# TANGLE LAKES BUREAU OF LAND MANAGEMENT ARCHAEOLOGICAL DISTRICT RARE VASCULAR PLANT INVENTORY - 2006 TECHNICAL REPORT


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## ABSTRACT

In 2006 the Alaska Natural Heritage Program (AKNHP) conducted a vascular plant inventory of Tangle Lakes Archaeological District (TLAD) in accordance with an assistance agreement with the Bureau of Land Management, Glennallen Field Office (BLM). The objective of this project was to inventory and document the occurrence of rare plant species that occur on BLM-Glennallen District lands. This information is meant as a proactive step in the management of rare botanical resources on public lands. This first of three phases is concentrated on TLAD. Subsequent inventories will be focused on Gulkana Wild and Scenic River Corridor and the Delta Wild and Scenic River Corridor. AKNHP summarized previous vascular plant collections in the area and identified species of conservation concern that would possibly occur in TLAD. The 2006 inventory targeted diverse habitat types and areas proposed for construction of off-road vehicle trails. The AKNHP staff visited TLAD from 13 – 16 July and 1 – 4 August 2006 and sampled most habitats and TLAD areas. A total of 83 collections were made representing 78 vascular plant taxa. All the species encountered were relatively common to interior Alaska and the Alaska Range. Most rare plants in Alaska are apparently not effective disperses and the extensive recent (12,000 years ago) glaciation of the TLAD region makes the population establishment of these species unlikely. Areas, however, that were not wholly overridden and that possess greater diversity of surficial geology such as the Amphitheater Mountains to the south, may harbor rare plant species. Rare species that may be present, but were not detected are are described in this report. One introduced plant species was found in a remote trail.

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## EXECUTIVE SUMMARY

The Glennallen Field Office District of the Bureau of Land Management supported vascular plant inventories and data reviews to document the occurrence, distribution, and relative abundance of plants of conservation concern occurring in the Tangle Lakes Archaeological District. Future efforts will be focused on the Gulkana Wild and Scenic River Corridor and the Delta Wild and Scenic River Corridor. The inventory was developed to provide baseline information for future management of natural resources on BLM-managed lands. In 2006 the University of Alaska Anchorage (UAA), Alaska Natural Heritage Program (AKNHP) conducted field inventories in Tangle Lakes Archaeological District under Assistance Agreement Number LAA 08-001. The primary goal was to document the occurance and distribution of rare vascular plants and identify areas where plant species may be impacted by proposed off-road vehicle trails. The inventories targeted diverse habitat types and poorly sampled areas.

While in collection regions, we inventoried by hiking to as many habitat types and geographic areas as possible and collecting specimens that were considered significant. Access to collection sites was by foot or by off-road vehicles. At each collection site, data were gathered on site characteristics, including latitude and longitude, associated species, soil conditions, etc. Plants were then pressed and dried and catalogued at the Alaska Natural Heritage Program. Final taxonomic determinations and herbarium mounting of specimens were completed by Alaska Natural Heritage Program and the University of Alaska Fairbanks Museum staff.

A total of 83 specimens were collected, recorded, pressed, and curated by AKNHP in 2006. These collections represent 78 individual taxa. All the species we encountered were relatively common to interior Alaska and the Alaska Range. However, in the surrounding area a number of rare species have been collected. Rare species known from near TLAD include:

- *Aphragmus eschscholtzianus* (Alaska Natural Heritage Program Rank: G3-S3)
- *Arnica mollis* (G5-S1)
- *Carex laxa* (G5?-S1)
- *Douglasia gormanii* (G4-S3)
- *Draba porsildii* (G3G4-S1S2)
- *Draba ruaxes* (G3-S3)
- *Papaver alboroseum* (G3G4-S3)
- *Phlox richardsonii* ssp. *richardsonii* (G4T2T3Q-S2Q)
- *Potamogeton subsibiricus* (G3-S3)
- *Potentilla hippiana* (G5-S1)
- *Salix setchelliana* (G4-S3)
- *Viola selkirkii* (G5?-S3)

None of these species are listed by Alaska BLM as “Sensitive.” See Appendix II for definitions of Alaska Natural Heritage Program Ranks.

Despite only modest collection efforts in the Tangle Lakes area, the nature of the collections suggests that the diversity of vascular plants and of rare vascular plants is low. The majority of rare plants in Alaska are restricted to previously unglaciated

terrains and the extensive glaciation of the majority of TLAD region 12,000 years ago makes the population establishment of these species unlikely. The Amphitheater Mountains, however, were not wholly overridden and also appear to possess of more diverse surficial geology than the area to the south. One introduced plant species, *Rumex acetosella*, was found in a remote trail and it may represent a harbinger of future impacts from non-native species in the area.

*Key Words* –
Tangle Lakes Archaeological Distictc, inventory, vascular plants, rare plants, non-native plants

## INTRODUCTION

The Alaska Natural Heritage Program (AKNHP) conducted a vascular plant survey of the Tangle Lakes Archaeological District (TLAD), a 226,660 acre site on the southern side of the Alaska Range in in the Copper River Drainage managed by Alaska Bureau of Land Management (BLM), Glennallen District. TLAD is listed on the National Register of Historic Places due to its importance in early North American prehistory and it represents one of the densist concentrations of early subarctic archaeological sites. The BLM is entrusted with the management of these cultural resources as well as additional resource uses such as recreation, energy and minerals, and habitat and wildlife. To meet the management objective of documenting the floristic resources and preserving the biological integrity of the region, the AKNHP entered into an assistance agreement with BLM to collect and identify rare plants and note the locations, distribution and abundance of populations.

*Climate, Ecology, and Geomorphology*

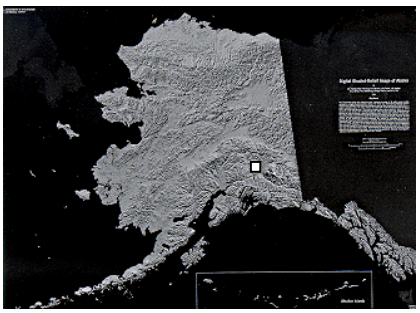


Figure 1. Location of the Tangle Lakes Archaeological District, represented by the white square.

Floristic elements are strongly influenced by the abiotic environment and here we briefly summarize climate and geologic patterns of the region. TLAD is located roughly 15 miles west of Paxson at 63º N, 146º W, along the foothills of the Alaska Range of interior Alaska (Fig. 1). The climate is cold, dry and windy and is largely buffered from precipitation by the Alaska Range to the north and the Chugach Mountains to the south. The mean annual temperature in Paxson is 25.2º F, with cool to warm summers (average July temperature is 53.4º F) and cold and dry winters (average January temperature is -1.8º F, Western Region Climate Center, 2007). Approximately 70% of Paxson's 20.2 inches of precipitation falls as rain; however, snow covers the ground for much of the year (and falls in all months except June, July, and August). The area receives 106 inches of snow on average. 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.

Tangle Lakes Archaeological District is a mosaic of rugged mountain ranges, extensive hills, broad valleys, lakes, and lowlands, with elevations ranging from 2,700 ft to over

4,700 ft at Whistle Ridge. Mount Hayes rises to over 14,000 ft 30 miles to the north of TLAD. The geology is complex, including Precambrian metamorphics 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 narrowly endemic vascular plants, at least at lower latitudes (Kruckeberg 1987, Kruckeberg 1991). The Wrangellia composite terrane dominates most of the TLAD; the terrane is a complex assembly of accreated material, primarily of oceanic affinity (Bittenbender et al. 2007). The Wrangellia terrane includes a mixture of basalts, carbonate layers, and mafic-ultramafic intrusives. Extensive Quaternary deposits were produced primarily by glaciers. Additionally, glaciers shaped mountains and valleys during maximum glaciation (ca. 150,000 ybp), but were not continuous 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, Fig. 2).

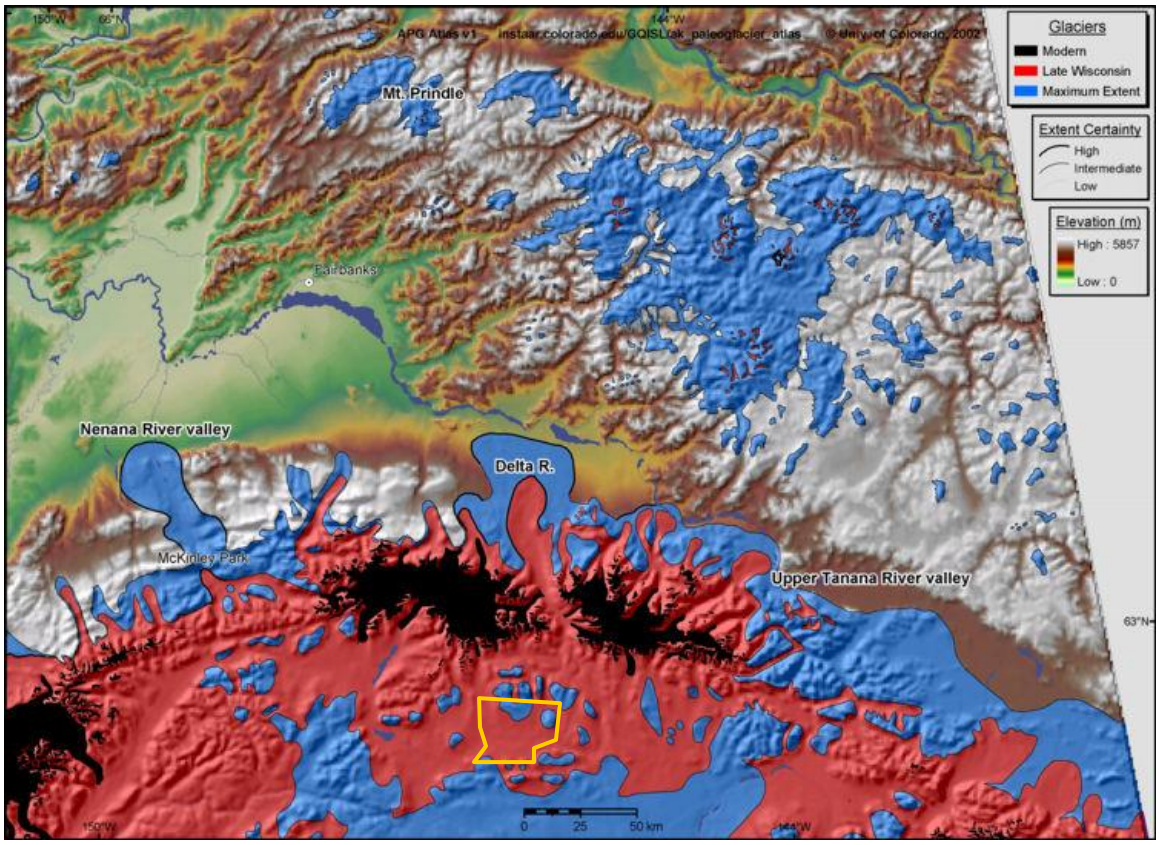
The TLAD is bordered by the Swede Lake Trail to the east, the Denali Highway in the north, the Maclaren River to the west, and the lower slopes of the Alphabet Hills in the south. The Delta National Wild and Scenic River and Gulkana National Wild River are found within TLAD and extend to the north and the west of TLAD. The region encompasses two low mountain ridges, Whistle Ridge, which runs east-west to an elevation of 4,700 ft and the peak west of Swede Lake, which is a broadly conical peak, rising to 4,660 ft. Glacial processes left a complex network of irregular lakes, ponds, and ridges of unsorted glacial till throughout the lowlands of TLAD. The Maclaren River drains the western side of TLAD, the Gulkana River drains the southern section, and the Tangle River to Delta River drains the central and northern portions of the region. Smaller streams and wetlands are scattered throughout TLAD.

Vegetation in TLAD is dominated by low and tall shrub tundra, composed primarily of shrub birch (*Betula glandulosa*) and willows (*Salix* spp.), which occupies floodplains and sideslopes. Dwarf shrub-ericaceous tundra is prevalent along ridges, eskers, and moraines, and dry graminoid meadows are scattered throughout the region. Nearly unvegetated talus slopes and fellfields are found on steep portions and the upper elevations of Whistle Ridge. Wet graminoid meadows are restricted to the margins of ponds, small lakes, and streams. White and black spruce woodlands are found in the extreme eastern portion of TLAD.

## METHODS

The Alaska Natural Heritage Program, University of Alaska Anchorage conducted a vascular plant survey of the Tangle Lakes Archaeological District (TLAD) in July and early August of 2006. Here we briefly review the sampling design and methods employed in this survey.

Figure 2. Glacial extents in interior Alaska (Manley and Kaufman 2002). The approximate boundary of TLAD is indicated as the yellow polygon.




## Collecting History of Tangle Lakes Archaeological District

The earliest collections of the area are from Alf Erling Porsild and his brother Robert Thorbjørn in 1926 along the Delta River at Black Rapids. A. E. Porsild was a Danish born botanist that worked in Greenland before being hired by the Canadian government in the same year (1926) to study reindeer/caribou grazing in arctic Canada and Alaska. Later he was the chief botanist of the National Museum of Canada. Numerous collections were made in the Alaska Range just north of TLAD in 1941 by L. J. Palmer of the Bureau of Biological Survey, U.S. Department of Agriculture, who was another prominent naturalist in the early to mid 1900's in Alaska, and oversaw the musk-oxen rearing and reintroduction to Alaska. S. Galen Smith made numerous collections in 1953 when the Denali Highway was completed. Extensive collections were made around Tangle Lakes and Paxson by Janice Dawe while she was conducting her graduate studies at University of Alaska Fairbanks in the late 1970's. Intermittent collecting has occurred since this time, primarily restricted to the immediate road corridor.

## Sampling Design

In order to attain the goal of determining the presence of the federally protected threatened and endangered species, state protected species, sensitive species and species of concern within TLAD, we used the reconnaissance method of floristic survey. After discussions with the BLM District Wildlife Biologist, we concentrated our surveys on proposed all-terrain vehicle (ATV) expansion routes and areas most likely to harbor rare plants. We surveyed the Swede Lake Trail and more intensively along proposed routes along the southern end of Swede Lake. Landmark Gap South Trail, Oscar Lake Trail and the proposed connecting routes between these systems were surveyed. Last, we surveyed a portion of Whistle Ridge (see Fig. 3). The reconnaissance method was recommended as the best approach for plant inventories in all Alaska national parks by the wide group of botanists at the Alaska Plant Inventory Working Group September 2000 meeting; the general methodology is also supported by Catling and Reznicek (2003). The reconnaissance method involves identifying survey areas within landscape units via spatial analysis using the following key criteria:

- regionally unique geological or geomorphologic features
- communities or habitats of biological concern
- likely habitats of 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)

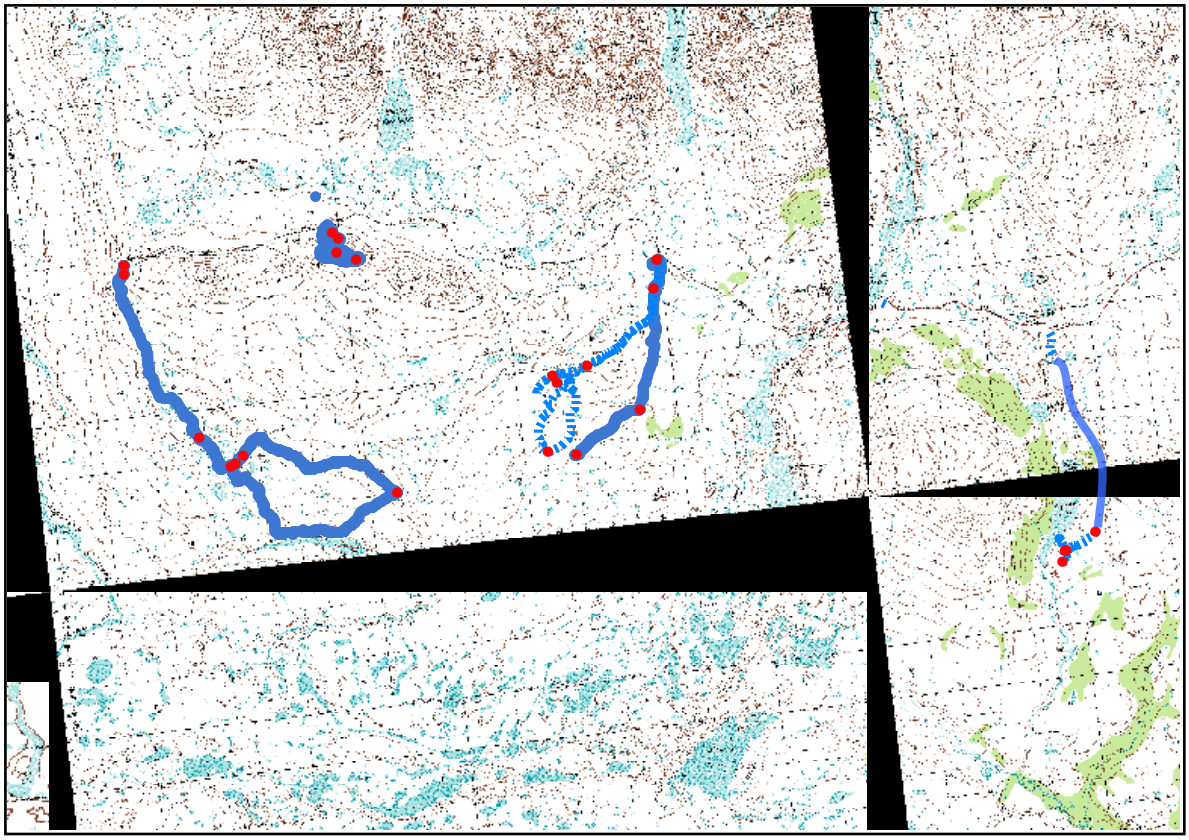
We selected collection sites to represent a range in variability of landcover types, wetlands, and plant associations within TLAD. Collection sites were explored by covering the region by foot or ATV and by carefully examining all plant species to identify those that were noteworthy. Greater time and effort was expended in high diversity and high environmental gradient areas.

This targeted, judgment-based approach is an efficient way to locate populations of species of special concern based on known habitat preferences and patterns of distribution. As surveys progressed, the list of species of special concern was refined, as well as knowledge of species' habitat and geography.

## Site Descriptions

After evaluating the locations of previous collections and giving consideration to logistic limitations, we decided to concentrate our sampling in four general collection regions. The primary collection region was the Swede Lake Trail, Landmark Gap South, Oscar Lake, and Whistle Ridge (Fig. 3). These regions allowed us to sample sites in a broad array of habitats and in areas most likely to be impacted by trail development.

Figure 3. Map of TLAD showing survey routes in the four collection regions investigated during the 2006 floristic inventory.



### *Swede Lake Proposed ATV Route*

Figure 4. Swede Lake proposed ATV route in an open white spruce and shrub woodland.

Swede Lake is located on the eastern boarder of TLAD at approximately 2,800 ft and the BLM is proposing to open a currently unimproved trail on to the southwest corner of the lake. We inventoried the approximately two mile region of the trail on 13 July 2006. The trail winds through a mesic, open, white spruce woodland, with small wetland intrusions and heavy shrub cover (Fig. 4). A well developed organic layer covers a mélange of mud, fines, and rocks. The area was dominated by shrub birch (*Betula glandulifera*), willows (*Salix alaxensis*, *S. barclayi,* and *S. pulchra*) and ericaceous shrubs (*Vaccinium uliginosum*, *V. vitis-idaea*, and *Ledum palustre*), with occasional white spruce (*Picea glauca*). In a number of locations small fens were found. Some of the fens were on relatively steep slopes and others were more poorly drained. The fen habitats were underlain by thick peaty soil and dominated by sedges and grasses (*Carex aquatilis, C. canescens, Eriophorum chamissonis*, *Arctophila fulva*, and *Calamagrostis canadensis*) with occasional forbs and borded with willows and sparse white spruce. Aquatic plants at the lake margin were too immature for identification.

### *Landmark Gap South Proposed ATV Route*

Landmark Gap South Trail is located in the center of TLAD at 3,100 to 3,500 ft in elevation. We inventoried the approximately five mile region of the proposed route on 14 July and 3 August 2006. The proposed trail bisects a number of habitats, primarily tall and low shrub scrublands (Fig. 5), mesic graminoid meadows and small ponds (Fig. 6). The scrub habitat was dominated by shrub birch (*Betula glandulifera*) with occasional willows (*S. pulchra*) and a thick carpet of crowberry (*Empetrum nigrum*) and lichens. Relatively common boreal forbes (e.g., *Cornus canadensis*, *Pedicularis labradoricus*, and *Lupinus arcticus*) were scattered along the trail margin and underneath the shrub canopy. The small ponds were shallow, with less than 1 m of water and had a rocky bottom with little aquatic vegetation. Narrow wetland corridors around the ponds and small creeks supported sedges (*Carex aquatilis* and *C. saxatilis*) and grasses (*Deschampsia caespitosa*, *Calamagrostis canadensis*, and *Vahlodia atropurpurea* in drier microsites) and were ringed by *Salix pulchra* and *Betula glandulifera*. In the lowlands between the knobs and ridges a mosaic of tussock grass-forb meadows weaves among the tall shrubs. In this habitat cloudberry is not uncommon, along with Altai fescue and goldenrod (*Rubus chamaemorus*, *Festuca altaica*, and *Solidago multiradiata*, respectively). We encountered a relatively recently drained pond that had a dry silty loam, moist soil and 30% bare ground. *Carex saxatilis*, *Juncus filiformis*, *Deschampsia caespitosa*, and *Ranunculus flammula* var. *filiformis* were the dominant species at this site.

Figure 5. Landmark Gap South Trail in tall shrub habitat.

Figure 6. Landmark Gap South Trail, pond margin, sedge-graminoid wetland habitat. Open mesic graminoid meadows are present behind the pond.

## *Oscar Lake Proposed ATV Route*

In the northwestern quadrat of TLAD is the well developed Oscar Lake Trail that terminates at the lake, approximately seven miles south from the trail's origin at the Denali Highway. The BLM proposes to construct a four mile trail running to the east and connecting with the western terminus of the Landmark Gap South Trail. We also surveyed an unimproved and restricted route extending from the Landmark Gap Trail southwest to the eastern end of Oscar Lake. The area we surveyed on 2 August 2006 ranged in elevation of 3,100 to nearly 4,000 ft in elevation. The habitats were very similar to those encountered along Landmark Gap South: primarily tall shrub habitats with smaller patches of forb-graminoid meadows (Fig. 7), wetlands, largely barren gravels or lichen dominated ridges, small ponds, and lakes (Fig. 8).

Figure 7. Oscar Lake Trail edge in an open forb-graminoid meadow.

Figure 8. Oscar Lake, low shrub dominated habitat with small graminoid meadows and wetlands interspersed.

### *Whistle Ridge*

We surveyed the central portion of Whistle Ridge on 1 August 2006. This area supported a barren alpine habitat absent from much of TLAD. The lower slopes of the ridge had deep organic soils with intermittently exposed dioritic rocks and supported a graminoid-dwarf shrub-willow mosaic (Fig. 9). The dominant species were the graminoids: *Carex micropoda*, *C. podocarpa*, *Arctagrostis latifolia*, *Festuca altaica*, the dwarf shrubs: *Cassiope tetragona*, *Empetrum nigrum*, *Spirea stevenii*, the willows: *Salix polaris*, *S. pulchra*, the forbs: *Artemisia arctica*, *Rhodiola integrifolia*, and *Castellija caudata*. Along the steep north-facing slope this mosaic transitioned into nearly unvegetated talus slopes (Fig. 10), with *Hierochloe alpina*, *Trisetum spicatum*, *Antennaria monocephala*, *Artemisia arctica*, and *Luzula arcuata*.

Figure 9. Whistle Ridge in a graminoid-dwarf shrub-willow mosaic.

Figure 10. Whistle Ridge, north-facing talus slope.

Fellfields occupied the top of Whistle Ridge in windblown and well-drained sites (Fig. 11). This open habitat had moderate slopes, with dioritic rock exposed from the turf and lichen substrate. The occasional ground squirrel mounds supported a localized lush graminoid community. *Dryas octopetala*, *Salix arctica*, *Festuca altaica*, *Hierochloe alpina*, and *Diapensia lapponica* were prevalent in the fellfields. On the eastern and southeastern slopes of Whistle Ridge, we encountered a number of snowbeds of mesic graminoid-forb tundra that were dominated by *Arctagrostis latifolia*, *Carex nigricans*, *Artemisia arctica*, and *Senecio lugens* (Fig. 12).

Figure 11. Whistle Ridge, groundsquirrel mound in fellfield habitat.

Figure 12. Whistle Ridge, mesic graminoid-forb tundra habitat.

## Field Methods

The field personnel consisted of two senior AKNHP botanists and project managers: Matt Carlson and Rob Lipkin. Access to the general collection areas was by ATV from the Denali Highway and by foot. Data and specimens were collected during two trips, one 13-16 July and one 1-4 August in the summer of 2006.

- Each site was mapped on an aerial photo or USGS topographic map and a georeferenced point was recorded using a handheld GPS. The routes surveyed were also mapped. Representative photos were taken of each site including the plant communities, unusual landforms, and notable plants.
- Each site was recorded and significant landforms and plant associations described. A species list was compiled for most sites, with notes on the abundance and habitat for all taxa collected, as well as other taxa present, where possible.
- Vouchers were collected and curated as discussed below.

Collections were made only if the population was large enough to support removal of individuals following the collecting protocols of Murray and Parker (1990) and Parker and Murray (1992).

## Vouchers and Curation

The following data were recorded with each vouchered specimen: date, unique collection number, latitude and longitude (NAD27, decimal degrees, taken from a handheld GPS unit); slope, aspect, elevation, topographic position, associated landforms, associated species, vegetation class, substrate, soil moisture, cover class or frequency class, notes on characters not preserved well, associated photo number, phenology, and ecological observations. Each voucher specimen is referenced to a specific geographic locality, generally less than 1,000 $m^2$ (10,764 $ft^2$), having a uniform habitat. Collections at each site ranged from single specimens to over twenty taxa.

The size of the population and area surveyed was included for species of concern. Population is defined here as a group of individuals of the same taxon that occupy the same locality separated from other such groups by more than 1 km (0.6 mile). This follows from the definition that NatureServe uses to define “element occurrences.”

The first set of collections is archived at the Herbarium of the University of Alaska Museum (ALA). Whenever there was sufficient material, a duplicate, set was deposited with the University of Alaska Anchorage herbarium.

Specimens were given conditional names in the field by AKNHP botanists. Plant collections were later sorted, examined and identified by AKNHP botanists and the collections were then sent to ALA where notable finds and difficult taxa were reviewed by the Museum staff.

## RESULTS AND DISCUSSION

Two botanists surveyed roughly 35 miles (approximately 250 acres inventoried) of the region. 78 species, representing 25 families were collected and have received identifications. The species are listed in Appendix I. Most species we observed are widespread and common in boreal Alaska. A relatively low diversity of substrate and habitat types was encountered, and the dominance of shrub birch habitats, which are notoriously species poor, are partially responsible for the low diversity. No rare plants present on the AKNHP tracking list, or BLM sensitive species list were collected in our surveys. One rare aquatic species, *Potamogeton subsibiricus* was previously collected from Delta National Wild and Scenic Corridor in Tangle Lakes, however. This species is considered rare globally and within the state (AKNHP 2007), but it is not considered a BLM Sensitive Species. An additional twelve species that are rare in the state (S3) to critically imperiled in the state (S1), but more common globally (G5 to G3) are know from the surrounding regions and it is possible they are present, but undetected in TLAD. These are briefly described here.

### Species of Conservation Concern in the Tangle Lakes Basin and Delta River Corridor

*Aphragmus eschscholtzianus* (G3-S3)
This is a small, white-flowered mustard that is endemic to Alaska and Yukon, primarily in the Aleutian and Alaska Ranges. It is known from approximately 40 sites and typically populations are not large. 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. 13). Although it is nowhere common, this species has been found at an increasing number of scattered sites in alpine areas within its range. This species is the only North American representative of the genus, whose other six species are found in the Himalayas and Siberia. Carolyn Parker of the University of Alaska Museum collected this species from Rainbow Ridge in a snowmelt area along the Richardson Highway to the northeast of TLAD. It is possible that this species may be present in similar habitats on Whistle Ridge, the peak west of Swede Lake and more likely along the steep slopes adjacent to the Delta National Wild and Scenic River.

Figure 13. *Aphragmus eschscholtzianus* and typical steep limestone scree slope habitat (Aniakchak Caldera).

*Arnica mollis* (G5-S1)
There is only a single collection of this yellow-flowered composite in Alaska, which is a collection of H. T. Shacklette from 1967 near the Maclaren Glacier, just north of TLAD (see Hultén 1968). This species of *Arnica* is quite common in the Rocky Mountains to the south. It is difficult to predict where this taxon may occur in region, but a likely area to expect it is along the along mountain meadows south of the Alaska Range spine and adjacent to the upper Delta River.

*Carex laxa* (G5?-S1)
This sedge is globally common, but it is known from only a handful of sites in Alaska. 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. There is a report of this species for the Mile 172-174 along the Richardson Highway in the vicinity of Paxson Lake. It is possible for this species to show up in wet habitats adjacent to woodlands in the southeastern portion of TLAD.

*Douglasia gormanii* (G4-S3)
This species' range is restricted to interior Alaska and the Yukon, primarily north of the Alaska Range, but it is not particularly rare. Alan Batten, Janice Dawe, and Dave Murray collected this species along Bear Creek on the Richardson Highway in a dryas-sedge-meadow and it is also known northwest of TLAD in high elevation sites of the Alaska Range (UAM 2007). It is possible that it may be present at higher elevations in TLAD.

*Draba porsildii* (G3G4-S1S2)
This is a fairly widely distributed mustard that is known from a few scattered sites in the mountains of central Alaska and Yukon. Alan Batten and Janice Dawe collected this species on unstable shaley scree at Darling Creek off of the Delta River.

*Draba ruaxes* (G3-S3)
The distribution of *Draba ruaxes* is concentrated in the Alaska Range to the Wrangell Mountains in Yukon with a number of outlying collections in the Tanana Uplands, Chugach Mountains, and on the Seward Peninsula. S. Galen Smith collected this species along Rainbow Mountain in 1953 and 1955 and it is possible for it to be found in the mountains to the southwest in TLAD.

*Papaver alboroseum* (G3G4-S3)
This is a striking light orange-pink poppy that ranges from Kamtschatka through the Aleutian and Alaska Ranges. It is found primarily on eroding alpine screes especially near glaciers. Carolyn Parker collected this species along a rocky stream bed and a south-facing dirt bank on Rainbow Ridge.

*Phlox richardsonii* ssp. *richardsonii* (G4T2T3Q-S2Q)
There is a report of a taxonomically questionable subspecies of *Phlox richardsonii* from Donnelly Dome, northeast of TLAD, in the AKNHP rare plant database. It is most likely that this taxon is synonymous with *Phlox hoddii* (R. Lipkin pers. comm.). This plant is known from approximately ten locations in east-central Alaska from dry mountain slopes and is also more abundant in the Northwest Territories.

*Potamogeton subsibiricus* (G3-S3)

This rare pondweed was collected from Tangle Lakes in 0.6 m water from a stoney bottom in mid August of 1953 by S. Galen Smith. This species is known mostly from Alaska and adjacent Yukon, but a few sites are also from Siberia and from Hudson Bay, Canada. It is moderately rare in the state, with about 15 known sites. This species has a combination of traits that distinguishes it from other *Potamogeton* species: it lacks floating leaves, the submerged leaves are linear, 1.5-2 mm wide, and 9-17 nerved, it has stipules free from the leaf, and it has a nearly round stem.

*Potentilla hippiana* (G5-S1, Summit to McCarty)
Along the Richardson near Summit (63 10' to 64 10'N. -145 40'W) at 2,000 to 3,000 ft elevation, Porsild made the only collection of *Potentilla hippiana* in the state (Porsild, 1939). This species is widespread in the Canadian and American prairies to the southeast. Despite numerous botanists collecting along the Richardson Highway, this species has not been collected again and it is not likely that it would be found in TLAD.

*Salix setchelliana* (G4-S3)
*Salix setchelliana* is a small willow with fleshy, reddish-margined leaves that is endemic to Alaska and Yukon and is found on sandbars and gravel bars along glacial rivers. A collection of this willow is recorded for the Delta Creek Campground along the Richardson Highway to the north of TLAD. It is possible that this species may be located along the Maclaren River and along the upper stretches of the Delta River in the National Wild and Scenic River corridor.

*Viola selkirkii* (G5?-S3)
This violet has populations scattered throughout the northern hemisphere, but it seems to be moderately rare in the state, with about 20 known locations from Juneau to Denali and the Tikchik Lakes. Two collections of the violet were made along the upper Delta River in mid June of 1999 in willow scrub habitats. One collection is from just below the confluence with Wildhorse Creek and the other is at the Rainy Creek-Delta River confluence. Both of these collections appear to be northeast of the Delta National Wild and Scenic River, but is is possible that *Viola selkirkii* will be found in TLAD.

## Non-Native Species of Conservation Concern in TLAD

We collected *Rumex acetosella* (sheep sorrel) a problematic non-native species in a relatively remote portion of the district along the proposed ATV Oscar Lake route, at 63.02891˚N and 146.37910˚W (Fig. 14).

Figure 14. Location of the non-native *Rumex acetosella* along the Oscar Lake Trail.

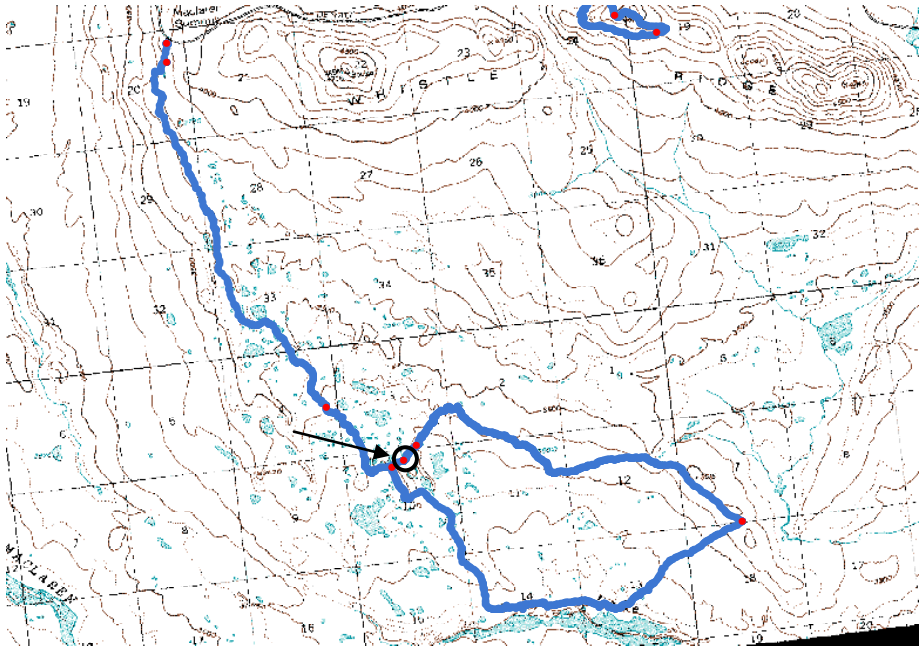


Figure 15. Habitat of the non-native *Rumex acetosella*. The plants are visible as the short red herbaceous plants in the foreground.

The site is a tall knob at the terminus of a closed trail. The top of the knob appears to to be used as a camping and hunting lookout, and is an open disturbed area surrounded by shrub birch (Fig. 15). We estimated roughly 100 plants were present. This species is widespread across Alaska in disturbed mineral soils and is one of the non-native plants that are invading more remote sites, such as alpine trails in the Kenai Mountains. *Rumex acetosella* is ranked as weakly to moderately invasive (51 out of 100 possible points) by the Alaska Natural Heritage Program (see http://akweeds.uaa.alaska.edu/), because there is little documented impacts to ecosystem function or community composition, but this species does have many characteristics of highly weedy and difficult to control species.

In general the Denali Highway is largely free of non-native species. Only in the most developed areas are the weakly invasive, but ubiquitous *Poa annua*, *Plantago major*, and *Taraxacum officinale* ssp. *officinale*.

The presence of non-native plants established in relatively remote areas of TLAD does indicate that this may become a larger issue for the BLM, especially if ATV or horse-packing use increases. ATVs that are previously used in more developed areas such as Anchorage, Fairbanks, and Mat-Su areas are likely to harbor numerous weed seeds that may be deposited in TLAD. Additionally, locating and controlling weed populations in remote areas will be difficult and expensive. We recommend that the *Rumex acetosella* population is completely removed – hand pulling for a few years should be successful in exhausting the seedbank in this small population. Additionally, we suggest that the BLM encourage or require ATV users to clean their off-road vehicles before use on BLM lands.

## CONCLUSIONS

We did not locate any Federal, State or BLM-listed rare or sensitive plant species in our 2006 surveys of TLAD. In general, the flora was not particularly diverse and while our surveys were only able to cover a small portion of TLAD, it does not seem likely that BLM-listed sensitive plants will be found within the TLAD boundaries and especially near the proposed ATV routes. One non-native plant population was located in a remote area

and we recommend that this population is destroyed and that the BLM consider measures to reduce the risk of future non-native plant introductions.

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# APPENDIX I – LIST OF VASCULAR PLANTS COLLECTED FROM TLAD IN 2006

| Coll Num | Species | Family | Specific locality | Lat_dd | Lon_dd | Elev (ft) | Habitat |
|---|---|---|---|---|---|---|---|
| 2006-196 | *Aconitum delphinilifolium* | Ranunculaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-251 | *Agrostis scabra* | Poaceae | Osar Lake Trail, hill, ATV pullout | 63.02891 | -146.379 | 3371 | Shrub birch tundra |
| 2006-170 | *Antennaria alpina* | Asteraceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-201 | *Antennaria monocephala* | Asteraceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-227 | *Arctagrostis latifolia* | Poaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-175 | *Arctophila fulva* | Poaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-257 | *Arnica latifolia* | Asteraceae | Maclaren Summit - Oscar Trail | 63.0864 | -146.433 | 3467 | Mesic forb-graminoid meadow |
| 2006-223 | *Arnica lessingii* | Asteraceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-171 | *Artemisia arctica* | Asteraceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-250 | *Calamagrostis lapponica* | Poaceae | Osar Lake Trail, hill, ATV pullout | 63.02891 | -146.379 | 3371 | Shrub birch tundra |
| 2006-206 | *Campanula lasiocarpa* | Campanulaceae | Valley between Oscar Lake and Landmark Gap South Trail | 63.02252 | -146.189 | 3261 | Mosaic of forb graminoid meadows and open Salix pulchra shrublands |
| 2006-240 | *Cardamine bellidifolia* | Brassicaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-174 | *Carex aquatilis* | Cyperaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-166 | *Carex canescens* | Cyperaceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-173 | *Carex canescens* | Cyperaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-228 | *Carex lachenalii* | Cyperaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-235 | *Carex lachenalii* | Cyperaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-190 | *Carex microchaeta ssp. nesophila* | Cyperaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-230 | *Carex micropoda* | Cyperaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | | Snowbed, in moist talus, dwarf shrub graminoid tundra |
| 2006-245 | *Carex micropoda* | Cyperaceae | Whistle Ridge | 63.08047 | -146.304 | 4372 | Snowbed |
| 2006-256 | *Carex pachystachya* | Cyperaceae | Osar Lake Trail | 63.03069 | -146.375 | 3290 | Mesic forb-graminoid meadow |
| 2006-229 | *Carex podocarpa* | Cyperaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-197 | *Carex saxatilis* | Cyperaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll in shrub birch-willow |
| 2006-236 | *Carex sp.* | Cyperaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |

| Coll Num | Species | Family | Specific locality | Lat_dd | Lon_dd | Elev (ft) | Habitat |
|---|---|---|---|---|---|---|---|
| 2006-254 | *Carex stylosa* | Cyperaceae | Osar Lake Trail | 63.03069 | -146.375 | 3290 | Swale-wet graminoid shrub birch-salix mosaic |
| 2006-263 | *Carex stylosa* | Cyperaceae | Landmark Gap South Trail - proposed ATV route | 63.02044 | -146.173 | 3203 | Dried pond in shrub birch mosaic |
| 2006-180 | *Castilleja caudata* | Scrophulariaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-224 | *Claytonia sarmentosa* | Portulacaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-179 | *Comarum palustre* | Rosaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-259 | *Cornus canadensis* | Cornaceae | Junction with Landmark Gap South Trail and survey route | 63.03069 | -146.132 | 3264 | Shrub birch ericaceous shrub |
| 2006-202 | *Deschampsia caespitosa* | Poaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-262 | *Deschampsia caespitosa* | Poaceae | Landmark Gap South Trail - proposed ATV route | 63.02044 | -146.173 | 3203 | Dried pond in shrub birch mosaic |
| 2006-184 | *Epilobium palustre* | Onagraceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |
| 2006-176 | *Equisetum sylvaticum* | Equisetaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-247 | *Erigeron peregrinus* | Asteraceae | Whistle Ridge | 63.08047 | -146.304 | 4372 | Snowbed |
| 2006-177 | *Eriophorum chamissonis* | Cyperaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-200 | *Gentiana glauca* | Gentianaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-232 | *Hieracium triste* | Asteraceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | | Snowbed, in moist talus, dwarf shrub graminoid tundra |
| 2006-237 | *Hierochloe alpina* | Poaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-198 | *Huperzia selago* | Lycopodiaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-248 | *Juncus drummondii* | Juncaceae | Whistle Ridge | 63.08047 | -146.304 | 4372 | Snowbed |
| 2006-261 | *Juncus filiformis* | Juncaceae | Landmark Gap South Trail - proposed ATV route | 63.02044 | -146.173 | 3203 | Dried pond in shrub birch mosaic |
| 2006-244 | *Kobresia myosuroides* | Cyperaceae | Whistle Ridge, broad ridge | 63.0834 | -146.304 | 4589 | Broad fellfield ridge, ground squirrel burrow |
| 2006-191 | *Lupinus arcticus* | Fabaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-239 | *Luzula arcuata ssp. unalaschcensis* | Juncaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-258 | *Luzula multiflora* | Juncaceae | Junction with Landmark Gap South Trail and survey route | 63.03069 | -146.132 | 3264 | Shrub birch ericaceous shrub |
| 2006-183 | *Luzula parviflora* | Juncaceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |
| 2006-189 | *Lycopodium alpinum* | Lycopodiaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-194 | *Pedicularis labradorica* | Scrophulariaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |

| Coll Num | Species | Family | Specific locality | Lat_dd | Lon_dd | Elev (ft) | Habitat |
|---|---|---|---|---|---|---|---|
| 2006-195 | *Pedicularis parviflora* | Scrophulariaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-246 | *Phleum alpinum* | Poaceae | Whistle Ridge | 63.08047 | -146.304 | 4372 | Snowbed |
| 2006-167 | *Poa alpina* | Poaceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-168 | *Poa arctica* | Poaceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-233 | *Poa arctica* | Poaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-234 | *Poa paucispicula* | Poaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-182 | *Polemonium acutiflorum* | Polemoniaceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |
| 2006-207 | *Polygonum viviparum* | Polygonaceae | Valley between Oscar Lake and Landmark Gap South Trail | 63.02252 | -146.189 | 3261 | Mosaic of forb graminoid meadows and open Salix pulchra shrublands |
| 2006-188 | *Potentilla diversifolia* | Rosaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-203 | *Pyrola minor* | Pyrolaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-260 | *Ranunculus flammula var. filiformis* | Ranunculaceae | Landmark Gap South Trail - proposed ATV route | 63.02044 | -146.173 | 3203 | Dried pond in shrub birch mosaic |
| 2006-241 | *Ranunculus pygmaeus* | Ranunculaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, seep/rivulet in dioritic rock outcrop in talus field |
| 2006-199 | *Rhodiola integrifolia* | Crassulaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-208 | *Rubus arcticus* | Rosaceae | Valley between Oscar Lake and Landmark Gap South Trail | 63.02252 | -146.189 | 3261 | Mosaic of forb graminoid meadows and open Salix pulchra shrublands |
| 2006-249 | *Rumex acetosella* | Polygonaceae | Osar Lake Trail, hill, ATV pullout | 63.02891 | -146.379 | 3371 | Shrub birch tundra |
| 2006-252 | *Rumex aquaticus L. var. fenestratus* | Polygonaceae | Osar Lake Trail | 63.03069 | -146.375 | 3290 | Swale-wet graminoid shrub birch-salix mosaic |
| 2006-226 | *Salix polaris* | Salicaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-172 | *Salix pulchra* | Salicaceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-193 | *Salix reticulata* | Salicaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |
| 2006-255 | *Sanguisorba canadensis* | Rosaceae | Osar Lake Trail | 63.03069 | -146.375 | 3290 | Mesic forb-graminoid meadow |
| 2006-225 | *Saxifraga nelsoniana* | Saxifragaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | 4089 | Mesic toe slope/graminoid, dwarf shrub willow mosaic |
| 2006-243 | *Saxifraga nivalis* | Saxifragaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-242 | *Saxifraga rivularis* | Saxifragaceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, seep/rivulet in dioritic rock outcrop in talus field |
| 2006-186 | *Senecio lugens* | Asteraceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |

| Coll Num | Species | Family | Specific locality | Lat_dd | Lon_dd | Elev (ft) | Habitat |
|---|---|---|---|---|---|---|---|
| 2006-231 | *Sibbaldia procumbens* | Rosaceae | Whistle Ridge, toe slope | 63.08903 | -146.305 | | Snowbed, in moist talus, dwarf shrub graminoid tundra |
| 2006-181 | *Solidago multiradiata* | Asteraceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-205 | *Stellaria longipes* | Caryophyllaceae | Valley between Oscar Lake and Landmark Gap South Trail | 63.02252 | -146.189 | 3261 | Mosaic of forb graminoid meadows and open Salix pulchra shrublands |
| 2006-178 | *Swertia perennis* | Gentianaceae | Swede Lake | 62.97845 | -145.885 | 2923 | Wet, muddy swale in open white spruce, birch shrublands |
| 2006-238 | *Taraxacum phymatocarpum* | Asteraceae | Whistle Ridge, side slope | 63.08692 | -146.301 | 4302 | Side slope, dioritic rock outcrop in talus field |
| 2006-253 | *Thalictrum sparsiflorum* | Ranunculaceae | Osar Lake Trail | 63.03069 | -146.375 | 3290 | Swale-wet graminoid shrub birch-salix mosaic |
| 2006-169 | *Trisetum spicatum* | Poaceae | Swede Lake trail sw route | 62.98268 | -145.865 | 3031 | Shrub birch tundra, occasional white spruce |
| 2006-204 | *Vahlodea atropurpurea* | Poaceae | Landmark Gap South proposed ATV trail | 63.04106 | -146.18 | 3452 | Pond margin on a broad knoll, shrub birch-willow and ericaceous shrublands |
| 2006-187 | *Valeriana capitata* | Valerianaceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |
| 2006-185 | *Veronica wormskjoldii* | Scrophulariaceae | Swede Lake trail | 62.97535 | -145.888 | 2930 | Wet graminoid-forb in tall-shrub birch white spruce |
| 2006-192 | *Viola langsdorfii* | Violaceae | Landmark Gap South ATV trail | 63.04476 | -146.16 | 3590 | Shrub birch and willow tundra knoll |

## APPENDIX II – DEFINITIONS OF AKNHP RANKS

| 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. |

| Species State Rankings | |
|---|---|
| S1: | Critically imperiled in state. |
| S2: | Imperiled in state. |
| S3: | Rare or uncommon in state. |
| S4: | Apparently secure in state, but with cause for long-term concern. |
| S5: | Demonstrably secure in state. |

| | |
|---|---|
| S#S# | State rank of species uncertain, best described as a range between the two ranks. |
| S?: | Unranked. |
| SU | Unrankable. |
| SA: | Accidental |
| SR: | Reported from the state, but not yet verified. |
| SRF: | Reported falsely. |
| SP: | Potential to occur in the state |
| SE: | Exotic--Some, or all, populations are introduced within state. |
| HYP: | Hybrid. |
| SSYN: | Synonym. |

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