delta R.	<i>Poa alpina</i>	2604	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Potentilla gorodkovii</i>	2620	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R.	<i>Woodsia glabella</i>	2656	Limestone outcrop, opposite braided mouth of Eureka Creek	63.254210	-145.794396
08/06/2009	Upper Delta R., Krebs' Cabin	<i>Phleum alpinum</i> ssp. <i>alpinum</i>	2600		63.220482	-145.808479
08/06/2009	Upper Delta R., Krebs' Cabin	<i>Plantago major</i>	2602		63.220482	-145.808479
08/06/2009	Upper Delta R., Krebs' Cabin	<i>Poa alpina</i>	2607		63.220482	-145.808479
08/06/2009	Upper Delta R., Rainy Creek	<i>Polygonum aviculare</i> ssp. <i>buxiforme</i>	2613		63.280993	-145.799766
08/06/2009	Upper Delta R., Rainy Creek	<i>Pyrola minor</i>	2623		63.280993	-145.799766
08/06/2009	Upper Delta R., Rainy Creek	<i>Braya humilis</i> ssp. <i>richardsonii</i>	2528	looked for <i>Salix setchelliana</i> and <i>Viola selkirkii</i> , as well as ferns <i>Cryptogramma</i> & <i>Cystopteris</i> -nothing found	63.280993	-145.799766